ELECTRONIC INDUSTRIES

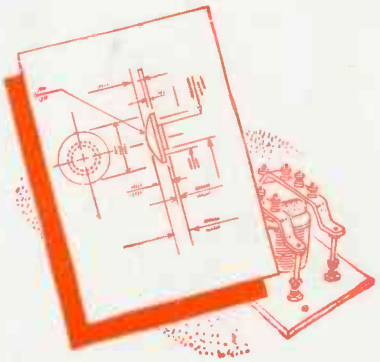
- ★ Features of Captured Enemy Radio Equipment
- ★ Broad Band Amplifiers ★ Postwar Planning
- ★ Carrier Current System on Alaskan Highway

WOMEN WAR WORKERS

SEPTEMBER

Caldwell-Clements, Inc.

The Thirty-First Time Was Also the First!



Not all contact problems yield the answer on the first try. In this case, thirty different combinations of materials were tested; the thirty-first experiment brought the desired solution. And—it was the first time the problem had been licked.

War demands have uncovered marvelous design ingenuity on the part of manufacturers. But new designs breed new material problems and this case was no exception. Indeed, it was plenty tough.

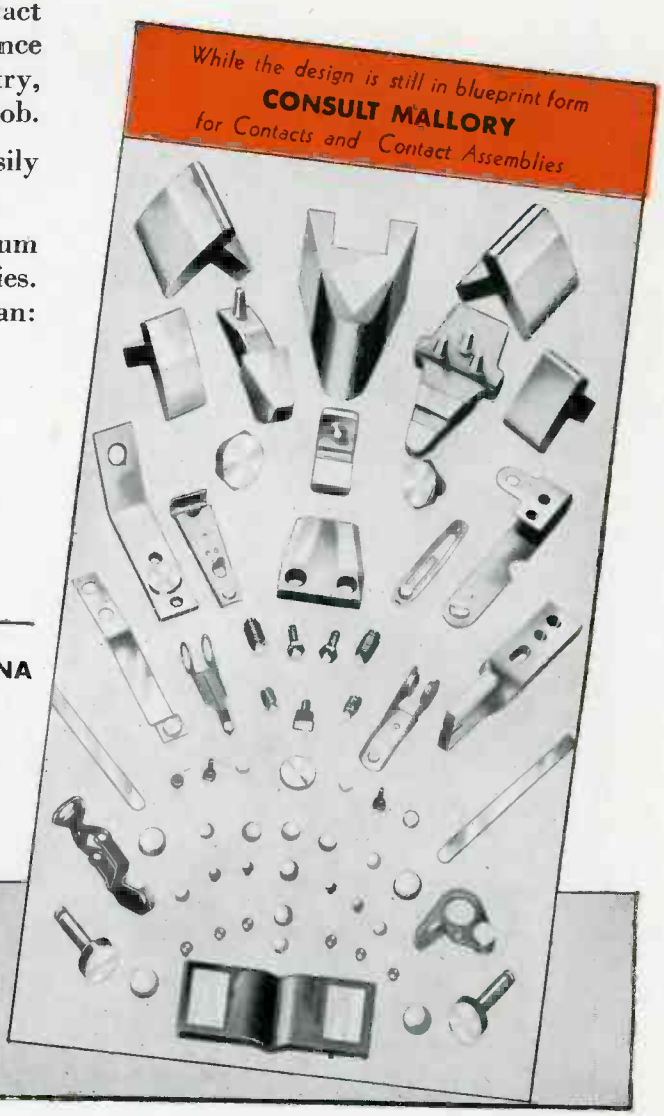
The part was a regulating relay for automotive equipment. The electrical contact specification was the knotty question. In test operation, alloys used produced excessive material transfer, indicating eventual contact failure. But Mallory engineers delved into experience and "know how" to come up, on the thirty-first try, with a Mallory Elkonium that measured up to the job.

Without that experience to draw on, tests might easily have run to a hundred and thirty-one tries!

Mallory aids many a manufacturer to get maximum life from contacts and complete contact assemblies. Specifically, Mallory services, in this connection, can:

1. Suggest contact alloy for any application.
2. Suggest backing materials and methods of assembly.
3. Suggest most suitable operating conditions for the contacts.

Mallory will be glad to cooperate with you.



P. R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA

Cable Address — PELMALLO

P. R. MALLORY & CO. Inc.

MALLORY

ELECTRICAL CONTACTS AND CONTACT ASSEMBLIES . . . NON FERROUS ALLOYS POWDERED METAL ALLOYS

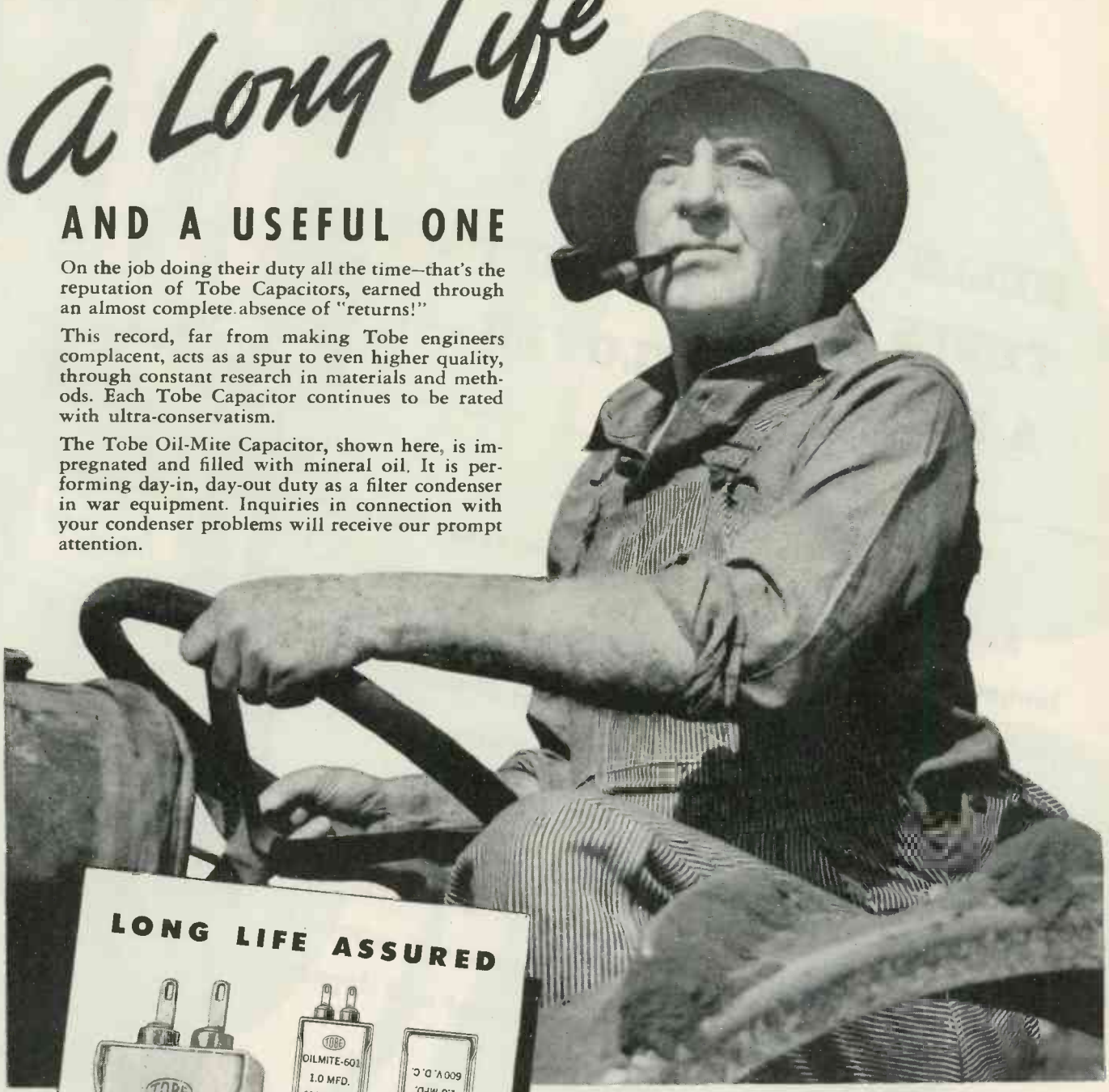
a Long Life

AND A USEFUL ONE

On the job doing their duty all the time—that's the reputation of Tobe Capacitors, earned through an almost complete absence of "returns!"

This record, far from making Tobe engineers complacent, acts as a spur to even higher quality, through constant research in materials and methods. Each Tobe Capacitor continues to be rated with ultra-conservatism.

The Tobe Oil-Mite Capacitor, shown here, is impregnated and filled with mineral oil. It is performing day-in, day-out duty as a filter condenser in war equipment. Inquiries in connection with your condenser problems will receive our prompt attention.



LONG LIFE ASSURED

Note new hold-down bracket that allows inverted or upright terminals. Takes less space and permits wiring either underneath or on top of chassis.

CHARACTERISTICS OF TOBE OIL-MITE CAPACITORS

STANDARD CAPACITY TOLERANCE.	±10%
TEST VOLTAGE	Twice D.C. rating
SHUNT RESISTANCE	.05 to 0.1 mfd. 20,000 megohms. .25 to 0.5 mfd. 12,000 megohms. 1.0 to 2.0 mfd. 12,000 megohms
RATINGS	.05 mfd. to 2.0 mfd. 600 V.D.C. .05 mfd. to 1.0 mfd. 1,000 V.D.C.
GROUND TEST	2,500 Volts D.C.
POWER FACTOR	At 1,000 cycles—.002 to .005

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

A SMALL PART IN VICTORY TODAY—A BIG PART IN INDUSTRY TOMORROW

EDITORIAL CONTENTS AND ARTICLES LISTED ON PAGE 4

HELLS BELLS, THESE TUBES MUST BE BUILT ON A FOUR-LEAF CLOVER . . .

Amperex transmitting and rectifying tubes have longer operating life packed into them than most hardened engineers anticipate. Now, this isn't a matter of luck . . . rather, it's the result of unceasing laboratory research and new production methods.

Amperex tubes are extremely precise . . . They're tank tough . . . They keep going at rated efficiency up to the very end. Wherever used, in civilian and military communications or in industrial applications—Amperex tubes are as constant and dependable as mathematical formulae.

BLOOD DONORS ARE URGENTLY NEEDED
. . . MAKE A DATE WITH THE RED CROSS

AMPEREX ELECTRONIC PRODUCTS

79 WASHINGTON STREET • BROOKLYN, N. Y.

EDITORIAL CONTENTS AND ARTICLES LISTED ON PAGE 4

ELECTRONIC INDUSTRIES

SEPTEMBER, 1943

In this Issue

Electronic Industries, September 1943, Vol. II, No. 9, 35 cents a copy. Published monthly by Caldwell-Clements, Inc., 480 Lexington Avenue, New York 17, N. Y. M. Clements, President; Orestes H. Caldwell, Treasurer.

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ORESTES H. CALDWELL
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M. CLEMENTS
Publisher

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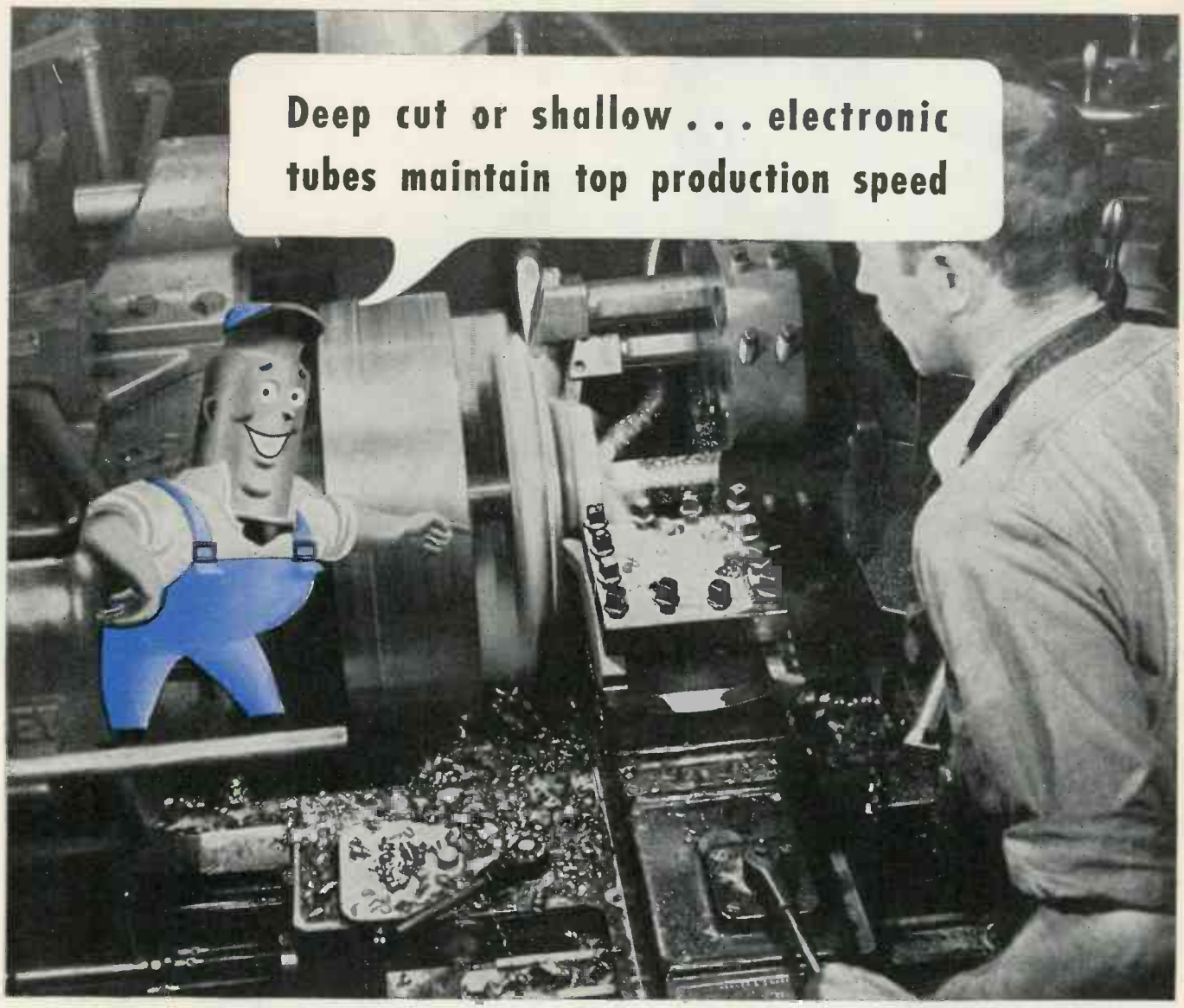
480 Lexington Avenue
NEW YORK 17



Deep cut or shallow . . . electronic tubes maintain top production speed

How the General Electric thyratron tube makes possible the simple and accurate control of motors

LIKE some silent guiding hand, a G-E electronic tube is busy at the benches and lathes of industry — cutting production costs and speeding war output.

This tube is the thyratron, a lightning-fast automatic switch. Its job is to keep machine speed constant regardless of variations in load so that production continues without interruption.

Thus, on the cutting lathe, in turning steel parts where depth of cut varies from deep to shallow, the thyratron automatically supplies the right amount of power to hold the speed of turning exactly constant, whatever the load.

On textile looms where variation of driving speed may result in imperfect cloth, the thyratron assures a uniform motor speed for perfect weaving.

Fast to a split cycle, accurate to a hair, the thyratron is at once a synchronous switch and a rectifier that enables DC motors to operate from an AC power supply.

It is the purpose of the G-E electronic tube engineers to aid *any* manufacturer of electronic devices in the application of tubes. General Electric, through nation-wide distribution, is also prepared to supply users of electronic devices with replacement tubes.

FREE BOOKLET ON ELECTRONIC TUBES

Send us the names of interested men in your plant and we will keep them informed of electronic developments. For example, we would like to mail without charge an illustrated book entitled "How Electronic Tubes Work," written in easy and understandable language, and showing typical electronic tubes and their applications. Address *Electronics Department, General Electric, Schenectady, New York.*

Tune in "THE WORLD TODAY" *and hear the news direct from the men who see it happen, every evening except Sunday at 6:45 P.M. E.W.T. over CBS. On Sunday listen to "The Hour of Charm" at 10 P.M. E.W.T. over NBC.*

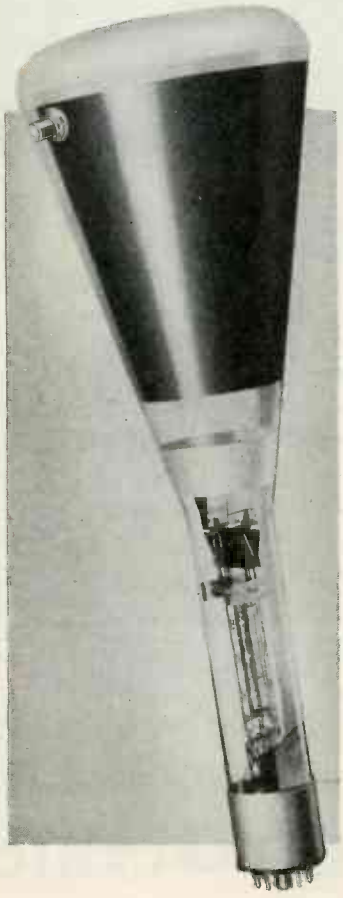
GENERAL ELECTRIC

162-811-4850

IT'S STILL √ *Check*

and √√ *Double Check*

for EACH and EVERY DuMONT TUBE



A thousand cathode-ray tubes are produced in the DuMont plant today where but a dozen were made before. Yet each and every DuMont tube continues to be meticulously checked for operating characteristics. Mass testing, without slightest deviation from critical DuMont standards, must match today's mass production.

And so DuMont engineers have developed and built the all-the-answers-at-a-glance test positions here shown. Tubes plug into corresponding receptacles and rest on the inclined shelf. Power supply voltages are adjusted for given tubes. Meters indicate circuit and operating conditions.

Sitting at the comfortable "electronic desk", the operator checks for brilliance, focus, deflection, leakage resistance and other characteristics—simply, quickly, positively. Meanwhile, a generous and representative percentage of each production run goes to life test racks so that anticipated service life is an established fact rather than a mere guess.

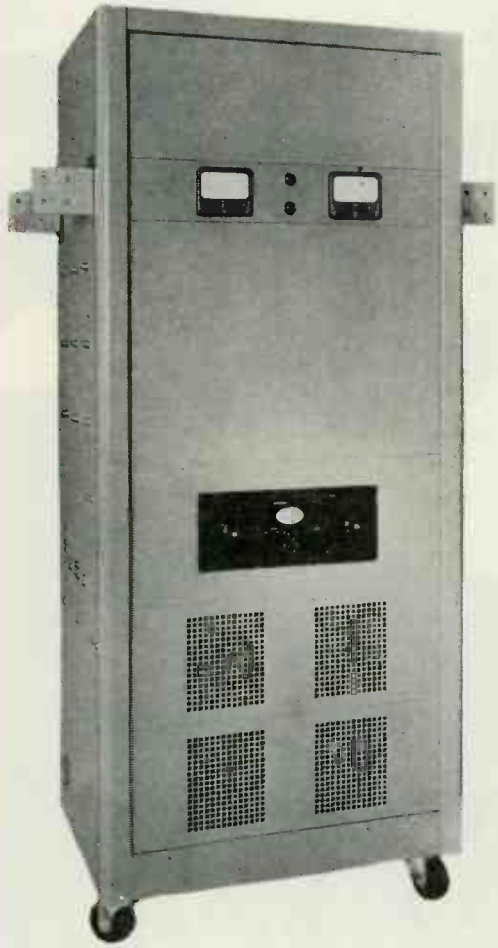
Check and double check—this DuMont test routine day in and day out, regardless of enormously stepped-up production, continues to safeguard an enviable performance record.

The new DuMont loose-leaf manual and catalog is now available. Write on business stationery for your registered copy.

DUMONT

ALLEN B. DU MONT LABORATORIES, Inc.
Passaic · New Jersey
Cable Address: Wespexlin, New York

For JOBS THAT TUBES CAN'T DO



Model 74000T

1 to 6 volts, 4,000 amperes, D.C. From any specified three-phase or two-phase supply. This unit is 42″ wide, 24″ deep and approximately 81″ tall. Mounted on casters for mobility. Remote control if desired.

ELECTRONIC tubes have our highest respect. We use them ourselves when they can do the job best. But tubes lack the muscle for heavy duty jobs at very low voltages.

For example — delivering 4,000 amperes of direct current at potentials of 1 to 6 volts.

Green rectifiers are used in vital wartime applications in America's foremost factories, laboratories, airports, railways and numerous other industries. Many of our customers are electrical companies who are in a position to *know* and *appreciate* GOOD electrical equipment.

If you need direct current from 25 amperes up to several thousand at potentials of 6 to 60 volts (or higher) may we submit specifications?

We design and custom-build rectifier equipments to meet any requirements.

As examples, may we send you literature describing Selectro-Platers and Multi-Platers? Just write us attention Dept. E.

W. GREEN ELECTRIC COMPANY, INC.

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

RECTIFIER ENGINEERS

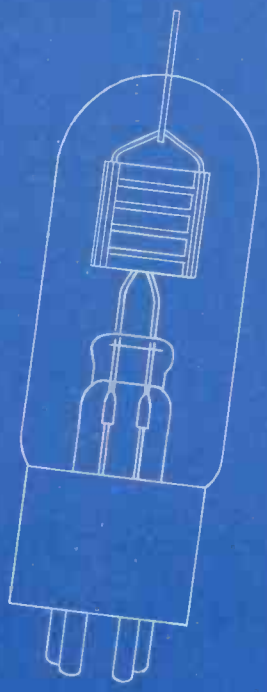
EST. 1892

Every blueprint starts from "blue sky." A new device, an improved process, a different method for doing things better, faster, more economically, all start with an idea. From this nebulous beginning, this "blue sky", ideas are translated onto blueprints.

If you are in this stage of your planning, consider the help that electronics and Westinghouse "know-how" can offer you. Today there are Westinghouse Electronic Tubes designed for every purpose. Tubes which can see, hear, feel. Tubes which clean the air, record brain waves, transform and rectify huge amounts of electrical current, weld metals, dry wood, detect vibrations, measure and control current flow, and perform an endless number of jobs with speed, accuracy, and utmost dependability.

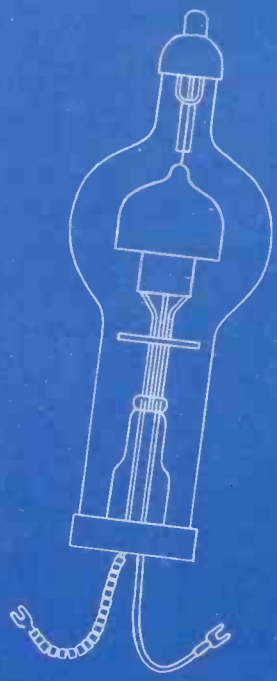
Before carrying "blue sky" ideas too far, investigate electronics thoroughly. Take advantage, too, of the advanced technical assistance that Westinghouse makes available for your use. Westinghouse Electric & Manufacturing Co., Bloomfield, N. J.

A FEW OF THE WESTINGHOUSE TUBES NOW SERVING INDUSTRY



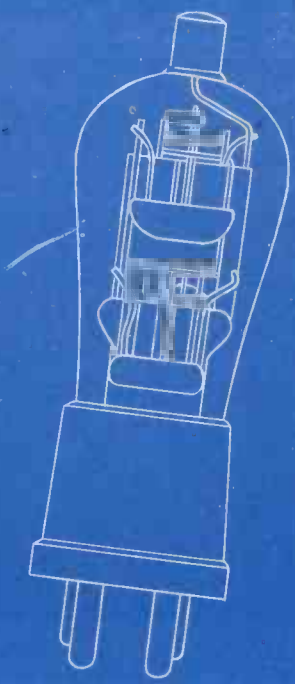
Kenotron

These high vacuum rectifiers supply high voltage low current DC for use in Precipitron, X-ray, high voltage testing and radio.



Phanotron

These tubes are used in many induction heating devices to supply high voltage direct current to the oscillators.

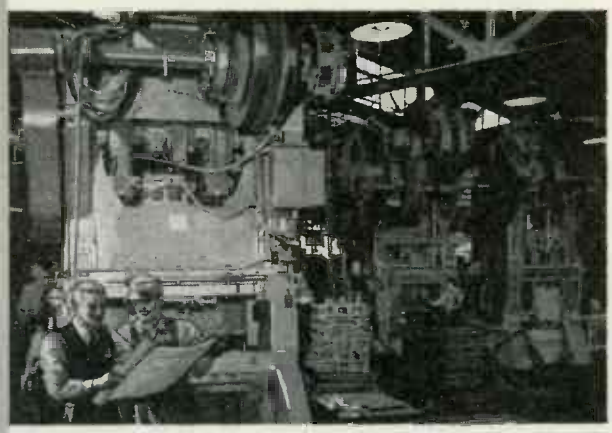


Electrometer Tube

With these tubes it is possible to measure current as low as 10^{-14} ampere and to indicate currents as law as 10^{-16} ampere.

ELECTRONICS RESEARCH

Technicians of Delco Radio are carrying forward pioneer research in the field of radio and electronics.



PROCESS ENGINEERING

Delco engineers are equipped through years of experience to translate swiftly the product of research and design into practical, useful products.

PRECISION ON A PRODUCTION BASIS

Delco specializes in the ability to mass-produce highly intricate products. Years of experience in the automotive radio field qualify Delco for vehicular radio production for war.

PROBLEMS

were made to be solved

For many years before the war, Delco Radio engineers were meeting and solving the problems of automotive radio . . . and putting their answers into mass production on the assembly line.

This practice gave Delco Radio technicians a head start on the problems of automotive radio for war, and prepared Delco Radio for the task of producing intricate war radio parts, components and assemblies in large quantity and of uniformly high quality of manufacture at a lower cost. Ability quickly to combine research engineering with mass-production methods has been applied in full measure to meeting the needs of the armed forces.

Whether the task at hand is one of pure research, or of mass-production methods, or a combination of both, Delco Radio is adequately equipped and experienced to do the job. Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

★ ★ ★ ★ ★ ★ ★

Back the Attack—

WITH WAR BONDS

Delco Radio

DIVISION OF

GENERAL MOTORS

PROTECTED BY VACUUM . . .

(ACTUAL SIZE PHOTO)

this condenser is protected by vacuum from moisture, dirt, changing characteristics and mechanical injury . . .

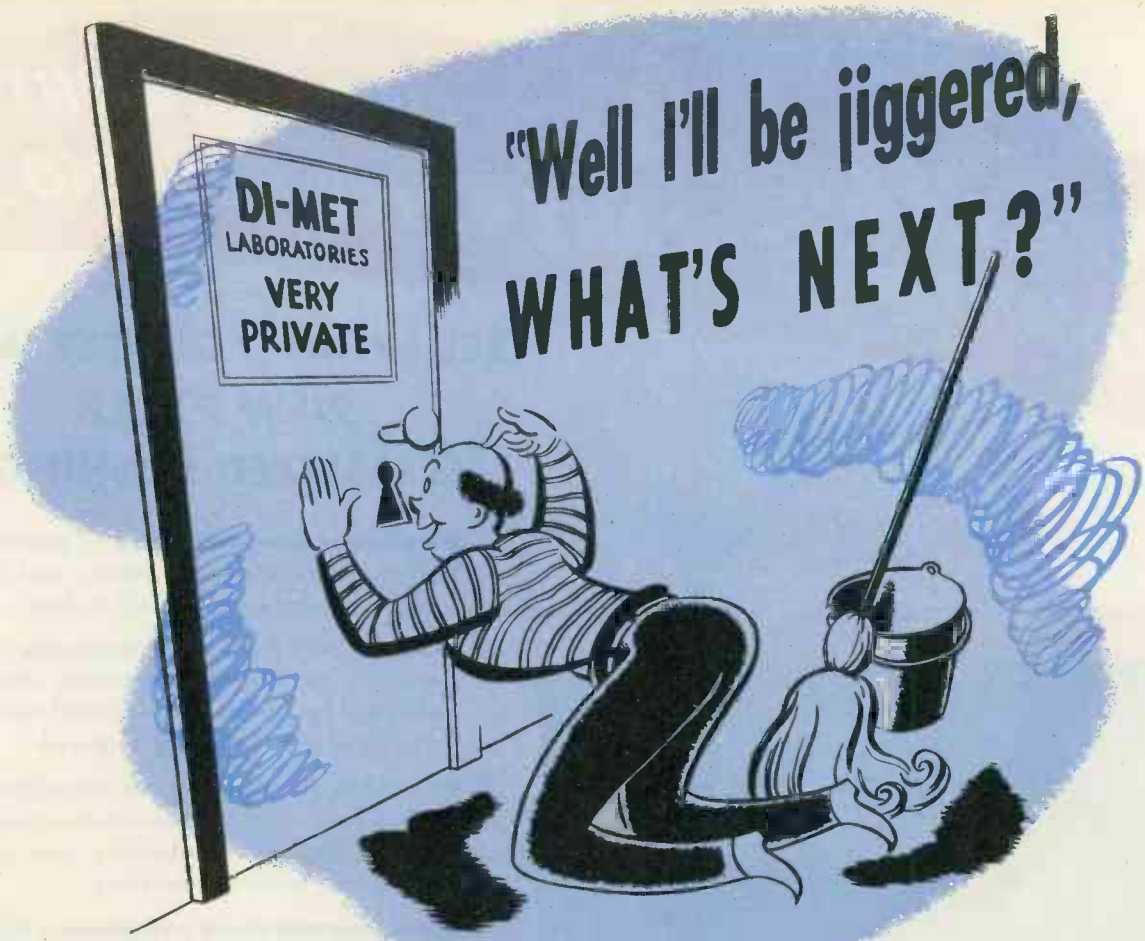
A permanent capacitance, 50mmf, 5000 volts, which fits any standard fuse mount and performs perfectly under most exacting conditions such as extremely high altitudes. A typical example of the quality vacuum products engineered and manufactured by this young and virile company under experienced heads, which among other things, pioneered the graphite anode and the carburizing of thoriated filaments.

* We invite inquiry. Increased facilities enable us to supply this permanent capacitance to firms with adequate priorities.

GENERAL ELECTRONICS INC.

101 HAZEL STREET, PATERSON, N. J.

Specialists on Engineering and Manufacturing Vacuum Products for Electronic Applications



SINCE the very beginning of the quartz cutting program, DI-MET engineers have constantly endeavored to improve quartz cutting results through better blade and machine performance. Their success in these efforts has been substantial, starting with the first DI-MET Rimlock blade offered to the quartz industry.

The Rimlock was developed by a radical departure in bonding procedures* which greatly increased the blade life and cutting speed. For the delicate dicing operation the DI-MET Resinoid Bonded Wheel proved highly efficient producing smooth, polished surfaces.

Latest developments in DI-MET laboratories include the "green-rim" resinoid bond for increased life, and Dynamic Tensioning—a process that puts cutting rims of metal type wheels under balanced tension—makes blades run flat during actual cutting operations and tends to *keep them flat* for the life of the blade!

Undoubtedly new and even better DI-MET developments are in store for quartz operators. And you can bet your share will come from DI-MET laboratories, since continuous effort and experimentation here are constantly improving existing quartz cutting techniques, producing *more* blanks per pound of quartz and eliminating unnecessary wastage. For any cutting problem—for every cutting operation—look to DI-MET!

FELKER DI-MET

FELKER MANUFACTURING CO.

1114 Border Ave. • Torrance, Calif.

TYPE C R
Bond: Copper
SIZES
Cut Off Wheels:
3", 4" and all even diameters up to 16"
Thick body
Wheels:
Diameters: Up to 6"
Thicknesses: 1/16" to 1/2"

RIMLOCK
Bond: Copper
SIZES
Cut Off Wheels:
3", 4" and all even diameters up to 16"
Thick body
Wheels:
Diameters: 1" to 6"
Thicknesses: 1/16" to 1/2"

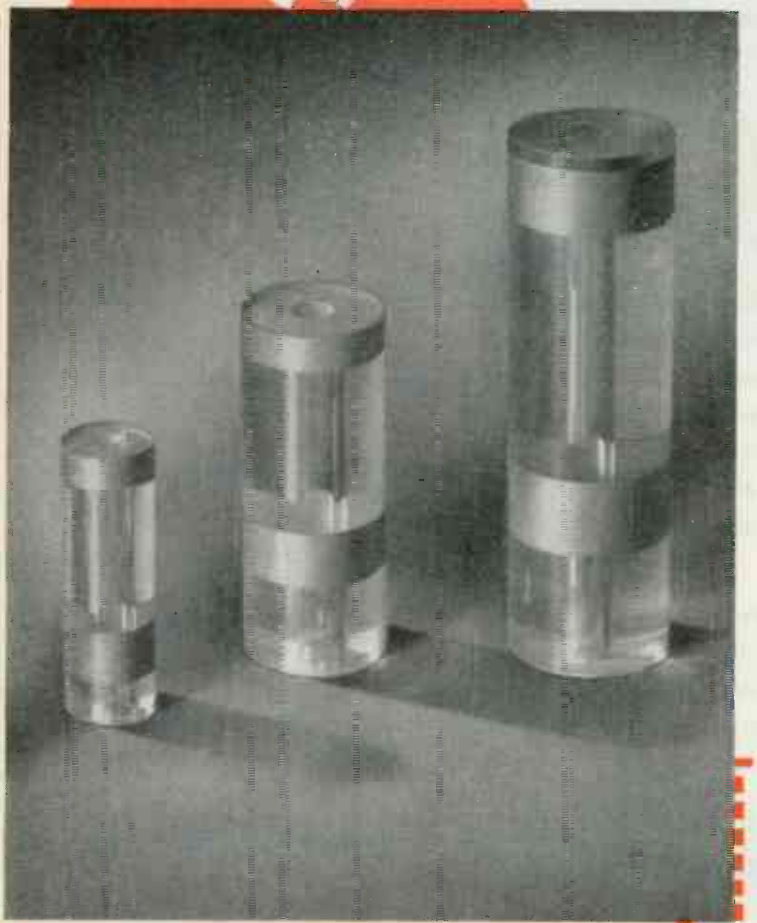
RIMLOCK
Bond: Steel
SIZES
Cut-Off Wheels:
3", 4" and all even diameters to 24"

RESINOID BONDED
Straight Wh-
Type D1T
Diameters:
3" 4", 5", 6".
Thicknesses:
1/32" to 1/2"

CUP WHEEL
Resinoid Bonded
Plain Cupwheel,
Type D6W
Diameter: 6"

MANUFACTURERS OF DIAMOND ABRASIVE WHEELS

PUZZLE... CAN YOU FIND ALL EIGHT ADVANTAGES IN ANY OTHER BUSHING?



SEE WHAT YOU GET WITH NEW PYREX METALLIZED BUSHINGS:

1. **Permanent hermetic bond** — positive seal against leakage of oil, water, and air—no gaskets, washers, or "dopes" to leak.
2. **Quicker, less expensive assembly** — fewer parts and fewer operations reduce labor costs and speed up production—several can be soldered at once—no baking required.
3. **Practically foolproof** — the metallized layer solders easily. You can use any common solder and flux, applied by soldering iron, soft air-gas flame or induction heating.
4. **Great thermal shock resistance**—will easily meet Army and Navy specifications for rapid temperature change.
5. **Superior electrical characteristics of glass**—low dielectric constant, low power factor, high dielectric strength, and great electrical resistivity.
6. **Negligible water absorption** — no glaze to crack or chip.
7. **Does not carbonize or track**—because it's inorganic.
8. **A wide selection in several standard sizes.**

MAIL COUPON for complete story

Corning Glass Works
Insulation Division, Department, EI-98
Corning, N. Y.

Please send me full details of improved method of metallizing on glass.

Name.....

Company.....

Street.....

City.....*State*.....

Pyrex Insulators
BRAND

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works.

MEMO for Post-War Reference:

NATIONAL UNION IS ONE OF THE LARGEST PRODUCERS OF CATHODE-RAY TUBES

In our cathode-ray tube production record, now climbing upward week by week, we see the working out of plans made long ago. Here are the dreams of our engineers come true. Here is the model factory they planned and equipped especially for cathode-ray tube manufacture—one of the Industry's largest. Here are the mass production machines they designed—built by this company's own equipment division. Here are the hundreds of skilled workers to whom they taught this special art of tube making that calls for the utmost precision and accuracy. Here are their laboratories with research continuing at an even greater pace, as though their work had just begun. And here are the results of all this thought and effort—National Union Cathode-Ray Tubes *by the carload.* Today, enroute to those who need them most—our fighting forces! Tomorrow, destined to bring to millions of homes a marvelously improved kind of television with larger images, with greater sharpness, reality, at mass-market prices—and to thousands of factories many new precision testing and measuring devices.

For engineers and production men, National Union is planning a comprehensive electronics industrial service—available as soon as war commitments permit.

NATIONAL UNION RADIO CORPORATION NEWARK, N. J. LANSDALE, PENNA.

NATIONAL UNION

RADIO AND ELECTRONIC TUBES

Production for the Present Engineering for the Future

Our electronic engineers are ready to work with you — to help design a hook-up for war machines, essential products or post-war models — that will embody the latest combat-tested electronic developments.

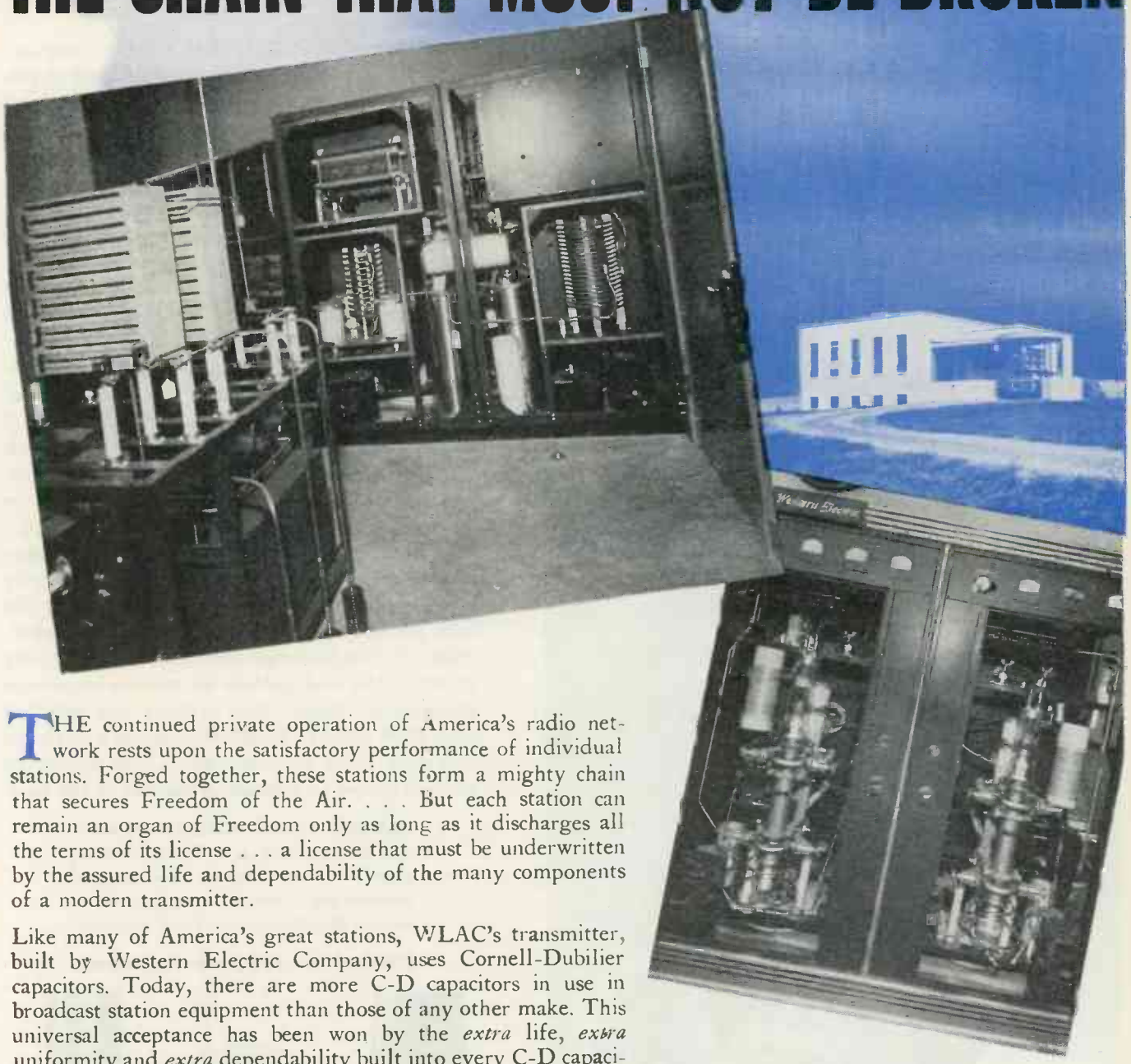
Gentleman Products Division of

HENNEY MOTOR COMPANY

Main Office: Freeport, Illinois

Factory: Omaha, Nebraska

THE CHAIN THAT MUST NOT BE BROKEN



THE continued private operation of America's radio network rests upon the satisfactory performance of individual stations. Forged together, these stations form a mighty chain that secures Freedom of the Air. . . . But each station can remain an organ of Freedom only as long as it discharges all the terms of its license . . . a license that must be underwritten by the assured life and dependability of the many components of a modern transmitter.

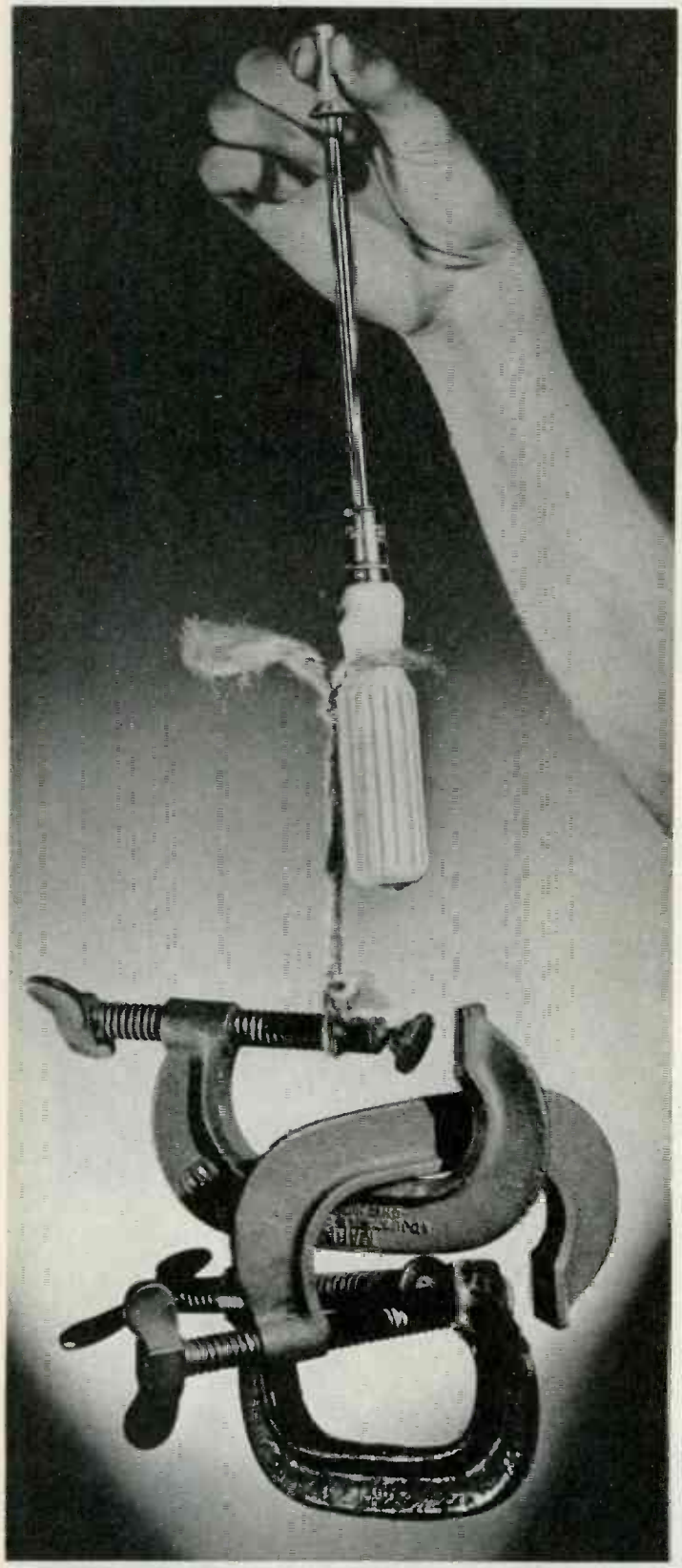
Like many of America's great stations, WLAC's transmitter, built by Western Electric Company, uses Cornell-Dubilier capacitors. Today, there are more C-D capacitors in use in broadcast station equipment than those of any other make. This universal acceptance has been won by the *extra* life, *extra* uniformity and *extra* dependability built into every C-D capacitor. Thirty-three years' exclusive specialization in capacitor manufacture is a significant guarantee of fine performance. Cornell-Dubilier Electric Corporation, South Plainfield, N. J.

A complete range of C-D capacitors is available for all transmitting, receiving and electronic applications. Send for catalog No. 160R describing the complete line of C-D CAPACITORS.

Cornell-Dubilier Capacitors

MICA • DYKANOL • PAPER • WET AND DRY ELECTROLYTICS

...It's no trick at all

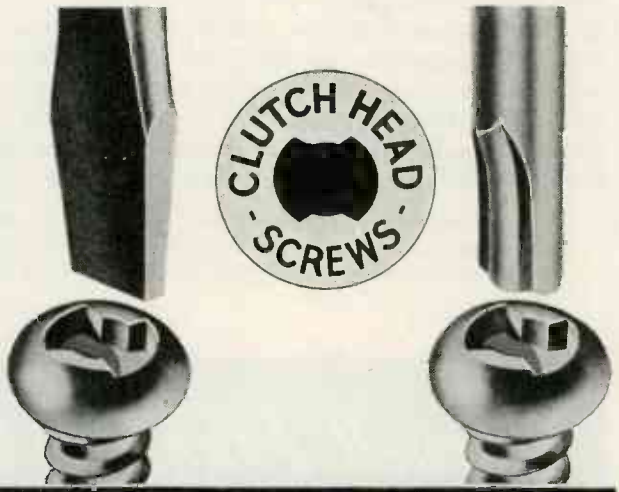


with this powerful CLUTCH HEAD "lock-on" feature to liquidate the problem of hard-to-get-at spots . . . to free slowed-down assembly from fumbling with human or "mechanical" fingers and dropping screws. A simple reverse turn of the driver in the Clutch locks screw to bit as a unit for fast and certain one-handed driving from any angle. Frankly, the iron clamps were added to emphasize the tenacity of the hold . . . yet, the lock is instantly released by the normal turning of the screw for the drive home with hand or power driver.

Many assembly lines operating in the war effort have found that this is just one of several factors contributed by CLUTCH HEAD SCREWS *alone* towards better and lower cost production. They have found that the combination of deep Clutch and self-centering bit smooths out hesitation, eases the fatigue load, and establishes confidence against slippage. They have found time and money economy also in the sturdy construction of the Center Pivot Assembly Bit with its longer uninterrupted "spell" in operation . . . plus its longer total life through briefly grinding the end surface to restore maximum efficiency as needed. Add to these, the fact that CLUTCH HEAD SCREWS *operate with an ordinary type screwdriver* . . . so important when it comes to emergency service in the field.

CLUTCH HEAD SCREWS are available in Standard and Thread-forming types for every purpose. Their unusual advantages have won recognition in many phases of wartime service.

United invites your inquiries.



UNITED SCREW AND BOLT CORPORATION

CHICAGO CLEVELAND NEW YORK

NOW...PARTY LINE OF THE AIR

WE CAN DELIVER

Complete units or any integral parts can be had promptly. We are tooled up and in production on these and many other inter-communication items. Write for details.

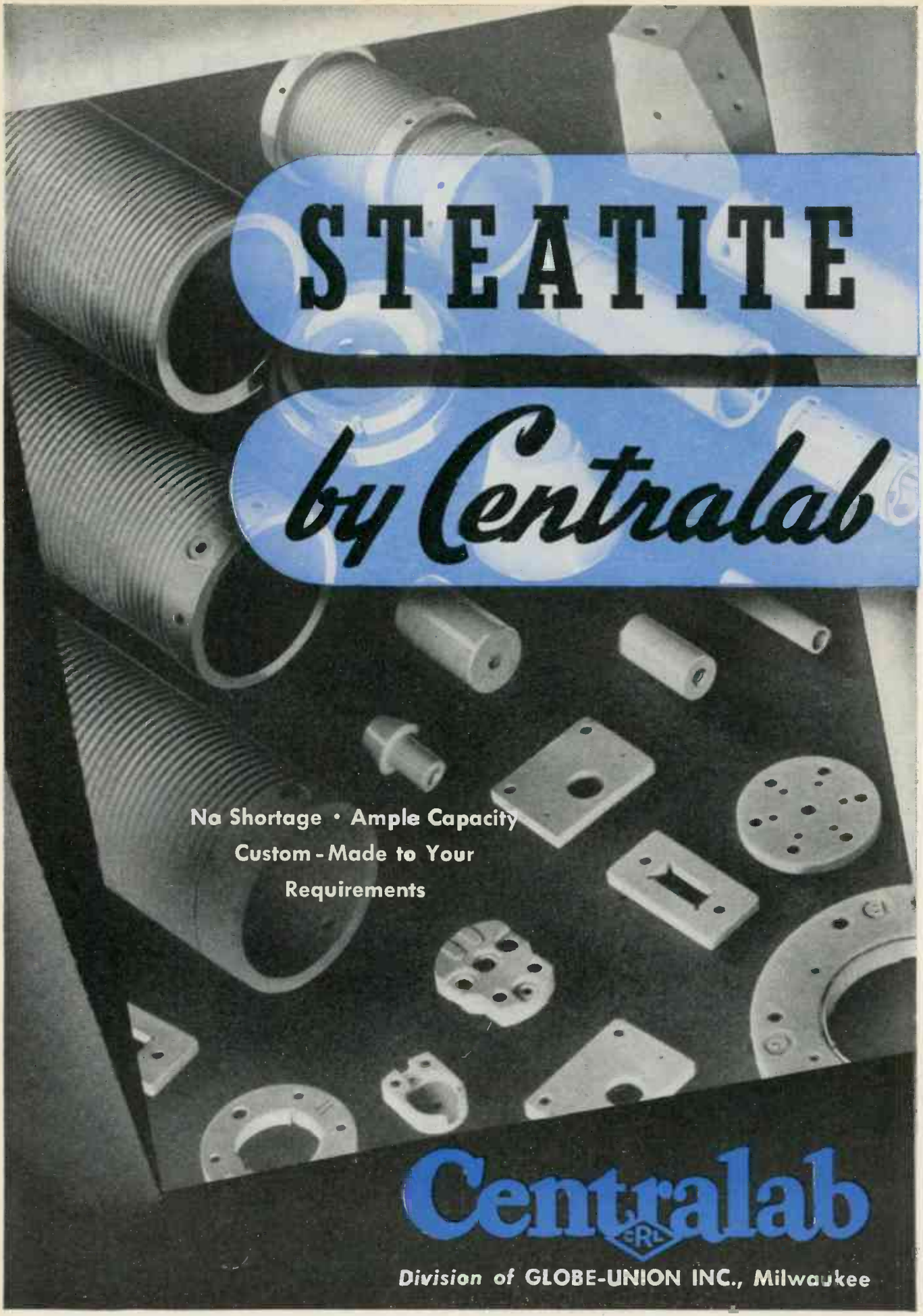
Back home, listening in is an indoor sport—but "upstairs" it's a matter of life and death! Ask a fighting bomber crew! Over their "party line"—*the bomber's inter-phone system*—all the crew, from pilot to tail gunner, simultaneously hear each message. The navigator sings out: "This is it . . . hold her s-t-e-a-d-y . . . on target!" Then the cheering words from the bombardier in the belly, "Bombs away!" and the command to speed home, mission performed.

We at Trav-Ler Karenola are happy to be one of the firms supplying the high quality inter-communication equipment that assures dependable audibility despite shell-shattered air and motor din.

TRAV-LER KARENOLA
RADIO AND TELEVISION CORPORATION

MANUFACTURERS OF QUALITY RADIO AND COMMUNICATION EQUIPMENT

1032 WEST VAN BUREN STREET • CHICAGO 7, ILLINOIS



(Right) *L. T. Campbell, Supt. Communications, Delta Air Lines, with J. B. Kramer, at Wilcox installation, Atlanta Station.*

SERVING THE NATION'S AIRLINES

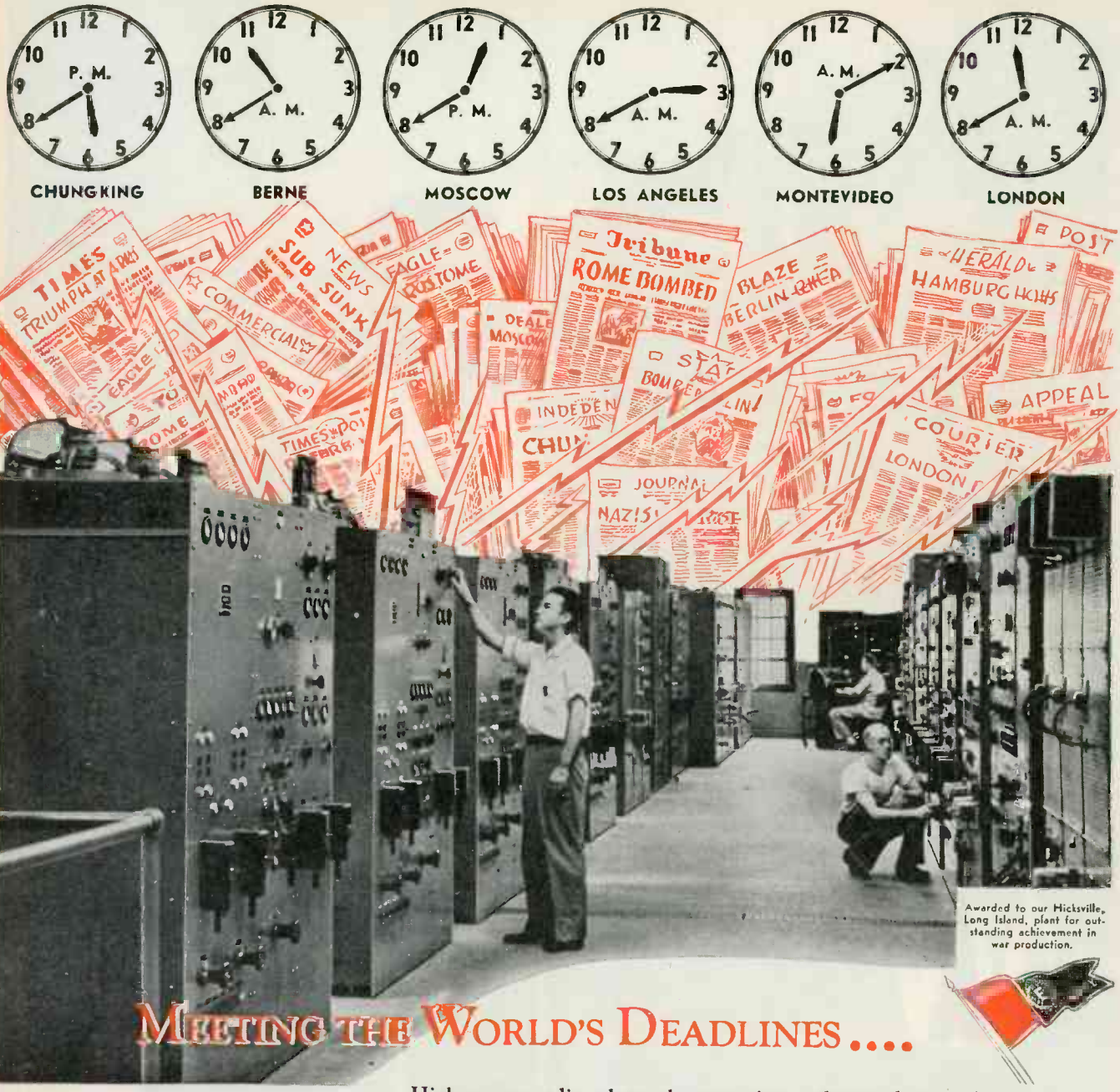
Wilcox equipment has been used by the major airlines for many years...and while, today, Wilcox facilities are producing largely for military needs, the requirements of the essential airlines also are being handled. Look to Wilcox for leadership in dependable communications!

Communication Receivers
Aircraft Radio
Transmitting Equipment
Airline Radio Equipment

WILCOX ELECTRIC COMPANY

Quality Manufacturing of Radio Equipment

14TH & CHESTNUT — KANSAS CITY, MO.



Awarded to our Hicksville, Long Island, plant for outstanding achievement in war production.

MEETING THE WORLD'S DEADLINES....

PRESS WIRELESS, INC., IS DEVELOPING AND MANUFACTURING

- HIGH POWER TRANSMITTERS
- DIVERSITY RECEIVERS
- AIRCRAFT AND AIRFIELD RADIO EQUIPMENT
- RADIO PRINTER SYSTEMS
- MODUPLEX UNITS
- CHANNELING DEVICES
- RADIO PHOTO TERMINALS
- FACSIMILE MACHINES

AND OTHER TYPES OF RADIO AND COMMUNICATION EQUIPMENT

High power radio telegraph transmitters, designed, manufactured and operated by Press Wireless, Inc., have been carrying a large share of the world's news for over fourteen years.

Today, the news traffic sent through Press Wireless transmitters is estimated in its final form at more than six million words every twenty-four hours.

To do this daily, often under adverse conditions, requires transmitters that are rugged, dependable, accurate, quickly adjustable in emergencies and engineered to deliver maximum efficiency at the lowest possible operating and maintenance costs.

These and other vital qualities have been built into Press Wireless transmitters since the day the company was formed to serve the American press. The outstanding record which Press Wireless transmitters have made in meeting the news deadlines is one of the reasons why they are also in service today on the world's front battle lines, aiding America and her Allies towards victory.

PRESS WIRELESS INC.

Executive Offices
435 N. MICHIGAN AVE., CHICAGO

Sales Offices, Manufacturing Division
1475 BROADWAY, NEW YORK CITY

NEW YORK • CHICAGO • LOS ANGELES • LONDON • HAVANA • RIO DE JANEIRO • MONTEVIDEO • SANTIAGO DE CHILE

the amateur is still in radio

He's not at his haywire rig in the attic...he's holding down key engineering spots in the laboratories, the factories, the army, navy and marine corps. Today the radio amateur is the top electronic engineer who is doing the impossible for his country and for the world. And why not?...the radio amateur has always done the impossible. He's the one who refused to obey the rules...demanded more and ever more from his "ham" rig. The equipment that he used...especially the tubes...had to have greater stamina and vastly superior performance capabilities. Thus the radio amateur literally forced electronics forward. For the products created to stand up under his gruelling treatment represented real advancement. Eimac tubes are a good example, for Eimac tubes were created and developed in the great amateur testing grounds. That's one reason why Eimac tubes have proved so vastly superior for commercial and war uses. Yesterday the leading radio amateurs throughout the world preferred Eimac tubes. Today these radio amateurs are off the air as amateurs but wherever they are, as the leaders in electronics, they're still using Eimac tubes.

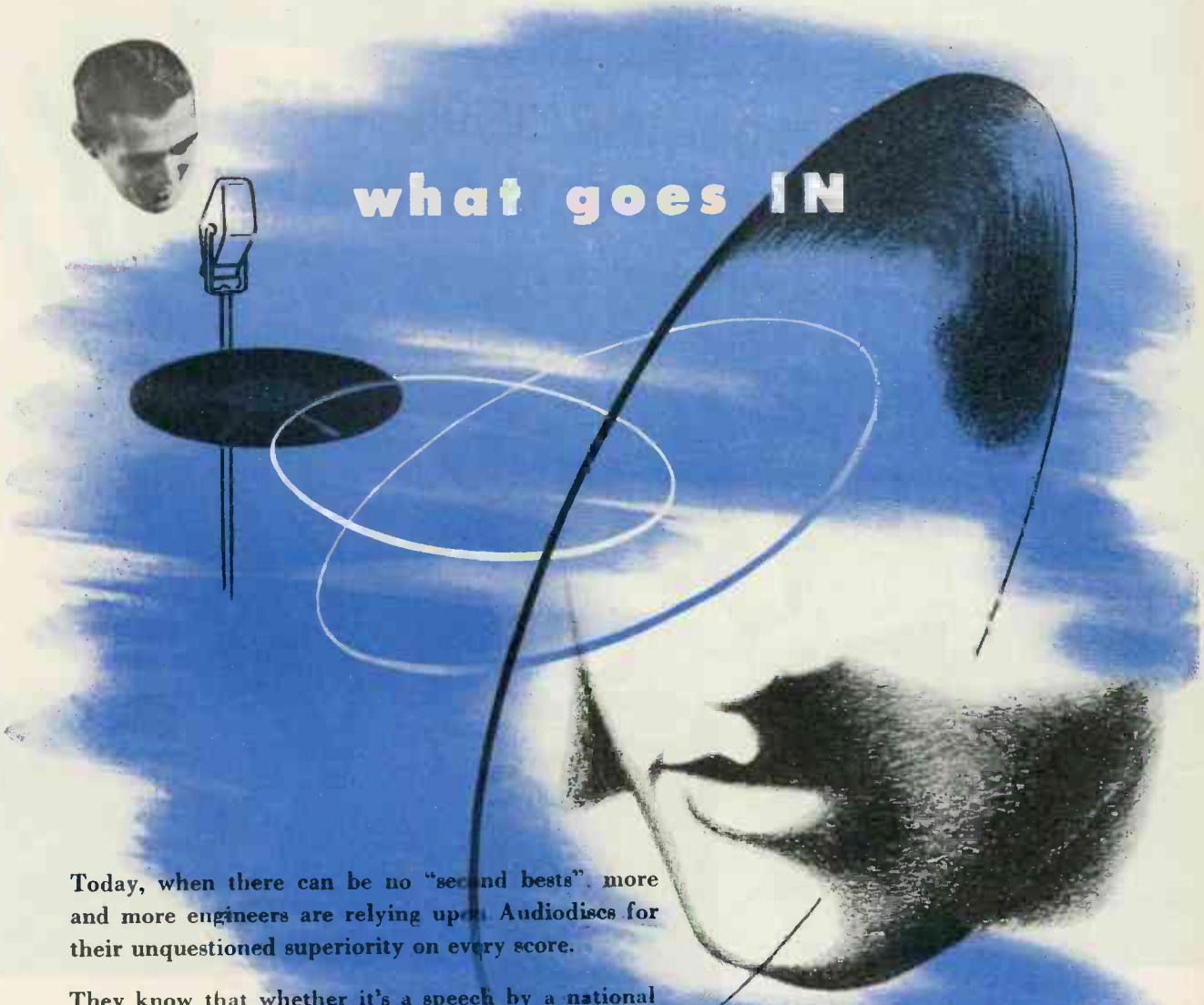
Follow the leaders to

Eimac U. S. PAT. OFF.

TUBES

EITEL-McCULLOUGH, INC. · SAN BRUNO, CALIFORNIA

Export Agents: Frazar & Hanser, 301 Clay St., San Francisco, Calif., U. S. A.



Today, when there can be no "second bests", more and more engineers are relying upon Audiodiscs for their unquestioned superiority on every score.

They know that whether it's a speech by a national leader, the preservation of vital war statistics, or a swing band recording for our boys overseas—absolute fidelity is matter-of-fact acceptance with an Audiodisc recording blank.

MUST come out

From the sheets of glass, smoother than any aluminum base, of absolutely correct gauge and strength, to the finest lacquer coating applied by an exclusive Audio process, Audiodiscs assure a longer-lasting blank—perfect playback performance, every time!

For wartime, as well as professional applications, Audiodiscs have won the distinction of being called the "world's finest recording blanks." Audio Devices, Inc., 444 Madison Avenue, New York 22, New York.

audiodiscs

they speak for themselves

Small, compact and lightweight

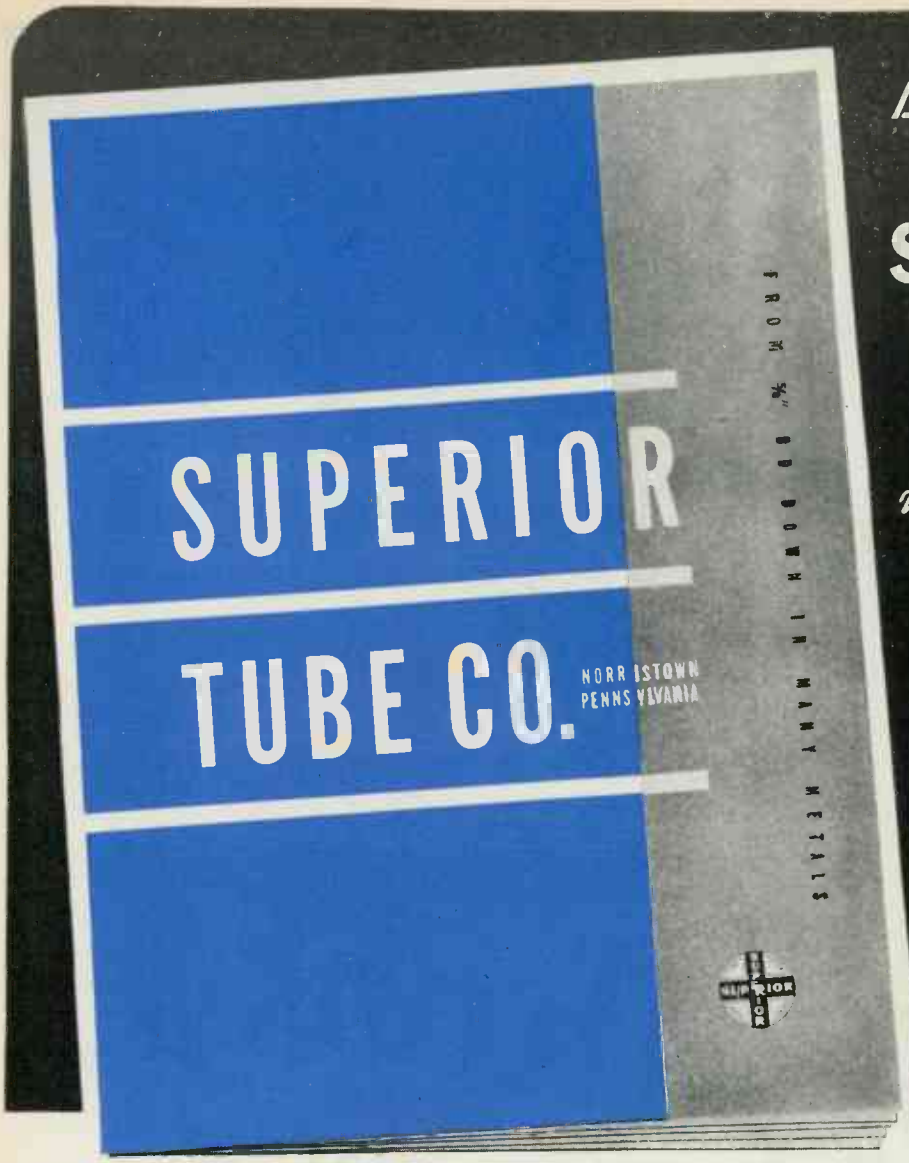
... yet highly efficient!

For example, take this hermetically-sealed unit designed by the N-Y-T Sample Department. While it weighs only five ounces and measures but 1⅜" in diameter by 1¾" high, it is both immersion proof and shock-proof. The moisture pouring off an icy transformer, which has just dived from a sub-zero temperature in the stratosphere to a few thousand feet above a steaming tropical zone, may well be imagined. Protection must be assured in all phases of modern warfare; equally important to functional efficiency and accuracy are size and weight.

This is but one of the innumerable solutions for vital Army, Navy and Air Corps requirements achieved by N-Y-T Unceasing research and testing are embodied in every transformer problem by our engineers.

NEW YORK TRANSFORMER COMPANY

22-26 WAVERLY PLACE NEW YORK, N. Y.



Brief, Concise Facts about

SUPERIOR
FINE SMALL TUBING
(Maximum OD – 5/8")

Write Today for Your Copy of
SUPERIOR BULLETIN 48

•

Whether your use of small tubing extends back over the years, or has been stepped up by the war, we believe this booklet has ready information that will save you time.

WRITE TODAY FOR BULLETIN 48 ON YOUR COMPANY LETTERHEAD.

SUPERIOR

The big name in SMALL TUBING *for Uncle Sam!*

SUPERIOR TUBE COMPANY, NORRISTOWN, PENNSYLVANIA

FOR EVERY SMALL TUBING APPLICATION

Tubing from 5/8" OD down... SUPERIOR Seamless in various analyses. WELDRAWN Welded and drawn Stainless. BRAWN Welded and drawn "Monel" and "Inconel". SEAMLESS and Patented LOCKSEAM Cathode Sleeves.

If the war should end tomorrow . . .

RADIO RECEPTOR, with a wealth of experience encompassing the entire history of radio, would be ready to convert its greatly expanded facilities to the construction and installation of Ground-to-Air Navigation, Communications and Airport Traffic Control Equipment for civilian use.

Now devoted to the war effort, these engineering and production facilities that built the first commercial ultra-high-frequency airport control units, which were installed at Washington National Airport for the Civil Aeronautics Administration, will be in a position to provide all advanced types of airport radio equipment—for municipal and private fields—under a single contract, if desired.

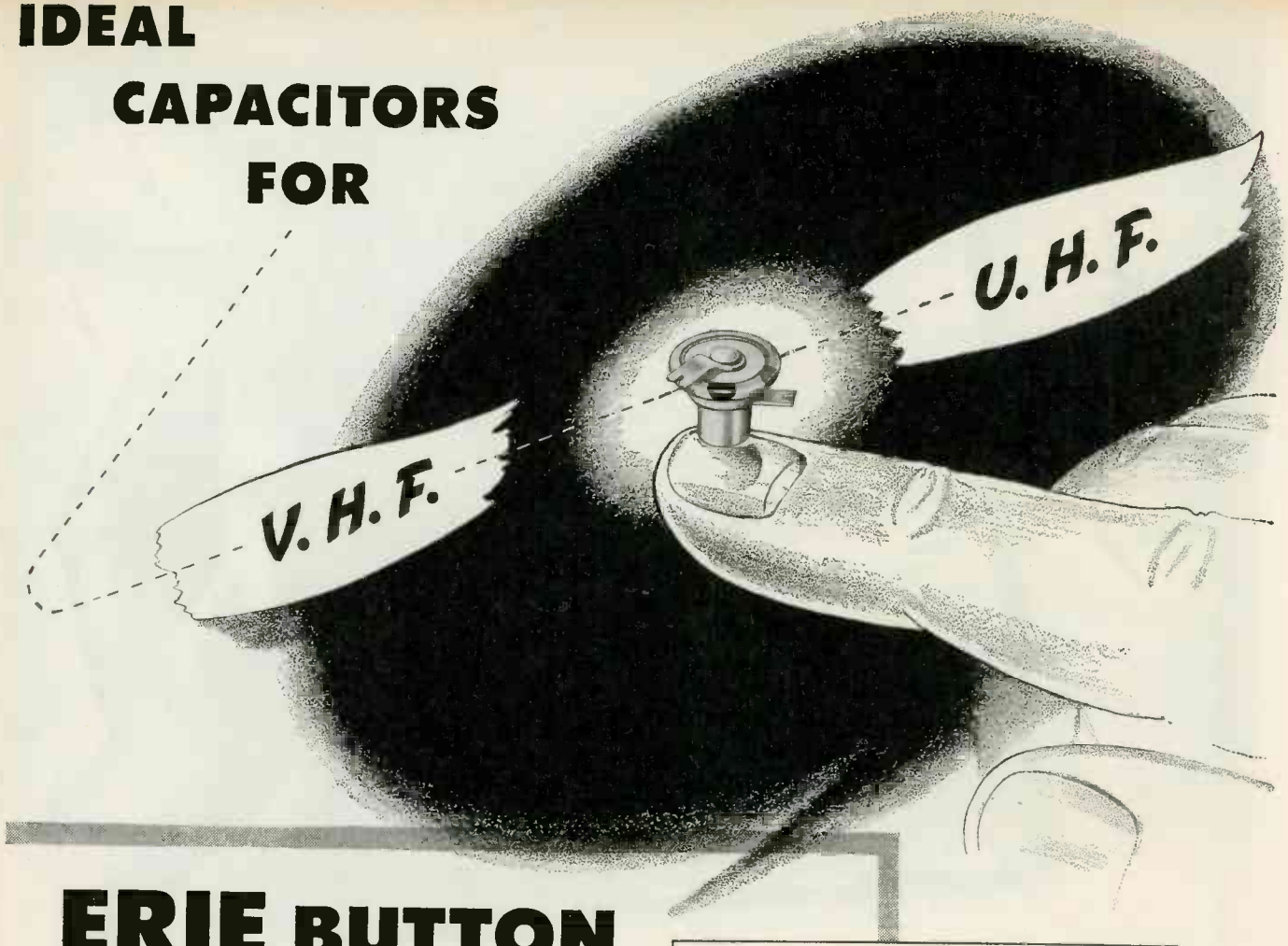
Today, RADIO RECEPTOR installations assure increased safety and efficiency in airports throughout the world. We'll be glad to send a copy of our revised booklet, "HIGHWAYS OF THE AIR", now in preparation. Please write on your business stationery to our Executive Offices, 251 West 19th Street, New York 11, N. Y.

RADIO RECEPTOR CO., INC.

Awarded for Meritorious Service on the Production Front

SINCE 1922 IN RADIO AND ELECTRONICS

IDEAL CAPACITORS FOR



ERIE BUTTON SILVER MICAS

CHARACTERISTICS

CAPACITY RANGE:
15 to 500 MMF at 1 mc.

POWER FACTORS:
.08% max. for capacity tolerance ± 5% or closer (for resonant circuit applications).
12% max. for capacity tolerance over ± 5% (for by-pass and blocking use).

MAX. WORKING VOLTAGE:
350 Volts A.C., 500 Volts D.C.
Flash Test (2 seconds) 1,000 Volts D.C.
Leakage Resistance, Over 10,000 megohms.

FOR V.H.F. and U.H.F. applications where short ribbon-type leads, low series inductance, and compactness are requisite factors, Type 370 Button Mica Condensers are ideal components.

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

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

The efficiency and quality of Erie Button Silver Micas have been thoroughly proven in large scale production quantities since 1941. Complete technical information will be sent to interested engineers on request.

INVEST TODAY IN BONDS FOR VICTORY

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

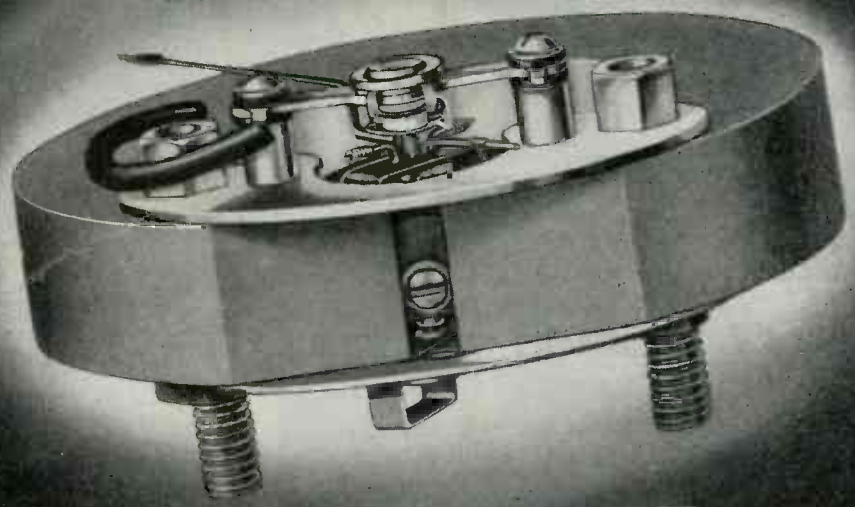
Introducing

INTERNAL-PIVOT ELECTRIC INSTRUMENTS

Type DW-51 voltmeter in a metal (brass) case

TYPE DW-51 D-c Voltmeters, Ammeters, Milliammeters, and Microammeters

TYPE DW-52 Radio-frequency Ammeters and Milliammeters (A-c Thermocouple Types)



ELEMENT ASSEMBLY

(Approx twice actual size)

Note the clean, simple lines of this compact element, made possible by the internal-pivot construction and by securing all parts solidly to the cast-comol magnet.

Type DW-52 ammeter in a molded Textolite case

for **THINNESS** obtained by the use of internal pivots—pivots solidly mounted on the inside of the armature instead of the outside

with **HIGH FACTOR OF MERIT**—resulting from a feather-weight moving element and relatively high torque

THESE new instruments are especially well suited for use in radio and other communications equipment where compactness is essential. In most ratings, they are approximately *one inch deep.*

Thinness is obtained by the internal-pivot construction. But this design affords much more than thinness.

The elements, on account of their high torque and large-radius pivots, are well able to withstand vibration. High torque combined with a lightweight moving element results in fast response. Good damping makes for ease and accuracy of reading. Large clearances ensure reliable operation.

All these features add up to a high factor of merit and all-round fine performance.

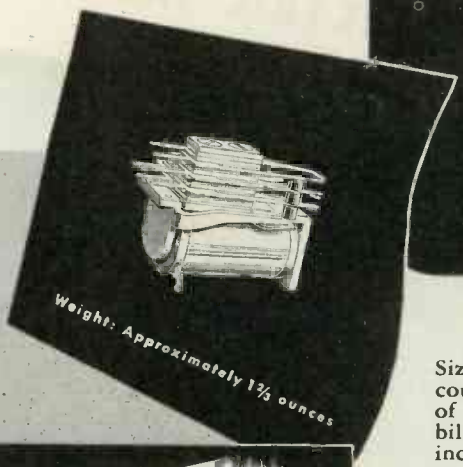
For complete information on ratings, prices, dimensions, and specifications, ask the nearest G-E office for Bulletin GEA-4064. Or write to General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

602-43-6200

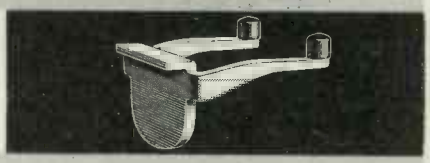
THE RELAY FOR THAT TIGHT SPOT

CLARE
Type K d. c.
Relay

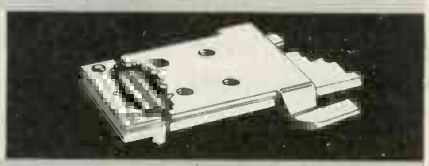


Strong, hard, long wearing Bakelite bushing insulators resist vibration and heavy contact pressures.

Heelpiece and coil core of magnetic metal, carefully annealed.



Hinge of "fatigueless" beryllium copper insures long life under vibration.



Nickel contact springs to which contacts are overall welded by special process.

Size isn't the most important feature of a relay, of course, but the Clare Type K d.c. Relay combines all of Clare's "custom-built" ruggedness and dependability in a size and weight to fit into designs where inches and ounces count.

Shown here in exact size, the Clare Type K measures but 1½" x 1¼" x 13/16". It can be furnished in the contact forms shown with as many as 12 contact springs.

Coil voltage range is from 1.5 volts to 60 volts, d.c. Contacts of 18 gauge silver, rated one ampere, 50 watts, or 18 gauge palladium, rated two amperes, 100 watts can be furnished.

In-built into the Type K are all the features that make Clare Relays resistant to moisture, heat, vibration and wear . . . that insure millions of uniform operations.

The Clare Type K Relay is designed for applications incident to vibration . . . no special anti-vibration springs are added. There are no bearings to chatter and wear as uniform armature movement is maintained by the use of a "fatigueless" beryllium copper hinge, heat treated and designed to provide a wide margin of safety.

Permanent assembly tightness is secured by binding the spring pile-ups under hydraulic pressure and tightening to the heelpiece. A coating of Glyptol is used as an additional precaution.

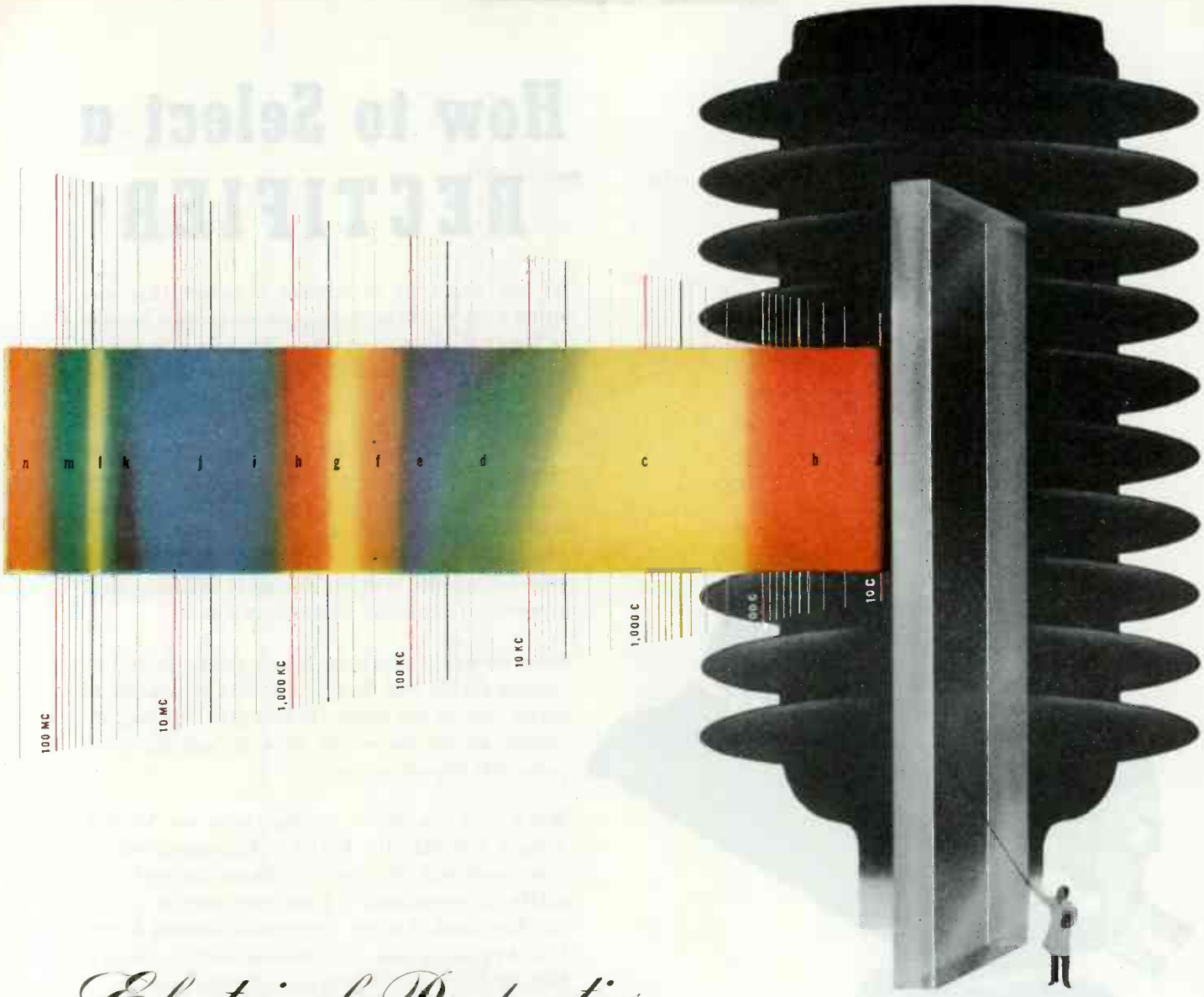
All metal parts of the Type K are specially plated to withstand a 200 hour salt spray test. Heat-treated Bakelite insulators provide the minimum moisture absorption required by exacting Army and Navy tests.

This diminutive, dependable Type K d.c. Relay is a definite advance in the design of a small, light relay. Like all Clare Relays it is "custom-built" to do just the job you have for it. Write us your specifications today. Let us place the experience of our engineers at your service. We are glad to do this whether your requirements are large or small.

Send for the Clare catalog and data book. C. P. Clare & Company, 4719 West Sunnyside Ave., Chicago, (30) 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



Electrical Properties

The colorful "frequency spectrum" is a rainbow of promise for the future electrical and electronic fields. Plastics are an important part of that future.

Under the impetus given industrial development by the war-production effort, plastics have proven their qualifications under exacting tests and field conditions.

LOALIN our polystyrene molding compound, has the finest high-frequency insulating properties of *any* plastic. Unexcelled in volume resistivity, dielectric strength and dielectric constant. "Loalin's" high dimensional stability and "zero" water-absorption indicate its use where only the "finest" will suffice. It is the lightest of all the plastics and one of the lowest in cost.

CATALIN Electrical & Mechanical Resin—in sheets, rods, tubes and special castings—is the "toughest" of the cast phenolics. In addition to excellent electrical characteristics, "Catalin" offers high mechanical strengths, low water-absorption and unequalled machinability.

Our technical staff is qualified to give expert counsel on current applications . . . or for post-war planning. They'll gladly tell you all about any of Catalin's growing family of modern materials—"plastics that have passed their *physicals!*"

Key to Frequency Band : A—Subsonic. B—Power Transmission & Distribution. C—Audio Frequencies. D—Power Line Carrier-Current Applications. E—Supersonics. F—Sea & Air Navigational Aids. G & I—Electronic Heating. H—Radio Broadcasting. J—Visual & Aural Short-Wave Communication. K—Therapeutic Oscillators. L—"FM" Radio. M—Television. N—Radio & Television Relay Transmission.

Cast Resins
Molding Compounds
Liquid Resins

CATALIN
CORPORATION

ONE PARK AVENUE • NEW YORK, N. Y.

ONE · OF · A · SERIES · ON · THE · PHYSICAL · PROPERTIES · OF · PLASTIC · MATERIALS

How to Select a RECTIFIER

To say one type of rectifier is better than any other type would be as fatuous as saying a bomber is better than a fighter plane. Each is better than the other when accomplishing the specific results for which it is designed.

Thus, the manufacturer of a product employing rectifiers must first determine the results to be obtained and the conditions under which the rectifier will function. Such data are essential when deciding whether Selenium, Copper Oxide or Tungar type of rectifier will do the most efficient, most economical and most satisfactory job.

Since General Electric makes all three—Selenium, Copper Oxide and Tungar—it has no reason to prefer one to the other. It can give you unprejudiced advice on which type is best for your particular requirements.

When next you need a rectifier, why not let G-E Tungar and Metallic Rectifier Engineers analyze your needs and offer their recommendations? Naturally, this engineering consulting service entails no obligation. Address inquiries to Section A-935-124, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

NEW PLASTIC INSULATING GROMMETS

#3/P-231

ALL HOLES ARE CONCENTRIC

#3/P-232

ALL CORNERS CHAMFERED

#3/P-234

ALL THREADS CLEAN & LUBRICATED

#3/P-233

ALL PARTS MATTE FINISH

Of special interest to production engineers seeking to cut down assembly time operations, Creative's new line of 100% phenolic plastic insulating grommets offers many important advantages. These new grommets, available in four standardized sizes, have been developed especially for use by Radio, Electronic Generator, Dynamotor, Aircraft and other manufacturers. Holes are concentric, with all corners chamfered, avoiding wire chafing. All threads are clean and lubricated. To promote easy gripping and reduction of assembly time all parts are matte finished.

Electrically, Creative grommets are ideal. For example, dielectric strength averages about 260 to 430 v.p.m.; dielectric constant 5.5 to 7.4; power factor at 10^6 cycles .02 to .05. Water absorption is unusually low at only .5% in 24 hour test.

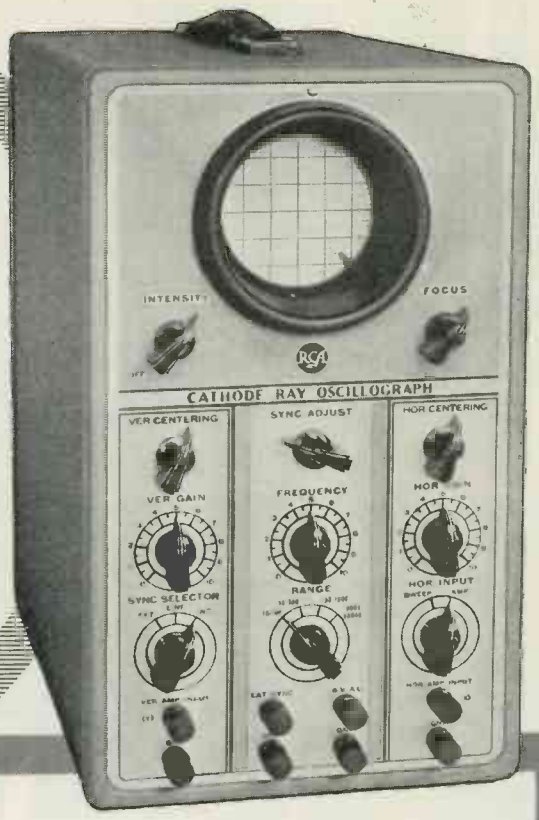
Creative grommets, available from stock, are sold at prices which reflect mass production efficiency

SEND FOR SAMPLE CARD AND PRICE LIST NOW

Creative Plastics Corp.

968 KENT AVENUE BROOKLYN 5, NEW YORK

The New RCA 3-INCH CATHODE RAY OSCILLOSCOPE No. 155-C



10 TO 60,000 CYCLES!

New improved timing axis oscillator provides extraordinarily wide range — 10 to 60,000 cycles — never before available in a 3-inch 'scope.

EXTRA-BRILLIANT IMAGE!

New built-in, deep, light-shield makes image appear surprisingly brilliant — even in bright daylight. Screen is quickly removable — easily changed.

DIRECT DEFLECTOR PLATE CONNECTION!

A special side opening in case is provided for direct deflector plate connection — facilitating use of tube for the higher frequencies.

Rugged enough to withstand every-day field and service usage, yet built throughout to exacting laboratory standards, this RCA 155-C 3-Inch Cathode Ray Oscilloscope is particularly recommended for all-purpose requirements. Note its unusual features, briefly described on this page. Write for special RCA Bulletin containing complete information about this fine instrument. Address Test Equipment Section 44C, RCA Victor Division, Radio Corp. of America, Camden, N. J.

RCA

RCA TEST AND MEASURING EQUIPMENT

NEW RCA UNIVERSAL BINDING JACK!

Extremely handy. A combination binding post and pin jack for universal application. Permits quick, positive connection with any type lead terminals. An exclusive RCA feature.

3-INCH CATHODE RAY TUBE!

Three-inch cathode ray tube assures adequately detailed image for practically all applications.

VERSATILE, PORTABLE, FOR LABORATORY AND SERVICE WORK!

Especially intended for the better class service engineers. For field service, industrial testing, and general commercial and laboratory work.

THE DAWN OF A NEW ERA

WITH electrons . . . revolving around their nuclei . . . has come the dawn of a new era. In this development . . . a broad experience in the specialized knowledge and building of vacuum tubes was a natural forerunner of Slater's electron tube progress. And Slater research continues in capturing and controlling the minute electronic currents to do their miraculous tasks in the war effort . . . and for the peace-time applications when victory is won.

SLATER ELECTRIC & MFG. CO.

BROOKLYN, NEW YORK

MANUFACTURERS OF PRECISION ELECTRONIC TUBES AND INCANDESCENT STREET LIGHTING LAMPS

THERE'S A SOURCE . . . AND ONE WELL WORTH INVESTIGATING

SMOKE . . . rings of it . . . was one of the first things televised for public demonstration. That tiny puff of smoke was the start of a bonfire. On Sept. 1, 1928,* in a public showing before critical newspapermen of San Francisco, Farnsworth engineers first demonstrated their magical science. And it was acclaimed.

Since then, television has come a long way. The original Farnsworth Dissector Tube, cathode ray tubes, circuits, synchronizing devices—all the original equipment—have been perfected.

Electronic television is on the threshold of world-wide expansion. People with a sound background in radio are looking forward to television as a new field of tremendous opportunity, rivaling the automobile industry in rapid growth.

Farnsworth research has always stressed both electronic tubes and circuits, for the correlated development of *both* proves more fruitful of results.

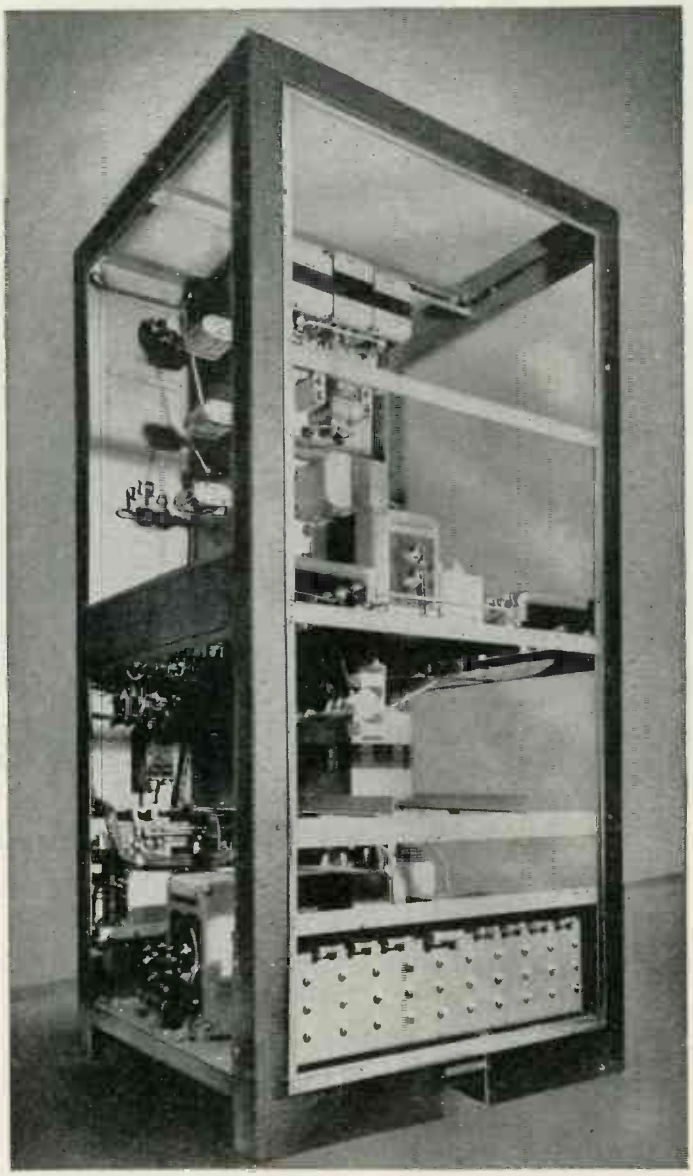
Naturally, our current production is entirely military. After peace comes, we'll be ready to help you and serve you.

*No. 2 *in a series depicting milestones in the history of Farnsworth Television.*

FARNSWORTH TELEVISION

• Farnsworth Television & Radio Corporation, Fort Wayne 1, Indiana. Farnsworth Radio and Television Transmitters and Receivers; Aircraft Radio Equipment; the Farnsworth Dissector Tube; the Capehart, the Capehart-Panamuse; the Farnsworth Phonograph-Radio.

A UNIQUE ENGINEERING GROUP IS READY TO ROLL UP ITS SLEEVES FOR YOU!



FOR wartime production or postwar planning... in the application of existing devices or the development of new designs... we are ready to help you harness the miracle of electronics to your specific needs. We have the background: 65 years of constant cooperation with the communications industry in all its phases. We have the facilities: military and government agencies may tell you some of the story. And we are neither too big to bother with small problems . . . nor too small to succeed with big ones. Can we get together?

JB SINCE 1878

J. H. BUNNELL & Co.

GENERAL OFFICES: 215 Fulton St., New York City · FACTORIES at Brooklyn, N. Y.

Designing Engineers and Manufacturers of:

ELECTRONIC INDUSTRIAL DEVICES ★ INDUSTRIAL RECTIFIERS
HIGH POWER RADIO FREQUENCY GENERATORS ★ TRANSMITTERS
RECEIVERS ★ AUTOMATIC TELEGRAPH EQUIPMENT

Our Country Honors
SKILLED HANDS
United for Victory

On August 12th, 1943, United Electronics Company received the coveted Army-Navy "E" Award for excellence in production of war materials.

In accepting the honor of flying the "E" burgee over our plant, we extend full and grateful recognition to the skill, the will and the spirit of loyalty which has motivated our personnel ever since Pearl Harbor. To the nation's official tribute we add a hearty "well done" for our family of workers which has achieved an outstanding production record in both quantity and quality of output.

Under the fresh inspiration of our "E" banner, we pledge ourselves to renewed and faithful effort. Our aim continues: more and better electronic tubes . . . for victory today and better living tomorrow.

UNITED
ELECTRONICS COMPANY
NEWARK . . . . . NEW JERSEY

This CONSERVATION PLAN

will help you

SAVE MAN-HOURS . . .

SAVE MATERIALS . . .

SPEED PRODUCTION

1. Conserve

by strategic selection, application and use of electrical equipment.

EXAMPLE

Standard gearmotors or speed reducers save materials required by sheaves, belts, chains and line shafts. In addition, they commonly effect power or energy savings up to 10.5%.

2. Conserve

by utilizing new developments that reduce need for critical materials and man-hours.

EXAMPLE

X-ray inspection detects defective castings or welded sub-assemblies before they are machined or assembled. It replaces "destructive" tests . . . reduces rejects . . . eliminates wasted machinery man-hours.

3. Conserve

by utilizing available facilities for preventing breakdowns and reducing machine outages.

EXAMPLE

"Maintenance Hints"—a complete, pocket-size manual covering recommended upkeep practice for electrical apparatus—is a maintenance help available without charge. Check your Westinghouse representative for copies.

4. Conserve

by utilizing materials which in many cases can replace critical materials and do a better job.

EXAMPLE

Micarta, a heavy-duty industrial plastic, outwears other materials in many bearing applications. Typical of many uses are steel mill roll neck bearings and marine stern tube and pintle bushings.

5. Conserve

by tapping all sources of salvageable scrap.

EXAMPLE

Systematic planning can uncover many ways of reclaiming worn equipment and waste material. Samples of salvage forms and organization charts in use in Westinghouse plants will gladly be made available on request.

Wartime Conservation means MORE than just conserving copper, steel, aluminum . . . it means the most strategic possible use of all of the ingredients of Victory—materials, man power, time and ingenuity.

These five major points comprise a complete program developed by Westinghouse for Wartime Conservation. This program packages up Westinghouse engineering experience in the entire field of electric and power equipment and related materials. Examples noted are but five of many specific recommendations.

This experience and these recommendations are offered fully and without obligation.

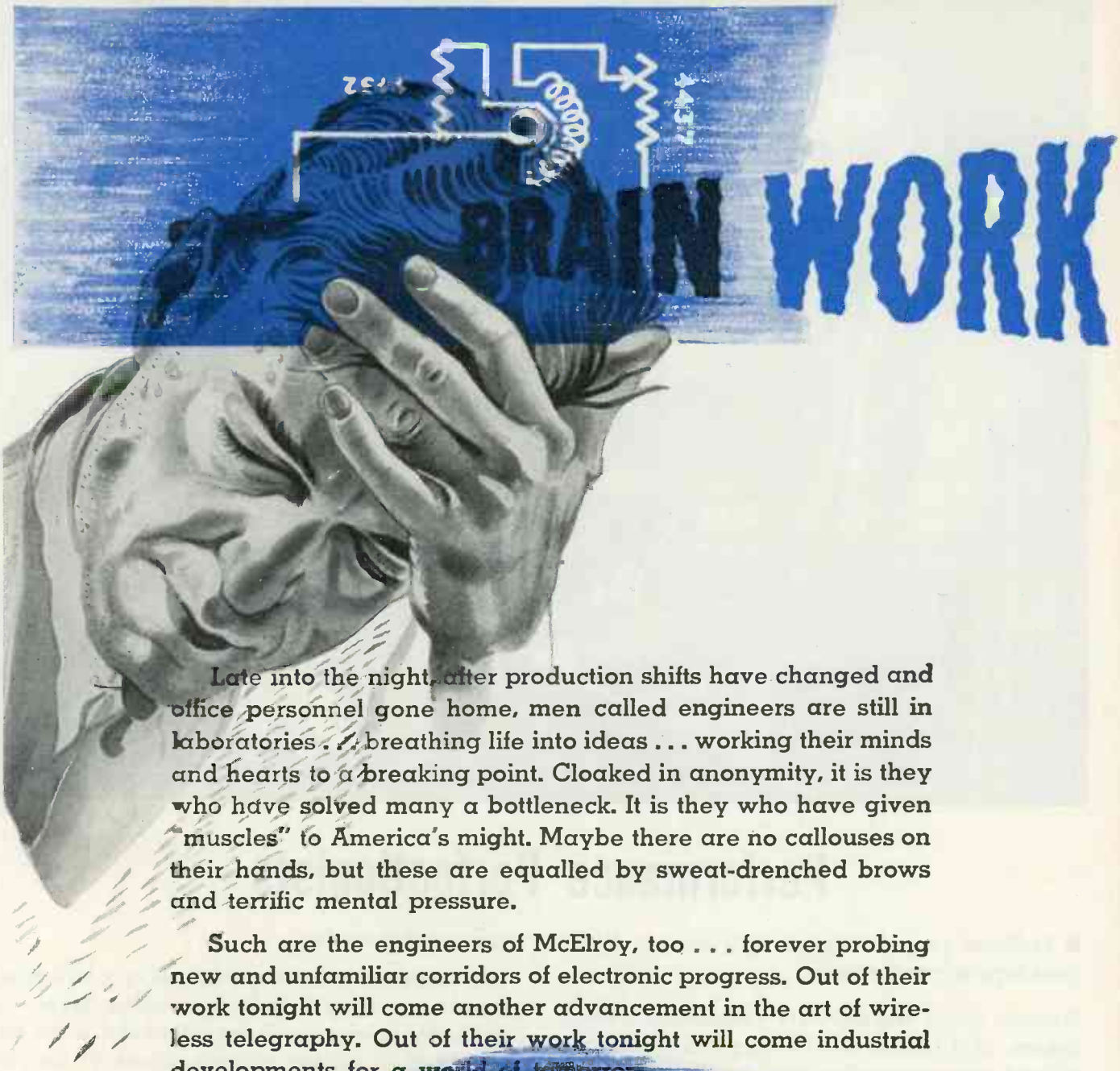
Ask your Westinghouse representative today for a copy of the new 100-page book, "WARTIME CONSERVATION." Or write direct to Dept. 7-N, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

J-90481

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

LET'S ALL PITCH IN TO HELP SHORTEN THE WAR . . . BACK THE THIRD WAR LOAN DRIVE



BRAIN WORK

Late into the night, after production shifts have changed and office personnel gone home, men called engineers are still in laboratories . . . breathing life into ideas . . . working their minds and hearts to a breaking point. Cloaked in anonymity, it is they who have solved many a bottleneck. It is they who have given "muscles" to America's might. Maybe there are no callouses on their hands, but these are equalled by sweat-drenched brows and terrific mental pressure.

Such are the engineers of McElroy, too . . . forever probing new and unfamiliar corridors of electronic progress. Out of their work tonight will come another advancement in the art of wireless telegraphy. Out of their work tonight will come industrial developments for a world of tomorrow.

TED McELROY AND HIS STAFF
ARE CREATIVE ENGINEERS

WE NEVER COPY . . . NEVER IMITATE
WE CREATE . . . DESIGN . . . BUILD
PLEASE FEEL FREE TO CALL UPON US
WHENEVER WE CAN BE OF-SERVICE

McElroy MANUFACTURING CORP.
82 BROOKLINE AVE., BOSTON, MASS.

WORLD'S LARGEST MANUFACTURER OF AUTOMATIC RADIO TELEGRAPH APPARATUS

Performance Perfectionists

● Technical progress depends upon tireless experiment to perfect performance.

Sylvania circuit engineers are performance perfectionists. They conduct never-ending tests on new circuit and tube combinations using experimental equipment. They constantly improve radio and electronic tube quality. And they compile data that is the raw material of invention.

This long-range Sylvania research policy, which maintained our standard of quality in peacetime, has proved invaluable in wartime. It has contributed to the improvement of military communications, to the perfection of Radar, to the volume production of cathode ray tubes, and to the development of timesaving electronic devices for war industry.

QUALITY THAT SERVES IN WAR

And it will prove no less valuable when victory widens the radio-electronics field. It will contribute to the development of FM radio and practical television. It will help to convert electronic military secrets of today into everyday miracles for better life and work tomorrow.

ARMY E NAVY

RADIO DIVISION

SYLVANIA ELECTRIC PRODUCTS INC.

Emporium, Pa.

RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES, INCANDESCENT LAMPS, FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES

Precise Load Rating OF LORD BONDED RUBBER MOUNTINGS

RESULTS IN HIGH EFFICIENCY OF VIBRATION ISOLATION

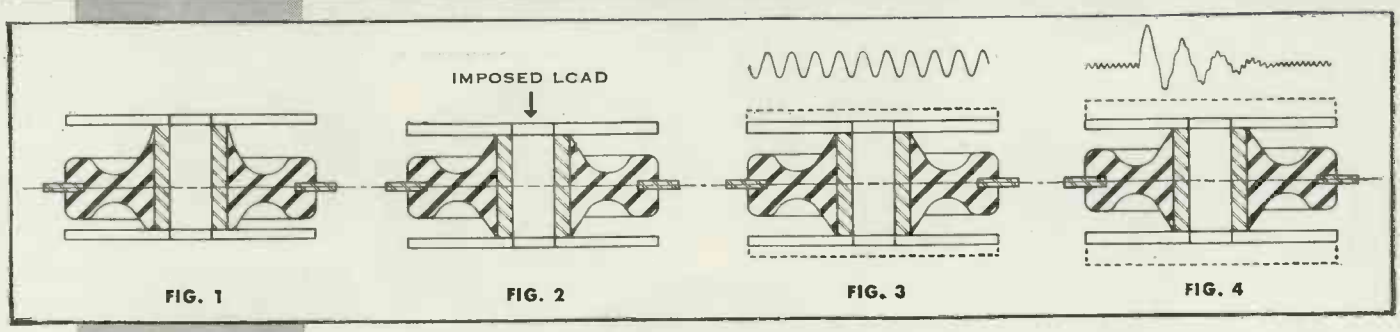


FIG. 1 FIG. 2 FIG. 3 FIG. 4

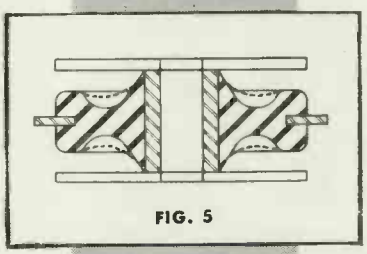


FIG. 5

Operation of Plate Form Mountings

ALL Lord Mountings are designed to operate on the principle of having the rubber "stressed in shear" when load is applied in the direction of the main axis of the mounting. This mounting design provides the required softness and deflection in the direction of the disturbing forces, and stability or resistance to movement in directions normal to the major thrusts, thereby obtaining the highest degree of vibration isolation efficiency.

The proper deflection of a mounting under a given static load is of paramount importance in selecting a suitable means of flexible suspension, and every Lord Mounting is designed to have a definite static deflection under its rated load. Lord Plate Form Mountings (non-snubbing type) are designed to deflect 1/16 inch when rated load is applied.

Illustrations above show a Lord Plate Form Mounting in the various positions it assumes while static or in action:

Fig. 1—Under no load (as shipped from factory). Note extension of center sleeve. Fig. 2—Under rated load; note that center sleeve has deflected 1/16 inch. Fig. 3—Operating in zone of free shear action under normal vibration. Fig. 4—Operating momentarily under sudden shock or in zone of resonance. *(see footnote)

Lord Plate Form Mountings are designed to cover a wide range of applications in every field of industry. They are made in four shapes (round, square, diamond, and holder types) and four sizes, with load ratings ranging from a few ounces to 300 pounds. Load ratings of each size can be varied by:

1—Utilizing different rubber compounds of varying degrees of stiffness to meet specific spring-rate requirements.

2—Changing dimensions of rubber element at flexing point. (See Illustration No. 5)

The remarkable efficiency of Lord Plate Form Mountings is due to the accuracy, precision, and uniform quality of manufacture.

Various factors must be considered when choosing mountings for individual installations. Through proper mounting selection, isolation efficiencies ranging from 75% to 85% reduction of disturbing forces may be expected, although reductions up to 97% are not unusual on equipment operating at very high frequency.

Write for bulletins 103 and 104. They give complete information on all Lord Mountings as well as an engineering discussion on vibration control. Better still, call in a Lord vibration engineer for consultation on your design problems. There is no obligation.

**Where frequent shock loads or operation in resonance zone are encountered, the use of Lord Vertical Snubbing Type Mountings is recommended. See Bulletin 103.*

INVEST TODAY IN BONDS FOR VICTORY

LORD MANUFACTURING COMPANY . . . ERIE, PENNSYLVANIA

Originators of Shear Type Bonded Rubber Mountings

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AHEAD

MAN reached for the stars and grasped . . . Electronics.

Devoted now to war, this amazing science promises wondrous adventures for mankind on THE ROAD AHEAD.

As constant research has developed the potentialities of Electronics, so the search for a BETTER WAY, here at American Lava, has perfected steatite insulation best suited to the new requirements.

Pioneers of steatite electrical insulation . . . now in our 41st year of Ceramic Leadership, we are able to say with full confidence that ALSIMAG Steatite Insulators represent the highest quality, precision, dielectric properties and mechanical strength to be found among the Steatites.

There will be no compromise with quality in the production of ALSIMAG Steatite Insulators.

AMERICAN LAVA CORPORATION

CHATTANOOGA, TENNESSEE

AWARDED JULY 27, 1942

Where stability is an important requirement, ALSIMAG Steatite ceramics are unsurpassed for lending rigidity and permanence of alignment to electronic circuits.

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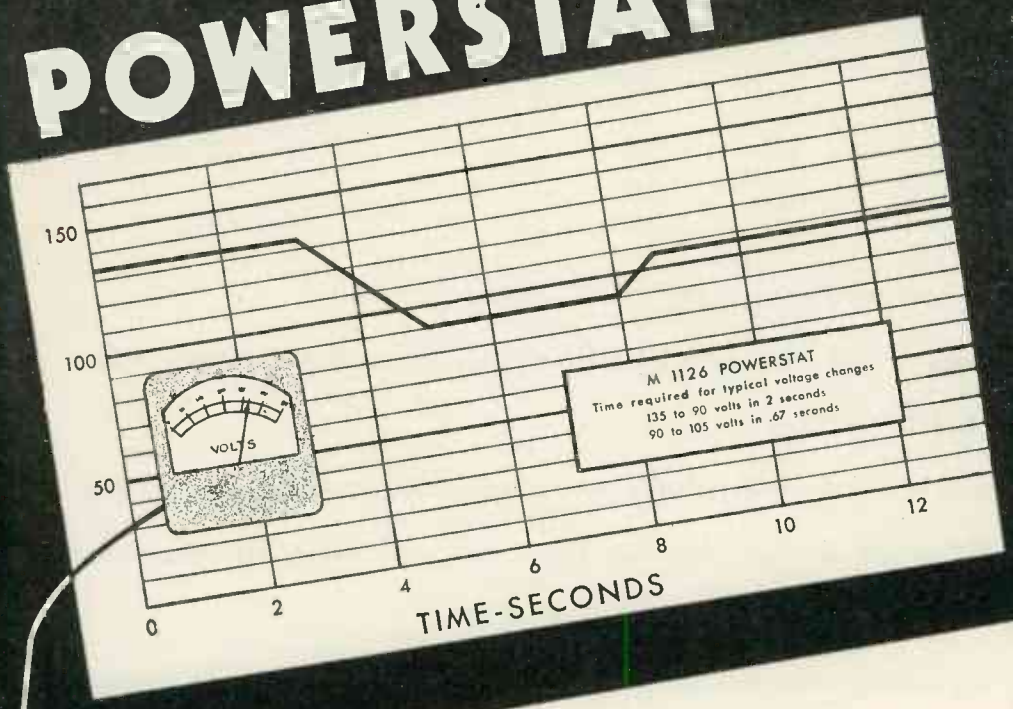
STEATITE CERAMIC INSULATORS

CHARACTERISTICS TAILORED TO YOUR REQUIREMENTS

Certainly,

POWERSTAT variable voltage transformers

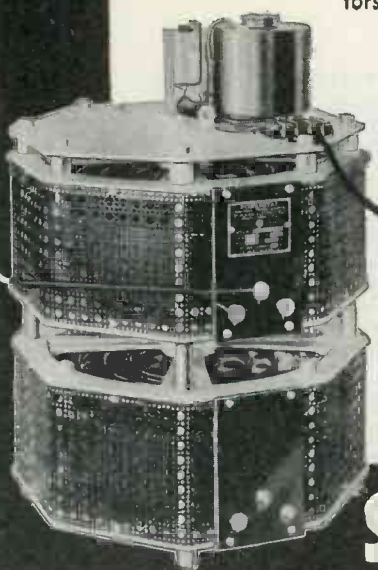


for REMOTE CONTROL

SECO'S Motor-Driven POWERSTAT Variable Transformers offer a highly efficient and accurate method of controlling AC power. It is unnecessary to bring heavy cable to cumbersome tap changers on switch boards or control desks. Simple wiring from your automatic control device or push button station to the pilot terminals of a Motor-Driven POWERSTAT Variable Transformer will enable the operator to control kilowatts of power safely and smoothly.

Where a self-contained piece of apparatus is required for rapidly controlling voltage to any desired value — investigate Motor-Driven POWERSTAT Variable Transformers. This equipment is used in radio transmitters, vacuum tube manufacture, electrical testing, induction heating, electric furnace temperature control, automatic voltage regulators and other applications where an efficient high quality control is required.

Standard types are available in sizes up to 75 KVA for 115, 230 or 440 volt operation on single or polyphase circuits.



FOR FURTHER INFORMATION
SEND FOR THESE BULLETINS
POWERSTAT Variable Voltage Transformers 149 IE
SECO Automatic Voltage Regulators 163 IE

SUPERIOR ELECTRIC COMPANY
92 LAUREL STREET, BRISTOL, CONNECTICUT

SUPERIOR *Electric Company*

What is a Gee-whiz-o-stat?

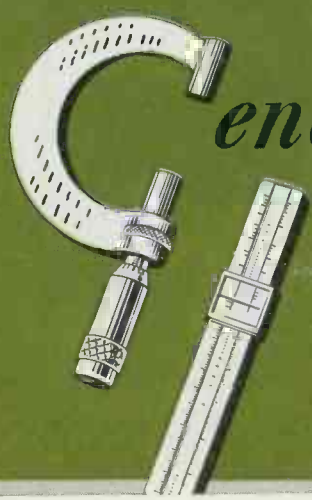
We wouldn't know either!

But General Instrument and their engineers are specialists in reducing these 64 dollar questions to practical production.

There are innumerable "gee-whiz-o-stats"—thingamabobs, ideas now being hatched, nameless today but destined for future fame and profit . . . new products for an era of peace time efficiency.

Perhaps you have such an idea . . . just a doodler's sketch on the back of an envelope. Don't throw it away—or file it. Bring it to General Instrument NOW. If it is based on sound principles, our engineers will design it, shape it to precision performance, ready it now for the starting gun of mass-production and post-war distribution.

It's better than a 2 to 1 chance that your home or auto radio owes its performance and better reception to G. I precision equipment.



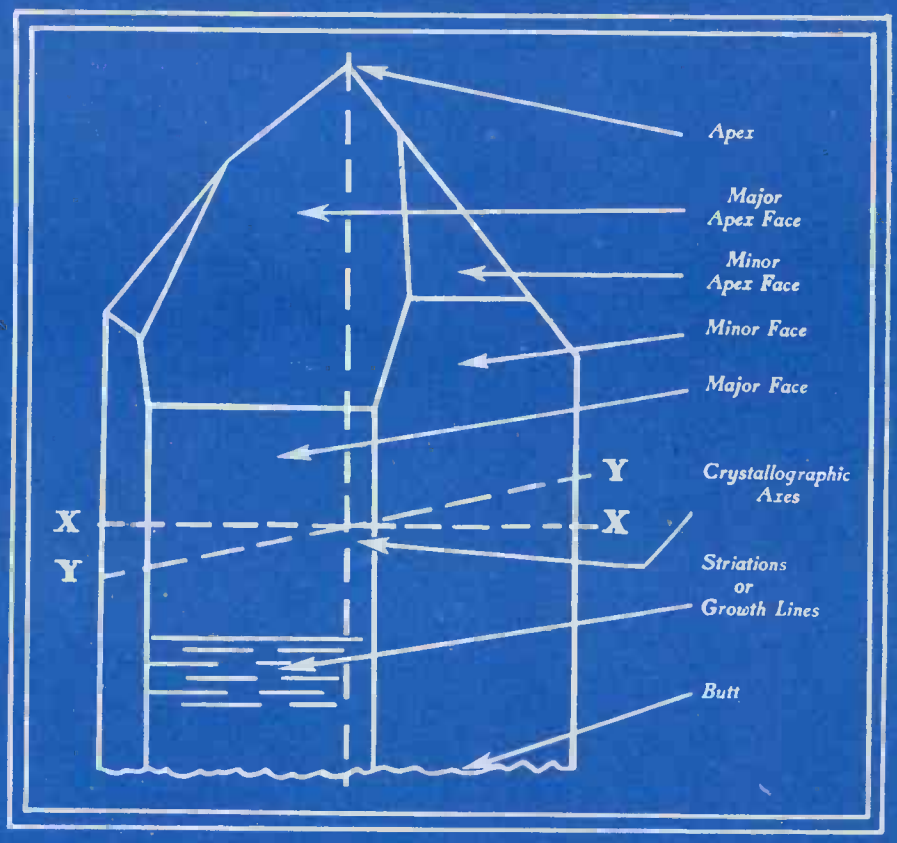
General Instrument CORPORATION

ARMY E NAVY

EXECUTIVE OFFICES • 829 NEWARK AVENUE • ELIZABETH, N. J.

THE INSPECTION OF QUARTZ...

DIAGRAMMED BY CRYSTAL PRODUCTS



Quartz with the better piezo-electric properties are imported. The mineral is usually classified according to size with pieces ranging from 100 to 300 grams.

A shipment of quartz nearly always represents a cross section of the quartz supply . . . some crystals will have good faces and apexes, others only few faces and no apexes, and still others no faces or apexes at all. It is therefore necessary that they be expertly sorted, usually into three groups, each one to be treated in a different method before cutting.

Next, in order, comes the study of impurities in the different kinds of crystals. The impurities can be seen with the naked eye, by having a beam of light pass through the crystal. This shows up such impurities as fractures or cracks, foreign particles included within the crystal, bubbles, needles, veils, color and ghosts or phantoms. The latter are cases where the crystal contains internal colored bands or planes parallel to the faces of the crystal. These really represent stages of growth of the crystal and it appears to the eye as if one crystal has grown within another. Crystals with excessive amounts of impurities are, of course, rejected.

Crystal

PRODUCTS COMPANY

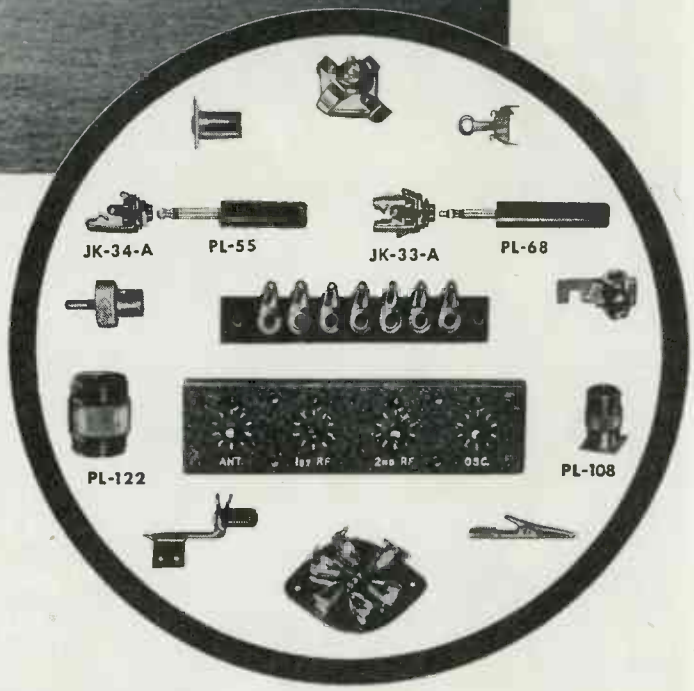
1519 McGEE STREET, KANSAS CITY, MO.

Producers of Approved Precision Crystals for Radio Frequency Control

ELECTRONICS... A MIGHTY WEAPON

This is ELECTRONICS in operation . . . but not until the full facts are released will you be able to see all the technical developments.

ELECTRONIC DEVICES physically, are assemblies of components, each one contributing its share toward making the instrument function. Among the many activities of American Radio Hardware is the manufacture of over one hundred parts used in ELECTRONIC equipment and applications. That our components are used in the production of this mighty weapon is in itself a fine tribute to our skill and our facilities.



ELECTRONIC equipment is comprised of many individual components . . . plugs, jacks, insulators, etc.

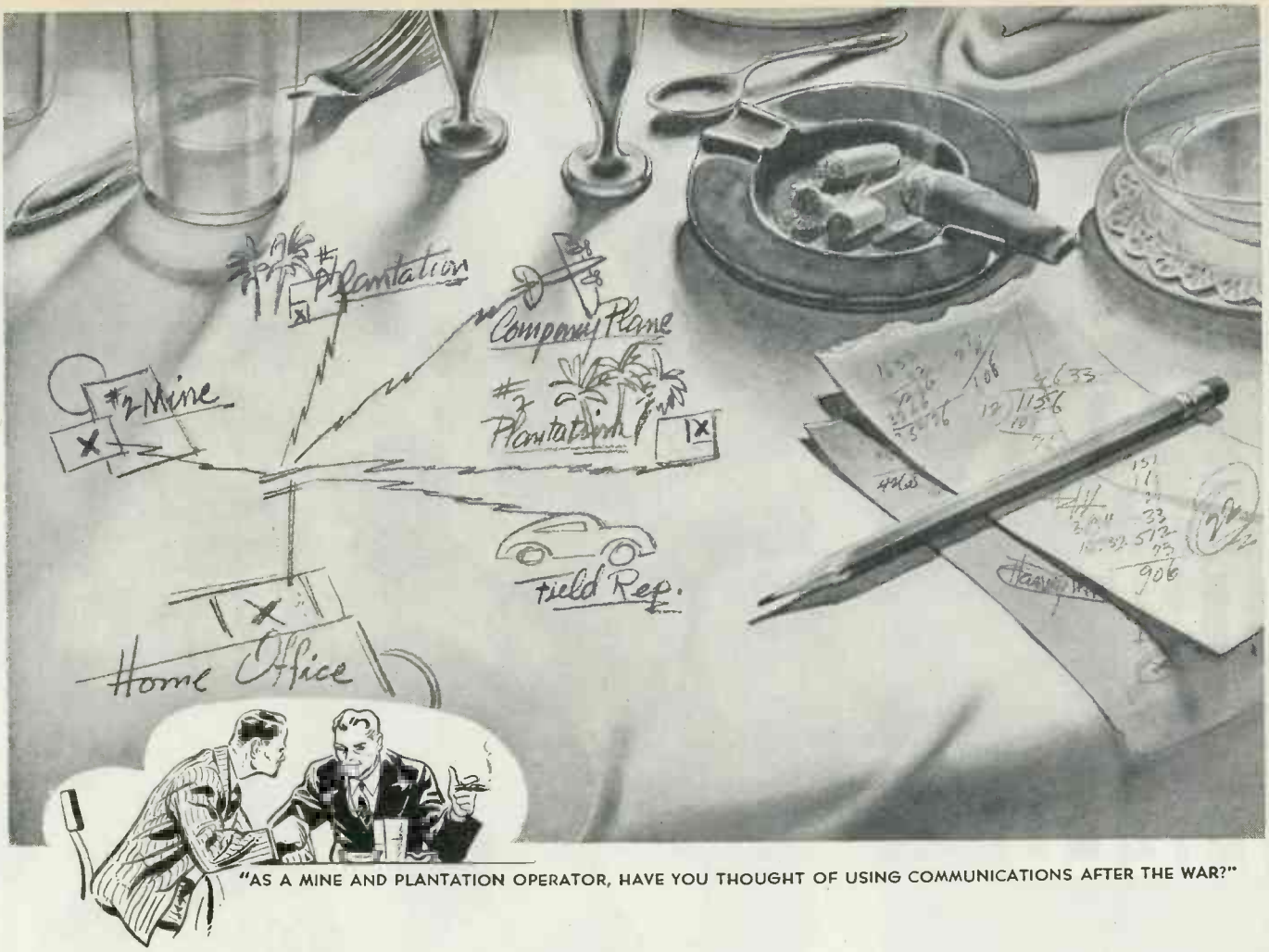
With electrical and mechanical tolerances as critical as they are nowadays, all of our components have been improved to a commanding degree. When they are released for general use, they will be able to serve you better than ever before. Your inquiries regarding the entire ARHCO line are welcomed.

ARHCO RADIO PRODUCTS

American Radio Hardware Co., Inc.

476 BROADWAY • NEW YORK 13, N. Y.

MANUFACTURERS OF SHORT WAVE • RADIO • TELEVISION • SOUND EQUIPMENT



"AS A MINE AND PLANTATION OPERATOR, HAVE YOU THOUGHT OF USING COMMUNICATIONS AFTER THE WAR?"

"Tablecloth" Communications

. . . or just plain pencil doodlin'—perhaps—and no doubt you've been doing some yourself, planning for post-war operations in your own business.

Our job right now is making specialized communications equipment for our government; and what we're learning now will be of utmost value to communications in YOUR business, post-war and after.

Since infinite peacetime applications come from the stimulation of war—YOUR communications equipment will be BETTER than ever. Better in design, lighter in weight and more compact through skilled manufacturing.

Here we have done a bit of doodlin' for applications in a mine and plantation set-up. Future "Tablecloth Communications" will dramatize possible uses of Harvey-Wells equipment in industries, transportation, lumbering and other allied fields.

HARVEY-WELLS
Communications inc.
★
HEADQUARTERS
For Specialized Radio Communications Equipment
SOUTHBRIDGE, MASS.

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ELECTRONIC INDUSTRIES

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

War-Radio Output to Go Up 35% in '44

The recent slowdown in war-radio contracts is distinctly a thing of the past. Demands now being made upon radio manufacturers by WPB and the Army and Navy are at an all-time peak. For 1944, an increase of 35 per cent in radio requirements is indicated.

During 1943, output has been at the rate of three billion dollars annually. For 1944, four billion dollars' worth of radio apparatus is scheduled. (These figures are to be contrasted with the quarter-billion-dollar normal civilian radio output, at manufacturers' prices.)

The new huge demand for war-radio equipment makes it apparent that no resumption of civilian-radio manufacture can be considered during the next twelve months, barring an unforeseen turn of the war. All civilian output is automatically banned, except for the trickle of Lend-Lease assemblies going to Russia and South America, from manufacturers with balanced inventories—a total of not over 100,000 sets annually. The sole civilian responsibility recognized by WPB's radio division, is only that of providing tubes and parts to keep at least one radio set working in each of the nation's 30 million radio homes. The rest is the all-out war job!

A Quarter-Million Radio Lassies!

The gal at the machine will be a favorite subject on magazine covers this month, for September issues of magazines all over the country are paying tribute to women workers in industry.

In line with this widespread publishing movement, the attractive young woman on our own front cover is properly representative of the 250,000 women workers now engaged in radio manufacturing plants.

Other industries were not "feminized" until war came along and the desperate shortage of manpower made it necessary to call in high school girls, matrons and even grandmothers.

But radio, from its early days, has been largely "manned" with female assemblers, and this same industrial policy of utilizing a majority of women in radio factories is now being carried over into war work on an ever-increasing scale.

Radio devices—admit it, Mister!—are today not man-made but woman-made miracles!

Our Paper and Printing Bow to War's Demands

Inexorable are the demands of war, and they are visited on our readers even through the pages of the magazine now in the reader's hands.

Chlorine is needed by Uncle Sam, and so our paper can no longer be bleached to the whiteness we once enjoyed. Nitric acid is required for explosives; its absence robs many organic colored inks of their bright hues. Civilian uses of phenolic resins have been restricted and with them our "shiny" inks.

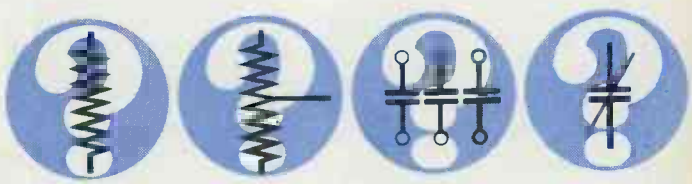
Meanwhile to meet the limitations set by the War Production Board, we have successively reduced the weight of paper used in printing our issues, until the present number appears on "40-pound" stock. All these are minor penalties of wartime; the bright days of peace will bring back better printing than ever.

Electronic Double-talk

For their radio-circuit diagrams, radio men have built up an acceptance of certain symbols quite different from the symbols used in the older electrical engineering field. And now as the radio-electronic tube penetrates widely into industry, confusion is being caused by these symbols that mean one thing to radio men; something entirely different to others.

Examples of these confusing double-meaning symbols are shown below. Resistors are confounded with transformers, capacitors with contactors, variable condensers with simple switches! And there are many others.

Because both radio and electrical engineers are reading the same pages in our issues and elsewhere, we are among the first to face this dilemma and to send up a cry for help. ASA, IRE and AIEE, get together,—we plead,—and put an end to this electronic double-talk!



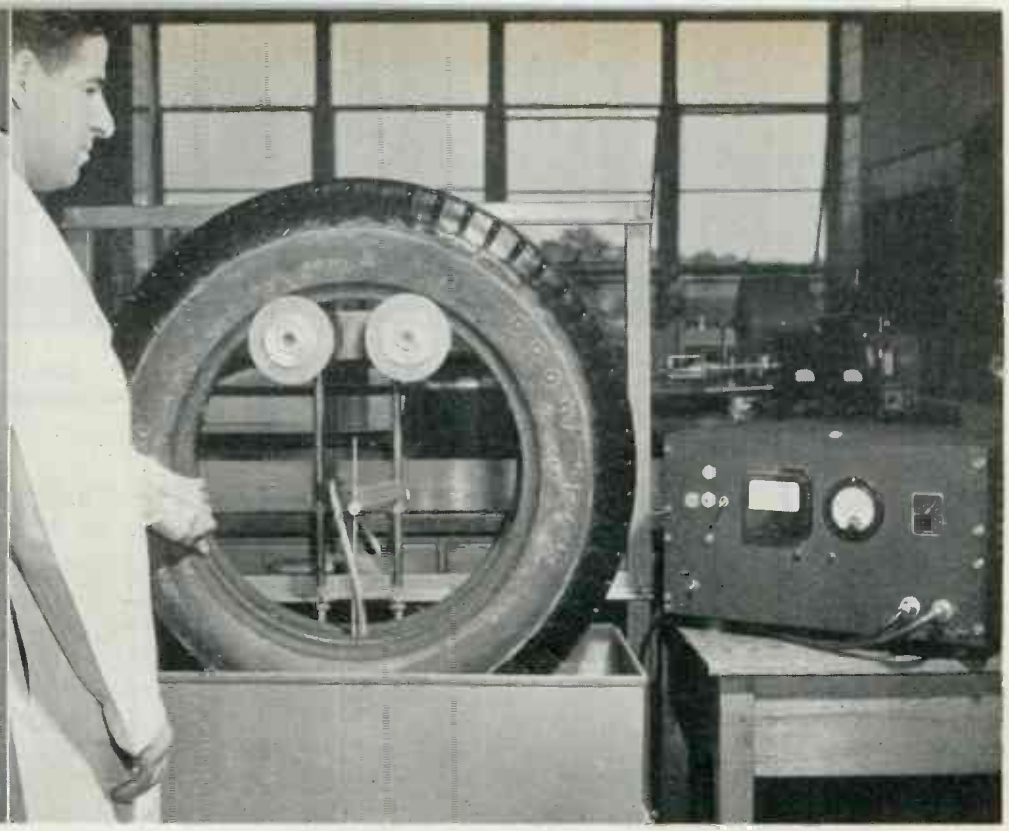
REACTOR? or RESISTOR?

AUTO-TRANSFORMER? or ADJUSTABLE RESISTOR?

CIRCUIT BREAKER? or CONDENSERS?

CONTACT? or VARIABLE CONDENSER?

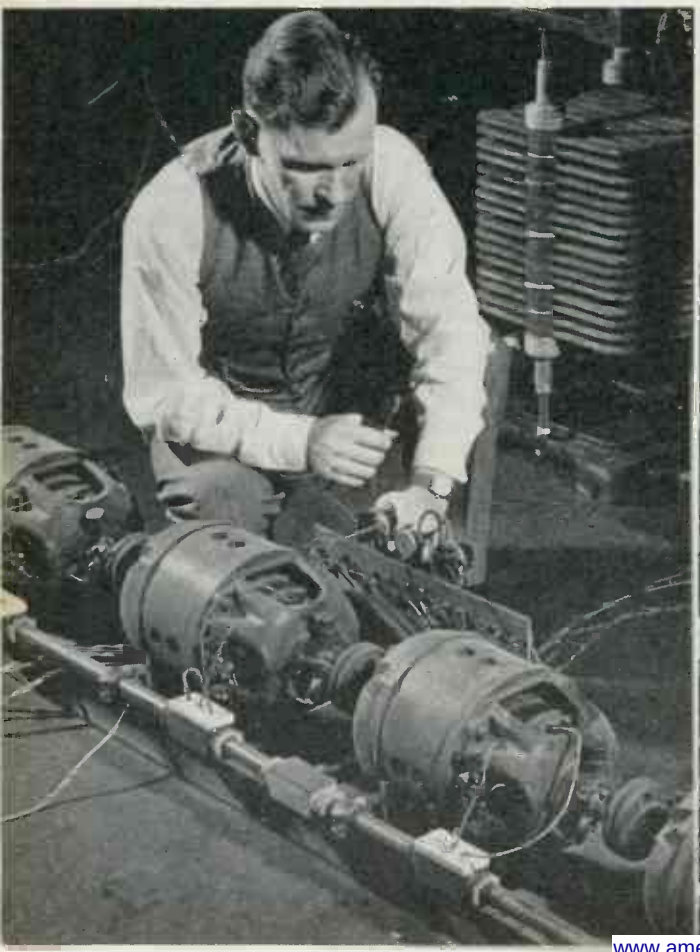
P.A. MEGAPHONE for use on merchant vessels, made by Guided Radio Corp., N. Y. Mike and speaker in megaphone, amplifier slung over shoulder



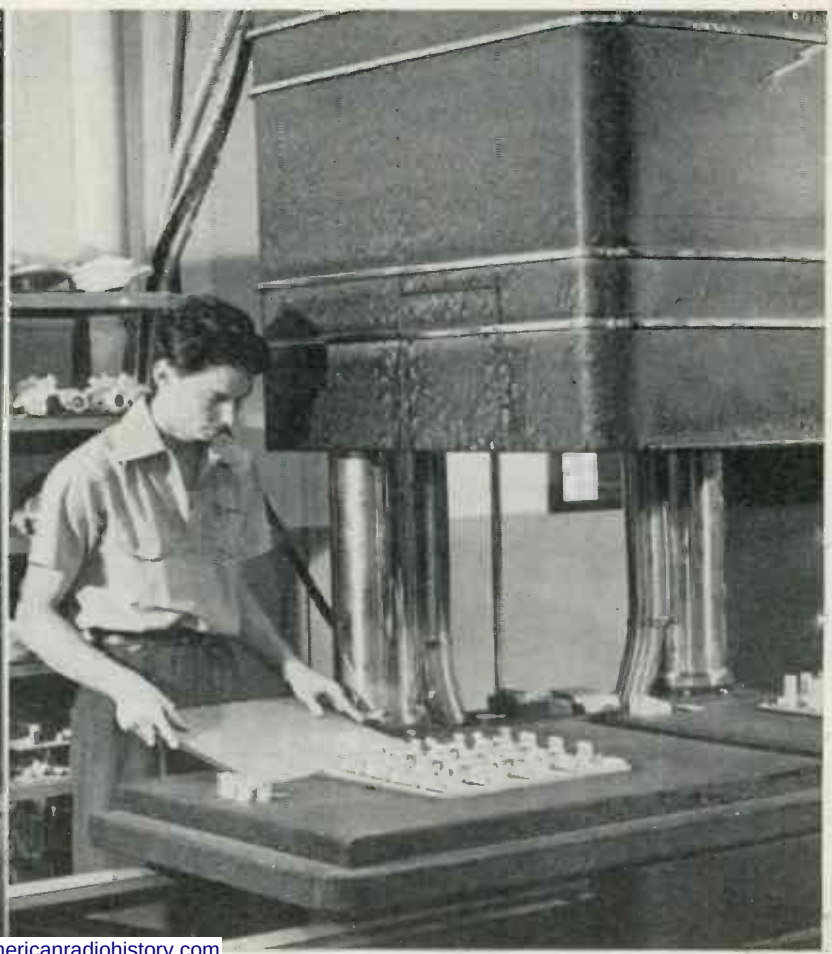
ULTRASONIC waves test tires in Goodyear Laboratory, Akron, Ohio. Magnetostriction generator in water feeds mike inside casing. Red light on panel indicates ply-separation. If tire is solid, mike receives signal and green lamp lights

TUBES Behind

ARC-BACK in ignitrons is studied with Westinghouse device. Arc-back voltages are stored in condensers wired to commutator segments of rebuilt motor while oscillograph and camera start. 1/30 second later, stored energy "plots" graph of flash-back on cathode ray tube screen. Camera records image

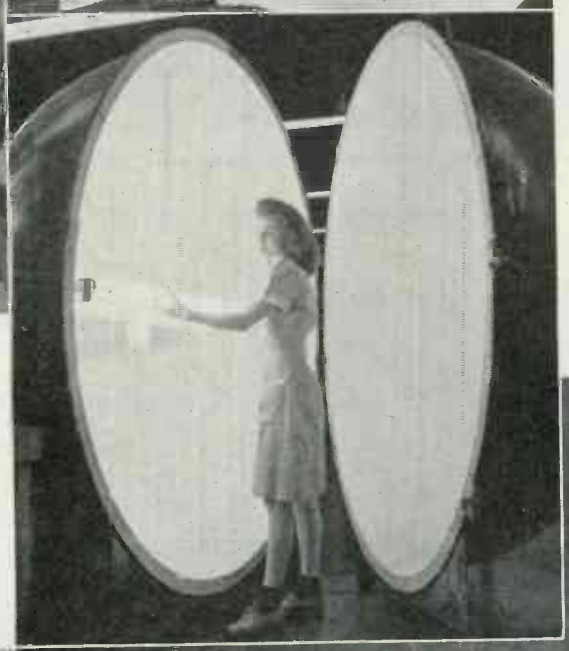


AUTOMATIC X-raying of small castings used in production of Lockheed airplanes



ELECTRON MICROSCOPE at Goodyear research laboratory aids in study of natural and synthetic rubber structure. Note photos on wall

← MOTOR CONTROL ON drill press at G-E Schenectady plant gives constant speeds of 25 to 1750 rpm, allows tapping, fly-cutting, and drilling molded compounds at controlled speeds



← LIGHT MEASUREMENT with seven ft. sphere and phototube checks radiation of fluorescent lamps

the LINES

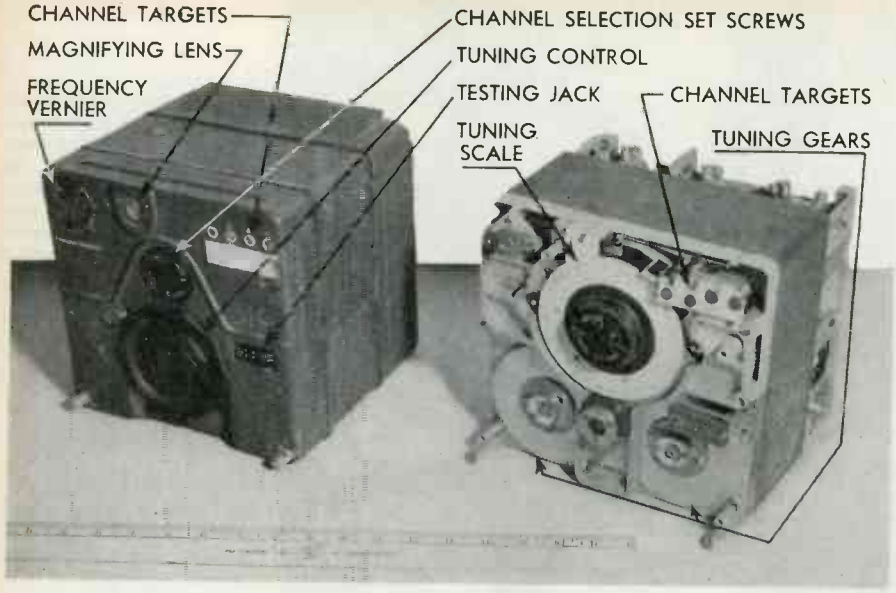
PE CONTROL on A.C.F. heater insures accurate hardening of .50 calibre machine-gun parts

↓ 500 KC INDUCTION HEATING equipment made for Carboloy Co., Detroit, by General Electric, for faster brazing of carbide tools

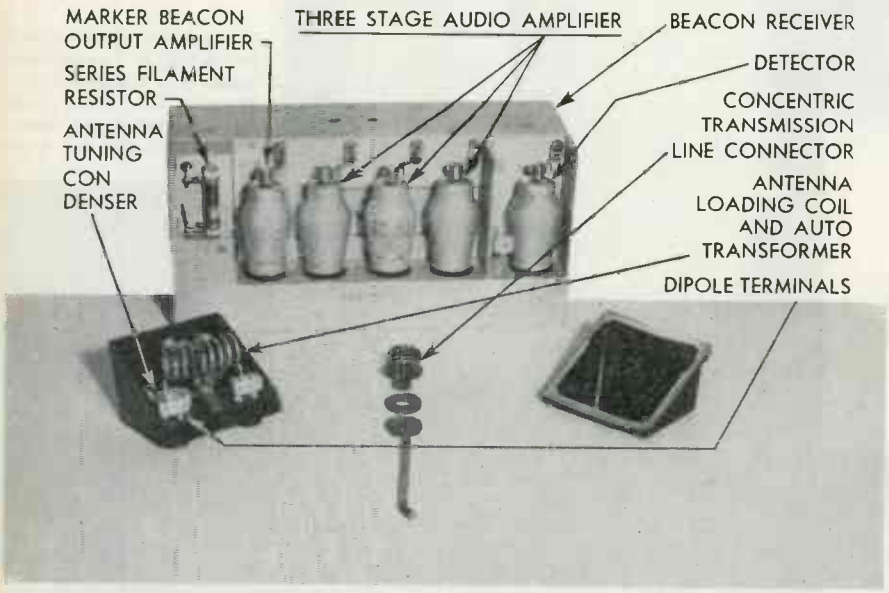
ENEMY

by GILBERT SONBERGH

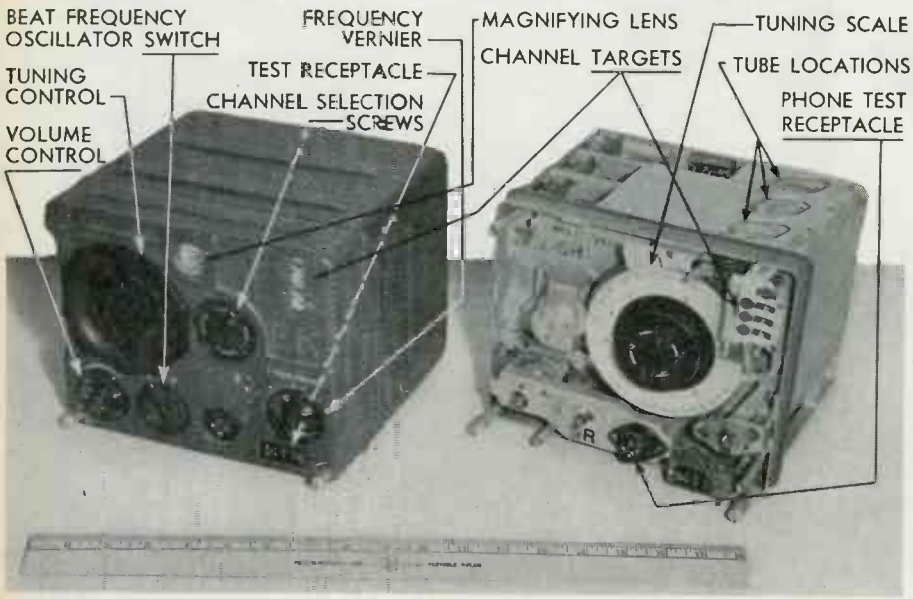
Analysis of equipment fighter plane captured



LONG and short wave transmitters used on the Messerschmitt Me 110 airplane



BLIND landing equipment removed from case to show arrangement of the tubes



EXTERNAL and interior construction of the long and short wave receiver units

• A great deal of German, Italian and Japanese radio communications and other electronic equipment has, of course, been captured by United Nations forces in the various war theaters. A brief analysis of some of this equipment in terms of materials used and construction methods employed should prove of interest and value to American radio engineers.

Most of this equipment is of a portable or semi-portable nature. The German and Italian units show wide use of aluminum and magnesium alloys, particularly for thin-walled die castings and sand castings. Sand castings are frequently employed as housings for the various subassemblies, which are in turn fastened to mounting plates, usually by four screws for ready accessibility. Another method involves large housings with cast partitions for the various shielded units. Panels, side walls and covers are frequently made of plywood or a material such as Masonite, covered on both sides with thin sheets of metal, usually aluminum. Panels and covers on units containing dynamotors and transformers are frequently cast with a diamond-grid-type surface for increased heat radiation. Such equipment sometimes is assembled in airtight housings, indicating highly efficient design of component parts and good heat dissipation by virtue of the rather heavy aluminum and magnesium bases and covers.

Material shortages

All of the equipment reflects shortages of steel, copper and zinc but no apparent shortages of aluminum, magnesium, nickel or tin, although silver solder has been widely used in later equipments. Gold plating of coil wires was noted in some instances. Screws, brackets, and other small parts are frequently made of zinc-plated steel or aluminum alloy.

The zinc coating on such steel parts is often very thin and is subject to considerable corrosion, particularly in humid climates. The magnesium parts show little corrosion, even when no protective finish

used on Messerschmitt in operating condition

is employed. Magnesium parts are sometimes coated with aluminum lacquer.

Copper and copper base alloys are generally restricted to terminals, contact springs, and other locations where low electrical resistance is imperative. Nickel, silver and phospher bronze are employed for spring members.

Copper-steel cable

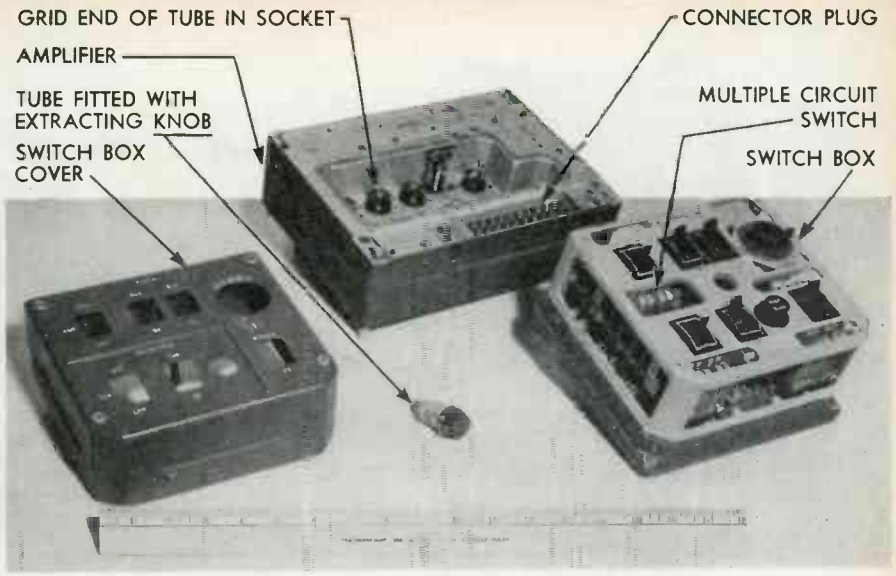
As evidence either of a marked shortage of copper or of very careful design in the German and Italian equipment, solid and stranded wire is generally considerably smaller than we are accustomed to use in American equipment. Stranded copper wire is frequently made up partly of steel and partly of copper wires for maximum strength and minimum use of copper.

Nickel-plating is not often used in the German and Italian radio equipment under discussion, but where it is used for protective or decorative purposes it has been noted that the plating is quite heavy.

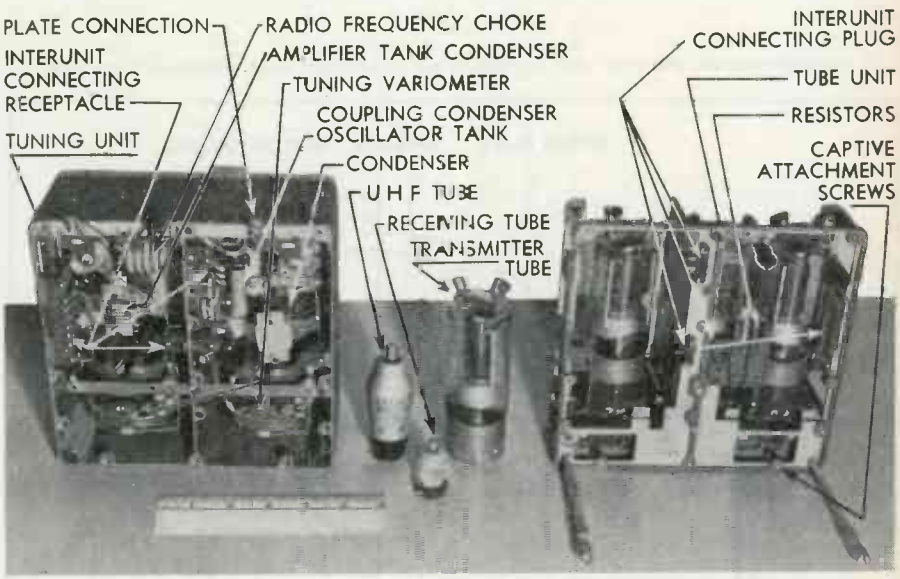
A striking feature of the German and Italian equipment is its lack of protection against the ravages of humid climates. The equipment was obviously not designed for use elsewhere than on continental Europe. Coils, capacitors, transformers, and other critical components are rarely potted.

The equipment does not reveal any apparent shortage of mica but that used is generally of a brown color, indicating inferior grades. Paper condensers impregnated with resinous compounds have largely supplanted mica condensers in later equipments. Another indication that the equipment was not properly designed for humid climates is the use of fiber spur gears both of the straight and zerol types. Anti-backlash spur gears are of the phenol fiber type. Music wire springs used on such gears are rarely coated with a protective lacquer. Some of the gears are of aluminum alloy, particularly in the aircraft radio equipment.

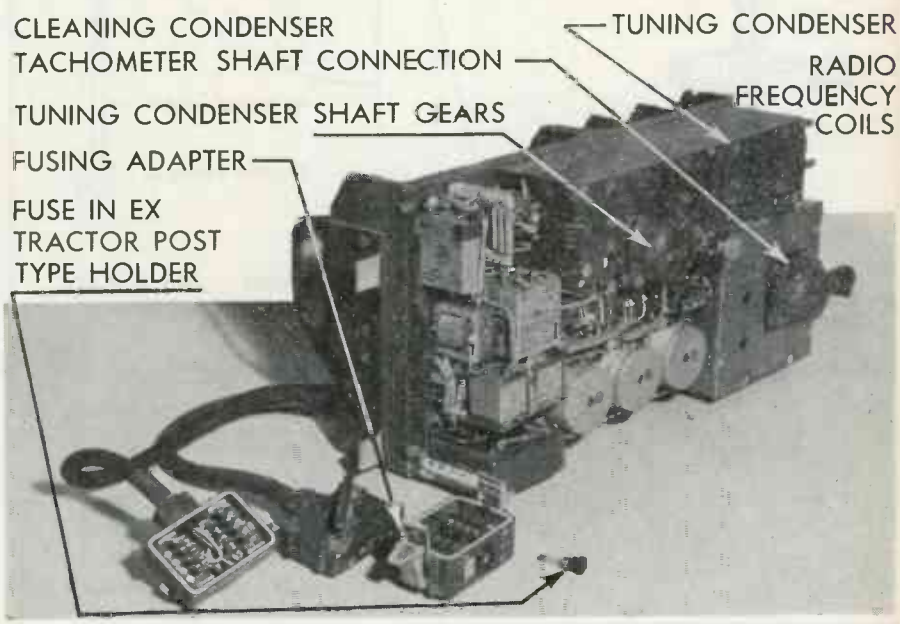
The tubes used are generally mounted in an inverted position.



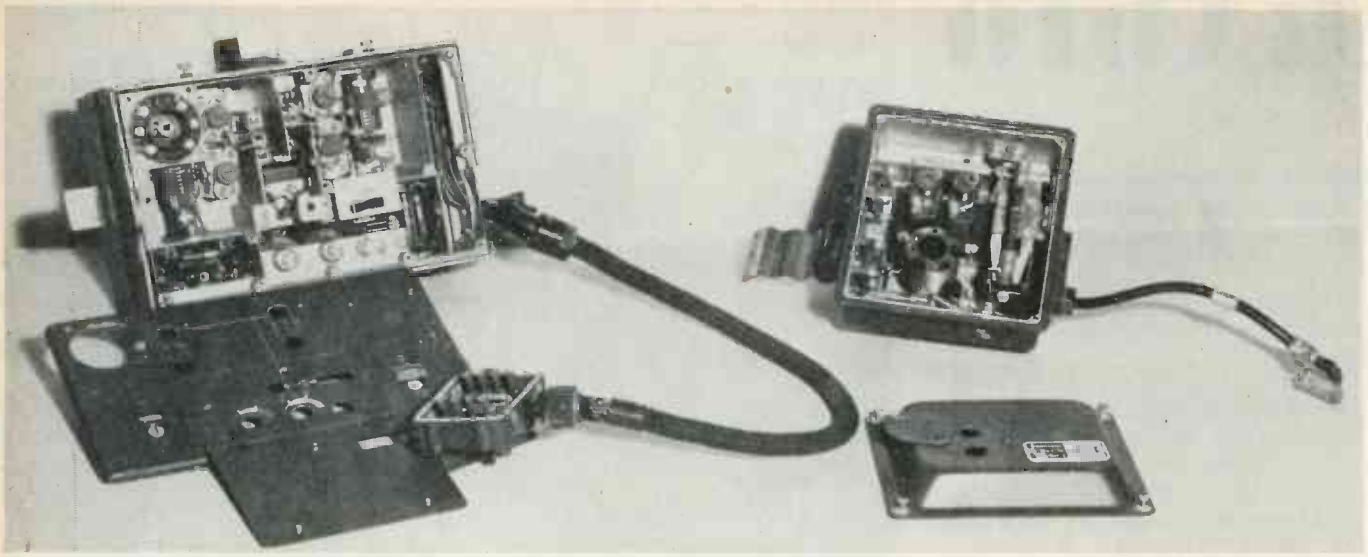
AMPLIFIER and switch control units used in the Messerschmitt interfone unit



TRANSMITTERS for long and short waves are mopa, identical except for frequency

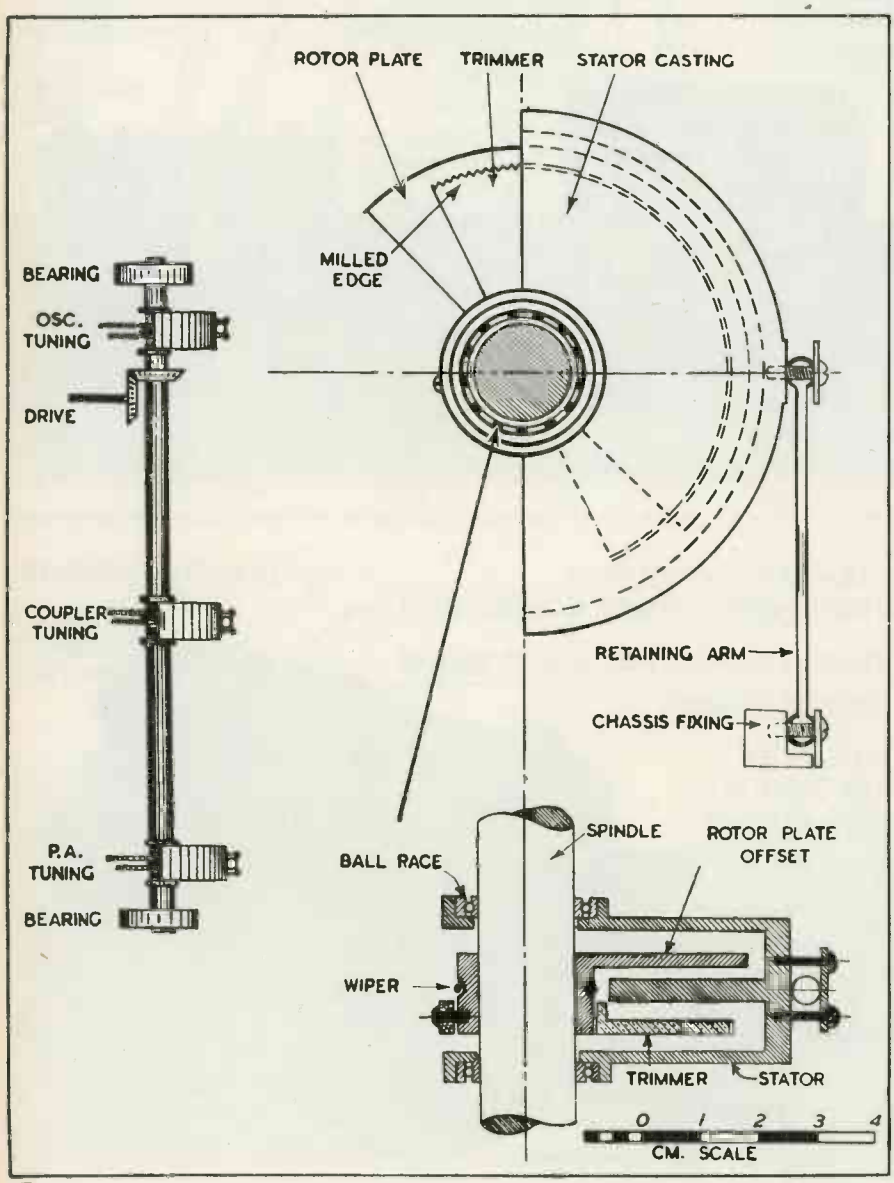


RADIO compass receiver is trf unit covering two bands for aural and visual use



BLIND landing equipment used on the Messerschmitt Me 110 fighter plane operates on the Lorentz system and consists of two units, the beacon receiver and the marker beacon receiver, both operating through a common audio amplifier

THREE-GANG German uhf transmitting condenser with "floating" stators



"Electronic Engineering," London

The leads to the various elements come through the sides rather than the base and make wiping contact with U-type cantilever springs. A few of the tubes have the elements horizontal rather than vertical.

The various methods used to shield tubes again indicate a lack of copper and steel. Some of the German sets employ extruded aluminum or hot-worked magnesium. Some shields are of molded compound with a thin sprayed-on metal surface. In other units the shield is simply a thin coat of metal sprayed directly on the tube itself.

Complete absence of crystals

All of the equipment indicates an almost total lack of quartz for crystals. Tank command sets and other equipment employ mechanical rather than quartz filters. In an ingenious German command receiver of 1942, the components are assembled on a rotating octagon made of sand or die cast magnesium, in a unit-type cell. This unit, rotating against wiping contacts, serves in place of crystals in tuning to different pre-selected frequencies.

An interesting frequency calibration checking device used in a German field transmitter and in one Italian transmitter consists of a minute bar of quartz inside a gas-filled glass envelope. When the tiny crystal is excited at its resonant frequency the gas glows. If the resonant condition does not check with an established reference point on the transmitter tuning dial, trimming condensers are adjusted until it does.

Enemy radio equipment uses very few lock washers. A gray cement similar to our red glyptal cement is frequently used to hold screws and other parts in place.

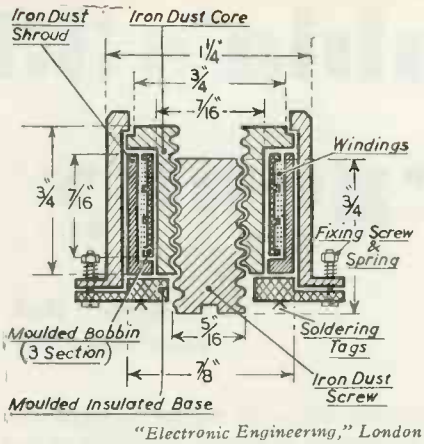
Condensers and resistors

Instead of mica compression-type trimming condensers, silvered ceramic types are used, even at low frequencies. Molded bakelite, mica insulation types are used in transmitters, together with a very compact type of wax-paper condenser.

Resistor and condenser mounting strips are sometimes made of laminated bakelite, but phenol-lamin materials are not commonly used. Soldering tag strips are made of ceramic, for low as well as high frequency equipment.

The variable condensers employ unit type stators, cast or machined from aluminum and magnesium alloys. The rotors are frequently assembled on porcelain shafts in which case contact with the rotor is made by assembling to the porcelain shaft a die cast detail containing a precious metal contact. This knife-like contact rubs against a disk welded to a cantilever spring of phosphor bronze or nickel silver. The porcelain shafts rotate in steel ball bearings.

In one interesting design of 3-gang uhf transmitter tuning condenser, the frame mounting the stator plates is not secured to the chassis. The entire assembly is supported by the ceramic spindle that carries the rotor plates, in order to avoid changes in capacitance with possible warping of the long ceramic rod. The stator plates are prevented from rotating by retaining arms which allow the assembly to assume its own position.



"Electronic Engineering," London

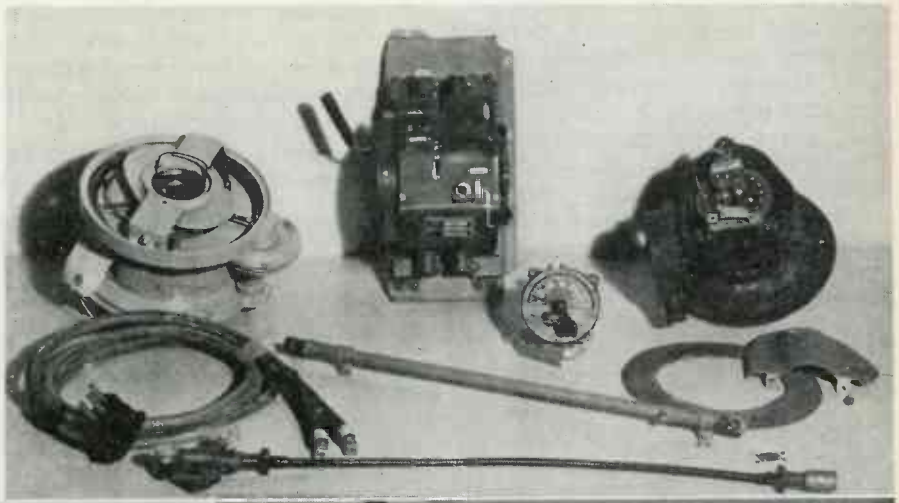
MOVING-CORE coil for rf or if use is completely enclosed in powdered iron

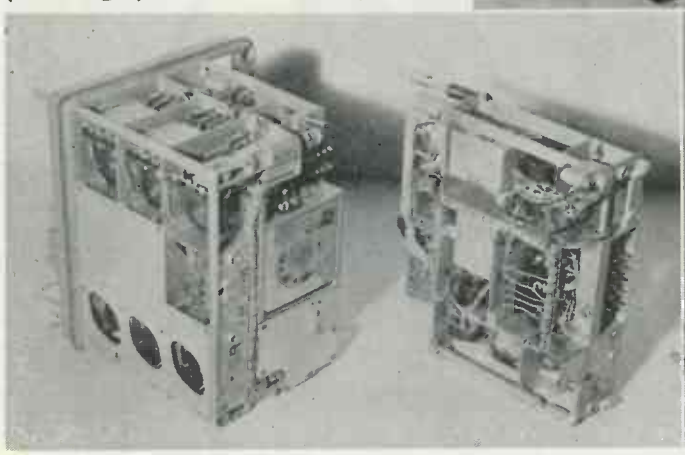
Coils, relays and similar components are frequently of the plug-in type for quick replacement. On equipment manufactured before and during 1941, nameplates of aluminum or magnesium alloy bore wiring diagrams and other information, including the name and location of the manufacturer, either engraved or stamped into the metal. Nameplates on some of the Japanese equipment are of sheet ivory, with the lettering cut in and blackened in the familiar manner.

In general, the Japanese equipment shows little originality from the standpoint either of mechanical design or electronic refinement. The Italian equipment copies earlier American equipment or in some cases reflects German practices. The Japanese equipment generally reflects American practices now considered obsolete—practices seen in Japanese merchandise on the American market prior to the war—such as wood frames for coils, cabinets, etc., and no moisture-proofing. No effort is made to protect ground wires with rubber-braided cloth or the like, affording a minimum of protection against mechanical injury. Rubber, as well as copper, steel and zinc, seems to be on the Axis' critical list. The very wide use of aluminum and magnesium alloys to conserve copper and steel and make for portability is noteworthy.

The workmanship on the German radio units is far superior to that of the Japanese or Italian equipment. In general, the design of the enemy equipment seems to be strained in the direction of over-simplification, perhaps demonstrating their need to get the equipment produced fast, even at the cost of some sacrifice in performance. With regard to the German equipment in particu-

(*Continued on page* 156)

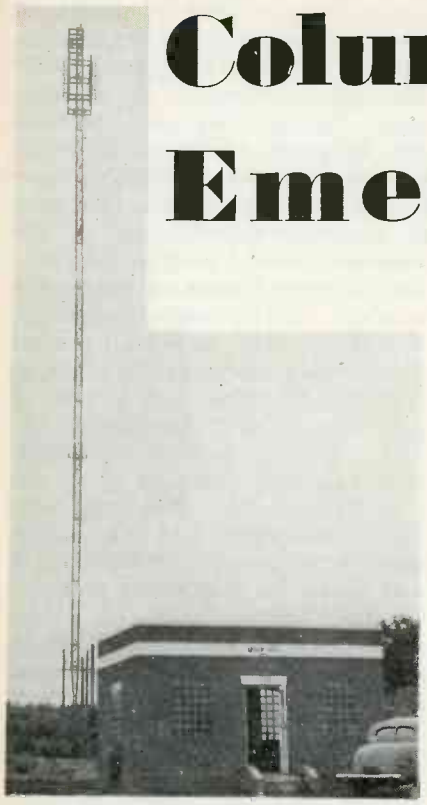




CONTROL units of the radio compass receiver unit (right); bottom views of long and short wave receiver units (lower left); Italian field telephone set (lower right)

Columbia's 330-mc FM Emergency System

330-mc link gives reliable communication over 40 miles in case of wire failures



RECEIVING antenna is mounted on 200 ft. pole above another antenna

• Linking together its New York studios and its high power short wave transmitters approximately 40 miles east on Long Island, Columbia Broadcasting System has a 25-watt ultra-high frequency FM system that over a long period of time has proven eminently satisfactory. The equipment was installed and is used only for emergency purposes in the event of wire line failures on Long Island where storms frequently are violent. In an emergency it may also be used to feed WABC's island transmitter.

Enclosed antenna

The transmitter is a General Electric model 4G8A1 operating on a frequency of 330.4 megacycles. It is installed on an upper floor of a tall office building approximately 860 feet above street level. The antenna is a Franklin type, completely enclosed in a wooden housing as a measure of protection against the elements. It is fed with a dual line coaxial cable. Between the transmitter in New York and the receiver on Long Island it is practically line-of-sight.

Although the equipment is seldom used, a program of twice-a-day tests has been carried on for a sufficiently long time to demonstrate that there is remarkably little variation in signal strength irrespective of season, the hour of day or night or weather conditions. Following are figures representing a considerable number of measurements made under a wide variety of conditions:

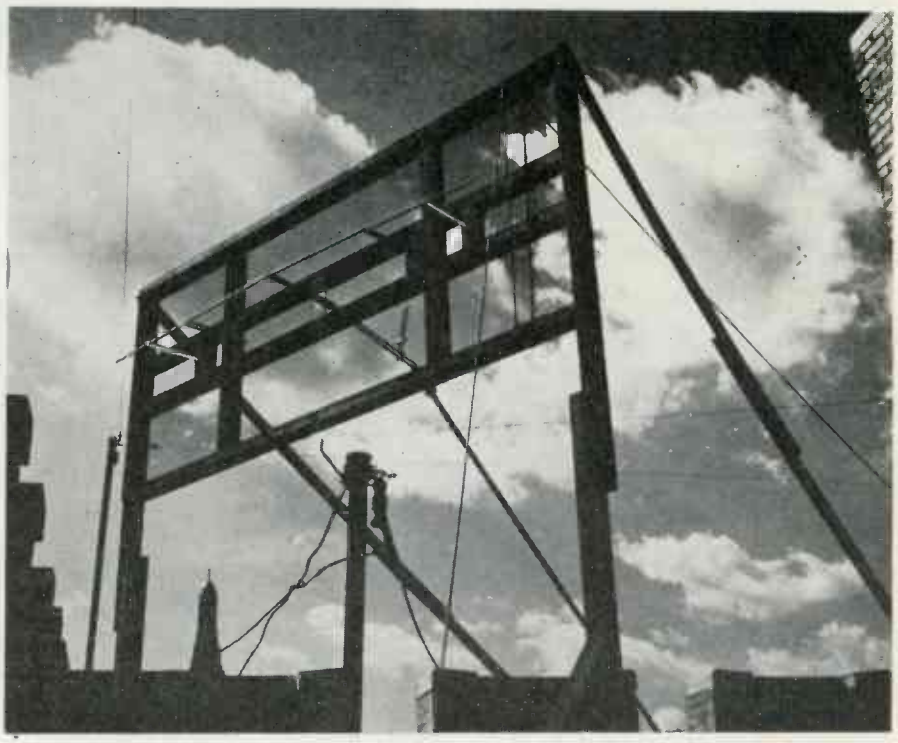
	Limiter Current	*Equiv. Recvr. Input voltage*	*No. of Measurements*
Day	.68 ma	150 microvolts	2
	.665 ma	135 microvolts	7
	.65 ma	120 microvolts	4
	.615 ma	85 microvolts	3
	.60 ma	75 microvolts	1
Night	.665 ma	135 microvolts	10
	.65 ma	120 microvolts	1
	.63 ma	100 microvolts	2

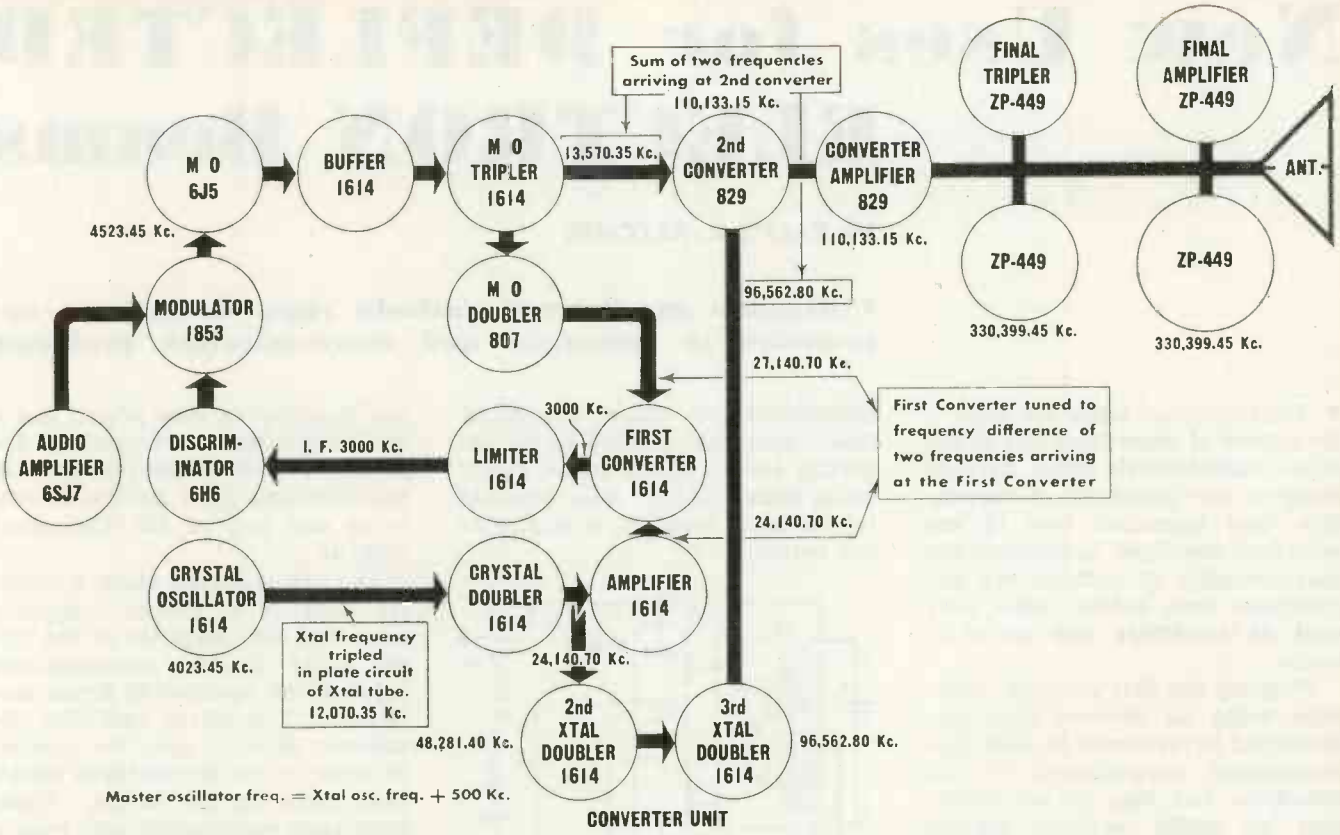
The range of noise level recorded during these measurements was extremely low, running from —48 to —59 db below program level. In a number of other measurements, however, noise as low as —65 db under program level has been recorded. Distortion has never been a problem, averaging in the neighborhood of 1.9 per cent with the highest ever recorded over a long period touching 4.8 per cent. On numerous measurements the distortion shows up at 1.6 per cent or better. These measurements were made at the output of the receiver and therefore represent overall distortion in the whole system.

Receiver installation

At the Long Island end of the link the receiver is a General Electric model LM156A. It is installed in a receiver house quite a distance from the transmitter and is turned on and off as occasion demands, by remote control. Periodic checks of the receiver are made but it has never been found necessary to make such checks very frequently. The antenna is approximately 200 feet

TRANSMITTING antenna, here shown in experimental form, is a Franklin type completely enclosed and mounted on the roof of a 62-floor building





BLOCK diagram of the 25-watt General Electric transmitter showing manner in which crystal and master oscillator frequencies are combined and eventually produce the final operating frequency of 330.45 megacycles

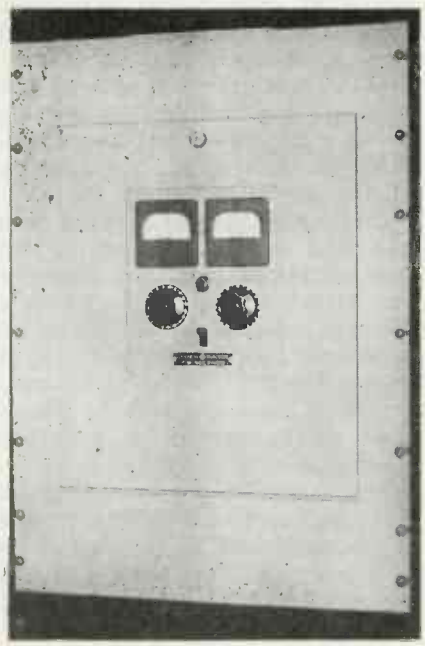
high at the top of a pole used for another antenna. It consists of five dipoles, each .64 wavelength long stacked above each other ½ wavelength apart with a copper screen ¼ wavelength behind the whole system. Inasmuch as the height of the antenna is about 200 feet and the receiver house is quite a distance from the base of the pole, a transmission line some 400 feet in length is necessary between the antenna and the receiver.

This is an Isolantite dual balanced line ¾ in. inside diameter and containing a pair of wires spaced ⅛ in. Losses in the line have been established as about 2 db per 100 feet. An interesting feature of the line is that it is jointless. Sections of the outer casing were soldered together on the ground, the line was rolled up and hoisted so that it is in effect a solid one-piece line. The line is kept under a pressure of 15 lb. per sq. in. although hydrogen is not used. Instead a special compressor equipped with a dehydrator pumps plain dry air.

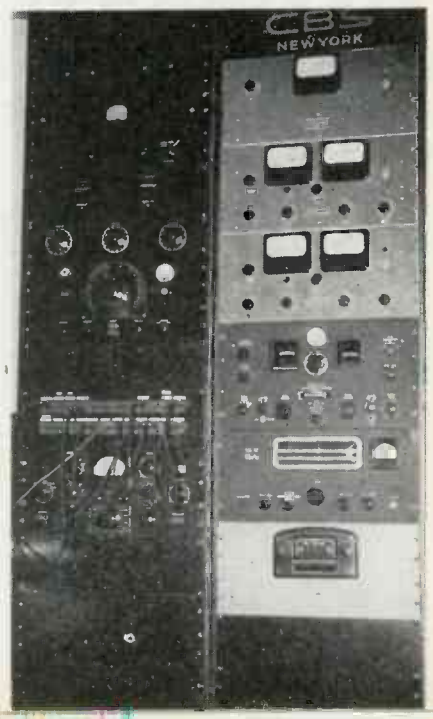
(*Continued on page* 162)

TRANSMITTER is a standard GE model and is rated at 25 watts power

RECEIVER, 200 ft. from pole is remotely controlled from transmitter



TEST equipment and measuring panel at New York end of the link



New Uses for DEFLECTED ELECTRON Beams

by RALPH R. BATCHER

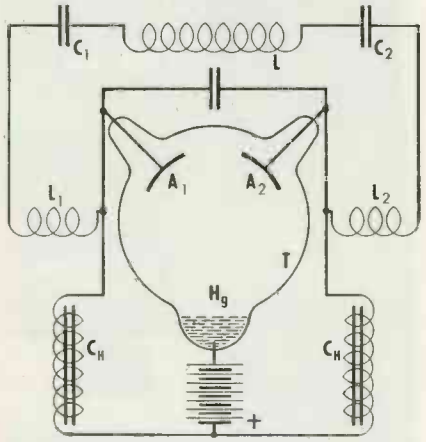
Utilization of directed cathode rays shows new approaches to industrial and communication problems

● Electron beam tubes are older in the matter of years than any of the other multielectrode tubes. In fact, many of the principles of thermionic tube operation now in use were first developed to improve the characteristics of cathode ray applications long before tubes were used as amplifiers and as oscillators.

Probably the first practical oscillator using an electron tube was developed by Vreeland in 1906, and commercial embodiment of his principles was long in use whenever an audio oscillator having good waveform and ample energy output was needed. This same basic principle has been "rediscovered" with variations many times in later years, so that now a whole series of such tubes has been described. They are used as oscillators, amplifiers and relays.

In the Vreeland circuit, Fig. 1, a mercury-pool cathode supplies an electron stream, which is directed toward one or the other of two anodes. The charging current of the capacitor C across A_1 A_2, builds up in the deflection coils L_1 L_2 which have a magnetic polarity such as to divert the ray to the alternate anode. The voltage in the series resonant circuit L_1 C_1 L C_2 L_2 C, builds up into self-sustaining oscillations having a frequency determined by these constants. Stable operation is aided by the inductive chokes in the anode supply leads, shown as C_H. The Vreeland tube is thus, basically, a synchronous switch.

Fig. 1. Vreeland's oscillator



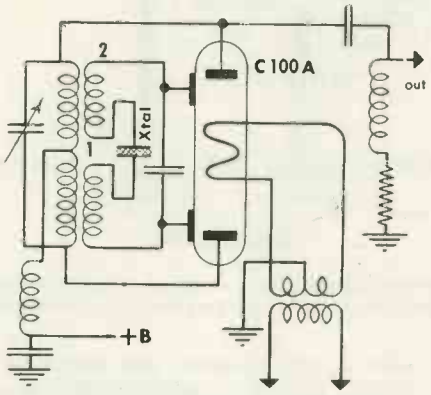


Fig. 2. Collins' oscillator

Another adaptation of this principle was by Goddard, using a tube with a heated cathode, two widely separated anodes and a deflection coil system inductively coupled to the oscillating circuit. The Goddard arrangement[1]* is not essentially different from the Vreeland circuit except that the tube used was somewhat more highly evacuated. For this reason it was more limited in its ac energy-producing capabilities. A modernized version of this oscillator was used by Collins Radio Co. as a crystal-controlled master-oscillator for radio transmitters. This is shown in Fig. 2.

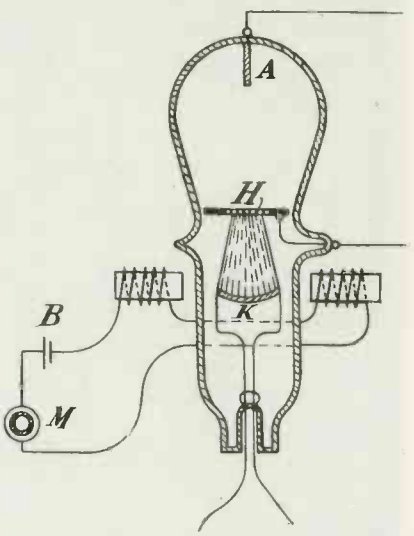
One early use of directed rays was that of a modulator. From 1906 to 1914 patents were issued to von Lieben and Reisz in which a directed ray of electrons was pulled back and forth across a series of slots in one electrode by an external magnetic field actuated by variations in the current of a carbon microphone[2], M in Fig. 3.

From this simple beginning we will jump next to a modern version of modulator use: in the production of phase-modulated signals. Shelby has described a tube which has a two-section screen, formed by bisecting a large circular sheet with two spiralled gaps having several turns and located 180 deg. apart (Fig. 4).

The ray is driven along a circular path at a carrier frequency rate, with the diameter of the circle equal to the instantaneous value of the modulating signal amplitude. The phase variation obtainable depends upon the number of turns in the Archimedian spirals that make up the target. Tubes have been constructed with even a greater number of turns in the spiral than in the tube illustrated.

A somewhat different system of producing phase modulation has been proposed by Skellett.[4] A cathode ray is focused so that it passes through a slot in a metallic electrode when undeflected. The carrier-frequency potential deflects the ray back and forth across the slot so that a series of pulses is produced during the intervals when the carrier potential passes through zero. An audio signal superposed on the carrier modifies the deflection so that the time instants at which these pulses occur have

Fig. 3. Early voice deflected modulator



*See bibliography at end.

Fig. 4. Shelby system for producing phase-modulated signals

greater or lesser intervals depending on the pitch, polarity and amplitude of the modulating signal.

A system of producing a series of pulses whose duration and phase bear some required relation to the applied signal, has been developed by Beatty and Scully.[5] Here the radio frequency carrier actually modulates the electron beam density. Voice or signal currents deflect the beam so that it is diverted to strike one of two targets, having a position and area designed in accordance with the type of pulse modulation desired.

Harmonic generators

Merlin Davis has shown[6] a harmonic generator where a continuously moving ray scans the surface of an electrode, Fig. 5E, upon which specially-shaped orifices (a) are provided. By applying a combination of definite frequencies to the two pairs of deflection electrodes, the beam can be made to generate harmonics having a waveform dependent on the shape of the orifices and the speed of traversal, striking different anode combinations (b) behind the perforated electrode (a) as shown.

One of the basic uses of an electron beam is that of a relay, where the influence of an external potential or a magnetic field projects the beam into one particular pickup electrode from a group. It is usual practice to utilize the energy collected on these electrodes to operate relays or amplifiers to accomplish some control principle.

There are numerous variations of this principle. One of the most interesting is a tube used by Seymour and Horton[7] which has a two-section target with a small gap between the sections. It is used in radio direction finder work (as in flight control) as follows: The tube is connected to a crossed-loop radio receiver system so that the electron ray normally moves along the gap, striking neither target. External deflection plates are suggested so that this adjustment permits the flight path to be changed to any angle with regard to the crossed-loop antennas. Any deviation of the plane from this line of flight will cause the beam to hit a target and operate a signal.

Electronic contactors

The principle of an electron beam as a contacting function is of great value in automatic inspection. The normal trace of a ray in a cathode ray tube as it moves over its fluorescent screen in some sort of test may be a circle, hysteresic curve, ellipse or some other regular curve. If the fluorescent screen is replaced by a target having the appropriate shape, any deviation of the movement of the ray from the regular pattern will cause the current in the target circuit to change—to control a relay or some other type of signal if desired. This method has many variations, all of value when the "answer" in any test or inspection problem is a complicated curve or a "two dimensional" factor. It has even been used with a vertically mounted cathode ray tube where the earth's field deflection caused the ray to strike or miss a target. This makes an automatic contacting and inertialess compass that is not affected by vibration and rough handling.

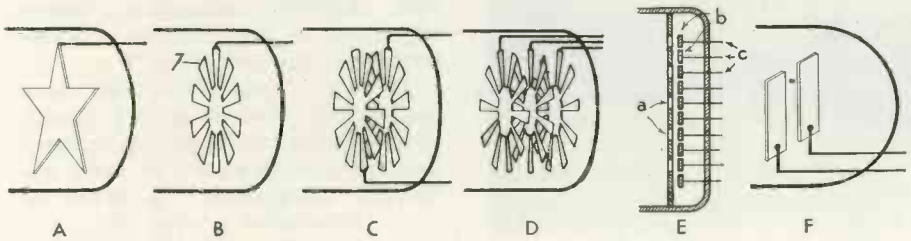
There are numerous examples where this principle is put to use. Marrison has shown a tube[8] wherein a multipointed star-shaped target replaced the screen in a regular cathode ray tube as in Fig. 5A. It is used to indicate relative changes in the frequencies of two independent sources. The lower frequency is used to initiate a rotary time-base. The higher frequency is applied in series with the anode supply voltage so as to change the deflection sensitivity at an equivalent rate. The trace of the electron ray follows a star-shaped path which is stationary if the two frequencies have a definite harmonic relation. If not, the ray hits the target at frequent intervals and produces an indication.

Another example[9] of the use of this system is the electron actuated relay of Ziebolz, Fig. 5F, producing an automatic industrial control tube having many practical uses. Here the ray can move to either of two targets under the action of electrostatic deflection fields, augmented or counterbalanced by electromagnetic fields if needed. The current in one or the other of the target circuits brings about suitable control functions. The auxiliary magnetic fields are used to produce an initial "bias" on the directivity of the ray so that the transfer from one target to the other occurs at a selected value. The advantage of an electron beam in the above application is that it is quick acting, having no inertia in itself; it is strictly a one way device, and adds no load or reflected action back into the controlling circuit and that it can be made to follow either linear or some other amplification relation.

As frequency multipliers

This application is an extension of the modulation principle used by von Lieben described above. In general, the ray is diverted so that it follows a definite pattern. A target with numerous spokes, or a plurality of targets provide a pulsating output current having a frequency rate several times that of the primary source that deflects the beam.

Fig. 5. Types of target structures used in beam deflection applications



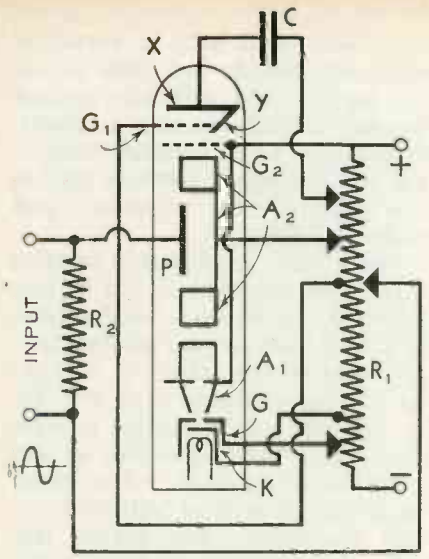


Fig. 6. Scanning wave generator directly synchronized

Usually the ray is moved in a circular path, as for instance, the frequency - multiplier tube of Hund[10] or that of Marrison[11] Fig. 5B. The latter also shows how two or three interlaced targets, Fig. 5C and 5D, can be used to produce two or three phase currents if desired, at the same time producing frequencies having an integral relation to that applied. A three phase generator was built by Hough,[12] using three targets in a cathode ray tube each supplying a potential to one leg of the input circuit of a three phase amplifier. A more intricate circuit by Heintz[13] has the added feature of producing polyphase voice-modulated signals by the expedient of modulating the intensity of the beam as it is rotated over perforated targets. The circular rotation of the ray is accomplished by the use of a 3 phase deflection coil system with the coil axes 120 deg. apart.

Any cathode ray tube can be used as an amplifier if desired, without taking note of what happens to the beam current that passes the orifices, since the tube has a "grid" and a plate. As a voltage amplifier requiring peak-to-peak swings of hundreds of volts such a tube might find some use but this is not within the scope of this article since the beam need not be deflected.

Secondary emission targets

In all of the previous examples of tubes functioning with deflected beams, metallic targets have been used as collectors. It is also possible to utilize the capabilities of an electron ray in producing secondary emission currents as it impinges certain surface coatings. For example a caesium-caesium oxide photoelectric surface will emit a greater number of electrons when it serves as a target for an electron ray, if certain simple precautions are employed.

A little thought will show that there are many variations of this principle. Since the emitted electrons can be made to follow directed paths depending upon the angle of impingement, curved targets can be utilized in obtaining large angular displacements of the secondary currents with small changes in the primary ray.

Combination targets have also been used. A tube recently described by Nagy and Goddard[14] produces a sawtooth waveform suitable for oscillographic or television applications at a frequency directly controlled by an applied signal.

This application is based on a very ingenious plan. The ray is deflected back and forth across two targets Fig. 6, one coated with carbon black, an absorbing anode, and the other having secondary emission properties, an emitting anode. A small capacitor, connected to these electrodes, is alternately charged and discharged. The

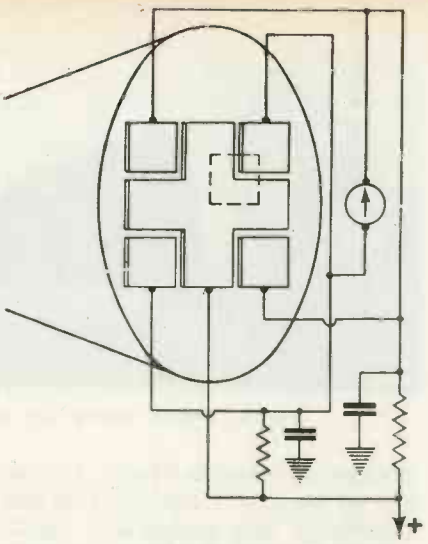


Fig. 7. Beam current application to mathematics

charge that appears on this capacitor is "driven" up (in a positive direction) and down (in a negative direction) and the charge's amplitude may reach a substantial part of the voltage applied to the tube.

In the practical embodiment of this principle, both sections of the target have secondary emission properties. During the interval when the ray strikes the part X, the secondary emission is neutralized and the condenser charges slowly but linearly (since the charging rate is proportional to the beam current, which is constant). When the ray is deflected to the target Y, the reversal of the charge occurs, at a faster rate on account of the higher current density of the secondary electrons.

Since the secondary emission rate may only be several times the primary current, normally the flyback time is not fast enough for efficient use as a time base for either oscillographic or television purposes. The flyback interval can be shortened, however, by several design expedients, one of which is to increase the beam current when it strikes the secondary emission target.

Practically, a tube built on these principles gives a saw-toothed wave having several hundred volts amplitude peak-to-peak with only a fraction of a volt applied to the deflection system. Extremely high output frequencies can be obtained with suitable precautions. Other variations of the principle are described in the reference.[14]

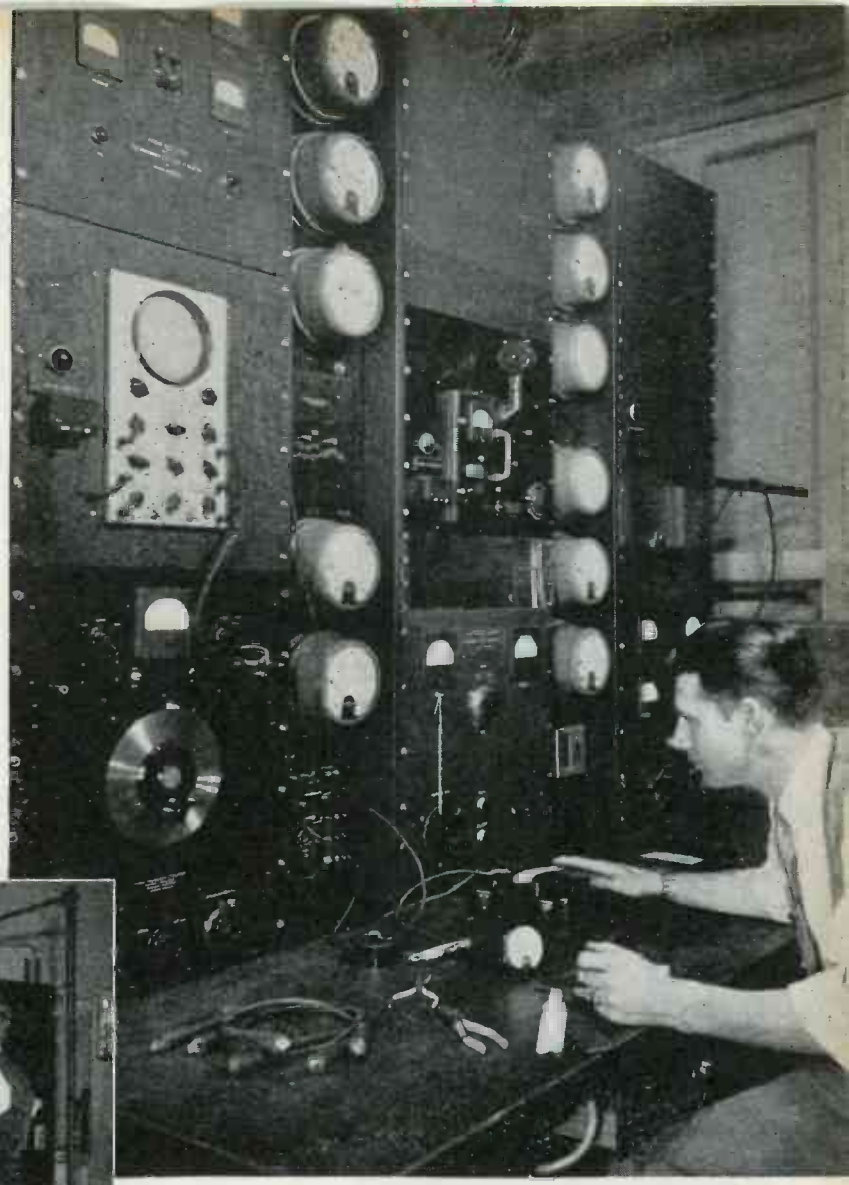
There is a field of electron beam application that is as yet hardly touched—the solution of mathematical processes such as those involving integration. A beam of

(*Continued on page* 156)

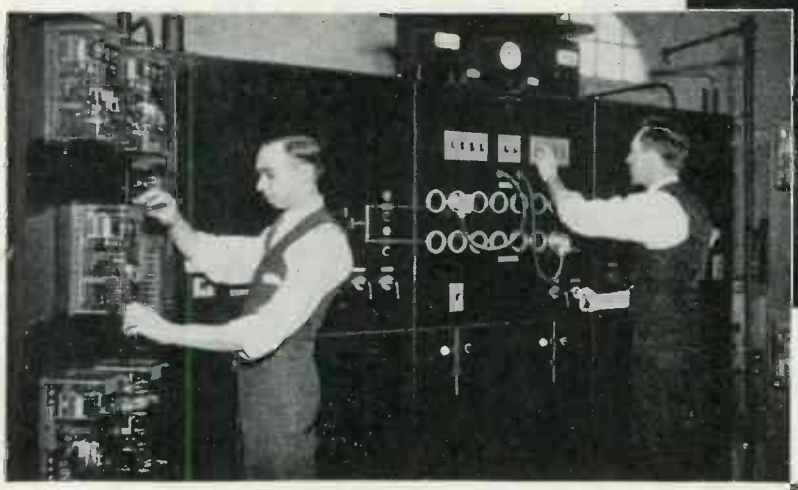
Fig. 8. Ziebold (Askania) tube developed for use in industrial control (see also Fig. 5E)

TESTING New GEAR

Much industrial equipment, long used at commercial frequencies, is now finding use under widely different operating conditions. In the Westinghouse Research Laboratories many shielded test rooms provide all facilities, such as test instruments and power sources of all descriptions covering wide ranges in voltage and frequencies up to many megacycles, for modern apparatus testing. Much of the work is in the newer field of telemetering and carrier current communication for which there is a special laboratory including a complete replica of a high tension transmission line on which protective gear, communication and telemetering equipment are tested; and a high-voltage dc laboratory with potentials up to 60,000 volts is available.



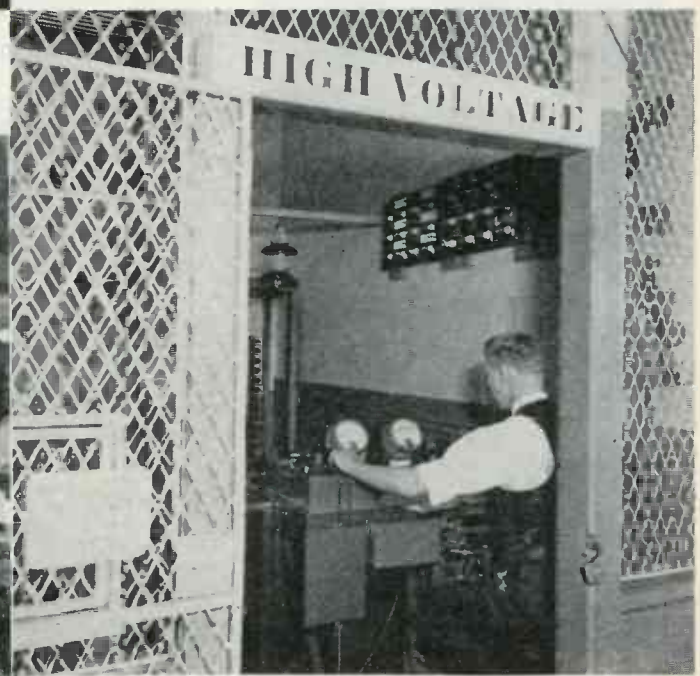
▲ MEASURING characteristics of a special instrument in the completely isolated high-frequency cage

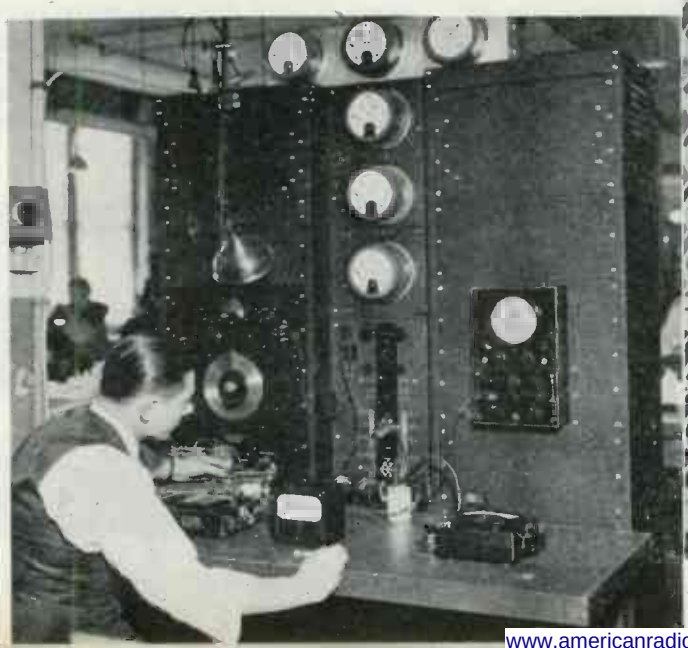


▲ CARRIER-CURRENT laboratory containing complete replica of high tension transmission lines

▼ HIGH-FREQUENCY calibration laboratory for testing various types of newly developed instruments

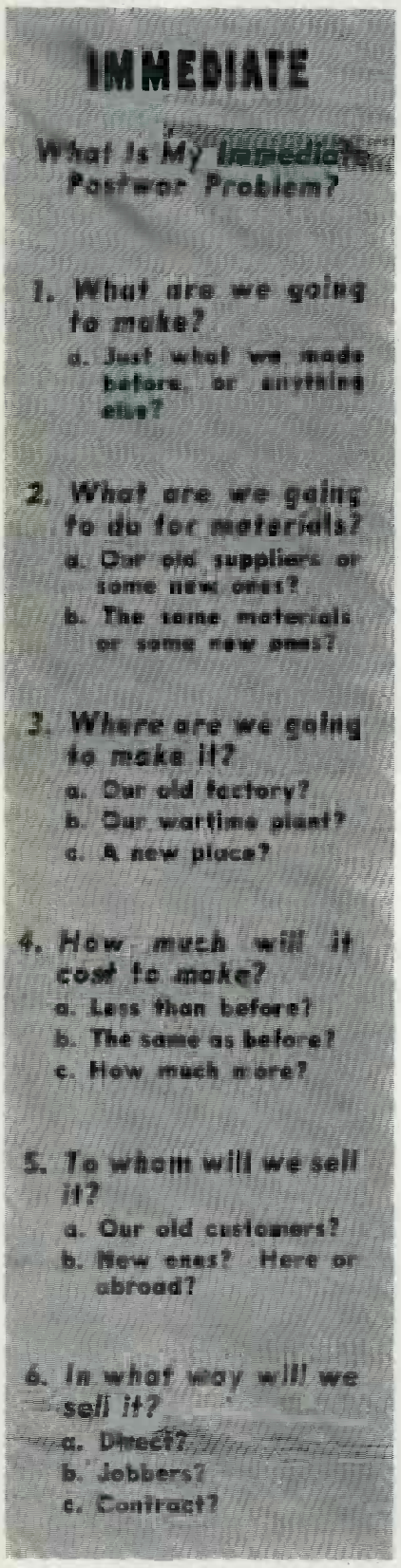
LABORATORY for advanced development of high-frequency and high-voltage measuring equipment ▼





ENGINEER-EXECUTIVE

Getting set for V-day is a matter for careful analysis for some of the very definite things that can be done



• Ask any person on the street what the electronic industries are going to do after the war, and your answer will be "wonderful things." Ask several radio executives a like question and, providing they have time to talk even a little bit, their answers will vary from alpha to omega.

One will say, "We are going to pick up the pieces and start making just what we were making before; the public will buy anything then." Another will say, "Our business is up 80 to 1 over prewar. I've got six men doing nothing but postwar. I hope we can at least do as much as we did before it started, but competition is going to be bad." Still another will answer, "I hired some people to find out, but all they talk about is unemployment, new factories, new products, labor problems and r- - - -. I just can't figure it." Finally, there is the man who has devoted hours each day to reading the thousands of booklets, articles, pamphlets and just plain nonsense on postwar topics, and frankly admits, "I'm all confused."

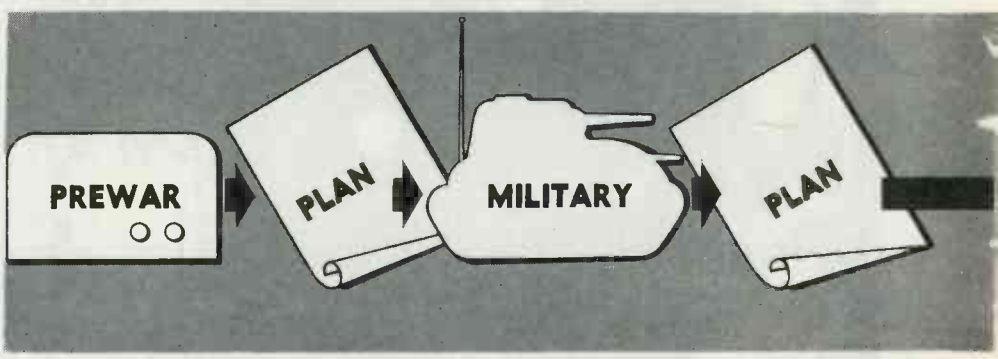
Now this doesn't mean that there isn't really intelligent planning going on in many companies. There is. But in all too few. Why so few? Well, except for a handful of the best-managed radio enterprises, planning didn't exist before the war, and, after all, postwar planning is no different from prewar or any other kind of forward planning. Even some who did plan before are so overburdened now that they have taken the easy way. I mean calling in the least busy man in the organization and telling him in no uncertain terms to get busy and plan, and plan, and plan.

The result, of course, is "good" advertising copy—lots of it—"who invented r- - - -?"; much sales effort—"take a swing around New England and tell our distributors we'll be ready when the great day comes"—; or maybe Chamber of Commerce speeches with lots of statistics—"airplane manufacture will be down 90 per cent but radio-electronics will be up 100 per cent."

—*and here's how*

This has gone just about far enough and right now it is long past time for the engineer-manager to take a good long look at what has been going on and call in the salesman, advertising department and public relations counsel, and say, "Fellows, you've had darned little to work with so far, but beginning now you're going to get a break. We're going to start planning for postwar and here's how we will go about it."

The first thing to do is to designate someone to keep track of what is to be done and to see that it gets done. He should know all about the business and a great deal about the electronics industry. He probably is very busy, but get someone to relieve him, at least enough so he can get this job running. He should be a production and sales-conscious engineer with vision. Sounds like a bill for an exceptional man, doesn't it? But every radio organization has one—especially every small company; it wouldn't run if it didn't. Anyway, get him on the job and make it possible for him to get rolling.



PLANS FOR POSTWAR

coupled with the will really to draw up a blueprint and that the buying public is going to expect to see done

Next, work out a plan. Maybe a few meetings are necessary. They kill time, but ideas do come out of conferences—especially if participants know why they are there. The plan should have definite form and actual assignments of things to do. Your own check list, like the one outlined, will help to start the thinking—from there on it's easy.

At the very top of the plan set down all about the company as it was before the war: its people, factory, products, costs, selling prices, customers, ideas and everything. Then set down all about it now. Next, lay out a very broad outline of its future. Make a heading, "Immediate Postwar"; then one for "Long-Range Course." We are going to talk more about these last two in a few moments, but before that let us look at the "as was" and "as is" a little bit.

Then and now picture

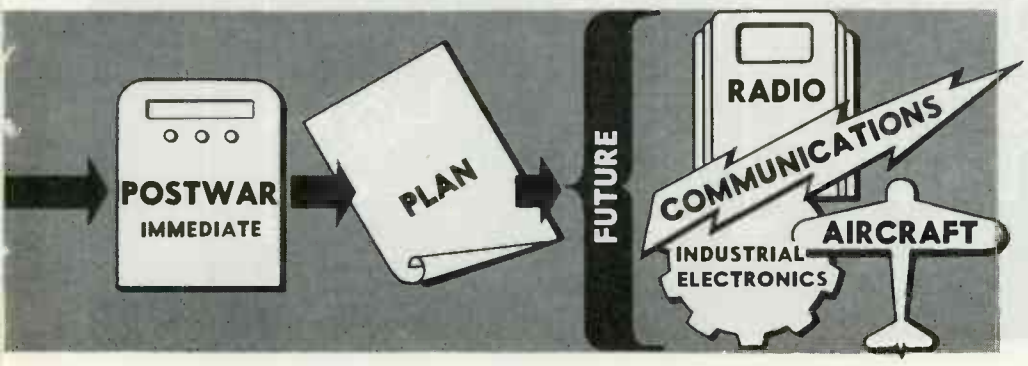
After setting down the then and now picture, several things will be very clear. Possibly only a few changes have occurred. If that is the case, it is exceptional for the electronics industry. The chances are that nearly everything has changed a good deal. There are new faces, maybe a new building or two, probably entirely new products and almost certainly a new customer.

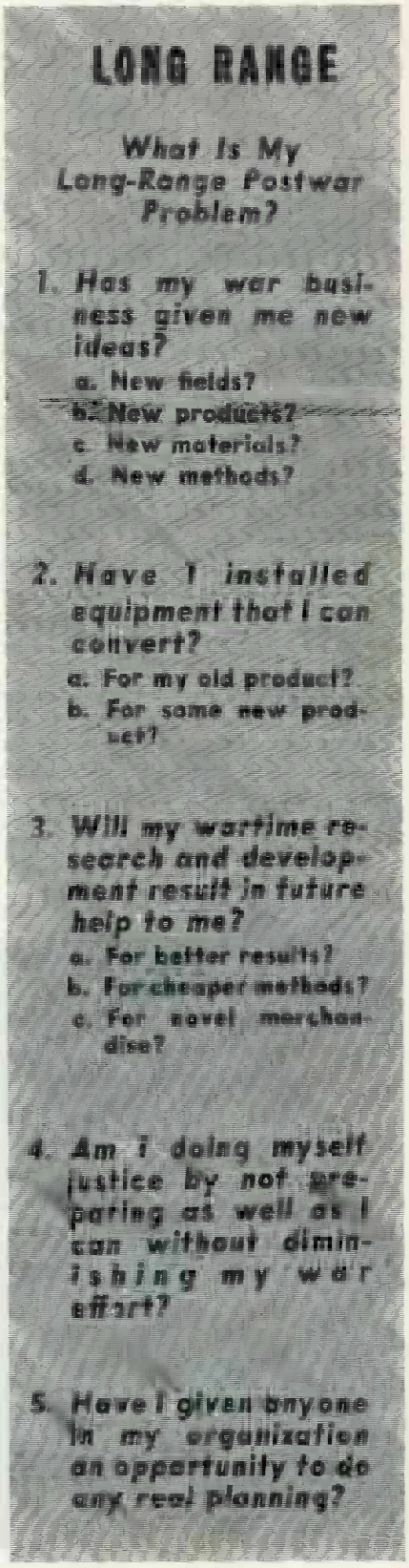
The job now is to really get the picture clearly enough in focus to see what advantages can be retained and what use can be made of even the worst of the disadvantages. Maybe it is a new milling machine, a punch press, a grinder, plating setup, plastics molds or powdered metals machine. On the other hand, possibly it is a battery of crystal saws or some specialized test equipment for which a future use will have to be literally wrung out of the earth. Every single bench, every machine, every inch of space and every person is a part of the coming problem, and unless they are calmly studied now, there won't be time then. When all of these jigsaw puzzle pieces have been put on the table—they are what we have to work with—then it is time to start the plan under our two headings — "Immediate" and "Long-Range."

Immediate problems

The immediate problem differs for companies. If there was a profitable prewar business, it is fairly simple. If the enterprise is new or has expanded greatly it will require a lot of hard work. Let us take the first kind. Naturally this company will go back to its old business. The most likely models should be brought out and studied. Will they be made identically or should certain easily made changes be incorporated? What part of the building will they be manufactured in? Who will be the supervisors and foremen? Are all of the tools, dies, jigs, fixtures and test equipment available and in good repair? Or do they need reconditioning? If so, can a program for this work be laid out? Are all of the former components or parts suppliers still available? Have they

(*Continued on page* 172)





Design of Broad-Band AMPLIFIERS

by MADISON CAWEIN
Manager of Research
Farnsworth Television & Radio Corp.
Ft. Wayne, Ind.

Simplified method for solving general problems dealing with amplifier response characteristics

● There is a great deal of prior art on broad-band amplification. From a theoretical standpoint, practically every phase of this subject has been covered many times over. Most of the standard texts on radio engineering devote space to the analysis of this subject, which an engineer can utilize to solve a particular problem. There is some need, however, for a universal method of attack employing a unified and simplified form of mathematics. It is the purpose of this paper to present what is believed to be a useful method, from the engineering standpoint, for solving a large majority of broad-band problems.

This method is an approximate method. It involves the calculation of resonant circuit response on the basis of pure numbers. For such calculations, the concept of "relative frequency," as introduced by Wheeler,[1] replaces the concept of frequency; and the concept of power-factor is used. "Relative staggering" is shown to be synonymous with coupling, for staggered-stage calculations. Rule-of-thumb formulas are developed for engineering design, based on a family of universal response curves.[2]

The symbols R, L, c, f, etc., will refer to circuit parameters as is usual in the literature. Other symbols will be used to denote quantities, as follows:

A denotes amplification

p denotes power factor = 1/Q

k denotes coupling = coefficient of coupling

s denotes relative staggering (explained in Section III)

B denotes relative bandwidth

G is defined as the "gain-constant" of an amplifying stage

The subscript "zero" refers to center-frequency response (i.e., A_0 is center-frequency amplification)

A "primed" symbol refers to peak response (i.e., B′ is relative peak-separation)

The subscript "—" refers to series circuits (i.e., $R_{—}$ is series resistance)

The subscript "||" refers to parallel circuits

d denotes differential frequency $= \pm (f—f_0)/f_0$ (on either side of resonance)

x and y denote relative frequency = 2d (refers to total differential frequency difference on both sides of resonance, i.e.: +d — (—d)).

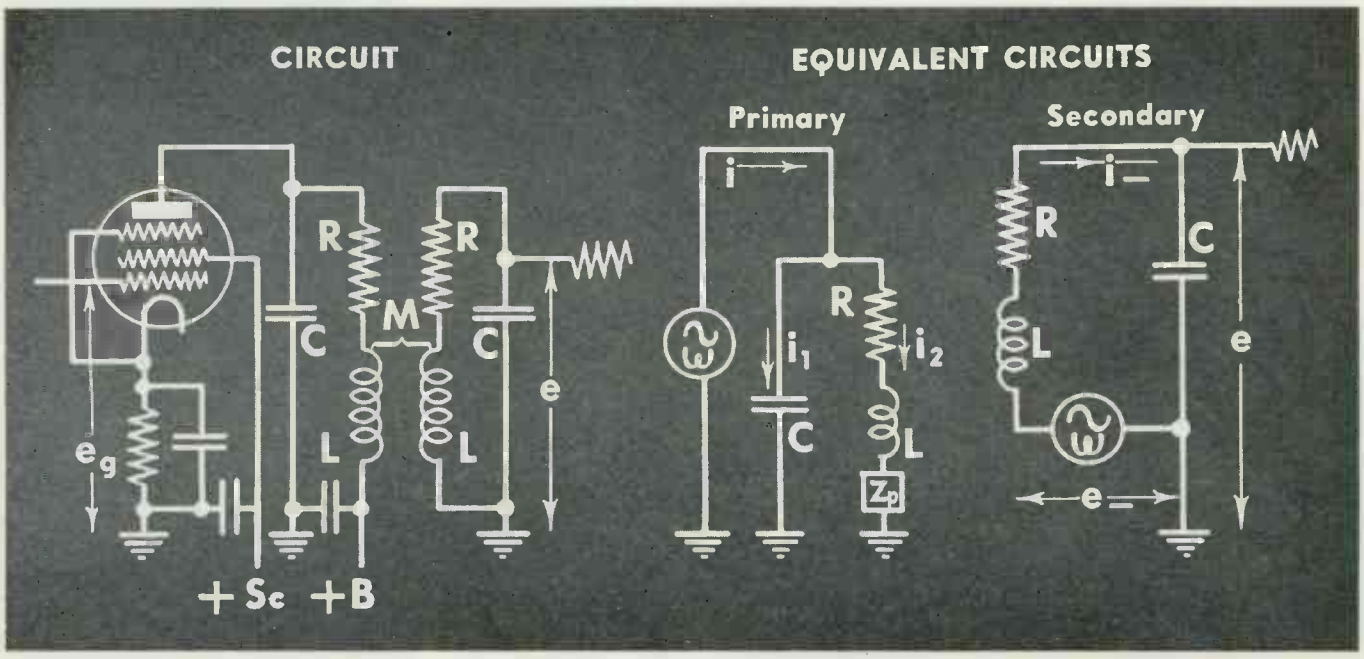
An approximation developed from General Circuit Theory will be employed throughout the text:

$$(1)\quad p = R_{-}c\omega_0 = 1/R_{||}c\omega_0 = 1/Q$$

The impedance of a series resonant circuit is:

$$(2)\quad Z_{-} = R_{-} + j\omega L + 1/j\omega c$$

Fig. 1. Universal reference circuit and a simplified equivalent



$$(3)\quad \omega = 2\pi f = 2\pi (f - f_0 + f_0)$$
$$= 2\pi f_0 (d+1) = \omega_0 (1 + x/2)$$

(3) expresses ω in terms of relative frequency. Substitute (3) in (2) and simplify, neglecting d wherever it appears in the expression (1 + d). (This assumes that d is small in comparison to unity. Whenever this approximation is used in numerator or denominator, the fact will be indicated by the symbols */ or /* following the equation.)

$$(4)\quad Z_- = \omega_0 L\ (R_-/\omega_0 L + jx) = \omega_0 L\,(p + jx)\quad */$$

Fig. 1 shows a typical double-tuned amplifier stage and its equivalent circuit. The impedance reflected in series with the primary of the transformer, from a resonant secondary of impedance Z—, is:

$$(5)\quad Z_p = (\omega M)^2 / Z_-$$

$$(6)\quad Z_p = k^2 \omega_0 L / (p + jx)$$

(6) is equation (5) simplified by means of (4) and substitution of $M = kL$.

Other equations relating to the equivalent circuit in Fig. 1 are:

$$(7)\quad i = g_m e_g = i_1 + i_2$$

$$(8)\quad i_1 = e/Z_-$$

$$(9)\quad e_- = -j\omega M i_2$$

$$(10)\quad e = i_-/j\omega c$$

The equivalent circuit of the primary is a constant current generator feeding two circuit branches in parallel. An impedance Z_p is reflected in series with the inductive branch and it may be proved easily that its value is as given in equation (5). Equation (7) is a statement of the approximate truth that in a pentode, considered as a constant current generator, the current is independent of the load and is proportional to the grid voltage. The factor of proportionality is the mutual conductance.

The equivalent circuit of the secondary is a constant-voltage generator feeding a series circuit. Equation (9) states that the generator voltage is in negative quadrature with the current in the inductive branch of the primary circuit and is equal in magnitude to the product of the mutual reactance and this current. Equation (10) states that the secondary grid-voltage is the product of the secondary current and the terminating capacitive reactance, which is in parallel with this grid.

Equations (2) to (10) are merely mathematical representations of the experimental laws of electric circuits.

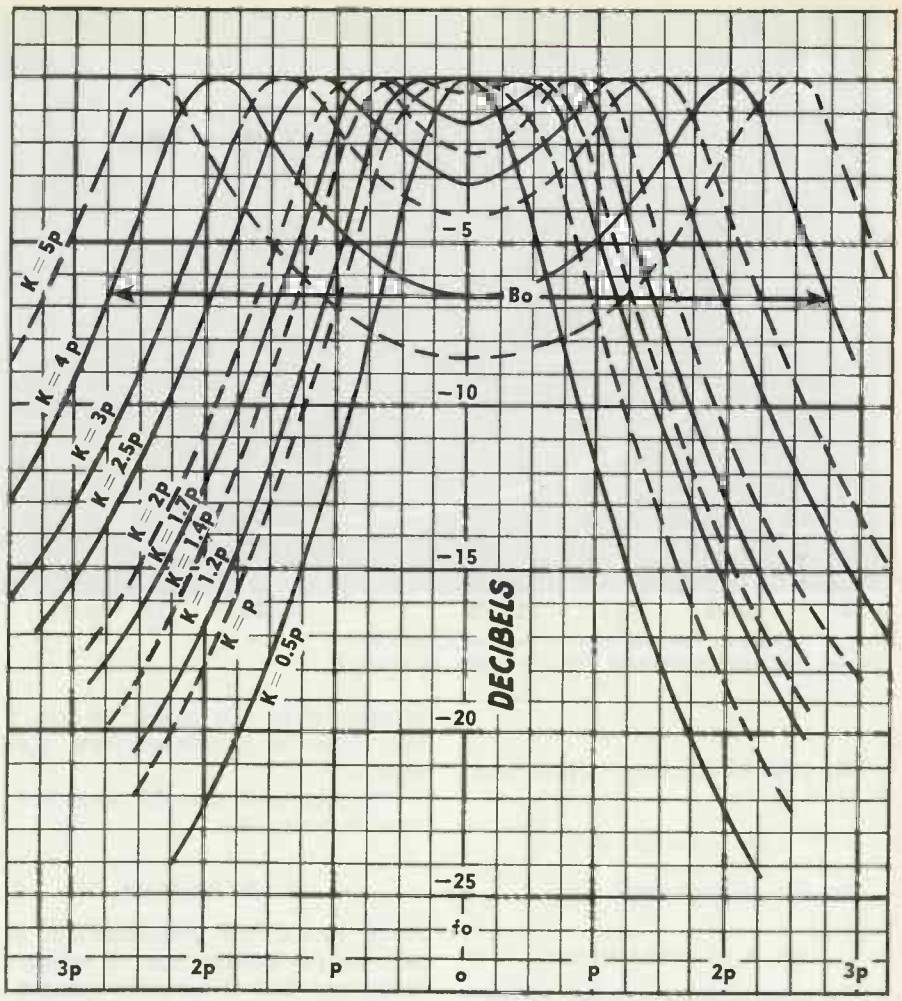


Fig. 2. Here the scale of abscissae is pure number: that is, units of p=1/Q. To convert to frequency, multiply by fo. For example, if the Q of the coils is 20, and the center-frequency is fo=10 mc, then each division (p) represents pf_0 cycles=0.05x10 mc=500 kc

The voltage amplification is:

$$(11)\quad A = e/e_g = i_-/j\omega c e_g = e_-/j\omega c e_g Z_-$$
$$= -\frac{j\omega M i_2}{j\omega c e_g Z_-} \text{ or } A = -\frac{kL}{c e_g}\left|\frac{i_2}{Z_-}\right|$$

Simple calculation of i_2 from the laws of parallel circuits, and substitution from equations (3) to (10) show that:

$$(12)\quad i_2 = \frac{g_m e_g (p + jx)}{(p + jx)(jp - x) + jk^2}\quad */,\ /*$$

$$(13)\quad A = \frac{k\, g_m}{\omega_0 c \sqrt{(p^2 + k^2 - x^2)^2 + 4p^2x^2}}$$

obtained by substituting (4) and (12) in (11). It shows a symmetrical function of x. A is here expressed in terms of the relative frequency x, and the constant parameters p and k. Since x, p and k are pure numbers, the graph of the function A is a family of universal curves. These are plotted in Fig. 2.

There are three forms of equation (13), obtained by algebraic manipulation:

$$(13)\quad (a)\quad A = kG/\sqrt{(p^2 + k^2 - x^2)^2 + 4p^2x^2}$$
$$(b)\quad A = kG/\sqrt{(p^2 + k^2 + x^2)^2 - 4k^2x^2}$$
$$(c)\quad A = kG/\sqrt{(p^2 - k^2 + x^2)^2 + 4p^2k^2}$$

$G = g_m/\omega_0 c$ is the gain-constant of the stage, and defines the absolute level of amplification. It would seem at first glance that this level is, then, inversely proportional to the frequency: this is true only because as f_0 is increased (Fig. 2) the relative bandwidth, which depends on x, increases proportionally; unless the scale of x is changed by modifying the power-factor, p. This will be clarified later.

Differentiation of (13) shows that the maximum value of A occurs at (or, can be determined by an examination of equation (13c))

$$(14)\quad p^2 + x^2 = k^2 \text{ or } x = B^1 = \sqrt{k^2 - p^2}$$

which is a well-known equation defining the relative peak-separation.

The gain at the peaks

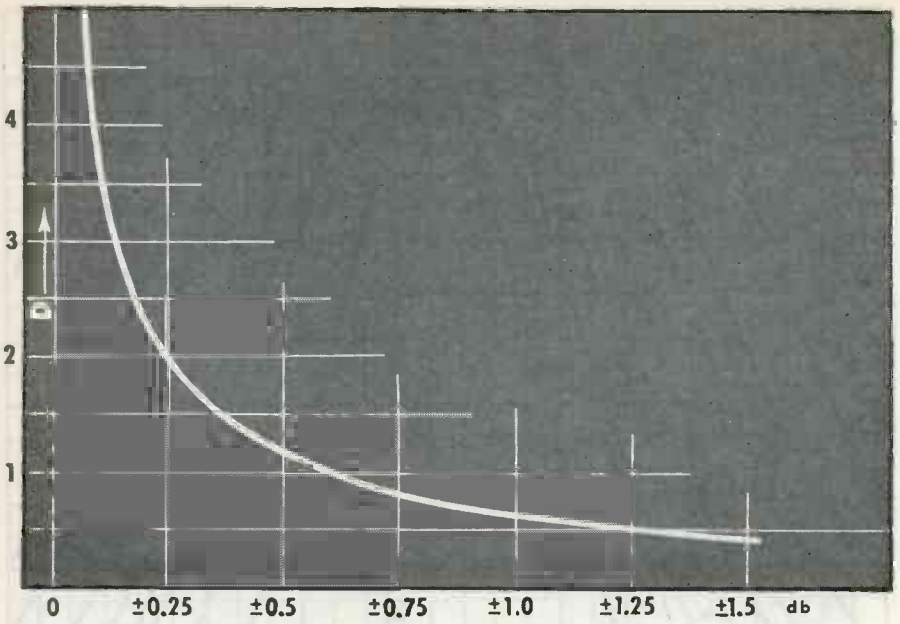


Fig. 3. Values of the Dip Function, D, as a pure number for various departures from flatness, in decibels

$(x = \sqrt{k^2 - p^2})$ is (15) $A^1 = G/2p$

The gain at the center frequency ($x = 0$) is:

$$(16)\quad A_0 = kG/(p^2 + k^2)$$

The dip-to-peak ratio is:

$$(17)\quad R_0 = A_0/A' = 2pk/(p^2+k^2)$$

The simultaneous solution of (14) and (17) gives two very useful relations:

$$(18)\quad p^2 = \frac{(B')^2}{2}\,\frac{1-\sqrt{1-R_\delta^2}}{\sqrt{1-R_0^2}} = \frac{(B')^2 D}{2} = \frac{B_\delta^2 D}{4}$$

$$(19)\quad k^2 = \frac{(B')^2}{2}\,\frac{1+\sqrt{1-R_\delta^2}}{\sqrt{1-R_0^2}} = \frac{(B')^2 D'}{2} = \frac{B_\delta^2 D'}{4}$$

D and D′ will be called the dip-function and the conjugate dip-function, respectively. These are related by the equation:

$$(20)\quad D' = D + 2$$

regardless of the value of R_0. Thus, for over-coupled stages (R_0 is imaginary unless k is equal to or greater than p) the following holds:

$$(21)\quad k^2/p^2 = D'/D$$

The graph of D is shown in Fig. 3. In Fig. 3 the scale of abscissae has been plotted in decibels of departure-from-flatness (± db from mean level between peaks and valley) for the convenience of those engineers who prefer to work with db-gain rather than absolute gain.

Thus, in designing an over-coupled stage of amplification, the only necessary data required is the determination of the bandwidth, B_0, and the desired departure from flatness over this band. k and p may then be calculated from (18) and (19).

The center-frequency amplification is, from (16):

$$(22)\quad A_0 = G\sqrt{D'}/B_0\,(D+1)$$

from which the amplification is seen to be independent of center-frequency, but is inversely proportional to the bandwidth in cycles (the factors G and B_0 each contain $1/f_0$, which cancels out of numerator and denominator).

Let B_0 = relative bandwidth of resonance curve at the gain-level of the dip.

Then the relative bandwith, B_0, across the valley is

$$(23)\quad B_0 = \sqrt{2}\,B'$$

This is shown in Fig. 2, curve $K = 4p$, and can be proved easily by calculating the value of x which makes $A = A_0$. This bandwidth is of some significance, as will be discussed later.

The analysis given in this section has been symmetrical, even as regards circuit components. Actually, if it is desired to get the maximum gain from a broad-band amplifier, it is usual to design the coils to resonate with the distributed capacitance on each side. These capacitances are in general slightly different. High-g_m amplifiers, such as the 6AC7, together with circuit components have a realizable minimum plate circuit capacitance of about $\mu\mu$f, and a realizable minimum grid circuit capacitance of about 16 $\mu\mu$f. The actual dissymmetry of the peaks (which did not show up in the mathematical analysis due to neglections indicated by */, /*) can be equalized by detuning the plate and/or grid circuits slightly from resonance at f_0.

It is usual to omit the plate-side damping resistor shown in Fig. 1, and to introduce all the damping in the grid side. This is allowable because of the fact that power factors are additive. As has been shown by Mountjoy,[3] the use of a grid damping-resistor only will increase the gain by several db per stage.

The design formulas are obtained in such a case by the methods outlined in this section, using different values of L, c, and R on each side of the transformer. Let p be the resulting power-factor of the grid circuit, and p_1 that of the plate circuit. Then, it can be shown that equation (13) becomes:

$$(13.1)\quad A = kG/\sqrt{(pp_1+k^2-x^2)^2+x^2\,(p+p_1)^2}$$

$$(13.2)\quad A = kG/\sqrt{(k^2-x^2)^2+x^2p^2}$$

obtained when p_1 is zero, which is double peaked, quite flat, and very selective for $k > p$. Since the value $p_1 = 0$ cannot be realized, the equation for a value of $p_1 = np$ will be of more practical use:

$$(13.3)\quad A = kG/\sqrt{(np^2+k^2-x^2)^2+x^2p^2\,(n+1)^2}$$

It is possible to realize a value of $n = 0.1$. The amplification calculated from equation (13.3) will be found to be about 6 db higher than that from equation (13), for this value of n. That is, a higher gain per stage is realized by using grid damping instead of grid and plate damping of the double-tuned transformer.

The peaks occur at a value of x obtained from differentiation of (13.3):

$$(13.4)\quad x' = 0.7\sqrt{2k^2-p^2\,[(n+1)^2-2n]}$$

A flat response is obtained by making $k = p$ in this case, which gives an overcoupled response having a departure from flatness corresponding approximately to a value of $D = 2$. The value of optimum coupling is obtained by making (13.4) equal to zero, and solving for k_0:

$$(13.5)\quad k_0 = 0.7\,p\,\sqrt{(n+1)^2-2n} \doteq p/2$$

for small values of n. The relative peak separation and the relative

(*Continued on page* 164)

NOISE in Vacuum Tubes

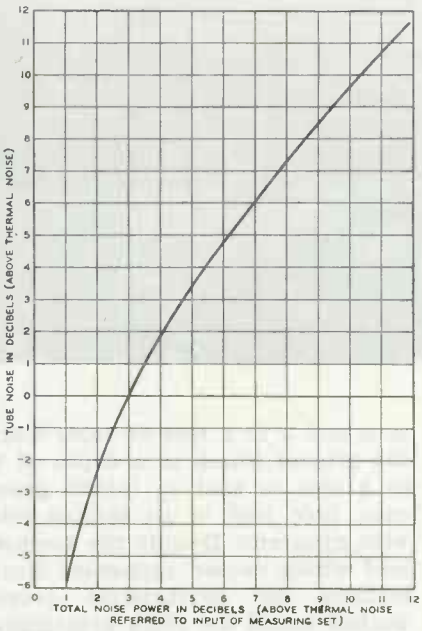
by J. J. DeBUSKE
Bell Telephone Laboratories

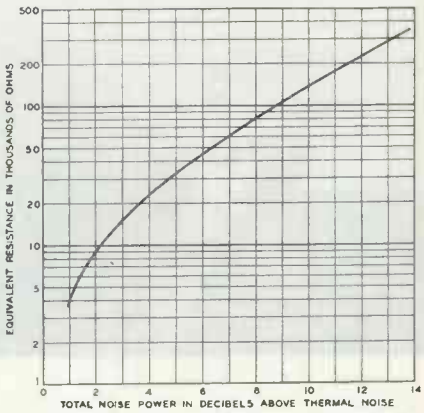
Intelligibility in long distance phone communications requires diligence in keeping tube and circuit noise down to a satisfactory level

● In long distance transmission systems, there must always be an adequate margin between signal and noise. Noise introduced at the point where the signal level is at its lowest—that is, at the input to each amplifier—will limit the permissible line attenuation, and hence the length of line between repeater stations. Close control of tube noise is therefore of importance in keeping down the cost of the system without sacrificing telephone quality.

Thermal noise power

Noise output of an amplifier whose input circuit is a pure resistance is the sum of the effects of thermal noise in the input resistance and of tube noise. If the amplifier had a perfectly quiet tube in its first stage, the noise measured by a meter in the output circuit would be due to the thermal noise. Replacing the quiet tube by an average tube would increase the power output of the amplifier by an amount due to tube noise.



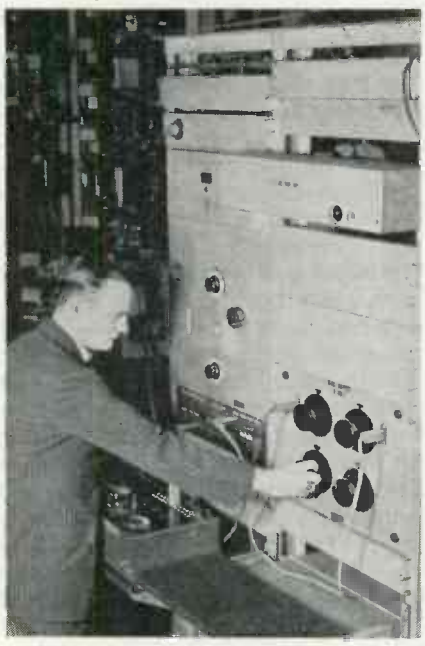


Several measuring sets for determining tube noise have been devised on this principle. The one described here was set up to meet the need for a fast and simple method of measuring, under actual operating conditions, the noise contributed by a tube in the first stage of the line amplifier in "K1" carrier systems. The measuring equipment is shown in the photograph and block diagram. The 135 ohm termination is connected to the input circuit of amplifier No. 1, which is the "K1" carrier-line type. This input circuit consists essentially of a transformer with impedance ratio 135:30,000 and a 30,000 ohm termination on the high side which is connected to the grid of the tube under test. An attenuator, a filter, a second amplifier and a calibrated thermocouple meter, which serves as a power measuring device, complete the equipment.

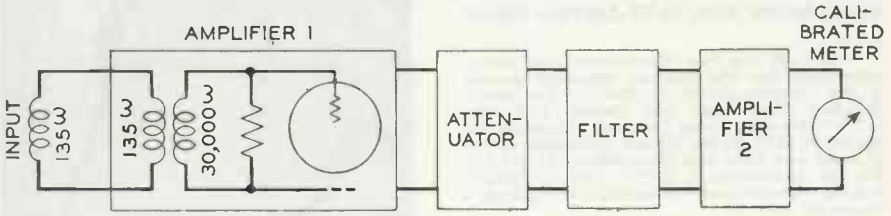
It has been shown by J. B. Johnson, experimentally, and H. Nyquist, theoretically, that thermal noise power may be expressed by the relation 4KTf where K is Boltzmann's gas constant (1.37 x 10^{-16} ergs per deg), T is the absolute temperature, and f the width of the frequency band of the measuring equipment. Substituting the operating values for temperature and frequency band it appears that the thermal noise power at the input of the amplifier is 3.4 x 10^{-14} milliwatts. This is 134.7 db below one milliwatt. Since the input of the amplifier is terminated by a matched impedance only half the noise power, 3 db less, is delivered to the amplifier.

(*Continued on page* 178)

NOISE MEASUREMENT test panel for carrier-line amplifier



BLOCK DIAGRAM showing arrangement of noise test equipment which permits amplifier tubes to be compared with ideally quiet samples



ALASKAN CARRIER CURRENT SYSTEM

• During October one of the communications engineering and construction feats of history is to be completed—one of the longest carrier communications systems in the world, which will link the United States and Alaska with telephone and telegraph service along the Alaskan Military Highway*. The carrier communications system extends more than 2,000 miles through the most rugged and difficult virgin wilderness in North America. The highway and the telephone link are being built within a little more than a year under the pressure of military necessity —a feat which engineers predicted before the war would take around a decade.

It was no "soft" job which the Signal Corps of the U. S. Army, aided by the telephone engineers, installers and construction crews of the Bell System, undertook—it was even a tougher task than the usual Signal Corps job to build communications lines in snow, muck or dust.

The first portion of the 2,060-mile communications line was constructed in sub-zero weather with temperatures ranging from 30 degrees below zero to 72 degrees below zero and 3 to 5 feet of snow with the ground frozen to a depth of 6 to 8 feet so that to install poles each hole had to be blasted out with dynamite. Despite the intense cold which caused numerous frost injuries the construction crews worked round the clock practically all the time. When spring came the Arctic muskeg became like a mudpond—muskeg mud is undoubtedly the worst in the world—so that to sink poles in many cases gravel for a depth of 12 to 15 feet had to be placed in the holes or many poles had to be set in a tripod formation literally floating on the ooze until it dried. Floods and washouts of the spring thaw also slowed the work.

When summer came, dust often was so thick when trucks were being driven over the new highway that not only truck drivers but also the telephone construction workers could not see through it. But the worst plagues were the myriads of mosquitoes, horseflies and the most tormenting insects which the Yukon Indians fittingly dubbed "no-see-ums."

BRIGADIER - GENERAL Frank E. Stoner, Chief of Army Communications Service, talking from the War Department in Washington when the second link of Alaskan telephone line opened

Military value

Besides the tremendous military tactical value of the new Alaskan Highway and its carrier telephone-teletypewriter system, these two media of transportation and communications are slated to play a most important role in the opening for development of the Yukon Territory and Alaska after the war with their huge potential oil fields, mineral deposits and thousands of miles of virgin timber. The project of building the Highway and the telephone line which will be completed from Helena, Montana, to Fairbanks, Alaska, within a year was through the most untamed wilderness of mountains and forests in North America, traversed only by Indians and trappers, and harks back to the pioneer days of the "opening of the West."

*Although the War Department has widely advertised that the Alaskan telephone project is the longest carrier system in the world, Standard Telephones and Cables, Ltd., the I.T.&T. Manufacturing Company in London, installed in 1938-39 the longest 3-channel system of open wire lines ever undertaken. It is 8,620 km, or approximately 5,400 miles in length, linking Moscow and Khabarovsk; it includes a broadcast channel.

The 2,060 mile telephone line carries two circuits which are expanded by "C" type carrier systems so as to provide seven talking channels and fourteen teletypewriter circuits. Critical shortages of copper made necessary the use of wire of only 30 per cent copper, which, however, was deemed desirable because of the greater strength of the copper-weld wire. But to bring up the transmission conductivity it was necessary to use repeater stations every 95 miles instead of the usual longer interval.

A radio link to Yukon Territory had been tried several years ago by the Alberta Government Telephone administration with poor success because of the "magnetic blackouts." Atmospheric disturbances, such as the Northern Lights, played hob with radio transmission and reception during the winter days in the Arctic regions. In addition to lacking the security value of the telephone line, radio could not furnish the variety of communications services that the open wire line could handle.

Repeater stations

To operate the long distance telephone conversations which are already in progress from Whitehorse to Washington and elsewhere in the United States and will be from the farther northern destination of Fairbanks by October, terminals, repeaters, ringers, power equipment, etc., were installed along the line in specially built repeater stations which are heated and afford living quarters for the permanent signal Corps crews which will operate and maintain the system when completed. Signal Corps troops have been specially trained to operate the carrier systems.

SOME ALASKAN EQUIPMENT

- 73—V1 Repeaters
- 28—C1 Carrier Repeaters
- 15—No. 18 Test Boards
- 7—C5 Carrier Terminals
- 6—40C1 VF Telegraph Terminals
- 5—Magneto Switchboards
- 2—H1 Carrier Terminals

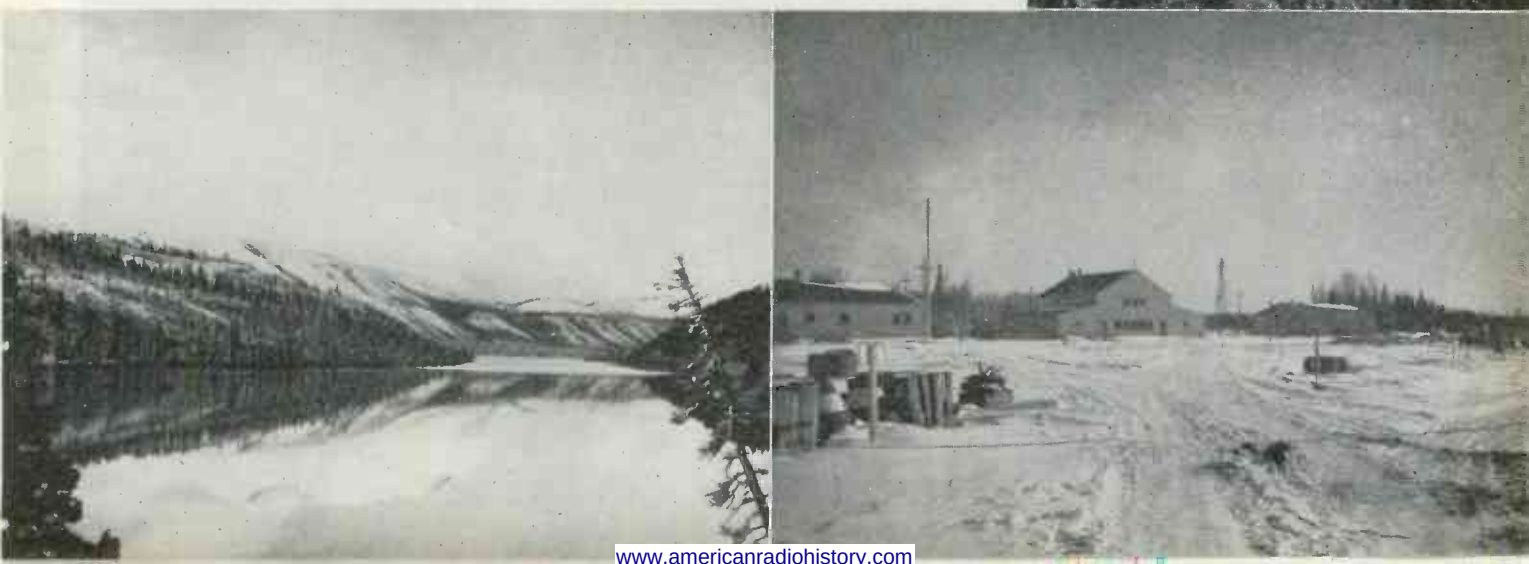
During the construction of the line radio stations were installed at strategic places, housed in Nissen Huts during the sub-zero winter, to serve for emergency communications for the highway and telephone line construction crews and to maintain a link between the Army Corps of Engineers which built the highway and the Signal Corps command in Washington and the United States. A radio officer of the Signal Corps Northwest Service Command, who had installed more than forty broadcasting stations in civilian life in the Northwest and Far West, flew about 20,000 miles supervising the radio operations during the construction period. For the operation of the telephone line four emergency radio stations of the portable type are to be located for emergency standby communications in event of failure on the telephone system. (This follows the usual practice of the Bell System in the United States of having emergency radio stations to carry on service when wire lines are disrupted.)

Several score of tons of carrier and repeater equipment were sent by Army Transport plane from the Atlantic Coast when the first link of the line from Edmonton to Dawson Creek was being rushed to completion during the early winter months of November and December, 1942. Since the spring and this summer the Signal Corps has rushed in communications equipment—wire, crossarms, pole hardware, carrier and repeater apparatus—by every means of transportation available. The Highway itself has been used as much as possible, the railroad up to Dawson Creek, shipping along the Alaskan coast and then by barges into the interior.

Record construction

The first link from Edmonton, Alberta, to Dawson Creek, British Columbia, a distance of 442 miles, was built in record time—by the third week in November only 5 miles of circuit had been placed and 93 miles of poles remained to be set. By assembling five wire line groups from the American Telephone & Telegraph Co., Bell Telephone of Canada and three other Bell System companies, together with a Signal Corps construction battalion of 140 men, work was rushed day and night so that by December 1 Brigadier General Frank E. Stoner, Director of the Army Communications Division, was able to talk from Washington, D. C., with Colonel Heath Twitchell of the Corps of Engineers at Dawson Creek—the line had gone

(*Continued on page* 184)



BUILT through a wilderness, the Alaskan Highway provides a supply line and communication facilities linking Washington with the northernmost outposts

FOR SAFETY

Engineering details of packaged automatic unit for emergency use of forced down bomber crews

GIBSON girl in use with antenna being raised by box kite

● We are all familiar with the heroic sagas of the crews of our long range bombers, forced down at sea while flying in transport or combat duty. The question has undoubtedly occurred to many radio men why a portable hand-powered transmitter could not be furnished these men to greatly increase their chances of rescue.

Shortly before Pearl Harbor, the British Air Ministry expressed interest in an emergency radio transmitter of rough German design picked up in the Atlantic. A small group of American manufacturers was permitted to make a hasty study of the transmitter in Washington, D. C. Bert Hemingway, then manager of the radio division, represented Bendix Aviation, Ltd. With the help of this information, the radio engineering department developed a working model within a 10-day and night period.

Component units

Invocation of the lend-lease program brought Bendix into close collaboration with the Signal Corps, and so today, through the cooperation and aid of the Signal Corps' Aircraft Radio Laboratory at Wright Field, we have the streamlined "Gibson Girl" embodying many new and desirable features. The title "Gibson Girl" should be self-explanatory on looking at the chassis outline.

Basically, the unit consists of a hand-cranked automatically keyed, 500 kc transmitter; an antenna, and means of support in dead calm or 50 mph gale, and a signal lamp for use at night. The component units are packed in a bag with parachute and static line attached and mounted for easy accessibility in planes with other emergency "life insurance" equipment. The weight of the complete assembly is 33 lb.

If forced down, the crew attaches the static line snap fastener to a structural member of the ship and throws the unit overboard at any altitude above 300 ft. The static line opens the chute when clear and the unit descends to the sea. Each component and the entire assembly is, of course, buoyant and water-tight, and is painted a bright chrome yellow. The unit will withstand the heavy pounding of a high sea for a minimum of five hours with no entrance of water and no deterioration of performance in any way.

When the crew has inflated the rubber life raft it picks up the unit, snaps open the bags and containers and withdraws the following equipment — each with concise directions permanently affixed:

RIGID final inspection and searching performance tests on the complete unit are carried on in the laboratories of the maker, Bendix Aviation

at SEA

by DON GUMPERTZ
Project Engineer, Bendix Aviation, Ltd.

transmitter including reel with 300 ft. of wire; handcrank, attached by leash, and ground wire and sinker; collapsible box kite in container for use in winds of from 7 to 50 mph; two Neoprene balloons sealed in inert gas, for use in calm or winds up to 20 mph; two hydrogen generators and inflating tubes; signal lamp; spare roll of antenna wire with all fittings; instruction and maintenance manual.

Operating instructions

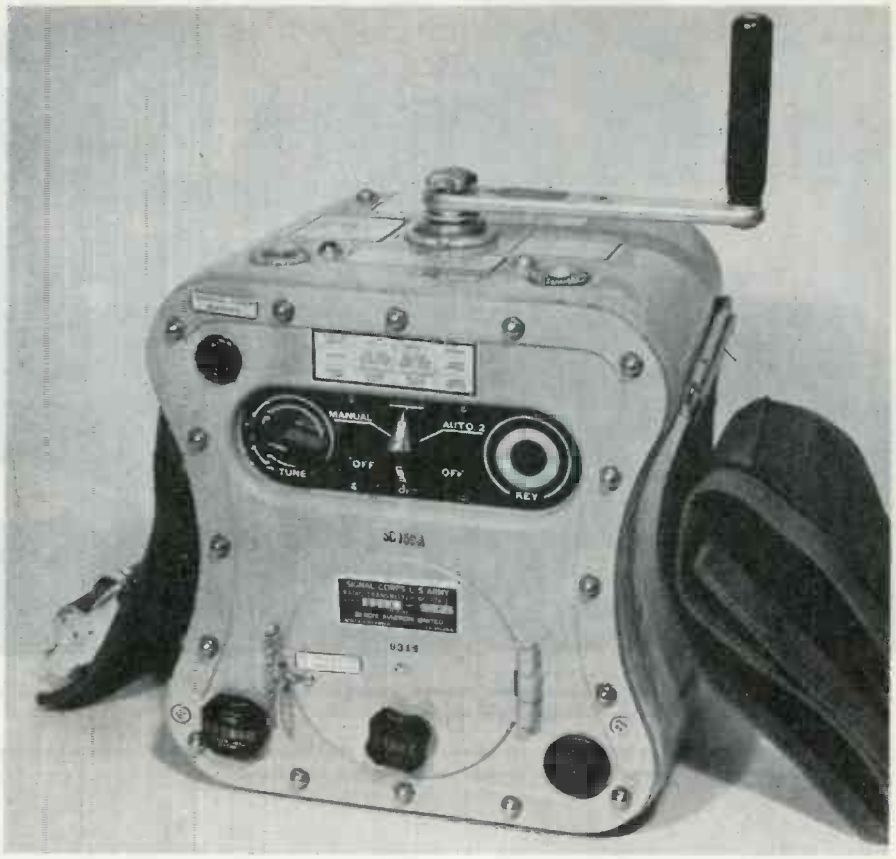
The briefest way to describe the assembly and operation of the unit will be to quote the instructions appearing on the transmitter.

"(1) Install crank; (2) set knob to proper radio signal; (3) raise antenna by kite or balloon; (4) strap unit between legs; (5) attach lead-in to antenna; (6) let ground wire into water; (7) crank at speed to light speed indicator lamp; (8) while cranking, tune transmitter to brightest glow in tuning indicator; (9) keep cranking; keep speed indicator lighted."

The hydrogen generator is operated simply by opening the unit at both ends, attaching the inflating tube and immersing the unit in sea water. An interesting note is the fact that in development of the hydrogen generator through paper analysis, the lightest and most efficient chemical for the use intended was determined and sought. A total of three lb. of this chemical was located in the United States; now the chemical is manufactured and delivered by the ton. The box kite is assembled merely by extending two sets of spiders in a fashion similar to opening an umbrella.

Waterproof construction

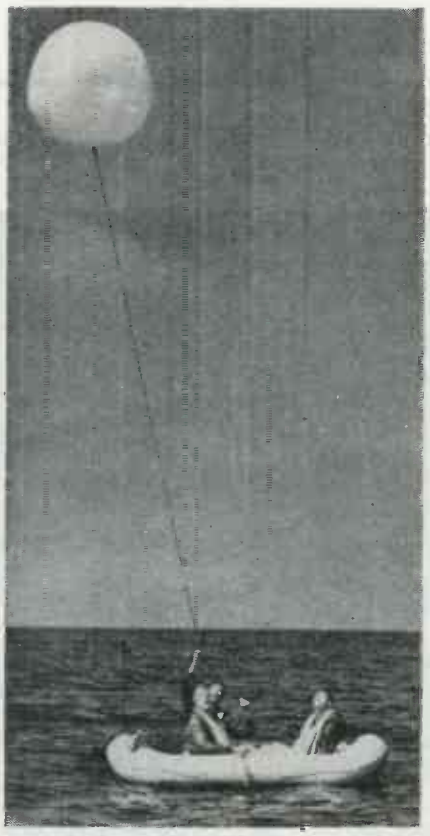
The transmitter proper is housed in a drawn aluminum case, the power supply and keying assembly secured to the case itself, and the rf and audio stages mounted on the inside of the front panel. The entire transmitter, including all shafts, is hermetically sealed and a dessicant is inserted in the unit to absorb whatever moisture remains at the time of assembly.



CONTOUR of equipment, knee held, suggested popular name

Emission is 500 kc, ICW, the modulation frequency 1000 cycles, modulation in excess of 100 per cent. The transmitter may be automatically or manually keyed. The signal lamp may be turned on continuously or manually keyed, as desired.

HYDROGEN balloon is used to raise antenna when winds are light

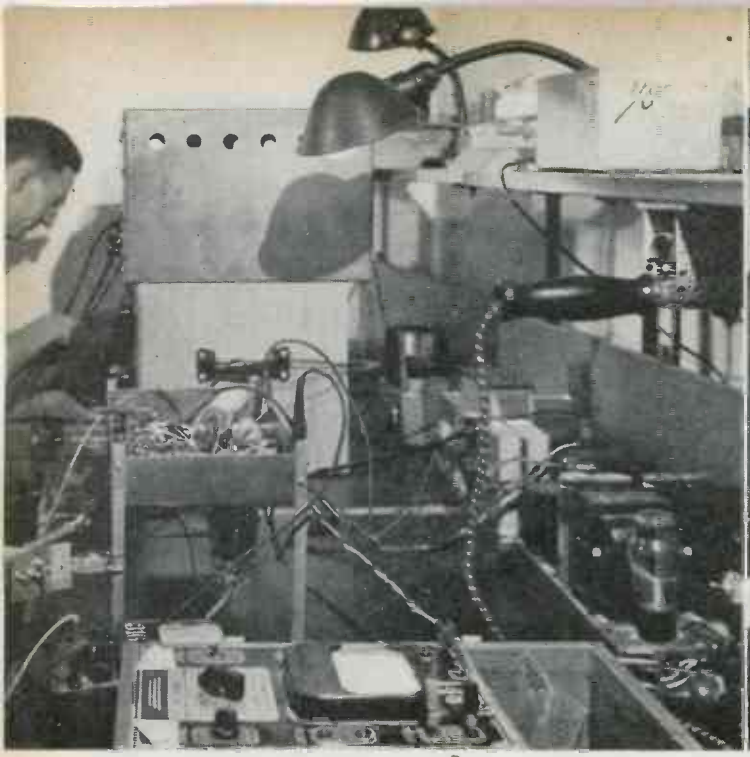


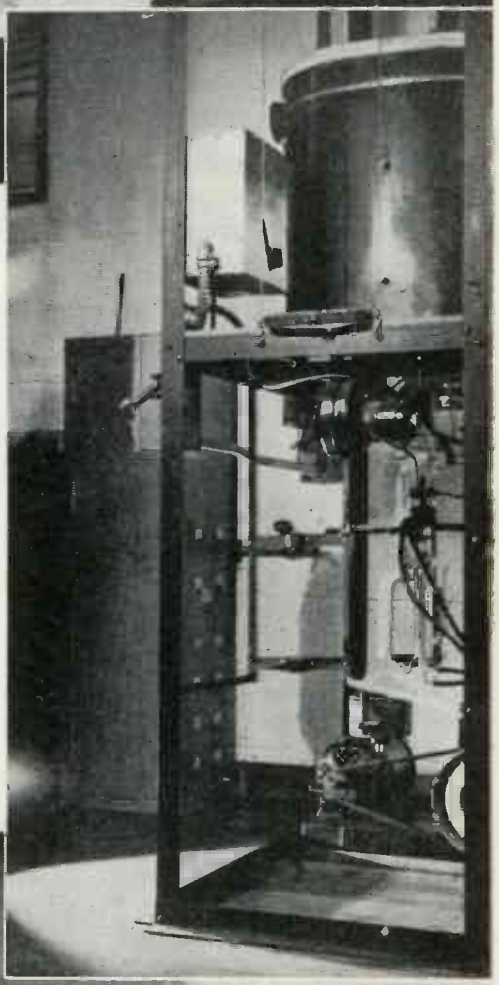
The power supply assembly is bolted into the case. This includes the main gear train, the generator supplying 28 volts and 300 volts dc, the voltage regulator and governor gear train assembly. The crank is turned at approximately 80 rpm which speed is geared up to approximately 5000 rpm to the generator shaft. Another take-off from the crankshaft is transmitted through a slip-type clutch to the governor gear train assembly. The governor itself turns at 1320 rpm, and as the crank is turned at any speed faster than 60 rpm the governor tightens up, causing the clutch to slip and hold the code wheel speed constant. The code wheel is a phenolic wheel with the desired characteristics molded into its perimeter. As the code wheel turns it lifts keying fingers, keying the transmitter as selected.

Voltage control

The voltage regulator consists of a spdt relay and resistor bridged across the low voltage winding and with contact spacing of .002 to .003 in. The relay rests in up position

(*Continued on page* 180)





▲ INSIDE one of the laboratories where equipment under development emerges in the form of electronic devices for many purposes

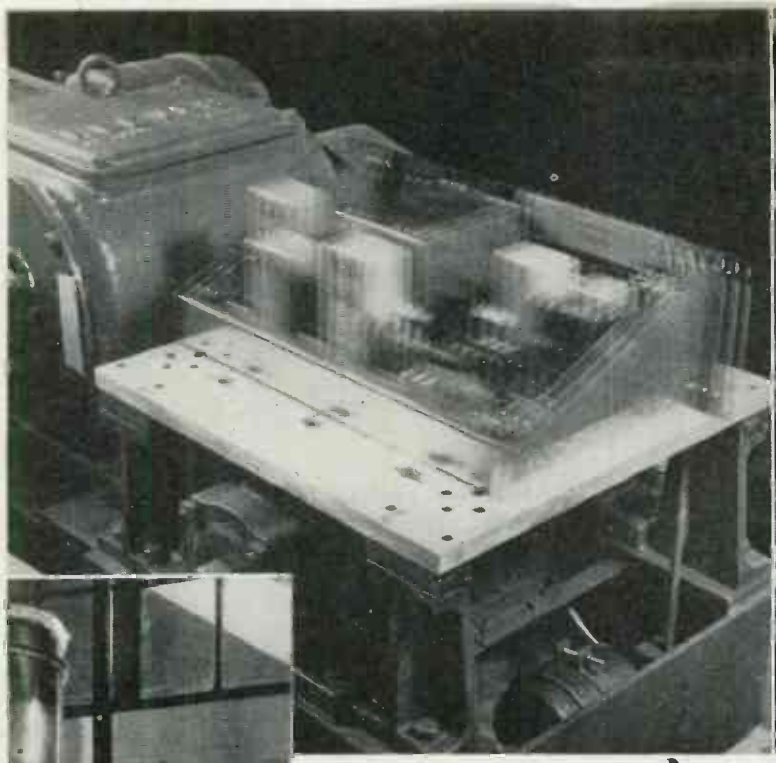
WHERE development work requires the use of test equipment that does not exist, such apparatus is designed and constructed to fill the need ▲

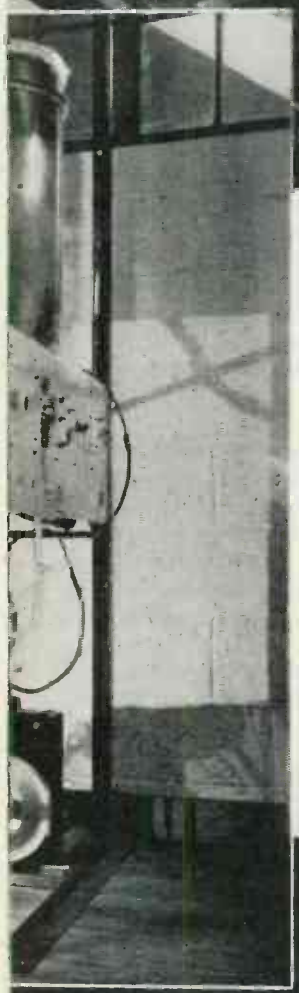
DEVELOPING

Modern laboratories in which Hazeltine engineers study

▼ NOTHING is taken for granted; though materials come from reliable sources, everything is tested with special instruments

DURABILITY of rotating condensers and other wearing parts can be predictable; here life tests of such things as controls are made ▼





▲ EQUIPMENT intended for the use of the armed forces is put through every conceivable test such as on this vibration machine illustrated above

PREQUENTLY special types of finishes are required for durability and here is shown one of many tanks for electro-plating parts to withstand various climatic conditions ▲

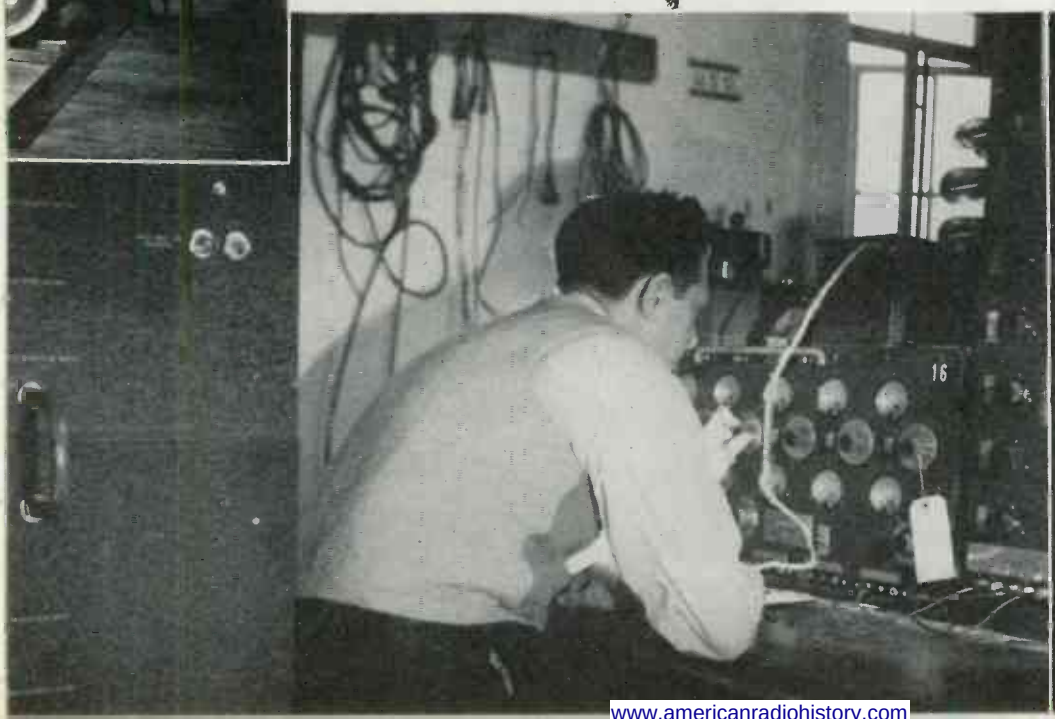
UHF TECHNIC

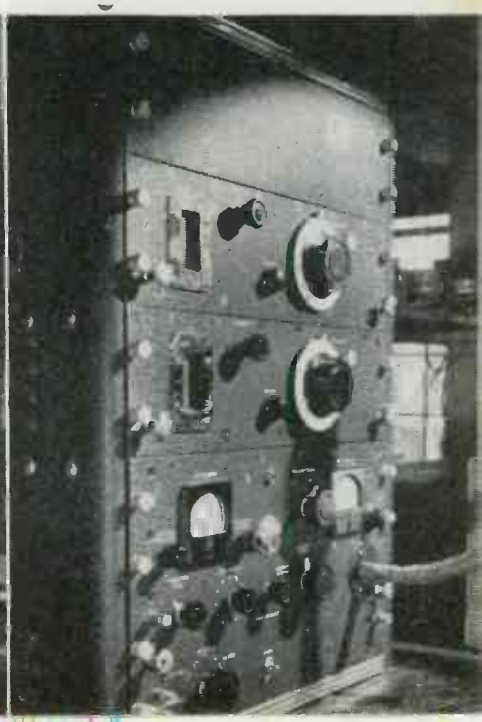
new approaches to problems of electronic application

← WHERE developments require the use of special types of large vacuum tubes these are designed and here built to order to designated specifications

▼ DETERMINING the characteristics of special tubes requires exhaustive testing, often with newly designed apparatus

▼ HAZELTINE designed FM signal generator



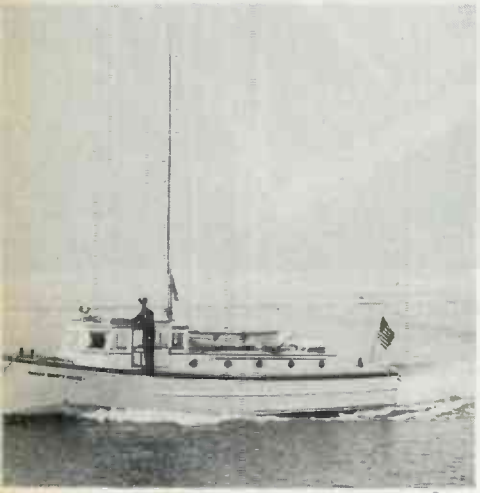


CONTROL desks, specially designed and built, are duplicate, back to back

POLICE RADIO

Nassau County combines advantages of both AM and FM

Four unattended remote receivers connected with head-



CRUISING L. I. Sound, this ship also carries both AM and FM equipment

● With some 274 square miles of territory to cover, the Nassau County (N. Y.) police department is now depending upon a combination of AM and FM to provide dependable two-way communication between headquarters in Mineola and 70 automobiles and a motor cruiser. The FM portion of the communication system is a comparatively recent addition. It is used only as a "talk-back" medium between the cars and the cruiser and headquarters.

Advantages of FM for police work are judged by Captain Wm. K. Allen, under whose supervision the entire system was installed and who is responsible for its operation and effectiveness, to be sufficient to warrant the change which was made from AM equipment in the cars. Regardless of the location of a car, FM puts a good solid signal into headquarters, day and night, in spite of weather conditions or the season of the year. Another advantage comes from the fact that it is impossible for unauthorized persons to understand FM transmissions unless equipped to do so, and not many of them have FM receivers.

Spread practically in the center of Long Island with metropolitan New York as its western border, Long Island Sound on the north and the Atlantic ocean on the south, the Nassau County police organization has a triple function to perform. First, there is the problem of policing within the borders of Nassau County with its important defense organizations, its residential communities and the many pleasure resorts that dot both salt-water washed shores; second, there is the need for maintaining close liaison with Metropolitan police in view of the extensive travel between New York and Long Island points; third, close cooperation with New York State police patroling the Island's extensive parkway system is necessary.

1 kw transmitter

Radio carries the brunt of the burden of all police communication not only in Nassau County but throughout the rest of Long Island which stretches for a distance of 125 miles to Montauk Point on its eastern tip.

Radio headquarters of the Nassau County system is located on an

AMPLIFIER and patch panels containing terminations for all receiver lines

EACH of the 70 mobile police units carries AM receiving equipment and for talk-back operators rely on 25-watt FM transmitters on 35.1 megacycles

FM TALK-BACK

in maintaining contact with 70 police cars and a ship. quarters through telephone lines cover 274 square miles

INSULATED type antenna, 89 ft. high is atop headquarters building

upper floor of the police building and centers around a Model 443-1 1 kw Western Electric transmitter operating on 2490 kc and installed as successor to a model 9C transmitter after that piece of equipment had served the county for seven years; it is still maintained in operating condition to serve in emergencies. The new transmitter, installed in the wall between the operating positions and a spacious closet which provides free access to the back for tube changes, etc., operates at 1000 watts during the day and 500 watts at night. It feeds an 89-ft. Blaw-Knox insulated tower mounted on the roof of the building. Transmission lines and antenna tuning equipment thus are all within the building.

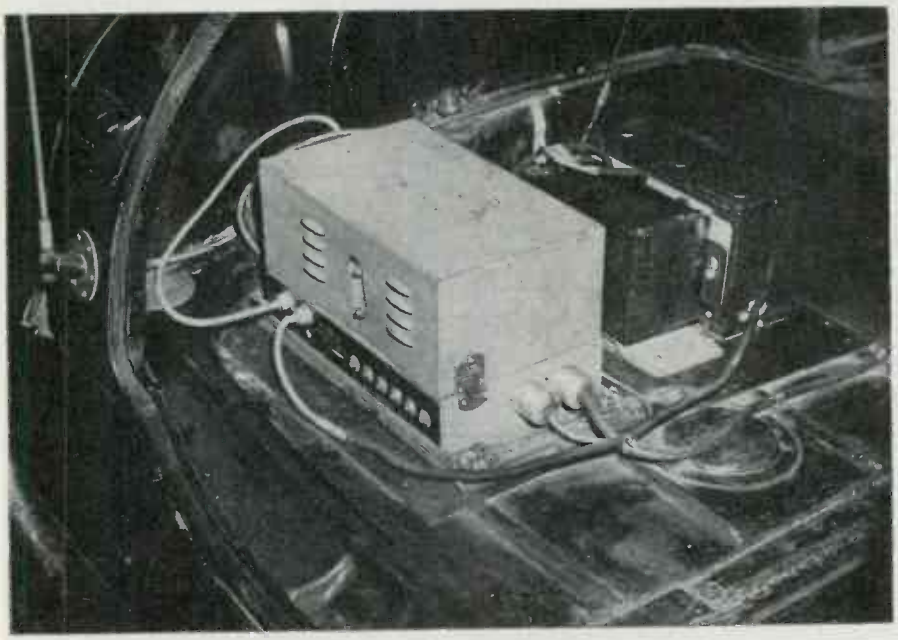
Across the room from the transmitter are two racks of speech input and auxiliary equipment. Included are two 119A amplifiers, one being a spare; associated with them are four 116-A pre-amplifiers, two of them having been converted to audio oscillators to provide the tone signal used for calling cars. The racks also hold two receivers, two volume control indicator panels, the frequency standard, power level indicator, modulation meter, etc. as well as patching equipment.

Duplicate controls

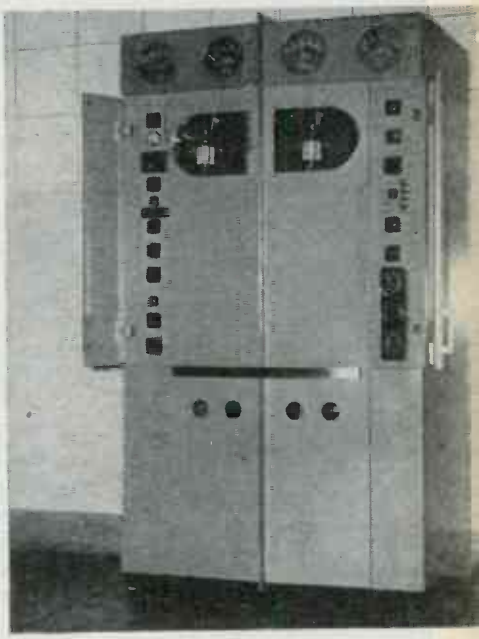
The operating position, centrally located in the radio room, is a twin desk with all controls in duplicate. Thus there is always a spare control position, or, on occasion, two operators may work together. The desks were especially designed for the purpose and built to order. Each holds antenna meter, modulation percentage indicator, volume control, etc. Press-to-talk switches are foot controlled, leaving the operator's hands free to manipulate controls. It is this equipment that is used for calling all cars.

The "talk-back" system, important as an instant indication of the proper receipt of orders by the police in 70 cars and the cruiser, is identical in all cars and the boat. Each is equipped with a Link model 25 UFM transmitter of 25 watts capacity operating on a frequency of 35.1 mc. Installation in the cars has been standardized and quick replacement in case of trouble is

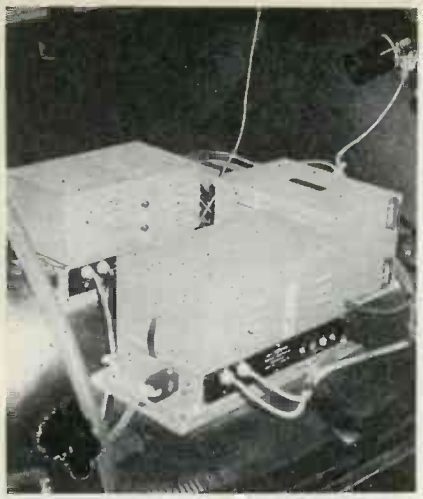
GENERAL view of twin controls showing normal operation position



INSTALLATION of mobile equipment including the Link 25-watt transmitter, the power supply and receiver for AM, arranged for quick servicing

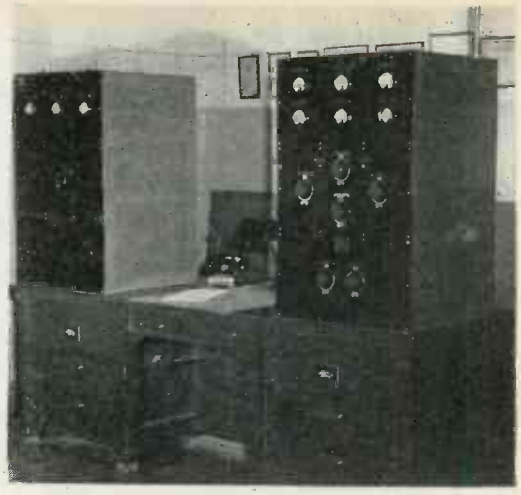


COVERING the county, transmitter for AM is a 1 kw Western Electric



INSTALLATION in Captain's car has both AM and FM transmitters

ANTENNA tuner is located indoors at the base of the tower



ORIGINAL transmitter, after 7 years' service, retired to emergency duty

provided for in the mountings. The transmitters feed whip type antennas mounted at the back of the cars.

Remote receivers

For reception from the cars dependence is placed on four remotely located receivers, also Link, which are mounted on poles at strategic points throughout the county and are entirely unattended. It has not been found necessary to give them any attention except at intervals of about four months. Location of the receivers is such that no matter where a car may be, signals from it will be picked up by at least one receiver and generally by more than one. Output of the receivers is fed to headquarters over leased telephone lines terminating in a mixing panel with attenuators and a 94A amplifier so that lines can be accurately balanced.

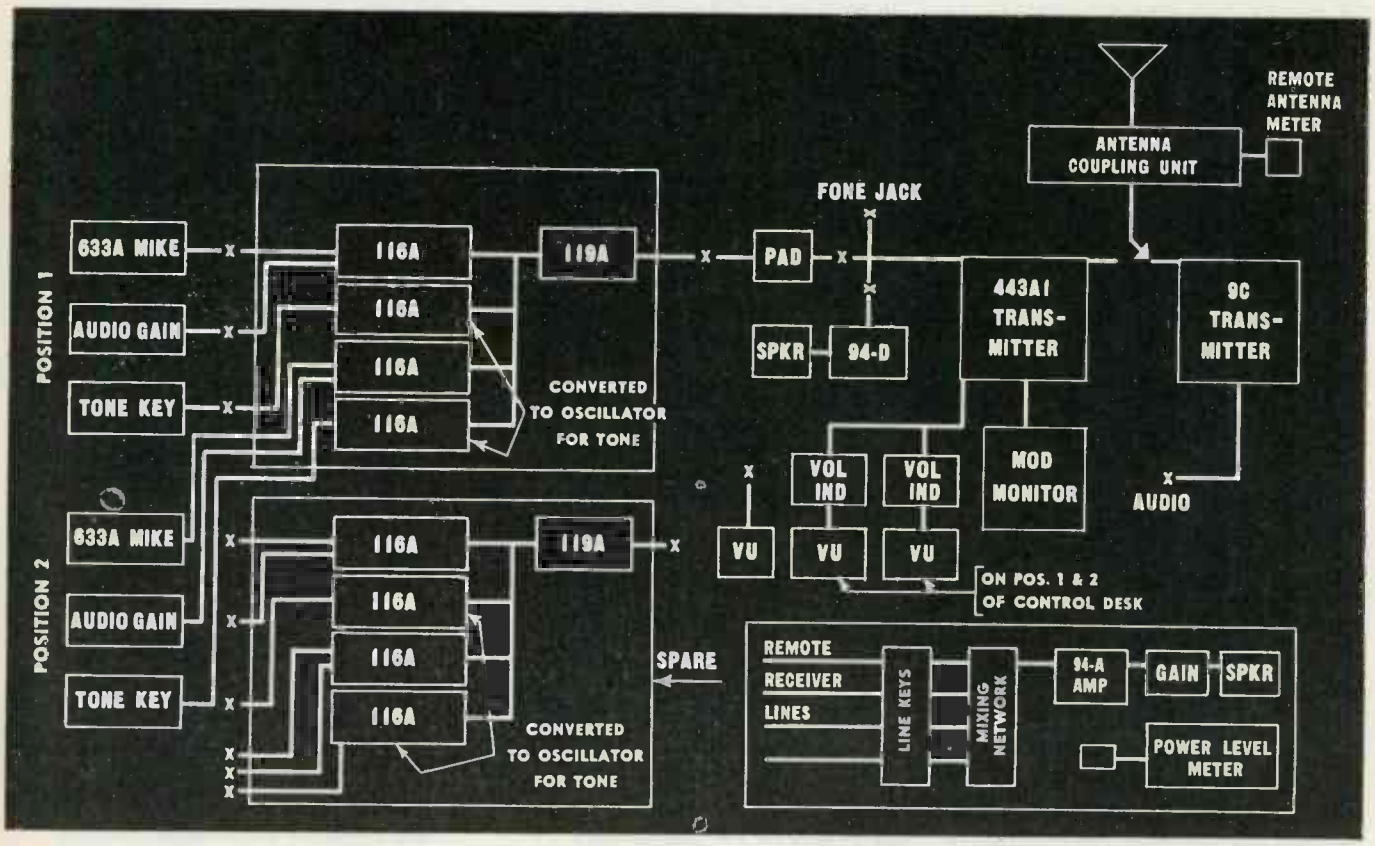
Balanced lines

In the event of trouble with one of the receivers, it may be cut out of the circuit at the patch panel. This automatically loads the line to 600 ohms so that all lines remain balanced.

Own service shop

Although four receivers are in constant operation under normal conditions, main reliance is placed on one of them which is mounted on a pole standing on a ridge which runs almost the length of the Island. This receiver is at an elevation of approximately 360 ft. For service, the County maintains a well equipped shop, does all its own work.

SCHEMATIC diagram of the complete Nassau County communications system in which AM is used for calling mobile police units and FM is used for talk-back



An ENGINEER in COMMAND

About Ralph Heintz, of Jack & Heintz, and his firm's amazing industrial-relations policies

RALPH M. HEINTZ—Assoc. IRE, 1921; Member, 1927; Fellow, 1930. Co-founder and still part owner of Heintz & Kaufman, South San Francisco, Calif., tube manufacturers. Built radio equipment for Byrd and Ellsworth polar expeditions. Now a partner in Jack & Heintz, Bedford, Ohio, joins Bill Jack in working 15 to 20 hours a day, 7 days a week. Mrs. Heintz, with little time to see her husband at home, became a radio "ham" and had a large "on-the-air" acquaintance with ship operators and radio enthusiasts throughout the world

• The firm of Jack & Heintz, Cleveland, is pretty well known to American industry by reason of its revolutionary labor policies of free $15 work-shoes, free vitamin-balanced meals, free dental clinic, and free sunbaths, massages and Florida vacations for its 7,000 "associates"—all coupled with amazingly low production costs!

But few radio men realize that Partner Ralph Heintz of the outfit is a highly qualified radio-electronic engineer, since 1930 a Fellow of the IRE, and the co-founder and still part owner of Heintz & Kaufman, South San Francisco, Calif., builders of radio tubes.

Banish fear

Heintz is the design and production genius of the present Cleveland executive team, and his engineering ideas, coupled with the unique labor policies of the firm, have resulted in producing airplane starters at prices 10 to 40 per cent lower than competitive firms operating along regulation lines.

In the Jack & Heintz management platform a cardinal policy is to banish fear—fear of the boss, fear of toothache, fear of illness, fear of postwar layoff, etc. Building confidence instead of fear leads to a constructive attitude, whereby management needs only to guide its "associates," instead of having to prod indifferent employees into reluctant action. This point of view is familiar to the sales departments of successful businesses, but less familiar in production.

Based on the theory that a good meal is an essential necessity for a man or woman to do a good job, each associate, whether on the day or night 12-hour shift, is furnished a hot meal once each day. The meals are planned by a trained dietician, prepared in a tasty manner and served in the cafeterias at each of the four plants. Coffee is at the disposal of associates at all times. Once each shift doughnuts are served.

Hot baths, massage

Each associate is also encouraged to take the vitamin capsules furnished in order to ward off colds and to furnish the body with the necessary vitamins to maintain good health. The winter climate of the Great Lakes region is severe, and the use of vitamins to avoid illness undoubtedly reduces absence due to illness.

Health Centers equipped with steam baths, infra-red and ultra-violet lamps, for both men and women, are available to associates at all times. Trained masseurs and masseuses administer steam baths and massages to all associates who may be in need of correction of minor ailments, general body tone-up treatments, or foot troubles. At these Health Centers, colds, minor ailments and general "tired out feelings" are taken care of immediately upon discovery, thus eliminating the possibility of absenteeism due to more serious ailments, colds or rundown conditions. The general condition of each associate can be maintained at its best, production maintained, and absence due to illness reduced.

The proper care of teeth is a matter neglected by most factory workers until serious illness results and it is necessary to get medical advice. For this reason a dental clinic is maintained where Jack & Heintz associates can have their teeth X-rayed and cleaned and where teeth that need immediate attention will be cared for. Absenteeism due to toothache is thereby eliminated. The associate is advised to go to his own dentist for anything but emergency treatment.

First Aid rooms and dispensaries are also available where associates receive first aid and care for any sickness or injury. Registered

(*Continued on page* 186)

At Jack & Heintz—7000 "associates" work 12 hours a day, 7 days a week, and like it. Here's why:

No production pressure.
No time clocks.
No employee numbers.
No formalities.
No "fear" of the boss.
No closed doors to officials' offices.
Confidence in being treated squarely.
Good wages due to long work hours.
Balanced lunch free each day.
Free work shoes fitted individually.
Free dental and medical care.
Steam baths and massage to fight colds and fatigue.
Vacations with expenses paid.
All called by first names.
Associates discipline themselves.
Pride in doing an essential war job well.

Superstability at UHF

by S. YOUNG WHITE
Consulting Engineer

To fully utilize the communication channels opened up in this range requires unusual attention to factors that control circuit constancy

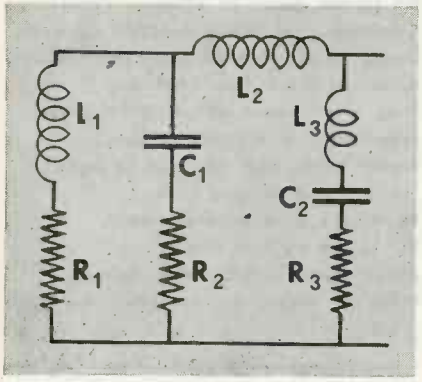
• We all remember the articles on "How to Make a 2½ Meter Transceiver" that were so abundant in the carefree days before the war. The coil was invariably made of No. 14 wire wound on a pencil, then slipped off and soldered directly across a three plate condenser. This form of inductance could be recommended for its simplicity, low losses, and the ease whereby the turns could be spread or squeezed together to adjust the inductance.

Requires six-place accuracy

Uhf comes of age during this war and its vast possibilities for postwar use require a sustained accuracy of frequency setting far beyond anything the radio engineer has ever been called upon to design. This means that every component and circuit effect that influences frequency must be investigated to six-place accuracy. Since the accuracy of calibration of a receiver is the summation of many major and minor effects, the present need is for designs of really stable inductances.

A project was laid out to investigate solenoid type coils for the frequency range of 50 mc to 400 mc, for apparatus which must have superstability—that is, an accuracy of frequency setting and maintenance equal to that of a mobile crystal. Coils were investigated in the inductance range of 5 to 200 millimicrohenries (.005 to .2 microhenries). Tuning both by variable condensers and iron cores was investigated, as well as means for obtaining maximum possible secular and cyclic stability, and the highest practicable values of Q. This report gives some results of the investigation and some theory developed during the research.

Fig. 1. Equivalent circuit of uhf tank



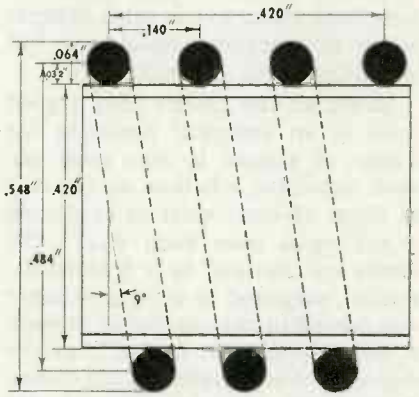


Fig. 2. Three turn wire-wound coil

We shall limit ourselves to the case in which the coil is to be used in its resonant condition. Since a capacitor is a vital part of such a circuit, the complete circuit under investigation is that of Fig. 1.

Equivalent circuit of uhf tank

The true inductance of the coil is shown as L_1, and the losses associated with it as R_1. This includes resistance and eddy current losses in the conductor, the terminals, and the metal parts of the adjacent tuning condenser. C_1 is the distributed capacitance and R_2 the losses therein. L_2 is the inductance of the lead to the tuning condenser, C_2, whose inductance turn is L_3, and whose losses are represented by R_3. L_1 and C_1, together with R_1 and R_2, give us the apparent inductance of the coil, but since inductance and capacitance follow absolutely different laws, they must be kept well separated in our minds.

There are several difficulties in finding proper laboratory equipment to yield reliable test data. The dc resistance of such a coil may be as low as 1 milliohm (0.001 ohm), so ordinary bridges are useless. The resistance of the conductor must be obtained by calculation of the cross-sectional area and length.

Since the inductance may be a small fraction of a microhenry, the usual good 1000-cycle bridge will not give more than one significant figure, and cannot usefully be employed.

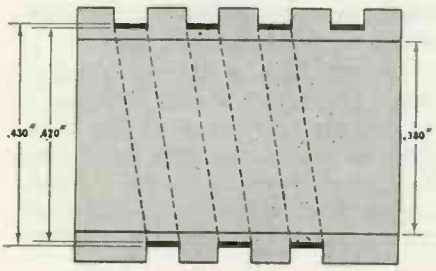
In attempting to use a good rf bridge operating at 1 mc it is necessary to place these small inductors in series with a much larger inductor, and since the bridge is only accurate to about 1 per cent, these readings likewise prove to be of little help.

Measuring Q and frequency

A Q-meter is available for use at these frequencies, but there is some doubt as to its accuracy, especially since there is great difficulty in properly connecting a small two turn coil. Either the coil is connected directly to the binding posts, in which case its field is severely affected by the metallic mass of the posts, or long leads must be soldered to the coil, in which case there is some doubt as to what is actually being measured.

The method found most useful was a rather unfamiliar one: using "grid-dip" indications. We have all noticed that when we couple a tuned circuit to an oscillator, and tune the oscillator through the resonant frequency of the tuned circuit, the grid current of the oscil-

Fig. 3. Three turn strap-wound coil



lator will dip, as power is drawn by the tuned circuit. It is not generally realized that if we plot the shape of this resonant dip against frequency, we have plotted the shape of the resonance curve of the circuit under investigation, and have consequently measured both the resonant frequency and the Q of our unknown circuit. No correction is required if the Q exceeds about 200, but at lower values a correction is required.

Although we can measure the Q of a complete circuit only by this method, we have overcome binding post difficulties, and also the necessity of connecting a vacuum tube voltmeter (with its inherent high input losses) across our tuned circuit. We also require a frequency measuring setup which will permit quick determination of frequencies in this region with an accuracy of better than one kilocycle.

Our total instrumentation thus includes obtaining dc resistance by calculation, Q to an accuracy of about 1 per cent, and, at the same time, frequency to about five figures by the grid absorption method (which can only give us those figures on a coil and a condenser together). The frequency measuring device is useful mainly when we make the circuit oscillate by connecting an acorn tube to it. This result is accurate to six figures.

With these limitations, many measurements must be made to deduce the influence of each element on the Q and frequency. The writer, having made about a quarter million such measurements, is able to make fair guesses about the reasons for some of the phenomena, but by no means all of them.

Before we consider such questions as best length and diameter of the coil, and whether we shall wind it with Invar or electroplate the winding directly on the form, let us bring out some design points by comparing theory and practice concerning two similar coils.

Round wire versus flat strap

Fig. 2 shows a coil wound on a ceramic form. The wire is No. 14 copper, and there are three turns. The length is 420 mils (center-to-center of the end turns of the winding). The o.d. of the coil form is likewise 420 mils. This is chosen so that a ⅜ in. core can be used for tuning if desired, with the thinnest practicable wall thickness that can be commercially produced in ceramic.

Fig. 4A

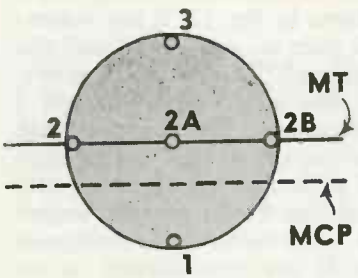


Fig. 4B

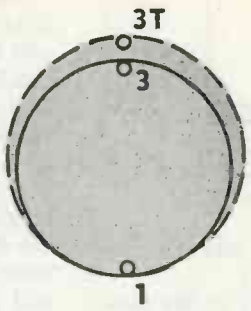


Fig. 5

Illustrating current distribution in wire and in strap conductors at high frequencies

Fig. 3 is a similar coil, except it is wound with ribbon or strap whose width is the same as the thickness of the No. 14 wire (64 mils). The coil form is grooved, and is likewise of ceramic. Most of this work was done with superstеatite or Alsimag 196, two very similar materials.

Our real interest in these calculations is not to design a coil to a given inductance, but to investigate what points are most important in designing for absolute cyclic and secular stability. Good cyclic stability means that we can heat and cool the coil any number of times, and that when it returns to room temperature the inductance will be the original inductance unchanged except in the sixth figure —a few parts in a million. Secular stability means that the assembly will be unaffected by time. The smallest practicable change of frequency with temperature is also desired.

Value of inductance formulas

The main point to watch in applying inductance formulas at uhf, where the number of turns is small, and their cross-section large in relation to the size of the coil form, is the actual current path through the conductor. This is brought out in Fig. 4, where we are free to consider all the current being concentrated at 1, or 2 (the mean diameter), or 3. We know that at radio frequencies the current at 2A, the center of the conductor, will be small because of skin effect. We are also interested in how pronounced the skin effect is, how deeply the current penetrates the wire.

We find that the first step in calculating rf inductance is to calculate an equivalent "current sheet inductance," wherein all doubt about the diameter of the actual current path is removed by assuming it to be an infinitely thin sheet located at the mean turn 2-2A-2B in Fig. 4. A later correction is made for eddy currents, and for actual current path.

Thus, the true current sheet inductance in microhenries of the coil of Fig. 2 is given by the formula (Bull. 74 Bureau of Standards):

$$L = 0.025 \left(\frac{d^2 N^2}{l} \right) K$$

where

d = Diameter of mean turn
N = Number of turns
l = length of winding
K = A constant dependent on d/l, being supplied in the form of a curve.

While the formula neatly evades the question of the actual diameter of the current path by arbitrarily assuming it to be the mean turn, even this simplification leaves to us the decision as to length of winding. Since the coil is of little use without its accompanying tuning condenser, we can so arrange the connection that the current is taken off the center line of the end turn, or at the outer or inner ends, corresponding to 2 and 2B in Fig. 4. Thus the length can vary from a minimum of 356 mils to a maximum of 584 mils, a ratio of 1 to 1.64, which is a very large margin for error indeed when we are interested in a few parts in a million.

Even though we arrange to take off from the center line, the end turn is always assymetrically located in the field of the coil, and there is some reason to believe the current prefers a path toward the outer side of the end turn. If we take off from some point other than the outside, we have forced the current into a compromise path fairly difficult to evaluate. Also the constant K depends on the length, so we have a doubly difficult decision to make when we assign a length to the coil merely by considering its geometry. This problem of course exists in all applications of the formula but is tremendously exaggerated in these tiny

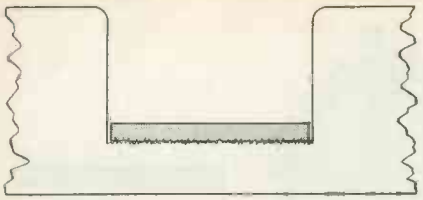


Fig. 6. Ceramic crystals lock strap in place

coils, where the wire size can be relatively enormous.

If we assign a length of 420 mils to the coil, and the mean turn is 484 mils, K becomes 0.66, and the resultant L is 82.6 millimicrohenries. This doubtful result we correct with another formula for coils wound with spaced round wire. The resultant low frequency inductance L_0 is given by

$L_0 = L - 032\ aN\ (A + B)$

where

L = .0826 microhenries

a = radius to mean turn (0.242 in.)

A = a constant dependent on the ratio of wire diameter to winding pitch

B = a constant depending on N. We obtain both from curves published in the above bulletin.

Solving, we find that L has been reduced by 9.2 millimicrohenries and the low frequency inductance is 73.4 mmh.

We must recognize we are straining this formula to the limit. Since the radius is so small and the wire so large, the result given is just a little better than guessing.

Our inability to calculate an inductance is not of great importance at this stage of the uhf art. Any serious worker will wind up dozens of coils to check the Q, stability, temperature coefficient, and tuning range with a given variable condenser or iron core, and it is easy enough to find a suitable value of uhf inductance. The matter has been reviewed to fix our minds on what factors are important in designing for thermal, cyclic and secular stability. Let us look again at the formula with that in mind.

Importance of mean current path

By far the most important element in the foregoing formulas is d^2

$\frac{}{1}$. While we have defined d as the mean turn diameter, what we really are interested in is the mean current path, or the distribution of the current through the cross-section of the conductor. We are also interested in variations in that path caused by thermal effects in the coil form and the conductor itself.

Let us look at Fig. 4, and assume it is one of the center turns of the coil shown in Fig. 2. It has a companion turn on either side, and the flux through it is fairly symmetrical. The small circle marked 1 now represents the shortest path the current can take, 2 the medium length path, and 3 the longest path. We find that 3 is 31 per cent longer than 1. Of course, its dc resistance will be 31 per cent greater, so we can expect the current to divide in inverse ratio.

Path 3 is of greatest diameter, and its inductance turns out to be 75 per cent more. Adding $R+jX_L$, we find that the impedance of 3 is 2.2 times that of the shortest path. From this point of view alone we can deduce the mean current as being not at the physical mean 2—2B, but about one-third the way

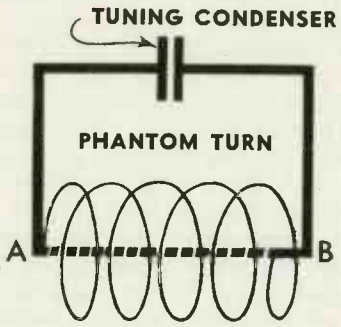


Fig. 7. Showing effect of lead connections external to the coil

up from the coil form. This distribution is probably affected also by eddy currents in the wire. We shall leave the question of redistribution with temperature for later.

It is with relief that we consider the coil of Fig. 3. We have here at least an approximation of the current-sheet inductance, and the diameter of the mean turn must lay between narrow limits. We can also expect to find less complex behavior with temperature. But how does its Q compare with the coil of Fig. 2, which has so much more wire, and how thin can we make the strap? We still have the same indefiniteness with regard to length, of course.

In the course of a number of years devoted to the investigation of coils in this inductance range, it was determined that the Q of coils of Figs. 2 and 3 is just about the same, and would consistently run (with air dielectric or good ceramic or mica condensers) about 675 to 720, at frequencies in the order of 150 mc. Since we could not separate coil and condenser losses, we can only make a fair guess as to the coil losses alone. Strap of many widths and thicknesses and of various materials, from silver plated Invar to bronze, was investigated.

Dc and rf resistance

The coil of Fig. 2 was wound with 4.56 in. of No. 14 wire with a dc resistance (calculated) of 0.957 milliohms. Let us call this 1 milliohm.

The coil of Fig. 3 was wound with hard-drawn silver wire, which was then flattened, giving a strap the same width as the thickness of the No. 14 wire, (64 mils), 5 mils thick. The dc resistance was 10 milliohms, or about 10 times that of the wire. The Q at 100 mc was so similar we can call both of them 700.

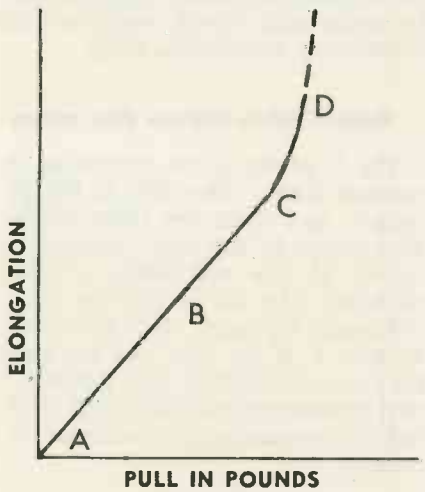
The inductance of each, with a ceramic condenser across it, was measured as closely as possible (the value of the condenser being measured to three places). The coil of Fig. 2 had 69 millimicrohenries, and the strap coil 66 millimicrohenries. This is of course different from their calculated values, but is in fairly close agreement considering the vagueness of the length and mean-turn dimension.

Since the impedance of a microhenry at 100 mc is 628 ohms, 69 millimicrohenries is 43.3 ohms. Since the Q is 700, the series rf resistance of the system is 43/700, or 0.062 ohms.

From wide experience, the writer would be inclined to say that the rf resistance of the condenser is about 20 milliohms, leaving 42 milliohms as the resistance of either coil. While this value is by no means presented as being accurate, it is not very far off. In general, a very good condenser will run 2,000 Q, and the coil alone 1,000, and the combination 700, all in round figures. Thus, the ratio of rf resist-

(*Continued on page* 188)

Fig. 8. Determination of winding tension



DIRECT WRITING OSCILLOGRAPH

by **LOVETT GARCEAU**
Director, Electro-Medical Laboratory, Inc.

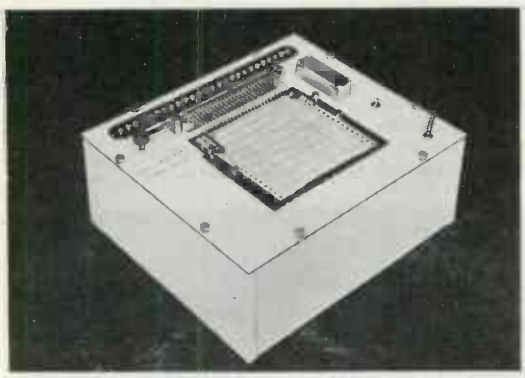
Low frequency phenomena simply recorded by electromagnetic pens on electrosensitive paper

• The need for a direct writing oscillograph has long been felt by all those who have had occasion to study the shapes and time relations of electrical waves. The difference between such an oscillograph and a recording galvanometer is slight —just in the matter of frequency range.

Successful photographic oscillographs, which respond to higher frequencies, operate by recording the shadow of a moving conductor as in the Einthoven type, the reflection of a beam of light from a mirror as in the Duddell type, the trace of a beam of electrons directly upon the photographic plate in the cathode ray oscillograph, or, in the more common form of this instrument, photography of a fluorescent screen activated by the electron beam.

However, all photographic methods have the disadvantage of considerable expense for plates, and delay between the time the measurement is taken and the time the results can be seen, necessitated by the developing and fixing of the film. Hence a mechanical writer producing an immediately visible trace offers welcome advantages.

25 CHANNEL chronograph in which the styli do not move. Records are formed by the mark left by current passing through the dry electrosensitive paper, requiring no development

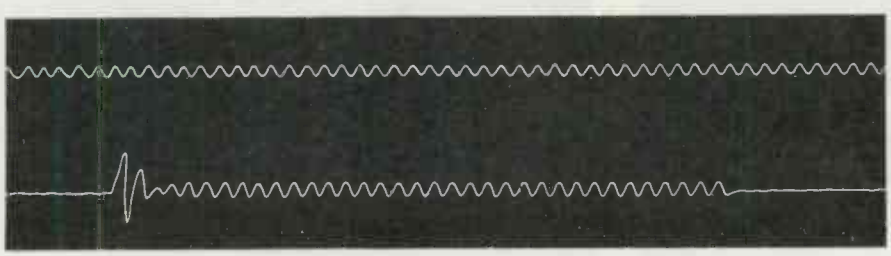


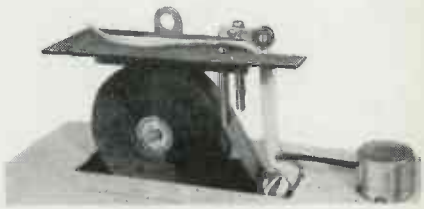
Pen driving unit

As it was desired to take oscillograms of very considerable duration, search was immediately instituted for an ink-writing recorder which would provide such records on low-cost paper tape. A Boehme Undulator, used by the Western Union Telegraph Co., as a cable syphon recorder, was secured and an amplifier was constructed to magnify these small voltages so that they could be recorded by the modified telegraph instrument.

The development of the present instrument was started when the author was engaged in electrophysiological research at the Harvard Medical School in 1934, when oscillograms of the small low frequency potentials, originating in the brain, were being studied.

OSCILLOGRAM of the current flowing through a solenoid. As the plunger is drawn in, its motion affects the inductance. Upper trace is a 60 cycle timing wave





PEN WRITER with magazine lifted to show tape roll on the reel

Because of apparently inescapable limitations caused by an hysteresic effect and a large thermal coefficient of piezoelectric devices, it was decided to use an electromagnetic pen driving unit, working in conjunction with an electromagnetic field magnet. In the final design the armature coils in these instruments operate from the output of an amplifier and, in order to match effectively the plate impedance with available tubes, have a large number of turns of fine wire. Such a structure is necessarily delicate and intense oscillation is likely to destroy it. Poor low frequency transformer characteristics make it impractical to use a low impedance coil fed from a step-down transformer, and a low impedance coil

(*Continued on page* 206)

INTERNAL VIEW of pen driving unit showing stationary armature and field coils. Armature, only, moves through vertical axle that drives pen stylus through a crosshead in turret

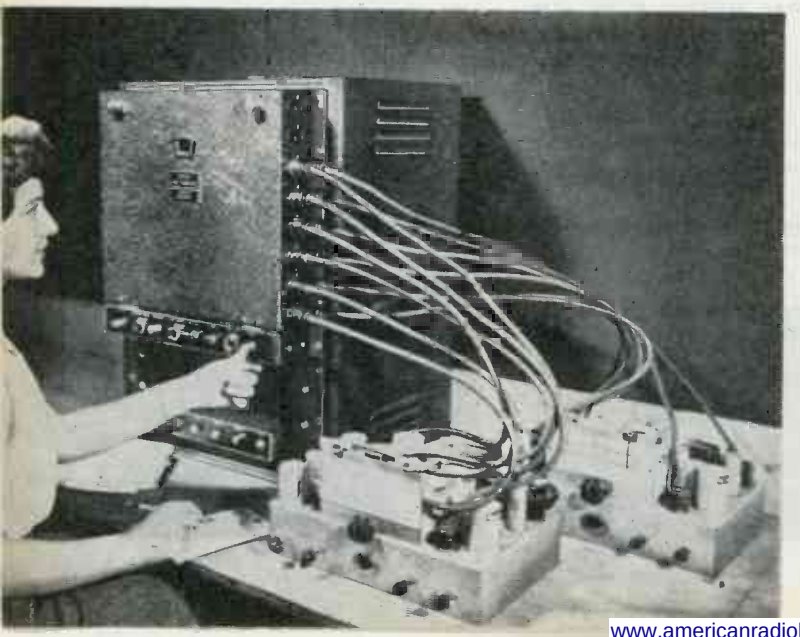
PRODUCTION TIME-

LAPPING FIXTURE holds twelve electrodes. By adopting technic used to lap crystals themselves, RCA Camden plant cuts electrode lapping time to 0.8 minutes from old hand-lapping time of 2.0 minutes each. Close-up at top right

FORMING SMALL PARTS with a riveting machine. At Emerson Radio and Phonograph Corp., N. Y. C., a standard riveting machine was drafted into service to press out small parts. Fitted with proper punches and dies, the improvised forming-machine has been entirely successful. Sample parts shown at bottom right

FINAL TEST of radio, electronic, or electrical equipment in four minutes or less with a Rotobridge, manufactured by Communications Measurements Lab., N. Y. C. Plug-in connectors allow automatic matching of up to 120 wiring and resistance and reactance values against equivalents in an identical equipment known to be in order

DRILLING and countersinking holes in one operation is accomplished by means of special collar, mounted on drill shank, which carries countersinking cutter. Developed at Caterpillar Tractor Co., Peoria, Ill., idea should have wide application

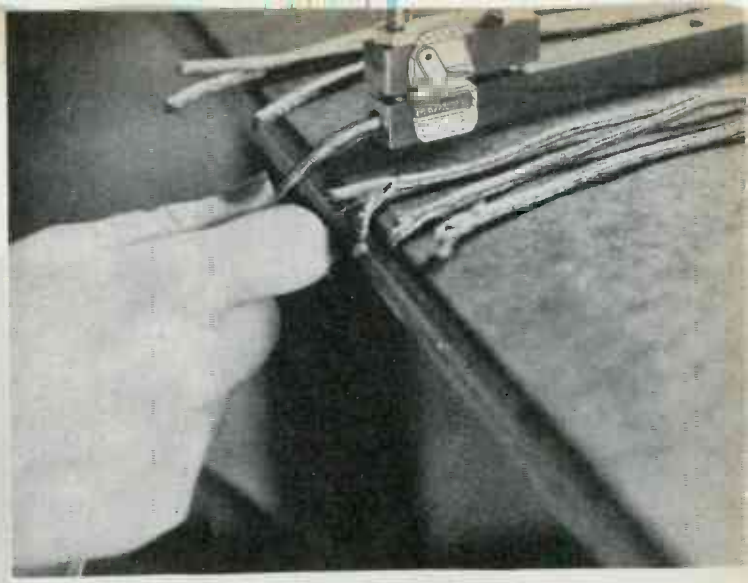


SAVERS

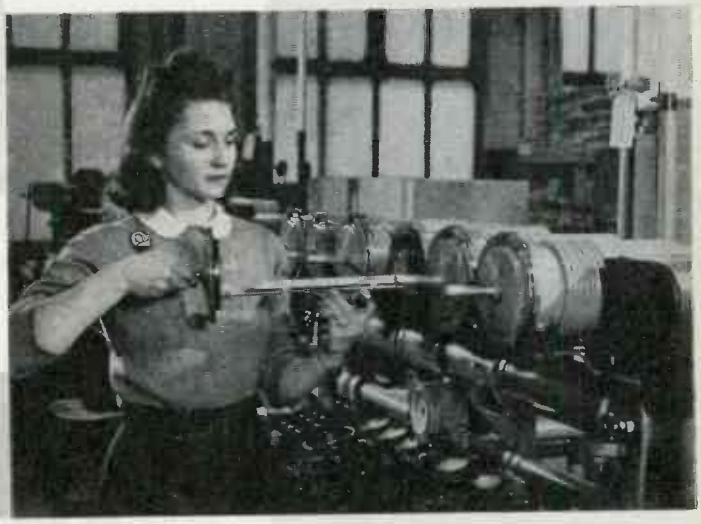
LOCAL SILVER-PLATING of electrical equipment to reduce contact resistance with portable apparatus developed by Rapid Electroplating Process, Inc., 1414 So. Wabash, Chicago. Powered by rectifier or battery, swab-like applicator anodes are used, with electrolytes for silver, gold, zinc, copper, nickel, tin, or cadmium plating

REMOVING BROKEN TAPS from soft castings at Gilbert & Barker Mfg. Co., West Springfield, Mass. Small nut is drilled out oversize 2/3 way through, placed over and welded to broken tool

INDUCTION HEATING equipment speeds testing of samples of carbon-free silicon steel for transformers, at General Electric laboratory. Heating to 2700 deg. F. enables determination of amount of carbon present to within 0.001%

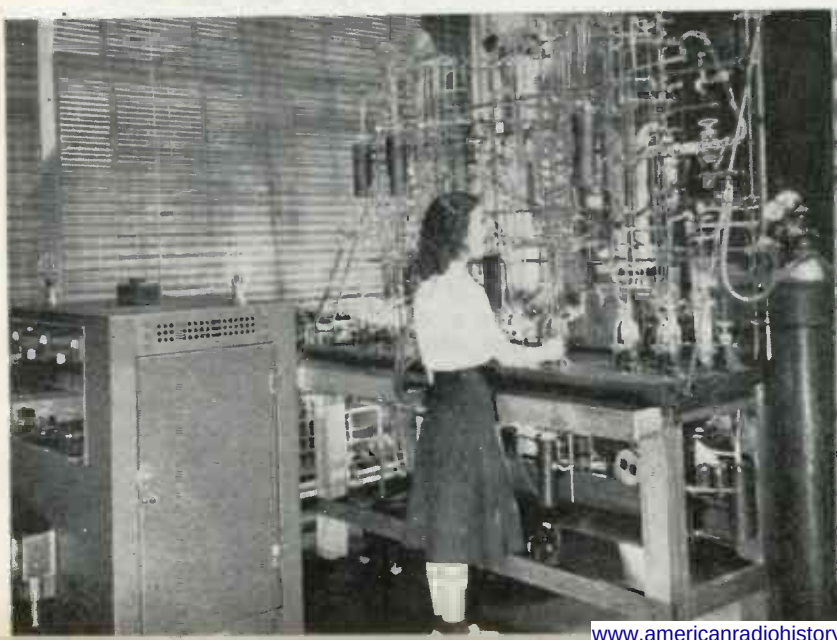


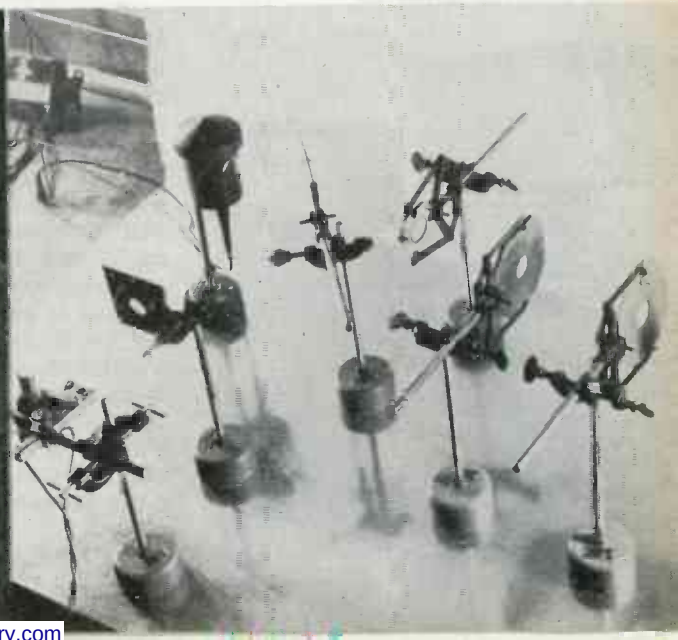
SHIELDING STRIPPER cuts time of operation from 55 seconds to 15 seconds at Submarine Signal Co., Boston, Mass. Wire is inserted, then pulled out. Pawl-action knife cuts metal braid. Screws adjust for length and depth of cut

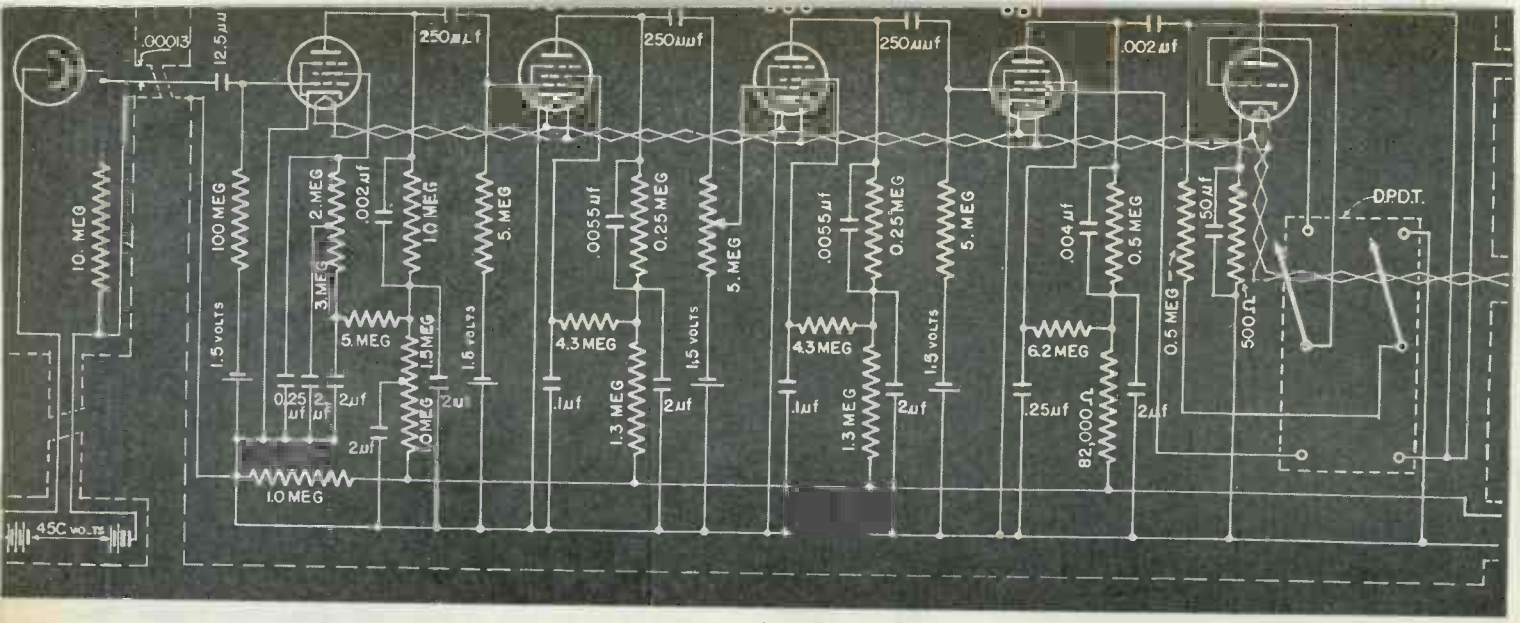


SILVER SUBLIMATION method efficiently plates quartz crystals in Western Electric Chicago works. Operator inserts tray of finished blanks into vacuum chamber for evaporation and deposition of protective silver film

ALNICO STANDARDS for lenses, phototubes, lamps, and other elements of laboratory optical setups are easily adjusted on metal table or wall with new type clamp-stands developed by Norman F. Barnes of G-E's Schenectady laboratory







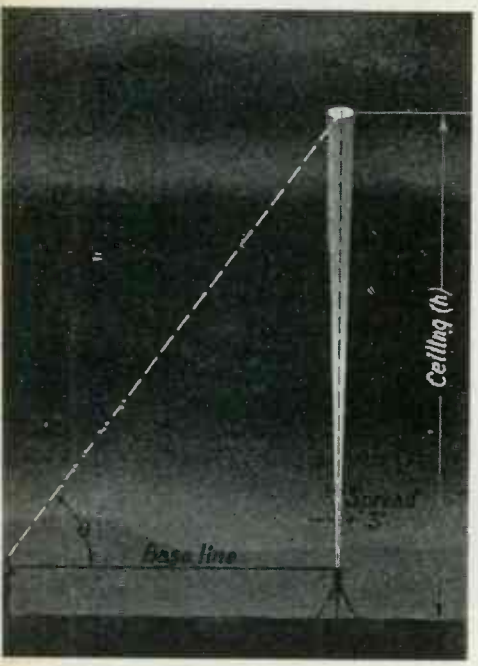


Fig. 1. Basic method of measuring cloud height. h = Base line × tan θ. Night-time observer uses clinometer on visible reflection from high-intensity light-source

Fig. 2. Vertical beam projectors. A, at right, for visual work. B, at left, used with electronic ceilometer

MEASURING

by LAURENCE W. FOSKETT and B. LYLE HANSEN

Instrument Division, U. S. Weather Bureau

• Information concerning the height of the cloud ceiling and the rate at which it is lifting or lowering is important to the meteorologist and vital to the safe arrival and departure of aircraft at an airport.

Up to the present time, such information has been obtained by methods which were not entirely satisfactory, either because they failed to give reliable information under adverse weather conditions or because they were not satisfactory for use throughout the entire day and night.

The photoelectric method of cloud-height determination, however, has now emerged from its experimental stages, and a number of standardized units are under construction for the U. S. Weather Bureau. This method involves scanning a vertical beam of light with a sensitive photoelectric pick-up, noting the angle of elevation at the point where a reflection from a cloud is detected, and determining the height of the cloud by triangulation. Clouds as high as four miles may be measured in full daylight, since the phototube responds only to the light of the vertical beam, which is modulated at 120 cycles per second.

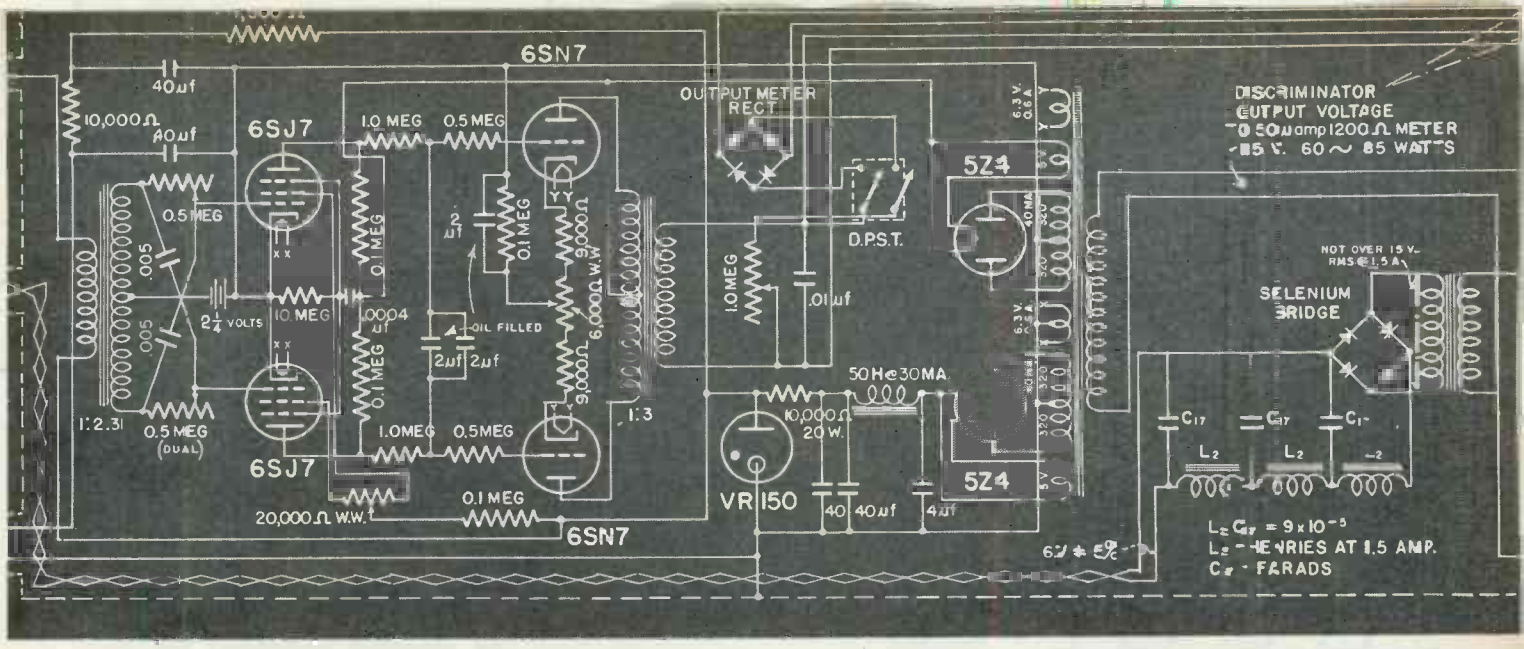
The proper classification of clouds usually will let the observer know whether they are low, medium or high clouds. In the event that the clouds are of the convection type, the calculation of the condensation level offers a fairly reliable estimate of their height. These clues, however, are not infallible.

Usual measuring methods

Reports from pilots encountering the ceiling in the immediate vicinity of an airport are not often available at the time routine observations are being taken, and they are never available in inclement weather.

Observing the time required for a balloon having an assumed ascential rate to ascend to the height of the cloud ceiling is largely restricted to daylight hours and is practically worthless in the case of rain or snow ceilings. However, it does provide satisfactory information when there are low overcast clouds.

An observer, situated at a known distance from a ceiling light projector (see Figs. 1 and 2-A) may use a clinometer to measure the angular elevation of the spot



Cloud Heights

Photoelectric "ceilometer" receives daytime reflection from clouds up to four miles high

formed at the base of a cloud by the projector. From the angle thus measured and knowledge of the distance between the observer and projector, the height of the ceiling is readily determined. When a rain or snow ceiling exists, the spot disappears and a luminous shaft extends from the projector to the height at which the beam has been completely attenuated, by reflection and scattering by the rain or snow particles. In this event, the observer determines the elevation of the top of the luminous shaft. This method is simple, accurate, direct and convenient. However, it is limited to the hours of darkness.

Photoelectric method

Seeking to develop a more dependable means for obtaining information on ceiling heights, the Weather Bureau sponsored a project for this purpose at the National Bureau of Standards. The work carried out at that Bureau is described in another paper.[1] This work pointed to a possible solution to the problem, and the photoelectric equipment was developed. The equipment consists of a mercury-arc projector and the pickup unit.

In operation, this equipment is used as illustrated in Fig. 1, with the photoelectric pickup, or "ceilometer," being used by the observer to determine the (angular) elevation of the projected spot on the cloud base. The projector directs vertically an intense beam of modulated light. This light is scattered at the base of the cloud and forms the spot which is detected with the ceilometer.

The ceilometer consists essentially of a phototube situated behind an optical system which may be manually or automatically made to scan the projector beam. The pulsating current from this tube is fed through a very high resistance load to produce a pulsating voltage. This voltage is amplified by an amplifier tuned to the frequency of pulsation of the projector beam, and passed through an electronic synchronous switch or discriminator to an output meter. The output meter indicates when scattered light from the projector beam is received at the phototube. The angular elevation of the spot is determined by noting the position of the optical system for a maximum reading of the output meter. Background light affects the output

Fig. 3. L. W. Foskett with ceilometer built for Weather Bureau by Crouse-Hinds Mfg. Co., Syracuse, N. Y. Amplifier at left, discriminator and power supply at right

Fig. 4. Close-up shows how automatic driving and recording motors were added by Weather Bureau

Fig. 6-A

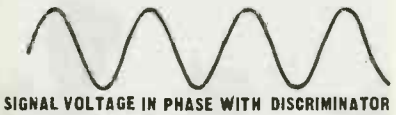


Fig. 6-B

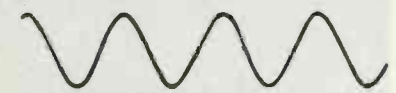


Fig. 6-C

meter but little, and measurements of the projector spot elevation may be made in full daylight as well as at night.

The results obtained with the preliminary equipment were encouraging, but much remained to be done before dependable equipment suitable for operation by field personnel could be produced. In order to solve this problem, the Weather Bureau had constructed several experimental units, one of which was placed in operation at the Washington National Airport and the second at the Central Office. Observations taken with these devices indicated that several important changes and additions would be necessary in the design before they could be used in the field. A substantial number of the improved devices is now being purchased and will be installed at stations throughout the U. S. within the next year.

The modulated beam required can be obtained by operating a mercury arc from an alternating current supply, thereby eliminating the need of mechanical modulation. If a 60 cycle power supply is employed the light is 95 per cent modulated[2] at a frequency of 120 cycles per second.

An arc being a small intense source makes it possible easily to direct a maximum amount of flux into a small area of the sky, thereby increasing the signal to noise ratio of the equipment for a given power input. Furthermore, if the arc is oriented properly the accuracy with which the angular elevation of the projected spot can be determined is well within the limits required.

One other reason for choosing the mercury arc is its spectral energy distribution, which is suitable for use in conjunction with the most sensitive phototube surface.

Mercury arc projector

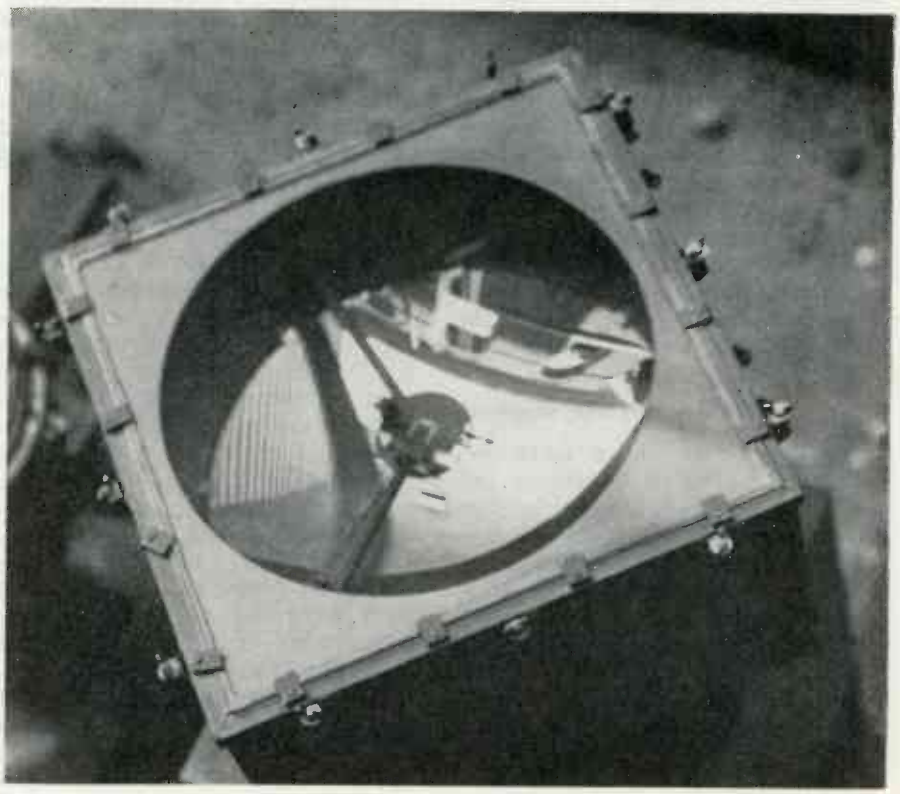
In the preliminary work, a water-cooled arc lamp was employed in the projector. It soon became apparent that this type of lamp, in its present stage of development, would not be satisfactory as severe winter weather renders its use impractical if not impossible. To date, no practical method has been found for keeping the water system of such a lamp from freezing when the equipment is not in use and subzero temperatures prevail.

To meet the requirements of this service, an air-cooled, capillary-tube type arc lamp was developed by the General Electric Co. Figs. 2-B and 5 show a projector having a lamp of this design. The projector is made up primarily of two housings. The upper contains the optical parts of the projector, consisting of the 1,000-watt mercury lamp (B-H6) of dimensions approximately 3/50 by 1 in. located at the focus of a 24-in. precision-grade parabolic mirror having a focal length of 10 in. The lower housing, fastened to the drum by a slip fitter, contains the cooling and electrical equipment for the arc. This equipment consists primarily of a motor-driven air compressor and a high voltage transformer.

Automatic equipment for protecting and starting the arc are a minimum, there being but one automatic pressure switch. The arc and its cooling equipment operate from a 120 volt, 60 cycle supply and require about 1,500 watts. On installation, the optical axis of the projector is fixed precisely vertical and the lamp, which is mounted horizontally, is oriented so that the long dimension of the image formed on the base of the cloud

(*Continued on page* 164)

Fig. 5. Light source from above. Note capillary tube centered over reflector



LABORATORY KINKS

A laboratory test setup that will prove of value in many kinds of tests is a magnetic comparator (Fig. 1). For one thing, it is useful in checking air-cored windings for shorted turns. A balanced magnetic structure is assembled from lamination stock, such as a good grade of silicon steel. It is essential that the two outer legs have equal magnetic susceptibility so they must have the same cross-section and length and be of the same material.

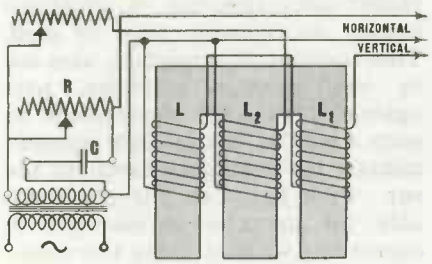


Fig. 1

Two identical coils L and L^1 having a great many turns (say several thousand), are inserted on the outer legs. They should be tight-fitting. Windings from two high-resistance chokes, such as the replacement components for small ac-dc receivers provide satisfactory coils here. The center leg can be a similar winding or a larger one but should fit the center leg rather tightly.

A suitable ac potential that does not get the winding overly hot is connected to this coil, as shown in the circuit. The two outer windings are connected series-opposing, to the vertical deflection system of an oscillograph.

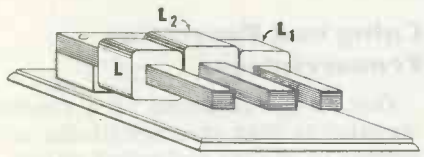


Fig. 2

The windings on the outer legs are positioned so that no deflection is noticed on the oscillograph when the inner coil is energized with a 60 cycle potential. This balancing is rather critical and when once found the coils can be blocked or cemented tight so that they are immovable. A typical assembly is shown in Fig. 2.

To test, a short-circuited turn of No. 30 copper wire can be placed on one of the outer legs of the core, and a substantial deflection should be noticeable on the oscillograph. A turn of No. 36 wire should also produce a measurable deflection. The sensitivity depends upon the magnetic density produced by the center winding, the number of turns on the pick-up coils and the sensitivity of the oscillograph. In use the winding to be tested is dropped over the core, whereupon a deflection occurs if any shorted turns are present.

The same device is also useful in comparing magnetic material samples. Place two razor blades, hacksaw blades or laminations across the open ends in symmetrical positions. If the size, material and temper are alike no deflection should be noted. Unlike samples produce an oscillogram similar to that shown in Fig. 3. For best results in comparing magnetic characteristics it is desirable to

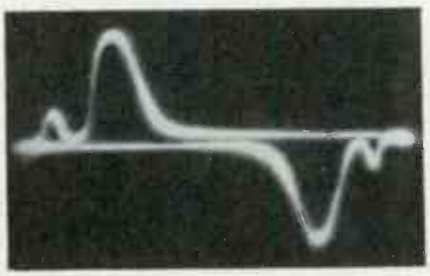


Fig. 3

apply a 60 cycle sinusoidal potential to the horizontal deflection system through a phase shifting circuit RC such as shown in Fig. 1, where R (max) equals 100,000 ohms and C equals 0.05 mfd. R is adjusted so that the variations in the oscillogram resulting from magnetic variations show up to best advantage.

For production testing of magnetic materials the magnetic structure can be changed from the elongated E shape, shown in Fig. 2, to any other balanced arrangement that will accommodate the shape of the material to be tested. An H shape, such as in Fig. 4, is often satisfactory.

It is not difficult to mount a small balanced magnetic structure on an extension cord so that the thickness of paint on a magnetic

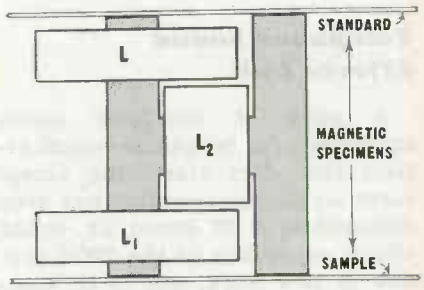


Fig. 4

base can be estimated, by noting the deflection produced by known thicknesses of finishes.

If a magnetic core can be assembled that is precisely symmetrical as to its structure, a turn "counter" can be set up. Coil L_2 is mounted as in Fig. 1, together with L, a coil whose turns are known. L_1 is an unknown coil whose turns are nominally the same as L. Here the deflection amplitude that occurs when the turn ratio is not unity is calibrated in terms of percentage of the turns in L.

Simplified Tests on Electronic Components

A cathode ray oscillograph provides an excellent means for the production testing of many forms of apparatus, inasmuch as the indication is instantaneous and there is no necessity of waiting for the needle of a measuring instrument to come to rest. However, practically, there is a lack of a standard calibration that stays constant under the hazards that production test apparatus may undergo.

This can be overcome by making tests on a comparison basis, where the characteristics of one item are visually "balanced" against a standard item. An ordinary automobile vibrator unit used as a continuously operating transfer switch will sometimes simplify the most elaborate test. These units, operating on 6 volts, transfer the oscillographic leads from one part of the circuit to another or from the standard to the item being tested so rapidly that both records appear superposed on the screen. In some cases, a vibrator can be used that has extra contacts on it, connected so as to alter the horizontal deflection displacement enough to offset one of the two vertical deflections so as to simplify comparisons.—RRB

BC Operating Methods

Wartime economies when men, materials, and supplies are scarce

Telephone Sound Effects Unit

A piece of broadcast studio equipment for telephone sound effects that does everything except carry on the conversation has been designed by F. G. Street, Jr., sound effects supervisor at the WOR studios in New York, and in its completed form it accurately reproduces all of the more important sounds heard over a telephone. First problem was the dial tone and this was obtained with a buzzer and relays arranged so that the dial tone comes in as soon as the instrument is lifted and goes off and stays off as soon as the dial is turned the first time.

The ringing impulse as heard at the other end seemed simple enough to duplicate by merely using a twenty-cycle generator commonly used for ringing telephone bells. It was discovered, however, that this sound is not composed of the twenty-cycle ringing current alone, but consists of a higher note, approximately 800 cycles, modulated by the twenty-cycle impulses. In order to supply this complex sound, a single tube oscillator which supplies plenty of harmonics was used with the output fed to the grid of a second tube with the twenty-cycle note fed into the cathode circuit to modulate it.

Dial tones

It was noted that if the cradle contacts were opened even for a moment as in attempting to call back the operator, the dial tone returned. In order to avoid this a holding relay was inserted which was operated by the plate current of a 6A3 tube. Thus when the phone is hung up, the filament of the tube is cut but until the filament has cooled slightly the plate current continues to flow, preventing the relay from unlocking so that the dial tone cannot return for two or three seconds.

The hanging up or lifting of the phone at the other end of the line was another sound effect difficult to reproduce. To overcome this and place complete control in the hands of the sound effects engineer, a second instrument is connected in series with the one through which the actor talks, and the "hanging up" is controlled by the sound operator at the console through a system of two relays which cuts the voice lines from both conversationalists, so that when the receiver is hung up the clatter is heard but everything else is cut, even the conversation.

Attenuators control the level of the dial tone, the ringing impulse and the final mixed output of the unit, which is fed through a mike line directly into the control room and also through a single stage amplifier into the receiver of the instrument on the near telephone, which the operator can use for monitoring purposes. To obtain the closest approximation to telephone quality an acoustic filter is used. This consists of a receiver, also fed by the monitor amplifier, held against a dynamic microphone in such a way as to duplicate approximately the resonance cavity of the ear. Pilot lights on the panel enable the operator to monitor all operations without using the monitor telephone instrument.

Telephone monitor

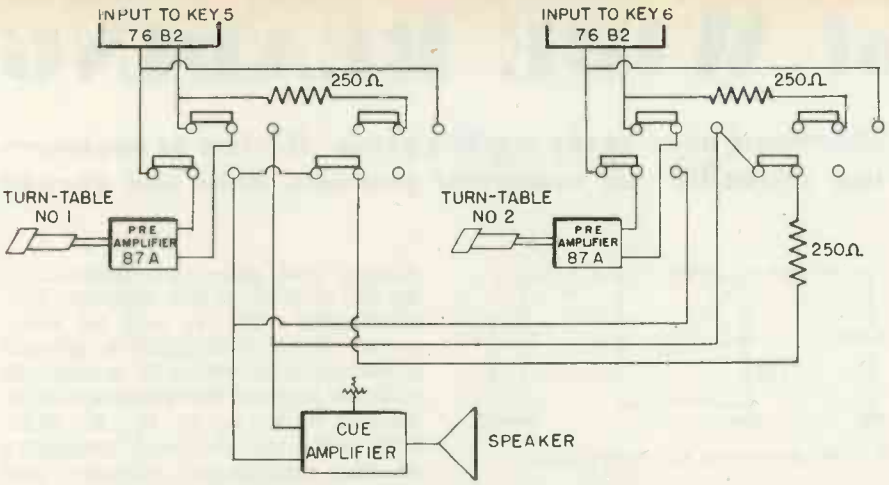
The complete unit contains eight monitor lights, eight keys controlling ringing impulses, busy signal, incoming or outgoing calls (to avoid getting dial tone on an incoming call), dial clicks, operator's buzzer, filter and auxiliary bells, a knob for lifting the remote cradle, four attenuators, a high pass filter, three separate power supplies, one-, three- and eighteen-volt batteries, oscillator, modulator, amplifier, voltage regulator, twenty-cycle generator, time delay tube, nine mixing coils, eighteen interlocking relays and three telephone instruments.

SOUND EFFECTS unit for duplicating all sounds heard when using a telephone in use in one of the WOR studios in New York

Cuing and Presetting Transcriptions

One of the problems of a studio operator is that of exact timing on cutting in of cues and sound effects. The accompanying circuit diagram for cuing and presetting records and transcriptions in broadcasting stations was furnished by Jack P. McNally, studio engineer at WINS, New York City, who designed and installed this useful system on the double turn-tables in the various control booths of their studios.

All that is required to duplicate this wiring in any studio is to use



CIRCUIT diagram of WINS method for cuing and presetting transcriptions, developed by studio engineer, J. B. McNally

spring-return switches, having four transfer combinations similar to Centralab Type No. 1456—low-capacity, lever action. One switch, connected as shown in sketch, is used with each turn-table.

When switch is in normal position the output of turn-table goes direct to the console—or "Air" position. In "Cue" position the output is fed into a separate cue amplifier and speaker located in the control booth.

The advantages of this system are several. The use of spring-return switches prevents the operator from leaving the turn-table "In" on "cue position." The location of the switches on the right hand of each turn-table enables quick cuing of records. The use of a separate amplifier and speaker allows the operator to monitor the program on the air and still cue the waiting transcription.

When in "Cue" position the input to the console is connected to a load resistance of 250 ohms. When both switches are in regular or normal position, a load of 250 ohms is connected across the input of the cue amplifier to prevent hum pick-up.

How WJZ Will Move

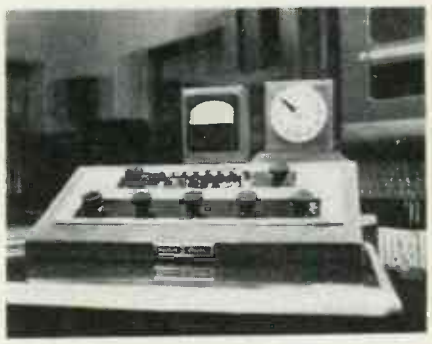
Removal of the Blue network's WJZ station together with its 800-ft. vertical radiator from Bound Brook to Lodi, both in New Jersey, represents quite an engineering problem, particularly in view of the fact that there must be no time lost off the air. Reason for the move, as is fairly well known, is that OWI wants the space to add four short-wave transmitters to the two already operated there by NBC. OWI will build three of them, NBC the fourth. Moving WJZ out and the others in will save the government $100,000 in critical materials and much man power.

At present WJZ has a 50 kw main transmitter and a 25 kw auxiliary housed at Bound Brook. There is also an auxiliary antenna. Progressive steps in the move contemplate construction of a 10 kw auxiliary transmitter from the 25 kw job for installation at Lodi. In the meantime the 50 kw transmitter will be put on the auxiliary antenna leaving the vertical tower antenna free for removal to the new site, where it will be used temporarily with the auxiliary transmitter. The idea is that there will be less change in signal strength in the field with 50 kw going into the auxiliary antenna as compared with 10 kw into the vertical tower in the new location, than if an attempt were made to move both the big transmitter and the tower at the same time.

Actual work of moving and new construction will be done by the Blue network, of which George O. Milne is chief engineer. Engineering of the job will be under the guidance of Raymond F. Guy, who has been with the station since it opened up in 1921, and is now Radio Facilities Engineer for NBC.

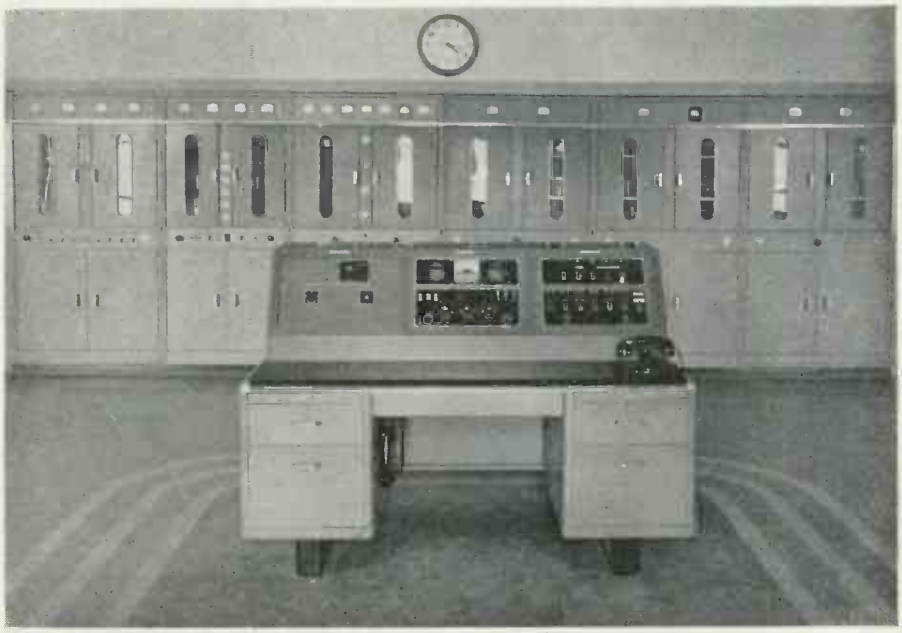
Studio Timing Device

Glenn Flynn, engineering department of radio station WOW, Omaha, Nebr., has developed an interesting gadget which though not



electronic nevertheless has considerable value in assisting announcers to time their efforts with split second accuracy. It is similar to a clock dial except that it is marked in five second intervals, both clockwise and counter clockwise from 12 to 6. When the announcer receives the time signal from NBC he notes the time discrepancy, if any, and moves the pointer manually to indicate it.

TRANSMITTER room and modernized, centrally located control panel in WIBG's new 10,000 watt installation in Philadelphia



SURVEY of WIDE READING

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

Warning a Car Overtaken by Another

K. Patermann (Akustische Zeitschrift, Berlin, Vol. 7, No. 4, 1942; German Patent No. 694508 reviewed)

Audio frequencies emitted by the overtaking car are received by the car to be overtaken. Using Doppler's principle, maximum sensitivity of the receiver is not adjusted for the sender frequency but for a frequency resulting when the speed of the overtaking car exceeds that of the other car by 20 to 40 km/min.

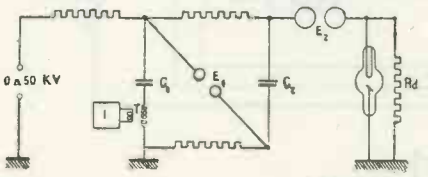
X-Ray Tube Operated with Pulsating Voltages

P. Herreng (Academie des Sciences, Comptes Rendues, Paris, No. 9, Vol. 214, 1942)

Operating characteristics of an X-ray tube submitted to voltage pulses were investigated. Periodically recurring voltage pulses were generated by means of condenser discharge. It was decided, upon a consideration of maximum permissible anode temperature, to use an average anode voltage of 50 kv during the pulse and a saturation current of 2.9 amp. The pulse frequency of 400 pulses per second was so chosen that the anode would cool off between successive pulses.

The figure shows the pulse generating device. Alternate discharges of condensers C_1 and C_2, set up by alternating voltages impressed on transformer T by generator I, provide pulses, duration and shape of which may be regulated by changes in resistance Rd. Tungsten and a mixture of alkali-earth oxides, respectively, were used as filaments.

It was found that for continuous operation and a pressure of 10^{-6} mm., the tube could not be operated with a voltage higher than 56 kv; however, with very short pulses considerably higher voltages may be used, e.g., 80 kv for pulses lasting 4 microseconds. Duration of exposure for radiographs and diffraction patterns may be of the same order when using pulses provided the average power is the same. Consequently, the pulsating-voltage X-ray tube permits the taking of radio-stroboscopic pictures of rotating systems or of diffraction patterns of oscillating samples without an increase in time of exposure as compared with objects at rest. The pulsating frequency may



PULSE generator for X-ray tube

readily be synchronized with that of the periodic phenomenon under investigation.

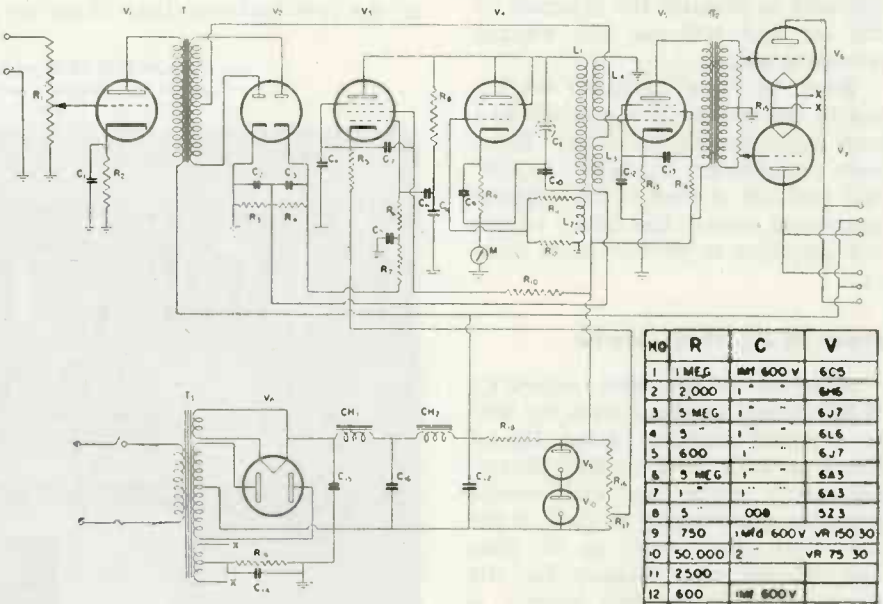
Driving System for Mechanical Vibrators

E. V. Potter (Review of Scientific Instruments, July, 1943)

An oscillator system has been developed for driving mechanical sound generators or other vibrating mechanical systems requiring that the vibrating member be driven at its resonant frequency. Due to heat developed in the moving parts of the mechanical system, the resonant frequency may vary within considerable limits during operation.

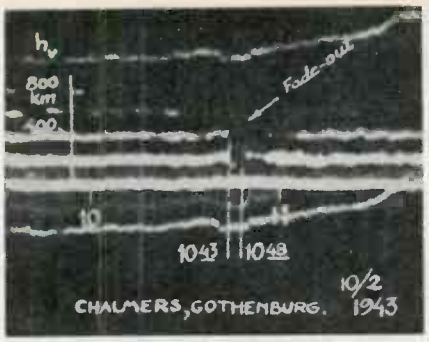
To obtain a control action, the vibrating member is made to vary a capacity and, in a preamplifier, this change in capacity is converted into a voltage whose frequency and phase are determined by the motion of the vibrator. Discriminator tube V_2 and its associated circuit is designed to provide a voltage that varies in magnitude with the amount the frequency of oscillator V_4, L_1, L_2, C_8, R_{11}, R_{12} deviates from the resonant frequency of the mechanical vibrator and varies in polarity depending on whether the oscillator frequency is too high or too low. For this purpose, part of the discriminator input is derived from the preamplifier via transformer T_1 and part from the output of oscillator tube V_4 via coil L_3. The discriminator output, in turn, controls reactor tube V_3 so as to make the frequency of the oscillation generated by oscillator tube V_4 equal to the instantaneous value of the vibrator frequency.

It is stated that the driving frequency will remain within a few tenths of a cycle of the resonant frequency of the vibrator, even though the oscillator and vibrator frequencies may drift by as much as 500 cycles per second in 12 to 17 kilocycles. Also, the control will be effective, even though variations in driving power and acoustical load cause wide variations in the amplitude of the vibrator motion.



NO	R	C	V
1	1 MEG	MM 600 V	6C5
2	2,000	1 " "	6H6
3	5 MEG	1 " "	6J7
4	5 "	1 " "	6L6
5	600	1 " "	6J7
6	5 MEG	1" "	6A3
7	1 "	1" "	6A3
8	5 "	000	523
9	750	1 MFd 600 V	VR 150 30
10	50,000	2 "	VR 75 30
11	2500		
12	600	1MF 600 V	
13	750	1 "	
14	15 MEG	12" 150 V	
15	1 "	16" 600 V	
16	25,000	16" 450 V	
17	1,000	16 "	
18	2500		
19	700		

AUTOMATIC frequency-controlled oscillator and amplifier circuit



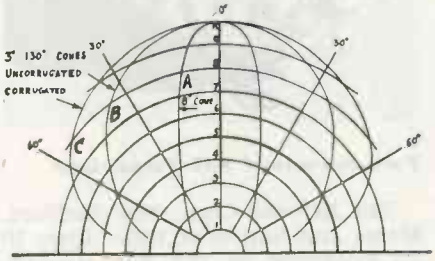
GUINEA PIG muscle fiber

Electron-Microscopy of Tissues

Fritiof Sjoestrand, Stockholm (Nature, London, June 26, 1943)

It is stated that the lack of a suitable method to prepare tissues has been an obstacle to the practical use of the electron microscope for consistent studies in this field. According to the report, Altmann's technic of freezing and drying has been found suitable, providing specimens have a thickness of less than 0.05 μ.

The figure is a stereophotograph of a skeletal muscle fiber from a guinea pig, fixed according to Altmann's technic of freezing-drying. It was taken with an electromagnetic electron microscope, magnification 15,000, accelerating voltage 60 kv. The method of taking pictures and the interpretation of the photographs is still being elaborated upon.



LOUDSPEAKER characteristics

Wide-Angle-Radiation Loudspeaker

R. W. Carlisle (Journal of the Acoustical Society of America, July, 1943)

Conditions for wide-angle radiation from loudspeaker cones are investigated, assuming the directional pattern of a cone to be similar to that of an array of pairs of point sources arranged along a cross-section of the cone. To find the pattern of the radiation characteristic, relative intensities for a listener at any sufficiently distant point are calculated by vectorially adding the sound intensities emitted by the point sources.

The result indicates the use of a fairly flat cone so as to obtain a wide radiation pattern. Also considerable phase retardation of the acoustical vibration in the cone is desirable; it depends on the material as well as on the dimensions and shape of the cone. The phase shift along a cone cross-section should be proportional to frequency if the radiation pattern is to be invariant with frequency. The figure shows experimental radiation characteristics for 3000 cycles for an 8 in. 105 deg. corrugated cone and for 3 in. 130 deg. corrugated and uncorrugated cones.

It is proposed to construct loudspeakers consisting of two or more truncated conical surfaces connected by corrugations or a change in conical angle. Also, the development of medium-size conoids combining a change in angle with increased depth of corrugations toward the outside is suggested.

Spot Welding Control

W. B. Nottingham (Review of Scientific Instruments, June, 1943)

The circuit shown makes available a time range extending from any small fraction of a half-cycle up to 60 half-cycles and it also provides a means of adjusting the average current supplied during each half cycle over a very wide range by a phase control of the starting time.

Mercury rectifiers T_1 and T_2 supplying welding transformer Tr_0 are started by voltage sparks produced alternately through the step-up transformers Tr_1 and Tr_2 and controlled by strobotrons T_3 and T_4. Regenerative amplifier T_5, T_6 supplies sharply peaked waves definitely phased relative to the ac line voltages to the inner grids of the strobotrons. Timing signals provided by the "biased multivibrator" circuit including tubes T_8 and T_9 are applied to the outer grids of the strobotrons.

Operation of the various circuit elements is explained in detail (including considerations as to the choice of dimensions used) thereby providing a basis for adapting the device or part of it to be used in other control applications. Construction and performance of the mercury tubes, including life tests, are discussed.

Radio Noise Chart

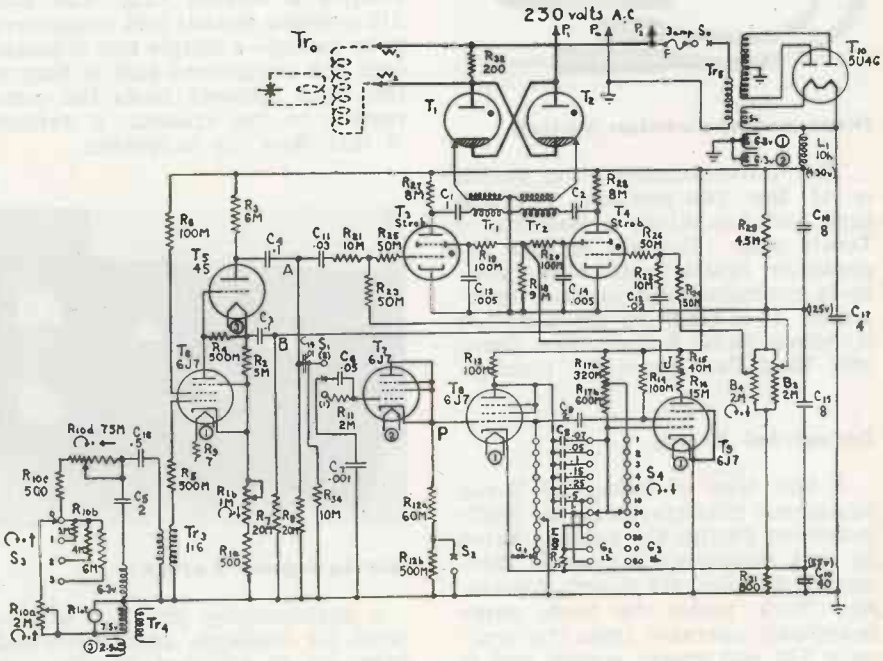
J. McG. Sowerby (Wireless Engineer, London, July, 1943)

The background noise originated in a receiver is partly due to thermal agitation of the free electrons in the first circuits of the receiver and partly to shot noise in the first tube. A nomogram is shown which permits computation of both components from the determining tube and circuit constants and the temperature.

Recording High-Speed Transients

W. Nethercot and H. Beattie (Journal of Scientific Instruments, London, May, 1943)

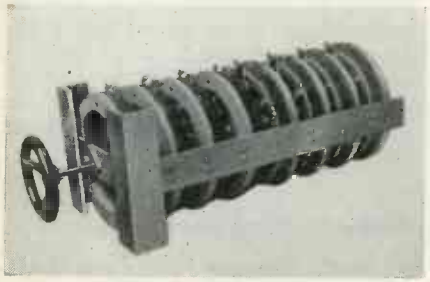
A photographic technic to investigate and record single high-speed transient phenomena with a high-vacuum, hot-cathode, sealed-off glass-tube cathode-ray oscillograph is described. The technic has been found by the authors to give the best results consistent with reasonable trouble and expense.



WELDER control circuit adjustable between one half-cycle and 60 half-cycles

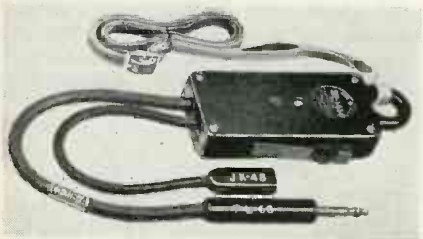
WHAT'S NEW

Devices, products and materials the manufacturers offer



Tandem Rheostat Assemblies

The tandem unit, manufactured by Ohmite Mfg. Co., 4835 Flournoy St., Chicago 44, consists of eight 1000 watt, 12 in. diameter rheostats mounted in a steel frame. It is controlled by a single hand wheel. Rheostats in tandem are insulated from each other so that they may be used for simultaneous control of several circuits or phases of a circuit. Two rheostats can be separately controlled by means of concentrically located knobs. In this type of unit two rheostats are mounted in tandem with the shaft of the rear unit extending through the hollow shaft of the front unit. For increased capacity, the front or back units can consist of several rheostats connected together.

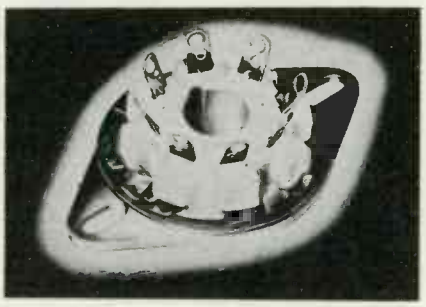


Intercommunication Switch

This intercommunication switch is of the two-position, two-pole type and has either a Bakelite or Tenite case. Contact springs are phospher bronze with silver contacts, manufactured to close tolerances. It is made by the Trav-Ler Karenola Radio & Television Corp., 1032 West Van Buren St., Chicago.

Industrial X-ray

A new type of industrial X-ray equipment manufactured by North American Philips Co. and marketed by that company's Industrial Electronics division, 419 Fourth Avenue, New York, under the trade name Searchray, operates from the ordinary 110 volt power supply and is both fluoroscopic and radiographic in action. In operation, objects are placed in a closed compartment and become visible immediately through an eye-level eye-piece. Safety for the operator is assured by a ray-proof, shockproof housing with full automatic interlocks. Accessories which permit radiographic examination covering a maximum area of 11 x 14 in. using standard 12 x 14 X-ray film or paper are supplied. The compartment measures 21x18x9 in. and the fluoroscopic screen is 12 x 16, maximum observable area being 8½ x 11½. The whole unit is approximately 69 x 26½ x 24 in. weighs 425 lbs. and occupies about 5 sq. ft. of floor space.

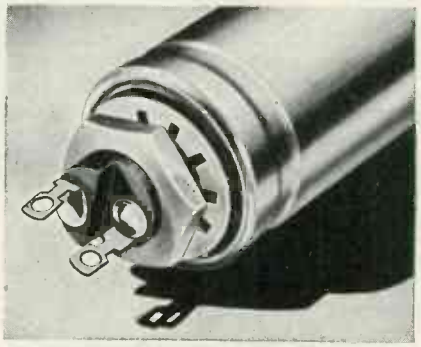


Locking Ring

In order to lock sockets and components to chassis and bases with the assurance of a positive lock and no damage when unlocking, the A. W. Franklin Mfg. Co., 175 Varick St., New York, has developed a locking ring. The ring fits between chassis and component to be locked—a simple tool is placed over the component and ⅛ turn to the right securely locks the component to the chassis; a further ⅛ turn does the unlocking.

Multipurpose Tester

A multipurpose precision instrument for research, production and field use is afforded in the new Ferris standard signal generator, noise and field strength meter, Type 22-32, made by Ferris Instrument Corp., Boonton, N. J. Heater type tubes give increased ruggedness in the noise meter, and the signal generator provides an accurate means for calibrating the noise meter, thereby eliminating the need for an internal shot noise tube and calibration charts. An audio power tube is included in the noise meter, with provision for switching the indicating output meter from the radio diode to the audio power output tube. This arrangement makes possible very substantial readings of high peaked transients of short duration, such as ignition noise. The noise meter is equipped with a calibrated antenna rod having an effective height of ½ meter to facilitate noise and field strength measurements.



Two-terminal Oil Capacitor

The Aerovox Corp., New Bedford, Mass., has improved their Type 10 oil capacitor by the new double-terminal feature. Heretofore, this capacitor has had a single insulated terminal and grounded can, although when screw-mounted on a metal chassis it could be fully insulated by an insulating washer. The new double-terminal feature means that both terminal lugs are insulated from the "floating" can and no insulating washer is required. The capacitors are hermetically sealed and will pass all immersion tests required by Governmental agencies. This is accomplished by the use of the new one-piece molded bakelite terminal assembly which prevents penetration of moisture and leakage of oil. Available on high priorities only, they are filled with either Hyvol vegetable oil or mineral oil, rated up to 4.0 mfd. at 600 v dc and to 5 mfd at 1500 v dc. The can is similar in design to the usual inverted-screw-mounting metal-can electrolytics.

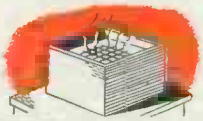
BOY-IT'S GOT TO BE GOOD

The Hytron 807—peacetime all-purpose favorite—is now a veteran. Before it joins its battle-scarred brothers, however, like all Hytron tubes it must pass Hytron factory specifications which weed out the 4-F's as efficiently as Army doctors at an induction center. Unless a Hytron 807 is in top fighting condition, it never leaves the factory. Let's look at a few of the many test hurdles it must surmount.

BUMP TEST

Ever stop to think of what a leaping, bouncing jeep or peep can do to a tube's "innards"? One answer to the question of a tube's ability to withstand such punishment, is the Bump Test. Several resounding smacks by a heavy, swinging hammer loosens up the weak sisters pronto!

IMMERSION TEST



A "PT" boat leaning back on its stern, and plowing a foaming furrow through steaming tropical waters would spell disaster to poorly-cemented bases and top caps. That is why Hytron 807's are thoroughly soaked in a hot bath, before they are O.K.'d.

LIFE TEST

Day and night, Hytron 807's on life-test racks are proving that they can give long, dependable service. Soaring skyward in our big bombers, these tubes have a big investment in men and matériel to protect. Long after the big fellows have been patched for the last time, these tubes are still doing their jobs.

VIBRATION TEST

Link-trainer for 807's aspiring to tank service is a motor-driven eccentric arm which shakes the tube like an angry terrier while a v.t. voltmeter in the plate circuit records the ability of the elements to take it like the iron men who ride those clanking, thundering monsters.

HYTRON TOLERANCES tighter than CUSTOMER TOLERANCES

No manufacturer makes all tubes of a given type exactly alike. Hytron does manufacture its tubes to tight specifications which insure against slight inaccuracies due to meters and the human element. Engineered to these narrower limits, Hytron tubes fit exactly the circuit constants with which they must operate.

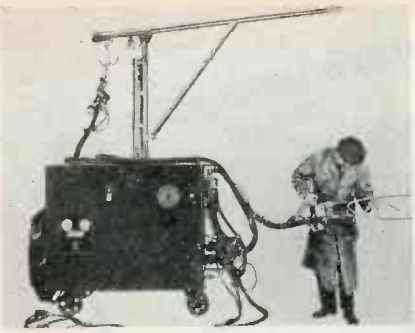
OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON RADIO TUBES

HYTRON

ELECTRONIC AND RADIO TUBES **CORPORATION**

SALEM AND NEWBURYPORT, MASS.

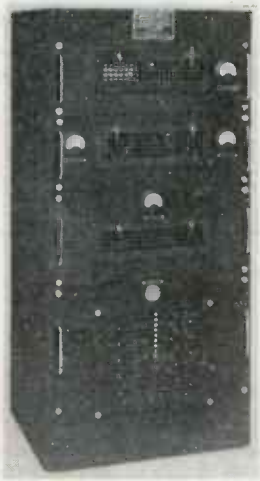


Spot-Welding Aircraft

A self-contained field-repair cart for repair spot-welding of steel parts of an airplane on the spot, has recently been developed by Progressive Welder Company, Detroit. Equipped with an electronic timer and a wide selection of both air-operated and manual "tong" type guns, the repair cart is capable of doing any kind of spot-welding job on stainless and other light gage steels. Refrigeration of transformers, cables, and guns eliminates the need for external water connections and the only connection necessary to the repair cart is a power lead. Since the cart is provided with long cables, the connection can be made in a hangar or elsewhere and the cart rolled right out onto the landing field, if necessary. The cables are of a concentric kickless type.

Airport Transmitters

Designed to fulfill future requirements of CAA operated airport control towers, two new types of 50-watt transmitters are being produced by Air Associates, Inc., Los Angeles, one for ultra-high frequencies and the other for operation on low frequencies but convertible to uhf. Both have file cabinet construction with four racks mounted on ball bearing tracks. The two lower racks are interchangeable in both transmitters and contain power supply and modulating unit. The two upper racks likewise are interchangeable so that conversion from 200-400 kc to 126-132 mc is simple. Two crystals, one in reserve, are supplied with each transmitter; hinged doors on the three top racks protect tuning adjustments; special cooling blowers with air drawn through a glass wool filter are integral.



Selenium Battery Chargers

Three general types of battery chargers, all supplying rectified ac through selenium cells are now being manufactured by the Selenium Rectifier Division of Federal Telephone and Radio Corp., East Newark, N. J., manufacturing associate of International Telephone and Telegraph Corp. The types of rectifiers are: low voltage types, which are portable, have wide charging rate control and may be equipped

for switching from 6 to 12 volts, with equal efficiency at either voltage; communications types ranging from 24 to 48 volts equipped with a filter to eliminate ripple and available for floating or cyclic charging as well as automatic regulation and taper charge; general utility types for central power stations and other general applications for 110 volts and up providing floating or taper charge, multi-rate charging with trickle end rate and automatic regulated charging.

Extractor Post Terminals

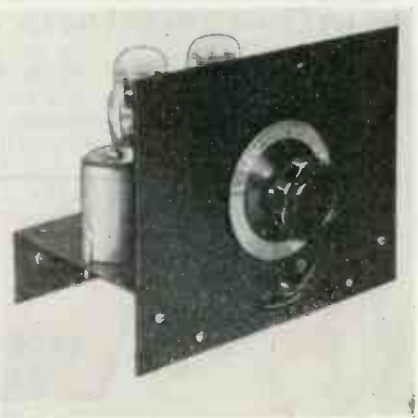
Anti-vibration side terminals are now mechanically connected by electrical welding to the metal shell inside the plastic body and backed up by soft solder. The welding process makes the terminal connection in effect one-piece, integral with the metal parts, and unaffected by heat and severe vibrations. The extractor post No. 1075 for fuses to 15 amps., made by Littelfuse Inc., 4747 Ravenswood Ave., Chicago, measures 2½ in. overall. Length from front to panel 2⅛ in.; mounting hole ½ in.

Relay for Aircraft

The Kurman Bantam relay, especially developed for aircraft use, comes in one to six pole construction and is available in standard front connected, screw terminal, solder lug, eyelet or switchboard mounting. The coil and shading pole assembly are in one unit, replaceable without special tools. The relay may be supplied with tropical treatment for use under any humidity conditions and its construction eliminates pull-in due to butt joints in the magnetic iron structure. Kurman Electric Co., Long Island City, N. Y., is the manufacturer.

Lafayette Learner's Kits

Lafayette Radio Corp., Chicago and Atlanta, is now able to offer radio training kits in quantity, to military and private training programs. One and two tube regenerative kits are designed to provide complete basic receiver training at the lowest cost. The one tube kit demonstrates grid leak detector operation and the effects of regeneration. With the addition of a minimum of parts an rf stage can be added without redrilling the chassis or moving component parts of the detector circuit. Alignment procedure can then be demonstrated in its simplest form. These kits may be operated either from power supplies or from batteries when proper tubes are used.



SYNFLEX

RIGID to FLEXIBLE • RODS • TUBES • SHAPES

COMPOUNDERS AND EXTRUDERS OF SPECIFIC MATERIALS FOR SPECIFIC USES

FLEXIBLE RUBBERLIKE TUBING

TEST DATA	FT-10 Sub-Zero	FT-11 Transparent	FT-22 Versatile	FT-33 Heat
Dielectric Strength				
Dry VPM	280	1000	1200	900
Wet VPM	450	910	900	800
Low Temperature				
Flexibility °F. (°C.)	−85 (−65)	−63.4 (−53)	−59.8 (−51)	−22 (−30)
Impact °F. (°C.)	−70.6 (−51)	−54.4 (−48)	−41 (−40.56)	−5.8 (−21)
Elevated Temperature				
Continuous °F. (°C.)	150 (65.56)	188.6 (87)	194 (90)	190 (87.78)
*Soldering	Flows	Flows	Flows	Good
**Aging (Baking) at 100°C. (212°F.) good after	100 days	100 days	130 days	50 days
Tensile Strength PSI	2550	3000	3200	2900
Hardness Shore "A"	40-45	55-60	65-70	75-80
Flame Resistance	Do not support combustion			
Water Absorption %	−1.4	+0.4	+0.9	+0.75
Chemical Resistance	Good	Very Good	Very Good	Good

All tests made on Standard #8 Tubing.
*1 minute immersion in molten solder at 450°F.
**Rapid flattening between jaws of a vise to thickness of twice the wall.

USES

FT-10: Battery drain, pilot relief, window channels, mechanical rubber goods. (Lowest Temperature.)

FT-11: To facilitate circuit and wire code identification, sealing cable ends, conduit, sheath. (Transparency, Low Temperature, and Good Dielectric.)

FT-22: Sheath, sleeving insulation, communications and mechanical rubber goods. (Highly Versatile.)

FT-33: Transformer, communications and electrical manufacturing. (Baking and Soldering Temperatures.)

Sizes: From B.&S. #24 (.021" I.D.) to 2.000" I.D.—Special sizes on request.

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Key Switches; Jacks

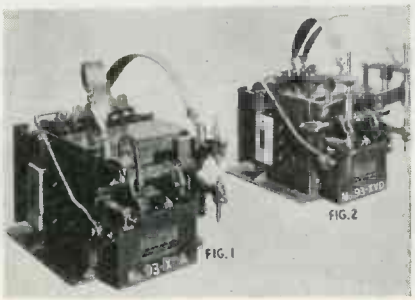
Key switches, allowing for a maximum of seven springs in each quadrant are provided in a wide variety of locking and non-locking combinations by Audio Development Co., 2833 Thirteenth Ave., Minneapolis, Minn. Silver alloy contacts are standard but special contact materials can be supplied. Switches are supplied with or without mounting plates. Also available are new telephone type jacks featuring welded box construction which assures rigid alignment. Springs are non-aging and additional springs allow for the switching of auxiliary circuits. They can be supplied for all standard 2- and 3-circuit telephone type plugs.

Pilot Lights

This new series of Gothard pilot lights is designed for grounded pilot light panels. Measuring approximately 2 in. in length, they mount on 1 in. centers. Body of hexagon design facilitates the use of a socket wrench in installation. Bulb change is from the front without disturbing body mounting or wiring. The bulb automatically comes out when the jewel holder is unscrewed. Bayonet socket lamps (long or round) may be used. The assembly is well ventilated for cool operation and is available with either faceted or plain jewels. Made by Gothard Mfg. Co., 1300 N. Ninth St., Springfield, Ill.

Double Electrode Spot Welder

Two new types of duplex jaw spot welders, designed for efficient welding of light gage sheet and wire, have been developed by the Eisler Engineering Co., Newark, N. J. Fig. 1 shows a unit equipped with rocker arm; Fig. 2, one supplied with vertical press arrangement. Each is foot operated by means of treadles. Transformers have five secondary tap connections providing different heat positions, in addition to fine control by a rheostat. An automatic timer cuts welding current after a preset interval. The equipment is designed so that a skillful operator may make from 120 to 175 welds per minute.



If one foot treadle is in operation the other is prevented from operating, but the machine can be set up to two different jobs in sequence, with different jaws, and under different heat positions. The welders are built for single phase ac of 110 to 440 volts, 25 to 60 cycles, ½ to 3 kva. The welders are production machines suitable for welding of radio tubes and other electronic equipment.

Insulation Tester

A new battery-operated insulation tester which measures the exact leakage of all insulation from zero to 200 megohms at a test potential of 500 v. dc, is available from Superior Instruments Co., 227 Fulton St., New York. This instrument, known as Model 610-B, operates on 2 self-contained batteries and is designed to function with a

high degree of accuracy both as a resistance measuring instrument and as an insulation tester. Housed in a heavy-duty oak portable cabinet with a bakelite panel the device measures 9½ x 8½ x 6 in. When battery operated, the 500 v. potential is made available by means of an integral vibrator power supply by throwing a front panel toggle switch. Price $62.50. Another model, 610-E, operates on 110 v. ac and is available for $52.50.

Aircraft Magnetometer

Designed primarily for magnetic control of the air frame, the model MW-3 magnetometer, manufactured by Waugh Laboratories, 420 Lexington Ave., New York, is useful also as a general purpose precision instrument for magnetic measurements. It is comprised of an indicating unit with stabilized, low gain amplifier and an electronic bridge for indicating field strength and polarity and a pickup unit which supplies the controlling signal—mounted for rotation about a vertical axis to accurately determine angles. Some of the outstanding advantages of the device, according to the company, is its ability to determine accurately null position and polarity, reversibility of flux gate, 180 deg. apart, and accurate protractor scale, read to 3 minutes of arc.

High Frequency Heating

Almost any non-metallic material can be heated uniformly and in minutes where ordinarily it required hours, with high-frequency heating equipment, manufactured by the Girdler Corp., Louisville, Ky. Heating is accomplished with-

in the article or molecule itself by reason of its molecular resistance to the high-voltage, high-frequency current passed through it from flat electrode plates covering opposite sides or top and bottom of the mass to be heated. All coils, tubes, controls, etc., are encased in a compact safety cabinet.

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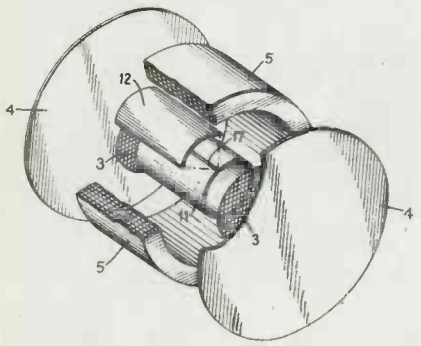
NEW PATENTS ISSUED

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 within their specific classifications.

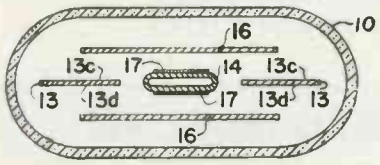
SPECIAL TUBES

Space-Charge-Cathode Tube — Electrons from cathode 12 are focused into the interior of drum 11 through slot 17 and are then caused to rotate in circles in the drum through the influence of a magnetic field produced by coil 5. These rotating electrons form the cathode of the electron tube having control grid 3 and plate 4. By this arrangement cathode 12 is not required to provide the peak emission necessary at a certain instant



of the cycle, but electrons continuously withdrawn from cathode 12 are stored up within cylinder 11 as rotating space charge and are extracted as they are needed by the main oscillating circuit. W. T. Gibson, International Standard Electric Corp., (F) May 8, 1940, (I) July 20, 1943, No. 2,324,772.

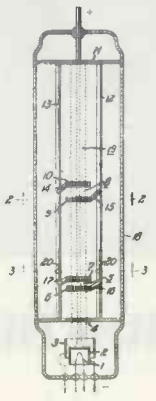
Low-Mu Vacuum Tube—Special tubes were designed to have the following characteristics: high-power output, low amplification factor and a sharp cut-off for negative control grid potentials. It is common to all constructions described that the plate is not arranged opposite the emissive cathode surface and that the electrons follow curved paths to reach the plate. The control grid is mounted opposite the emissive cathode surface outside of the electron paths and influences their course by so changing the equipotential field



that the electrons are more or less prevented from leaving the cathode. In the embodiment shown, 14 represents the cathode, 17 the emissive cathode surfaces. The plate surfaces 13c, 13d are not facing the emissive cathode surfaces. However, upon application of a plate potential, the electrons leaving the cathode will be drawn to the plate unless this is prevented by a negative potential applied to control grid 16 arranged opposite the emissive cathode surfaces. It will be seen that the amount of electrons reaching the plate depends on the control grid potential. Other embodiments including curved electrodes are described and claimed. R. C. Hergenrother, Hazeltine Corp., (F) March 8, 1941, (I) July 20, 1943, No. 2,324,776.

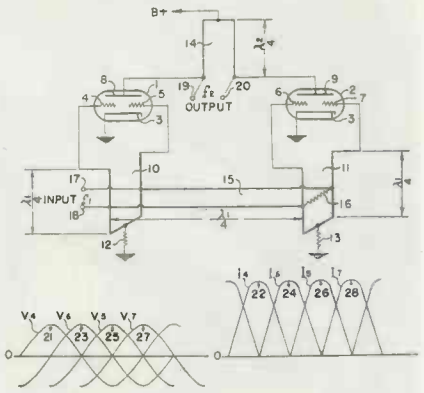
HIGH FREQUENCY

UHF Generator—In the uhf generator shown, feedback from inductor 9,10 to modulator 6,7 is provided through Lecher wires 12, 13.

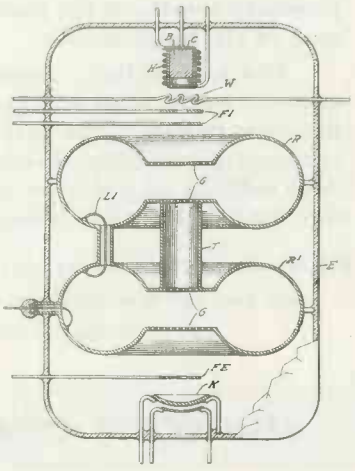


F. Ludi, "Patelhold" Patentverwertung & Elektro-Holding A.G., (F) March 6, 1941, (I) July 6, 1943, No. 2,323,613.

Frequency Multiplier — Referring to the diagram, curve V_4 indicates the voltage applied to grid 4 and curve V_6 that applied to grid 6. The 90 deg. phase shift is due to quarter-wave transmission line 15. Similarly, curves V_5 and V_7 indicate the voltages at grids 5 and 7, respectively, which are also 90 deg. out of phase, and 180 deg. out of phase with respect to voltages at grids 4 and 6, because grids 4 and 5 (6 and 7) are connected at opposite terminals of quarter-wave transmission lines 10 (11). I_4, I_5, I_6 and I_7 represent the corresponding plate currents. Plates of tubes 1 and 2 being connected to opposite sides of transmission line 14, the output will be proportional to the difference of currents to the two plates, i.e. to the difference between currents I_4+I_5 and I_6+I_7. It will be seen that the resultant output is of double the input frequency. If plates 8 and 9 are connected together, the output being taken between the common point and ground, all four currents add up to give a frequency four times the input frequency. A. L. Nelson, Farnsworth Television & Radio Corp., (F) Jan. 18, 1940, (I) July 6, 1943, No. 2,323,672.



Ion-Containing UHF Tube—It is intended to avoid the formation of a space charge due to the high-intensity electron beam in a velocity-modulation tube. To neutralize the unwanted space charge, positive ions are generated within the tube by any suitable device. In one embodiment a barium container C surrounded by a resistance heater is located in the tube opposite the cathode and the vaporized barium is ionized by the heated wire mesh



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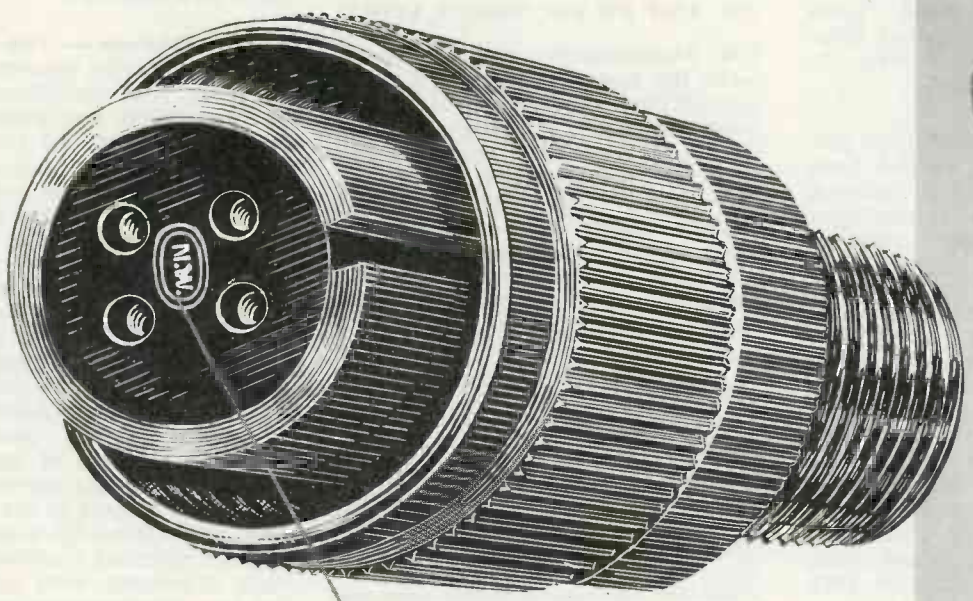

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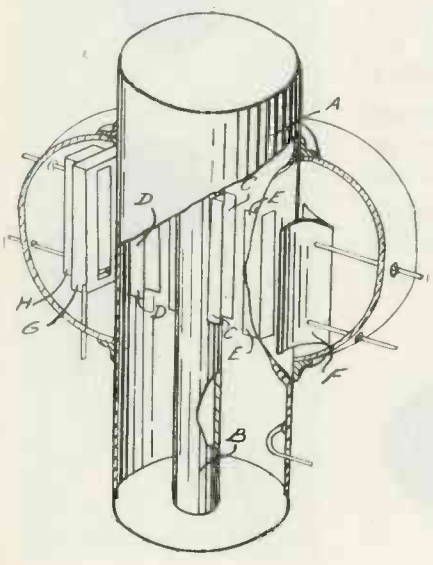
W. The barium ions are concentrated in a beam towards the cathode K by the action of focusing electrodes F1. Barium ions are recommended because, when neutralized and condensed, they may act as a getter, because the cathode may be coated with a barium compound and the barium from the beam can then be used to replenish the barium contents of the cathode, and because barium ions also tend to neutralize the space charge near the cathode making it possible to use cathodes of complex shape. Alternatively, caesium or mercury ions can be used. Hans Motz, International Standard Electric Corp., (F) Dec. 11, 1940, (I) July 6, 1943, No. 2,323,560.

Resonant Chamber—A high frequency tuned circuit in the form of a resonant chamber is claimed. It consists of a pair of conical conducting surfaces, having a common axis, arranged with their apices adjacent each other and a spherical conductor connecting the bases of the cones with one another. The resulting shape is that of a sphere with two oppositely situated cones missing. A tunable capacity may be arranged between the two apices of the resonator to provide for change of resonant frequency. A low loss circuit is provided, the natural oscillations of which are not harmonics. P. S. Carter, RCA, (F) Jan. 7, 1939, (I) June 29, 1943, No. 2,323,201.

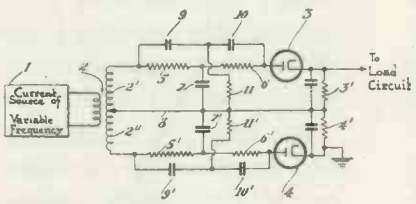
Resonant Cavity Oscillator—An oscillator of the velocity-modulation type comprising only one resonant cavity is claimed. Essentially, the arrangement consists of two hollow cylinders A and B constituting a closed concentric transmission line section, provided with slots formed by extensions D, C and E for passage of the electron stream. H is the cathode, F the collector anode. The electron stream is velocity-modulated in the gap between D and C, it becomes bunched during passage through C and transfers energy to the resonator when traversing the space between C and E. For tuning, the length of the resonator can be made adjustable. Several sets of slots, either parallel or obliquely arranged, may be provided. J. H. Fremlin, International Standard Electric Corp., (F) Nov. 27, 1940, (I) June 1, 1943, No. 2,320,860.



FM AND PHASE MODULATION

FM Transmitter and Receiver—In the phase shifting method of generating frequency modulation, lower modulating frequencies produce a proportionally greater phase shift in the carrier and are, therefore, subject to distortion at a modulation depth still suitable for higher modulating frequencies. To overcome this difficulty, the conventional predistortion network is so constructed that—while it functions in the usual way for the higher modulation frequencies to produce a phase shift in the modulator which is inversely proportional to the modulation frequency—at lower modulating frequencies the phase shift tends to become constant and to be limited to 30 deg. maximum. This effect has to be compensated for in the receiver. Suitable designs for the predistortion network and for the receiver network are described. E. H. Armstrong, (F) Oct. 12, 1940, (I) July 6, 1943, No. 2,323,698.

Discriminator—The combination of T filter 5,6,7 and inverted T filter 9,10,11 is constructed to have a maximum impedance at frequency f_1, the impedance falling off rapidly as the frequency is either increased or decreased. Filter network 5',6',7',9',10',11' has a similarly shaped impedance-frequency characteristic, the maximum-impedance frequency being f_2. Frequencies f_1 and f_2 are located at, or even beyond, the extremities of the frequency deviation range of the applied frequency-variable waves. Their mean represents the center frequency of the input voltages. Since at that point the impedances of the two networks are equal, the voltages developed across resistors 3' and 4' will be equal and of opposite polarity, thus cancelling out. As the input frequency deviates from the center frequency, the impedance of one of the combination networks will increase while the other decreases. The resulting difference in voltage developed across resistors 3', 4', respectively, will depend upon direction and amount of the frequency variation. H. Kihn, RCA, (F) April 16, 1942, (I) July 6, 1943, No. 2,323,609.



MISCELLANEOUS

Radio Beacon—Two-course or four-course radio beacons are provided by two non-directional antennas. If two non-directional antennas are so spaced and the currents in the antennas so phased that the algebraic sum of the space and time phase angles is 180 deg., the array will produce a space pattern of cardioid form. Maximum radiation will be propagated along the line joining the two antennas and in the direction of the lagging antenna. By energizing both antennas with two differently modulated currents—the signals may be complementary—in such a way that one antenna is lagging with respect to the one current and the other with respect to the other current, two differently modulated oppositely oriented cardioid patterns, each impressed with only one of the two characteristic signals, will be radiated. The intersecting line may serve as a two-course radio beacon. Various ways to produce suitably phased current fed to antennas spaced a suitable distance apart are described. Alternatively, the object of the invention may be obtained by combining currents which if used by themselves would give a circular and a figure-of-eight pattern in two non-directional antennas. Again two differently modulated currents have to be used, both being applied to both antennas. Similar arrangements to produce four-course radio beacons are described. F. G. Kear, (F) Feb. 27, 1935, (I) June 1, 1943, No. 2,320,521.

Crystal Electrodes—The electrodes claimed are intended for piezo-electric crystal oscillators producing oscillations in liquids. It is proposed to use at least one grid-shaped electrode at the side of the crystal adjacent the liquid so that the crystal surface may be partly in direct contact with the liquid. If the other electrode also is in the form of a grid, a corrugated diaphragm is provided to prevent radiation of energy. J. Gruetzmacher, Alien Property Custodian, (F) June 19, 1940, (I) June 29, 1943, No. 2,323,030.

ONE SQUARE INCH* of this fine glass bound mica insulating material weighs only .013 lbs. Yet MYKROY'S mechanical strength is comparable to that of cast iron.

This exceptional lightness factor in a ceramic insulator is a strategic advantage—especially in applications where a minimum of weight is vital to swift and easy mobility. Hence MYKROY is becoming a familiar part of such instruments as "Walkie-Talkie" and aircraft electronics devices.

If your equipment demands the most advanced and efficient insulation, let us demonstrate the specific advantages and uses of MYKROY.

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No. 4		No. 8
6.68	Dielectric Constant (Dry)	6.75
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.00240	Power Factor (Dry)	.00164
.00241	Power Factor (Wet)	.00231
1.60	Loss Factor (Dry)	1.11
1.62	Loss Factor (Wet)	1.54
630 Volts per Mil.	Dielectric Strength	660 Volts per Mil.

From Reports of Independent Testing Laboratories

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ASSOCIATION NEWS

Radio Technical Planning Board to Organize

Problems of spectrum allocation, standardization and other matters tied up with them came a step nearer to solution with the appointment, middle of August, of committees by the Institute of Radio Engineers and the Radio Manufacturers Association looking to the formation of a "Radio Technical Planning Board" as originally proposed by Chairman James L. Fly of FCC. A. S. Wells, Chicago, heads the RMA group and associated with him are: H. C. Bonfig, Camden; W. R. G. Baker, Bridgeport; R. C. Cosgrove, Cincinnati; Walter Evans, Baltimore; Fred D. Williams, Philadelphia. The IRE committee is headed by Haraden Pratt, New York, with whom are associated Alfred N. Goldsmith, New York; B. J. Thompson, Princeton; H. M. Turner, New Haven.

Working together, these committees have produced a plan for RTPB and the plan will be submitted for ratification at a meeting scheduled for Sept. 15 in New York at which the following original "sponsors" will be invited to participate: American Institute of Electrical Engineers, American Institute of Physics, American Radio Relay League, FM Broadcasters, Inc., National Association of Broadcasters and National Independent Broadcasters. Other major, non-profit radio organizations, as well as communications, aeronautical and similar groups may be included later.

Advisory body

According to the present plan, RTPB will be a technical advisory body, to formulate recommendations to FCC and other government and industry organizations on the technical future of radio developments, including frequency allocation and systems of standardization for public services such as television and frequency modulation. RTPB will study, investigate and recommend procedure to FCC and other agencies having final authority.

The matter of the appointment of a chairman to head up RTPB is open to considerable speculation. Among those who have been mentioned for the job are Dr. Goldsmith, W. R. G. Baker and Haraden Pratt.

R. C. COSGROVE

RMA to Study Postwar Problems

RMA will undertake studies of the industry's postwar problems on a broad scale. A special RMA committee on "Postwar Planning" has been organized by President P. V. Galvin for work on the industry's many future reconversion problems and also some immediate matters.

Chairman of the new special committee is R. C. Cosgrove, vice-president and general manager of the Crosley Corp., Cincinnati, and the committee includes many prominent industry executives. Mr. Cosgrove also is chairman of the Association's Set Division. The new RMA postwar project is among activities and services planned for RMA members following the Association's recent annual meeting.

Wide jurisdiction in the field of postwar planning, including reconversion of the industry to civilian production and also immediate problems relating to war contracts and their termination, has been given to the committee. Its work on industry economic problems will be correlated with that of the technical planning agency now being organized by RMA and the Institute of Radio Engineers. The committee is authorized to organize subcommittees or panels and to deal with such subjects as:

Liaison planning with government and industry agencies
Reconversion to civilian production
Public relations — promotion and advertising
Distribution problems
War contract termination
War inventory disposal
Problems re government plants
Re-employment and labor relations
Market analysis, research
Patents and licensing
Export markets

Cooperation by the committee with government and industry agencies and organizations is proposed.

Following is the RMA Committee on Postwar Planning appointed by President Galvin and including representatives of major industry groups:

R. C. Cosgrove, Chairman (Crosley Corp., Cincinnati); W. R. G. Baker (General Electric Co., Bridgeport, Conn.); M. F. Balcom (Sylvania Electric Products Inc., Emporium, Pa.); John Ballantyne (Philco Corp., Philadelphia); H. C. Bonfig (RCA Victor Division, Camden); Walter Evans (Westinghouse Elec. & Mfg. Co., Baltimore); A. H. Gardner (Colonial Radio Corp., Buffalo); Leslie F. Muter (Muter Co., Chicago); J. J. Nance (Zenith Radio Corp., Chicago); E. A. Nicholas (Farnsworth Television & Radio Corp., Ft. Wayne); Ross D. Siragusa (Continental Radio & Television Corp., Chicago); Ray F. Sparrow (P. R. Mallory & Co., Inc., Indianapolis); A. S. Wells (Wells-Gardner & Co., Chicago).

Conventions and Meetings Ahead

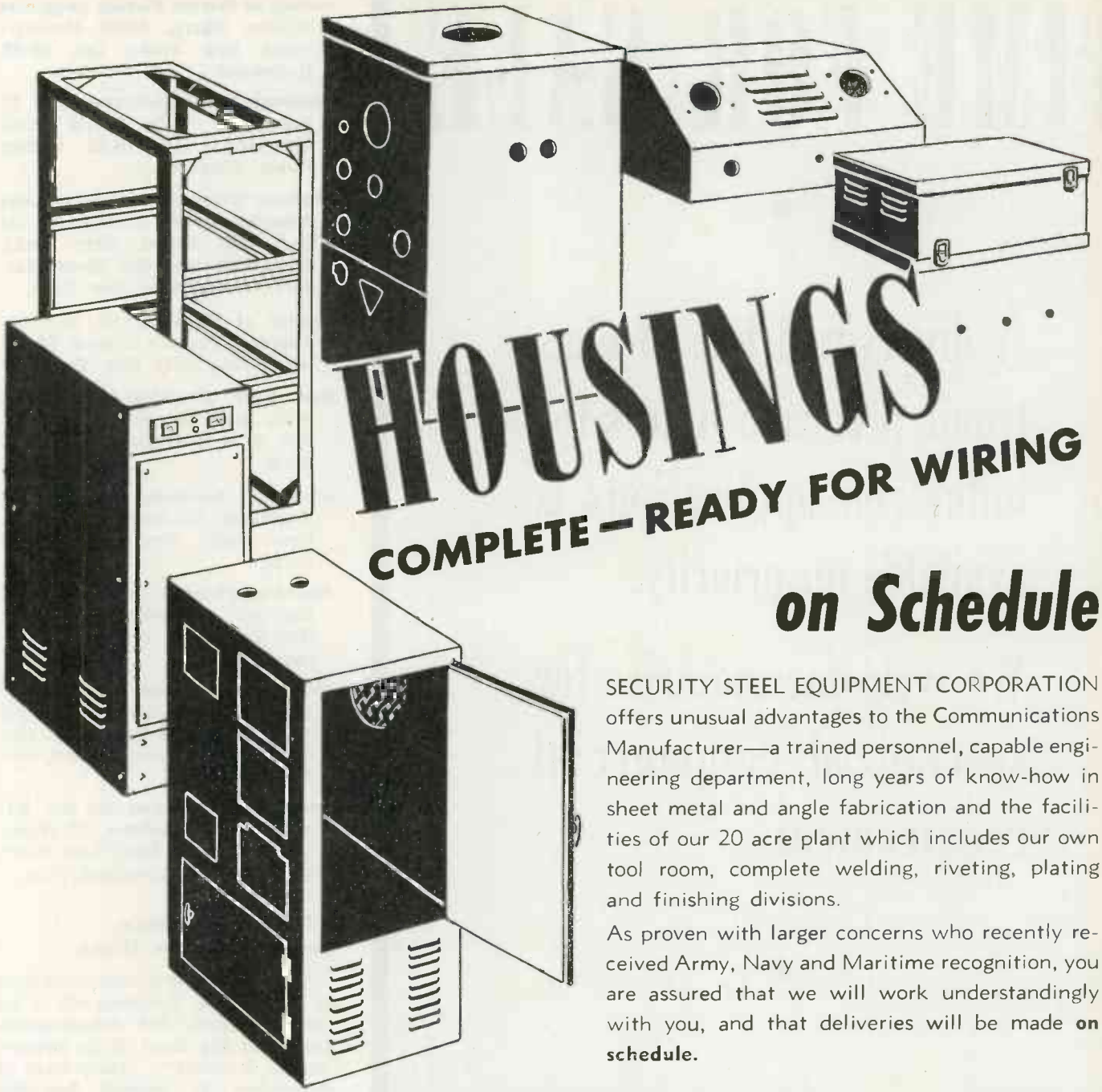
American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York City), National Technical Meeting, Sept. 2-4, Salt Lake City, Utah.

American Mathematical Society, Sept. 12-13, New Brunswick, N. J.

Optical Society of America (A. C. Hardy, Massachusetts Inst. of Technology), Oct. 7-9, Pittsburgh.

Electrochemical Society (C. G. Fink, Columbia University, New York), Oct. 13-16, New York, Hotel Pennsylvania.

American Welding Society (Miss M. M. Kelly, 29 West 39th Street, New York), Oct. 18-21, Chicago.



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Security STEEL

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Society of Motion Picture Engineers (Sylvan Harris, Hotel Pennsylvania, New York), Oct. 18-22, Hollywood.

National Metal Congress (W. H. Eisenman, 7301 Euclid Ave., Cleveland), Oct. 18-22, Palmer House, Chicago.

National Electrical Manufacturers Association (W. J. Donald, 155 East 44th Street, New York), Annual Meeting, Oct. 25-29, Waldorf-Astoria Hotel, New York.

Society of Rheology (R. B. Dow, Aberdeen Proving Ground, Maryland), Oct. 29-30, New York.

New York Electrical Society (29 West 39th Street, New York), Nov. 4, 29 West 39th Street, New York.

American Institute of Chemical Engineers (50 East 41st Street, New York), Nov. 15-16, Pittsburgh.

American Physical Society (Karl K. Darrow, Columbia University, New York City), Nov. 26-27, Chicago.

National Association of Manufacturers (G. G. Geddis, 14 West 49th Street, New York City), Dec. 8-10, Waldorf-Astoria Hotel, New York.

American Association for the Advancement of Science (27 Washington Square, New York City), Dec. 27-Jan. 1, Cleveland, Ohio.

FM Broadcasters Study Postwar Work

With nearly forty representatives in attendance, including six of its nine directors, FM Broadcasters, Inc., held the third of its gatherings in a period of ninety days in Milwaukee in August. Included among the guests were Major Edwin H. Armstrong, father of FM; Dr. W. R. G. Baker, General Electric's vice-president; and George Adair, FCC's assistant chief engineer. Much time was devoted to postwar problems, culminating in the appointment of Walter J. Damm (W55M Milwaukee), president of FMBI, to represent the association in the Radio Technical Planning Agency, which is the national group comprising representatives of the broadcasting and radio manufacturing industry studying peacetime activities. Time was also devoted to a consideration of suitable mileage separations and trade area allocations for FM transmitters. The engineering committee

A New Dunco
DYNAMIC-BRAKING RELAY

FOR SPLIT-SERIES FIELD AIRCRAFT ELECTRIC MOTORS

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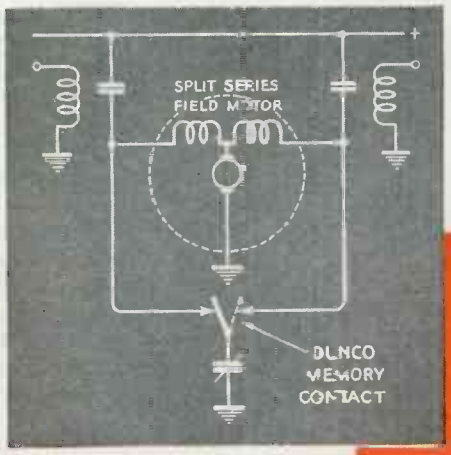
The Relays are of the famous Dunco "Nutcracker" type with the new, light-weight construction, and having exceptionally strong contact pressure. There are no sliding contacts. Dunco positive "Memory" contacts select the proper field winding to give reverse torque for braking. All parts and contacts are readily accessible for inspection. Although the Relays represent a radical new design they are actually only a new combination of proved components, every detail of which is time-tested. They operate in all positions, and withstand salt-spray, vibration and altitude tests.



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will prepare a report for presentation before the next FMBI meeting, looking to the presentation of suitable recommendations to FCC, if necessary.

Major Armstrong emphasized mistakes in allocation that had been made during the past twenty-five years, as reported elsewhere, suggesting that whatever approach is made to the problems of standardization and allocation, some provision be made to allow for the correction of errors in judgment.

Dr. Baker pointed out the necessity of manufacturers producing FM receivers that shall be truly satisfactory to the public, and the responsibility of FM broadcasters to produce a good signal.

George Adair reported that FCC is following FMBI suggestions and making further measurements of wave propagation characteristics in the band between 42 and 50 mc, adding that FCC is short of FM receivers and putting in a bid to borrow them wherever they may be available.

Walter Evans, representing Westinghouse's four FM stations resigned from the FMBI board of directors and his place was taken by Lee B. Wailes, Westinghouse station general manager.

Craven Comments on Larger Aspects of Allocation

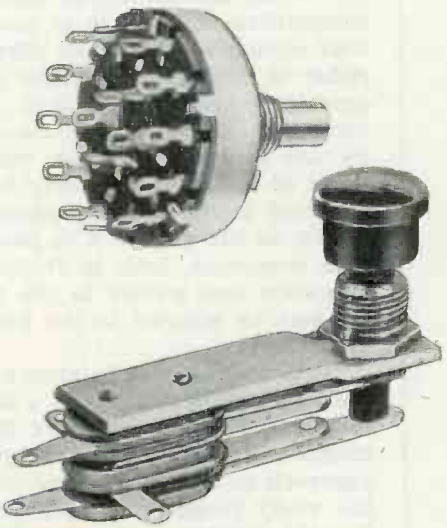
One of the best-informed of the experts on radio allocation is Commissioner T. A. M. Craven, member of the Federal Communications Commission, and former chief engineer of the regulatory body, as well as radio short-wave expert of the U. S. Navy.

In continuing the discussion on future allocations of broadcasting, communications, television, FM, and industrial services, appearing on pages 74 and 75 of our August issue, Commissioner Craven comments on some of the larger considerations behind radio allocation:

Many factors influence solution

"In planning the allocation of channels to broadcasting, including television, many persons fail to coordinate all of the factors which influence the solution of the problem. For example, there is a relation between radio frequency allocation, radio equipment design, the economics of manufacture, sale of equipment and the type of operating organization of the stations

to Manufacturers OF ELECTRONIC EQUIPMENT



...who use Push and Selector Switches

The electro-mechanical components manufactured by the Chicago Telephone Supply Company have been standard for quality and workmanship since 1896. In spite of wartime demands, manufacturers of electronic equipment may be assured of the same craftsmanship and service to which they have become accustomed throughout the years.

Chicago Telephone Supply Company is also producing plugs, jacks, variable resistors and switches (separate and in combination with variable resistors). Inquiries are invited from manufacturers on these and similar items.

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which render service to the public. Likewise, there is a relation between regulatory philosophies and radio frequency allocation. If there be allocated only a few channels it is possible that strict Government regulation of many phases of broadcasting might become necessary. On the other hand, if there are many channels the entire relationship between Government and private enterprise might be most liberal.

"There is a relationship between freedom of speech and radio frequency allocation. If there are sufficient channels allocated to broadcasting to permit the establishment of as many stations as are feasible economically, radio will become reasonably 'free' and the doctrine of unlimited competition can prevail. On the other hand if radio frequency channels are scarce we shall continue to have with us all of the problems of a limited medium for the dissemination of facts and opinion.

Economics and services

"Lastly, it is important to consider the economics of broadcasting and its effect upon the development of new services. If frequency modulation, facsimile, aural and television broadcasting are to be maintained as separate competitive services, it is possible that economies cannot be effected, either in frequency allocation or in operating organization and performance. On the other hand, if we are to consider these various types of modulation merely to be different methods of broadcasting service to the public, it is possible that economies, both in frequency allocation and service to the public, may be effected to the benefit of everyone.

"It is necessary to balance all of these factors in arriving at a satisfactory solution," concludes Commissioner Craven. "Hence, a limited approach on the part of any one of the many groups which should be brought together, may not be in the public interest."

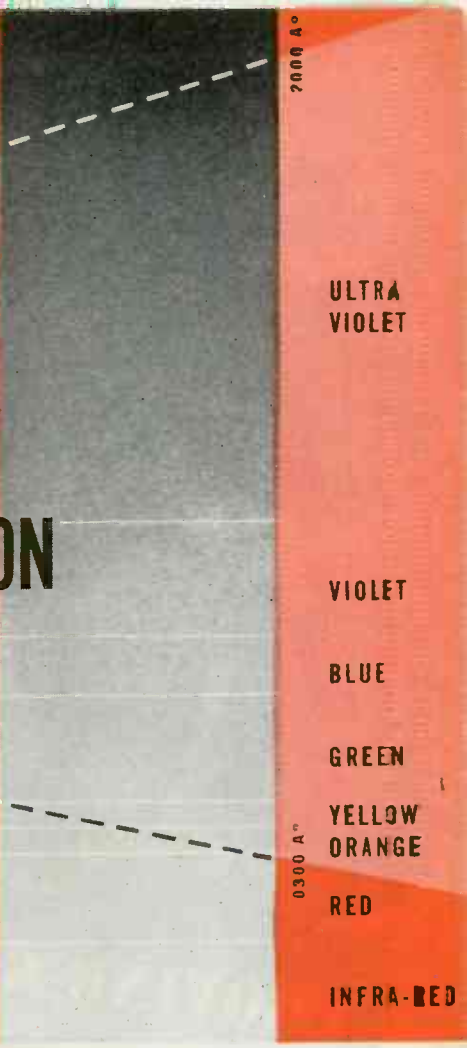
New CBS Short Wave Transmitters for OWI

Another international broadcasting station is to be added to the network of short wave transmitters, being used by the Office of War Information's Overseas Division to beam American news, propaganda and programs to all parts of the world during the war. The start toward the establishment

RCA 935—A NEW PHOTOTUBE

FOR PRECISE MEASUREMENT OF

ULTRAVIOLET RADIATION



IF YOU deal with ultraviolet radiation and have a measurement or detection problem, RCA 935 may be of help to you. This new tube was designed by RCA engineers to give high sensitivity in the ultraviolet range—down to 2,000 Angstroms—yet to eliminate the effects of infra-red radiation. Applications already include use in the detection of certain hazardous gases, in the continuous analysis of certain solutions, and for the measurement of ultraviolet radiation *per se*. There's an RCA phototube for nearly *every* application.

The RCA 935 has an overall length of 4¼ inches (max.); max. diameter, 1-5/16 inches; skirted miniature cap; T-9 bulb; intermediate shell octal 5-pin base. Maximum ratings are as follows: anode supply voltage, 250 (d-c or peak a-c); anode current, 20 microamperes; ambient temperature, 50°C; luminous sensitivity at color temperature of 2870°K, 30 microamperes per lumen. Mounts in any position. Range: 2000A° to 6300A°. *RCA Victor Division, Radio Corporation of America, Camden, New Jersey.*

Here are the 935's most important features:

- **High ultraviolet sensitivity — 0.02 microamperes per microwatt (at 2537 A°)**
- **No response to infra-red**
- **High vacuum—for high stability**
- **High leakage resistance — 500,000 megohms**
- **Special envelope glass — providing excellent U-V passage**

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Please send me the RCA publications checked below:

.....RCA Phototubes—containing 16 pages of helpful information on phototube operation for relays, measurement, and sound reproduction.

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TUNE IN "WHAT'S NEW?"

RCA's great new show Saturday nights, 7 to 8, E. W. T., Blue Network.

RCA ELECTRON TUBES

of this station, which is to be constructed by the Columbia Broadcasting System, resulted from the authorization by the WPB Non-Industrial Facility Committee this week for the construction of the transmitters and associated equipment and station building at Wayne, N. J.

This authorized the allotment of materials for the new station, which will have two short wave transmitters to furnish the two-frequency coverage that the OWI has instituted. Construction will cost $476,150 and the project involves the alteration of a leased, one-story and basement building, together with the installation of the two transmitters and their equipment.

CBS still has to apply to the FCC for a construction permit which will be granted speedily. This makes the second addition to the original fourteen short wave stations, lined up by the OWI for the war broadcasting, the previous one having been the Crosley station. The OWI Overseas Division is also still using the transmitters of A. T. & T., RCA Communications and Press Wireless.

To Expand Resistor Manufacturing

Prospective expansion of radio resistor facilities to provide sufficient capacity to meet the requirements of the Armed Services during the remainder of 1943 and the first half of 1944 has been planned as a result of an August meeting of the Fixed and Variable Resistors Industry Advisory Committee with officials of the WPB Radio and Radar Division.

All plants must operate at capacity and proper distribution must be maintained to achieve these goals, Daniel J. Connor of the WPB Radio Division told the industry group. He stressed that there should be no repetition of the June situation when the production of resistors slumped approximately 15 per cent. The committee members attributed the June slump to the hot weather, vacations, absenteeism, lack of adequate supervision, lack of orders and high labor turnover.

Standardization of resistors should benefit both the industry and the Armed Services, Col. G. C. Irwin of the Army Signal Corps Standards Agency stated at the meeting. He pointed out that standardization is important to the

TRANSTAT VOLTAGE REGULATORS for smooth control of A. C. Voltage

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Standard Type TH Transtat Voltage Regulators operate on 115, 230 and 460 volt single phase or polyphase circuits and handle 20 KVA and smaller loads. They maintain voltages within a narrow range in changing from no load to full load.

The American Transformer Company also manufactures motorized and fully automatic voltage regulators. Full information upon request.

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Army because troops in the field are able to obtain repair parts to fit the equipment in use. The progress on resistor specifications is entirely satisfactory, Col. Irwin said, except for the long time it has taken to develop the program.

The Government Presiding Officer at the meeting, Elmer R. Crane, Chief of the Division's Standards Components Section, urged the early placement of orders by manufacturers so they can secure their materials. Mr. Crane declared that the Radio Division recommends manufacturers accept orders only to the extent of their ability to produce and to deliver commitments to the Army and Navy. This would spread the load and the scheduling would be relatively unnecessary, he added. The scheduling procedure under Order M-293 was explained by Oscar W. McDaniel of the Radio Division.

Armstrong Cites Past Errors in Allocation

At a meeting of the FM Broadcasters, Inc., at Milwaukee, Wis., last month, Dr. Edwin H. Armstrong, inventor of the superheterodyne, frequency modulation, and other radio improvements, cited the dangers inherent in any rigid straight-jacketing of radio allocation in the future. He further pointed out a long series of mistakes which had been made during the past twenty-five years of radio history which came about because those who laid out the wavelength allocation proceeded on the theory that they, at the time they took action, knew all there was to know about radio.

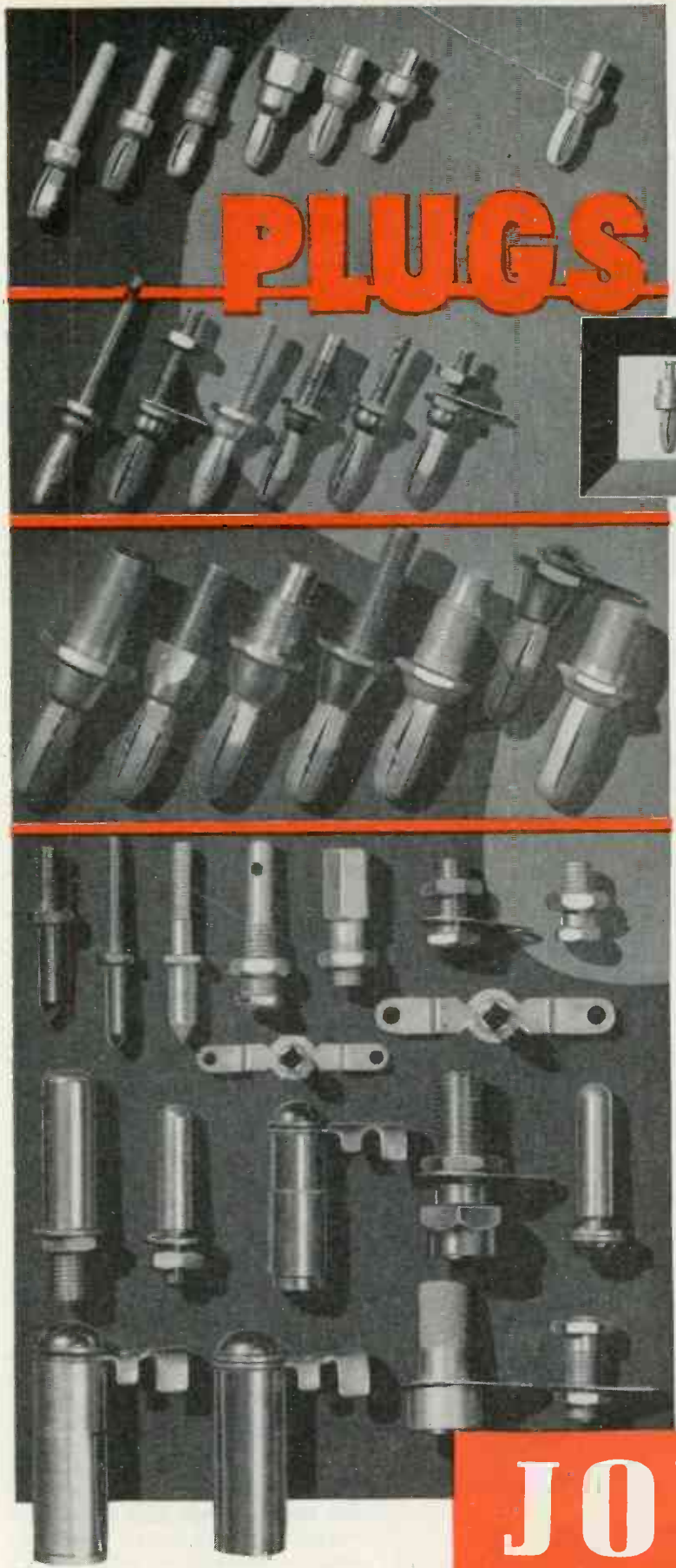
Three classic blunders

Said Dr. Armstrong: "The classic example of this, of course, was in the radio allocation which gave all the wavelengths below two hundred meters to the amateur!

"A second blunder was the assumption that a five-thousand-cycle modulation band was all that would ever be required for good broadcasting. This assumption resulted in a permanent impairment of the quality of transmission on the standard broadcast band.

"A more recent illustration was the allocation of television to wave bands where it had no business to be, that is, where the modulating frequency was a large percentage of the carrier frequency."

Dr. Armstrong suggested, therefore, an approach to the problem of



PLUGS are Vital

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standards and wavelength allocations which would be "sufficiently flexible" to permit correction of the errors of judgment which will this time undoubtedly be made, just as they have been made in the past!

Repair Shortage Cuts Radio Audience Only 4%

Within the past few months rumors have circulated to the effect that anywhere from 15 per cent to 40 per cent of U. S. radio homes are currently without radio service, because of the lack of tubes, batteries, and repair service. These reports in many cases have been promoted by newspaper interests which are feeling radio advertising competition.

Such exaggerated claims of radio audience cuts are untrue, declares Dr. Frank Stanton, CBS vice-president in charge of research. This flat contradiction comes from an April, 1943 nationwide study based on a scientific cross-section of 5,997 face-to-face interviews conducted by Elmo Roper for CBS.

The facts are these:

1. 95.7 per cent of all U. S. Radio homes have one or more radios in working order. (This checks very closely with a study conducted by Life magazine in December, 1942, based on 5,971 cases, which showed 95.8 per cent.)

   This means that 4.3 per cent of U. S. radio homes are without service.

2. 21.7 per cent of all radio families report "second" sets out of order. With some sixty million sets owned by the U. S. audience, the tremendous backlog of secondary sets has to date prevented loss of radio service to the great majority of these families.

Going back to fact No. 1 (homes entirely without radio service) what is par for this situation? **Over a period of years, on a nationwide basis, from 3 per cent to 6 per cent of all radio homes have been without service.**

For example, adds Dr. Stanton, the CBS-Starch Quarterly Reports, for urban areas, show a range of 2.9 per cent to 6.4 per cent between 1934 and 1937. The average for both urban and rural areas, at the end of 1937, was 4.2 per cent of radio owners with sets out of order, based on findings of the Joint Committee on Radio Research.

Like the course of the stars across the heavens, Cardwell progress has been sure and steady. Occasionally, we try a different path or make a mistake, but when that happens, we generally discover something new to add to the desirability of Cardwell Condensers.

Unvarying, however, is Cardwell Quality. The years have brought changes in the line, and our condensers have found countless new applications in military and civilian life. Cardwell Quality remains, as always, the *Standard of Comparison*.

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FCC Eases BC Construction Policy

A policy was established by the FCC in mid-August upon consideration of a report and recommendations of its Committee on Critical Radio Materials that under certain stated conditions it would be in the public interest to grant applications for permits to construct or change local channel standard broadcast stations which involved the use of idle equipment. This FCC policy, which is a relaxation of its previous position freezing the installation of new broadcasting stations, is to be put into effect in the case of increases of power for 100-watt stations to 250-watt and for the construction of new 100-watt or 250-watt local channel stations.

Under its new policy, the FCC stated that applications for permits to construct new 100-watt and 250-watt local stations "in cities or towns where no station is located at present and not located in metropolitan districts already served by radio stations," together with applications for the increasing of power from 100-watt to 250-watt must record a satisfactory showing on the following points:

(1.) All required materials, except vacuum tubes, may be obtained without priority assistance. (The WPB has informed the FCC that building construction requires a clearance which may be obtained only when the WPB is satisfied a direct contribution to the war effort is clearly indicated.) (2.) The applications involve no inconsistencies with the FCC rules and regulations. (3.) The applications tend toward a fair, efficient and equitable distribution of radio service, are consistent with sound allocation principles, offer a substantial improvement in broadcast service and are otherwise in the public interest.

Pending applications for local stations which had been dismissed without prejudice under the previous April 27, 1942, "freeze order" may be reinstated with submission of a petition within a month, ending in mid-September.

Veteran Operators Award Three Scholarships

Commemorating the sixth anniversary of the death of Guglielmo Marconi, the Veteran Wireless Operators Association late in July presented three Marconi memorial scholarships. With Ted R. McElroy, president of the McElroy Mfg. Co., Boston, and world's champion code operator at the key to send international Morse signal "S," the program was broadcast over the Mutual network from New York's WOR.

As the result of a contest conducted under the auspices of Science Service, which sponsors science and engineering clubs in high schools in forty-two states, a tie was declared between Frederic Corbin Leiner, East St. Louis, Ill., and Francis Herbert Horne, Johnstown, Pa. Both will receive tuition-free scholarships at the RCA Institutes in New York and a special award of a scholarship in television engineering at the Midland Radio and Television Schools after the war. In the interim, Lothar Shnitkin, a graduate of the Brook-

VETERAN wireless operators make awards: Wm. McGonigle, J. R. Poppele, Francis Horne, champion operator "Ted" McElroy, and Lothar Schnitkin

THE "Wondergift" PALM

Only the gods can read the entire electronic palm, but electronic engineers are learning fast. On their boards already are "wondergifts" to man that almost stagger the imagination.

Each new electronic advance calls for a special motor or generator—often a super-special one. That, implies a motor builder in position to work out the exacting power problems involved. That, means Leland.

Over the last two decades Leland has emphasized special motor designs in many fields—is already serving electronics in a score of ways—shall continue to do so as special drive and power generating problems arise to demand special engineering.

Consult Leland, if possible, forwarding preliminary data with the inquiry.

Leland

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lyn Technical High School, will be given a scholarship in the home study division of the Midland School.

Mr. McElroy announced, during the broadcast, the inception of a special award to the nationwide winner of a code speed contest to be conducted under the auspices of Science Service and the American Institute of New York City. Also taking part in the broadcast was Major General Joseph O. Mauborgne, former Chief Signal Officer of the Army.

W. D. Terrell, First U. S. Radio Head, Retiring

After 32 years in government service, William D. Terrell, pioneer head of federal radio regulation has given up his post as chief of the FCC's Field Division and has retired from office.

Twice exempted from automatic retirement by Executive Order, Mr. Terrell, who is now 72 years of age, has been in radio from its very start.

In 1911 Mr. Terrell was made "Wireless Ship Inspector" in the Department of Commerce. His "staff" comprised another inspector, the late R. Y. Cadmus. In 1915, he became "Radio Inspector in Charge," with a force of 35 persons.

When Herbert Hoover became Secretary of Commerce, Mr. Terrell was put in charge of technical aspects of radio regulation in the old Radio Division. And when the Federal Radio Commission was created in 1926 Mr. Terrell continued his supervisory activities and inspections, and his experience and advice proved of great value to the Radio Commission.

Mr. Terrell continued in charge of the Radio Division when it was taken over by the Radio Commission in 1932. When the FCC took over all communications in 1934, Mr. Terrell was made head of the FCC Field Division. His home will continue in Arlington, Va.

Further Radar Ban

"The extent of current public discussion of radar is causing increasing concern to the Government," states Byron Price, director of the Office of Censorship. He adds:

"The principle of radar is generally understood here and abroad, and some limited disclosures have been made officially. New methods of applying the principle are being developed, however, and there is much the enemy does not know. The fact of prior publication should not be used to cover added description, discussion, and deduction, or to support a theory or draw a conclusion.

"Radar is a secret weapon within the meaning of the Code. Editors and broadcasters are especially requested to be alert to every mention of radar and military electronic devices; to establish beyond all question that there is appropriate authority for every statement made; and to submit all material on the subject—other than that released by appropriate Government authority—to the Office of Censorship for review in advance of publication or broadcast. So inclusive a request would not be made if the highest considerations of national security were not directly involved."

Cotton Heads British Radio Procurement

Richard W. Cotton, for many years with the Samson Electric Co., and more recently managing director of the British Rola Co., London, England, has been appointed assistant director of the British Air Commission in Washington in charge of procurement of radio apparatus. The appointment is considered unusual in that Mr. Cotton is a U. S. citizen.

Maybe It Was a "Hydrolant" You Heard!

Ever hear of a hydrolant?

Neither had Uncle Sam's sailors, but hydrolants are now crackling from radio stations along the East coast to warn of hazards at sea. The U. S. Navy's Hydrographic Office has coined the term from the phrase "hydrographic messages of the Atlantic."

These Morse code messages warn of sunken wrecks, drifting mines, unexploded depth charges, changes in position of lights or buoys, and other data that help protect our men from danger. This service is not a new one but has just been improved.

Each major broadcast will now carry the prefix, "Hydrolant Number." The hydrolants are numbered serially so that shipmasters can tell whether they have recorded all the important warnings. "Hydrolants Unnumbered" are not put in the series because of their purely local interest

WEIGHT 2 LBS., CHRISTENED RADIOSONDE

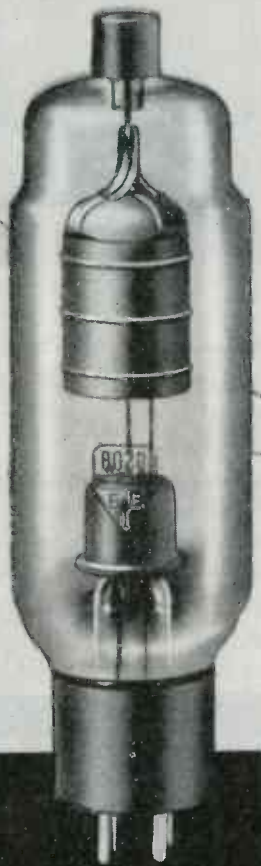
... talks fluently from birth!

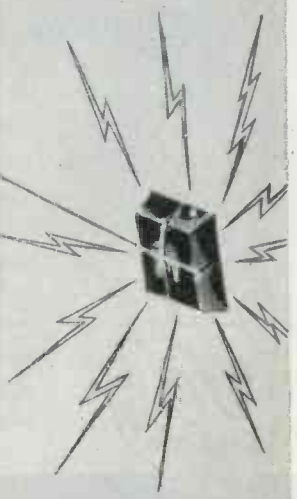
This tiny brainchild of meteorologists renders an invaluable service for all its short-lived existence!

Upper air soundings — to determine the pressure, temperature and relative humidity at various altitudes — are obtained by the use of the Radiosonde. It is carried aloft by a free balloon, and radio signals are transmitted to a ground receiving station where the signals are converted into respective readings.

When the balloon bursts — usually in the 20,000 feet vicinity — the instrument is carried down by means of a small parachute. Some thirty-odd stations throughout the U. S. make observations by this method.

This is only one of the innumerable peace-time applications of electronic tubes. With the advent of new advancements in the field of electronics, ELECTRONIC ENTERPRISES can be expected to achieve an important position — equal to that now assimilated in war work — in the development and production of these vital units. Inquiries are invited.





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NEW BOOKS

Tables of Functions with Formulae and Curves

By Dr. Eugene Jahnke, formerly Prof. at the School of Mines in Berlin, and Fritz Emde, Dr.-Ing. E.H., Dr. Techn. E.H., Prof. of Electrotechnics at the Stuttgart Technical College, published by Dover Publications, New York City, 1943, $3.50.

This book, published under license of the U.S. Alien Property Custodian, is the third edition of one of the outstanding compilations of mathematical tables. Addressed to mathematicians and scientists, it will also prove useful to engineers concerned with mathematical computations. Care has been taken to present the most frequently needed material, and to arrange the contents for ready reference.

The text includes higher functions, such as sine, cosine and logarithmic integrals, error integrals, theta-functions, elliptic integrals and functions, Legendre functions, and Bessel functions. There is an appendix with tables of elementary functions which will be of particular value in engineering calculations. It contains tables of powers, reciprocals and square roots of complex numbers, vector addition, cubic equations, trigonometric functions, exponential functions, natural logarithms, as well as circular and hyperbolic functions of complex variables.

Dynamical Analogies

By Harry F. Olson, E.E., Ph.D., Acoustical Research Director, RCA Labs., Princeton, N. J., published by D. Van Nostrand Co., Inc., New York, 1943, 196 pages, $2.75.

The book starts with a systematic review and comparison of definitions of the fundamental elements and of some of the basic formulas used for electrical, mechanical rectilineal, mechanical rotational and acoustical systems.

Examples illustrate the analogies in the respective simple networks and filters. The action of electrodynamic, electromagnetic, electrostatic, magnetostriction and piezo-electric transducers and generating systems is described.

With the aid of tables a readily comprehensive survey of the essential relations in each of the four systems and of their similarity

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Prime requirements of most electronics and communications equipment are light weight and compactness. Westinghouse matches these requirements with a full line of featherweight, space-saving dynamotors.

Westinghouse dynamotors are built to operate from 12 and 24 d-c voltage systems—with a variety of output ratings to meet your most exacting specifications.

These dynamotors are now being built in huge quantities for service all over the world. But facilities are available right now to build many more. For details on specific ratings and sizes, call your nearest Westinghouse office. Or write Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Dept. 7-N. Ask for special bulletin B-3242.

Remember, too, that Westinghouse builds a complete line of electrical equipment for aircraft—motors, generators, relay switches, voltage regulators, radio blower motors. Ask us for full information.

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LOW RIPPLE
Commutators, brushes, brush springs and magnetic proportions are precision-controlled to provide minimum ripple.

LONG LIFE
Westinghouse Dynamotors are designed for long life with minimum maintenance. They are built to operate 1,000 hours without servicing under average operating conditions.

QUIET OPERATION
To insure minimum noise level standards, armatures are dynamically balanced, bearings and end brackets matched to within .0001 of an inch.

EXCELLENT COMMUTATION
Commutators are designed for high standards of electrical service and rigidly built to Westinghouse specifications which insure long wear, little maintenance, and excellent commutation under all service conditions.

Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

DYNAMOTORS

has been given. The extremely methodical treatment brings out very clearly the existing analogies so that the principal objective in the book certainly has been accomplished. As stated in the introduction, the principal objective is "the establishment of analogies between electrical, mechanical and acoustical systems so that anyone familiar with electrical circuits will be able to analyze the action of vibrating systems."

The analyzation of the action of vibrating systems has been carried out in another recent book, "Electromechanical Transducers and Wave Filters" by Warren P. Mason, which was reviewed in the February issue of "Electronic Industries." The subject of the two books is the same, the approach is entirely different. While the present book gives the background for the analogies and develops the corresponding differential equations, Mason's book assumes all this as known and presents network theory and its applications to equivalent mechanical and acoustical systems. The two books supplement one another, one stressing the basic principles involved and the other, the procedure as well as the results.

Radio Engineers' Handbook

By F. E. Terman, Prof. of Electrical Engineering, Stanford University, Past Pres. I.R.E., published by McGraw-Hill Book Co., New York City (18), 1943, 1018 pages, $6.00.

A book of this type, containing 13 sections that cover practically every subject of interest to a communication engineer cannot be reviewed in detail. It is hoped that calling it a "practical" book will not give a wrong impression as to its scope because for some reason "practical" seems to be an antonym for "theoretical."

Actually this reviewer finds it the most carefully laid out manual on radio design matters ever noted. Radio engineers who have to work at every kind of problem and to come up with an answer on all of them, will appreciate the thoroughness of the presentation. It contains a minimum of historical and reportorial material on what has been done, and a maximum of concrete design data on how to do it. Liberal references, largely from I.R.E. Proceedings, files and other easily-obtainable sources permit further study of nearly every subject. The book provides an excel-

CASED MODEL

RAYTHEON

Voltage Stabilizers

Accurately Control Fluctuating Voltage to ± ½%

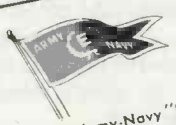
Raytheon Voltage Stabilizers are available for incorporation in your product or equipment for almost any type of service. There are three designs —cased, uncased and endbell models—to meet your installation requirements. All Raytheon Stabilizers deliver controlled output voltage to ± ½% over their full rating. Write, outlining your needs —Raytheon Engineers will make recommendations.

Raytheon Voltage Stabilizers Give You These Outstanding Advantages . . .

- Hold constant varying A. C. input voltage to ± ½%.
- Stabilize at any load within their ratings.
- Quick action . . . stabilizes within 2 cycles . . . variations cannot be observed on an ordinary volt meter.

Endbell Model

- Wide A. C. input voltage limits . . . 95 to 135 volts.
- Entirely automatic . . . no moving parts . . . requires no maintenance . . . connect it and forget it.



The coveted Army-Navy "E", for Excellence in the manufacture of war equipment and tubes, flies over all four Raytheon Plants where 12,000 men and women are producing for VICTORY.

RAYTHEON MANUFACTURING Company

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lent desk reference book and makes interesting casual reading because at almost any place to which the book may be opened one is likely to find information on details or arrangements that somehow he has lost track of.

Certainly the result belies the accuracy of the recent congressional edict as to the capabilities of a college professor in practical matters. A very satisfactory reception by communication men is predicted.

Magnetic Circuits and Transformers

By the E. E. Staff, Massachusetts Institute of Technology, published by John Wiley & Sons, Inc., New York, Chapman & Hall Ltd., London, 1943, 718 pages, $6.50.

In the second volume in the Principles of Electrical Engineering series undertaken by the Staff of the Massachusetts Institute of Technology, the text is a basic course on computation of magnetic-circuit performance, principles associated with the concepts of interlinked electric and magnetic circuits, and their application to the design and analysis of transformers. Though some mathematics is used, the treatment is based on describing the physical performance in plain language; it is an essentially practical book, intended for the engineering student or practicing engineer, with many considerations and suggestions as to material and dimensions of windings, cores and transformers.

Handbook of Chemistry and Physics

Editor in Chief Charles D. Hodgman, M.S., Associate Professor of Physics at Case School of Applied Science, published by Chemical Rubber Publishing Co., Cleveland, Ohio, February 1943, 2551 pages, $4.00.

A revised 27th edition of the handbook carrying over one hundred pages of new composition has been published. As in the previous editions, an effort has been made to present useful data in condensed form so as to afford ready reference for the user.

The volume contains 271 pages of mathematical tables, about 1000 pages on properties and physical constants, 200 pages of general chemical tables, a 200 page chapter on specific gravity and properties of matter, 154 pages on heat, 5

From Munda to Messina...

Sturdy Majestic-built Walkie-Talkies are carrying our military communications into the very jaws of the enemy's guns. In the air, on the ground, other Majestic-built electronic equipment, including infinitely precise crystals by the thousands, are serving our armed forces on every front. And today —the Majestic production lines are longer and busier than ever.

No task has been too complex—no schedule too severe, Majestic is doing it well—is looking for more and bigger jobs to do.

But none of this would have been possible without the help and cooperation of our parts and materials suppliers. Whatever credit Majestic may earn in the war production program, we pass on in generous measure to these companies, with a "Well done—and thank you."

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MAJESTIC RADIO & TELEVISION CORP.

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Builders of the Walkie-Talkie—Radio of the Firing Line

pages on sound, 450 pages on electricity and magnetism, 152 pages on quantities and units, and 144 pages on miscellaneous subjects.

It will be of interest to the electronic engineer that a special section of 43 pages is devoted to radio formulas, including characteristics of thermionic vacuum tubes, though the value of the book for anybody working in this field is more likely to be in the amount of information on other less familiar problems which may come up in connection with development and research in electronics.

NEW BULLETINS

Rack and Panel Electrical Connectors

The first bulletin to be issued on Type DP Rack and Panel Electrical Connectors has just been released by Cannon Electrical Development Co., 3209 Humboldt St., Los Angeles, Calif.

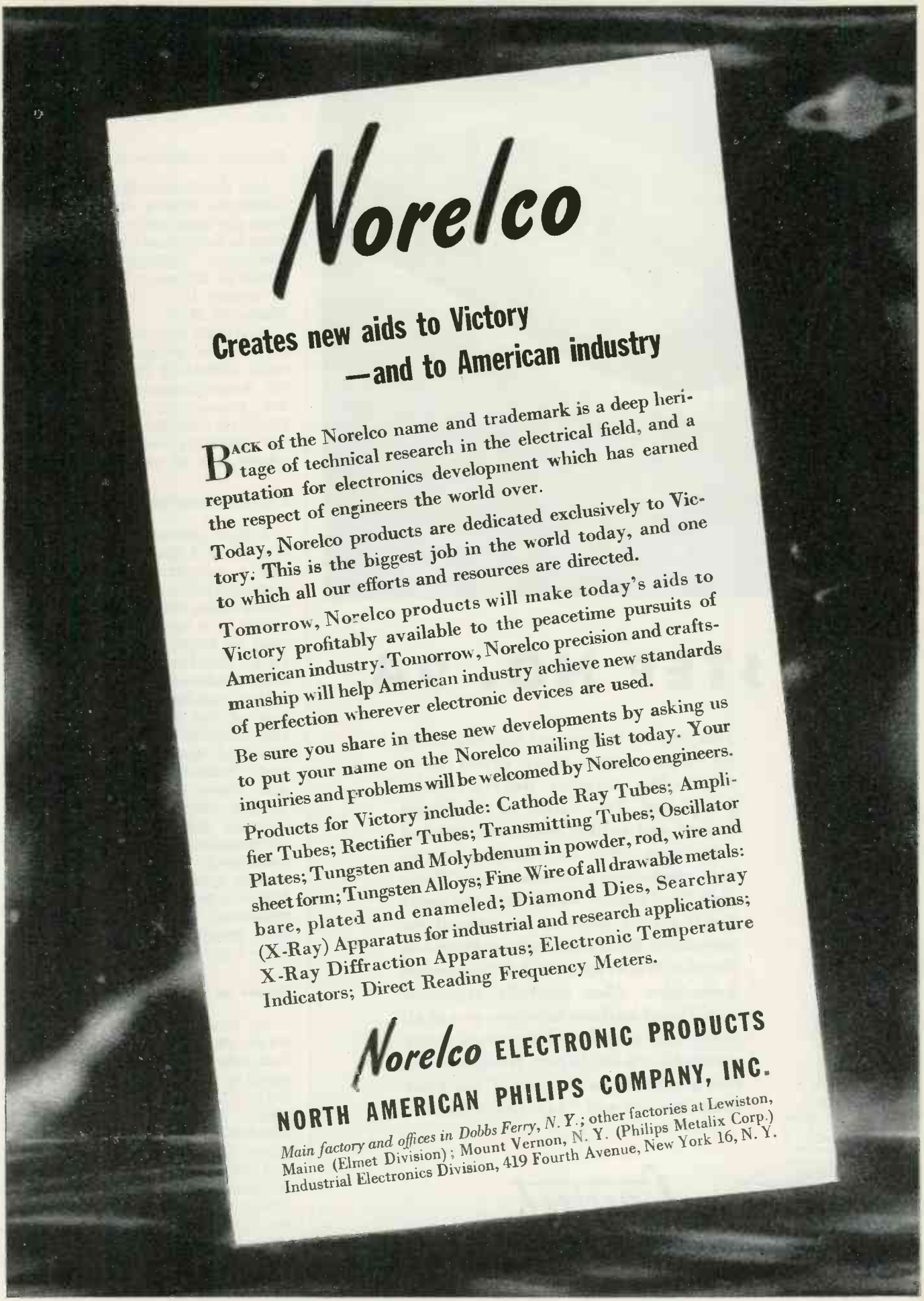
The new bulletin contains 28 pages and includes description, applications, illustrations, sketches and tabular data on connectors constructed to fit the chassis of types used in a variety of applications in radio and instrument installations in aircraft, tanks, electrical pipe organs, etc.

Aircraft Terminal Catalog

Thomas & Betts Co., Elizabeth, N. J., has published a revised and enlarged edition of Aircraft Catalog No. 36. It contains up to date information on electrical connectors for aircraft wiring, covering Sta-Kon terminals, wedge-on terminals, tite-bind terminals, bonding jumpers and specialties. Owners of the first edition are to receive a complete set of new pages to bring catalogs up to date.

New General Electric Primer on Radio

A 68-page primer intended to help the beginner understand the fundamentals of radio has been produced by the General Electric Electronics Department. The book is the outgrowth of a training course in radio prepared for people employed in nontechnical positions in the radio industry. The scope of the material is broad, with mathematical and engineering treatment on fundamental theory held to a minimum. Hence, the point of view of the practical serviceman has been adopted rather



than that of the advanced engineer.

Copies may be obtained from the Advertising Division, Electronics Department, General Electric Co., Bridgeport, Conn., for 25 cents in coin.

Remote Indicators and Motors

New developments in the field of miniature motors and control devices are described in the catalog of Remote Indicators and Motors with Electronic Applications, recently issued by Kollsman Instrument Div. of Square D Co., 80-08 45th Ave., Elmhurst, N. Y.

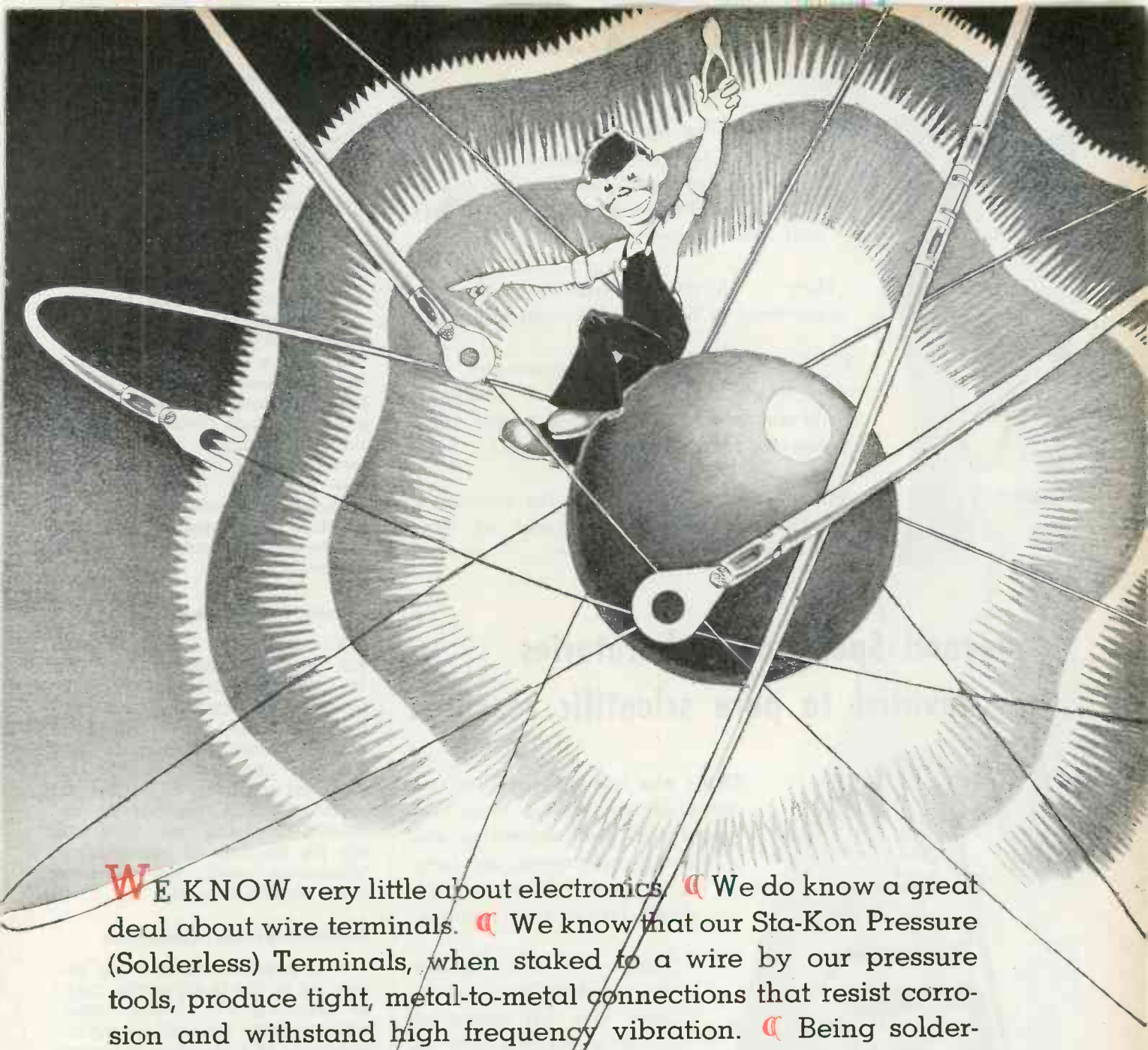
Rotatable transformers, drag cup motors, two phase generators, remote indicating devices, including the micro-horsepower telegon unit, are among the units described. Complete information is given on the operating characteristics, size, weight, etc. of each unit.

Custom Molding Plastics

A brief picture story of the operation of a plastic molding plant and a comparative table on the characteristics of various types of compression molded plastics are included in a new 4-page bulletin issued by Imperial Molded Products Corp., Chicago. The bulletin provides condensed information on the custom molding facilities and service of the company and shows and describes the work of the engineering, mold-making, production and finishing departments. It also shows some of the typical molded parts produced. A table covering both thermosetting and thermoplastic materials provides a convenient method of checking various types of plastics on twelve different properties, including heat resistance, acid resistance, cold flow resistance, tensile strength, impact strength, etc.

Tubes in One Syllable

To anyone who is seeking a simple explanation of modern vacuum tube functions, a bulletin just issued by General Electric, Schenectady, N. Y., entitled "How Electronic Tubes Work," is recommended. In 24 pages printed in two colors, the construction, operation and purposes of the principal types of tubes used for industrial application are set forth. Starting with an illustrated description of the various elements that make a tube work, the booklet includes easily understandable diagrams showing



WE KNOW very little about electronics. ¶ We do know a great deal about wire terminals. ¶ We know that our Sta-Kon Pressure (Solderless) Terminals, when staked to a wire by our pressure tools, produce tight, metal-to-metal connections that resist corrosion and withstand high frequency vibration. ¶ Being solderless, Sta-Kons install fast. Made in any desired size or type of tongue. ¶ Approved. Patented. ¶ Under the T&B Plan, Sta-Kons, like all other T&B products, are sold only through T&B Distributors who reduce the manufacturer's selling costs, thereby reducing the cost of all electrical equipment to the user. ¶ T&B Engineering Service is available through T&B offices in leading cities. Feel free to use it. ¶ Write us for Sta-Kon Bulletin No. 500.

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how and why the elements do the things they do. Included are explanations of Kenotrons, Pliotrons, Phanotrons, ignitrons, glow tubes, phototubes and pentodes.

Colloidal Graphite

A four-page illustrated bulletin, No. 431-DD, on "dag" colloidal graphite for impregnation and surface coatings has just been released by the Acheson Colloids Corporation of Port Huron, Mich.

This is a detailed discussion of the impregnating capacity of colloidal graphite dispersions and the application and results of impregnation and surface coating of colloidal graphite for various industrial products. It includes the reasons for colloidalization of graphite for this purpose and notes on the methods used to impregnate materials.

Wartime Telephone Helps

Though small in size, "75 Ways for Telephone Folks to Help Win the War" booklet recently published by Kellogg Switchboard and Supply Company, 6650 South Cicero Avenue, Chicago, incorporates seventy-five useful and specific tips on maintenance of telephone equipment. The suggestions, explained in detail and illustrated are for the care of switchboards, telephones, cords, power equipment, outside lines, etc.

Radiotelegraph Apparatus

A 12-page catalog is being distributed by the McElroy Mfg. Corp., 82 Brookline Ave., Boston, Mass., which includes illustrations and descriptions of high-speed automatic radiotelegraph assemblies, the Wheatstone code tape perforator, automatic transmitters, high-speed recorders, etc. Also shown is a full color chart of codes and signals.

Metal Shielded Wire

The Precision Tube Co., Philadelphia, Pa., has recently published a four-page bulletin covering a new method of protecting insulated wires by means of metal shielding.

Panel Instruments

A four-page folder describing its alarm systems, thermometers, ventilators and chimes is published by O. B. McClintock Co., Minneapolis, Minn. Several models are illustrated.

INDUSTRY NEWS

Hector to WPB

Dr. L. Grant Hector, National Union Radio Co., Newark, N. J., late in July was appointed production consultant on miniature tubes in the War Production Board's Radio and Radar division.

Haydu Buys Building

Haydu Brothers, Plainfield, N. J., manufacturer of precision electronic products, has purchased a modern plant to be used as general sales offices. Sales of precision parts, neon equipment (after the war), and the complete line of burners, mixers, cross fires, etc., for the glass working industries, will be handled from the offices to be housed in the new building. The company is planning representation in the Latin American countries and will launch a campaign shortly.

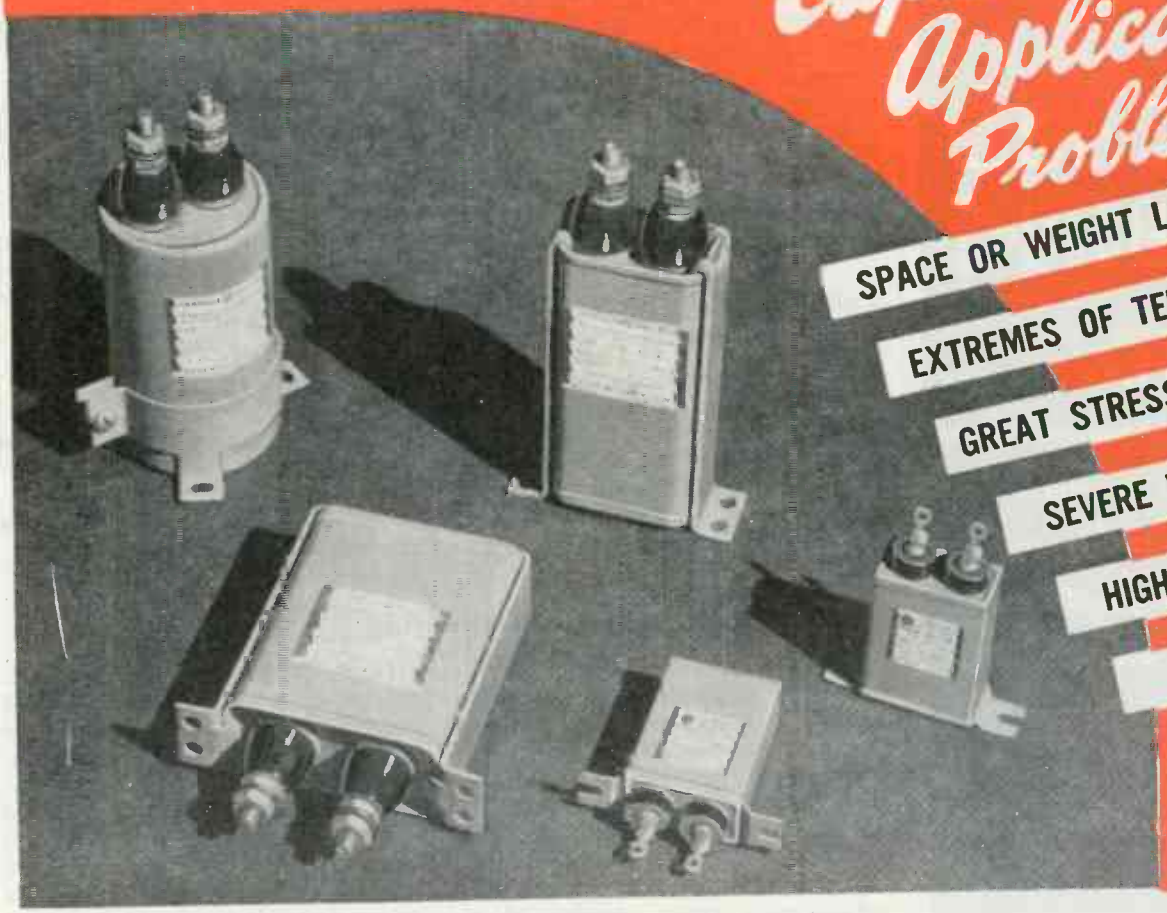
Plan More Tubes For Home Sets

Expansion of the production program for tubes for civilian home receiving sets is being studied by WPB. The proposed expansion would bring up production to about 50 per cent of normal.

Adams Joins Hytron

JOHN Q. ADAMS, lately employed in government work, has returned to industrial pursuits as a sales executive for the Hytron Corp., Salem and Newburyport, Mass. Previously connected with the Connecticut Radio & Television Corp., Mr. Adams has been associated with the radio industry for more than 20 years

HAVE YOU ANY OF THESE *Capacitor Application Problems?*



- SPACE OR WEIGHT LIMITATIONS
- EXTREMES OF TEMPERATURE
- GREAT STRESS OR SHOCK
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Whatever your specifications, we're likely to have the answer

WE are in an excellent position to provide you with hermetically-sealed capacitors for wartime applications. Our extensive engineering, research, and manufacturing facilities are at your service.

In some cases there will be no need to look further than our standard line of Pyranol* capacitors for built-in applications.

The line includes more than 350 ratings in space-saving shapes and sizes. Many of the ratings are available in three shapes—oval, cylindrical, rectangular—to make your design problems easier. And they can be mounted in any position.

BE SURE TO GET your copies of our time-saving catalogs on d-c (GEA-2621A) and a-c (GEA-2027B) types. Ask your G-E representative for them by number, or write to General Electric, Schenectady, New York.

**Pyranol is the G-E trade mark for capacitors and for askarel, the synthetic, noninflammable liquid used in treating G-E capacitors.*

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GENERAL ELECTRIC

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Military Super Capacitors

Industrial Condenser Corp., Chicago, is in production on a new line of heavy duty, high voltage capacitors for continuous operation up to 150,000 volts working. A typical 0.5 mfd unit for 50,000 volts dc is 28 in. high and weighs 175 lb. It is designed for 24 hours continuous operation and total submersion in salt water. The units can be used in surge and lightning generators, and are equipped with solder seal terminals for operation at highest altitudes and under high humidity.

Tubes in the Candy Industry

C. J. Woods, sales engineer of the Industrial Electronics division of the North American Philips Co., Inc., addressed a meeting of the Candy Executives' Club Monday evening, August 16, at the Hotel Bossert in Brooklyn, on postwar applications.

Stressing the importance of X-ray ("Search-Ray") equipment to avoid lawsuits resulting from foreign inclusions in candy, Mr. Woods showed a typical modern tube and a special Geiger tube designed for certain types of automatic X-ray inspection.

High-frequency dielectric heating for certain types of drying operations was discussed as a distinct possibility with several advantages over conventional methods.

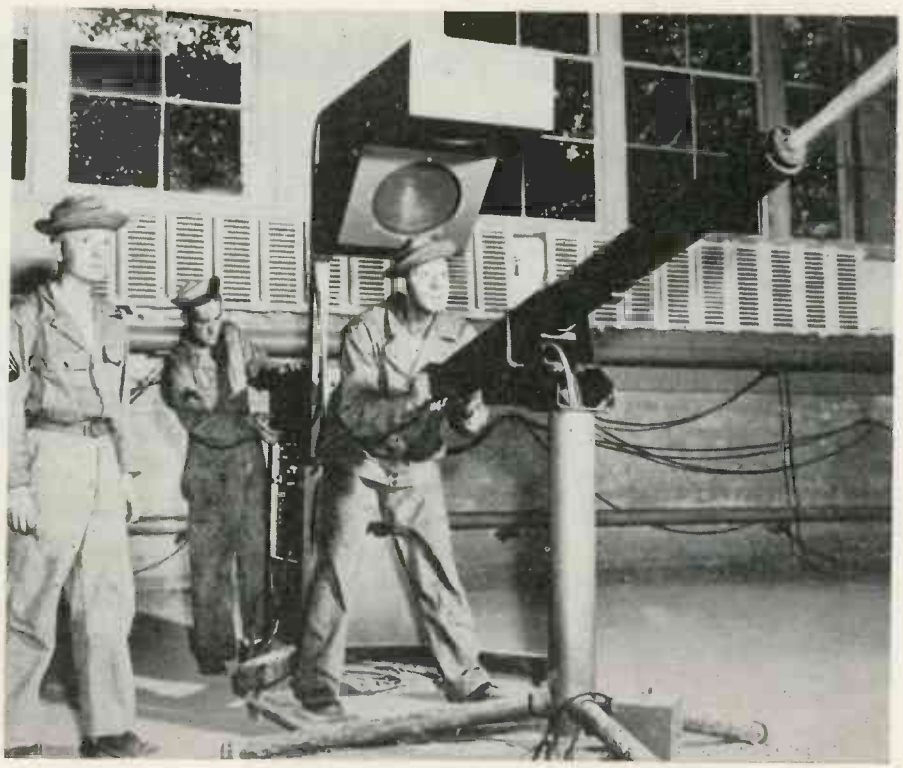
Precise control of temperatures, and germicidal irradiation were other probable postwar tube applications described.

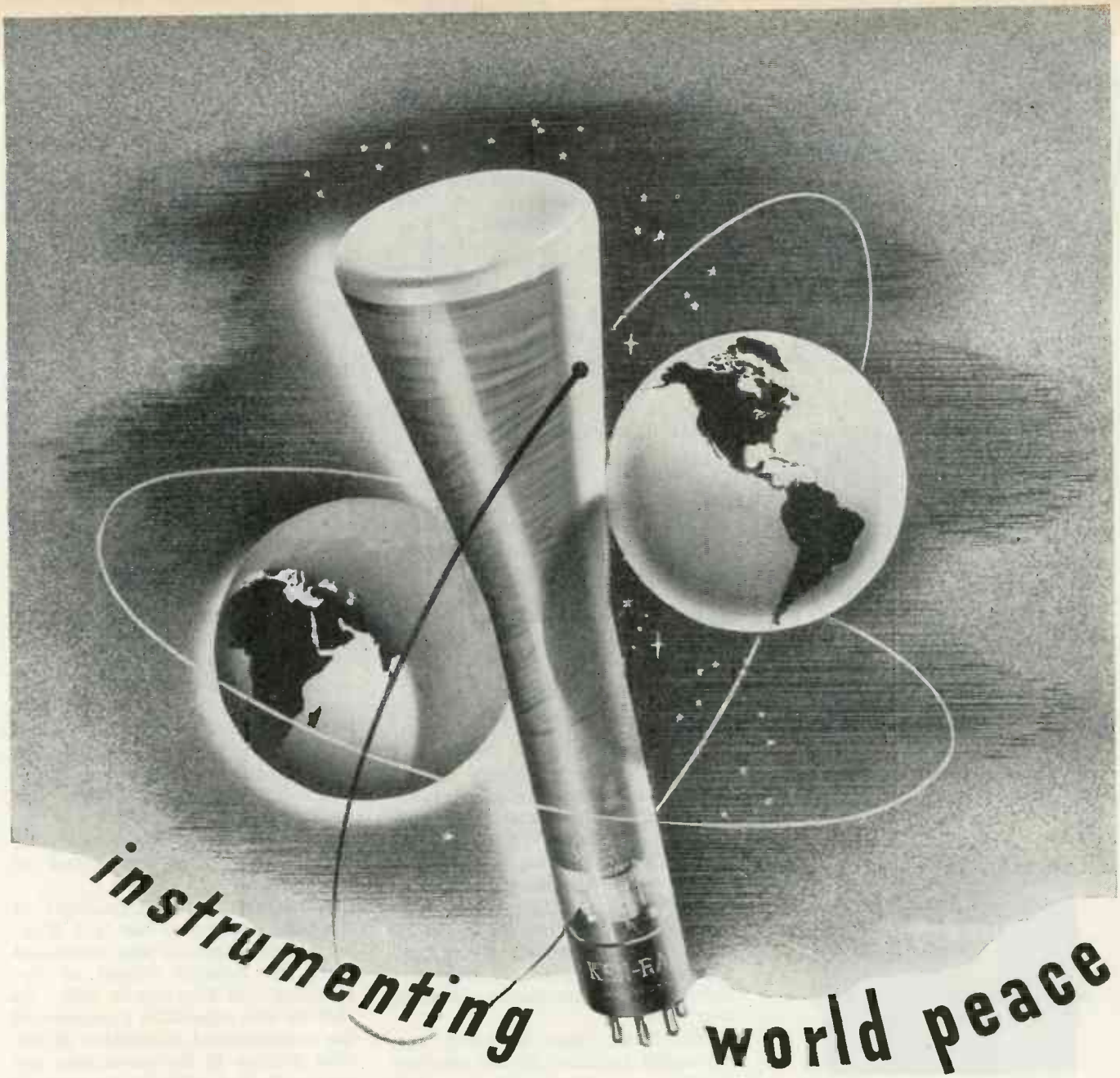
Sylvania Elects Poor

Walter E. Poor has been elected president of Sylvania Electric Products, Inc., Emporium, Pa. He succeeds B. G. Erskine who has been elected chairman of the board.

Realism in Machine Gun Training

Here's a new kind of war training with a decidedly electronic flavor. Working together, Operadio Mfg. Co., St. Charles, Ill., and Edison General Electric Co., Chicago, have produced a mock up of a machine gun which fires just like one of those lethal weapons and sounds like one. Operadio took care of the sound part, which consists of a phonograph record of a 50-caliber machine gun in action with a background of tanks, dive bombers, screaming bombs and bullets and heavy guns. When the trigger is pulled by trainees, everything happens at once. The gun, hydraulically operated, spits lead pellets at a moving target, an amplifier and loudspeaker provide the realism. There are about 1000 of the trainers in use and it is estimated that they save about $10,800,000 worth of ammunition an hour.





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Ken-Rad completely converted to the mightiest of all war tasks looks to the day when it can place at the command of peaceful progression the techniques developed for war New miracles will then be performed with Ken-Rad electronic tubes

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CATHODE RAY TUBES

INCANDESCENT LAMPS
FLUORESCENT LAMPS

SPECIAL PURPOSE TUBES
METAL AND VHF TUBES

OWENSBORO KENTUCKY U S A

Dr. Rosenthal Directs Scophony Research

Dr. A. H. Rosenthal has been appointed director of research and development of Scophony Corp. of America, New York. He will head a group of scientists and engineers engaged in research in television, and the field of electronics in general, including various applications of supersonics. Arthur Levey is president of Scophony with which are associated Television Productions, Inc. (a Paramount subsidiary) and General Precision Equipment Co.

Solar Moves Offices

Solar Mfg. Corp. and Solar Capacitor Sales Corp. have moved their general offices to 285 Madison Ave., New York, from the Bayonne, N. J., plant. Manufacturing activities continue in this plant as well as in Eastern plant No. 2 at Bayonne, West New York, and in plant No. 3 at Chicago.

I. J. Kaar Manager of G-E Receiver Div.

I. J. Kaar and G. W. Nevin have been appointed managers of the receiver and tube divisions, respectively, of General Electric's Electronics Department, announces Dr. W. R. G. Baker, vice-president in charge of the department. The receiver division is located at the company's Bridgeport, Conn. works, while the headquarters of the tube division are located in Schenectady, with manufacturing plants in four cities.

Mr. Kaar, who formerly was managing engineer of the receiver division, was graduated from the University of Utah in 1924 with a B.S. degree in electrical engineering. In October of that year he joined General Electric at Schenectady as a student engineer on "Test," and in 1925 was transferred to the radio engineering department where he was engaged for several years on the development and design of high-power transmitters. In January, 1933, he entered the General Engineering laboratory to work on the development of radio receivers, and made many contributions to vacuum tube and radio circuit design.

In September, 1934, Mr. Kaar was transferred with the nucleus of what is now the receiver division engineering section to the G-E Bridgeport plant. On November 15 of the same year he was appointed designing engineer of the radio receiver section there. Later, when the G-E Radio and Television (now Electronics department) was formed, Mr. Kaar became designing engineer of the receiver division of that department. On October 1, 1941, he was named managing engineer of the receiver division, the position he held until his new appointment.

Mr. Kaar is a native of Dunsmuir, Calif. He is a member of the Society of Naval Engineers, Sigma Nu, and Tau Beta Pi, a fellow and past director of the Institute of Radio Engineers, and chairman of the television technical committee of that body.

Mr. Nevin, the new manager of the tube division of the G-E Electronics department, was graduated from the Bentley School of Accounting and Finance in 1929. In 1942 he was appointed chairman of the management committee of the tube division of the electronics department, the position he held at the time of his new appointment. He is a native of Freedom, Idaho.

I. J. KAAR

RCA Lab Organization

Following dedication of its modern research facilities last September, RCA Laboratories has revealed organization details. The project is under the direct charge of vice-president Otto S. Shairer, who is also chairman of the Planning Committee, of which Ralph R. Beal, research director, is group chairman for engineering and E. C. Anderson, manager of the license division, group chairman for commercial applications. Under Mr. Beal is E. W. Engstrom, director of general research; V. W. Zworykin and B. J. Thompson, associate directors of general research; and the

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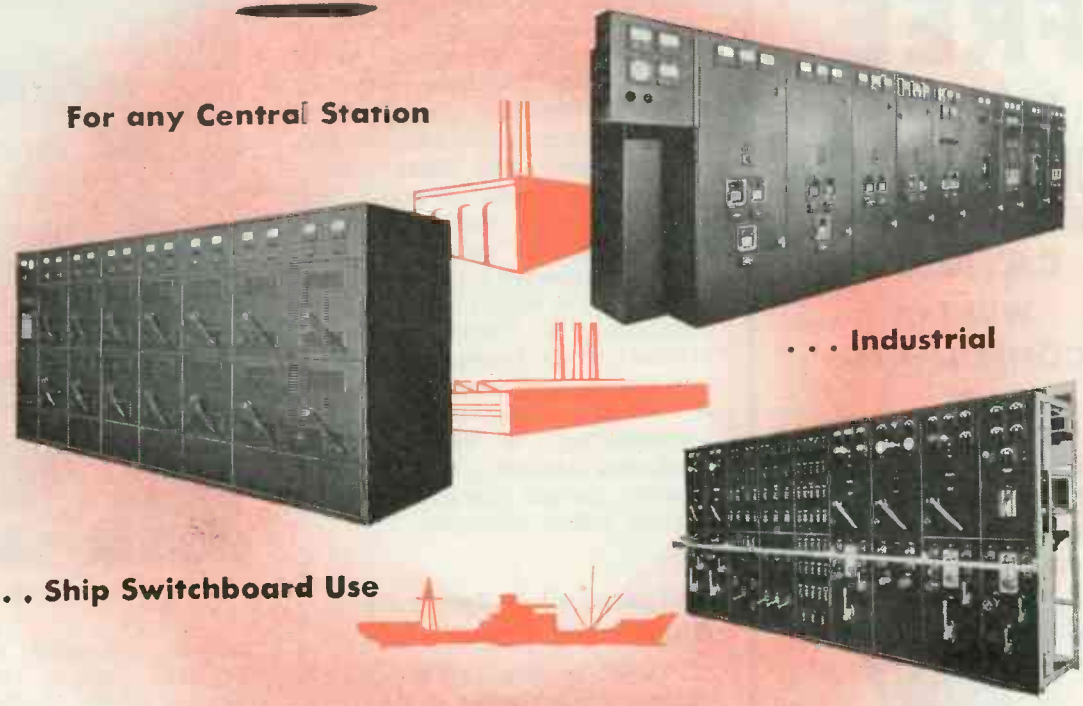

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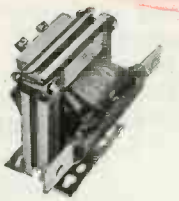
Type CT Indoor Current Transformer for 5, 8.7 and 15-kv service built to the standardized EEI-NEMA dimensions and performance.



Type KO Indoor Current Transformer for 5,000-volt service. Dependable metering accuracy . . . lower burdens.

Type PT Indoor Potential Transformer. Primary rating 230 to 14,400 volts. High accuracy . . . heavy burdens . . . high impulse level.

Type VS Indoor Potential Transformer. Primary rating 230 to 2,300 volts. Metering accuracy . . . heavy burdens . . . small size and weight.

Type CV Indoor Potential Transformer. Primary rating 115 to 600 volts. New lightweight design . . . small size . . . high accuracy . . . heavy burdens.

Regardless of your requirements, you'll do better by standardizing on Westinghouse Instrument Transformers.

First, completeness of line assures your getting the *one* unit that meets your specific size . . . weight . . . mounting . . . burden limitations . . . with highest accuracy.

Second, you benefit from uniform standards of manufacture and performance.

Third, you realize tangible benefits from Westinghouse research and manufacturing experience on all types of transformers. The development of Hipersil steel, which carries ⅓ more flux with less weight, is a case in point.

Five units (as illustrated) meet 80% of all requirements, but many more types and sizes are available. See your Westinghouse Instrument Transformer Catalog No. 45-000 . . . make it your *standard* reference.

For Navy and other jobs requiring highly specialized units, Westinghouse furnishes Instrument Transformers built to specifications. Ask your Westinghouse Representative for details. Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa., Dept. 7-N.

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following research engineers: G. H. Brown (transmitters); W. L. Carlson (radio receivers); R. S. Holmes (radio systems); R. D. Kell (television); H. F. Olsen (acoustics); C. J. Young (electro-mechanics); Dr. I. Wolf (radio systems); H. Sadenwafer, manager of laboratory service; H. H. Beveredge, director of communications research; and the following research engineers: H. O. Peterson (radio reception); C. W. Hansell (radio transmission); J. L. Callahan (terminal facilities); A. F. Van Dyck, manager industry service division; and these section engineers: G. Mountjoy and S. Wm. Seeley; directly under Harry G. Grover, general patent attorney, are these experts: J. G. Norton (receivers); S. B. Smith (facsimile and television); H. Tunick (communications); C. D. Tuska (radio direction finding and miscellaneous); C. W. McClair (tubes); C. L. Davis (Washington); W. Van B. Roberts (technical adviser); W. H. Martin (foreign patent attorney); A. O. Carlson (office manager).

"Klystron" is Sperry's Registered Trademark

Paul B. Hunter, patent attorney for the Sperry Gyroscope Company, Garden City, N. Y., calls attention to the fact that the word Klystron is a registered trademark of the Sperry Gyroscope Co., Inc., and points out that when the word is used, indication should be made by capitalization or quotation marks that this is a registered trademark to avoid improper use of the term.

Weather Test

R. H. FRYE, chief engineer, Electronic Laboratories, Inc., Indianapolis, determines whether a power supply unit will work in any weather by testing it under operating conditions in new temperature, humidity and altitude chamber

Lt. Commander Henry Hutchins, USNR

Henry A. Hutchins, formerly sales manager of National Union at Newark, N. J., rejoined the Navy shortly after the outbreak of war and is now a Lieutenant Commander stationed at the Naval Training School (Indoctrination) located at the University of Arizona, Tucson. Comdr. Hutchins is a graduate of Annapolis, and throughout his active commercial career in radio, held a warm interest in everything having to do with the Navy and ships.

LT. COMDR. HENRY HUTCHINS

Need a Portable Oscillograph?

Word comes from the Daven Company, 191 Central Ave., Newark, 4, N. J., that it is offering for sale or trade a Westinghouse portable oscillograph, type 492509, Serial No. 1059872, six strings, with positions for three additional strings. The unit is complete with photographic attachments and operating spares.

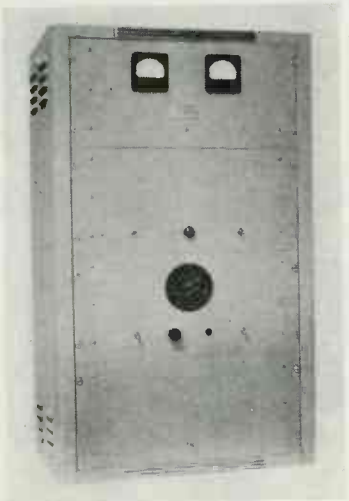
Hallicrafters Entertains Ingles

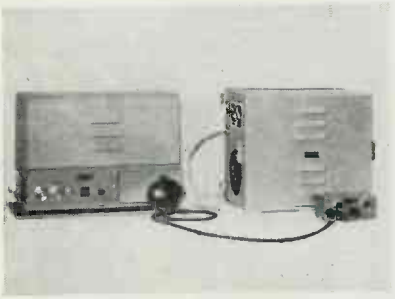
Major General Harry C. Ingles, newly appointed Chief Signal Officer of the U. S. Army, paid his first visit to Chicago late in July and was entertained by Hallicrafters and other manufacturers that are producing Signal Corps equipment. Other high-ranking army officers at the gathering included Lieutenant Colonel John M. Niehaus and Brigadier General Edgar L. Clewal.

RADIOTELEPHONE EQUIPMENT

FOR *Your* APPLICATION

Complete 22 Watt High Frequency Mobile Installation

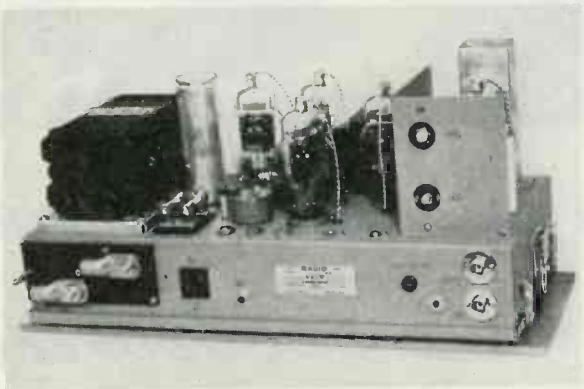




Type 11X Receiver and PTL-10X Transmitter for Mobile Applications.

★ ★ ★ ★ ★ ★ Complete 50 Watt Central Station Installation. ★ ★ ★ ★ ★ ★

Type PRS-9X, 30-40 MC Mobile Receiver with Dust Cover Removed.



Type PTS-22X, 30-40 MC Mobile Transmitter with Dust Cover Removed.

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PARTIAL LIST OF TYPICAL PRODUCTION MODELS

SERIES 17	10 Watt Multi-Channel Transmitter, Receiver and Power Supply in 8¾" x 15" x 11" Cabinet. 6 and 12 Volt DC and 117 Volt AC Models available.
SERIES 26	20 Watt Multi-Channel Transmitter and Receiver available for operation from 6, 12, 32 and 110 Volts DC or 117 Volts AC.
SERIES 56	50 Watt Multi-Channel Transmitter and Receiver available for operation from 12, 32 and 110 Volts DC or 117 Volts AC.
SERIES 6	Includes Tunable and Multi-Channel Fixed Tuned Receivers for Mobile, Marine or Central Station application.
TYPE 11A	Single Frequency Crystal Controlled Station Receiver for frequency ranges up to 8,000 KC.
TYPE 11X	Crystal Controlled Mobile Receiver, for frequency ranges up to 8,000 KC.
TYPE PTL-10X	Instant Heating 10 Watt Mobile Transmitter, for frequency ranges up to 8,000 KC.
TYPE PTL-22X	Instant Heating 22 Watt Mobile Transmitter for frequency ranges up to 8,000 KC.
TYPE PTS-22X	Instant Heating 22 Watt Mobile Transmitter, range 30-40 MC.
TYPE PR-9X	Crystal Controlled Mobile Receiver, range 30-40 MC.
TYPE PRS-9A	Crystal Controlled Station Receiver, range 30-40 MC.

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KAAR ENGINEERING CO.

PALO ALTO, CALIFORNIA

Manufacturers of High Grade Mobile and Central Station Radiotelephone Equipment

"Tee" Promoted by RCA

The title of assistant general sales manager of RCA-Victor Division, Camden, N. J., has just been conferred on L. W. Teegarden, long experienced radio executive, who will have charge of all distributing, selling and warehousing, as well as supervising the company's four regional directors. H. C. Bonfig, general sales manager, announced "Tee's" appointment. Mr. Teegarden has been active in radio and electronic operations since 1930, when he came to RCA from the old Edison Lamp Works at Harrison, N. J.

L. W. TEEGARDEN

Record Groove Cut into Film Ribbon

To The Gray Mfg. Co., Hartford, Conn., has been assigned a patent issued to Henry P. Clausen of White Plains, N. Y., for a "machine for making a long-playing sound record." Instead of the ordinary type of disk record, the new kind patented by Mr. Clausen resembles, in principle, a movie sound track in which the sound-making groove is cut into a long roll of material cut to any length desired. With such a device an entire musical composition of any length could be made so that it all could be played without the usual interruptions for the changing of record disks.

The machine that plays this kind of recording has no turntable, but an arrangement by which the recording is unwound from one spool and rewound onto another, with the phonograph pickup arm traveling on the "record."

RELAYS BY GUARDIAN...

★ The smooth operation of rail and airlines depends largely upon efficient traffic control systems. Split-second response, unfailing operation, and a minimum of maintenance are characteristics of these systems.

The Series 5 D.C. and the Series 10 A.C. relays are adaptable to numerous signal system applications. Both A.C. and D.C. types are sensitive and require but a minimum of power. Contacts are adjustable; switch capacity ranges up to double pole double throw. Series 5 D.C. relay consumes a minimum of .01 watts, maximum 5.5 watts. Delayed attract or release is available on this unit. Series 10 A.C. requires an average of 5 VA; minimum .3 VA with single pole single throw contacts of 1.5 amp. capacity.

Write for Series 10 bulletin for A.C., or Series 5 bulletin for D.C. applications.

Series 10 A.C. Relay

Special base. (Round base is standard.) Dimensions: Length 3-9/32"; Width: 2-3/8"; Height 2-7/32". Weight: Approx. 11 ounces with cover.

GUARDIAN ELECTRIC

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A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

Universal Mike in New England

The Gerber Sales Co., Boston, Mass., has been appointed New England factory representative for the Universal Microphone Co., Inglewood, Calif.

Minderman to FCC

Earl Minderman was appointed early in August, director of information for FCC. For the past year he has been director of OWI's division of research and information, previously was national director of information for WPB.

RCA Demonstrates Research Facilities

RCA Laboratories late in July was host to a group of editors who were shown many of the wonders of the corporation's research center officially dedicated last September in Princeton, N. J. It is here, pointed out vice-president Otto S. Shairer, in charge of the laboratories, that about two-thirds of all research now is carried on with some 360 of the company's more than 600 research specialists at work with the most modern of facilities. Following a trip through the various individual laboratories, visitors were shown these things: A new method of treating glass with hydrofluoric acid, applicable quickly and easily to large sheets, and practically eliminating surface reflection and increasing light transmission; the process will have important applications in optical systems, notably for television work; a new optical system for television operating at the equivalent of f.7, or four times faster than the hitherto fastest f1.5 which permits larger and brighter projection of pictures; a new method of "tacking" thin plywood sheets together with radio frequency-generated heat prior to bonding also electronically; an electronic counter capable of measuring speeds up to .00001 second and demonstrated measuring the speed of a rifle bullet as it passed through successive targets a little over a foot apart; numerous demonstrations of industrial electronic heating, supplemented by motion pictures showing modern methods and applications; a description and demonstration of the electron microscope by Dr. V. K. Zworykin, who explained newly perfected methods of examining structure of metals virtually by making "finger-prints" of them. Major research at the present, stated Mr. Shairer, centers on cathode ray tubes and their manifold uses.

Saved "Moly"

COL. C. O. BICKELHAUPT of Fort Monmouth, N. J., paid tribute to R. H. Amberg, president of United Electronics Co., Newark, N. J., for his saving of molybdenum, commonly used in pure sheet form for the anode plate in tubes, by substituting a zirconium-treated graphite anode. Awarding the coveted Army-Navy "E," Col. Bickelhaupt termed Mr. Amberg "a tube engineer of distinction who has been in the transmitting tube field for 30 years"

MEASURING STRESS AT 60 M.P.H.

CALLS FOR IRC RESISTORS

A locomotive driving-rod packs plenty of power as it hurtles its heavy load over the rails. To detect and accurately measure stress changes in driving rods, under actual running conditions, presented an exciting challenge to engineering ingenuity. Heretofore such data was approximated through polaroid means or empirical formulas, based on scale models.

ANOTHER IRC DEVELOPMENT

Research on the intricate device finally evolved, indicated the need for a very thin resistance element of uniform characteristics . . . sensitive enough to accept every stress modification yet sufficiently stable so that readings made from time to time would be comparable. I R C engineers solved the problem by a unique application of I R C's exclusive Metallized coating to a non-conductive plastic strip.

If you are confronted with a question involving resistances, why not consult I R C, the company that makes resistors of more types, in more shapes, for more uses than any other manufacturer in the world?

* PREFERRED FOR PERFORMANCE * FIXED & VARIABLE RESISTORS

INTERNATIONAL RESISTANCE COMPANY

425 N. BROAD STREET • PHILADELPHIA

U. S. Army Signal Corps Photo

RMA Export Committee Again Headed by Coogan

Walter A. Coogan, director of the International Division of Sylvania Electric Products, Inc., has been reappointed Chairman of the Export Committee of the Radio Manufacturers Association for the coming year.

Electronic Illumination May Be 90% Cheaper

Electric light costing only a tenth of what it does today and used lavishly in our homes is foreseen as a practical possibility for 30 years hence by Ward Harrison of Nela Park, Cleveland, Ohio, in a report to the Illuminating Engineering Society.

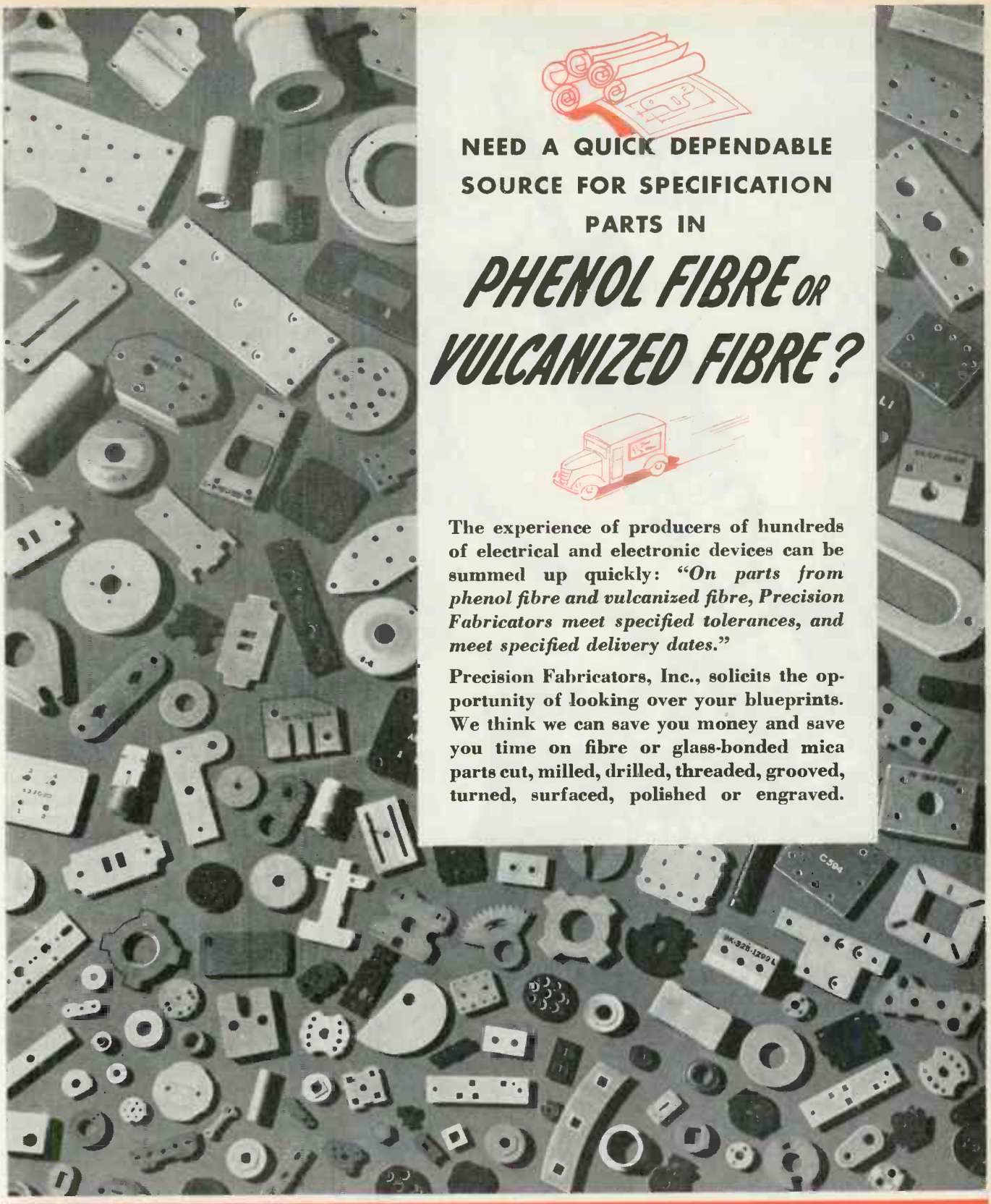
Our lighting of tomorrow may be as different from present-day lighting as Edison's first incandescent lamp differs from present lamps. A 100-watt lamp of today gives us five times the light of a lamp of the same wattage in 1913 and at one-half the cost for current.

The best artificial light source of today, the fluorescent lamp, is less than one-quarter efficient. Improvement in its efficiency will mean more and better light. Maintenance of candlepower and eliminating the starters now used on fluorescent lamps are only two of the refinements which the future may bring.

Greatest advantage of the fluorescent lamp, according to Mr. Harrison, is its superior quality of high-level local lighting, but future lighting promises to be many times brighter.

Lieutenant Berman

LIEUTENANT E. J. Berman, U. S. Signal Corps, recently paid a surprise visit to Shure Brothers, his former alma mater. He had just completed the prescribed course at Officers Candidate School, Fort Monmouth, New Jersey, and was greeted by his brother Jack (at right) and S. N. Shure. "Gene" Berman is remembered as the former sales manager of Shure Brothers, manufacturers of microphones and acoustic devices



NEED A QUICK DEPENDABLE SOURCE FOR SPECIFICATION PARTS IN

PHENOL FIBRE OR VULCANIZED FIBRE?

The experience of producers of hundreds of electrical and electronic devices can be summed up quickly: *"On parts from phenol fibre and vulcanized fibre, Precision Fabricators meet specified tolerances, and meet specified delivery dates."*

Precision Fabricators, Inc., solicits the opportunity of looking over your blueprints. We think we can save you money and save you time on fibre or glass-bonded mica parts cut, milled, drilled, threaded, grooved, turned, surfaced, polished or engraved.

PRECISION *Fabricators* INC.

ROCHESTER, N.Y. NEW YORK: 369 LEXINGTON AVE. • DETROIT: 14319 STRATHMOOR AVE. • PHILADELPHIA: 6710 HOLLIS ST.

SPECIFICATION FABRICATORS OF MYCALEX ★ PHENOL FIBRE ★

VULCANIZED FIBRE ★ RUBBER ★ ASBESTOS AND OTHER MATERIALS

Thanks, Mr. Landis

Editor, Electronic Industries:

Our Editorial Section has called my attention to the article on the War Emergency Radio Service, by S. P. McMinn, (W2WD) in the August issue of "Electronic Industries."

This is one of the most effective articles of its kind it has been my pleasure to examine, and the obvious care taken in the preparation and presentation gives it added value. If the Office of Civilian Defense has been of real aid in helping to prepare this article, it has been time well spent, but I am very sure that the major credit belongs to the author and your publication.

JAMES M. LANDIS,
Director

Office of Civilian Defense,
Washington, D. C.

Waterproof Coating for Soluble Crystals

A system of waterproof coatings for piezo-electric crystals is the invention of John H. Ream, of Cleveland, covered by U. S. patent 2,324,024.

Mr. Ream's invention consists in coating the crystals with alternating layers of metal foil and moisture-proof plastic adhesive, with the necessary electrical leads securely sealed in. These waterproof capsules are good even for quartz crystals, he claims, because they prevent the precipitation of moisture that sometimes impairs their efficiency in present setups.

Rights in the patent are assigned to the Brush Development Co.

Paper Reflector Slips Confuse Axis Plane Spotters

A United Press message from Berne, Switzerland, reports a new device that counteracts enemy radio-location apparatus and complicates the detection of Allied planes, being used by British fliers.

During the raids on Milan, Turin and Genoa, thousands of strips of paper, an inch wide and one foot long, black on one side and with a metallic coating on the other were dropped by RAF planes, it was stated. Their use was allegedly discovered by a young technician at a radio location station who was experimenting independently.

He found that they deflect the micro-waves and beams of radio location apparatus and baffle operators endeavoring to detect and locate Allied planes.

These Facts We Know to be True . . .

Brush Spring for Aircraft Radio Dynamotor

"Micro-Processed" for best combination of strength, electrical conductivity, and resistanee to heat.

Design stress, 68,000 lb. per sq. in. for service at 270 deg. F.

Produced by the hundred thousand to tolerances of:

± .002 in. on outside or inside diameter
± 4% on brush pressure at specified compressed length.

Calibrated Spring for Aircraft Instrument

"Micro-processed" for minimum drift and maximum proportional limit.

Design stress, 65,000 lb. per sq. in.

Produced by the thousand to tolerances of:

± .004 in. on free length
± .001 in. on outside diameter
1 deg. on squareness of ends
± 0.6% deviation from standard deflection curve
0.2% maximum drift, full load for 24 hours

Flexible Centering Ring

Punched and formed while soft and ductile, then hardened to a tensile strength of 200,000 lb. per sq. in. "Micro-processed" by the thousands to hold center in plane of rim to within .005 in.

Illustrations Approximately Twice Size

THESE three beryllium copper springs may well be considered "fussy"—yet they were produced in the quantities noted—by the same production control routine used by Instrument Specialties Company on hundreds of less rigid but nonetheless important spring jobs.

These springs owe their success to "Micro-processing"—a precise technique by which the extraordinary spring qualities of beryllium copper are consistently predicted and controlled by I-S through every step of production, beginning with the spring wire itself.

Spring users are rapidly learning that they can expect more of their springs. As a result, many manufacturers are designing more service life into springs; are setting up and are obtaining closer tolerances and improved electrical qualities; are making steady use of our ability to control drift performance when necessary.

These are statements of fact which we can back up to the hilt. There is no better test of micro-processing than on your own springs—those now in use or on your drawing boards. Whether your requirements are as rigid as those illustrated or not, you can expect and will obtain, improved performance and greater freedom of design when you use "Micro-processed" beryllium copper springs. You can prove these statements to your own satisfaction without obligation by sending samples or drawings to our engineering department.

INSTRUMENT SPECIALTIES CO., INC.

DEPT. E-2, LITTLE FALLS, NEW JERSEY

"MICRO-PROCESSED" I·S BERYLLIUM COPPER SPRINGS

WASHINGTON

Latest Electronic News Developments Summarized by *Electronic Industries'* Washington Bureau

MANUFACTURERS RESPOND TO ARMED SERVICES—Because of the imperative need for radio and electronic equipment by the American Army and Navy and the United Nations' armed forces, the manufacturing industry is having the greatest production load in history placed upon it and, according to results, has responded in most excellent fashion. For July the production and deliveries of completed apparatus for the Signal Corps and Lend-Lease showed an 18 per cent increase over June which had been the previous high record month for the Signal Corps. August production, on preliminary estimates, was understood to be even higher than July by around 10 per cent. Stimulation of this increased production has been largely due to efforts of Major General William H. Harrison, the new Chief of the Signal Corps' Procurement and Distribution Service, who took over that post July 1 and who has been conferring with the major manufacturers (prime contractors) from all over the country on their problems of production, materials and manpower. These conferences, it is believed, have resulted in a greatly increased spirit of cooperation.

ALLOCATIONS AND PRODUCTION STUDIED—Governmental authorities, like industry, are seriously concerned with the problems of postwar transition from war economy to a peacetime normal production period. The FCC and its Chairman James Lawrence Fly realize that the postwar frequency allocating program is most complicated and important and are hopeful that the studies being made by the projected IRE-RMA Radio Technical Planning Board will be launched at the earliest possible instant. The FCC Engineering Department already has commenced its analysis of the demands and uses of postwar radio services. There is almost an absolute certainty that a number of radio services, particularly television and frequency modulation, will be shifted to new frequency bands with expanded space in the spectrum. In order to arrive at a comprehensive foundation for the postwar allocation, the FCC leadership feels that it may take from six months to a year, so that speed is most imperative in the allocation planning in the event that the war should terminate sooner than anticipated.

DECENTRALIZATION OF SIGNAL CORPS PROCUREMENT—Under a reorganization of the Procurement and Distribution Service in the Signal Corps, the field agencies have been decentralized so as to give them full responsibility for purchasing and production and the Headquarters staff in Washington will coordinate the requirements of the armed services, together with maintaining yardsticks on the flow of production of equipment and parts and their distribution. To put this new policy into effect Major General Harrison has designated Brigadier General John Henry Gardner, who during the past year has been Director of the Aircraft Signal Service at Wright Field, Ohio, as Assistant Chief of Procurement and Distribution. General Gardner will be directly in charge of the Washington staff, and General Harrison will devote a major share of his attention to the work of the field agencies. The field agencies which are being set up as separate decentralized units comprise the Eastern, Central and Western Signal Depots, the Philadelphia, Monmouth, Dayton and Chicago Procurement Districts, the Boston and Lexington Signal Depots, and the Storage & Issue Agency, the Inspection Agency and the Installation and Maintenance Agency. Colonel Eugene V. Elder, who has been in charge of the Requirements and Purchasing Division for the past eighteen months, has been placed in command of the Philadelphia Procurement District which will be considerably expanded in its scope. Colonel Glenn H. Palmer who has been in the procurement headquarters staff for the past half-year has succeeded Colonel Elder.

ELECTRONICS MANPOWER—Electronic manufacturers having draft deferment problems of key skilled employees can address their "headaches" to WPB Radio Division Deputy Director John S. Timmons or his special assistant in the manpower field William A. Johnson, formerly of ANEPA. The War Manpower Commissioner is soon to issue a new draft deferment appeal plan for electronic manufacturers to Selective Service state directors, while WPB Radio Division is supplying a list of critical manufacturers by states to Selective Service Headquarters.

GUNNER BY REMOTE CONTROL

His battleground is located far from the fighting fronts. His skill and long experience have been lent to the making of vital parts—parts that are vital to a boy in a bomber over Germany or his neighbor's son in a fighter in the Pacific. Their equipment is dependent on split-hair accuracy of Utah Parts—and he's giving it to them. He's a gunner by remote control.

There are hundreds like him at Utah—soldiers in coveralls. By the skill of their hands and the sweat of their brow, they're making sure that Utah Parts don't fail at the critical moment—as a switch releases a stream of machine gun bullets . . . as a headset receives a command to take a strategic height. These and many other vital electrical and electronic devices are being turned out in quantity and *on time* . . . by this precision task force at Utah. Important to the success of this task force is the work of the Utah laboratories. Here, new solutions to electrical and electronic problems are being worked out. Here, a great store of knowledge and experience is being accumulated.

Tomorrow that knowledge and experience will be at the service of peacetime America. There will be better Utah products built—more convenience, enjoyment and efficiency for many Americans—because of today's great advancements, necessitated by war.

UTAH RADIO PRODUCTS COMPANY, 850 Orleans Street, Chicago, Illinois. Canadian Office: 560 King Street, West, Toronto. In Argentine: UCOA Radio Products Co., SRL, Buenos Aires. Cable Address: UTARADIO, Chicago.

PARTS FOR RADIO, ELECTRICAL AND ELECTRONIC DEVICES, INCLUDING SPEAKERS, TRANSFORMERS, VIBRATORS, VITREOUS ENAMELED RESISTORS, WIREWOUND CONTROLS, PLUGS, JACKS, SWITCHES, ELECTRIC MOTORS

Utah

DEFLECTED BEAMS

(*Continued from page* 66)

constant density deposits a definite number of electrons per unit of time. If the beam has a large area (divergent focus) and constant density the number of electrons which would strike a target depends upon the amount the beam area overlaps the target area. Since the beam has two degrees of freedom, two independent variables can be handled. A third variable can be applied by utilization of the modulation grid in the tube. The effect of nonlinear functions can be handled in some cases by special shaped targets and if needed the use of beams with special shaped cross-sections.

A tube utilizing these principles has been described by Koch,[15] developed for measuring power, and the average, effective or logarithmic functions of current or voltage. In one version a beam with a square cross-section impinges on a five element target Fig. 7. A two-dimensional deflection produced by the voltage and current respectively in a circuit cause the beam to dwell on the electrodes in order, for a length of time in each instance depending on the phase relation between the voltage and current. Other possibilities of functional measurements are also shown.

REFERENCES

[1] U. S. patent—1,159,209
[2] U. S. Reissue—13,779
[3] Electronics—Feb. 1940, Page 41
[4] U. S. patent—2,300,436
[5] U. S. patents—2,300,394 and 2,256,336
[6] U. S. patent—2,053,268
[7] British—247,344
[8] U. S. patent—1,882,849
[9] U. S. patent—2,314,302
[10] U. S. patent—1,929,067
[11] U. S. patent—1,882,850
[12] U. S. patent—1,763,309
[13] U. S. patent—1,983,172
[14] Wireless Engineer Vol. XX—June 1943, Pages 273-299
[15] U. S. patent—2,324,851

ENEMY RADIO

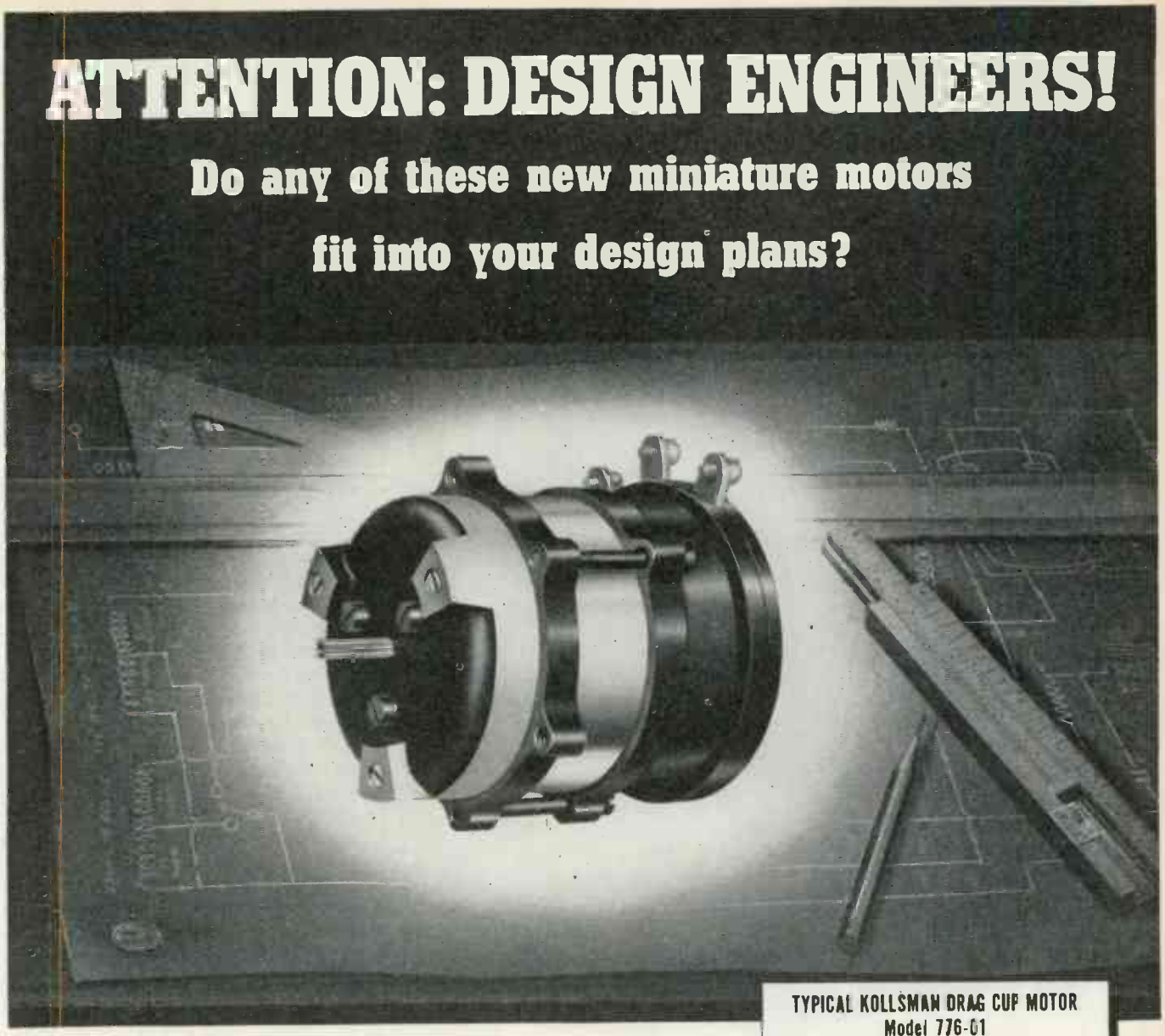
(*Continued from page* 61)

lar, the aim from the military standpoint seems to have been to standardize on an absolute minimum number of tube and component-parts types, for ease of replacement.

Many samples of the various types of enemy radio apparatus captured by United Nations forces are forwarded to the Office of the Chief Signal Officer for examination. Some of this equipment is sent to Signal Corps and Aircraft Radio laboratories for analysis and to manufacturers of similar American equipment. Information from these sources is later correlated.

ATTENTION: DESIGN ENGINEERS!

Do any of these new miniature motors fit into your design plans?



TYPICAL KOLLSMAN DRAG CUP MOTOR
Model 776-01
(Illustrated above actual size)

Frequency—400 cycles
Voltage Phase 1—24 volts
Phase 2—35 volts
Speed, no load—5700 RPM
Torque, stalled—.70 in./oz.
Weight—Complete Motor—12 oz.
Shaft Assembly— .53 oz.

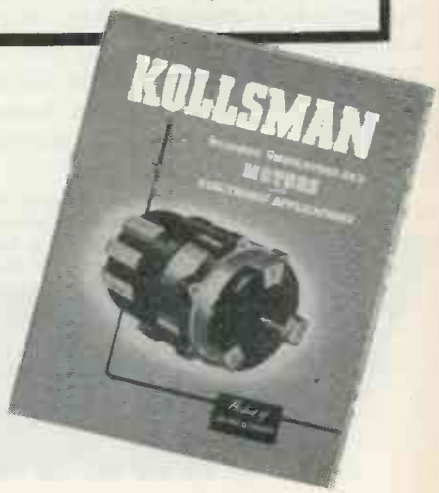
OF interest to design engineers of many electrical and electronic manufacturers will be the new line of miniature motors with special remote indication and control applications, just released by Kollsman Instrument Division of Square D Company.

Typical of these new units is the Drag Cup Motor illustrated actual size above. It is specially designed for installations requiring quick-starting, stopping and reversal characteristics. This is obtained by an extremely lightweight rotor having correspondingly low inertia. Extensive tests have shown it to have definite performance advantages over other motors of this type.

Similar design and operational advantages are to be found in the other Kollsman Motors described in the catalog pictured at right.

★ ★ ★

Complete information and performance data on Kollsman remote indicators and motors with electronic applications now available in catalog form. Please write for copy on your letterhead. Address: Kollsman Instrument Division, Square D Company, 80-12 45th Ave., Elmhurst, New York.



ELECTRICAL EQUIPMENT • KOLLSMAN AIRCRAFT INSTRUMENTS

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

The engineering department of Vultee Aircraft, Inc., Vultee Field, Calif., has made a thorough investigation and analysis of a complete captured Messerschmitt Me 110-C fighter plane, including a detailed analysis of the aircraft's radio equipment.

All of this equipment and its wiring was built in along the left side of the cockpit. Fabricated as a bench assembly, the entire equipment may be installed or removed as a unit. The particular aircraft investigated was probably four years old and the description of the radio equipment should be interpreted in the light of this fact.

Radio equipment in the Messerschmitt Me 110 includes two complete communication channels, radio compass receiver, blind approach and traffic communication equipment, and interphone.

Two complete transmitters, identical except for coil and condenser equipment, provide 50 to 75 watts output of cw, icw, and phone on 300-600 kc and 3-6 mc.

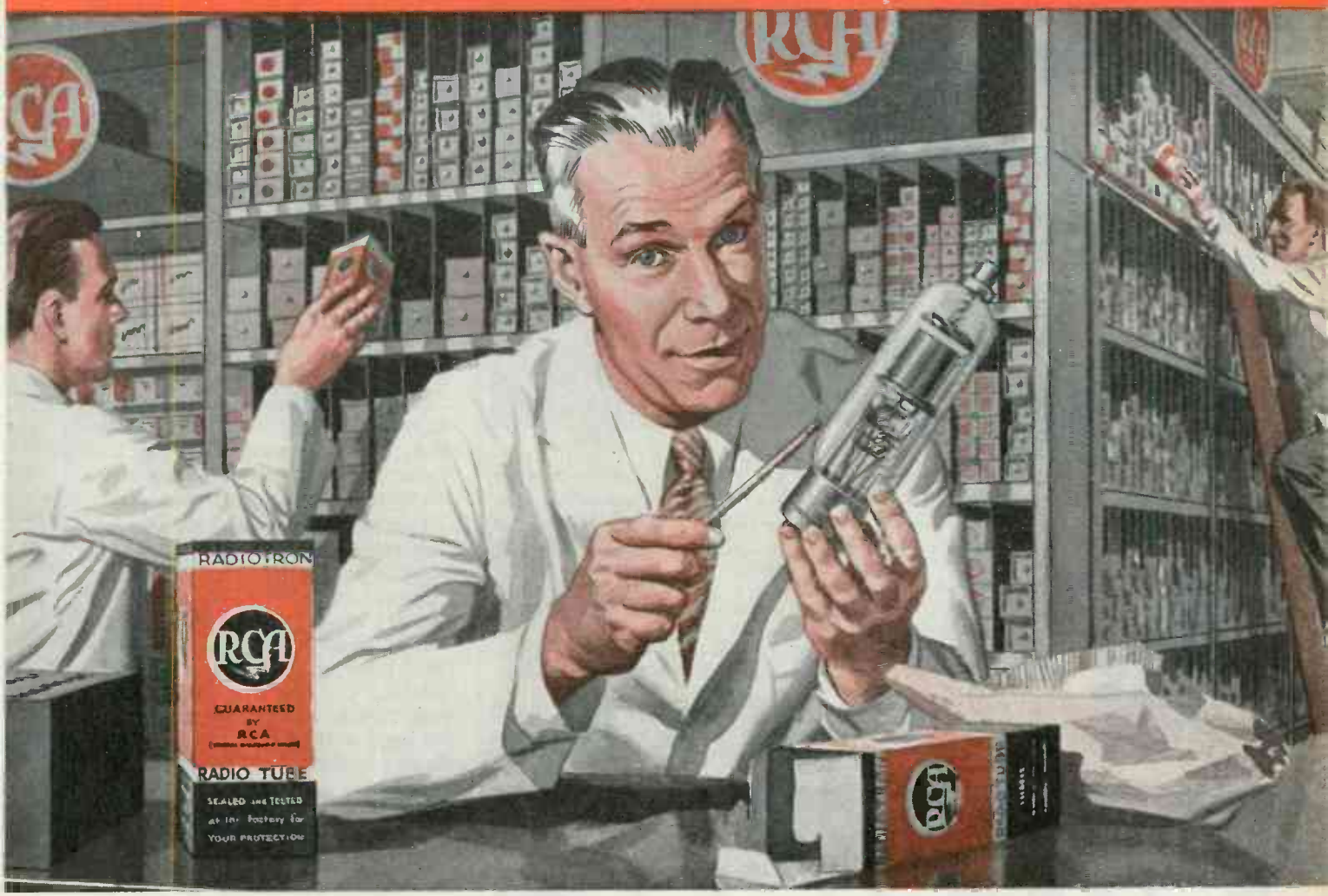
The transmitters are master-oscillator power-amplifier type. The oscillator is an RL-12-P35 rf pentode, a 24-volt heater-cathode type tube of 50 to 75 watts plate dissipation. The power-amplifier stage uses two of these tubes in parallel, operating at 750-800 volts on the plates.

Both stages are tuned with ganged variometers, calibrated in frequency, and open-stacked mica condensers. In the low frequency transmitter the coils are of Litz wire on molded plastic forms with powdered iron cores. The high-frequency coils are of edgewise-wound copper strap on ceramic forms with powdered iron cores. The front panel of each transmitter carries a test-set receptacle, enabling checking of all circuits without removing the transmitter. All wiring, in spite of being cabled, is not color-coded.

The two receivers provided are also identical, except for the operating frequencies involved. They are eight tube superhets, using in all positions a type RV-12P-2000, a miniature rf remote cut-off pentode.

The Messerschmitt radio compass is apparently older than the other items, being originally designed for battery operation but now provided with plate power from the same dynamotor used for the blind landing equipment. The receiver is a trf type equipped with a static suppressor and a beat-oscillator for reception of cw signals. It can be op-

NEED HELP FAST?



See your local RCA Tube and Equipment Distributor

— your Emergency Electronic Expediter

RIGHT around the corner is a man you ought to know: your own local RCA Tube and Equipment Distributor.

Tackling tough jobs is his business—like locating tubes and other electronic equipment when you need them in a hurry to fill some priority order. For all you know, he probably carries them in stock. Can't hurt to find out anyway—and he may be able to save you a whole lot of trouble and unnecessary delay!

He has the kind of technical "know how", too, that you'll find mighty useful. His angle on how to use a piece of equipment is well worth listening to. Remember, the chances are he's been in radio since its early knee-pants days.

So next time you're stuck for stock, need something electronic in a howling hurry, or find yourself up against something that takes intelligent and tradewise expediting, get in touch *right away* with the man we've picked to serve as your *Emergency Electronic Expediter*.

If you don't know who he is, write us today.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

...for TECHNICALLY INFORMED SERVICE

NORMALLY ADEQUATE STOCKS

FAST DELIVERIES

INTELLIGENT EXPEDITING

RCA ELECTRON TUBES

RCA Victor Division • RADIO CORPORATION OF AMERICA • Camden, N. J.

erated on two bands to provide aural-nul or cardioid direction finding, interlocked A-N aural homing, or visual homing. The receiver, when used as an aural-nul direction finder, is not sensed. The 180° ambiguity can be removed in the normal manner.

When operated as a direction finder, the indication of the loop position is given on a large azimuth scale whose lubber line is also variable, being operated by a remote indicating, aperiodic navigational compass mounted in the after portion of the airplane fuselage. Through this method it is possible to get direct magnetic headings from the station upon which bearings are being taken without mathematical correlation of loop position and compass reading. Within this indicator is also contained the automatic quadrantal-error cam.

Connection between the azimuth indicator and the loop rotating head is by flexible shaft contained in rigid tubing. The loop consists of two 6½ in. dia. turns of steel tubing, without protection or streamlined housing. However, the specifications for this loop call for the drag not to exceed ten pounds at 250 mph with the loop set perpendicular to the axis of the ship.

In order to eliminate broad nul indications common to radio direction finders mounted in aircraft, a zero cleaning circuit is provided. The signal required for this circuit is obtained from a short vertical antenna used also for the main beacon receiver. Coupling to the compass receiver is through the antenna-loading unit and a concentric line.

The Lorenz blind-landing system consists of two units: main beacon-receiver and marker-beacon receiver. The tubes used in this equipment are similar to those used in the direction finder receiver, making up the total, together with those in the transmitters and communication receivers, of only three types used in the airplane. The main beacon-receiver is of the trf type and operates from a vertical antenna 80 cm high through a concentric transmission line. The construction of this equipment places great stress on mechanical rigidity to the extent that its mechanical design approximates that of conventional uhf transmitters.

The audio output of this main beacon receiver is fed to the audio system of the marker-beacon receiver, since the single audio-system can serve for both of the dis-

Wide awake and ready...

Engineers, like fighter pilots, are cool and calculating individuals . . . fellows who believe in nothing unless proven. Along with them, we know that the future holds out promises of many new and revolutionary developments . . . and every angle and possibility is being carefully analyzed. However, like your true engineer, we make no predictions . . . we're simply wide awake and ready.

Meanwhile, there's work to be done . . . important war work . . . and this occupies our immediate attention. It isn't new to us because our experience goes back to the beginning of radio. We've manufactured sound systems, test equipment and numerous electronic devices. We maintain a model organization where management-labor relations are the most cordial . . . making for the highest standards of quality and efficiency. Yes, ECA is busy . . . but, occasionally, our production schedules enable us to take on additional contracts.

Now . . . more than ever . . . invest every dollar you can spare in United States War Bonds and Stamps.

ELECTRONIC CORP. OF AMERICA

ELECTRONIC CORP. eca ☆ OF AMERICA ☆

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

associated signals. The marker-beacon receiver has no rf amplification. Its detector operates directly into the audio amplifier and filter. The antenna for the marker beacon receiver is a dipole, coupled to the receiver through a matching transformer and concentric line. Operation of the main beacon is on 9 meters, and the marker beacon receiver on 7.9 meters.

Interphone communication is provided only between the radio operator and pilot. The interphone amplifier uses the same tubes as the receivers, and the small extractor knob for removing these tubes is stowed inside its case. The amplifier chassis also contains the tubes used as suppressor grid modulators for the transmitters. It is shock mounted in a similar manner to the receivers and transmitters and is independently fused.

The radio equipment of the Messerschmitt Me 110 in general represents the best practices. The facilities described have been provided at a total weight of only 300 lbs., despite the fact that the equipment appears heavier than American equipment. This illusion is probably created by the fact that the units are each smaller than equivalent American units and therefore in the aggregate, due to their number, seem to represent a considerable increase in weight.

Standardization appears to have been the watchword. This is particularly true of cabling in the installation, and with individual components within the pieces of equipment themselves.

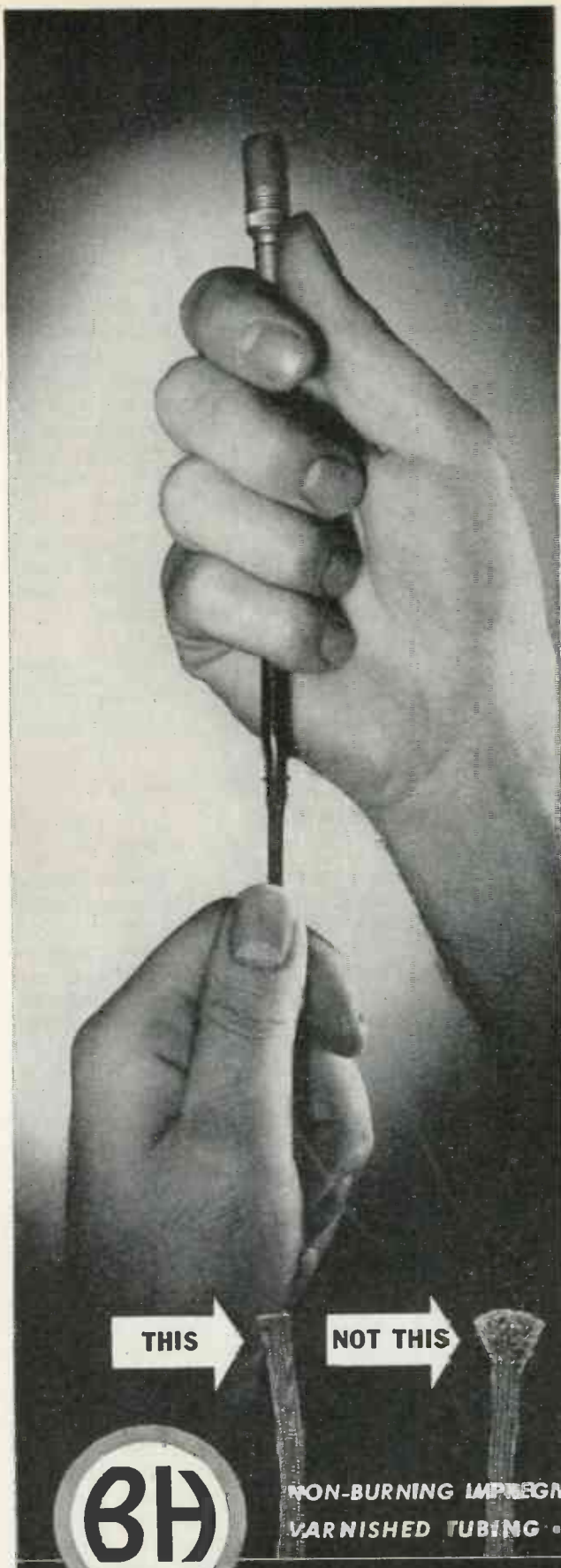
Standardization of tube types has been achieved through the selection of the most complicated tube structure necessary and providing this tube with sufficient external connections so that it may be connected as required.

Photos through courtesy of Vultee Aircraft, Inc., Engineering and Development Dept.

CBS FM SYSTEM

(*Continued from page* 63)

Although this 25-watt FM link system is maintained only for emergency use and interruptions to wire service seldom make its use necessary, it can be put in operation with a program on the air in less than a minute and a half. E. Fubini and Frank J. Bleil, Columbia Broadcasting System engineers, were in charge of the installation of the link and had the responsibility of ironing out kinks and getting it into its present smoothly operating condition.



TOUGH TEST

you can easily make proves new "extra flex" Fiberglas sleeving is non-fraying

A new sleeving which we have just developed is as flexible as a piece of string and also non-fraying. A buyer of thousands of feet of sleeving was convinced of its flexibility, but skeptical of our non-fraying claims until he applied a tough test of his own, which you can easily duplicate—this way:

Secure from us a sample of new BH extra flexible Fiberglas Sleeving equal in size to the saturated sleeving you now use. Insert the end of a mechanical pencil into the ends of both the new BH extra flexible Fiberglas Sleeving and your present saturated sleeving and push *hard*. BH extra flexible Fiberglas Sleeving will spread slightly *but without breaking*. The usual saturated sleeving will break down at the edges and separate. As an added test, tap the ends of both pieces of sleeving with your finger. Continued manipulation will produce only the slightest fuzz on the BH extra flexible Fiberglas sample, whereas the saturated sleeving will readily unravel and become progressively worse.

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

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

All sizes, from No. 20 to 5/8", inclusive, are available. Write for samples of this radically new and different sleeving today—in the sizes you desire. Seeing is believing! Bentley, Harris Manufacturing Co., Dept. I, Conshohocken, Pa.

BH PRODUCTS

NON-BURNING IMPREGNATED MAGNETO TUBING • NON-BURNING FLEXIBLE VARNISHED TUBING • SATURATED AND NON-SATURATED SLEEVING

BENTLEY, HARRIS MANUFACTURING CO.
Conshohocken, Penna.

DESIGN OF BROAD BAND AMPLIFIERS

(*Continued from page 72*)

bandwidth are, respectively:

$$(13.6)\quad B' = 0.7\,p \qquad (\text{for } k = p)$$

$$(13.7)\quad B_0 = \sqrt{2}\,B' = p$$

Thus, the relation between parameters is $k = p = B_0$ for flat design when using single-sided damping.

It is of interest to the experimental engineer that the formulas for k and p given by equations (18) and (19) depend upon quantities which can be checked with a signal generator and a vacuum-tube voltmeter, i.e., on bandwidth B_0, and on a function of valley-peak gain as expressed by D.

(*Editor's Note: This is the first part of the article on the design of broad-band amplifiers which will be concluded in our October issue.*)

REFERENCES

1. H. A. Wheeler and J. K. Johnson, "Proceedings of the I.R.E.," June, 1935, page 594.
2. F. E. Terman, "Radio Engineering," page 56, McGraw-Hill, 1937.
3. Garrard Mountjoy, "RCA Review," January, 1940, page 299.

MEASURING CLOUD HEIGHTS

(*Continued from page 92*)

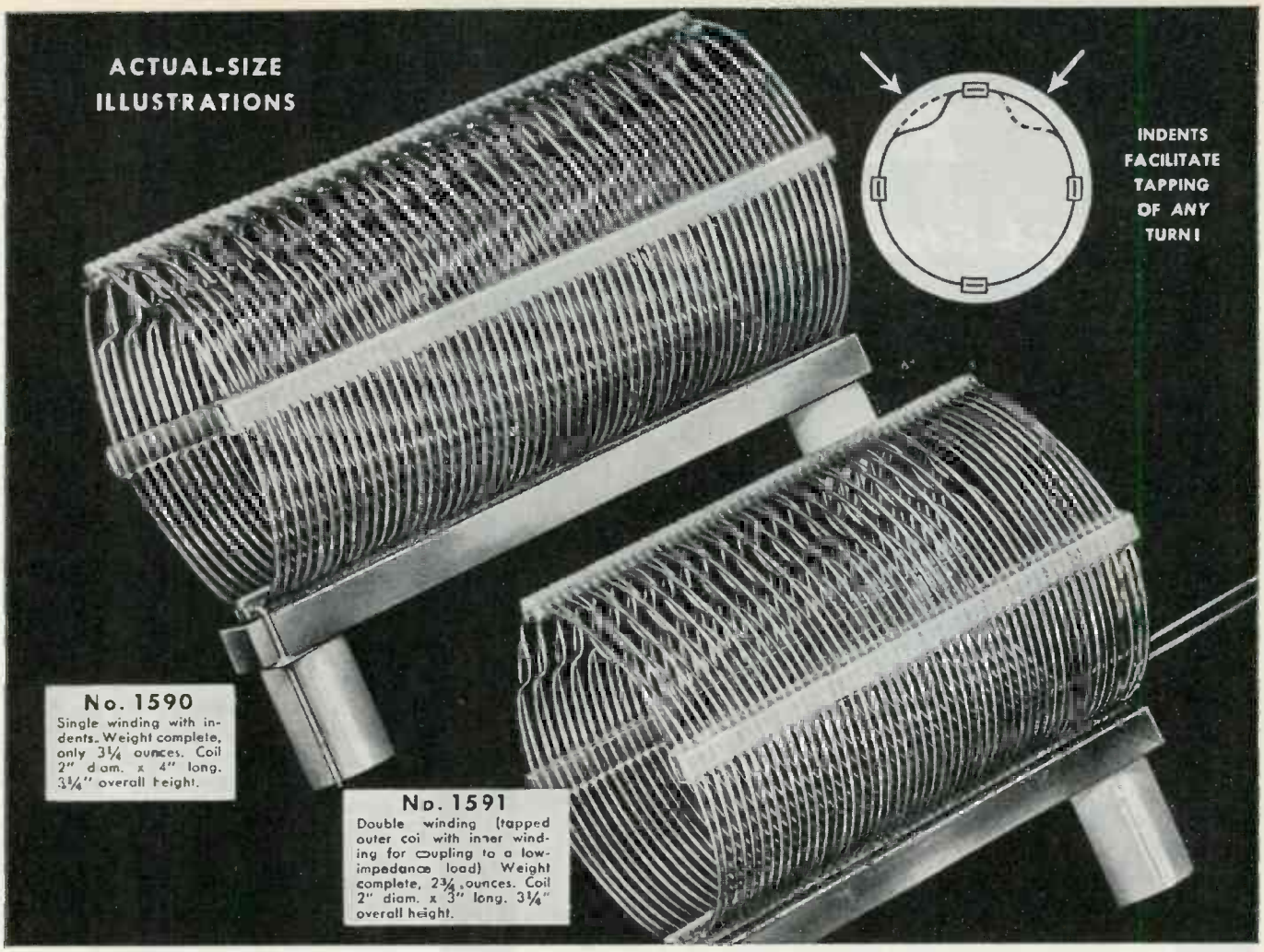
is perpendicular to the plane determined by the projector beam and the ceilometer.

This projector has been found to give satisfactory service and, except for the arrangement of the housings, its design is considered satisfactory. It is thought that if all the equipment were housed in one enclosure, a somewhat more satisfactory unit would result.

Pickup unit

Figs. 3 and 4 show the assembled ceilometer. The component parts are the amplifier, power supply and discriminator, drum containing optical system and phototube, indicating output meter, automatic slow motion drive and weatherproof enclosures.

The optical system consists of an 8-in. plano-convex lens and diaphragm mounted in the drum so that the phototube, situated back of the diaphragm, "sees" an area of the clouds having the approximate size and shape of the projector spot. The high-vacuum phototube, an RCA 929, has a spectral response which enhances its use in conjunction with the mercury arc. It is fed through a 10^7 ohm load resistor from a 450-volt



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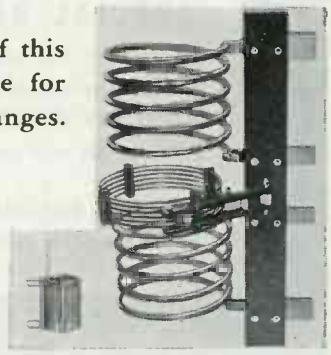

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battery. The amplifier (see diagram) is similar in many respects to the one used in the preliminary work. It is RC coupled and tuned to 120 cycles. Its design is such that all the tubes except the 6J5 have a high grid impedance. This is essential, especially with the 38, where the grid load resistor is 100 megohms. A further feature of the design is that the current required in the plate and screen circuits is small, making it possible easily to filter the power required by these circuits. This amplifier has been found to work satisfactorily under various conditions of operation.

Discriminator and power supply

Work with the experimental units demonstrated that the synchronous commutator or discriminator used in the original equipment was not practical. A good phase shifter was necessary, and the coupling between the amplifier and the discriminator had to be improved. Circuits correcting these faults were developed and are shown in the wiring diagram, with the power supply. The discriminator, consisting of the 6SJ7 and associated circuits, has been found to be very sensitive. Its sensitivity probably can be attributed to the fact that it is in reality a bridge. The disadvantage of the circuit is the fact that it has to be balanced. However, it has been found that once balanced, it will remain so for many weeks and through many cycles of turning the equipment off and on. The discriminator output is 120 cycles. The potential difference developed by the discriminator when it is receiving a signal is measured by means of the 6SN7 and a meter. This is fed to a 50 microampere output meter through a bridge-connected rectifier. The power supply is designed to operate from a 120 volt, 60 cycle supply, requiring about 85 watts.

Theory and analysis of operation

In order to make the equipment as sensitive as possible within the limits imposed by operating conditions several factors must be considered in the design of the amplifier and discriminator. A theoretical discussion of these factors can be found elsewhere[1, 3]. A brief statement of them follows:

Inasmuch as the minimum signal that can be detected is limited

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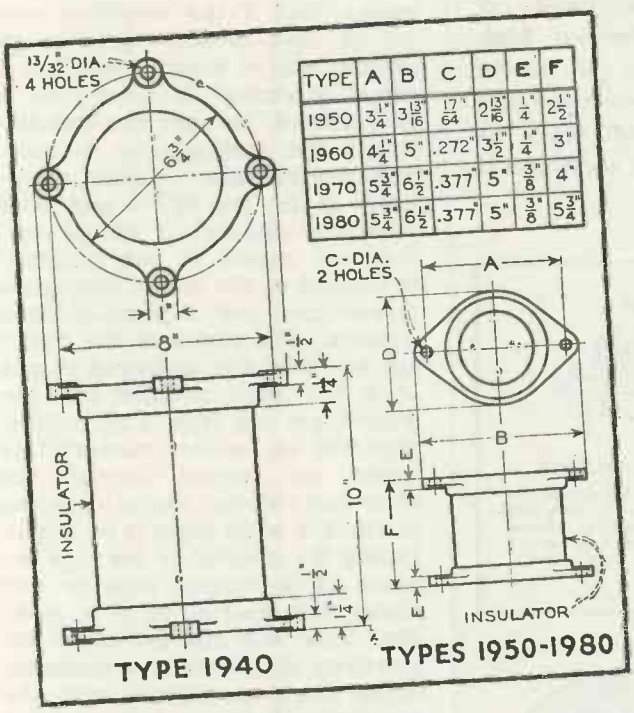

TYPE	A	B	C	D	E	F
1950	3¼"	3 13/16"	17/64"	2 13/16"	¼"	2½"
1960	4¼"	5"	.272"	3½"	¼"	3"
1970	5¾"	6½"	.377"	5"	⅜"	4"
1980	5¾"	6½"	.377"	5"	⅜"	5¾"

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by the noise associated with the phototube and amplifier, it is desirable to increase the ratio of signal to noise by (1) making the load resistor of the phototube so large that the shot noise of the phototube is predominate over the thermal noise of the input impedance of the first tube and (2) narrowing the band-width of the amplifier until $f_o^2 = f_1 f_2$ (where f_o is the frequency at which the amplifier is tuned and f_1 and f_2 are the frequencies where the output of the amplifier is 70.7 per cent maximum output). While further narrowing of the band-width will increase the signal-to-noise ratio, there is no point in so doing because when the above conditions associated circuits. It will be seen phototube signal current that can be detected is limited solely by the decay constant of the amplifier output meter or its associated circuit.

Application of discriminator

In addition to the above factors the detection of cloud heights is further complicated by fluctuations in the shot noise level arising from varying background brightness. This means that if the amplifier output is read directly there is no positive way of knowing whether a signal or change in noise level is encountered. To overcome this difficulty the discriminator is used. The discriminator consists essentially of the two 6SJ7's and their associated circuits. It will be seen that the output of the amplifier is coupled to the 6SJ7's through a transformer and a phase-shifting network. The plates of the 6SJ7's are fed from the unfiltered output of a full wave rectifier and the screens are fed from a dc supply. With the suppressors connected as shown, the current through the plate load resistors varies as shown in Fig. 6-A when there is no signal. During the interval ab the tube behaves as a normal pentode and during the interval bc it is inactive. Figs. 6-B and 6-C show respectively the effect of a moderate signal which is in phase with the plate current of these tubes and the same signal slightly out of phase. It is seen that under phased conditions the average plate current of one tube is increased while in the other tube it is decreased. This causes a potential difference to appear across the two oil-filled condensers. This potential difference may be measured with a high impedance voltmeter or by means of

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the circuit shown. The circuit shown is a balanced circuit and it is evident that the grids of the 6SN7 tube are at a high potential with respect to ground. However, the tube is self biased and the cathodes are at an even higher potential, thus allowing normal operation. This circuit has been used to provide sufficient power to operate a recorder without disturbing the discriminator bridge, from which only a very small current can be drawn.

It is evident that noise coming from the amplifier will also affect the discriminator tubes. However, as the phase of shot and thermal noise pulses is random, their average effect over a sufficient length of time will be zero and no voltage will appear across the condensers. This provides a means for discrimination between the phased signal and the random pulsations of the shot and thermal noise, thereby providing a means through which the reading of the amplifier output meter is made independent of the noise level of the equipment.

As has been stated above, the minimum signal current that can be detected is dependent on the decay constant of the output meter or its associated circuit which, in this equipment, is primarily the time allowed for discrimination. However, conditions of operation impose a limit on the time constants allowed. This arises from the fact that there is only a limited time allowed for the traverse of the beam. If the time constant is too long the output meter will not give a significant reading before the spot has been passed.

Cloud-height recording

A recorder has been successfully used in conjunction with a ceilometer. The recorder functions to indicate the angle or angles at which the amplifier output meter reading is elevated by the presence of clouds in the projector beam and the relative value of the output meter reading at these angles. In so doing, it provides a record of the height of cloud layers and their variation with time throughout the day.

Fig. 4 shows the automatic scanning drive and a Selsyn generator (at right) which transmits the angular elevation of the drum to the recorder. An automatic, mercury reversing switch is provided. A Selsyn motor on the recorder posi-

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tions the recording element on the chart paper, while the paper feed determines the time scale. The intensity of the record indicates the intensity of the signal received by the ceilometer.

Equipment built according to the design outlined in this paper has functioned satisfactorily during periods of severe weather. Clouds at an elevation of 20,000 ft. have been measured during the daytime. Rain and snow ceilings have been measured with the ceilometer. The height of haze layers occurring at inversions has been measured and checked by radiosonde ascents.

[1]"Daytime Measurement of Cloud Heights," by M. K. Laufer and L. W. Foskett, Journal of the Aeronautical Sciences, March, 1941, Vol. 8, No. 5.

[2]"The Development of Water-Cooled Quartz Mercury Lamps," E. C. Noel, Journal of Applied Physics, Volume 11, 1940.

[3]A Theoretical Analysis of the Operation of Ionization Chambers and Pulse Amplifiers, E. A. and A. G. Johnson, Physical Review, Volume 50, July 15, 1936.

ENGINEER-EXECUTIVE PLANS FOR POSTWAR

(*Continued from page* 69)

their tools in condition? If not, when can they do so? What would a 1941 model cost if made today, or 1944, or 1945? That's not difficult to answer. Just take today's labor and basic raw materials costs and apply them to the 1941 parts list.

Maybe the answer is not right on the button, but you know enough to talk about it. What about the company's old customers? Are they still there? Have the competitors gotten to them? Which ones can be counted on? By working in this way within a few months the salesman can say not "we'll be ready when the great day comes," but quietly and confidently, "How many No. 147 models would you want three months after V day if the price were $46.95?"

Plans can be made

He will have new things to talk about, too, as we will see later on, but the important thing is he will be talking sense. Of course, the war is far from won, but the small few hours of cost accountants' time that have been spent are saving many more precious hours that might have been wasted in the kind of circle-running, postwar planning that has been going on.

Now for the company that has grown from nothing during this period. Its problem is more difficult, but, on the other hand, it has less obligation in plant and personnel continuity. Every moment

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not actually necessary to the war effort should be used to plan. While an engineer is waiting for an answer from the Signal Corps or Ordnance, while an executive is waiting in Washington, while either one is traveling, plans can be made.

The big thing is to know what is to be done and what problems exist. They are definite, concrete things, not mystic dreams. A certain product can be made profitably with our jigsaw puzzle pieces; another cannot. One can be sold; another has a negative or a saturated market. Put them down and cross them off. When one looks good, process it. Where will it be made? Which machines will be used? What will it cost? Who will buy it? How quickly can it be made? One thing is sure, there is enough unproductive waiting time—trains, hotels and official anterooms—to answer all of the questions any electronics company has. Just be sure that the program is rolling and in such shape that the engineer or executive can use that time to plan and not just to wait.

Long range course

The "Long-Range Course" is the type of planning that the public expects. But miracles never, or seldom, happen without immense preparatory effort. Time for this type of work will be more difficult to find without conflict with the war effort. Observation is, however, that if intelligently done, such a plan can be carried on without in any way lessening activity and accomplishment of military objectives.

The answer is so simple that most laymen know it when they unwittingly ask, "Won't all this radio and r---- work make great changes?" The tendency of persons myopically close to the grindstone is to say, "It's all old and, anyway, we haven't time to think of peacetime applications." Such thinking is just the opposite of intelligent planning. By every research and development engineer keeping his mind open and his vision activated, these applications will suggest themselves, but there must be a place where they can be coordinated and stored.

That is the function of a long-range plan—not necessarily to do new work (there is an immense amount of it being done in military channels), but to relate these accomplishments to new civilian products. Set up the planning

mechanism so that each new discovery or idea is put under a civilian use; spotlight and neatly file in order of its application importance to your electronics company.

Some day an engineer will have an hour or a day free. Then just peel off the top idea on the stack and go to work. When he must return to his war project, just table the other until the next opportunity arises. By that time collateral military work may have advanced the whole project anyway. The point is to have a plan with a program pointing toward definite civilian products. The market research and investigation work can be done even though the project is held up engineering-wise.

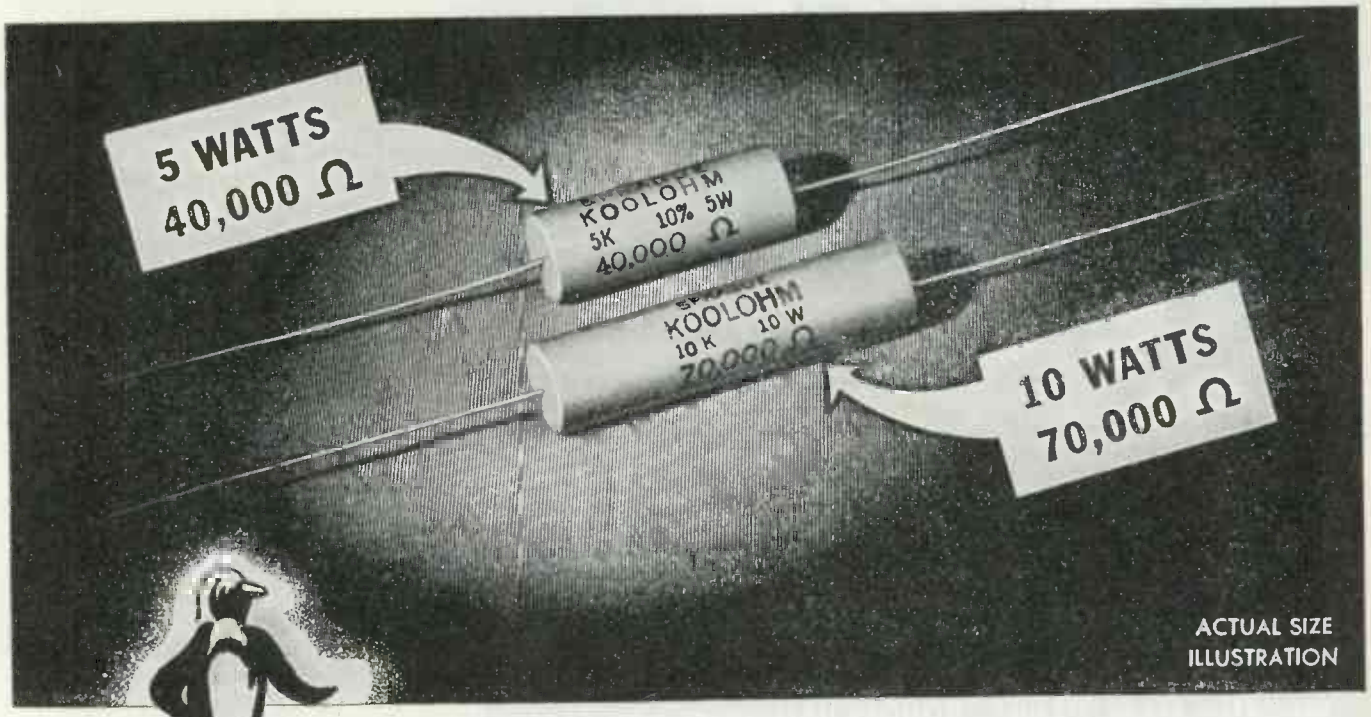
Then on V day the company can go full blast on number one or one hundred, and it will know just where it is going. The leader in a field that is noted for its outstanding research work has said, "The normal time from conception to marketing of a new product is seven years. Our wartime period is seven months." Think what that means to the electronics industry.

When V day comes

It is time that the electronics industry stopped talking vaguely and in large round words patting itself on the back about its wonderful accomplishments and even more wonderful future. A long time elapsed between Hertz and World War I during which it was all there. Two more years until 1920 and four till 1924, which was a sad year for many radio companies.

The public expects radio, television, facsimile and r- - - - full blown a year postwar. It does not care much whether it is on 100 kilocycles or 3,000 megacycles, but it is looking for great new things. The public expects all manner of domestic and industrial electronic controls. It does not care whether they are photoelectric cell or pulse operated. What matters is that it wants them. The public expects wonderful air transport and private plane facilities. It does not care whether the radio range is 200-400 kc or 125 mc, 4 course aural and visual, or even whether the plane power supply is 24 volt dc or 400 cycle ac. It just expects these things to be **right** as a matter of course. Unless every electronics engineer, executive or company—each separately and as an industry united—gets to work, and quickly,

THESE RESISTOR WATTAGE RATINGS MEAN WHAT THEY SAY



...Regardless of the ohmic values

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Although Koolohm Resistors themselves are no larger—often smaller—than ordinary resistors, their wire is 2¼ times larger in actual cross-sectional area! This is especially important in the high resistance values where very fine wires so often fail to carry the currents involved in power resistor operation, or to withstand the corrosive effects of operation in high humidities. *Play safe* with Koolohms!

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In brief, there's no need to "play safe" with Koolohms. You don't have to use a larger resistor than you actually require. You can forget your worries as to whether the wire size is big enough to carry the current and the resistor body large enough to withstand the temperature rise involved. *You can use any Koolohm at its full wattage rating—any time, anywhere!*

This freedom of use is made possible because Koolohm design is based upon a time-tested, inorganic insulating material. This is sintered on the wire *before it is wound*—at 1000° C.! The insulation is flexible, and has a dielectric strength of 350 volts per mil at 400° C.!

Samples free to industrial users. Catalog on request to all who are interested in better, more dependable resistors.

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POWER WIRE WOUND RESISTORS AND METER MULTIPLIERS

planning and working on the problems indicated by their plans, the public will be sorely disappointed.

Let us resolve to do a bang-up 100 per cent war job and then use our waste time to prepare for what is expected of us.

NOISE IN VACUUM TUBES

(*Continued from page 73*)

If an ideally quiet tube could be inserted in the first stage of amplifier No. 1, the thermal noise would produce a reading of 1 milliwatt on the calibrated thermocouple meter when the overall gain of the measuring set had been adjusted to 137.7 db. Any actual tube in this position will give a larger reading due to its tube-noise.

The db change in attenuator setting required to bring the meter reading back to one milliwatt indicates in db the total noise power above thermal noise referred to the input of the measuring set. The tube noise-power is the difference between the thermal noise-power and the total noise-power. It is shown plotted against total noise-power. Since the input transformer is not ideal, corrections must be made for its effect on the input termination. Tube-noise power is shown expressed in ohms equivalent resistance, that is, the ohmic resistance required in the grid circuit to generate thermal noise equal to the noise voltage developed by the tube.

Another noise measuring set, designed by G. L. Pearson, differs in that the amplified noise voltage of the tube under test is adjusted by an attenuator to give a suitable reading on the output meter when there is no terminating resistance in the grid circuit of the tube. By adding grid resistance until the noise output is doubled, the tube noise voltage E becomes equal to the thermal noise voltage and may be calculated from the expression

$$E^2 = 4KTR$$

where R is the added grid resistance and may be represented as the ohms equivalent resistance of tube noise. Where the noise characteristics of various type of tubes are required, the arrangement of Pearson is desirable.

The two methods of measurement are functionally similar in that the equivalent input circuits of both sets may be represented by a grid resistance and an assumed resistance representing the ohms equivalent resistance of tube noise. In Pearson's arrangement, however,

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But *constant voltage* is almost non-existent on today's overcrowded power lines. Wartime consumers are busier. Huge volumes of electrical energy are being intermittently used and released. Heavy sags and destructive surges inevitably occur. For that reason, manufacturers in every field are stabilizing power themselves with SOLA CONSTANT VOLTAGE TRANSFORMERS.

Sola "CVs" equalize voltage sags and surges, absorb variations as great as 30%, feed a controlled flow of power to machines. And they protect the *very life* of sensitive instruments and electronic tubes.

Engineered for long, trouble-free service, Sola "CVs" are instantaneous in action, without moving parts, self-protecting against short circuit. They have a place on *your* production lines —the life lines of American victory.

Note to Industrial Executives: *Sola "CV" transformers are available in standard 10VA to 15KVA units. Special units built to specification. Ask for bulletin* 10CV-74

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the measurement is made by varying the amount of grid resistance while in the other set the grid resistance remains constant.

FOR SAFETY AT SEA

(*Continued from page 77*)

as the generator comes up to speed, throwing the field across the low voltage armature winding. When the preset voltage is developed, the relay will start vibrating very rapidly between up contact and center, effectively inserting a varying amount of resistance in the field. If the unit is cranked much too rapidly, the relay will vibrate between the down contact and center, thereby inserting full resistance into the field or momentarily shorting it. Resistance is represented by pilot lamps in series, one of which is placed beneath a transparent plastic window, thereby indicating when sufficient cranking speed has been attached. The other indicator is a neon light connected to the rf circuit to indicate proper tuning of the transmitter.

The front panel mounts the complete rf and audio sections. The rf stage consists of an electron-coupled Colpitts oscillator using a 12A6 tube. The frequency stability required of this transmitter is plus or minus .05 per cent. The only features which will not be found in usual practice are the switching segment on the back of the variable condenser and the degenerative rf feedback. By setting the variable condenser switching segment at 90 deg. to the rotor plates and connecting a padding condenser, equal to the maximum value of the variable condenser, to the contact finger and across the condenser, the effective variable capacity of the condenser may be approximately doubled.

Frequency stability

The rf degeneration is used to minimize frequency shift with voltage change and tank circuit detuning. The transmitter is capable of loading specified power into an antenna ranging from 400 to 800 mmf and 5 to 70 ohms in any combination. The variable condenser brings the tank circuit into resonance under these conditions, as indicated by the rf indicator light. Frequency must not shift over 500 cycles on detuning the unit to 50 per cent antenna current. The audio-oscillator consists of a 12SC7 dual triode, one section transformer

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New Metalizing Method...

Eliminates Loose Graphite Particles

Taylor's exclusive Processed Carbon Anodes allow higher anode voltages. These amazing new type anodes open new fields for tube design.

Seamless, and without high resistance weld spots, they are accurately machined from solid graphite, then entirely metalized to combine the desirable characteristics of carbon with the advantages of other type anodes. Because they do not warp, they provide insurance against efficiency loss due to changing electrical characteristics. A special method of fusing lead wire to anode assures positive continuity between tube connection and anode. And too, this new Taylor Process allows complete and permanent degassing of the anode.

You will hear more about this far-reaching development as its applications continue to increase Taylor Tube efficiency on a "More Watts Per Dollar" basis.

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tuned as an audio oscillator and the second section being used as a straight amplifier. The circuit uses a large amount of negative feedback in order to hold frequency constant with very large changes in tube characteristics.

The general specification for performance characteristics of this unit are undoubtedly familiar to most radio engineers. The transmitter must show no degradation of performance after being subjected to temperatures ranging from —55 deg. to +70 deg. C. and long periods of severe vibration. The unit must perform satisfactorily at temperatures from —35 deg. to +60 deg. C., and under varying pressure and humidity conditions. Power output averages 3.5 watts and when loaded into a 300 ft. vertical antenna the unit can get out surprisingly well, the minimum service range being taken as a circle of 200 mile radius over sea water.

Final tests

Production and inspection present many interesting problems not usually encountered. Although production figures cannot be given, it is no military secret that when the plant manager "turns on the line" it is not safe to stand around the terminal position.

In the final electrical test positions, the units are run at 80 and 100 rpm while the following data is taken: torque, rf frequency, audio frequency, modulation percentage, governor speed, keying by phones and tape, rf frequency on 50 per cent detune, voltage regulation, operation of indicator lights, power output and load characteristics. Torque is limited to 45 in.-lb. maximum and overall efficiency from mechanical input to automatically keyed output must be 8 per cent minimum. Following this test position the units are buttoned up and subjected to air-pressure and four-hour water immersion test. The unit is then presented to Signal Corps' final test where all the above tests are repeated on the sealed up unit.

Needless to say, this project has presented many problems not usually encountered in radio development and production. In fact, it was sometimes a relief to the writer to have an electronic trouble develop for the novelty of looking at a circuit diagram once again! It is also a thrill to hear of the cases in which this unit has saved the lives of American fighting men. Those who have been saved by this

VIBRATION TESTED

Long before the war, TUNG-SOL established the practice of "Vibration-Testing" all radio tubes of new design and tubes picked out at regular intervals from the production line. Making tubes that meet government standards was nothing new.

Today the TUNG-SOL Radio Tubes in communication equipment of jeeps and planes and tanks and in portable sending and receiving sets are subjected to far more severe conditions than will ever be encountered in civilian uses. TUNG-SOL Tubes are giving praiseworthy performances . . . a direct result of "Vibration-Testing."

Manufacturers of electronic devices and of electronically controlled equipment will find TUNG-SOL a most satisfactory source of dependable tubes for every application. TUNG-SOL research engineers will be glad to assist you now in making your post-war products more efficient through Electronics.

Current is introduced through the various circuits of the tube while it is being rapidly vibrated. Uniformity of the current flow is indicated by sensitive meters and is positive proof of proper design and construction. Tubes that pass this most exacting test are truly classed as "VIBRATION-TESTED."

TUNG-SOL
vibration-tested
RADIO TUBES

TUNG-SOL LAMP WORKS INC., NEWARK, N. J., *Sales Offices:* ATLANTA, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK
ALSO MANUFACTURERS OF MINIATURE INCANDESCENT LAMPS, ALL-GLASS SEALED BEAM HEADLIGHT LAMPS AND CURRENT INTERMITTERS

device become eligible for membership in the "Order of Gibson Girls" on verification by their Commanding Officer and notification of Bendix Aviation, Ltd., North Hollywood, Calif. Such men are presented a certificate and award in what appears destined to become one of the world's most exclusive aviation fraternities.

ALASKAN CARRIER CURRENT SYSTEM

(*Continued from page 75*)

through and the Signal Corps was there on time. The commencement of the construction during November, 1942, came during the worst blizzard in forty years when the temperature fell to 72 degrees below zero.

It was notable that in the initial call between General Stoner and Colonel Twitchell only a couple of days of tests of the "C" carrier channel to clear up line faults had been conducted. This was remarkable because hoarfrost is one of the greatest hazards of carrier wire communications. After the opening of the circuits to Dawson Creek the telephone and teletypwriter channels had a veritable flood of messages.

900-mile link

The second section of the Alaskan Telephone Line from Dawson Creek to Whitehorse was 900 miles and was the longest single link in the system. This was opened to communications service last May 24 with conversations between Major General Dawson Olmstead, who just retired as Chief Signal Officer of the Army, and who talked with Lieutenant Colonel Dee Berry, Signal Officer of the Northwest Service Command, and to Major Ora Roberts, Officer in Charge of the project. Major General W. D. Styer, Chief of Staff of the Armed Service Forces, talked with Colonel Kenneth B. Bush, Chief of Staff of the Northwest Service Command.

Work on the last leg from Whitehorse to Fairbanks, 633 miles, has been pushed from both ends so that it is anticipated the deadline of mid-October for the line's completion will be attained. Incidentally, the Signal Corps has always been in the forefront in communication between the United States and Alaska and has operated for 43 years the Washington-Alaska Military Cable and Telegraph System as well as a huge radio station network in Alaska for both military and civilian use.

This is the reason they called the tube KLYSTRON*

Does it seem far-fetched to you?

Can there be any possible similarity between an ocean wave and an ultra-high frequency tube?

As a matter of fact, there's a very definite similarity.

A breaking wave is the best way we know to picture what happens to electrons in the KLYSTRON tube invented by the Varian brothers—Russell and Sigurd—and Dr. William W. Hansen.

Inside this tube, the inventors were able to direct a stream of electrons which concentrated their power and released it much as waves do when they mount into crests and crash on the shore.

That's why the tube is called KLYSTRON. The name comes from a Greek word that denotes the breaking of waves on a beach.

Initial research on the KLYSTRON was done in California at Stanford University. The Sperry Gyroscope Company was quick to see the tube's possibilities. So they helped the inventors carry on further development of the KLYSTRON as a valuable tool of war and aeronautics.

When the tube got beyond the early experimental stages, the Varian brothers and Dr. Hansen joined Sperry's staff of inventors, engineers, and research men.

With the close co-operation of the Army and Navy, the development and perfection of the KLYSTRON continued, and is still continuing.

Applications of the KLYSTRON include the generation, amplification, and reception of ultra-high frequency waves. Naturally, they are being devoted exclusively to war uses at present.

When the war is won, Sperry research will explore the fascinating field of KLYSTRONICS** in relation to the comfort and security of a world at peace.

SPERRY

GYROSCOPE COMPANY, INC.

BROOKLYN, N. Y.

Division of the Sperry Corporation

*KLYSTRON is a registered trademark of the Sperry Gyroscope Company—Registration No. 371650.

**Trademark

ENGINEER IN COMMAND

(*Continued from page* 83)

nurses are on duty at dispensaries 24 hours a day. Two physicians are employed.

A company ambulance is at the service of associates in the event of an accident in any of the plants or in the event of an automobile accident on the roads while associates are engaged in going to or from work. With this service available, it is possible to immediately transport injured associates to a nearby hospital for necessary care.

Supply shoes

From experience it was found that many shop men were suffering from serious trouble with their backs, making it necessary to visit the steam rooms frequently. This back trouble was believed to have been caused from foot ailments resulting from improper care of the feet. An experiment was carried on in which 100 men were given proper and comfortable shoes to wear while working. After a period of time this experiment portrayed the fact that these 100 men were no longer suffering from habitual back trouble, whereas it was necessary for the remainder of the shop men to continue to make frequent visits to the steam rooms for correction of back ailments. Therefore, in order to eliminate such suffering, comfortable shoes have been provided by the management for all associates. The purpose is bifold (1) the elimination of absenteeism due to foot ailments, and (2) the education of the associates regarding the importance of proper care of their feet. These top-quality $15 shoes are purchased in quantities at $7.50 per pair.

Music, too, can play its part in keeping workers happy. Through the medium of the public address system, strains of popular music can be heard throughout the plants of Jack & Heintz. Songs can be requested by and dedicated to the associates.

The associates of Jack & Heintz voted to work seven days a week on 12-hour shifts. In order that no working man-hours are lost and in order that it not be necessary for associates to spend personal time after working hours to handle various personal business matters, Jack & Heintz maintains counsel on the subjects listed below, giving assistance in all cases:

1. Selective Service assistance is given and deferment cases are filed for essential associates.

AN INSPIRING CHALLENGE to the imagination is this ever-expanding science of electronics.

From the laboratories of Rogers Radio Tubes Limited in Toronto, Canada, in 1924, came the first A. C. Tube for domestic radios.

War-time censorship postpones the announcement of our new developments in radio tube design. Meanwhile, Rogers Radio Tubes are today wholly devoted to serving the armed forces of the United Nations.

ROGERS

POWER TUBES

ROGERS RADIO TUBES LIMITED • TORONTO, CANADA

1-1-42

2. Assistance on housing, relating to the purchase of, sale of, or rental of homes, is available to those associates in need of such services.

3. Matters regarding the obtaining of automobile licenses, transfers and titles are taken care of for the associates.

4. Matters related to tire recapping and mileage rationing are also handled for the associates.

Vacations in Florida or Canada

Many of the men and women at Jack & Heintz have been working long hours for two years without a vacation. The management is of the opinion that all associates need and are entitled to a rest.

A furlough plan has, therefore, been established whereby associates and their wives are sent to Fort Lauderdale, Fla., or Honeymoon Isle for a period of two weeks. Traveling expenses are paid by the management, and the associates receive in addition miscellaneous expense money. Cottages at both Fort Lauderdale and Honeymoon Isle have been leased by the company for use of associates.

Expense money provided

In the case of unmarried associates, traveling charges in addition to expense money are provided by the management and the associates are free to vacation where they choose, although men may go to Harbor Island, Canada, in the summer.

The J. & H. management believes that upon return from these vacations the associates are rested and better able to maintain the company's high-speed production schedules.

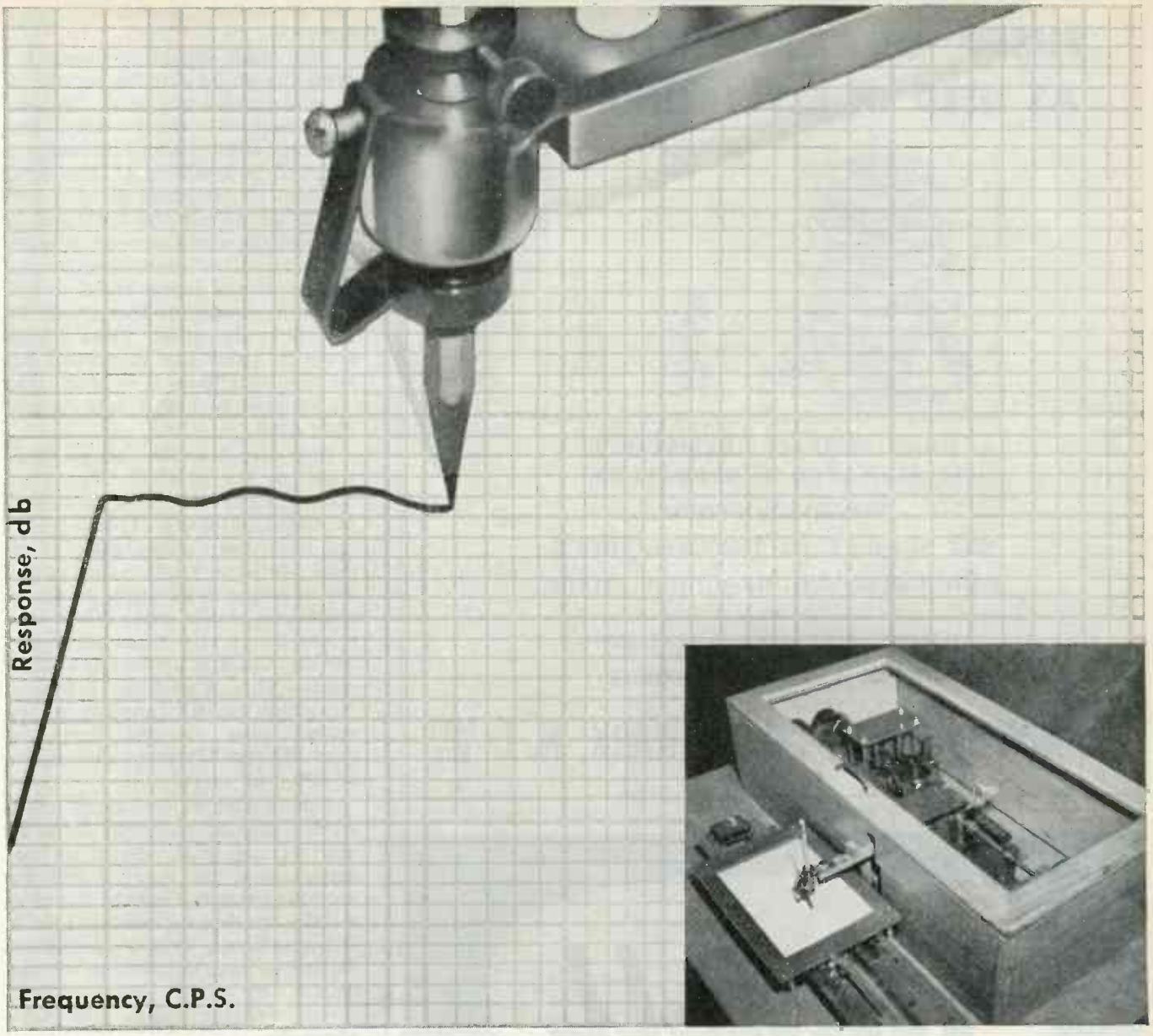
"This undoubtedly helps to avoid absenteeism also," declares Ralph Heintz, observing that up to the time of writing this, "there has not been a single unauthorized absence for over three months among the 7,000 associates."

SUPERSTABILITY AT UHF

(*Continued from page* 86)

ances of the two coils given is one to one.

The No. 14 wire has a cross-section area of 3,225 sq. mils, and the strap only about one-tenth as much, or 320 sq. mils. We have removed 90 per cent of our conductor and still have the same rf resistance. Of course the eddy current loss in the strap is much less, since



It writes by ear...

For years, Shure Engineers have relied upon accurate and scientific measurement in determining microphone performance. They do not rely, alone, upon listening or point by point measurement.

Shure Engineers designed this Automatic Curve Recorder to plot the operating characteristics of our microphones. It writes by ear.

This and other advanced testing techniques have enabled Shure to meet and often exceed the rigid requirements of microphone design demanded by the Army and Navy. You will have every right to expect new standards in microphone performance after the war is won.

ARMY E NAVY

SHURE MICROPHONES

SHURE BROTHERS, 225 West Huron Street, Chicago

Designers and Manufacturers of Microphones and Acoustic Devices

one dimension (thickness) is negligible.

How thick should the strap be? With the No. 14 wire the ratio of dc to rf resistance is 1 to 40. General experience at usual radio frequencies would lead us to believe it can well be 1 to 3 or 4. The strap is about 10 milliohms dc, or one in 4. If we halved the thickness of the strap it would become 20 milliohms, or half of the 40 rf milliohms, and we should expect the Q to fall, which in practice it does—from 700 total Q to about 550. Thus, a 4 mil strap is about the minimum, but on the other hand it is found that an increase to 7 or 8 mils does us little good.

How deep does the current penetrate the No. 14 wire? The 5 mil strap has enough conductor to give us maximum possible Q (the writer has never been able greatly to exceed 700 as a group value of Q). We find that if we calculate the dc resistance of the outer 2 mil skin of the No. 14 wire it has an area of 390 sq. mils, and a value of 8 milliohms. This is probably increased somewhat by the crowding of the current near the coil form, and probably the current can be said to be using all of it.

Round wire of the same cross-section area as the strap is No. 24, with 317 sq. mils. Since we can deduce that the current will use only the outer two mils of the cross section, we find its resistance to be 18.5 milliohms, with a consequent loss of Q, and in addition we can expect increased eddy current losses over the strap. The Q is about 475.

This set of facts and deductions fits together pretty well. It clearly shows that a very large conductor is of little value, that wires below about No. 18 show a steady loss of Q, and that strap five mils thick and of a width somewhat in excess of 50 mils is thoroughly satisfactory.

Form-factor of the coil

In uhf coil design we must quickly recognize that we cannot design a coil per se. It must be part of a structure including the tuning condenser, the trimming and tracking means, the tube socket, etc. Connection leads (in the usual sense) must be entirely absent. The only band switch that can be tolerated is one where the coil terminals engage the socket terminals directly, and so on. The length and diameter of the coil

RESISTORS IN THE AIR

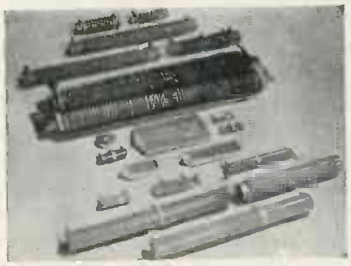
In the new Bendix RTA-1B two-way telephone for aircraft and ground station service, WARD LEONARD wire wound vitreous enamel resistors are used.

To quote from an article in March 1943 FM Magazine by Mr. R. B. Edwards, Bendix radio engineer, "Aircraft radio apparatus design might be described as the radio engineers' delight, for no restrictions are put upon the designers ingenuity in using the best he can find in materials and methods to assure absolute dependability."

But the use of Ward Leonard Resistors is not confined to communications. You find them used by the Army, Navy and by industry for every purpose where dependable resistors are required to operate under most difficult conditions.

Ward Leonard Engineers are at the service of every manufacturer of equipment using resistors. They will gladly suggest the resistor from the Ward Leonard line that will not only give you the best possible service but will be best adapted to the conditions of assembly.

WARD LEONARD RESISTORS are built to withstand heat, moisture, vibration and other adverse operating conditions. The line covers a wide range of types, sizes, ratings, terminals, mountings and enclosures. Let us send you bulletins describing resistors of interest to you.



WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) *devices since 1892.*

WARD LEONARD ELECTRIC COMPANY, 61 SOUTH STREET, MOUNT VERNON, NEW YORK

must then be designed as part of this structure. Fortunately the form factor is not critical.

For use with a variable condenser, the coil must be long enough to reach from stator to stator. The condenser must be specially designed to go with it. Since the internal resistance in the tank circuit is only a few milliohms, no sliding contact can be used to ground the rotor.

For iron-core tuning, the length must be sufficient to insure a reasonable length of core travel, to permit the design of a reciprocating movement for a reasonably large dial. Coils of the dimensions shown are a good compromise to tune from 100 to 140 mc with a suitable low-loss core immune to temperature drift (in certain cores this may be below 2 parts in a million per deg.).

A little-recognized effect encountered in lengthening a coil is the enlargement of the "phantom turn" as shown in Fig. 7. The rectangle completed by the heavy dotted line is the phantom turn. It is true that the wire of the coil is in spiral form in going from A to B, but it also forms a field due to its progression from one point to another. This is usually ignored in coils of a hundred turns or so, but does cooperate with the loop formed by the tuning condenser to form an inductance as shown. This loop may easily be 10 per cent or more of the circuit inductance at 150 mc and is little affected by the iron core.

An undesirable effect results when such small coils are lengthened too much, in that the field of the coil ceases to be axial. The coil of Fig. 2 has a winding pitch of about 9 degrees. This tends to isolate the end turn from the group field to some extent, and the field may have a maximum intensity which is ten to fifteen degrees off the axis line especially when there is a tuning condenser up against one side. This must be allowed for when coupling the coil to something else, and also in designing the shield around the coil. This effect also increases the eddy current losses in the conductor. This is a clue for any engineer wishing to design SLF core tuning, as permeability tuning can be made absolutely SLF for about 1 : 1.25 tuning range.

The economics of making ceramic tubes for core tuning also dictates as short a coil form as possible. Every slight increase in

NOW! perfect control of variables in industrial processes, through

FLASHTRON

THE HEART OF MODERN ELECTRONIC CONTROL

PRESSURE
TEMPERATURE
LIQUID LEVEL
FLOW
SPECIFIC GRAVITY
GAS ANALYSIS
SPEED
CURRENT
MOTION
VOLTAGE
AIR-FUEL RELATION
WATER ANALYSIS

The Thordarson Flashtron enables manufacturers of controls to apply electronic principles in the measurement or regulation of such factors as temperature, pressure, flow, speed, frequency, light, etc., etc., . . . thus insuring lightning-fast action, and hence greater accuracy.

The Flashtron, of course, is not a complete control "system". Rather it is the electronic "heart" around which to design a control set-up which can approach ±0 tolerance in keeping a check on widely diversified elements involved in manufacturing and analytical processes.

Flashtron is a "package" unit, which any control manufacturer may incorporate as the heart of a system designed to meet the needs of some particular industrial operation.

We invite control manufacturers to investigate Flashtron. On request we will be very glad to send a brochure which fully explains what Flashtron is, and what it does.

ARMY E NAVY

THORDARSON

ELECTRIC MFG. COMPANY
500 WEST HURON ST., CHICAGO, ILL.

Transformer Specialists Since 1895

length increases the probability of the tube developing camber—that is, ceasing to be straight.

Selection of coil diameter

The smaller the diameter the more compact the structure, the more concentrated the external fields, and the less chance of their coupling into surrounding metal to cause eddy current losses.

The resultant lessened inductance-per-turn allows a wider range of choice to the designer in tailoring his L/C ratio to fit the band in which operation is desired. The coil of Fig. 2, for instance, has a current sheet inductance of a little over 80 milli-microhenries. If we keep everything constant but vary the turns only, we can make up the table:

Number of turns	Inductance Mmh
1	9
2	36
3	82
4	146

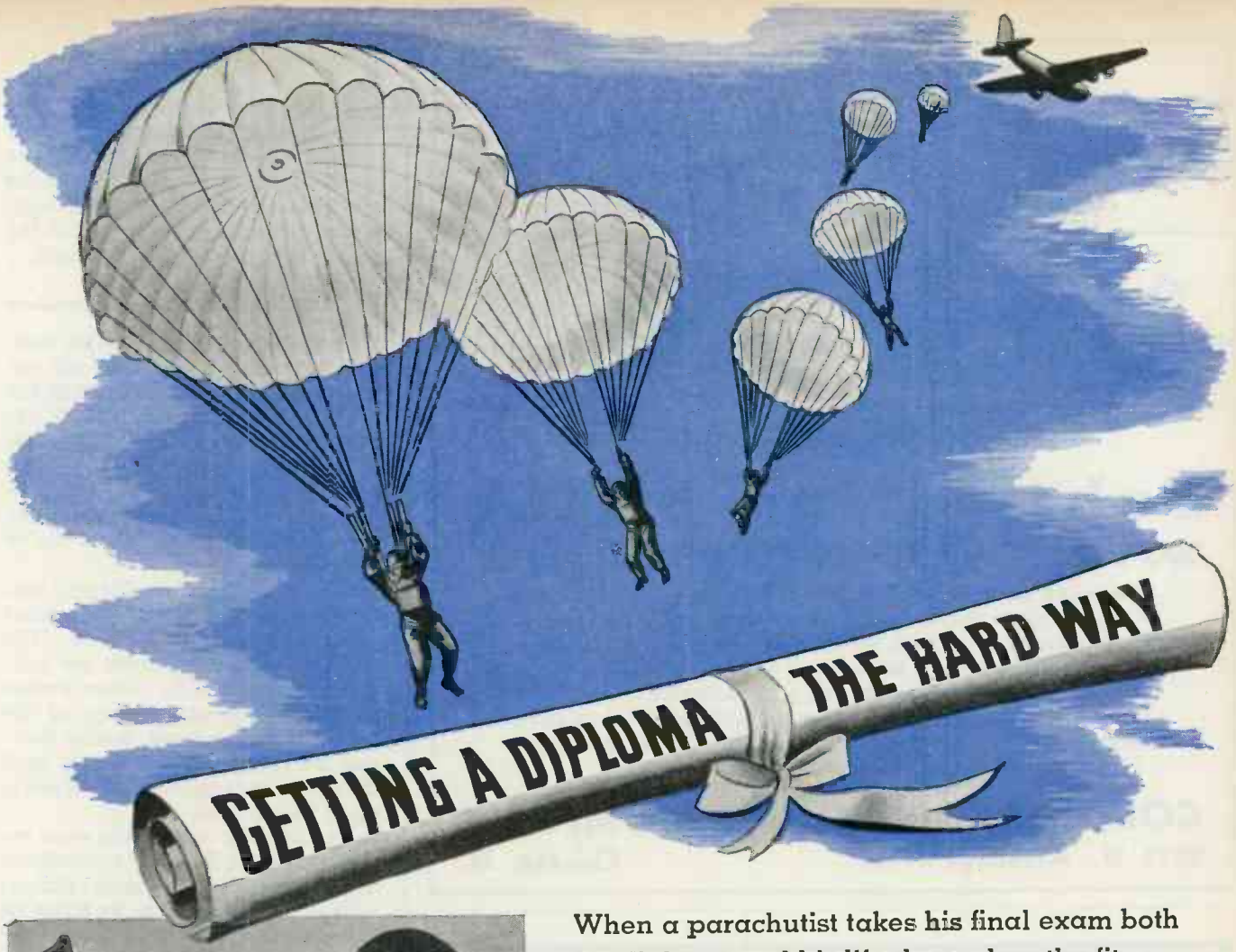
Both Acorns and 9000 series tubes are quite sensitive to L/C ratios, and these inductance jumps are quite large. A coil one-quarter inch in diameter would allow much greater freedom, in choice of inductance in this range.

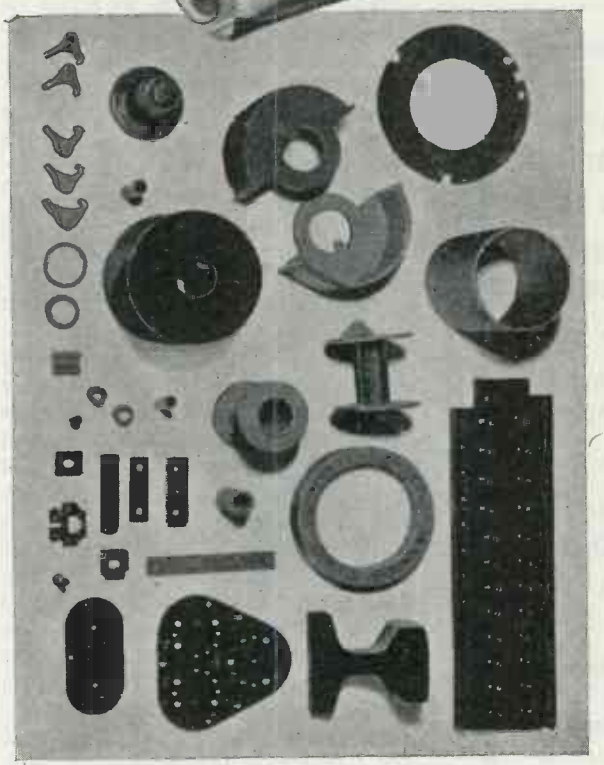
If the coil is to be used with a variable condenser, the Q falls slowly as we reduce the diameter to a quarter inch, and then quite rapidly, and at about ⅛ in. is quite low. The optimum range of diameter is 200 to 425 mils.

Tuning control rod

Two other factors guide us if we are using core tuning, however. The core must be mounted somehow on an actuating push rod, and to obtain maximum tuning range, which can hardly ever reach 1 : 1.50, we must arrange the diameters of the core and coil so that the core fills the coil as much as possible. In superstable oscillators we must mount the core on a ceramic rod, a reasonable size being 3/16 in. so if we used a 250 mil core there wouldn't be much iron in the core.

It is difficult to produce ceramic tubes with a wall thickness below about 20 mils and still have freedom from ovality and camber so the core can freely slide through them. The smaller the diameter, the less room there is for the core, reducing the tuning range. Incidently, the grooved form of Fig. 3 is much easier to make, as the thick "lands" between the grooves





When a parachutist takes his final exam both his diploma and his life depend on the fitness of his rip cord.

Lives also frequently depend upon the fitness of inconspicuous radio and electrical parts of Formica laminated plastic used in war equipment — such parts as insulating spools, insulating spacers, breaker arms, radio tube socket bases, terminal strips, rheostat cores and other insulating parts.

Formica combines lightness with strength, dimensional stability, and resistance to change through chemical action. It has a low power factor, low dielectric loss. There is a wide variety of grades each of which emphasizes some one of the many valuable properties of material for special purposes.

ARMY E NAVY

FORMICA

THE FORMICA INSULATION COMPANY

4647 SPRING GROVE AVENUE • CINCINNATI OHIO

reinforce the thin wall during firing.

These two considerations decided the choice of the diameter of the form shown in Fig. 3. This form works out quite well in practice and provides sufficient mechanical movement of the core to permit the design of a good dial mechanism.

Winding under tension

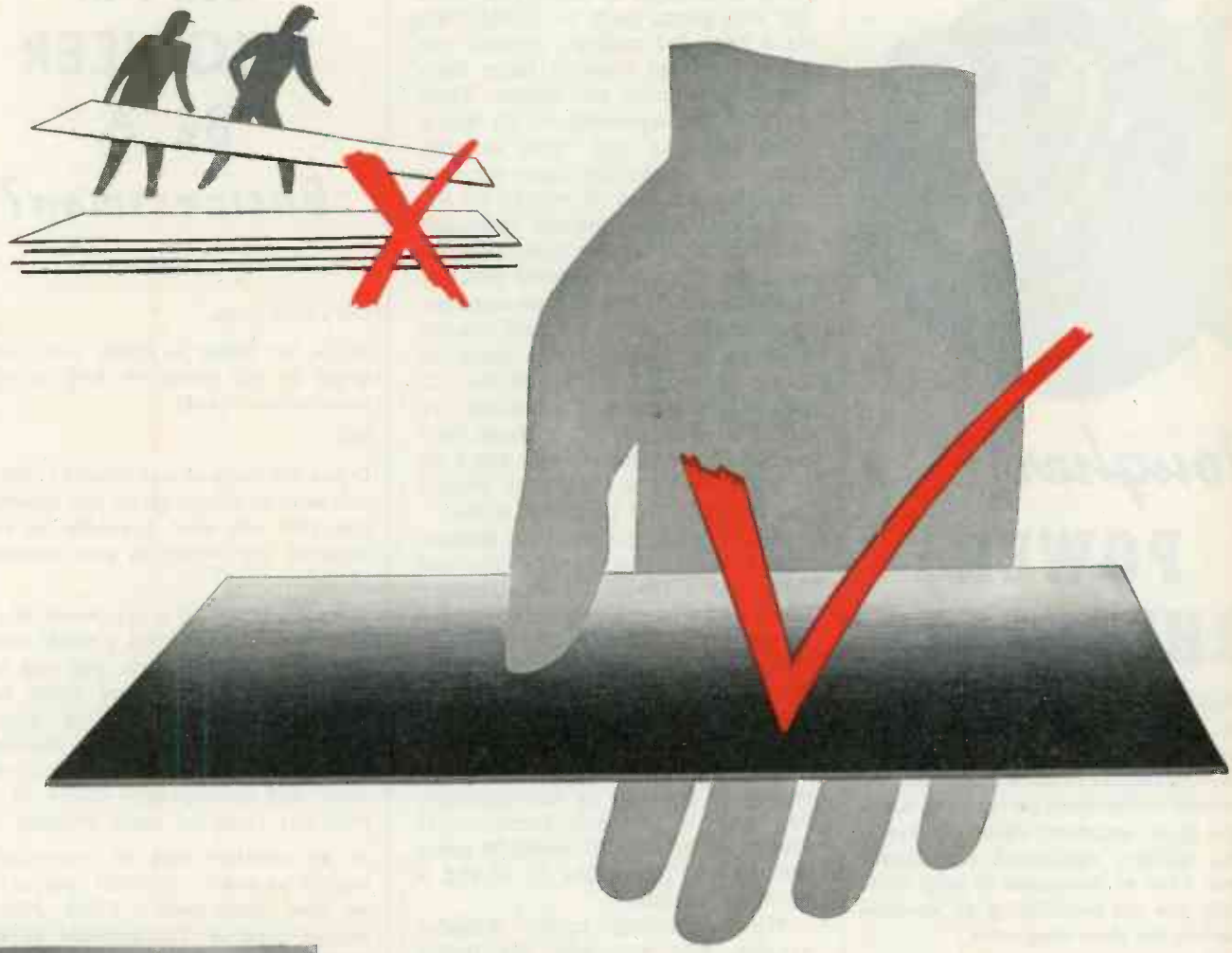
Most low resistance metals suitable for use as a conductor will expand about 18 parts per million per deg. C. The Invar type alloys expand only about 1 part, but because of their high nickel content cannot be used in the field of the coil. The magnetic loss in the nickel being very high, they must be well plated with silver or copper.

Only two possible coil-form materials have almost infinite secular stability—glass and ceramic. The ceramic expands 6 parts per million per deg. C. In severe mobile work, a temperature range of 100 deg. C is encountered. Severe thermal working of the parts with such different expansion coefficients must be overcome.

The ceramic form is the most reliable member of the combination. The only way it can change dimension is by breakage, so we know its dimensions will be identical a thousand years from now. Its expansion of 6 parts per million per deg. C. is fairly low. It is much better to try to bring the expansion of the wire down from 18 to 6 than to attempt to make a coil form which would expand 18 parts. Although the latter would result in an assembly free from thermal working, it would have a much greater change in inductance.

Better results are obtained by taking advantage of the elasticity of the metallic conductor. If we weight and stretch a ten ft. length of the silver strap used on the coil of Fig. 3, for example, we can run the curve of Fig. 8. The length will increase in a linear manner at first, and if we remove the weights it will spring back to its original length. When we reach C on the curve, we have exceeded the elastic limit, and the strap will be permanently stretched. We note the midpoint of the curve, at B, and wind our coil with the wire under that tension. It will then hug the coil form like a rubber band, and while its cubic volume will continue to change at 18 parts per deg., its length will always be just sufficient to go around the form, the difference being taken up by the elas-

"WE WANT TAYLOR FIBRE"



This war-born product is an auxiliary fuel tank that adds important miles to American airmen's bombing missions. It is made of Taylor Fibre. Why? Because Taylor Fibre sheets, shipped and stored flat, are quickly and easily formed to make these light-weight, leak-proof, auxiliary gas tanks that are so economical in comparison to the importance of their job that they can be discarded in flight, if necessary, as soon as they're empty. You never know what can be done with Vulcanized or Phenol Fibre until you Take it to Taylor

It happened recently in one of our customers' plants. We were an unidentified witness. The workmen were forming an important war instrument from vulcanized fibre sheets.

Suddenly the men stopped their work, turned their backs on the sheets they were using, and replaced them with a new batch that had just been delivered.

"Why the change?" we asked, innocently. "Oh, this is Taylor Fibre," one of the men replied. "We like to work with Taylor. It forms so easily. You can always depend on it. No 'bugs' in it."

Taylor Fibre's dependability is the result of the VERIFIBRE PROCESS—Taylor's name for quality-control. It means that every inch of Taylor Fibre is checked and verified at every step in its manufacturing process—a process that is completely Taylor-controlled under the roof of the industry's most modern plant. Cotton cellulose, papers, resins, chemicals are all produced or refined by Taylor. The result is a finished product that is quality-controlled.

TAYLOR FIBRE COMPANY

NORRISTOWN, PENNSYLVANIA

LAMINATED PLASTICS: VULCANIZED FIBRE • PHENOL FIBRE

SHEETS, RODS, TUBES, AND FABRICATED PARTS

ticity. It is thus truly the slave of the coil form.

If we use a conductor with a lower coefficient of expansion than the coil form, such as Invar with its 1 part per million, suppose we wind it on the form at room temperature without stretching. Then we cool the assembly to 40 below zero, and the coil form shrinks. This would leave the Invar winding unsupported, and of course its dimensions would change radically, as a spiral is the weakest possible geometric form. To avoid this, we must stretch the Invar on anyway, so its inside diameter would change 6 parts per million, the same as silver or copper stretched on. If we plate the Invar with silver, we find that we must put a dense, burnished coat at least 4 mils thick on it to prevent the flux from reaching inside to the high loss nickel.

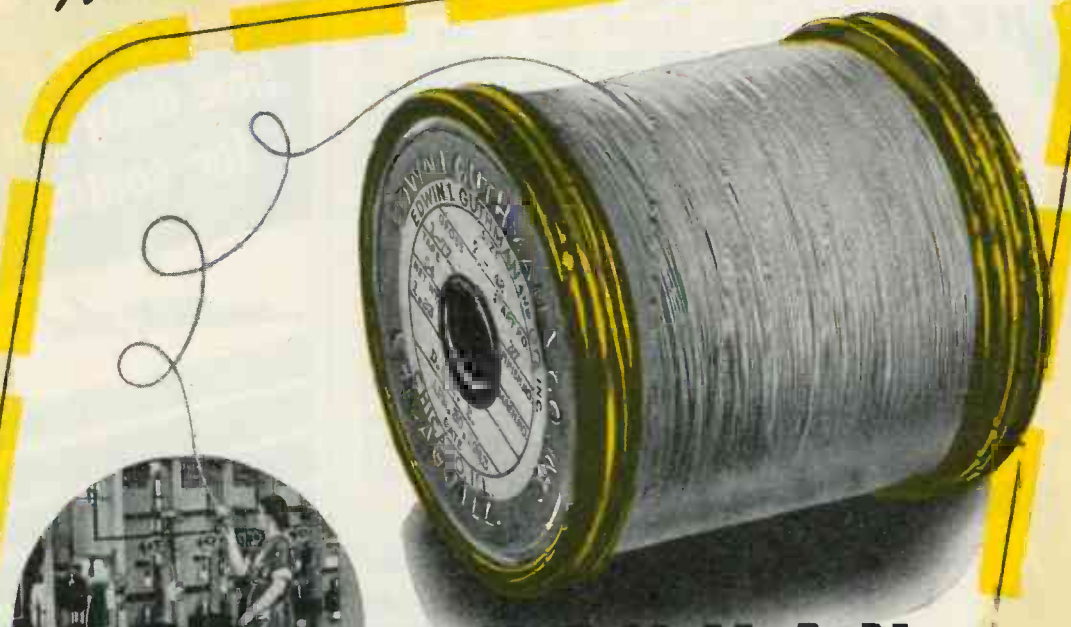
If the conductor had no dimension and was the slave of the coil form, our formula for true inductance shows that the temperature coefficient of inductance of the coil would be 6 parts per million. Since the important term is $d^2/1$ and since both expand 6 parts, the result is d, which is 6. The change in apparent inductance would of course be greater, as the dielectric constant of the coil form would also be increasing, at about 70 parts per million, increasing C_1 of Fig. 1 by that amount.

While winding under suitable tension will maintain the inside coil diameter at that of the form, the wire itself will still change in cross-section at the rate of 18 parts per million. In the coil of Fig. 2 the outside diameter of the winding will expand 7.8 parts per million by adding the contribution of the active copper to that of the more inert ceramic. The o.d. of the strap coil increases only 6.16 per million, as the strap is so thin it adds little to the total.

Current distribution shifts

There is probably some redistribution of the current through the wire of the coil wound with No. 14 due to the great increase in resistance of the copper, which is over 3,000 parts per million per deg. C. It does not seem to the writer, however, that the mean turn is shifted much more than that due to simple expansion of the wire. Probably the mean-turn shifts about 6.7 parts per million, since it does not follow from point 3 up to 3T (Fig. 4). The capacity between turns

Another Leader in Radio Manufacturing



GUTHMAN *Super Q Wire*

★ The large and complete Guthman "Super Q Wire" Manufacturing Department serves the leading manufacturers of radio equipment with standard types of Litzendraht and textile served wire for RF use. ★ Guthman's own, specially designed equipment for manufacturing insulating material is adjustable to give uniform quality, and to meet individual design requirements. ★ Our experience helps us in maintaining a high standard of perfection, and qualifies our analysis of design problems and difficult requirements within a minimum element of time. Tests are made in our own proving grounds. ★ Guthman products are no higher priced than others of comparable quality. The usual Guthman dependability for service is available even in today's critical production situation. ★ Though producing for war contracts, we can accept additional orders in our Super C Insulated Wire Department. All of our work is engineered to meet U.S. Government Army and Navy, R.M.A. and N.E.M.A. Standards.

EDWIN I. GUTHMAN & CO. INC.

15 SOUTH THROOP STREET CHICAGO

PRECISION MANUFACTURERS AND ENGINEERS OF RADIO AND ELECTRICAL EQUIPMENT

must increase, of course, due to increased diameter of the wire.

Having given the reasons for wishing to have the coil the slave of the coil form, let us look at the coil wound with No. 14. The wire is so large and strong that it is very difficult to wind it under sufficient tension, and at the same time keep the pitch constant. In practice when we attempt this, we are never sure the pitch is uniform. The wire is only in line contact with the form, and is far from its obedient slave. When we make a severe heat run it is quite usual to find that it has shifted somewhat in pitch. It also has the bad habit of sometimes trying to "wind up"—that is, to progress away from one end and pile up at the other. Numerous heat runs still leave us in doubt as to the actual inductance versus temperature change except that in general it is somewhat more than that of the strap coil.

Use ceramics for permanence

Strap wound on any of the uhf ceramics never shifts. The microscope tells the story—shown exaggerated in Fig. 6. The surface of these ceramics consists of very tiny crystals, as sharp as church steeples! When a strap of comparatively soft metal is firmly laid down on them, they puncture the surface of the metal and firmly anchor the strap at all points. Another dividend is obtained from this anchoring. Losses in the ceramics are not negligible—they are not bad, but they do exist. By impaling the strap on these "spikes" we reduce the area of the metal in intimate contact with the ceramic, and the small air-gap introduced lessens the dielectric loss.

It was at first suspected that these "spikes" would work their way deeper into the strap, but experience has shown that with very hard drawn and rolled strap this did not happen, provided a certain minimum winding tension was maintained. This could be insured by passing a controlled current through the strap while winding, thus heating it up and obtaining a shrink fit when the wire cooled. In short, the cyclic stability of the No. 14 wire coil was always in doubt, but that of the strap coil was perfect.

Since the foregoing has shown the need for a conductor at least 4 mils thick, we attempted to burn on the winding. Taking silver powder in a liquid carrier, we

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MANPOWER!

Find the engineer!

Find the foreman!

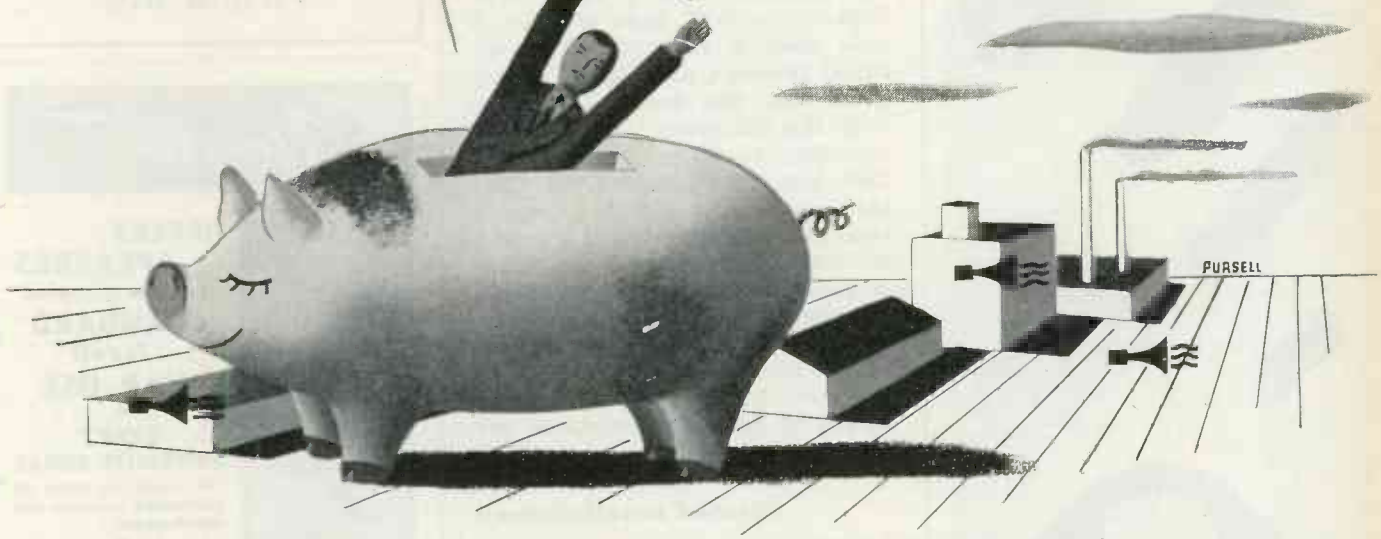
Find the production manager!

Find these men . . . fast . . . and you'll find savings too! The most important of all. Straight-Line Communication saves *manpower* . . . at a time when it's never been so important.

It reaches one man . . . or a thousand . . . *quicker* and *better* than by any other method. It will quickly pay for itself . . . through the savings in man-hours alone!

It makes your telephone system more effective . . . by getting the party wanted without delay.

Equally important, it helps in emergencies, by speedy broadcasts of warning signals . . . fire alarms, air raid alerts, all clear.



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ARMY NAVY E

STROMBERG-CARLSON, ROCHESTER 3, N. Y.

STRAIGHT-LINE COMMUNICATION SAVES MANPOWER • SPEEDS THE WORK TO VICTORY

heated the painted-on coil to reduce it to metallic silver, and then fuse the silver particles together by melting, all in a non-oxidizing atmosphere. The coating had to be so thick that surface tension did not suffice to hold it in place, and drip points developed. The melting point of silver was so high the ceramic tended to warp. We did not succeed, and it looks like a very difficult job.

Plating difficulties

Plating-on can be done in two ways—by masking off the form so that the spiral is put on directly, or by plating the form all over and then grinding a spiral right into the ceramic, thus forming the coil.

The grinding is extremely difficult in practice. Ceramics are very difficult to grind with small wheels, being nearly as hard as the wheels. Furthermore, it is almost impossible to hold them in a chuck or on a mandril. None of their dimensions is true and they wobble quite a bit. Thin-walled forms often break. The silver is left, moreover, with a very ragged edge.

Plating after masking runs into the difficulty that a very dense high-conductivity coat at least 5 mils deep is required. The so-called jeweler's plate takes a long time, and the density decreases with the thickness. We found it necessary to plate on three mils, then buff off about one mil, then plate again, and buff down—for a total of three times to get a good 5 mil coat. The surface is quite important—it must be buffed smooth. Apparently a coat that looks "frosty" due to surface irregularities forces the current to run up and down hill, so to speak, and the length of path and resistance are increased.

Method unsatisfactory

Both plating and burning-on would run into the difficulty that the metal would be in intimate contact with all the crystals forming the surface of the ceramic, with consequent increased dielectric losses. The writer regrets to report failure with both systems. We never obtained a really high Q coil, and we finally gave up because of the very satisfactory behaviour of the coil of Fig. 3.

It has doubtless been noted that in the foregoing discussion no provision has been mentioned for a tickler winding. Except for special circumstances, an ultra-audion

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WHATEVER your resistance problems may be . . . you are sure to find the right answer at Ohmite. Our extensive range of types and sizes makes possible an almost endless variety of regular or special resistors to meet every requirement. Core sizes range from 2½" diameter by 20" long to 5/16" diameter by 1" long . . . and are produced with standard or special windings, terminals and other features. Many are stock units.

Because of their extra dependability under the most critical operating conditions, Ohmite Resistors are used today in all types of electronic and electrical applications . . . in planes, tanks, ships, in laboratory research and development, in scientific instruments and in the production tools of war.

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The resistance wire is evenly wound on porcelain core, rigidly held in place, insulated and protected by Ohmite vitreous enamel. Dissipates heat rapidly—prevents hot spots and failures. Core sizes range from 2½" diameter by 20" long to 5/16" diameter by 1" long.

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type of oscillator offers many advantages—the type where the tuned circuit is connected between grid and plate of a triode. This offers the advantages of grounding the heater and cathode, a necessity when ac or fluctuating dc is used on the heater. The tube capacities are also placed in series, allowing the use of a larger value of tuning capacity to swamp out the tube capacity.

Performance in oscillator

The thermal stability of an oscillator using a carefully laid out circuit based on one of these strap coils is rather astonishing. The writer has been on the air with a receiver of standard make costing nearly $150. On the ten meter band the warm up drift lasted nearly an hour. A receiver at 125,000 kc using these strap coils warmed up to within 1 kc of final frequency in 55 sec., using acorn tubes.

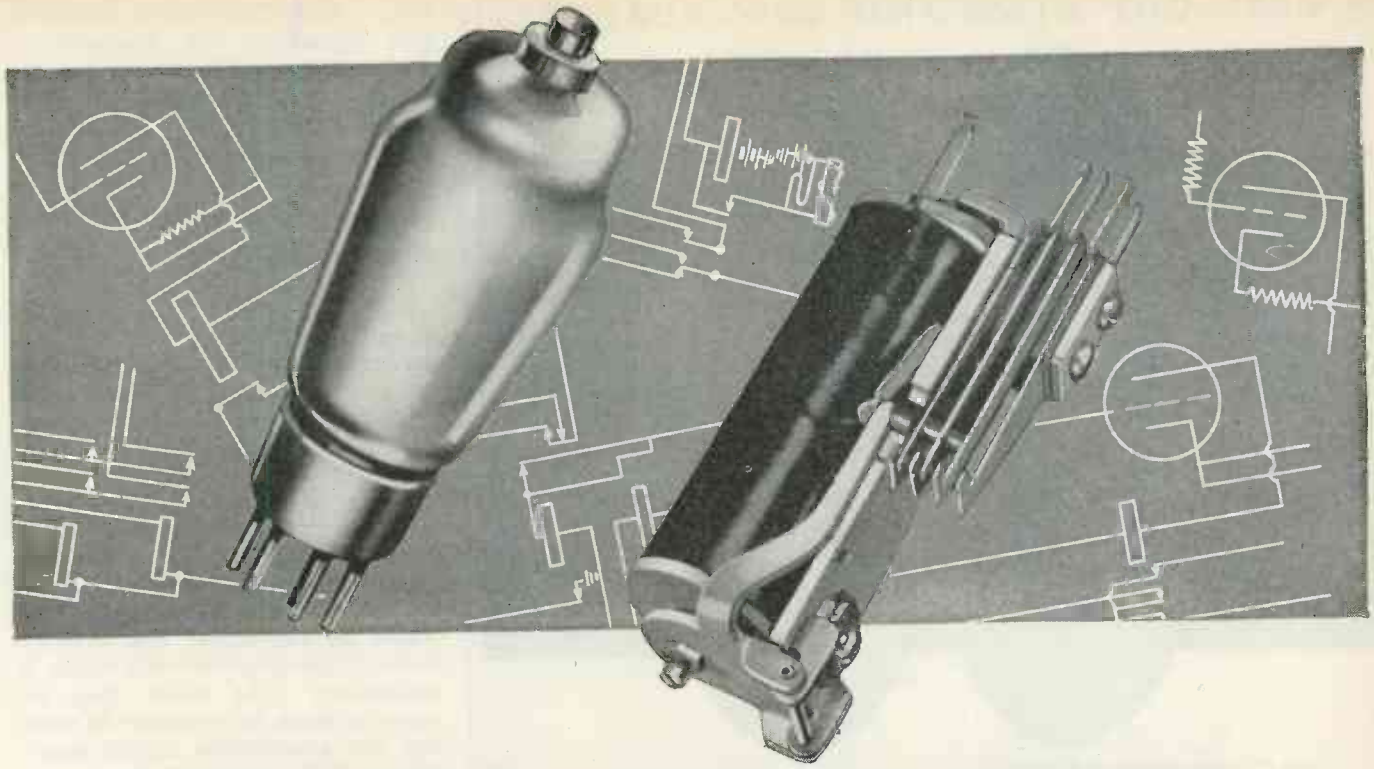
A favorite heat run on our oscillators is from 70 deg. F. to 217 deg. F. The frequency shift at the end of two hours was three kc. This is considerably better than an amateur crystal.

The voltage stability was a change of 7 kc at 125,000 for a line voltage change of from 95 to 135 volts, with an unstabilized power supply.

Since the winding must be maintained in high tension, some unyielding support must be given the termination of the winding. This can well be done by arranging some additional structure to be integral with the coil form to take the strain and provide a mounting for the tuning condenser, the band switch contacts, the trimmer, etc. If it is found necessary to fasten the coil form to another ceramic piece, cement should not be used because it will "give" slightly with time. Also avoid lead glaze, as the losses are high. Use dust glaze that melts about 1700 deg., and as little as possible.

Summary

While much of the data here given is incomplete, and some is merely guesswork based on long experience, it is thought this original attack on the various problems of low-loss stable inductances should be helpful. The facts ascertained allow us to develop a very good coil which can be produced in quantity, is almost infinitely stable both in a cyclic and secular sense, has as



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All along the fighting fronts where the tools of war are being used —and in industrial plants where they are being made—electronic science is working miracles to hasten the day of victory.

Team-mates in this new world of magic are the electronic tube, in its infinite variety of types and applications, and the Automatic Electric relays, stepping switches and other control devices that are so often needed to make electronic developments take practical and useful form.

Electrical control has been Automatic Electric's sole business for over fifty years. That is why electronic designers in scores of industries are finding it both helpful and profitable to work with Automatic Electric field engineers in determining the right control apparatus for each job. Together, they speed new electronic developments through the laboratory and into the production line.

If you have a control problem—whether electronic or just electrical—it will pay you to take these two steps: First, be sure you have the Automatic Electric catalog of control devices. Then, if you would like competent help in selecting the exact combination to meet your need, call in our field engineer. He will be glad to place his experience at your disposal.

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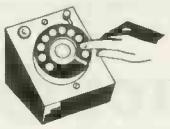

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MUSCLES  FOR THE MIRACLES OF ELECTRONICS

high a Q as can well be obtained, and inductance vs. temperature change of only 6 parts per million per deg. C. With such a coil, tunable or fixed tune gear with crystal stability can be designed.

DIRECT WRITING OSCILLOGRAPH

(*Continued from page* 87)

directly in the plate circuit of ordinary amplifier tubes presents an impedance mismatch which is wasteful of power.

A modification of the Baldwin balanced armature telephone receiver seemed to be the best solution. Here the field magnet is stationary and terminates in four pole pieces, one at either side of each end of a short iron armature balanced at the center and free to move in the armature coil which is stationary. The latter may be made as large as necessary to present the appropriate circuit impedance, 8000 ohms for regular receiving pentode power tubes operated in push-pull. The power supply is fed to the center tap of the armature coil, thus neutralizing the effect of the dc component of the plate currents in the tubes.

The armature operates over a considerable arc in order to obtain adequate amplitude of the recorded trace, but the assembly is designed to secure a linear motion throughout this range. By the choice of a suitable material of very low residual magnetism (armco ingot iron) any effect from hysteresis is so small as to be impractical to measure. Eddy-currents are entirely negligible in the frequency range over which the instrument is operated because of the comparatively loose coupling between the armature and the armature coil.

A voltage of about 30, peak-to-peak, is required for maximum deflection, which is of the order of an inch, measured peak-to-peak at the stylus tip on the paper. The frequency range is still being extended, with present designs operating up to 100 cycles and even to 120 cycles per second at a slightly reduced amplitude. The response is closely linear with regard to amplitude, and approximately flat with respect to frequency over the entire range.

One feature of this recorder is the use of "Teledeltos" facsimile paper, which is an electrically conductive paper (used dry) with a very light grey heat sensitive sur-

SCR-299

Vanguard of Invasion!

The SCR-299 Mobile Radio Communications unit played a great part in the invasion of Africa and Sicily . . . these units were used as mobile radio stations, transmitting voice commands to fast moving armored units while in action, or as permanent radio stations . . . even under the most difficult operating conditions.

A leading military authority said, "My observations in the theatres of war make it possible to say that the SCR-299 hit the jack pot in the mobile radio field as has the jeep in transportation."

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THE WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT

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CHICAGO, U. S. A.

face, which becomes marked by passing an electrical current from a stylus through the paper to a metallic platen beneath, resulting in a highly contrasted black line. The surface is not marred by the roughest handling and the trace, instantly visible, is permanent.

Electrical damping used

The stylus arm is made from a solid bar of aluminum ⅛ in. diameter so that there is no possibility of breakage through rough handling. A rather heavy pressure of the stylus on the paper, of the order of some 15 grams, is required to make a clear continuous trace. The driving and restoring forces, however, are so large that the resultant friction has little or no effect upon the damping of the element so the performance is independent of paper speeds and other mechanical variables. It is quite insensitive to vibration and may be used in moving vehicles and in airplanes.

Critical damping

The necessary critical damping is introduced by an electrical network which is permanently adjusted. The stylus itself carries a direct current from a 300 volt internal source, limited to a few milliamperes. The value of this current is not critical and is of the order of 10 to 15 milliamperes for paper speeds in the range up to 10 cm per second. The stylus itself is a minute accurately ground conical point of a refractory ruthenium alloy. The trace, only .010 in. wide, permits extreme resolution at moderate tape speeds.

Permanent adjustments

Since all adjustments of the writing element are permanently fixed at the factory, it is hung out of the way beneath a horizontal panel with only the upper end of the vertical axle of the armature projecting. To this is attached a cross-head which carries the stylus arm. The cross-head is protected by a little aluminum turret. The only possible injury which the instrument could receive would be from forcible deflection of the stylus arm sideway beyond its proper limits of travel. If this should occur a slipping clutch within the cross-head relieves strain on the axle. To reset the stylus arm the operator merely pushes it forcibly an equal amount in the re-

Said the War Correspondent to the Folks Back Home:

"Tanks storm rail center —smash counterattack"

Whether for beaming a headline across the world or bringing it into your home, Federal is a leading manufacturer of radio transmitting and receiving tubes, including the giant tubes used by Mackay Radio in its world-wide Communications Service

In your morning paper
It's only an arrow
Creeping toward a dot on the map . . .

But out there
Where the angry earth
Convulses under your feet
From the thundering steamroller charge
It's hell on wheels
As the tanks attack at dawn

* * *

And close on their clawing heels
Spattered with the same mud and lead
As the mopping-up forces
Comes the soldier with the typewriter . . .
The war correspondent

* * *

When you read his eye-witness account
Of how this town was taken
Read between the lines
And give a thought
To the man under the helmet
Whose only command is . . .
Get the story!

* * *

Helping him get the story *through*
Relaying it from field radio
To command outpost
To towering Mackay Radio
Trans-Atlantic radio telegraph station
Is the voice and ear of electronics
The vacuum tube . . .
Giving wings to his words
Just as it helps plane and tank
"Work together better
Because they can talk together"

* * *

Here at I. T. & T.'s manufacturing associate
Federal Telephone and Radio Corporation
Where a great many of these tubes are made
Our hats are off
To the men who use them
To speed victory . . .
Some day they'll help men
Build a better world

IT&T

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION *67 Broad St., New York 5, N. Y.*
Manufacturing Associate:
FEDERAL TELEPHONE AND RADIO CORPORATION

verse direction, so that the stylus when released will return to its normal base line.

The lateral dimension of each pen unit has been kept small so that any number of elements can be mounted side by side in perfect symmetry on 1¾ in. centers, with no wasted paper space between them.

Any mounting position

As a consequence of the inkless writing feature, the Garceau Velograph may be mounted in any position, such as on a vertical relay rack panel. Where extreme amplitudes of vibration are to be encountered these are completely neutralized by a counterbalanced astatic writing head.

While the Garceau Velograph was primarily developed for use in the Garceau Electroencephalograph, now in use for the neurological testing of military personnel, it soon became apparent that the technical needs of the present emergency even more urgently required a direct-writing oscillograph.

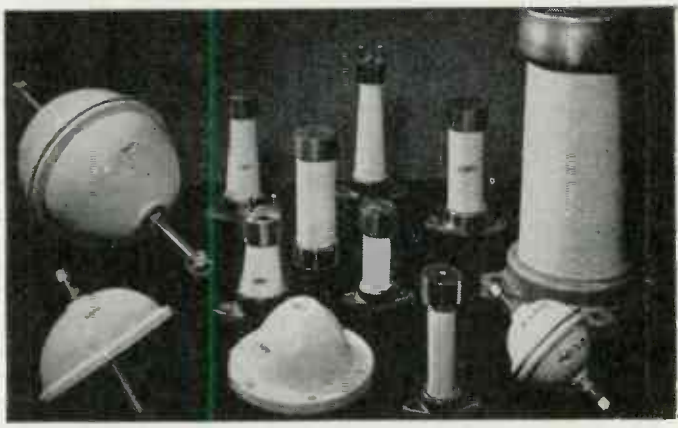
Sound ranging of artillery, vibration analysis in aircraft and engines, strain analysis in various structures all lend themselves to this recording system. The instrument has been made available with gear shifts enabling a selection of paper speeds from the synchronous motor drive, a multiplicity of channels up to a maximum of 20, and direct coupled preamplifiers of almost any required degree of sensitivity.

Another adaptation using electrosensitive "Teledeltos" recording paper is shown in the multichannel Chronograph. The styli in the Chronograph do not move at all. The occurrence of the events which it is desired to time simply interrupts the marking current. The result is an inertialess recording system of absolute accuracy. Present applications include timing the sequence of events in automatic machinery, sound ranging, timing the flight of projectiles, recording the incidence of alarms and power failures and a multitude of other military and industrial jobs occasioned by the war program. Records of the running time of spot welders and other factory machinery provide an absolute production record check of great value in time studies on machine tool performance for studying operators, material flow and other factors affecting factory production.

FOR HIGH-FREQUENCY POWER SOURCES

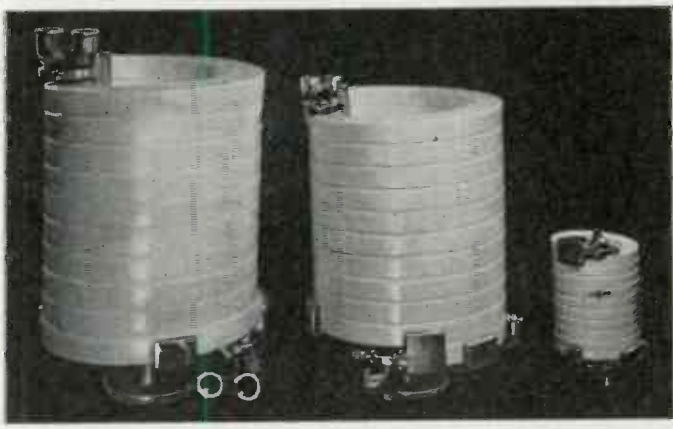
LAPP GAS-FILLED CONDENSERS

In any electronic circuit, wherever lump capacitance is needed, Lapp condensers will save space, save power and save trouble. Available for duty at almost any conceivably-useable voltage rating and capacitance, they bring to any application notable mechanical and electrical advantages: practically zero loss, smallest space requirement, non-failing, puncture-proof design, constant capacitance under temperature variations. *Shown, at left, Unit No. 25934, rated at 200 amp., 6500 volts, capacitance variable 4300 mmf. to 11000 mmf.; right, Unit No. 23722, rated at 50 amp., 7500 volts, capacitance 45 mmf. to 75 mmf.*



STANDOFF, BOWL, ENTRANCE INSULATORS

Standoff, bowl, entrance and other special-purpose insulators are available in wide range as standard Lapp catalog items. Other insulators of special design are easily produced by Lapp methods, either in porcelain or steatite. The wide choice of such insulators available from Lapp simplifies the design of high-frequency equipment. Also, Lapp is equipped for production of many special assemblies, of porcelain or steatite, and the associated metal parts.



LAPP PORCELAIN WATER COILS

For cooling of high-frequency tubes in radio transmitters and other electronic power sources, Lapp porcelain water coils have been widely used. With nothing about the porcelain to deteriorate, sludging is eliminated, and with it the need for cleaning and water changes. Porcelain pipe and fittings in any needed size are also available as catalog items. We welcome inquiry on any Lapp equipment for experimental or industrial electronic application.

Lapp

INSULATOR CO., INC.

LEROY, N. Y.

High-Frequency Degassing of Tubes

A process developed to improve the vacuum of an electron tube by induction heating is reported in the July issue of the "General Electric Review."

"To safeguard the operation of U. S. Signal Corps radio tubes, in the field, G-E electronics engineers are using high-frequency induction heat to drive gas from the metal parts of the tubes, and to 'explode' tiny pellets of barium inside the tubes to absorb any remaining particles of gas which may come from the metal while the tubes are in use. Such gases, if not properly exhausted during manufacture and absorbed during operation, would cause premature failure of the tubes.

"The tubes are placed in a machine which exhausts the air. As they pass around the machine, the tubes go through a series of water-cooled coils of copper tubing from which the high-frequency induction waves emanate. Although the waves do not affect the glass and other insulating parts of the tubes, when they strike the metal parts they cause them to heat and give off gases which are exhausted. The tubes then pass by another high-frequency coil which causes vaporization of the barium. This absorbs whatever gases may not have been exhausted, and provides for future absorption of small amounts of gases driven from the internal metal tube parts when they are in field operation."

Army Displays Captured Enemy Radio Materiel

Electronic and radio manufacturers who are in Washington between September 9 and 26 can see a notable display of Signal Corps equipment, together with German and Japanese captured apparatus, which is being exhibited at the Army Show on the Monument Grounds between 14th and 16th Streets on Constitution Avenue, N.W. The display includes a Japanese Direction Finder which was captured on the Aleutian Islands.

Among the Army's own Signal Corps equipment on exhibition will be the Handie-Talkie set (SCR 536) and other equipment ranging up to the large mobile transmitter (SCR 299), both of which won such high commendation in the North African and Sicilian combat zones. There will be a number of other familiar pieces of Signal Corps equipment, including the Walkie-Talkie, Guidon, Vehicular and Pack Sets. The exhibition will include completely operating Signal Corps manned outpost and division headquarters, television as used by the military forces, light beam voice apparatus and the transmission and reception of radiotelegraph code under conditions of battle noises.

One feature of Signal Corps participation will be the reception of news dispatches from combat areas over the world-wide radio circuits operated by the Army Communications Service with the news items flashed on an illuminated screen.

Commander Brengle to Overseas Base

Lieutenant Commander Ralph P. Brengle, U.S.N.R., who has been Assistant Head of the Radio Division of the Bureau of Ships in recent months and formerly was Chief of its Procurement Section, was recently assigned to an overseas base. In civilian life Commander Brengle was head of the Ralph P. Brengle Sales Co. of Chicago, and active in the radio-electronic field.

LITTLE GIANTS OF DEPENDABILITY

JAMES KNIGHTS *Crystals*

Crystals For Victory!

The men of the James Knights Company have pioneered in the manufacture of Crystals since 1932. Increased production during the present emergency period came naturally as already existing production facilities were called up. James Knights will be making Crystals too when this war is over—supplying them to those who demand the utmost in dependability and efficiency.

Any Type, Cut or Frequency

PRECISION CUTTERS OF QUARTZ FOR COMMUNICATIONS AND OPTICAL USES

The JAMES KNIGHTS Company

SANDWICH, ILLINOIS

PHONE 65

FIRST MILESTONE of the ELECTRONIC ERA

How "Edison Effect" Was Discovered 60 Years Ago

by DR. CLAYTON H. SHARP†

The year 1883 marked the discovery of the basic phenomenon underlying the branch of electricity which we call electronics. Electronics embraces the phenomena and laws of the emission of electrons, or particles of negative electricity, and the transportation of electric charges by them, usually under controlled conditions. Radio at both the sending and receiving ends is based on electronic technology. Recent years have seen a rapid extension of the field of electronics in many directions and the future holds promise of revolutionary developments in the domain of power engineering through the utilization of the minute and nimble electron.

The fundamental discovery referred to above was made not by a professional scientist but by a professional inventor who was at the same time a man of broad and profound scientific attainments, the man to whom we must ascribe a major part in the transformation of the world of yesterday into the world of today, Thomas Alva Edison.

The story of this discovery is about as follows: One of the major difficulties with Mr. Edison's new carbon-filament incandescent lamps was the unduly rapid blackening of the interior of the bulb of some of the lamps. In studying this, Mr. Edison noticed that on one side of the bulb of some lamps there would be found a line of clear, unblackened glass in the plane of the legs of the filament and on the side of the positive leg. It was as if the positive leg were casting a shadow of something emitted by the negative leg.

Inserted a "plate"

Mr. Edison, assuming that particles were actually being given out or expelled, arranged a trap to catch them. He did this by sealing a wire inside the bulb in the plane of the legs of the filament, and bringing out an insulated lead therefrom. He found that if this lead were connected through a galvanometer to the negative leg of the filament a current flowed from the filament to the wire. No such current flowed when connection was made with the positive leg. The hypothesis that charged particles emitted from the negative leg were traversing the vacuum was thereby greatly strengthened. Numerous experimental lamps were made, some containing one wire, some two and some a plate or a wire and a plate, and all led to the same conclusion.

The phenomenon thus discovered was an isolated one in electrical science, and under the name "Edison effect" remained a scientific curiosity for a number of years. Mr. Edison demonstrated it at the Philadelphia Exposition of 1884 and it was viewed with great interest by various noted scientists among whom was Sir William Preece, chief engineer of the British telegraphs, who obtained some of the lamps from Mr. Edison, took them to England and described the effect before the Royal Society.

Fleming's cylinders confirmed

Professor J. A. Fleming, later Sir Ambrose Fleming, next carried out a systematic investigation of the effect. He surrounded the legs of the filament with little metal cylinders as shields which could be raised or lowered at will and would serve to cut off any emanation from them. The existence of such emanation or particles such as Mr. Edison visualized, was conclusively proved.

A number of years later Marconi introduced his system of wireless telegraphy, using the Branley coherer as detector. The coherer was an inefficient and troublesome device, and a better detector was sorely needed. Investigations of the coherer showed that it owed its detecting properties to its ability to pass current in one direction while stopping it in the other direction—in other words to its valve action. Professor Fleming bethought himself that it was just this action that the "Edison effect" lamps had manifested. As a result, he produced the "Fleming valve", the first device purposely made as a radio detector dependent on electronic action.

Dr. Lee deForest took the next step in the development of the radio tube by introducing the principle of the control of the flight of the electrons by means of an auxiliary electrode—a stroke of genius which elicited the admiration of Mr. Edison himself. Thus the modern radio tube was evolved from the "Edison effect" lamps of 1883.

DR. CLAYTON SHARP demonstrating, 50 years later, that Edison's "tube" of 1883, produces excellent quality in modern broadcasting circuit

It is interesting to note the extent to which Mr. Edison's experimental lamps embodied the elements of the modern tube. It is possible to do this since a considerable number of the original lamps are preserved in the historical lamp collection in the Edison Institute at Dearborn, Mich. In these old lamps we find the hot cathode as the negative end of the filament, the plate or anode voltage furnished by the fall of potential in the filament itself, and the plate and control grid represented by the wire and the plates introduced by Mr. Edison for experimental purposes.

The various elements being thus present, these lamps should be capable of operating as radio tubes, and as a matter of fact they are. Some years ago at my request, some exact replicas of these old lamps were manufactured, and experiments were made on them at the Electrical Testing Laboratories in New York. It was found that these lamps did indeed act as practical detectors when connected in a radio receiving circuit. A grid-voltage plate current characteristic curve was taken of one of the lamps containing a wire and a plate and this curve had the same shape as a corresponding curve for a modern tube.

Edison's "etheric force"

Mr. Edison thus made practical radio tubes in 1883 and they were operable directly from the mains of the dc Edison system. But unfortunately in those pre-Hertzian, pre-Marconi days there was no radio.

How close Mr. Edison himself came to originating wireless communication is but little appreciated. As far back

†Dr. Sharp, a leading electrical and research investigator, and, until 1933, vice-president of Electrical Testing Laboratories, New York, died in 1942. The accompanying statement was prepared by him for the Fiftieth Anniversary of the discovery of the Edison Effect, held under the auspices of the New York Electrical Society in Madison Square Garden, Sept. 28, 1933.

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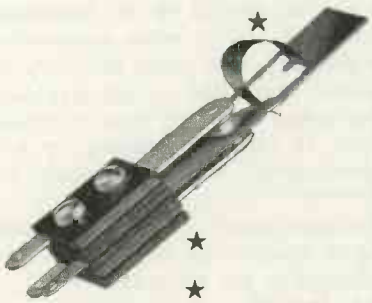
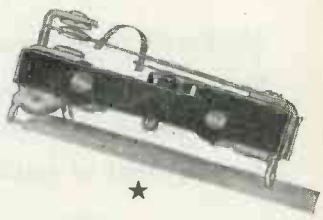


Open Blade Switch



Midget Switch

A-2 Bracket with threaded sleeve and nuts for panel mounting.

1-0 Overtravel Plunger

All Switches Actual Size Except Open Blade

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FOR POSITIVE ACTION SPECIFY ACRO

as 1875 he discovered and demonstrated the transmission of electrical impulses through the ether, that is without a return wire to make a complete metallic circuit. These were his "etheric force" experiments which called forth a great deal of discussion at the time and which were exhibited at the Paris Exposition of 1881 where they were viewed by many of the leading scientists of the day. The "sending" apparatus was a buzzer with one terminal grounded and the detector was a tiny spark gap enclosed in a black box, exactly the same kind of thing as Hertz used years later. It was apparently a partial anticipation of Hertz's work.

In the year 1885 Mr. Edison applied for a patent which was granted in 1891, for means for transmitting signals electrically without connecting wires. This patent shows the use of high masts carrying condenser surfaces for spreading abroad the electrical impulses, and even shows two vessels equipped with the equivalent of modern antennas on their masts. The specification for this patent is prophetic, reading in part as follows:

"The present invention consists in the signalling system having elevated induction plates or devices*******.

"I have discovered that if sufficient elevation be obtained to overcome the curvature of the earth's surface and to reduce to the minimum the earth's absorption electric telegraphing of signals can be carried on by induction without the use of wires connecting such distant points. This discovery is especially applicable to telegraphing across bodies of water, thus avoiding the use of submarine cables, or for communicating between vessels at sea*******".

That this patent was of substantial merit is attested by the fact that it was bought by Mr. Marconi.

Thus Mr. Edison had almost within his grasp all the elements of a wireless system. He had the high-frequency currents, the elevated masts, and the detecting apparatus. It needed only the coordination of these elements to achieve practical results. But Mr. Edison was preoccupied with the difficult problems connected with his lighting and power system and was obliged to leave these promising fields of research and development to others.

However, his fundamental discovery, the Edison effect, was not forgotten and we are today gathering the fruits of his labors in all the manifold applications of the science of electronics.

[Another story puts the discovery of the Edison Effect on a more matter-of-fact basis. According to this, the early lamps (operating on direct-current, of course) began to fail by breaking of the filament near one of the lead-in wires. Edison was first to notice that this breakage oc-

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The molded paper capacitors, supplied by *Micamold* for a number of years, have been wax impregnated. Now we have added a comprehensive line of oil impregnated capacitors which are being widely used in radio and electrical equipment. Of these, the types 336 and 337 are the same size as the familiar postage-stamp mica capacitors.

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BACK THE ATTACK — GET BEHIND THE THIRD VICTORY WAR LOAN DRIVE

curred always at the "positive" end of the filament. After many experiments, he reasoned that some kind of "particles" were coming from the hot filament and bombarding the positive end of the filament, breaking it down. He further reasoned that these "electrical particles" must be negative in sign. Also he observed the blackening and sharp "electron shadow" mentioned by Dr. Sharp. Goaded by the business necessity of finding what was causing his filaments to break and his lamps to fail prematurely, Edison then carried on the experiments of inserting the extra wire or "plate," which confirmed his electron "emission and bombardment" theory— though of course he then did not use the word electron.—EDITOR]

Brain Waves Made Audible by British Invention

The joint invention of a mathematical physicist, Dr. R. Furth, and a physiologist, Dr. E. A. Bevers, both of the University of Edinburgh, this device enables the sick brain to "sing"—to tell an examining physician in musical notes where the trouble lies.

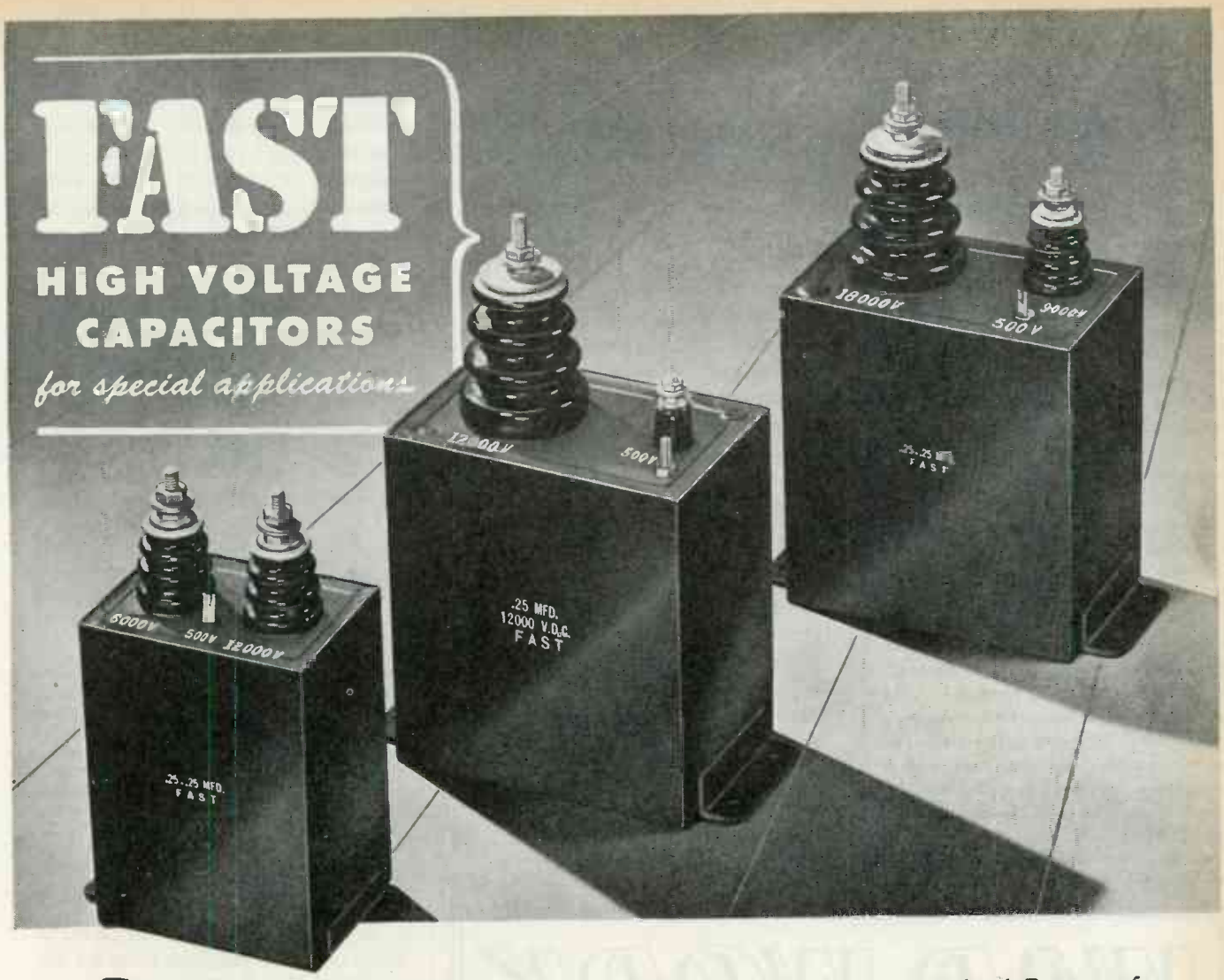
The "encephalophone," as the new diagnostic instrument is termed, is intended entirely as a clinical instrument, Drs. Furth and Bevers report to the British Association for the Advancement of Science through its official journal.

The phenomenon of "brain waves" has been well known for past decade. The cells of the brain give off minute electrical impulses in rhythmic form that can be picked up by electrodes placed against the skull, amplified greatly and recorded in the form of graphs either by photography or by a moving pen. Certain patterns of rhythm, notably the "A" waves and the "B" waves, are common to all normal people, although each individual has a specific pattern of his own.

Determines injury seat

But in abnormal brain conditions, variant rhythm patterns appear. This is now an accepted method of diagnosing certain forms of epilepsy. Even drunkenness is believed to produce a characteristic brain wave of its own. Sites of brain injuries for which there is no superficial evidence may be determined.

But, Drs. Furth and Bevers maintain, this is a slow process and its chief value has been in research. They sought to produce an instrument that the practicing psychiatrist could use the way a stethescope is used.



These rugged high-voltage capacitors, specially designed for vital war use, are but another example of FAST *years-ahead planning.* Day-in and day-out . . . FAST Capacitors serve silently but faithfully . . . under the most varied and severe conditions. On burning deserts. In humid tropics. In frigid artics. On the seas . . . beneath the waves . . . and above the clouds. In their line of duty, FAST Capacitors daily meet and withstand drastic atmospheric changes *in the span of a few minutes* . . . from sub-zero to high operating temperature . . . from extremely low pressure to sea level. Because of their stability, FAST Capacitors are in wide use in the various branches of the Armed Forces . . . and in every type of industry.

Often, FAST has anticipated and originated major capacitor refinements which soon became "standard" . . . and proved to be the difference between the success or failure of many applications. On any capacitor problem, consult our engineers. They're glad to help you.

"When you Think of Capacitors . . . Think FAST"

Standard or Special Units to Meet Every Need

FAST Condensers and Capacitors are produced in many types and sizes, in standard and special designs, for a great variety of electronic and electrical applications in war and industry. Paper Capacitors — Oil or Wax impregnated — Rectangular or Tubular — in sizes from the smallest to the largest. Units specially engineered or built to government specifications including thermal cycle and salt water immersion tests.

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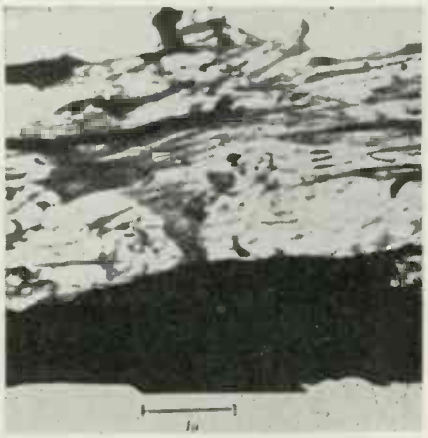
They have accomplished this with a device by which the abnormal brain wave causes changes in the pitch of a constantly sounded musical tone—as some types of submarine detectors indicate the presence of something unusual in the water by similar changes in pitch.

The tone, they explain, is produced by two independent high-frequency oscillators of very slightly different frequencies. These two frequencies are mixed, so that whenever the frequencies coincide with each other there is a beat. These frequently recurring beats are heard as a tone of a certain pitch through a loudspeaker or through earphones.

"Slow sweeps of tone"

The oscillators in turn are so connected with the electrodes placed on the scalp so that the currents coming from the brain interfere with the oscillations and produce a tone of quite different pitch. The changes produced in the "A" and "B" waves are standardized, distinct and unmistakable, and the physician easily can become familiar with them. Abnormal waves produce striking variants from these pitches.

One advantage, they say, is that the doctor can determine the brain waves of the patient, at the same time having his eyes free to observe.



This micro-photo of guinea pig muscle fiber should have appeared with the article "Electron-Microscopy of Tissues" appearing on page 97. An item for the illustration showing apparent connection between radio fade-out and sun spot eruptions which appears on page 97, will be included in a forthcoming issue

Skin Resistance Reveals Nerve Injury

Drs. Curt P. Richter and David T. Katz of Johns Hopkins Hospital describe in the Journal of the American Medical Association a test to map those areas of the skin which have a higher electrical resistance than normal.

If the electrical resistance of the area affected by a nerve is high a nerve has been cut. Thus the surgeon can determine which nerves have been injured and how badly. Without such knowledge the wound may heal, but the patient may be left with no feeling in part of a hand or foot and, worse still, without the use of fingers or toes. Pinprick and other tests are common but not too effective in determining which areas are affected by peripheral nerve injuries.

Radio in Aviation

American aviation has come a long way from the first night transcontinental mail flight in 1921, and radio navigation communications have played a vital part in the progress, the Office of War Information notes in a comprehensive report covering all phases of American air transport.

On that first flight in 1921, pilots were guided along the way by bon-

this man is wasting his time . . .

. . . unless the component parts specified in electronic engineering are equal to the task the design requires of them. The man-hours spent in new developments deserve the best components. The performance of the most intricately conceived circuit is no more dependable than the tubes contained in it.

The complete dependability of Raytheon Tubes is a long-established fact in both civilian and military experience. Whether the need be for standard tubes, or for tubes of special design, Raytheon meets the most exacting requirements.

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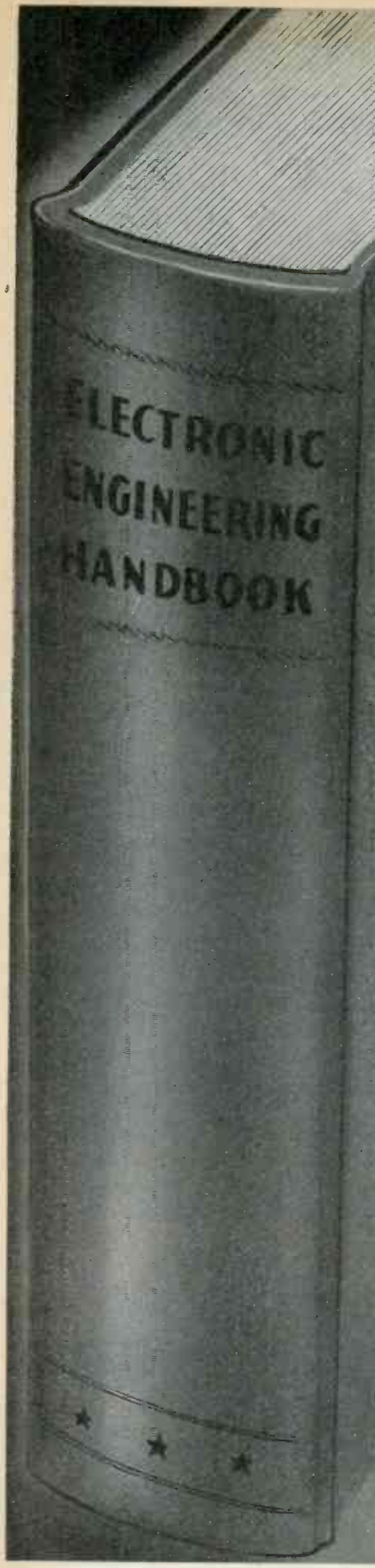

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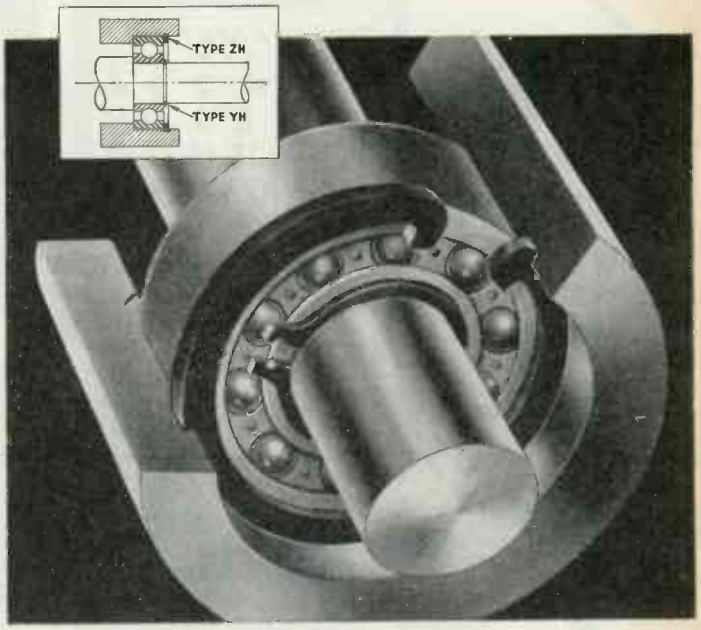
SMART DESIGNING COULD SAVE MONEY FOR YOU, TOO



These efficient, yet inexpensive artificial shoulders save metal as well as money.

National retaining rings are being used for more and more new applications these days when every ounce of metal and every cent of cost are so important.

Every shoulder or collar on your machines or on your metal products should be examined to see how much savings you can effect by using retaining rings.

It's expensive to hold a mechanism in place with unnecessarily big shoulders or collars,—or to temporize with small cotter pins, etc. Let us show you how spring steel retaining rings can do a thoroughly efficient job for you.

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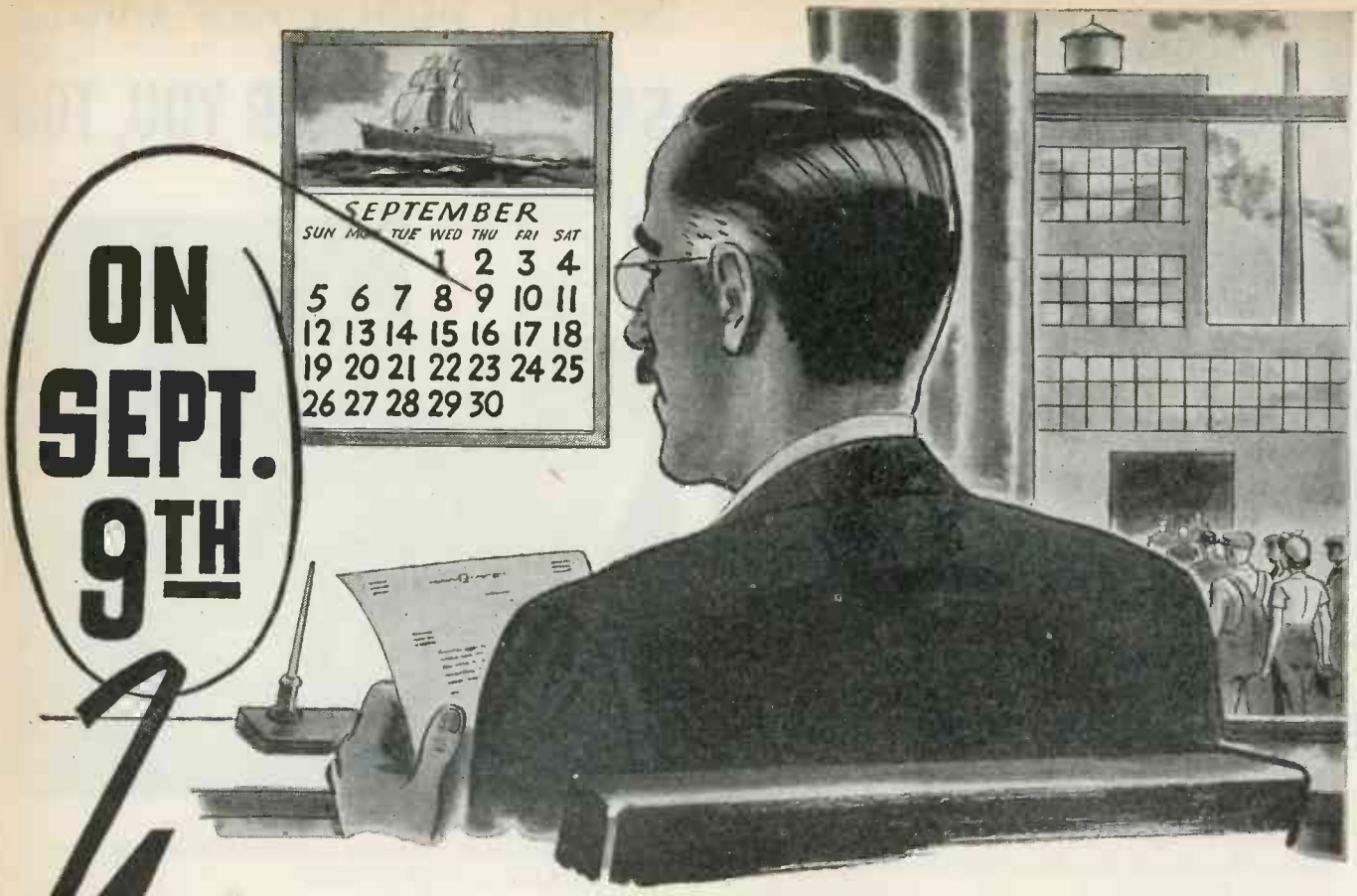


Your Bond Selling Responsibilities Double!

Starting September 9th, your Government will conduct the greatest drive for dollars from individuals in the history of the world—the 3rd War Loan.

This money, to finance the invasion phase of the war, must come in large part from individuals on payrolls.

Right here's where YOUR bond selling responsibilities DOUBLE!

For this extra money must be raised *in addition* to keeping the already established Pay Roll Allotment Plan steadily climbing. At the same time, every individual on Pay Roll Allotment must be urged to dig deep into his pocket to buy *extra* bonds, in order to play his full part in the 3rd War Loan.

Your now *doubled duties* call for these two steps:

1. If you are in charge of your Pay Roll Plan, check up on it at once—or see that whoever is in charge, does so. See that it is hitting on all cylinders—*and keep it climbing!* Sharply increased Pay Roll percentages are the best warranty of sufficient post war purchasing power to keep the nation's plants (*and yours*) busy.

2. In the 3rd War Loan, every individual on the Pay Roll Plan will be asked to put an *extra two weeks salary* into War Bonds—over and above his regular allotment. Appoint yourself as one of the salesmen—and see that this sales force has every opportunity to do a real selling job. The sale of these *extra* bonds cuts the inflationary gap and builds added post-war purchasing power.

Financing this war is a tremendous task—but 130,000,000 Americans are going to see it through 100%! This is their own best *individual* opportunity to share in winning the war. The more frequently and more intelligently this sales story is told, the better the average citizen can be made to understand the wisdom of turning every available loose dollar into the finest and safest investment in the world—United States War Bonds.

★ ★ ★

BACK THE ATTACK With War Bonds!

This space is a contribution to victory today and sound business tomorrow by "ELECTRONIC INDUSTRIES"

fires set by obliging farmers—today, for the benefit of all flying in the United States, the Civil Aeronautics Administration maintains and operates 408 intermediate-frequency radio range and marker stations, 197 ultra-high frequency radio fan markers, and 72 ultra-high frequency radio range stations (which are expected to be increased to 143 during this year).

Also in the airways system, the report noted, are 446 weather-reporting stations, joined by a 54,000-mile teletype circuit for quick reporting of meteorological conditions from coast to coast. Traffic from point to point along the airways is directed from 23 control centers, located at strategically chosen major airports, by the use of a 10,400-mile teletype circuit and 35,745 miles of interphone circuits to check and clear movements of swiftly traveling aircraft along the airways.

UHF in postwar aviation

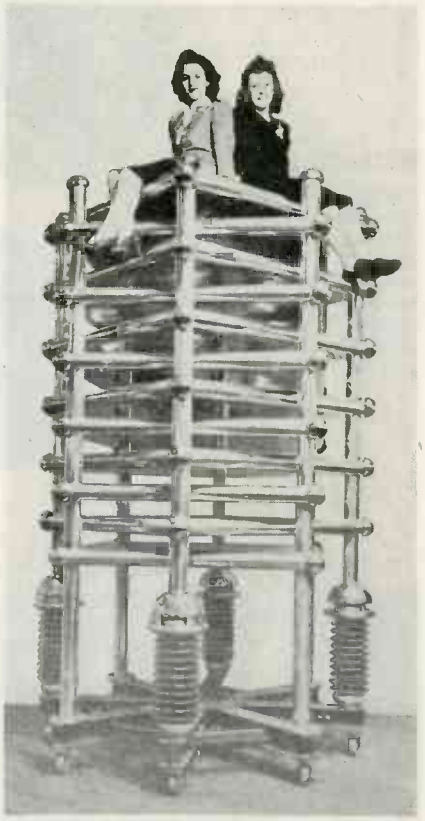
As is well known, and was projected before the Pearl Harbor attack, the immediate postwar problem of the airways, as seen by the CAA, and cited in the OWI report, will be the rebuilding of the entire domestic airways system by substituting ultra-high frequencies for the old standard intermediate frequencies ranging between 200 and 400 kilocycles. Uhf radio will eliminate static and will provide a visual as well as an aural course, and among its innovations will be two voice channels on every radio range station, the employment of ultra-high frequency for traffic control, ultra-high frequency localizers for all important airports, with glide path, and ultra-high frequency markers to permit the pilot to land under instrument conditions.

Pointing out that present flights ranging beyond the American-Canadian-Alaskan network of airways necessarily must be accomplished with considerably less accurate guidance from communication aids, the report nevertheless stated that the Federal Airways Service is now operating six intercontinental super-radio stations capable of communicating with aircraft at any point on the globe. These stations, operated by the CAA, with the Army providing security in the coding and decoding of messages, are located at New York, New Orleans, San Francisco, Seattle, Honolulu and Anchorage, Alaska, and have been of inestimable value to the armed forces, placing the United States several years ahead of any other country in the development of intercontinental airways.

CAA radio engineers, the OWI report said, are now cooperating with the armed forces in establishing a vast network of airway communications systems in the North Atlantic area, in South America, Africa, Europe, Asia and Australia.

Giant Air Capacitor

Using only non-critical materials instead of the half ton or so of aluminum normally required, Federal Telephone & Radio Corp. has recently completed a giant 200,000 volt air capacitor (2500 mmf) for use in a phantom antenna in its Newark, N. J. high-power transmitter laboratories. There are twelve hollow plates fabricated of 16-gage sheet steel, 76 in. square welded at the edges. Plates were first copper-plated and then nickel-plated and highly polished. Supporting insulators are designed for 400,000 volts dry flashover. Though the whole assembly weighs over a ton, it is castor mounted, readily movable and can be taken down or assembled in a day.



FEDERAL'S 200,000 volt 2500 mmf phantom antenna capacitor built entirely of non-critical materials

BD-72

● Military authorities doubt that the war will be won by any secret super weapon. They count on fighting efficiency developed out of many small things — advantages gained from foresight and painstaking attention to detail.

For example, take the BD-72 portable military switchboard developed at *Connecticut,* in cooperation with Signal Corps engineers. It has many features we can't tell you about, but we can say that the BD-72 was designed to save space, to get into operation faster, to stand a lot of rough usage under fighting conditions. Small things? Not if its small size permitted getting one more machine gun aboard the truck. Not if it helps "get the message thru" even *seconds* sooner. Small things sometimes loom large when the job is to get the jump on the enemy.

All over America, the doom of the Axis is being made more and more certain by giving the fighting men of the United Nations better fighting tools. The birth of better ways of doing things *after* the war, is an all-important by-product of this effort. *Connecticut Telephone & Electric* is an excellent source of ideas for developing your postwar product or manufacturing methods, if they involve communications, or the engineering and manufacture of precision electrical devices.

CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES INC.

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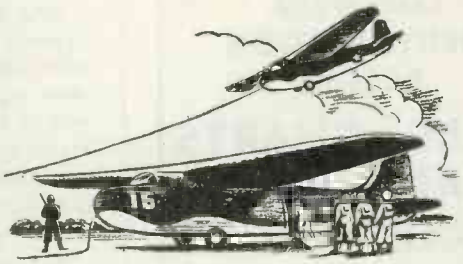
ARMY-NAVY "E"

For the second time within a year, the honor of the Army-Navy Production Award has been conferred upon the men and women of this Division.



WAR GLIDERS

for example

Rivets and other cold-forged parts for gliders are made on equipment used regularly in the manufacture of Hassall *special* rivets, nails and screws. So are metal products for bombers, pursuit planes, training planes, parachutes, PT boats, assault boats, belts and thousands of other war needs. Send us your specifications.

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ELECTRONIC TOMORROWS!

Breathless Prophesy from the Pages of Our Non-technical Contemporaries

Bert Dieter slipped the July 1949 *Reader's Digest into his pocket and whistled three shrill blasts when he came out of the Chrysler Building; and in* 13 *seconds when his electronic broom pulled up, he got on and pushed two buttons and zipped off for home, coat tails flying. Nobody gave him a second look.*

Out over Central Park he zoomed up to 3,200 *feet, the legal altitude for all Scarsdale-bound traffic, set his electronic gyroscope to keep him on the beam, and peeled a still inky copy of the New York Times out of the facsimile radio built into the handle of his broom. But the news was pretty dull—just John L. Lewis demanding another* $2 *a day boost for his miners so they could install electronic door-openers on their home refrigerators, like everybody else.*

He was still reading and just becoming conscious that a blonde in a low-necked, soybean silk dress had pulled up beside him, when the electronic phone in his vest pocket rang. As he listened, his face paled. "But dear, I don't even know who she is; she just now pulled—okay, okay, keep your electronic eye on me; I'll be right there." And he slapped his throttle wide open and cut straight for home. —Walter Adams, in Better Homes & Gardens, August, 1943.

FM Gets New System of Call-Letters

To gear frequency modulation (FM) broadcasting for its anticipated postwar expansion and public acceptance, the FCC Aug. 24 adopted a new system of call letters like that currently used by standard broadcast and commercial television stations. The change in the FM station calls becomes effective November 1 and will affect approximately 45 FM broadcasting stations now in operation as well as all future licensees.

Numerals cumbersome

The Commission's decision to discard the combination of letter-numeral calls for FM stations arose out of several disadvantages and inherent limitations based upon the past experience of FM broadcasters themselves and the advisability of making the change at the present time since transmitter construction is halted because of the war.

It was pointed out by the FCC that licensees of FM stations have found that the letter-numeral system is somewhat cumbersome and does not meet with general public acceptance. In addition, a change in frequency of an FM station under the old system involved a change in its call with consequent confusion to the listening public. Finally, the Commission believed that as FM broadcast stations were licensed in more and more cities it would become increasingly difficult to identify the station call with a particular city through the use of an initial letter or letters.

New system

The FCC explanation of the new system of FM call letters was as follows:

"This system of CALL LETTERS for FM stations will replace the present combination of letter-numeral calls (such as W47NY, W51R, etc.) presently used by FM broadcasters. In cases where a licensee of an FM station also operates a standard broadcast station in the same city, he may, if he so desires, retain his standard call letter assignment followed by the suffix 'FM' to designate broadcasting on the FM band. Thus, if the licensee of a standard broadcast station with the call letters 'WAAX' (hypothetical), also operates an FM station in the same location, he will have the choice of using the call 'WAAX-FM' or he may, on the other hand, be assigned a new four-letter call—say, WXRI. Similarly, an FM broadcaster on the West Coast, who also operates a standard broadcast station 'KQO' may, if he likes, use the call 'KQO-FM' or he may ask for a new four-letter call 'KQOF' for his FM station. This choice will remain entirely with the FM operator.

"FM licensees may inspect at the FCC a list of the approximately 4,000 four-letter calls which are available for assignments. This number appears ample to supply calls for all additional standard, commercial television, FM stations and non-broadcast classes for some time to come. (The Commission wishes to call attention to the fact, however, that all three-letter calls have already been assigned.)

"All call letters beginning with 'W' are assigned to stations east of the Mississippi River; all station calls with 'K' are located west of the Mississippi and in the territories. A breakdown of the 4,000

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UNIVERSAL now makes available to prime and sub-contractors complete voice communication components from microphone to plug, manufacturing these units in entirety within its own plants.

MICROPHONES, SWITCHES, PLUGS and JACKS now ready for earliest possible deliveries to manufacturers of all types of military radio equipment . . . making available the vast experience and engineering ability of this exclusive microphone manufacturer.

Available from stock, 1700U series microphone. Single button carbon type, push-to-talk switch, etc. For trainers, inter-communication and general transmitter service.

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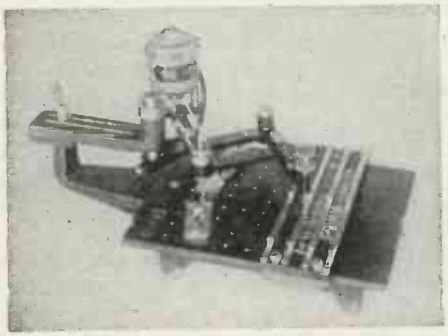
—MICO— ENGRAVER



For lettering panels of steel, aluminum, brass, or bakelite, or for marking finished apparatus.

A sturdy machine for routine production as well as occasional engraving.

Attachments increase its versatility to include large work on flat or curved surfaces.

Excellent engraving can be produced by an inexperienced operator.

Prompt delivery. Catalogue on request.

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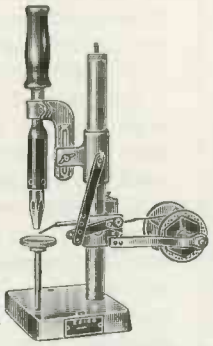

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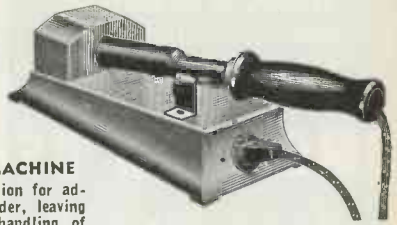
are widely used in industrial plants throughout the country. They are designed to withstand the strain of continuous service required of factory tools.



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designed for treadle operation for advancement of iron and solder, leaving operator's hands free for handling of product.

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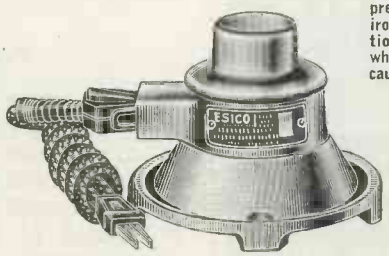
prevent overheating of soldering irons between soldering operations. Irons do not deteriorate when being used. The idle period causes oxidation and shortens life.



SOLDER POTS
ruggedly constructed pots of various sizes designed for continuous operation and so constructed that they are easily and quickly serviced, should elements have to be replaced.

Write for Catalog

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four-letter calls available shows approximately 2,900 'K' calls and 1,100 'W's' still unassigned.

"FM stations are asked to have their requests, indicating a preference in call letters, filed with the Commission by October 1. If no request has been received from an FM licensee by that date, the FCC will, at its discretion, assign a new four-letter call to that station.

"It is recommended that FM operators, who wish a new four-letter call, list their first, second and third choices, and in the event two stations seek identical call letters the request first received by the Commission will be honored.

"All FM stations will use their new call letters on the air effective November 1, next.

"Under the old system the first letter of an FM call, either K or W, indicated the geographical position of the station in relation to the Mississippi River, the number designation showed the frequency on which that station was operating and the last letter or letters gave a clue to the city from which the broadcast emanated.

TRANSIENTS — IN CHILDREN, AND IN ELECTRONIC CIRCUITS

by JOHN MILLS

When a fidgeting child is shaken by an exasperated adult there are illustrated the types of vibration which the engineer classes as "natural" and "forced."

An excited child just naturally bobs up and down at a characteristic rate. When the adult takes hold its vibration is forced and at a different frequency. Usually when the adult lets go the child makes a few convulsive movements as he settles down. These are natural in his attempt to restore his equilibrium. The engineer would call them transient vibrations, for they are not steady but short lived, and each is less violent than the preceding.

Transient vibrations

In all systems—that is arrangements of things—which have natural frequencies of vibration, a few transient vibrations follow any series of forced vibrations. They are illustrated by the faint "ing" of sound which can sometimes be heard from a loudspeaker just as its current is turned off.

But such transients also occur at the start. It is as if the body offered a momentary objection, expressed in its own natural manner, to the imposition of a force which would make it vibrate. Its natural vibration represents its losing struggle to return from displacement forced upon it. It is a transient vibration which dies out quickly; and then there is only the steady oscillation corresponding to the external force.

Such transients occur at the start whenever habitual or natural rhythms are altered. They are unavoidable; but they can be made negligible in their effects. One way of doing so is illustrated by a high-quality microphone for speech or music. Its transient vibrations accompany the start of every syllable or musical note. You don't hear them, however, for they aren't sent out over the radio. The microphone's designer cleverly devised it so that the pitch of its natural vibrations is above those of the vibrations enforced by the sound waves. Thus the unavoidable transients introduce no tones to conflict with the orderly vibrations of voice or instrument. The transients are inaudible.

Let 'em die unheard

Letting transients waste their energies unheard is as desirable in human relations as in telephonic transmission. The even tenor of our ways has been upset by the War. Under its relentless force our personal rhythms are seriously disturbed: our comings and goings must be timed to its demands. But each new control of our habits, which the war requires, is met by our own transient objection. Each of these natural responses should die unheard.

There must be less thoughtless clamor at the new routines we need to follow; less instinctive and hasty revolt; our complaints must never obscure for ourselves or for others the clear road of national duty. Let us keep our transients to ourselves. —*Bell Laboratories Record.*

Electronic Scale

Frequency modulation is used to automatically sort packages according to their weight. As described in patent No. 2,323,023 to T. B. Flanagan and R. T. Pounds, a condenser is mechanically coupled to the scale used for weighing the articles; its capacity varies with the weight on the balance.

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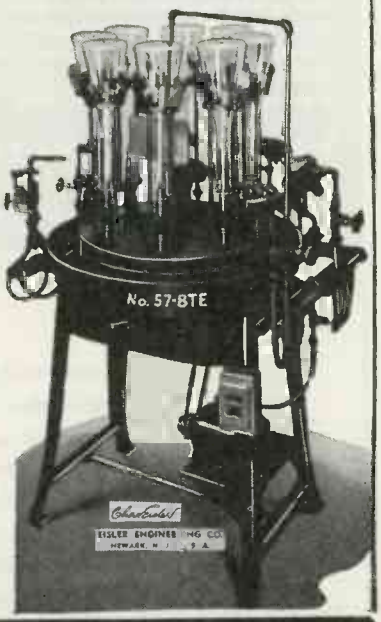

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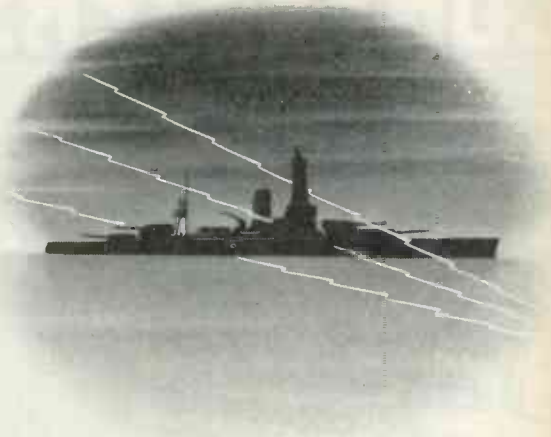

THICKSKINNED BATTLESHIPS HAVE NERVES!

Beneath their many inches of armor-plate, Uncle Sam's battlewagons are as finely co-ordinated as champion boxers . . . instantly responsive to commands. A network of nerves . . . the lines of electric communication . . . runs through the ship. The command, "Battle Stations!" is electric . . . *literally.*

To keep these nerves alive with energy is one of the war jobs now being done by Stancor Transformers. When peace is won, American industry will enter a new age of electronics . . . the transformation of electric power to build and serve a happier world. Stancor engineers are preparing, by foresighted research, to serve the needs of peace after victory.

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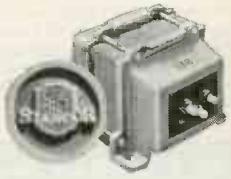

The condenser capacity controls the frequency of an oscillator, the output of which is applied to a discriminator working a relay. Upon operation of the relay a contact is made and a solenoid operates a lock which then permits movement of a slide for the packages thereby causing them to deviate from their normal paths. If the frequency of the oscillator is equal to the discriminator frequency, and the circuit is so dimensioned that this occurs for the correct weight of the articles, no current will flow to operate the relay and the articles will take their normal paths.

Percival Plunges into Piscatorial Possibilities; Now Proposes "Piscatronics"

Editor, Electronic Industries:

In the newspapers I read that the New York Aquarium's five electric eels, for many years one of the more popular exhibits with the city's ichthyologists, have been removed from public view and are now being used in secret war research, as disclosed by Dr. Christopher W. Coates, director of the Aquarium.

Scientists from Yale, Columbia, and Johns Hopkins universities make regular visits to the Aquarium at the Bronx Zoo and are using the eels for medical study.

"The eels are working full tilt for the war," says Dr. Coates. "The research study is both physical and physiological. I can't tell you very much about it, but it is pretty important."

To meet battery shortage?

This delayed news about research on electric eels as a source of emf reminds me that in view of our present acute battery shortage, more attention might well be given in wartime to the culture of **Electrophorus Electricus** for their voltage-producing proclivities. It is known that such an adult eel can deliver over 600 volts, and Dr. Coates has bent the pointers of several husky voltmeters when his slippery pets decided to give off a particularly savage jolt.

In this "era of transition" when even Kansas farmers are digging ponds and raising fish as food crops, instead of pork and beef, I think we may well give study to animal electricity or fish emf to replace our scanty supply of man-made batteries. If the war goes on, the time may even come when many a farmer BCL will have a fish-globe containing an electric eel, under or inside his radio—just as once prior to 1927 we all had storage-batteries which burned holes in our living-room rugs.

Bright new science

Perhaps in this new development we are on the trail of a whole new science which someday may burgeon and bloom like the electronic art itself. For those who are not satisfied with our present bright galaxy of fancy "onics" (thermionics, radionics, optionics, etc.), I propose for this new art the name of "piscatronics."

Some callous engineers will decry eel B-batteries as being in a class with an earlier proposal to use Iowa lightning bugs as pilot lights in farm radios. Minds so circumscribed and narrow are not the kind we want, or have been taught to look for, in the bright new field of electronics—or should we say eelectronics—at least according to the ads in popular magazines.

If it's "nerve" voltage they want

In a later statement about his electric eels, Dr. Coates reveals that the present scientific use of the eels is primarily in the direction of studying nerve emfs and "human nerve" activity. If that is all Johns Hopkins and Yale want—instead of the electric eels, I can refer them to some life-insurance agents and book salesmen I have met, whose "nerve" would have to be measured not in mere volts but in kilovolts!

I regret having to cut short this letter, but the postman has just delivered a new batch of popular, home, women's and garden magazines, each containing a leading article on "The Electronic Future," and I cannot wait to find out what all these gifted authors have in store for us.

Yours, piscatronically,
Percival P. Pentode

Electronic City, N. Y.

P.S. Let me thank you for the sympathetic reception given my observations in your columns. This is in sharp contrast to that recently accorded my brother-in-law, the late John W. Durfee of OWI, whose treatment by the Washington correspondents and press generally, as you must agree, was not even human!

"ELECTRONIC INDUSTRIES"

Advertisers

SEPTEMBER 1943

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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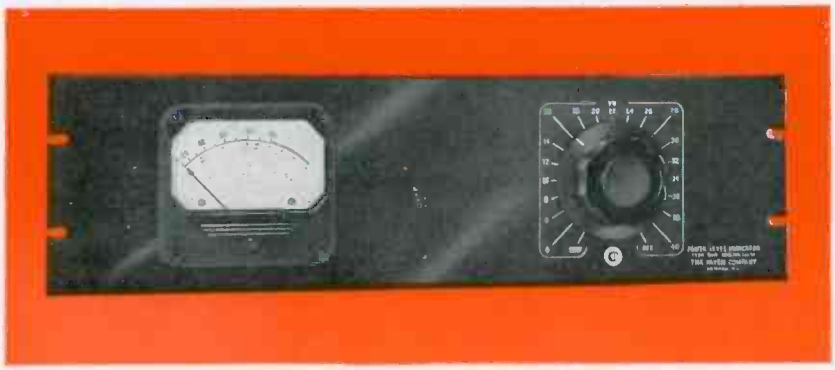

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But of that number, RCA had promoted from the ranks by inspection time that night exactly 36 receiving tubes for special duty. Each was picked, for some fundamental characteristic, as an *RCA Preferred Type Tube.*

Why did RCA do this? To develop larger manufacturing runs on fewer types, resulting in better tubes of greater uniformity at lower cost.

That this was a sound, forward-looking program is evidenced by the similar Army-Navy Preferred Type Tube program—to release for other uses materials formerly tied up in many styles of tubes, and to insure ready replacement of *standard* types on the fighting fronts. If you'd like a copy of the latest revised (March 1, 1943) "Army-Navy Preferred List of Tube Types", we will gladly send it to you.

Since this "Preferred Type" idea has such definite peace-time advantages, our application engineers invite inquiries *now* from equipment manufacturers as to tubes most likely to be on the post-war preferred types list.

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