

ELECTRONIC INDUSTRIES



- ★ Press Wireless Worldwide Communications Net
- ★ Men Behind Radar ★ Medical Electronic Uses
- ★ Jap Radio Equipment ★ Postwar Standards

Buy War Bonds

JULY

Caldwell-Clements, Inc.

Even the Most Minute Part Has Its Big Moments



The contact points in a fighter plane's "turn and bank" indicators are not much for size, but they must be brutes for action. Like all component parts in a plane's electrical apparatus, they must function perfectly or spell trouble for the pilot. Always, he must be sure of his maneuver.

Under war need's pressure, a new type "turn and bank" indicator—an instrument in which the pointer remains stationary to show the degree of deviation from normal flight—called for contacts capable of operating 75 times a second, but extremely sensitive. Tiny contacts they are, less than a tenth of an inch in diameter, but they make and break the circuit that controls the speed of the gyroscopic motor.

Early in the designing, Mallery contact experience was sought. Standard contact materials set up excess arcing, creating unwanted radio interference. Then Mallery metallurgists, working against time, developed a combination of metals—standard tungsten for one point, Elkonium-34 for the other—that licked the problem in jig time. Just one contribution to the development of accurate combat maneuvers, to be sure, but an excellent example of how concentrated cooperation is functioning to insure that even the most minute part does its bit at the critical moment.

Mallery's years of contact experience and "know how," stimulated by war production demands, are furnishing innumerable solutions to perplexing problems of contacts and contact assemblies. Many of the applications developed in the Victory effort have significance for the future.

When you have contact problems, bring them to Mallery.

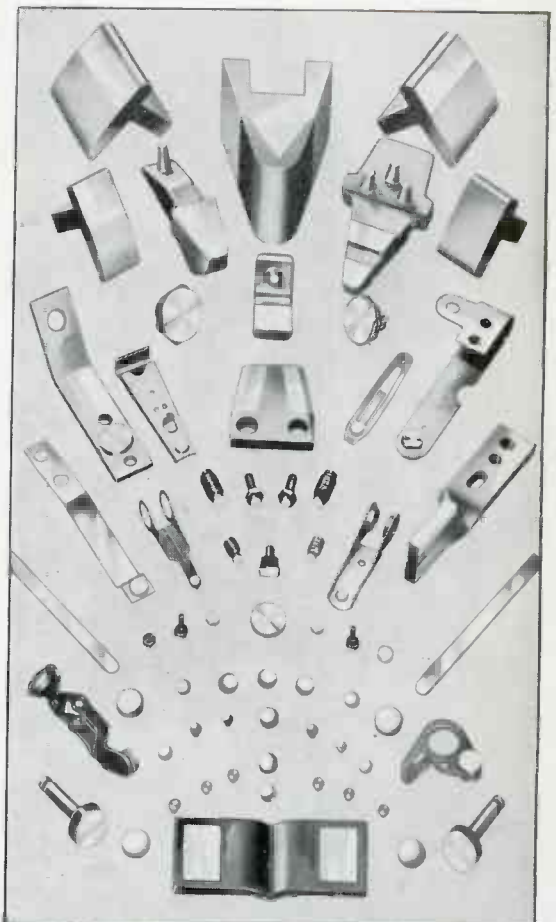
P. R. MALLORY & CO., Inc.
INDIANAPOLIS, INDIANA
Cable Address—PELMALLO



*While the design is
still in blueprint form*

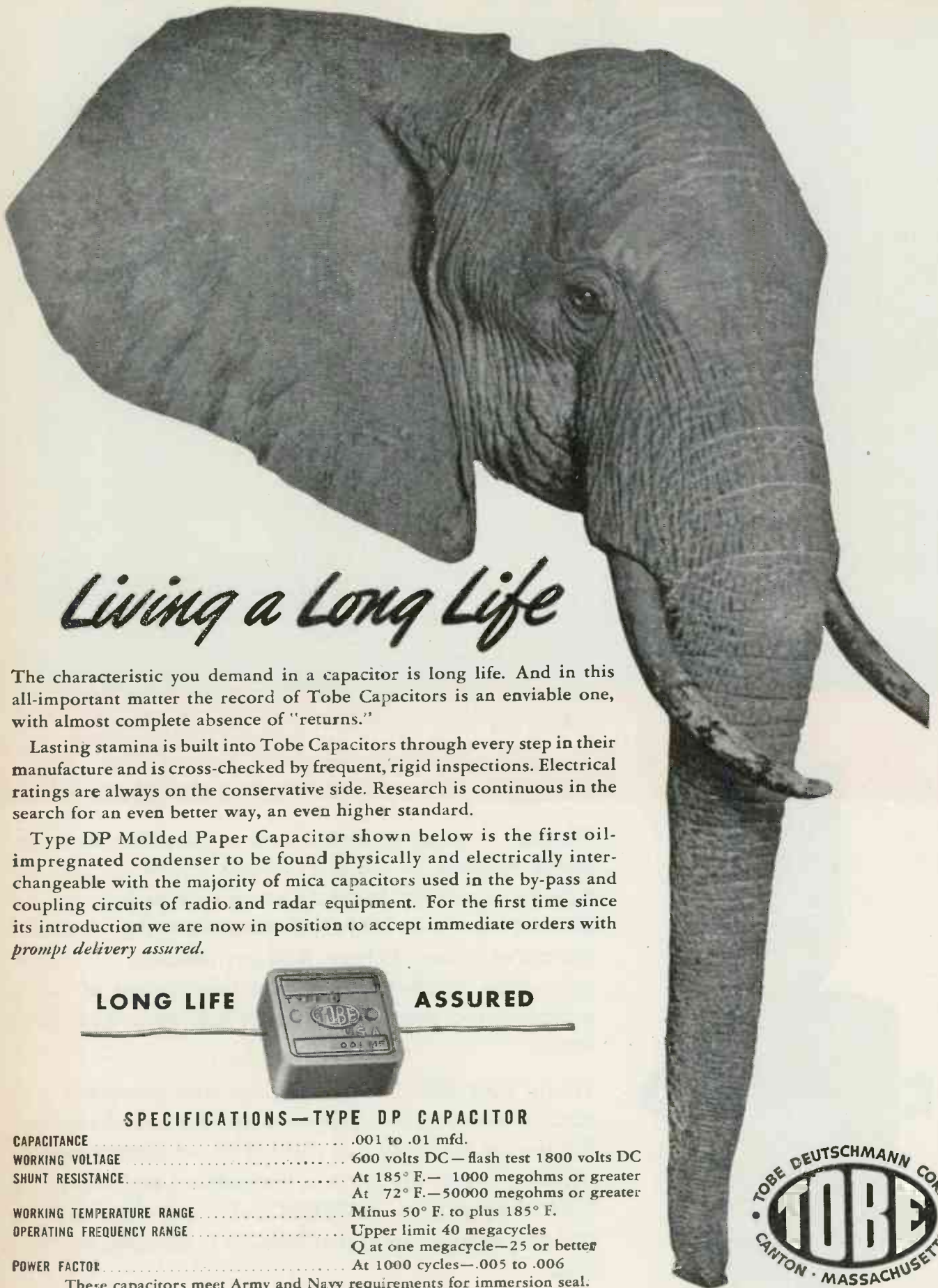


CONSULT MALLORY
*for Contacts and
Contact Assemblies*



P. R. MALLORY & CO. Inc.
MALLORY

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



Living a Long Life

The characteristic you demand in a capacitor is long life. And in this all-important matter the record of Tobe Capacitors is an enviable one, with almost complete absence of "returns."

Lasting stamina is built into Tobe Capacitors through every step in their manufacture and is cross-checked by frequent, rigid inspections. Electrical ratings are always on the conservative side. Research is continuous in the search for an even better way, an even higher standard.

Type DP Molded Paper Capacitor shown below is the first oil-impregnated condenser to be found physically and electrically interchangeable with the majority of mica capacitors used in the by-pass and coupling circuits of radio and radar equipment. For the first time since its introduction we are now in position to accept immediate orders with *prompt delivery assured.*

LONG LIFE



ASSURED

SPECIFICATIONS—TYPE DP CAPACITOR

CAPACITANCE001 to .01 mfd.
WORKING VOLTAGE	600 volts DC— flash test 1800 volts DC
SHUNT RESISTANCE	At 185° F.— 1000 megohms or greater At 72° F.—50000 megohms or greater
WORKING TEMPERATURE RANGE	Minus 50° F. to plus 185° F.
OPERATING FREQUENCY RANGE	Upper limit 40 megacycles Q at one megacycle—25 or better
POWER FACTOR	At 1000 cycles—.005 to .006

These capacitors meet Army and Navy requirements for immersion seal.



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

EDITORIAL CONTENTS AND ARTICLES LISTED ON PAGE 4



More tube hours are going into battle



Through a series of design and construction developments tending to prolong normal operating life, we have increased the length of actual service that is being derived from each AMPEREX tube. Basically, our facilities are of laboratory type. And any measure of our war production, computed solely on the number of tubes manufactured, would not be a true indication of our total effort.

We, at AMPEREX, have kept pace with numerical production increases being registered throughout the nation. But we are infinitely more proud of our attainments in building longer life into our transmitting and rectifying tube designs. Each AMPEREX radio and radar tube is bringing extra hours of performance to equipment at the front.

AMPEREX ELECTRONIC PRODUCTS

79 WASHINGTON STREET

BROOKLYN, NEW YORK



SEA DOGS

Hats off to the Sea Dogs . . . those intrepid bluejackets who are making naval history! Tales of their courage, endurance and sacrifice will live long after the last gun is silenced and the sea is safe again for all free men.

They're the men who make possible the naval feats that are adding up to victory. They're the men who are at their posts when the cry of "*Battle Stations!*" is heard. They're the men who never lose hope or courage . . . who carry out orders unquestioningly. As one young seaman so aptly expressed it—"They give you a tough job to do, and you do it. That's all."

That's all.

Like the bluejackets on a United States battleship who shot down 32 attacking Jap planes and later sank three Jap cruisers and one destroyer.

Or the seamen on the little U. S. Destroyer Laffey who bravely tackled four Jap warships, and fought until their last gun was silenced.

Then there was the sailor who, lying on the blistering deck of the crippled aircraft carrier Hornet, with one

leg broken and the other shattered, tried to climb off his stretcher to have another shot at the Japs.

And the sea dogs who stood unhesitatingly behind Admiral Callaghan as he led the cruiser San Francisco right into a hell of fire between two lines of Jap warships, and then finished off a battleship, a cruiser and a destroyer.

That's our Navy . . . youngsters, most of them . . . the generation the old fellows called "spoiled" and "soft."

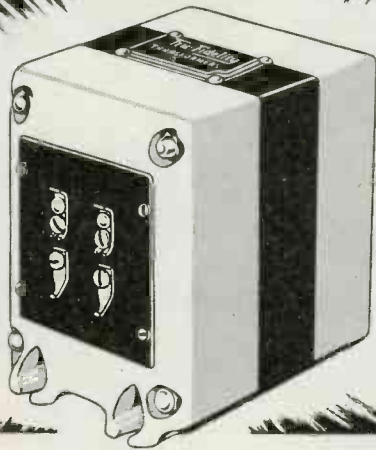
That's our Navy . . . every mar-jack of them the finest example of American manhood this country has ever produced.

That we may not let them down, Cornell Dubilier is using every minute of its thirty-three years of experience and every facility at its disposal to build capacitors that are absolutely reliable—that can be depended upon to stand up under tough treatment and battle action. We are proud to think that C-D Capacitors, in all types of communication systems, are helping to guide the destinies of America's great fleets.

A Tribute to the American Sailor

CORNELL DUBILIER ELECTRIC CORPORATION, SOUTH PLAINFIELD, N. J.

PERFECTION
from a
HUNDRED PAIRS
OF HANDS



The "human element" so consistently mentioned as a necessary part of every great accomplishment, is exemplified in the high quality of Thordarson transformers. From engineering laboratory to final inspection, countless pairs of hands and minds work in harmony to bring about in each complete transformer a coordination of effort that makes for superb performance.



THORDARSON

ELECTRIC MFG. COMPANY
 500 WEST HURON ST., CHICAGO, ILL.

Transformer Specialists Since 1895

... ORIGINATORS OF TRU-FIDELITY AMPLIFIERS

ELECTRONIC INDUSTRIES

JULY, 1943

In this Issue

	Page
Editorial	53
The Men Behind Radar	54
WIBG's Five Towers	56
Radars in Production	59
Captured Japanese Radio Equipment	60
Electronic Aids in Biological Sciences	62
Line of Sight Distances	67
Press Wireless Communications Net	68
Factory Short Cuts	72
Food Product Irradiation	74
Standardization Effects on Postwar Radio	76
Army-Navy Electronic Medical Aids	78
Rating Ceramic Condensers	80
When Engineer Is Boss	83
Signal Generator Characteristics at UHF	84
High Speed Electronic Photo Light	87
Laboratory Kinks	88
Amplifier Tubes for Low Anode Potentials	89
Who Will Distribute Electronic Supplies	90
Electronic Tubes on the Job	92
Survey of Wide Reading	94
What's New	96
U. S. Patents	102
Association News	106
Washington News	125
New Books	132

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ORESTES H. CALDWELL
 Editor

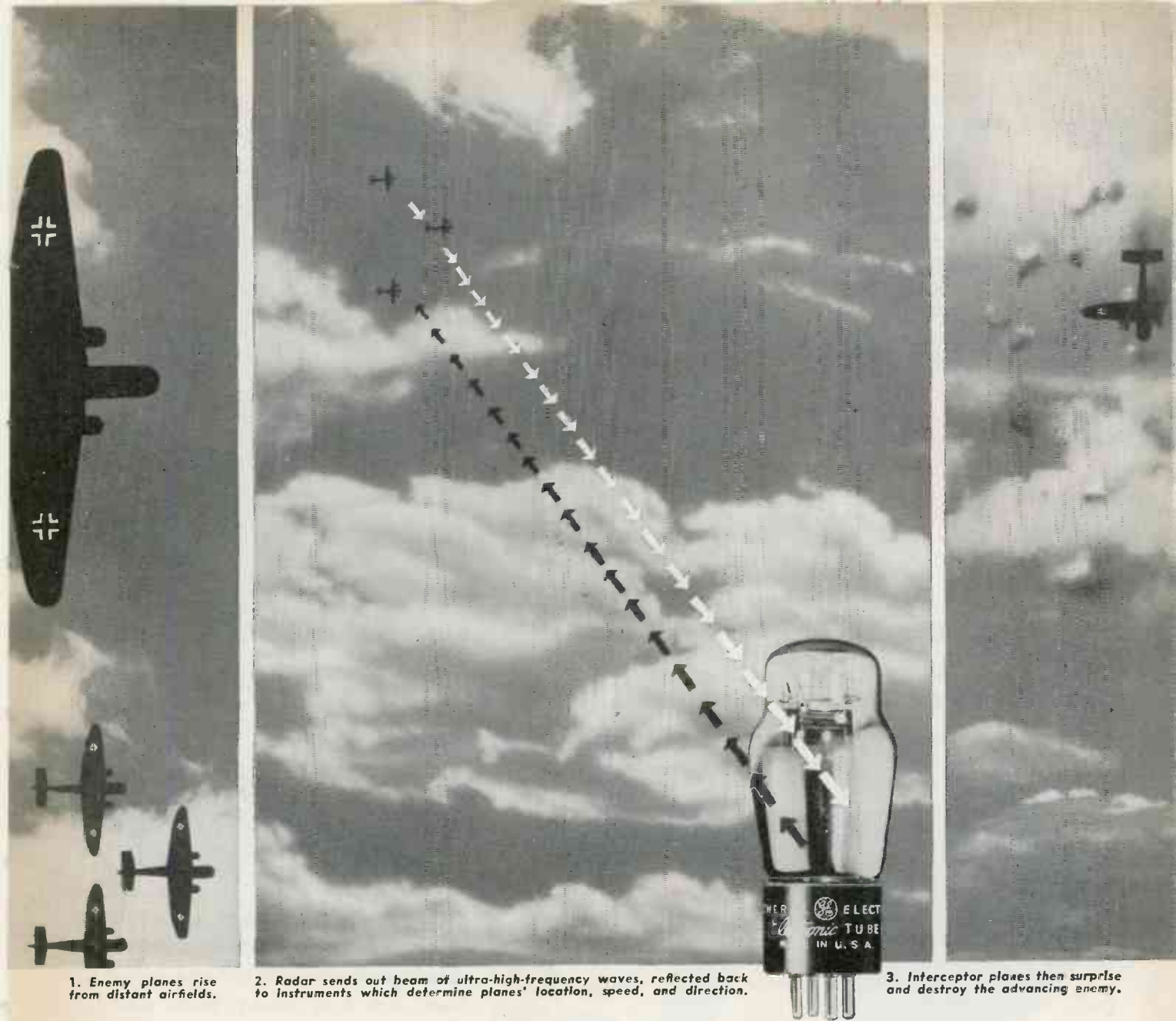
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1. Enemy planes rise from distant airfields.

2. Radar sends out beam of ultra-high-frequency waves, reflected back to instruments which determine planes' location, speed, and direction.

3. Interceptor planes then surprise and destroy the advancing enemy.



The facts about RADAR

"The whole history of Radar has been an example of successful collaboration between Allies on an international scale."

THE NEW YORK TIMES, MAY 16

THIS amazing electronic invention that locates distant planes and ships despite darkness and fog is a great co-operative achievement of Science and Industry.

In this country and in the British Isles, over 2000 scientists and engineers, some

working alone, some in the Army and the Navy, many in research laboratories of colleges and industrial firms, joined eagerly in the search for Radar knowledge.

Team-work that succeeded. Once this electronic device had been perfected, industry after industry rallied to the nation's call to manufacture Radar. General Electric is proud to have played a large part, with other manufacturers, in supplying to the Army and Navy this key weapon whose peacetime applications hold so high a promise.

As early as the Twenties, G-E engineers and scientists were developing the kind of high-frequency tubes, circuits and apparatus that make Radar possible. Thus long before Pearl Harbor, G.E. was able to build Radar equipment.

Post-war applications will be many. Radar will guard and guide the flight of great commercial transports. Planes will land blind. Transoceanic liners will slip safely into fog-bound harbors — all with Radar detection equipment.

In addition to Radar, General Electric is supplying to the Army, Navy, and Marines radio transmitters, antennae and receivers, carrier-current equipment, all kinds of electronic measurement equipment, and monitors. *Electronics Department, General Electric, Schenectady, N.Y.*

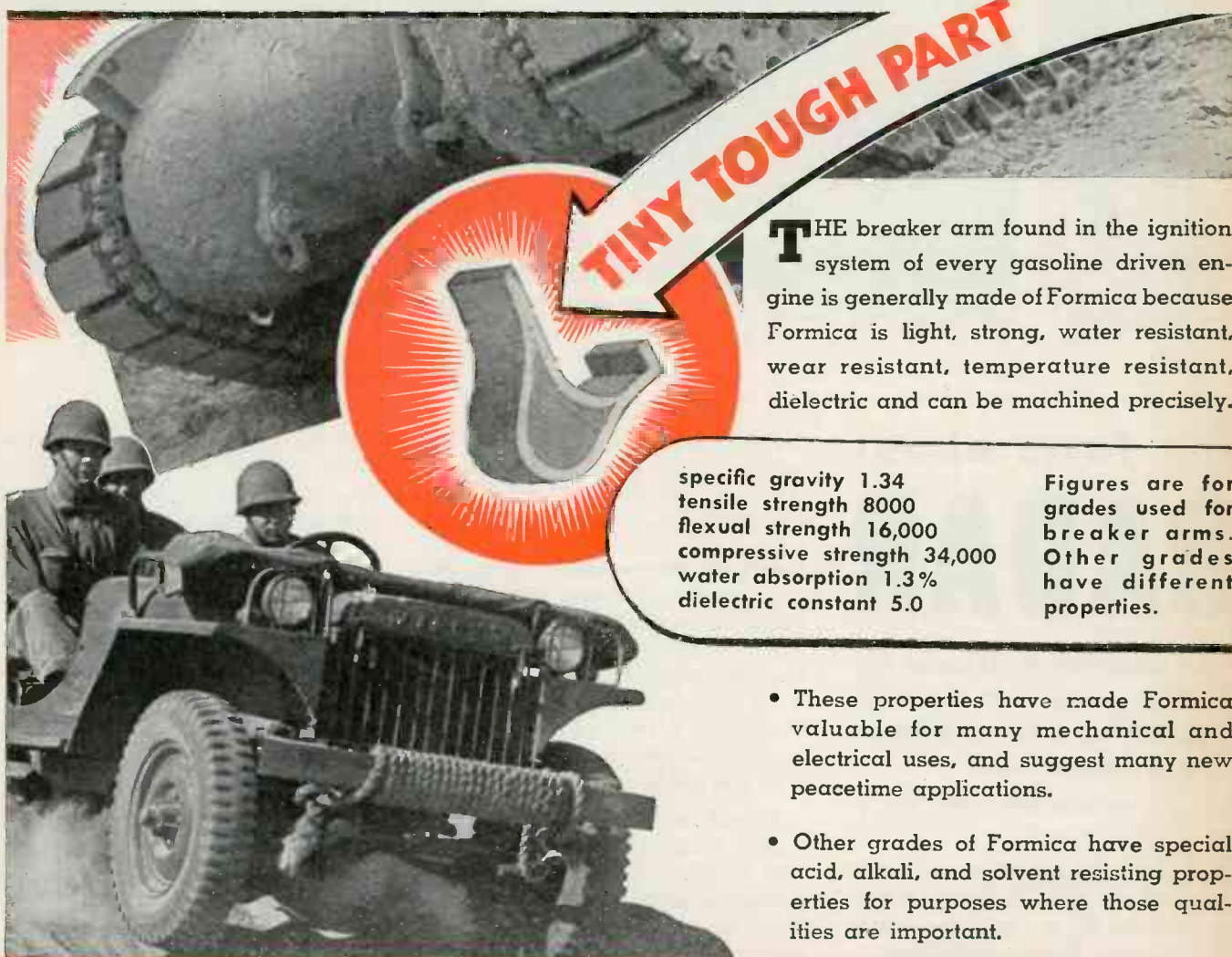
Tune in General Electric's **WORLD TODAY** and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over C.B.S. . . . On Sunday evening listen to the G-E Mazda Lamp program over N.B.C. network.

GENERAL ELECTRIC

G-E employees are now purchasing over \$1,000,000 in War Bonds weekly



THESE TOUGH MONSTERS CAN'T MOVE WITHOUT THIS TINY TOUGH PART



THE breaker arm found in the ignition system of every gasoline driven engine is generally made of Formica because Formica is light, strong, water resistant, wear resistant, temperature resistant, dielectric and can be machined precisely.

specific gravity 1.34
 tensile strength 8000
 flexual strength 16,000
 compressive strength 34,000
 water absorption 1.3%
 dielectric constant 5.0

Figures are for grades used for breaker arms. Other grades have different properties.

- These properties have made Formica valuable for many mechanical and electrical uses, and suggest many new peacetime applications.
- Other grades of Formica have special acid, alkali, and solvent resisting properties for purposes where those qualities are important.

THE FORMICA INSULATION COMPANY, 4647 SPRING GROVE AVENUE, CINCINNATI, OHIO



OFFICIAL U. S. NAVY PHOTOGRAPH

MYCALEX
THE INSULATOR
is an integral
part of RADAR...

THERE IS ONLY ONE MYCALEX

A secret weapon stands guard. It keeps constant vigil along our shores, rides on the bridges of our battleships, watches faithfully over the skies and the seas. Darkness, rain, clouds, and storms cannot blind its sure stab for hostile aircraft and ships. RADAR locates enemy targets, measures the distances, points the swift annihilation of vandal raiders. Ultra-high frequency waves make possible this new miracle. The electronic age shrivels the forces of barbarism.

MYCALEX plays its part in making this secret weapon available to aid us—plays its part in this as faithfully, as dependably, as in all other applications. There is scarcely a phase of the entire war program in which MYCALEX is not performing, as reliably as it has for more than a quarter century of peace-time services. Navy and Army approval is the reward for years of dependability, and the Mycalex Corporation of America has been labouring night and day since before Pearl Harbor to meet the needs of our armed forces.

The return of peace will reveal new realities born of the blood and smoke of war, and MYCALEX will serve as always in these visions turned real.

MYCALEX is not the name of a class of materials. MYCALEX is the registered trade-name for low-loss insulation manufactured only by the Mycalex Corporation of America in the Western Hemisphere. MYCALEX is specified by engineers because MYCALEX is required. There is only one MYCALEX.



Trade Mark Reg. U. S. Pat. Off.

MYCALEX CORPORATION OF AMERICA

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

60 CLIFTON BOULEVARD

CLIFTON, NEW JERSEY

*Today this
flag flies over*



From this world headquarters for radio-electronic research flow new weapons, new discoveries and inventions vital to the winning of an Allied victory!

TODAY, over RCA Laboratories, flies a new distinguished battleflag—the coveted Army-Navy “E” Award.

One of the few laboratories in America to receive this award, RCA is at once proud of this distinction, and humbly aware of the responsibilities that it imposes. For much of the progress of the entire radio-electronic industry stems from the work done in these laboratories.

It was perhaps with this thought in mind that—at the dedication of the RCA Laboratories in Princeton—the Chief Signal Officer of the Army called them “The Hidden Battlefront of Research.”

HIDDEN—because, for the duration of the war, this magnificent building of 150 separate laboratories must be closed to all but the scientists and research technicians who are working on radio-electronic instruments important to our military effort.

BATTLEFRONT—because in the waging of modern warfare, radio-electronics is of first importance. It follows the flag and the fleet—locates the enemy—flashes urgent orders—safeguards the convoy—guides the bombers—directs the artillery—maneuvers the tank. This science fights on every front.

And when that certain day of Victory comes, RCA Laboratories will be devoted to the happier task of making our peacetime world richer, safer, more enjoyable and more productive—through new and finer products of radio, television and electronic research.

OTHER SERVICES OF RCA WHICH HAVE EARNED OUR COUNTRY'S HIGHEST WARTIME AWARDS



The Army-Navy “E” flag, with two stars, flies over the RCA Victor Division plant at Camden, New Jersey.



The Army-Navy “E” flag, with one star, has been presented to the RCA Victor Division at Harrison, New Jersey.



The Army-Navy “E” flag, with one star; also the U.S. Maritime Commission “M” Pennant and Victory Fleet Flag have been awarded to the Radiomarine Corporation of America in New York City.

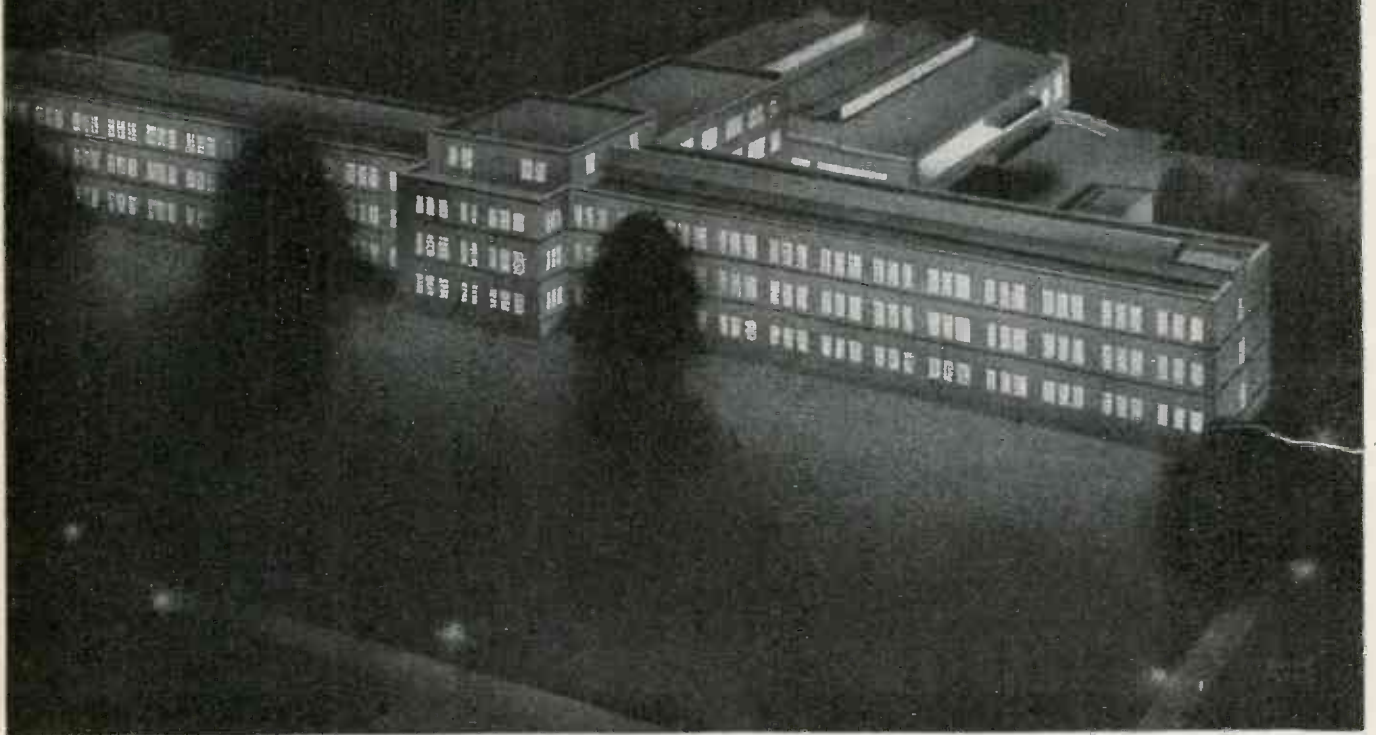
*A Service of
Radio Corporation of America*



RCA

WORLD HEADQUARTERS

America's Secret Battlefield
RCA Laboratories



Laboratories

FOR RADIO-ELECTRONIC RESEARCH

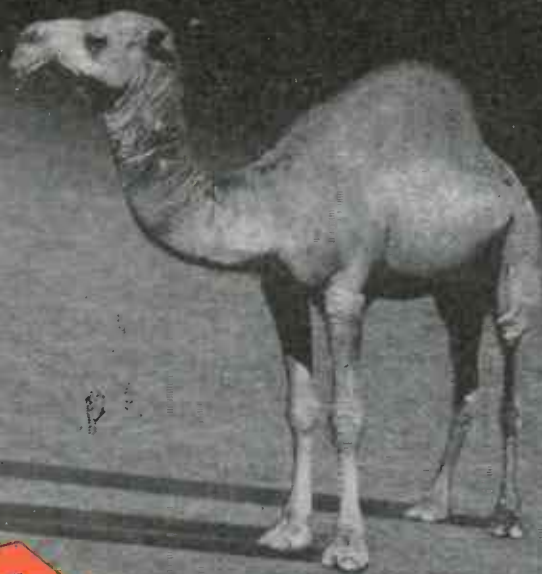
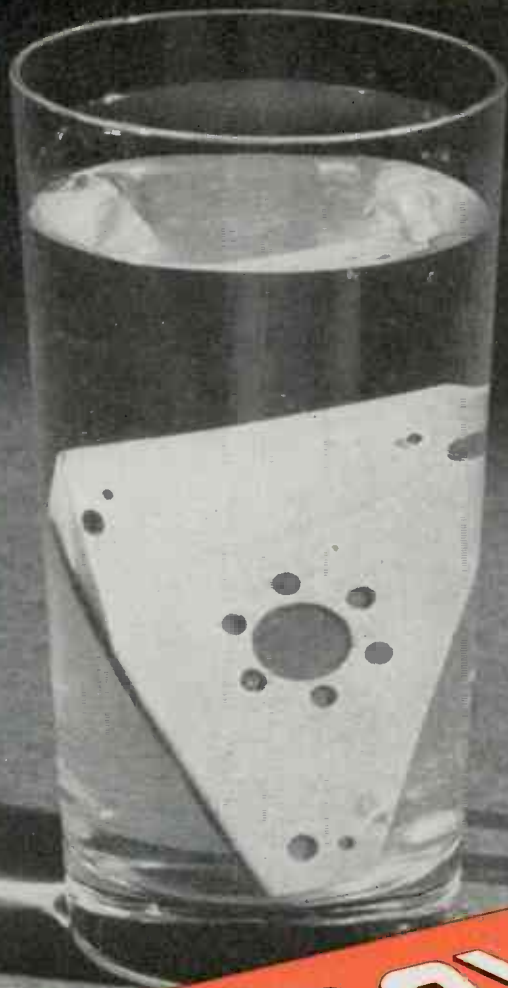
PARTS by Centralab

● Since 1922 Centralab has been synonymous with Quality. Parts by Centralab include:

STEATITE INSULATORS
CERAMIC TRIMMERS
HIGH FREQUENCY
CIRCUIT SWITCHES
CERAMIC CAPACITORS
WIRE WOUND CONTROLS
SOUND PROJECTION CONTROLS

Centralab

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



MYKROY

TYPICAL EXAMPLES OF MYKROY APPLICATIONS

- Stand-off Insulators
- Variable condensers
- Tube and Crystal Sockets
- Mounting strips
- Structural supports for radio circuits
- Plug-in bases
- Insulated couplings
- Lead-in insulators
- Antenna reel insulators
- Motor generator brush holders
- Padding condenser supports
- High voltage arc shields
- Oscillator circuits
- Fixed condensers
- Impregnated resistors
- Radio frequency coil forms
- Radio frequency panel assemblies
- Radio frequency switches
- Relay bases and arms

DOESN'T DRINK!*

One of the many reasons why MYKROY is a more efficient insulating material is that MYKROY is non-porous. Its superior mica and specially prepared glass are fused in intimate molecular contact. Hence, hydrosopic absorption and adsorption of oils, vapors or moisture are virtually nil. Surface treatment and impregnation are not needed.

This advance over old-style ceramics makes MYKROY a more dependable insulator under conditions of heat and humidity . . . whether in steaming jungle, dense ocean fog or the acid-laden vapors of a submarine.

MYKROY dissipates negligible electrical energy throughout the entire range of frequencies. It bonds inherently with metals, and will not warp. MYKROY combines extreme lightness in weight with mechanical strength comparable to cast iron. It can be machined or molded with great precision.

Ask our engineers for detailed specifications concerning MYKROY—the perfect insulation for today's more exacting needs.

* ABSORPTION FACTOR .02% IN 48 HOURS

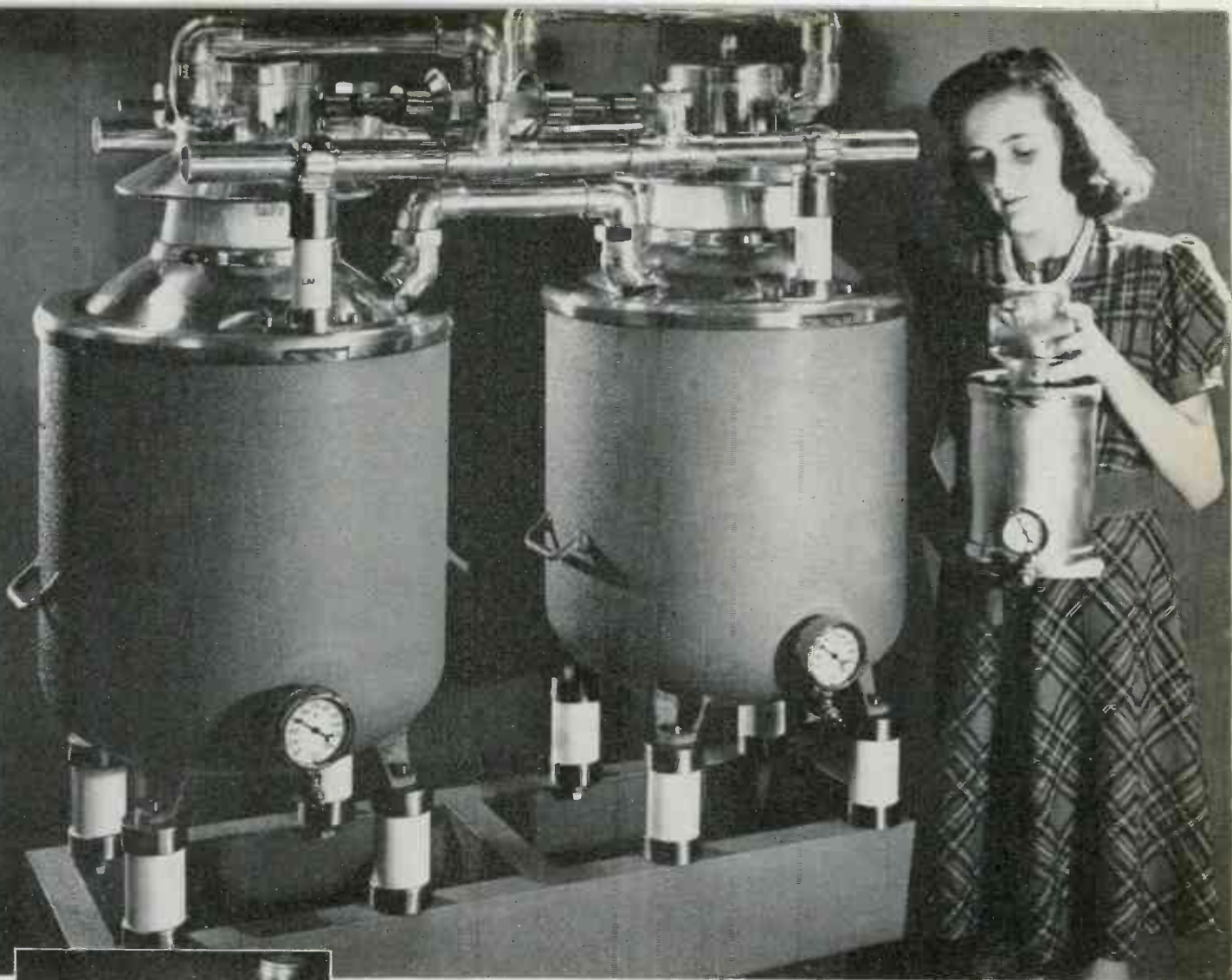
MYKROY IS SUPPLIED IN SHEETS AND RODS . . . MACHINED OR MOLDED TO SPECIFICATIONS

MADE EXCLUSIVELY BY

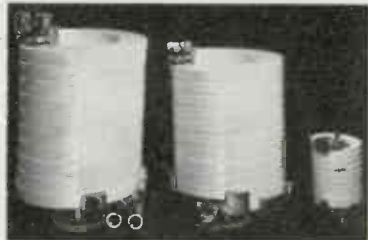
ELECTRONIC MECHANICS
INC.

70 CLIFTON BOULEVARD • CLIFTON, NEW JERSEY
Chicago: 1917 NO. SPRINGFIELD AVENUE . . . TEL. Albany 4310

www.americanradiohistory.com



Standoff, bowl, and other special-purpose insulators are available in wide range. Lapp is also equipped for production of many special assemblies, including porcelain or steatite, with all associated metal parts.



Lapp porcelain water coils, porcelain pipe and fittings provide a means for cooling high-frequency tubes, without sludging, eliminating need for water changing or cleaning.

LAPP *high-capacitance* CONDENSERS FOR INDUSTRIAL

ELECTRONIC CIRCUITS For lump capacitance in any high-frequency circuit, Lapp gas-filled condensers save space, save power, save trouble—and use no mica. Available for use at any needed voltage rating and capacitance, they operate with practically zero loss, are puncture-proof, fail-proof and constant in capacitance under temperature variation.

Above is Unit No. 26541, consisting of two No. 25934 units. The assembly provides pivoting bus conductors, arranged so that the units may be used singly, in series, or in parallel, providing capacitance continuously variable from .0022 mf. to .022 mf. Each unit is rated at 200 amp., 6500 volts, capacitance variable .0043 mf. to .011 mf.; the combination in series, 200 amp., 13,000 volts, .0022 to .0055 mf.; in parallel, 400 amp., 6500 volts, .0086 to .022 mf. In the girl's hands is Unit No. 23722, rated at 50 amp., 7500 volts, capacitance .000045 mf. to .000075 mf.

Lapp

INSULATOR CO., INC.

LEROY, N. Y.





LOOKING TOWARDS THE WORLD OF TOMORROW

AN INSPIRING CHALLENGE to the imagination is this ever-expanding science of electronics.

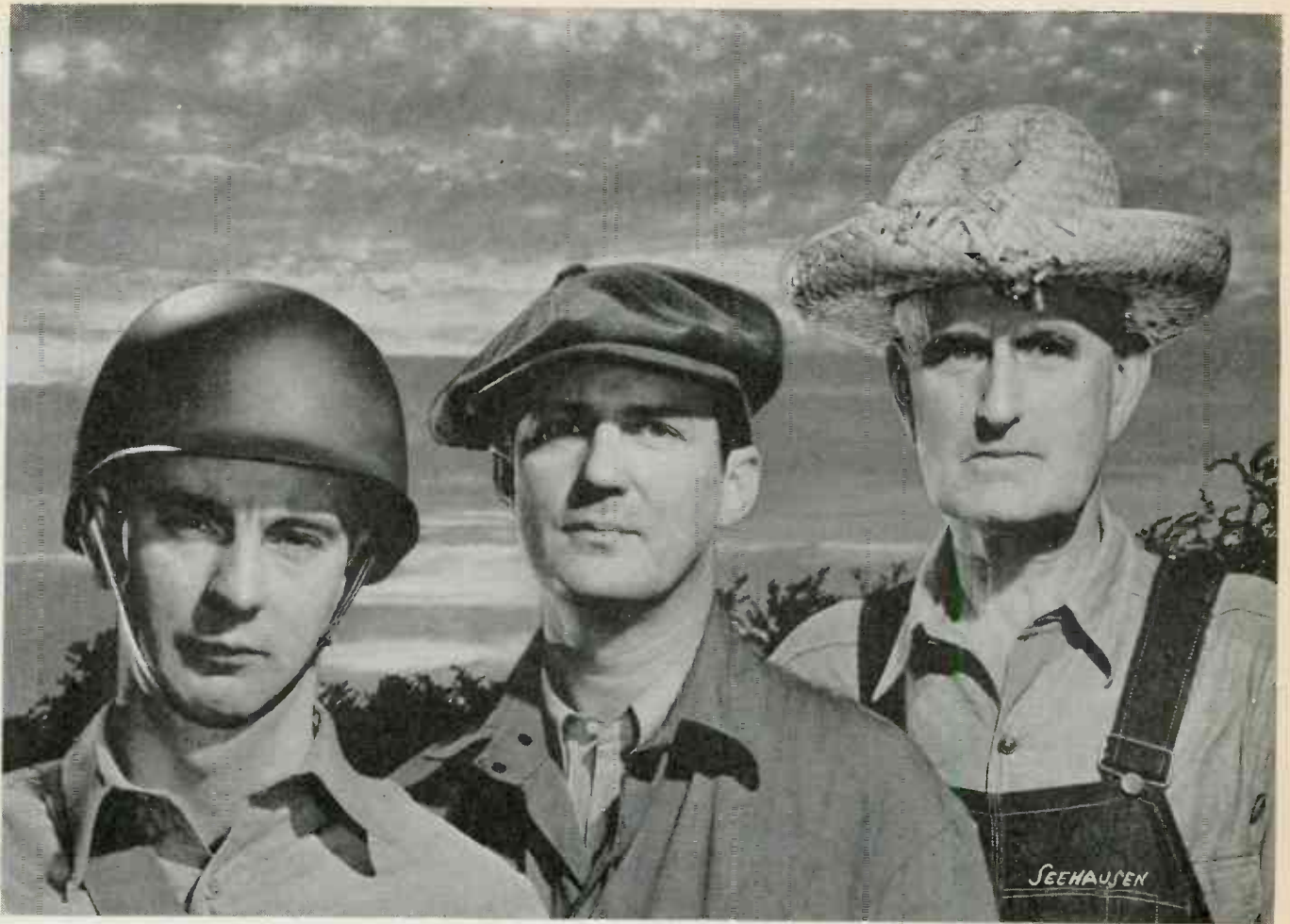
From the laboratories of Rogers Radio Tubes Limited in Toronto, Canada, in 1924, came the first A.C. Tube for domestic radios.

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

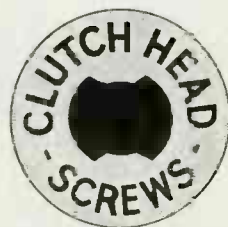
POWER TUBES

ROGERS RADIO TUBES LIMITED • TORONTO, CANADA



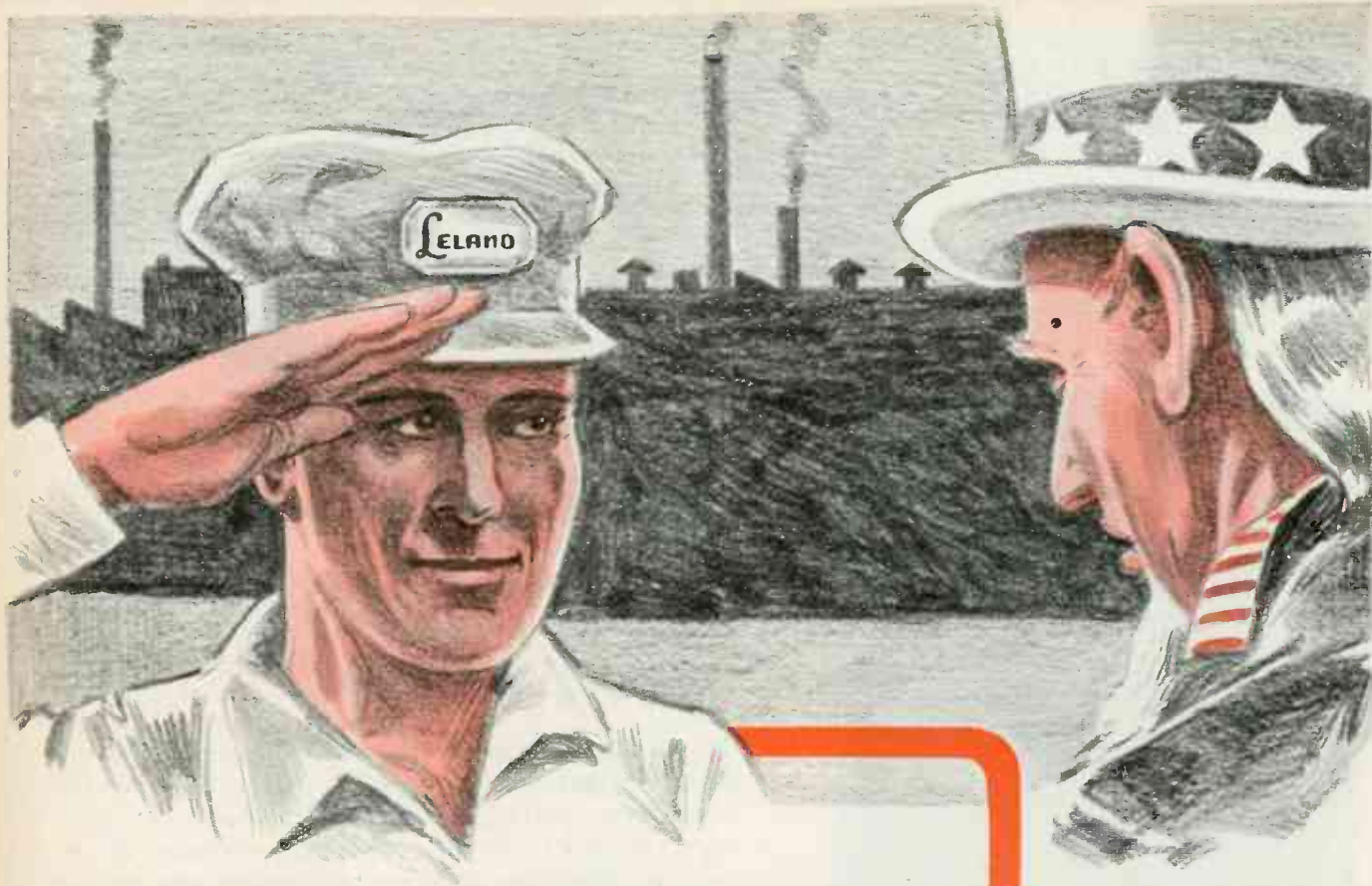
We men in the field hand it to you for a swell job . . . to you Engineers and to you men and women who roll them off the assembly lines . . . *fast and right*. But our job is to **KEEP 'em rolling**. That means we have to be able to take things apart and put them together again . . . *in a hurry*. So, one thing you can do to help us is to "button them up" with **CLUTCH HEAD SCREWS**. You see, **CLUTCH HEADS** operate with a standard type screwdriver, any time, anywhere . . . and that's a break for us who have to work with ordinary tools. This special feature of *screwdriver control* in **CLUTCH HEAD SCREWS** is a time-saver and a life-saver when it comes to repairs and adjustments in the field. No worry, no hunting for special tools to fit the clutch; the good old trusty screwdriver does the business. Yet, with **CLUTCH HEADS**, you "on the line" have all the advantages of assembly bits for speed, safety, security, and . . . the higher-ups will like this . . . for low cost operation.

CLUTCH HEAD SCREWS are contributing importantly to many phases of the war effort. They are available in Standard and Thread-forming types for every purpose . . . the **ONLY** modern screw operative with assembly bit or standard type screwdriver.



Note the economy feature of this Center Pivot assembly bit for delivery of long uninterrupted service. No delay, no expense because a brief application of end surface to a grinding wheel restores original maximum efficiency.

UNITED SCREW AND BOLT CORPORATION
CHICAGO CLEVELAND NEW YORK



"LELAND ELECTRIC REPORTING, SIR!"

"Your order has been executed, sir, and Leland motors, generators, dynamotors, alternators and voltage regulators have reported for duty. Installations have been made and are being made, to power field radio and phone equipment, airplane instruments, automatic pilots, fathometers on ships, etc. Reports received, sir, indicate successful operation on electronic equipment everywhere...on land...on sea...under the sea...and in the air. Any further orders, sir?"

Yes, many Leland designs, some of them exclusively Leland, are serving in all branches, Army...Navy...Air Services... Merchant Marine... Coast Guard. In fact, around 98% of the Leland output is being channeled for war duty—Leland's contribution in time of crisis.

Leland production largely earmarked for armed services, but Leland engineers for consultation on post-war needs immediately available.



SPECIAL LELAND
POWER INVERTER

Leland

WAR DUTY MOTORS

THE LELAND ELECTRIC COMPANY • DAYTON, OHIO

So that our guns will SHOOT STRAIGHT



★ Knobs set. Camera ready. Firing circuit closed. BANG! Yet no sound, smoke, damage, to upset the serenity of the lab atmosphere. But . . .

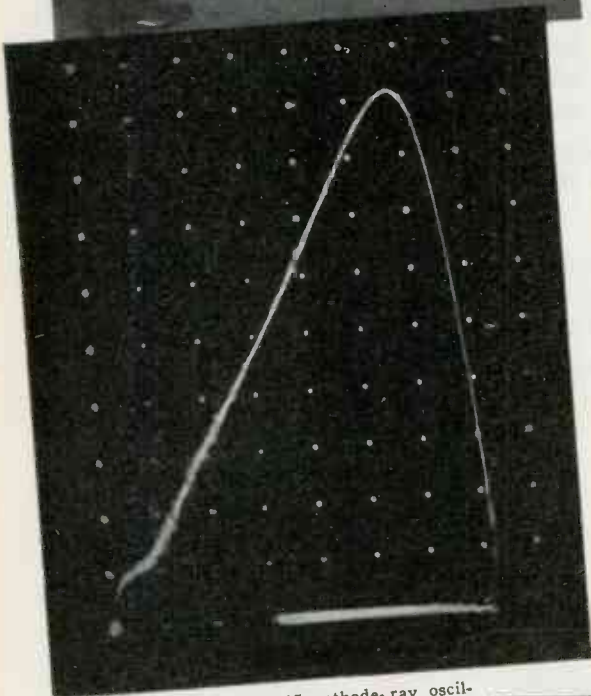
Months later an American shell lands *smack* on the distant target. Precise powder charge has rounded out expert spotting, accurate calculations, fine gun-crew teamwork. To the growing consternation of our enemies, American marksmanship attains new heights of accuracy with its *electronically-checked* gun-powder. Specifically:

DuMont Type 235 cathode-ray oscillograph is being used in conjunction with a closed-bomb method of powder testing. Signals for the oscillograph are generated by the closed-powder-bomb. Potentials furnished by burning powder provide the horizontal and vertical deflection signals. Luminous dots electronically imposed on the short-persistence screen provide an accurate calibration means. The resultant combination oscillogram is photographed for a permanent record.

Thus each lot of powder, whether experimental or in production, is checked for vital burning qualities. Uniformity is assured. Our gun crews can be confident that their powder charges are *right*.

All of which is but another example of how DuMont specialists work with technicians in many different fields, in the application of cathode-ray technique.

★ *Submit your cathode-ray problem.
Write for latest literature.*



Above: DuMont Type 235 cathode-ray oscillograph. Below: Typical oscillogram for a given powder sample, showing matrix of dots providing an accurate reference or coordinate system for the burning powder graph, permanently photographed.

DUMONT

**ALLEN B. DU MONT
LABORATORIES, Inc.**

Passaic • New Jersey
Cable Address: Wespexlin, New York

FERRIS

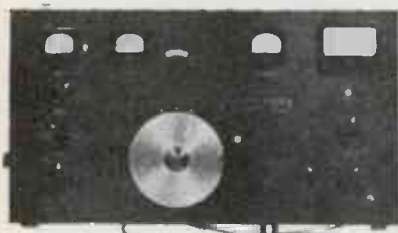
INSTRUMENTS



MODEL 40-A
20-250 Mc.



MODEL 48-A
200-500 Mc.



MODEL 16-C
50 Kc.-25 Mc.

Precision measurements at U.H.F. now made possible by new Ferris standard amplitude-modulated signal generators, substantially free from frequency modulation, including crystal controlled U.H.F. generators for frequency standards.

Many new instruments for special application available. Let us have your problem. Possibly we may already have a design adaptable.



MODEL 45-B
75-150 Mc.
Crystal Controlled

ONE OF THREE
FERRIS PLANTS
BUILDING
FERRIS
INSTRUMENTS



ARMY-NAVY
"E" AWARD
December 11, 1942

WRITE FOR NEW CATALOGUE SHOWING LATEST INSTRUMENTS • ADDRESS

FERRIS INSTRUMENT CORPORATION

110 CORNELIA STREET
BOONTON, NEW JERSEY



**POWER LINES
DOWN!**

IRC RESISTORS Send the Signal

When trouble develops on a high voltage power line, time is of greatest essence. For in our fast-moving electro-mechanical age, minutes quickly translate themselves into countless man-hours. Communications go "dead" . . . lights snuff out . . . vital production grinds to a sudden halt . . . and it's "taps" for a busy world.

Another IRC Contribution

Until comparatively few years ago, when power transmission interruptions occurred, it often required hours to locate the trouble. Today, thanks in part to the contribution of IRC research engineers, the point of disruption in any electrical circuit—whether power or communications—can readily be spotted in a matter of moments.

Specially designed, IRC high voltage power resistors dependably dissipate the heavy loads and deliver the voltage required to operate trouble-signalling mechanisms. On receipt of signal, other instruments in which resistors play an important role accurately locate the point of disturbance within a few feet.

Here at IRC we welcome—and usually solve—unusual problems in the field of resistance devices.

And because IRC makes more types of resistance units, in more shapes, for more applications than any other manufacturer in the world, many leading engineers make it a point to seek our unbiased counsel. There is no obligation, of course.



INTERNATIONAL RESISTANCE COMPANY

425 N. BROAD STREET • PHILADELPHIA



Meet your RCA TUBE and EQUIPMENT DISTRIBUTOR!

... 'Round the Corner Supplier of Electronic Items to War Industry

Need RCA Tubes and other electronic equipment in a hurry?

Need "trade-wise" expediting on important material orders that require intelligent follow-through?

Then get in touch with your nearest RCA Tube and Equipment Distributor today! Filling hurry-up priority orders—often from stock—is his business. If he hasn't got what you need, he'll know where to obtain it as fast as priorities permit. He knows the trade. He knows delivery conditions. Equally im-

portant, he knows the technical angles of the equipment that he sells. You'll find his technical help and suggestions invaluable—and these, like his delivery facilities, pertain not only to RCA Tubes and Equipment, but to countless other related electronic items produced by many other manufacturers as well.

There are over 300 of these RCA Distributors throughout the United States to serve you. If you do not already know the one nearest you, a list will gladly be sent on request.

- ✓ TECHNICALLY-INFORMED SERVICE
- ✓ NORMALLY LARGE STOCKS
- ✓ FAST DELIVERIES
- ✓ INTELLIGENT EXPEDITING



RCA ELECTRON TUBES

RCA Victor Division, RADIO CORPORATION OF AMERICA, Camden, N. J.



"MY BOY OWNS THIS PLACE!"

SOME TIME AGO I retired, just a good, old fashioned, real-American retirement . . . thought I had served my time and done my share.

When the war started I went back to work . . . a good tool maker can do a lot to help lick those fellows, you know. And it is fun to work for my boy. I'm proud of him and proud of America that makes men like him possible. He had the same start I had only now he owns this shop. And that is one of the things we are all fighting for—to preserve that American FREEDOM of opportunity.

Pardon me, I've got work to do now. When the war's over look me up—on the front porch.



hallicrafters
CHICAGO, U. S. A.



BUY MORE BONDS!



REVERE
WISTENHUFF

THE SKILL *and* THE WILL
... today and tomorrow

Only one American in many thousands is privileged to wear the "E" pin, symbolic of high achievement on the production front. It symbolizes skill and determination above and beyond the high average standard set by American Industry. . . . The men and women of Connecticut Telephone & Electric Division have been honored by the Army-Navy Production Award twice in a period of six months. This symbol

of a job being well done in the cause of Victory is evidence, too, of what may be expected when the war is won. . . . The manufacturer seeking cooperation in product engineering and improvement, the development of production control, or any problem involving the application of advanced electrical or electronic knowledge, is cordially invited to discuss the matter with our engineering staff.



CONNECTICUT TELEPHONE & ELECTRIC DIVISION

MERIDEN



CONN.

© 1943 G.A.I., Inc., Meriden, Conn.

**DESIGN, ENGINEERING & PRODUCTION
OF PRECISION ELECTRICAL EQUIPMENT**

MAGNAVOX SAVED YOUR GOVERNMENT EIGHT MILLION DOLLARS

EXCERPTS from Ford Motor Company's broadcast, "Watch the World Go By," April 5, 1943, in which Earl Godwin paid respects to American free enterprise.

"Take the folks at the Magnavox Company of Fort Wayne, Indiana . . . that before the war made superbly-toned radio-phonograph combinations. Today they're building Solenoid firing controls for aircraft-mounted machine guns for Ford-built Liberator bombers and Army and Navy planes . . . Within fifteen days of the time Uncle Sam asked Magnavox for these controls, working models were completed and firing tests furnished. Thirty more days and the controls were being turned out . . . Increased firing pressure 180%, decreased weight 18% and reduced battery drain 50%, and the mass production techniques developed by

Magnavox have saved the government approximately eight million dollars in manufacturing costs."

We are making equipment for Army, Navy, Coast Guard, Marine Corps and Maritime Commission, in our new six acre factory, on prime and sub-contracts. Facilities for additional contracts become available from time to time. Write, wire or phone The Magnavox Company, Fort Wayne, Indiana.



The skill and craftsmanship which won for Magnavox the first Navy "E" award (and two White Star Renewal Citations) among radio receiver manufacturers, have served the radio industry capably for a span of thirty-two years.

Magnavox

THE GREAT VOICE OF RADIO

COMMUNICATION AND ELECTRONIC EQUIPMENT

Their guns were loaded and aimed...yet

ELECTRONICS FIRED THE FIRST SHOT



On Sunday, November 8, in North Africa, the sound which broke the peaceful stillness of that eventful night was not the booming of allied guns, nor the throbbing engines of countless landing barges. It was a VOICE—the friendly voice of the President of the United States saying “We come among you to repulse the cruel invaders—Have faith in our words—Help us where you are able.”

At many points where our boys landed along the North African coast there was little, if any, resistance because electronics had already won the day. By short wave radio America's motives had been made clear. Days of fighting were avoided. Thousands of lives were saved.

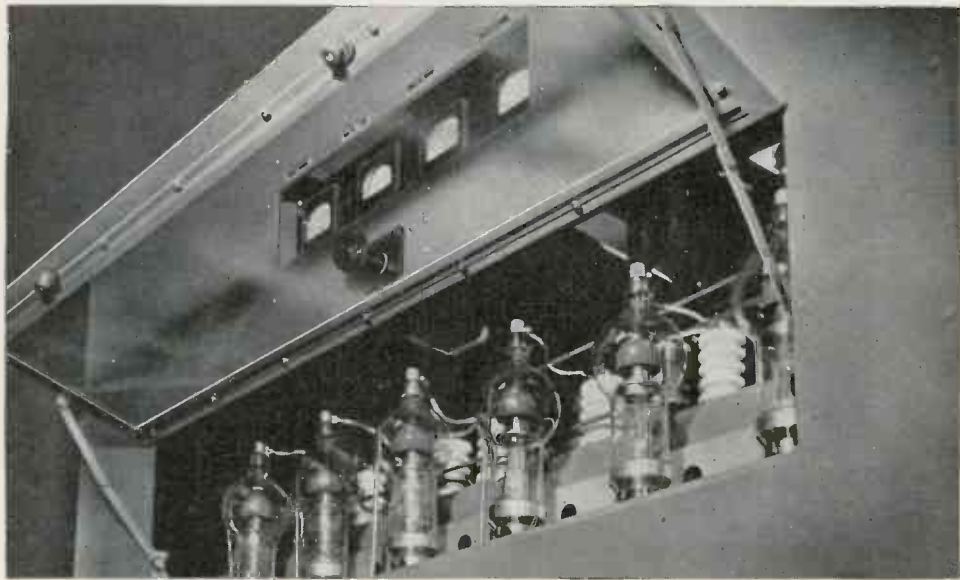
Distinguished service on many fronts has won the electronic tube a place among the great weapons of modern warfare. Yes, electronic tubes can *fight!* And to supply these fighting tubes for our fighting forces the men and women of National Union have doubled and redoubled production. We know the day is coming when these tubes and the knowledge which builds them will be reconverted to the needs of peace. In

National Union's plans for this new age of electronics, there is to be a comprehensive industrial service . . . to aid engineers and production men in applying the miracle of electronics to their production, testing and packaging processes. Today, to the extent that present war work will permit, National Union invites consultation with producers of war goods regarding their electronic tube problems.

NATIONAL UNION RADIO CORPORATION • NEWARK, NEW JERSEY • LANSDALE, PA.

NATIONAL UNION RADIO AND ELECTRONIC TUBES

Transmitting Tubes • Cathode Ray Tubes • Receiving Tubes • Special Purpose Tubes • Condensers •
Volume Controls • Photo Electric Cells • Exciter Lamps • Panel Lamps • Flashlight Bulbs



Since 1878

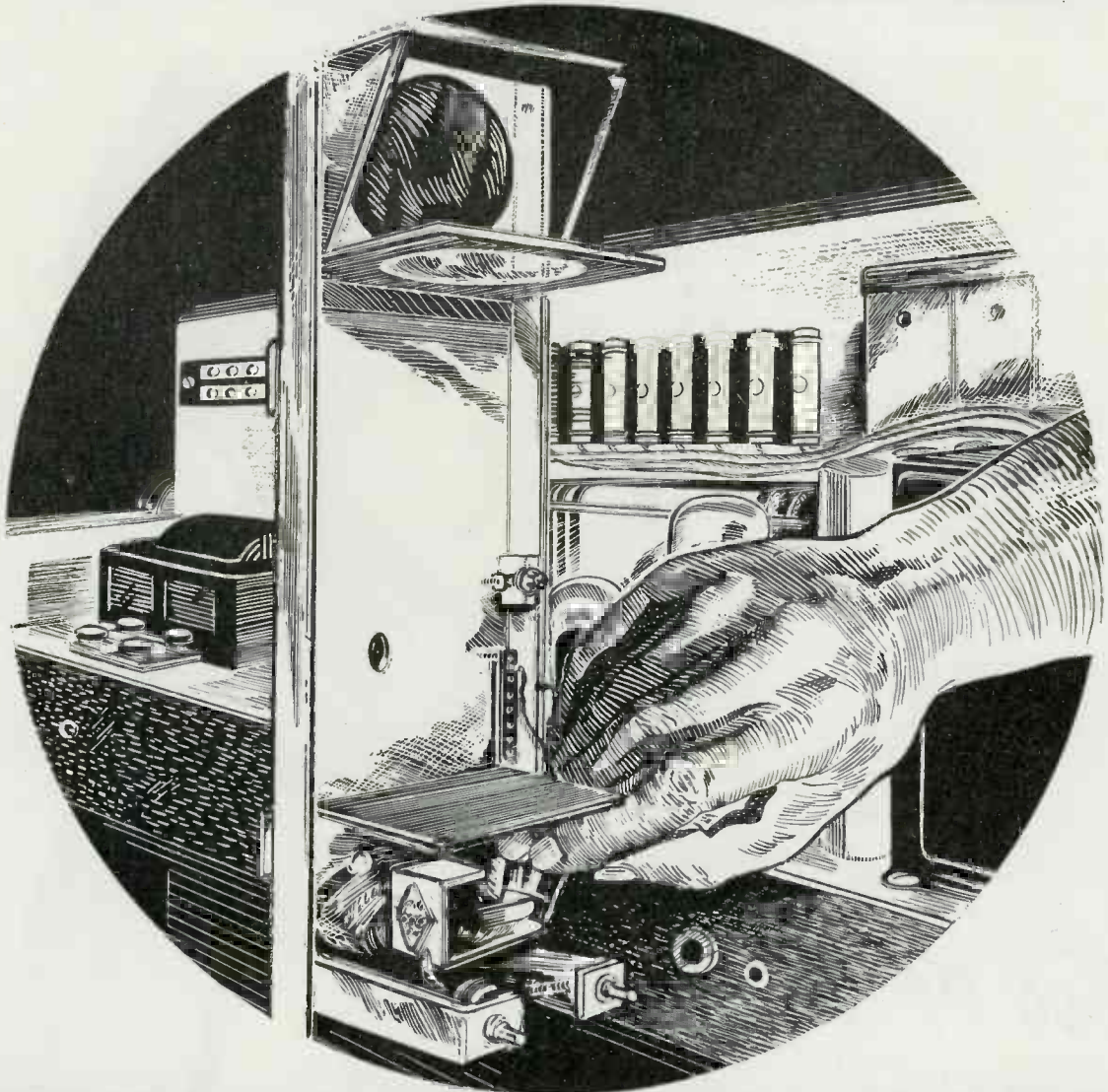
THROUGH the growth years of the communications industry in all its phases, the pioneers have depended upon equipment of Bunnell design and manufacture. Today the industry broadens its horizons; its developments will revolutionize untold hundreds of industrial processes. Again the pioneers will look to the technical assistance of the Bunnell Engineering Group. Their experience is at your disposal.



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

ON GUARD AGAINST SABOTAGE!



ELECTRONIC TUBES AID PLANT PROTECTION

America's war production plants are carefully guarded . . . night and day electronic tubes guard against intrusion. Units that transmit a virtually invisible light beam are powered by tubes that are constantly on the job . . .

guarding against sabotage! . . . Raytheon's experience during its war time production of tubes for our armed forces will prove an invaluable factor when these new developments can be released for general domestic uses.



RAYTHEON



Raytheon Manufacturing Company

Waltham and Newton, Massachusetts

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



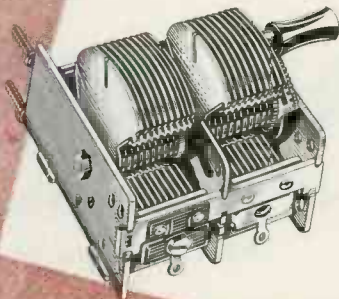
Tool up for peace

Tooling up for Victory—the conversion of more than 30,000 American plants into war production was the most gigantic achievement in industrial history. Will the business of tooling up for peace present like difficulties? Not if we plan ahead! General Instrument's research and engineering facilities are now devoted to war efforts, but we are looking to the future when the accumulated skill and experience of today will be diverted to solving the mechanical and electrical problems of tomorrow. How about that idea of yours? Why not bring that brain child to us now?

General Instrument
CORPORATION

Executive Offices: 829 Newark Avenue, Elizabeth, New Jersey

In big cities and remote towns all over the land, for more than a quarter century, millions of owners of home radio sets have enjoyed better reception because of General Instrument precision equipment.





the Hope
OF THE WORLD
today -

**WILL BE THE REALITY
OF TOMORROW**

American industry is working . . . and working hard . . . to keep the light of Liberty burning bright; not only for Americans, but for all men. Electronic Corporation of America realizes that the war is not yet won, but believes that it is not too early to make plans for the peace to come.

Electronic Corporation of America is now engaged in 100% war production of electronic devices and equipment . . . and is pledged to continue the all-out effort 'till the world is swept clean of Nazism. Then, but not until then, the whole world will know the direct benefits of American productive genius and engineering know-how in the field of electronics.

• The engineering skill and modern mass production methods of ECA can supply electronic devices and equipment in quantities to manufacturers and government agencies. Your inquiries are invited.

"Buy More—AND MORE—War Bonds"

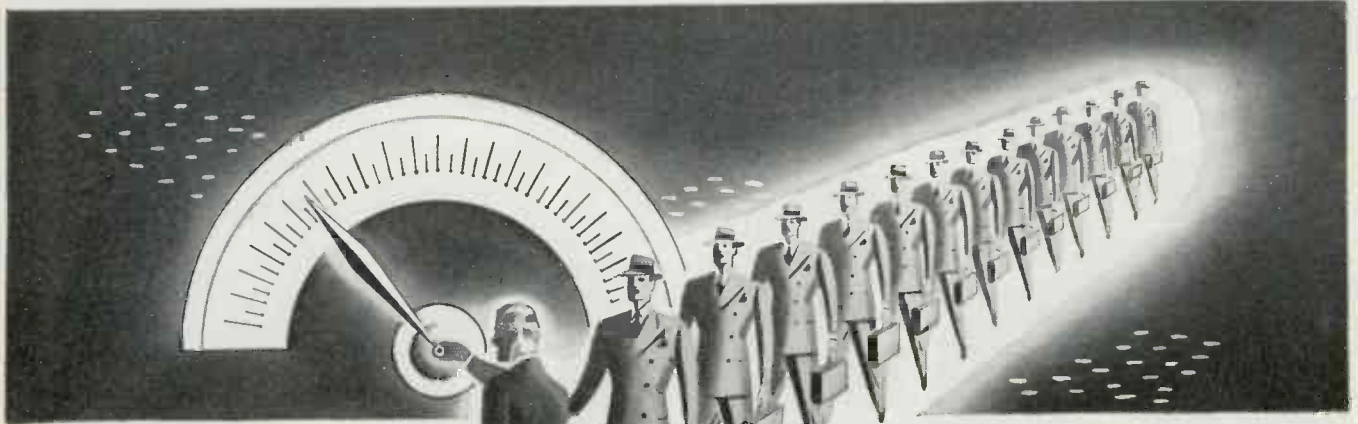


"LET'S WIN THE WAR NOW . . .
WITH THE UTMOST IN PRODUCTION."

ELECTRONIC CORPORATION OF AMERICA

45 WEST 18th STREET, NEW YORK CITY . . . PHONE WATKINS 9-1870

ONE OF A SERIES OF ADVERTISEMENTS SHOWING DeJUR PRECISION PRODUCTS IN ACTION ON THE HOME FRONT



IN GOOD WORKING ORDER...



America is watched over by people... "little people"... the policeman, the druggist, the shopkeeper, the repairman and so on. Bulking large in the life of the community these days is the radio serviceman... he's got to keep present sets operating for the duration.

Because his must be dependable equipment, you'll find that a DeJur Meter is the heart of his sensitive testing and checking apparatus. He has learned from long and constant use that this meter is consistently accurate, that it can take a lot of punishment, and that it can save precious time by enabling him to get to the bottom of the trouble immediately. For the fine job that the Radio Servicemen are doing in wartime America, the needle of the DeJur Meter points with pride.

KEEP BUYING WAR BONDS AND STAMPS



DeJUR-AMSCO CORPORATION

SHELTON, CONNECTICUT

NEW YORK PLANT: 99 Hudson Street, New York City • **CANADIAN SALES OFFICE:** 560 King Street West, Toronto



Not an easy one . . .

From guarding the law to—yes—delivering babies, a policeman's life is not an easy one. Needed in a thousand different places at one time, his head must remain cool, and his orders must be transmitted quickly, clearly and undistorted by any adjacent noises.

Here, then, is another vital postwar use for Electro-Voice Microphones. It is impossible now to estimate the "good" which will be accomplished with the new Electro-Voice communication microphones for police applications. They are, we believe, incomparable from the standpoint of articulation (we can't tell you the percentage and you wouldn't believe it if we did!) level, reduction of background noise, stability, weight and size.

If you are a contractor, directly serving the war, and are in need of this newest Electro-Voice, we'll gladly send you full particulars. Meanwhile, if your limited quantity needs may be filled by any of our Standard Model Microphones, with or without modifications, contact your local radio parts distributor. He can help solve your problems and speed your smaller orders.

Note: Any model Electro-Voice Microphone may be submitted to your local supplier for *TEST* and *REPAIR* at our factory.

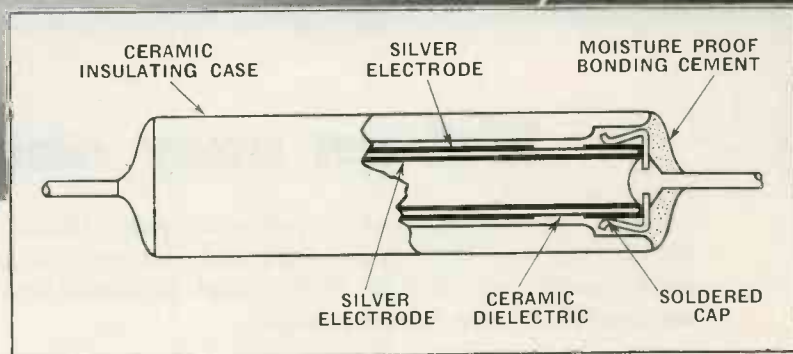
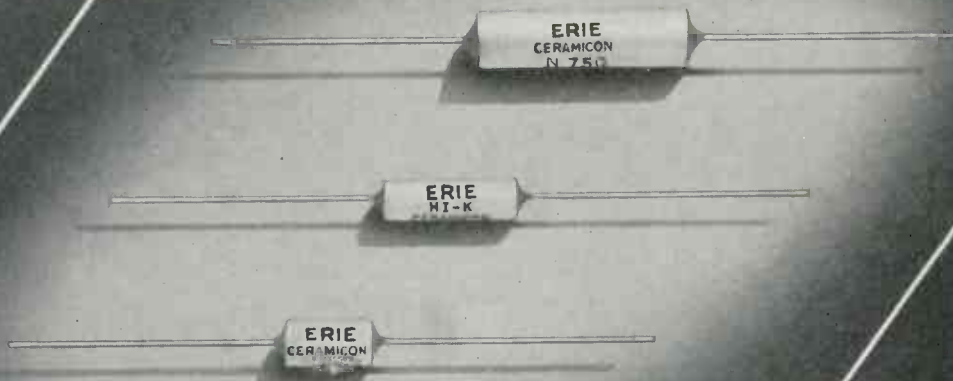


Electro-Voice MICROPHONES

ELECTRO-VOICE MANUFACTURING CO., Inc. • 1239 SOUTH BEND AVENUE • SOUTH BEND, INDIANA

ERIE *Insulated* CERAMICONS

REG. U.S. PAT. OFF.



for

MODERN ELECTRONIC DESIGNS . . .

THE modern trend toward more compact electronic assemblies necessitates the use of *insulated* components. Fully appreciating the inherent advantages of insulated components, we have concentrated on the production of Insulated Ceramicons, since we first introduced ceramic condensers in this country nearly seven years ago.

Details of construction are shown in cross-sectional drawing above. The ceramic case is sealed with a resin-bonded cement and unit is vacuum-impregnated with a specially developed wax. These units possess greater mechanical strength, provide better protection against humidity, a more direct and uniform electrical path, and can be located anywhere in the chassis regardless of proximity of other components.

Erie Insulated Ceramicons are made in nine temperature coefficients ranging from +100 parts per million per °C to -750 parts per million per °C, and in capacities up to 375 mmf in the latter temperature coefficient. Erie "Hi-K" Ceramicons are made in insulated styles up to 5,000 mmf. Where choice of capacitors lies within these ranges, the use of Insulated Ceramicons is advantageous.

For greater protection and better design, specify Erie Insulated Ceramicons when available capacities meet your requirements.

For complete information covering operating characteristics of Erie Insulated Ceramicons write for data sheet.

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



EASTERN PLANT NO. 1



EASTERN PLANT NO. 2



MIDWESTERN PLANT NO. 3



3 Plants ... 2 Flags ... **ONE PURPOSE**

To beat the band of Axis bandits, three Solar factories are now operating "round the clock". The men and women of Eastern Plants 1 and 2 were told "Well Done" by the Army and Navy; they proudly wear the Army-Navy "E".

The Midwestern Plant has just started production;

the men and women of this modern air-conditioned factory are ready to help you speed the day of Victory.

If your capacitor or filter problem is made ours, you can be certain of "Quality Above All".

Solar Manufacturing Corporation, General Offices: Bayonne, New Jersey.

Ⓢ 3761

Solar **SOLAR** — **CAPACITORS** —

CAPACITORS and RADIO NOISE SUPPRESSION FILTERS

www.americanradiohistory.com



JAMES

Crystals

KNIGHTS

CRYSTAL HEADQUARTERS

Behind the volume production of James Knights Crystals stands a background of specialized experience nearly as old as radio itself. The service of James Knights Crystals in thousands of vital battlefront positions is a tribute to the modern and carefully engineered facilities which produce them. If you have an essential Crystal problem, these dependable facilities are at your command.

.... Phone 65

The JAMES KNIGHTS Co.
SANDWICH, ILLINOIS



*Any Type,
Cut or
Frequency*

**PRECISION CUTTERS OF QUARTZ
FOR RADIO AND OPTICAL USES**

**AMERICAN MEN and AMERICAN SHIPS
are equal to any occasion...**



OFFICIAL U. S. NAVY PHOTO

*On United States
Naval Vessels*

AmerTran Transform-
ers, Reactors and
Rectifiers are used
in Radar, fire control,
searchlight control,
communications and
other applications.

IN THE beginning the enemy had a field day. But it's the end of a war that determines the victor.

Already, the United States Navy has proven that it is master of the best the Axis can produce. That goes for personnel, for ships and for equipment.

Take Radar, for example. Only a nation of the greatest inventiveness and highest technical development could

have produced the quality of Radar equipment that helped to smash the Jap at Midway, Coral Sea and elsewhere.

We contemplate the future of the war and of our Country with complete confidence. Our Armed Forces, assisted by American technical knowledge and industry, will win in the end.

AMERICAN
TRANSFORMER COMPANY
178 EMMET STREET, NEWARK, N. J.



PIONEER MANUFACTURER OF
TRANSFORMERS, REACTORS AND RECTIFIERS
FOR ELECTRONICS AND POWER TRANSMISSION

ELECTRONIC INDUSTRIES • July, 1943

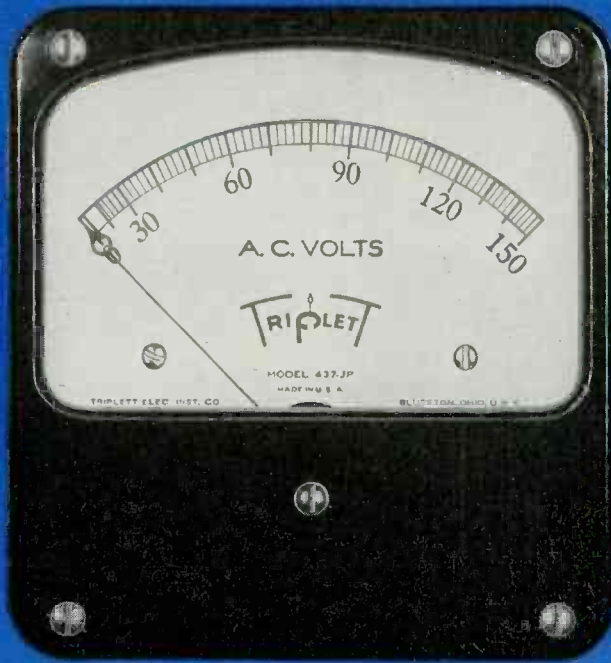
AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

TRIPLETT

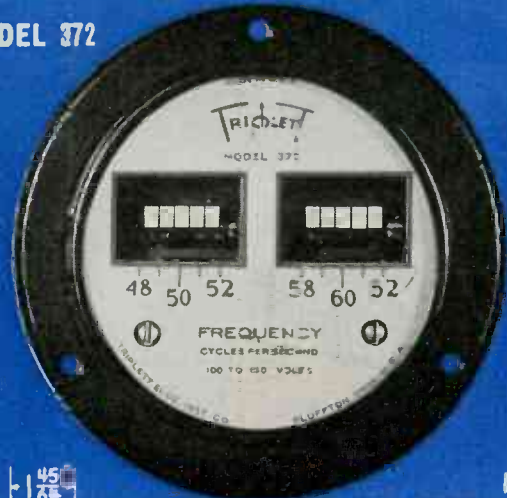
NEW *Combat Line* INSTRUMENTS

THESE PHOTOGRAPHIC REPRODUCTIONS ARE THREE-QUARTER SIZE

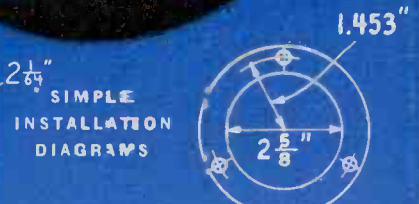


MODEL 437-JP

MODEL 372



Model 437 - J P

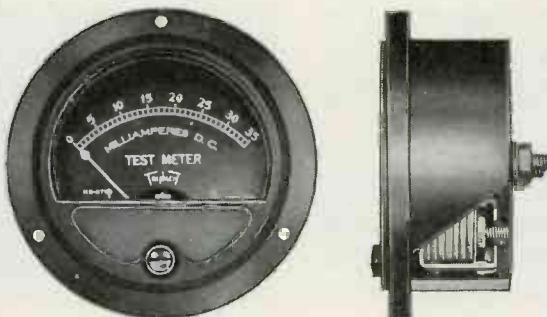


Model 372

SIMPLE
INSTALLATION
DIAGRAMS

Maximum Service in Minimum Space

TRIPLETT *Thin Line* INSTRUMENTS



Precision performance by new *thin* instrument with *standard* Triplet movement housed in either metal or molded case. No projecting base; wider shroud to strengthen face; simplified zero adjustment; balanced bridge support; metal bridges at both ends; doubly supported core. For "Precision in limited space" write for Triplet Thin Line Bulletin.

The Triplet Combat Line

New answers to specialized needs of War: Production speed-up and standardization; Performance under the stress and vibrations of combat service. Model 437 J P—A rectangular line of meters to meet dimensions shown (see diagram). Wide-open scale for maximum readability. Complete coverage AC-DC Voltmeters, Ammeters and Wattmeters. Magnetic or static shielding provided on order. Molded Plastic Case for maximum protection in high voltage circuits. Pivots, Jewels and other component parts designed to meet severe vibration requirements.

Model 372—Frequency Meter—"All-American make" Vibrating Reed Frequency Meter. Maximum readability by grouping of Reeds. Range-Frequency-Voltage to meet specific requirements. Protected against excessive panel vibration. In standard 3 inch mounting or on special order in any cataloged Triplet Case.

A WORD ABOUT DELIVERIES

Naturally deliveries are subject to necessary priority regulations. We urge prompt filing of orders for delivery as they may be consistent with America's War effort.

TRIPLETT ELECTRICAL INSTRUMENT CO.
BLUFFTON, OHIO



THE AMERICAN WAY IS FOR ALL TO SAY... "TAKE MORE THAN 10% EVERY PAYDAY"



The Army-Navy "E" Award
conferred upon the J. P. Seeburg
Corporation for outstanding production
of War Materials in each of
its Four Plants

*This honor is sincerely appreciated by each and every
one of us, and is accepted with sober consideration
of the greater responsibilities it demands.*

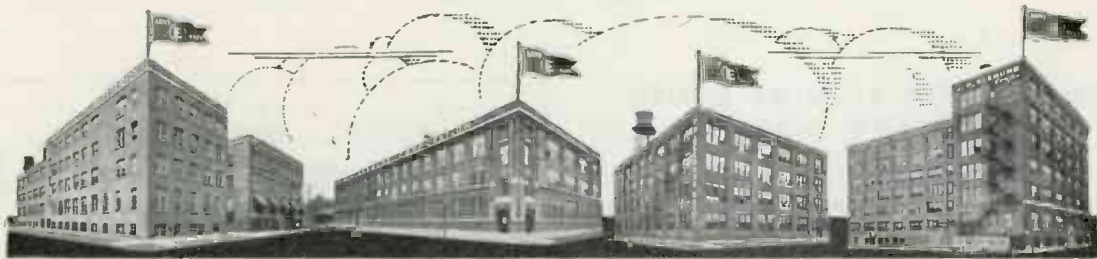
J. P. SEEBURG CORPORATION

J. Marshall Seeburg
PRESIDENT

Makers of Fine
Musical Instruments
Since 1902

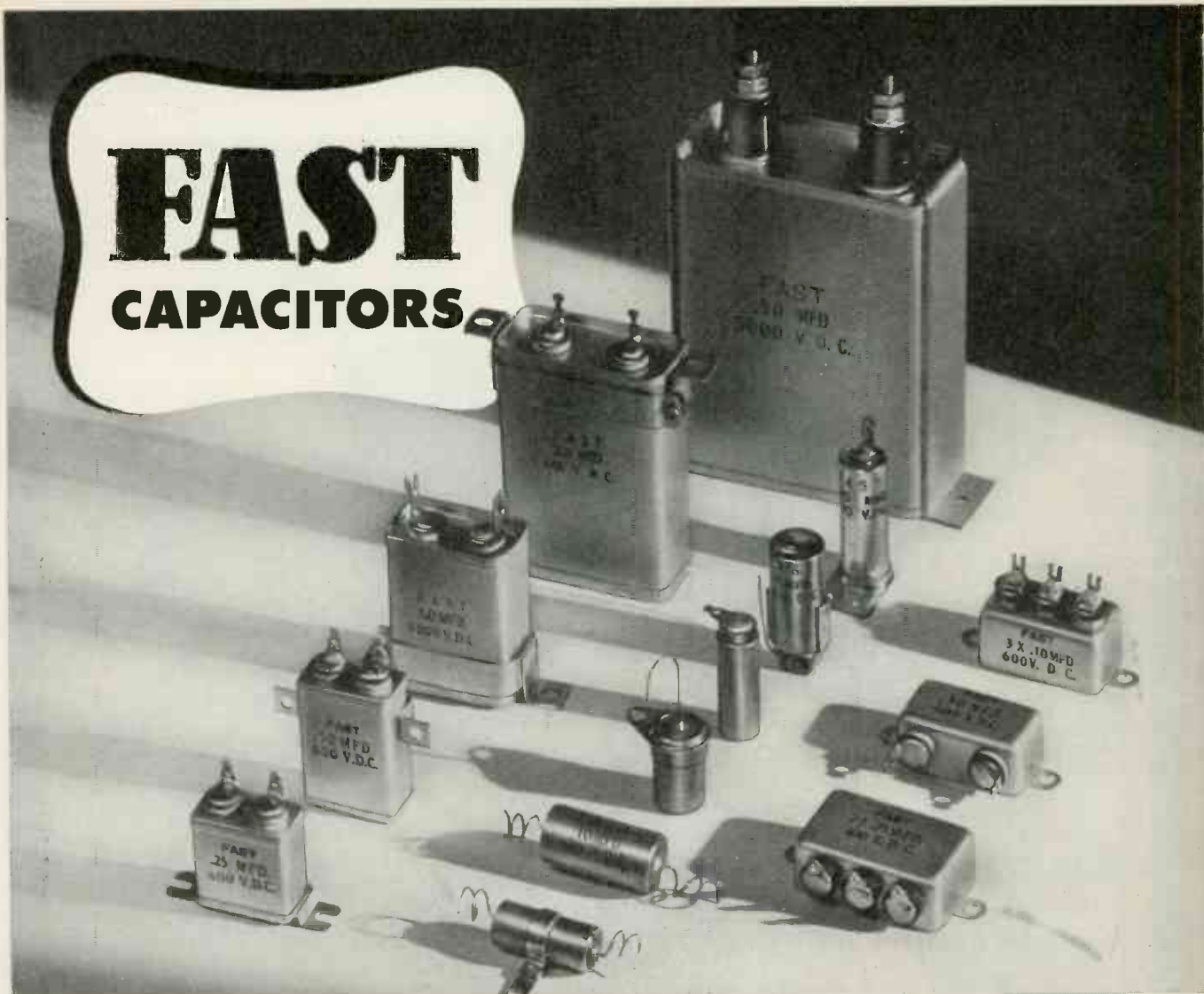
Seeburg

J. P. SEEBURG CORPORATION ★ CHICAGO, ILLINOIS

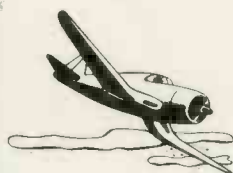


AIR CRAFT RADAR • AIR CRAFT CONTROLS • TANK COMMUNICATION EQUIPMENT • AVIATION TRAINING DEVICES • AIR CRAFT GUN TURRET EQUIPMENT • AIR CRAFT TRANSMITTER EQUIPMENT

FAST CAPACITORS



Known for the Service They Give!



Back of FAST capacitor service lies a quarter of a century of engineering skill and manufacturing technique. Back of FAST capacitor performance is intense scientific research in the chemistry of raw materials and in dielectrics. From such a background flows FAST quality, precision exactness, product uniformity

... so vital in every phase of the war.

And just as FAST engineers are today bending every effort for military victory... so, too, they will be ready to serve peacetime needs tomorrow... fortified with the *plus*-experience born of war. FAST engineering aid is at your service...when ever capacitor problems trouble you.

★ 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.

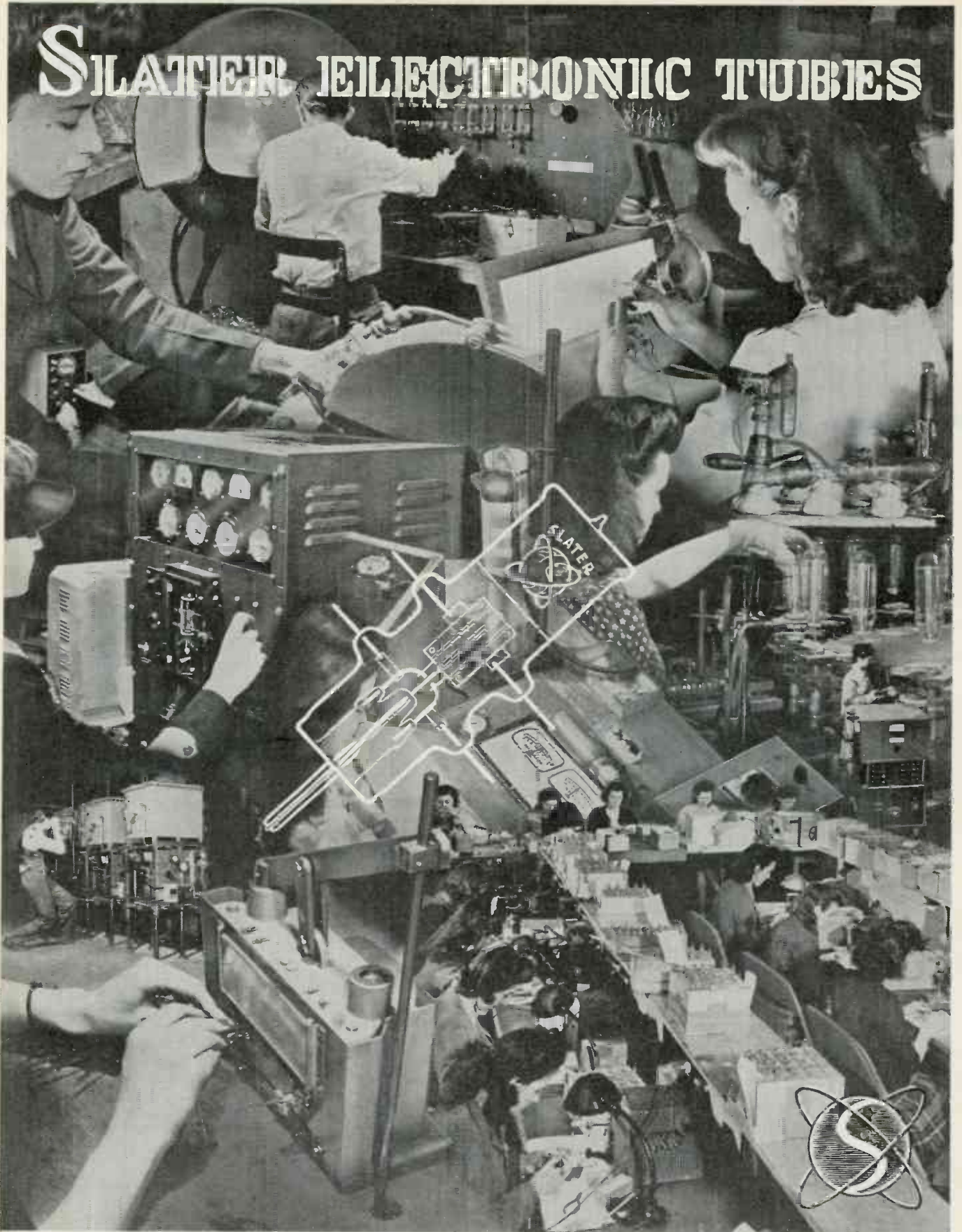
JOHN E. FAST & CO.

Capacitor Specialists for 23 Years

3129 North Crawford Avenue, Chicago

Canadian Representatives: Beupre Engineering Works Reg'd.
2101 Bennett Avenue, Montreal, for Power Factor Correction
J. R. Longstaffe, Ltd., 143 Berkeley Street, Toronto, for Special Applications

SLATER ELECTRONIC TROUBLES



WHERE SKILLED HANDS REFLECT THE HIGH STANDARDS OF EXCELLENCE OF SLATER PRODUCTS

SLATER ELECTRIC & MFG. CO. BROOKLYN, NEW YORK
MANUFACTURERS OF PRECISION ELECTRONIC TUBES AND INCANDESCENT STREET LIGHTING LAMPS

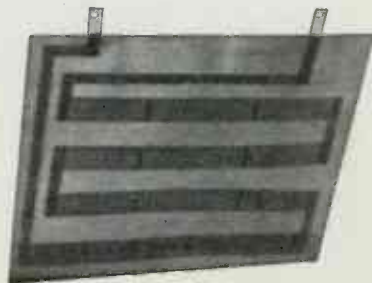
Here's design help on
HIGH ALTITUDE PROBLEMS



Proper functioning of sensitive radio parts in the rarified atmosphere and sub-zero temperatures encountered at high altitudes has been a troublesome problem. Westinghouse engineers have co-operated with many designers to work out a variety of solutions, of which the accompanying illustrations are typical examples.

Perhaps these are directly applicable to your problem; or it may be that yours is completely different. In either case, trained and experienced Westinghouse representatives are ready to help you; call them today. Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pennsylvania. J-94566

Tuffernell polymerizing potting compound. A new material that does not melt. Has negligible coefficient of expansion, maintains flexibility at -40°C and offers good moisture resisting and electrical characteristics.



Battery heater for installation between cells to maintain $65^{\circ}\text{--}70^{\circ}$ temperature, for maximum battery efficiency.



High altitude carbon brushes, eliminating excessive wear and providing dependable d-c power under severe high altitude conditions.



Solder seal bushings for transformers, condensers, vibrators, antennas.



Westinghouse

PLANTS IN 25 CITIES...OFFICES EVERYWHERE

Reliability ★ **BUILT IN** ★ for The Nerve Centers of Air Lines

The dependability of Wilcox equipment has been proved in use by leading air lines. Today, the entire output of Wilcox factories goes to military needs. Wilcox was chosen to help win the war by "building in" reliability for vital communications. When the war is over, Wilcox facilities will be ready to keep pace with a greater air-borne world.



Wilcox Installations. Photo, courtesy American Airlines

There **MUST** Be Dependable Communications

Communication Receivers
Aircraft Radio
Airline Radio Equipment
Transmitting Equipment



**WILCOX ELECTRIC
COMPANY**

Quality Manufacturing of Radio Equipment

14th & Chestnut

Kansas City, Missouri

Security posted



MANY TIMES every day "surprise attacks" occur along your power line. Some heavy user momentarily stops operation. A sudden over voltage slams like lightning into delicate machines, precision tools or precious vacuum tubes. You can't see these blitz attacks but you can't escape seeing the results—higher percentage of rejections, damage to sensitive instruments, premature failure of expensive electronic tubes.

Every unit, however small, is responsible for its own security. This cardinal rule of combat applies in production too. That is why, everywhere in industry, you will find SOLA CONSTANT VOLTAGE TRANSFORMERS on duty at important "out-guard" posts.

Sola "CVs" are especially designed to protect against surprise overload assaults. They will ab-

sorb voltage sags and surges as great as 30%—and still feed constant, rated voltage to your machines. Sturdy Sola sentinels ask no relief. Day and night, without care or supervision, they stick to their posts—instantaneous in action, without moving parts, self-protecting against short circuit.

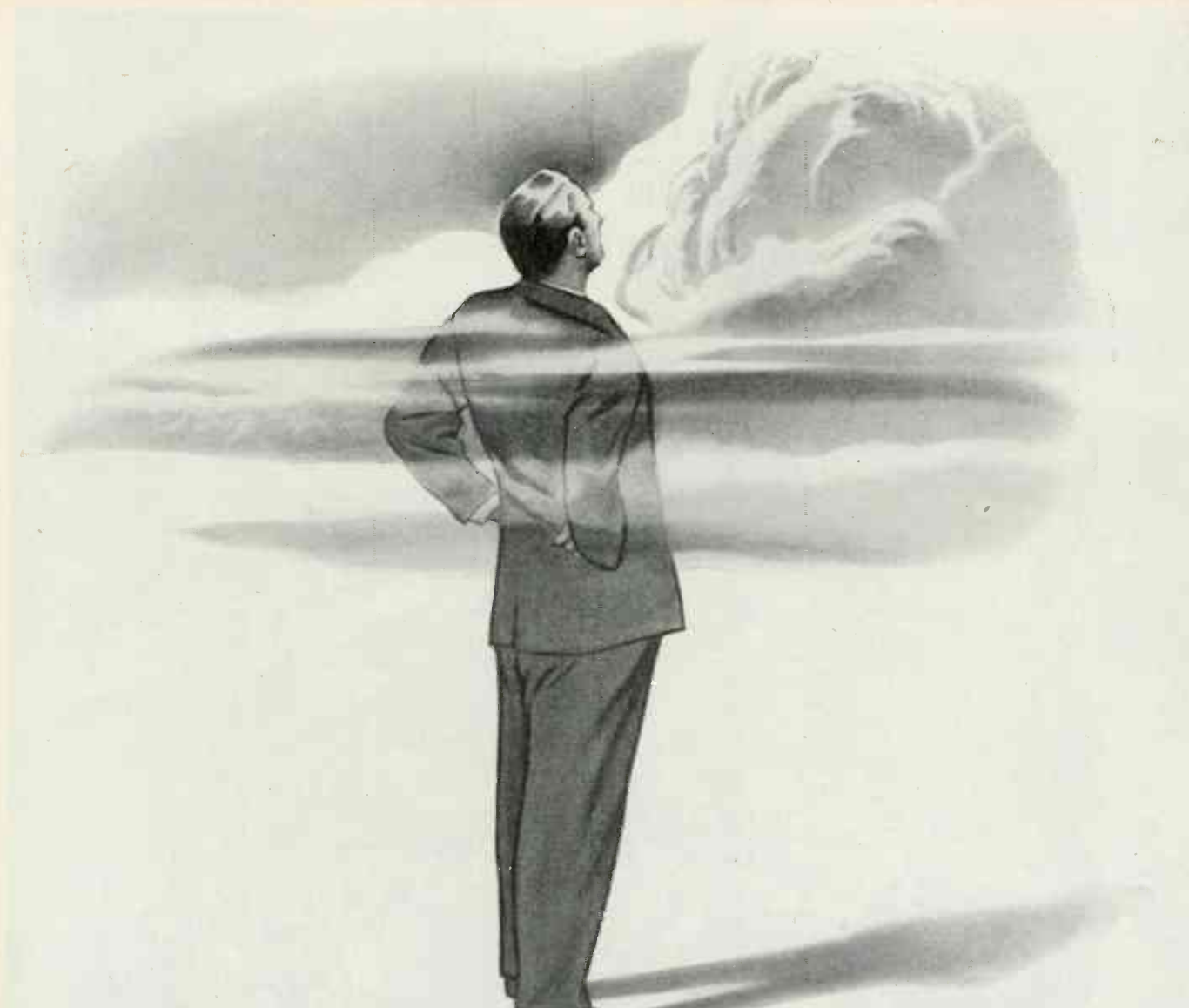
Many vital points in your production system are vulnerable to attack. Secure them with Sola "CVs". SOLA CONSTANT VOLTAGE TRANSFORMERS are built in standard units from 10VA to 15KVA capacity, or in special units to your specifications.

Note to Industrial Executives: *The problems solved by Sola "CV" transformers in other plants and products may have an exact counterpart in your own. Find out. Ask for bulletin 10CV-74.*

Constant Voltage Transformers

SOLA

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs • Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago, Ill.



BUT OUR FEET ARE ON THE GROUND

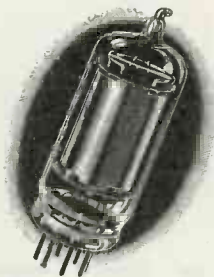
Here at Tung-Sol we are doing a lot of looking ahead to the wonderful new post-war world. We see new comforts and pleasures in the home . . . improved manufacturing methods in industry . . . great advancements in medicine and in communications . . . all brought about by the science of electronics.

But our feet are on the ground. We know that most of the future benefits to be derived from electronics will result from the improvement of devices and

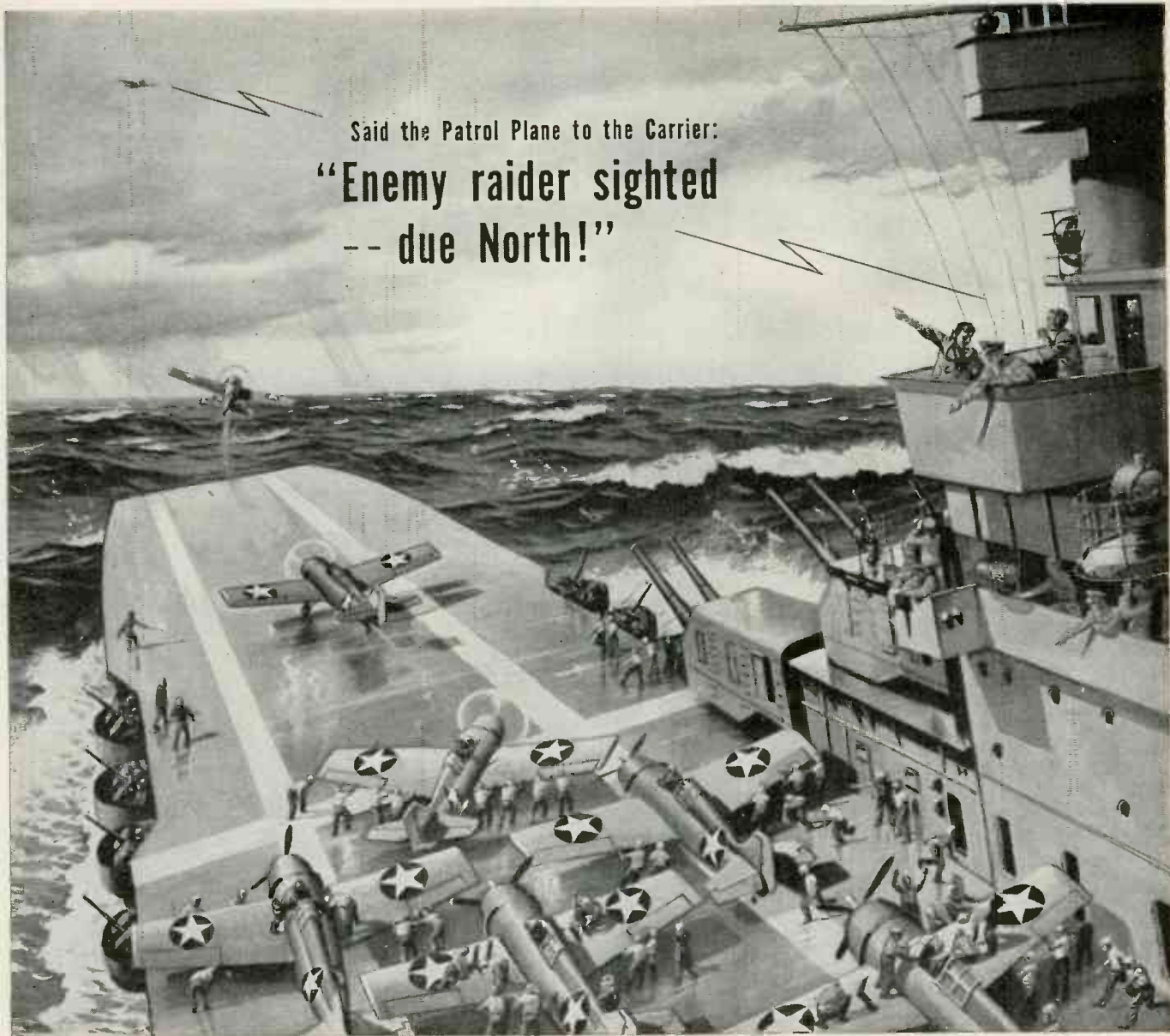
equipment already in existence, and we are doing some very realistic work and planning to bring about these changes.

When the war is won we will have ready a greater vastly improved line of Tung-Sol tubes for transmission, reception and amplification. Our staff of research engineers, with their knowledge of war-time advancements in electronics, will be available to help you make your post-war products better.

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 THERMAL SWITCHES



Said the Patrol Plane to the Carrier:
**“Enemy raider sighted
 -- due North!”**

They work together better . . .
 because they can talk together

The streaking
 Reconnaissance plane
 Can't wait
 Until its wheels touch
 The lifting flat top
 To tell its news . . .
 While still
 Only a growing shape
 Over the horizon
 This homing eagle
 Calls to the mother ship . . .
 Summons its brother warbirds
 To the kill . . .
 By radio.

In a matter of minutes
 The whole angry brood
 Will swarm down
 And polish off
 The fleeing cruiser that

Just a few seconds before
 Was a threat
 To our bridge of ships . . .

Seconds count
 In this thundering war
 Of time and teamwork . . .
 And seconds are saved
 By the radiotelephone.

Today, modern radio equipment
 Designed and manufactured
 By I.T.&T. associate companies
 Is helping Uncle Sam's fighting forces
 Work together
 On land, sea, and in the air . . .

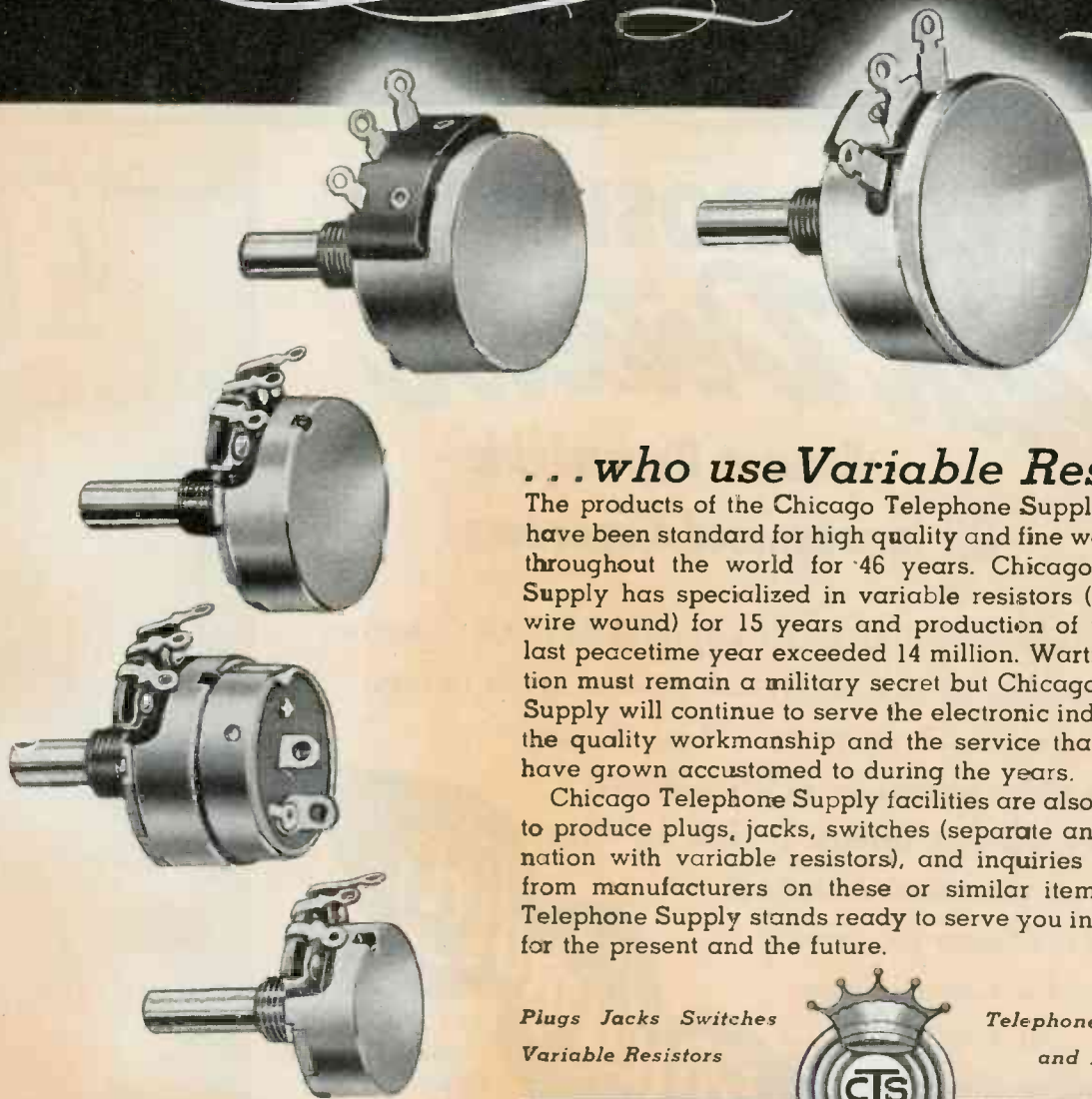
Tomorrow, the broad experience
 Of I.T.&T.
 In the field of communications
 Will help men build
 A better world.

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Television techniques have advanced a long way since modern electronic television was demonstrated in the then small Farnsworth laboratory 17 years ago. Farnsworth's original Dissector Tube, cathode ray tubes, circuits,

synchronizing devices — all the original equipment — have been perfected. *Electronic television* has grown up . . . at war's end, television is confidently expected to rapidly become a major influence in the world.

Ever since Farnsworth experiments created electronic television, our research has stressed both electronic tubes and circuits, for the correlated

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Our primary interest has always been television and allied electronic development. Farnsworth, pioneer of electronic television, continues in this field during wartime. Our current production is entirely military, of course. But after Victory, we'll be ready to help you with your television problems.

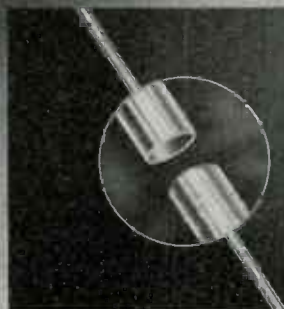
FARNSWORTH TELEVISION



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

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Precise instruments, vital to all Communications, must depend upon accurately made, positively balanced Pointer Tubing. Today Precision Tube Company supplies this high grade Aluminum Alloy Pointer Tubing to over 80% of the Instrument Manufacturers in this free Land. There must be a reason.



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ELECTRONICS

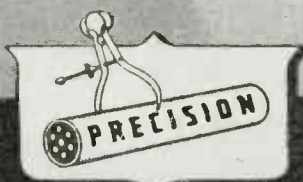
Metal Shielded Wire — insulated wires shielded with Seamless Aluminum or Copper Tubing — offers the only positive protection against Moisture, Electrical Interference and Mechanical damage. It is a **MUST** for dependable Electronic Equipment where failure cannot be tolerated. Made in a wide variety of sizes and combinations.

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We at Precision Tube Co. are specialists in spherical accuracy. Aluminum, brass, copper and nickel tubing manufactured to close tolerances. Metal Shielded Wire for electronic and Radar devices. Precision Tubing for electrical instruments of all types.

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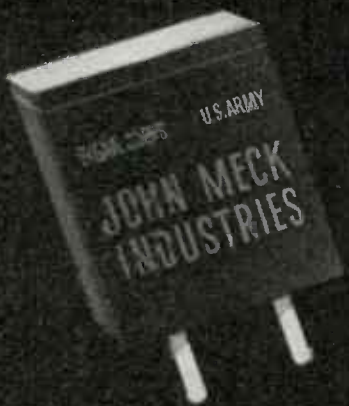


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is now available in quantity. These are in excess of the needs of war

ANY TYPE OF CUT OR FREQUENCY

is now possible thru the advances made in manufacturing techniques and facilities.

YOUR NEEDS—LARGE OR SMALL

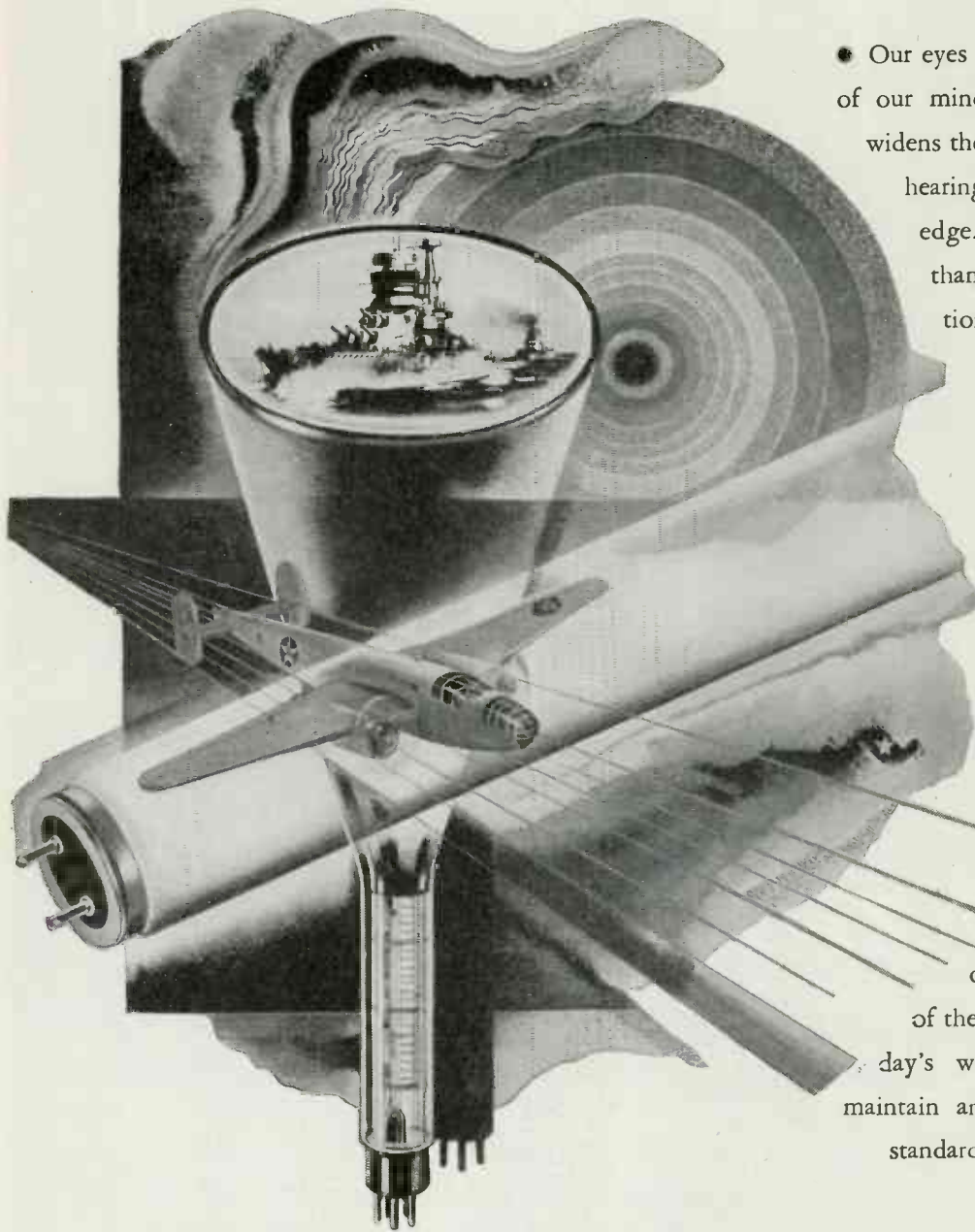
will get immediate action in our Special Crystal Service Division.

PHONE PLYMOUTH (INDIANA) 33

JOHN MECK INDUSTRIES
PLYMOUTH, INDIANA



To see and hear beyond the beyond

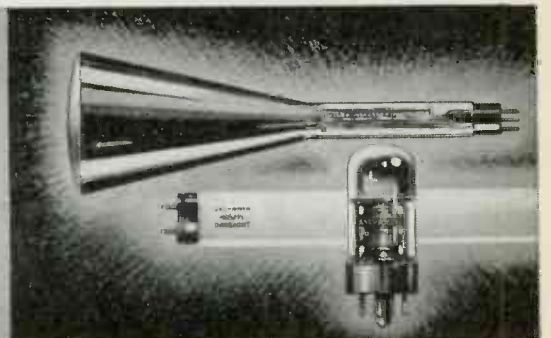


• Our eyes and ears are the advance guards of our mind's march forward. Whatever widens the horizons of human vision and hearing, reveals new vistas of knowledge. So our chosen work for more than forty years has been exploration of uncharted realms of sight and sound. Starting with the humble incandescent lamp, progressing to radio and electronic tubes, fluorescent lamps and equipment, we are today busy with ventures which are contributing vitally to the winning of the war. And important as these may be to Victory, their full flower will come as enduring boons to better living in the years beyond. How could anyone, glimpsing the rich promise of the future, be content to do each day's work with a firm resolve to maintain anything less than the highest standards known!

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

VITAL TO VICTORY is the ever-increasing number of electronic devices that miraculously bridge the gap between man and the machine tool in war industry. Electronic contributions to technology make inspection and processing more automatic and foolproof. From long experience, Sylvania has developed and applied electronic tubes to industrial as well as military uses.



Mica

TRANSMITTING CAPACITORS



OUR WAR EFFORT

From January 1941 to December 1942, Aerovox . . .

- Stepped up production output 500% for our Armed Forces.
- Increased production floor space 300%.
- Sought, hired, trained, and put to work additional workers—a 300% increase in productive personnel.
- Opened second plant in Taunton, bringing work to available workers there.
- And—doing more and more; growing week by week!

• Be it tiny "postage-stamp" mica capacitor or large stack-mounting unit—regardless, it's a precision product when it bears the Aerovox name.

Only the finest ruby mica is used. Each piece is *individually gauged and inspected*. Uniform thickness means meeting still closer capacitance tolerances. Also, sections are of exceptionally uniform capacitance, vitally essential for those high-voltage series-stack capacitors. Meanwhile, the selection of perfect mica sheets accounts for that extra-generous safety factor so characteristic of **ALL** Aerovox capacitors.

Our new Transmitting Capacitor Catalog lists the outstanding choice of types. • Write on your business stationery for your registered copy.



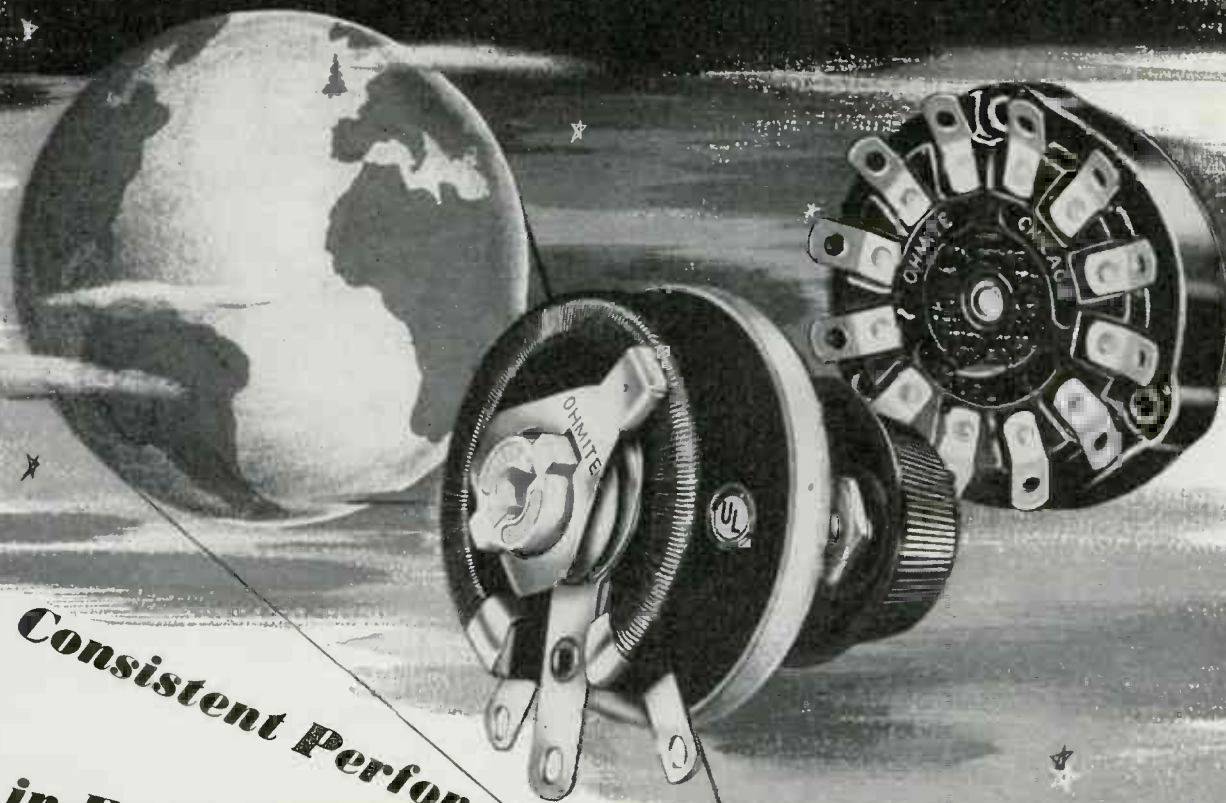
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Years of world-wide service in all types of applications, under all kinds of operating conditions, have proved the sterling qualities of Ohmite Products. During this time, we have helped pioneer many applications of resistance units in electronic and electrical devices. As a result, we have developed and produced the widest range of types and sizes in power rheostats, resistors, and tap switches to meet every need.

**Send for Catalog and
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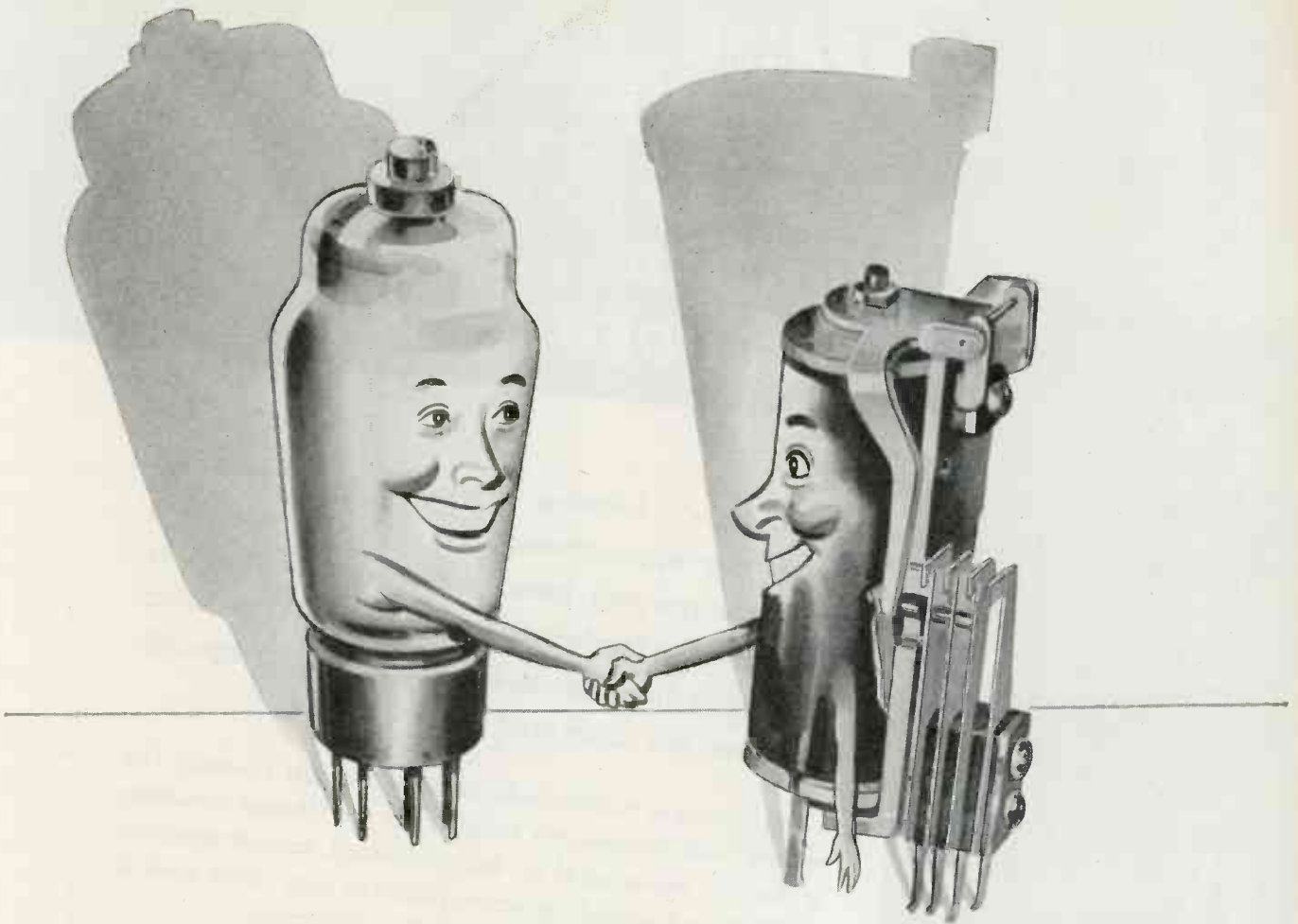
Write on company letterhead for helpful 96-page guide in the selection and application of rheostats, resistors, chokes, tap switches and attenuators.



Today, Ohmite Units serve in plant and laboratory—and on every battle front, from below the sea to the stratosphere, and from “down under” to the top of the world. Tomorrow, they will be ready and eager to meet new postwar requirements.

**OHMITE MANUFACTURING COMPANY
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LET'S POOL OUR KNOWLEDGE

WORKING with electronic engineers in scores of industries has taught us a lot about electronic science—what it is doing to increase the effectiveness of our tools of war—how it is speeding up war production—about the miracles it promises for our postwar world.

We have learned, for example, how much this “new-old” science depends on the right electrical controls—the important part that relays, stepping switches, solenoids and other control devices play in putting electrons to work.

And that's *our* strong point. We know electrical control because that has been our sole business for over fifty years. So why not pool our resources? Let's apply *our* experience in electrical control to *your* problems in making electronic developments do a better job at lower cost.

First step in this direction is to make sure you have the Automatic Electric catalog of control apparatus. Then, if you need help on any specific

electronic problem, call in our field engineer. Behind him are Automatic Electric's fifty years of experience in control engineering. His recommendations may save you time and money.



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MUSCLES FOR THE MIRACLES OF ELECTRONICS



DRAWN
DIE CAST
FORMED
MOLDED
EXTRUDED



No one type of housing structure is suitable for all transformer applications. UTC units are housed in structures ranging from heavy sand castings to bakelite cases made in 30 cavity molds. A few structures, with their relative advantages for specific functions, are illustrated below.

This unit is a tunable inductor in a die cast housing. The casting itself incorporates facilities for the internal mounting of the unit, mounting of the terminal board, tapped mounting facilities, and tapped set screw hole. The only screw used in this entire item is that for setting the inductance.

Drawn round cans are ideal for many applications. The type illustrated effects small base dimensions with screw mounting. The cylindrical shape lends itself ideally to hermetic sealed units.

Drawn octagonal cans are simple in construction, and effect a minimum of volume. The two hole flange type mounting permits the construction of a unit poured with compound, having the same overall and mounting dimensions as an equivalent open channel mounting unit. Four hole mounting octagonal cases are used where additional mounting strength is required.

The extruded can used on the now famous UTC Ouncer unit affords submersion test construction a minimum of weight, and sufficient metal thickness in the base opposite the terminal board for tapped mounting holes. Pioneered by UTC, the Ouncer unit is probably the most popular item in aircraft communication equipment.

May we design a unit to your war application?



UNITED TRANSFORMER CO.

150 VARICK STREET

NEW YORK N. Y.

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ELECTRONIC INDUSTRIES

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

Postwar Radio Re-Allocation

Allocation of the radio spectrum on an equitable basis with due regard to the importance of services to be rendered—existing and future—is still, of course, a matter of conjecture and it may be of strife, before everybody concerned is satisfied. In the interim, however, there is one point upon which there can be no question, and inadvertence in the omission of certain frequencies from the chart of proposed allocations previously printed on these pages serves to emphasize that point. This is the position of unquestioned value which has always been enjoyed by the extensive amateur fraternity and the vital necessity of allotting that hard-working group a very definite place in the picture. As it stands now, amateur allocations occupy test slices of the spectrum an octave apart, in harmonic relationship, in nine bands. And there is good reason why those allocations should be continued in any re-shuffling that may result from other necessity.

Radio's Debt to the Amateur

Time was when everything lower than 200 meters was amateur property, discarded by others as worthless but nevertheless subsequently discovered by the amateurs themselves to be the most fertile field for development in the entire art.

Never forget that it was the amateurs who pioneered that no-man's land and led the way to making known its usefulness for a host of services then scarcely

thought of. That our 50,000 amateurs will continue the work they have so ably carried on if given a chance, is a foregone conclusion. And it is equally as sure that they will go on turning up applications of great value.

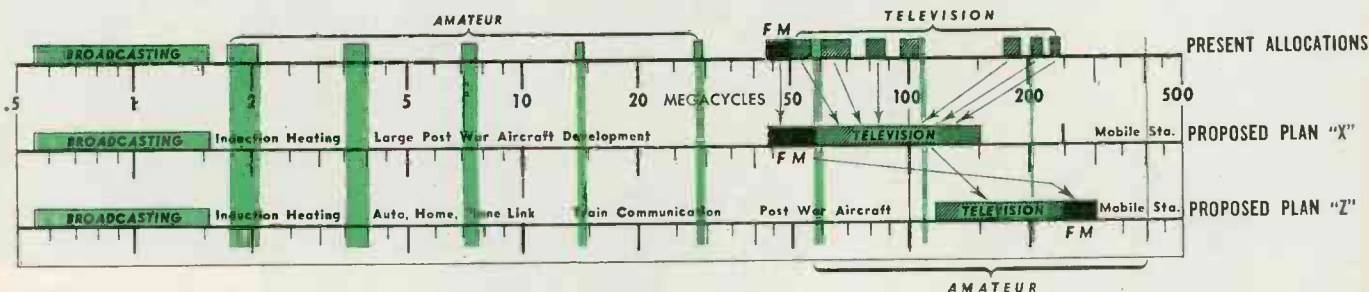
Amateurs want, and on the basis of the record of their achievements should have, a substantial continuance of the allocations they have so well used. They have earned the right to use them, as any superficial survey of their present war services will indicate. The industry and the art have a definite need for the mass training ground represented by amateur activity.

Government-Owned Equipment?

Many varied postwar blueprints and predictions are now being unfolded to the public. Most of these place their faith in continued operation of the free business enterprise system in the peacetime period, as well as the desirability of maintaining a high level of employment. And all of these plans lay emphasis on the necessity for increased cooperation between business and government, and between all the segments of industry, agriculture and labor.

A big domestic issue after the war will be what to do with our vast government-owned manufacturing facilities. Up to the present time, the Defense Plant Corporation has built and equipped 1479 plants and other facilities, costing approximately \$7,000,000,000. This includes 54 plants for radios and radio equipment and an expenditure of \$60,000,000 for radio equipment and scientific instruments alone.

HAVE YOU DRAWN UP YOUR PLAN FOR POSTWAR RADIO RE-ALLOCATION?



Extensive changes in the radio spectrum seem inevitable for the postwar period, to provide for new discoveries, new services. Meanwhile, radio, television and apparatus design will all be held up until the new allocations are fixed. Sketched above are a couple of postwar re-allocations which are now being discussed by radio men. (Naturally for lack of space it has been necessary to omit showing many important services, such as maritime, aeronautical, beacons,

direction-finding, mobile, fixed, general experimental, and others. For these, the reader is referred to the complete spectrum issued as a supplement to our January issue.)

What do you think of the postwar proposals above shown in the sketches? Or how would you assign channels for fullest usefulness of broadcasting (AM and FM), television, and other present services, as well as for taking care of the many new services that will have to be provided for?



Stretching back to mid-September, 1922, when two research scientists, Dr. A. Hoyt Taylor and Leo C. Young, first observed the reflection of radio signals from steel buildings and metal objects, more than 2000 scientists,

← **DR. A. HOYT TAYLOR**, Head Physicist, Superintendent Radio Division, Naval Research Laboratories
LEO C. YOUNG, Assistant Superintendent for Research.
 ↓ Naval Research Laboratories



Some of **THE MEN WHO**



▲ **REAR ADMIRAL HAROLD H. BOWEN**, United States Navy

▲ **R. C. NEWHOUSE** and **LLOYD ESPENSCHIED**, Bell Telephone Laboratories

← **JOHN H. DELLINGER**, Chief, Radio Section, National Bureau of Standards

engineers and physicists have steadfastly worked toward solutions of problems that have made Radar possible. Of them these men are credited with having done the pioneer work

L. A. HYLAND, Executive Engineer, Bendix Aviation Corp. →

DR. ROBERT M. PAGE, Physicist, Naval Research Laboratories ↓



DEVELOPED RADAR



← RUSSELL H. VARIAN, SIGURD VARIAN and DR. W. H. EANSEN, Research Engineers Sperry Gyroscope Co.

← DR. IRVING WOLFF, Physicist, RCA-Victor Division, RCA

(Editor's Note—As we go to press, the Signal Corps has not been able to supply portraits of its men who contributed technically

Suppressing 10,000 Watts to 10 Watts Over 200 Degrees

by JOHN H. HENNINGER

Chief Engineer, WIBG, Philadelphia

Predictions and performance made to match with very close accuracy in radiation system using five towers

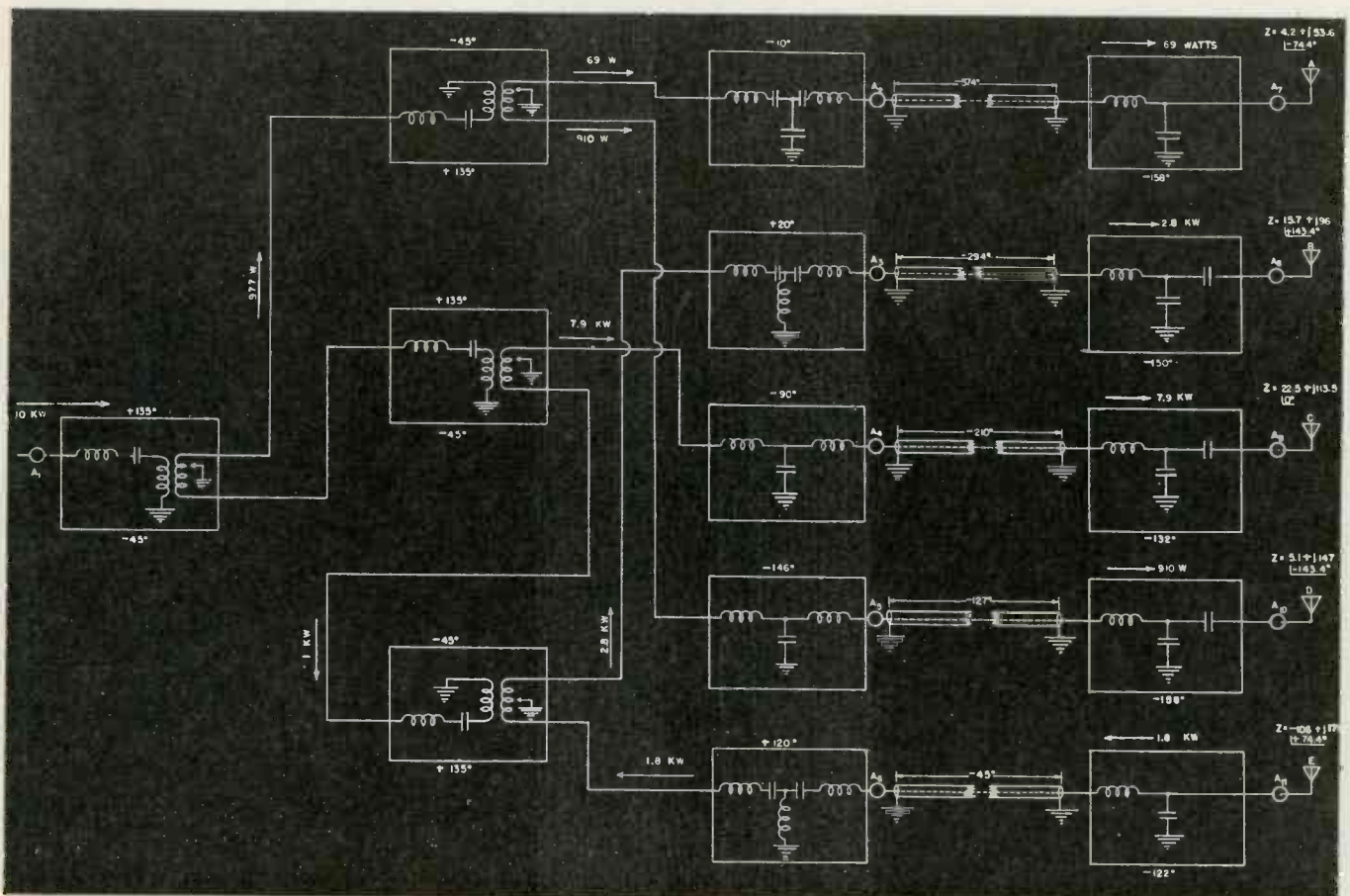
Setting what is believed to be a new mark in antenna directivity and in the accuracy with which performance can be made to match predictions, WIBG, Philadelphia, is now using a five tower radiation system with which the greatest power radiated in any direction over a semicircle where suppression is greatest, is about one ten thousandth of the power radiated in the direction of maximum signal. In other words, 10,000 watts is radiated where it is wanted, with suppression down to less than 10 watts over an arc of more than 200 degrees.

The story of WIBG going 10,000 watts with full-time operation dates back to July 5, 1941, when permission was granted by the Federal Communications Commission. WIBG has always operated as a dawn-to-dusk 1000-watt station. The Havana Treaty opened up the 990 kc channel in the United States with the proviso that the entire Canadian border be protected to 25 microvolts per meter 10 per cent of the time at any point inside Canada. This involved a lot of consideration on the design of a proper directional antenna to give this

amount of suppression. The nearest Canadian border point is only 275 miles from our location. Besides protecting the Canadian border, it was necessary to protect WNOX in Knoxville, Tenn., as well as a station in Cuba. All these limitations made it necessary to have an antenna with a great amount of suppression over a very wide angle. Raymond M. Wilmotte of Washington, D. C., consulting engineer, was asked to design this antenna.

Due to the unusual design, a plot of ground had to be obtained 600 ft. wide and 1500 ft. long in a north-

METHOD OF OBTAINING NECESSARY PHASE SHIFTS and power relation in the five radiators that go to make up the complete WIBG radiation system



west position, and also in the north-western part of Philadelphia to give the proper angle of suppression with the maximum signal in the Philadelphia area. After about four months of searching a 36-acre plot of ground was purchased just outside of Philadelphia, and on it was erected a five-element array and ground system plus an up-to-date transmitter building.

The transmitter site and antenna design were submitted to the FCC and approved, but at about this time the priorities problem had arrived, and after a year of construction work WIBG finally went on the air full time with its new 10,000 watt transmitter on May 18, 1943.

The antenna system consists of five 250 ft. uniform section guyed

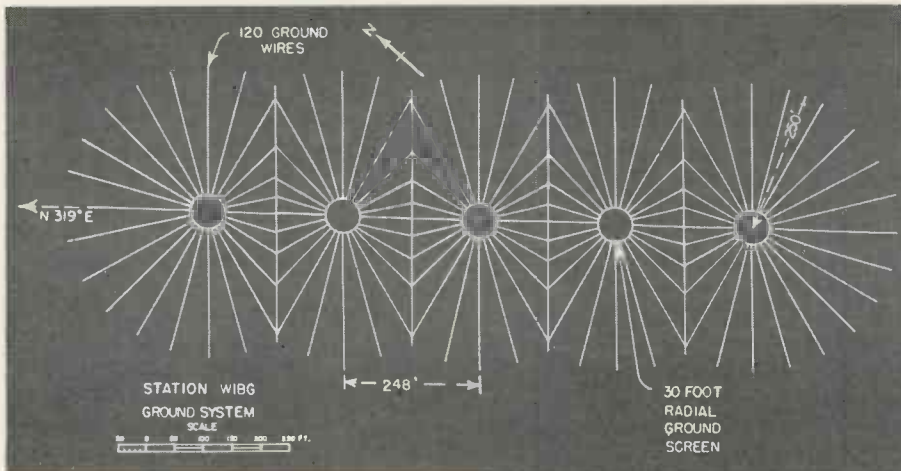
the current in the radiators, and five phase shifters, one of which is fixed for the central tower and four variable for the other towers.

Checking phase relation

A sampling loop is provided at the base of each tower which connects with a 1/4 in. coaxial transmission line to transmit a small amount of power back to a Western Electric 2A phase monitor in the transmitter building. This arrangement permits a check on antenna current-ratios as well as the phase relation between each of the radiators. The transmitter and all the branching and phasing equipment were assembled on the job due to the shortage of help that existed in radio factories at that time.

On January 1, 1943, the equipment installation was completed and the Western Electric 10,000 watt transmitter was tuned into a dummy antenna, and the problem of tuning the antenna array was undertaken next. Mr. Wilmotte sent C. X. Castle, one of his staff engineers, to direct the work. Mr. Castle and myself began the tuning on Jan. 16, 1943, and completed the antenna May 15, 1943.

Five sets of impedance measurements were first made at each tower. Starting with tower (A) the impedance was measured with towers (B) (C) (D) (E) floating. Another measurement was made with (B) series tuned to ground, and (C) (D) (E) floating. The next measurement was with (C) series tuned



WIBG ground system and the five vertical radiators

radiators and spaced 90 degrees (248 ft.) apart in a straight line. Under the base of each radiator is a mesh screen of copperweld wire in a 30 ft. radius bordered by a 20 gauge copper strip four inches wide. To the bordering strip are fastened 120 No. 10 bare copper radial wires extending from the base pier for a distance of 250 ft., equally spaced and buried six inches.

The radiators are coupled to the transmitter through coaxial transmission lines and Western Electric 101A coupling units one at the base of each tower; 3600 ft. of 1 1/2-in. coaxial transmission line were used in the installation, mounted on wooden rollers so that they may move freely during expansion and contraction. They have been equipped with expansion joints every 250 ft. and are under 15 lbs. pressure at all times.

The branching and phasing equipment, built by the Western Electric Co., consists of four current-ratio networks that control



to ground and (B) (D) (E) floating. This procedure was followed with each element making a total of 25 measurements at the base of each radiator. With these measurements the mutual impedance of each radiator was calculated. On calculating the impedances of the radiators we found that tower (E) had a negative resistance and instead of taking power from the transmitter in the usual way was going to feed power back to the transmitter.

Adjusting current ratio

The next step was to consider the array as four separate antenna arrays. The center tower (C) is the radiating tower in the final antenna so we paired them off into (A) and (C), (B) and (C), (C) and (D), (C) and (E). The spacing between (A) and (C) is 180 degrees, (B) and (C) 90 degrees, (C) and (D) 90 degrees, (C) and (E) 180 degrees. This gave two antennas with 90 degree spacing, and two antennas with 180 degree spacing. Power was then fed into one of the four pairs of towers and we adjusted the phase and current ratio in this pair until we had the nulls in the proper directions where suppression was needed in the final pattern. When the nulls were obtained, the phase reading, and current ratio readings on the phase monitor were recorded.

This procedure was carried out for each of the four pairs of tow-

ers. When all phases and current ratios for all towers were obtained, power was fed to all five towers, at the same time adjusting them for phase and current previously obtained. But again the problem of the (E) tower which had negative resistance came up, as it was bringing power back to the transmitter. In order to get a check on the pattern two 500 watt electric light bulbs were connected between the input side of the (E) phasing network and ground and dissipated the power coming back in this manner. The phasing network was of course disconnected from the current transformer which feeds both (B) (E) towers. We could control the phase of (E) tower but had to control the current in the manner shown.

Diverting power

Adjustments were made to the array until the nulls appeared in the proper places although not suppressed as much as required. We then returned to (E) tower and after several nights of work it was found possible to divert the power that was coming back to the transmitter into the array through tower (B). This was possible because (B) and (E) are connected through the same current-ratio transformer. We now had control of all currents and phases in towers (A) (B) (D) (E), tower (C) being the reference tower. Thereupon the phase and current-

ratios were set so that the nulls were in their correct places and very sharp.

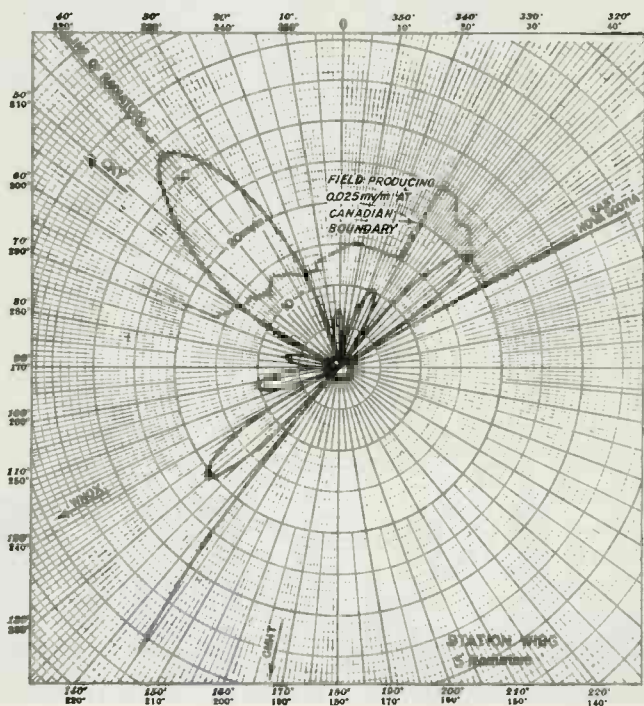
Checking effective field

To determine the effective field in all directions the ground conductivity was next determined. Obtaining permission from the FCC to operate with 2.5 kw on the (C) tower alone, non-directional, with all other towers floating, we took approximately 25 measurements on each of 11 radials spaced around the site in the following manner: one in the direction of maximum signal and 10 evenly spaced around the 200 degrees where maximum suppression was required. Measurements at these same points were then repeated when WIBG went on the air, daytime, with 10,000 watts directional. With these measurements and the ones made on the non-directional operation, the ground conductivity for each of the radials was computed, from which the effective field at one mile on each of the radials was determined.

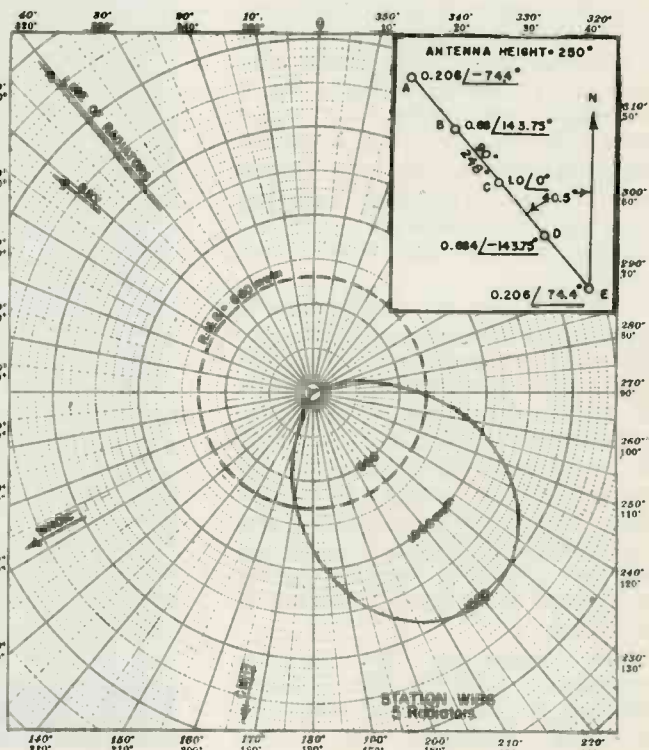
As a result WIBG has suppressed 10 kilowatts of power down to less than 10 watts over an angle of more than 200 degrees. In parts of that angle less than 3 watts of power is being radiated, and over an angle of 180 degrees there is no direction in which a power in excess of 6 watts is being radiated. In the direction of maximum signal, which

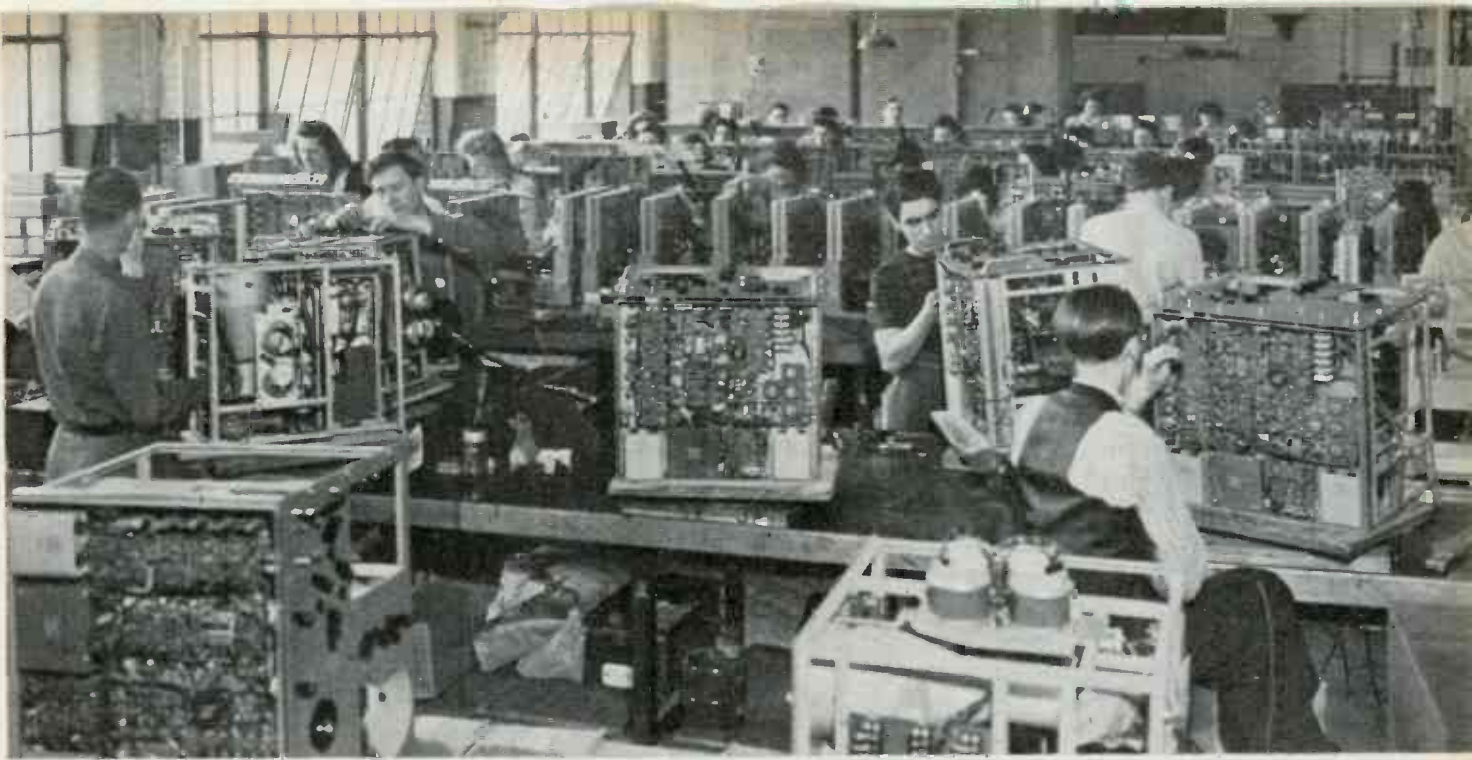
(Continued on page 182)

AN ENLARGED VIEW of central circle of curve at right is necessary to show extremely high attenuation toward Canada. A maximum of 37 mv/meter appears along the line of the radiators



PATTERN of the radiator quintette at WIBG



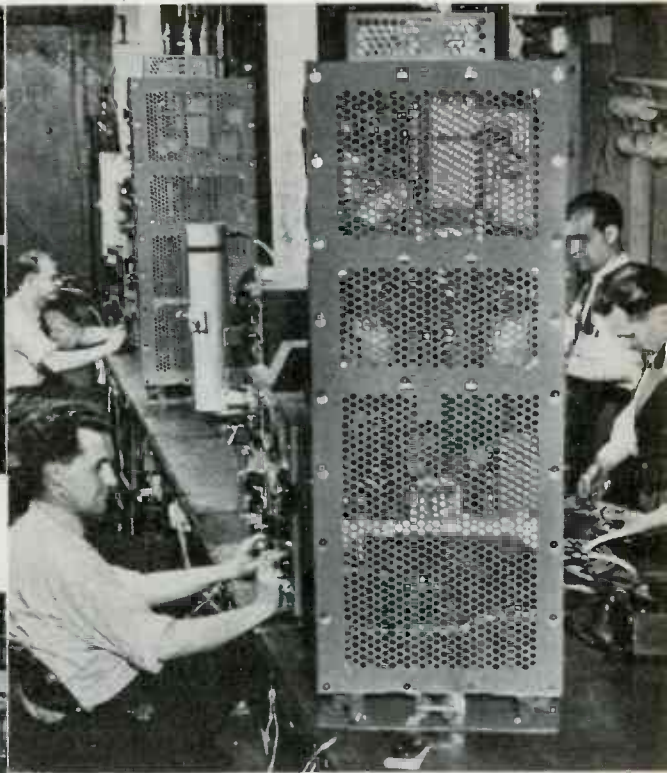


THESE PHOTOGRAPHS, first to be released for publication, show actual production of Radar equipment for the U. S. Navy. This view, taken in one of the factories operated in New England by the General Electric Co. shows one phase of manufacturing

RADARS in PRODUCTION



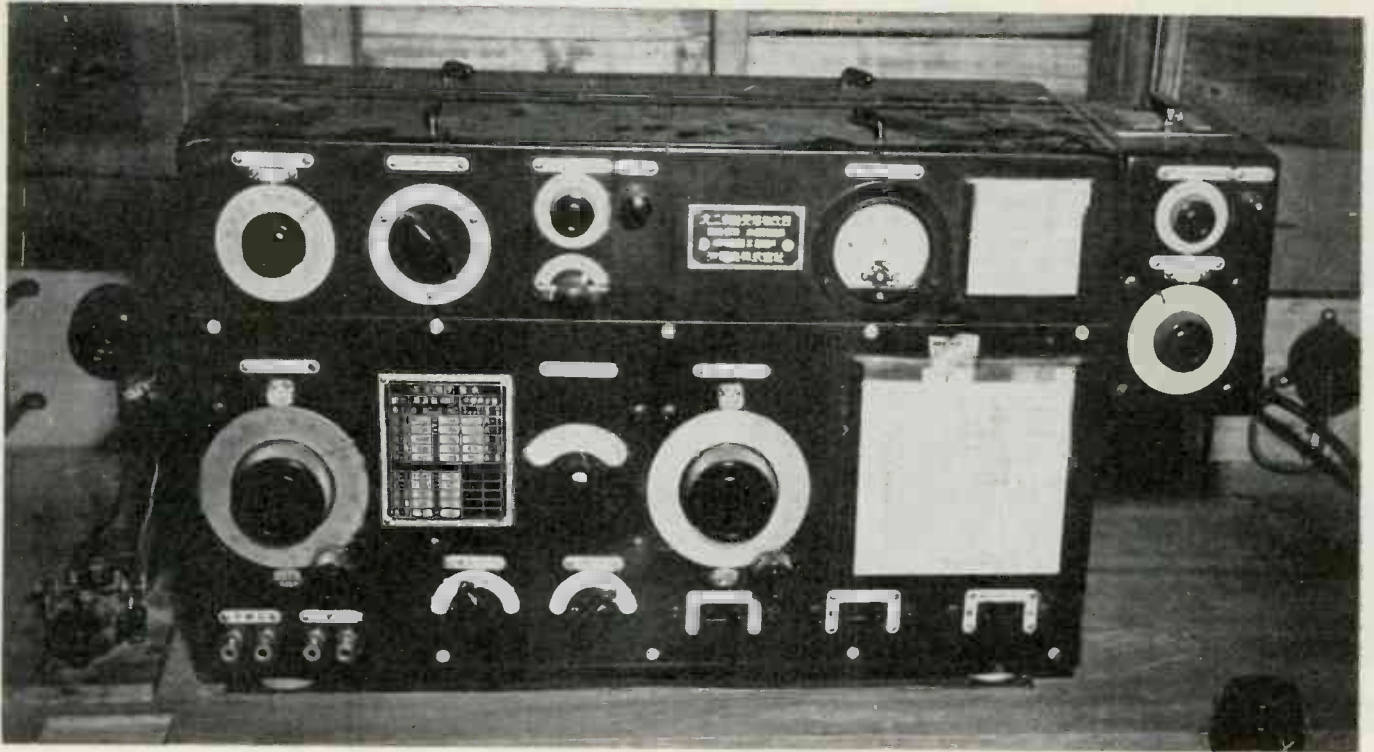
▲ LOOKING DOWN the length of one of the long production lines where part of the construction work is carried on



▲ PART OF the testing laboratory where Radar transmitters are tested prior to shipment to the Navy

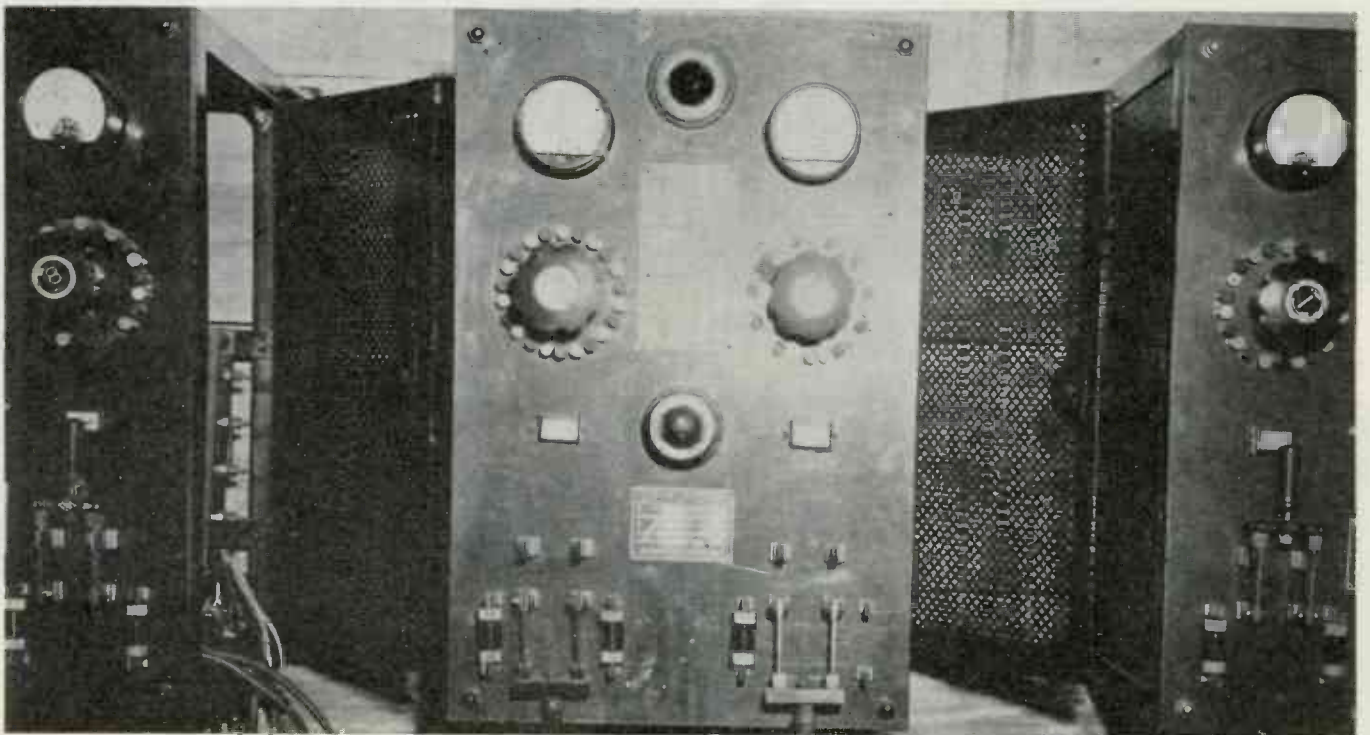


← ASSEMBLING and wiring apparatus for the Army at Specialty Products Div. of Western Electric

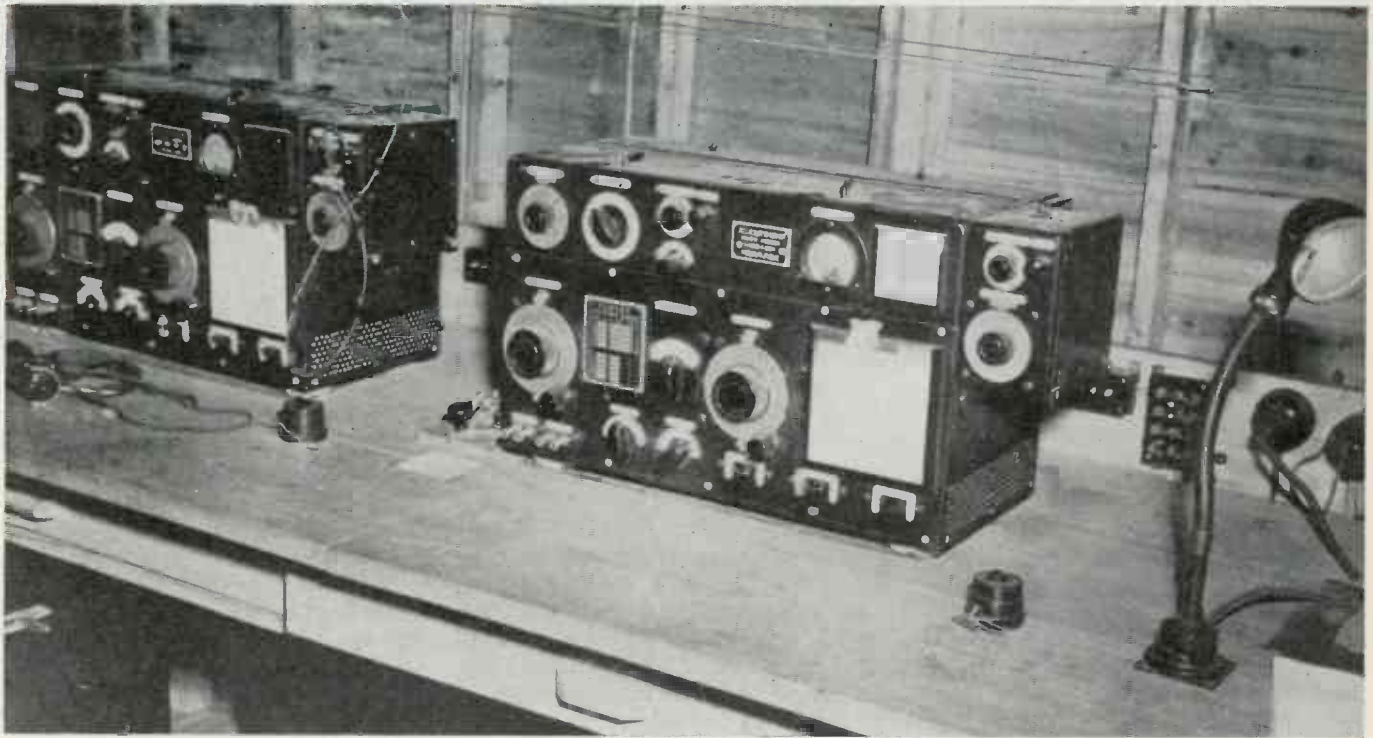


JAPANESE COMBINATION RECEIVER-TRANSMITTER, captured on Guadalcanal, has continuous frequency range from 20 to 20,000 kc. It was abandoned by the enemy in perfect operating condition during the early stages of the fighting

CAPTURED JAPANESE



TRANSLATION OF THE NAMEPLATES on this power panel identifies it as a Japanese version of Tungar battery charging equipment. It was abandoned after the blitz on Gavatu in the Solomons and like much other equipment was undamaged



TYPICAL OPERATING POSITION, shown in this view, includes two complete stations. According to the nameplates the equipment was manufactured in Tokyo by Oki Denki Kabushiki Kaisha (Oki Electric Co.) in January 1942, and is model 92

RADIO EQUIPMENT



GENERAL VIEW OF A SOLOMON ISLANDS Japanese radio station shows the battery charging panel as well as much more radio apparatus, now doing duty in the original location for American Army forces occupying this hot spot in the Pacific area

ELECTRONIC AIDS in

by R. R. BATCHER

Some of the earliest recollections of childhood are of the simple diagnostic methods used by the doctor: Counting the pulse, taking the temperature, listening to chest sounds while saying a-a-ah, and examining the tongue. Now all of these simple checks, and most of the more elaborate diagnostic tests are receiving engineering attention, with the exacting influence of scientific measurements.

It is manifestly impossible to review all the practical applications to medical and biological arts of such a versatile tool as the thermionic tube, when all its numerous uses as an amplifier, oscillator, or in its role as an oscillograph, microscope, etc., are considered. It is the purpose of this review to list some of the work that has been tackled, with notes on the results that have been discovered and on problems still to be solved. It is not to be inferred that the doctor of the future must be an electrical engineer with a sideline of medicine, but there is certainly a role for these instruments in medical research, and certain types are finding general use in the hands of specialists and some general practitioners.

The use of electricity in medicine has gotten off to a shady start by the many electrical cure-alls and magic rays that have been discredited in the past.* The medical use of terms for scientific appliances that are at variance with the customary definitions of the engineer seems to cast doubt in his mind as to the validity of the operating principle of the device. On the other hand, it seems that the engineer's use of the term "direct currents" for "galvanic" currents, and the term "alternating" currents when "faradic" currents, or possibly "sinusoidal galvanic" currents are meant, are just as confusing to the medical user. Many such terminology differences can be cited but no suggestions are to be given here as to what anybody can do about it.

Radiation therapy

There are numerous methods of utilizing electronic devices, each based on known physiological phenomena: (1) Changes in the flesh-resistance, (2) measurement and study of electrical potentials generated by muscular and organic actions, (3) the changes in organic functions caused by electrical shocks, (4) the effects of heat generated by dielectric and eddy-current losses, (5) study of rhythmic functions of certain organs and possible disturbances, (6) determination of the effectiveness of particular sensations, as aural, optical, taste, etc., (7) cauterization by electrical currents, and numerous other physiological conditions which are either effected or measured by electronic equipment.

The matters of X-ray therapy, radium therapy, and the use of artificial radio-active neutrons open up far-reaching fields for investiga-

tion. One line of research uses simulated radium obtained by the activation of a simple salt such as a phosphorous compound with radiation produced by the "cyclotron." The method permits the speed of movement of the salt in the blood stream to be measured with ionization gages. The cyclotron is an inspiring machine in which elements are actually transmuted. The injection of radioactive salts directly into the blood stream has considerable therapeutic value, possibly even greater than that of natural radium. The possibilities in this field are still to be discovered since science is just at the threshold on the therapy of strong radioactive substances. The value of any new process in any field is determined by measurements and in these studies electron circuits provide the most useful gage of intensities, duration and effects of treatment.

However, the electronic engineer is mainly interested in the problems that use tubes with which he is familiar, and the rest of this article will deal with these phases, starting with one of the simplest.

While the early system of pulse counting, using a watch, gives important information, still it is found that a knowledge of the steadiness of the pulse rate gives other clues. A cardiometer gives a record of the pulse rate on a tape, which permits accurate analysis of regularity. One attack has been toward an indicating cardiometer

*It is not the intention of the writer to enter into the medical aspects of this equipment, or to make suggestions as to what disorders are being treated with any device, or to compare the merits of various systems. All the methods mentioned, however, are based on scientific facts proven by reputable medical authorities. A description of the "come-ons" fostered by pseudo-medical organizations with a fantastic agglomeration of radio parts going under elaborate names, would fill a book. The systems of connections and parts used in the majority of these devices do not fool anyone who is acquainted with radio however.

ELECTROMYOGRAPH employing a cathode ray tube and recording camera. Electro Medical Lab., Holliston, N. Y.



BIOLOGICAL Sciences

A survey of the most outstanding applications of electronic devices to the fields of medicinal therapy and research

where the pulse rate is indicated on a meter scale, but as yet no satisfactory solution of all the difficulties of this plan has been reported.

Pulse rate measurements do not give the whole story, however, since the character of the heart beat gives much information on cardiac disorders, so that a stethoscope is a common item in any medical kit. However, sounds are hardest to describe and each physician must learn for himself by actual study just what to listen for. The sound transmission characteristics of the common stethoscope are rather weird from the viewpoint of an engineer, and too much dependence is attached to the hearing efficiency of the physician. A scientifically improved stethoscope (non-electronic) has been developed by RCA, but it is possible that the very feature that it "gives sounds that doctors have never heard before" will retard its adoption by the practitioner who has learned to diagnose chest and heart sounds with his own stethoscope, crude as it may be.

Amplifying stethoscope

Amplifying stethoscopes have been available for years — with which a large number of students can be shown irregular heart beat tones simultaneously—a great aid in demonstration and classroom work but giving tones different from those heard with a stethoscope.

A visual stethoscope, using a cathode ray oscillograph, approaches the problem from a new angle, giving pictures of the heart beat.

These instruments pick up the sounds of the heart and chest with a contact microphone. The amplifying stethoscope, operating into a headset or speaker, or the stethograph with its recorder, is also

suited for the study of chest sounds —especially when both sight and sound checks are made at the same time. In some cases vibrations are applied to the chest by an oscillator driven "vibrator" such as a speaker element, by a percussion device, or by having the patient hum or voice a steady tune. This method requires the analysis of waveforms, or the comparison of the wave shapes as picked up at various positions on the chest.

It is claimed that the changes caused by typical pulmonary diseases are recognizable, so the method provides a simple means of making clinical analyses. However, in common with many other new systems of medical diagnosis, the electrostethograph requires a new mode of analysis, and its use will probably be confined to research groups and to the chest specialists who have the time and patience to master the waveform analysis.

Another system of pulmonary analysis which is being investigated depends upon electrical impedance measurements between points on the chest. This impedance between two points on the body consists of a resistance-capacitance network, with the addition (in some cases) of a potential generated within the tissues or by contact effects with the electrodes. The electrical problem is that of measuring the characteristics of a high loss capacitor.

Electrocardiograph

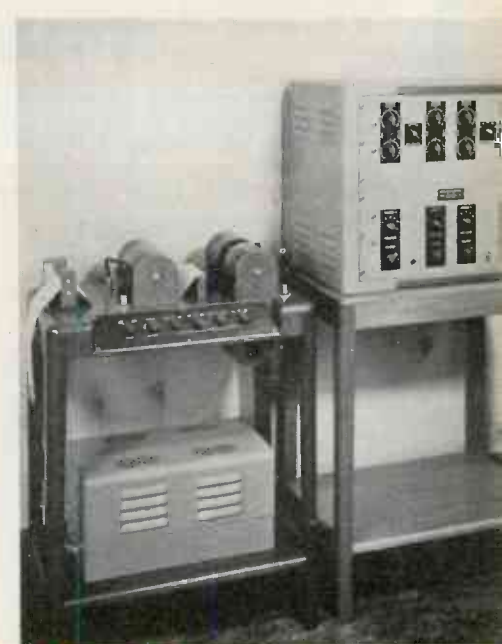
A particularly useful system of heart action analysis uses an electrocardiograph. One of the early electrical experiments was that of Galvani who showed that some sort of relation existed between muscular activity and electrical currents, using the frequently described tests

on the muscles of frogs. Important developments toward the utilization of the currents generated by the body organs were made by Einthoven, using the string galvanometers which he invented for these very tests. These researches were directed toward the recording of the cyclic potential waves generated by the heart as an improved method of diagnosis. The technique that Einthoven developed experimentally is still used in making and analyzing electrocardiograms.

An amplifier is an essential part of any modern cardiograph, since the record is much more conclusive than that obtained with the sensitive galvanometer connected directly to the pickup electrodes, as used by Einthoven.

The apparatus required consists of this special low-frequency amplifier and an oscillograph capable of indicating and recording the fluctuating

ELECTROENCEPHALOGRAPH. Four channel amplifier having "microvolt" sensitivity, operating magnetically driven pens. *Rahm Instruments, Inc.*



ELECTRON TUBES AIDING MEDICAL ART

RESEARCH

TEST	INSTRUMENT	REMARKS AND ELECTRICAL CHARACTERISTICS
Heart potentials Pulse rate Heart beats Blood pressure Blood flow	ELECTROCARDIOGRAPH CARDIOTACHOMETER AMPLIFYING STETHOGRAPH HEMADYNAMOMETER PLETHYSMOGRAPH— Electroarteriograph etc.	Input voltage nominally 1 Millivolt. Must amplify at 1 cycle/sec. Electronic amplifier. Times and records pulse surges. Has microphone input—Must have good gain at low frequencies. Balances blood pressure against a measurable air pressure. One system uses photocell to trace color changes after dye is injected.
Mental-physical coordination Mental reaction	PSYCHOSOMATOGRAPH PATHOMETER, PSYCHO-GALVANOMETER, ETC.	Records muscular action currents or physical movements. Notes skin resistance change with external voltage applied by electrodes. Requires high gain stabilized dc amplifier.
Muscular contraction	ELECTROMYOGRAPH	Records muscular action currents or physical movements.
Nerve currents Brain waves	ELECTROENCEPHALOGRAPH ELECTROENCEPHALOGRAPH	Sensitive high impedance amplifier with non-polarizing electrodes. Input voltage 5 to 100 Microvolts. Must amplify at 1 cycle/sec.
Chest sounds Body temperature	AMPLIFYING STETHOSCOPE PYROMETER	Has microphone input. Sometimes used with oscillograph. Uses thermocouple or resistance change to operate recorder.
Vibration sensitivity Respiration Fatigue	PALLESTHESIOMETER RESPIROMETER SOUND ANALYZER	Vibration applicator. Tests sound transmission of body tissue. Measures volume and pressure of air, and respiratory rate. In one system frequency changes in heart sounds are noted.

THERAPY

TYPE OF TREATMENT	REMARKS AND ELECTRICAL CHARACTERISTICS
PULSATING CURRENTS (Cortical Stimulators) LOW FREQ. SINE WAVES SPARK THERAPY (Electrodesiccator) LONG WAVE DIATHERMY SHORT WAVE DIATHERMY SHOCK THERAPY X-RAY THERAPY (Radiology) ULTRAVIOLET THERAPY INFRARED THERAPY VIBRATION THERAPY SUPERSONIC THERAPY X-RAY (Radiography)	Low frequency relaxation oscillator sometimes used. Delivers potentials with controlled output at one to 10 cycles per second. Spark jumps to skin. Used to remove malignant growths. Frequency of the order of 1 to 3 megacycles, 50-300 watts power. Frequency of the order of 20 to 75 megacycles, 50-500 watts power. Delivers controlled 6000 voltage and current for a preset interval. X-rays have a 30 trillion to 30-billion megacycle frequency. Uses a wavelength selected within the range 2800 to 3300 A.U. Uses a wavelength selected within the range 7000 to 20000 A.U. Generally mechanical, but it may be tube oscillator driven. Vibrations of 10 to 500 kc per second delivered to air, solids or fluids. Sharp, contrasty pictures with simple and safe procedure required. Fluoroscopic methods often used.

MEASUREMENTS

DOSAGE	INSTRUMENT	REMARKS AND ELECTRICAL CHARACTERISTICS
Diathermy	THERMOMETER	(No good "dosage" meter known). Energy absorbed generally considered proportional to oscillator plate power level.
Radium	IONIZATION GAGE & COUNTER	Ionization gages operate high speed electronic counting circuits.
X-Ray	RADIOGRAPHIC EXPOSURE METER	Cuts current off when a photocell trained on a fluorescent plate, accumulates enough charge to trip thyratrons.
X-Ray therapy	IONIZATION CHAMBER AND INTENSIMETER	Measures degree of conductivity of air exposed to X-rays under specified conditions. Calibrated in roentgens.*

* (A practical measurement of X-ray quality is a statement of the thickness of aluminum or copper (in mm) that will reduce the original intensity to one-half).

ACCESSORIES

INSTRUMENT	REMARKS AND ELECTRICAL CHARACTERISTICS
SURGICAL KNIFE, Cutting or Fulgeration COAGULATION (DESSICATION) HEARING TESTS— (Audiometer) HEARING AIDS CYCLOTRON BOMBARDER LENARD RAY TUBE ELECTRON MICROSCOPE SUBCUTANEOUS METAL LOCATOR PHOTOMETERS (Color Analyzers) CATHODE RAY OSCILLOGRAPH	High frequency applied to needle or loop of wire to cut and sear flesh. Same equipment as surgical knife, with different electrodes. A six frequency audio oscillator, attenuator and calibrated receiver, to disclose percentage hearing loss. Light weight audio amplifier with microphone input. Produces artificial radioactivity by bombarding many elements by high speed neutrons or protons. A HV cathode ray tube delivers beam of electrons directly into atmosphere. Electron ray transmitted through section being studied, is diverged by subsequent focusing to give great magnification. Electronic circuit sensitive to electromagnetic or electrostatic field changes. Skin color comparisons, vitamin measurements, etc. Used to indicate variations due to many of above effects.

tuations of the pulse rate. The deflection is generally calibrated in millivolts, and on the film record can be one cm./millivolt or more. In the usual case, the input potentials are of the order of one to two millivolts. The amplifier must have a flat frequency characteristic over the range of from 0.5 to several hundred cycles per second, the latter limit being set by the extremely rapid surge occurring at one point during each pulse. It is desirable that visible monitoring be possible before and during any exposure interval. The oscillograms must be timed accurately in terms of tenths of a second or less to enable accurate interpretation of the pictures.

Although subject to some qualifications, the view may be taken that the movements of the various compartments in the heart each generate and project potential waves in certain directions toward the body extremities. This assumption, however, will permit the analysis of the recording methods. Electrical contacts are made on the surface of the skin at three points, say on each arm and the left leg. Oscillograms are successively or simultaneously made showing the potential difference between each of the receiving positions. It has been found that each oscillogram is distinctive and follows a standard pattern in a normal heart. Likewise all variations have been systematically analyzed and rules have been formulated showing the type of cardiac disorder. Typical oscillograms for the four sets of connections are illustrated.

Potentials emitted

In order to explain the action, an analogy might serve to illustrate the methods used. Assume that the intensity of the rotating beam from a lighthouse is modulated in a certain manner during each revolution. Assume also that there are receiving observers positioned in three different directions and that it is not possible to measure the light intensity directly at any one of these positions, but that it is easy to measure the relative difference in the light intensities received at any two of the three positions. The difference varies continually over the cycle of revolution—at one instant it will be stronger at point A than B, and later this condition will be reversed, and so on for B-C and for C-A.

Theoretically, the records of the three intensity difference patterns must be examined together in order

to get the complete picture; but it happens that each of the patterns has quite distinctive characteristics, and a whole system of diagnosing cardiac disorders has been built up around them.

From a scientific standpoint it may seem that this method is indirect and that other methods, as for example one delineating a polar diagram, would give superior results. In fact, equipment has been described that produces such "polar" cardiograms. It uses a cathode ray tube fitted with three sets of magnetic deflection coils with axes 120 deg. (or some standardized angle) apart.

The resulting cardiogram, however, does not have a time element associated with it, since the position of the fluorescent spot depends upon the relative voltage vectors from the heart. In fact the cathode ray spot, during tests on some patients, may rotate clockwise, and with other patients counterclockwise, a diagnostic factor not discoverable when three isolated cardiograms are made.

To bring in the time factor in this method, the cathode ray is modulated with a standard signal (say a 10-cycle tone), so that a discontinuous or dashed line pattern is formed, each section of which represents a definite time interval. The spot usually moves slowly enough so that the direction of rotation is noticeable.

The usual electrocardiogram is taken in three parts, one each being formed using successive pairs of the three electrodes taken in rotation. Many practitioners, however, prefer the addition of a fourth lead applied to the front of the chest or to the back, or used as a searching probe to locate signs of coronary diseases which may not be readily apparent when the three-lead system is used. The procedure with which this fourth electrode is attached and the records analyzed has not been standardized, however.

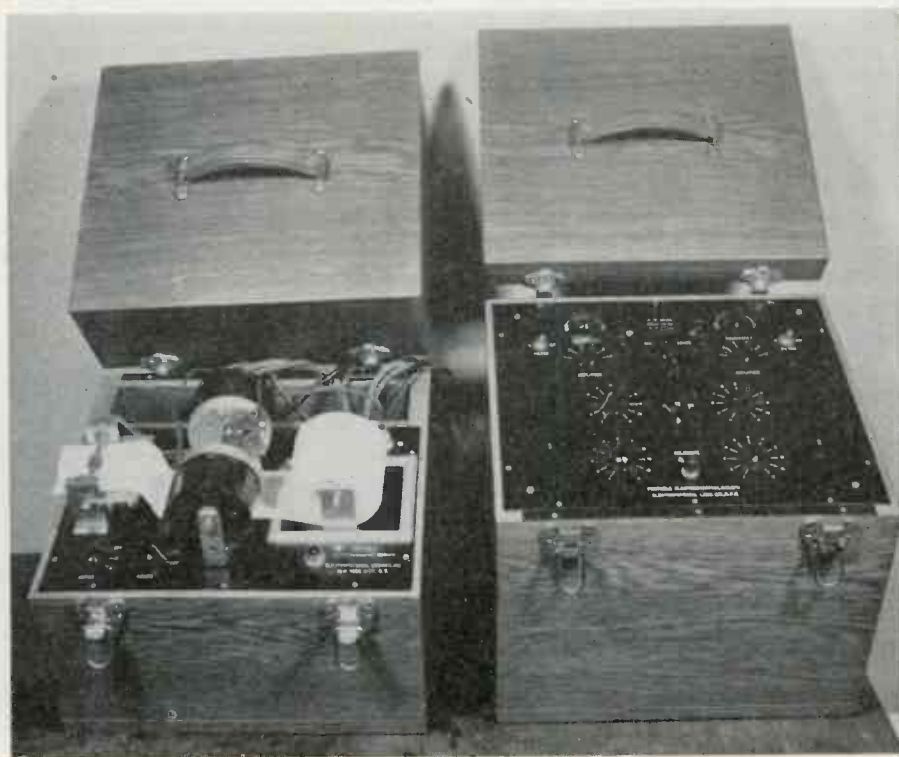
Cardiogram analysis

Experiments show that the rotating "beam" of electrical potential does not fall in a plane, but exhibits a front to back movement as well. A sort of "stereoscopic" view is therefore obtained when the third dimension is added.

As shown, a normal electrocardiogram bears a definite pattern. Usually the prominent characteristics are designated P, Q, R, S and T. Analysis of abnormal patterns shows section variations which have been charted in many reference books for comparison.

In electrocardiographic measurements, as in all other electrical equipment developed for biological research, the frequencies involved are relatively low, one or more cycles per second, so that one of the greatest design problems is that

TWO CHANNEL portable encephalograph. Electrophysical Labs., Inc., New York





FIVE CHANNEL direct writing oscillograph, the Garceau Velograph

of eliminating 60-cycle pickup potentials which show up superimposed on the desired waveform. It is found that power line potential gradients are usually high in an ordinary (non-shielded) room, so that one's body acts as its own "antenna," as anybody knows who has touched the input posts to a cathode ray tube and noted the large 60-cycle wave that results. The usual solution involves some sort of balancing out with reversed phase components of an applied potential.

Muscle control electrical

The manner by which all body movements are initiated is quite complicated and for the most part unknown. Nerve potentials are known to originate in some part of the brain, traveling as a series of discrete pulses of electrical potential down the particular nerve to stimulate a unit of muscle tissue into action. The nerve pulses travel at such a speed as to reach the fingers, say, in about 20 milliseconds. Their magnitude is of the order of a few microvolts, but at times they have a wider range in level and velocity.

These nerve conduction pulses are the hardest to measure and study of any in biological research

yet discovered. In order that a particular nerve can be "tapped" it must be isolated, and connected to an amplifier which must have an "infinite" impedance input. Moreover, the connections must be made through non-polarizing electrodes where ionization effects are neutralized.

The many electrical effects in the psycho-neuro-somatic field have been isolated and studied, but the underlying relation between them does not seem to have been completely explained. The nerve pulses originating in the part of the brain that controls a particular muscle function, differ from the several types of brain waves (which are described later). They are still different from the muscle action potentials which are set up by the body tissues when active.

In some part of the brain numerous "standard oscillators" must be present to control the pulsing and rhythmic functions that are continuous; heart-beats, respiration, etc., or periodic such as certain glands and organs. The engineer will observe that the frequencies at which these operate are not in harmonic relation with each other! The method by which the electrical return path of the current "slugs" through a nerve is completed, is not definitely established. It is evident that equally important "signals" must be transmitted back to the brain by the various senses which function continuously. Possibly the greatest amount of engineering work has been done in studying the sense of hearing, by isolating individual nerves connecting the basilar membrane in the inner ear with the brain.

Each nerve seems to be sensitive to a certain small range of frequencies, but inhibited by frequencies

within certain other range. Only by analyzing and correlating the pulses from the whole bundle does the mental process make intelligence from these pulse groups. The inhibiting process also is a curious effect and is part of the system where a person can select what he hears, and more-or-less unconsciously be deaf to other tones and noises which may be superimposed.

Electromyograms

Other distortion troubles in cardiographs are caused by somatic or muscle action currents, the same effects as discovered by Galvani. These action potentials are by themselves useful in other diagnostic studies, however.

One of the problems that has been studied by the application of tube circuits is the effect of muscle tensions, under abnormal stresses. The reports of pilots "freezing" on to the controls have started the scientific search as to the extent and cause of such muscular tensions. The potentials generated by the muscles themselves have been recorded during flight, wherein the pilot was subjected to both typical and abnormal flying discomforts in order to test the muscular reactions. Electrodes connected to those muscles operate into light weight amplifiers and produce waves which are fed to a recorder on the plane or transmitted down over a radio circuit.

It has been suggested that many body and organic actions are dependent upon the acceleration with which the stimulated parts respond. For example, a good analysis of the energy output of the heart would be given by the product of the average blood pressure, the change in

(Continued on page 185)

CORTICAL STIMULATOR, used in nerve and mental therapy, delivers an electrical shock of prescribed strength. Rahm Instruments, Inc.



RESEARCH AMPLIFIER with six independent high gain channels (right) with associated power amplifiers (left). Rahm Instruments, Inc.



Line of SIGHT Distances

A chart to determine the optical path length to horizon and probable coverage of an uhf transmitter

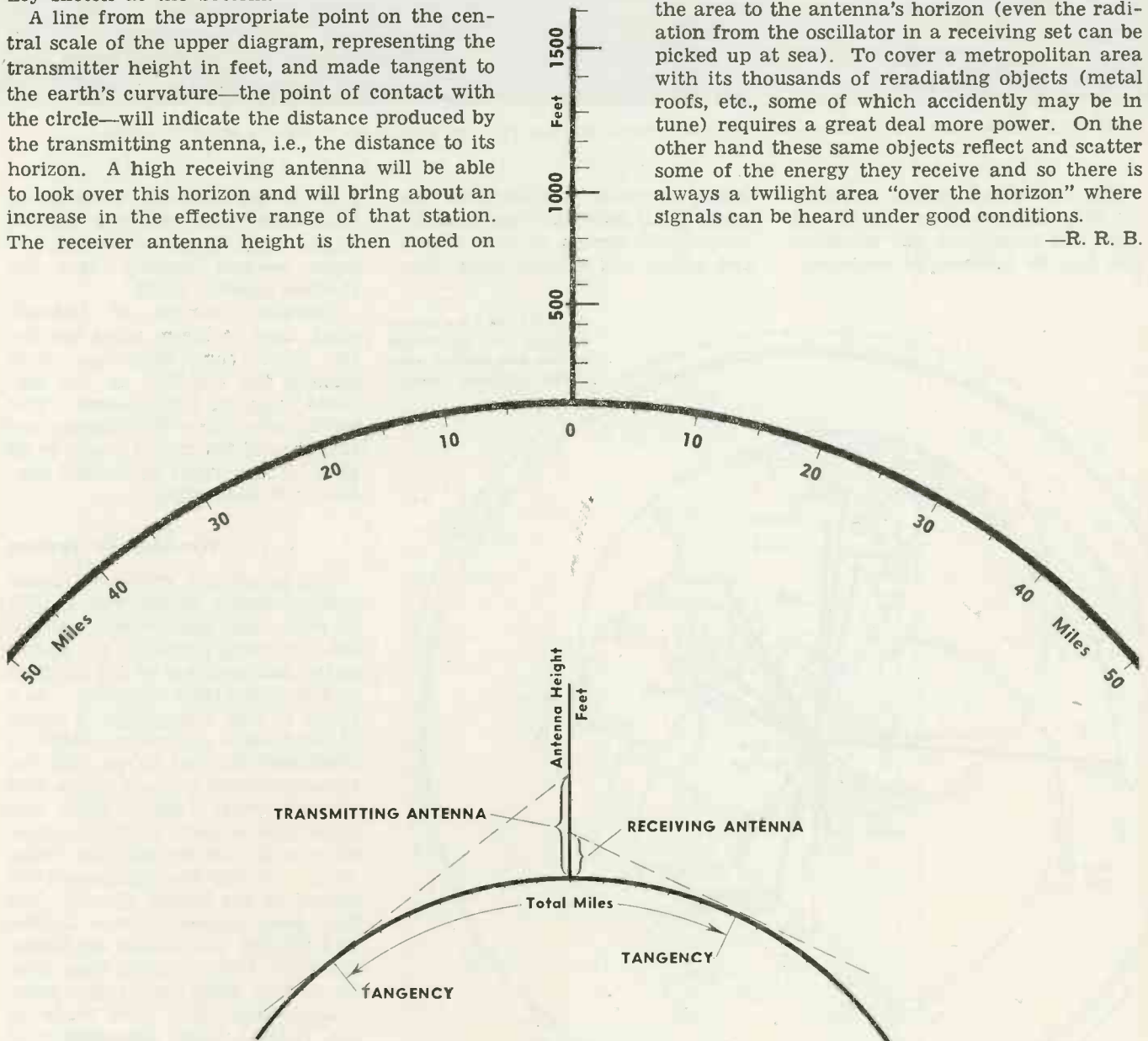
Ultra-high-frequency waves, the same as with light waves, will not be noticed beyond the optical horizon unless by the agencies of reflection and re-radiation. The heights of the antennas at both the transmitter and the receiver determine the normal distances such waves will travel. The diagram below is of use in visualizing this effect and in determining the actual distance expectancy. A guide to its use is indicated on the key sketch at the bottom.

A line from the appropriate point on the central scale of the upper diagram, representing the transmitter height in feet, and made tangent to the earth's curvature—the point of contact with the circle—will indicate the distance produced by the transmitting antenna, i.e., the distance to its horizon. A high receiving antenna will be able to look over this horizon and will bring about an increase in the effective range of that station. The receiver antenna height is then noted on

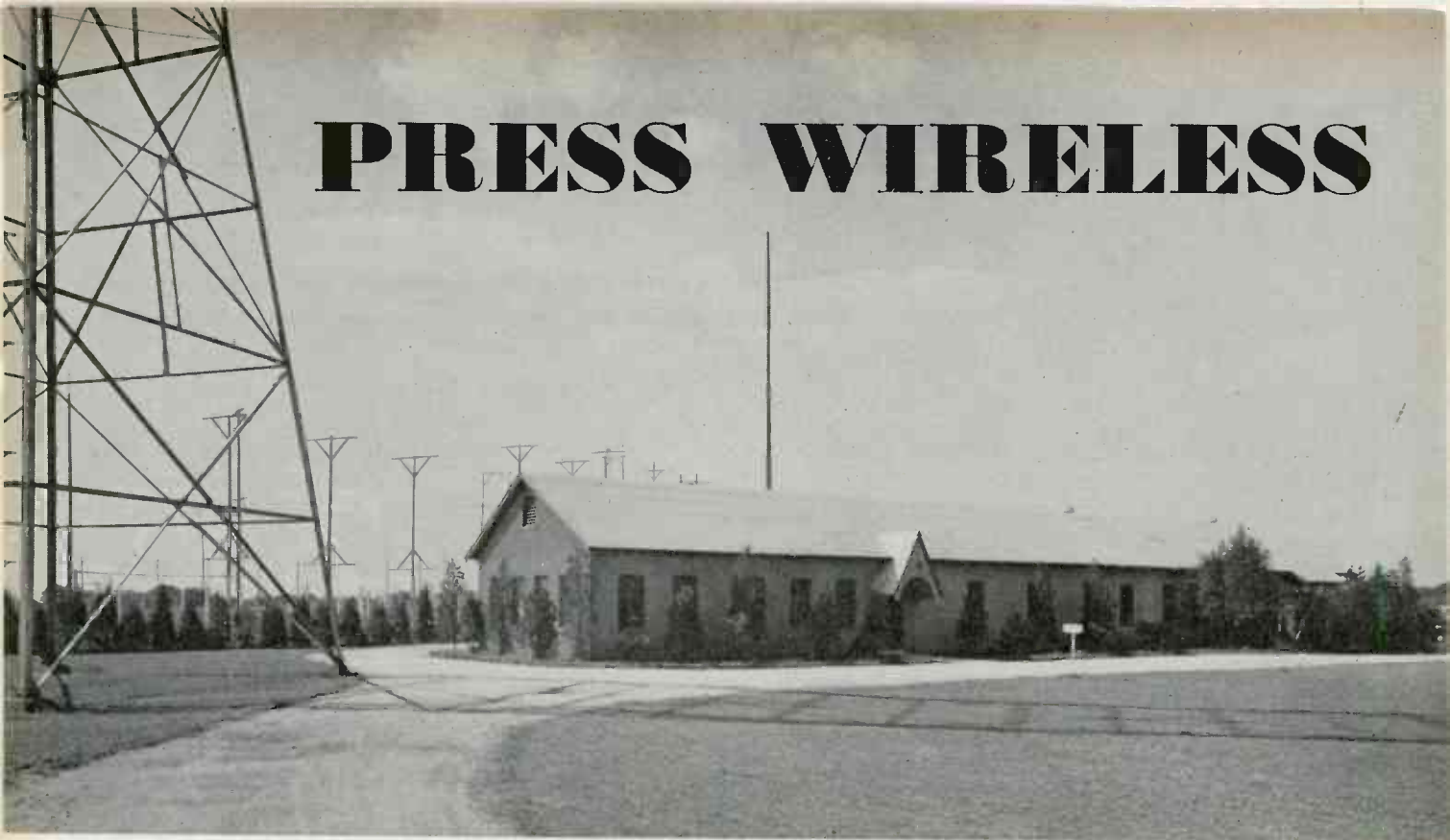
the same central scale, and a line to the right, also drawn tangent to the "earth" will indicate the additional distance effected by the receiving antenna. The sum of these distances will show how far uhf wave transmission can be expected in normal operation.

In the case of stations located in areas where there are relatively few obstructions, such as buildings, power lines, poles and even trees, it takes but little transmitter energy to completely cover the area to the antenna's horizon (even the radiation from the oscillator in a receiving set can be picked up at sea). To cover a metropolitan area with its thousands of reradiating objects (metal roofs, etc., some of which accidentally may be in tune) requires a great deal more power. On the other hand these same objects reflect and scatter some of the energy they receive and so there is always a twilight area "over the horizon" where signals can be heard under good conditions.

—R. R. B.



PRESS WIRELESS



EXTERIOR VIEW of one of the Press Wireless transmitting stations showing part of the extensive antenna system

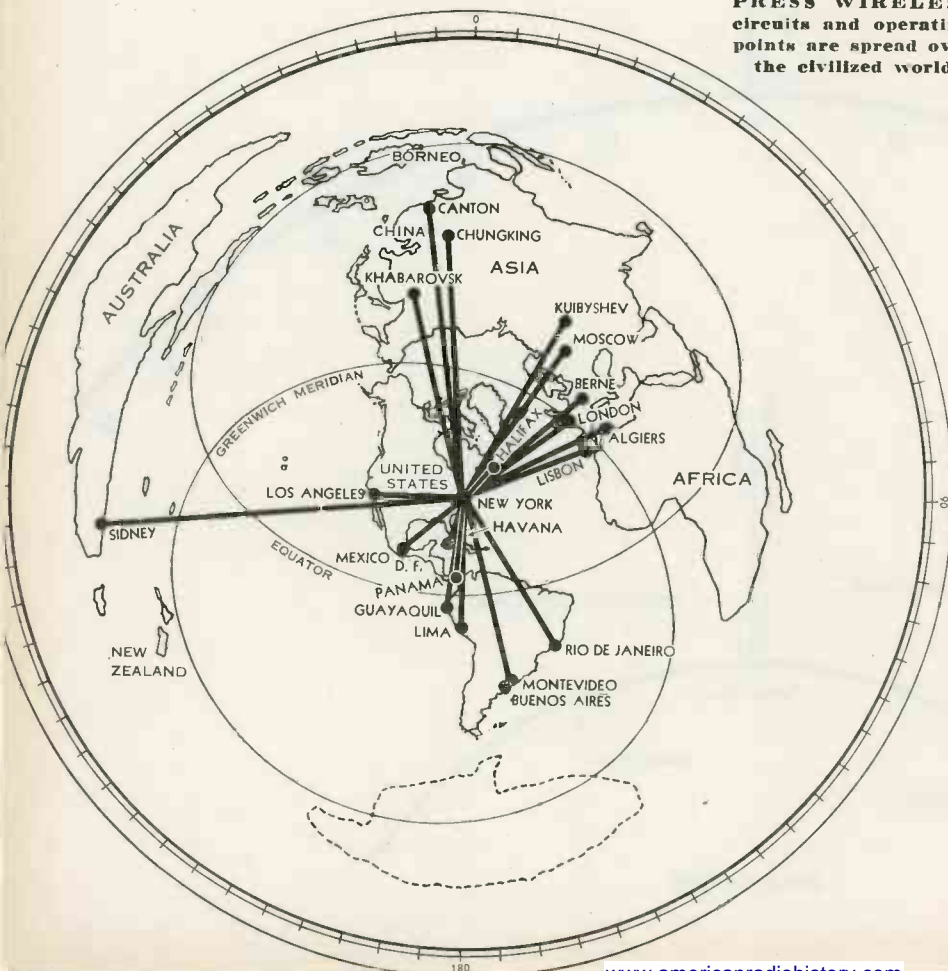
The speed and volume required for the exchange of modern global news and important war information tax all commercial communi-

cation facilities. Throughout the world at all important points of interest great arrays of steel towers and gaunt, tall wooden poles, sus-

pending the elaborate antenna installations, send out and receive, uninterruptedly, newscasts and pictures beamed directly over the shortest possible route.

Likewise, climate or location, wind, sleet or storm must not deter these communications from making the deadline in the editorial rooms of a newspaper. This service also keeps Washington and branches of the armed forces in all parts of the world in instant contact with each other.

PRESS WIRELESS
circuits and operating
points are spread over
the civilized world



World-wide system

The experience with news transmission during World War I, with its delays and other faults, brought out in a glaring manner the inadequacy and mistakes of the methods and facilities then employed. As a result of this observation, a group of progressive American newspaper publishers decided to go into the communication business in the field of short wave radio. Their first move was to make a traffic agreement with the British Post Office which controls the communication system of the British Empire. The first press circuit between London and Halifax was started on February 22nd, 1922, followed soon after by circuits with France and Italy.

Application was then made to the Federal Radio Commission in Washington for licenses to op-

Communications Net

by FRANK E. BUTLER

Thirty-three transmitters serve for telegraph, telephone and picture transmission service throughout United States and 21 foreign cities

erate similar circuits in the United States. Accordingly, after certain licensed frequencies were allowed, Press Wireless, Inc., was organized on the basis of articles of incorporation approved by members of the Federal Radio Commission, of which Dr. O. H. Caldwell, editor of "Electronic Industries," was then a member. The charter members of the new company were: The Christian Science Monitor, The Chicago Daily News, The Chicago Tribune, The San Francisco Chronicle, The Los Angeles Times. Later, The New York Times, New York Herald Tribune, The Associated Press, The United Press Association, King Features Syndicate and the North American Newspaper Alliance became stockholders.

Eight million words daily

Within less than ten years the handling of news service advanced to such proportions that by the year 1941 the company was serving virtually every metropolitan daily newspaper and many hundreds of

broadcast stations throughout the world, besides carrying much of the official communications of the United States and other governments on its principal circuits under special license.

The news distributed in these newscasts is not gathered and edited by Press Wireless. The company acts only as the carrier of news, which is supplied their respective subscribers by several American and foreign news agencies who file their news reports with a company station at pre-established times of the day when the subscribing receivers at diverse points on the earth are tuned to the frequency employed at the time.

Many newscasts daily are transmitted simultaneously from two or more transmitters tuned to different frequencies. This is done on schedules with transmissions received at the same time at nearby, far distant and intermediate points; one might be received simultaneously in Maine, Alaska and South Africa. This type of bulk

news distribution simultaneously to a large number of subscribers throughout the world results in cutting the individual transmission cost to a minimum. It is estimated that this system has increased the quantity of news distributed four times and that the total news printed from Press Wireless newscasts distributed by the newspapers and broadcasting stations of the world is 8,000,000 words per day.

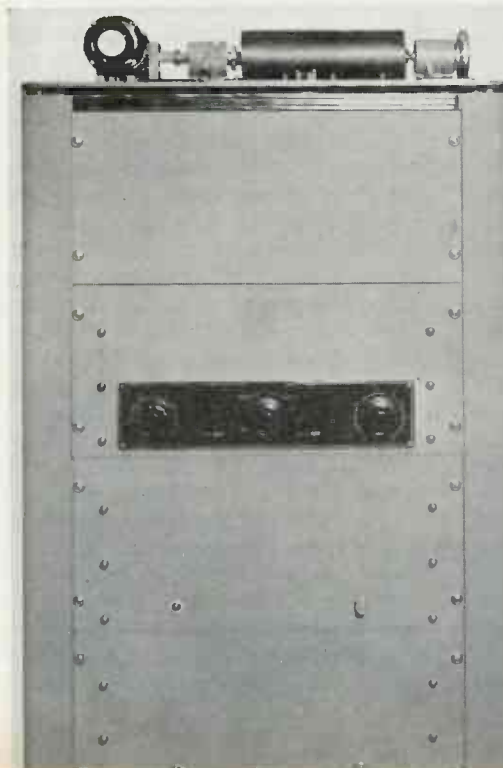
21 foreign cities

Press rates are divided into three classifications, for three typical overseas stations, the figures given being the rate per word from an east coast transmitter to the receiving point.

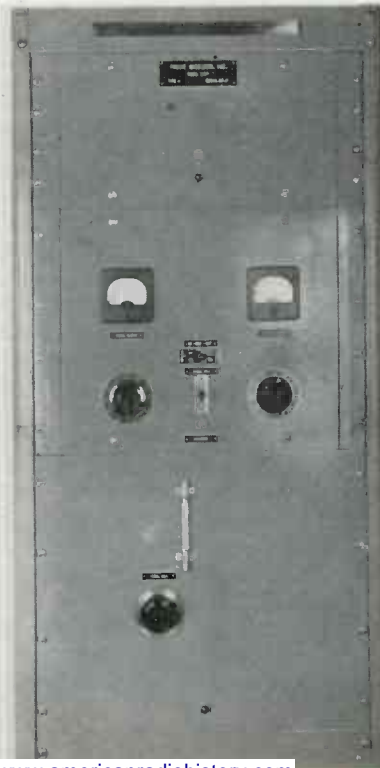
	Berne	Moscow	Chungking
Urgent12	.08	.14
Ordinary07	.04	.09%
Deferred05		

At both the Atlantic and Pacific seaboard two high powered transmitting stations and nearby receiving installations are in operation, the location of which cannot be

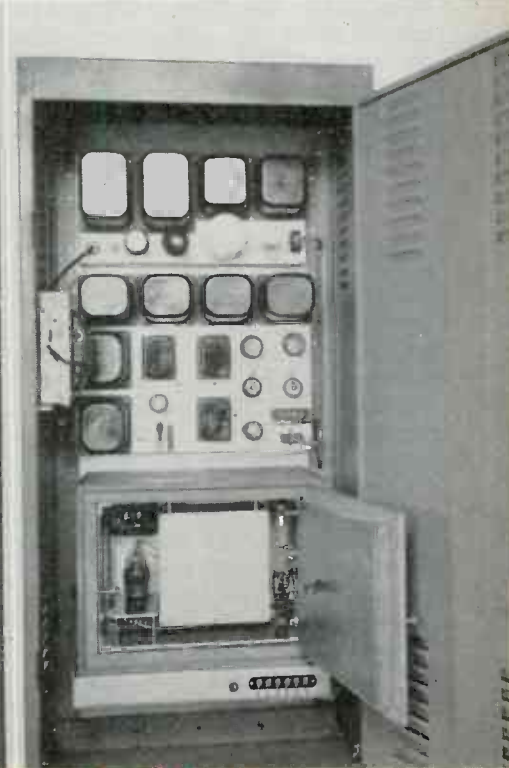
STANDARD TYPE of photo transmitter used in radio picture transmission

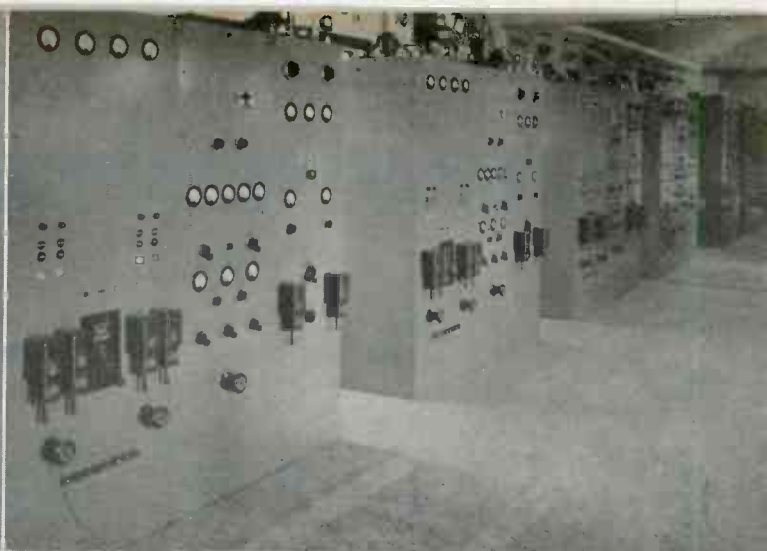


FRONT VIEW of earlier type radio anti-fade equipment



REAR VIEW showing the interior of early type anti-fade equipment





TRANSMITTING STATION INTERIOR (left above), showing a portion of the 26 transmitters and the antenna patching system. Right, the 40 kw telegraph-telephone transmitter. Left, sweep converter panel of the new style anti-fade equipment



of the final amplifier stage. This voltage, controlled by a potentiometer to produce a time delay, is used to heat the filament of a type No. 12Z3 tube.

Automatic alarm

A relay in the plate circuit of this tube is normally open with plate current flowing, but interruption for a period of 10 seconds or more will cause this relay to drop out to sound an alarm system and light an indicating lamp, which indicates which transmitter is not functioning normally. This device will function when the transmitter goes off the air for any kind of interruption such as an alternating current interruption, the operators at the control center neglecting to keep their automatic transmitter across the line, or a failure in the lower power stages of the transmitter resulting in a loss of excitation to the amplifier. In other words, as soon as the final amplifier does not draw plate current, the alarm sounds.

On the panel mounting with these tubes and indicator lamps, there is a meter jack for the type 12Z3 tube. This jack is used by the engineers to determine whether or not the filament circuit of the tube is receiving voltage. There are times when the operator at the control center starts keying the transmitter, and sufficient time has not elapsed for the heater to reach the proper temperature for the plate current to flow again and stop the alarm from ringing. By merely plugging in a milliammeter the operator can check immediately as to the operation of the trans-

disclosed for military reasons. These stations maintain regular wireless telegraph service with twenty-one foreign cities and countries, including London, Berne, Havana, Buenos Aires, Guayaquil, Montevideo, Panama, Rio de Janeiro, Moscow, Delhi, Halifax, Chungking, Khabarovsk, Kuibyshev, Mexico City and others. The terminals in the United States also communicate, by agreement, with government radio administrations in England, Switzerland, Russia, China, Mexico, Peru, Belgian Congo and French West Africa.

Radio photo channels

Last December regular radio-photo service between Asia and America was formally inaugurated, this service quickly following similar service between America and Russia which had been in operation for some time. The opening of the radio-photo service with China makes possible for the first time accurate transmission of the Chinese language, with its thousands of characters. The Morse or Continental code with their dots and dashes can handle only Roman letters and it has never been possible to telegraph Chinese or any other non-Roman letters with complete

fidelity. Such languages heretofore have had to be reduced to Romaji, an approximate equivalent in Roman characters of the original tongue, before transmission by telegraph. Now it is possible to send a radio-photo of Chinese characters. The cost of transmitting a 5 x 7 inch radio-photo picture between New York and Moscow or Berne is "Urgent", \$.90 or "Ordinary", \$.60. This applies only to press service.

33 transmitters

There are 26 complete transmitters, ranging from 10 kw to 40 kw, at the eastern transmitting station and 7 in the western transmitting station. Each of the Press Wireless transmitters is equipped with an automatic alarm device of special design. The circuit is actuated by the keying and amplifier stages. Any interruption to the keying or to the normal power output of the transmitter is signaled to the operating engineers, after a predetermined number of seconds, by an alarm light with indicated transmitter number at the Control Board and also by the ringing of an alarm bell. The voltage to operate this alarm system is derived from a resistor placed in the cathode circuit

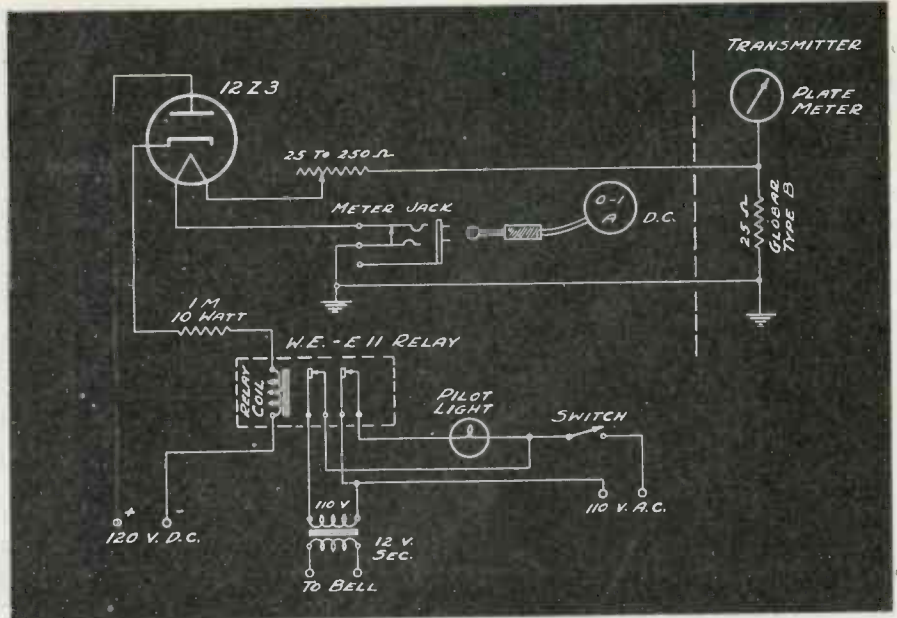
mitter by observing whether or not filament current is flowing in the 12Z3 filament. A switch is provided in the 110 ac pilot light and alarm system for the bell, which enables the operator to mute the bell while the transmitter is being tuned. This switch is closed as soon as the transmitter is put on the air for commercial operation.

Portable monitors

Local signal monitoring at the transmitters is done with the use of portable monitors and rack mounted receivers. They are small compact units mounted on trolleys which are moved to any desired position among the transmitters for special check-ups on transmitted signals. These units have continuous frequency coverage from 3 to 30 megacycles and are battery operated. A special monitoring studio under the supervision of an experienced listening operator is always on duty for continuous monitoring of radio-telephone transmissions, for the purpose of maintaining perfect signal transmission, but in no wise is this service for the purpose of censorship.

The beaming of the radio signals is determined from azimuthal maps using the Great Circle with the North Pole representing its center. Beam antennas are so oriented that transmission of signals takes place over the shortest path between two points on the earth's surface. It

STANDARD 40 kw and 10 kw telephone and telegraph transmitters built and operated at one of the Press Wireless east coast stations for trans-Atlantic, trans-Pacific and South American circuits



ALL PRESS wireless transmitters are equipped with this simple type of automatic alarm which indicates trouble by bell and lamp signals

will be seen when using the Great Circle map, with New York spotted as the center, that London is approximately 52 degrees northeast, Moscow 34 degrees, Algiers 67 degrees, Sidney 266 degrees, four degrees south of being due west. Canton, China, is about 353 degrees or nearly directly north of New York.

Antenna patching

Looking at a common Mercator flat map, the directions appear entirely different, but wireless waves

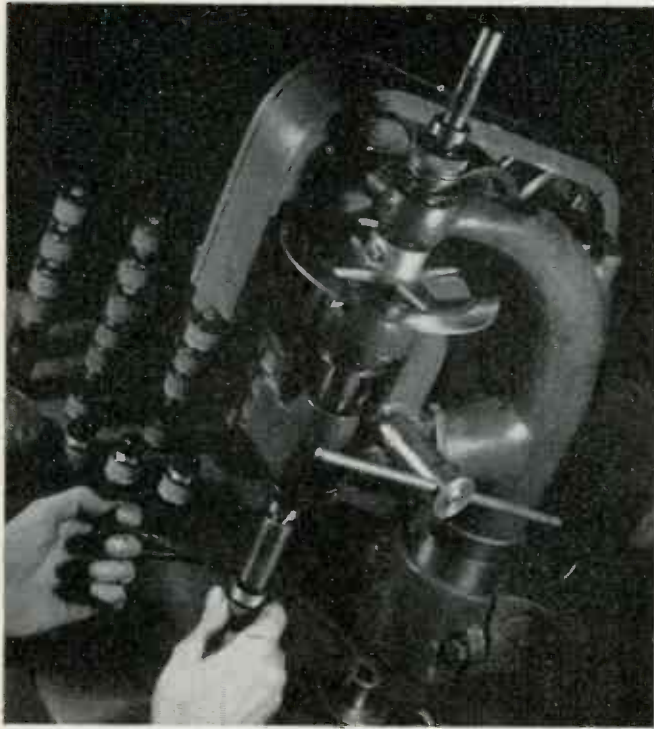
must be beamed over the shortest path. The antenna for this purpose which is used at the East Coast transmitting station consists of eight different types of construction, each particular type, or combination, being chosen according to the service required. For point to point service, highly directive beam antennas are used, but for general newscasts to a number of listeners a broader beam type of antenna is switched in. A unique patching system is used which allows a considerable selection of antennas for each transmitter and the switching can be accomplished in a matter of a moment or two.

The responsibility of determining the material to be transmitted, what is to be censored, which picture or text is to be used originates at the East Coast offices of the company where a battery of teletype, telephoto and facsimile machines are installed and operated. A network of wire channels connects this control and traffic collecting and distributing center with the transmitting station and receiver stations which are tied together by wire circuits for control relaying and frequency checking.

Code letters

The method of controlling the traffic and the issuance of orders to the transmitter engineers as to just what to do at a given instant is handled by means of the simple system of code letters sent over the teletype tape, which in one line gives the information what combination of one, two or more trans-

(Continued on page 186)



1. Lapping in Tapping Machine

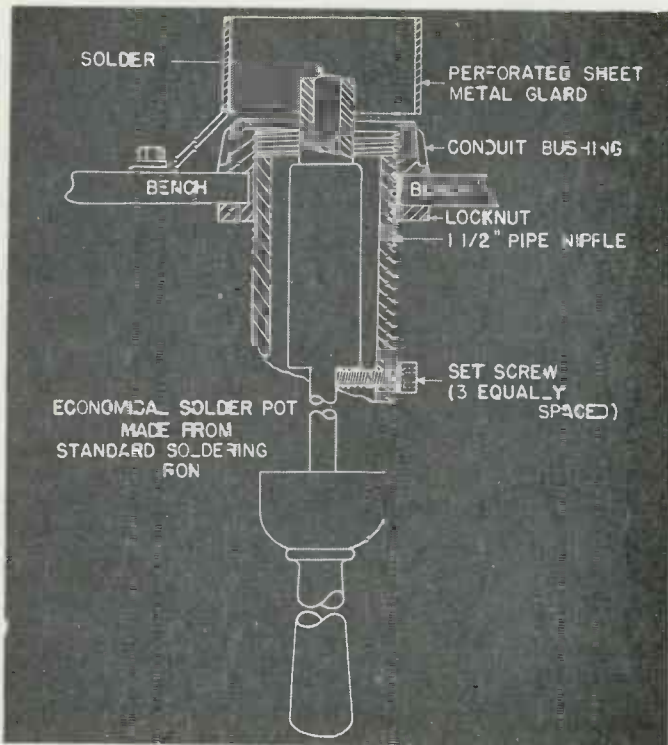
is unusual operation performed in Mansfield plant of Westinghouse Electric & Mfg. Co. With lapping compound applied, the threads are lapped to fit by using the forward and reverse motions of the tapping machine spindle



2. Precision Filament Measurement

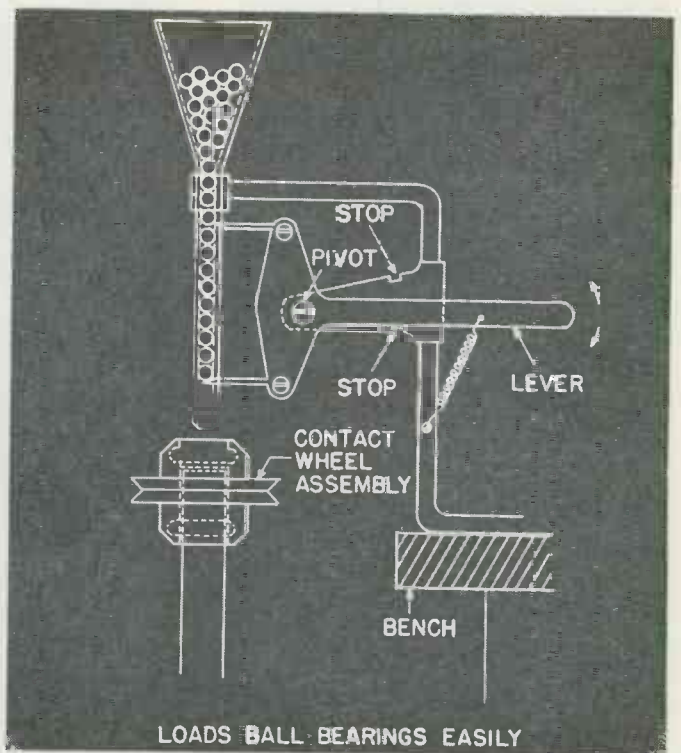
in the Westinghouse Lamp Division plant is accomplished with a small battery and voltmeter connected in series with the pointer of a dial micrometer and the surface plate. When pointer touches plate the indicating circuit is closed

10 FACTORY Short Cuts



3. Soldering Pot Made from Iron

facilitates production of small parts in General Electric instrument division. Standard fittings hold a small iron through a hole in bench. Tip is ground flat and drilled with a $\frac{1}{4} \times \frac{1}{8}$ hole, thus forming a miniature soldering pot



4. Loading Ball Bearings

has been simplified with this home-made device which operates on the order of an escapement mechanism to feed bearing balls in groups of nine to properly fill race as hand lever is moved. A General Electric man devised equipment

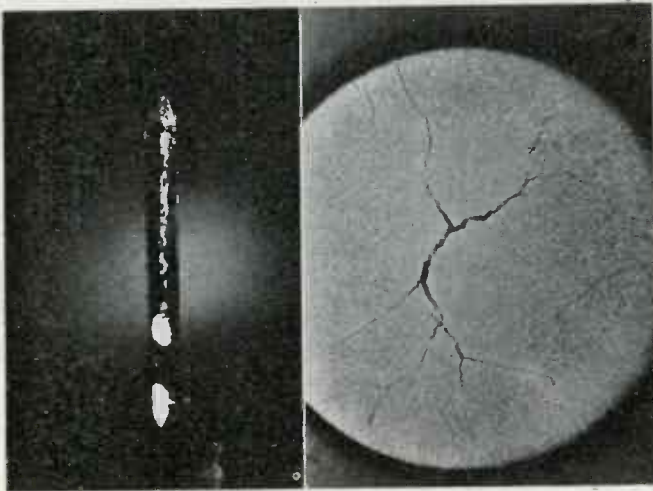


5. Work in Small Spaces

has been speeded up through inventive ability of Fred Vines and Joe Quinn who developed extension pliers at Murray Body Corp. plant, Detroit, for inserting skin clamps in inaccessible places in Thunderbolt airplane wings.

6. Thermostatic Frequency Control

Applying thermostatic principles, E. O. Thompson, Philco research engineer, and production engineer D. E. Sunstein have developed a thermal compensator that maintains closer control of frequency with temperature shifts

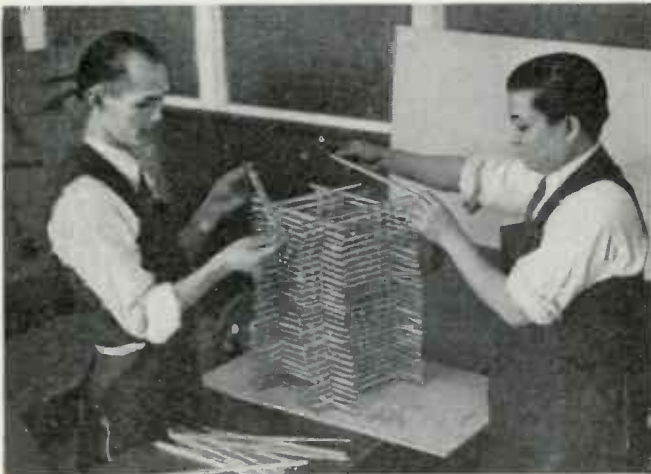


7. Fluorescent Liquid Check

developed by Maganflux Corp. Zyglo oil reveals hidden flaws in tungsten seal leads for vacuum tubes. Under U V light cracks glow a brilliant green. Microphotograph shows a cross-section of a flaw thus found

8. To Guard Against Rust

Tiny ball bearings furnished by New Departure to aircraft industry for delicate instruments are never touched by hands but are delivered after inspection in small sealed glass bottles that are filled with rust-preventing oil



9. Floor Sweepings Savings

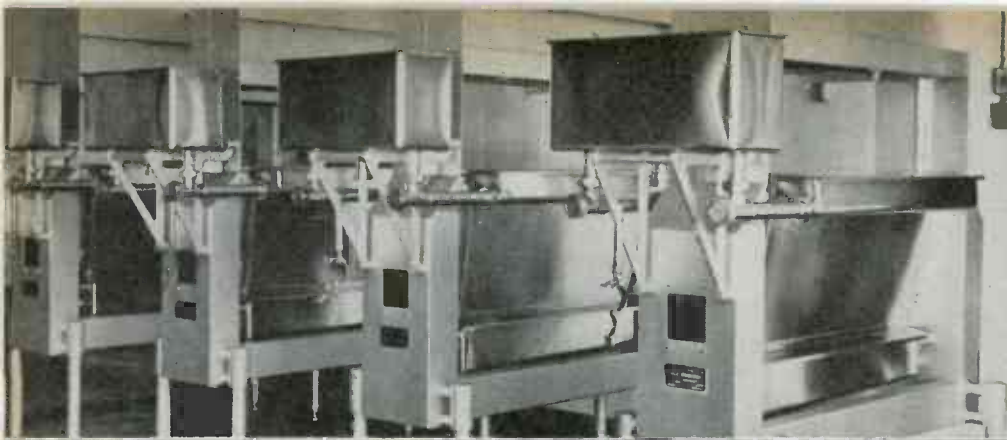
represent among other things more than 150 half pound bars of solder smelted from lunch time sweepings made by four Chinese-American students at the training school operated by Federal Telephone & Radio

10. Sheet Metal Operations

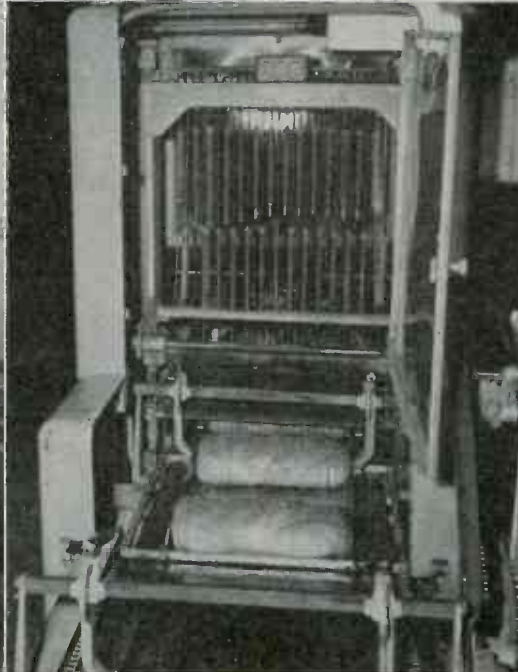
in considerable variety are carried on by Federal Telephone & Radio. Upper left, spraying molten copper on transmitter frame; right, steel grit blasting; lower left, spray painting; right, the giant air compressor

FOOD

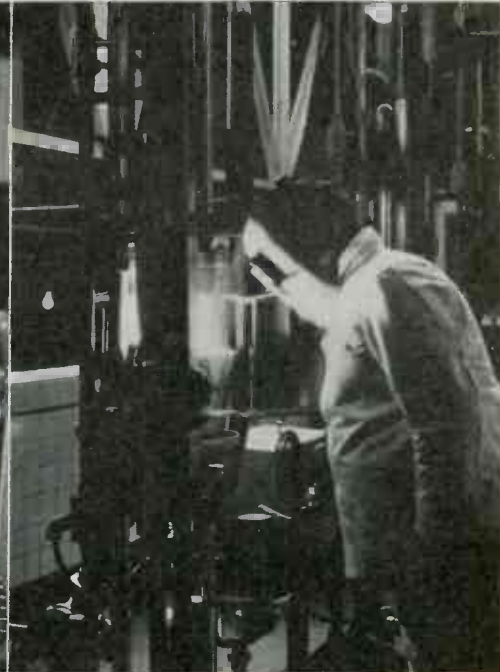
IRRADIATED VITAMIN D MILK processing is automatic in these four Hanovia units in the Riverside plant of the Borden Company, New York



DESTROYING SURFACE BACTERIA by irradiating insides of milk cans with 2537 Angstrom unit ultra-violet. Additional Sterillamps on ceiling



BAKERY USE OF ULTRA-VIOLET germicidal radiation insures product's sterility from time it leaves oven until packaged. Sterillamp at top of slicer



ACTIVATED YEAST for feeding animals, fortifying foods with Vitamin D, shown flowing through Cherry Burrell machine at Fleischmann Labs., N. Y.

For several years it has been common practice to subject certain foods to ultra-violet radiation to increase vitamin D content. "The sunshine vitamin" is one of those which are most commonly lacking in the civilized diet. Essential to the body's metabolism of calcium and phosphorus, it is produced by the "activating" effect of ultra-violet light on the sterols, whether in the human skin cells or in food-stuffs intended for human consumption.

Irradiation of milk

Products suited to irradiation include milk, yeast and, with certain reservations, the cereals. The activation of the ergosterol may be by carbon arc or mercury vapor light or by low velocity electron bombardment. High and low pressure quartz mercury vapor tubes are in wide use.

Various plans for the irradiation of milk have been used. The basic principle involved is to have

the milk flow in the thinnest possible layer through the zone of radiation, over plane or irregular surfaces, usually in a vertical direction. Factors which must be controlled are the rate of flow and the intensity of the radiation. Flow is best held uniform through gravity feed of the milk, with a float valve in the supply tank to hold the level of the milk at a predetermined point.

With quartz tube mercury vapor light sources, intensity of radiation is subject to several disturbing factors: ambient temperature changes; line-voltage variations; and aging of the quartz envelope. One method which, under proper conditions, makes automatic adjustment for all three factors employs an ultra-violet-sensitive phototube trained on the quartz lamp. Through suitable amplification and control circuits, the tube adjusts input voltage to maintain the radiation at a predetermined level. As a further check, a recording ultra-violet meter may be used.

Commercial irradiation of yeast by high pressure mercury lamps was begun in 1928, under the Steenbock patents, by Standard Brands. Present day commercially irradiated yeast may contain as high as 7,200 U.S.P. units of vitamin D per gram, as compared to a few hundred units per gram for the best commercial, unfortified cod-liver oil.

Such yeast, in a dry powder form, serves as a convenient vehicle for enrichment of food products, and for feeding to cows and other animals, both to prevent rickets and to add vitamin D to the product as in the case of milk or eggs. Milk produced by cows fed irradiated yeast is termed metabolized vitamin D milk to differentiate it from the directly irradiated vitamin D milk.

Activation of grains

Irradiation of products such as grains and cereals, while considered commercially successful, is

PRODUCT Irradiation

by GILBERT SONBERGH

How ultra-violet rays are used for vitamin production and bacteria control. X-rays in inspection and processing

faced with the problem of poor penetration of the ultra-violet radiation. The optimum condition, of course, for profitable irradiation of cereals, is where a single layer of the grains passes under the ultra-violet source on a slowly moving conveyor-belt. Since adequate quantities of vitamin D are lacking from all normal infant and most adult diets, we may confidently look to ever-widening utilization of the various irradiation processes.

Sterilization processes

While the exact nature and characteristics of the various bands of ultra-violet radiation are still the subject of much debate, considerable food-industry use is made of the germicidal properties of the low pressure mercury line at 2537 Angstrom units. Such radiation is widely employed to reduce airborne and surface bacteria and molds in processing, storage, and packaging.

Both hot cathode and cold cathode types of sources are employed. The former differs from the common fluorescent lamp only in that the mercury pressure is adjusted

INSPECTION FOR PRODUCT QUALITY by X-ray. These G.E. fluoroscopic units are supplied by conveyor belt at left. Operators reject bad fruit with convenient levers

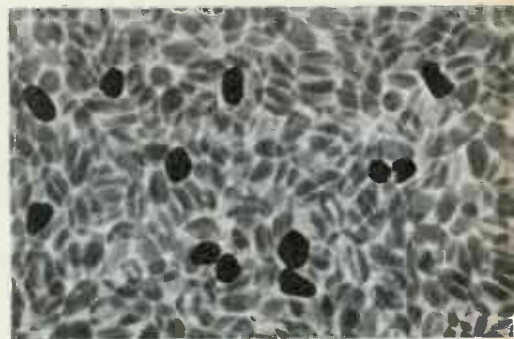
for the 2537 response, the internal fluorescent coating is omitted, and a special glass for maximum transmission of the radiation is used.

The cold cathode type requires a special high-voltage transformer but eliminates the need for electron-emissive filaments and delayed starting circuits and generally provides considerably longer life on intermittent service.

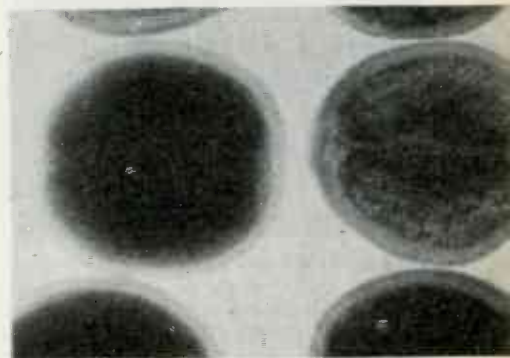
Ultra-violet sterilization serves the food industries in many ways. In the meat industry, to prevent spoilage and wasteful trimming due to slime, mold, and bacteria in processing, packing, storing, and cutting operations. In the milk industry, over conveyors and capping machines, inside milk cans and bottles, tanks, etc., and for general sanitation over large areas. Countless installations of Westinghouse and General Electric germicidal lamps have been made in plants of the baking industry, soft drinks, brewing, cheese making, on the farm, and in the dairy. In the post-war period, we may expect extensive use of small tubes in home refrigerators.

(Continued on page 186)

MILK IRRADIATOR in cross-section. Float-type tank insures constant thickness of milk film on flow-boards. Photo-cell measures and controls output of quartz lamp

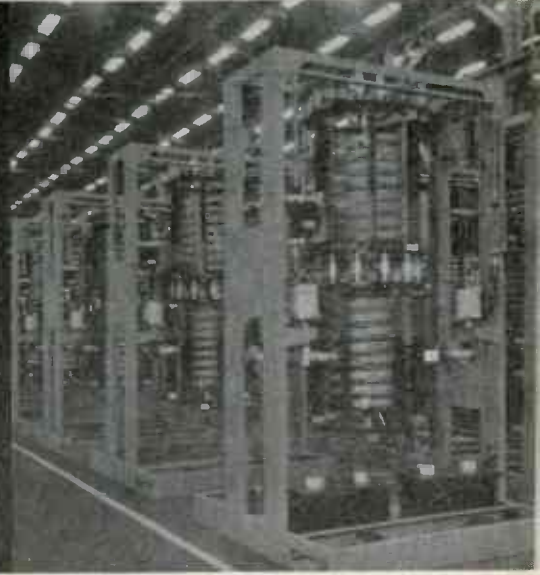
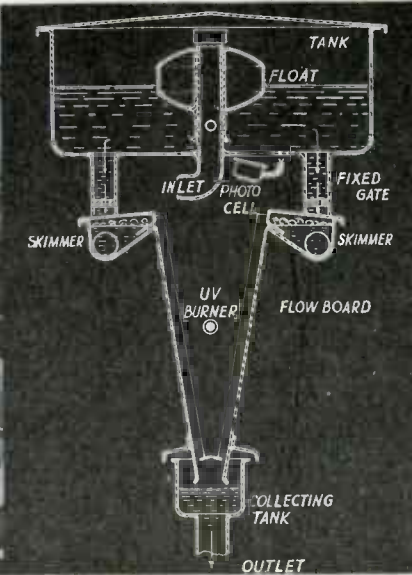


INSPECTION FOR INCLUSIONS by X-ray. Typical radiograph shows sand stones among peanuts. Other uses for fluoroscopy include checking fill of containers



ORANGES UNDER FLUOROSCOPE are seen as at left if good; as at right if defective

SEVEN 200 KW OSCILLATORS for flowing electrolytically-deposited tinplate on strip steel to make food cans. These tuning units were photographed ready for shipment from the Westinghouse Radio Div.



Standardization Effects on POSTWAR RADIO

by HAROLD P. WESTMAN

Coordinating views of the armed services and industry on radio components promises material benefit



HAROLD P. WESTMAN, secretary War Committee on Radio, American Standards Association and former secretary Institute Radio Engineers

In the development of any program, it is not only logical but essential to give thought to those conditions which may be faced when the major part of the plan has been accomplished. Knowledge of these future possibilities may be helpful not only in reaching more long-lived solutions but in exposing features of the immediate problem which might not otherwise be obvious. Some thought has, therefore, been given to the possible use of war standards on radio components during the succeeding years of peace.

This subject divides into two parts, military and civilian. The probability is that at the termination of the war there will be a repetition of the events which followed World War I. Not only will the Armed Services cancel uncompleted orders but much equipment will be left in foreign parts and additional apparatus and supplies will be "junked" through sale to the general public. In this disposal of excess equipment and supplies, the

older and the less-useful designs will be first on the list while the more up-to-date apparatus will be retained for training and experimental purposes.

Expanding production

Since Pearl Harbor our production of radio apparatus has been steadily increasing. The industry has been expanded and, as skills are being acquired in the construction of the finest equipment which can be made, the production figures are becoming more and more astronomical in character. Each year as the war continues we may expect all previous figures to be dwarfed by an industry that has for the first time in its youthful career really taken the brakes off and applied itself fully to the job of translating every man-hour of time and each ounce of material into usable equipment.

When the war ends, an overwhelming proportion of the equipment will have been manufactured during the last year or so and it will conform to the standards pre-

pared by the War Committee on Radio. It is this apparatus which will be retained for future use while the output of our plants for the earlier months will have been expended in service and disposed of to the public. The Services will then have real standards in the form of physical equipment and not just words on paper.

From this we may assume that the Armed Services will continue to use these standards. Two important factors will be evident. Procurement of new equipment will cease for a substantial period of time, and some revision of the war standards will be in order to stimulate the invention and design of improved components based on the weaknesses observed under combat conditions.

The radio industry may expect a virtually complete termination of all production for the Armed Services and a certain amount of competition in the civilian field from the sale of excess military equipment. The amateur builder will be confused by a plethora of parts ideally suited for his communica-

IMPORTANCE of standardization is indicated by this view showing an early stage in assembling radiophone equipment in a Radiomarine Corp. plant



tions receivers and transmitters. Much equipment will be converted by him to civilian use.

There can be but little application of the standards for radio components for military use to civilian life. The ranges of temperature, barometric pressure, and mechanical abuse that the Armed Services encounter are far beyond those conditions met in civilian life and require a much higher grade of components. Also the penalty for failure differs markedly in the two types of service.

Manufacturers will have learned how to make better components at little or no increase in cost of manufacture as compared with their prewar performance. While the process of learning may have been expensive, that will have been defrayed under government contracts and be forgotten while the skills are carefully nurtured. Thus if we go back to a highly competitive parts business in which a sharp pencil is an all-important tool for staying in business, we may still expect a better product than the public previously received.

Standardization dividends

In so far as components are concerned, reasonably complete standardization will pay large dividends to everyone. It will permit the component manufacturer to con-

centrate on the fewest number of styles and sizes, both electrical and mechanical, that will meet the requirements of the designer of a receiver. This will enable him to quote the lowest possible price for his product.

The set manufacturers, on the basis of well designed and effective components at low cost and the technical advances resulting from the war, will be able to produce receivers of superior performance and life. The public will thus be assessed a minimum price for its broadcast service both in the initial cost of the receiver and in its maintenance.

Sound basic design

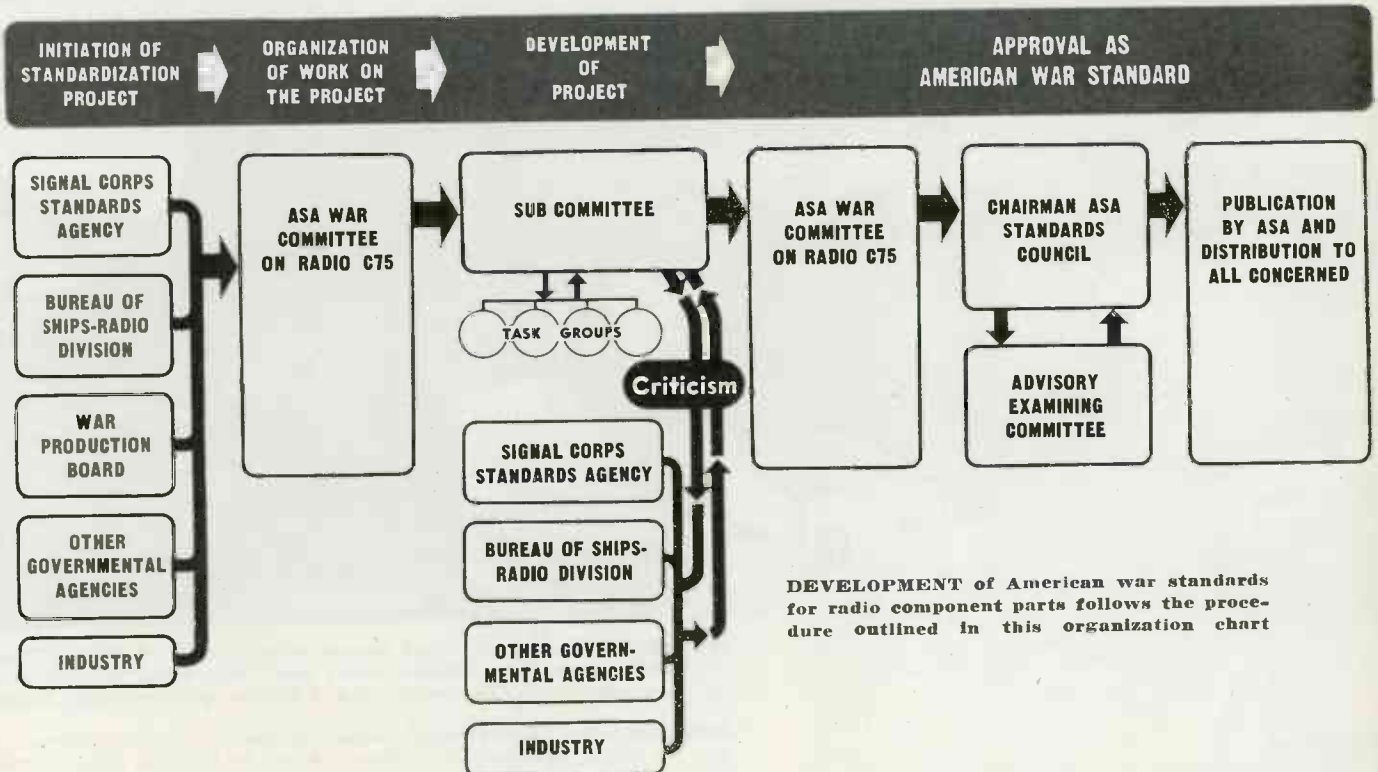
It must be clearly recognized that these views are based on standardization of components only. No proposal is being made in regard to the final design of the receiver. This will continue to be a field in which originality of design, both basic and as concerns frills and gadgets, will determine public acceptance of the product. Whether this cabinet or that be used, whether the panel be vertical or slanted, whether there be a multiplicity of loud speakers or one super unit, are the sleepless nights of the sales and advertising departments.

We do know, however, that in any highly competitive market, the

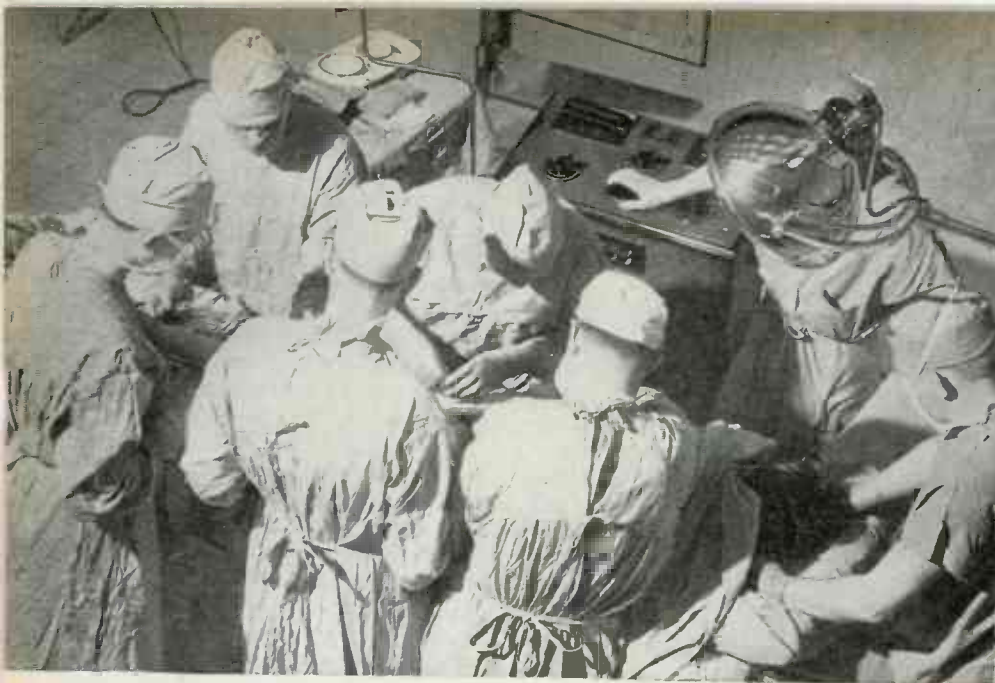
products of which are technical and reach deeply and constantly into the homes and lives of the public, the substitution, as a continuing policy, of superfluous or superficial gadgets in lieu of sound basic design is inevitably fatal. There must be adequate and enlightened design back of a beautiful panel to keep the set sold and the public interested in the future products of the manufacturer.

This should not be interpreted as indicating that there is no place for specialties and design differences on which sales and advertising slogans and campaigns may be launched. We like to exercise our individuality and own not only a useful product but one that differs from that of our neighbor.

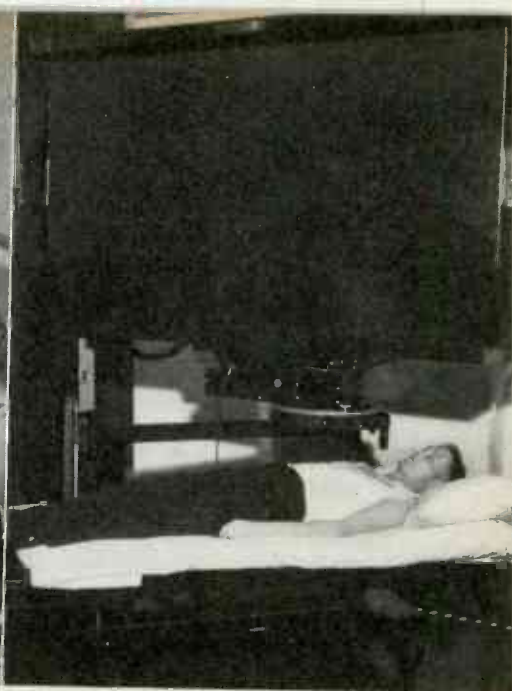
At the termination of the war, the radio industry will be "decommissioned". It will face unsettled conditions resulting from technical advances made during the war, regulatory changes resulting from these technical considerations, excess production capacity, expensive habits learned during the war when results took precedence over costs, a necessity of getting into civilian production fast to meet the accumulated needs of a market which has been starved for years, and a general reorganization as to the quality and performance of the receivers to be designed and sold. A magnificent headache!



DEVELOPMENT of American war standards for radio component parts follows the procedure outlined in this organization chart



RADIO KNIFE—An operation at Naval Medical Center with Davis-Bovie electro-surgical unit which uses two spark produced rf currents for incising and coagulating. Some models use tube oscillators for cutting current



DEEP THERAPY—GE 400 Kilovolt unit in operation at Naval Medical Center

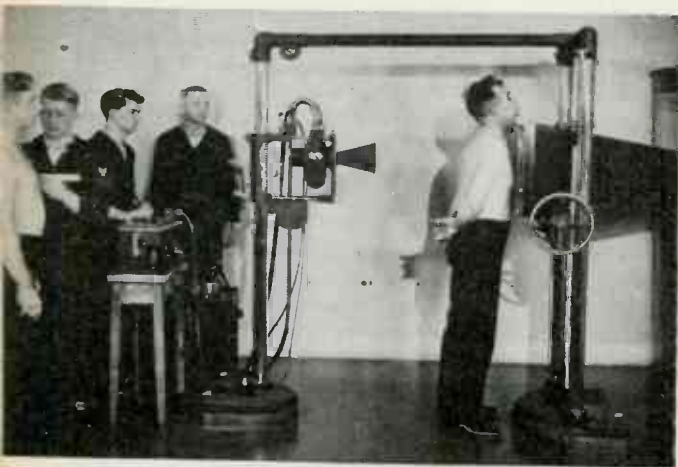
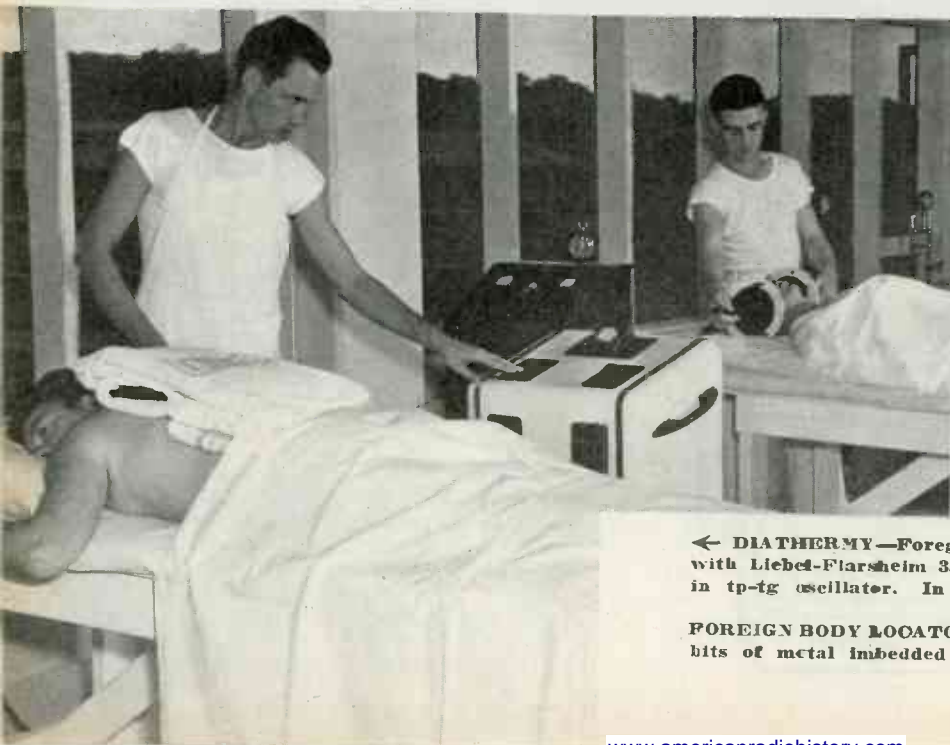


PHOTO-FLUOROGRAPHIC UNIT — This Westinghouse equipment was developed for rapid-fire, inexpensive chest X-ray. It photographs screen images on 35 mm film

ARMY-NAVY Electronic Medical Aids

World War I: 7% of wounds were fatal.

World War II: Only about 1% are fatal.



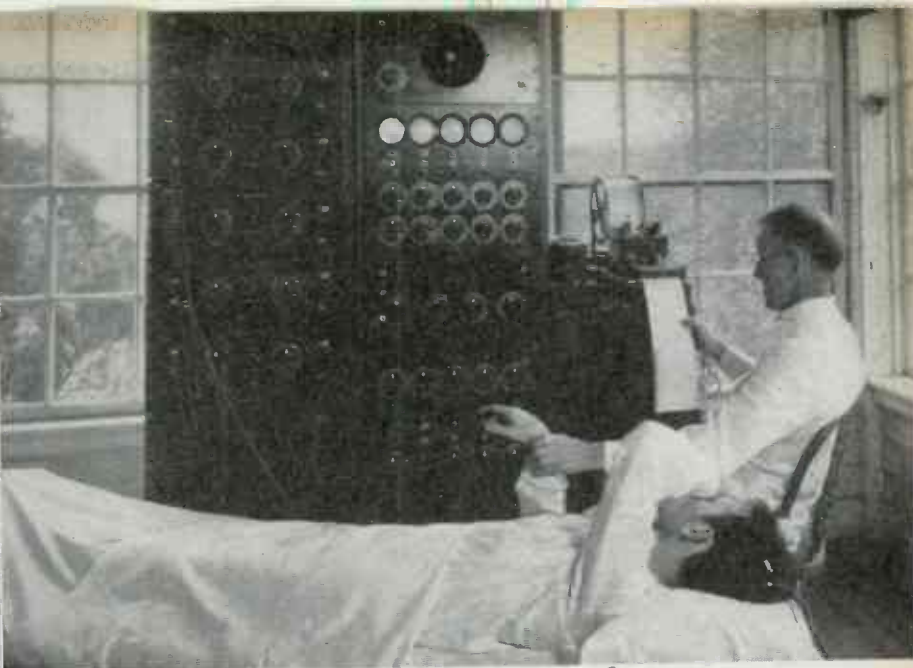
← **DIATHERMY**—Foreground patient being treated for injured back with Liebet-Flarsheim 350-watt short wave unit using WL-462 tube in tp-tg oscillator. In background deForest generator for sinus



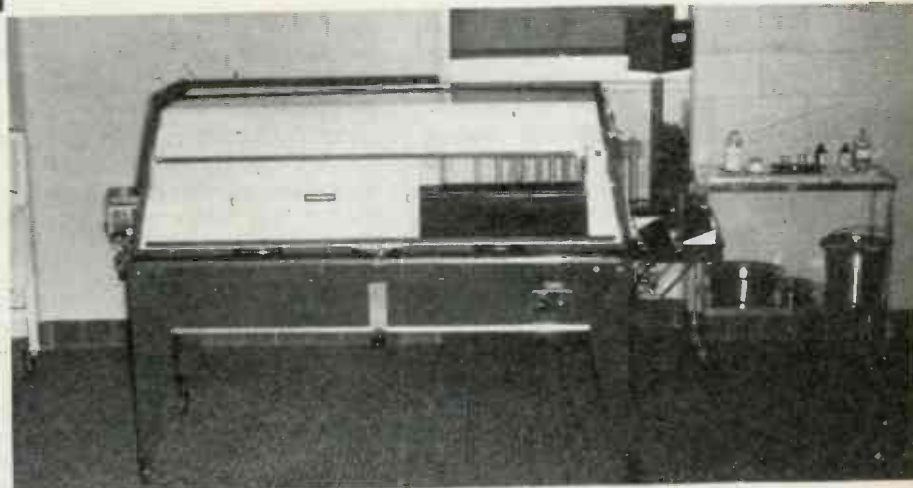
FOREIGN BODY LOCATOR—Moorhead-Berman device for locating bits of metal imbedded in patient. Made by Waugh Laboratories



MOBILE-PORTABLE X-RAY—Packed in three cases, Mattern-Beeber unit can be assembled in 3 to 5 minutes without bolts or screws. Designed by Lieut. Commander W. N. Montgomery, Brooklyn Naval Medical Supply Depot, unit may be air or boat borne to isolated areas, and is used widely by Marines. Signal Corps photo shows Navy personnel X-raying leg of injured soldier enroute to Ireland



ELECTROENCEPHALOGRAPH—This Garreau brain wave recorder, under test, combines both visual analysis (note 5 cathode ray tubes) and recording on paper using five-pen writing unit

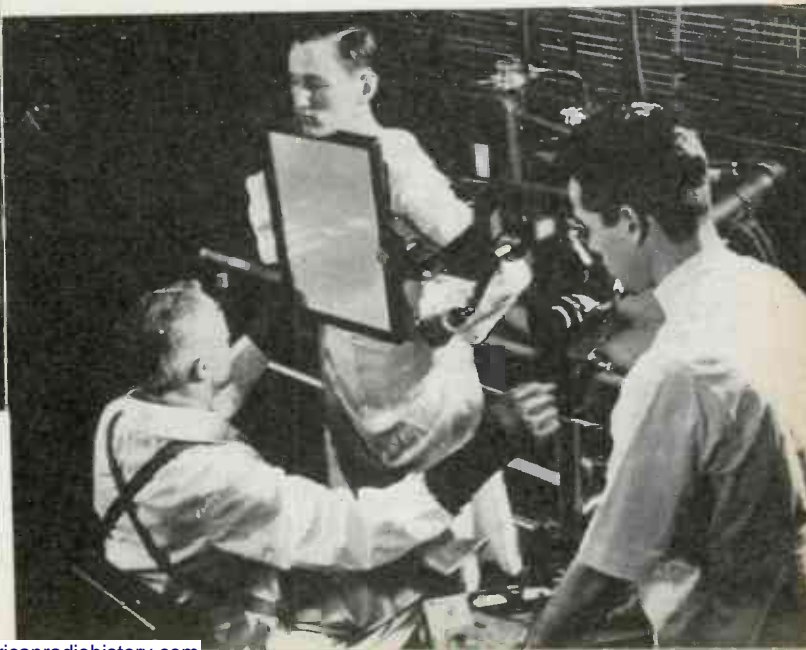


FEVER CABINET—Liebel-Flarsheim unit in use at National Naval Medical center

Electron tubes in modern medical equipment are responsible for a big share of this encouraging news



GRASS ELECTROENCEPHALOGRAPH—Used for brain wave analysis with 4-pen recorder



FIELD X-RAY—Portable Westinghouse apparatus can be set up on battlefield in 10 minutes →

RATING



TEST APPARATUS, designed by Erie Resistor engineers, permits individual tests on the temperature coefficient of Ceramicons, at 25 deg. C. to 85 deg. C.

The temperature - capacitance characteristics of ceramic dielectric materials of the titania-alkaline earth series is one of the factors influencing condenser design and application. The dielectric materials in the series are produced by blending varying amounts of titanium dioxide and a suitable alkaline earth, together with the necessary flux. Titanium dioxide has a highly negative capacitance change with temperature, while the alkaline earth undergoes a moderately positive change with temperature. Any intermediate value can be obtained by suitable choice of the proportions of the constituents. Unfortunately, one of the properties of this material is a non-linear relationship between capacitance and temperature. In general, it is true that for the materials which have large proportions of either of these materials the curve is a closer approach to linearity than for those which are composed of a blend to produce small capacitance changes with temperature.

Because of this property, it is not possible to state the temperature coefficient, which is approximately the slope of the temperature-capacitance curve, without also specifying the temperature, or to state temperature coefficient and tolerance without also specifying the temperature range. See, for example, Fig. 1 which shows the percentage change of capacitance versus temperature for one of the

more nearly linear materials. The temperature coefficient, the slope of the curve, varies from -875 parts/million/ $^{\circ}\text{C}$ at -40°C to -700 parts/million/ $^{\circ}\text{C}$ at $+85^{\circ}\text{C}$. Fig. 2 shows the same information for materials commonly referred to as having zero temperature coefficient. While the capacitance change is very small over the complete temperature range, it is also quite non-linear with temperature. The temperature coefficient varies from -36.5 parts/million/ $^{\circ}\text{C}$ at -40°C to -5 parts/million/ $^{\circ}\text{C}$ at $+85^{\circ}\text{C}$. Notice also that in both Figs. 1 and 2, the coefficient becomes increasingly positive as the temperature is increased. This characteristic is typical of all the materials under discussion.

Tolerance requirements

This condition has existed since temperature-sensitive ceramic dielectric condensers were introduced, but until recently has been unimportant because tolerances were broad, operating temperature ranges narrow, and because, while the temperature coefficient varies with temperature, it is a reproducible characteristic with any given condenser. Furthermore, all condensers of the same material, or mixture of materials, behave the same.

With the narrower limits on temperature coefficient, and the wider temperature ranges now required in equipment for the Ser-

vices, this factor is causing misunderstanding in the procurement and application of these condensers, and especially in the specification of temperature coefficient.

This characteristic must be considered whenever the operation of a circuit is affected, either purposely or by factors beyond the control of the design engineer, by capacitance changes resulting from temperature variations. There is a need to bring this to the attention of all concerned, and to adopt a standardized method of specifying this property. This choice of method should be governed by the following requirements:

1. It should present the information in a form readily usable by the design engineer.
2. It should permit rapid testing so that the characteristics can be verified in production quantities.

In order to explain the method of specifying the temperature-capacitance characteristic to be proposed, an example of the calculations used for circuit compensation will be given.

Compensation limits

After the capacitance value and the nominal temperature coefficient of the compensating condenser which will produce, for example, exact compensation for temperature effects on a circuit have been determined, the allowable variations from the nominal value are determined. Assume that a parallel resonant circuit of the non-adjustable type is under discussion. From the allowable variation of frequency with temperature, the variations in each component are assigned and a proper portion of this used to determine the limits of the temperature coefficient of the compensating condenser.

Let us further assume that the nominal temperature coefficient required above is -444 parts/million/ $^{\circ}\text{C}$, and that the allowable tolerance is ± 46 parts/million/ $^{\circ}\text{C}$. The circuit, then, will function properly with a compensator which has any constant rate of capacity

CERAMIC Condensers

by FRANCIS X. MAIDA

Development Engineer, Erie Resistor Co.

Sensitivity factor method to determine required limits for temperature coefficient value simplifies specification

change between -490 and -398 parts/million/ $^{\circ}\text{C}$.

Fig. 3 shows the frequency variations that will result in the limiting cases; that is, when either the -398 or -490 parts/million compensator is used, after the circuit has been adjusted to the desired frequency at 25°C . For any given temperature such as T_1 , the frequency may have any value between $+f_1$ and $-f_1$, depending upon the temperature coefficient of the compensator. If the reference point is 25°C , it matters little whether the frequency variation with temperature is linear, as long as it always remains within the limits established by Fig. 3.

Capacitance variation

This condition can be translated into terms of allowable capacitance variation as shown on Fig. 4. Curves 1, 2 and 3 show the fractional change of the compensator's capacitance with temperature, for -398 , -444 , and -490 parts/million/ $^{\circ}\text{C}$ respectively. Any condensers whose capacity change, from that at room temperature and any other temperature, say T_1 , lies between the limits set by curves 1 and 3 will satisfactorily meet the requirements of circuit stability. Therefore, the capacitance-temperature characteristic of the compensator may have any shape as long as the change of capacitance at any temperature over the operating range remains within the

area bounded by curves 1 and 3 on Fig. 4.

The measured characteristic of one compensating condenser which will meet the requirements is shown on Fig. 5. At any temperature in the operating range of -40°C to $+85^{\circ}\text{C}$, the capacitance change falls in the area bounded by 1 and 2. These lines represent hypothetical condensers having a constant rate of change of -398 and -490 mmf/mmf/ $^{\circ}\text{C}$ respectively. On the same figure, the temperature coefficient of the compensator versus temperature is shown. Note that even though it varies between -510 parts/million/ $^{\circ}\text{C}$ at -40°C and -360 parts/million/ $^{\circ}\text{C}$ at $+85^{\circ}\text{C}$, a variation of $+66$, -84 , about -444 , the curve is at all points between the lines representing -444 ± 46 parts/million/ $^{\circ}\text{C}$.

The method of determining whether a given condenser will operate satisfactorily resolves itself into the problem of determining

whether the capacitance change at any temperature is within certain limits. Thus, instead of attempting to specify temperature coefficient, which is approximately the slope of the temperature-capacitance curve—a variable quantity—we are specifying that the capacitance change remain within two linear limits. As will be pointed out later, the latter method permits much simpler tests to be performed to determine the suitability of a condenser.

Percentage change

Since we are no longer concerned with temperature coefficient, but, rather, are specifying limits at any temperature for the percentage change of capacitance, a corresponding terminology is required. The limits may be stated in terms of a "Sensitivity Factor," "S," expressed in percentage, which when multiplied by the difference be-

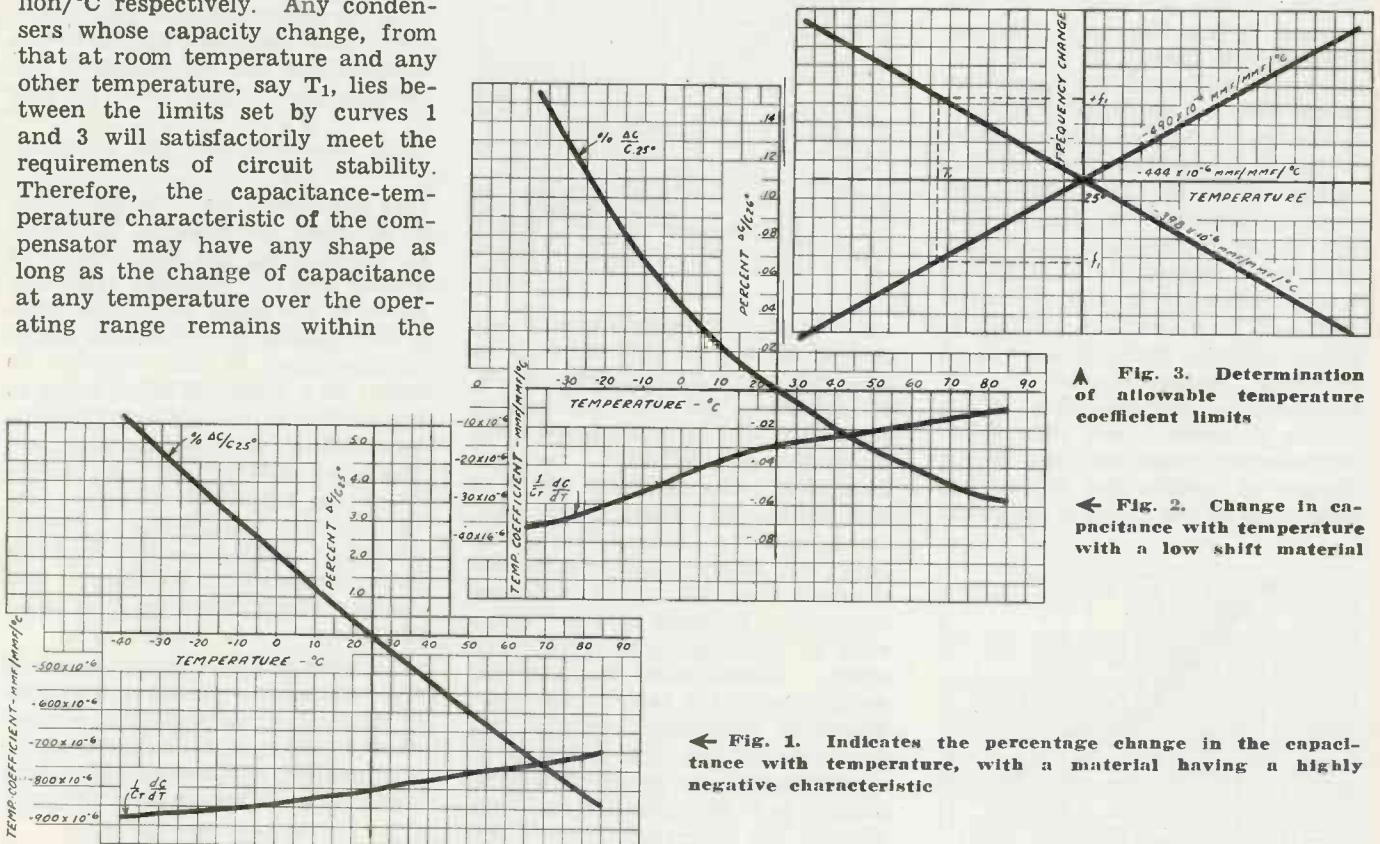
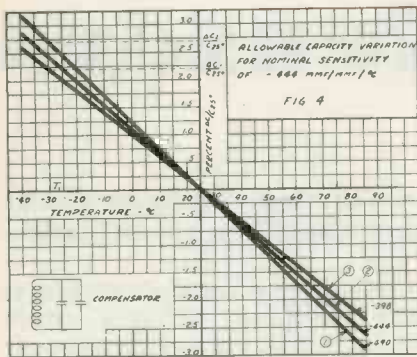


Fig. 3. Determination of allowable temperature coefficient limits

Fig. 2. Change in capacitance with temperature with a low shift material

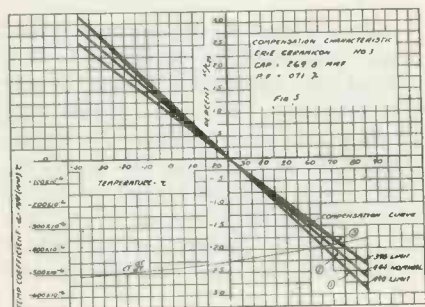
Fig. 1. Indicates the percentage change in the capacitance with temperature, with a material having a highly negative characteristic



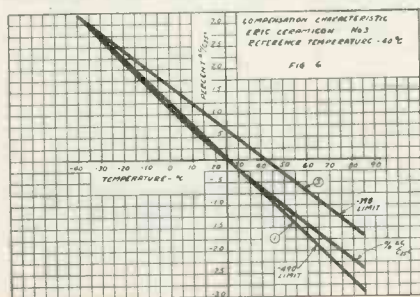
tween the temperature in question and 25°C will give the percentage change of capacitance from that at 25°C. For example, the compensator in the above illustration would be specified as follows:

$$S = -0.0440\% \pm 0.0046\%$$

Thus at +85°C, the capacitance change will be between (85-25) (-0.0440 ± .0046)%, or between -2.36% and -2.92%.

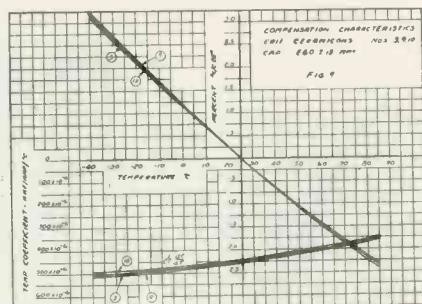
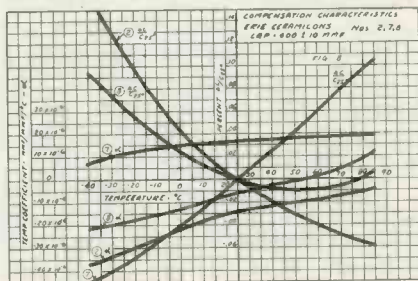
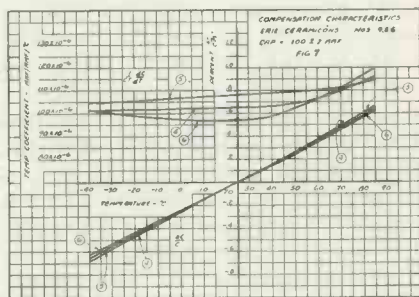


One of the limitations of this method is that for any reference temperature except 25°C, or any other value adopted, the sensitivity factor does not apply directly. This is illustrated for an extreme case, on Fig. 6, which shows the compensation curve for the same condenser illustrated by Fig. 2. On the latter illustration where the reference temperature is 25°C, the sensitivity factor, S, between -40°C and +85°C. is .0440% ± .0046%. If this sensitivity factor is applied at reference temperature of -40°C, for example, the condition shown on Fig. 6 results. Over part of the temperature range the capacitance change is within the limits, but over some of the range it falls out-

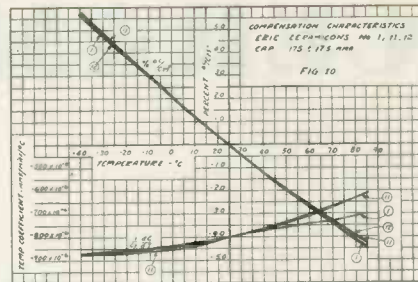


side. This, of course, results directly from the fact that the temperature coefficient is not constant, and will require consideration whenever the reference temperature is appreciably different from 25°C.

A logical line of attack to overcome this effect is indicated by the uniformity of the temperature-capacitance characteristic of condensers made of the same material, or blend of materials. This uniformity has been proven by a great



number of observations over a period of 18 months, and appears to hold not only for condensers made of materials of one production batch, but also for those made from materials of different batches. Thus it is a characteristic which is reproducible in practical commercial operations. Figs. 7 through 10 show the temperature-capacitance characteristic for three different condensers in each of four materials in the titania-alkaline earth series. Notice that the nominal sensitivity factor varies from condenser to condenser, but that the curvature of the characteristic is approximately the same. This similarity can be demonstrated by plotting the difference between the



actual temperature coefficient at any temperature and the temperature coefficient represented by the nominal sensitivity, and expressing this in parts/million/°C.

This is shown on Figs. 11 through 14 for the characteristics of Figs. 7 through 10 respectively. It will be possible, then, to prepare such information for each dielectric composition in use, to serve as a guide to indicate the compensation of the condenser at any temperature once the nominal has been established. This guide cannot be exact, but will be within the limits indicated by the spread of the curves on Fig. 11 through 14.

Measurement considerations

The true temperature coefficient of a condenser is expressed as

$$\frac{1}{C_T} \frac{dC_T}{dT}$$

where C_T is the capacitance at the temperature T.

In order to determine this quantity, a continuous curve of capacity versus temperature can be obtained experimentally. The slope of this curve is $\frac{dC_T}{dT}$, and the temperature coefficient can be calculated by dividing the slope by C_T .

Since C_T depends on the temperature it should also be obtained from the curve at the point where the slope is determined. For materials under consideration it can usually be taken as a constant value equal to the measured capacitance at room temperature, or when greater precision is desired, it can sometimes be expressed as $C_T = C_{25} (1 + \gamma' \Delta t)$, where C_{25} is the capacity at 25°C, γ' is the approximate temperature coefficient, and Δt the temperature change from 25°C.

Obtaining a continuous curve of the capacitance change undoubtedly yields very complete data of condenser performance, but is a laborious process, and one which is time consuming. The capacitance may

(Continued on page 187)



Mr. Nicholas has been 30 years in radio, first as ship operator and later as installation engineer for the old Marconi company. As vice-president in charge of sales for RCA and later manager of patent licensing, he developed the rounded ability which characterized the founding of the Farnsworth company in 1939. This organization has since become a leader in radio, television and electronic research and manufacture.

Many engineers who have not previously been concerned with the problems of management have found that war has revolutionized their thinking and working habits—has placed upon them additional responsibilities, that necessitate a different approach than the methods outlined in text-books and taught in engineering classes.

The native or acquired talent of being able to concentrate on a single objective has long been considered a virtue of utmost importance in the success of an engineer. Retiring within a sphere of mental thoughts that must not be disturbed by the intrusion of other subjects, must now give way to an added virtue; the ability to seek and obtain the assistance of others.

Cooperation and action

In viewing the larger pattern of things which the added managerial duties present to him, the engineer will find that assistance and cooperation are essential to action.

"The great end of life is not knowledge but action."

In these words, Huxley presents a thought which every person clothed with executive responsibility must keep foremost in his mind, especially so the engineer who has just taken on such responsibilities.

When Engineer IS BOSS

by E. A. NICHOLAS

President, Farnsworth Television & Radio Corp.

What the technician must think about when he gets into executive responsibilities

As an engineer, his main forte has been his knowledge; as an executive, his main forte must be an ability to get action. And this ability will depend directly upon his thinking habits.

True, there are many rules of practice that are essential to successful executive thinking. Some of these rules may not be familiar to one who previously has devoted his efforts solely to engineering.

For example, executive thinking must be in terms of evaluation; things must be seen in their proper proportions—with relation to the objectives of the executive's organization as a whole; first things must be put first. An open road must be given to the thinking that is important to the organization's objective, regardless of the difficulties and inconveniences involved; and the irrelevant must be by-passed regardless of its immediate attractiveness.

The engineer may previously have been concerned solely with the solution of particular problems assigned to him. As an executive, he must continually decide whether the solution merits its time and cost.

The executive must have the courage to make decisions; he must have the faculty of thinking in terms of the future; he must have the ability to plan a program and the courage to insist that it is carried through to completion.

Faith in others

But all of these characteristics or rules of conduct for executive thinking are well recognized and more or less generally practiced. There is, however, another rule that is perhaps not so well recognized, although it is probably of the greatest

importance to successful executive action.

I believe it was Cardinal Gibbons who said, "I have lived eighty-six years. I have watched men climb to success, hundreds of them, and of all the elements that are important for success, the most important is faith." This faith for the executive must embrace a faith in those with whom he works.

The engineering-minded man is more likely to become an individualist in his thinking habits than is a person whose work has been of a more general executive nature. In many cases, this is highly desirable in engineering.

Flexibility in thinking

But the engineer vested with new managerial responsibilities is called upon to be more flexible. He must learn to pass his thoughts on to others and enable them to add their best thinking to his. True, he must lead them, he must work with them and have faith in them. His strength and the success of that which he seeks to accomplish, as well as depending upon his leadership, depends upon giving a clear channel for the abilities of each person whom he leads.

As an engineer, an individual's success is generally evaluated on the basis of his personal accomplishment—as an executive his work goes beyond the confines of his own laboratory and the measure of his success is the accomplishments of his associates.

In other words, good management, which is synonymous to executive ability, is measured by group or organization accomplishment, rather than by the accomplishment of any one individual.

SIGNAL GENERATOR

by H. J. TYZZER

Ferris Instrument Corp.

The increasing use of ultra-high frequencies has introduced many new problems as far as the application of standard signal generators is concerned. Unlike the lower broadcast frequencies, for example, the characteristics of the signal generator itself play a much more important part at uhf and must be considered if accurate results are to be obtained.

A signal generator, as the name implies, is a device or instrument for the generation of radio signals of definitely established frequency and intensity, with or without modulation. One of the principal functions of a radio signal generator is to serve as a signal source for the testing of radio receivers, in which case the signal generator is generally considered to deliver signals equivalent to those to be received when the receiver is in future use.

Dummy antennas

The methods of measuring broadcast and short wave receivers, standardized by the Institute of Radio Engineers in 1938 provide a common basis for such receiver measurements. A form of standard dummy antenna as outlined by these standards is shown in Fig. 1. This dummy antenna is essentially a capacity reactance at the low broadcast frequencies and becomes purely resistive in the range above 10 mc. This resistance of 400 ohms, however, is considerably in excess of ultra-high frequency antenna resistance normally encountered.

Not only is this dummy antenna not adapted to uhf frequencies but also the method of connecting the signal generator to the receiver requires special consideration.

Leads

Whereas, in the case of broadcast band generators the length of lead from the generator to the receiver, which usually includes the dummy antenna placed at the receiver input terminals, is of minor importance this is not true at the higher frequencies. If widely separated high and low rf leads of appreciable length are employed, the delivered signal varies widely with frequency and may quite likely be far different from that produced by the signal generator. Twisting the two leads together to form a transmission line from the generator to the point of application requires a thorough consideration of transmission line technique.

A twisted pair or concentric line such as an internal conductor with outside conducting shield provides a transmission line of definite characteristic or surge impedance as determined by the capacitance and inductance of the line per unit length. If such a transmission line is left open or short circuited at the far end, serious reflections occur particularly when the line is long as compared with a quarter wavelength of the frequency involved. In order to avoid these reflections the transmission line should be terminated in a resistance equal to its characteristic impedance.

An illustration of this procedure is the Ferris Model 18C, a signal generator (trade name—Microvoltage) covering the range from 5 to 175 mc. This instrument uses a transmission line 3 ft. long which has a characteristic impedance of 30 ohms and both ends of the line are terminated in 30 ohm resistances. The output voltage across the terminating resistance at the far end of the cable is adjusted to be that which is indicated by the output attenuator.

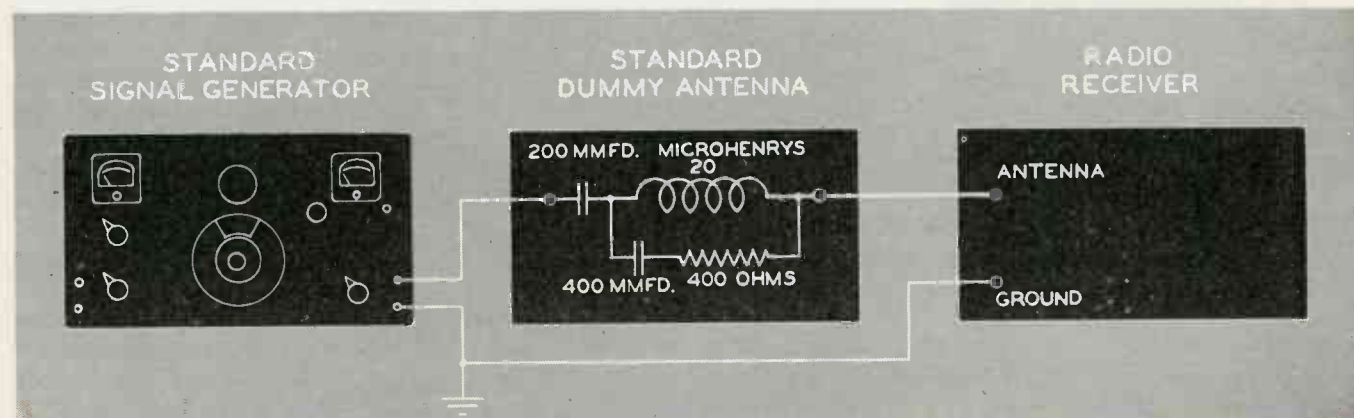
Output impedance

The application of a further load to the output terminals will tend to reduce the delivered voltage and if of sufficiently low value of resistance will give rise to reflections and standing waves. This indicates the desirability of providing as low an output impedance as possible at the end of the cable to minimize the amount of upset by the application of additional load.

The main drawback to this procedure is that the lower the output resistance the more power must be supplied by the signal generator to maintain a given voltage. This increased power usually means a stronger oscillator, higher voltage power supply and better shielding within the generator which adds to its cost.

Another method is to provide an output cable without termination, such cable to have an impedance equal to the anticipated load which will be applied. As the average ul-

Fig. 1—This standard form of dummy antenna is not adapted for use at ultra-high frequencies



Characteristics at UHF

Design of equipment and method of using it requires special consideration in view of many problems involved in obtaining reliable results

tra-high frequency receiver has an impedance to match a half wave antenna which is usually about 75 ohms, this cable may have a 75 ohm characteristic impedance. This method requires a less costly generator but has the disadvantage that without the proper load the variations of output with frequency due to reflections are considerable. Then, too, there is the question of whether the output shown by the attenuator is with or without transmission line loading.

In the case of a 30 ohm line as described with a 30 ohm termination, the application of an additional 75 ohm load reduces the termination to approximately 21.5 ohms by its shunting effect. This results in a drop in output voltage of about 23 per cent and causes some reflections which are dependent upon the frequency involved and length of line as well as the amount of mismatch. The effect of other values of resistance load on the termination and delivered voltage is shown in the curve, Fig. 2. These points were actually observed in measurements taken at 100 mc with an 18C Microvolter at maximum output level. Some deviation from these values at other frequencies may be expected due to reflections particularly at higher frequencies and low values of load resistance but in general will be of the same order.

Load value

The error introduced by this 75 ohm load may be reduced considerably if an additional 75 ohms is placed in series with the load, thereby reducing the shunting effect to that of 150 ohms, making the line termination 25 ohms, and reducing the output voltage by only 12 per cent with less reflection due to mismatch. Under these circumstances the voltage applied to the receiver terminals is one-half of that at the transmission line termination. This has the additional advantage that the receiver loading is more nearly correct.

In some of the more elaborate ultra-high frequency generators, such as the Ferris Model 40A (Fig. 3), a 3 ohm tap is provided on the

30 ohm termination. Connection of the average receiver load to this 3 ohm tap has but little effect on the delivered voltage or the transmission line termination but only one-tenth of the maximum voltage appears at the tap.

Frequency modulation effects

There is another effect encountered in high and ultra-high frequency signal generators which may differ from the actual receiving conditions in the field. This is the modulation characteristic of the signal generators. Small amplitude modulated signal generators such as the 18C are invariably modulated by plate voltage variations in the oscillator. In the case of high frequencies this variation of plate voltage produces variations in oscillator frequency as well as amplitude. The amount of frequency modulation depends upon the frequency involved and the tuning capacitance in the oscillator tank circuit among other factors.

As actual radio transmitters of the amplitude modulated type usually employ crystals, with frequency multipliers and modulated rf amplifiers giving freedom from frequency modulation, their effect on a receiver may be quite different from a signal with both amplitude and frequency modulation present.

This is of course particularly true when overall measurements including audio response are taken, as band width measurements under these circumstances will not be cor-

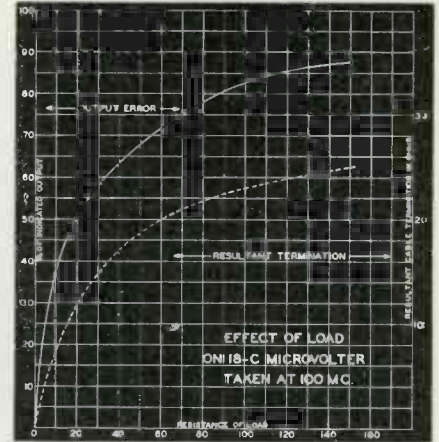


Fig. 2—Effect of resistance loads on termination and delivered voltage

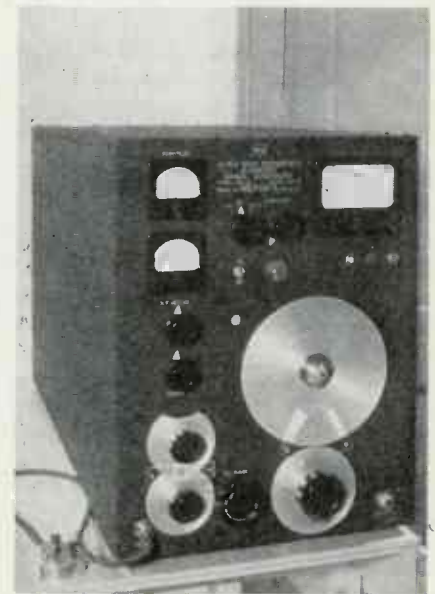


Fig. 3—Ferris model 40A signal generator for ultra-high frequencies

Fig. 4—Essential elements of 18C attenuator which is constructed in four sections with careful attention to thorough shielding

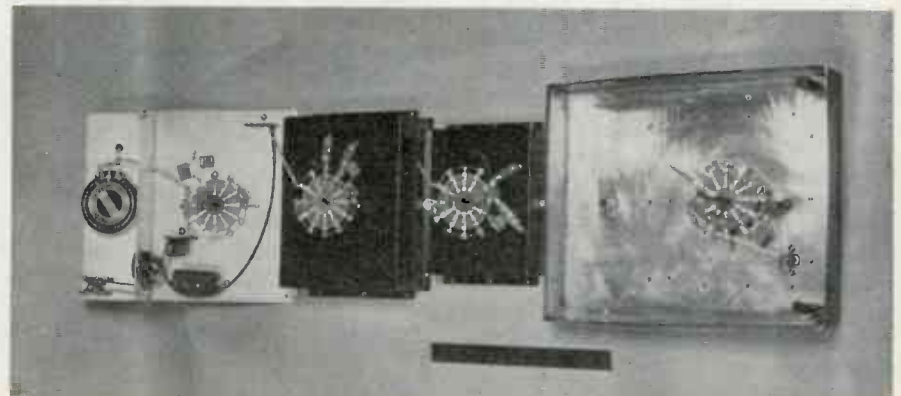




Fig. 5—Resistors in 18C attenuator are virtually buried in aluminum block to avoid undesirable coupling

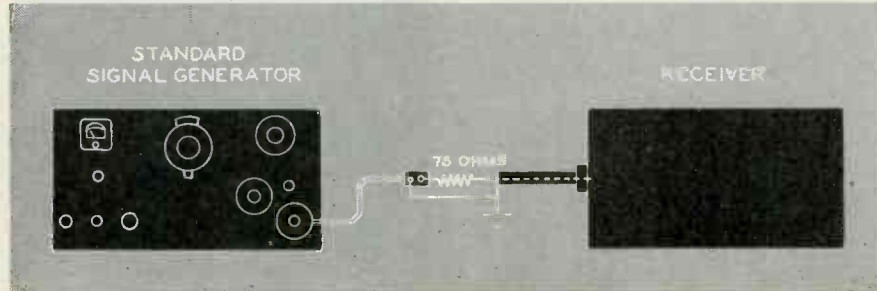


Fig. 7—Method of inserting additional resistance to double load on generator and more nearly match input circuit to the receiver

rect when frequency modulation as well as amplitude modulation is present. Many government specifications insist that signal generators used for this type of measurement be free from frequency modulation. An example of a signal generator which is free from frequency modulation (the Ferris Model 16C) consists of an oscillator, buffer stage and modulated rf amplifier. It covers a range of from 50 kc to 25 mc with an output from a fraction of a microvolt to two volts across a 30 ohm terminated transmission line. A similar signal generator having a range of from 25 to 250 mc, the Ferris Model 40A, delivers up to 1 volt across a 30 ohm termination and has a 3 ohm tap giving one-tenth of this output.

In a third generator, covering the range from 200 to 500 mc (the Ferris Model 48A) freedom from frequency modulation is obtained by using a very strong stable resonant line oscillator to which a modulated rf amplifier is weakly coupled, thereby having but little if any reaction on the oscillator. This generator also has a 30 ohm terminated line with a 3 ohm tap and delivers a maximum of 0.1 volt across the 30 ohms or one-tenth of this value at the tap. These three signal generators collectively cover the range from 50 kc to 500 mc with freedom from frequency modulation.

In addition, crystal controlled generators which provide a standard of frequency as well as cali-

brated output and freedom from frequency modulation have been provided for spot frequency work. These employ frequency multipliers and modulated rf amplifiers and so duplicate the average ultra-high frequency transmitter.

The difference of behavior of various types of signal generators at high and ultra-high frequencies under varying conditions has been somewhat disconcerting to many laboratory workers, but if due consideration of the conditions is taken

the analysis of observations is not too involved. For example, if we attempt to measure the output from an ultra-high frequency signal generator with a vacuum tube voltmeter we find that certain precautions must be observed.

Input diodes

At these frequencies we approach the resonant frequency of the input circuit of the VTVM with the result that the resonant rise may give readings in excess of the applied voltage. By the use of input diodes having an inherent high resonant point and very short leads between the transmission line terminating resistor and VTVM reasonably accurate measurements up to 500 mc may be made. If a slight increase in lead length shows an appreciable rise, indications are that operation is too close to the resonant input frequency to be accurate. The actual error due to resonance has been given by L. S. Nergaard* in the form of a correction factor to be applied to the indicated voltage. This correction factor is equal to

$$1 - \left(\frac{\lambda r}{\lambda} \right)^2$$

where λr is the resonant wavelength of the diode and for an RCA acorn tube equals 40. λ is the wavelength employed in cms.

As stage measurements may be made by applying the signal to the grid of the rf amplifier tube, it is

*Radio at UHF (RCA Inst. Tech. Press).

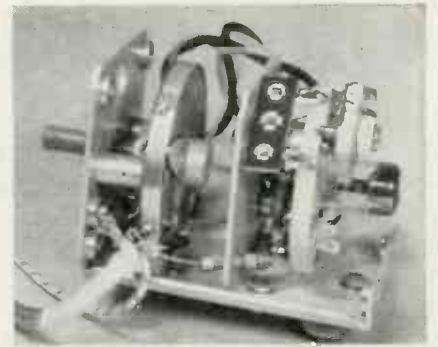


Fig. 6—Diode assembly used in 18C attenuator showing silver ribbon inductance potentiometer

important to consider the loading effect of the tube on the generator and any resonant effects due to lead lengths, etc. It will be readily seen that this ultra-high frequency technique is quite different from that employed in the design of broadcast receivers, for example, and the characteristics of the signal generator are liable to play an important part in the results.

Absolute value

The question has often been asked how the absolute value of a microvolt or millionth of a volt is determined and the impression is widespread that the variation between different types of signal generators is due to the difficulty in establishing a one microvolt standard. In view of the foregoing analysis of transmission line termination, it appears quite evident that this is probably the real seat of differences encountered.

It is a comparatively simple matter to establish an audio frequency value of 0.1 volt or 100,000 microvolts by direct reading with a thermocouple and galvanometer for VTVM calibration. Proper design of the VTVM to avoid resonance error permits its use at the higher frequencies and successive decade steps or reductions of 10 to 1 will eventually reduce this value to 1 microvolt. Of course it is necessary to check each decade step accurately and provide adequate shielding to prevent overall feed which would upset the output but this can be done. In fact, it is remarkable how two entirely different types of attenuator will give the same answer for a 1 microvolt level, which indicates the correctness of the result. In use the signal generators indicate practically the same level for 1 microvolt at frequencies where they overlap (20-25 mc) in spite of the vast difference in attenuators. Fig. 4 shows the essential ele-

(Continued on page 188)

HIGH SPEED Electronic PHOTO LIGHT

by **ARTHUR PALME**

Pittsfield, Mass.

Trigger circuit for "freezing" rapid-moving objects

While not in the least comparable in smallness, lightness and ease of transportation with the commonly used electric photoflash bulb, the Edgerton electronic speed light will become now quite popular in view of the restrictions, placed upon the general availability of the flash bulb.

ing only about 1/30,000 of a second, permitted the needle-sharp arresting of motions, hitherto entirely beyond the scope of the fastest mechanical camera shutters.

In the following is given a detailed description of the basic circuit. Slight variations, particularly in the "trigger circuit," can be made

and will be found to work equally as well as the method indicated. This circuit is common to all existing speed lamps of this type.

Referring to the circuit diagram, the following component parts are required:

A 3-winding transformer T_1 of about 300 to 500 va. capacity and very short time rating.

Primary 110 to 115 volt, 60 cycles.

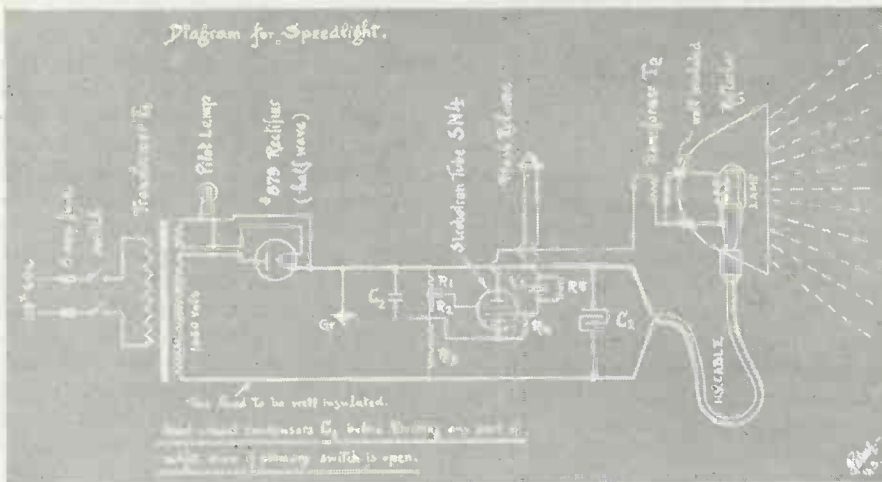
First secondary 1650 volt.

Second secondary, fully insulated from first, 2½ volt. Such a transformer is listed ready-made by the Raytheon Co. of Waltham, Mass. as cat. No. U-3149.

One half-wave rectifier tube, such as RCA-879 or similar. Its filament is heated by the 2½ volt winding of T_1 .

One Strobotron tube, such as SN-4 of Sylvania Electric Products, Salem, Mass., or similar.

(Continued on page 133)



Circuit of high-speed light. Caution: Short-circuit condensers C_1 before touching any part of outfit, even if main switch is open

About ten years ago Prof. Harold E. Edgerton of M.I.T. took up an old French idea to utilize an electric spark discharge as an illuminant for photography, where extremely high speed was to be arrested, far beyond the capacity of any kind of mechanical shutter.

Circuit action

Benefitting by modern achievements with electronic tubes and experiences with electric discharges through tubes, filled with certain rare gases, Edgerton developed an outfit, in which the discharge of a condenser was directed through a krypton or argon-filled glass tube, emitting a very powerful and photographically highly actinic light. In addition, such a discharge last-



Typical photo made in 1/30,000th second (100 mfd). Light ten feet from subject. Agfa SS Panfilm. Lens opening f:16

LABORATORY KINKS

Extending the Range of a Signal Generator

A problem comes up at times in laboratories that are not equipped to measure signals in the ever-increasing higher frequency ranges; that is, measuring a frequency beyond the range of its signal generator. This signal can be applied to a mixing or a detector circuit of some kind, together with an adjustable signal of a lower frequency from a standard oscillator or the signal generator. The oscillator is set so that some undetermined harmonic of the latter is found to beat with the unknown signal. This will happen at more than one setting of the dial, assuming, as is generally the case, that harmonics exist in the oscillator. Carefully determine several of these frequencies that appear in successive order on the dial of the standard where beat notes occur, with emphasis on avoiding missing any one of them in order. Since the unknown frequency is higher than the standard it will be evident that the greater the difference the more numerous the points where these beats are heard.

A trial computation can be made using several successive frequencies determined in this way: f_1, f_2, f_3, f_4 , etc., applied to the relation $f_x = \frac{f_1 f_2}{f_2 - f_1}$

If no intermediate beat has been missed this computation gives a rough value of the unknown. The precise value will be the value of either f_1 or f_2 multiplied by some integer which gives the value nearest f_x . Inasmuch as extra beat notes are frequently noted, the value should be checked using a third beat note setting, f_3 , and then a fourth in the same succession, f_4 ,

$$\text{then } f_x = \frac{f_1 f_2}{f_2 - f_1} = \frac{f_2 f_3}{f_3 - f_2} = \frac{f_4 f_3}{f_4 - f_3} \text{ etc.}$$

Any of these relations that do not give the same value of f_x should be disregarded, as false harmonic tones were probably used.

In order to assist in making these computations the accompanying chart can be used to advantage.

Speeding Up Inductance Measurements

When making tests on a Q meter (or other type of instrument based on resonance measurements) inductance and capacitance values bear reciprocal relations with each other at the frequencies listed in the table. For greatest convenience these frequency points can be "spotted" on the oscillator dial direct and the capacitance scale can be provided with values equal to the reciprocal of capacitance values.

TABLE 1

Frequency	Inductance
50.33 KC	$L = 10^4 \div C$
159.16 KC	$L = 10^3 \div C$
503.30 KC	$L = 10^2 \div C$
1.5916 MC	$L = 10 \div C$
5.033 MC	$L = 1.0 \div C$
15.916 MC	$L = .10 \div C$

(Values are in m.m.f. and millihenries.)

For greatest accuracy the distributed capacitance of the inductance coil must be added to the capacitance value of the tuning capacitor at resonance.

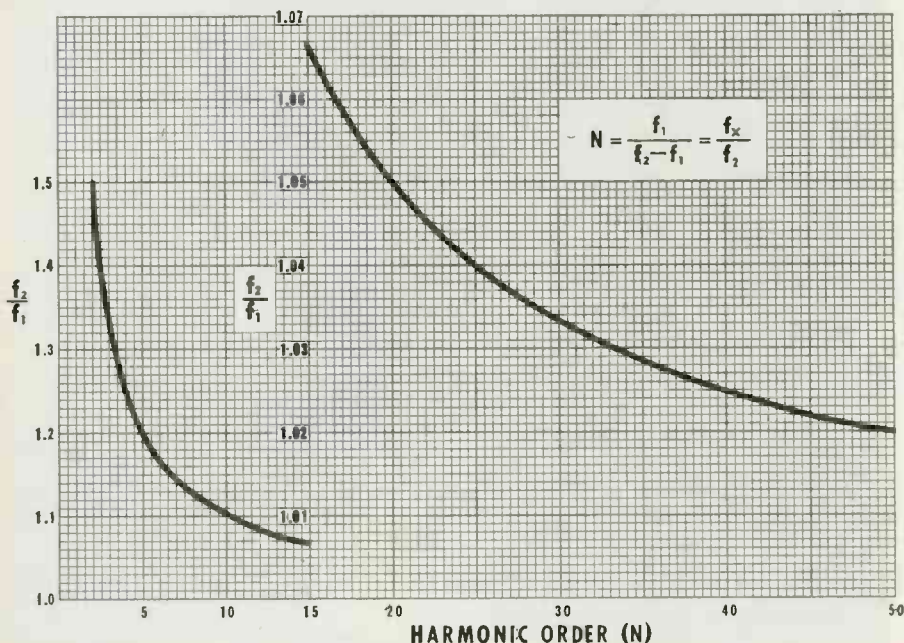
The distributed capacitance of the coil can be quickly measured (if it has an inductance greater than a few microhenries) by connecting in another coil having an inductance of 1 per cent or less of the first, across the tuning capacitor. It will resonate at a frequency 10 times (or more) greater than the value selected for the test coil and used in Table 1. Having resonated the new coil to that frequency, connect the coil whose capacitance is to be determined across the tuning capacitor, and find out how much the setting of the latter has to be altered in retuning. The inductance change due to the two coils in parallel will be quite small and the shift can be considered to be that caused by the distributed capacitance of the coil alone.

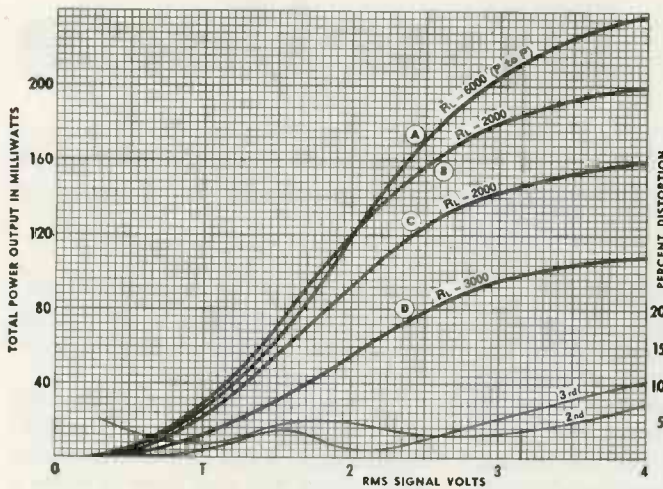
When the inductance being checked is small to start with, it may not be possible to find a second coil sufficiently small to carry out this procedure. The usual method* in this case is to determine the capacitance C_1 needed to tune the coil to resonance with frequency A (select the latter so that practically full scale capacitance is needed) and then reduce this capacitance until it is approximately one-quarter of the first value, whereupon a deflection due to the second harmonic of the oscillator setting can usually be noted. Call this value C_2 . Then $C_D = \frac{C_1 - 4 C_2}{3}$. Since C_D is

usually quite small it is necessary to use extreme care in making these settings. If the second harmonic of the oscillator is not evident, the oscillator must be carefully retuned to the doubled frequency.

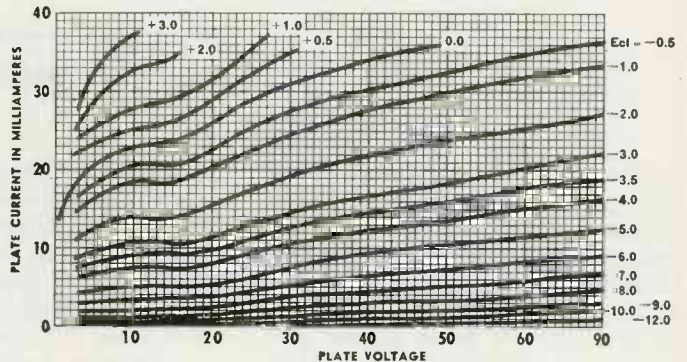
*Reference Proc. IRE, Aug., 1921, p. 300

HARMONIC ORDERS in signal generator range





POWER OUTPUT curves at 28 volt operation on filament screen and plate. (A) Push-pull operation, (B) parallel operation, (D) single tube operation all with fixed -3.5 v bias. Curve (C), parallel operation with 150 ohm self bias. Below, plate characteristic curves with 0.2 meg. grid resistor



AMPLIFIER TUBES for LOW ANODE Potentials

Type 28D7 power output tube developed by Sylvania for simplified mobile operation

One of the main arguments against the use of electronic devices for incidental control problems is the nuisance factor brought about by the need for auxiliary equipment in the way of a power supply for filament and plate circuits. In many places the use of a power line as the direct source of both voltages has brought about the necessary simplification. In mobile operation, however, a power line source is non-existent, and storage battery operation is obligatory.

Tube for aircraft

At the present time there is considerable interest therefore in a double section beam power amplifier tube, type 28D7, developed by Sylvania, designed especially for aircraft service, where a 28 volt battery is often standard equipment. It uses this battery for both filament and plate supply. A tube of this type can doubtless be adapted to the solution of the problem of operating a radio receiver directly from a 32 volt farm lighting system. Giving an output of the order of 200 milliwatts at these voltages, a maximum of more than 100 volts is not recommended.

The Type 28D7 is a Lock-In output tube, consisting of two beam

power amplifier units in the same bulb, having the control grids and plates of each section brought out to separate pins. A common cathode connection is provided and a common terminal for the screen grids. The heaters are connected in series internally, and the cathodes are not tied to either heater terminal.

The two sections of the tube may be operated separately, they may be connected in parallel, or they may be employed in a push-pull circuit. Two different recommended loads per section are specified, the choice depending on whether both sections are to function as single-ended amplifiers or whether the two sections are to operate in push-pull. Where each section is used as a single-ended amplifier, the load per section should be 4,000 ohms, to insure reasonably low second and third harmonics. If the two sections operate in parallel, the load would be approximately half this value. For push-pull operation, the load per section should be 3,000 ohms since with this value the third harmonic is low and the second harmonic, although high, will be canceled by the push-pull circuit. A plate-to-plate load of 6,000 ohms should therefore be used.

The tube will furnish comparatively large amounts of power at low plate voltages. Since the cathode power is proportionately higher than usually used in power output tubes, for this reason the power output of a Type 28D7 is very flat over a wide range of heater voltage. There is a drop in power output of approximately 3 per cent with a heater voltage change from 32 volts to 17.5 volts.

600 mw output

In applications where the tube is required to operate for any extended period at heater voltages in excess of 28 volts, a resistor should be inserted in series with the heater supply voltage and the heater.

Power output of the order of 600 milliwatts is possible from a single Type 28D7 under Class A conditions at approximately 11 per cent distortion. Another Type 28D7 is capable of furnishing the driver power with an interstage transformer having an impedance of 6:1.

Ratings

Heater Voltage	28.0 Volts
Heater Current	0.400 Ampere
Maximum Plate Voltage	
(Per Section)	100 Volts

(Continued on page 183)

WHO WILL Distribute

Sales engineers likely the key with business gravitating to organizations best qualified by experience to handle it

Summing up many interviews with radio wholesalers, distributors, salesmen representatives, and parts jobbers, regarding the postwar distribution and industrial marketing of electronic devices and parts, the opinion appears to be almost universal that the methods and channels of merchandising, distribution and servicing of this radio-electronic material will not change very much from what they have been in the immediate past and during the prewar days.

That there will be much more electronic business and on a wider scale of parts and material, is quite generally expected. But it is not anticipated that any new form of selling or servicing will be inaugurated, although in some cases the belief is that one or two of the larger manufacturers, now engaged in the manufacturing of radio-electronic devices may, conceivably, establish their own systems of selling and servicing their own brands of electronic products.

Aaron Lippman, the Newark, N. J., distributor, who last year led the move to change the name of the

radio-parts jobbers' body to that of the National Electronic Distributors Association, believes that there are already jobbers in the present field who are best capable of handling electronic equipment. The ones best fitted for this job, he thinks, are the ones that have "ham" experience, and have seen fit to enter the industrial field.

Electronic sales engineers

"There is no doubt the war will release a good many radio engineers, who will have some ambition to enter the electronic field as a business," says Mr. Lippman. "The present-day jobber who is wide awake certainly has the jump on any newcomers because he already has a representative inventory, and with his contacts of today he certainly should be in a position to furnish the equipment and service that is required.

"The jobber will have to make some changes in his personnel to handle the new field of electronics. For instance, I believe his entire sales force must be replaced by

electronic sales engineers, men who will be in a position to advise the use of the various equipment to be sold by the distributor.

"I also feel that a jobber will have to set up a repair department to maintain some of his equipment. The jobber will also have to have a definite understanding with his suppliers as to territorial protection, with a definite sales plan."

Distributes economically

A. D. Davis, president of Allied Radio Corporation, Chicago, observes:

"Let us disabuse ourselves once and for all that the word 'electronic' means anything else but tubes of various sorts, resistors, condensers, volume controls, switches, etc. There is presently existing a means of distribution of such equipment. No other means of distribution has come forward which would tend to perform this economic function at a lower cost or give greater service.

"If the application engineers should develop new products which become specialties, then the distribution of those new products will fall into the classifications naturally suiting them. For instance, soldering irons, radio sets, and tube testers, are electronic equipment and can be distributed by any radio or electronic distributor, which is one and the same term. On the other hand, photoelectric-cell door-openers and safety devices, where engineering is involved, are not over-the-counter businesses excepting insofar as a packaged item might be developed to be easily adapted to each individual requirement. In such cases distribution will seek its natural field, though I do think the distributor who is already familiar with electricity, physics, and the operation of high-frequency equipment, will be in better position to handle such equipment than the ex-grocer turned 'electronic' distributor!

"I would also like to get off my chest," continues Mr. Davis, "my observation that there is a long haul from discovery of an elec-

CONVERSION TABLES

To Convert	Into	Multiply by	Conversely Multiply by
Atmospheres	Lb./sq. in.	14.70	0.0680
B.Th.U.	Calories	0.252	3.97
B.Th.U.	Foot Pounds	777.4	0.001285
B.Th.U.	Watt-hours	0.2930	3.41
C°	F°	$(C° \times \frac{9}{5}) + 32$	$(F° - 32) \times \frac{5}{9}$
Calories	Kilogrammetres	427.0	0.00234
Centimetres	Inches	0.3937	2.54
Cubic Centimetres	Cubic Inches	0.06102	16.39
Cubic Feet	Cubic Metres	0.0283	35.31
Cubic Inches	Litres	0.0164	61.0
Cubic Yards	Cubic Metres	0.7646	1.308
Dynes	Poundals	0.00007233	13825.52
Dynes	Grammes weight	0.0010194	980.39
Ergs	Foot-lb.	7.373×10^{-8}	1.36×10^7
Feet	Metres	0.305	3.281
Feet/min.	Miles/hr.	0.01137	88.0
Feet/sec.	Miles/hr.	0.68182	1.467
Feet/sec.	Metres/min.	18.288	0.0547
Foot-lb.	Kilogrammetres	0.1384	7.23
Foot-lb./sec.	Horse-power	0.0018	55.0
Feet/min.	Metres/sec.	0.00508	196.8
Gallons	Litres	4.546	0.2205
Gallons (Water)	Cubic Feet	0.161	6.211
Grains	Grammes	0.0648	15.432
Grammes	Ounces	0.03527	28.35
Grammes c.c.	Lb./cu. in.	0.03613	27.68
Grammes/sq. m.	Ounces/sq. yd.	0.0295	33.9

Data chart compiled by engineers of International Telephone & Telegraph Co.

Electronic SUPPLIES

tronic principle and its use in war, to its becoming part of a billion-dollar-a-year market in peacetime. Experimentation, engineering, establishing a demand so that the new equipment can replace old equipment (and without too much economic dislocation)—all these things have a habit of taking anywhere from a few years up to a few generations. I am not by nature conservative but I think I would make haste slowly before gambling on the so-called electronic age.

"So while I am bullish on the eventual electronic development, I don't think there is going to be an electronic revolution. You see the mere fact that we might have radio receivers operating on ultra-high frequencies, displacing the present broadcast bands, in my opinion cannot be termed a radical change. We have not opened up any new fields—we have merely substituted better equipment for such as existed before.

"So if you want my opinion on the future distribution set-up—I feel that the present set-up is well able to function within the foreseeable future—and do a swell job too."

Improved merchandising

Charles Cooper, president of Cooper-Di Blasi Distributing Company, 259 West 14th Street, New York, a veteran wireless pioneer and one of radio's oldest parts distributors, predicts a vast improvement in radio electronic merchandising during the period following the close of the war. In Mr. Cooper's estimation, those best fitted by past experience, service and acquaintance with the trade and its technical problems, will be the ones best qualified to carry on postwar electronic distribution. Slight modification in methods might be inaugurated, as necessity or circumstances dictate, he declared, but the old framework of radio-parts distribution will remain the same.

Streamlined methods

Irving Sarnoff, president of Bruno-New York, located at 460 West 34th Street, New York City, thinks that postwar distribution of electronic devices and parts will have to be streamlined, and improved methods of manufacturing

and selling inaugurated. The order of the future will be lower manufacturing costs, without the sacrifice of quality, together with lower distribution costs so as to deliver to the ultimate consumer a better and higher class product which is cheaper in price than during prewar days. Closer relationship between the manufacturer and dealer will be necessary in order that local retail stores and service men can compete in price with the large mailorder houses or chain stores. It is conceivable, he thinks, that some, if not much of the electronic devices used in branches of industry other than communications will be distributed through their own specialized distributing media. For example: A medical apparatus which is electronic in character might be handled and sold by a medical supply house though its servicing might be confined to the radio service man.

Branching out

Radio Wire Television, Inc., formerly Wholesale Radio Service Company, 100 Sixth Avenue, New York City, expresses the opinion through Max Fine, purchasing agent and Ben Lehman, advertising

manager, that the future course of electronic merchandising will be pretty much the same as it was and now is—but that the field is gradually branching out into industries other than that of communications. They feel that from experience and contact, the radio dealer and service man is better qualified than anyone else to carry on this class of merchandising and service.

Ben Gross, president of Gross Distributing, Inc., 570 Lexington Avenue, New York City, believes that selling and distribution methods should be improved to meet the coming demands for the postwar trade. Today is not too soon to think about it and to do something about it. Apparently no effort is being made by any of the organized groups—either the national or local organizations.

George Hantenschild of the M & H Company, located at 512 Market Street, Philadelphia, dealers in radio, believes a great future awaits the electronic industry. He insists that the merchandising of its parts and especially the servicing of electronic equipment must remain among those, who in the past, have been engaged in that business. Everything depends upon the ag-

(Continued on page 190)

(Continued from preceding page)

CONVERSION TABLES

To Convert	Into	Multiply by	Conversely Multiply by
Horse-power	B.Th.U./min.	42.41	0.0236
Horse-power	Watts	746.0 ^a	0.00134
Horse-power	Kilogrammetres/sec.	76.04	0.01315
Imperial Gallons	U.S. Gallons	1.205	0.830
Inches	Feet	0.0833	12.0
Inches	Metres	0.0254	39.37
Inches	Millimetres	25.4	0.03937
Inches	Yards	0.0277	36.0
Inches of Mercury	Lb./sq. in.	0.4902	2.04
Joules	Watt seconds	1.0	1.0
Joules	Ergs	107	10 ⁻⁷
Kilocalories	B.Th.U.	3968.0	0.000252
Kilocalories/Kilogramme	B.Th.U./lb.	1.80	0.55
K.Cal./cm. ² /cm./hr./C°	B.Th.U./in. ² /in./hr./F°	5.598	0.180
Kilogrammes	Lb.	2.205	0.454
Kg./P.S.	Lb./h.p.	2.235	0.4475
Kilogrammes	Tons	0.000984	1016.2
Kilogrammes/sq. cm.	Lb./sq. in.	14.22	0.0703
Kilometres	Miles	0.621	1.609
Kilowatt Hours	Joules	36 × 10 ⁵	27 × 10 ⁻⁷
Kilowatts	Horse-power	1.3406	0.746
Knots	m.p.h.	1.151	0.868
Litres	Pints	1.76	0.568
Metres	Yards	1.094	0.914
Metres sec.	m.p.h.	2.24	0.447
Pounds	Lb. weight	0.03107	32.15
Square Centimetres	Square Inches	0.155	6.4516
Square Metres	Square Yards	1.197	0.8361

Data chart compiled by engineers of International Telephone & Telegraph Co.

ELECTRONIC TUBES on the

Advantages Over-balance Induction Heating Costs

Though the cost of heating with rf current in industrial applications may be considerably higher than by other means, that cost is really of small moment in view of other advantages, points out D. J. Finn, general sales manager of the Industrial and Sound Division, RCA Victor Division of the Radio Corp. of America. "To heat the same object under old methods," he says, "the cost might be—let's say 1c per kw. With rf heating the cost might well be in the neighborhood of 6 to 7c per kw, but bear in mind that the heat is controlled and localized, which means in reality the net cost is not so much, since there is no cost for heat that would be wasted under the 1c per kw set-up. With rf it is not necessary to heat associated elements; actual contact with the material to be worked on is not necessary with induction heating;

the surfaces of the material under consideration are not adversely affected; there is little heat loss to surroundings; gases are eliminated, which means less likelihood of corroded surfaces."

Teletesting of Airplanes

In an article on modern test methods for metal, Alfred V. de Forest, in *Metal Progress*, mentions a resistance-wire strain gage. It consists of a wire grid, the resistance of which varies linearly with strain and may be recorded by a multi-element oscillograph.

In a recent development for airplane testing, the change in resistance is used to modulate the frequency of a short-wave radio transmitting to the laboratory oscillograph the strains during test flights from distances up to 150 miles. Distance recording or "teletesting" is thus made possible.

Electronic Compensation for Flicker

When looking at an object through hot air rising from a stove, the image often seems to flicker before one's eyes. This impression is due to variations in the index of refraction of the air which is dependent on temperature. The same effect impedes telescopic observation of stars.

A device compensating for these apparent movements of the stars is described in Patent No. 2,304,755 to Vladimir K. Zworykin. Obviously, the amount of shifting and refocusing required to compensate for the deviation of the image from its original position is not a computable function of time but varies rather irregularly. Therefore, the correcting force can not be controlled by any independent source but only by the undesired deviation itself. Furthermore, rapid adjustment is necessary, requiring an inertia-less control mechanism.

An electronic telescope is used showing the picture on the fluorescent screen of a cathode-ray tube. To maintain the picture stationary, a comparatively small portion of the electron stream, the density distribution of which changes with a displacement of the image, is used to derive a magnetic field which depends on the density distribution and consequently on the displacement. This magnetic field is applied to the electron stream so as to keep it in place.

Controlling Case Hardening Skin

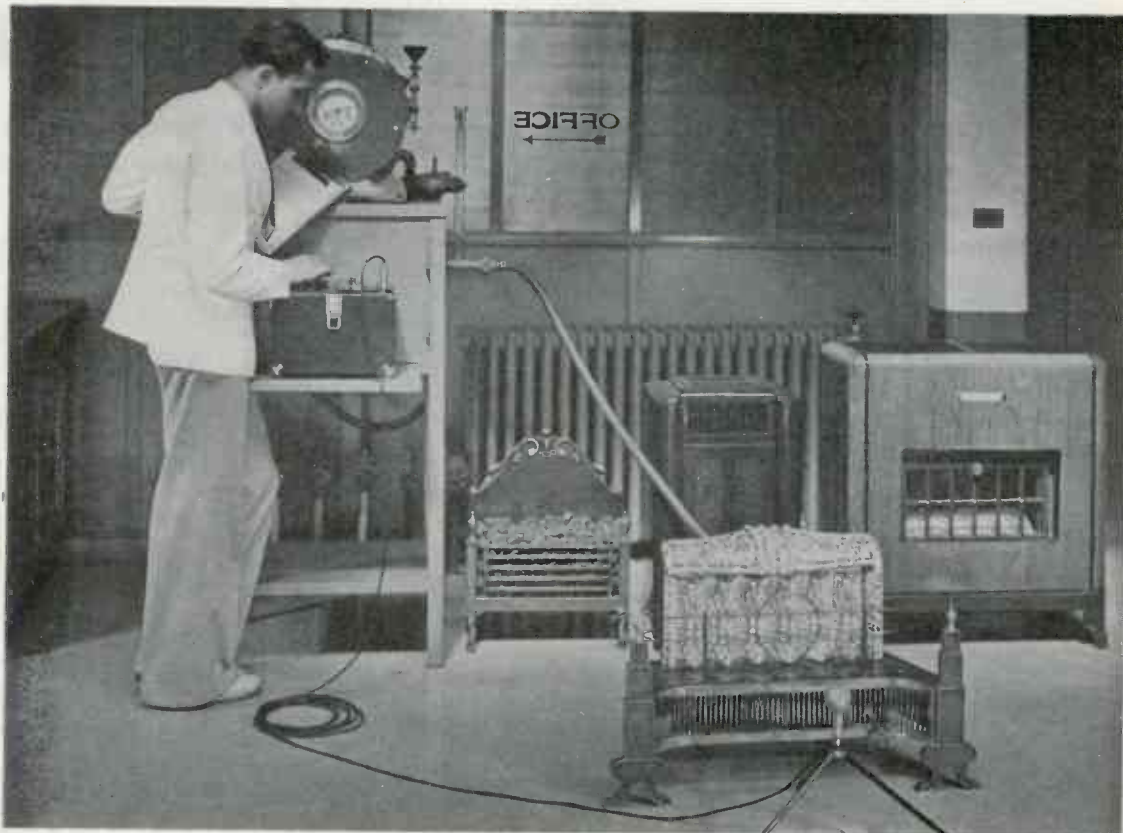
Taking case hardening as a specific example, RCA Victor Division of Radio Corp. of America makes plain why it is possible to do a very much more precise job with induction heating than can be done by other means. The depth and area of the case hardening or skin effect can be much more closely controlled. At the same time, self-quenching methods are possible. The quench is brought about by having the heat flow back into the metal rather than having water or some other cooling fluid applied externally. By controlling the rate and the frequency at which the rf power is applied, the degree or depth of hardening can be mathematically predetermined.

X-Raying a Military Monster's Skin



INSULATED WITH compressed gas instead of oil, which permits reduction of its bulk by two-thirds, this million-volt General Electric X-ray machine is used by the Ford Motor Co. for inspecting welds in the armor-plate skin of M-4 tanks and M-10 tank destroyers hulling in Detroit factories

JOB



STANDARD NOISE meter being used in laboratory to test noise level produced by gas fired space heater

Testing Gas Heaters for Noise

To set effective limits to the noise which gas-operated room heaters may produce, the Testing Laboratories of the American Gas Association make use of a standard noise meter with its microphone placed at a specified distance from the heater operating full blast.

Noise intensities are measured in decibels by the use of a sound-level meter placed at a distance of 18 in. from the meter's microphone, as shown. Permissible limits range from 55 decibels for normal operation, to 70 decibels for immediate ignition or extinction. The significance of these noise levels may be better understood when it is considered that an intensity of 50 decibels corresponds to the noise level of an average office, 60 that of normal conversation, while 75 would represent that resulting from operation of a typewriter.

Syracuse's Novel Firehouse PA System

The city of Syracuse, N. Y., has for some time been using a somewhat novel method of simultaneously communicating with all of its police, fire, water and public works offices, in which a public-address system functions over a closed cir-

cuit connecting these various departments. The system is the invention of Harold O. Quick, chief of the engineering radio division, who has patented it. The basic idea was to provide a thoroughly reliable system which would be considerably quicker than older, and more common, gong and telephone systems; a prime requisite was a visual means of constantly determining the condition of all circuits. This has been done by providing a continuous circuit, closed to dc and containing milliammeters to indicate continuity of flow of a predetermined current of small volume. An elaborate switching arrangement permits either of two audio amplifiers with their associated microphones to be connected to the main line connecting the city's 23 fire stations, and other municipal offices.

Northwestern's Lab for Lightning Analysis

Northwestern University, Evanston, Ill., has just completed a high-voltage laboratory with cathode-ray equipment for analyzing power-line and lightning discharges and surges.

The lightning maker consists of a 15-foot-high generator, and a cathode-ray oscillograph capable of measuring electrical discharges

running into millions of volts. Initial tests are being made on the 1,500,000 volt level.

Dr. J. F. Calvert designed the machine and its laboratory. From a balcony on one side, observers may watch the procedure of "building up" the terrific voltage prior to the crash. When the discharge comes, the lightning flash, several feet long, cracks like a giant whip as it leaps between two large brass spheres.

The lightning discharge, although lasting a matter of millionths of a second, is literally taken apart for study of its effects on electrical transmission lines and on power production. Insulation failures due to sudden electrical changes, and resulting breakdowns, are still major problems of power companies and manufacturers of electrical equipment.

Bolts write biography

This dissection of lightning flashes is accomplished by means of a cathode-ray oscillograph. This apparatus merely lets the lightning write its biography in a stream of electrons inside the cathode-ray tube.

The whole life story of the flash is written in billionths of a second through the beam of electrons which travels at a speed as high as seven miles a second.

SURVEY of WIDE READING

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

On FM Systems

D. A. Bell (Wireless Engineer, London, May, 1943)

The article contains a comparison of interference and propagation characteristics of FM and AM communication systems. Known data on fluctuation noise, impulsive noise, modulated interference, cross modulation, transmitter gain and propagation characteristics are compiled.

Shunt-Excited Broadcasting Antenna

S. S. Banerjee and S. Y. Tiwari (Indian Journal of Physics, Calcutta, Oct. 1942)

A shunt-excited antenna is essentially a vertical antenna efficiently grounded and excited at a suitable point above ground. The effect on the intensity of the radiated field when the excitation point is gradually altered is the subject of the present theoretical investigation.

From the current distribution in the parts above and below the excitation point—the portion above is assumed to behave as an insulated system—an expression for the vertical field strength is derived for an antenna of any length and for the excitation point being situated at any point above ground.

In the case of a quarter-wave antenna, the current distribution in the antenna and, consequently, the radiated field strength is not af-

ected by a change of the excitation point. The formula is evaluated and tabulated for half- and full wave antennas and for a distance of one wave-length from the antenna. In the table, A equals $I e^{j\omega t/c}$, I being the current amplitude in the antenna and c the velocity of light.

Most General Solution of Maxwell's Equations for Closed Cylindrical Conductors

E. Ledinegg (Annalen der Physik, Berlin, Vol. 41, 1942, pp. 537-566)

The article is concerned with the computation of the most general solution of Maxwell's equations for closed conducting cylinders. Rigorous mathematical analysis shows—provided the cylinder constitutes a singly-connected space, i.e., a hollow cylinder as distinguished from the space between two hollow cylinders said to be doubly-connected—that a complete solution satisfying the boundary conditions is obtained by superimposing electric-type fields and magnetic-type fields. The electric-type field used in any special case has no magnetic component parallel to the cylinder axis and its electric component in this direction is to be identical with that of the particular field to be composed; corresponding conditions are imposed on the magnetic field.

For doubly-connected spaces, the existence of solutions of Maxwell's equation satisfying the boundary conditions and having neither

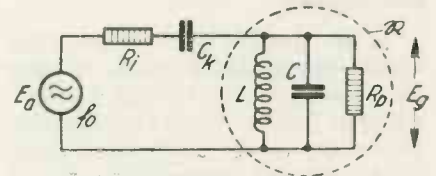
electric nor magnetic axial components is proved. This type field vanishes identically in singly-connected cylindrical spaces.

It is stated that, for plane electromagnetic waves, the principle of superposition may be extended to infinite hollow cylindrical conductors by suitably modifying the boundary conditions.

Receiver Input Circuit

H. Behling (Funktechnische Monatshefte, Berlin, Vol. 7, 1942)

The article contains a mathematical investigation on the effect of the input circuit of a receiver on voltage amplification, i.e., on the ratio of antenna electromotive force E_a to grid voltage E_g at the first tube, at a predetermined antenna impedance. Voltage step-up in the input circuit reduces tube noise as compared with signal voltage. Conditions for maximum voltage amplification are derived.



Receiver input circuit

In the case of a single resonant input circuit, shown in the diagram, maximum voltage amplification is obtained if C is so chosen that $1/L(C - C_k) = \omega_0^2$, making the input circuit resonant at the operating frequency, and if at the same time $\omega_0 C_k (R_p/R_i)^{1/2} = 1$. Under these circumstances the ratio E_a/E_g becomes a maximum and equals $1/2 (R_p/R_i)^{1/2}$. C_k may be replaced by an inductance without any change in the results except for L_k now being so chosen as to make the input circuit resonant at the operating frequency.

The reactance of the generator may be zero, for instance for a quarter-wavelength antenna. Then, a coupling transformer, having a ratio equal to R_p/R_i , substituted for L will give optimum performance, which again is equal to the above expression for E_a/E_g .

For R_i small compared with R_p , optimum performance is obtained for $C = 0$, and for C_k and L constituting a resonant circuit. In this instance, $E_a/E_g = \omega_0 L/R_p$.

Next, a two-resonant-circuit band-pass-filter input is considered. Similar maximum condi-

HALF WAVE ANTENNA		FULL WAVE ANTENNA	
Height of excitation point from the ground in fractions of λ	Field strength in fractions of A	Height of excitation point from the ground in fraction of λ	Field strength in fractions of A
1/32	— .6046	1/32	— .3639
1/24	— .5989	1/24	— .3696
1/16	— .5930	1/16	— .3753
1/8	— .0331	1/8	— .3992
1/4	— .6046	1/4	— .3639
1/3	— .7678	1/3	— .2007
—	—	2/5	— .0145
—	—	1/2	+ .2407
—	—	2/3	+ .0326
—	—	3/4	— .3639
Insulated	— .6046	Insulated	— .3639

tions are obtained. The maximum amplification depends on R_1 , R_p and the coupling between the two filter circuits.

If R_1 is small compared with R_p for both circuits, best performance is obtained if $w_0 C'_k R_p = 1$, C'_k being the coupling capacitance between the two circuits. Under the most favorable conditions, $E_s/E_c = \frac{1}{2} w_0 L/R_p$, which is half the value for single circuit coupling.

A specific example illustrating the use of the formulas is included.

A Sonic and Supersonic Transmitter

L. Ehret & H. Hahnemann (*Zeitschrift fuer technische Physik*, Berlin, No. 10, Vol. 23, 1942)

According to a report in the May issue of the *Wireless Engineer*, the transmitter described is intended to produce sonic and supersonic waves of strong intensity in gases. It is a Hartmann's air-jet generator modified to permit separation of the sound field from the flow of air. The device may also be adapted to generate supersonic waves in liquids.

Capacity Pick-up Transducer

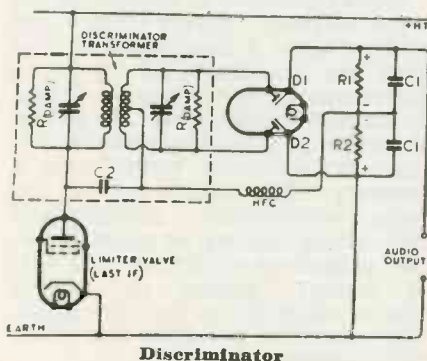
E. V. Potter (*Review of Scientific Instruments*, May 1943)

The circuit was developed for seismic investigations. It is based on the principle that the current set up in the coupling circuit between two oscillators is indicative of detuning caused by a change in oscillator capacity. Sensitivities up to 2 ma per micro-microfarad change in capacity and a current range of 5 to 40 ma can be obtained with 25L6 oscillator tubes. The circuit is readily adaptable, covers a frequency range from 0 to over 200 kc, and is not affected by local magnetic or electrostatic fields.

Theory of the Discriminator

C. Tibbs (*Wireless World*, London, May, 1943)

Operation of the discriminator circuit shown is explained in detail. Phase relation between the voltage



developed across the primary and both halves of the secondary of the discriminator transformer—the latter being composed of induced and injected components—are considered. Two diagrams illustrate the conditions for unmodulated carrier and for maximum frequency modulation, respectively.

Effects of transformer turns ratio, Q-value of primary and secondary resonant circuits, and coupling of the transformer are investigated.

Miniature Geiger-Muller Counter

L. F. Curtiss (*Journal of Research of the National Bureau of Standards*, Vol. 30, No. 2)

Geiger-Muller counters are essentially ionization chambers containing two spaced electrodes having a voltage applied to them. Upon incidence of ionizing radiation the contents of the chamber becomes conductive and discharge takes place. The number of discharges is counted and permits conclusions as to the frequency of the ionizing particles and sometimes as to their nature.

The paper reports the construction of a Geiger-Muller counter having an internal diameter of 0.8 mm and a length of about 3 cm. The filling gas is a mixture of amyl acetate vapor and argon at about 4 mm pressure.

A narrow, well-defined beam of radiation can be located and measured by this counter. Another special application, suggested by its shape resembling a large hypodermic needle, is to introduce the counter directly into the material to be tested, e.g. a biological specimen or even a live animal.

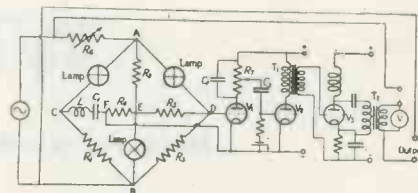
Further work is in progress in an effort to improve the characteristics of these miniature tube counters and to determine the lowest limit of tube diameter that can be used.

AC Voltage Stabilizer

A. Glynne (*Journal of the Institution of Electrical Engineers, Part II*, London, April, 1943)

The stabilizer is intended to provide a constant voltage supply unaffected by fluctuations in the mains, for testing ac indicating instruments, meters, and potentiometers.

The stabilizing effect is obtained by means of a bridge circuit including two metal-filament lamps whose resistance changes with the voltage. Consequently, a variation in the supply voltage causes a change in the lamp resistors and unbalances the bridge. The bridge is balanced for the desired voltage and the un-



AC voltage stabilizer

balance voltage developed used to regulate the supply.

However, little power is available from the bridge circuit, and an amplifier was, therefore, incorporated. It was then found that no adjustment of the input voltage to the bridge would reduce the output voltage to zero, due to a third harmonic present in the output circuit. Any change in the voltage supply produces a further component voltage in the output in quadrature with the main component.

To overcome this difficulty, the circuit shown was designed and proved satisfactory. The bridge network may be regarded as consisting of two four-arm bridges with one pair in common; the loads are represented by L , C_1 , R_4 and R_5 , respectively. The two bridges develop voltages of equal magnitude which consist of sine, cosine and third harmonic components. The circuit and its applications are discussed in detail.

Measuring Expansion of Metal Powder

(Westinghouse Engineer, May, 1943)

In designing molds, it is necessary to know how much to allow for shrinkage or expansion of a metal powder under various conditions. P. R. Kalischer of the Westinghouse Research Laboratories has developed an electronic device which graphically records expansion and compression versus time, temperature or any other component that lends itself to translation into millivolts.

To obtain a temperature versus expansion graph, the metal is heated in a controlled atmosphere by an electronic furnace to any degree of temperature desired and this temperature recorded by a potentiometer. The revolving slide wire portion of the potentiometer is connected to a transmitter, the receiver operating the chart movement of a second recording instrument. The stylus of this second instrument is actuated by an electronic device which translates changes in the length of the metal into millivolts.

A continuous graph of expansion and contraction from room temperature to 1100°C and back may be made, and the net shrink for a specific metal powder under controlled conditions can be interpolated to within 1/10000 inch.

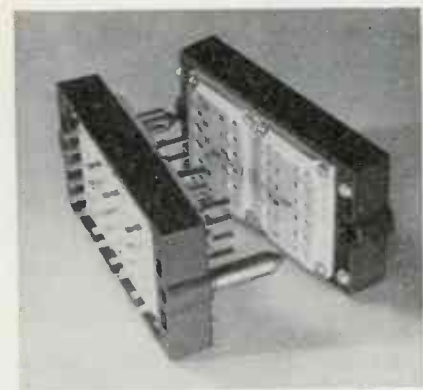
WHAT'S NEW

Devices, products and materials the manufacturers offer



New "Tube Type" Crystals

Newly added to the range of piezo electric quartz crystals produced by John Meck Industries, Plymouth, Ind., is this special purpose type, housed in a conventional metal tube case. By means of this mounting, complete freedom from moisture and atmospheric pressure changes are secured. The company's plant is fully equipped to fabricate all crystal oscillators and resonators, completely from the raw quartz.



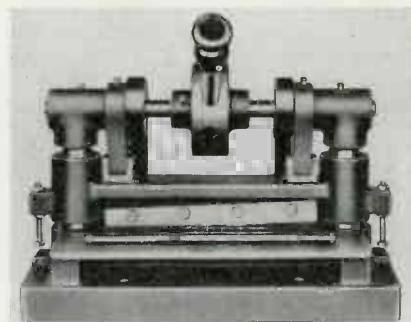
Plug-Receptacle

A plug-receptacle assembly of new design is announced by Lapp Insulator Co., Inc., LeRoy, N. Y. For use with panel-rack type of radio equipment, this connector features mechanical precision, rugged construction to withstand considerable mistreatment in the field, full-floating contacts, and, because of the fact that steatite is used as the insulation, a particularly high order of resistance to flashover and surface tracking. In construction, each plug and receptacle consists of a zinc die-casting on which are mounted four ceramic plates, which hold the metal contacts in full floating position. At the ends of the male plug are accurately ma-

chined steel pins, which engage corresponding holes in the female receptacle, to provide positive and accurate alignment.

Polystyrene Battery Retainer

The Electric Storage Battery Co., Philadelphia, is manufacturing a plastic storage battery retainer for certain types of Exide batteries of polystyrene. The new retainer has certain inherent advantages and uses less material which is critical for the war effort.



Metal Shear for Precision Work

Suitable for precision work on light and medium weight metals and materials that cannot otherwise be rapidly worked, the Di-Acro Shear, No. 2, is announced by O'Neil-Irwin Mfg. Co., Minneapolis, Minn. The shear can be quickly arranged to shear, slit, square, strip or notch to extremely close tolerances and all ductile and pliable materials can be worked, frequently eliminating the necessity for expensive dies. Both shear blades are of heavy tool steel, accurately ground and aligned, with a maximum shearing width of 9 in. and a maximum shearing capacity, full width of 22 gauge steel plate.



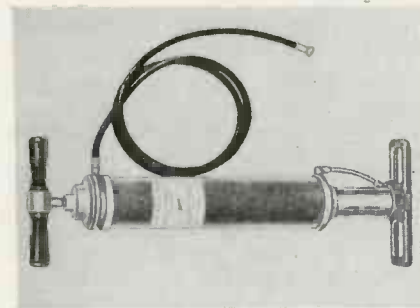
Selenium Rectifier

A new selenium rectifier of the half-wave type has a working temperature range from -70 deg. C. to $+75$ deg. C. and a negative temperature coefficient. All associated equipment such as meters, relays, etc., have positive tempera-

ture coefficients with resulting compensation when used with selenium rectifiers. Consists of two rectifying elements assembled in a tubular plastic case and rated 10 v. ac. Impedance in the forward direction is of the order 1,000 ohms. Impedance in reverse direction is of the order 1 megohm per plate. Manufactured by Selenium Corporation of America, 1800 W. Pico, Los Angeles.

Air Drying Device

Here is a simple, quick, easily operated way to obtain dry air, consisting of a hand operated air pump combined with a chemical drying tube. The drying agent is in a transparent container mounted concentric with the pump barrel. The drying agent contains a color index which is blue when the chemical is active, and turns pink when it becomes saturated. The



drying chemical may be replaced when saturated, or may be removed from the tube and reactivated by heating in an open pan. This device, first developed by Victor J. Andrew Co., 363 E. 75th Street, Chicago, for use with coaxial cables in radio transmitting stations, is equally applicable to many other uses. Price, \$26.50.

Sensitive Relays

Relays designed to operate at low input currents, varying from a few milliwatts to a maximum of one watt are manufactured by Sigma Instruments, Inc., Boston, Mass. Particularly suitable because of balanced springs and armatures in aircraft or wherever vibration is a problem. The relays are of low mass construction, exceptionally fast-acting and can be made to follow pulsations occurring at a rate of several hundred per second. Where supplied for precise adjustment, they are free from any retentivity effects.

ONE *Expert* TO SEND THE MESSAGE



Miss Gertrude Theberge records results of 955 ultra-high-frequency performance tests.



ONE *Expert* TO PROVIDE THE EQUIPMENT



VR105-30 and VR150-30
Baseous voltage-reguator tubes

Specialists on the Factory Front must back up those on the Fighting Front. As an American, you would be proud to see at Hytron carefully trained girls holding down important supervisory and technical jobs, and displaying manual dexterity on fine work which a watchmaker would admire.

Here at Hytron we realize fully our responsibility for fashioning well the radar, radio, and electronic tubes upon whose performance the lives of our fighting men depend. To fulfill this trust, we have gone all out to train hundreds of new specialists capable of building to exacting standards countless dependable War tubes. That their skills may help bring closer the day when our boys come marching home, is the sole purpose of all Hytron employees.

Oldest Exclusive Manufacturer of Radio Receiving Tubes

Hytron

ELECTRONIC AND
RADIO TUBES

Corporation



SALEM AND NEWBURYPORT, MASS.



MADE IN U.S.A.
UNITED ELECTRONICS
COMPANY

SO MUCH... FOR SO MANY.

**THEY PUT
THEMSELVES
IN THEIR WORK**

Look at a United Tube! Where you see a filament, we see faces... faces of United employees. Men and women of United are putting not only their skilled hands, but their very selves into their product.

BY SO FEW



UNITED Tubes for the United Nations are pouring out in a ceaseless stream touching every shore of this warring world. So *much* material of victory for so *many* . . . from the hands of so *few*!

Almost before the echoes of Pearl Harbor died away, United had swung 100% of its labor and facilities into production of transmitting tubes of Army and Navy specifications. And tubes of some

of the first Radar and other devices used to protect our ships and shores came from the hurrying hands of United employees.

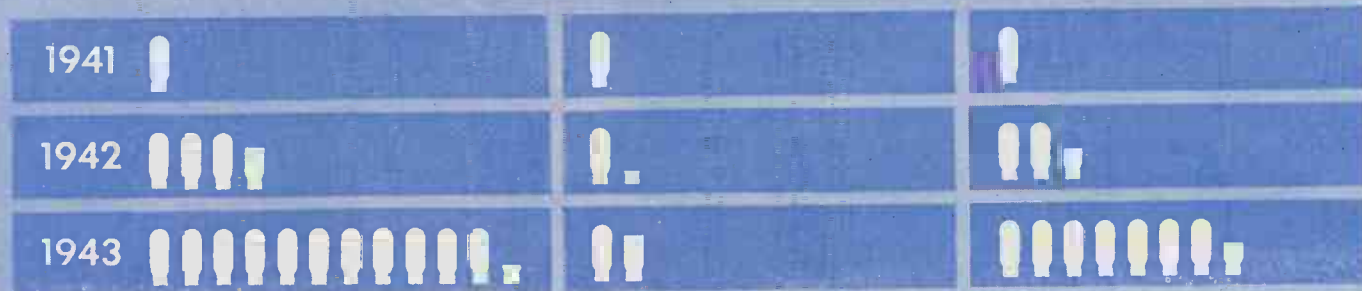
United men and women number hundreds, not thousands. Yet in terms of production per employee, as well as overall company output, United has achieved a record which we believe is unique in the nation.

HERE IS THAT RECORD:

Relative production, May 1943, compared with average monthly output in 1941 & 1942

Production per employee, May 1943, compared with average month, 1941 & 1942

Production per sq. ft. of space, May 1943, compared with average month in 1941 & 1942



Significantly, this achievement has added meaning because it is superimposed on an already established, high normal output. Moreover, United production volume has been accompanied by parallel progress in the development of new, improved and special types of electronic tubes. At the same time, United ingenuity has made important contributions to efficiency by effecting

substitutes for many scarce, critical materials.

In grateful acknowledgment of a job well done, the management of this company salutes its heroes and heroines of the production front. These men and women are rendering truly distinguished service in the defense and freedom of our country. We know our country will share this glow of pardonable pride.

UNITED

ELECTRONICS
NEWARK



COMPANY
NEW JERSEY



Vibrometer

A rugged and simple instrument for measuring the frequency and amplitude of vibrations is manufactured by C. G. Conn Ltd., Elkhart, Ind. Designed to meet Army Air Force requirements, this vibrometer has a frequency range from 800 cpm to 2000 cpm and an amplitude range of .001 to .010 in. The amplitude measured is in peak to peak values. Weighing only four ounces, the instrument has a protective cover which also serves as a mirror to enable the operator to see the scale by reflection when looking at the top in hard-to-reach places.

Mica Capacitor Alternates

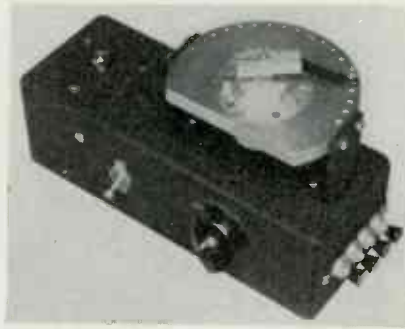
Small oil-impregnated oil-filled capacitors for use in assemblies where both space and weight are at absolute minimum, are announced by Aerovox Corporation, New Bedford, Mass. Originally designed as metal-cased alternates for mica capacitors, these Type 38 oil tubulars are now being used for newly-designed equipment. Despite extreme compactness, this unit meets many of the exacting conditions to which the replaced mica capacitors are normally subjected. They are conservatively designed with no skimping of insulation or oil-fill despite their size. They meet all standard specifications for paper dielectric capacitors used as mica alternates.

Pressure Terminals and Connectors

Sta-Kon pressure terminals are available in all wire sizes No. 22 to 250. Small and compact, the diameter of the barrel is no larger than the insulated wire itself. Once installed the Sta-Kon actually becomes a part of the wire and provides a secure, vibration-proof grip

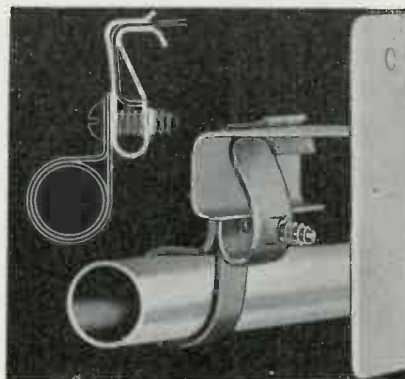


derived through the long indenture which runs parallel to the wire strands. A highly conductive electrical connection is the result. Corrosion and fatigue tests prove the connection is sound, both mechanically and electrically, and that initial, low resistance is unimpaired by age or service. Manufactured by The Thomas & Betts Co., Inc., Elizabeth, N. J.



Aircraft Autosyn Calibrator

For the rapid and accurate calibration of aircraft autosyn indicating motors, Televiso Products Co., 6533 Olmstead Ave., Chicago, has developed a piece of test equipment that may be operated by semi-skilled personnel. It is a compact unit, 10 by 6 by 3 inches, weighing six pounds, which functions as a jig to hold a standard autosyn motor under test without the need for clamps. Pin holes are held to a tolerance of .0002. The instrument has as an integral part a standard autosyn motor against which production jobs may be tested; it is supplied either with or without 400 cycle power supply and VT voltmeter.



Wiring Harness Fastening

To facilitate the fastening of tubing, wiring harnesses and the like in aircraft work, Tinnerman Products, Inc., 2111 Fulton Road, Cleveland, has developed a special type of speed nut that snaps around rolled sections, thus eliminating the need for drilling holes which weaken the structure. As

the screw is tightened, the two legs are forced inward to give a firm spring tension grip. It is made for 8Z and 10Z sheet metal screws, designed for use on various sizes of Z stringers, is aircraft spring steel with a zinc metal gray finish. A similar product is made for beaded extrusions.

Glass Working Machinery

A glass lathe of the horizontal floor type is manufactured by Eisler Engineering Co., Newark, N. J. The machine produces small and medium size electronic tubes and various cylindrical glasswork. It has a hollow coaxial aligned spindle, one stationary and one movable chuck and is adequately supplied with fires of circular shapes, mounted on a carriage, which can be moved either length or crosswise by means of handwheels. The two universal chucks holding the work are adjustable from 1/8 in. to 4 in. diameter. The bed is normally 34 in. long but can be provided for greater length if required. The stand is fabricated and welded in all parts. Two glass tubings are placed through the hollow spindle respectively and fixed in the chucks.

Compacted-Metal Technique

Fine metallic powders, compressed in dies under tremendous pressures into various shapes and sizes, followed by sintering to convert such pieces into solid metal masses, is accomplished by Henry L. Crowley & Co., Inc., West Orange, N. J.

Tandem Power Rheostats

Compact, sturdy tandem power rheostat assemblies of two or more sections are available from Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y. These assemblies are made up of two 25-watt or two 50-watt rheostats rigidly coupled together and held in a metal cradle. The usual one-hole mounting and locking-projection features are retained. The individual rheostats can be of any standard resistance value, taper, tap and hop-off, and all units go through the same degree of rotation as the single shaft is turned.



Specify

STEATITE

and stop worrying

*There is
NO
Shortage!*

Centralab

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

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.

TELEVISION

Television Transmitter— Direct current and low frequency correction is applied to the composite picture and synchronizing signal and additional pulses are added to the synchronizing signal to increase it to a value greater than is desired in the final signal. The tops of the synchronizing signal are then clipped off at a fixed level with respect to "black" in the picture. K. R. Wendt, RCA, (F) Oct. 23, 1940, (I) June 8, 1943, No. 2,321,343.

Picture Reproducing System— To delay the synchronizing signal with respect to the video signal, an electronic time delay device is inserted into the synchronizing signal channel. The time delay device comprises an electron discharge device having an electron transit time substantially equal to the desired time delay. W. A. Tolson, RCA, (F) Sept. 30, 1940, (I) June 8, 1943, No. 2,321,335.

SEISMIC WAVE RECORDING

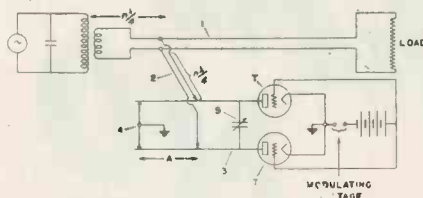
Seismic Surveying— The seismic waves are converted into electrical pulsations and recorded. The sensitivity of the recorder is initially reduced and increases at a rate which is inversely proportional to the rate of decrease of the seismic wave amplitudes so that a constant-amplitude record is obtained. B. B. Weatherby and W. T. Born, Geophysical Research Corp., (F) May 26, 1933, (I) June 8, 1943, No. 2,321,341.

Seismograph Control— In seismicographic surveying it is desirable to control the gain of amplifiers independent of signal strength and as a predetermined function of time. A multiple switch and time-delaying condenser-resistor networks supplement the amplifier circuit to provide suitable screen-grid potentials effecting the gain control. At the same time, part of the multiple switch operates to connect and disconnect geophones and amplifiers so as to reduce the required number of amplifying channels and recorders. E. J.

Shimek, Socony-Vacuum Oil Co., (F) Feb. 21, 1940, (I) April 20, 1943, No. 2,317,334.

UHF AND HF DEVICES

Transmission Line Modulator— In previous systems, the plates of modulating tubes T were directly connected to transmission line 2, and either incomplete modulation or incomplete transfer of power from source to load was obtained. For satisfactory operation of the original device, it is required that the impedance of line 2 at its junction with line 1 vary from a value which is very low to one which is very high as compared with the impedance of line 1. It is the object of the coupling proposed by the invention to provide this impedance variation as a function of available



impedance variations of tubes T by transforming the tube impedances to a much lower value. In the embodiment shown, the coupling consists of line 3, intended to tune the tube capacitances to resonance, condenser 5 and grounded movable tap 4. Lines 2 and 3 are so connected that the maximum and minimum impedances obtained at the junction are of proper value to effectively provide a short-circuit and an open circuit at the junction of lines 1 and 2, as the modulating tubes are operated. G. L. Davies, Washington Institute of Technology, (F) May 6, 1942, (I) May 18, 1943, No. 2,319,535.

UHF Transmission Line— When oscillating electrical potentials are applied to strips 11 and 12, an oscillation current perpendicular to the cylinder axial is set up in each half of tube 10 and on fins 11 and 12. Gap 13 constitutes a capacity, and each half of the tube with part of each strip or fin 11 and 12 forms an inductance. The current is a maximum for the series-resonant frequency of these two elements, and so is the resulting magnetic flux. Therefore, this is the best condition for transmitting energy of a certain frequency along the line from one end to the other, since the flux couples all of the



imaginary transverse line segments together. If a band-pass filter effect is desired, the transmission line may be made to respond at two different but adjacent frequencies by placing strips 11 and 12 to one side of the diameter so that the two circuits resonate at different frequencies. More sections can be included tuned to identical or different frequencies. Other modifications are shown and claimed. G. L. Usselman, RCA, (F) Aug. 16, 1939, (I) April 27, 1943, No. 2,317,503.

UHF Concentric Line— The filter properties of a line composed of two concentric conductors and dielectric spacing discs are recognized, and the detrimental effect of the small concentrated capacitances constituted by the discs is explained. To overcome this difficulty it is proposed that the effective electrical length of each line section—which is the axial length of the air dielectric section between two spacing discs plus the axial length of a dielectric disc times the root of the dielectric constant of the disc material—be smaller than half the wavelength to be transmitted. It is further suggested to provide a terminal resistance which has the same frequency dependence as the characteristic impedance of the cable and therefore terminates the cable free from reflections. H. Buchholz, General Electric Company, (F) Aug. 31, 1940, (I) April 27, 1943, No. 2,317,439.

Velocity-Modulation Tube— If the opening through which the beam passes is a large fraction of a wavelength, and the beam extends over this area, the acceleration given some electrons near the outer part of the beam may be very different from that of electrons near the center. Provisions are proposed to restrict the dimension and control the shape of the electron beam so that the width of the effective part of the beam does not exceed 20 per cent of the wavelength. The beam may either be solid or in the form of a hollow annulus; the latter configuration is obtained by a similarly shaped active cathode surface. Care is taken



It's Like Old Times For STEATITE

THE WAY THINGS WERE GOING a few months ago in the Steatite Industry, you probably thought you would just have to get along without this top-ranking insulating material for the duration. That's all changed now.

STEATITE IS AVAILABLE AGAIN. And there isn't much likelihood of any more shortages—unless a couple of planets get into the war. For today the Steatite Industry has the productive capacity—both in raw materials and fabricating equipment—to meet your requirements for essential applications.

THERE IS NOTHING QUITE LIKE STEATITE for high-frequency applications. It "does the trick," that's all... in fact, other materials are *rated* according to how nearly they approach Steatite in characteristics and performance. This superiority explains why you may have been unable to get adequate quantities of Steatite in the war's earlier stages. Uncle Sam always buys the very best. It was a "rush hour" alright for Isolantite.

TODAY AT ISOLANTITE, just as throughout the industry, it's like old times. With our expanded production facilities and trained war-personnel, we are once more in a position to give reasonably prompt delivery. Coil forms, small stand-off insulators, and pressed parts are just a few of the shapes Isolantite is prepared to furnish.

IT'S GOOD TO RETURN TO THE NO. 1 INSULATING MATERIAL... but better still to be able to specify Isolantite,* long the first name in Steatite.

ISOLANTITE

CERAMIC INSULATORS

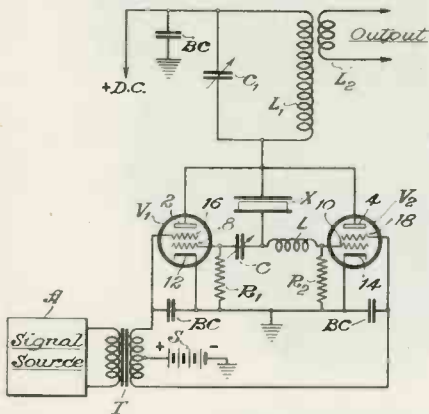
ISOLANTITE INC., BELLEVILLE, NEW JERSEY

*Registered trade-name for the products of Isolantite Inc.

that the field strength between the grids is constant within 5 per cent over the beam area. C. V. Litton, International Standard Electric Corp., (F) Aug. 27, 1940, (I) April 13, 1943, No. 2,316,264.

FM AND PHASE MODULATION

Frequency Modulator—The two tube circuits, V_1 , crystal, C, and V_2 , crystal, L, respectively, tend to oscillate at different frequencies. They are, however, connected to the common tank circuit C_1 , L_1 and thereby entrained to generate oscillations of a single frequency intermediate the resonant frequencies of the two individual circuits. When modulation potentials are differentially applied to grids 16 and 18 of the tubes, the oscilla-



tion of that tube supplying the greatest amount of power to the tank circuit will control and the frequency of the output circuit will shift toward the frequency at which that tube considered alone tends to operate. Another embodiment is shown in which the crystal is connected between control grids and cathodes of the tubes. G. L. Usselman, RCA, (F) Oct. 2, 1941, (I) May 11, 1943, No. 2,318,979.

Phase Modulation—The plate impedances of amplifier tubes 13 and 14 are connected across the input circuits of rf amplifiers 11 and 12, respectively. No plate current flows in tubes 13 and 14 when no modulating signal is present. The modulating signal increases the plate impedance of one of tubes 13, 14 at the same time that it decreases the plate impedance of the

other tube. Current of oscillator frequency will flow through condenser C_1 and the plate impedance of tube 13 in series therewith to produce a leading voltage across the plate impedance which is applied across the input circuit of rf amplifier 11. Similar considerations may be applied to coil L_1 and tubes 12 and 14, except for the fact that a lagging voltage will result. J. Evans, RCA, (F) Oct. 15, 1941, (I) May 11, 1943, No. 2,318,934.

Stabilized Frequency Modulator

—Frequency drift of the oscillator is held to a minimum by means of an automatic phase shift control obtained through a feedback stabilizing circuit including a piezoelectric crystal series resonant at carrier frequency. E. S. Winlund, RCA, (F) Sept. 26, 1941, (I) April 20, 1943, No. 2,316,927.

Noise Control in Phase Modulation

—It is intended to automatically silence a uhf PM receiver, operated with AVC, when the carrier amplitude drops below a predetermined level. For this purpose, the amplitude modulation limiter tube is rendered ineffective by a voltage applied to its screen grid and derived from the rectifier providing AVC potentials by means of an additional tube and a relay. At the same time, a monitor indicating amplitude modulation is actuated by the control circuit. B. Trevor, RCA, (F) Oct. 22, 1941, (I) April 20, 1943, No. 2,316,902.

MISCELLANEOUS

Intercommunication System

—Regeneration and consequent oscillation is avoided, though high energy levels may be used, by providing an automatic control device which reduces amplification of the second party's transmitter during transmission by the first party and vice versa. Simultaneously, the amplification level of the transmitting system is increased by the same control system. W. Hasenberg, (F) Jan. 22, 1941, (I) May 18, 1943, No. 2,319,680.

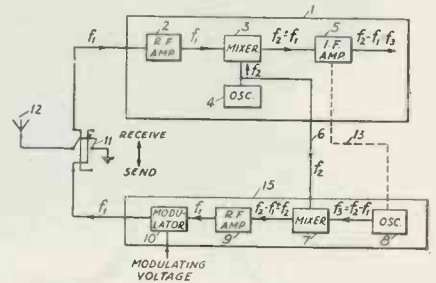
Transmission Level Control

—The device controls the amplification in a repeater station according to the intensity of carrier or guide frequency. Two relays for increasing and decreasing amplification, respectively, are connected in a four-resistance bridge circuit. One resistance is a rectifier tube; its value is varied by the controlling intensity. If the intensity has the desired value, the tube resistance just balances the bridge; upon any deviation one of the compensating relays responds to the unbalance of

the bridge. H. Hannemann et al, Alien Property Custodian, (F) Dec. 13, 1940, (I) April 27, 1943, No. 2,317,764.

Two-Way Communication

—In the two-way communication system shown, oscillator 8 is tuned to intermediate frequency f_3 , and oscillator 4 only has to be adjusted for simultaneously varying sending and receiving frequency. The diagram is self-explanatory. If it is



desired to have different sending and receiving frequencies, oscillator 8 should be tuned accordingly, or a frequency multiplier inserted between mixer 7 and rf amplifier 9. Don C. McRae, (F) Sept. 6, 1941, (I) April 27, 1943, No. 2,317,547.

Relay Tube

—Upon light impinging upon the photoemissive cathode of a gaseous-discharge tube, glow-discharge occurs which in turn heats a bimetallic cathode strip to such temperature as to bend and close a contact. Light-controlled relay action is obtained. A similar action of the tube may be obtained if a controlling potential is used to start the glow discharge. E. C. Dench, (F) March 2, 14, 1943, (I) April 20, 1943, Nos. 2,316,772-3.

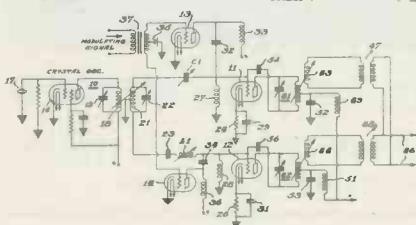
FM Control

—The device is intended to silence an FM receiver whenever it is detuned. A sawtooth oscillator is provided which either oscillates strongly or not at all depending on its control-grid bias; its oscillations cause silencing of the receiver. Suitable bias is combined from the output of the frequency detector, the AVC supply and an additional amplifier tube. N. P. Case, Hazeltine Corp., (F) Nov. 13, 1940, (I) April 20, 1943, Re. 22,302.

Loop-Antenna Core

—A clearance is provided between the core, preferably composed of comminuted magnetic material, and the winding. The inductance is thus little increased as compared with the flux density. Another feature is that the winding is wound in the region of maximum curvature of the core. W. Van B. Roberts, RCA, (F) June 29, 1940, (I) April 13, 1943, No. 2,316,623.

(Continued on page 177)



CROLITE

the **STEATITE** custom-built
to your precise needs

AGAIN AVAILABLE PROMPTLY

◆ There's no bottleneck at Crowley's. Even before Pearl Harbor, *but in anticipation*, Crowley production facilities had been stepped up four-fold; since then, four-fold again. The giant plant is humming night and day. Skilled artisans long experienced in steatite fabrication guarantee you top quality along with quantity. A tremendous stock of raw materials backed by fully developed and controlled domestic sources insure against material shortages and shut-downs.

Crowley has met peak war demands. And there is still a surplus production capacity to be put to work.

Orders requiring months to fill a year ago are now handled in weeks. And by taking advantage of an outstanding inventory of dies and tools covering established designs and sizes, deliveries are reduced to days on standard pieces. Again we say, *there's no bottleneck* at Crowley's.

◆ Other substitute materials are now critical. Switch back to Crolite steatite which is now available—and on time. Try the war-gear facilities of this pioneer steatite manufacturer. Engineering collaboration, specifications, quotations, samples cheerfully furnished.

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ASSOCIATION NEWS

RMA & IRE Discuss Post-war Planning

Although points of difference remain to be ironed out between the Institute of Radio Engineers and the Radio Manufacturers Association, some progress has been made toward the organization of a radio technical planning body such as was independently proposed by both IRE and RMA. Already an agreement has been reached on a number of variations in views between the two organizations as the result of meetings during recent weeks. Another joint session of the RMA and IRE representatives was planned for the week of June 21-26, as this issue goes to press, to be held at Washington.

Also the IRE planned a general organization meeting before the end of the month, to go ahead with its own plan.

Sponsor groups approve

Considerable enthusiasm toward the IRE plan has already been shown by a number of the other sponsor bodies, drawn from technical and scientific organizations in the electronic and radio fields. Some of the organizations invited to participate have expressed great interest in or approval of the plan and others have already appointed their representatives to the organizing group to expedite the setting up of the agency. Besides the IRE and RMA, these sponsoring groups would include:

American Institute of Electrical Engineers, American Institute of Physics, American Radio Relay League, National Association of

Broadcasters, FM Broadcasters, and Independent Broadcasters, Inc. Under the present IRE plan, no government body would be included among the sponsors, but the combined planning association or board would work closely with Washington authorities.

Wells heads RMA committee

Action to establish the RMA's proposed Radio Engineering Planning Board, for technical studies of peacetime allocation and other radio service problems, standardization, etc., was also reported from the RMA's Chicago meeting. The special RMA committee authorized to confer with a similar IRE committee regarding the somewhat different IRE plan, and also with FCC officials to develop a definite program, was appointed by President Paul V. Galvin as follows: A. S. Wells, chairman, and Messrs. W. R. G. Baker, H. C. Bonfig, R. C. Cosgrove, Walter A. Evans, and Fred D. Williams.

Fly asks industry control

FCC Chairman Fly was reported earlier in the month as feeling the projected postwar planning agency was not yet "working" out satisfactorily because of the divergence of views between the different industry groups. The FCC, he said, was "sitting on the sidelines, waiting for the industry to reach an agreement." The Commission desires only to cooperate with any feasible plan, he emphasized, because of the essential aims of such a program. Mr. Fly also stressed that postwar planning must not be done through the FCC but must be

industry-controlled, with the Commission representatives not voting but merely keeping informed and rendering any advice or service to the planning agency but not in any way guiding the panels. He stated that he took a very definite position that the postwar planning must be industry-controlled.

"Democratic representation"—IRE

"The successful development and operation of the proposed plan depends on a number of factors," declared Haraden Pratt, chairman of the IRE committee and vice-president of Mackay Radio & Telegraph Co. "These include broad and democratic representation of all organizations having a major interest in the project, democratic procedure particularly including appropriate methods of selecting all officials and members of the active technical panels, and the setting of a stated tenure of office for these workers, with suitable substitutions for inactive groups or individuals. There should be further included, budgetary planning prior to the formation of the agency, and suitable budgetary participation of those concerned as well as open accounting. In addition there are urged democratic voting and reporting methods and fully judicial procedure at all steps with adequate opportunity for the public expression of all viewpoints on given questions."

Conventions and Meetings Ahead

American Physical Society, July 10, Stanford University, California.

American Designer's Institute (Robert Gruen, 30 East 55th Street, New York), July 14, 115 East 40th Street, New York.

Associated Police Communication Officers (J. M. Wherritt, Police Department, Jefferson City, Mo.), Aug. 31 to Sept. 2, Madison, Wis.

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.

Society of Motion Picture Engineers

Next Month's Chart Supplement

ELECTRONIC CONTROL OF INDUSTRIAL PROCESSES

A chart that every industrial engineer will find to be a "must." A practical guide for the plant operator in adopting the newer electronic methods to control processes which heretofore have been inadequately handled by purely mechanical means—especially those in the many fields where a non-linear conversion must be effected.

A chart invaluable to engineers in factories, plants and mills, who are faced with problems of control of motor speeds, process temperatures, humidity adjustments, hydraulic action, vapor pressures, chemical reactions and combustion mixtures.



AN IMPORTANT ANNOUNCEMENT

FROM THE NATION'S LEADING PRODUCER
OF STEATITE CERAMIC INSULATORS

DUE TO TREMENDOUS EXPANSION IN CAPACITY AND

PLENTIFUL RAW MATERIALS...THE STEATITE CERAMIC INDUSTRY

CAN SUPPLY STEATITE INSULATION FOR ALL NEEDS.

THE TRADE CAN RELY ON STEATITE

SUBSTITUTE MATERIALS ARE NOT NEEDED



STEATITE CERAMIC INSULATION
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SAVE TIME - CUT COSTS

FASTENING RADIO and ELECTRONIC PARTS!



**- Eliminate Lockwashers
- Save Assembly Time
by using
Self-Locking PALNUTS**

Wherever you now use a regular nut, jam nut or nut and lockwasher to keep parts tight . . . one Self-locking PALNUT will do the job with unflinching security, in less space—at less cost—with less assembly time.

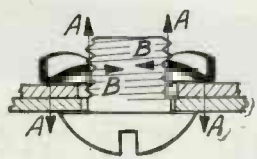
Self-locking PALNUTS are single thread, tempered spring steel locknuts formed to fit standard screw threads. Easily applied with an ordinary wrench—or, on fast moving assembly lines, with Yankee and Power Drivers. PALNUTS weigh 70% less than jam nuts, 80% less than regular nuts—90% less than nut and lockwasher. Cost less than half as much as nut and lockwasher combined. Used for over 10 years on radio, electrical and all types of mechanical assemblies. Several types available, in a full range of sizes.

Send details of your assembly for data and samples. Write for Palnut Manual No. 2, giving full information.

THE PALNUT COMPANY
83 CORDIER ST., IRVINGTON, N. J.



Shown above is the Self-locking PALNUT used to fasten Electrolytic Condensers to the chassis. This replaces regular nut and lockwasher, saving weight, cost and assembly time. Use on Electrolytic Condensers approved by U. S. Signal Corps.



DOUBLE LOCKING ACTION
When the PALNUT is wrench-tightened, its arched, slotted jaws grip the bolt like a chuck (B-B) while spring tension is exerted upward on the bolt thread and downward on the part (A-A), securely locking both.



Self-Locking PALNUTS

(Sylvan Harris, Hotel Pennsylvania, New York), Oct. 18-22, Hollywood.

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

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

IRE Against Socialization

Any form of socialization or engineering talent, such as is contemplated in the Kilgore-Patman legislation, is very definitely against the principles of the Institute of Radio Engineers. Early in June, points out I. S. Coggshall, chairman committee on public relations, IRE's board of directors adopted resolutions making plain its position and urging defeat of any such measures. The resolution follows:

"Whereas, The Board of Directors of The Institute of Radio Engineers is of the opinion that the scientific and technical resources of the Nation and in particular the radio personnel and facilities of the country are mobilized to a high degree and are working efficiently in the war effort; and

"Whereas, It appears that enactment of the Kilgore-Patman Bills S-702, HR-2100 to mobilize the scientific and technical resources of the Nation, to establish an Office of Scientific and Technical Mobilization, and for other purposes, would actually endanger the war effort by a reorganization of these resources along totally untried lines, and

"Whereas, It is the opinion of the Board of Directors that the premises given in the declaration of policy of S-702 are unsound and not representative of the facts, and

"Whereas, The enactment of these bills would establish a post-war bureaucracy inimical to the best interests of scientific and technical progress and thus also to the best interests of these United States; therefore, be it

"Resolved, That the Board of Directors of The Institute of Radio Engineers finds no valid reason for enactment of Senate Bill S-702 and House Bill HR-2100 and strongly opposes such enactment because these bills if enacted will result in confusing the war effort; and furthermore be it

"Resolved, That the Board of Directors of The Institute of Radio

The
TRUTH



about

STEATITE INSULATORS

Having examined all the evidence about steatite insulators, it is found that:

- ▶ Expanded plant facilities and improved production methods enable General Ceramics and Steatite Corporation to supply all kinds of Steatite Insulators at short notice.
- ▶ Therefore, there is no need for your Engineering Department to compromise on performance nor for your Research Department to devote time to the development of alternate materials.

Read then this sentence —

If you have any insulator problem — whether specialized or standard, let General Ceramics be your counselor.



General Ceramics



AND STEATITE CORP.
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There Goes The
IMPROVED GATES TRANSMITTER
You'll Want Tomorrow!

A few years ago we "got a kick" when a station in Alaska bought Gates equipment—*Alaska seemed so far away . . .* and names like Kiska and Pantelleria were places we left behind in our geography books.

But today, we at Gates suddenly find ourselves at the crossroads of the world. Everyday Gates transmitters, tuning and control unit, amplifiers and remote equipment start on their journey to the many odd-named war fronts.

Our experience of over 21 years of good designing, durable construction and assured performance, stand behind every Gates product. To this has been added new methods of engineering, improved efficiency. These developments are vital to our Armed Forces and of great significance to you who have plans in post-war radio.

Our engineering staff stands ready to assist and advise on the maintenance of your present equipment—whether you are Gates-equipped, or not.



RADIO AND SUPPLY CO.

QUINCY, ILLINOIS, U. S. A.

Manufacturing Engineers Since 1922

Engineers expresses its general opposition to any proposals which would have the effect of placing the scientific and technical personnel and facilities of the Nation under government supervision and control."

RMA's War Production Conference

More than 500 manufacturers attended the June 10 War Production Conference of the Radio Manufacturers Association in which "production, and more production" toward the winning of the war was the keynote. Many high Army and Navy officials attended the annual industry meeting and discussed many war production problems, together with the beginning of post-war planning.

Chairman James L. Fly of the FCC recommended that the industry begin its planning for future peacetime products, and Director Ray C. Ellis of the WPB Radio and Radar Division discussed the huge \$4-billion military radio program. President Paul V. Galvin of RMA urged all pressure on the war program and also early consideration of future postwar planning.

Officers of the Association elected included re-election of President Paul V. Galvin of Chicago, and Treasurer Leslie F. Muter. Vice Presidents elected included R. C. Cosgrove of the Crosley Corporation, Cincinnati, Ohio; M. F. Balcom of Sylvania Electric Products, Inc., of Emporium, Pa.; W. P. Hilliard of Bendix Radio Division, Baltimore; R. F. Sparrow of P. R. Mallory & Co., Indianapolis, and Thomas A. White of Jensen Radio Manufacturing Co., Chicago.

New directors of the Association elected included John Ballantyne of the Philco Corporation, Philadelphia, Pa.; Walter A. Evans of Westinghouse Electric & Mfg. Co., Baltimore, Md.; Robert C. Sprague of Sprague Specialties Co., North Adams, Mass.; George Blackburn of Chicago Transformer Corp., Chicago; Floyd C. Best of Chicago Telephone Supply Co., Elkhart, Ind., and A. Bloom of General Instruments Company, Elizabeth, N. J.

Police Radio Officers at Madison, Wis. Aug. 31

At a meeting of the executive committee of the Associated Police Communication Officers (APCO) held in Decatur, Ill., June 3, it was decided to hold the 1943 National

Facts about STEATITE LOW LOSS INSULATORS

NO SHORTAGE EXISTS

in STEATITE parts so necessary in Radio and Radar Equipment for the war effort—the demand is being met.

EXPERIENCED ENGINEERING STAFF

—with years of training in research and the development of methods and processes—so necessary to produce precision made STEATITE parts of rigid and exacting specifications.

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—are available for producing precision made extruded, pressed and machined STEATITE parts
—NO SHORTAGE exists of production facilities.

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—for STEATITE are no longer necessary—STEATITE parts *are available* for prompt delivery in all sizes, shapes and quantities.

*For the duration 100 per cent of our attention—
all personnel and equipment—is being
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INSULATORS



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achievement"

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Ceramics for the World of Electronics

FREQUENCY AT A GLANCE

Simply READ the REED

Figure 1. Here, the vibrating reed shows a frequency of 60 cycles per second. It is easy to read because the white enamelled flag on the 60 cy. reed is vibrating through *three times* its normal length — against a black background.

Figure 2. This same meter now shows a frequency of 60.5 cycles. The 60.5 cy. reed shows maximum vibration, bracketed by the 60 cy. and 61 cy. reeds vibrating equally but to a lesser extent, directing the eye to the 60.5 cy. reed.

Figure 3. Now, both 60.5 cy. and 61 cy. reeds are vibrating equally, each but slightly less than maximum. True frequency is correctly read as 60.75 cycles per second. These examples show how *half-cycle increments* give easy, accurate readings.

J-B-T Vibrating Reed Frequency Meters, because of their fundamental soundness and simplicity of design, are low in power consumption and are permanently accurate, even under adverse vibration conditions. Because they are not affected by wave form, by normal temperature change, or by external magnetic fields, these instruments are giving excellent service on engine-generator sets — in laboratories — and in many types of electronic equipment.

For prompt delivery — for the *RIGHT* meter to fit your specifications and needs—specify J-B-T Vibrating Reed Frequency Meters — available in full range of frequencies, voltages, reed groupings and case sizes. Our engineers will gladly work with you on your problems... without obligation.



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Illustrated Bulletin VF-43 is now ready. Write for your copy now.

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Figure 1



Figure 2



Figure 3

Conference at Madison, Wis., on August 31, September 1 and 2.

As it was not possible to hold the Convention in Buffalo as originally scheduled, Madison was chosen because it is centrally located and yet far enough north to assure reasonably cool weather. Also, Madison is the seat of several large military radio training schools, explains Ray S. Groenier, Chairman 1943 National Conference, whose address is 14 S. Webster St., Madison, Wis., where he is chief radio engineer of the Madison Police Department.

Holding a conference this year was considered extremely important because of the many problems brought on by the war. Discussions on wartime operations, W.E.R.S., O.C.D., priorities, etc., will occupy most of the time. The Conference will be condensed to three days rather than the usual four.

Australian Radio Becoming Americanized



FRANK E. BUTLER

Under the guidance of John V. L. Hogan, who presided, the New York section IRE gathered together something over a hundred members for its Old Timers Meeting early last month and listened to Frank E. Butler, formerly assistant to Dr. Lee deForest and at present associate editor of "Electronic Industries," tell of the trials and tribulations that attended the birth of the three-element vacuum tube. Mr. Butler's talk was illustrated with lantern slides showing replicas of the various set-ups as originally used by Dr. deForest in his epoch-making experiments.

Radio conditions as they exist in Australia were outlined briefly by

UTAH PARTS ARE USED IN THESE PRODUCTS

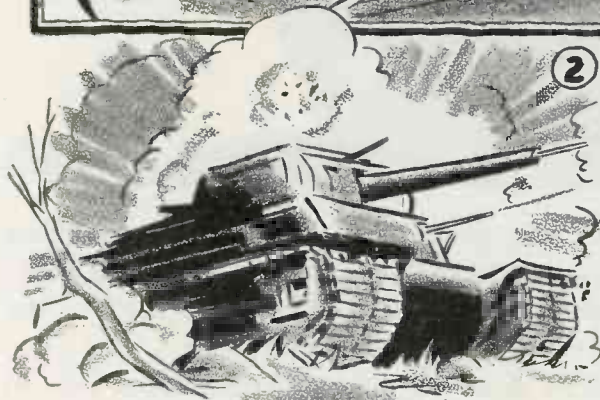
DO YOU KNOW **WHICH** PARTS?

(ANSWERS AT BOTTOM OF PAGE)



① PINBALL GAME

BING-BING-BING! AND THE NAVY IS 5500 POINTS AHEAD! A UTAH PART HELPS KEEP THE LITTLE BALL BOUNCING AROUND THE BOARD.



②

TANKS

MUST HAVE EARS. AND UTAH PARTS IN THEIR RADIO EQUIPMENT HELP MAKE SURE THAT THEY HAVE ADEQUATE COMMUNICATIONS. FOR RELIABLE PERFORMANCE AND LONG LIFE...IT'S **UTAH.**

③

TELEPHONE EQUIPMENT

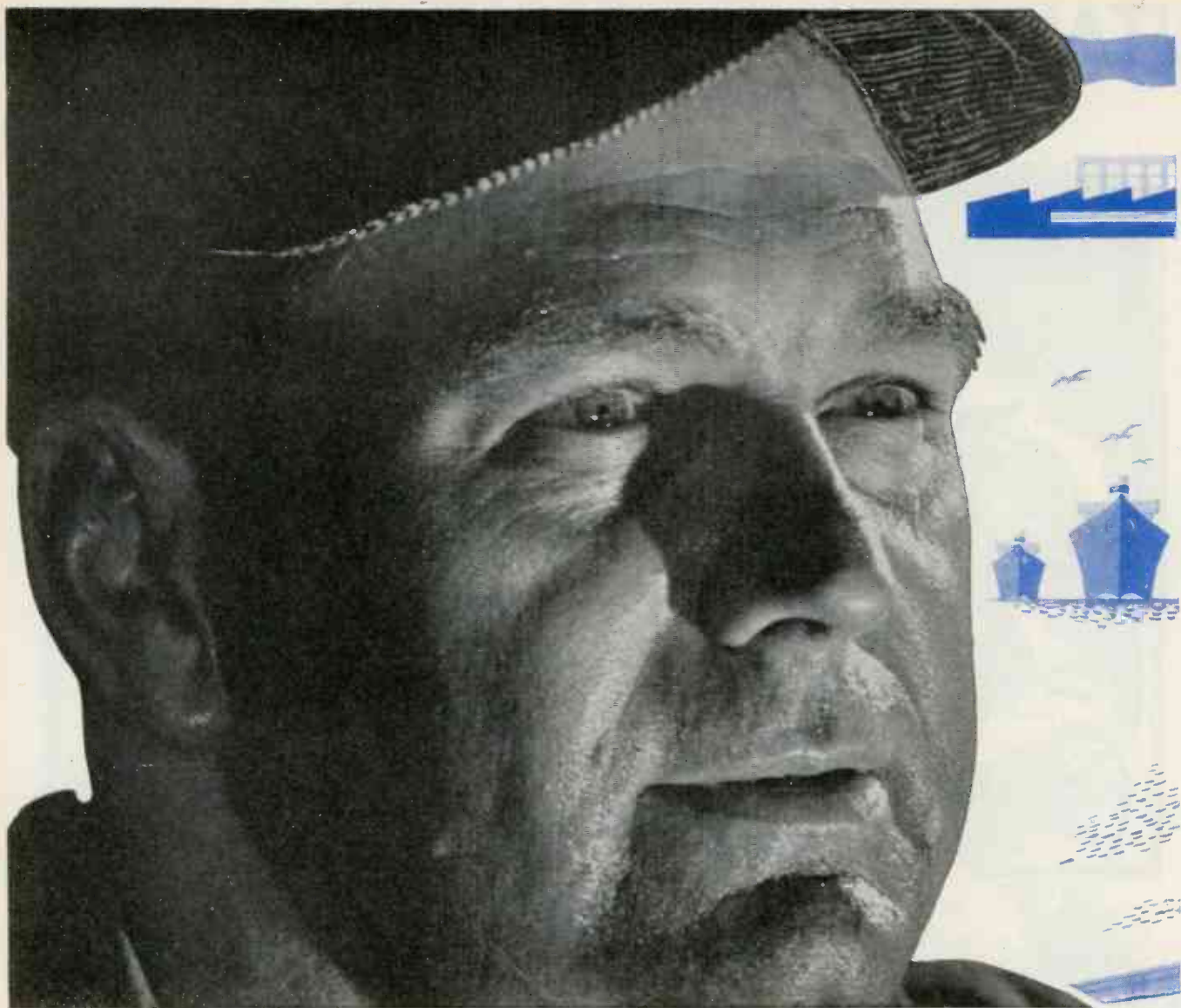
A SHOOTING WAR MEANS A TALKING WAR... AND UTAH PARTS ARE HELPING THE SIGNAL CORPS, NAVY AND AIR CORPS MAINTAIN COMMUNICATIONS.

THE ABOVE IS ONLY A SMALL SAMPLE OF THE MANY PRODUCTS UTILIZING UTAH PARTS. TODAY, THEY'RE BEING USED FOR WAR—BUT "TOMORROW" UTAH, ALONG WITH THE REST OF AMERICA, WILL AGAIN BE IN THE SWING OF PEACETIME ACTIVITY. THE THINGS THAT WAR HAS TAUGHT WILL BE PUT TO PEACETIME USE. WARTIME RESEARCH & MANUFACTURING METHODS NOW DEVOTED WHOLLY TO WAR WILL BE BENEFITING AMERICAN HOMES AND FACTORIES. THERE WILL BE GREATER CONVENIENCE AND ENJOYMENT IN RE-UNITED FAMILY CIRCLES... GREATER ECONOMY AND EFFICIENCY IN INDUSTRIAL PRODUCTION.



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Everyday, electronics and manpower become closer allies.

Today, Westinghouse Electronic Tubes are hard at work on hundreds of industrial and military fronts, adding their own power to manpower. By helping to perform many tasks better, they are speeding up production, improving quality and extending man's control into the realms of the impossible.

For example, you will find Westinghouse tubes saving time and work on jobs such as these: vibration detectors for rotors, heat treating, welding and dust precipitation. You'll also find them as part and

parcel of amazing developments which enable men to "see" in darkness, land planes at "ceiling zero," keep ships off rocks in fog-bound harbors and detect planes at great distances.

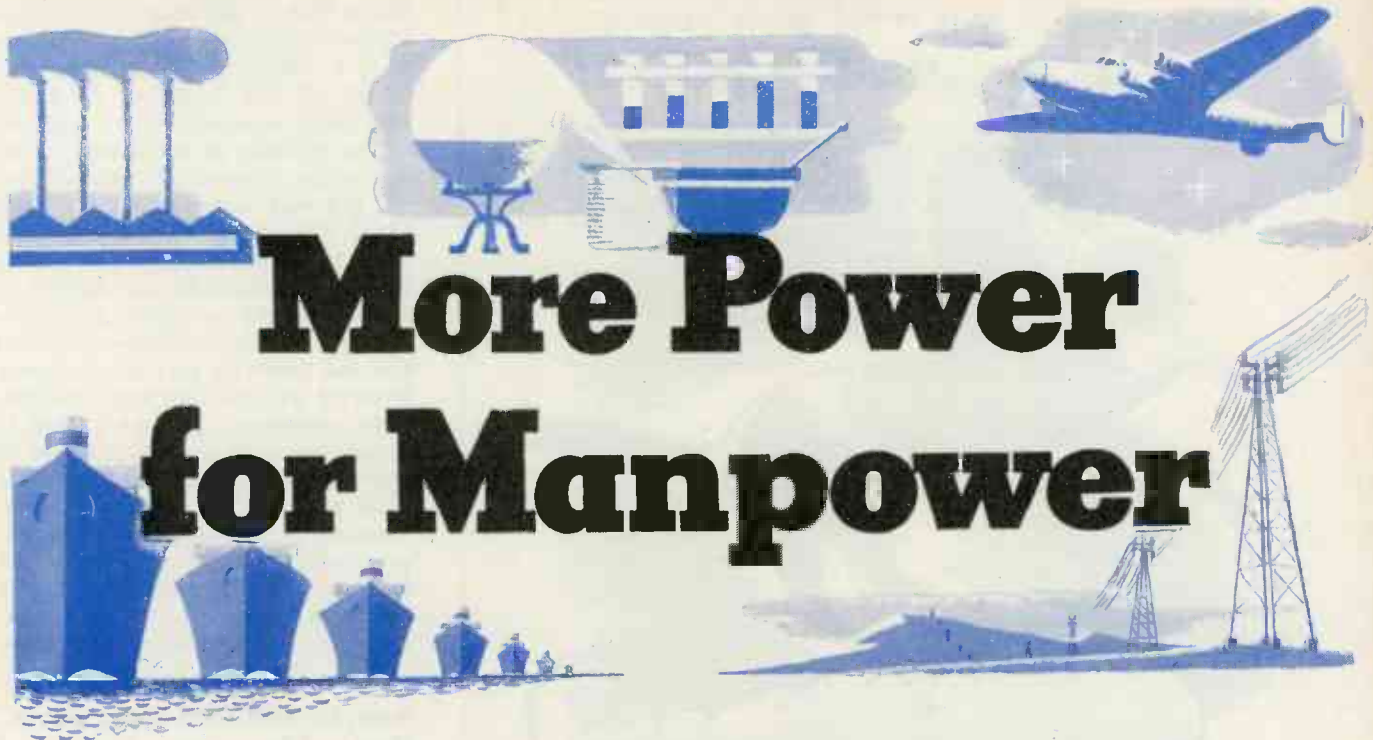
All of these are today's developments, jobs in which Westinghouse tubes are building a reputation for perfection of design and construction.

In your thinking and planning for today and tomorrow, include the use of electronic tubes. Westinghouse . . . pioneers in electronic "know how" are at your service. Westinghouse Electric and Manufacturing Company, Bloomfield, N. J.

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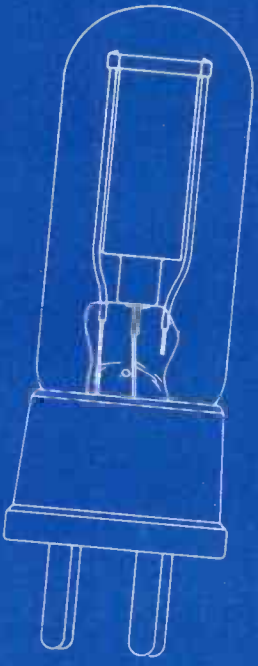


Electronic Tubes *AT WORK*



More Power for Manpower

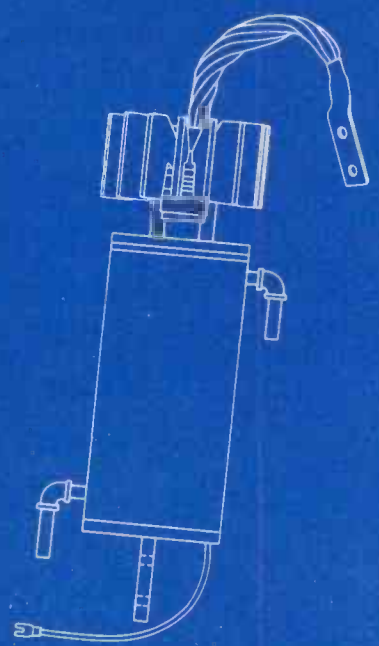
A FEW OF THE WESTINGHOUSE TUBES NOW SERVING INDUSTRY



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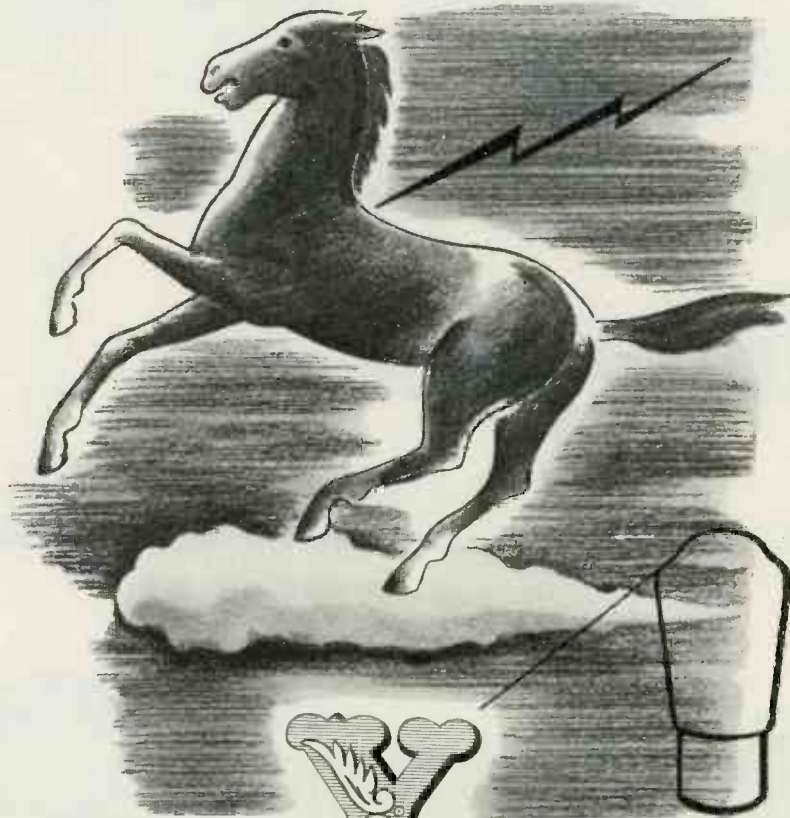
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SPLIT CYCLE CONTROL
Microamperes to Kiloamperes

*when you hitch your wagon
to the galloping electron . . .*



YOU know, of course, that
electronic applications can be
made in almost any industry . . . can



help in the making of almost any product.

What you may not know is that OPERADIO engineers
have helped develop some of the most advanced
electronic devices of World War II, and
OPERADIO craftsmen have helped build them!

When you need help with electronic problems
involving design, engineering, or contract
manufacturing, let OPERADIO supplement
your own facilities, serving as your
electronics development and manu-
facturing division. Come to OPERADIO!

OPERADIO MANUFACTURING CO., ST. CHARLES, ILL.

Φ *Symbol of Electronic Excellence*

OPERADIO

Major Wm. E. Osborne, of the Australian Army, and at greater length by O. F. Mingay, who is general secretary of the Institute of Radio Engineers, Australia, and a member of the Ministry of Munitions of the Australian Government. He pointed out the very considerable extent to which Australian radio in general is swinging over from British to American standards, the former as represented by low power transmitters and very sensitive receivers and the latter by very much higher powered transmitters with less sensitive receivers. This he judged to be in line with proper progress in view of the great distances that must be spanned, the sparsely distributed population, and bad atmospheric conditions. Radar, he said, is doing a splendid job for Australia where all strategic locations now are adequately protected.

Nearly 100,000 Take Free Radio-Electronic Courses

Noting the tremendous nationwide interest in free courses for training in radio work since October, 1940, Manpower Chairman Paul V. McNutt announces that more than 80,000 men and women have undergone training in radio, and that an additional 18,000 have been enrolled in electronics courses. These free courses are offered through more than 220 colleges and universities in more than 1,000 communities.

Mr. McNutt's statement, based on a report made to him by Dr. W. W. Charters, Chief of the WMC's Bureau of Training, indicated that three radio courses; Fundamentals of Radio; Radio and Pre-radar; and Ultra-high Frequency Techniques; are most popular with trainees, with as many as 15,000 students enrolled at one time for the course in Fundamentals of Radio. (A Signal Corps officer points out that approximately 6,000 employees of one Signal Corps station have received this radio training, and that while few of these men and women had technical knowledge, skill, or interest in radio before they were employed, they met all qualifications for assignment as inspectors, radio repairmen, specialists, and candidates for advanced training upon completion of the course).

Pointing to the increasing demand for women with radio and electronics training, Mr. McNutt said that within the last six months, more and more women

SUPERIORity in TUBING

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Intensive Specialization

(IN SIZES $\frac{5}{8}$ " AND UNDER IN MANY METALS)

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

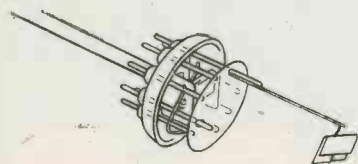
FOR EVERY SMALL TUBING APPLICATION

Tubing from $\frac{5}{8}$ " OD down...SUPERIOR  Seamless in various analyses. WELD-DRAWN  Welded and drawn Stainless.

BRAWN  Welded and drawn "Monel" and "Inconel". SEAMLESS and Patented LOCKSEAM Cathode Sleeves.



would ALADDIN'S face be red!



ALADDIN thought he was great shakes.

When he rubbed his lamp and muttered "Abacadabra," wonderful things began to happen. But with the modern Sylvania electronic tube no rubbing, no magic words are necessary. Here is real magic — not in a big clumsy lamp, but in a tube no bigger than your thumb. Naturally, the story behind these unusual tubes cannot be told for the duration. But it's no secret that to build real magic into these tubes, Sylvania specified Callite Tungsten components for the tube elements. If you need precision incandescent lamp and electronic tube components, or have a metallurgical problem involving the use of tungsten, molybdenum and their alloys, C-T engineers and their facilities can be of assistance to you. Your inquiries are cordially invited.

Specialists in the manufacture of Hard Glass Leads, Tungsten and Molybdenum Wire, Rod and Sheet, Formed Parts and other components for Electronic tubes and incandescent lamps.

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have registered for the radio courses. The Aircraft Radio Laboratory at Wright Field alone, he added, has more than 200 women preparing themselves through this training for radio jobs.

Radar and Postwar World

Dr. Gerald Wendt, science editor of Time Magazine, discussing "War Babies and Postwar Living" at the May 25 meeting of the Sales Executives Club of New York, stressed the fact that there is too great a gap between research men, engineers, and sales executives.

Civilization as we know it, Dr. Wendt said, is affected far more by science than by religion or any other force. Products of the research laboratories develop entirely new habits of living, thinking, and feeling, and should be thought of in these terms rather than merely as new products to sell. The development of radar, Dr. Wendt suggested, may indirectly result in a rebirth of community life and club life. Although radar as such will certainly be widely used on ships and in aviation, the important influence is the fifteen-times-normal expansion it and communications-needs have occasioned in the radio industry. Television is inevitable, but if receivers cost several hundred dollars they will largely be used by clubs, town halls, and other small groups, rather than in every home.

Developments in microwave technique and vast increases in available radiotelephone channels, Dr. Wendt said, presage wide use of some kind of walkie-talkie equipment for communication from train, auto, or baseball park to nearby telephone central stations.

In an inspiring, rapid-fire talk, Dr. Wendt also discussed highlights of synthetic rubber, vitamins, 100-octane gasoline, plastics, new metals, and food dehydration, emphasizing the fact that engineers, managers, and sales executives should devote greater thought to the changes in our way of life which such new developments may mean.

Broadcast Technicians Needed by Signal Corps

National Association of Broadcasters is currently emphasizing the great need of the U. S. Signal Corps for technicians who have broadcasting station experience, and urging that those who have re-

A NEW DI-MET DEVELOPMENT
THAT *Improves*
DIAMOND BLADE PERFORMANCE

A new exclusive process is now being applied to all DI-MET blades for obtaining DYNAMIC FLATNESS—a process which produces and sets a predetermined balanced, radial tension that keeps blades flat under normal operating conditions of heat, pressure and high r.p.m.

IN THE PAST, blade manufacturers depended upon static flatness to eliminate wobble . . . flatness that was proved by testing on surface plates but which was not necessarily permanent. Tests show that entirely new conditions appear after blades are put in operation. Unequalized strains in an apparently flat blade are released by high speed rotation, pressure and heat. These strains reassert themselves throughout the blade and destroy its original shape by warping. So a blade which tests flat on the bench will not nec-

essarily remain flat after being put in service! To overcome these problems DI-MET engineers have succeeded in relieving blades of unequal internal strains, thus acquiring perfect flatness and introducing the correct balanced, radial tension. This "set" keeps the rim slightly contracted until relieved by the heat of normal operation. In effect, balanced tension neutralizes expansion of the rim under actual operating conditions and produces a stiffer, more rigid blade for any given thickness.



LOOK FOR THIS DI-MET SYMBOL  WHICH GUARANTEES DYNAMIC FLATNESS

Dynamic flatness is exclusive with DI-MET blades and is materially aiding in the production of more crystals per pound of quartz by cutting thinner wafers of excellent surface finish, with less wafer breakage.

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**THE 34100 SERIES
R F CHOKES**

Many have copied, few have equalled, and none have surpassed the genuine original design Millen Designed for Application series of midget RF Chokes. The more popular styles now in constant production are illustrated herewith. Special styles and variations to meet unusual requirements quickly furnished on high priority.

General Specifications: 2.5 mH, 250 mA for types 34100, 34101, 34102, 34103, 34104, and 1 mH, 300 mA for types 34105, 34106, 34107, 34108, 34109.

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**MALDEN
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cently been inducted or are about to be inducted make their qualifications known so that advantage may be taken of special skills. It is suggested that when any man having broadcasting experience is inducted, a letter be sent immediately to Office of the Chief Signal Officer, Military Personnel Branch, Washington, D. C., attention of Lt. Col. Richard R. Kilgore, Enlisted Section, giving this information: name and age, home address, Army serial number, reception center to which he has been directed to report, arrival date at reception center, short statement covering his duties at the station where he has been employed, including length of time in radio and license, if any. Such information will permit the Signal Corps properly to evaluate qualifications.

**War Jobs Offered
By Signal Corps**

The War Department announced that an exceptional opportunity is presented to women seeking war jobs, in a large-scale program about to be launched by the Signal Corps to train civilian inspectors for duty in factories producing military telephone, radio, and radar equipment.

Several thousand women already are engaged in this work, and their services have proven highly satisfactory. Men, too, are sought, but they must be outside Selective Ser-

vice age brackets or unfit, physically, for military service.

The course lasts 6 weeks, 8 hours a day, 6 days a week. The pay, at the rate of \$1,752 a year, starts when the trainee begins the course. Opportunities for advancement depend on the individual's skill and the available vacancies.

Trainees learn electrical and radio terminology, the use of diagrams and simple blueprints, many factory processes, and the application of such measuring instruments as vacuum-tube voltmeters and cathode ray oscillographs. In the final week of the course, the individual works under the resident Signal Corps inspector to whom he or she is to be assigned.

Applicants are advised to apply to the nearest office of the Civil Service Commission, where selections are to be made through interviews and simple aptitude tests.

Operators Available

In response to an FCC inquiry, more than 550 holders of first- and second-class radiotelephone licenses have indicated that they are available for immediate employment in essential communication jobs. Names are being sent to the War Manpower Commission and other interested groups. The list was compiled from a postcard survey of a sample of 1000 of the nation's 20,000 licensees in these classifications.

Communications Equipment Building at Clifton, N. J.



Work is under way in Clifton, N. J. on the first building of a modern industrial group of structures for the Federal Telephone and Radio Corporation, manufacturing subsidiary of the International Telephone and Telegraph Corporation.

This initial unit, a one-story brick and structural steel building, will contain about two acres of space under one roof for the manufacture of communications equipment to be

used in the war effort. Louis S. Weeks is the architect and the Turner Construction Co., general contractor.

Covering the site comprising the former Yountakah Country Golf Course in the Township of both Clifton and Nutley, N. J., the completed project will eventually house all International Telephone and Telegraph Corporation manufacturing activities in the United States.



Save

30 TO 50% WEIGHT

IN RADIO TRANSFORMERS AND OTHER ELECTROMAGNETIC APPARATUS WITH

HIPERSIL* CORES



On a soldier's back or in a plane, ounces quickly become pounds. That's why a new material that can cut weight *and* increase efficiency is important news.

Hipersil, the new magnetic steel, does just this. It increases flux-carrying capacity $\frac{1}{3}$... saves 30 to 50% weight.

At present, Hipersil cores are used in a steadily increasing variety of communication applications... in radio transformers, chokes, relays, reactors and loading coils. They should be used wherever high permeability is wanted at both high and low densities, and where high fidelity and light weight are of greatest interest.

Hipersil makes possible these design improvements:

SMALLER SIZE of core cross sections and coils... ideal for airplanes, tanks, submarines, "walkie-talkie" sets...

WIDER RANGE OF LINEAR RESPONSE. Knee of the saturation curve for Hipersil is higher than for ordinary silicon steel. It gives approximately $\frac{1}{3}$ greater straight-line response for winding and core cross section.

SIMPLIFIED CONSTRUCTION. Split-core design makes coil and core easy to assemble, saves man-hours. No laminations—just two or four pieces to handle.

Ask your Westinghouse representative about standard Hipersil core sizes now available.

*Registered trade-mark, Westinghouse Electric & Mfg. Co., for High PERmeability SILicon Steel.

J-70407



GET THE FACTS ABOUT HIPERSIL

Write for B-3223, a data book crammed with application and performance facts about Hipersil. Address: Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.



Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

HIPERSIL

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RADIO

INTERFERENCE FILTERS



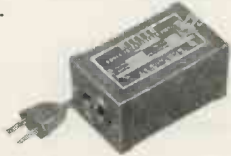
INDUSTRIAL FILTERS

Miller industrial filters are designed for all types of radio interference producing devices and are highly effective at broadcast and short wave frequencies. They have highest attenuation characteristics at all frequencies used in radio communication. Each filter is completely sealed for complete protection under all climatic conditions.



AIRCRAFT INTERFERENCE FILTER

The No. 7884 Radio Interference Filter, developed expressly for aircraft use, will effectively suppress noise present in the ship's electrical system. Insure noise-free radio reception by installing a Miller Duo-Lateral Wound Radio Interference Filter. Dimension 2½" diameter by 3" long. Weight 1.25 lbs. Write for specification sheet.



APPLIANCE FILTER

Designed for use with larger household appliances and commutator type motors, as well as communication type receivers and recording equipment, this Miller Filter, No. 7515, uses larger capacitors and heavier capacitor inductors to handle load requirements up to 550 watts. Size 2½" square x 4" long. 115 volts, 550 watts.



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BUILDERS OF QUALITY RADIO INDUCTANCES SINCE 1924

Letters to the EDITOR

Who Has Priority in Assignment of Radio Channels?

Editors, *Electronic Industries*:

I do not know who wrote the article on pages 78-79 of your June issue so I am writing direct to you to correct any erroneous impression which might result from the last part of the last paragraph on page 79.

IRAC does not "exercise primary control over the radio spectrum" nor does the law give the President the right to "make first selection of the radio channels for the use of government and military services." Likewise, it is wrong to say "from the channels that are then left after the Interdepartmental Committee has taken its needs, the FCC assigns remaining channels to the use of the general public." And, too, there is no basis for IRE "recognizing the wider responsibility of the Interdepartmental Committee."

The facts are:

1. Both the President and the FCC have the right to assign channels to stations under their jurisdiction. (Sec. 301, 303, 305, and 323 of the Communications Act of 1934).
2. At present the IRAC is a committee of the Board of War Communications (see Executive Order of the President dated September 24, 1940).
3. The FCC and IRAC have been able to allocate and assign frequencies by coordinating government and non-government needs at regular monthly meetings of their engineering representatives. In some cases, frequencies are assigned to government stations on conditions that no interference present or future, shall result to non-government operation. The converse is also true. Then, too, some frequencies are assigned for the exclusive use of non-government stations.
4. The international problem must always be considered. The Madrid Convention, Cairo regulations, N.A.R.B.A. and Inter-American Convention and Agreement contain important provisions regarding the rights of nations. However, the limiting

technical factor is the degree of interference which may result to services having priority on the frequencies assigned or to be assigned. This is obviously a job for the engineers and has been handled with highly satisfactory results.

James Lawrence Fly
Chairman

Federal Communications Commission, Washington, D. C.

In view of the heavy wartime responsibilities which Chairman Fly is carrying as chairman also of the Board of War Communications, we are glad to print above, without comment, his interpretation of the existing situation.

Of the sections of the Communications Act cited by Chairman Fly, Section 301 relates to conditions of licensing; Section 303 to the general powers of the FCC; and Section 323 to the interference between stations. Section 305 reads as follows:

"Government-Owned Stations

Sec. 305(a) Radio stations belonging to and operated by the United States shall not be subject to the provisions of sections 301 and 303 of this Act. All such Government stations shall use such frequencies as shall be assigned to each or to each class by the President."

Statements appearing in our June issue were based upon the above text of the law.—EDITOR.

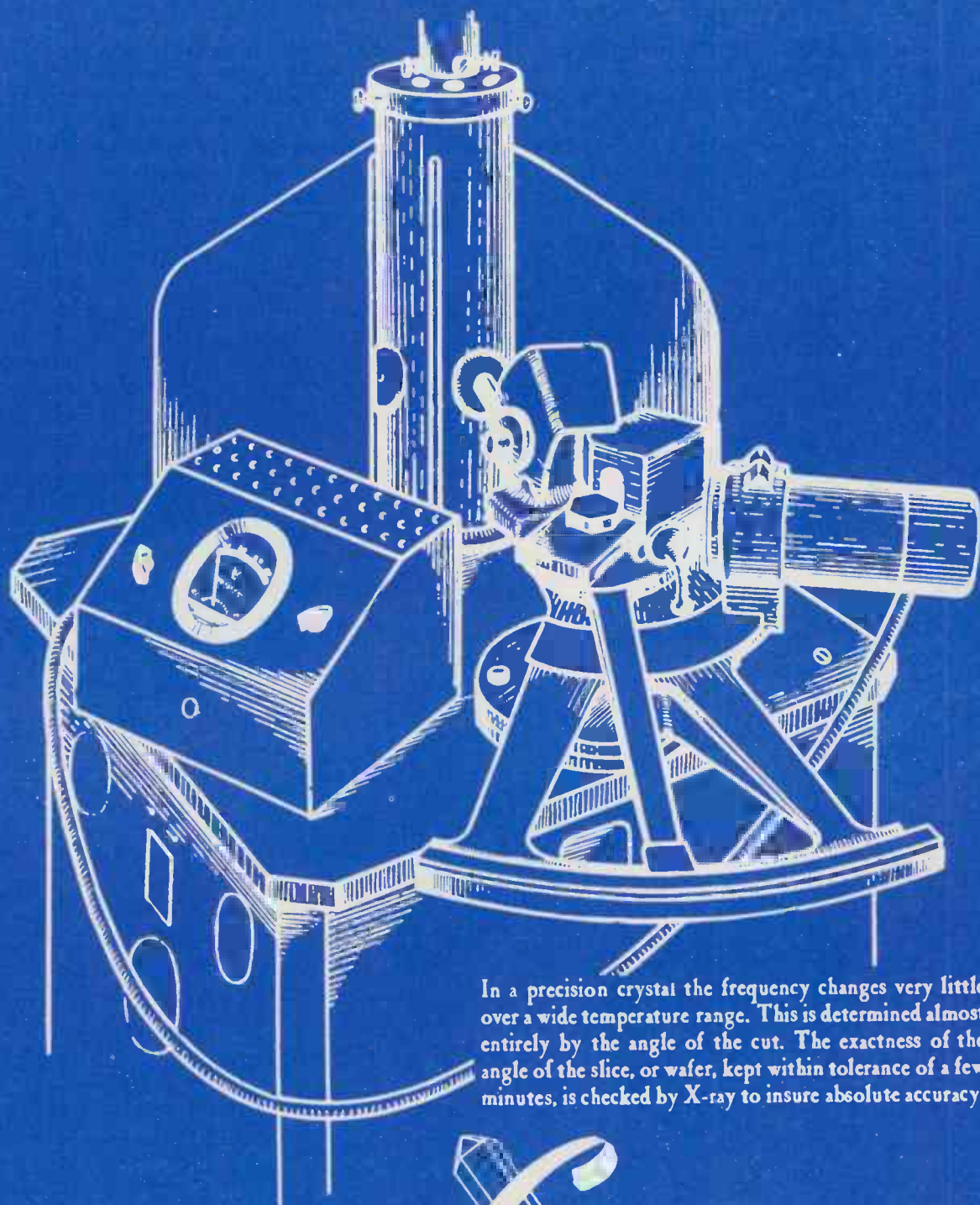
Wanted—Technical Data

Editors, *Electronic Industries*:

Very consistently, manufacturers and suppliers provide inadequate and incomplete technical data in advertisements and descriptive literature. It shows up especially when one attempts to use typical catalog data in either mechanical or electrical design. It shows up especially in these difficult days because of the extra effort required to obtain explicit and complete information.

It therefore occurred to the writer that there might be an interesting possibility and definite novelty in an attempt by a group such as the publishers of "Electronic Industries" to do some missionary work to improve the situation. It is entirely possible, for example, that you would find warm

CHECKING THE EXACTNESS OF THE ANGLES OF THE SLICE, OR WAFER, OF A CRYSTAL



In a precision crystal the frequency changes very little over a wide temperature range. This is determined almost entirely by the angle of the cut. The exactness of the angle of the slice, or wafer, kept within tolerance of a few minutes, is checked by X-ray to insure absolute accuracy.

Crystal

PRODUCTS COMPANY
1519 MCGEE STREET, KANSAS CITY, MO.

Producers of Approved Precision Crystals for Radio Frequency Control

Dunco High Efficiency **RELAYS FOR SMALL-SPACE USE**

It's much more of a trick to make a fine, accurate wrist watch than it is to produce an alarm clock. Similarly, the task of making really dependable and durable midget relays is one that calls for the best that a specialized manufacturer, already accustomed to high standards of quality, can give it—and here Struthers Dunn engineering excels.

As a result, Dunco Midget Relays have established new standards of performance in a wide variety of applications where space is at a premium, and where dependability under exacting conditions of use is essential. They are produced in dozens of standard and special types and sizes for almost any requirement. Dunco Midgets are Underwriter approved.



26 Dunco representatives located in every major war equipment manufacturing center throughout the U. S. and Canada are trained to help you in all problems of relay selection and use. Write or wire for address of your nearest representative.

OTHER DUNCO RELAY-TIMER TYPES

30 ampere — Sensitive — Instrument Controlled — Low Voltage, Heavy Current, D. C. — Mechanical Latch-in (Electrical Reset) — Mercury Contact — Telephone Auxiliary — Lamp Controlling — Polarized — Overload — Timing — Sequence, Ratchet Type — Motor Reversing, and many others.

Write for the New Dunco Catalog and Relay Data Book.

STRUTHERS DUNN, Inc.

1321 ARCH STREET

PHILADELPHIA, PA.

LATEST

NEWS FROM WASHINGTON

Concerning the Electronic Industries



RADIO-ELECTRONIC MFRS. AT TOP OF CLASS—While "overconfidence and complacency" because of the Tunisian victories caused a distinct slump in production of war munitions during May, Undersecretary of War Patterson inferentially at least lauded the electronic and radio manufacturing industry by citing that aircraft and ground communications equipment alone stood out as not having declined in that month. WPB Chairman Donald M. Nelson in his monthly report for April recorded that signal equipment output of that month was 12 per cent higher than in March. For 1942 in his report to President Roosevelt, Chairman Nelson recorded that during the last quarter of that year ground ordnance and ground signal equipment formed 23 per cent of the total munitions production, contrasted with 17 per cent in the first quarter. In 1943 he predicted that the scarcity of vital materials, particularly steel, copper and aluminum, forms a critical limiting factor, while the shortage of manpower also is a major obstacle. The peak of war production is to come late in 1943 and early in 1944, it is forecast.

TREMENDOUS PROCUREMENT TASK AHEAD FOR ARMY—The 1943-44 task of war production for the radio manufacturing industry is cut out in a very huge "blueprint" under the funds allotted to the Army Signal Corps for the fiscal year commencing July 1. (Congress was slated to approve the huge 71½-billion-dollar War Department supply bill speedily and without change.) For procurement of communications equipment, with electronic and radio apparatus constituting over 90%, the Signal Corps is to receive \$4,796,131,773. This amounts to 86.27% of its total budget for the 1944 fiscal year. Three-fourths of this huge fund, an aggregate of \$3,659,473,705, is to meet the needs of the Army Air Forces; \$366,010,624 for Lend-Lease; and, \$1,533,413,671 for the Army Ground Forces and Army Service Forces.

BILLIONS FOR RADIO—The Chief Signal Officer points out that of the new appropriation, the Army Air Forces allotment includes \$2,750,094,494 for radio apparatus to be installed in the projected 99,740 new Army airplanes. Other apparatus for the Army Air Forces comprises \$89,500,000 for radar equipment; \$303,000,000 for tactical ground equipment; \$335,000,000 for improved air-borne equipment; \$57,200,000 for additional Army airways radio stations; and the remainder for maintenance of these services. The facilities of the entire communications manufacturing industry of the United States are devoted to making military equipment, divided 82% for the Army and 18% for the Navy.

INCREASED ACTIVITY FOR WPB RADIO AND RADAR DIVISION—The WPB Radio and Radar Division is receiving a budget for the next fiscal year of \$489,000 with a total of 172 persons, an increase of 10 employees over the current year's operations. While the House slashed the funds of many government agencies, it did not reduce Ray Ellis' Division, which was described to the House Appropriations Committee as requiring "exceptional specialists because the entire art is in the state of development and there are continued changes coming in." In a summation of this Division's activities to the House Appropriations Committee, WPB Operations Vice-Chairman Donald B. Davis cited how the radio division takes the requirements as spelled out by the various claimant agencies and presents them, in terms of materiel needed, to the WPB Requirements Committee and then receives the allocation of materiel for sub-division among the producers. It also maintains close liaison in fields of conservation and development with Army, Navy and other government agencies.

IRAC TO STUDY POSTWAR RADIO ALLOCATIONS—The Interdepartmental Radio Advisory Committee, which makes recommendations to the President on frequencies, has named a committee to study postwar allocation which is to be headed by FCC Commissioner T. A. M. Craven and includes among its members, Dr. J. H. Dellinger, Bureau of Standards Radio Division Chief and noted radio scientist. Besides planning for the frequencies to be used by the government after the war, the committee contemplates frequent conferences with different branches of the radio industry.

PRODUCTION NOTES—WPB Radio & Radar Division is now considering whether to schedule military and civilian home receiver-tube production together or to set up the definite requirements of civilian tubes necessary for replacement and direct the companies to make them. Several of the larger tube manufacturers are leasing plant floor space for assembly of tubes in towns where labor conditions are not tight; then the tubes are shipped into the main plants for final inspection. . . . Radio and Radar manufacturers are now being encouraged by WPB and the armed services to use aluminum and magnesium (even though the materials are tight), for air-borne apparatus because of the greater weight factor of substitutes.

Extended Range!



Permoflux Dynamic Headphones Mean Extra Striking Power!

Carrier planes cannot safely extend operations beyond their effective communication range. A few extra miles may sometimes mean the accomplishment of otherwise impossible objectives. The high sensitivity and wide, uniform frequency response of Permoflux Dynamic Headphones at all altitudes, provide improved intelligibility under adverse noise level conditions — assure reception of vital messages at maximum distance from home base.

BUY WAR BONDS FOR VICTORY!

TRADE MARK
PERM-FLUX
CORPORATION
4916-22 W. Grand Ave., Chicago, Ill.

PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS.

response from manufacturers and a welcome change in advertising copy if an effort was made to provide readers with actual dimensioned drawings and engineering data, instead of wind and propaganda. This could not be done with all advertisers, of course, but it might prove to be a worthwhile experiment.

This thought is passed along to you for whatever use you wish to make of it.

D. Martin,

Chief Radio Engineer

J. H. Bunnell & Co.,
81 Prospect St.,
Brooklyn, N. Y.

Electronic-Equipment Maintenance

Editors Electronic Industries:

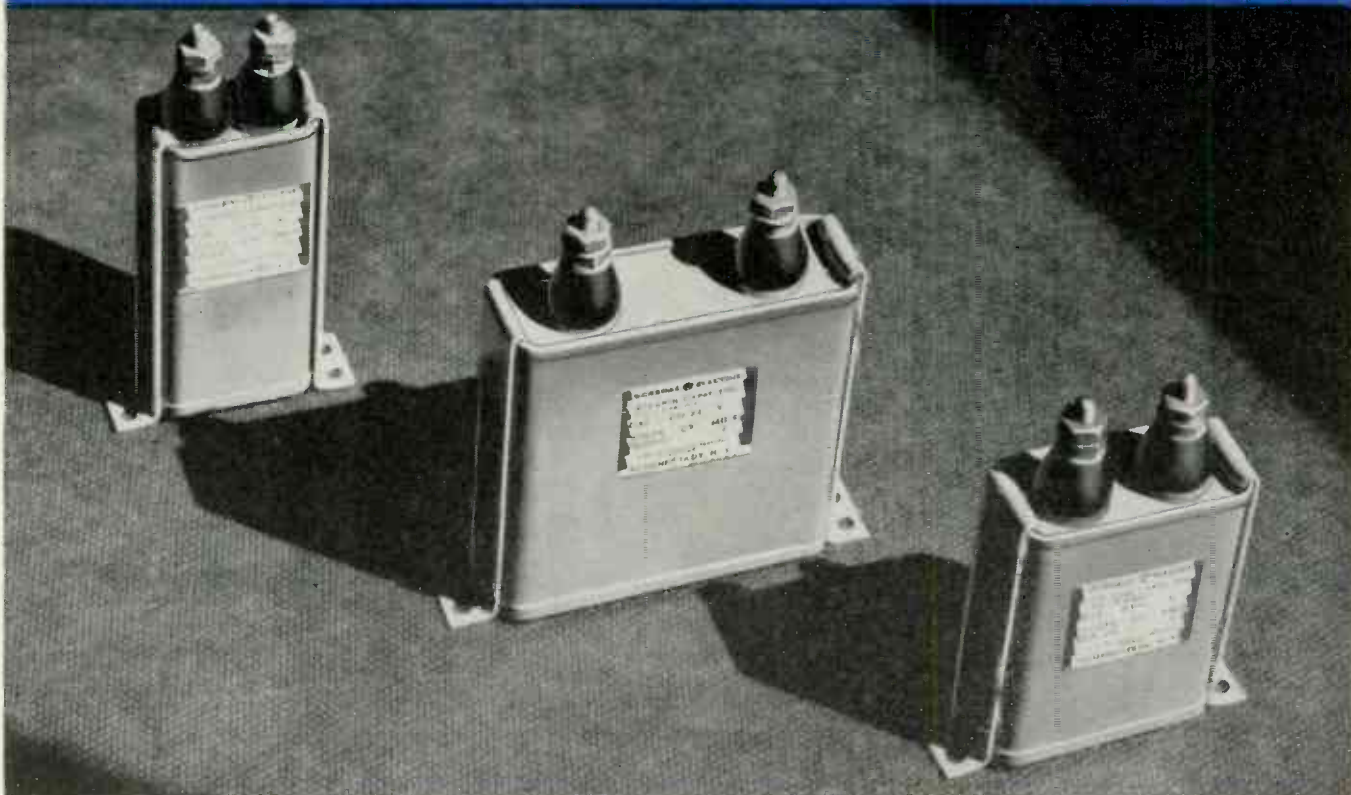
Referring to your recent article on maintenance of electronic equipment, I firmly believe that the post-war problem of servicing industrial electronic control equipment can best be solved by training the upper-bracket radio servicemen in that work, for they already have a thorough knowledge of the fundamental principles involved in the construction and operation of such devices.

Two types

There are two types of radio servicemen. One, the parts-changer, knows the names and physical characteristics of the various component parts, but does not know why they are used, what takes place in them, nor what to do about it. If a situation arises requiring individual thought or originality. The second type (unfortunately in the minority at present), has taken the trouble to acquire an engineering education or its practical equivalent, knows why as well as what, and can readily adapt himself to new devices, new circuits, and new uses for old circuits. The training now being given ex-servicemen by the Army Signal Corps will be instrumental in providing another post-war group from which electronic control servicemen may be drawn and trained.

My own introduction to the electronic field was unorthodox. Long before the days of Hammond organs, etc., my two little daughters were struggling with music, and it was difficult to keep them interested. In order to increase their desire to learn, I designed and built them a portable electronic organ with a five-octave range on a

It's easy for you to design with PYRANOL CAPACITORS



More than 350 *standard* ratings to choose from,
in sizes and shapes to meet your requirements *best*

COMPACTNESS—High capacitance per cubic inch, because of Pyranol's unusual dielectric properties.

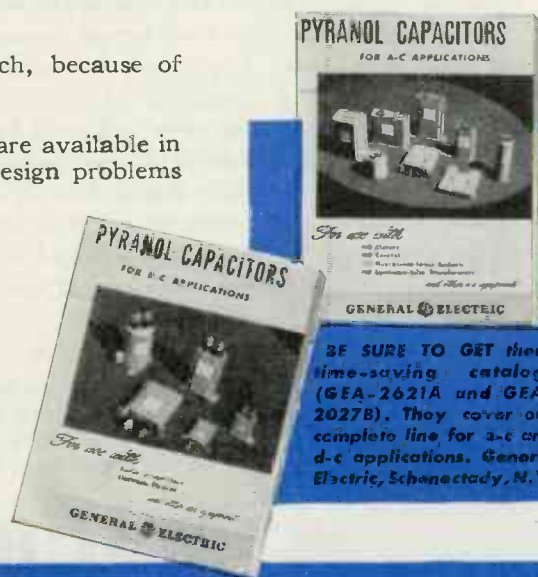
SPACE-SAVING SHAPES—Many of the ratings are available in oval, cylindrical, or rectangular cases to make your design problems easier.

CONVENIENCE—They will work equally well mounted in any position.

DEPENDABILITY—Hermetically sealed for permanence and uniformity of characteristics.

LONG LIFE—Ensured by superior materials, supervised manufacture, individual testing.

Pyranol is the G-E trade name for askarel, a synthetic, nonflammable liquid used in treating G-E capacitors.



BE SURE TO GET these time-saving catalogs (GEA-2621A and GEA-2027B). They cover our complete line for a-c and d-c applications. General Electric, Schenectady, N.Y.

GENERAL ELECTRIC

AIR SUPREMACY.. Thanks to the X-RAY!



Dispatches from the African Desert and other far-flung United Nations' battlefronts pay tribute constantly to the superiority of Allied aircraft. The X-Ray has played an important part in the development of the high degree of mechanical efficiency evident in design, construction, and performance of these planes. X-Ray analysis of molecular structure aids in the development of stronger alloys; X-Ray inspection of vital parts eliminates the need for excess "safety factor" to compensate for possible hidden flaws; the resultant reduction in weight means better maneuverability, superior combat performance, that have brought many a victory to our fliers at the front. The greater strength and reliability have prevented many a crack-up.

After the war, many industries will profit from these war-time lessons. Untold new fields of accomplishment will open to the design engineer who knows how to eliminate the "ignorance factor", the unnecessary extra weight, from his design considerations. The X-Ray will lead the way to more and better products of every mechanical variety.



THE X-RAY TUBE IS THE HEART OF THE X-RAY MACHINE... The majority of leading makes of X-Ray apparatus are equipped with Machlett Tubes.

MACHLETT
Laboratories Inc.
SPRINGDALE CONNECTICUT

LARGEST PRODUCERS OF X-RAY TUBES
X-RAY TUBE SPECIALISTS SINCE 1898

single-octave keyboard, automatic key-change switch, thumb swell pedal, etc., which was quite a success. Then I developed for my radio shop a capacity relay which turned a spotlight on each person who entered. As soon as he was seated it turned on the radio nearest his chair. If he moved to another chair, it cut off the first radio and started another one near his latest seat, etc.

It happens that I am manager of the Shreveport Symphony orchestra. At one of our concerts I met a department superintendent of one of our major oil concerns. We were discussing the little organ I had built my daughters, so I invited him to come to see it. When he entered the shop the capacity relay began to perform for him and he became so interested in its operation that we began to talk electronics. He wanted a device to use in recycling operations that could get the saturation of the recycled gas by following the protons in the gas molecules. I was able to work out his problem satisfactorily, and the word got to another oil company who wanted geophysical devices built to do specific jobs. I designed and built them.

Army design engineers

A number of years ago I was visiting a friend of mine at Barksdale Field. He was a major at that time in charge of Air Corps Ordnance in the southwest area, and we were enjoying a glass of beer at the residence of a captain who at the time was in charge of all Air Corps weather stations in the southwest area. We were arguing about whether C.I.T. or M.I.T., was the best technical school, and the argument spilled over into a remark to the effect that all Army design engineers went at problems the longest and hardest possible way around. That resulted in my being thrown the problem of designing a quick and accurate means of measuring daytime ceilings, which at the time were a matter of guesswork. I designed and turned over to them a photoelectric inclinometer that was very simple and inexpensive. That started me working on many problems of an Air Corps nature.

Again in therapeutics; while a doctor was giving me an old-time diathermy treatment the machine went wild and burned a hole through my shoulder. I told him how I thought I could design one that would be safe, and got the job. He told others, and for several years

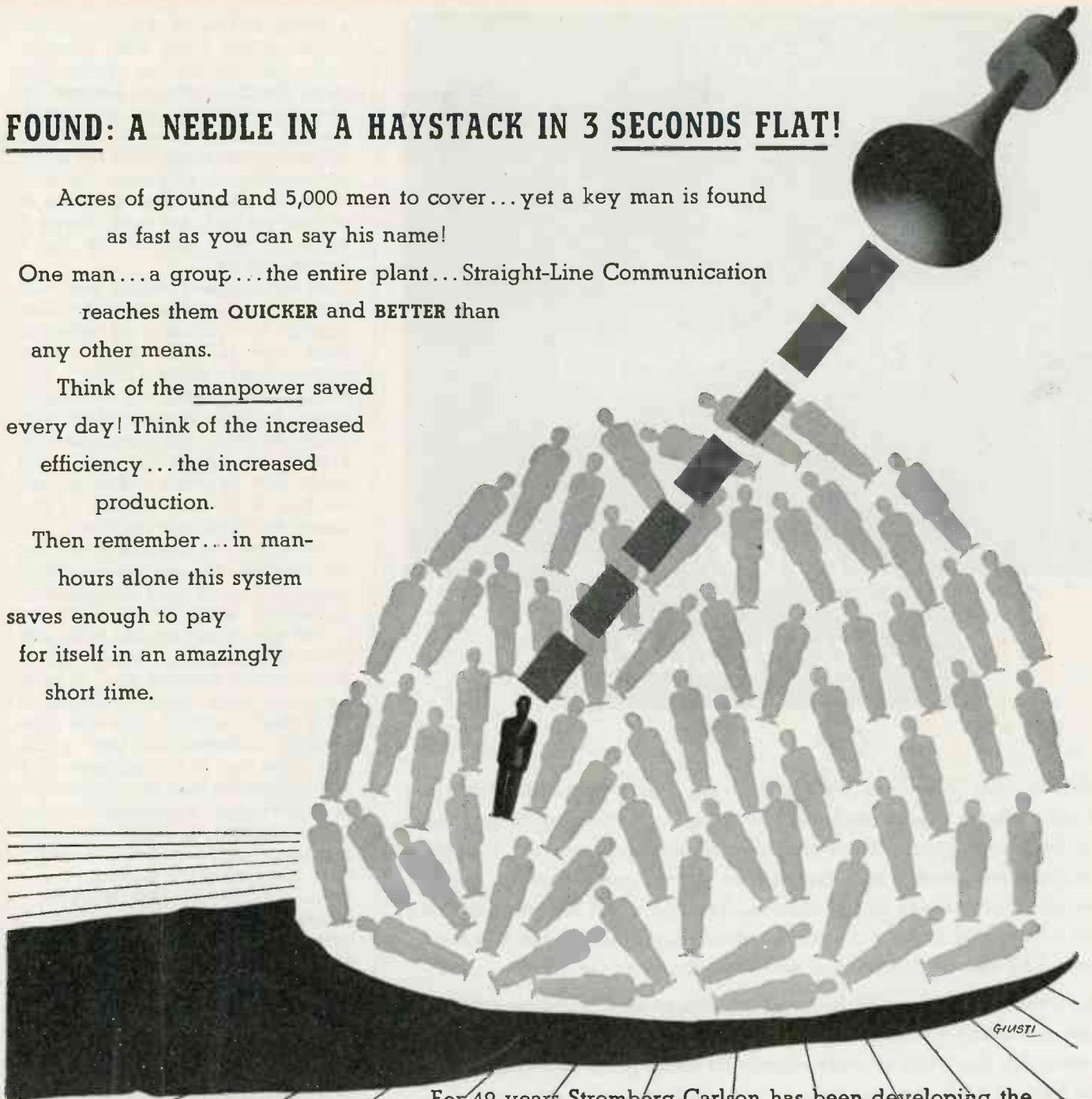
FOUND: A NEEDLE IN A HAYSTACK IN 3 SECONDS FLAT!

Acres of ground and 5,000 men to cover... yet a key man is found as fast as you can say his name!

One man... a group... the entire plant... Straight-Line Communication reaches them **QUICKER** and **BETTER** than any other means.

Think of the manpower saved every day! Think of the increased efficiency... the increased production.

Then remember... in man-hours alone this system saves enough to pay for itself in an amazingly short time.



For 49 years Stromberg-Carlson has been developing the finest type of sound reproducing equipment. Today this equipment is playing a vital role in speeding plant production all over the country.

If you have any communication problem that needs solving... why not get in touch with the

Sound Systems Division of the Stromberg-Carlson Company,
100 Carlson Road, Rochester, New York. Write for free Booklet No. 1934.

STROMBERG-CARLSON



STRAIGHT-LINE COMMUNICATION SAVES MANPOWER • SPEEDS THE WORK TO VICTORY





**A PROMISE
OF
THINGS TO COME**

We call it the "American Way" of life—the right to think, speak, act and worship as we please, and respect the right of others to do the same. For the preservation of these principles we are again at war. We of this company are proud of the major role we and the radio-electronic industry are privileged to play in this struggle. The free world we are fighting for will be a vastly happier and more comfortable world thanks to war-time radio and electronic advances now little known to the public.

The contributions we will be able to make in new parts, new designs, new principles are multiplying daily. We're fighting harder now to hasten the day when we may release for constructive peaceful purposes the fruits of these many months of war production and research.

Thanks to improved techniques and plant expansion, most variable condensers, tube sockets, inductors, insulators, hardware and other parts can now be shipped more quickly than heretofore. We will be pleased to quote price and estimate delivery for your war requirements. Ask for free catalog 967D.



JOHNSON

a famous name in Radio

E. F. JOHNSON COMPANY
W A S E C A , M I N N E S O T A

a steady stream of doctors, having heard of me from other doctors, have been having me design and build special electronic devices not on the market; to accomplish specific results in certain diseases, operations, treatments, or for use in certain types of diagnosis. None of these devices are either patented or on the market, for each device I build is for a specific job for a specific doctor.

An oil-company supply salesman wanted to increase his prestige among his clientele by showing them how to make their rubber belting last much longer, and wanted for the purpose a small electronic portable dynamometer that would measure instantaneous belt pressure at any given point, and could find no such device on the market, so he came to me. I designed and built one for him.

I feel that we are just scratching the surface of electronic control equipment, and that the postwar period will usher in the beginning of the true electronic age. The wise radio technician will begin now to train himself for that era. If more literature were made available to servicemen, written with the least possible mathematics, they would lose their fear of the unknown and begin to realize that the problems of the electronic industries are no more difficult to solve than the problems of the radionic industry with which they are familiar.

M. J. Edwards

Radio Hospital,
2726 Coral Street,
Shreveport, Louisiana

Electrical Jobbers Eye Electronic Industries



Growth of electronic applications is attracting eager attention of the old-line electrical distributors whose National Electrical Wholesalers Association held its War Conference at the Hotel Statler, Buffalo, N. Y., May 24-26. In center behind flowers is President D. Lyle Flife of Detroit; at left is William L. Batt, vice-chairman WPB; at right (standing) C. G. Pyle, NEWA managing director, and Harvey Conover, publisher



Electronic briefs: **radar**

Radar is a method of transmitting ultra-high-frequency radio waves to an object which reflects the wave back to its source. The time required for the round trip from the transmitter to the object and back to the receiver is the measure of the distance to the object. The direction is established through the use of directional wave transmission.

High transmitter power is essential in radar for the amount of energy which is reflected is extremely small. Plate voltages are in the order of tens of thousands of volts and plate currents are measured in tens of amperes. The vacuum tubes used in such equipment must be capable of operating efficiently and dependably over long periods under extremely heavy loads.

High voltage, high frequency, operation at absolute peak emission...ability to stand momentary overloads of as much as 400%...unconditional guarantee against emission failure due to gas released internally...are the features which marked Eimac tubes as ideal for this important application. These are some of the reasons why Eimac has been "Standard" in Radar transmitters for the past number of years. Just one more proof that Eimac tubes are first in the important new developments in electronics.

EIMAC
304T

EITEL-McCULLOUGH, Inc.
SAN BRUNO, CALIFORNIA

Export Agents: *Frazar & Hansen*
301 Clay Street, San Francisco, California, U. S. A.

Follow the leaders to



Awarded for high achievement in the production of war materials.

Eimac
REG. U. S. PAT. OFF.
TUBES

DEPENDABLE



Accuracy and dependability
are built into every Bliley
Crystal Unit. Specify BLILEY
for assured performance.

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ERIE, PENNSYLVANIA

BLILEY ELECTRIC COMPANY . . . ERIE, PA.

Bliley Crystals

NEW BOOKS

High Frequency Thermionic Tubes

By A. F. Harvey, published 1943 by John Wiley & Sons, Inc., 440 Fourth Ave., New York City, 235 pages.

This book is a timely and extensive guide to the procedures in the generation and utilization of very high-frequency electrical energy in the many specialized fields to which they have been applied. Following the trend toward the use of frequencies in the centimeter range, the author points out the difficulties attending their generation, and the failure of the usual design rules for that condition.

Dr. Harvey's approach to the problem is of a style well suited to the engineer who has to work with such frequencies, and at no time does he let the subject "get lost" in the mathematics which could be associated with the problem. However, much new and original material is included, especially on the operating principles of magnetron.

After a consideration of the problems associated with tubes of usual construction, but which have been designed for use at these high frequencies, the major part of the book is devoted to magnetron principles, studies of retarding-field generators and the newer developments of the velocity modulated tubes, such as the klystron and others.

Attention is also given to the general subject of wave guides and horn radiators. This book is an important contribution to the subject, and provides an excellent text or reference.

Radio Data Handbook

Edited by Lieut. Nelson M. Cooke, United States Navy, U. S. Naval Research Laboratory, Washington, published by Allied Radio Corporation, Chicago, 48 pages, 25c.

The handbook is intended for students, servicemen, or experimenters and supplies nomographs, practical information, data and formulas. Included are formulas for decibels, resistance, inductance, reactance, "Q" factors, transients, peak average, vacuum tube constants, etc., as well as data on radio color codes, interchangeable tubes, pilot lamps, plug-in ballast resistors, and coil windings. The book also contains four-place log. and trig. tables.

CANNON

Visual Aids

TO HELP YOU LICK THE MANPOWER SHORTAGE
BY MAKING YOUR WORKERS MORE EFFICIENT



TRAINING FILMS— Ready now! The new Cannon Electric Slide Film with sound tells your employees how to use electrical connectors correctly and efficiently. Clears up confusing terminology. Explains assembly techniques. Shows how AN part numbers are established and facilitates the ordering of replacements.

CATALOGS— Engineers, production executives, service men need the basic information clearly presented in the new catalogs covering many types of Cannon Connectors.



WALL CHART

Gives the insert arrangement and shell sizes on AN specification connectors at a glance, thereby facilitating designing, wiring and servicing operation in factories as well as in the field.



TEAR OUT THIS COUPON AND ATTACH TO YOUR BUSINESS LETTERHEAD



CANNON ELECTRIC

Cannon Electric Development Company, Department A-122
3209 Humboldt Street, Los Angeles, California

Please send us more information on the visual aids checked below:

TRAINING FILM CATALOGS WALL CHART

List of American Standards

Published by the American Standards Association, New York, 20 pages, free.

The pamphlet contains a list of publications by the American Standards Association, arranged by subjects of which electrical engineering, chemical industry and motion pictures may be of interest to the electronic engineer.

Commercial Standards, American Safety Standards and American War Standards are included. The last six pages are devoted to an alphabetical listing of standards.

Super-Electricity

By Raymond F. Yates, published by D. Appleton-Century Company, New York and London, 1942. Illustrated, \$2.00.

Because so many members of the general public are asking the readers and editors of "Electronic Industries" for the names of books which explain the electronic field clearly to the layman, we make this delayed listing of Mr. Yates' popular exposition which was published late in 1942.

The author gives a brief account of the history of the electronic art from its inception in 1905 to the present time. He shows how to get a thorough grounding in the fundamentals of the subject at home and in school or college. Then he surveys the whole electronic field as it exists today, with special emphasis on the possibilities of obtaining a job or going into business.

The Electron Microscope

By E. F. Burton and W. H. Kohl, published by Reinhold Publishing Corp., New York, 233 pages, \$3.85.

Written by two men who played an outstandingly important part in introducing the electron microscope to American science and industry, the book describes in clear and simple language the performance of the light microscope as well as of the electron microscope.

The basic principles and their historic development are given and explained by analogies to well-known laws of nature; the behavior of light rays and electron rays is stated and illustrated by numerous, instructive pictures. Though easy to read, the text contains an abundance of facts on construction and operation of one of the most recent tools of research and industrial investigation, as may be expected when the authors are experts in the field covered by their book.

TAYLOR TUBES



Efficiency in Action...

As always, Taylor is building the finest tubes possible to produce. Every Taylor Tube is designed and engineered to deliver maximum service under strenuous battle conditions. Unfailing, "on the air" performance is their keynote—extra power for vital communications is their heritage. You can rely on Taylor Tubes "More Watts Per Dollar" service in any situation.

Taylor HEAVY **CUSTOM BUILT** DUTY **Tubes**

TAYLOR TUBES INC., 2312-18 WABANSIA AVE., CHICAGO, ILLINOIS

**Basic Facts on
Electricity Needed to
UNDERSTAND
ELECTRONICS!**



603 pages
\$3.50

**BASIC
ELECTRICITY
for
COMMUNICATIONS
by
W. H. TIMBIE**

A clear, concise, practical book for those who want to prepare themselves now for the rapidly growing fields of Communications and Industrial Electronics.

Only those facts and principles every communications or electronics worker needs to know—and know well, are presented. Actual job problems are used throughout to show, step by step, how to solve electrical and communications problems that arise in practice.

This book gives you a comprehensive picture of the fundamental laws and principles governing communications practice. You will know the instruments and apparatus used—what they look like—how they work. You will know the symbols and language of the trade, and learn to figure quickly daily problems. This book will give you a foundation that will serve you well at all times and prepare you for advanced work in the field.

-----On Approval Coupon-----

JOHN WILEY & SONS, Inc.
440 Fourth Avenue, New York 16, N.Y.

Please send me a copy of Timbie's BASIC ELECTRICITY FOR COMMUNICATIONS on ten days' approval. At the end of that time, if I decide to keep the book, I will remit \$3.50 plus postage; otherwise I will return the book postpaid.

Name

Address

City and State.....

Employed by

EL-7-43

**The Mathematics of
Physics and Chemistry**

By Henry Margenau, Associate Professor of Physics, Yale University, and George Moseley Murphy, Assistant Professor of Chemistry, Yale University, published by D. Van Nostrand Company, Inc., New York, 1943, 581 pages, \$6.50.

As indicated by the title, the authors' aim has been to present those parts of mathematics which form the tools of the modern worker in theoretical physics and chemistry. Due to its concise language and the numerous illustrating examples and problems, the text is well suited for self-study, and, of course, may be used as a text book on senior or first year graduate level. For anyone acquainted with the subject treated, it provides ready reference for particular solutions, as each chapter, though continuous, is divided into many sections under sub-headings which are listed in the comparatively extensive index.

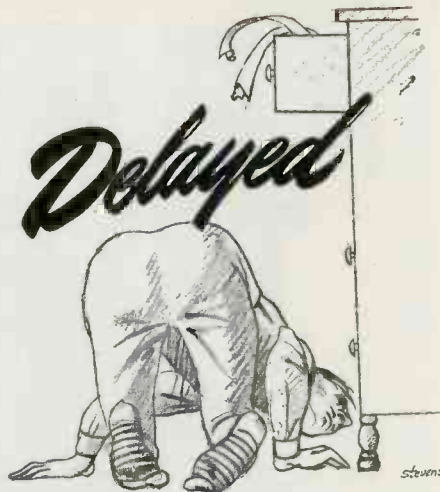
At present, any research or development engineer has to have a certain amount of theoretical background, and the book seems particularly recommendable because it provides the indispensable mathematical basis as well as some of the results most frequently used.

Several chapters will be of special interest to the electronic engineer: Differential equations, essential for the understanding and handling of the fundamental wave equation which is treated in detail; some of the special functions, e.g. Bessel's function, required for mathematical treatment of problems on frequency modulation and vector analysis.

**Revised Chart for
Electrical Wiring**

Published by James Steel Mahan,
201 N. Wells St., Chicago, Ill.
Price 10c each.

A newly revised chart, 16 3/4 in. x 18 1/2 in. is now ready for distribution, as an aid for electrical construction workers. The master chart was originally developed in 1935 and approximately 155,000 copies have been in use. Since the Code revisions of 1940, many requests were made for a revised chart to meet the latest requirements. This chart is of particular value at this time due to the action of the War Production Board in stopping or materially curtailing the manufacture and use of wiring systems using critical materials.



**BY A
MISSING LINK?**

So you're struggling to catch the 8:12 into the city in the morning, with no time to spare, and all of a sudden it's gone . . . you're betrayed by a missing link. It certainly would try the patience of a saint.

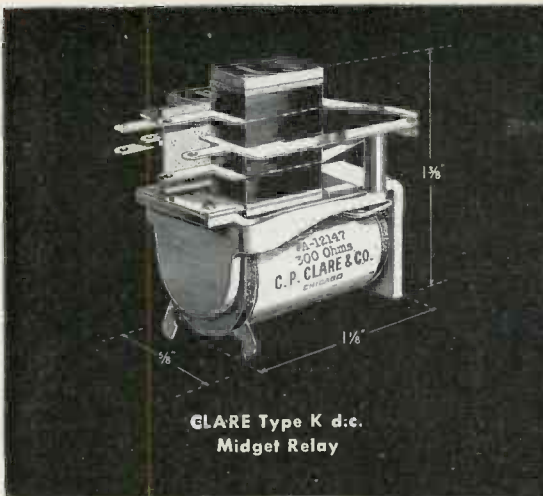
But what is even more exasperating, is when you're scheduled to go into production and can't obtain some missing parts. Or, sometimes, you may need the whole piece of equipment, and you just cannot put your finger on it.

There is one difference, though. Maybe you can't get trained help in searching for a cuff-link, but Harvey's can help you to locate radio components. We may even have it on our shelves.

If we do not have the parts you require, our experienced staff can find it, purchase it, and expedite deliveries on it. This facility in locating components is due to years of constant association with sources of radio supply.

Before you lose your temper, call Harvey. He can surely be of assistance to you.





A Veteran of 59,000,000 Operations!

This Clare Type K d.c. Midget Relay is still in good mechanical and electrical condition after 59,448,200 operations—a typical example of the long life and rugged serviceability you can depend on in a “custom-built” relay. It has been used for pulsing antenna switching relays. It was set for 16 operations per second, energizing a secondary relay having a 90 ohm coil operating on 28 volts.

The Clare Type K d.c. Midget Relay is dwarf-size and feather-weight, “custom-built” for mobile applications, where resistance to constant vibration and severe shock is essential.

It is extremely small—only $1\frac{1}{2}'' \times 1\frac{1}{4}'' \times \frac{13}{16}''$ overall, and weighs approximately $1\frac{3}{8}$ ounces. It is a solid, compact unit, employing no anti-vibration springs, no bearings to rattle loose—no part of it can be loosened by vibration or shock.

Spring insulators are made from XXX Bakelite; also available in $\frac{1}{8}''$ Mycalex, insuring minimum high frequency losses. The screws anchoring spring pile-ups to the heelpiece are enclosed in Polystyrene tubes, tightened under pressure, and Glypto-sealed at head and foot. Each relay is given a 1000 volt a.c. insulation breakdown test.

The armature assembly, heelpiece and coil core are made of magnetic metal, carefully annealed. Uniform armature movement is assured by a hinge of “fatigueless” beryllium copper, heat treated and designed to provide a wide margin of safety, insuring long life under vibration and shock and permitting millions of uniform operations.

The small coil is carefully wound to exact turns on precision machines, and can be supplied impregnated with a special varnish. It is covered with a transparent

acetate tape. Type number and data regarding resistance is shown on each coil.

The coil is equipped with a front spool head having a flat side, which locks the entire coil in place against the heelpiece, preventing it from turning or becoming loose. The screw holding the coil in place is equipped with a split type lockwasher. Coil voltage ranges from 1.5 volts to 60 volts d.c.

This relay can be furnished with contacts either of 18 gauge silver, rated one ampere, 50 watts, or of 18 gauge palladium, rated 2 amperes, 100 watts; normally open, normally closed, or double throw; and with any number of springs up to and including 12. Contact springs are made of nickel silver to the user's specifications, and the contacts are over-all welded to these springs by a special process.

Spring bushings are made under a special process—designed, constructed, and attached to the springs so that the small springs used on this relay are not weakened, thereby assuring uniformity of relay operation and long life.

All metal parts of this relay are specially plated to withstand a 200 hour salt spray test. For high voltage a special Bakelite insulating strip can be supplied between pile-ups. Like all Clare Relays, this Type K d.c. Midget can be “custom-built” to meet specific requirements.

Our engineers will be glad to “custom-build” the relay that meets your requirements. Write us regarding your problem. Ask for the Clare catalog and data book. C. P. Clare & Co., 4719 Sunnyside Avenue, Chicago, Illinois. Sales engineers in all principal cities. Cable address: “CLARELAY”.

CLARE RELAYS

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

DELAYS *Are Not* NECESSARY!



...get vital radio and electronic parts and equipment — Quickly!

Research in electronics is now devoted almost exclusively to wartime applications—and every minute counts in war!

Electronic engineers and research technicians need not delay completion of vital projects for lack of parts or equipment. Lafayette Radio Corp. is headquarters for every nationally known manufacturer in the field.

The reputation of Lafayette Radio Corp. for complete stocks and prompt deliveries is well known to thousands of electronic engineers. We can fill your needs—quickly!



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CHICAGO, ILLINOIS

ATLANTA, GEORGIA

NEW BULLETINS

DuMont Reference Manual of Cathode Ray Tubes and Instruments

Besides describing the complete line of cathode ray tubes and instrument products of DuMont manufacture this deluxe loose leaf manual contains a wealth of information on the principles and uses of an oscillograph and a number of applications notes.

Ward Products Production Brochure Facilities

The Ward Products Corp., 1523 East 45th Street, Cleveland, Ohio, has issued a 24-page illustrated brochure outlining in detail the production facilities and equipment available in its two plants for handling contract work from other manufacturers. Primarily engaged in making radio antenna equipment, the company is interested in any current or postwar contracts in related fields which involve a reasonable number of the facilities described—regardless of the product classification.

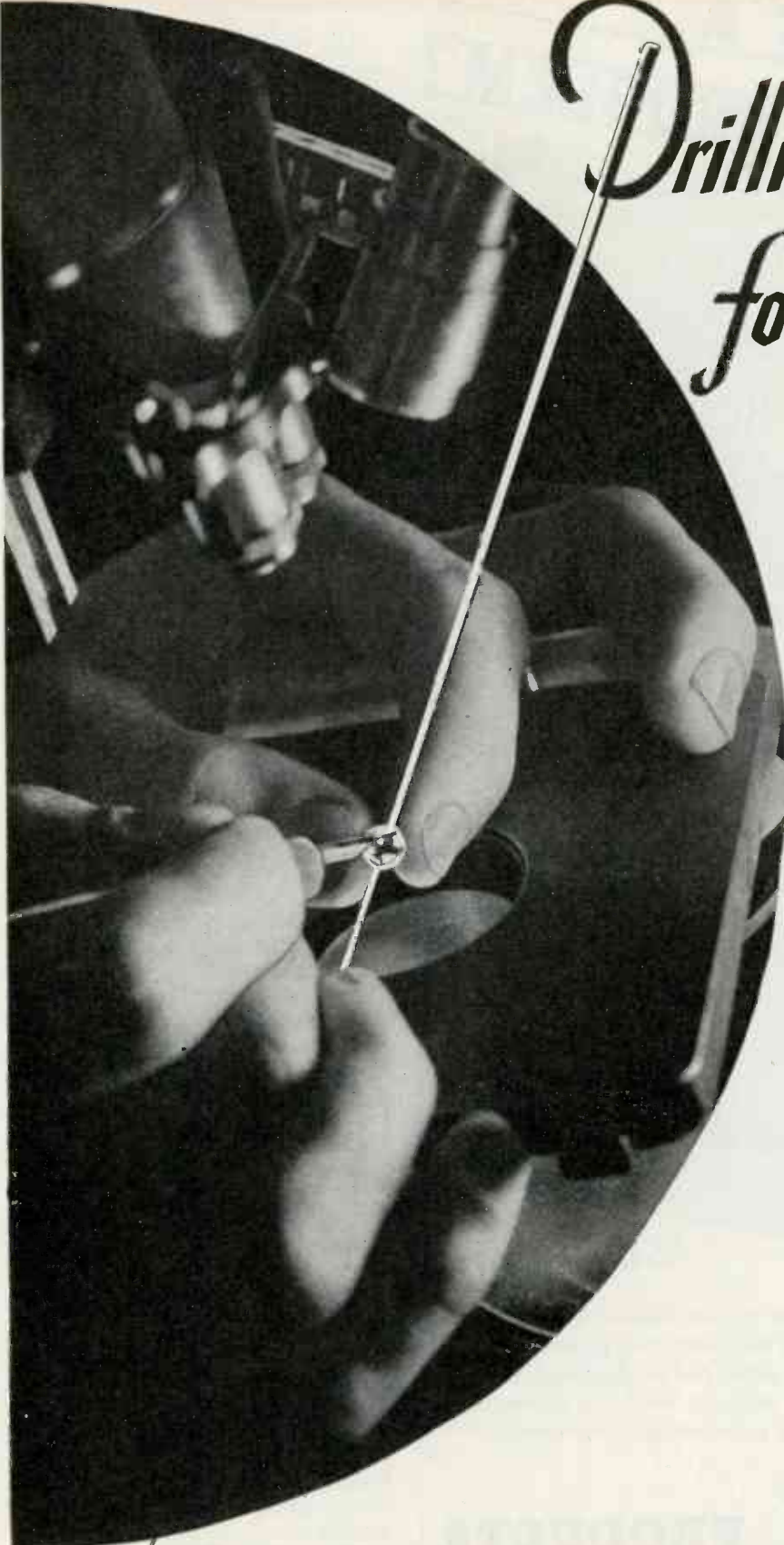
Radio-Training-Kits Brochure

Lafayette Radio Corporation's Special Department, 901 W. Jackson Blvd., Chicago, for handling the needs of instructors and school management has just prepared this new brochure to aid schools in their government training courses. Company engineers have expressly designed the kits mentioned in this folder to fit present training programs. Starting with fundamentals and progressing to basic receiver and transmitter operation, a progressive training program may be built up around these kits.

Metal Stampings in Small Lots

An attractive booklet entitled "A Small Lot Metal Stamping Device Without Prohibitive Die Costs," by Dayton A. Rogers, has been published by the Dayton Rogers Manufacturing Co., 2835 S. 12th Ave., Minneapolis. The booklet is written by an engineer for the manufacturer who from time to time requires a limited number of metal stampings and where the cost of conventional dies would be prohibitive. Illustrations of the plant and blueprints of some examples which have effected savings in production are included.

Drilling Diamonds for Victory



DRAWING of fine wire for delicate precision instruments depends on the accuracy with which the diamond dies are made. Philips manufacture these dies down to .0008 of an inch with diamond drilling machines developed by Philips engineers.

This operation—as well as the actual drawing of the wire—calls for extreme precision and exemplifies the wide technical knowledge and skill behind all Philips products.

Today, the research and experience of the North American Philips Company in electronics are devoted to the single aim of aiding the United Nations war effort. Tomorrow, this knowledge will aid industry in creating a new world for free men.

Products For Victory include Cathode Ray Tubes; Amplifier Tubes; Rectifier Tubes; Transmitting Tubes; Electronic Test Equipment; Oscillator Plates; Tungsten and Molybdenum in powder, rod, wire and sheet form; Tungsten Alloys; Fine Wire of all drawable metals: bare, plated and enameled; Diamond Dies; X-Ray Apparatus for industrial, research and medical applications.



NORTH AMERICAN PHILIPS COMPANY, INC.

Electronic Research and Development

Factories in Dobbs Ferry, N. Y.; Mount Vernon, N. Y. (Philips Metalix Corp.); Lewiston, Maine (Elmet Division)

DO YOU HAVE A PRODUCTION PROBLEM?

Ward

CAN HANDLE CONTRACTS THAT REQUIRE:

Radio, Electronic or Mechanical Engineering	See Page	2
Completely Equipped Tool Room		3
Automatic Screw Machines		4
Hand Screw Machines		5
Swaging Operations		6
Punch Presses		7
Foot Presses		7
Drill Presses		8
Threading Operations		9
Lathe Operations		10
Milling Operations		10
Light Section Spot Welding		11
Intricate, Soft and Silver Soldering		12
Plating		13
Buffing and Sanding		13
Wire Braiding		14
Packaging		14
Painting or Spraying		15
Infra-red Baking or Air Dried Finishes		15
Intricate Mechanical and Electronic Assembly		16
Careful Inspection		16

All these facilities are available to you.

THE WARD PRODUCTS CORPORATION
1922 East 45th Street
Cleveland, Ohio

Write for your copy of this illustrated brochure

The Ward Products Corporation offers the services of its two fully equipped plants to help you solve your manufacturing problems. The brochure illustrated above describes in detail our production facilities and other qualifications for handling contract work for present or post-war needs. Send for your copy on your business letterhead.

The
WARD **PRODUCTS CORPORATION**

1523 EAST 45TH STREET CLEVELAND, OHIO

Precision Work

The story of fine precision work on a mass production basis is told in a new booklet released by the Ace Manufacturing Corp., Erie Ave. at "K" Street, Philadelphia, Pa. Describing in detail precision grinding, production machining, metal stamping, heat treating and tool and die work, it is a typical example of the giant strides industry is making under the exacting demands of wartime production.

Manufacturers are asking for precision which used to be impossible, for tolerances as close as .0001 in, for finishes which a speck of dust or a warm hand distorts—and the company claims to be turning them out by the thousands on 24-hours-a-day, and 7-day-a-week schedules.

Electrical Rectifiers

McColpin - Christie Corporation, Ltd., 4920 S. Figueroa St., Los Angeles, has published illustrated catalogs Nos. 300 and 301 describing its 50 new model industrial electrical rectifiers. Prices are included.

Air Cooled

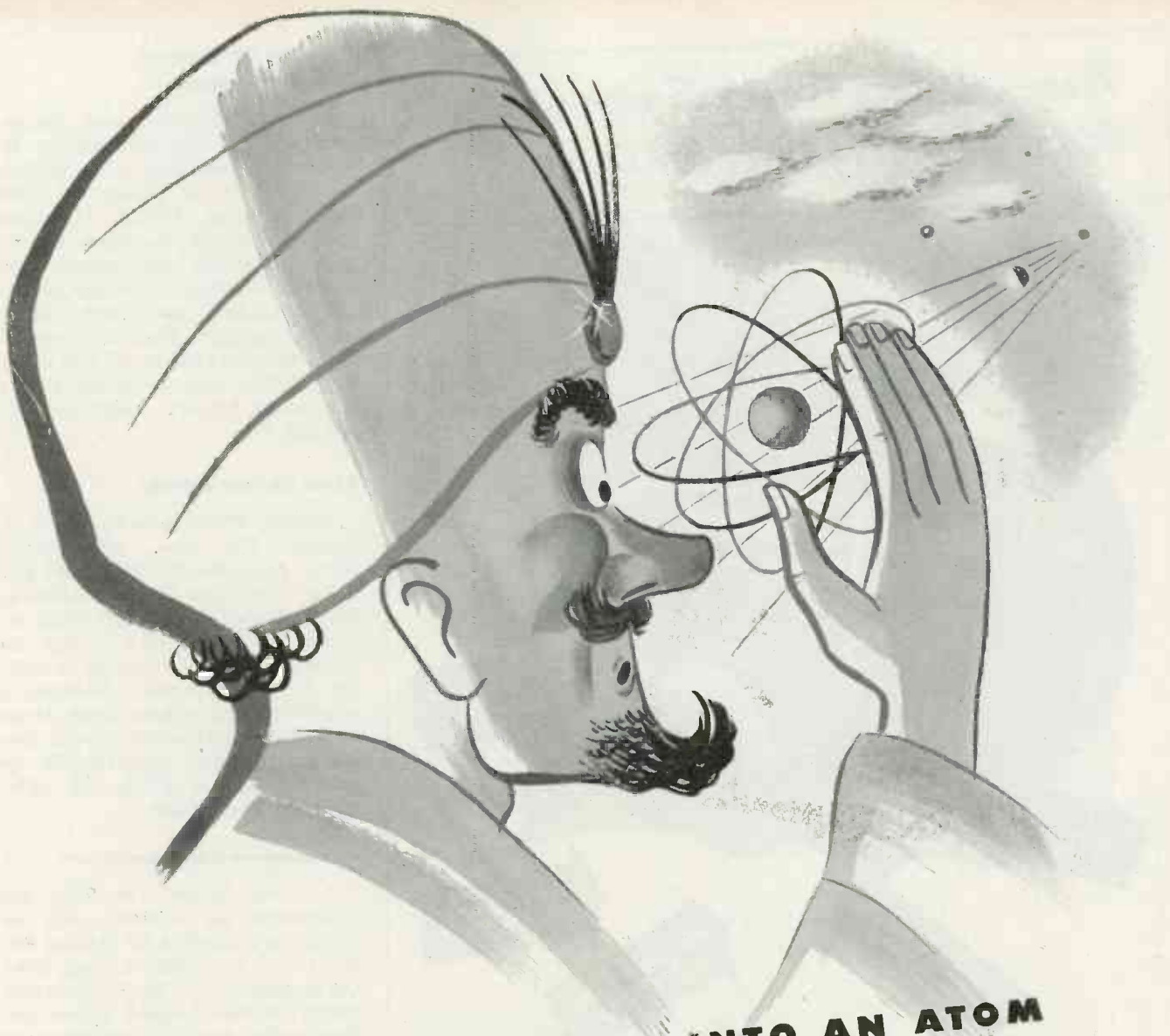
Transformer Catalog

"Power Where You Need It," a new bulletin issued by Acme Electric & Mfg. Co. of Cuba, New York, outlines and gives examples of air cooled transformer applications in war production industry. The bulletin also describes in detail the various types of air cooled transformers manufactured by this company, and lists the complete range of 55 degree ratings in auto type, two winding type, three winding type and four winding type transformers up to 50 kva.

Bulletin 103 Relay

Bulletin 103 Relay, published by Ward Leonard Electric Company, Mount Vernon, N. Y., describes a relay designed for aircraft power circuits. It will perform at high values of acceleration of gravity and also under conditions of vibration and shock. The armature and contact assembly are designed to retain either position under these conditions.

The normally-open, single pole contacts are rated 25 amperes at 24 volts dc non-inductive load, with good characteristics on inductive loads. The contact gap and tail spring tension are adjustable. Molded Bakelite nearly 3/8 in. thick forms the base.



THE CRYSTAL-GAZER LOOKS INTO AN ATOM

Hocus-pocus with a crystal ball has been replaced by the electron microscope . . . and a host of other devices . . . that really give us a vision of the future. Today's unpublished observations . . . censored by war secrecy . . . will be the basis for tomorrow's industry.

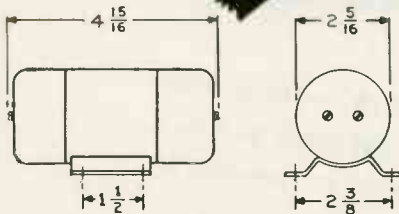
Stancor Transformers are now fighting the war with armies of electrons . . . speeding the energies of military communications. But Stancor engineers are looking ahead . . . through the clearer-than-crystal glass of scientific research . . . to the practical problems of the coming age of electronics.



STANCOR

STANDARD TRANSFORMER CORPORATION
1500 NORTH HALSTED STREET · CHICAGO

Now—A Tiny Power Supply Unit Weighing Only 34 Ounces



OUTPUT		INPUT		EICOR PART NO.
VOLTS	AMPS	VOLTS	AMPS	
200	.050	28	1.0	2316-21
		14	2.0	2316-22
150	.067	28	1.0	2316-23
		14	2.0	2316-24
100	.100	28	1.0	2316-25
		14	2.0	2316-26

Continuous duty. 50°C temperature rise.
Regulation 20% from no load to full load.

Here is Eicor's answer to your need for a power supply that is much smaller, much lighter, and completely dependable. This tiny Dynamotor is now available to manufacturers of electronic equipment for critical applications where space and weight requirements are of utmost importance.

SAMPLES AVAILABLE

Our specialized experience can be of help to you. Samples of this exclusive Eicor product in the types listed at left furnished quickly for development purposes on priority order.

Write, wire or phone

Bimetal for Circuit Breaker Design

Physical properties and characteristics of a new thermostatic bimetal are described in a bulletin issued by W. M. Chace Co., 1628 Beard Avenue, Detroit. Intended for thermostatic resistors, the bimetal ranges in applications from flashers to motor overload protection, including particularly circuit breaker designs. Electrical resistivity is given as 850 ohms per circular mil foot and deflection rate is practically uniform between 0 and 400 deg. F.

Time Delay Relays

Bulletin 800 released by The R. W. Cramer Co., Inc., Centerbrook, Conn., describes its Type TDC time delay relay. This relay provides an adjustable or fixed time delay between the closing of a control circuit and subsequent closing or opening of a load circuit. Consists of a self-starting synchronous motor with a dust protected, sturdy gear train, an electro magnetically operated clutch, a switch and switch tripping mechanism.

Communication Receivers

A 4-page folder describing and illustrating its unitized radio assembly is published by Harvey Machine Co., Inc., 6200 Avalon Blvd., Los Angeles, Calif. Ready-built simplicity of this method makes possible rapid, accurate assembly and repair of radio sets by unskilled operators. No circuit diagrams, solder or special tools are needed.

Synthetic Rubber

"The Five Commercial Types of Synthetic Rubber" is the title of a 40-page booklet just published by the United States Rubber Co., 1230 Sixth Ave., New York. The booklet deals with the comparative properties of natural and synthetic rubbers and the properties and characteristics of the five synthetics, Buna-S; Buna-N; Neoprene; Butyl and Thiokol, all made by different manufacturers.

Condensed Catalog

Bulletin Z6200 of Wheelco Instruments Co., 540 N. Michigan Ave., Chicago, is a new issue of this company's condensed catalog, and gives current prices and short descriptions of all Wheelco instruments. The bulletin refers to other bulletins issued by the company.

EICOR INC. 1501 W. Congress St., Chicago, U. S. A.
DYNAMOTORS • D. C. MOTORS • POWER PLANTS • CONVERTERS
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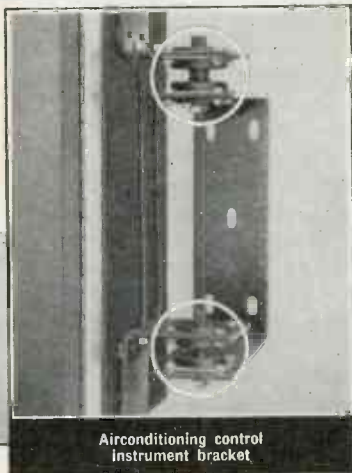
DESIGNING for use of . . .

LORD MOUNTINGS

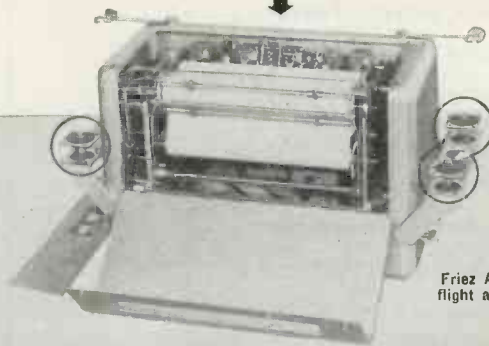
BONDED RUBBER



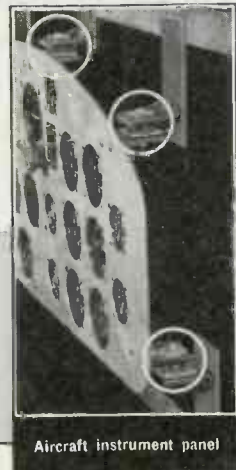
TYPICAL INSTALLATIONS OF ← LORD PLATE FORM SERIES MOUNTINGS →



Airconditioning control
Instrument bracket



Friez Aircraft
flight analyzer



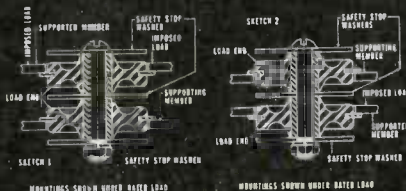
Aircraft instrument panel



Series mounting using
center spacer, allowing
greater lateral movement

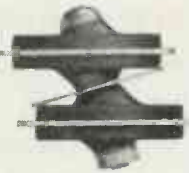


Standard square
plate form
series mounting



MOUNTINGS SHOWN UNDER RATED LOAD

MOUNTINGS SHOWN UNDER RATED LOAD



Standard series mounting
under load and in extreme
lateral movement position.
Note snubbing washer



Combination square plate
form and holder type
series mounting

LORD Shear Type, Bonded Rubber Mountings isolate vibration, absorb shock, minimize noise translation. They are compact, sturdy, light weight, and ease of installation is an important feature. Lord standard mountings are made in tube form and plate form, in various shapes and many sizes, and with load ratings ranging from a few ounces to 1500 pounds. They are designed for application on all types of mechanical and electrical devices from delicate instruments to massive equipment.

When mounting extremely delicate or sensitive equipment, the use of mountings in series is recommended. Lord mountings in series are formed by connecting the center sleeves of two single units as shown in the illustrations. In operation a series mounting arrangement: (1) Doubles the axial deflection and (2) Greatly increases the lateral softness of the mounting system.

The resultant effect of the increased deflections in all directions is a marked decrease in the natural frequencies of the mounted system and practically complete isolation against the harmful effects of vibratory forces. The degree of lateral softness may be varied by inserting spacers between the mounting units; increasing the distance between the mountings increases the lateral movement for any given force.

Illustrations show typical methods of installation and application. To install Lord mountings in series, provide recessed hole 1/32" larger than rubber diameter in both the *Supported*

and *Supporting* members, for clearance. Drilled, punched or tapped holes should be provided for fastening.

Sketch No. 1 shows the simplest arrangement of series mounting, the lower unit being fastened to the *Supporting* member and the upper mounting is fastened to the *Supported* member. Sketch No. 2 shows a type of series installation where the *Supporting* member is attached to the upper mounting, and the *Supported* member or imposed load is attached to the lower mounting. This method is often used in conjunction with method shown in sketch No. 1, where several points of suspension are necessary. The aircraft panel illustration shows typical example, sketch No. 1 arrangement being used at base of panel and sketch No. 2 arrangement at top.

Series mounting arrangements can also be made up by using a Standard Plate form mounting in conjunction with a Holder Type mounting, eliminating the necessity of recessing the member where holder base is fastened.

The use of snubbing washers as shown is recommended. They prevent excessive movement under shock loads, either vertically or transversely without interfering with normal operation. The metal washer between the two mountings may be eliminated when a center spacer is used for greater lateral freedom.

Complete information on dimensions, load rating and methods of installation are contained in our Bulletin 104. Send for your copy.

LORD MANUFACTURING COMPANY . . . ERIE, PENNSYLVANIA
Originators of Shear Type Bonded Rubber Mountings



"PACKAGED PRODUCTION"

A NEW STRATEGY
FOR BETTER PRODUCTION

We created "Packaged Production" especially for some very famous manufacturers faced with hard-to-solve war production problems.

Your Metal Fabrications: Precision Machine Work: Electrical & Mechanical Assemblies can also be accomplished here under exceptionally up-to-date facilities plus carefully engineered methods and closely coordinated controls. Whether it's a complete product, or an urgently needed part, all the production responsibilities are safe in our hands. You have nothing to worry about when you "Let Lewyt Do It." If prior commitments permit, we'll gladly lend you a hand.



Lewyt
CORPORATION

60 BROADWAY, BROOKLYN, N. Y.

MILESTONES TOWARD THE ELECTRONIC ERA

Tesla's Contributions in High Frequency Field

by DR. L. P. WHEELER,

Chief, Information Div., F.C.C.; President, I.R.E.

During the early part of the last decade of the nineteenth century the attention of the whole scientific world was challenged by Nikola Tesla's public demonstrations of the effects of high-frequency alternating currents.

It is apparent from a study of his patent specifications that while he was perfectly aware of the possibilities of his high-frequency devices for space communications and understood that signals for this purpose might be propagated as electromagnetic waves, nevertheless, his real and abiding interest was in the propagation of power which he thought his methods would achieve not by radiation as waves but (in a not very clearly explained manner) by some form of corpuscular or electronic convection initiated by the combination of high voltage and high frequency employed.

Patent specifications

Whatever may have been the cause, it is nevertheless the fact that in comparison with the effect of his development of the induction motor on the electric power industry, Tesla's contributions to the high-frequency field have been remarkably sterile. This seems to the writer somewhat unfortunate, for a perusal of his pertinent patent specifications would seem to indicate that, although not exploited effectively for communication purposes, there are at least three matters of prime importance to the radio art today on which Tesla's ideas were clearer than those of his contemporaries.

These are, first, the idea of inductive coupling between the driving and the working circuits; second, the importance of tuning both circuits, i.e., the idea of an "oscillation transformer," and third, the idea of a capacity loaded open secondary. It seems to be incontestable that all three of these fundamental ideas are clearly revealed in Tesla's patent specifications and lectures prior to 1894, although their application to communication purposes while mentioned is made incidental to the power transmission objective. As none of these ideas appear in the specific literature of the radio art prior to the patent specifications of Marconi, Lodge, and F. Braun of the years 1897-1900, it would seem that Tesla's name is worthy of perpetuation as a pioneer of these ideas which have been so basic in the radio art down to the

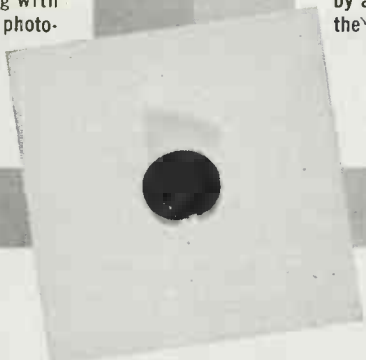
Precision's Unseen Foe



Unretouched photograph of microphone carbon electrode as used in military communication devices, after cleaning with Celanese lint-free wipe cloth. These photographs show why the manufacturer of this military communication equipment has adopted Celanese Assembly Line Fabric for wipe cloths.



Magnified approximately seven times, the same electrode is shown after being wiped by an ordinary cloth. Because lint will affect the electrical characteristics and uniformity of this precision part, it is particularly important that the electrode be lint-free in assembly...Center below, photograph of electrode actual size.



Comparative tests in cleaning metal and glass surfaces and lenses are the reason why manufacturers of communication devices, precision instruments and optical equipment are increasingly adopting lint-free Celanese* Assembly Line† fabrics for uniforms, hats, gloves and wipe and bench cloths.

For further information, consult our Precision Fabrics Division, Dept. H H

CELANESE CORPORATION OF AMERICA

180 Madison Avenue, New York 16, N. Y.

*Reg. U. S. Pat. Off. †Trademark Under a current ruling of the Federal Trade Commission, CELANESE yarn is classified as RAYON

Stamping Grounds

for ELECTRONIC TUBE PARTS AND SHIELDS...



Shown here are just a few typical samples of GOAT Electronic Tube Parts and Shields that have been stamped, drawn and formed on GOAT machines, dies, and presses.



SMALL TOUGH JOBS . . . handled with skill, precision and efficiency, are a regular part of GOAT Service. GOAT'S position today, as largest independent manufacturer of electronic tube parts, is due to GOAT'S experience and growth. From the days of radio infancy, GOAT has been able to design and improve the parts needed by this industry as it demanded greater sensitivity and durability as well as quantity production. Today, GOAT serves almost every electronic tube manufacturer with a tremendous variety of stock parts. Facilities are so complete that GOAT actually can supply any kind of small metal stamping, made in any metal, to any required degree of accuracy.

GOAT

METAL STAMPINGS, Inc.

Division of THE FRED GOAT CO., INC.
314 DEAN STREET, BROOKLYN, N. Y.

Goat has meant Accuracy since 1893

present. He never succeeded, however, in translating these ideas into an operative system for the transmission either of signals or power.

Communications

In addition to this major pioneering activity, Tesla made at least two contributions specifically in the communications field which are not generally known. The first is that embodied in the patent specification No. 613,809, dated Nov. 8, 1898 (application July 1, 1898), entitled "Method of and apparatus for controlling mechanism of moving vessels or vehicles." This method of remote control operates on a succession of radio impulses whose incidence on a receiving antenna energizes through relays the battery powered steering and propelling motors of the moving vessel and whose sequence and duration (at the will of the operator) determine the direction and amount of rudder rotation. As the inventor states that any method of producing the radio impulses (whether invented by himself or others) may be used, no details of the transmitting and only the decohering device of the receiving circuit are described in full. This latter ingenious device is quite unlike those in common use at the time and is stated to be very dependable in action. Without passing on the operative merits of the proposed system, it certainly deserves more recognition than it has received, as the earliest venture in a field of radio application of great and growing importance.

The second of these less known contributions is contained in patent specifications Nos. 685,957 and 685,958 of Nov. 5, 1901 (application March 21, 1901), entitled "Apparatus for the utilization of radiant energy" and "Method of utilization of radiant energy," respectively. These describe a scheme which in so far as it would be actually operative depends on the changes in the charge on a condenser produced by the incidence of the radiation on an elevated capacity plate antenna connected to one of the condenser terminals. It is thus seen to embody an application of the photoelectric effect discovered by Hertz in 1887, although Tesla seems to have been ignorant of that fact and the explanation he offers is largely fallacious. It is not necessary to go into any of the details of these specifications. They are only mentioned here as illustrative of the experimental keenness which independently rediscovered the Hertz effect and the ingenuity involved in finding a possible application for it. As far as I am aware this is the only suggestion of such an application on record and hence possibly worthy of being recalled.

NEED HELP? Use Electronic Production Aids

SHAKE 'EM TO PIECES

How tough is your stuff? New G-E vibration motors shake materials, and with amazing speed—to discover how much abuse they'll take. Compresses years of wear into a few minutes' test. Vibration frequency, up to 20,000 per sec. Learn scientifically how much wear your products will stand. Several types available. Facts in Bulletin GEA-4091. Also tells about vibration meters.

Electronically Controlled SPOT WELDING

Speeds Production 540%

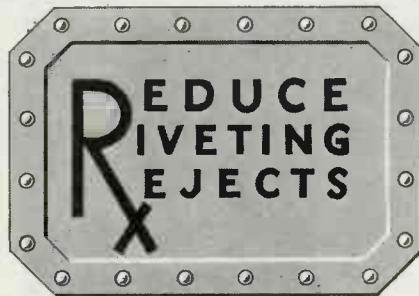
We know it's good; we use it ourselves. Spot-welding frames for G-E switchgear enclosures speeded production 540% over riveting; 375% over bolting. Saves time, materials, man power. ARE YOU RIVETING where you should be SPOT WELDING? Switch now! And to get the best results from spot-welding, use G-E electronic control. G-E engineers will be glad to help you with any control problem. Write to your G-E office or to Electronic Control Section, General Electric Company, Schenectady, N. Y.

SYNCHRONOUS MOTOR USERS...

Have you heard about the new G-E electronic synchronous-motor exciter? Can be used in place of rotating exciters to save space, materials. Takes standard a-c power and electronically gives you steady, easily controlled d-c. Quiet. Dependable. Low-current control circuit for easy automatic control if desired. Small, single control, like radio volume control, adjusts voltage. Ties in with standard synchronous-motor controls. Uses long-life G-E phanotron rectifier tubes. Any G-E office can quote. Ask about CR7501-B.

SIMPLIFY VARIABLE-SPEED DRIVE ELECTRONICALLY

New G-E Thy-mo-trol drive gives you full, stepless speed control on a single dial. Operates from a-c power. No gears, clutches, or belts needed to vary speed. Smooth, shockless acceleration at maximum permissible rate. No current peaks on line. Dynamic braking for quick stops. Holds speed within plus or minus 2% from no load to full load at any speed up to basic. Full torque at low speeds! It pulls and pulls and pulls. Compact. Easy to install. Motor is only major moving part. Ask about CR7507. Bulletin GED-972A. Standard ratings up to 10 hp. Special forms and ratings if you need them.



If exact timing would improve your riveting results, install G-E electronic timers. They take the guesswork out of timing. One Detroit manufacturer found they cut rejects for new operators—improved results for old operators. They use simple circuit, yet provide exact timing. Several ratings available, covering time ranges from 1/20 second to two minutes. Good for millions of operations. Low cost. Sturdy. Knob on front for easy adjustment. Many other applications, too.

TOO MUCH RACKET



IN YOUR FACTORY ?

Too much noise fatigues workers, cuts down production. Have you too much noise in your factory? Find out with a G-E sound-level meter. Accurately tells you *how much* noise and where it's coming from. No guesswork. This high-precision instrument gives quantitative measure of sound as it affects the human ear. Small, portable, battery-operated. Easy to use; requires no special training. Full instructions given. Many companies have purchased sound-level meter for multitude of purposes. See Bulletin GEA-3151.

PHOTOELECTRIC RELAYS IN STOCK!

Limited quantity of high-speed relays (CR7505N100). More than 450 operations a minute. Operates on light-intensity change of 1/2 foot-candle. Time delay up to 1/2 second for holding relay closed after light impulse, which may be as short as .001 second. Excellent for simple register-control jobs. Automatic seal-in circuit if desired. Relay contacts handle up to 10 amp at 230 volts. Operates on 115 or 230 volts, a-c; 50/60 cycles. Power consumption, 30 watts. Many special features.

FREE!



A book of examples of electronic production aids. No. GEA-3891

General Electric, Sec. A 676-101 Schenectady, N. Y.

In addition to "Practical Electronic Ways," Bulletin GEA-3891; please send me the bulletins checked.

- GEA-4091—Vibration motors and meters
- GED-972A—Thy-mo-trol drive (electronic motor control)
- GEA-1755E—Photoelectric relays
- GEA-2791C—Electronic control for resistance welding
- GEA-3151—Electronic sound-level meter

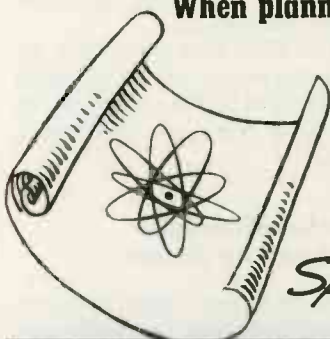
Name
 Company
 Address
 City State

8930

When planning new machines, processes, buildings—

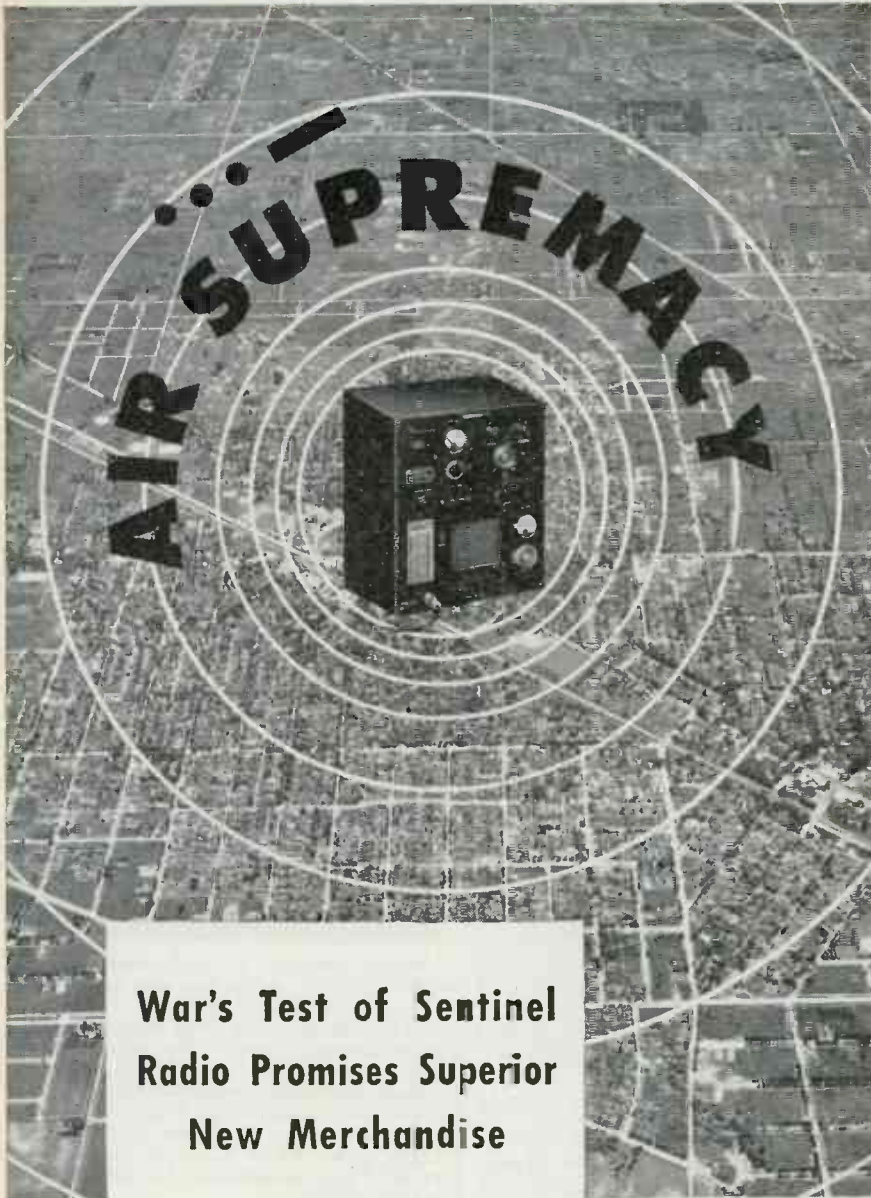
LOOK TO ELECTRONICS

Electronic production aids, like these on this page, offer real opportunities for improvements and economies. Come to General Electric for electronic answers to your problems. General Electric, Electronic Control Section, Schenectady, N. Y.



Speed Production Electronically

GENERAL ELECTRIC



War's Test of Sentinel Radio Promises Superior New Merchandise

● America's domination of the air over many battle fronts is not only an aircraft achievement. Radio has played an outstanding part in flying successes—and to this Sentinel has contributed a tremendous volume of important equipment.

The new radios, radar, and electronic equipment to bear the Sentinel name after the war will reflect the extreme precision built into today's battle front models.

SENTINEL RADIO CORPORATION
2020 Ridge Ave., Evanston, Ill.

FUTURE FEATURES:

are still a laboratory secret but we pledge, improved Performance, increased Value and Traditional Sentinel Quality

Sentinel RADIO

Quality Since 1920

Long Wave Reflections Proved Radar Theory

The fact that even very long radio waves, such as those emitted by a broadcast station, obey the reflection theory presently used with ultra-high frequencies to make radar the effective weapon it has become is pointed out by L. A. Hyland, executive engineer of the Bendix Aircraft Corp., who proved the principle as long ago as 1932. And it was the ill-fated dirigible Akron that served as the target to make the proof possible. Noting certain reflection characteristics of ultra-high frequency waves while working with the Navy Department in 1930, Hyland questioned whether longer waves would be reflected or re-radiated from a moving object comparable in length with the length of the waves used. That was where the Akron came in. With bulky equipment installed in a windowless panelled truck on a Virginia farm, it was possible to detect the big dirigible while it was still 30 miles away, detecting Washington broadcasts as they were reflected from the ship.

Bottlenecks Caused by Draft Calls

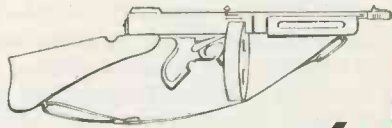
In labor supply, bottlenecks are occurring in certain critical components of electronic and radio apparatus because local draft boards are not familiar with the importance of these components and are not granting deferments for skilled workers in these plants. The WPB Labor Division is now launching an educational campaign to cure this situation.

Imported high-grade mica remains tight; domestic mica production is being pushed, while substitutes like various resins, oil paper, etc., can be used for certain types of equipment, but for high frequency radio apparatus the best grades are important.

Excellent work has been done by tube manufacturers in the salvage of tungsten, but WPB continues to stress cutting down of any tungsten waste.

PE Sewing-Machine Safeguard for Blind

An "electric eye" device which safeguards sightless workers operating electric sewing machines, and at the same time increases their efficiency, is being demonstrated by the American Founda-



FROM THE *business* END OF THE "TOMMY" GUN...

*...comes the research engineering skill
to speed wartime manufacture and
solve postwar production problems*

GENERAL

Electronic



INDUSTRIES

A Division of Auto-Ordnance Corporation

GREENWICH • STAMFORD • BRIDGEPORT • NEW YORK

● Our fighting forces needed Thompson Submachine Guns . . . thousands . . . fast! Auto-Ordnance Corporation has produced them on time!

The arsenal of freedom required tools of war production. Auto-Ordnance's Thompson Tool Division helped—is helping—to supply them!

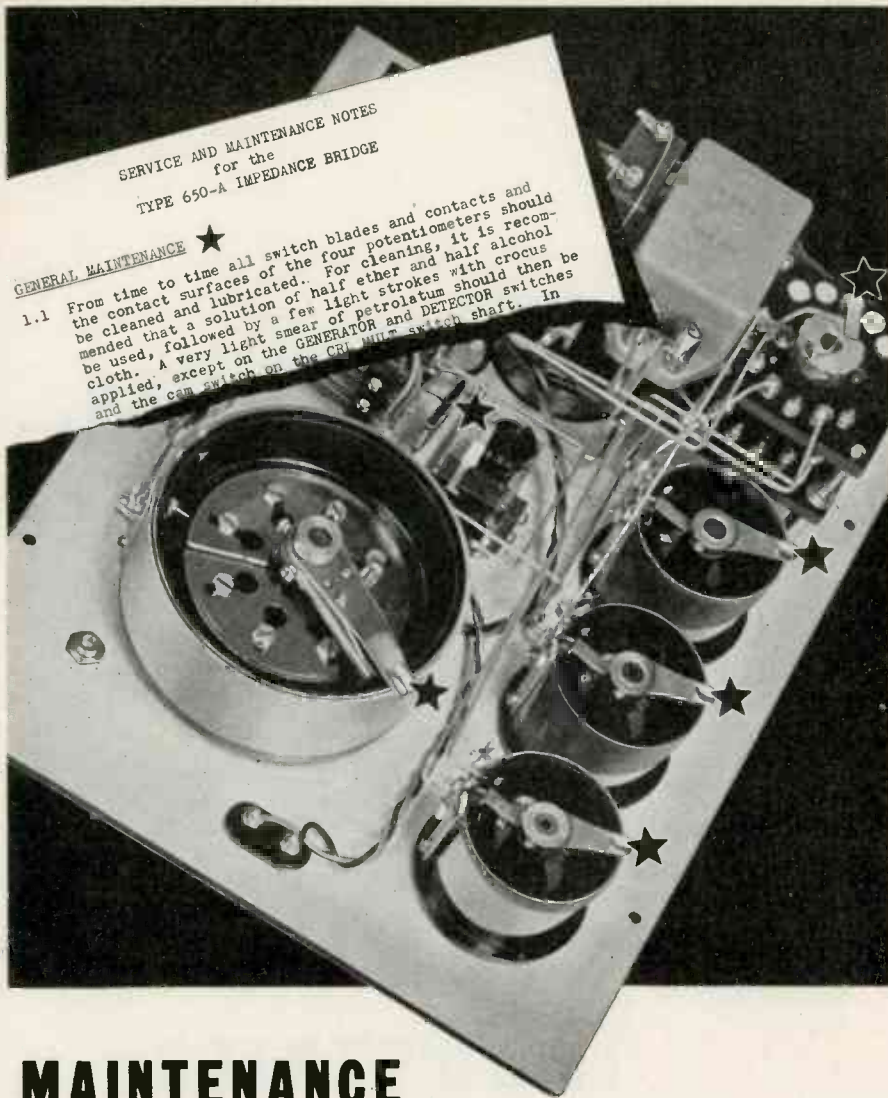
The research engineering skill that has made good in the business of developing and producing guns, tools, vacuum tubes of both standard and special types, and other such weapons of Victory has achieved even greater, though secret, accomplishments in the fields of *Electronics, Hydraulics and Electromechanics!*

Many industrial leaders are already planning to "get the jump" on competitors after the war, with electronic devices to reduce production time, cut costs and improve precision manufacture. Perhaps we can make a notable contribution to your planning. Write to Engineering Department, General Electronic Industries, 342 West Putnam Avenue, Greenwich, Connecticut.



Army-Navy "E" awarded to Auto-Ordnance Corporation for excellence in production of "Tommy" Guns.

PRODUCTS MANUFACTURED INCLUDE ELECTRONIC CONTROLS • VACUUM TUBES
HYDRAULIC SERVOS • ELECTROMECHANICAL DEVICES



MAINTENANCE

helps to keep them in service

Your impedance bridge, like your automobile, needs occasional cleaning and lubrication.

Moving contacts wear out faster when dry and when dust gets into them. Neglect may result in failure when equipment is needed most.

Periodic maintenance will go a long way toward keeping your electrical test equipment in trouble-free operation. Increased life and reliability will more than repay you for the effort. Set up a definite maintenance program for your test equipment.



★ Thousands of users of General Radio instruments find our SERVICE AND MAINTENANCE NOTES useful in keeping their instruments in service. If you do not already have these notes for your GR instruments, send us the type numbers and serial numbers of the equipment you have. Your service notes will be forwarded promptly.



GENERAL RADIO COMPANY
Cambridge, Massachusetts

NEW YORK

LOS ANGELES

tion for the Blind, 15 West Sixteenth Street, New York.

The device consists of a photoelectric control system which when attached to the regular commercial model, brings the machine to a complete and sudden stop at the moment the operator's hands or fingers approach dangerously near the needle. This is accomplished by projecting a beam of light from the left hand side to the "shoe" of the machine as the operator sits facing it. The sewing machine operates normally until this beam of light is interrupted as it would be by the worker's hand getting in its way. When such interruption occurs, the photoelectric cell immediately operates an amplifier which in turn controls a relay instantaneously to disconnect the driving motor and apply an electro-magnetic brake to the fly wheel.

Tones tell of broken threads

The attachment has also two small switches which tell the blind worker through two distinct buzzes of different tones, when either of the threads on the sewing machine run out or become broken. One tone indicates that the break is the needle thread, and a lower tone indicates that it is the bobbin thread. This invention, which has been made as a simple compact unit to be operated from regular electric service, is the work of J. C. Kleber, sound engineer of the Foundation and M. G. Gregory, a member of his staff.

The perfected device will be installed in the Illinois Industries for the Blind. The National Industries for the Blind is also planning to adapt this safety device for other machines for the 2,500 employees in the fifty-one Sheltered Workshops throughout the country.

Recent Army-Navy "E" Awards

Solar Mfg. Corp., Bayonne & West New York, N. J. (2 plants).

Driver-Harris Co., Harrison, N. J.

RCA Laboratories, Princeton, N. J.

Zenith Radio Corp., 6001 Dickens Ave., Chicago, Ill. (white star added).

Raytheon Mfg. Co., Newton & Waltham, Mass. (4 plants).

Radio Speakers, Inc., 221 E. Cullerton St., Chicago, Ill.

H. M. Harper Co., 2620 Fletcher St., Chicago, Ill. (white star added).

Sylvania Electric Products, Inc., Emporium, Pa. (white star added).

after **V**ictory . . .

A STATEMENT BY E. A. TRACEY, PRESIDENT
MAJESTIC RADIO AND TELEVISION CORPORATION, CHICAGO



Since five months before Pearl Harbor, Majestic has been engaged in war production. The "Walkie-Talkie," famous radio of the firing

line, and airplane marker beacons are Majestic products. Our engineers have developed, and our factory has built, several different types of communications equipment. Thousands of quartz crystals are being produced. Majestic has placed its entire facilities, resources and personnel exclusively at our government's disposal. All this has made its mark upon the Majestic organization. There are new names in executive positions,—names of men that are well known throughout the radio industry for their accomplishments in engineering and production, that are accustomed to doing things largely and well. In its key positions, Majestic is today one of the strongest organizations in our industry.

Under the stress of war time schedules, new standards of production have been established in the Majestic factory. Manufacturing tolerances, requiring precision unheard of in days of civilian radio, are now commonplace, and yet, production rolls from the assembly lines in an unbroken stream and at a higher tempo than ever before. Even so, one hundred per cent capacity is still a mythical figure we have not even approached. Majestic today is a more efficient,—a more capable organization.

After Victory, this strong Majestic organization will turn to civilian radio. Already plans are being prepared and the groundwork is laid.

Tempered in the crucible of war time production, led by dynamic, experienced veterans of the radio industry, with improved facilities and larger resources, Majestic cannot help but be an important, outstanding factor in the post war radio industry.

There will be new luster added to an already famous name in radio.



Majestic

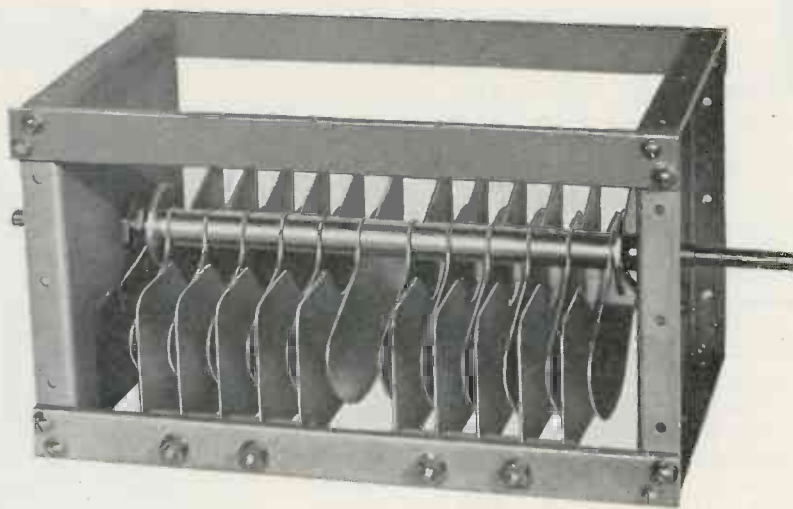
MIGHTY MONARCH
OF THE AIR



Builders of the Walkie-Talkie—"Radio of the Firing Line"

Trustworthy

IN A THOUSAND APPLICATIONS...



• Over the wide range of applications, it is with great satisfaction that we of Cardwell hear the word "trustworthy" employed so frequently by users of our condensers. It proves the value of our traditional policy of *Bold Design — Frequent Practice — Frequent Mistakes!*

By daring to tread untried paths in design . . . by constantly applying our knowledge to different variations of our original idea . . . by making mistakes (yes, we've made plenty) — we've brought Cardwell Condensers up to the highest ideals of quality and dependability. You, too, can trust them.

Inquiries Answered Promptly

CARDWELL CONDENSERS

THE ALLEN D. CARDWELL MANUFACTURING CORPORATION

BROOKLYN, NEW YORK

Dr. Coolidge Gets Chilean Honors

Dr. William D. Coolidge, General Electric vice-president and director of research, has been awarded the "Order del Merito" (Order of Merit) of Chile for his "many services to civilization." News of this honor came to Dr. Coolidge in a letter from Dr. Leonardo Guzman, director of the Chilean National Radium Institute.

Dr. Guzman, who was formerly Minister of Public Education, Minister of the Interior and Director of General Health for his government, recently visited Schenectady, where he was interested especially in G-E's research with million-volt X-rays for industrial and therapeutic use, an outgrowth of Dr. Coolidge's work.

Sees Wide After-War Use of Radar

Frank H. McIntosh of the War Production Board, Radio and Radar Division, told the NAB War Conference at Chicago, Illinois, that radar is "a godsend to this war and we in the electronic field believe it will be a tremendous factor in the winning of the war."

Predicting commercial use of radar after the war, Mr. McIntosh said radar would be applied to vehicles, ships and airplanes. Referring to airplane use, he said this detecting and ranging equipment would give necessary indication of hazards and knowing this will tend to minimize casualties.

Cinephone Adds Two

David E. Chapman has been appointed chief engineer and Lionel B. Cornwell general manager of United Cinephone Corporation, Torrington, Conn. Mr. Chapman was formerly vice-president of Airadio in Stamford, Conn., and Mr. Cornwell was chief engineer of the Bendix-Westinghouse Automotive Air Brake Co., Elyria, Ohio.

Duke Honors Morgan

Duke University, Durham, N. C., late in May conferred the honorary degree of Doctor of Science upon Thomas A. Morgan, president of the Sperry Corp. since 1929. Sperry at present includes three units: Sperry Gyroscope Co., Long Island; Ford Instrument Co., Long Island City, and Vickers, Inc., Detroit, and Waterbury, Conn.

**YOU'LL OPEN YOUR EYES WHEN
YOU SEE MY ECHOPHONE EC-1**



Echophone Model EC-1

6 tubes, 3 bands. Tunes from 550 kc. to 30 mc. Beat frequency oscillator. Bandspread logging scale. Self-contained speaker. Electrical bandspread on all bands. AC/DC, 115-125 volts. ECHOPHONE RADIO CO., 201 EAST 26TH ST., CHICAGO, ILLINOIS



All honor to the men behind the guns Ken-Rad salutes them heroes they Not only salutes with words but with electronic tubes that sight time and fire the guns that detect enemy nearness *in advance of sight or sound*

Electronic engineers knew before anyone else that the blitz on Britain was thwarted by the locators which gave the ground defenses time for repulsing action And we know that Electronics will be the servant of men of good will for whom Ken-Rad now is working at war!

TRANSMITTING TUBES
CATHODE RAY TUBES
SPECIAL PURPOSE TUBES
METAL AND UHF TUBES

KEN-RAD

OWENSBORO KENTUCKY U S A

What's Wrong With This Picture?



Leslie G. Thomas, vice-president of International Resistance Company

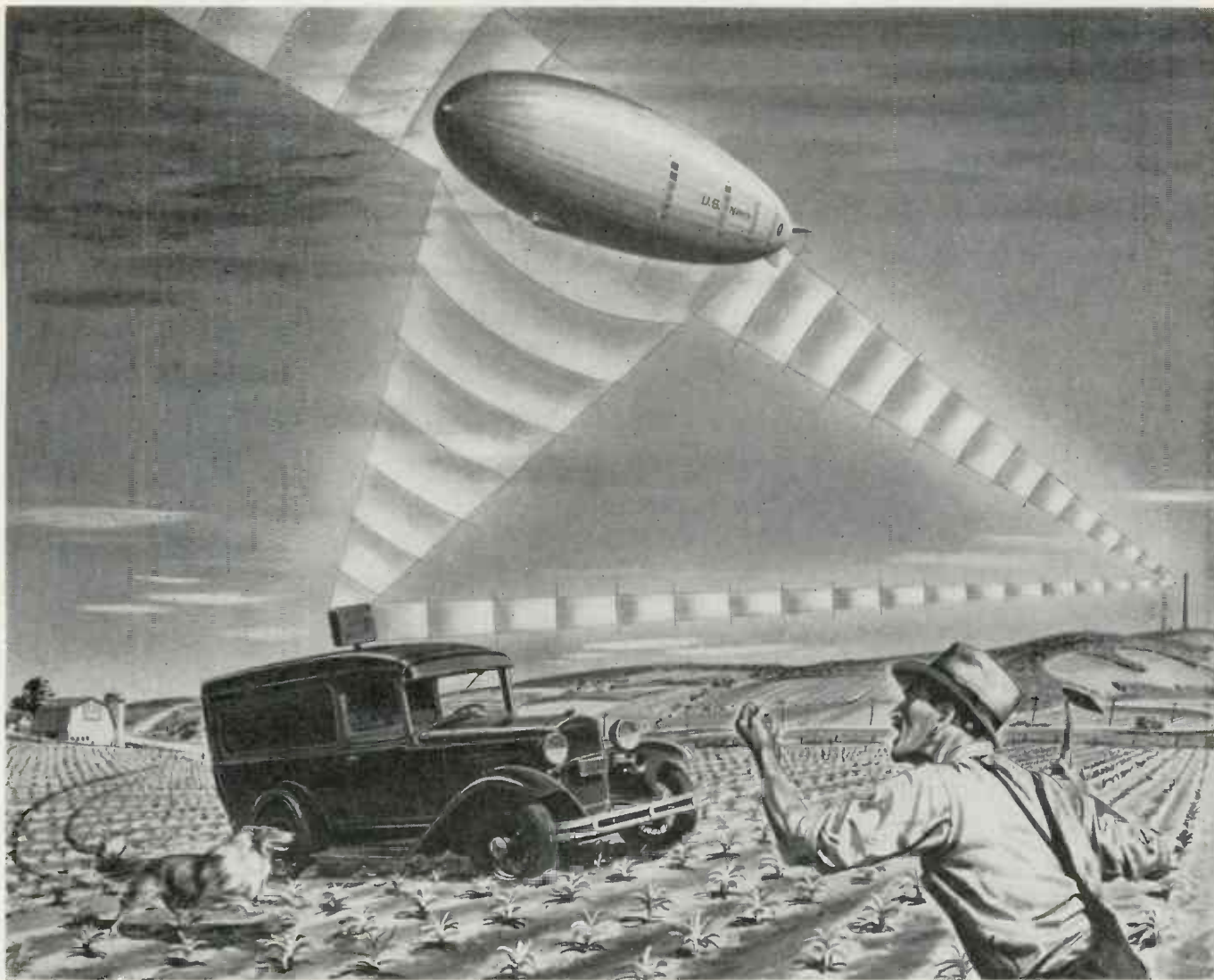
Missing from Mr. Thomas' lapel is the "E" pin which he wears with pride. Having won the Army-Navy Award last September and more recently the added Star for maintenance of its production record, IRC in acknowledging Mr. Thomas' outstanding performance as works manager has announced his election as vice-president in charge of production.

Mr. Thomas is one of the pioneer production men in radio manufacturing, having been associated with the industry since the early 1920's. He is a member of the Radio Club of America and right now is engaged in a production job of greatly increased magnitude which may not be fully revealed for several months.

Hilliard to Altec Radar

John K. Hilliard, chief transmission engineer of the M-G-M sound department, recently consultant to the Radiation Laboratories of Massachusetts Institute of Technology, has joined the war production staff of Altec Lansing Corporation, Los Angeles, as chief engineer of the Radar and Motion-Picture Division. Hilliard is chairman of the theater standards committee of the Research Council of the Academy of Motion Picture Arts and Sciences, a member of the Motion Picture Standards Committee of the Royal Scientific Society of Great Britain, and is the author of many publications on technical subjects in the communications and motion picture fields.

RADAR! ... Who first detected aircraft in flight by radio?



In 1932... on a lonely farm...

a man sat in a truck equipped with a variety of radio measuring devices. There was music in the air, on that spring morning... pleasant music, broadcast from local radio stations for the entertainment of Washington housewives. High over the peaceful countryside, the dirigible Akron was quietly soaring... and a few people craned their necks to look at it.

But still it would have been a day of no special importance to the world, save for this one man... a radio engineer. He, too, was listening to the radio... *listening for radio waves that he hoped would be reflected off the big airship.* And he was right. *The signal came through!* From within the dark interior of that truck, he detected by reflected radio waves the approach of the distant dirigible, and by the same means followed its course as it flew.

That day, eleven years ago, marked the practical beginning of Radar... the greatest secret weapon of the war... the means by which not only land-based stations but planes and ships detect and locate enemy targets. Shortly thereafter, the research and manufacturing organization then owned and managed by this man became a part of

the Bendix Aviation Corporation, and the products evolved from his experiments joined the many other members of the Bendix "Invisible Crew."

The ultimate development of Radar in all its forms was accomplished by the cooperative efforts of American Industry, the National Defense Research Council and the technicians of the Navy and the Army... and by the further pooling of this country's developments with those of Great Britain. But as early as 1932, the giant dirigible Akron, by unwittingly reradiating waves of broadcast stations, confirmed the theories of this Bendix engineer... and so marked the practical beginning of what we know today as Radar detection.

The Bendix Aviation Corporation has in its files a letter from the Secretary of the Navy to this engineer acknowledging his contribution to the discovery of Radar reflection from moving aircraft.

Bendix also supplies for Radar applications the variety of instruments, controls and equipment called collectively, "The Invisible Crew." Bendix makes not only the radiant wave equipment of Radar, but the auxiliaries essential to its operation: hydraulic controls, gyroscopic stabilizers, torque amplifiers, remote indicating systems and directional instrumentation.



VEHICLES OF VICTORY TRANSPORTS OF TOMORROW

"The Invisible Crew" of Bendix... instruments, controls and equipment... now fight beside our boys in every U. S. plane, tank and ship. And tomorrow... they will serve the whole New Age of Transportation.

THE INVISIBLE CREW
Precision
Equipment by **Bendix**
AVIATION CORPORATION

SPECIFY RELAYS* WITH...

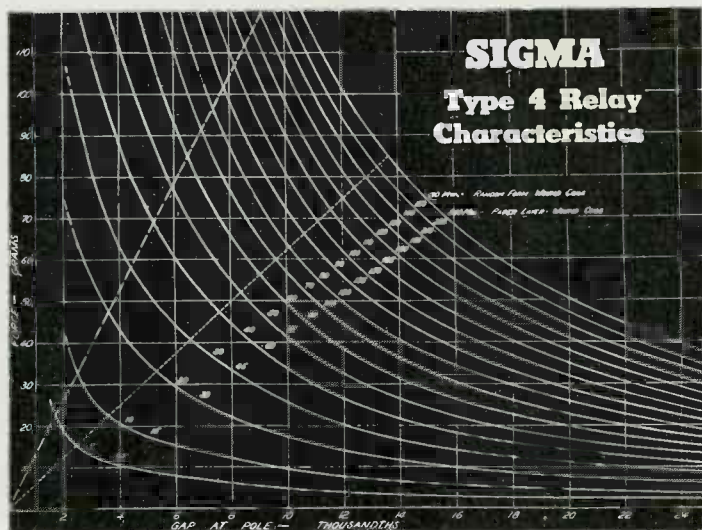


Assurance!

It is now possible to predetermine with relative exactness the performance of a Sigma Sensitive Relay in a proposed circuit; to design the circuit for desired relay performance; and to avoid costly trial and error research.

*SIGMA SENSITIVE RELAYS OF COURSE

NEW TYPE 4 R



Operating characteristics of the Sigma Type 4 Relay have been reduced to a family of curves comparable to those used to describe performance of a vacuum tube. These curves are reproduced in a bulletin which besides describing the method of their use, gives data on basic requirements which must be satisfied under different operating conditions.

Careful consideration of this bulletin should preclude "mismatch" of relay to circuit which has all too often lurked like gremlins to upset the proper operation of an otherwise soundly engineered piece of equipment.

Your copy is ready for mailing.

SIGMA
Sigma Instruments, Inc.
Sensitive **RELAYS**
 62 FREEPORT ST., BOSTON, 22, MASS.

Carlton Mellick to Goat Stampings, Inc.

Carlton Mellick has been appointed sales manager of Goat Metal Stampings, Inc., Brooklyn, N. Y., as well as of The Fred Goat Co., Inc., and Swing-O-Ring, Inc. Mr. Mellick was associated with Miehle Printing Press & Manufacturing Co., for the past twelve years. He also served in Washington as special WPB representative for the Tin Conservation Division.

L. K. Marshall of Raytheon

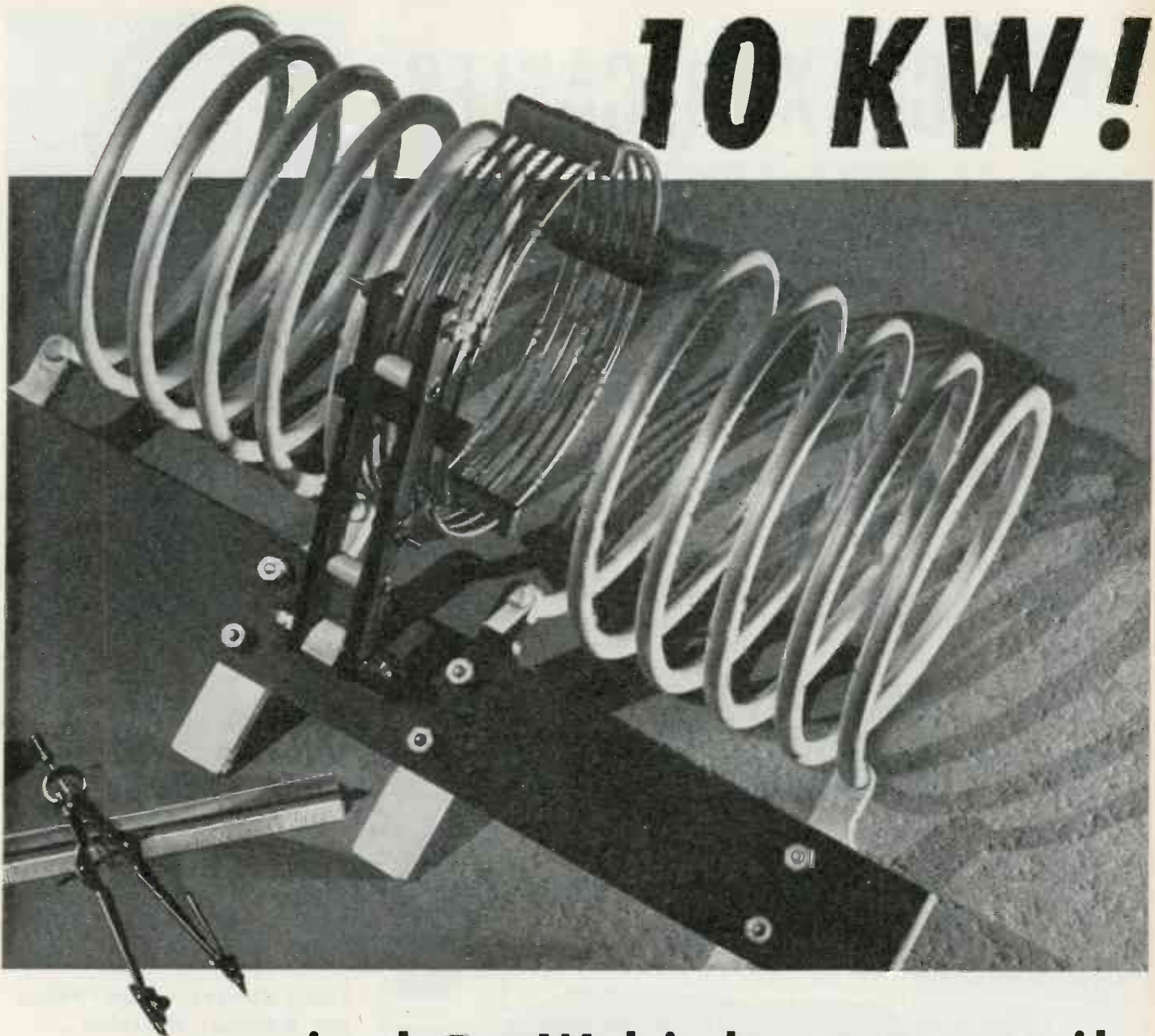


Here's the seldom-photographed Lawrence K. Marshall, president of Raytheon Mfg. Co., of Newton and Waltham, Mass., snapped just as he rose before 20,000 guests on Governor Gore's Waltham estate, to accept four Army-Navy E's awarded the Raytheon factories. David T. Schultz presided

Frische Named Sperry Research Director

Carl A. Frische has been named chief research director of the Sperry Gyroscope Co., Inc., succeeding Hugh Willis, who is now General Sales Manager of the company. Mr. Frische assumes charge of the company's Garden City, L. I., laboratory which employs more than 1,500 technicians for the design, development, and test of military, marine, and aircraft precision instruments. For the last year he has had complete charge of research engineering—working full time on developments for the armed services. Since joining the Sperry organization in 1933, he has made many contributions to the development of aviation; notable

10 KW!



... a typical B & W high-power coil

Over 10" in diameter by 20" long, and designed for 10 KW. service, this variable-link final amplifier, plate coil, is a good example of B & W engineering at work on the job of matching modern inductor requirements. B & W Inductors of this general type are available in all standard frequency ranges. Coils are bolted in place, and may be switched for band-changing with a minimum of time and effort. Connections are silver-soldered,

and all metal parts, including coils, are heavily silver-plated. Coils in the unit illustrated are of $\frac{5}{8}$ copper tubing. Other B & W Air Inductors of this type utilize tubing as large as 1".

FAST DELIVERIES on all B & W Air Inductor types are assured by our greatly expanded facilities, and straight-line production on most smaller types. Engineering data on any type upon request.

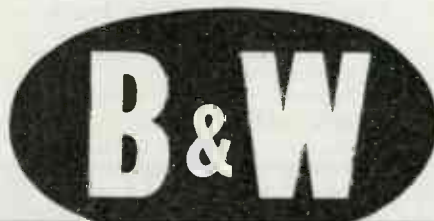
BARKER & WILLIAMSON, 235 Fairfield Ave., Upper Darby, Pa.

Air Inductors

"BABIES AND JUNIORS" (25 to 75 watts)

STANDARD TYPES (100 watts to 1 KW.)

SPECIAL HIGH-POWER TYPES
(to 10 KW. and above)



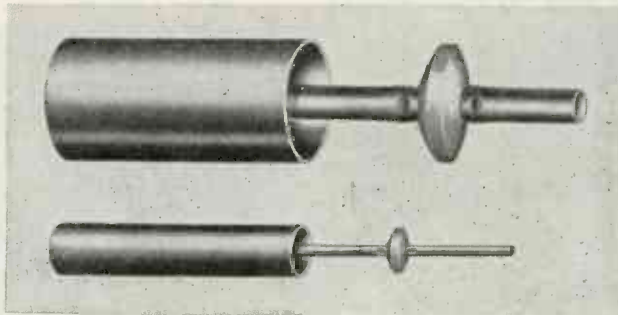
TURRETS — BAND HOPPERS —
SWINGING LINK ASSEMBLIES, ETC.
SPECIAL RADIO AND ELECTRONIC
EQUIPMENT ASSEMBLIES

Variable Air Condensers
(Integral neutralizing types)

MANUFACTURERS OF QUALITY ELECTRONIC COMPONENTS FOR OVER A DECADE



COAXIAL CABLES



... for Radio Transmission Lines

The VICTOR J. ANDREW CO., pioneer manufacturer of coaxial cables, is now in a position to take additional orders, in any quantity, for all sizes of ceramic insulated coaxial cables and accessories. The Andrew Co. engineering staff, specialists in all applications of coaxial cables and accessories, will be pleased to make recommendations to meet your particular requirements.

"Attention!"

If coaxial cables are your problem... write for new catalog showing complete line of coaxial cables and accessories.



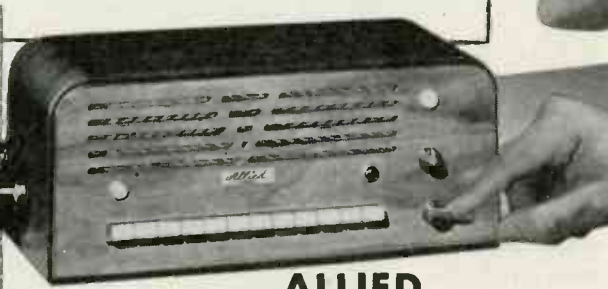
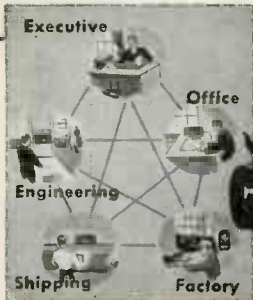
VICTOR J. ANDREW CO.

363 East 75th Street, CHICAGO, ILLINOIS
ANTENNA EQUIPMENT

Talk to any Point in your Plant

... IN A SPLIT-SECOND!

SAVE MAN HOURS... SAVE STEPS... SAVE MONEY



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INTERCOMMUNICATION SYSTEMS

Speed communication between departments... remove traffic from your switchboard! The new 10-Station "SUPER-CHIEF" illustrated handles up to 5 separate 2-way conversations. New features include: Private Multi-Station Conference—Call Waiting and Busy Signal Lights—No Eavesdropping—Privacy Earphone—High Power. Available with any number of stations.

★ Other versatile low-cost Allied Intercom Systems for War and Industry. Easily installed and operated. Our veteran staff can help you. Send for literature and full details.

Write, wire or phone. Haymarket 6800.

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EVERYTHING IN ELECTRONICS AND RADIO

COMPLETE CENTRALIZED SERVICE On Electronic and Radio Needs

Simplify your procurement... speed delivery... get everything in Electronics and Radio from this one dependable, central source. Over 10,000 electronic parts... all famous brands... for the Armed Forces and for Industry.

FREE!

NEW
Most Complete
Up-to-Date 1943
BUYING
GUIDE



CARL A. FRISCHE

among these were the development of automatic pilots, bombsights, and the soundproofing of airplanes. Mr. Frische received an A.B. degree from Miami University (Ohio) in 1928; and M.S. in 1931, and a Ph.D. degree one year later from State University of Iowa (Iowa City). He held a Research Fellowship at Columbia University for a year previous to joining the Sperry company; and is a member of the American Institute of Physics and Institute of Aeronautical Sciences.

Aircraft in Washington

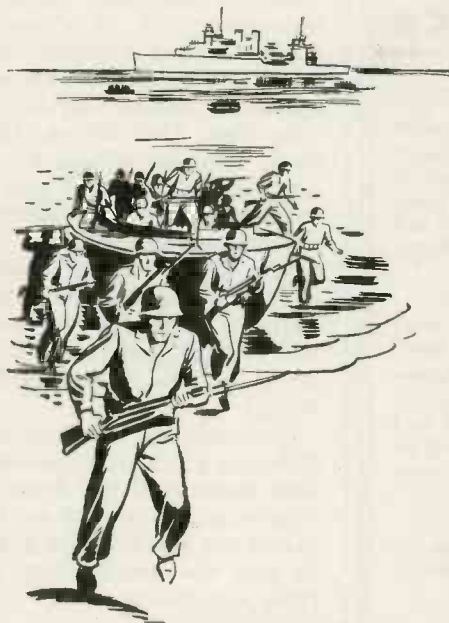
Aircraft Accessories Corp., Kansas City, Kans. and Burbank, Calif., has opened an office at 732 17th Street N.W., in Washington. District manager Emery Johnson is in charge.

Cook Electric's New Plant for Bellows Division

"New business has necessitated expansion of the Bellows Division of Cook Electric Company," says W. C. Hasselhorn, president. "This expansion has resulted in the opening of a new plant for the Bellows Division at 909 Diversey Parkway, Chicago."

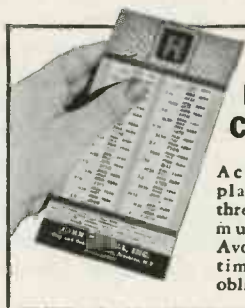
The new factory, which is 125 feet long by 48 feet wide, has a modern testing laboratory with the newest facilities for altitude tests for aircraft work. The machine shop is equipped with new tools of latest design. The engineering department for the Bellows Division is also located at the new plant. The Bellows Division, already operating on a double shift, is in charge of William F. Laser as manager.

General offices of the Cook Electric Company are located at 2700 Southport Avenue, Chicago.



ASSAULT BOATS for example

Special cold-forged metal parts for assault boats are made on equipment used regularly in the manufacture of Hassall special nails, rivets and screws. Thousands of similar examples.



Decimal Equivalents Chart **FREE!**

Accurate to four places. Printed in three colors for maximum legibility. Avoids errors. Saves time. No cost. No obligation.

JOHN HASSALL, INC.

Established 1850

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IT AIN'T FUNNY, McGEE!



When Vital War Work STOPS Because of Slow Deliveries of RADIO and ELECTRONIC Supplies

LABORATORY development work, plant maintenance . . . in any one of many places, Radio and Electronic Parts and Equipment are performing vital functions in war industries. And when new or replacement supplies are needed, they're usually needed NOW! Slow deliveries just "ain't funny" to the hard pressed P.A. fighting to maintain rush war production schedules. Aware of the need for SPEED and complete delivery of one or a hundred different items, we cooperating distributors have organized a unique coast-to-coast INDUSTRIAL EMERGENCY SERVICE. In the face of increasing scarcity, it is giving industry in war-time, an entirely new conception of speed and efficiency in the distribution of Radio and Electronic Supplies! Telephone, wire, or mail your orders. You'll get your goods in a jiffy.



Free

A big reference book and buyers guide crammed with helpful information on thousands of Radio and Electronic parts and equipment. Free to Purchasing Agents and other officials responsible for buying and specifying in industries using this equipment. Ask for it NOW on company stationery, please!

WRITE OR PHONE YOUR NEAREST DISTRIBUTOR

TERMINAL RADIO CORPORATION

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Telephone: WOrth 2-4416

NEW YORK

WALKER-JIMIESON, INC.

311 South Western Ave.
Telephone: Canal 2525

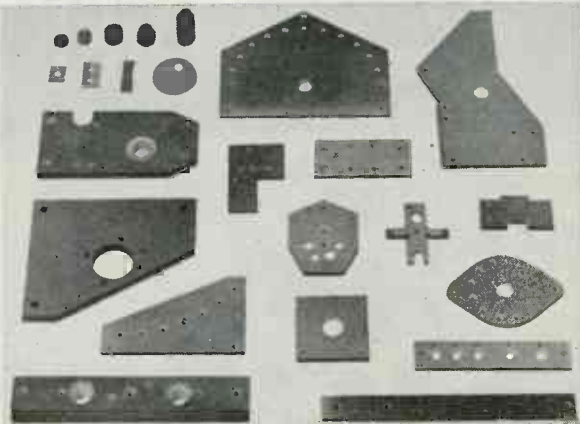
CHICAGO

RADIO SPECIALTIES COMPANY

20th & Figueroa Streets
Telephone: Prospect 7271

LOS ANGELES

★ "FREEDOM from WORRY" About Glass Bonded Mica



That's one "freedom" we can guarantee you because we are experts in fabricating parts from sheets and rods, **IN QUANTITY.**

Our men have the "know-how" and experience that insures **QUALITY and SPEED** as well, in turning out your orders.



We especially invite war work, offering you the assurance of faithful following of your instructions in every particular.

Army and Navy "OK"

Our raw materials and finished parts meet Army and Navy standards for electronic equipment.

Write or phone for complete details, without any obligation

COLONIAL KOLONITE COMPANY
2212 West Armitage Avenue Chicago, Ill.

Coming thru the Fog!

★ Men, machines and military missions depend every minute of every day upon the operating efficiency of radio communications. Astatic Co-Axial Cable Connectors, Multi-Contact Plugs and Sockets, Dynamic Microphones and other radio parts equipment are manufactured with utmost precision and skill to insure the highest and most dependable operating efficiency under the most trying conditions.

ASTATIC

THE ASTATIC CORPORATION
YOUNGSTOWN, OHIO

In Canada:
Canadian Astatic, Ltd.
Toronto, Ont.



Sylvania Buys Electro Metals, Inc.

Sylvania Electric Products Inc., with executive offices in New York, announces the purchase of the manufacturing facilities, including plant and machinery, formerly operated by Electro Metals, Inc., of 2010 East 71st Street, Cleveland, Ohio. Electro Metals has been a large manufacturer of lead-in wires for use in radio tubes, incandescent and fluorescent lamps.

The present staff of employees will be retained and Sylvania will continue operations at the present site. Sylvania will continue to supply the present customers of Electro Metals.

According to the announcement, Sylvania acquired these new facilities because of the desirability of integrating within its own organization an operation so closely tied in with the manufacture of radio tubes and lamps.

Raytheon Sets Up Production Control

Dr. P. T. Weeks, plant manager of the Raytheon Production Corp., 55 Chapel Street, Newton, Mass., announces the organization of a Production Control Department.

Kenneth R. Johnson will direct this new department which will include a Scheduling section to be headed by Lyman W. Robbins; a Materials section to be headed by Leo Barsam; and a Finished Stock Control section to be handled by Frank Fenwick. Mr. Johnson has been in charge of the Planning and Scheduling Department for the past year. Previous to joining the Raytheon organization, he was Production Manager and Assistant Publisher of the Boston Evening Transcript. He is a graduate of Iowa State College in Business Engineering, and also the Harvard Graduate School of Business Administration.

Four-Acre Blackout Radio Plant Opens

Opening of a new four-acre blackout plant on the East Coast to speed production of special type radio equipment for the Army, has been announced by Walter Evans, vice-president in charge of the Westinghouse Radio Division. Production of the plant will augment the division's present large output of communications equipment, already increased more than 40 times since start of the Government's

SKILL

To Meet Your Specifications

PERFORMANCE is the real measure of success in winning the war, just as it will be in the post-war world. New and better ideas—production economies—speed—all depend upon inherent **skill and high precision** . . . For many years our flexible organization has taken pride in doing a good job for purchasers of small motors. And we can help in creating and designing, when such service is needed. Please make a note of Alliance and get in touch with us.

ALLIANCE DYNAMOTORS

Built with greatest precision and "know how" for *low ripple—high efficiency—low drain and a minimum of commutation transients*. High production retains to the highest degree all the "criticals" which are so important in air-borne power sources.



ALLIANCE D.C. MOTORS

Incorporate precision tolerances throughout. Light weight—high efficiency—compactness—continuous duty. An achievement in small size for continuous duty and in power-to-weight ratio. Careful attention has been given to distribution of losses as well as their reduction to a minimum.



Remember Alliance!
—YOUR ALLY IN WAR AS IN PEACE



REMOTE CONTROL



Available in sizes up to 75 KVA

Large amounts of POWER can now be controlled by a push button or automatic device

Choose **POWERSTAT MOTOR DRIVEN VARIABLE TRANSFORMERS** for control. When regulation of voltage, current or power is necessary in your design, **POWERSTATS** are the answer to your most rigid specifications. This equipment is an engineered combination of a **POWERSTAT VARIABLE TRANSFORMER** and a highly damped low speed motor of advanced design.

for

- SMOOTH STEPLESS CONTROL
- EXACTING CORRECTION
- FREEDOM FROM OVERSHOOTING
- ZERO WAVE FORM DISTORTION
- CONNECTION TO AUTOMATIC OR PUSH BUTTON CONTROL STATIONS
- GOOD REGULATION WHERE OUTPUT IS TO BE INDEPENDENT OF LOAD AND POWER FACTOR

SELECT
POWERSTAT MOTOR DRIVEN VARIABLE TRANSFORMERS

Send for **POWERSTAT** Bulletin No. 149 IE and Automatic Voltage Regulator Bulletin No. 163 IE.

SUPERIOR ELECTRIC CO.

91 LAUREL ST. BRISTOL, CONN.

AT LAST!

A New Sleeving— Flexible as String and Non-Fraying



THIS — NOT THIS



AFTER many experiments, we have developed a super-flexible Fibreglas Sleeving which will not fray.

This sleeving is made by an entirely new, recently-discovered process. Formerly, to prevent excessive fraying, it was necessary to saturate the sleeving, sometimes to a degree where stiffness became objectionable. The new BH Fibreglas Sleeving is as limp and flexible as string—you could tie any kind of a knot with it—yet the severest handling will produce only the merest fuzz at the end.

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

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

All sizes, from No. 20 to $\frac{5}{8}$ " , 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.



NON-BURNING IMPREGNATED MAGNETO TUBING • NON-BURNING FLEXIBLE
VARNISHED TUBING • SATURATED AND NON-SATURATED SLEEVING

BENTLEY, HARRIS MANUFACTURING CO.
Conshohocken, Penna.

preparedness program, Mr. Evans said.

Designed to conserve critical materials, the new plant used 1,554,000 board feet of lumber, at an estimated saving of 1,920 tons of steel. It required the use of more than one acre of pressed wood panels in place of window glass. Westinghouse will operate the factory for the Defense Plant Corporation.

Center clear of traffic

The plant area is divided into two main sections, one for assembly of parts, the other for machining and fabricating. An innovation is the handling of interior traffic, which flows next to the side walls, leaving the remaining areas clear. Lighting and ventilation are carefully controlled in the building which contains nearly two miles of tubular fluorescent lamps to simulate daylight working conditions. Huge electric fans, effecting a complete change of air every 15 minutes, provide ventilation.

The new plant is the third large manufacturing area to be acquired by the Westinghouse radio division in the last few years. In addition, 12 other divisions and more than 100 subcontractors are aiding the company's record-breaking production of radio equipment.

Will Produce and Repair Electronic Tubes

Detroit Electronic Laboratories, 10345 Linwood Avenue, Detroit, Mich., has been formed and will concentrate on the development and manufacture of special purpose electronic tubes, particularly those used in control equipment for resistance welding. A repair service for ignitron tubes also will be operated covering such tubes as GE series GL and GF and Westinghouse WL series ranging from 150 to 1200 kva. John D. Gordon, formerly general manager of Taylor Winfield Corp., will be general manager.


Henry Dressel Goes Up at Stackpole

The Stackpole Carbon Company of St. Marys, Penna., announces the appointment of Henry Dressel as its supervisor of electronic components engineering. Mr. Dressel has been a member of the Stackpole engineering staff for several years. Prior to that, he was associated with the Oak Manufacturing Company in Chicago.

★ *In a Hurry . . .*

REMLER

Plugs and Connectors



**Made to
ARMY SIGNAL
CORPS SPECIFICATIONS**

Remler made plugs and connectors of the following types are used by more than fifty concerns engaged in manufacturing communications equipment for the U. S. Army Signal Corps:

Types:	PL				PLP		PLQ		PLS	
50-A	61	74	114	150	56	65	56	65	56	64
54	62	76	119	159	59	67	59	67	59	65
55	63	77	120	160	60	74	60	74	60	74
56	64	104	124	354	61	76	61	76	61	76
58	65	108	125		62	77	62	77	62	77
59	67	109	127		63	104	63	104	63	104
60	68	112	149		64		64			

Special Designs to Order

Remler is equipped to manufacture other plugs and connectors of special design—in large quantities. Submit specifications.

Prompt Delivery • Inspection

Signal Corps inspectors in attendance. Uniformity assured—no rejects. Write, wire or telephone if we can be of assistance.

Remler facilities and production techniques frequently permit quotations at lower prices

*Manufacturers of Communication Equipment
SINCE 1918*

REMLER COMPANY, Ltd. • 2101 Bryant St., • San Francisco, Calif.

General Ingles Made Chief Signal Officer

Major General Harry C. Ingles, who had been deputy commander of the European theatre of operations, was nominated by President Roosevelt June 24 to be Chief Signal Officer of the Army, succeeding Major General Dawson Olmstead, who had served in that post since October, 1941.

General Ingles' confirmation by the Senate is expected to be expedited so that he will take over the Chief Signal Officer post by July 1,

the beginning of the new War Department fiscal year.

General Olmstead is slated to retire on that date, but in all probability will be recalled to active service to serve as the War Department's representative on major governmental communications policy planning boards.

With the appointment of General Ingles, considered an exceptionally able Signal Corps Officer who has had a most distinguished Army communications career and who has had a considerable experience in important general staff positions,

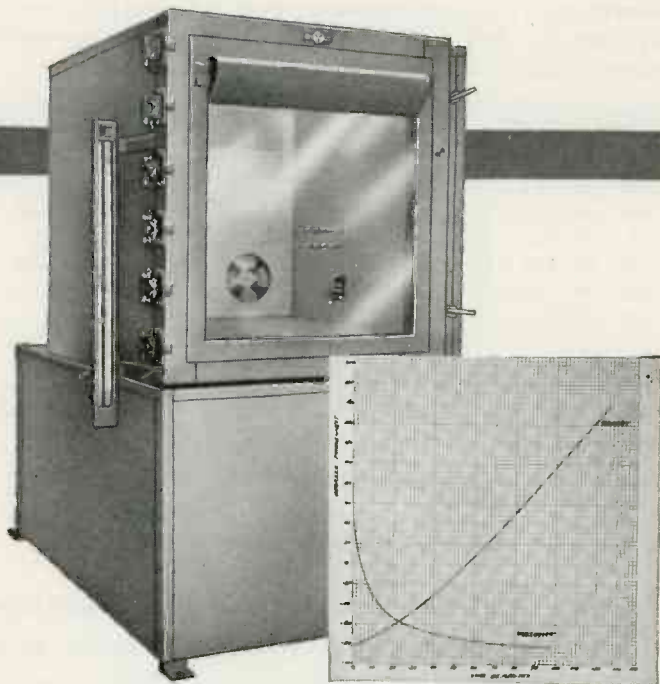
the Signal Corps is expected to be placed in a higher echelon of the Army command because of importance in supplying the communications of the armed forces greater than has existed in the past few years.

General Ingles comes to the Chief Signal Officer post from the European theatre of operations where he was the deputy commander to the late Lieutenant General Frank M. Andrews, killed in an airplane crash in Iceland. Therefore his background and experience in this war is believed to be most valuable and important to the Signal Corps. He had served under General Andrews as the Signal Officer of the Caribbean defense command and later as his chief of staff. Before that he had been Signal Officer of the Third Army and had been Signal Officer in the Philippines. He headed the department of applied communications at Fort Monmouth and was on the operations and training division of the general staff. He is a distinguished graduate of the Command and General Staff School, and the Army War College. From 1924-26 he was director of the Fort Monmouth Signal School.

Flight-similitude Cold Testing

Only *Mobile* units offer program controlled or manually set flight-similitude conditions. These units provide completely coordinated altitude-temperature curves to a maximum of 80,000 feet altitude at a temperature minimum of -120° F.

Reheat and humidity testing is standard also in these *Mobile* units, up to $+185^{\circ}$ F with fully controlled humidity conditions according to your requirements. Our production time has recently been cut by almost 40%. We invite your inquiry.



May we work with you?

MOBILE REFRIGERATION

630 FIFTH AVENUE



NEW YORK 20, N. Y.

Goodyear's New "Static Eliminator"

In a special statement to "Electronic Industries," the Goodyear Tire and Rubber Co., Akron, Ohio, gives the following exclusive details on the operation of its "static eliminator" or "reducer,"—one of a long series of such "static eliminators" which have aroused both the interest and skepticism of radio men.

"Our eliminator is a device used inside a standard radio. While in effect the device is unequal to results produced with frequency modulation, it can reduce or eliminate some kinds of static which have been baffling heretofore. The device consists of an attachment beneath the amplification tube, this attachment in turn being connected to static eliminator. The eliminator is about 4 inches by 2 inches, by $2\frac{1}{4}$ inches, and is plugged to the radio into or near amplification tube. The entire device weighs less than six ounces. We feel that the new eliminator can be retailed for several dollars after the war. It now uses highly critical materials but will be available immediately for military use, especially for war-planes."

Invention of the eliminator has

been ascribed to Gilbert J. C. Andresen, research physicist for the Goodyear Company. A further statement from the company adds:

"The new radio static neutralizer will eliminate static whether due to atmospheric conditions or man-made machines. It makes use of small electronic tubes in such a way that they are automatically adjusted to each radio signal, whether weak or strong. They serve to discriminate between static and the desired signal and automatically control the amount of static energy which can pass through the radio.

"A detection control circuit eliminates static which is louder than the incoming signal, even in cases where the static is so loud as to obliterate the incoming signal entirely under ordinary circumstances.

"In tests at the Goodyear company, the device eliminated extreme static of high recurrent pulse frequency such as that caused by the ignition system of an airplane engine or an electric razor.

Eliminated ignition spark

"In one test, a 25,000-volt spark from the ignition system of an engine was projected directly upon the antenna of a receiving set. The neutralizer eliminated this so effectively that it was possible to tune in a short-wave radio program from Europe.

"In addition, the neutralizer also gets rid of static that is on the same frequency as the incoming signal. This is done by means of a circuit which uses the energy of the static to build up a current to opposite electrical sign. This current then neutralizes the static so that it has no effect upon the signal.

"Despite its great effectiveness, the device is simple, compact, and rugged," concludes Goodyear's statement. "It can quickly be built into any radio set."

How Radar Saved England

In the dark days when it appeared that England might fall because of the German blitz, it is now known that a single electrical device, the Radar, was largely responsible for saving England. The British did not have sufficient planes and gasoline to keep their planes in the air continually to be ready to fight off the German bombers when they chose to attack. Thanks to the development of the Radar, which signalled the approach of the enemy planes, it was only necessary to send up British

ONE "QUICKIE" SALVAGE JOB ISN'T ENOUGH...

YOU'VE JUST BEGUN TO SCRAP!

"ONCE OVER LIGHTLY" doesn't even begin to turn up the full scrap potential of the average industrial plant. Tremendous quantities have been either neglected or overlooked.

Yet today, as American boys come to grips with the enemy, demand for scrap of all kinds—especially copper, brass and bronze—soars beyond all anticipations. The War Production Board stresses *again* that the enormous demand for copper scrap cannot possibly be met. It's our No. 1 salvage problem!

LOOK OFTEN — LOOK HARD!

So be ruthless with that old stuff that's been collecting dust since the Year One! Put a strong-arm executive in charge of your salvage operation and make it a *continuous* job! Tell him to use commando tactics if necessary, but to keep that scrap coming.

It's amazing what the second and third time around will yield when everybody is convinced that you mean business. Out they come—hidden tons of ancient parts and fittings, useless dies and jigs, everything from cotter pins to drill presses!

KEEP THOSE FURNACES GOING!

Right now, America's copper refineries are operating at an average of 80% of capacity. Think what that means! In some hard-fought action, the cartridges just won't be there. *And your boy, or your neighbor's kid, will pay the price!*

If you put it off, you postpone victory. And a lot of swell fellows are going to have to spend just that much more time in the blood and muck of trench and fox-hole. You can't let that happen!

WHAT IS DORMANT SCRAP?

Obsolete machinery, tools, equipment, dies, jigs, fixtures, etc., which are incapable of current or immediate future use in the war production effort because they are broken, worn out, irreparable, dismantled or in need of unavailable parts necessary to practical re-employment.

FOLLOW THIS RULE

If it hasn't been used for three months, and if someone can't prove that it's going to be used in the next three—sell it*—or scrap it!

*Scrap and used equipment dealers pay well for usable machinery and materials.

USE IT—SELL IT—OR SCRAP IT!

Maybe you can't use some good machinery—yet it hasn't reached the scrap stage. Okay—sell it. Usually somebody else is looking for that equipment. You'll get prices far better than those for scrap. And you'll do your Uncle Sam a good turn into the bargain.

HOW TO SELL YOUR SCRAP

If you have no regular scrap dealer, find one in the classified phone book. He'll buy usable materials, too; or you can find a Used Equipment Dealer in the same place.

Don't expect your scrap heap to be a gold mine—the dealer works under a price ceiling, the same as you do. But you will find there's a million dollar feeling in the knowledge that you're doing your part all the way.

BUSINESS PRESS INDUSTRIAL SCRAP COMMITTEE

ROOM 1261, 50 ROCKEFELLER PLAZA, NEW YORK CITY

BUSINESS PRESS INDUSTRIAL SCRAP COMMITTEE
ROOM 1261, 50 ROCKEFELLER PLAZA, NEW YORK CITY

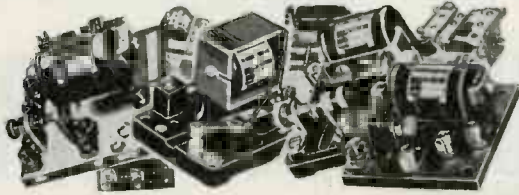
Please send scrap manual.

Your name

Company name

Company address

**BUYS 100,000
RELAYS ONLY 24
REJECTS!**



**Kurman's Famous 23 Yr. Record
Scores New High—99.00076% O. K.**

Yes, maybe there are other relay manufacturers who could turn out a big order like this as swiftly as we did. But, only Kurman with its 23 years of experience, its unsurpassed facilities, its knowing what to do and how to do it could (we believe) do the job and have only 24 rejects. Here again is striking proof that confidence in Kurman when it comes to relays is valuable insurance when it comes to your product's performance. No matter how exacting your requirements may be for power and sensitivity, your best bet is "Consult Kurman."

**KURMAN ELECTRIC
CO.**

30-30 NORTHERN BLVD., LONG ISLAND CITY, N.Y.



When
**WILL
THE WAR END?**

No one knows. Victory may come with startling suddenness... let us hope so.

When the war does end, you will find the ERWOOD engineering talent available for your problems.

THE ERWOOD COMPANY

225 WEST ERIE STREET

CHICAGO, ILLINOIS

planes when the enemy was approaching.

When we think of the Radar it is because of its value for wartime uses, said Richard P. Brown, of Brown Instrument Co., in a talk at Philadelphia. But after the war, passenger ships equipped with this device will be able to locate other ships or icebergs through the fog and avoid the danger of collision.

Landing fields for planes will be equipped with the Radar and incoming pilots can be advised of their exact location in relation to the landing field.

The day may come when passenger planes will be equipped with the Radar to avoid collisions with other planes or mountains. Travel by air will become safer because of new devices such as the Radar.

Slepian Honored

Dr. Joseph Slepian, associate director of Westinghouse research laboratories was recently awarded the Benjamin Garver Lamme medal by American Institute of Electrical Engineers. He was honored for his work in developing the ignitron and for work on power system circuit breakers.

Dr. A. W. Hull

Dr. Albert W. Hull, new president of the American Physical Society, pictured in the General Electric Research Laboratory with one of many electronic tubes on which he has made important improvements, and which now have important war uses. The magnetron, dynatron and screened-grid tube for radio



DR. A. W. HULL

frequency amplification are among his developments. He is assistant director of the G. E. Research Laboratory. The Society which he now heads numbers about 4,000 members, including the nation's physicists and scientists working in allied fields.

Dr. Hull has received many other honors, including the Howard N. Potts gold medal of the Franklin Institute, awarded in 1923 for his work on X-ray crystal analysis; the Morris Liebmann Prize in 1930 for his work on electronic tubes; and the honorary degree of Doctor of Science the same year from Union University.

Born in Southington, Conn., Dr. Hull was graduated in 1905 from Yale University, where he also obtained his Ph.D. in 1909. After four years as instructor and as assistant professor of physics at Worcester Polytechnic Institute, he joined the G. E. Research Laboratory staff at Schenectady, N. Y., in 1914 as research physicist. In 1928 he was made assistant director of the laboratory.

Lab Tests vs. Field Conditions

"A most important consideration is the smoothness of operation of an instrument or control," said Dr. P. G. Weiller of Kollsman Instruments before the N. Y. Society for Measurement and Control.

"What I mean by smoothness is very hard to describe. The trouble with it is that the conception of smoothness to the average production man differs in many ways from that of the designer. The production man lives in another environment and he has many other worries besides the instrument. In addition, he is never too familiar with it.

"The designer, on the other hand, knows almost only the instrument and very little about the processes it is intended to control. This consideration is very important when you lay out your final performance test which should decide whether the instrument is ready for the market or has to be further improved. Some of the large companies are extremely punctilious and very ingenious about such tests. Sometimes they submit a new

product to a year or so of grueling tests before it is released for sale. In spite of all this care, the first year's output of these products is often beset with bugs. I have known numerous cases where the whole first year's output of instruments and controls has been taken back and replaced by later models.

Inexpert personnel

"The reason for such errors is not lack of intelligence or care. It is the fact that laboratory tests, no

matter how carefully devised, can never fully duplicate field conditions. One of the main reasons for these failures of laboratory tests is the personnel who handle the product. No matter who tests the instrument in the laboratory, he will soon become expert at it and he will unconsciously operate the instrument on the basis of his experience. The performance of the instrument in the hands of an experienced laboratory staff just does not duplicate operation in the field.



**WE'D LIKE TO
Emphasize
Our Service!**

Building good springs, exactly to your specifications, is what we're expected to do. Furthermore it's what we have always done and will continue to do. But we'd like to stress Accurate Service. It's not the ordinary kind of service you would expect from an ordinary source of supply; that isn't good enough —today! The service we mean is the kind that's based on the complete cooperation of everyone here . . . in the office . . . in the plant . . . and in the field; not the "take-it-or-leave-it," "best-we-can-do" kind. It's the kind of service that gets things done—whether helping you work out problems of design or in production.

Accurate service will be helpful to you, if you use springs and wire forms.

Write for our new Handbook of Technical Data on Springs.
No obligation.

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TRANSFORMER

Precise . . . Simple

PERMEABILITY-TUNED

CAMBRIDGE THERMIONIC CORP.
445 CONCORD AVE., CAMBRIDGE, MASS.

"It is also very difficult to reproduce conditions due to humidity and dust, or a combination of both, present in many plants. In many machine shops, for instance, there is a certain amount of iron dust in the air, mixed with minute globules of lubricant. This will, after prolonged operation, get into instrument boxes and settle on the magnets of relays. Similar interference can be found also on the contacts of small relays. This is to mention only one cause of misoperation which is almost impossible to detect in the laboratory," observed Dr. Weiller.

Uses Rubber as Conductor and Shield

The war effort received a major contribution with the development by American Steel & Wire Co., a U. S. Steel subsidiary, of a new type, large-size electrical cable, using rubber as a conductor of electricity rather than as an insulating material.

The rubber permits transmission of higher voltages for operation of X-ray machines and heavy industrial equipment.

Corona discharges

High-voltage cables have along their entire length some slight discharge of electrical energy. This electrical discharge comprises ionization of small amounts of air which may be present and electrical sparks or arcs, all of which are highly injurious to rubber insulation.

Even in the case of heavily insulated high voltage cable the discharge can occur around the outer surface of the insulation from outside, eventually causing it to crack, fall and become useless. The only answer to this problem is to carry off so-called "charging" or static electricity as rapidly as it comes from the conductor. The procedure is known as shielding.

One method of shielding has been to apply several strands of metal over the insulation, running the length of the cable.

Bending metal causes gaps

Under favorable conditions a metallic shield of this type is satisfactory, but if the cable is bent and subsequently straightened, or when it expands and contracts with alter-

ANNOUNCING

CP-39 A NEW HEAT RESISTANT PLASTIC FOR COIL FORMS

CP-39 has just been released by Creative for electronic manufacturers for use in coil forms. A.S.T.M. specifications show water absorption at 24 hours to be only .45% and specific heat resistance 15% higher than other commonly used high heat resistance plastics.

This ideal coil form material is fully cured before fabricating, thus assuring closest tolerances. Since it costs little or no more than standard Creative cast forms you should test it on your instruments.

Write us today about your coil form or other plastic problems. Deliveries on standard materials for uses approved by WPB are running about three to four weeks. Your inquiry will receive prompt attention.

ILLUSTRATED FOLDER SENT ON REQUEST

NO MOLD EXPENSE

CREATIVE PLASTICS CORP.
962 KENT AVE., BROOKLYN, N. Y.

nate heating and cooling in service the metal shield tends to separate slightly from the surface of the insulation, forming gaps at intervals throughout its length.

To overcome this difficulty the American Steel & Wire Co. developed a semiconducting rubber which can be placed between such metallic shields and the insulation to carry off and dissipate the discharge from the conductor before any damage to the insulation can take place.

Electronic Pictures Puzzle Percival; Yet He Perceives Prophetic Portent

Editors, Electronic Industries:

There are those who find in the stars the reasons for all events—from causes great enough to affect all mankind, to those trivial enough to control minor details of the activities of a single individual.

And now I am momentarily expecting to hear of new groups of thinkers who will base all "variations of the unexpected" on the work of electrons!

This matter of electronics is getting me confused—no end, resting my knowledge on advertisements only.

There was a time when the science of electronics apparently was accurately pictured by thunderbolts which flashed out from mysterious gadgets.

"Hoop-and-ellipse" era

But time proved that this conception was wrong and that the electronic art deals with enormous hoops and ellipses encircling the earth—or the atoms—or whatnot! But even here the revised conception was not complete, for the artists soon caught up and showed us how huge gobs of molten ectoplasm drip from a point on each of these pictured orbits.

And just when I had become accustomed to this and had begun to figure out which way to jump, to miss the splashes when these balls of melted gooey fell, it seems that even this was all wrong!

For now, in the newest crop of ads, electronics deals with a row of arrows shot out from some hidden source toward an overhead plane—which arrows then turn neatly around and boom-e-rang back to

We're... "ALL WORK TO WIN THE WAR!"

IN THIS BOMBER IS MORE THAN ONE VITAL GUTHMAN PRODUCT

We can not tell what these important jobs are, but we are working hard so that these products can keep up essential communications. The price of being selected for such war time tasks is reflected in the skilled efforts of our 700 employees. Guthman-made radio units are being supplied for tank, army, and command car transmitters and receivers, and other army and navy signal corps equipment. Housed in our 60,000 square foot building is one of the most modern radio, electrical and chemical laboratories. Our plant is 100% concrete and brick, completely sprinkler-equipped.



EDWIN I. GUTHMAN & CO., INC.

15 SOUTH THROOP STREET ★ CHICAGO

**PRECISION MANUFACTURERS AND ENGINEERS
OF RADIO AND ELECTRICAL EQUIPMENT**

Radell

Makers of Precision
Engineered
**ELECTRONIC
PRODUCTS**

Radell
CORPORATION

6327 GUILFORD AVENUE, INDIANAPOLIS, INDIANA

TURNER
101 CARDIOID
Stops

**BACKGROUND
NOISES**



*Offers best features of
both Velocity and Dynamic*

Utilizing a 2-element generator, 101 offers true cardioid characteristics; extremely sensitive to sounds originating in front of the microphone, the rear may be considered dead. Where the going is tough and acoustic conditions practically impossible, Turner 101 assures complete intelligibility. Equipped with tilting head, balanced line output connection and heavy duty cable. Available in Standard, DeLuxe and Broadcast models.

Free

Write for your copy of Turner's new catalog.



The TURNER Co. . . Cedar Rapids, Iowa

the source, to disappear under the canvas.

Maybe all of these conceptions are right and the whole thing ties up with the bureaucratic system of economics, where, it will be remembered, the thunderbolts in the claws of the NRA eagle gave way to an era of much activity, going around in circles, only to explode from sheer self-momentum!

If so, maybe the most recent portrayal of a straight-shooting system (where a ray gets to the objective, does a job, and comes right back without digressing), signifies that something new and unusual in the handling of national affairs may be in the offing!

Percival P. Pentode
Electronic City, N. Y.

He Heads Princeton Labs



Here's E. W. Engstrom, director of the RCA Laboratories at Princeton, N. J., operating a portable rf power source used for "bombarding" or degassing tube elements and for heat-treatment of small metal parts. This portable bombarder can be moved from laboratory to laboratory, and supplements the built-in power sources in vacuum-tube exhaust set-ups

"Look for a Radar Age"

"Jot down in your little notebook the legend: 'Radar—April 23, 1943,' because that word will become as commonplace in radio's lexicon as radio itself," counsels Editor Sol

Taischoff of Broadcasting Magazine. Here's the rest of his comment:

"On April 23, the Army and Navy decided that the secrecy that has shrouded use of that term might now be lifted. It has been no secret to the craft, however, that this radio-electronic development for radio detecting and range-finding, traveling with the speed of light, has taken the gamble out of blind-flying, and has been used on land, sea and in the air to detect approach of the enemy and to measure his distance.

"Many believe the ban on radar had been carried to the point of absurdity. Government agencies identified with the design, manufacture and purchase of radar equipment, have been prevented from using the term.

"We're glad the military high commands have decided to release the secret. The process itself, however, probably will remain locked within the vaults of the military until after the war. Then look for a Radar Age."

DEHYDRATION OF FOOD BY RF

The Industrial Electronics Division of the Federal Telephone and Radio Corporation, in cooperation with the Office of the Quartermaster General of the United States Army, has developed a process of dehydrating food by means of radio-frequency energy. The process makes possible, for the first time, removal of 99 per cent of the moisture content from a compressed vegetable block, reports Vernon W. Sherman, of Federal Telephone and Radio Corporation, Newark, N. J., in I. T. & T.'s "Electrical Communication."

Conventional methods of dehydration rely on heat and forced air to remove water from vegetables. With these older processes, it is possible to remove 95 per cent of the moisture content without injury to the product. Vegetables so dehydrated can be reconstituted, i.e., the normal water content can be restored by soaking in water, the vegetables returning to their original state and retaining their natural color and flavor.

"Case-hardening"

Many root or semi-perishable vegetables, including beets, carrots, cabbage, onions and potatoes with a residual moisture content of five



Meissner "Align-Aire"

Condensers Meet Exacting Performance Requirements!

Meissner "Align-Aire" (midget) units are now encased in the newly developed, low loss, bakelite (number 16444) and occupy extremely small space... only 7/16" in diameter and 1 1/4" long... they are an ideal trimmer for high frequency coils. Midget "Align-Aire" Condensers are exceptionally stable. Capacity range 1 to 12 mmfd.

Many years of engineering research developed the Meissner "Align-Aire" Condensers to meet exacting performance requirements of high frequency circuits.

Samples sent upon request.

AVAILABLE ONLY ON PRIORITIES



MT. CARMEL, ILLINOIS

"PRECISION-BUILT ELECTRONIC PRODUCTS"

DANNEMAN PRECISION DIE-SETS

Precision Bored on Master - Plates

for accurate stamping of metal and mica film parts and components.

Of special interest to radio and radar, electronic and electrical, aviation and instrument manufacturers.

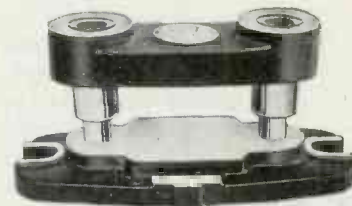
Our experience in this field is your assurance of our ability to serve you well.

DANNEMAN DIE-SET COMPANY

Exclusive Sales Representatives

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Literature on request

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PROBLEMS IN AIRCRAFT, TANKS, ETC.

WITH

AMPERITE

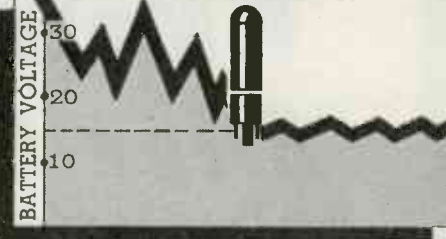
BATTERY CURRENT & VOLTAGE REGULATORS

Features:—

1. Amperites cut battery voltage fluctuation from approx. 50% to 2%.
2. Hermetically sealed — not affected by altitude, ambient temperature, or humidity.
3. Compact, light, and inexpensive.

Now used by U. S. Army, Navy, and Air Corps.

Send us your problem.



VOLTAGE OF 24V BATTERY & CHARGER VARIES APPROX.

50%

WITH AMPERITE VOLTAGE VARIES ONLY

2%

AMPERITE COMPANY • 561 Broadway, New York, N. Y.
 In Canada: Atlas Radio Corp., Ltd., 560 King St. W., Toronto

Cable: Alkem, New York

per cent, will keep only a few weeks in humid atmospheres and they cannot be packed satisfactorily inasmuch as the moisture present causes mold to form and makes them inedible. Consequently, attempts have been made to reduce the moisture content further. With conventional forced hot air drying, many vegetables develop a tough, blackened skin known as "case hardening" when the moisture content is reduced below five per cent. "Case hardening" is a permanent change and prevents reconstitution to their former freshness and color.

The electronic dehydration method developed by Federal not only makes it possible to remove 99 per cent of the moisture but it also permits this high degree of dehydration after the vegetables have been compressed into a small block or briquette 6x3x 3/4 inches. As will be recognized by those familiar with dehydration processes, compression of vegetables prior to total dehydration is an unprecedented procedure. Other processes require exposure of as much of the vegetable surface as possible to facilitate evaporation.

Moisture 99% removed

With all but one per cent of the moisture removed, it is possible to pack all types of dehydrated vegetables in sealed containers and transport them to any part of the world without danger of decomposition. Extensive studies have shown that the length of time vegetables may be kept in good condition increases very greatly as the moisture content approaches one per cent. Evidence now indicates that vegetables dehydrated by the electronic method will not deteriorate over a period of one to two years even in hot, humid climates.

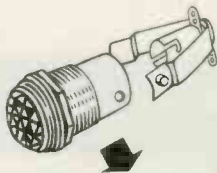
Vegetables reconstituted after electronic dehydration may be cooked and served the same as fresh vegetables. Reconstitution is accomplished by soaking the vegetables in water. They then return to their original color and consistency and retain their normal taste and aroma. The vitamin content of electronically dehydrated vegetables is especially high due apparently to the much shorter processing time.

Last 20% removed electronically

The exact method of dehydration cannot be disclosed at present. Briefly, however, 80 per cent of the moisture is removed by conven-

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tional methods, leaving the vegetables pliable but without formation of "case hardening." The vegetables are then compressed into bricks and the remaining moisture is removed electronically after which they are ready to be wrapped in paper, wax coated, packed and shipped. The whole procedure is well adapted to automatic straight line production.

Laboratory results show that one pound of water may be removed electronically with less than one kilowatt hour of energy, a figure which is economically good in comparison with other methods.

In addition to the above mentioned vegetables, dried whole milk also has had its moisture content reduced electronically from two per cent to one per cent. This small difference makes it possible to ship dried whole milk without danger of its butter fat content becoming rancid. Unlike dried skim milk, dried whole milk can be reconstituted to be as palatable and nutritious as fresh milk.

SPOT PLANES 150 MILES AWAY

Weather is still a factor for lower-flying planes, and even the ships plying in the sub-stratosphere have to pass through these layers on their way up and down, says James Stokley in a chapter of "Science Remakes Our World."*

Fog is one of the greatest dangers to aviation, but inventive ingenuity has now made it possible to look through it.

Aerial photographs from great altitudes have been made with infrared light, showing details hundreds of miles away as clear as those much nearer. Yet with ordinary light photographs the distance is completely obscured in haze.

Such experiments have led to a common idea that infrared rays can look through fog. A device has been constructed for taking photographs on special film in infrared light and developing it immediately and automatically, with the thought that it might be placed on the bridge of a ship, so that the pilot could make port in foggy weather.

The main trouble is that infrared rays do not penetrate fog. There is no region of the radiant energy spectrum which will penetrate fog any better than visible light.

*Copyright 1942 by James Stokley. Published by Ives Washburn, New York. \$3.50.

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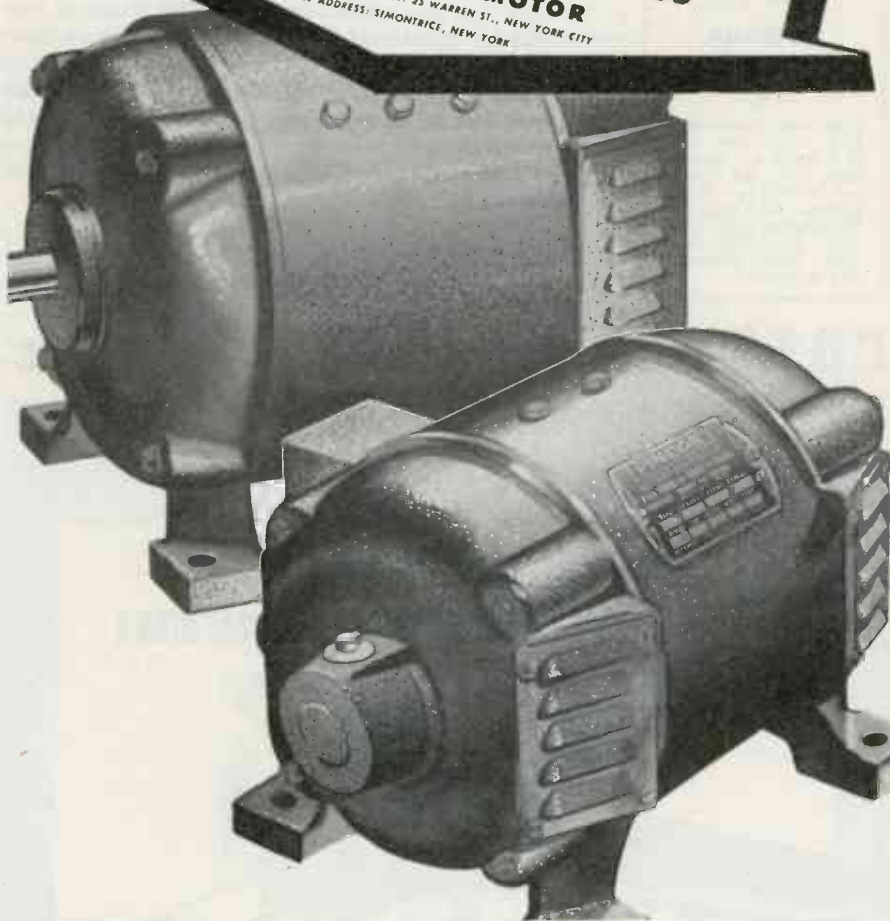
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The common belief that infrared rays do go through fog was based partly on photographs showing their superior penetration of haze, and partly on the misuse of a formula for the transmission of light through suspended particles.

This formula applies only if the particles are of about the same size as wavelengths of light, which the haze particles actually are. However, fog particles are some five hundred times bigger—each about 0.06 inch in diameter—and light waves equally long would have to be used to produce an effect. But though waves as long as this may penetrate the fog, they in turn are absorbed by the gases of the atmosphere, so their advantage would be offset.

But even though they cannot penetrate a dense fog, infrared rays have important possibilities. One is the detection at night of enemy aircraft—or ships—that approach in darkness and are not considerate enough to provide lights or to warn of their coming.

Heated objects

Infrared rays are given off by any hot object. Hold your hand near a flat-iron that is in use, and you can feel them, even though you cannot see them, because they are made of waves too long for the eye to detect. The hot cylinders of an airplane engine, or the hot funnels of a steamer, give them off copiously. So does the mass of hot gases exhausted from either type of engine.

Since infrared rays are like light waves, they may be focused, either with lenses or with concave mirrors, and an image formed of anything which is emitting or reflecting them. Some means had to be found to make this image visible, and fortunately there are several ways of doing it. One, devised by Dr. V. K. Zworykin of the Radio Corporation of America, invented a means of doing it with electrons. A lens forms an infrared image on a thin metal plate which is coated with a compound of silver, caesium and oxygen.

Where the rays fall on such a film tiny bits of atoms called electrons are discharged. These in turn can be focused with an electron lens—one kind consists of a circular

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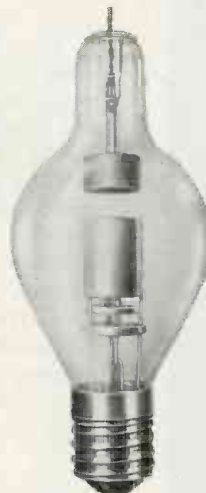
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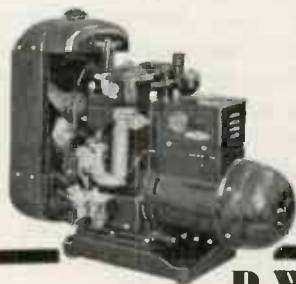
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electromagnet—on a glass screen coated with a fluorescent material. This glows where electrons strike, and the picture becomes visible.

Purdue discovery

A still simpler means of making visible an infrared image was invented by Roscoe H. George, assistant professor of electrical engineering at Purdue University. His discovery grew out of the observation that certain substances, related to those with which the final screen of the Zworykin infrared telescope was coated, are phosphorescent. That is, they continue to glow for a time after they have been excited with light either visible or in the ultraviolet range, the waves of which are too short to be seen.

Electrons and X-rays can also excite phosphorescence, and phosphorescent materials store energy, then give it off again later. But if they are sprayed with infrared rays they give it off more quickly. That is, you can take a phosphorescent screen out into the sunlight, expose it, then bring it into a darkroom, and it will be seen to glow. But if, in that darkroom, you have a source of infrared and hold the screen in its beam, it glows more brightly, but for a shorter time.

In Professor George's invention, the idea is to focus the infrared rays from the distant source, such as the plane's exhaust gases, on a phosphorescent screen with a concave mirror. It operates like an astronomer's reflecting telescope. Inside the telescope is a source of invisible ultraviolet, which shines on the screen and makes it glow faintly. Where the infrared rays fall, it glows more brightly, and the image is made visible.

Short waves

Although infrared rays will not penetrate fog, ultrashort radio waves, many times longer still, will do so. There are various ways of producing such waves. One is with the klystron, developed in the physics laboratory of Stanford University by Sigurd and Russell Varian. Another is the magnetron of Dr. A. W. Hull, of the General Electric Research Laboratory.

The waves produced by these devices are about 20 inches long, much

shorter than those used regularly in broadcasting. They have many of the properties of light waves. They can be focused in a beam like that from a searchlight and just as light waves are reflected and sent back, so these are reflected, particularly by a metal object such as an airplane.

Detected bombers

It is by the use of such waves that the Japanese bombers which attacked Pearl Harbor on December 7, 1941, were detected when they were 130 miles away. It was not the fault of the apparatus that its indication was ignored.

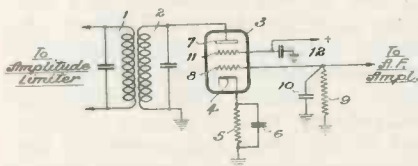
No present-day military device is kept more carefully secret than the details of this equipment, just what is in it, and how it functions. However, enough has been revealed from official sources to get a general idea of the fundamental principles. In February, 1941, for instance, a patent (No. 2,231,929) was granted to Joseph Lyman of the Sperry Gyroscope Co. and, like all patents, was published by the U. S. Patent Office.

NEW PATENTS ISSUED

(Continued from page 104)

Screen-Grid-Tube Discriminator

—Transit-time-current flow to grid 8 of tube 3 is utilized to indicate mean frequency deviations of the applied modulated waves. Anode 7 and grid 8 are at a negative direct current potential equal to the voltage drop across resistor 5. Electrons having passed accelerating grid 11 are slowed down in the space between grid 11 and anode 7, reverse their direction of travel and again traverse grid 11, coming in the vicinity of grid 8. It is stated that an alternating voltage of high frequency on plate 7 will accelerate some electrons so much that they are enabled to reach grid 8 in spite of its negative voltage, and that



the transit time current to grid 8 is proportional to the square of the frequency. This transit current through the circuit of grid 8 sets up a voltage across resistor 9 which



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is also a function of the square of the applied frequency, and in the frequency range used may be considered approximately linear. It will be seen that the desired discriminator action is obtained by suitably selecting, connecting and using a screen-grid tube. S. Hunt, RCA, (F) May 20, 1941, (I) April 20, 1943, No. 2,316,868.

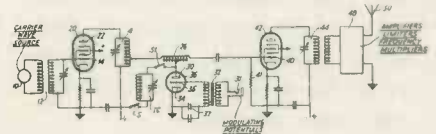
Intermediate Frequency Receiver—A network is claimed that supplies constant intermediate frequency voltages to the converter tube grid independent of frequency. W. W. Moe, General Electric Company, (F) July 24, 1941, (I) April 13, 1943, No. 2,316,610.

Control Voltages—The device is intended to amplify or generate control voltages for automatic band width control, automatic frequency control, etc. in such a way that no reversing of polarity occurs. A secondary-electron-emission auxiliary cathode is used to obtain an amplified signal of the original polarity. J. van Slooten et al, RCA (F) May 3, 1940, (I) April 13, 1943, No. 2,316,474.

Discriminator—A discriminator providing control potentials to keep the oscillator frequency of a heterodyne receiver constant is described. The plate voltages of the two discriminator rectifiers are

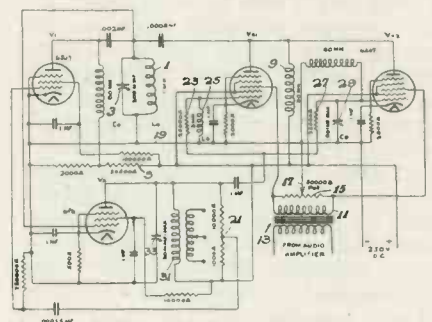
used as bias for the grid of the other rectifier, respectively, and a steep frequency-voltage characteristic is obtained. L. F. Curtis, Hazeltine Corp., (F) Jan. 16, (I) April 13, 1943, No. 2,316,317.

Phase Modulation—Inductance 26 and plate resistance of tube 36 constitute the phase shift network. Control is effected by varying the plate resistance in accordance with the modulating potential which is applied to grid 35 of the tube. For high frequencies, circuit TC may be connected to tune out the plate



capacity of tube 36. A high degree of phase shift and total phase variation is provided and no concomitant amplitude modulation is introduced. Another variable resistance may be substituted for the plate resistance. M. G. Crosby, RCA, (F) July 26, 1940, (I) April 13, 1943, No. 2,316,155.

FM Modulator—The reactance-tube circuit is intended to avoid the necessity for frequency stabilization and to provide constant-amplitude output. Tubes V_1 and V_2 constitute the oscillator; V_{x1} and V_{x2} are reactance tubes, equivalent to an inductance and a capacitance, respectively, which reactances are equal at oscillator frequency. Their control grids are supplied with modulating potential in push-pull relation. Under certain additional conditions, in-phase changes in the mutual conductance of tubes



V_{x1} and V_{x2} will cancel out and will cause no appreciable change in oscillator frequency. Regarding constant-amplitude output, an adjustment is found which results in neutralizing the resistance equivalent to the plate resistances of the reactance tubes and shunted across the tuned circuit. Amplitude modulation of the oscillator is thus minimized and undesirable loading of the tuned circuit eliminated. C. F. Sheaffer, RCA, (F) Sept. 13, 1940, (I) April 6, 1943, No. 2,316,123.

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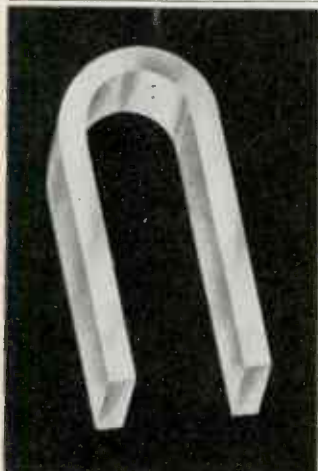
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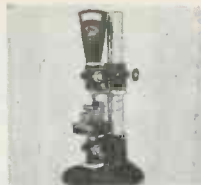


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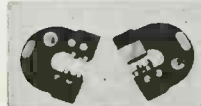
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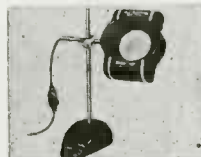
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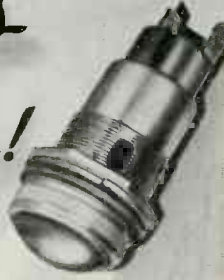
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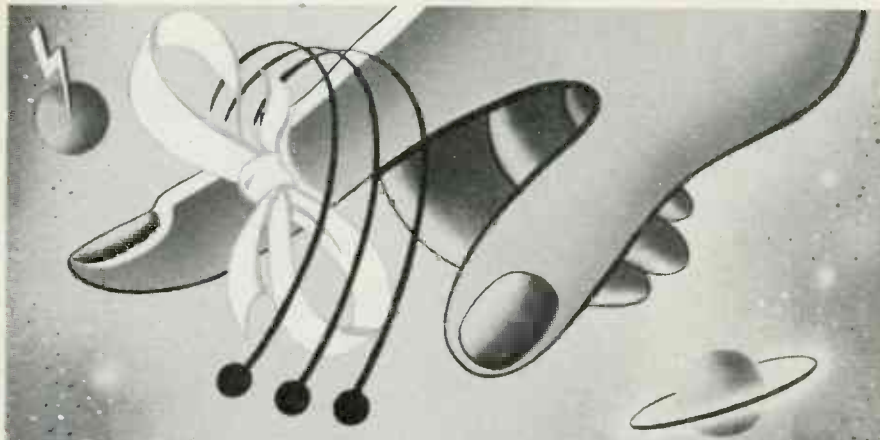
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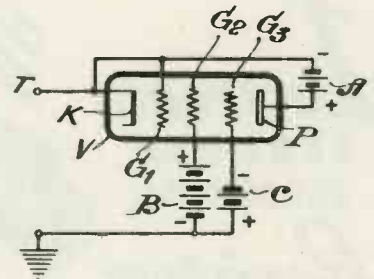
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Frequency Control—A frequency control for a mark and space wave keying receiver as used for telegraphy, facsimile teletype printers, etc. is described. Essentially two different frequencies are received alternately, heterodyned and converted into two voltages, respectively. The invention is concerned with maintaining the two resulting heterodyned frequencies constant upon changes in transmitter or receiver frequency. H. O. Peterson, RCA, (F) May 23, 1941, (I) April 6, 1943, No. 2,316,017.

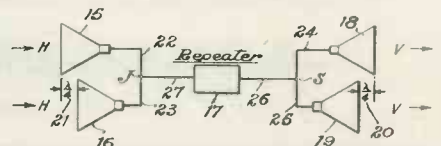
Frequency Calibrator—The frequency of a standard oscillator and of the oscillator to be calibrated are heterodyned; the resulting beat frequency is applied to a low pass filter and a fluorescent indicating tube. Due to the combined action of low pass filter and tube, minimum visual indication is produced for high beat frequencies which indication increases as the frequency approaches zero. R. L. Downey, General Electric Company, (F) Dec. 26, 1941, (I) April 6, 1943, No. 2,315,945.

Negative Resistance — It was found that if the voltage on G_2 was of the order 100 volts and the other two voltages of the order of 10 volts, there is a negative resistance between terminal T and ground. Hence if a parallel tuned circuit of sufficiently high anti-resonant im-



pedance is connected between T and ground, oscillations are obtained; or if resistance and capacity are suitably associated with the system, relaxation oscillations will occur. W. van B. Roberts, RCA, (F) Aug. 30, 1941, (I) April 6, 1943, No. 2,315,658.

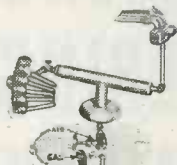
Directional Antenna — To obtain directional reception, for instance in a repeating station, two antennas 15 and 16 are displaced along the preferred direction of propagation by a distance 21 of ap-





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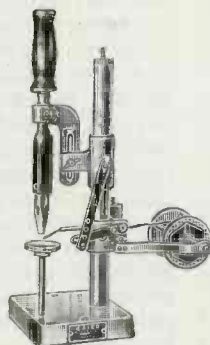


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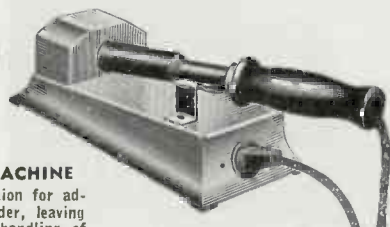


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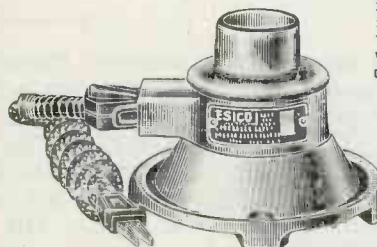
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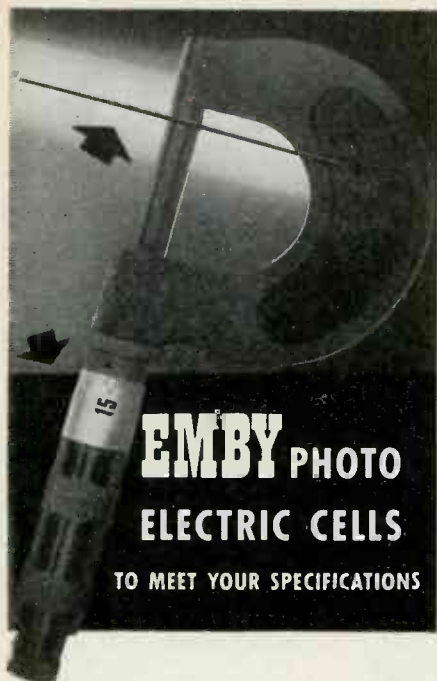
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proximately one-quarter wavelength or an odd multiple thereof. Line 22 is made so much longer than line 23 that a 90° phaseshift is obtained. Waves traveling in the direction indicated by arrows H will then reach junction point J in phase, while waves arriving from the opposite direction will reach antenna 16 first and, line 23 being shorter than line 22, will be 180° out of phase with the corresponding wave reaching point J from antenna 15. Thus, directional reception may be accomplished. More than 2 antennas can be employed to improve the effect. Waves emitted by antennas 18 and 20 combine in a similar manner to produce a resulting wave propagated substantially in the direction indicated by arrows V. H. O. Peterson, RCA, (F) Sept. 27, 1941, (I) Feb. 16, 1943, No. 2,311,467.

WIBG

(Continued from page 58)

is toward Philadelphia proper, about 55 kilowatts is being radiated.

There are two patterns used at WIBG, one for daytime operation and the other for night-time. The one described herein is the one used at night. The only difference in patterns is that over the 200 degrees where 10 watts of power is being radiated at night this is increased to approximately 500 watts in daytime.

The operating constants on the operation of the antenna are as follows. (A) tower lags (C) tower 89 degrees. (B) tower leads (C) tower 140 degrees. (D) tower lags (C) tower 132½ degrees, and (E) tower leads (C) by 89.5 degrees. The currents in each of the radiators are (A) 3.6 amps, (B) 10.55 amps, (C) 14.9 amps, (D) 10.55 amps, (E) 3.6 amps. To give some idea of the amount of suppression produced by this array a few of the effective fields strength values on several of our radials where suppression is required are:

Toward Station CKY (direction 292 degrees) effective field 13.6 mv/m; Station CKY (direction 330 degrees) effective field 8.6 mv/m; Station CKY (direction 10 degrees) effective field strength values on CMHT (direction 192.5 degrees) effective field 485 mv/m; Station CMHT (direction 242 degrees) effective field 14.6 mv/m.

In order to maintain this pattern currents have to be kept to within one-tenth of an ampere in each of the radiators, and the phase must be kept within one-half degree. A special meter was designed to measure the current-ratios in each radiator, and I have hopes for pre-

Coming!

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The ELECTRONIC ENGINEERING HANDBOOK will be a manual and encyclopedia of electronic engineering practice. It will bring together in one standard handbook, all of the basic reference material needed in electronic design, production, operation and maintenance—a vast fund of practical working data heretofore obtainable only from widely scattered sources. It will be completely indexed and especially arranged for instant reference.

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ELECTRONIC DEVELOPMENT ASSOCIATES

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senting it in this magazine at a later date.

In summing up the results of this antenna covering one month of operation, no difficulty has been found in keeping it tuned, and after taking field measurements every day for two weeks no appreciable change in the suppressed signal has been found with either dry or wet weather conditions. WIBG therefore goes on record as having the only antenna built to date that produces suppression over such a wide angle—a major technical achievement! Over 700 field measurements were made in the proof of performance tests which were made for the FCC. Mr. Wilmotte and Mr. C. X. Castle deserve much credit for the work they have shown in this job for the progress of the radio art, as antennas of this type will enable stations to get power increases to better serve their territories.

AMPLIFIER TUBES

(Continued from page 89)

Maximum Screen Voltage (Per Section)	67.5 Volts
Maximum Plate Dissipation (Per Section)	3.0 Watts
Maximum Screen Dissipation (Per Section)	0.5 Watt

Physical Specifications

Base	Lock-In 8-Pin
Bulb	T-9
Diameter	1-3/16" Max.
Overall Length	3-5/32" Max.
Seated Height	2-5/8" Max.

Base Pin Connections

	Section
Pin 1—Heater	
Pin 2—Control Grid	2
Pin 3—Screen Grid	1 & 2
Pin 4—Plate	
Pin 5—Plate	
Pin 6—Cathode & BCP	1 & 2
Pin 7—Control Grid	1
Pin 8—Heater	
RMA Basing No. 8BS-L-O	

PHOTO LIGHT

(Continued from page 87)

One condenser "bank" C_1 . The size of this "bank" will depend upon the desired light output of the equipment. From 15 to 100 microfarads is recommended. The lower limit will give sufficient light for home use, baby pictures, etc. The upper limit will give an exceedingly powerful flash, enough for dance scenes, indoor sport events, etc. For color photography two to four

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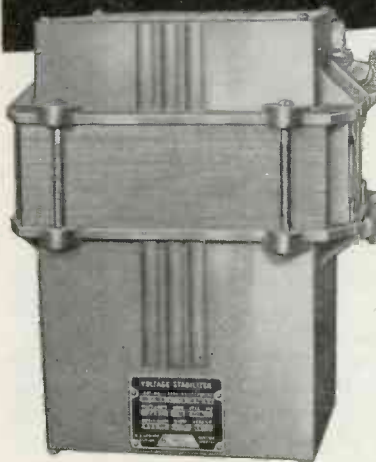
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Individual sets, each of 100 mf may have to be used simultaneously.

Any condenser, suitable to operate with about 200 volt dc and stand short-circuit discharges, will be found suitable. Dry or wax type condensers will not stand up. Oil or better still Pyranol condensers stand up very well. The battery may comprise 2 to 4 individual condenser units in parallel.

Auxiliary condenser C_2 . This can be a paper condenser of 1 mfd for 400 volt. Auxiliary condenser C_3 . This can be a paper or mica condenser of 1/100 mfd for 400 volt. Resistor R_1 of 125,000 ohms and 2 watts. Resistor R_2 of 25,000 ohms and 2 watts. Resistor R_3 of 1 megohm and 2 watts use two 2 megohm resistors in parallel. There is high voltage across this resistor. Insulate the high potential end very well to prevent flash to other parts. Resistor R_4 of 1 megohm and 2 watts. Resistor R_5 of 1 megohm and 2 watts.

Kick-off transformer T_2 . This is a small, high ratio spark coil, such as used for the ignition of toy gasoline motors on model airplanes or model racing cars. The high potential lead from this coil ends in a bare wire, wound 2 or 3 times around the discharge tube, free ending. The electro-static field within these turns ionizes the tube sufficiently to cause its flash-over.

Discharge tube. This is a glass tube of about pencil diameter, with an electrode at each end. The tube may be straight some 10 inches long, or it may be bent into hairpin or spiral shape. The tube is krypton or argon filled and will stand up for many thousand flashes. Suitable tubes are made by Eastman, Lee Speedlite, General Radio (Strobolux) and others.

High voltage cable to connect power box to light in reflector must be highly insulated.

Charging time for this outfit is 6 to 10 seconds, depending upon size of condenser "bank." Weight of a 50 mfd outfit is about 40 lbs.

Photographic exposure time depends also upon total capacity of condenser bank. An outfit with 100 mfd gives enough light to get a fully exposed negative on press film at 10 foot distance with lens closed to f:16 or f:22, which will give considerable depth of focus.

The operator should always remember and never lose sight of the fact that this is a high voltage device. If carelessly handled it is capable of administering a dangerous electric shock.



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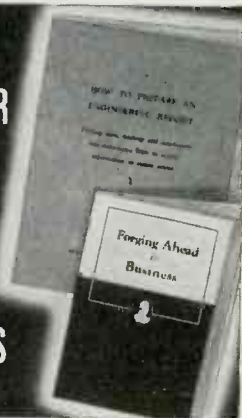
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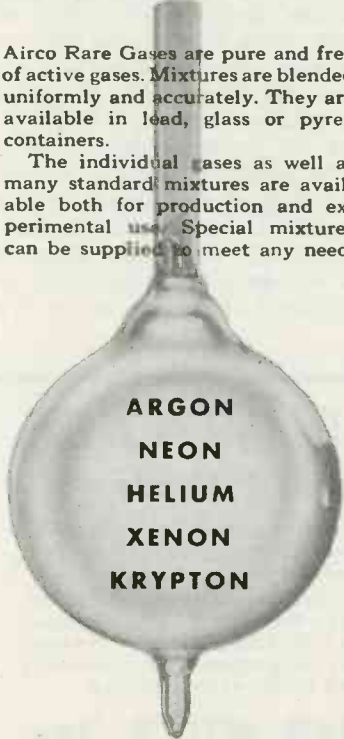
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ELECTRONIC AIDS IN BIOLOGICAL SCIENCES

(Continued from page 66)

heart volume, and the beats per minute. To check this principle, an elaborate electronic system has been devised with numerous pickup devices each equipped with two or more electronic differentiating circuits. This permits not only the principle effect being studied but the first and second derivatives of the amplitude variations can be determined. Simultaneous records of many functions are possible, such as: verbal reaction time, verbal energy output, eye movement, and blink count, facial expression, sweating in left palm, tremors of left finger and cardiac activity. The amplitude records together with their first and second derivative curves give 17 simultaneous records. This setup fairly outdoes the type-tests usually accorded some elaborate machinery!

Blood pressure recording

An instrument that continuously measures and records the blood pressure is known as a hemadynamometer. Methods vary but the principle of measurement generally utilizes the pneumatic arm bandage wherein either the fluctuations in pressure or else the points where that pressure exceeds a pre-established limit are amplified and recorded. A type of differential pressure unit of a type that indicates when air pressure exceeds a definite limit has a steel diaphragm free to move near the poles of an electromagnet, somewhat like a telephone receiver with an unclamped diaphragm. The spaces on each side of the diaphragm are connected to the unknown pressure system and a source of adjustable air pressure. Whenever the pressure on one side increases to exceed that on the other the diaphragm moves and generates a surge in the electromagnets.

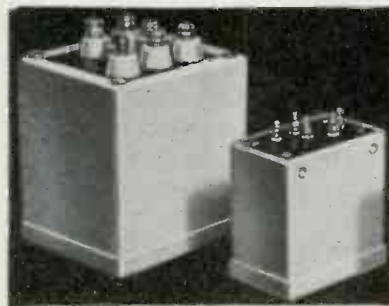
Flight personnel

Electronic amplifiers and photocells have been applied to physiological studies dealing with the effects of high altitudes on flyers.

A photocell and its associated amplifier measures the light transmission factor of the skin, say that through an ear lobe. The amplified photocell currents are transferred to an automatic recorder along with other data dealing with the flight

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conditions at the same time. This principle utilizes the principle that the amount of CO₂ absorbed when excessive, produces marked changes in the opacity of the cartilage.

(Editor's note: This is the first of two installments devoted to the use of modern electronic devices in medical diagnosis and treatment. The second will appear in a later issue).

PRESS WIRELESS

(Continued from page 71)

mitters are to be thrown on the air at an exact time. When that second appears a signal indicates to the operator to start sending, the engineer at the transmitter, not knowing where his signals are going unless he chooses to plug in. Practically all of the 26 transmitters are "on the air" at all times and are constantly being regrouped and reallocated to different channels at all times of the day and night.

Make own equipment

The design of the transmitting equipment is based on intensive research and long experience. The equipment has capacity for continuous, high speed traffic loads, day after day, without breakdown and has proven sound under all conditions of wet, humid tropic heat or cutting Arctic cold. In order to cope with the increasing problems appearing from time to time and to meet the rigid requirements of the military service of the government, a Research Department was organized in 1938 under the direction of P. D. Zurian, vice-president in charge of engineering.

A number of patents have resulted from this activity and specially designed water cooling equipment for high power transmitter use in tropical countries has been developed.

This department also conceived and developed the anti-fade device used by the Byrd Antarctic Expedition for sending all its radio photographs from Little America to the United States. An improved, similar device is now used on all Press Wireless radio-photo circuits. The Federal Radio Commission in 1929 licensed the company 40 radio frequencies between 4,000 and 20,000 cycles, but has since transferred eleven of these frequencies for military use during the war.

Numerous devices have been perfected for the simultaneous use of one licensed frequency for two radio-telegraph channels and one radio-telephone channel.

Owing to the highly secretive character of all the methods and apparatus used it is not possible to disclose the various circuits and other highly interesting data which represents the vast research and development carried on under the leadership of Joseph Pierson, president and general manager. From its beginning the company has been obliged to make its own equipment and every transmitter used has been made, or extensively remodeled, in its own plant.

FOOD PRODUCT IRRADIATION

(Continued from page 75)

Equipment for the fluoroscopic examination of various food products has been rather widely employed, even though the first applications date back only a very few years. In view of the countless applications of X-ray as a check on product quality, on unwanted inclusions, and on the correct filling of containers, it is no great stretch of the imagination to look forward to the day when this type of consumer protection may be required by law for many of the

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food processing and packing industries.

Future developments may point towards two other important applications of X-radiation to foods. First, experimental work has been done on bombardment of various plants to kill bacteria, and on meats, particularly on pork, with the object of destroying trichinosis germs. Second, X-radiation seems to have certain as yet unpredictable effects on the genetics of plants whose seeds have been subjected to bombardment. Experiments with "million volt" equipment are now under way, and we may perhaps expect to find X-rays providing us with bigger and better fruits and vegetables.

Savings effected

Where the X-ray fluoroscopic examination is to determine inner quality of the product itself, equipment may quickly pay for itself. In the classic example, when the California Fruit Growers Exchange installed three fluoroscopic units in its Santa Ana, California, plant at a cost of approximately \$10,000, the first year of their operation saved \$60,000 worth of oranges which otherwise could not have been separated from bad fruit and would have been discarded.

CERAMIC CONDENSERS

(Continued from page 82)

be measured at several temperatures over the operating range, and if the temperature increments are small, substantially the same information can be obtained more rapidly. However, even in this case the measurement technique and computations are too laborious when it is desired to determine only whether the values are within certain predetermined limits.

Sensitivity factor

On the other hand, using the method of sensitivity factor, the measurement consists essentially in determining if the capacitance remains within easily determined limits as the temperature is changed. Even though the limits change with temperature ($S \times \Delta t$), they are symmetrical about a nominal value. Thus it would be feasible, using a comparison type of measuring circuit, to change the reference capacitance in accordance with the temperature and nominal sensitivity desired. The limits on capacitance change would then be symmetrical about zero when referred to the reference ca-



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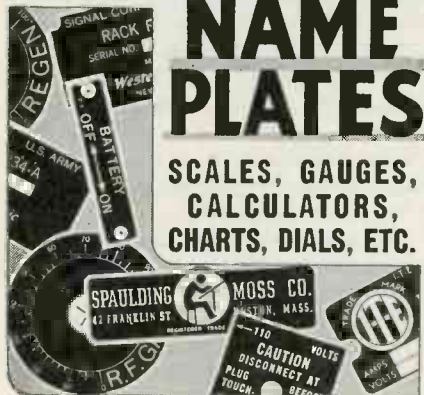
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capacitance. Another factor worthy of mention is that each reading of capacitance constitutes all the data and computation necessary to determine whether the compensation is within limits at that temperature; it is not necessary to take two readings, as in the case of temperature coefficient measurement, to determine the characteristics of the condenser at one temperature.

Because the curvature of all the materials investigated to date in the titania-alkaline earth series is positive, it is possible to reduce the

the characteristic. It is highly desirable to eliminate the measurement at -40°C because of the difficulty encountered. Usually the measurements at this temperature are less reliable than those at elevated temperatures because of condensation and other effects. If only two measurements are taken, one at 25°C and the second at 85°C , it is possible to determine whether the capacity change will be within limits at -40°C using general data similar to those shown on Figs. 11 through 14. From only two measurements, therefore, the complete behavior of the material can be specified to a good degree of accuracy. It will be analogous to obtaining two readings on a condenser whose capacitance change with temperature is linear and connecting the points with a straight line, except that in the case of ceramic compensators, the points are connected by a curve of known curvature.

It is believed that this method of specifying the effect of temperature on the capacity of the titania-alkaline earth series of dielectric materials presents the desired information in a form that is readily usable, and permits rapid testing and verifying of the suitability of a condenser for a specific application.

SIGNAL GENERATOR CHARACTERISTICS

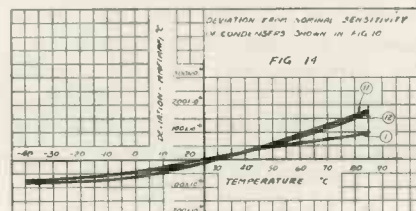
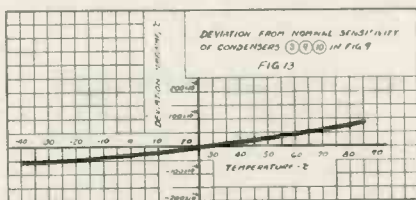
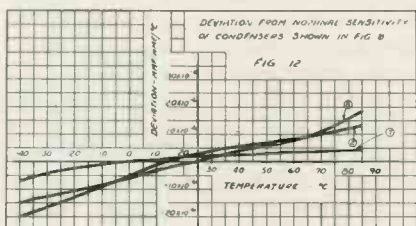
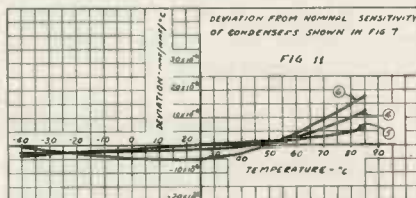
(Continued from page 86)

ments of a 16C attenuator which is constructed in four sections carefully shielded from each other. The series and shunt resistors of the network are wire wound in a non-inductive manner.

This construction may be contrasted to the 18C attenuator shown in Fig. 5 in which the resistors are of the ceramic covered carbon type having low inductance. These resistors are practically buried in a solid aluminum block to avoid coupling and common ground currents.

Although the electrical values as well as physical characteristics of these two attenuators are widely different, careful design to provide a reduction of ten to one in each successive step gives the same answer for 1 microvolt at 20 megacycles without modulation. The starting point or high level of 100,000 microvolts is established in each case by direct reading with a special VTVM.

An interesting application of two attenuators of the type shown in Fig. 5 is employed in the Model 40A.



measurement time considerably by considering only the worst cases. Reference to any of the curves presented reveals that at the extremes of the operating range, namely -40°C and $+85^{\circ}\text{C}$ this condition obtains. Thus if the capacitance change of the compensator is within the allowable limits at the extreme temperatures, it can be assumed safely that it will also be within limits at any intermediate points. From only three measurements, one at 25°C , another at -40°C and the last at 85°C , it is possible to determine the performance of the condenser.

This can be carried one step further, because of the uniformity of

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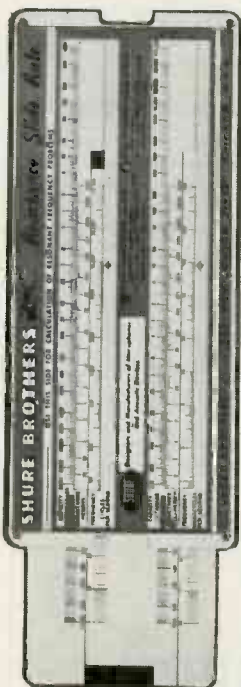
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Because the maximum output here is greater, more attenuation is required than can be obtained in a single unit without common coupling. Therefore two units are used in cascade and a unique form of interlocking controls which can be seen in the photograph Fig. 3 maintains proper relationship between the two units. The two controls are in the form of dials placed one above the other, with an arc cut out of each which permits turning of one only when the other is in a certain position.

Inductive potentiometer

The diode assembly employed in the 18C is shown in Fig. 6 which also shows the silver ribbon inductive potentiometer. This potentiometer is calibrated to show continuous variation of output levels between the decade steps.

The diode is a 955 tube with grid and plate tied together and is adjusted and frequency corrected to indicate the actual output at the end of the transmission line. Having established this output with the normal 30 ohm termination the effect of additional loading should be considered by reference to the curve, Fig. 2. As most ultra-high frequency receivers are designed to operate with a transmission line between the antenna and receiver it appears desirable to include a section of such transmission line in receiver measurements.

Voltage source

The signal generator then replaces the antenna as a voltage source and as such should have similar characteristics. In the case of a co-axial transmission line the outer sheath of which is grounded the procedure outlined previously is indicated. In other words, considering a 75 ohm line an additional 75 ohms may be inserted between the generator and input to the cable as shown in Fig. 7. The loading on the signal generator is then 150 ohms and the voltage applied to the line is one-half that indicated after the load correction (Fig. 2) is applied. This arrangement has the additional desirable feature of placing more nearly the proper loading on the input circuit to the receiver.

In the case of a dual line balanced to ground the signal may be applied in a like manner between one side of the line and ground. Specifications for such tests usually allow a factor of 1.41 to be applied over and above the balanced volt-

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COLD

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age requirements so that equal voltage appears across the first resonant circuit. The amount of signal applied must of course take care of the energy absorbed by the other side of the balanced line which is terminated in its characteristic impedance to maintain symmetry.

With a knowledge of the characteristics of the signal generator and a correct analysis of output load plus an allowance for modulation we may readily account for seeming discrepancies and our faith in the instruments rises accordingly.

WHO WILL DIS-TRIBUTE SUPPLIES

(Continued from page 91)

gressiveness, vision and courage of the present set-up.

M. Oberst, manager of The Eugene Wile Company, 10 South Tenth Street, Philadelphia, expresses an optimistic view of the future and a gradual letting down of government restrictions, but raises the question as to what the tens of thousands of boys, now in the service, who have newly been instructed in radar and other radio equipment, are going to do after the war is over. Will this sudden influx of talent and ambition flood the market with new electronic ser-

vice shops or have a tendency to establish a large number of irresponsible gyp shops or merchants?

Can cope

A. J. Slap of Raymond Rosen, Inc., at 32nd and Chestnut Streets, Philadelphia distributors for RCA and other electronic equipment sees a continuation of the present standard of radio merchandising, pointing out that no one can predict what the future may dictate in the way of changes. But no matter what happens, those already in the business, with their wide experience and clientele, will best be able to cope with the changing world of electronic merchandising.

M. Radiman, general manager, J. E. Wagenseller, chief engineer, N. O. Radiman, publicity director and Louis Herbach, founder, all connected with the progressive firm of Herbach & Radiman, located at 522 Market Street, Philadelphia, look forward to a vast expansion in the electronic industry. They report that other industries, as they gradually incorporate newly invented electronic devices applicable to their operations, quickly turn to the old established radio houses for their supplies, advice and service-

ing. As a result, their own business has expanded way beyond the confines of supplying parts to service men, amateurs and radio dealers.

New types of customers

Included in the rapidly extending types of new business is the field of education, college experimental laboratories, steamship lines, oil companies and surgical-instrument houses, all of whom are in some way or other employing or experimenting with new electronic devices. Members of this firm expect that 16-mm. sound-on-film recordings for home reproduction of music, which is now in an advanced and simplified form, will ultimately follow alongside the customary disc recording, and in some forms of reproduction, possibly supplant it.

Jerry Mathis and George F. Hall of the Consolidated Radio Company, 612 Arch Street, are keenly alive to every changing condition and are ready for any emergency or change that may occur at the termination of the war. They think future merchandising or servicing will not be greatly different and will be solved and handled satisfactorily by those radio firms now

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Interview in Boston, New Bedford or New York, can be arranged. Traveling expenses paid to place of interview.

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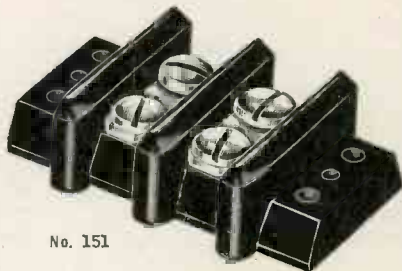
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in the business. It is a matter of conjecture what will happen, if there is a sudden cessation of the war, and if millions of tubes or equipment are dumped on the market.



Aaron Lippman, the New Jersey distributor who proposed the new Electronic title (NEDA) for the former National Radio Distributors Association

The future of the parts jobber, according to one school of distributor thinking depends not so much upon what the jobber may do now or later, but more upon what certain government agencies will operate—or how they will curb future activities. Meanwhile the parts jobbers, as a whole, are now doing the best they can, as they watch for any new move made by forces beyond their control. And whatever those moves may be they will be met and solved quickly.

Extend present methods

A. N. Kass, manager of The Radio Electric Service, located at the corner of 7th and Arch Streets in Philadelphia, one of the largest radio distributors in that territory, is optimistic about the future of electronic merchandising possibilities. His company's business throughout the war period has advanced to satisfactory proportions and is now limited only by the number of priority orders that its customers can obtain. Its radio business has now spread into many other channels and types of outlets besides radio communications. Mr. Kass sees no new or better way of handling future merchandising of radio-electronic parts and servicing than the present methods.

PRECISION PARTS

THEIR END-USE IS A SECRET

A story of amazing accuracy of American instruments will come out of this war. It can't be told yet because there are still a lot of surprises in store for Herr Hitler and his gang of bandits. There is no secret, though, back of the amazing precision work that has made this accuracy possible.



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JULY

	Page		Page		Page
Accurate Spring Mfg. Co.	167	Farnsworth Television & Radio Corp.	45	Ohmite Mfg. Co.	50
Ace Mfg. Corp.	191	Fast & Co., John E.	36	Onan & Sons, D. W.	175
Acme-Danneman Co., Inc.	171	Felker Mfg. Co.	119	O'Neil-Irwin Mfg. Co.	181
Acme Electric & Mfg. Co.	185	Ferris Instrument Corp.	17	Operadio Mfg. Co.	116
Aerovox Corp.	49	Formica Insulation Co.	6		
Air Reduction	185			Palnut Co.	108
Alliance Mfg. Co.	161	Gates Radio & Supply Co.	110	Perm-O-Flux Corp.	126
Allied Radio Corp.	158	Gemex Co.	176	Pioneer Gen-E-Motor	173
American Lava Corp.	107	General Ceramics & Steatite Corp.	109	Powers Electronic & Communication Co.	177
American Transformer Co.	33	General Electric Co.	5, 127, 147	Precision Tube Co.	46
Amperex Electronic Products	2	General Electronic Industries, Div. of Auto-Ordnance Corp.	149	Printloid, Inc.	179
Amperite Co.	172	General Instrument Corp.	26		
Andrew Co., Victor J.	158	General Radio Co.	150	Radell Corp.	170
Astatic Corp.	160	Gentleman Products	175	Radio Specialties Co.	159
Automatic Alarms, Inc.	176	Goat Metal Stampings, Inc.	146	Raytheon Mfg. Co.	25, 183
Automatic Electric Sales Corp.	51	Gothard Mfg. Co.	172	RCA Laboratories	8, 9
		Guthman & Co., Inc., Edwin I.	169	RCA Victor Div., Radio Corp. of America	19, Cover 4
Barker & Williamson	157			Remler Co., Ltd.	163
Bendix Aviation Corp.	155	Halicrafters	20	Rogan Brothers	179
Bentley, Harris Mfg. Co.	162	Hamilton Institute, Alexander	184	Rogers Radio Tubes, Ltd.	13
Bliley Electric Co.	132	Harvey Radio Co.	136		
Bunnell & Co., J. H.	24	Hassall, Inc., John	159	Scherr Co., Inc., George	179
Burstein-Applebee Co.	190	Hipower Crystal Co.	190	Seeburg Corp., J. P.	35
		Hopp Press, Inc.	187	Selenium Corp. of America	182
Callite Tungsten Corp.	118	Hytron Corp.	97	Sentinel Radio Corp.	148
Cambridge Thermionic Corp.	168			Shure Brothers	189
Cannon Electric Development Co.	134	International Resistance Co.	18	Sigma Instruments, Inc.	156
Capital Radio Engineering Institute	185	International Tel. & Tel. Corp.	42	Slater Electric & Mfg. Co.	37
Cardwell Mfg. Corp., Allen D.	152	Isolantite, Inc.	103	Sola Electric Co.	40
Celanese Corp. of America	145			Solar Mfg. Corp.	31
Centralab	10, 101	Janette Mfg. Co.	181	Standard Transformer Corp.	141
Chicago Telephone Supply Co.	43	J-B-T Instruments, Inc.	112	Stromberg-Carlson Co.	129
Cinema Engineering Co.	188	Johnson Co., E. F.	130	Struthers Dunn, Inc.	124
Clare & Co., C. P.	137	Jones, Howard B.	191	Stupakoff Ceramic & Mfg. Co.	111
Clarostat Mfg. Co., Inc.	187			Sun Radio Co.	188
Colonial Kolonite Co.	160	Kahle Engineering Co.	173	Superior Electric Co.	161
Connecticut Telephone & Electric	21	Ken-Rad Tube & Lamp Corp.	154	Superior Tube Co.	117
Continental Electric Co.	175	Knights Co., James	32	Sylvania Electric Products, Inc.	48
Cornell Dubilier Electric Corp.	3	Kurman Electric Co.	166		
Cottrell Paper Co., Inc.	174			Taylor Tubes, Inc.	135
Creative Plastics Corp.	168	Lafayette Radio Corp.	138	Terminal Radio Corp.	159
Crowley & Co., Inc., Henry L.	105	Lapp Insulator Co., Inc.	12	Thermador Electrical Mfg. Co.	188
Crystal Products Co.	123	Lectrohlm, Inc.	179	Thomas & Skinner Steel Products Co.	178
		Leland Electric Co.	15	Thordarson Elec. Mfg. Co.	4
Dalis, Inc., H. L.	186	Lewyt Corp.	144	Triplett Electrical Instrument Co.	34
Daven Co.	Cover 3	Lord Mfg. Co.	143	Tung-Sol Lamp Works, Inc.	41
De Jur-Amsco Corp.	28			Turner Co.	178
Deutschmann Corp., Tobe	1	Machlett Laboratories, Inc.	128		
Dial Light Co. of America, Inc.	180	Magnavox Co.	22	United Electronics Co.	98, 99
Drake Electric Works, Inc.	191	Majestic Radio & Television Corp.	151	United Screw & Bolt Corp.	14
Du Mont Laboratories, Inc., Allen B.	16	Mallory & Co., Inc., P. R.	Cover 2	United Transformer Co.	52
		Meck Industries, John	47	University Laboratories	184
Echophone Radio Co.	153	Meissner Mfg. Co.	171	Utah Radio Products Co.	113
Eicor, Inc.	142	Micamold Radio Corp.	44		
Eisler Engineering Co.	181	Mico Instrument Co.	189	Walker-Jimieson, Inc.	159
Eitel-McCullough, Inc.	131	Millen Mfg. Co., Inc., James	120	Ward Products Corp.	140
Electric Soldering Iron Co., Inc.	181	Miller Co., J. W.	122	Westinghouse Electric & Mfg. Co.	38, 114, 115, 121
Electronic Corporation of America	27	Mobile Refrigeration, Inc.	164	Wilcox Electric Co.	39
Electronic Mechanics, Inc.	11	Monarch Mfg. Co.	180	Wiley & Sons, Inc., John	136
Electro-Voice Mfg. Co., Inc.	29	Mycalex Corp. of America	7		
Engineering Co.	174			Zophar Mills, Inc.	186
Erie Resistor Corp.	30	National Lock Washer Co.	133		
Erwood Co.	166	National Union Radio Corp.	23		
Espey Mfg. Co., Inc.	178	North America Philips Co., Inc.	139		

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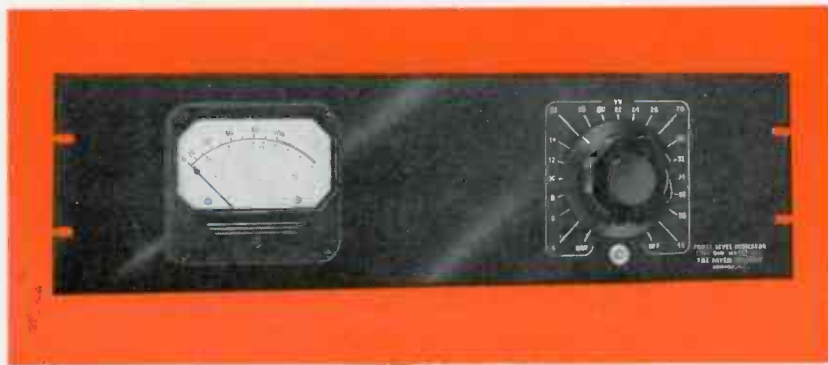


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 - With the advent of war, the government recognized the advantages of such a program and issued an "Army-Navy Preferred List of Tube Types." The latest revision of this list is dated March 1, 1943. We will be glad to send you a copy on request.
 - The urgent requirements of war are proving the worth of this program in releasing for other purposes the large quantities of materials ordinarily tied up in many types and styles of tubes. Also, the principle of Preferred Type Tubes is proving a blessing on the fighting fronts — where vital replacements can be expedited for equipment designed to use standard types of tubes.
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The advantages of the Preferred Type Tube Program are so far-reaching that it is only logical to assume that we will continue the program after the war. Our applications engineers will be glad to consult with equipment manufacturers concerning the tube types most likely to be on our list of post-war preferred types.