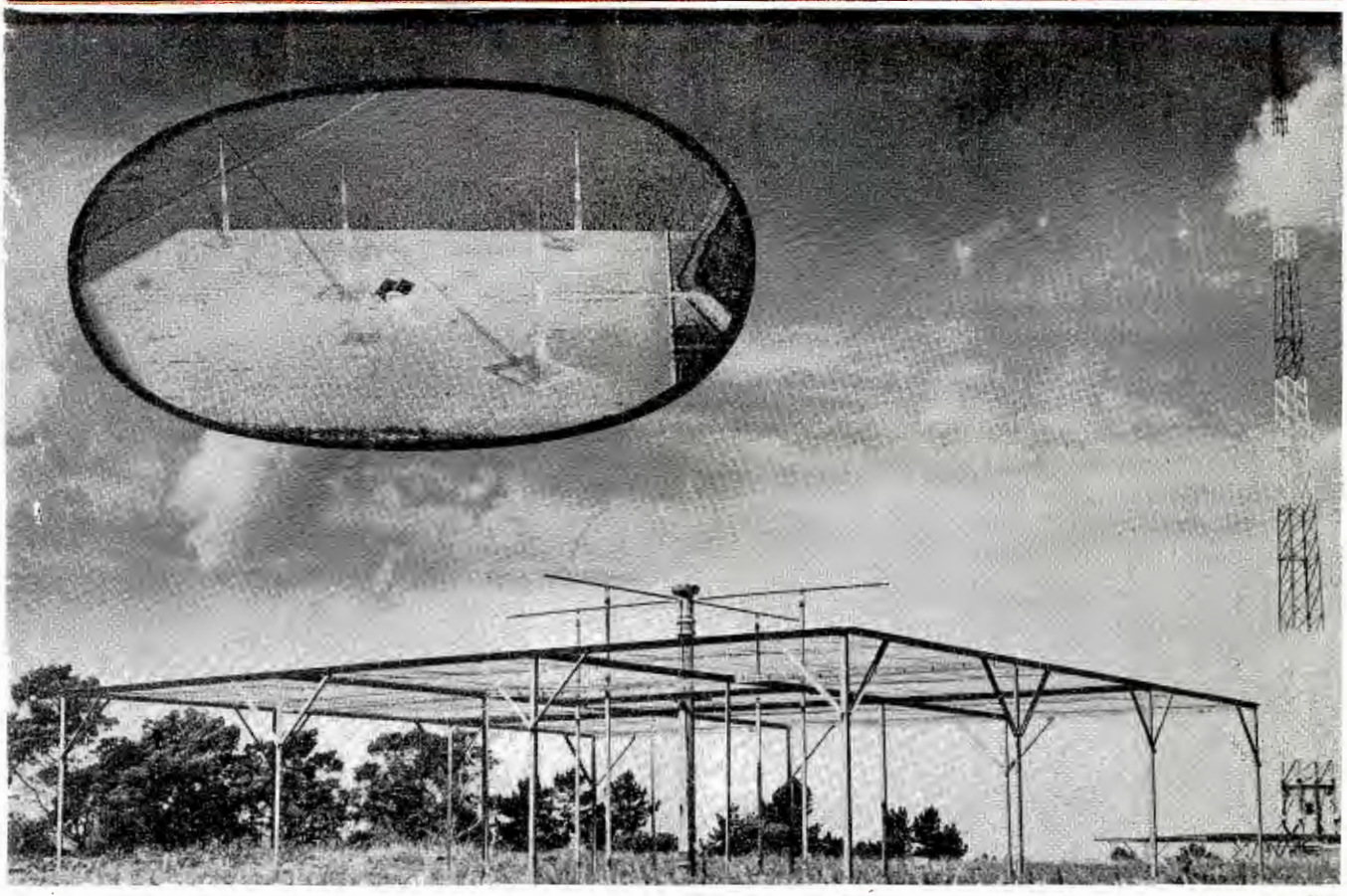
COMMUNICATIONS



OCTOBER 1944

★ RADIO ENGINEERING

★ CAA FOREIGN-ROUTE INSTALLATIONS

★ REBUILDING DIRECTIONAL ANTENNAS

★ HIGH VOLTAGE R-F INSULATOR DESIGN

★ VIDEO TUBE TESTS

★ AERONAUTICAL COMMUNICATIONS

"Ham" Radio and HYTRON

PAST . . . .

THE radio amateur trained himself during peace to be invaluable to the Nation during war. Specializing on tubes exclusively designed for ham radio, Hytron when war began was prepared for immediate and direct conversion to war production. Hytron transmitting and special purpose tubes proved by the ham were ideally suited—with little or no changes—to military applications. Years of practical experience made Army and Navy specialists of radio amateurs overnight. Peacetime tools of these same hams, Hytron tubes joined immediately this new fighting team.

. . . . PRESENT

HAMS with the Services in all parts of the world know the war job Hytron is doing. High-speed receiving tube techniques plus know-how derived from special purpose engineering of tubes for the amateur, make possible a flood of dependable Hytron radar and radio tubes to these fighting ex-hams and potential hams. Proud of winning the Army-Navy "E" for its performance on a huge production job, Hytron is also proud of its ham friends who are transforming innocent-appearing Hytron tubes into deadly weapons.

FUTURE . . . .

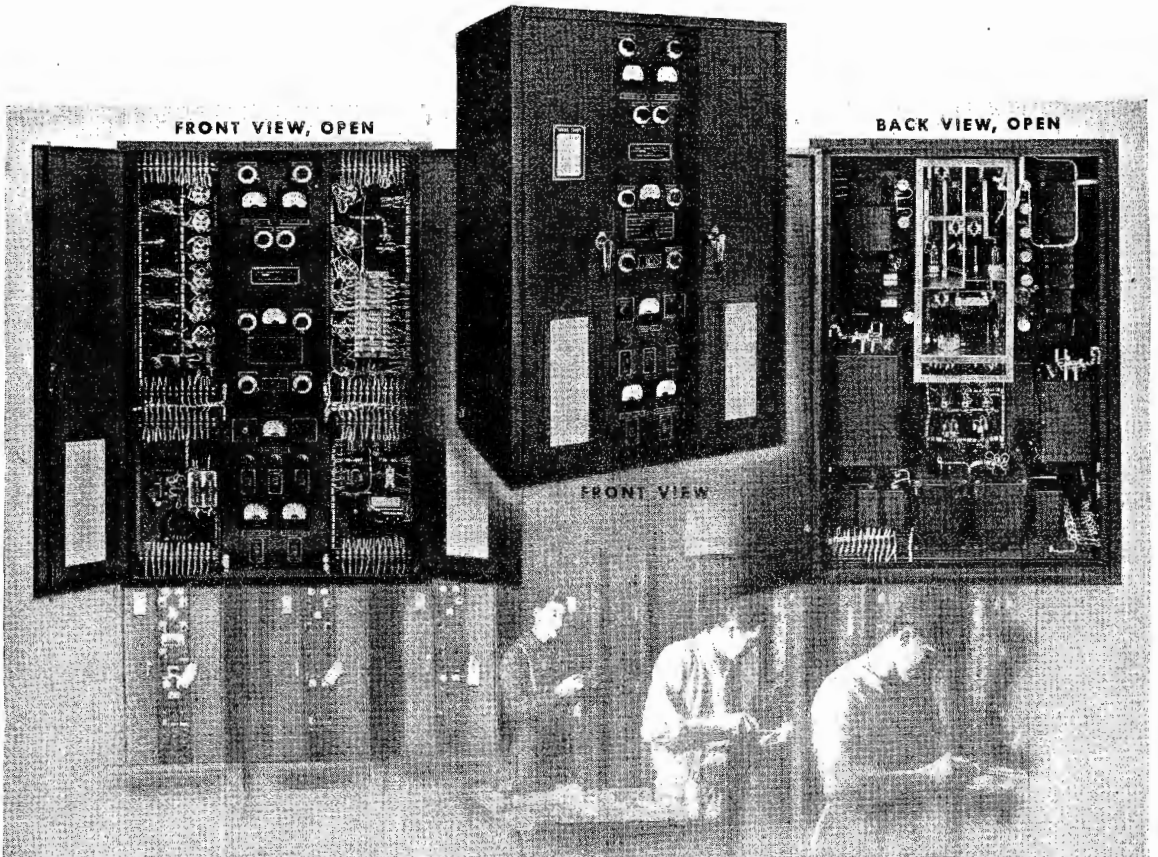
THERE should be no concern about adequate post-war amateur frequencies. Excellent wartime performance on far-flung battle fronts has made for ham radio many enthusiastic and influential friends. The ARRL reports that it looks forward with absolute confidence to the opening of new frontiers in expanded frequency ranges to be made available to the post-war amateur. Hosts of hams will return to their old friend, Hytron. For the more familiar lower frequency bands—the very high frequencies—or the new superhighs—their choice will be Hytron.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

BUY ANOTHER WAR BOND



AIRPORT TRAFFIC CONTROL TRANSMITTER

Type U-459—50 watt—116-145 mc. range

Type U-459 is a ground station transmitter intended for airport traffic control, airline and itinerant communication. It can be supplied with 125 watt output and other frequency bands.

A similar transmitter, supplied by us for the use of the Army Air Forces, is meeting severe service in all sections of the globe.

PRINCIPAL OPERATING CHARACTERISTICS

Power Supply .....110-120 v., 60 cycle single phase
Power Input, Unmodulated .....690 watts
Power Input, 100% Modulated.....750 watts
Unmodulated Carrier Output .....45 watts
Output Frequency in Bands.....116 to 145 mc.
Antenna Load Impedance ...72 ohm concentric transmission line
Permissible Modulation.....100%
Distortion of 1000 cycles at 90% modulation.....Less than 7%
Distortion of other frequencies at 90% modulation.....Less than 12%
Frequency Response from Line Input.....±1 db from 100 to 3000 cycles
Operating Temperature Range .....—15 to +50° c.
Operating Humidity Range.....0 to 100%
Carrier Noise with Audio Input shorted and Gain Control at maximum.....Less than 2%
Effective Operating..To the horizon. Depends on height of transmitting and receiving antennas

ACCESSORY EQUIPMENT — *Also available:* Remote Control Unit; Microphone push-to-talk, release-to-listen type for local control without amplification; Horizontally and Vertically Polarized Antennas.

COMPLETE DETAILS, PRICE AND DELIVERY ON REQUEST

RADIO RECEPTOR COMPANY, INC.

251 WEST 19th STREET • NEW YORK 11, NEW YORK

AIRWAY AND AIRPORT RADIO • SOUND SYSTEMS • INDUSTRIAL ELECTRONICS • ELECTRONIC H. F. HEATERS

SINCE 1922 IN RADIO AND ELECTRONICS

LEWIS WINNER, Editor
F. WALEN, Assistant Editor

We See...

STRIDENT TESTIMONY ON THE EXTENSIVENESS OF RADIO COMMUNICATIONS today appears in a master frequency list just issued by the International Division of the FCC Engineering Department. The list discloses that some thirty-five services and over two-thousand organizations now use radio communication systems. The services include aircraft, agriculture, airport, broadcast, coastal harbor, coastal phone, direction finding, forestry, geophysical, international broadcast, intership phone, mobile press, maritime calling, marine fire, motion picture, police, relay broadcast, relay press, ship harbor, ship telephone, state police, special emergency, and television broadcast. And at this writing it appears as even this extensive list may be increased within the next few months.

AERONAUTICAL COMMUNICATIONS will play a major role in the postwar era, according to Delos Rentzel, chairman of RTPB panel 11 on *Aviation Radio*. Testifying before the FCC, he said that at least 250,000 private aircraft and 3,000 domestic and international aircraft will be operating by 1950 and will require radio equipment. He pointed out that 300 airports, now operating, will increase to 6,000 and passenger and cargo volume will increase to 1,000%. All these facilities will require radio, he emphasized. Both v-h-f and u-h-f will be used, he said, with the ultrahighs running as high as 8500 to 10000 megacycles!

A COMPROMISE ON F-M AND TELEVISION frequency allocations has been reached by the RTPB panels. Dr. C. B. Jolliffe, chairman of panel 2, told the FCC recently that 41 to 43 mc are proposed for educational f-m and 43 to 56 mc for commercial f-m. Television, he said, will receive nine channels, each 6-mc wide, between 60 and and 114 mc, and 17 additional channels below 250 mc.

SOME MONTHS AGO we ran a note saying that OWI needed engineers and technicians. Another plea for help has come from OWI. Engineers are needed for Australia, Hawaii, China, and India. Applications can be made at 119 West 57 Street, New York or 111 Sutter Street, San Francisco, California. Send your applications to the OWI Overseas Branch.—L. W.

COMMUNICATIONS

Including Television Engineering, Radio Engineering, Communication & Broadcast Engineering, The Broadcast Engineer. Registered U. S. Patent Office.
Member of Audit Bureau of Circulations.

OCTOBER, 1944

VOLUME 24 NUMBER 10

COVER ILLUSTRATION

Aerial view and closeup of a CAA-built SRAZ facility on a British West Indies Island.
(Courtesy Civil Aeronautics Administration)

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F. WALEN, Secretary **A. GOEBEL, Circulation Manager**

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HARVEY 106 PA
200 to 300 VOLTS

HARVEY
OF CAMBRIDGE

New
HARVEY 206 PA
500 to 1000 VOLTS

for REGULATED POWER SUPPLY

If you're looking for a dependable, controllable source of laboratory D.C. power for operation with pulse generators, measurement equipment, constant frequency oscillators, amplifiers and other equipment requiring a constant flow of D.C. voltage, it will pay you to get in touch with Harvey of Cambridge.

The Harvey Regulated Power Supply 106 PA will meet your every requirement in the lower voltages. It has a D.C. output variable from between 200 to 300 volts that is regulated to *within one per cent.*

The new Harvey Regulated Power Supply 206 PA is for higher voltages. This latest Harvey development operates in two ranges 500-700 at ¼ of an ampere and 700 to 1000 at .2 of an ampere. Both ranges have accurate regulation to *one per cent or better.*

Whatever your requirements, one of these Harvey Regulated Power Supply units will meet them with efficient, dependable performance.

We'd be happy to supply you with complete information on either or both of them.

HARVEY
OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.
442 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

WHAT WE'VE BEEN THROUGH!

1251200 TINNISWOOD. B. SGT.
ROYAL AIR FORCE.
P.R.(O) UNIT.
BNAF.
24/9/43.

DEAR SIRS,

During a few quiet spare moments out here on the latest battle front, I thought that perhaps you would care to know the history of one of your model 8-K Recording Machines. Just what it has been through, just what it has done for thousands, perhaps millions of people all over the world, and just what it is doing at the present moment.

It was available in Cairo over two years ago, and the RAF purchased it for the Mobile Recording Unit for work on the front, recording everything and anything that would be interesting to the public of the world.

I am the engineer that has had the pleasure of operating this machine all this time, and being in the radio trade for fourteen years, should know when a set is well made or not.

It has travelled over 23,000 miles. Aproximatly 20,000 by road, track, or desert, in one of the hardest sprung trucks of the British Army, and 3,000 by air.
It has recorded bomb and shell explosion in slit trenches, covered with dust.
Blown over on one occasion by blast.
Dropped on numerous occasions.
Has recorded in the air, and on sea rescue craft, with better results than expected.

2

Has travelled to:+ Amman Transjordan, to Tripoli, back to Cairo, back to Tripoli, on to Tunis, Bizerte, on to Algiers, back to Tunis, on to Sicily, all through Sicily, on to Italy. All this way by truck, recording, reecording, recording. Never once, through all this bumping, buffetting, and banging about, has it let our little party down. Never in my opinion, has any radio apparatus stood up so well, for so long in such conditions.

Recordings from this machine have been broadcast from the following countries. England; America; Canada; New Zealand; Australia; Sth Africa; Egypt; Palestine; Algeria. Perhaps presently, from Italy itself.

Please thank your engineers and assembly workers for such an efficient and trouble free recorder, and may you continue to put such products on the market.

If you care to acknowledge this letter please address to my home in England. 110 Cardinal Avenue, Morden Park, Morden, Surrey, GB.

Yours truly,

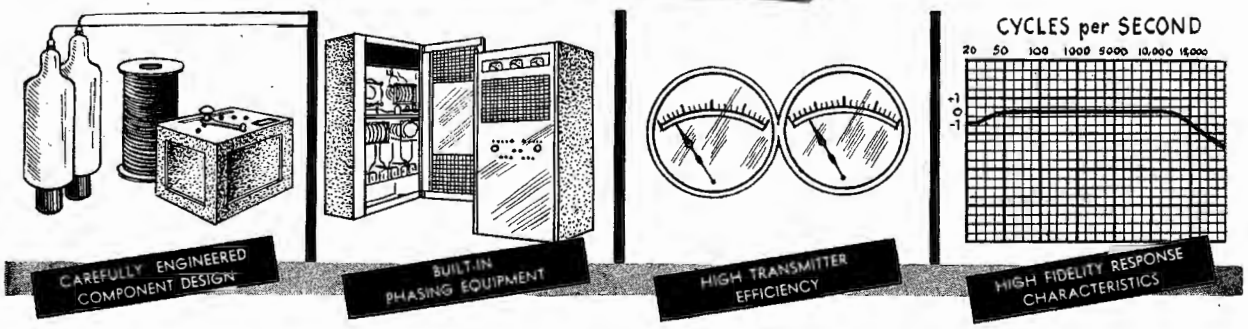
B R Tinniswood

To:+ The Managing Director,
Presto Recording Corp.
242 W. 55th St., New York; U.S.A.

Presto Recording Corporation, New York 19, N.Y., U.S.A.
World's Largest Manufacturers of Instantaneous Sound Recording Equipment and Discs
Walter P. Downs, Ltd. in Canada

From GATES Engineering Laboratories—A Preview of New Transmitter Designing for the Post-War Radio Industry . . . .

Gates "BC-10"
5-10 KW BROADCAST TRANSMITTER



Here is one of the new things to come from Gates! Our engineers have already developed and approved engineering designs for this transmitter to be produced as quickly as the demands by the military on Gates' production no longer exist. The "BC-10" may be used for either 5,000 or 10,000 watt carrier. It is high level modulated and will be available complete with built-in phasing equipment.

May We Send You Details Regarding the Gates Priority System for Prompt Post-war Delivery?

(Wartime restrictions do not allow the sale of new broadcasting equipment without priority; therefore, this equipment is presented merely to acquaint you with Gates' developments.)

Gates
RADIO and Supply Co.
QUINCY, ILLINOIS, U. S. A.

Manufacturers of Radio Broadcast Transmitters, Speech Equipment, Recording Apparatus and Allied Equipment in the Electronics Field.

No wonder American industrialists are dizzy! – Columnists, commentators, conferences and a host of critics on the sidelines advising business to "Go ahead" — to "Hold back" — to "Stand still."

Red lights today, green lights tomorrow.

Through the maze of conflicting regulations, press releases, industry bulletins, it is safe to predict, however, that civilian production will resume shortly. But we must win the war first.

We at G. I., realizing that wars always end more suddenly than they begin, decided long ago on a post war planning schedule. It may help to clarify your problem to know that we will be under way immediately when Uncle Sam issues the go-ahead signal.

Our products comprise new and improved components in the electronic and radio fields — variable condensers, automatic tuning mechanisms, record changers and new items developed and perfected from the research of our wartime experience.

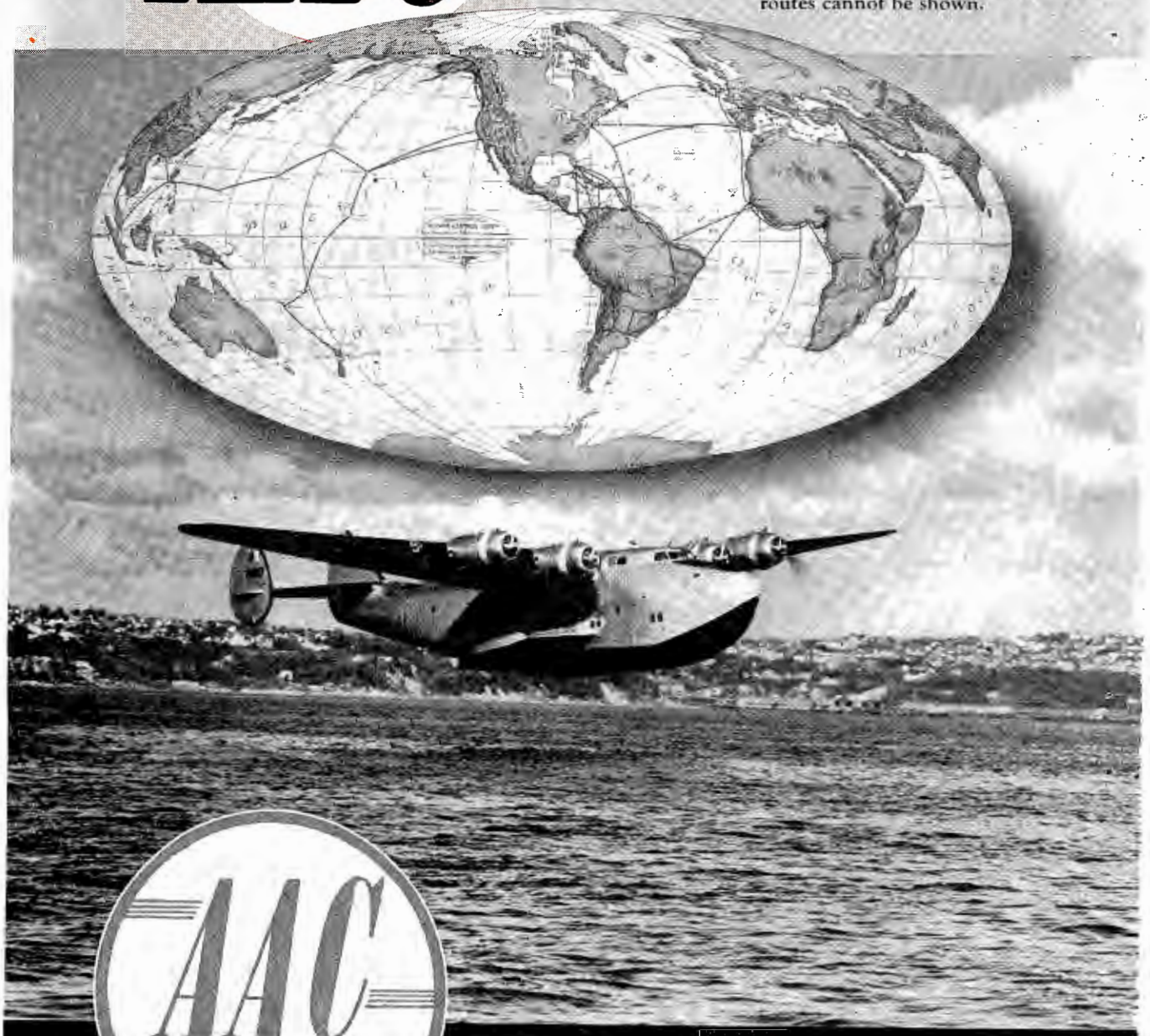
The first in our industry to be so honored. ARMY NAVY

GENERAL INSTRUMENT CORP.

829 NEWARK AVE., ELIZABETH 3, N. J.

AAC PRECISION

* The Pan American World Airways routes shown below are those in existence on December 7th, 1941. Present routes cannot be shown.



AAC Products

ARMY NAVY

AIRCRAFT PRECISION RADIO

Kansas City, Kans.

RADIO PRODUCTS Serve PAA

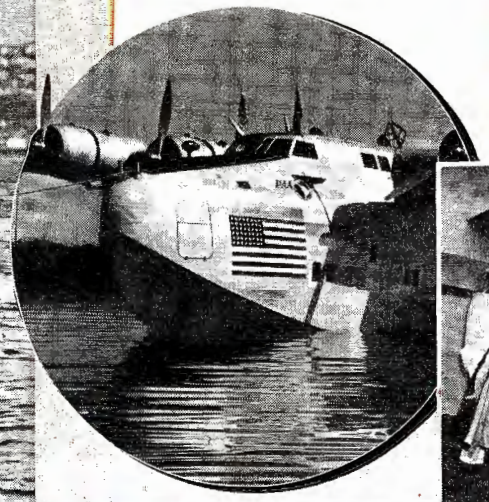
PAN AMERICAN WORLD AIRWAYS continues to perform a vital wartime service by speeding men and materials to every U.S. front and outpost... and AAC Precision Radio Products play an important part in this service.

As the giant *Clippers* spread their wings across the world, AAC Products help to maintain communications along the lifelines of this vast system which flies to every continent on the globe. These products are in use at operations bases, both here and overseas.

This is just one example of how the engineering and production skill of Aircraft Accessories Corporation serves the world's great airlines—as well as various branches of the armed forces. As one of America's largest producers of transmitters and other precision radio equipment, AAC offers the services of its Engineering Department in designing special equipment for you, without obligation.

ELECTRONICS DIVISION

KANSAS CITY, KANSAS



In war as in peace the PAA Clippers serve humanity. Here 1810 pounds of medical supplies go aboard at LaGuardia Field.

(E-54)

ACCESSORIES CORPORATION

and ELECTRONICS • ENGINEERED POWER CONTROLS

New York, N. Y. Burbank, Calif. Cable Address: AACPRO

Light? We call it "LIGHT FANTASTIC"!

. . . a transformer headed for 65,000 feet "altitude" . . . at 350 degrees temperature!

And to top it off, it had to be "lighter than anything on the market," *they said. What, we asked, was it for? They couldn't tell us, and we don't know to this day, but we do know it was badly needed.

"It has to operate not only on a 60-cycle current at ground level, but from 400 to 2600-cycle current, and what's more, at a simulated altitude of 65,000 feet."

Thermador built this special transformer equipment. It passed the above mentioned requirements. That wasn't enough. They gave it another test, in which they changed the temperature from ambient (the temperature of a fairly warm room) to 350—in two hours. It passed that test, too. This is all we know of one of the most mysterious jobs we ever did, in the not-mysterious method in which we built all of our tansformers.

*For reasons of military security names cannot be given.

BUY WAR BONDS

THERMADOR ELECTRICAL MANUFACTURING CO.

5119 SOUTH RIVERSIDE • LOS ANGELES 22, CALIFORNIA

As the field of Electronics broadens and new, more complex equipment goes into service the need for more accurate test and measuring instruments becomes greater. The war has lent great impetus to the progress of Electronics and has accordingly accellerated the development of Electronic instruments. Into the past two years have been crowded a normal ten years of technological progress.

Today the most advance developments are not being released for general use. However, today is not too soon for you to make your plans for post-war activity. And, along that line, you should make note of the fact that *-hp-* engineering is in the vanguard of electronic instrument developments.

Oscillators to test wide range television channels, new high frequency signal generators, special signal generators for F. M. use, new vacuum tube voltmeters . . . all providing split-hair accuracy for more exacting measurements and ruggedly constructed to perform in the field under circumstances of war, are examples which merely hint of the better things to come.

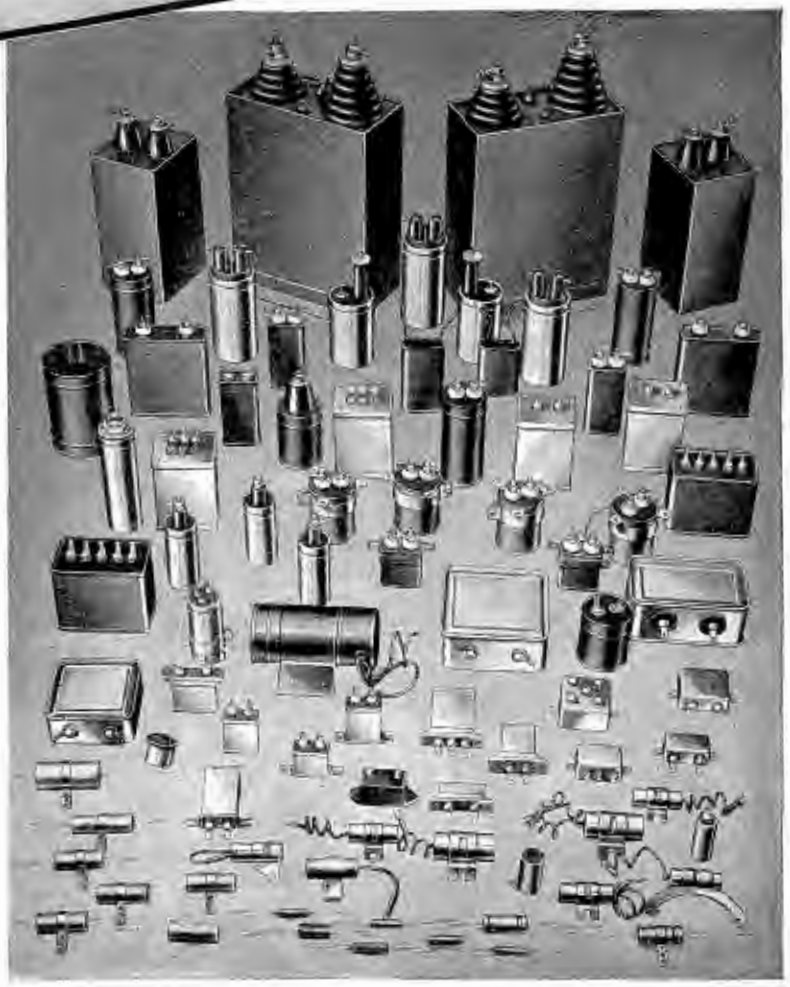
-hp- engineering is at your service, whether your problem is immediate or for post-war. Write today, there is no cost or obligation. Direct Canadian inquiries to Atlas Radio Corporation, 560 King Street West, Toronto 2, Canada.

HEWLETT-PACKARD COMPANY

927

Box 927E - Station A - Palo Alto, California

A TYPE FOR *Every* APPLICATION
OIL-FILLED CAPACITORS



● Functionally fitted to given application—that's the keynote of the extensive Aerovox oil-filled capacitor line. A plentiful selection of containers, mountings, terminals, sizes and impregnants, assures virtually custom-built capacitors with guaranteed performance.

Aerovox offers both Hyvol and Hyvol-M (mineral oil) liquid impregnants. For applications subjected to wide temperature variations, and where weight and size are important, Hyvol is recommended. Hyvol capacitors are considerably more constant with temperature variations than are those with other impregnating materials of the same specific inductive capacity, showing no capacitance drop until temperatures of −20° F. (−29° C.) are reached. At −40° F. (−40° C.) the maximum capacitance drop that may be expected is of the order of 5 to 10%.

Hyvol-M (mineral oil) capacitors have an exceptionally flat temperature coefficient of capacitance curve but approximately 35% greater bulk and corresponding weight which usually rules them out in favor of Hyvol.

At any rate, Aerovox offers both Hyvol and mineral oil capacitors, as well as wax-impregnated units for limited service—along with that wide choice of containers, mountings, terminals—to meet your exact needs.

● **NEW CATALOG** lists the exceptionally wide selection of Aerovox oil capacitors, as well as other types. Write on business letterhead for registered copy available only to engineers, designers, electronic maintenance men, manufacturers of equipment, and executives.

AEROVOX *Capacitors*

INDIVIDUALLY TESTED

AEROVOX CORPORATION, NEW BEDFORD, MASS., U. S. A. · SALES OFFICES IN ALL PRINCIPAL CITIES

Export: 13 E. 40 ST., NEW YORK 16, N. Y. · Cable: 'ARLAB' · In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.

Another modern electrical development pioneered and perfected by Sprague

Pioneered many months ago by Sprague, glass-to-metal seals for Sprague Capacitors and hermetically-sealed *Koolohm Resistors have progressed far beyond any "laboratory curiosity" stage. Not only are they being produced commercially at better than 10,000 seals per day, but they have proved highly efficient both electrically and mechanically. Seal sizes range from very small up to 3" diameter. They work equally well with practically any metal including steel, brass, and monel metal, and do not require the use of glass bushings and adjacent metal rings with "matched" temperature coefficients of expansion.

There are, of course, plenty of "scientific" reasons why glass-to-metal seals of this type are not feasible. Here again, however, the allegedly impossible has simply provided the incentive for another outstanding Sprague engineering achievement. Actually, the only disadvantage to the seals so far uncovered is the fact that corona voltages are a little lower than we'd like them to be—yet this limitation only becomes a factor at voltages upwards of 25 KV. In all respects, the Sprague glass-to-metal seal answers the old problem of guarding Capacitors and Resistors adequately against leaks and moisture—and without organic bushings or other materials which might be attacked by fungus.

Today, glass-to-metal sealed Sprague Capacitors and *Koolohm Resistors are available in 8,000 electrical characteristic combinations—which is another way of saying that there is a sealed unit for every application that needs one. Details gladly sent on request.

SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASS.
(Formerly Sprague Specialties Co.)

ARMY E NAVY

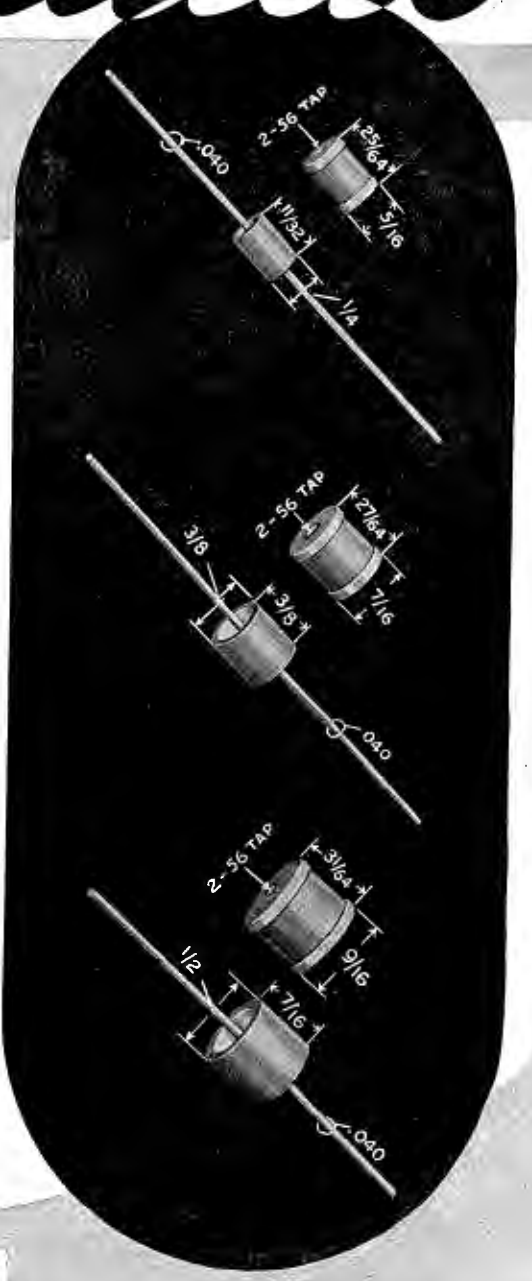
*T. M. REG. U. S. PAT. OFFICE

SPRAGUE

PIONEERS OF ELECTRICAL-ELECTRONIC PROGRESS

Centralab

CERAMIC CAPACITORS *for* HIGH VOLTAGE



These capacitors are engineered by Centralab for special applications . . . accumulative capacities ranging from 2MMF to 20MMF in zero temperature coefficient . . . to 4MMF to40MMF in maximum negative (N750 PPM) temperature coefficient.

Individually the capacity ranges are as follows:

855	2MMF to 5MMF in zero T. C. 4MMF to 10MMF in N750
854	5MMF to 10MMF in zero T. C. 10MMF to 20MMF in N750
853	10MMF to 20MMF in zero T. C. 20MMF to 40MMF in N750

Working voltages from 8,000 to 10,000 D.C. Energy dissipation up to 2 KVA with 15°C rise.

End lead or axial screw terminals available.

Send for Bulletin No. 814.

Producers of Variable Resistors • Selector Switches • Ceramic Capacitors, Fixed and Variable • Steatite Insulators.

Centralab

CRL

Division of GLOBE-UNION INC., Milwaukee

A FEELING FOR SCIENTIFIC PROGRESS

"EVERYBODY talkin' 'bout heaven aint goin' there". No more will mere talk secure a ticket to Post War's "promised land", where big profits may depend on low production costs. Why not, then, ride through with a contract manufacturer who has the *peace-time* cost-conscious skill and ability?

We've been "Man-Friday" to American Industry since it was in swaddling clothes... ever since Thomas Edison shed light on the world with his carbon filament electric lamp.

We've had a hand in shaping scientific progress... we've fabricated many component parts of *pace-setting* mechanical and electrical products for other manufacturers since 1888 . . . our experience spans more than a half-century of precision manufacturing developments. *All hands at Lewyt's are cost sensitive.*

Lewyt is *not* a war baby. Lewyt is a "Manufacturer's Manufacturer" with 56 years' experience. We'd like to talk with production engineers up against today's wartime requirements, and those thinking ahead to peace-time problems. Maybe we can't figure on your job *now*, but we *can* quote on WAR BONDS. They start at $18.75.

Lewyt

LET LEWYT DO IT

ARMY E NAVY

ESTABLISH AN ACQUAINTANCE WITH OUR PRODUCTION SKILLS

We specialize in electric and electronic instruments, chassis and housings; mechanical and electrical assemblies; highest precision machine work; sheet metal fabrications; all types of welding, product finishing, etc. Consult Thomas Register for Lewyt listings. Write on your business stationery for illustrated 48-page book, "Let Lewyt Do It"... no charge, no obligation. LEWYT CORPORATION 76 BROADWAY, BROOKLYN 11, N. Y

When that Great Day dawns you'll be in the market for new types of components for your electronic devices now in the planning stage. Among your needs will be resistors embodying those characteristics which the new applications demand.

For months, in the midst of war production, the IRC Engineering Staff has been looking ahead—designing, adapting, testing, perfecting—to incorporate in peacetime resistors special features developed for war uses and which will anticipate industry's future requirements.

Yes, "IRC will be ready" to supply resistors of *all types* on a mass production basis. . . . In the meantime and without obligation, our Research Engineering Department invites you to discuss with them (confidentially, of course) any resistor problems connected with your peace-time production.

PREFERRED FOR PERFORMANCE
IRC
FIXED & VARIABLE RESISTORS

INTERNATIONAL RESISTANCE CO.

401 N. Broad St. Philadelphia 8, Pa.

IRC makes more types of resistance units, in more shapes, for more applications than any other manufacturer in the world.

Life Testing ON THE GRAND SCALE!

One of the most elaborate cathode-ray tube test racks in this country operates day and night, seven days a week at National Union. For, at N. U., cathode ray tube production is now reaching heights undreamed of in pre-war days. To achieve this production, entirely new testing techniques, on an unprecedented scale, have been developed.

Examples of the newest tried and proven N. U. products are the four cathode-ray tubes illustrated. All of these N. U. cathode ray types can be produced in a variety of screen materials, which will have various postwar applications in television and industrial electronics.

Here at National Union are many such ultra-modern products ready to serve your peacetime needs. Ready, yes, in large volume—and backed by as fine an electronic tube research service as has ever been available to industry. Ready, indeed, from the day our present obligations are fulfilled and reconversion can get under way. Count on National Union.

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

NATIONAL UNION
RADIO AND ELECTRONIC TUBES

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

Perfection is Our Aim!

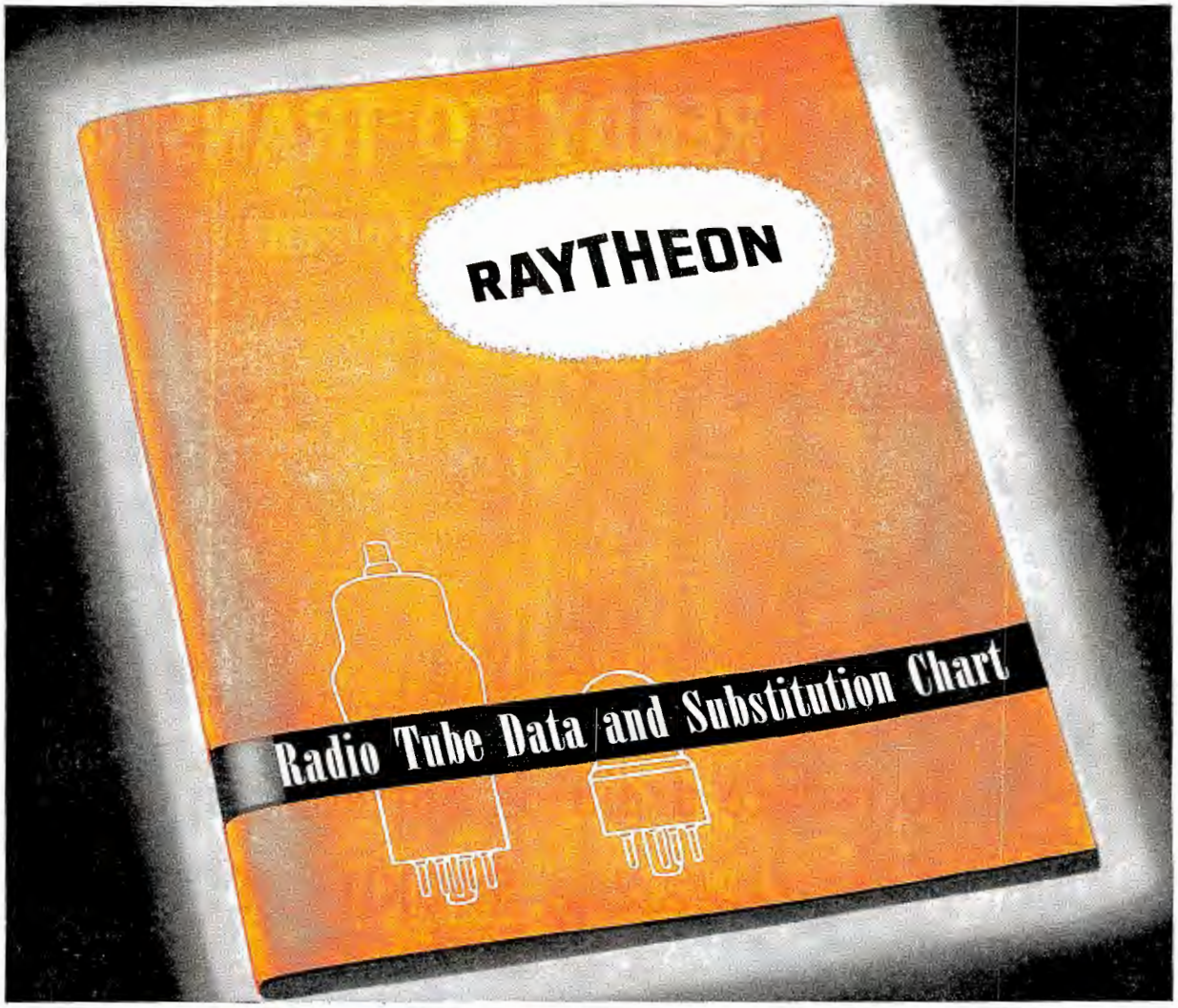
In every industry there are various methods of turning out products for similar use requirements. Usually there is *one best way* — a way based on developing and following certain tested techniques — proved processes that in themselves guarantee uniform quality every step of the way.

James Knights owes its reputation for unquestioned dependability to a steadfast determination of finding the *one best way* of carrying out every manufacturing operation. The culmination is a certainty — the positive assurance of better operating performance for every James Knights Crystal.

The *JAMES KNIGHTS* Co.
SANDWICH, ILLINOIS

JK CRYSTALS

CRYSTALS FOR THE CRITICAL



NEW COMPLETE RADIO TUBE DATA BOOK BY RAYTHEON

THE new complete data on tubes, including characteristics, outlined drawings and basing diagrams of all standard receiving tube types; simplified interchange information including over 1600 substitutions; hearing aid tube data and technical information regarding radio panel lamps. All this is included in the new Raytheon Tube Data and Substitution Chart prepared by the Technical Service Department of Raytheon Manufacturing Company.

The value of the technical information in this manual is inestimable and yet it may be obtained FREE from your Raytheon receiving tube distributor. Everyone concerned in the repair and maintenance of radios must have this ready reference book.

This manual is the first step in a tremendous merchandising plan which will bring you better business. This program teamed up with the superior, "Plus-Extra" quality Raytheon Tubes, will assure you of better customer goodwill, faster turnover and greater profits.

Raytheon Manufacturing Company

RADIO RECEIVING TUBE DIVISION

Newton, Massachusetts • Los Angeles • New York • Chicago • Atlanta

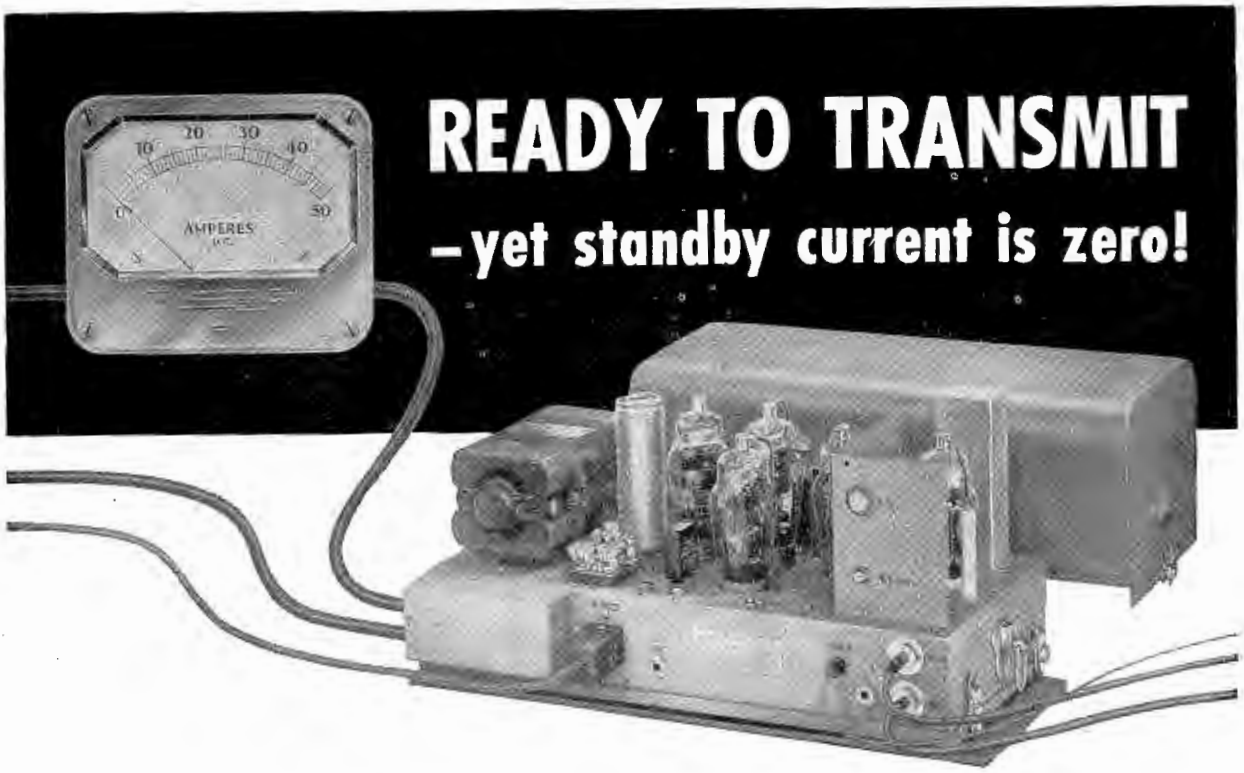
All Four Divisions Have Been Awarded Army-Navy "E" With Stars

RAYTHEON

High Fidelity

RADIO AND ELECTRONIC TUBES

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



READY TO TRANSMIT
—yet standby current is zero!

To reduce drain on batteries specify
KAAR *Instant-Heating* RADIOTELEPHONES

One of the special features of Kaar mobile transmitters is their instant heating tubes. When the "push-to-talk" button on the microphone is pressed, the transmitter immediately goes on the air... but between transmissions standby current is zero. By eliminating battery drain during standby periods, this 22-watt transmitter can be operated from a vehicle's 6-volt ignition battery without requiring frequent re-charging.

The PTS-22X shown above operates on frequencies between 30 and 40 megacycles. (Available up to 62-MC on special order.) Two other Kaar transmitters, the PTL-10X and PTL-22X, for operation in the 1600-2900 KC band, are likewise equipped throughout with instant heating tubes.

Notice also how the dust cover can be removed by releasing two luggage type catches. Likewise the entire chassis can be removed for checking or servicing by releasing four additional catches.

These are but two of the features which make Kaar Radiotelephones so popular for military, civil and commercial communication between mobile units and a central station.

KAAR
ENGINEERING CO.
PALO ALTO, CALIFORNIA

KAAR ENGINEERING CO.

Export Agents: FRAZAR & HANSEN
301 Clay St., San Francisco 11, Calif., U.S.A.

MOBILE RECEIVERS—Crystal controlled superheterodynes for medium and high frequencies. Easy to service.

CRYSTALS—Low-drift quartz plates. Fundamental and harmonic types available in various holders.

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World-Wide Radio Communications

...Provided by WILCOX Equipment

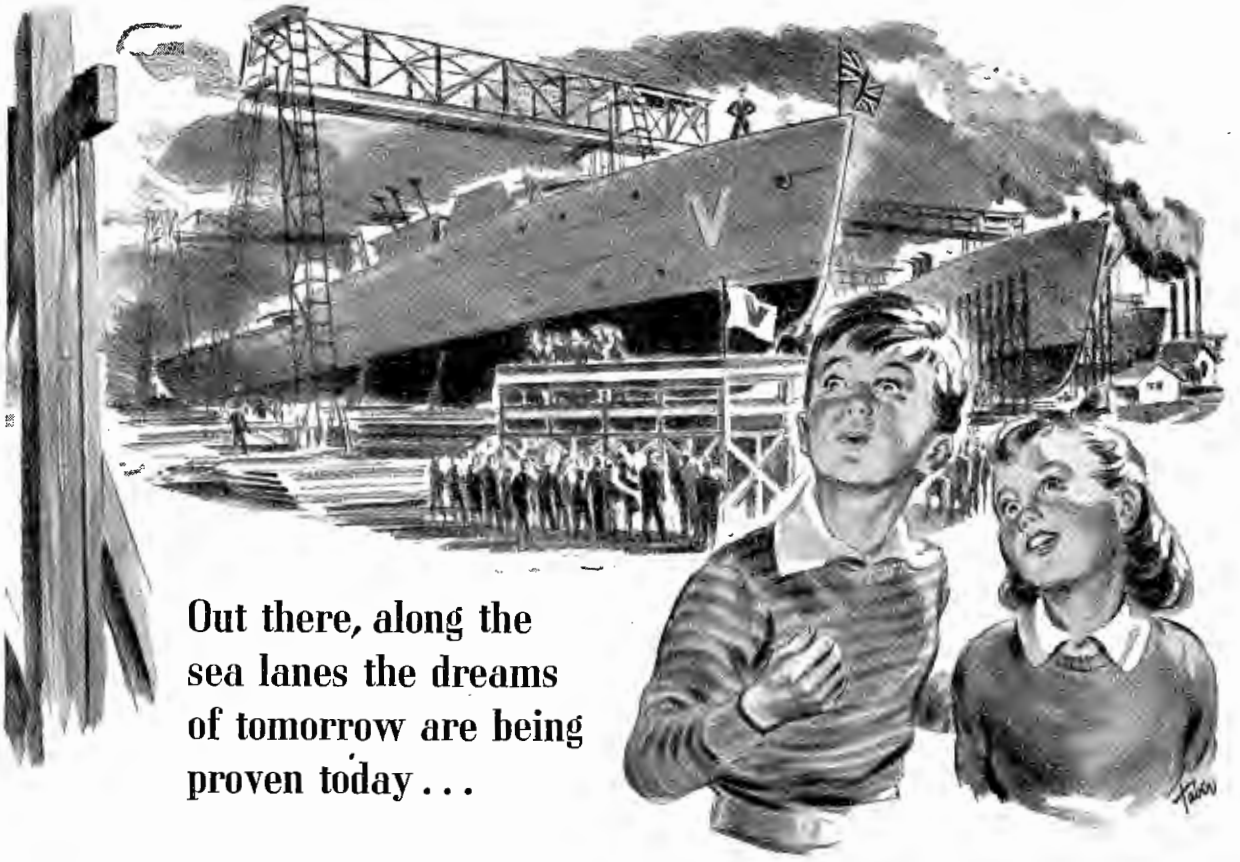
Today, Wilcox Aircraft Radio, Communication Receivers, Transmitters and other advanced radio equipment are in use in all parts of the world, helping make possible the sustained and mighty air attacks against the Axis. And for many years, the major commercial airlines of the United States have relied upon Wilcox dependability in their daily operations. In the post-war period you can rely on Wilcox to retain its dominant position in the field of Radio Communications!

WILCOX ELECTRIC COMPANY

Manufacturers of Radio Equipment

Fourteenth & Chestnut, Kansas City, Mo.

WHERE TOMORROW MEETS TODAY



Out there, along the sea lanes the dreams of tomorrow are being proven today . . .

CORVETTES "turn on a dime"—destroyers race at abnormal speed—that's the navy of today! Mastery of the sea depends on new and ever-improved equipment.

Today on our fighting ships, many pieces of electrical apparatus are designed and produced by Small Electric Motors (Canada) Limited. At the moment we are devoting all our efforts to turning out material of an advanced scientific nature. Research, engineering and inventive genius work hand in hand to produce equipment that normally would be much longer in developing.

In the days to come you may wish to benefit by this "know-how." These experiments and achievements in technical war contributions will be reflected and recognized in the electrical world of tomorrow. Small Electric Motors plan with confidence a noteworthy role in the post-war era.

DESIGNERS
AND MANUFACTURERS
Of All Types of Precision Electrical Apparatus Including:

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SMALL Electric Motors
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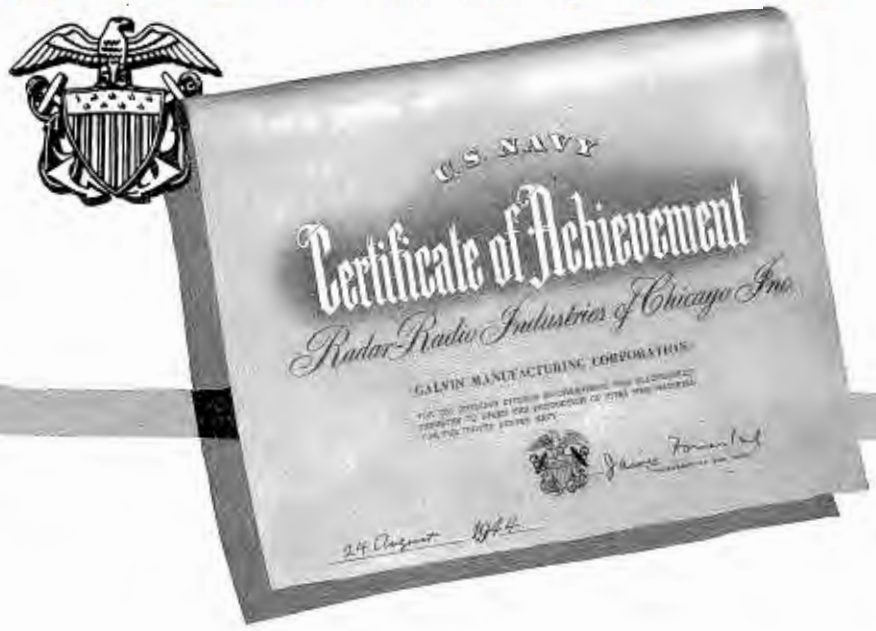
Extraordinary

RECOGNITION



The United States Navy has created a special award of merit. This certificate of achievement was presented to the Radar-Radio Industries of Chicago in a colorful ceremony at Wrigley Field on Sunday, September 10th, for their extraordinary contribution to the successful prosecution of the war. The Galvin Mfg. Corporation, manufacturers of Motorola F-M radio for home and car, is proud of its membership in the Radar-Radio Industries of Chicago . . . and also proud of the part it has been privileged to play in the winning of this signal honor.

Since considerably before Pearl Harbor, Motorola has designed, built and delivered military radio communications in great quantity among which are the famous "Handie Talkie" (an exclusive Motorola Radio First) and the equally celebrated F-M "Walkie Talkie." When victory has been won Motorola's greatly expanded production facilities will be available for the immediate production of Home and Car Radio, Portables and Automatic Phonographs.

BUY ANOTHER WAR BOND TODAY!

GALVIN MANUFACTURING CORPORATION, CHICAGO 51

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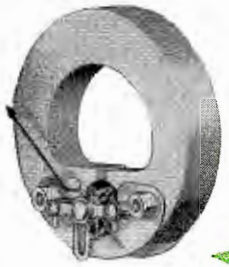
The United States Navy has awarded the men and women of Hallicrafters a special "Certificate of Achievement"... first award of its kind... for outstanding service with the radar-radio industries of Chicago in speeding vital war material to the Navy. Added to the four Army-Navy "E" awards, this makes five times Hallicrafters workers have been cited for distinguished service. They promise that this kind of service will be continued until total victory is ours.

★ *BUY A WAR BOND TODAY*

hallicrafters RADIO

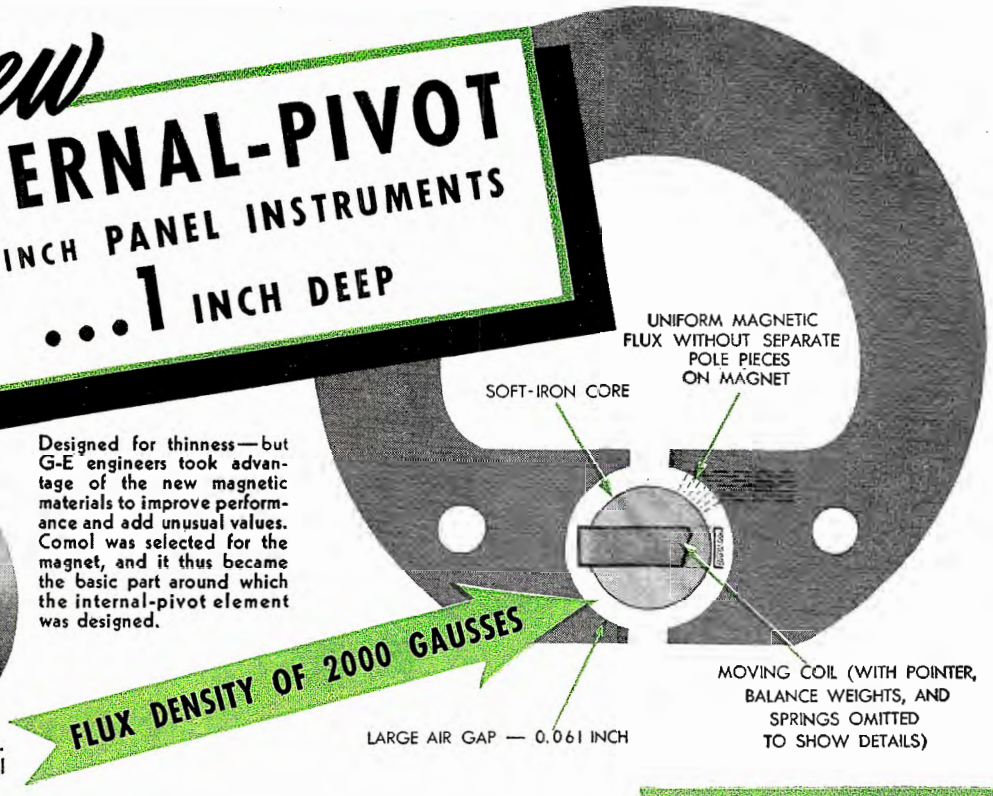
THE HALLICRAFTERS CO., MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

New INTERNAL-PIVOT 2½-INCH PANEL INSTRUMENTS ...1 INCH DEEP



Moving element mounted on one-piece comol magnet

Designed for thinness—but G-E engineers took advantage of the new magnetic materials to improve performance and add unusual values. Comol was selected for the magnet, and it thus became the basic part around which the internal-pivot element was designed.



Extra Values That the Comol Magnet Gives You

AN air-gap flux density of approximately 2000 gausses—made possible by the comol magnet—means a magnetic field some 50 per cent stronger than that of the conventional chrome-steel magnet.

Higher Torque This greater magnetic strength provides a substantial increase in torque. Since the weight of the moving element is about the same as that of other designs, the torque-to-weight ratio is much higher.

Faster Response The greater flux density also allows the use of a larger air gap, which minimizes any tendency toward stickiness. Faster response, which is assured by the high torque and lightweight moving system, enables accurate readings to be taken more quickly.

Improved Performance Large-radius pivots and good damping are among the other good features in the internal-pivot design—a design that packs all-round fine performance in a small space. They all add up to an instrument that is well able to withstand abnormal vibration and shock and maintain its rated accuracy.

For complete information, ask our nearest office for Bulletin GEA-4064, which covers instruments for use in radio and communications equipment; or Bulletin GEA-4117, which describes those suitable for naval aircraft. *General Electric Company, Schenectady 5, N. Y.*

Buy all the BONDS you can—and *keep all you buy*

GENERAL ELECTRIC

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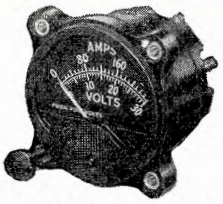
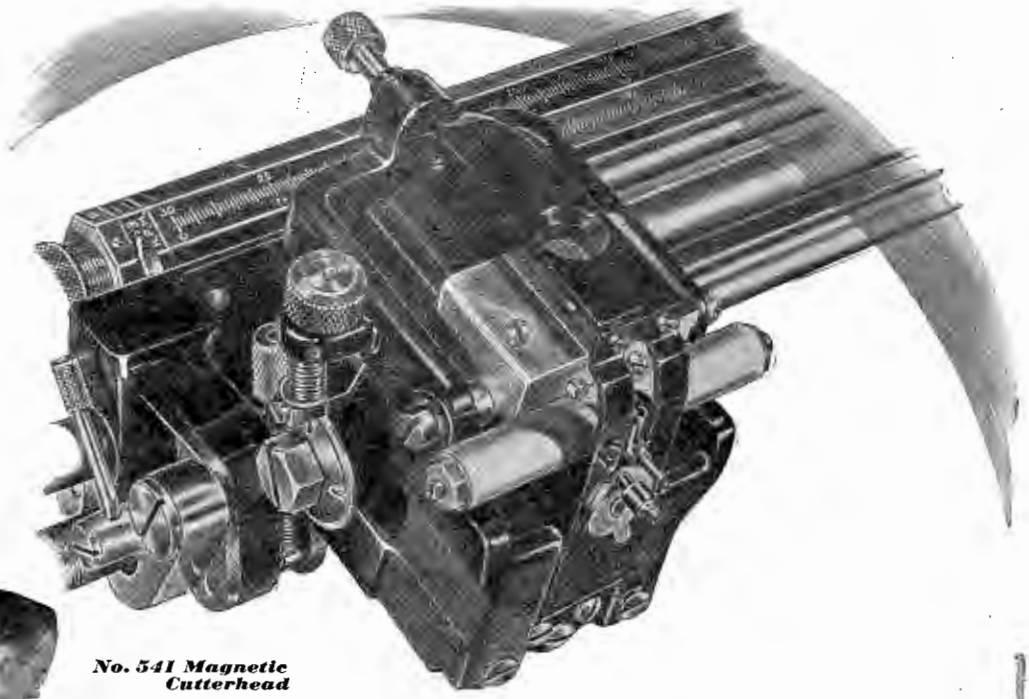


Type DW-53 d-c voltmeters, ammeters, and volt-ammeters. Designed to measure voltage and current in battery and battery-charging circuits on naval aircraft. Designed to meet all applicable Navy specifications.

For radio and other communications service: Type DW-51 d-c voltmeters, ammeters, milliammeters, microammeters; Type DW-52 radio-frequency ammeters (a-c thermocouple type). Cases are brass or molded Textolite.

HEADQUARTERS FOR ELECTRICAL MEASUREMENT



No. 541 Magnetic Cutterhead

ideal frequency response

— flat within ± 2 db. to 9,000 cycles, with an exceptionally low distortion content.

Measured by the "light" method, the Fairchild Magnetic Cutterhead reveals an ideal curve for instantaneous recording.

And mechanically, it offers exclusive features that damp the moving armature; that permit its accurate adjustment without disassembly of the cutterhead; and that fully modulate the groove at 98 lines per inch with a minimum of distortion — a feature extremely desirable in making masters for pressing.

Standard with the No. 539 Fairchild Recorder, the No. 541 Magnetic Cutterhead is easily adapted to any recorder.

With professional use in mind, all Fairchild recording instruments are built to meet the exacting requirements of the radio and communications fields. To electronic skill Fairchild has added the plus of exceptional mechanical skill — skill long practiced in .0002" tolerance production of aerial cameras, electronic devices and radio direction finders.

The result of persistent research to provide unusually high volume level recording with exceptionally low distortion content is the No. 541 Magnetic Cutterhead. Descriptive and priority data are available.

SOUND EQUIPMENT

Fairchild CAMERA AND INSTRUMENT CORPORATION

88-06 VAN WYCK BOULEVARD, JAMAICA 1, N. Y. • *New York Office:* 475 TENTH AVENUE, NEW YORK 18, N. Y.

SOUND EQUIPMENT—*PRECISIONIZED*—mechanically and electronically—*FOR FINER PERFORMANCE*

Casting the International Meter Rods in Paris 1874. The degree of accuracy attained 1/10,000,000 of a quadrant of a terrestrial meridian.

WHO SETS THE *Quality Standard* FOR TRANSMITTING TUBES

UNITED

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IN every art or craft, the work of some acknowledged master sets the standard.

Since 1934 UNITED has won recognition by specializing exclusively in the engineering, design and building of transmitting tubes which are unchallenged for excellence. UNITED tubes excel in every electronic application . . . including radio communication, physiotherapy, industrial control and electronic heating. In these and other applications, tubes by UNITED continue to win top honors for uniformly dependable performance.

In communication equipment for airlines, commercial broadcasting, police radio stations and other vital civilian services, UNITED transmitting tubes set the standard. Accept nothing less than UNITED quality tubes for your requirements.

Order direct or from your electronic parts jobber.

UNITED ELECTRONICS COMPANY

NEWARK, 2 New Jersey

Transmitting Tubes EXCLUSIVELY Since 1934

PLAN YOUR PLANT DRIVE NOW!

Good organization will be needed to sell the 6th. The task of raising the huge sum required will be the most difficult ever asked of Industry. As each new military success brings us closer to Victory, the public naturally will feel that the urgency of war financing is lessened—whereas it isn't. So organize now to prevent a letdown on the home-front from causing a letdown on the fighting front. Build your plant's payroll campaign around this fighting 8-Point Plan. You don't have to wait for the official Drive to start—swing into action NOW!

1 **BOND COMMITTEE**—Appoint a 6th War Loan Bond Committee from labor, management and each representative group of the firm.

2 **TEAM CAPTAINS**—Select a team captain, for each 10 workers, from men and women on the payroll—but not in a supervisory capacity. Returned veterans make most effective captains.

3 **QUOTA**—Set a quota for each department and each employee.

4 **MEETING OF CAPTAINS**—Give a powerful presentation of the importance of the work assigned to them. Instruct them in sales procedure. Have them carefully study the Treasury Booklet, *Getting the Order.*

5 **ASSIGNMENTS**—Assign responsibilities for:
- (a) *Music, speeches and announcements of the opening rally.*
- (b) *Pre-drive letter to employees from management and labor.*
- (c) *Competitive progress boards.*
- (d) *Meeting schedules, etc.*

6 **CARD FOR EACH WORKER**—Dignify each personal approach with a pledge, order, or authorization card made out in the name of each worker. Provide for a cash purchase or installment pledge. Instruct each captain to put a pencil notation on the card to indicate the subscription he expects to solicit from each worker.

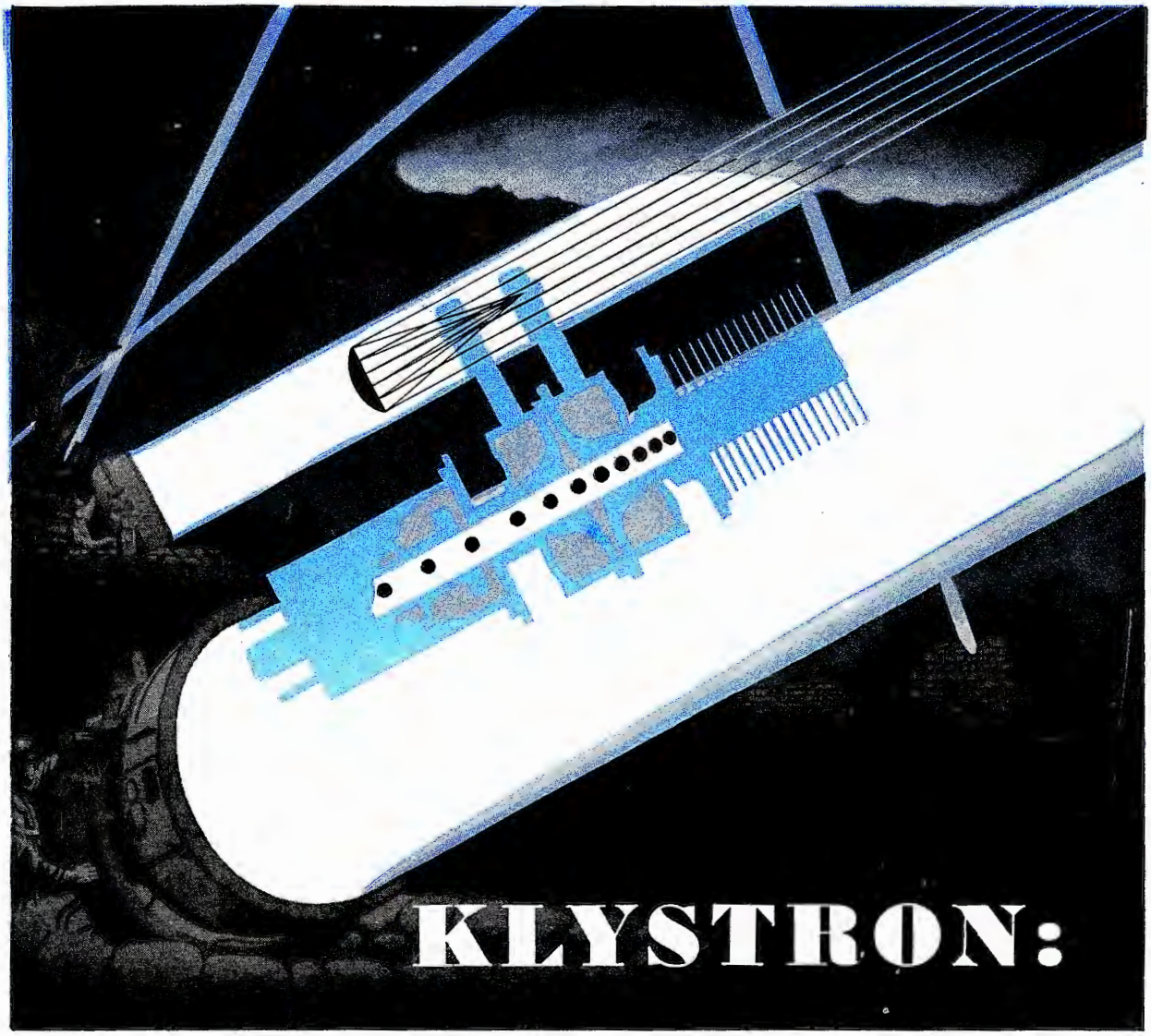
7 **RESOLICITATION**—People don't mind being asked to buy more than once. Resolicit each employee toward the end of the drive in a fast mop-up campaign. Call upon your State Payroll Chairman; he's ready with a fully detailed plan—NOW!

8 **ADVERTISE THE DRIVE**—Use all possible space in the regular media you employ to tell the War Bond story.

The Treasury Department acknowledges with appreciation the publication of this message by

COMMUNICATIONS

This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council



A pencil of energy beamed like light

IF YOU'LL imagine an *invisible* searchlight beam, you'll have a good picture of how Klystron-generated radio waves can be directed into a narrow "pencil" of energy.

▶ This direction is accomplished by suitable reflectors. The beam of ultra-high-frequency waves travels in a straight line, and it can pierce fog, smoke, and clouds which would stop a light beam.

Sperry-developed Klystron tubes are used in many equipments now serving our Armed Forces. Later, *Klystronics* will open the door to the development of many ingenious peacetime devices.

▶ Klystrons are now being produced in quantities, and certain types are available.

The name "KLYSTRON" is a registered trade-mark of the Sperry Gyroscope Company, Inc. Like many other Sperry devices, Klystrons are also being made during the emergency by other companies.

Sperry Gyroscope Company INC.

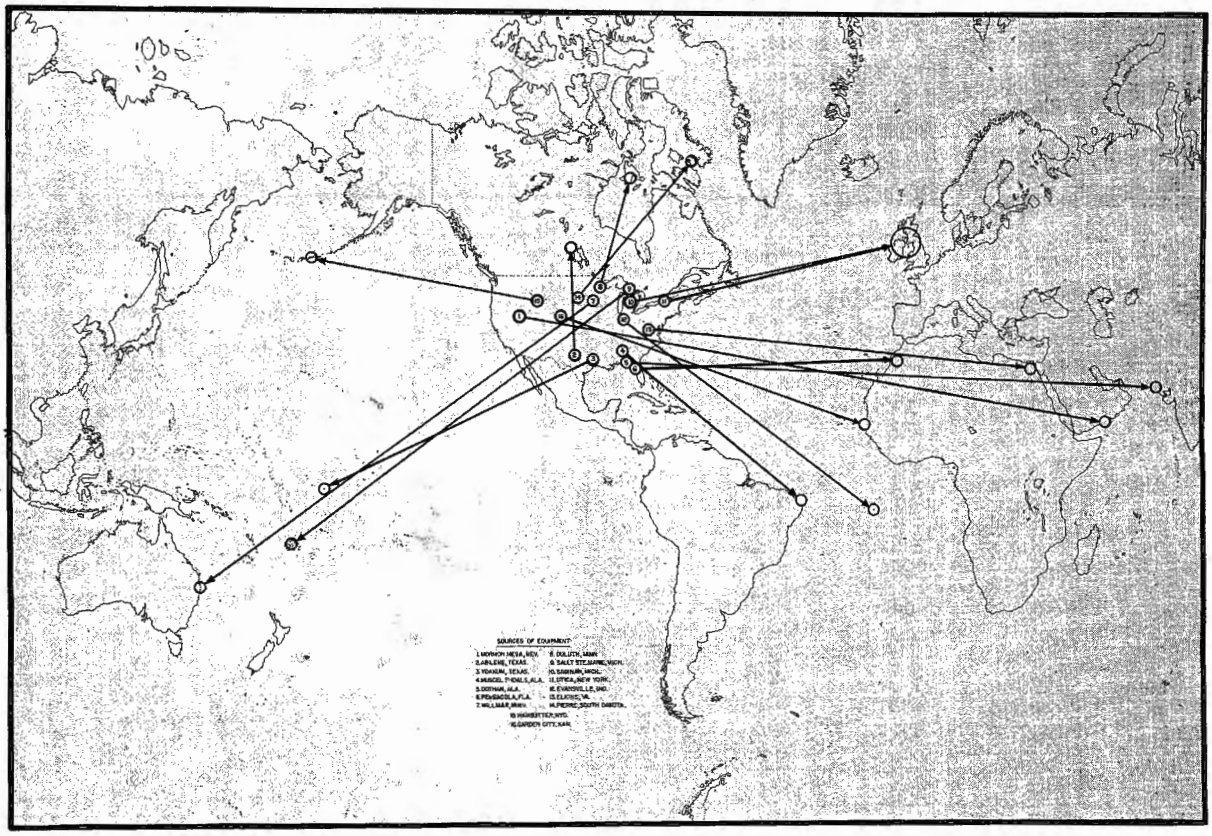
GREAT NECK, N. Y. • DIVISION OF THE SPERRY CORPORATION

GYROSCOPICS • ELECTRONICS • AUTOMATIC COMPUTATION • SERVO-MECHANISMS

COMMUNICATIONS

LEWIS WINNER, Editor

* * OCTOBER, 1944 * *



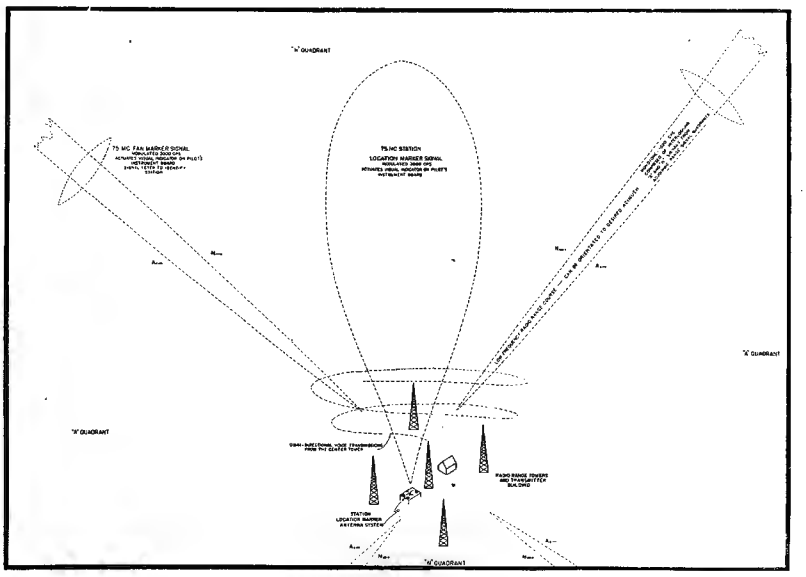
CAA WORLDWIDE ACTIVITIES IN COMMUNICATIONS

by C. C. RICHELIEU
Chief, Foreign Unit,
Signals Div., CAA

WHEN our military forces wanted worldwide communications and airways radio aids with which to fight our global war, they called on the Federal agency best fitted to provide them—the Civil Aeronautics Administration. As in many another case where civilians were "drafted" because they had gained the know-how through experience, the CAA delivered, and to the satisfaction of all.

Figure 1 (above)
Some of the foreign destinations of decommissioned CAA radio-range facilities.

For years before the United States entered the war, the Civil Aeronautics Administration was busily engaged in providing equipment and engineering service for the expansion of domestic air routes and to serve our outlying possessions of



Figures 2 (left) and 3 (above)
Figure 2, CAA radio engineer Taylor with 10-kw low frequency tuning unit. Figure 3, approximations of directional signals by various CAA-range facilities.

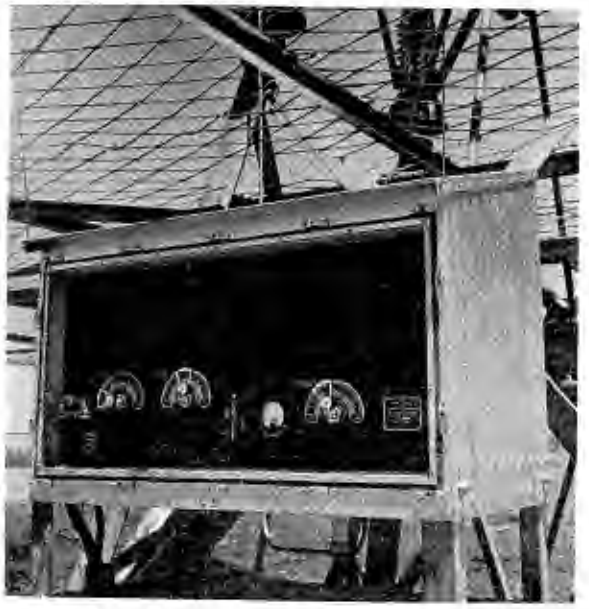
Alaska and the Pacific Islands. The Army Air Forces, in the spring of 1942, called upon the CAA to assist their Army Airway Communications System in the immediate establishment of urgently needed radio navigational aids, communications, and weather reporting stations to serve the many new global air routes then being established to all parts of the world. Not only were engineering personnel needed but also equipment—specialized radio-range equipment then common only to the regular domestic airway services of the CAA. To have obtained such equipment by the usual procurement procedures from manufacturers already heavily backlogged with military contracts would have meant months of delay. The CAA welcomed the opportunity to offer both equipment and engineering assistance as a contribution to the war effort. How the job was accomplished, how complete radio-navigational facilities were established at remote locations throughout the world, makes an interesting story.

In order to engineer and supervise the field work of engineers being assigned to military projects, Airways Extension Sections (Foreign) were established in both the Signals and Airways Engineering Divisions of the Federal Airways Service. By direction of Thomas B. Bourne, Director of Federal Airways, and under the able guidance of E. H. Smith, Chief of the Signals Division, and C. M. Lample, then Chief of the Airways Engineering Division and now Assistant Director, Federal Airways Service—who was succeeded in 1943 as Chief of Airway Engineering by H. W. Howard, both radio and civil engineers were requisitioned from all seven of the CAA's domestic regions as well as various sections and units of the Washington office. A large number of experienced radio and civil engineers were thus obtained—men with years of construction and radio installation experience behind them—men with the much needed know-how—all anxious and ready to contribute their part in the war effort.

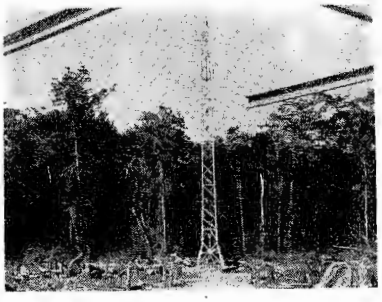
While these engineers were being assembled and processed through the requisite State Department channels preparatory to their foreign assignment, A. H. Hadfield, Asistant Chief of the Airways Engineering Division made initial project surveys on the Crimson Airway, northeast through Canada to Greenland. He was later joined by H. S. Stokes, Assistant Chief of the Signals Division, on a project survey trip through Africa and parts of India.

It has always been the policy of the CAA to plan carefully, engineer, and lay out every field project well in advance of actual construction. We would have preferred to follow this policy with respect to the foreign projects for the AACS, but time would not permit. Advanced planning, discriminate choice of construction design, carefully laid out plans and drawings, were necessarily by-the-board. Consequently, with very little special preparation for their foreign work, CAA engineers were dispatched to all parts of the world. Men working on CAA domestic projects in Wyoming and Iowa in September of 1942 found themselves in the heart of Africa or on a South Pacific Island in October.

Simultaneously with this organization of personnel, the Airway Engineering Division of the CAA, in collaboration with the Army Air Forces and Naval Operations, made a careful survey of ex-



Left, a SRA radio-range tower tuning house. Below, SRA under construction in India.



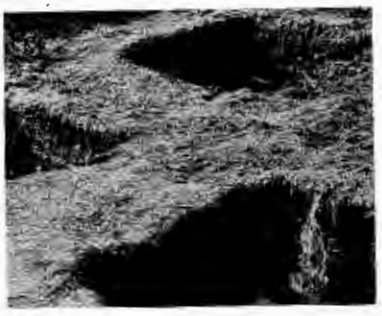
Above, left, typical native house at an Arctic project. Above, partially completed tower in South America. Right, SRA-tower base being completed somewhere in South Pacific.

isting domestic radio range facilities that could best be spared for foreign use. The various regional offices then arranged for their personnel to decommission, dismantle, and ship as directed. complete radio-range facilities from over thirty different points within the United States, (Figure 1). The prompt manner in which all regions handled this emergency order, often with little or no advance notice, contributed materially to the successful completion of the job laid before us by the AAF. In some cases the equipment removed was replaced with temporary homing (non-directional aid) or, if originally an SRA facility, with improvised loop-type range equipment. Selection of the stations removed, however, was made with such care that domestic airline service was not at any time seriously affected. Even before domestic stations were decommissioned and equipment removed, orders were placed with various manufacturers for replacement equipment and deliveries are now being made. Many of our patriotic domestic facilities, drafted for war service in 1942, are still at war overseas, while these home-front replacements are performing the civilian job of keeping the Federal Airways the safest system of airways in the world today.

The CAA's Central Depot, located in Fort Worth, Texas, filled emergency requisitions entailing the engineering and actual fabrication of many special pieces of equipment, even to the extent of a complete system of low-frequency transmitters required for the Alaska program, with efficiency and dispatch. Figure 2 shows CAA engineer Taylor with a tuning unit for a 10-kw low-frequency transmitter typical of the ones built by the Central Depot for Alaskan service. The crystal grinding laboratory, located in the Central Depot, supplied carefully matched low-frequency crystals to equip the foreign range stations all over the world.

The first foreign projects to be "transplanted" for the AACS were in the United Kingdom. P. L. Coupland, Senior Airway Engineer (radio) and now Superintendent of Shops, Central Depot, Fort Worth, Texas, made installation of a number of MRLZ-D stations (loop-type radio range with voice and v-h-f station location marker) and fan marker facilities in the Great Britain area starting in early 1942 and completing them in early 1943. During Mr. Coupland's stay in England, he participated in an additional assignment to North Africa. This story is related here because it covers one of the many coincidental happenings that occurred on the Foreign Airways Extension Program. One day late in November 1942, a rush call was received by the CAA in Washington asking for immediate release of one loop-type radio range—to be flown *that night* from the United States to North Africa—installation to be made by available Army personnel. After much to-do, it was decided that one unit of a dual-unit range facility then at Presque Isle, Maine, waiting air transportation to Coupland in Great Britain, should be sacrificed in the interest of the emergency at hand. The Army dispatched a plane to Presque Isle, picked up the range equipment, stopped enroute for crystals at Millinocket, Maine, and for an engine generator power plant at Atlanta and then con-

(*Continued on page* 80)

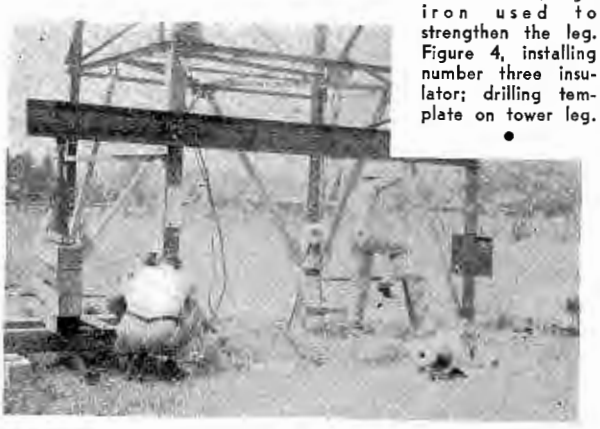


Right, above, excavations for tower footings at South Pacific radio-range project. Right, a splinter-proof (bomb-proof) cement building to house the radio-range equipment on a South Pacific island.

Right, finished transmitter building at South Pacific project.

Right, dual radio-range transmitters and coupling unit, in center, at South Pacific project.

REBUILDING BROADCAST DIRECTIONAL ANTENNA SYSTEMS



Figures 1, 2, 3, 4 (top to bottom, left)
Figure 1, hand drill used to drill required 176 5/8" holes. It is shown drilling holes to bolt "U" beam to tower leg. Figure 2, installing insulator. Figure 3, insulator installed; angle iron used to strengthen the leg. Figure 4, installing number three insulator; drilling template on tower leg.

WHEN the war has ended and materials are available again, many stations will probably find it necessary to redesign and alter their directional arrays. In some cases, such changes may require moving one or more of the towers, and perhaps installing insulation components. In all cases, operation must be maintained during the construction.

All three problems faced WMBG in 1941 when the night power was increased from one to five kilowatts. The original array consisted of two shunt-fed grounded towers. The new proposed array consisted of three insulated towers. This required the insulation of the two shunt-fed grounded towers, moving of one and the installation of an additional new tower.

The problem of maintaining service was accomplished by the use of two of the three towers to provide a temporary directional pattern, while the third tower was moved. This method of maintaining service was complicated, however, since the tower to be moved was not only one of the grounded towers, but the center tower. It was not practical to disassemble the tower and reassemble it at the new location, for changes in its physical dimensions would have changed the mutual induction. Thus the impedance of the other two towers would have changed, and operation as a temporary directional would have been impossible. In addition, the height of the tower exceeded a quarter-wavelength. Therefore during disassembly it would have ultimately reached a resonant value. Since the spacing of the other towers was very close, or one-eighth wavelength, the mutual induction was very severe. The tower could have been insulated first and then disassembled. However this was discarded in favor of moving the tower in standing position, and keeping it grounded during the move.

New foundations, transmission lines

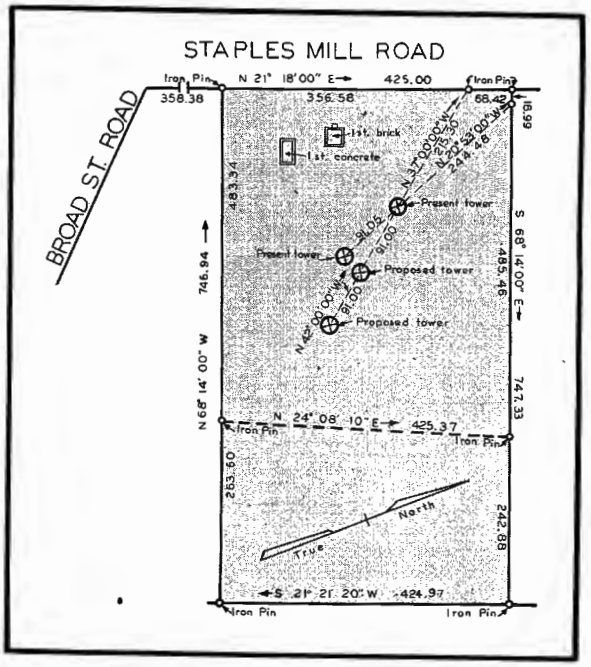


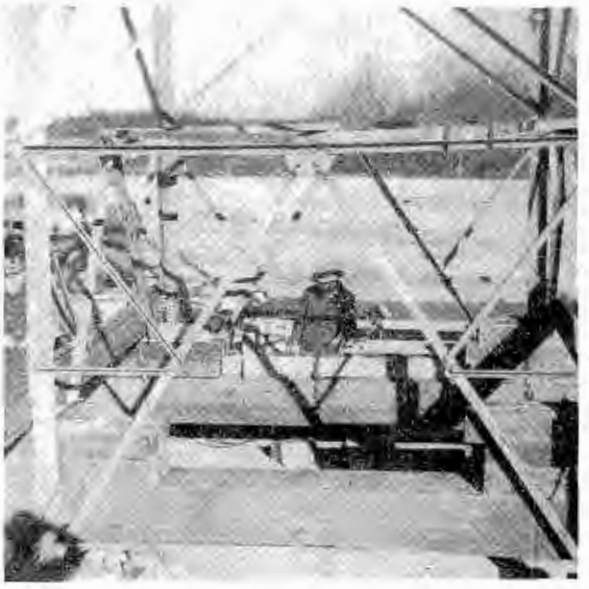
Figure 5
Tower location plot for WMBG, situated on east side of Staples Mill Road, north of Broad Street Road, near Richmond, Virginia.

by WILFRED H. WOOD
Chief Engineer, WMBG,
Richmond, Virginia

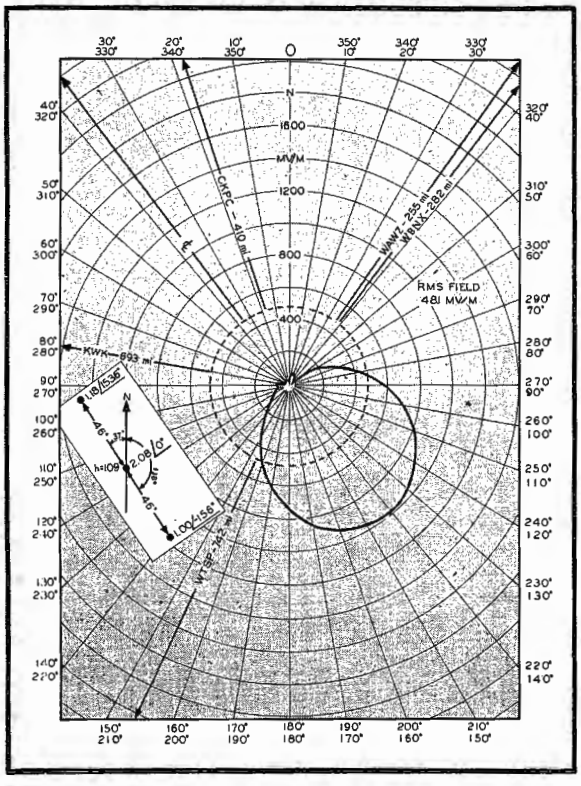
and ground systems were first installed. Then the new tower was erected, and the old tower, which was not to be moved, was insulated.

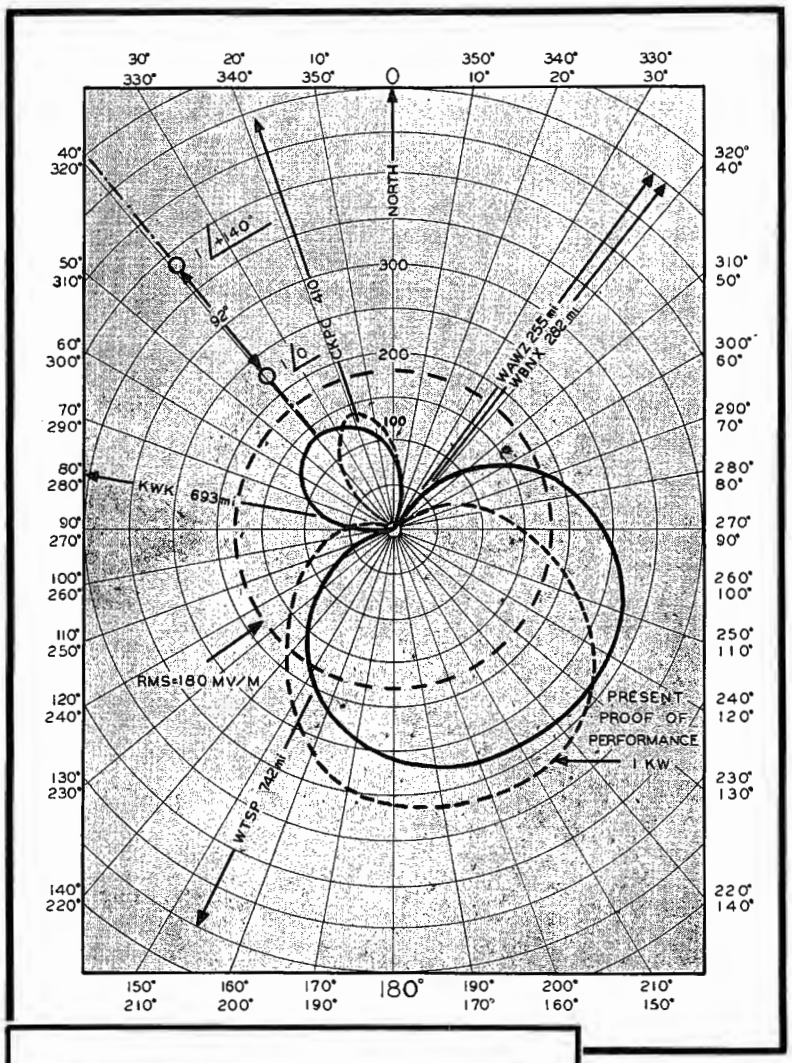
In insulating the towers, it was necessary to design, first, a drill template, since the holes for the insulators had to be positioned correctly. And incidentally one hundred seventy-six $\frac{5}{8}$" holes had to be drilled. Electric drills were tried, but greater accuracy and ease was possible with a hand drill of the clamping type. This type drill automatically exerted high pressure against the tower leg.

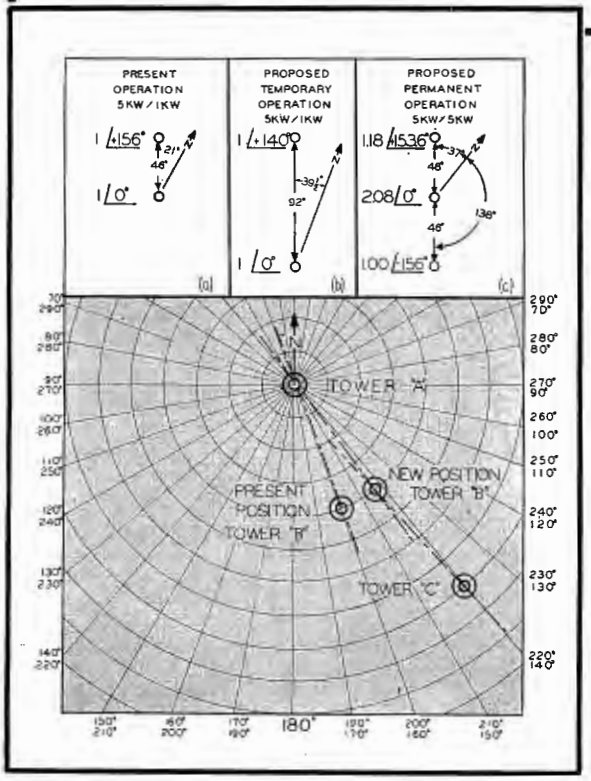
In another construction step, a piece of *U* beam had to be bolted from leg to leg of the tower above the area which would receive the insulator. The *U* beam extended several feet past the legs of the tower. Therefore a jack was placed near the end of the beam, and installed and adjusted to accept the weight bearing on the leg. This procedure did not interfere with the insulator installation work. The leg was then cut off at a suitable point with a cutting torch. Since the old foundation bolts were too long, they too were cut off with the cutting torch. Strange as it may seem, the bolts were



Figures 6, 7, 8, 9 (top to bottom, right) and 10 (bottom, left) Figure 6, guyed tower (tower has eight guys). Figure 7, view of the tower being moved. Figure 8, close-up showing the skids and blocking chained to the tower legs. Figure 9, tower over the new foundations. Jacking up in preparation for skid removal. Figure 10, plot of horizontal plane pattern of new array.







Figures 11 (top) and 12 (left)

Figure 11, pattern of old and temporary arrays. Figure 12, tower changes.

cut without injury to either the threads or nuts. The insulator was then installed, bolted in place and the jack removed. This step was repeated for each of the other legs.

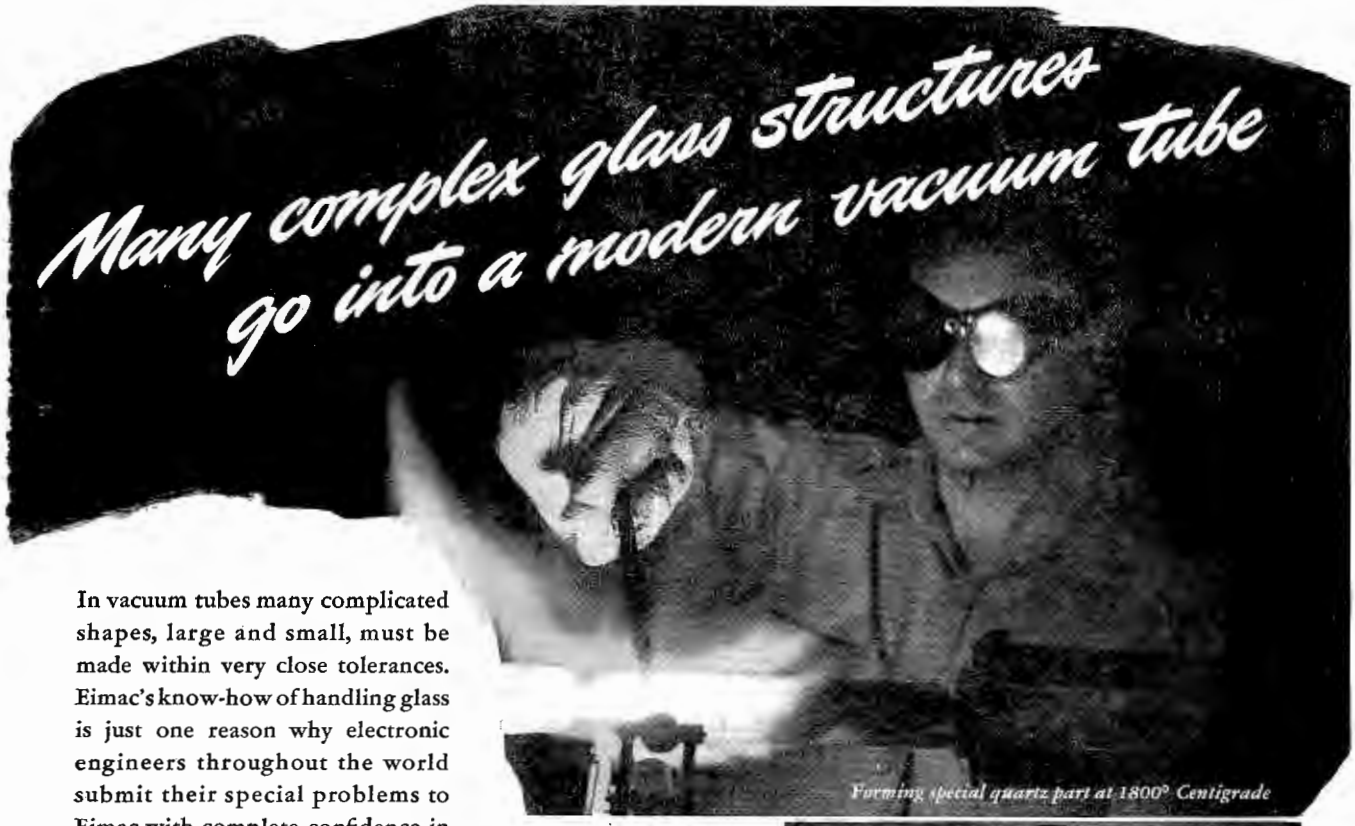
After the new insulated tower was installed and the old tower insulated, the towers were then tuned up into the temporary directional array. The next step involved the moving of the 215-foot Lehigh tower. The new foundations were installed as soon as the ground work had been completed. In this foundation, eight steel anchors were sunk in the ground around the tower, approximately 100 feet from the base, in eight evenly spaced directions. The anchors were the same type used in guying high electric poles. Eight steel guy cables, properly broken with strain insulators, were then installed on the tower one-fourth of the distance from the top. Each guy was terminated in a block and fall, so that the guys could be adjusted as the tower moved. Four cables were stretched on the ground from the base of the tower to four anchors. These served to prevent the base from slipping if the moment of balance was ever exceeded. Two pieces of *U* beam were also bolted to the tower and the tower jacked up off of the old foundations, using four jacks. Two large pieces of timber were used for track and two other pieces were used as skids. The skids were blocked against two pieces of *U* beam to accept the weight of the tower. The blocking and the skids were then securely chained to the legs of the tower, with the chain tightened with turnbuckles. The track was blocked level and coated with grease, and a large piece of lumber was butted against the ends of the track. This facilitated pulling. The jacks were then lowered and the weight of the tower rested on the skids, which in turn rested on the track.

The actual movement of the tower was accomplished by a chain hoist attached to the piece of lumber butted at the end of the track and one of the skids. Once ready for movement, the actual time required to slide the tower over was only an hour. The vertical position of the tower was maintained as it was moved, by adjusting the block and falls on the end of each guy. Two carpenter levels had been strapped to one leg of the tower to indicate any serious departure from vertical. When the tower reached the new foundations, it was again jacked and the skids removed. The legs were then cut off, insulators installed, and made fast to the new foundation.

The actual cost of moving the tower

(*Continued on page 76*)

Many complex glass structures go into a modern vacuum tube



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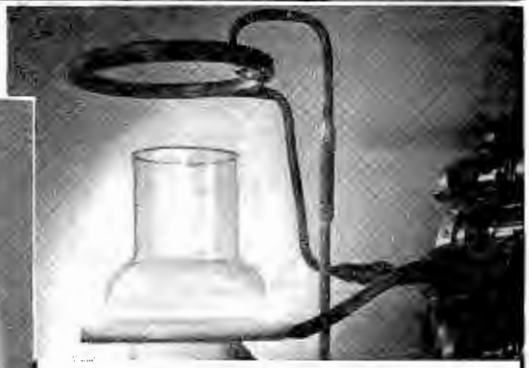
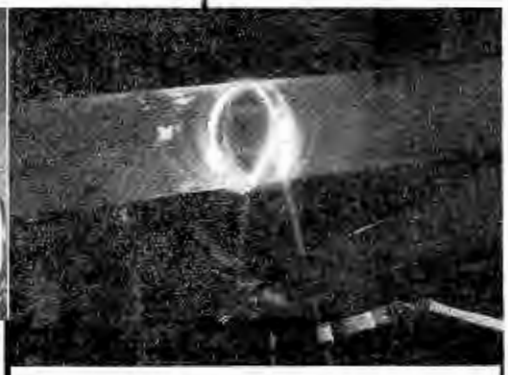


The use of R. F. heat in making glass to metal seals simplifies and speeds many such sealing operations

Making very large glass seals requires expert handling. Two 17" glass cylinders are being joined



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HIGH-VOLTAGE R-F INSULATOR DESIGN NOTES

by SIDNEY WALD
RCA Victor Division
Radio Corporation of America

Material	Dielectric Constant K	Power Factor τ at 1 mc	Loss Factor $K\tau \times 10^{-4}$ at 1 mc
Polystyrene	2.5	0.0002	5
Fused quartz	4.2	0.0003	12
Mica	7.0	0.0002	14
Pyrex glass	4.5	0.002	90
Steatite	6.1	0.003	183
Mycalex	7.0	0.003	210
Yellow bakelite	5.3	0.007	371
Porcelain, wet process	7.0	0.006	420
Black bakelite	5.5	0.035	1900
Cloth base bakelite	5.6	0.050	2800
Cellulose acetate	6.8	0.036	2400

Table 1
Approximate critical constants for three groups of insulating materials.

EVERY piece of electrical and communications equipment consists of a number of components which are joined by conductors. These are in turn supported by insulators. It is the function of conductors and insulators to confine the various currents to definite paths with as little loss as possible. In low-voltage circuits, loss in insulators manifests itself as a reduction of Q of tuned circuits and inferior operation of the equipment as a whole.

Breakdown of insulation in high-voltage circuits, particularly at high frequencies, can, however, result in complete failure of the equipment. Without adequate insulation for high voltages, an otherwise good circuit design becomes unreliable and in some cases dangerous to the operator.

It is perhaps due to the fact that engineering curricula in the past have not sufficiently stressed the subject that there is a general lack of knowledge concerning the design and behavior of dielectrics. Many excellent text books are available on the theory of dielectrics, but there appears to be a dearth of adequate design information in concrete form which can be applied to specific problems by the average engineer. In the absence of such information, high-voltage problems have often been handled by laborious trial and error tactics or by over-design. The former method seldom leads to an optimum result and is exceedingly wasteful of both time and materials. The latter course stands in the way of design of compact equipment.

High voltage r-f insulation is required in transmitters to support conductors passing through metal partitions, for supports or *stand-offs*, dielectrics for capacitors, and for coaxial transmission lines.

Insulators may break down because of (*1*)—excessive heating of the dielectric, (*2*)—evidence of visual corona (sometimes known as brush discharge), (*3*)—surface flashover through the surrounding air, and (*4*)—puncture of the insulating material.

Internal Heating

An insulator, otherwise well designed, may heat excessively due to high-loss factor of the material. Since the loss factor is defined as the product of power factor and dielectric constant, one of the first considerations in the choice of an insulating material must be low-dielectric constant and low-power factor.

Where the insulating material is to be used as a dielectric in a capacitor, however, the dielectric constant should be high and the power factor as low as possible in order to obtain the maximum capacity and lowest loss.

Where the material is to be used as an isolating medium only, both dielectric constant and power factor must be as small as possible to minimize heating due to the flow of radio-frequency displacement current.

The approximate critical constants for three groups of insulating materials appear in Table 1.

The internal heating in watts per-cubic-inch of insulating material is given by the relation

$$W = 2\pi f \tau G^2 K \times 0.2244 \times 10^{-12} \quad (1)$$

where f = frequency, cycles
G = voltage gradient in the dielectric, volts/inch rms
K = dielectric constant
τ = power factor of dielectric

If the ambient temperature of the component is always below about 70°C, from heating consideration alone, polystyrene would be an ideal choice. However, in high-power equipment, the ambient temperature may rise above the softening point of polystyrene. In addition, organic materials, in the event of an accidental flashover, may carbonize, thus damaging the surface and inviting subsequent breakdown.

Steatite, mycalex, and certain types of glass are most commonly employed as low loss, high-voltage insulating materials.

Corona

A second cause of insulator failure is the corona discharge. This type of breakdown is characterized by the ionization of air at an insulator boundary with emission of a characteristic bluish glow, intense local heating, and evolution of ozone.

The formation of corona indicates excessive local voltage gradient. High voltage gradient can usually be reduced by shaping the insulator so that the stress on the dielectric body is increased while the stress on the surrounding air is reduced.

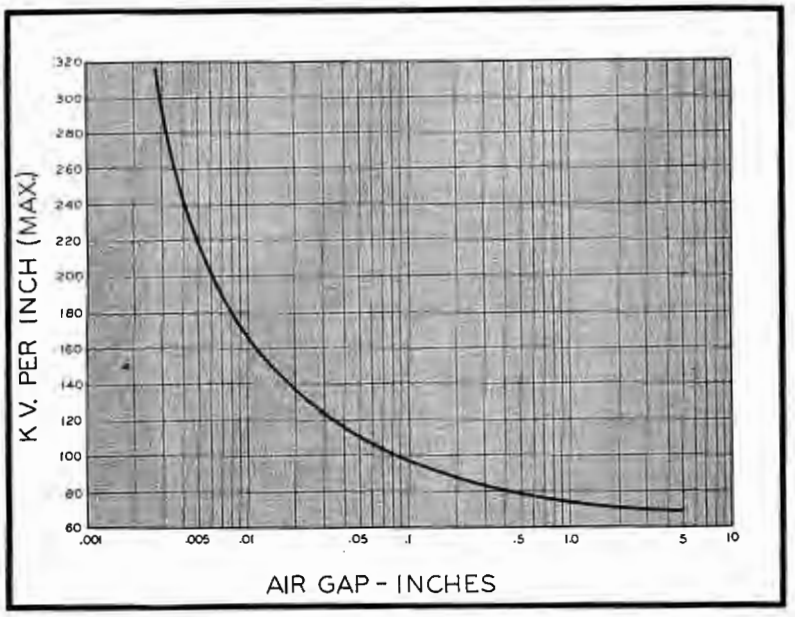
Whether or not a given design will fail due to corona can be predicted by use of formulas to be given subsequently.

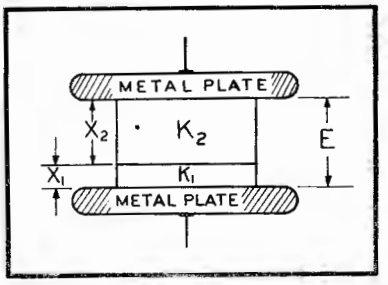
Sparkover or Flashover

This type of failure is closely allied to corona and is a more violent discharge through the air surrounding the insulator. Whether sparkover or corona occurs first is determined by the geometric configuration of the insulation in relation to the oppositely charged or grounded surface. The same calculations which apply to corona are applicable to the prediction of sparkover.

Puncture

The puncture-voltage gradient of solid insulating material is many times





Figures 1 (above) and 2 (left)
Figure 1, flat plates. Figure 2, parallel flat plates; voltage gradient required to break down air at 25° C and 760 mm.

greater than the corona or sparkover gradient of air. Hence, such a breakdown indicates that the insulating material was being electrically stressed to its ultimate limit. Insulator designs are seldom so ideal that no other type of failure occurs before puncture.

To summarize, it may be said that an insulator design is satisfactory if the following conditions are attained:

(*1*)—Negligible internal heating of the dielectric at the normal working voltage of the part.

(*2*)—No evidence of either corona or sparkover until about twice the normal working voltage is applied.

Insulator Geometry

The simplest method of attacking an actual insulator problem is to determine its similarity to one of several simple geometrical configurations and then to calculate the breakdown voltage of the simplified electrodes. Arriving at this voltage requires two distinct steps:

(*1*)—Determine the maximum voltage gradient which exists in the field between the electrodes.

(*2*)—Determine the maximum voltage gradient which air can withstand for that particular electrode shape and spacing.

(This assumes of course that it is the air surrounding the electrodes which breaks down first. Since the puncture voltage of solid dielectrics is many times that of air, this is a reasonable assumption.)

Corona or sparkover will occur when the voltage gradient in *step 1* equals that found in *step 2*.

Flat Plates

If the actual insulator contours resemble two flat discs or plates with one or more dielectrics (one of which may be air) between them, then the following relations may be used for calculation (Figure 1):

Let X_1 = thickness of dielectric whose permittivity = K_1
X_2 = thickness of dielectric whose permittivity = K_2
E = total impressed voltage (max.)
e_1 = voltage appearing across X_1
e_2 = voltage appearing across X_2
g_1 = voltage gradient in layer K_1
g_2 = voltage gradient in layer K_2

$$g_1 = \frac{E K_2}{X_1 K_2 + X_2 K_1} \qquad (2)$$

$$g_2 = \frac{E K_1}{X_1 K_2 + X_2 K_1} \qquad (3)$$

For the case where $K_1 = 1$ (i.e. air)

$$g_1 = \frac{E K_2}{X_1 K_2 + X_2} \qquad (4)$$

The breakdown gradient of air is shown in Figure 2 as a function of air gap.

If the air gap is very small compared to the thickness of solid dielectric, then X_1K_2 can be neglected and

$$g_1 = \frac{E K_2}{X_2} \qquad (5)$$

$$\text{or } E = \frac{X_2 g_1}{K_2} \qquad (6)$$

Example 1: Find the breakdown voltage of a ceramic condenser with an extremely small air gap between ceramic and end plates (approximately 0.005″).

Given: ceramic thickness = 0.25″
ceramic dielectric constant = 6.7″

From Figure 2, $g_1 = 214$ kv-per-inch

Breakdown voltage

$$E = \frac{0.25 \times 214}{6.7} = 8 \text{ kv (peak)}$$

If there were no air gap, that is, if the two flat electrodes were fired on the ceramic, then

$$g_2 = \frac{E K_1}{X_1 K_2 + X_2 K_1} \qquad (3)$$

Therefore $X_1 = 0$, $g_2 = \frac{E}{X_2}$

$$\text{or } E = X_2 g_2 \qquad (7)$$

For ceramic, the puncture gradient is about 895 kv-per-inch (maximum).

Therefore $E = 0.25 \times 895 = 224$ kv (peak).

It must be borne in mind, however, that although 224 kv is required for puncture of steatite, the piece may fail by r-f heating long before puncture.

To illustrate this latter limitation, one may assume a power factor of 0.3%, and an allowable power loss of 1 watt per-cubic-inch

$f = 2mc = 2 \times 10^8$ cycles and

$K = 6.7$

Thus one obtains

$$G = 10^{-8} \sqrt{\frac{W \times 10^{12}}{2\pi f \quad K\tau \times 0.2244}}$$

$= 4.2$ kv-per-inch

Now if the ceramic condenser having the 0.005 air gap is again considered, for the breakdown voltage of 8 kv as calculated above, then from equation *3*,

$$g_2 = \frac{8 \times 1}{(0.005 \times 6.7) + (0.25 \times 1)}$$

$= 28.3$ kv-per-inch

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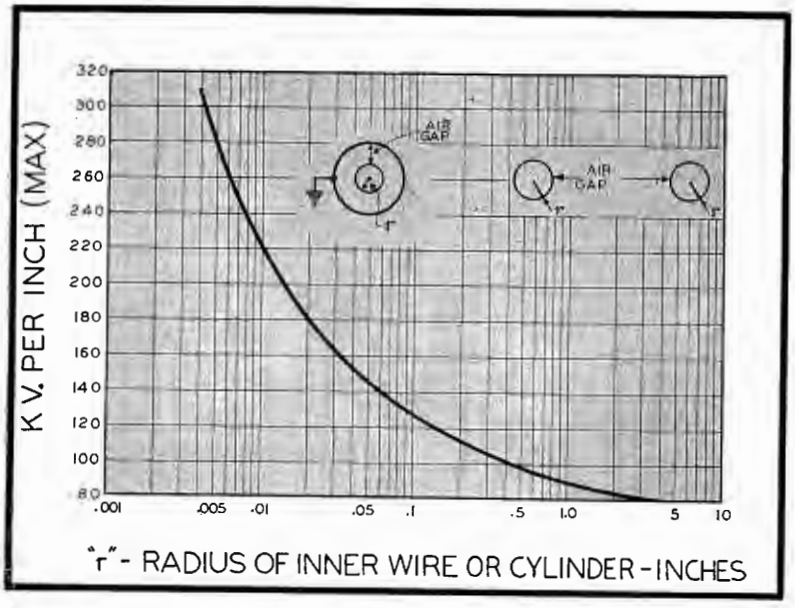


at high frequencies insulating material may not be stressed to anything like its puncture gradient. Internal heating may be minimized by reducing the capacity, power factor, and dielectric constant of the insulator as much as possible. If the impressed voltage were direct instead of alternating, these heating conditions would not apply.

Example 2: Calculate the plate spacing required for a flashover of 3600 v peak, in a parallel plate air condenser.

Find a point on Figure 2 such that

$$\frac{3600}{X} = g$$

if $X = 0.03$

$$g = \frac{3600}{0.03} = 120 \text{ kv-per-inch}$$

which falls on the curve.

The gradients may be found in the same way for any number of insulations in series in a uniform field. The formula for the gradient at any point in a combination of n layers in series is

$$g_p = \frac{E}{K_p\left(\frac{X_1}{K_1} + \frac{X_2}{K_2} + \frac{X_3}{K_3} + \frac{X_n}{K_n}\right)} \qquad (8)$$

g_p = kv-per-inch in p layer
K_p = dielectric constant of layer where gradient is required
X_1 = thickness of layer whose dielectric constant = K_1
X_2 = thickness of layer whose dielectric constant = K_2
X_n = thickness of layer whose dielectric constant = K_n
E = total impressed voltage (max.)

Coaxial Cylinders

The voltage gradient at radius X is

$$g_x = \frac{1}{XK_x}\left(\frac{E}{\frac{\log_e \frac{r_2}{r_1}}{k_1} + \frac{\log_e \frac{r_3}{r_2}}{k_2}}\right) \qquad (9)$$

Example: Let $r_1 = 0.375''$ = conductor radius
$r_2 = 0.5''$
$r_3 = 1.75''$
$k_1 = 1$ (air)
$k_2 = 4$ (glass)
$E = 19$ kv rms

We first find the voltage gradient at the surface of the conductor.

$$g_1 = \frac{10 \times 1.41}{0.375 \times 1\left(\frac{\log_e 1.33}{1} + \frac{\log_e 3.5}{4}\right)}$$

$= 120$ kv-per-inch

To find whether the air will break down we refer to curve of Figure 3. For an inner conductor of radius 0.375", G = 100 kv-per-inch. Therefore, this arrangement would go into corona. The critical voltage is $100/120 \times 19 = 15.8$ kv rms.

Parallel Cylinders of Wires

If the spacing is large with respect to the conductor radius

$$\text{then } g = \frac{E}{2r \log_e \frac{S}{r}} \qquad (10)$$

where E = voltage between conductors
r = conductor radius
S = spacing between centers of conductors

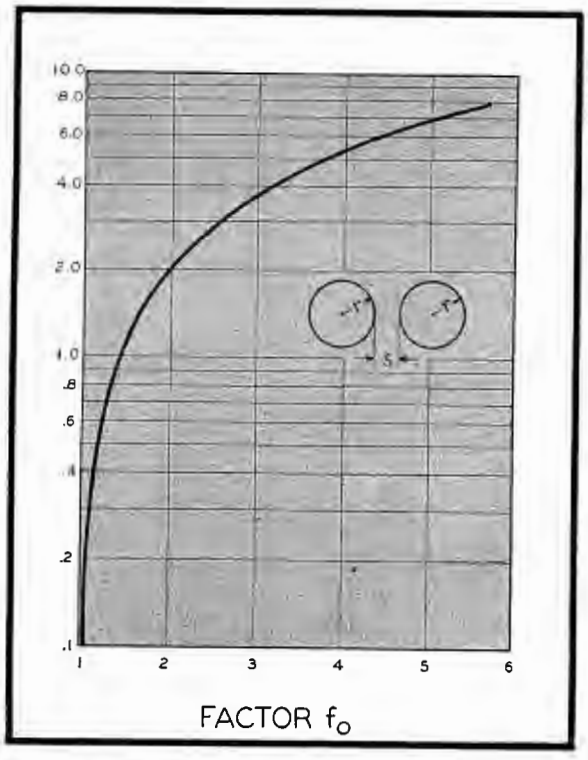
Example: Let $r = 0.03''$
$S = 0.25''$

We are to find the breakdown voltage. Referring to Figure 3,

g for 0.3 = 164 kv-per-inch

$$E = g\left(2r \log_e \frac{S}{r}\right)$$

$= 164\ (0.06 \times \log_e 8.33)$
$= 164 \times 0.06 \times 2.12 = 21$ kv (max.)

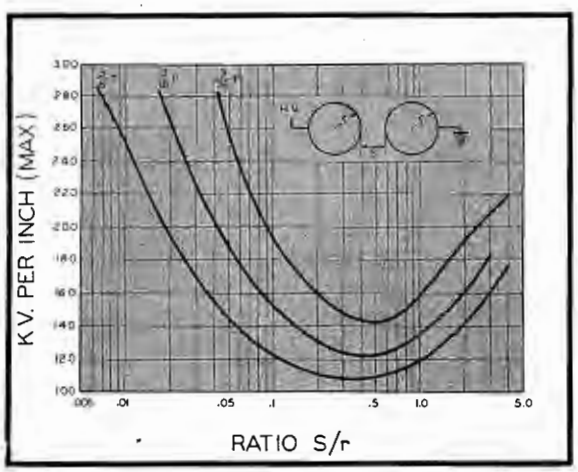


Figures 3 (top) and 4 (left)

Figure 3, coaxial or parallel cylinders; voltage gradient required to break down air at 25° C and 760 mm. Figure 4, equal spheres, one grounded; factor f_o for use in expression

$$g = \frac{E}{S} f_o$$

for sphere gap.



Figures 5 (left) and 6 (below)

Figure 5, equal spheres, one grounded; voltage gradient required to break down air at 25° C and 760 mm. Figure 6, effect of altitude on puncture gradient of air at 25° C. $G = G_o A$, where G = breakdown gradient at altitude; G_o = breakdown gradient at standard conditions, 25° C and 760 mm.; and A = altitude factor.

If we have equal spheres (one grounded)

$$g = \frac{E}{S} f_o \qquad (11)$$

E = total voltage (max.)
S = spacing between surfaces
f_o = a constant for $\frac{S}{r}$ determined from Figure 4.

We use figure 5 to determine the critical gradient for air.

With sphere to grounded plane, we use $2S/r$ in finding f_o from Figure 4, where S is given spacing to plane. Then $g = E/S\, f_o$ (as for 2 spheres). We then refer to Figure 5 for the breakdown gradient, using $2S/r$.

Note that 2S is used in these calculations, since a sphere and a plane separated by 2″ have half the puncture voltage of two spheres separated by 4″. To find the puncture voltage we then multiply the puncture gradient by S (not 2S).

The breakdown gradients for air shown in the curves apply only for a temperature of 25° C and normal atmospheric pressure of 760 millimeters.

To estimate the breakdown gradient for air at any temperature and pressure, the following formulas may be used:

$$G = G_o A \qquad (12)$$

where G = breakdown voltage gradient at given pressure and temperature
G_o = voltage gradient at standard conditons (760 mm and 25°C)
A = altitude factor

$$A = \frac{9.95\, p}{273 + T} \qquad (13)$$

where p = barometric pressure, inches of mercury
T = temperature, degrees centigrade

Strictly speaking, the correction factor A is accurate only for a uniform field, the value of A increasing with the curvature of the conductor. Figure 6 shows the manner in which A varies with altitude for a temperature of 25°C. It can be seen that at 40,000 feet, A lies between 0.2 and 0.3 depending on the curvature.

It has been shown that air has a lower puncture voltage than any good solid dielectric. Since an air gap in an insulating system usually is effectively in series with the solid insulation, it will always break down long before the solid insulation is punctured. If the air space can be electrically short-circuited, then the insulation may be stressed to its flashover value without the formation of internal corona. Of course external corona may form if the electrodes are improperly shaped, but this will ordinarily not be harmful if the external corona voltage is higher than the maximum operating voltage.

Air gaps in practical designs occur between metal fittings and solid insulation. There are several methods of short-circuiting this gap or eliminating the air space:

(*1*)—Firing a metallic coating on the insulation at area of contact with metal fittings.
(*2*)—Coating the area of contact with a colloidal suspension of carbon such as *aquadag* or *oildag*.
(*3*)—Filling the air space with a high dielectric constant, low-loss grease.
(*4*)—Glazing insulator to the metal.
(*5*)—Fusing metal to glass without presence of air bubbles.

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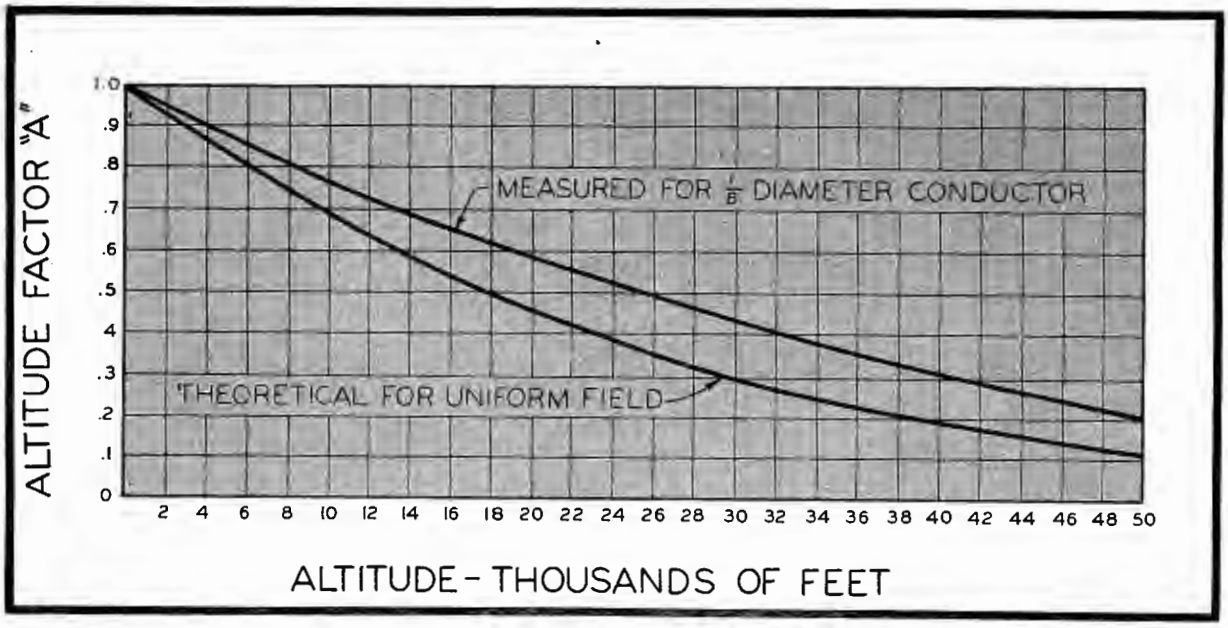

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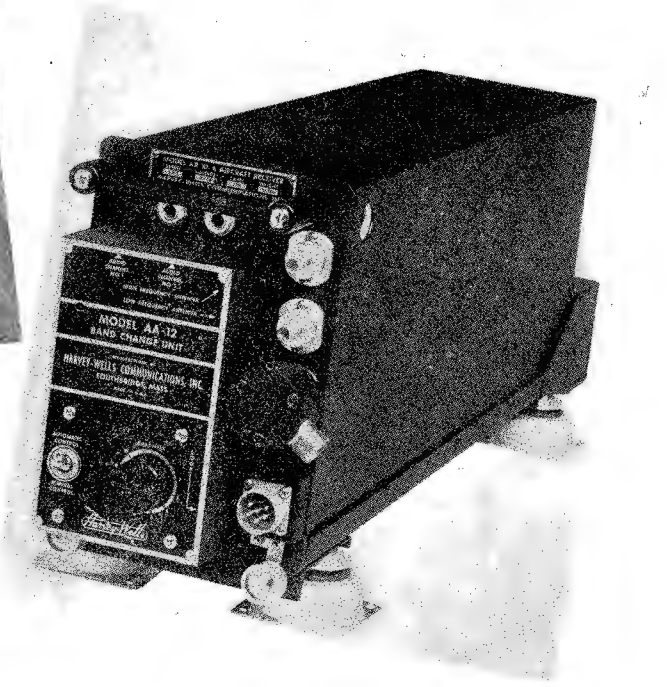

Figures 1 (right) and 1a (above)

Figure 1, complete commercial general-purpose aircraft receiver on its shockmount. Figure 1a, C. A. Harvey, author of the paper, conducting aircraft receiver laboratory tests.

DEVELOPING A GENERAL-PURPOSE COMMERCIAL AIRCRAFT RECEIVER

by C. A. HARVEY

Vice President-Chief Engineer
Harvey-Wells Communications, Inc.

BEFORE the war most aircraft were supplied with one multi-channel crystal-controlled receiver covering a range of 2 to 10 mc for company communication, two range receivers each covering a range of 200 to 410 kc, as well the necessary transmitting equipment. Inasmuch as radio plays such a vital part in the successful operation of an airline, it is necessary to provide every safeguard against radio equipment failure, and to this end spare receivers were frequently carried and considered solely as stand-by units.

Inasmuch as three separate receivers were needed for normal operation of these aircraft, and others were carried as spares, the receiving equipment became very burdensome. It was generally conceded that any one radio receiver in an airliner should be so designed and built as to cover all channels used in all operations. Thus two of these proposed all-purpose receivers could do the work of four or more of the original type, and at the same time, more efficiently.

Naturally, these two new receivers could neither weigh as much or be as large as the four or five receivers that they would replace or there would be no saving; the new receiver could be only slightly, if at all, larger than than any of receivers it replaced in spite of the fact that it was proposed to have far greater performance. Briefly, a receiver was desired to receive the radio range frequencies, day and night communication frequencies both by continuous tuning and by pretuned crystal controlled channels, and operate as an aural null direction finder with a loop antenna. In addition the complete receiver was to be remotely controlled, small as possible, and weigh less than thirty pounds. Coupled with general performance, size, and weight specifications were all the usual rigid electrical specifications on sensitivity, selectivity, image rejection, spurious frequency rejection, dual channel cross-talk, power output, and many others.

In a new project such as this, there were many interlocking problems. It was desirable to house the new receiver within one of the standard *atr* cabinets inasmuch as the *air transport rack* is becoming the standard rack for aircraft radio equipment. The basic unit is the full size *atr,* with the next larger size the 1½ *atr* and the next smaller unit the ½ *atr* cabinet. Preliminary design work indicated the feasibility, as well as the great desirability, of housing the new receiver completely within a ½ *atr* unit measuring 19½" long, 4¾" wide and 7½" high, providing the size of the individual components going into the construction of the unit could be held to a size which would allow them to be placed within the receiver in an accessible manner.

Further, preliminary discussion disclosed the fact that it would be highly desirable to have at least twelve crystal-controlled channels in the 2500 to 8000-kc range, and in addition, have two frequencies spot tuned within the 200 to 410-kc range. Inasmuch as the variable range from 2500 to 8000 kc was being divided up into two bands, a little addition will show that the proposed receiver was to have eighteen different functions, namely: to receive on three variable bands, on fourteen fixed frequencies, and to operate with a loop antenna and supplementary amplifier when desired.

These eighteen functions called for a nineteen-position bandswitch with one position occupied by a take-off contact. Investigation showed that even if the nineteen-point switch could be used, and that although a twenty-four point switch wafer was available, they were both somewhat impractical in that the nineteen-point switch wafer had but a 20° radial separation between contacts, and the twenty-four point wafer had but a 15° separation. With both these wafers special and not in general usage, and knowing that the common twelve-point switch was readily available, it was decided to use the twelve-point switch wafer with two completely independent radio-frequency input channels.

With the addition of a relay to select either of the two input channels, we then had provisions for the required nineteen functions with a few spare positions. Although the decision to use two completely separate radio-frequency input

REVOLUTIONARY TUBE DESIGN

FOR BETTER BROADCASTING

1. Filament Posts
2. Exhaust-tube Protective Cap
3. Metal Exhaust Tube
4. Filament Lead Seal (metal-to-glass)
5. Low-inductance Grid Terminal
6. Entrant Metal Header
7. Grid Seal (metal-to-glass)
8. Corona Ring
9. Filament Terminal Blocks
10. Filament Support Rods
11. Hard-glass Bulb
12. Grid Support Rods
13. Anode Seal (metal-to-glass)
14. Filament Heat Shield and Rod Reinforcement
15. Electrostatic Shield
16. Anode Flange
17. Anode (¼-inch thick copper)
18. Grid Welded to Supports
19. Tie Wires for Self-Supporting Filament Assembly
20. Filament Strands
21. Common Tie of Self-Supporting Filament Assembly

RCA 9C22, air-cooled twin of 9C21, offers high performance to broadcasters.

THIS IS the story of a new tube design that "rewrites the rule book."

The tube is the new RCA 9C21, a high-power, water-cooled triode . . . which, together with its air-cooled twin, the 9C22, offers important advantages to broadcasters. In designing these tubes, RCA engineers have established new concepts of high-power, high-frequency tube design.

Their goal was higher frequency performance for tubes of high-power design. Drawing upon their years of experience in designing and building tubes, they worked out unique innovations that produced the results they sought.

For example, one of these innovations is an *entrant metal header* which allows short, internal filament leads, and a short, low-inductance path to the grid . . . highly important factors in improving high-frequency performance. For industrial oscillator service these new design features, shown here in an "X-ray" view, give the 9C21 a 50 kw output at a maximum frequency of 25 Mc, and a 100 kw output at 5 Mc or below. In high-level modulated service (at 5 Mc or below) the 9C22 provides 38 kw maximum output. Thus a pair of 9C22 tubes may be used conservatively as a tube complement for the output stage of a 50 kw transmitter.

A better tube, for better broadcasting . . . and another example of the engineering leadership that makes RCA transmitting tubes the standard of comparison in the broadcasting industry.

Remember, *the Magic Brain of all electronic equipment is a Tube . . . and the fountain-head of modern Tube development is RCA.*

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RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

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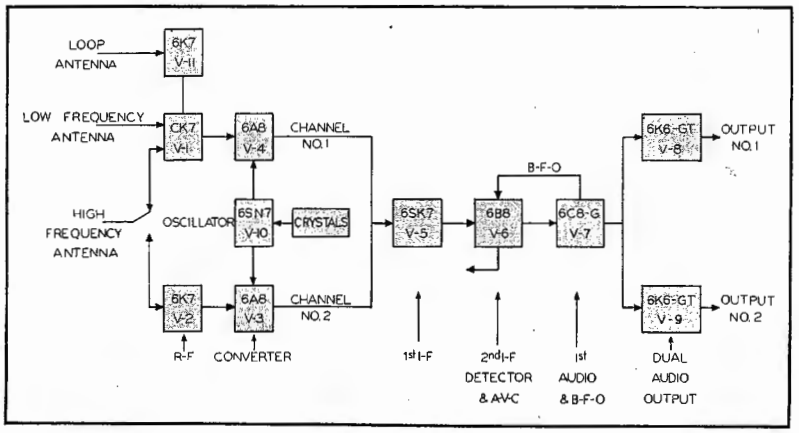


Figure 2
Block diagram of the complete receiver.

channels meant that there would be at least two more tubes within the receiver than at first thought, it was still deemed entirely feasible to develop the receiver to be housed in the *½ atr* size, even including the dynamotor power supply. It was felt that if the receiver could be housed in the *½ atr* size, and if the weight could be kept at thirty pounds or under, the design would be eminently satisfactory. Tentative electrical specifications given to the engineering group to shoot at were as follows:

Sensitivity: Two microvolts or better on all frequencies for a standard output of 50 milliwatts, with a 6 db signal-to-noise ratio.

Selectivity: A signal 3 kc off resonance to be 25 db down at any frequency in the 200 to 410 kc band. Rejection of all spurious frequencies, including image and i-f to be at least 65 db down.

Dual Channel Coupling: To be better than 90 db down.

With the above specifications in mind, the stage was set for some engineering investigation. It did not take long to determine, for instance, that the impedance common to the parallel grids of the two output tubes determined to a large extent the coupling between the output channels, and that this impedance would have to be maintained at a rather low value in order to meet the cross-talk requirements.

This, in turn, dictated the use of a first audio-frequency amplifier between the proposed diode detector and the dual output channel in order to secure an output of 300 to 400 milliwatts for each channel.

The next engineering decision involved a choice of i-f frequency—whether it should be in the vicinity of 112 kc, 455 kc, or 1600 kc. The use of the 112 kc was discarded inasmuch as it would not be possible to get a satisfactory image rejection ratio at the high frequency end of the receiver range; namely, 8000 kc. The use of 1600 kc was also ruled out because of the difficult, if not impossible, task of securing the required overall selectivity. At a frequency of 455 kc it was felt that a two-stage amplifier with high *Q* coils in the i-f transformers, and the use of reasonably high-gain tubes, would result in a sufficiently sensitive i-f channel and a sufficiently selective one to meet specifications. This combination, it was felt, should result in a sensitivity of approximately 50 microvolts for standard output, leaving the r-f amplifier and antenna coil to provide a gain of at least 25 times.

In considering the radio-frequency amplifier, it was decided to use three tuned circuits, namely: one in the grid of the radio frequency amplifier, one in the plate of the r-f amplifier, and a third in the grid of the converter, rather than the conventional two tuned circuits, in order to make sure of obtaining the required selectivity on the low frequency band and, as well, securing the required spurious frequency rejection on the high frequency bands. These three tuned circuits, plus the tunable oscillator, as well as a tuned circuit at the input of the loop amplifier, dictated the use of a five-gang variable condenser. With all this information at hand, it was time to start the construction of the first engineering model.

In the design of any radio receiver, the intermediate frequency and audio channels require very little engineering except for the i-f transformers themselves. In this design, we wanted reasonably small i-f transformers yet, at the same time, required high *Q* coils. This combination was secured by using the high *Q* coils and enclosing them further within powdered iron pots. The use of these pots allowed the coils to be placed, physically, much closer together for optimum coupling, and permitted the use of a small shield can, 1⅛" square. The coils used have an effective *Q* in excess of 250, even when enclosed within the shield can. The design of these i-f transformers presented another problem. With space generally at such a premium underneath the chassis of the receiver, much thought was given to placing small components, such as grid and plate decoupling resistors, diode loads, filter circuits, and avc circuits, within the i-f transformer shield can. The various components within any shield can were properly grouped and correctly spaced. The i-f transformer was itself carefully oriented on the chassis of the receiver so as to make very short leads between the tube elements and the circuit elements contained within the i-f transformer shield can.

The i-f transformer assemblies used in this receiver all have eight connections coming out of the shield can, not including the ground connection, whereas the conventional i-f transformer assemblies have but four. Two of the transformers, for instance, have as many as eighteen separate components within each shield can, including the two ceramic trimmers and the two padding condensers associated with the i-f coils.

To save tubes, the tube complement of the i-f and audio channels was finally boiled down to separate 6A8 tubes as converters, one for each r-f imput channel; one 6SK7 first i-f amplifier; one 6B8 as second i-f amplifier diode detector, and separate diode avc; one 6C8GT as combination b-f-o and first audio amplifier; and two 6K6GT tubes as dual output tubes.

Figure 2 shows the block diagram of the receiver.

Selection of tubes was most important in that the receiver was being designed to operate from either twelve or twenty-

Figure 3 (below, left)
Views of the antenna compartment removed from the receiver.

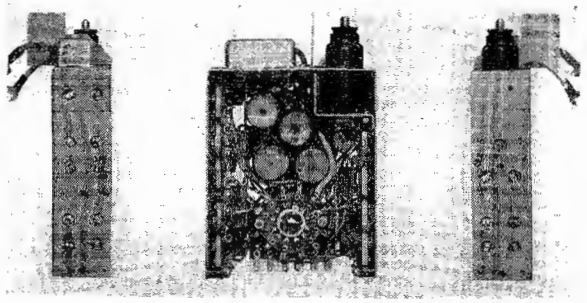
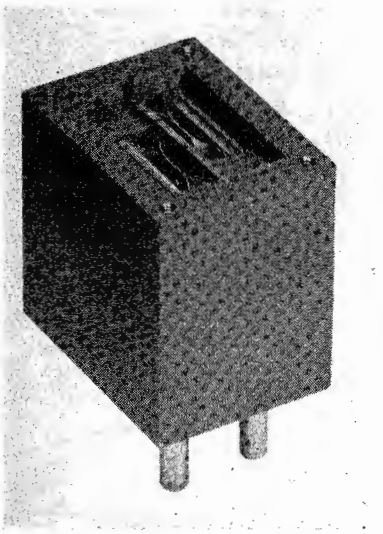


Figure 4
Internal view of the dual-crystal holder used in the receiver.



The instruments of Sudden Death will bring them longer life!

TODAY, electrical instruments are among the deadliest weapons in freedom's arsenal. They guide planes on bombing missions, direct gun-fire, and perform a hundred other killing missions.

But the magic of instruments will not always be put to these frightful uses. The day is coming when they will bring better health, greater happiness, and increased usefulness to everyone. They will be used more and more to improve the efficiency of industry's products—to safeguard our safety in the home, in the factory, and on the streets or in the skies—to improve all the services of the professions and sciences so that they can make a better world in which to live *longer*.

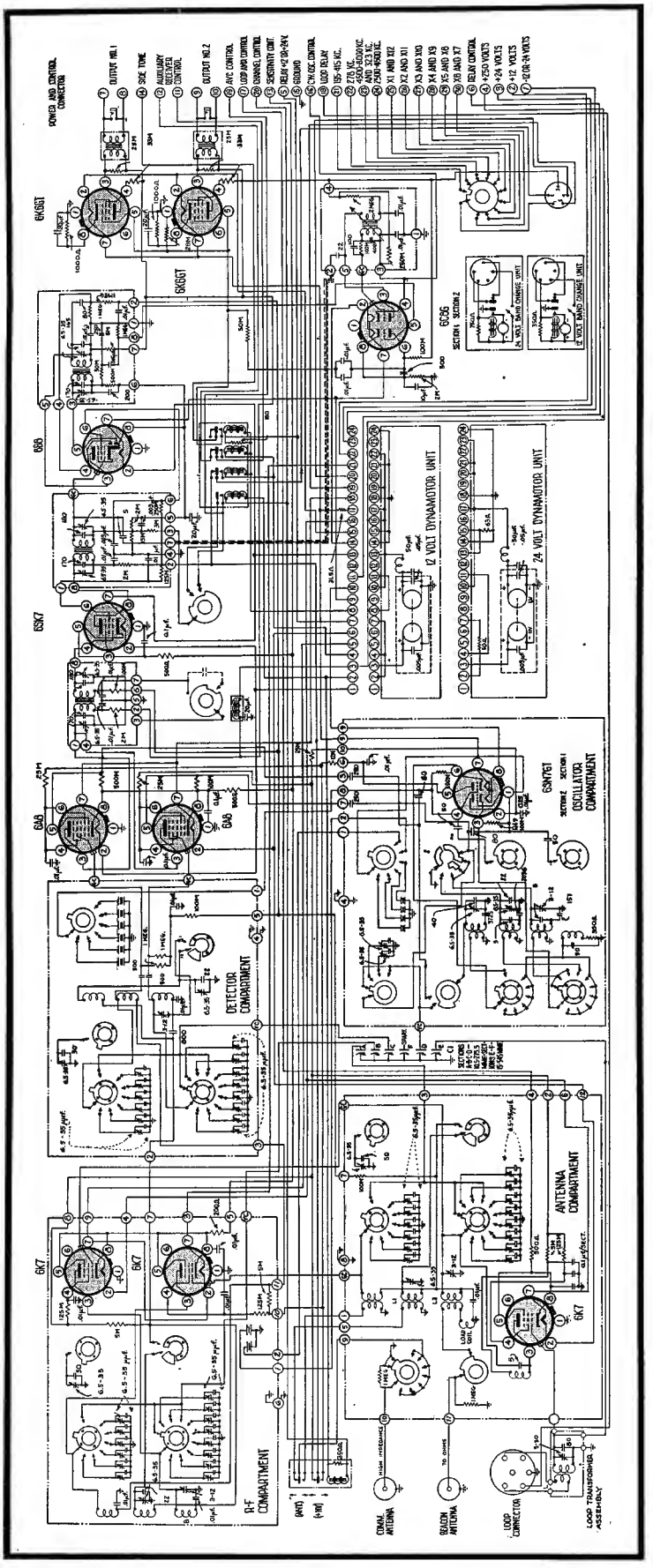
Many companies will make these instruments and will make them very well. Among them, we believe, will be our own organization, creating instruments of *sustained accuracy** to be used for all the purposes of peace, progress, and longer life.

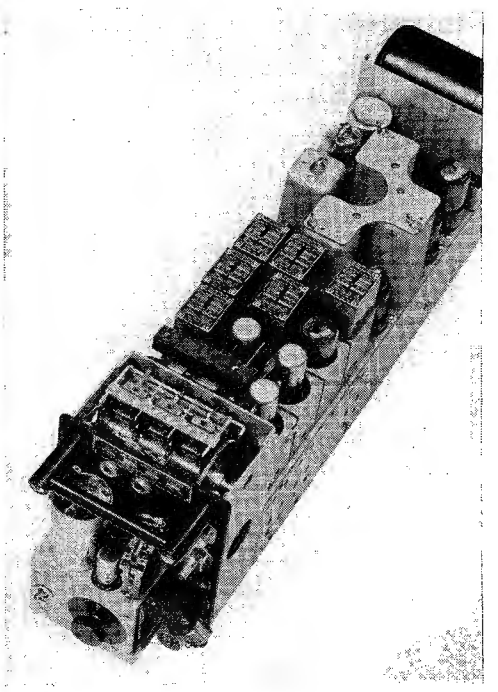
* * * * * * *

***SUSTAINED ACCURACY** is not an easy quality to achieve. It must take into account all factors of use—must then employ the design, the alloys, the construction that infallibly protect an instrument against all threats to its reliable performance. Such instruments, obviously, must be built with performance—not price—in mind. We invite the inquiries of those who are interested in such standards.

Boes instruments

for Measuring, Metering & Testing Equipment ☆ *The W. W. Boes Co., Dayton, Ohio*





four volts d-c, and therefore, some easy means of changing the receiver had to be found which, of necessity, meant an easy means of reconnecting the tube filaments in a series-parallel combination keeping the use of supplementary balancing resistors at a minimum. With these tubes, and some circuit engineering, the specification on dual channel cross-talk was met and even slightly bettered, and an i-f channel sensitivity of 50 microvolts for standard output was achieved. An i-f selectivity was also realized with a band width of about 7.5 kc at 25 db down.

After a couple of false starts, it was proposed to build the r-f unit into separate compartments, namely: one compartment for the oscillator tube and its associated circuit, one compartment for the circuits associated with the converter tubes, a third compartment containing the radio frequency amplifiers and their associated plate circuits, and a fourth compartment for the loop amplifier tube and the antenna circuits associated with the radio frequency amplifiers. In this way, it was felt that unwanted couplings could be kept at a minimum, and by using double ended tubes in the r-f stage, such as 6K7, it should be easy to completely isolate circuits on the same frequencies and thereby end up with a very stable receiver. A 6SN7 was selected for the high-frequency oscillator using one section for each of the two channels. Separate 6K7 tubes were used in the r-f amplifier, and a third 6K7 as the loop amplifier. The triodes of the 6SN7 were so arranged that they could be connected as normal oscillators when the variable frequency bands were being used and as

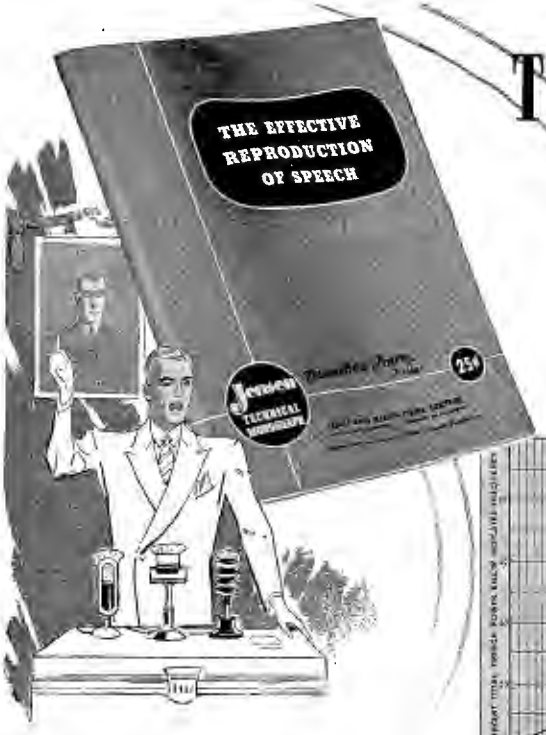
●

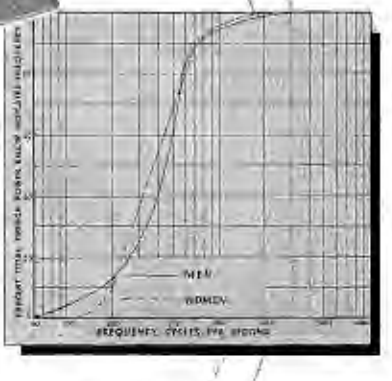
Figures 5 (top) and 6 (left)

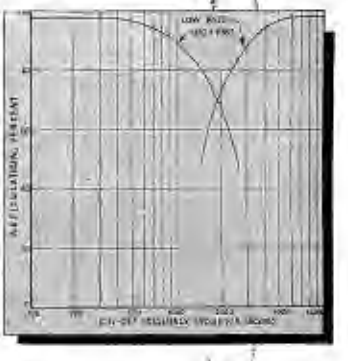
Figure 5, a view of the receiver with band-change mechanism. Figure 6, circuit diagram of complete receiver.

●

THE EFFECTIVE REPRODUCTION OF SPEECH...







When casually considered, the reproduction of speech may appear to present less exacting requirements than the reproduction of music. Yet *faithful* speech reproduction requires a frequency band almost as wide as for music. Amplified speech for strictly *communication* purposes usually presents a different requirement. Here, such matters as articulation, loudness, masking, power requirements and the ability to deliver the message through noise, become the more important considerations.

"The Effective Reproduction of Speech"—Number 4 in the series of JENSEN Technical Monographs—presents much up-to-date data on this important subject in convenient form, together with useful conclusions and practical information for everyone interested in sound reproduction. Get your copy from your JENSEN jobber or dealer, or fill out the coupon and mail it with 25c for each copy ordered.

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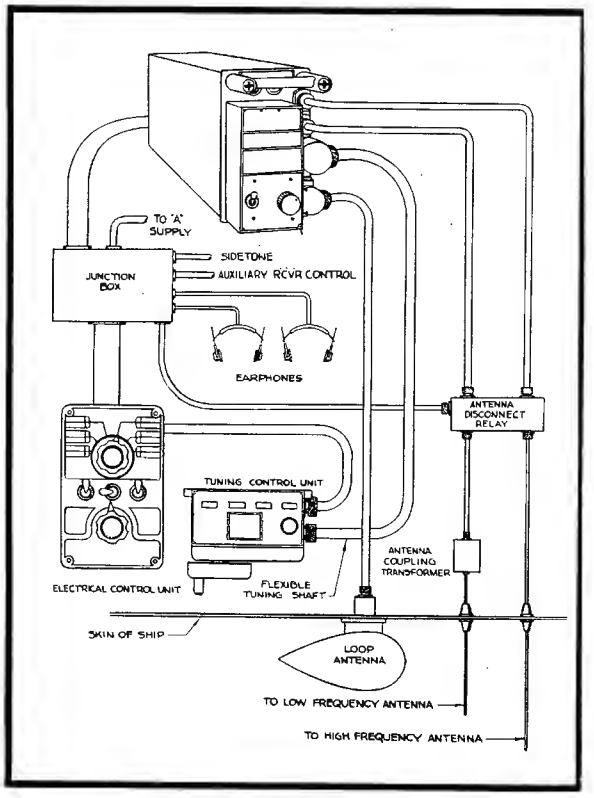
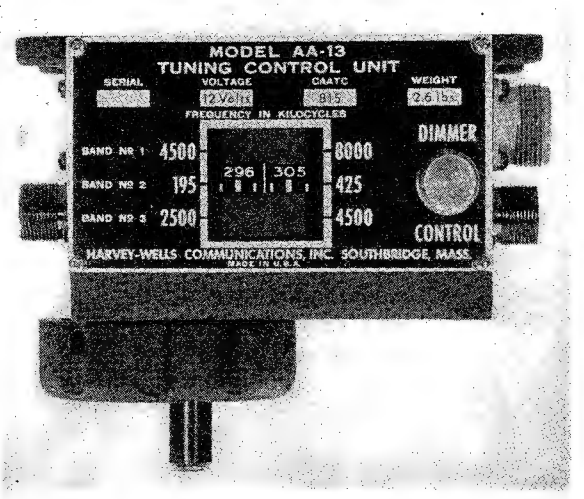
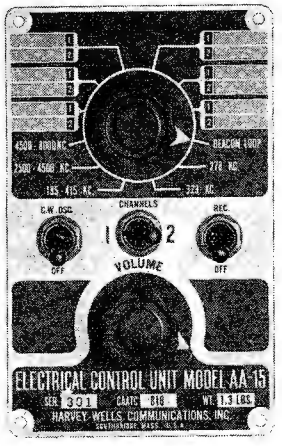
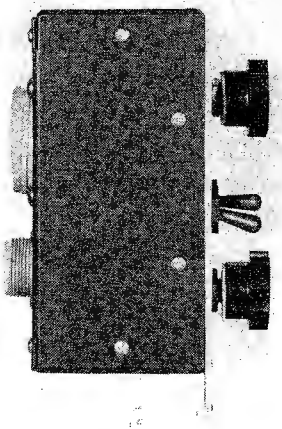


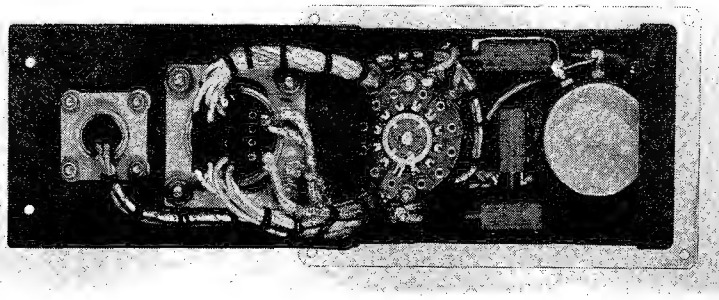


Figures 7 (above, right), 8 (below) and 9 (upper left)

Figure 7, the mechanical control head. Figure 8, electrical control head. Figure 9, a typical aircraft installation.







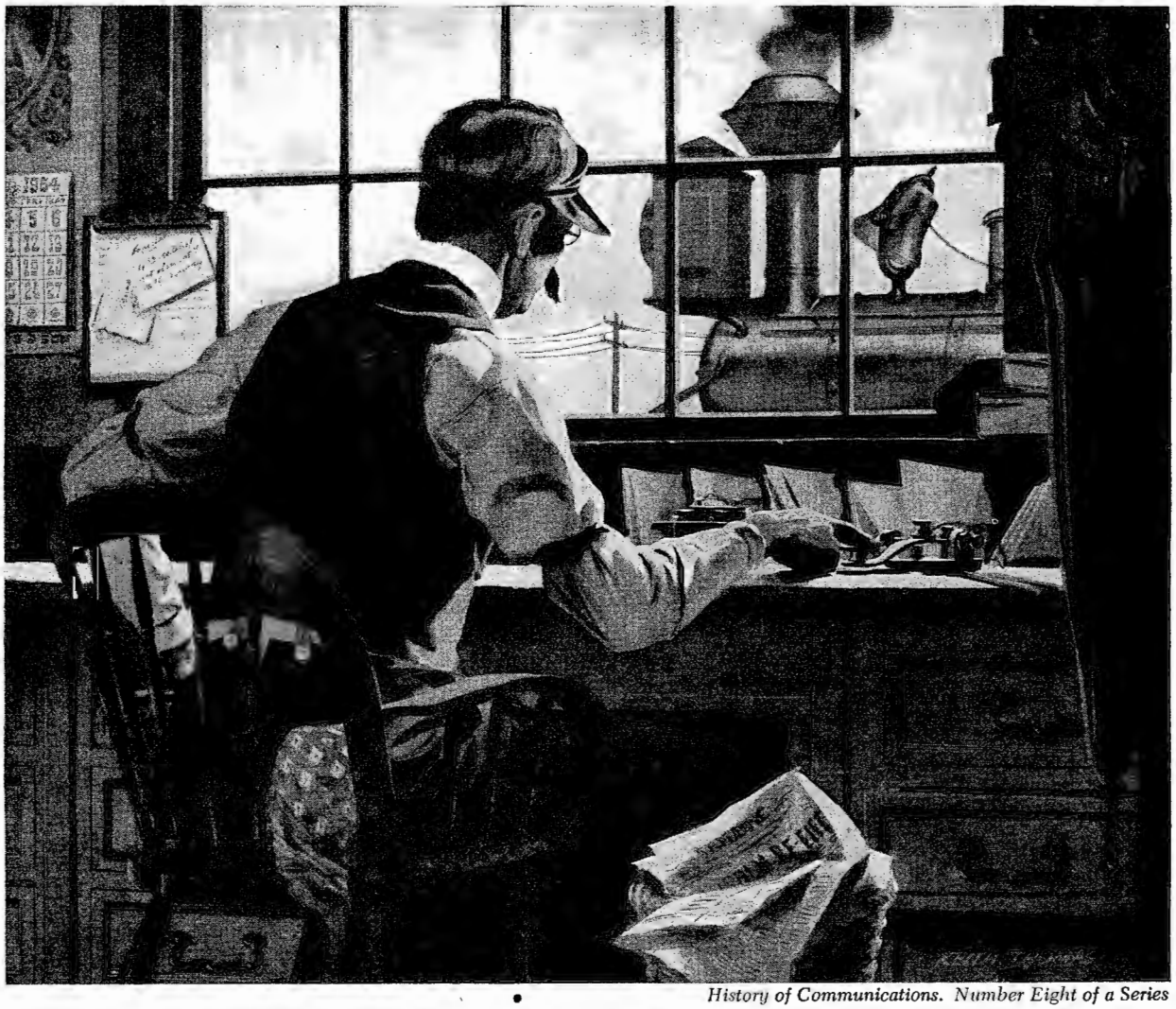
crystal oscillators in the Pierce circuit for fixed frequency reception.

The design of each of these four separate compartments was a full engineering job in itself. Having worked out the various engineering details on a circuit design over a period of many weeks, it became necessary to select the proper components used in these various compartments, keeping in mind, all the while, the necessity for components of small physical size, yet designed in such a manner that there could be no question as to their excellence. Within the antenna compartment, for instance, will be found one tube socket, three switch wafers, four coils, seventeen trimming condensers, fifteen padding condensers, one three-section bathtub-type condenser, and six resistors—all these in a space measuring approximately 1½"x4"x5½" or approximately 33 cubic inches. This is shown in Figure 3. Yet, each part is so located as to make it readily accessible for inspection and maintenance, and all are mounted firmly in order to withstand the shock and vibration to which such equipment is subjected in aircraft service.

The crystals for the twelve crystal-controlled channels are housed in six dual crystal holders, (Figure 4). As these are most closely associated with the oscillator compartment, two of these dual holders are mounted on top of the oscillator compartment, three on the detector compartment, which is on one side of the oscillator unit, and one on the r-f compartment, which is on the other side of the oscillator unit. In this way, the crystal leads are kept short and the crystals are not unduly loaded by stray capacities.

As there are sixteen separate switch wafers associated with the four removable compartments, each group in any one compartment is carefully aligned before placing the compartment into the chassis so that all wafers can be turned by a common switch shaft inserted through the front of the receiver. This shaft is driven by a small mechanism consisting of a small high-speed d-c motor and a set of reduction gears. This motor is energized by a small relay mounted adjacent to it. This relay is also used to silence the receiver during the switching operation to eliminate switching noise. The switch also projects through the band-change mechanism to

(Continued on page 76)



History of Communications. Number Eight of a Series

EARLY RAILROAD COMMUNICATIONS BY TELEGRAPH

Communication by telegraph was probably one of the first of the electronic arts which met with commercial success in America. Of constant interest to every boy in a small town, the telegrapher down at the depot was a hero — a man of great science. With the advent of faster locomotives, telegraphy was a speedy method of traffic control.

Today, and for the postwar period, the picture will include electronic voice communications for the streamlined trains which travel one hundred miles per hour. There must be a more flexible control via electronics, plus the added possibility of passenger luxury in radio telephones. Universal stands ready as an electronic manufacturer to serve in the era of applied electronics.

< Model 1700-UB, illustrated at left, is but one of several military type microphones now available to priority users through local radio jobbers.

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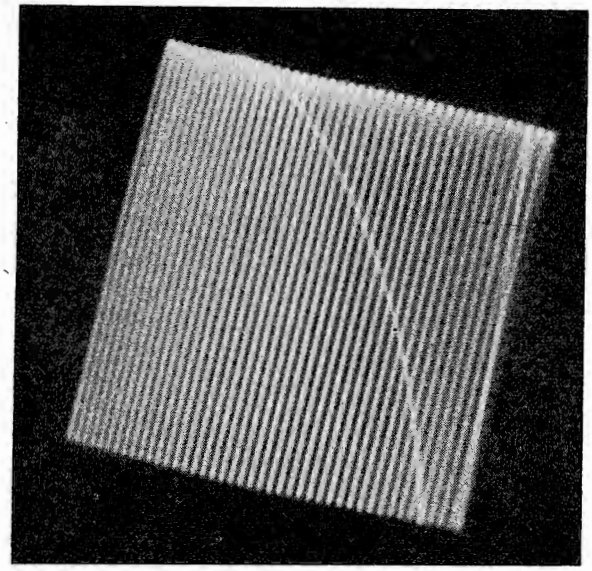
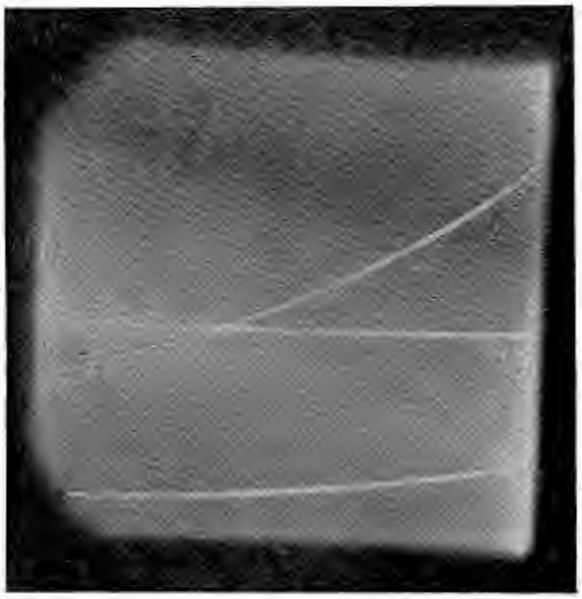


CATHODE-RAY TUBE TESTING

by J. R. BEERS
Development Engineer
North American Philips Co., Inc.



Figures 1, 2, 3 (top to bottom, left)

Figure 1, raster for checking light output of cathode-ray tubes. Figure 2, raster shows cross which indicates presence of gas. Figure 3, pattern used for line-width measurement; compressed until light lines at center begin to merge.

DUE to its inherent characteristics, the cathode-ray tube has many and varied applications. By means of it the scientist or engineer can translate into visible phenomena, for comparison and analysis, the normally invisible action of primary, electrical and magnetic forces, as well as physical, chemical and mechanical actions which act as primary sources to produce electrical or magnetic impulses.

With such a field for possible applications, it is apparent that it would be difficult to name all of them. However, it is practical to cite a few of the more common applications and measurements: Television reception; airplane detection; direction finding; frequency modulation; voltage, current and frequency measurement; tuned circuit alignment; phase measurements; rectifier wave-form study; crystal frequency study; peak emission of power tubes; and timers for color printing.

Although the foregoing represents but a few of the many applications it is evident that the c-r tube must be accurately designed and carefully checked if reliable results are to be obtained in its use. Accordingly, it becomes necessary to thoroughly and accurately check all characteristics such as:

(*1*)—Heater current
(*2*)—Cathode current
(*3*)—First anode current
(*4*)—Second anode current
(*5*)—First anode leakage
(*6*)—Grid leakage
(*7*)—Spot centering (position)
(*8*)—Spot displacement (leakage)
(*9*)—Cathode condition
(*10*)—Cathode illumination
(*11*)—Light output
(*12*)—Line width, vertical
(*13*)—Line width, horizontal
(*14*)—Grid cut-off voltage
(*15*)—Modulation characteristic
(*16*)—Focusing voltage

wherever a tube is used...

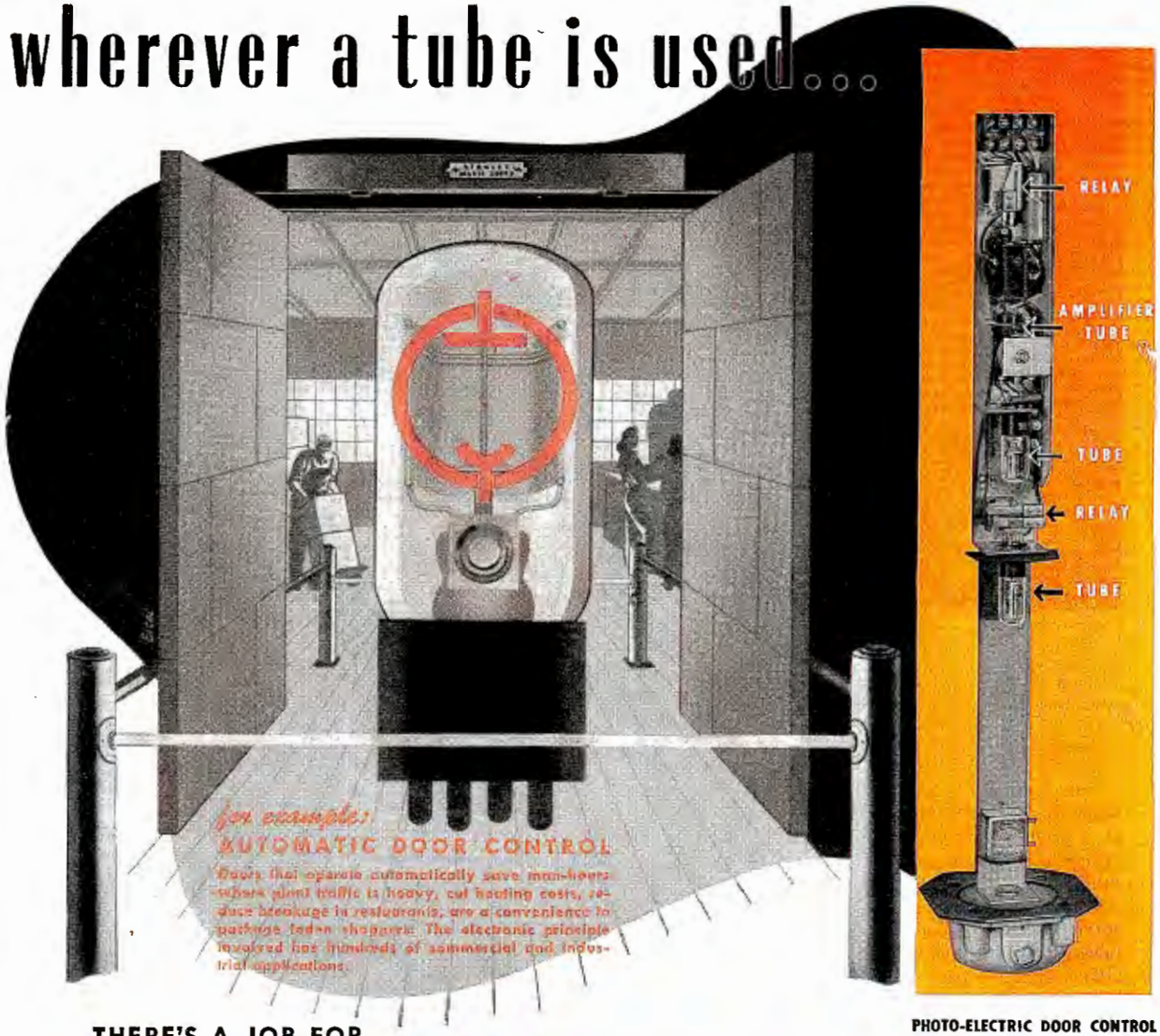


PHOTO-ELECTRIC DOOR CONTROL
Above unit manufactured by General Electric Co., is a part of STANLEY "MAGIC DOOR" CONTROLS.

THERE'S A JOB FOR *Relays* BY GUARDIAN

★ The "Magic Door" made by The Stanley Works of New Britain, Conn., uses a General Electric control unit which operates automatically at the approach of a pedestrian or vehicle. In this unit a beam of light focused on the cathode of a phototube causes a tiny current to flow. Enlarged through an amplifier tube this current operates a sensitive telephone type of relay such as the Guardian Series 405. Another phototube with an auxiliary relay, Guardian Series R-100, is employed to hold the doors open for anyone standing within the doorway.

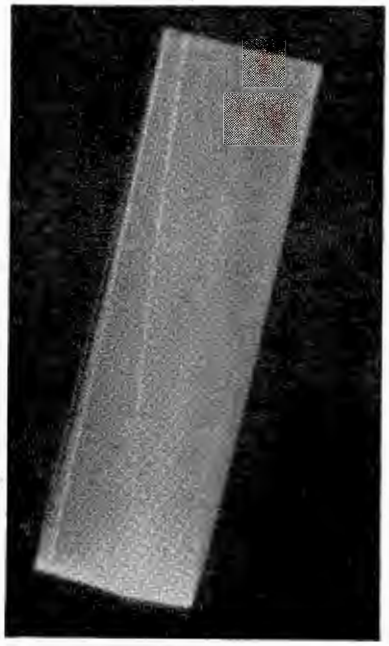
The telephone type of relay is extremely sensitive and able to operate on the small current supplied through the electronic circuit. The auxiliary relay, Series R-100, is required to handle a greater current. It is a small, efficient relay having a contact capacity up to 1 KW at frequencies up to and including 28 megacycles. Contact combinations range up to double pole, double throw. Standard coils operate on 110 volts, 60 cycles, and draw approximately 7 V. A. Coils for other voltages are available. For further information write for Bulletin R-6.

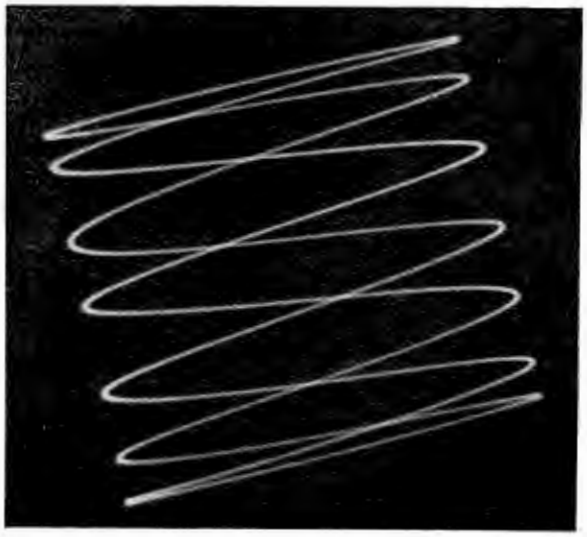
Consult Guardian whenever a tube is used—*however*—Relays by Guardian are NOT limited to tube applications but are used wherever automatic control is desired for making, breaking, or changing the characteristics of electrical circuits.

Series 405 Telephone Type Relay

Series R-100 H. F. Relay

GUARDIAN ELECTRIC
1623-L W. WALNUT STREET CHICAGO 12, ILLINOIS
A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY





Figures 4 (left) and 5 (right)

Figure 4, pattern for line-width measurement, at 90° to that of Figure 3. Pattern is compressed until light lines (¾ of distance from center to edge) begin to merge. Figure 5, 60 x 420-cycle pattern that shows non-astigmatic trace. Notice uniformity of trace width at all points.

(*17*)—Deflection factor, 1 and 2 plates
(*18*)—Deflection factor, 3 and 4 plates
(*19*)—Heater-to-cathode leakage
(*20*)—Capacity, grid to other elements
(*21*)—Capacity, K to other elements
(*22*)—Capacity, 1 to 2 plates
(*23*)—Capacity, 3 to 4 plates
(*24*)—Vibration check

This is quite a formidable list and in order to accurately make these checks on a production basis, it is quite necessary to have well-designed and carefully-built test equipment.

Capacity, voltage and current measurements are common to all electronic tubes and as such need no explanation. Other characteristics such as cathode condition, line width, light output, focusing voltage, deflection factor and other characteristics, which necessarily take the screen into consideration, will bear some comment.

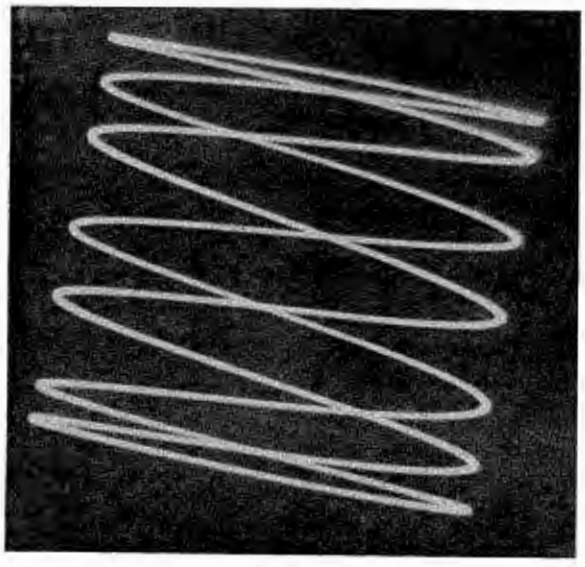
The light output of a c-r tube is determined by checking a raster of suitable area upon the screen. This raster, Figure 1, is formed by means of pulsating direct current voltages applied to both horizontal and vertical deflection plates. The usual frequencies applied for this measurement are sixty cycles on the vertical and 2940 cycles on the horizontal plates. A photocell applied directly to the tube face over the illuminated area then gives a direct reading in foot lamberts upon a calibrated microammeter or galvanometer.

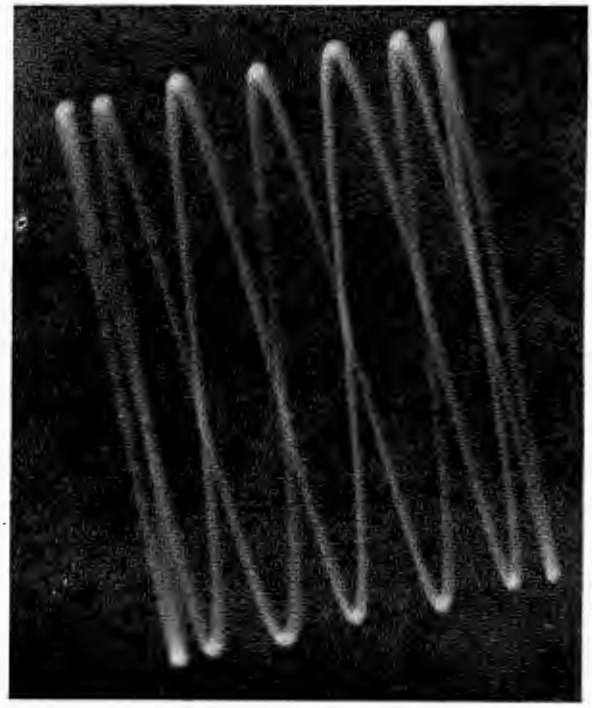
While it is also general practice to measure gas in other electronic tubes, the means of measurement in the c-r tube is somewhat different. In the case of electrostatic c-r tubes the presence of excessive gas is indicated by a gas cross, Figure 2, when the raster is at the rated light output for the tube. This cross is formed by the heavy gas ions which do not completely respond to the electrostatic field of the deflection plates.

The gas-cross test cannot be applied to magnetic deflection type tubes since ions are unaffected by magnetic fields. In this case, gas is measured by the gas ratio method in which the tube becomes its own ionization gauge. A positive potential of 250 volts is first applied to first anode or second grid, while the control grid is at zero bias

Figures 6 (left) and 7 (right)

Figure 6, 60 x 420-cycle pattern that shows an astigmatic trace. Notice broadening of trace at loops of pattern. Figure 7, pattern resulting from reversal of frequencies of Figure 6. Notice affect of astigmatic spot.





THE TROJAN HORSE IS NOT A MYTH!

His name is Rumor-Monger. His job is to divide us *from within.*

While our fighting men storm Festung Europa, Hitler's henchmen in America (avowed or otherwise) bore from within, invading us right here at home!

"Your neighbor," he hints darkly, "is your real enemy—not Hitler. Fight HIM!" To your neighbor, he slyly builds you down as "inferior"—because your faith, your color or your politics differ from his. "Put him in his place," he urges. To Mr. Jones down the street he whispers, "The Browns aren't doing their share to win the war!" To the Browns: "The Joneses' war efforts are spurred by profiteering, not patriotism. . . ." "No wonder there's no butter, it goes to England." . . . "OUR beefsteak is in Russia." . . . "Our casualties are way higher than they should be . . ."—And so on and on, ad nauseum.

Hitler is counting on his Trojan Horse to win Nazism's greatest victory over America, *internally,* by DIVIDING OUR NATION AGAINST ITSELF, so that IT CANNOT STAND—through deliberately creating Nazi-like racial disunion. He knows that *United We Stand, Divided We Fall* —as others before us fell! Therefore, he's working overtime to divide us! Will he succeed *here,* cancelling-out our European victories into American defeats? It is up to YOU to defeat him decisively, every time he crawls out of the slime which is his natural habitat to rear his ugly head and spew forth his loathesome bilge.

It is up to YOU to throw out his literature, cast out his words, give no credence to the noxious thoughts he seeks to plant in your mind. You can't simply dismiss him as a crackpot or a bore . . . for, REMEMBER, he bores YOUR COUNTRY from *within!*

THE MARK OF EXCELLENCE

Here at Kenyon, we're proud to play our small role on the stage of a BIG war. That's why EVERY Kenyon transformer used by our fighting forces throughout the world reflects only the highest precision craftsmanship. Kenyon workers are doing their full share to bring Victory nearer — by turning out top quality transformers uninterruptedly — and as fast as possible!

KENYON TRANSFORMER CO., Inc.

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

Figure 8 (above)
Image of cathode surface magnified approximately 200 times. Uniformity indicates perfect cathode surface directly under grid aperture.

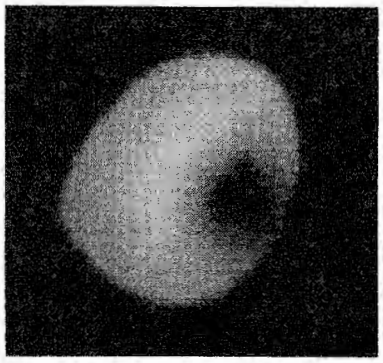


Figure 9 (above)
Image of cathode area at approximately 300 diameters. Dark spot indicates area of incomplete conversion on damaged surface of cathode.

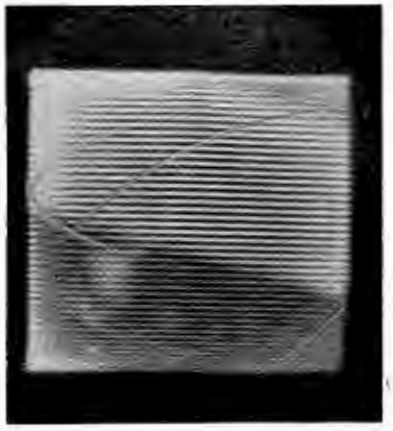
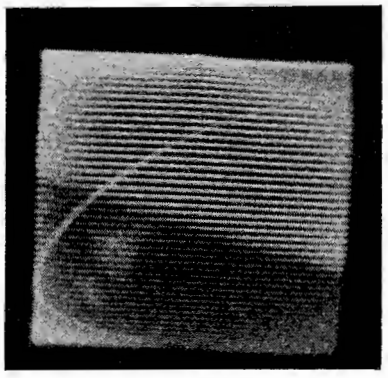


Figure 10 (above)
Background haze shown here reduces contrast of pattern.



and the final anode is 25 volts positive with respect to it. This reading is called the PIB_1 reading and may vary from 100 to 2000 microamperes. A second reading is then taken with the final anode 25 volts negative with respect to the control grid. This reading is best taken on a sensitive light-beam galvanometer, as the current should be in the order of hundredths of a microampere. Finally a third reading is taken, with a negative bias of 70 volts applied to the control grid and the anode 25 volts negative. The gas ratio is then obtained from the equation

$$G_R = \frac{NIb_1 - LIb_1}{PIb_1}$$

It will be apparent that the same readings may be made upon electrostatic tubes, but that the gas-cross test is considerably faster for production test.

Line width is also determined by use of the above-mentioned raster. To make this measurement, the horizontal amplitude is extended to approximately 75% of the face diameter of the tube and the vertical amplitude is then slowly reduced until the light lines of the raster begin to merge; they must not overlap to form a flat field. Figure 3 shows this pattern still holding a light and dark line structure. At this point measurement of the compressed pattern is made. This measurement divided by 49 (being the total number of lines) gives the individual line width. Without adjusting the focus of the beam the pattern is then reversed by interchanging the voltages applied to the plates and a line-width measurement is made at 90° to the first, as shown in Figure 4. If the readings are identical, the spot is considered to be a perfect circle. A variation in readings indicates an astigmatic spot, and the ratio of one to the other gives the degree of astigmatism. Figures 5 and 6 show perfect and astigmatic traces.

With horizontal trace focused to give minimum diameter, Figure 5, the loops are shown to have approximately the same measurements. At the extreme four corners the spot shows a definite rounded shape. With horizontal trace focused to minimum width, Figure 6, the loops show a definite broadening with a slightly hazy edge. The four terminals at the extreme ends of the pattern do not show a well defined spot. If sweep frequencies are reversed to show the pattern at 90° to Figure 6 and no focusing change is made, the pattern in Figure 7 results. Here the spot at the loops appears ellipitical and the trace is poorly defined.

Figure 11 (left)
Pattern on cathode-ray tube having no background haze.

Deflection sensitivities of c-r tubes are usually stated in mm/volt or d-c volts-per-inch. This may also be stated in r-m-s volts-per-inch. Since the c-r tube beam has no inertia, it always responds to peak voltages. Deflection sensitivity measurements made using an a-c and r-m-s voltmeter may be converted to d-c volts-per-inch readings by the following formula

$$\frac{\text{r-m-s v} \times 1.41 \times 2}{L} = \text{v/in d-c},$$

where L = total length in inches of deflected line.

This applies to tubes and circuits using balanced deflection. In unbalanced deflection the factor *2* is omitted.

It must also be remembered that deflection sensitivity of any c-r tube will vary with variation of second anode potential; therefore readings of second anode potential must accompany sensitivity measurements.

Although it is common practice to state sensitivity of c-r tubes as stated, it would appear that a more practical statement of sensitivity should be given by a sensitivity factor in mm/v/kv d-c, since deflection sensitivity is a linear function of second anode voltage. Division of this factor by potential in kv applied to second anode at once gives sensitivity.

The c-r screen is also used as a means of checking the emitting surface of the cathode. To do this the focusing potential is reduced considerably below normal operating value. Control grid potential is then varied from 0 to about −10 volts or to a point at which the cathode surface and grid aperture come into focus. A well converted and 100%-emitting surface will be uniformly bright, Figure 8, while a poorly formed or damaged surface will show dark areas, Figure 9. This inspection is necessarily made with a definite negative bias on the grid, as at zero bias there are usually sufficient electrons emitted from the total cathode surface to mask any dark areas directly below the grid aperture.

Spot shift in a c-r tube may be caused by electrical leakage in one or more of the deflection plate circuits. In circuits designed for use of balanced deflection the individual plates are connected to a second anode potential through resistors of 1 to 3

(*Continued on page* 89)

Getting down to EARTH

Let's talk facts. The AR-10-A Receiver shown above is one of the many pieces of precision equipment made by us for the Armed Forces. It has many exclusive features which were developed entirely in our own laboratories . . . The same exclusive features, the same rugged construction, the same unfailing performance found in the AR-10-A have been incorporated in post-war designs for commercial and civilian products. If you are interested in high-grade equipment covered by factory service, we'd like to talk facts with you now.

And face this fact: the war is *not* over! The Sixth War Loan needs your support. Let's all pitch in for the knockout!

We call this our "CASE BOOK." It's the story of Harvey-Wells and their place in Electronics. Send for it today. Your name on your letterhead is sufficient.

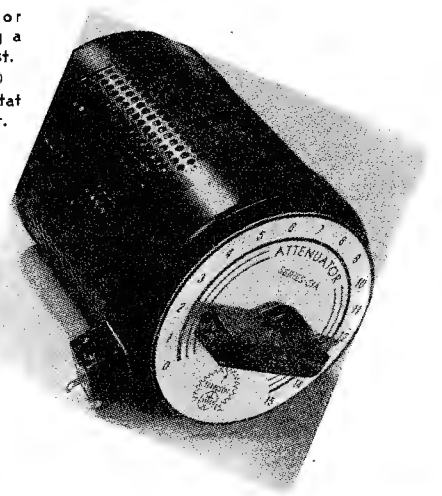
Communications
Aids to Navigation
Electronic Safety Devices

Harvey-WELLS
ELECTRONICS

HARVEY-WELLS COMMUNICATIONS, INC. SOUTHBRIDGE, MASSACHUSETTS

Left, attenuator windings receiving a galvanometer test. (*Courtesy Daven*)

Right, a Clarostat type attenuator.



RESISTIVE ATTENUATOR, PAD AND NETWORK
Theory and Design

In this portion of the paper, the basic theory of simple types of attenuators and networks of the series, shunt and L-taper impedance transforming configurations is shown together with the second set of tables of *hyperbolic functions of a real variable*.

In Part 1, a few of the transformation theorems frequently used by the network design engineer to save labor and affect economies in the construction and actual building of attenuators and networks were given, together with a table of the basic fundamental functions from which the whole series of *hyperbolic functions of a real variable* may be calculated.

In Part 2, the theory of the various simple forms of building out, attenuating and impedance transforming networks is developed. To facilitate the calculation of the insertion and transmission losses and the determination of the network elements, charts are presented. The use of these charts and the tabulations of *hyperbolic functions of a real variable* will be found of inestimable value in simplifying the procedure of design.

[PART TWO OF A FOUR-PART PAPER]

by PAUL B. WRIGHT

Communications Research Engineer

THE term *insertion loss* may be defined as being the loss which results from connecting a network between a source of power and the load to which that source was connected directly before the insertion of the network. It is numerically equal to ten times the logarithm taken to the base ten of the ratio of the power delivered to the load, before and after the insertion of the network. If the ratio of the powers be defined as equal to k^2 and the ratio is always taken so that it is equal to or greater than unity, the use of negative logarithms is avoided. The loss expressed in decibels may be written as

$$db = 10 \text{ Log}_{10} \frac{P_1}{P_2} = 10 \text{ Log}_{10} \frac{E_1^2/Z}{E_2^2/z} = 10 \text{ Log}_{10} \frac{I_1^2 Z}{I_1^2 z} \qquad (1a)$$

and also as

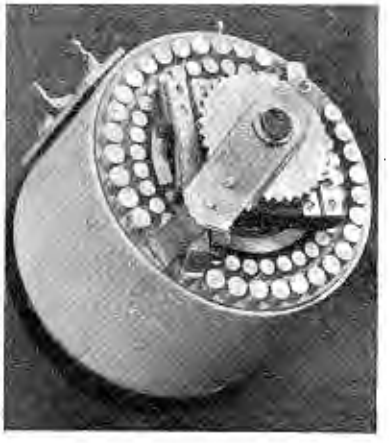
$$db = 10 \text{ Log}_{10} k^2 = 20 \text{ Log}_{10} k \qquad (2a)$$

When the source and load impedances are equal, the factor k may be interpreted as being equal to the current or the voltage ratios. If these impedances are uncqual, the change in impedance level must be taken into account. Care should always be exercised not to inadvertently interpret k as a current or a voltage ratio unless either the conditions of equal terminations are met or their inequality taken into account. The factor k is defined as being the positive square root of the power ratio and therefore is always equal to or greater than unity.

Transmission Loss

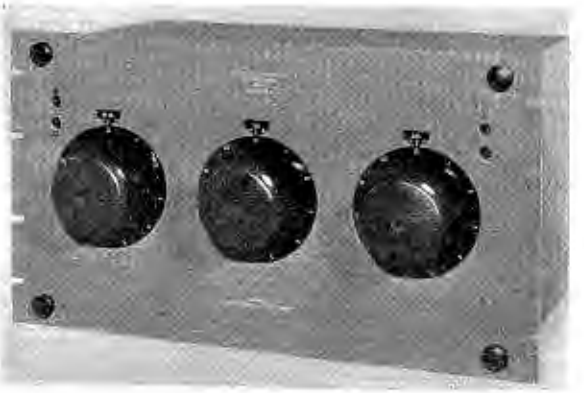
The term transmission loss refers to the loss in received power which results from connecting a network between a source and its load. Numerically, it is defined as being equal to ten times the logarithm taken to the base ten of the ratio of the input power delivered to the network, to the output power delivered to the receiving device or load. Thus the formulae of *1a* and *2a* apply directly simply by taking into consideration the difference in definition. When the network impedances

(*Continued on page 70; charts appear on pages 64, 66, 68*)



Left, attenuator of the bridged-T type. (*Courtesy Cinema Engineering Co.*)

Right, 100-ohm balanced shielded attenuator, relay rack mounting. (*Courtesy Leeds & Northrup Co.*)



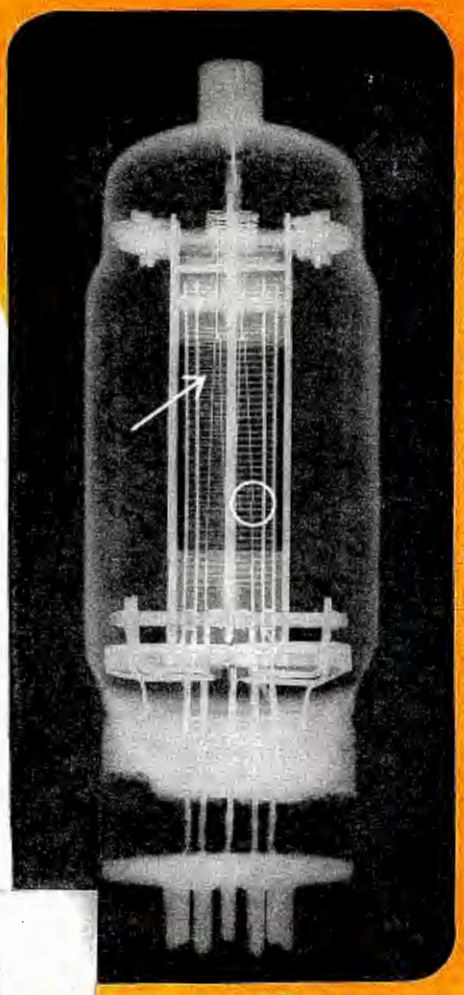
(Continued from page 62)

No (db)	A	B	C	D	E	F	a	b	c	d	e	f	No (db)
$20 \log_{10} e^{\theta}$	$\sinh \theta$	$\cosh \theta$	$\tanh \theta$	$\tanh \frac{\theta}{2}$	$\cosh^2 \theta$	$\sinh^2 \frac{\theta}{2}$	$\operatorname{csch} \theta$	$\operatorname{sech} \theta$	$\coth \theta$	$\coth \frac{\theta}{2}$	$\operatorname{sech}^2 \theta$	$\operatorname{csch}^2 \frac{\theta}{2}$	$20 \log_{10} e^{\theta}$
$20 \log_{10} k$	$\frac{k^2-1}{2k}$	$\frac{k^2+1}{2k}$	$\frac{k^2-1}{k^2+1}$	$\frac{k-1}{k+1}$	$\frac{(k^2+1)^2}{4k^2}$	$\frac{(k-1)^2}{4k}$	$\frac{2k}{k^2-1}$	$\frac{2k}{k^2+1}$	$\frac{k^2+1}{k^2-1}$	$\frac{k+1}{k-1}$	$\frac{4k^2}{(k^2+1)^2}$	$\frac{4k}{(k-1)^2}$	$20 \log_{10} k$
0.00	0.000000	1.00000000	0.000000	0.000000	1.00000000	0.00000000	∞	1.00000000	∞	∞	1.00000000	∞	0.00
.01	.001151	1.00000066	.001151	.000576	1.00000132	.00000033	868.810	.99999934	868.810	1737.02	.99999868	3014082	.01
.02	.002303	1.00000265	.002303	.001151	1.00000530	.00000132	434.216	.99999735	434.217	868.810	.99999470	754829	.02
.03	.003454	1.00000596	.003454	.001727	1.00001192	.00000298	289.519	.99999404	289.520	579.039	.99998808	335285	.03
.04	.004605	1.00001060	.004605	.002303	1.00002120	.00000530	217.155	.99998940	217.158	434.217	.99997880	188543	.04
.05	.005757	1.00001657	.005757	.002878	1.00003314	.00000828	173.702	.99998343	173.704	347.463	.99996686	120730	.05
.06	.006908	1.00002386	.006908	.003454	1.00004772	.00001192	144.760	.99997614	144.763	289.520	.99995228	83820.8	.06
.07	.008059	1.0000325	.008059	.004030	1.0000650	.0000162	124.085	.99996750	124.088	248.139	.99993500	61571.9	.07
.08	.009211	1.0000424	.009211	.004605	1.0000848	.0000212	108.566	.99995760	108.570	217.158	.99991521	47155.5	.08
.09	.010362	1.0000537	.010361	.005181	1.0001074	.0000268	96.5065	.99994630	96.5116	193.013	.99989261	37252.9	.09
.10	.011513	1.0000663	.011513	.005757	1.0001326	.0000331	86.8583	.99993370	86.8591	173.704	.99986742	30175.0	.10
.11	.012665	1.0000802	.012664	.006332	1.0001604	.0000401	78.9578	.99991981	78.9591	157.928	.99983963	24990.3	.11
.12	.013816	1.0000954	.013815	.006908	1.0001908	.0000477	72.3798	.99990461	72.3868	144.763	.99980924	20954.4	.12
.13	.014967	1.0001120	.014966	.007484	1.0002240	.0000560	66.8137	.99988801	66.8206	133.618	.99974027	17852.9	.13
.14	.016119	1.0001299	.016117	.008059	1.0002598	.0000649	62.0386	.99987012	62.0466	124.088	.99979024	15396.1	.14
.15	017270	1.0001491	.017268	.008635	1.0002982	.0000746	57.9039	.99985092	57.9125	115.808	.99970189	13410.4	.15
.16	.018422	1.0001697	.018419	.009211	1.0003394	.0000848	54.2829	.99983030	54.2921	108.570	.99966071	11785.5	.16
.17	.019573	1.0001915	.019570	.009786	1.0003830	.0000957	51.0908	.99980854	51.1006	102.187	.99961715	10441.1	.17
.18	.020725	1.0002148	.020720	.010361	1.0004296	.0001074	48.2509	.9997850	48.2613	96.5116	.9995702	9314.32	.18
.19	.021876	1.0002392	.021871	.010937	1.0004785	.0001196	45.7122	.9997611	45.7231	91.4327	.9995217	8358.94	.19
.20	.023028	1.0002652	.023022	.011513	1.0005305	.0001326	43.4254	.999735	43.4369	86.8591	.9994698	7544.4	.20
.25	.028787	1.0004144	.028775	.014392	1.0008290	.0002072	34.7379	.999586	34.7523	69.4902	.9991717	4826.3	.25
.30	.034546	1.0005964	.034525	.017268	1.0011931	.0002982	28.9218	.999404	28.9641	57.9125	.9988083	3353.4	.30
.35	.040306	1.0008122	.040273	.020145	1.0016251	.0004061	24.8102	.999189	24.8303	49.6403	.9983775	2462.4	.35
.40	.046068	1.0010604	.046020	.023022	1.0021219	.0005302	21.7070	.998941	21.7300	43.4369	.9978826	1886.1	.40
.50	.057597	1.0016574	.057502	.028775	1.0033175	.0008287	17.3620	.993473	17.3908	34.7523	.9966935	1206.7	.50
.60	.069113	1.0023870	.068968	.034525	1.0047797	.0011935	14.4649	.997619	14.5036	28.9641	.9952430	837.87	.60
.70	.080678	1.0032500	.080417	.040274	1.0065105	.0016250	12.3950	.996762	12.4352	24.8303	.9935316	615.38	.70
.80	.092234	1.0042444	.091844	.046020	1.0084906	.0021222	10.8420	.995773	10.8880	21.7300	.9915649	471.21	.80
.90	.103802	1.0053740	.103249	.051762	1.0107750	.0026852	9.63373	.994656	9.68549	19.3190	.9893380	372.41	.90
1.00	.115384	1.006635	.114623	.057501	1.013314	.0033175	8.66671	.993409	8.72418	17.3908	.986861	301.43	1.00
1.10	.12698	1.00803	.125968	.063237	1.016124	.0040150	7.87526	.992034	7.93852	15.8135	.984132	249.07	1.10
1.20	.13860	1.00956	.137287	.068968	1.019211	.0047797	7.215007	.990531	7.28401	14.5036	.981151	209.21	1.20
1.30	.15023	1.01122	.148563	.074695	1.022566	.0056109	6.656460	.988904	6.73115	13.3878	.977932	178.22	1.30
1.40	.16188	1.01302	.159799	.080417	1.026210	.0065105	6.177415	.987147	6.25786	12.4352	.974459	153.60	1.40
1.50	.17356	1.01495	.170999	.086134	1.030123	.0074744	5.761696	.985270	5.84800	11.6099	.970758	133.79	1.50
1.60	.18525	1.01702	.182150	.091844	1.034330	.0085068	5.398111	.983265	5.48998	10.8880	.966809	117.54	1.60
1.70	.19697	1.01921	.193257	.097549	1.038789	.0096073	5.076915	.981152	5.17457	10.2512	.962659	104.09	1.70
1.80	.20872	1.02155	.204317	.103248	1.043564	.0107750	4.791108	.978905	4.89435	9.68549	.958255	92.8077	1.80
1.90	.22050	1.02402	.215328	.108939	1.048617	.0120104	4.535147	.976543	4.64408	9.17938	.953637	83.2623	1.90
2.00	.23230	1.02663	.226274	.114624	1.05396	.013314	4.3048	.974061	4.41942	8.72419	.94880	75.1119	2.00
2.10	.24413	1.02937	.237164	.120298	1.05960	.014685	4.0962	.971468	4.21649	8.31266	.94376	68.0967	2.10
2.20	.25600	1.03225	.248001	.125968	1.06554	.016124	3.9062	.968758	4.03224	7.93848	.93850	62.0193	2.20
2.30	.26790	1.03527	.258773	.131627	1.07178	.017632	3.7327	.965932	3.86439	7.59713	.93304	56.7167	2.30
2.40	.27984	1.03842	.269486	.137283	1.07832	.019209	3.5734	.963001	3.71077	7.28423	.92738	52.0532	2.40
2.50	.29181	1.04171	.280126	.142925	1.08516	.020854	3.4266	.959960	3.56982	6.99671	.92153	47.9534	2.50
2.60	.30383	1.04514	.290704	.148563	1.09232	.022566	3.2914	.956810	3.43992	6.73120	.91580	44.3144	2.60
2.70	.31588	1.04870	.301211	.154185	1.09977	.024352	3.1658	.953562	3.31993	6.48569	.90927	41.0645	2.70
2.80	.32797	1.05241	.311637	.159799	1.10757	.026210	3.0490	.950200	3.20886	6.25792	.90288	38.1527	2.80
2.90	3.4011	1.05626	.321995	.165402	1.11566	.028128	2.9401	.946737	3.10564	6.04587	.89631	35.5524	2.90
3.00	.35230	1.06024	.332283	.170999	1.12409	.030123	2.8384	.943183	3.00948	5.84797	.88959	33.1974	3.00
3.10	.36453	1.06437	.342484	.176587	1.13284	.032182	2.7433	.939523	2.91984	5.69053	.88272	31.0708	3.10
3.20	.37681	1.06864	.352607	.182150	1.14206	.034330	2.6538	.935769	2.83602	5.48988	.87567	29.1286	3.20
3.30	.38913	1.07305	.362649	.187708	1.15140	.036523	2.5698	931923	2.75749	5.32742	.86849	27.3817	3.30
3.40	.40151	1.07760	.372596	.193257	1.16120	.038789	2.4906	.927988	2.68387	5.17447	.86116	25.7802	3.40

$\theta = 0.115129 \times \text{No(db)}$. $\epsilon^{2\theta} = k^2 \geq 1$ the ratio of input and output powers of resistive networks. $\epsilon = 2.718282$, the mathematical base.

(Continued on page 66)

Why Norelco Tubes give uniformly high performance



INSPECTION by X-ray is only one of the many rigid tests applied to NORELCO electronic tubes. Misalignment of elements and similar internal faults, which cannot be seen by close visual inspection, may still permit a tube to function. Spot radiographic inspection by Searchray guards against such "invisible" defects creeping into production runs, thus assuring tubes of high performance and long life.

Typical of the thoroughness of our inspection methods on certain tests is the use of Searchray, the self-contained, rayproof, shockproof, easily operated industrial X-ray apparatus designed and developed by North American Philips. In keeping with this organization's traditional watchfulness over the quality of its products, we make our own X-ray tubes, as well as fine wire for tube manufacture and diamond dies for our own fine wire drawing. These many tests and exacting quality control are reasons why NORELCO electronic tubes, with their consistently uniform characteristics, high performance and long life, should be your choice for postwar industrial use.

Although all the tubes we produce now go to the armed forces, we invite inquiries from prospective users. A list of tube types we are especially equipped to produce will be sent on request.

Unretouched radiograph of a defective NORELCO Type 813 tube taken by a NORELCO Model 150 Searchray, showing fractured filament and, on the left side, a misalignment of control and screen grids, as revealed through the surrounding graphite plate.

A NORELCO Type 813 Beam Power Transmitting Tube.

Let us send you our booklet telling the story of North American Philips. Behind this company is a team of outstanding electronic engineers, headed by one of America's leading physicists, and coached by a group with world-wide experience resulting from fifty years of research and development. Today we work for Victory; tomorrow, our aim will be to serve industry.

NORELCO PRODUCTS: Quartz Oscillator Plates; Amplifier, Transmitting, Rectifier and Cathode Ray Tubes; Searchray (X-ray) Apparatus, X-ray Diffraction Apparatus; Medical X-ray Equipment, Tubes and Accessories; Electronic Measuring Instruments; High Frequency Heating Equipment; Tungsten and Molybdenum products; Fine Wire; Diamond Dies.

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Factories in Dobbs Ferry, N. Y.; Mount Vernon, N. Y. (Metalix Division); Lewiston, Maine (Elmet Division)

(Continued from page 64)

No (db)	A	B	C	D	E	F	a	b	c	d	e	f	No (db)
3.50	.41395	1.08229	.382476	.198795	1.17126	.041153	2.4158	.923967	2.61454	5.03029	.85372	24.3043	3.50
3.60	.42643	1.08713	.392253	.204317	1.18185	.043564	2.3450	.919853	2.54937	4.89443	.84613	22.9550	3.60
3.70	.43898	1.09211	.401956	.209825	1.19269	.046055	2.2781	.915659	2.48784	4.76584	.83844	21.7138	3.70
3.80	.45158	1.09724	.411560	.215328	1.20389	.048617	2.2144	.911378	2.42978	4.64423	.83062	20.5689	3.80
3.90	.46424	1.10251	.421076	.220803	1.21551	.051254	2.1541	.907021	2.37487	4.52893	.82270	19.5111	3.90
4.0	.47696	1.10793	.430505	.226274	1.22751	.053965	2.0965	.902584	2.32286	4.41942	.81466	18.5312	4.0
4.5	.54157	1.13723	.476216	.253398	1.29329	.068615	1.8465	.879330	2.09989	3.94636	.77321	14.5737	4.5
5.0	.60797	1.17031	.519496	.280126	1.36963	.085156	1.6449	.854474	1.92494	3.56982	.73385	11.7436	5.0
5.5	.67638	1.20727	.560259	.306433	1.45750	.103635	1.4784	.828315	1.78489	3.26336	.68611	9.6495	5.5
6.0	.74704	1.24823	.598480	.332283	1.55808	.124116	1.3386	.801134	1.67090	3.00948	.64182	8.0568	6.0
6.5	.82017	1.29332	.634158	.357634	1.67268	.146660	1.2193	.773204	1.57689	2.79615	.59784	6.81848	6.5
7.0	.89602	1.34270	.667325	.382476	1.80284	.171350	1.1160	.744768	1.49852	2.61454	.55467	5.83583	7.0
7.5	.97484	1.39653	.698038	.406771	1.95030	.198265	1.0258	.716061	1.43259	2.45839	.51274	5.04365	7.5
8.0	1.05689	1.45500	.726384	.430505	2.11702	.227499	.94617	.687285	1.37668	2.32285	.47235	4.39563	8.0
8.5	1.14244	1.51828	.752457	.453658	2.30517	.259140	.87532	.658640	1.32898	2.20430	.43381	3.85894	8.5
9.0	1.23178	1.58660	.776364	.476215	2.51730	.293299	.81183	.630279	1.28805	2.09989	.39725	3.40952	9.0
9.5	1.32521	1.66018	.798233	.498165	2.75620	.330089	.75460	.602344	1.25277	2.00737	.36283	3.02953	9.5
10.0	1.42303	1.73925	.818186	.519496	3.02499	.369625	.70274	.574960	1.22222	1.92494	.33058	2.70541	10.0
10.5	1.525558	1.824096	.836336	.540193	3.32733	.412048	.65550	.548217	1.19569	1.85119	.30055	2.42691	10.5
11.0	1.633146	1.914984	.852825	.560259	3.66716	.457492	.61212	.522198	1.17257	1.78489	.37269	2.18583	11.0
11.5	1.746150	2.012222	.867772	.579688	4.04904	.506109	.57270	.496963	1.15238	1.72507	.34698	1.97585	11.5
12.0	1.864943	2.116131	.881298	.598480	4.47801	.558065	.53622	.472561	1.13469	1.67090	.22331	1.79191	12.0
12.5	1.989913	2.227050	.893520	.616635	4.95975	.613525	.50254	.449024	1.11917	1.62170	.20163	1.62992	12.5
13.0	2.121482	2.345354	.904547	.634158	5.50068	.672677	.47136	.426374	1.10553	1.57689	.18179	1.48660	13.0
13.5	2.260081	2.471431	.914485	.651052	6.10797	.735716	.44246	.404624	1.09351	1.53598	.16373	1.35922	13.5
14.0	2.406174	2.605700	.923427	.667325	6.78967	.802849	.41560	.383774	1.08292	1.49852	.14729	1.2456	14.0
14.5	2.560239	2.748604	.931469	.682985	7.55482	.874299	.39050	.363821	1.07357	1.46416	.13236	1.1438	14.5
15.0	2.722782	2.900622	.938691	.698038	8.41361	.950311	.36726	.344754	1.06532	1.43259	.11885	1.0523	15.0
15.5	2.894371	3.062251	.945177	.712504	9.37738	1.031126	.34550	.326557	1.05800	1.40350	.10664	.96982	15.5
16.0	3.075539	3.234026	.950994	.726384	10.4589	1.117013	.32515	.309212	1.05153	1.37668	.09561	.89525	16.0
16.5	3.266912	3.416535	.956206	.739700	11.6727	1.208267	.30610	.292694	1.04580	1.35190	.085673	.82763	16.5
17.0	3.469103	3.610357	.960875	.752457	13.0347	1.305178	.28826	.276981	1.040718	1.32898	.076718	.76619	17.0
17.5	3.682798	3.816150	.965056	.764677	14.5630	1.408075	.27154	.262044	1.036209	1.30774	.068670	.71019	17.5
18.0	3.908691	4.034583	.968797	.776364	16.2779	1.517291	.25584	.247857	1.032208	1.28805	.061435	.65908	18.0
18.5	4.147546	4.266396	.972143	.787549	18.2021	1.633198	.24110	.234390	1.028655	1.26976	.058129	.61230	18.5
19.0	4.400154	4.512356	.975134	.798233	20.3611	1.756178	.22726	.221614	1.025500	1.25277	.049115	.56942	19.0
19.5	4.667341	4.773267	.977808	.808440	22.7841	1.886633	.21426	.209500	1.022695	1.23695	.043890	.53005	19.5
20.0	4.950000	5.050000	.980198	.818186	25.5025	2.025000	.20202	.198020	1.020202	1.22222	.039212	.49383	20.0
20.5	5.24907	5.34348	.982332	.827475	28.5528	2.171600	.190510	.187144	1.017986	1.20850	.035025	.46049	20.5
21.0	5.56553	5.65466	.984239	.836336	31.9752	2.327330	.179682	.176845	1.016013	1.19569	.031276	.42968	21.0
21.5	5.90045	5.98459	.985941	.844778	35.8153	2.49234	.169478	.167095	1.014259	1.18374	.027920	.40123	21.5
22.0	6.25491	6.33434	.987460	.852825	40.1239	2.66715	.159870	.157867	1.012700	1.17257	.024922	.37493	22.0
22.5	6.63012	6.70511	.988816	.860483	44.9585	2.85233	.150822	.149150	1.011310	1.16214	.022246	.35059	22.5
23.0	7.02729	7.09808	.990027	.867772	50.3827	3.04904	.142246	.140889	1.010073	1.15238	.019850	.32797	23.0
23.5	7.44776	7.51459	.991107	.874706	56.4691	3.25729	.134266	.133088	1.008973	1.14324	.017712	.30700	23.5
24.0	7.89282	7.95592	.992069	.881298	63.2967	3.47801	.126696	.125690	1.00799	1.13469	.015798	.28752	24.0
24.5	8.36424	8.42380	.992930	.887566	70.9604	3.71190	.119556	.118715	1.00712	1.12668	.014093	.26941	24.5
25.0	8.86328	8.91951	.993696	.893520	79.5576	3.95966	.112826	.112118	1.00634	1.11917	.012570	.25254	25.0
25.5	9.39170	9.44479	.994378	.899169	89.2041	4.22239	.106476	.105880	1.00565	1.11214	.011211	.23685	25.5
26.0	9.95125	10.00137	.994988	.904547	100.0274	4.50068	.100492	.0999889	1.00504	1.10553	.0099978	.22222	26.0
26.5	10.54379	10.59111	.995532	.909640	112.1716	4.79555	.094844	.0944167	1.00449	1.09934	.0089145	.20852	26.5
27.0	11.17128	11.21595	.996017	.914485	125.7975	5.10792	.089514	.0891612	1.00400	1.09351	.0079497	.19578	27.0
27.5	11.83578	11.87795	.996450	.919078	141.0857	5.43897	.084490	.0841881	1.00356	1.08805	.0070876	.18385	27.5
28.0	12.53953	12.57934	.996835	.923427	158.2398	5.78962	.079748	.0794992	1.00317	1.08292	.0063201	.17273	28.0
28.5	13.28483	13.32241	.997179	.927551	177.4866	6.16120	.075272	.0750662	1.00283	1.07811	.0056349	.16232	28.5
29.0	14.07418	14.10966	.997485	.931469	199.0825	6.55475	.071052	.0708744	1.00252	1.07357	.0050232	.15257	29.0
29.5	14.91017	14.94367	.997758	.935174	223.3313	6.97183	.067068	.0669185	1.00225	1.06932	.0044781	.14344	29.5
30.0	15.79558	15.82720	.998002	.938691	250.5003	7.41360	.063310	.0631848	1.00200	1.06531	.0039923	.13489	30.0
31.0	17.72658	17.75476	.998413	.945177	315.2315	8.37738	.056414	.0562877	1.00159	1.05800	.0031683	.11929	31.0
32.0	19.89281	19.91793	.998739	.950994	396.7239	9.45892	.050270	.0502057	1.00126	1.05153	.0025206	.10572	32.0
33.0	22.32298	22.34537	.998998	.956206	499.3156	10.6726	.044796	.0443493	1.00100	1.04580	.0019669	.092815	33.0
34.0	25.04940	25.06935	.999204	.960875	628.4723	12.0345	.039922	.0398898	1.00080	1.04072	.0015912	.083094	34.0
35.0	28.10819	28.12597	.999368	.965056	791.0702	13.5630	.035576	.0355547	1.00063	1.03621	.0012641	.073734	35.0

2θ

θ=0.115129 × No(db) $\Sigma = k^2 > 1$, the ratio of input and output powers of resistive networks. $\Sigma = 2.718282$, the mathematical base.

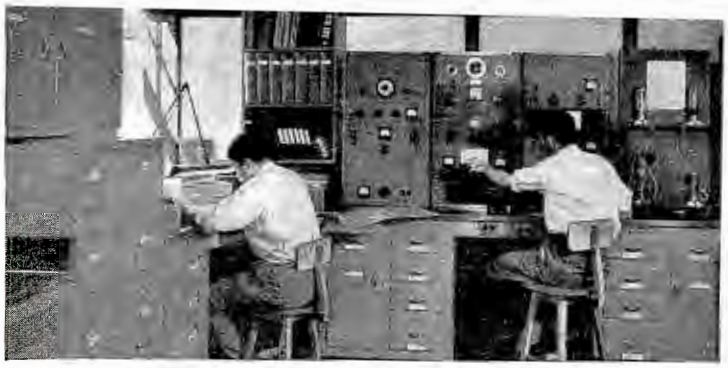
(Continued on page 68)

(Continued from page 66)

No (db)	A	B	C	D	E	F	a	b	c	d	e	f	No (db)
36.0	31.53990	31.55575	.999498	.968797	995.7654	15.2773	.031706	.0316899	1.00050	1.03221	.0010042	.065454	36.0
37.0	35.39017	35.40442	.999601	.972143	1253.4730	17.2017	.028256	.0282453	1.00040	1.02866	7.9780x10⁻⁴	.058129	37.0
38.0	39.71007	39.72266	.999683	.975134	1.5779x10⁹	19.36133	.025182	.0251745	1.00032	1.02550	6.3376x10⁻⁴	.051647	38.0
39.0	44.56694	44.56816	.999748	.977808	1.9863x10⁹	21.78408	.0224432	.0224376	1.00025	1.02270	5.0345x10⁻⁴	.045907	39.0
40.0	49.99500	50.00500	.999800	.980198	2.5005x10⁹	24.50250	.0200020	.0199980	1.00020	1.02020	3.9992x10⁻⁴	.040812	40.0
41.0	56.10465	56.10535	.999841	.982332	3.1478x10⁹	27.55267	.0178268	.0178237	1.00016	1.01799	3.1768x10⁻⁴	.036294	41.0
42.0	62.9423	62.95017	.999875	.984239	3.9627x10⁹	30.97508	.0158872	.0158861	1.00013	1.01601	2.5237x10⁻⁴	.032286	42.0
43.0	70.6233	70.63044	.999900	.985941	4.9886x10⁹	34.81522	.01413590	.0141589	1.00010	1.01426	2.0047x10⁻⁴	.028723	43.0
44.0	79.2406	79.24780	.999920	.987460	6.2801x10⁹	39.12390	.0126186	.0126186	1.00008	1.01270	1.5923x10⁻⁴	.025558	44.0
45.0	88.9112	88.91676	.999937	.988816	7.9062x10⁹	45.95838	.0112468	.0112467	1.00006	1.01131	1.2649x10⁻⁴	.022747	45.0
46.0	99.7606	99.76560	.999950	.990027	9.9531x10⁹	49.38280	.0100238	.0100236	1.00005	1.01007	1.0047x10⁻⁴	.019954	46.0
47.0	111.9339	111.9384	.999959	.991107	1.2530x10¹⁰	55.46920	8.9339x10⁻³	8.9337x10⁻³	1.000040	1.00897	7.9811x10⁻⁵	.018027	47.0
48.0	125.5923	125.5963	.999968	.992069	1.5774x10¹⁰	62.29815	7.9622x10⁻³	7.9630x10⁻³	1.000032	1.00799	6.3393x10⁻⁵	.016062	48.0
49.0	140.9174	140.9209	.999975	.992930	1.9839x10¹⁰	69.96045	7.0962x10⁻³	7.0960x10⁻³	1.000025	1.00712	5.0353x10⁻⁵	.014294	49.0
50.0	158.1123	158.1155	.999980	.993696	2.5000x10¹⁰	78.55776	6.3245x10⁻³	6.3245x10⁻³	1.000020	1.00634	4x10⁻⁵	.012730	50.0
51.0	177.4051	177.4079	.999984	.994378	3.1474x10¹⁰	88.20194	5.6368x10⁻³	5.6367x10⁻³	1.000016	1.00565	3.1772x10⁻⁵	.011337	51.0
52.0	199.0524	199.0549	.99987	.994988	3.9623x10¹⁰	99.02740	5.0237x10⁻³	5.0236x10⁻³	1.000013	1.00504	2.5226x10⁻⁵	.010099	52.0
53.0	223.3408	223.3428	.9999910	.995534	4.9882x10¹⁰	111.17140	4.4775x10⁻³	4.4774x10⁻³	1.000010	1.00449	2.0047x10⁻⁵	8.9954x10⁻³	53.0
54.0	250.5927	250.5947	.9999920	.996017	6.2797x10¹⁰	124.79735	3.9906x10⁻³	3.9905x10⁻³	1.000008	1.00400	1.5924x10⁻⁵	8.0128x10⁻³	54.0
55.0	281.1699	281.1717	.9999936	.996450	7.9057x10¹⁰	140.08584	3.5566x10⁻³	3.5565x10⁻³	1.000006	1.00356	1.2649x10⁻⁵	7.1386x10⁻³	55.0
56.0	315.4775	315.4790	.9999952	.996835	9.9527x10¹⁰	157.23950	3.1698x10⁻³	3.1698x10⁻³	1.000005	1.00317	1.0047x10⁻⁵	6.3597x10⁻³	56.0
57.0	353.9722	353.9737	.9999958	.997178	1.2529x10¹¹	176.48684	2.8250x10⁻³	2.8250x10⁻³	1.000004	1.00283	7.9806x10⁻⁶	5.6659x10⁻³	57.0
58.0	397.16302	397.16428	.9999968	.997485	1.5739x10¹¹	198.08214	2.5178x10⁻³	2.5178x10⁻³	1.0000032	1.00252	6.3397x10⁻⁶	5.0484x10⁻³	58.0
59.0	445.62494	445.62606	.9999975	.997758	1.9883x10¹¹	222.31303	2.2440x10⁻³	2.2440x10⁻³	1.0000025	1.00225	5.0338x10⁻⁶	4.4981x10⁻³	59.0
60.0	499.99950	500.00050	.9999980	.998002	2.5x10¹¹	249.50025	2x10⁻³	2x10⁻³	1.0000020	1.00200	4x10⁻⁶	4.0082x10⁻³	60.0
65.0	889.13922	889.13978	.9999937	.998875	7.9057x10¹¹	444.06989	1.1247x10⁻³	1.1247x10⁻³	1.0000006	1.00113	1.2649x10⁻⁶	2.2519x10⁻³	65.0
70.0	1581.13884	1581.13916	.9999980	.999368	2.5x10¹²	790.00696	6.3246x10⁻⁴	6.3246x10⁻⁴	1.0000002	1.00063	4x10⁻⁷	1.2657x10⁻³	70.0
75.0	2811.70791	2811.70809	.9999993	.999644	7.9056x10¹²	1405.35404	3.5566x10⁻⁴	3.5566x10⁻⁴	1.0000007	1.00035	1.2649x10⁻⁷	7.1157x10⁻⁴	75.0
80.0	4999.99995	5000.00005	.9999998	.999800	2.5x10¹³	2499.50002	2x10⁻⁴	2x10⁻⁴	1.0000002	1.00020	4x10⁻⁸	4.0008x10⁻⁴	80.0
85.0	8891.39497	8891.39502	.9999999	.999887	7.9057x10¹³	4445.19761	1.1247x10⁻⁴	1.1247x10⁻⁴	1.0000001	1.00011	1.2649x10⁻⁸	2.2496x10⁻⁴	85.0
90.0	1.5811x10¹⁴	1.5811x10¹⁴	1.0000000	.999937	2.5x10¹⁴	7905.69500	6.3246x10⁻⁵	6.3246x10⁻⁵	1.0000000	1.00006	4x10⁻⁹	1.2649x10⁻⁴	90.0
95.0	2.8116x10¹⁴	2.8116x10¹⁴	1.0000000	.999964	7.9056x10¹⁴	1.40578x10⁴	3.5566x10⁻⁵	3.5566x10⁻⁵	1.0000000	1.00004	1.2649x10⁻⁹	7.1132x10⁻⁴	95.0
100.0	5x10¹⁴	5x10¹⁴	1.0000000	.999980	2.5x10¹⁵	2.4995x10⁴	2x10⁻⁵	2x10⁻⁵	1.0000000	1.00002	4x10⁻¹⁰	4x10⁻⁵	100.0
105.0	8.891x10¹⁴	8.891x10¹⁴	1.0000000	.999989	7.9057x10¹⁵	4.4452x10⁴	1.1247x10⁻⁵	1.1247x10⁻⁵	1.0000000	1.00001	1.2649x10⁻¹⁰	2.2496x10⁻⁵	105.0
110.0	1.5811x10¹⁵	1.5811x10¹⁵	1.0000000	.999993	2.5x10¹⁶	7.9056x10⁴	6.3246x10⁻⁶	6.3246x10⁻⁶	1.0000000	1.000006	4x10⁻¹¹	1.2649x10⁻⁵	110.0
115.0	2.8116x10¹⁵	2.8116x10¹⁵	1.0000000	.9999963	7.9057x10¹⁶	1.4058x10⁵	3.5566x10⁻⁶	3.5566x10⁻⁶	1.0000000	1.000004	1.2649x10⁻¹¹	7.1132x10⁻⁶	115.0
120.0	5x10¹⁵	5x10¹⁵	1.0000000	.9999980	2.5x10¹⁷	2.5x10⁵	2x10⁻⁶	2x10⁻⁶	1.0000000	1.000002	4x10⁻¹²	4x10⁻⁶	120.0
125.0	8.891x10¹⁵	8.891x10¹⁵	1.0000000	.9999987	7.9057x10¹⁷	4.4452x10⁵	1.1247x10⁻⁶	1.1247x10⁻⁶	1.0000000	1.000001	1.2649x10⁻¹³	4x10⁻⁷	125.0
130.0	1.5811x10¹⁶	1.5811x10¹⁶	1.0000000	.9999993	2.5x10¹⁸	7.9056x10⁵	6.3246x10⁻⁷	6.3246x10⁻⁷	1.0000000	1.0000006	4x10⁻¹³	2.2496x10⁻⁶	130.0
135.0	2.8116x10¹⁶	2.8116x10¹⁶	1.0000000	.9999958	7.9057x10¹⁸	1.4058x10⁶	3.5566x10⁻⁷	3.5566x10⁻⁷	1.0000000	1.0000004	1.2649x10⁻¹³	1.2649x10⁻⁶	135.0
140.0	5x10¹⁶	5x10¹⁶	1.0000000	.9999980	2.5x10¹⁹	2.5x10⁶	2x10⁻⁷	2x10⁻⁷	1.0000000	1.0000002	4x10⁻¹⁴	7.1132x10⁻⁷	140.0
150.0	1.5811x10¹⁷	1.5811x10¹⁷	1.0000000	.9999993	2.5x10²⁰	7.9056x10⁶	6.3246x10⁻⁷	6.3246x10⁻⁷	1.0000000	1.0000006	4x10⁻¹⁵	4x10⁻⁷	150.0

(Continued on page 70)

Engineering at UTC



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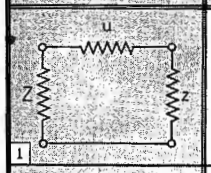
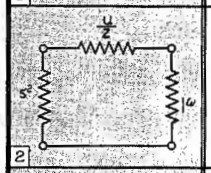
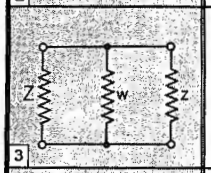
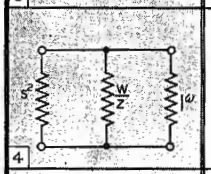
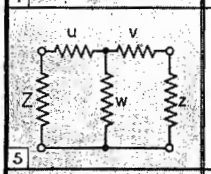
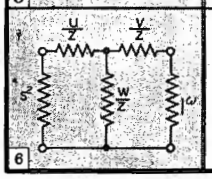
NETWORK	TYPE	IMPEDANCE BASIS	DECIBELS INSERTION LOSS	NETWORK ELEMENT VALUES	REQUIREMENTS
 1	SERIES	FULL	$20\,Log_{10}\,(1+uY_a)$	$u = NZ_a$	$Z \geq z \qquad Z_a = Z + z$ $Y_a = 1/(Z+z) = 1/Z_a$
			$20\,Log_{10}\left(1+\frac{u}{2z}\right)$	$u = 2NZ$	$Z = z \qquad k = \epsilon^{\theta} \geq 1$ $N = k-1 \qquad \theta = 0.115129 \times No\,(db)$
 2	SERIES	UNIT	$20\,Log_{10}\left(1+\frac{u/z}{s^2+1}\right)$	$\frac{u}{z} = N(s^2+1)$	$Z \geq z \qquad s^2 = Z/z \geq 1$ $N = k-1$
			$20\,Log_{10}\left(1+\frac{u/z}{2}\right)$	$\frac{u}{z} = 2N$	$Z \geq z$ $n = k-1$
 3	SHUNT	FULL	$20\,Log_{10}\left(1+\frac{Z_p}{w}\right)$	$w = nZ_p$	$Z = z$ $n = 1/(k-1) \quad Z_p = \frac{Zz}{Z+z}$
			$20\,Log_{10}\left(1+\frac{z}{2w}\right)$	$w = \frac{n}{2}z$	$Z = z$ $n/2 = 1/2(k-1)$
 4	SHUNT	UNIT	$20\,Log_{10}\left(1+\frac{z}{w}\frac{s^2}{s^2+1}\right)$	$\frac{w}{z} = n\frac{s^2}{s^2+1}$	$Z \geq z$ $s^2 = Z/z \geq 1$
			$20\,Log_{10}\left(1+\frac{z}{2w}\right)$	$\frac{w}{z} = \frac{n}{2}$	$Z = z$ $n/2 = 1/2(k-1)$
 5	SERIES AND SHUNT	FULL	$20\,Log_{10}\left(1+Y_a(u+v)+\frac{Y_a}{w}(u+Z)(v+z)\right)$		$Z \geq z$ $Y_a = 1/(Z+z)$
			$20\,Log_{10}\left(1+\frac{u+v}{2z}+\frac{(u+Z)(v+z)}{2wz}\right)$		$Z = z$
 6	SERIES AND SHUNT	UNIT	$20\,Log_{10}\left(1+\frac{u_1+v_1}{s^2+1}+\frac{(u_1+s^2)(v_1+1)}{w_1(s^2+1)}\right)$		$Z \geq z \qquad s^2 = Z/z \geq 1$ $u_1 = \frac{U}{Z} \qquad v_1 = \frac{V}{Z} \qquad w_1 = \frac{W}{Z}$
			$20\,Log_{10}\left(1+\frac{u_1+v_1}{2}+\frac{(u_1+1)(v_1+1)}{2w_1}\right)$		$Z = z$ $u_1 = \frac{U}{Z} \qquad v_1 = \frac{V}{Z} \qquad w_1 = \frac{W}{Z}$

(*Continued from page 62*)

and their terminations are matched, transmission and insertion losses become identical.

Unit Impedance

The placing of network elements and terminations upon a unit basis is a very useful substitution used by the network design engineer to save time. In the case of networks designed to have unequal terminating impedances, all terminations and element values are divided by either the value of the large or the small termination. This places the network on a conditionally unity basis and makes the element values become ohms-per-ohm large terminating impedance, or ohms-per-ohm small terminating impedance. The network is then terminated on a unit basis on one end and either a greater or less than unity value on the opposite end, depending upon which normal full value impedance termination is used for the reduction to unity basis. In this paper, all reductions are made so that the smaller terminating impedance is used for the division process. This places the smaller end at unity termination and the larger termination at $Z/z = s^2$ ohms. The element values are then in ohms-per-ohm small impedance, *z*. When the normal full valued terminations are equal, the terminations of each end of the reduced impedance network are unity.

All of the tables of *hyperbolic functions of a real variable* being presented in this series are on a unit basis. For networks of equal impedance termination, a single constant taken from the table gives the unit element value. It is then only necessary to multiply this constant by the impedance level at which the network is to operate to obtain the full element value. For networks of unequal termination, either one or two unit functions will have to be used per element, depending upon the type of network being considered. These have to be multiplied by the proper impedance coefficient to find the values for the elements. This procedure will involve either addition or subtraction or a quotient, again depending upon the configuration of network involved. Essentially, however, the operations require only the successive use of constants selected from the tables and the impedance levels which are to be used with them.

Figures 1 to 6
The insertion losses and element values given are equally valid for either complex impedances or simple resistances.

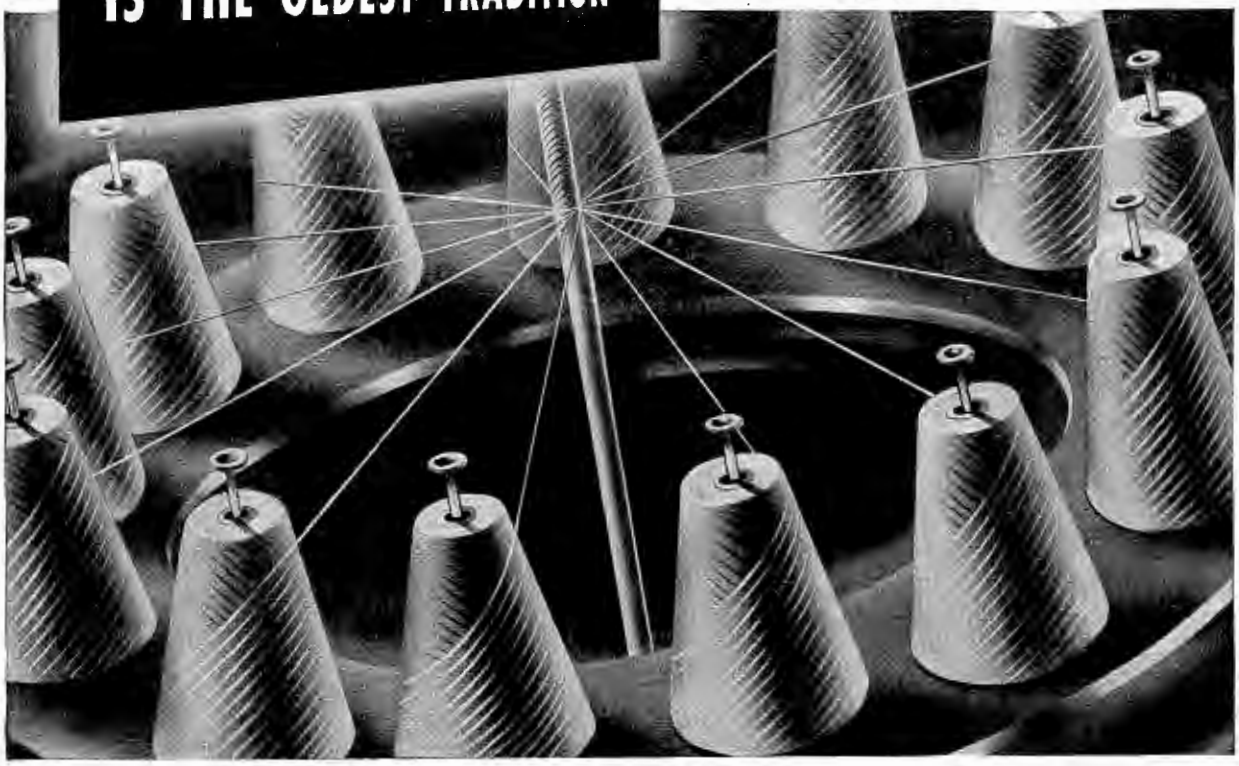
Graphical Representation

By the selection of suitable scales, the unit functions from the tables of functions may be plotted to any desired degree of accuracy for any range of interest. Interpolation for losses, not specifically given, may then be readily made to determine the in-between loss constants. The type of graph paper most suitable will depend upon the ranges of loss it is desired to represent. If the function is changing in magnitude very rapidly, semi-logarithmic paper is indicated, while if the magnitudes are changing at a nearly constant difference rate, linear graph paper should be used. If the range includes both types of differences, a combination type of graph may advantageously be used. Such graphs may be made of the two types of graph paper mentioned, combining them as needed.

Series Impedance

In many cases in communications work, it is necessary to know what the effect will be of inserting a given series impedance in a circuit. For instance, we might have the case of building-out resistances or impedances to make measuring devices read correctly according to their calibration, after which, the effect upon the loss caused by the insertion of the building out impedance may be readily calculated; or the addition of loudspeakers and connecting loops where the lengths

..WHERE LOOKING AHEAD IS THE OLDEST TRADITION



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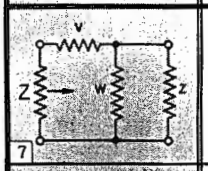
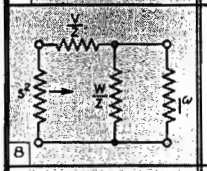
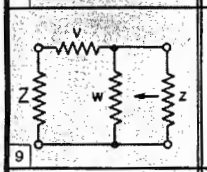
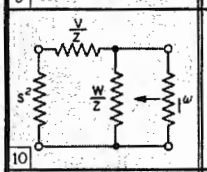
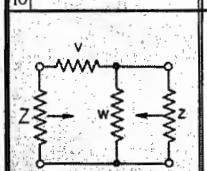
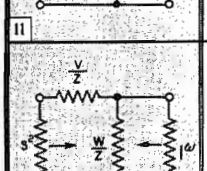
NETWORK	TYPE	IMPEDANCE BASIS	DECIBELS TRANSMISSION LOSS	NETWORK ELEMENT VALUES	REQUIREMENTS
 7	L TAPER CASE I	FULL MATCHED AT SERIES END	$20\,\mathrm{Log}_{10}\left[s\left(1+\frac{z}{w}\right)\right]$	$v = zs(s-r)$ $w = zsr/(1-rs)$	$Z \geq z \qquad S = \sqrt{Z/z} \geq 1$ $r = \epsilon^{-\theta} = 1/k \qquad \theta = .115129 \times \mathrm{No.(db)}$
			$20\,\mathrm{Log}_{10}\left(1+\frac{z}{w}\right)$	$v = Mz$ $w = nz$	$Z = z \;;\; M = (k-1)/k = (1-r)$ $n = 1/(k-1) = r/(1-r)$
 8	L TAPER CASE I	UNIT MATCHED AT SERIES END	$20\,\mathrm{Log}_{10}\left[s\left(1+\frac{z}{w}\right)\right]$	$\frac{v}{z} = s(s-r)$ $\frac{w}{z} = sr/(1-rs)$	$Z \geq z \qquad s^2 = Z/z \geq 1$ $r = \epsilon^{-\theta} \qquad \theta = .115129 \times \mathrm{No(db)}$
			$20\,\mathrm{Log}_{10}\left(1+\frac{z}{w}\right)$	$\frac{v}{z} = M$ $\frac{w}{z} = n$	$Z = z$ $M = (1-r) = \frac{k-1}{k} \qquad n = \frac{r}{1-r} = \frac{1}{k-1}$
 9	L TAPER CASE II	FULL MATCHED AT SHUNT END	$20\,\mathrm{Log}_{10}\left[s\left(1+\frac{v}{Z}\right)\right]$	$v = \sqrt{Zz}\,(k-s)$ $w = \sqrt{Zz}/(s-r)$	$Z \geq z \qquad s = \sqrt{Z/z}$ $k = \epsilon^{\theta} \qquad r = \epsilon^{-\theta}$
			$20\,\mathrm{Log}_{10}\left(1+\frac{v}{Z}\right)$	$v = Nz$ $w = mz$	$Z = z \qquad N = (k-1)$ $m = k/(k-1) = 1/(1-r)$
 10	L TAPER CASE II	UNIT MATCHED AT SHUNT END	$20\,\mathrm{Log}_{10}\left[s\left(1+\frac{v}{Zs^2}\right)\right]$	$\frac{v}{Z} = s(k-s)$ $\frac{w}{Z} = s/(s-r)$	$Z \geq z \qquad s^2 = Z/z \geq 1$ $r = \epsilon^{-\theta} = 1/k \qquad \theta = .115129 \times \mathrm{No(db)}$
			$20\,\mathrm{Log}_{10}\left(1+\frac{v}{Zs^2}\right)$	$\frac{v}{Z} = N$ $\frac{w}{Z} = m$	$Z = z \qquad N = (k-1)$ $m = k/(k-1) = 1/(1-r)$
 11	L TAPER CASE III	FULL MATCHED AT BOTH ENDS	$20\,\mathrm{Log}_{10}\left(s+\sqrt{s^2-1}\right)$	$v = A\sqrt{Zz}$ $w = o\sqrt{Zz}$	$Z \geq z \qquad s = B = \mathrm{Cosh}\theta = (k^2+1)/2k$ $\theta = \mathrm{Cosh}^{-1}s \qquad s^2 = E = \mathrm{Cosh}^2\theta = (k^2+1)^2/4k^2$ $s^2 = Z/z \geq 1 \qquad A = \mathrm{Sinh}\theta\; a = \mathrm{Csch}\,\theta$
			$20\,\mathrm{Log}_{10}\left(s+\sqrt{s^2-1}\right)$	$v = \mathrm{ZERO}$ $w = \mathrm{INFINITY}$	$Z = z$ THIS IS THE LIMITING CASE FOR MINIMUM LOSS. THE NETWORK VANISHES.
 12	L TAPER CASE III	UNIT MATCHED AT BOTH ENDS	$20\,\mathrm{Log}_{10}\left(s+\sqrt{s^2-1}\right)$	$\frac{v}{Z} = As$ $\frac{w}{Z} = as$	$Z \geq z \qquad A = \mathrm{Sinh}\theta = (k^2-1)/2k$ $a = \mathrm{Csch}\theta = 2k/(k^2-1)$ $\theta = \mathrm{Cosh}^{-1}s \qquad s = \mathrm{Cosh}\theta = \sqrt{Z/z} \geq 1$
			$20\,\mathrm{Log}_{10}\left(s+\sqrt{s^2-1}\right)$	$\frac{v}{Z} = \mathrm{ZERO}$ $\frac{w}{Z} = \mathrm{INFINITY}$	$Z = z$ THE ATTENUATION EQUALS ZERO AND THE NETWORK VANISHES

Figures 7 to 12

The transmission losses and element values given are valid for either complex impedances or simple resistances. The insertion losses may be obtained by application of equations 16 or 17 from Figures 5 or 6.

are short enough to neglect the reactive component in comparison to the d-c resistance at audio frequencies.

Referring to Figure 2, the power that would be received from a generator of unit voltage having zero internal impedance in series with an impedance of s^2 is

$$P_1 = 1/(s^2+1)^2 \qquad (1)$$

and after the insertion of a series impedance, the power received is

$$P_2 = 1/\left(s^2+1+\frac{u}{z}\right)^2 \qquad (2)$$

The insertion loss is

$$\mathrm{db} = 10\,\mathrm{Log}_{10}\frac{P_1}{P_2} = 20\,\mathrm{Log}_{10}\left(1+\frac{u/z}{s^2+1}\right) \qquad (3)$$

If a given loss is desired and it is not known what value the series impedance should have to give it, use may be made of the factor k from the definition and equation *3*,

$$k = 10^{db/20} = 1+\frac{u/z}{s^2+1} \qquad (4a)$$

or

$$k-1 = \frac{u/z}{s^2+1} \qquad (4b)$$

from which

$$u/z = (s^2+1)(k-1) = N(s^2+1) \qquad (4c)$$

where $N = k-1$ from the table in *Part 1*. The full impedance value is therefore

$$u = N(Z+z) = NZ_a \qquad (5)$$

where $Z_a = Z+z$ and $s^2 = Z/z$.

To find the element value when the insertion loss is given with the terminating impedances, it is merely necessary to find the loss from the db column of the functions given in *Part 1* and select the constant N. Then we multiply this constant by the sum of the terminal impedances.

Shunt Impedance

Placing a shunt impedance across a circuit reduces the impedance seen from either of the terminal ends and causes a definite insertion loss to the receiving device. As in the series case, the factors of importance are the insertion loss and the circuit element.

On a unit basis, referring to Figure 4, the power that would be received by the unit load, were the shunt not there is

$$P_1 = 1/(s^2+1)^2 \qquad (6)$$

and after placing the shunt on the circuit, the power received is

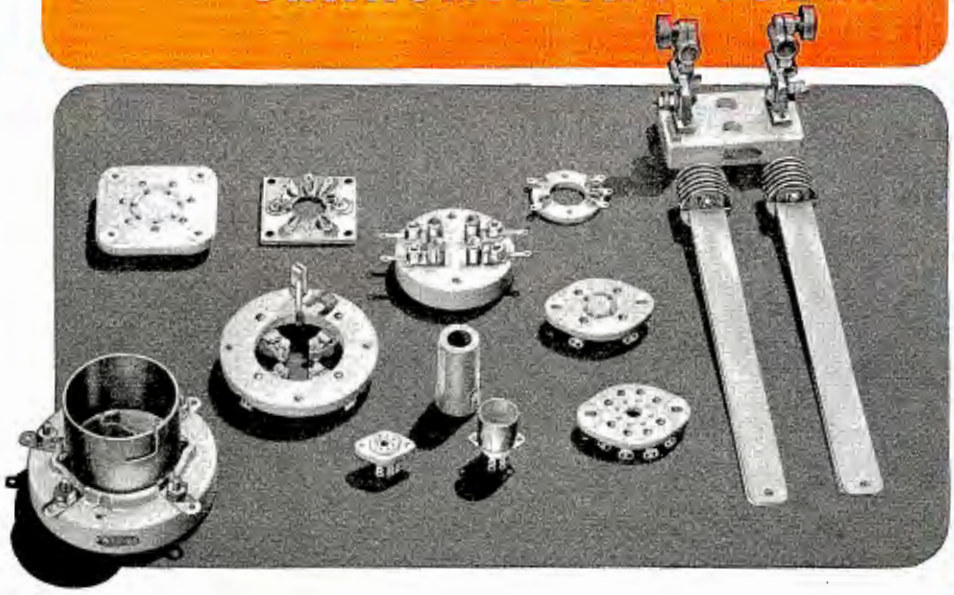
$$P^2 = (w/z)\Big/\left[\frac{w}{z}(s^2+1)+s^2\right]^2 \qquad (7$$

The insertion loss is

$$\mathrm{db} = 10\,\mathrm{Log}\frac{P_1}{P_2} = 20\,\mathrm{Log}\left(1+\frac{z}{w}\frac{s^2}{s^2+1}\right) \qquad (8)$$

When the insertion loss is known and the

Sockets
FOR ALL TRANSMITTING TUBES



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(*Continued from page 72*)

value of the shunt element required, from the definition of k and equation *8*, the unit impedance

$$w/s = \frac{1}{k-1} \cdot \frac{s^2}{s^2+1} \qquad (9)$$

or

$$w = [z/(k-1)]\,[s/(s^2+1)] = nz\,[s^2/s^2+1) = nZ_p \qquad (10)$$

where

$$n = 1/(k-1) \text{ and } Z_p = Zz/(Z+z) \qquad (11)$$

To obtain the element value for a required loss, it is only necessary to find the constant corresponding to n from the table in *Part 1* and multiply it by the parallel impedance of the terminal impedances.

Series and Shunt Impedances

In the general case, neither end of the inserted network provides a match between source and network input nor between load and network output. Further, since there are three unknown quantities, it would be necessary to arbitrarily assign two relationships between the parameters of the network and the terminations in addition to the loss requirement, in order to solve for the element values explicitly as functions of the arbitrary assignments. Since there are numerous varieties of combinations which could be assigned thus arbitrarily, only the insertion loss requirement for this case will be given.

Referring to Figure 6, the power delivered before the insertion of the network by a generator having unit voltage and zero internal impedance in series with a source impedance of s^2 is

$$P_1 = 1/(s^2+1)^2 \qquad (12)$$

and after insertion of the network, the power delivered to the unit load is

$$P_2 = \frac{w_1^2}{[(v_1+1)(u_1+w_1+s^2)+w_1(u_1+s^2)]^2} \qquad (13)$$

The insertion loss is

$$db = 10\,\text{Log}_{10}(P_1/P_2) = 20\,\text{Log}_{10}\left[1+\frac{u_1+v_1}{s^2+1}+\frac{(u_1+s^2)(v_1+1)}{w_1(s^2+1)}\right] \qquad (14)$$

where $u_1 = u/z$, $v_1 = v/z$, and $w_1 = w/z$
The insertion loss in terms of the full impedance elements and terminations is

$$db = 20\,\text{Log}_{10}[1+Y_a(u+v)+Y_a(u+Z)(v+z)/w] \qquad (15)$$

where $Y_a = 1/(Z+z)$, the reciprocal of the sum of the terminal impedances.

When $v = 0$, the insertion loss of the general L or taper pad is obtained with the series arm adjacent to the larger terminating impedance. The loss for this case is, from equation *15*,

$$db = 20\,\text{Log}_{10}[1+uY_a+Y_a(u+Z)z/w] \qquad (16)$$

When $u = 0$, the general L or taper pad is obtained with the series arm adjacent to the smaller terminating impedance. For this case, from equation *15*,

$$db = 20\,\text{Log}_{10}[1+vY_a+Y_a(v+z)Z/w] \qquad (17)$$

For the shunt impedance equal to infinity, or $w = \infty$, the insertion loss reduces to the case of the simple series impedance, $(u+v)$. This $(u+v)$ may be written as a new single value, say u_o, and the loss becomes from equation *15*,

$$db = 20\,\text{Log}_{10}(1+u_oY_a) \qquad (18)$$

which is identically the same form as Fig. 1, where $u_o = (u+v)$, and $Y_a = 1/Z+z)$. For $u = v = 0$, the simple shunt-impedance case is obtained from equation *15* and is shown in Fig. 3, the insertion loss reducing to

$$db = 20\,\text{Log}_{10}(1+Z_p/w) \qquad (19)$$

where $Z_p = Zz/(Z+z)$.

L-Taper Network, Type 1

This is an impedance transforming network which is matched at the series end only, and is shown in Figures 7 and 8 on a full and unit impedance basis, respectively.

Assuming a generator delivering a unit current into an impedance of s^2 and having an internal impedance of zero in series with a source impedance of s^2, the power ratio for Figure 8 is

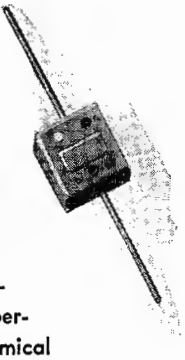
$$P_Z/P_z = s^2\left(\frac{w_1}{w_1+1}\right)^2 = \left(\frac{w_1+1}{w_1}\right)^2 s^2 \qquad (20)$$

From the definition of k and equation *20*,

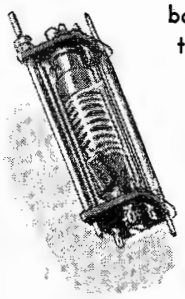
$$k = s\left(\frac{w_1+1}{w_1}\right) = s\left(1+\frac{z}{w}\right) \qquad (21)$$

PRODUCTION TESTING WITH PANORAMIC

Any variation in magnitude which can be converted to a variation in frequency—quantities such as length, permeance, volume, and height—can be more quickly and accurately measured by the PANORAMIC COMPARISON TECHNIQUE. Capacitors, inductors, resistors, and crystals are "naturals" for PANORAMIC production testing. A simple jig and a PANORAMIC COMPARATOR will provide your tester with an unbeatable combination for speed and accuracy on the production line.



In application, the component under test is placed into the jig containing the standard. The chosen tolerance may be established quickly by means of the panel control on the PANORAMIC COMPARATOR. From the deflections which appear on the PANORAMIC screen, deviations from the standard become immediately apparent both as to percentage and type. The instrument is usually adjusted so that a visible deflection indicates that the production unit is within the predetermined tolerance range, while the absence of deflection indicates an error in excess of the permissible tolerance. Coincident deflections indicate zero error; displaced deflections tell their own story regarding the percentage of error. PANORAMIC COMPARISON TECHNIQUE is economical in time and energy . . . but extremely accurate in results.



Our engineers will gladly suggest simple jigs for use in any type of production testing.

PANORAMIC RADIO CORPORATION
242-250 WEST 55TH ST. New York 19, N. Y.

(*Continued from page 74*)

where $w_1 = w/z$ and $s^2 = Z/z$.

From *21*, the element value w/z on a unit basis is

$$w_1 = w/z = s/k - s) = rs/(1 - rs) \quad (22)$$

The input or series side of the network is matched in impedance by its termination; hence we have

$$s^2 = v_1 + \frac{w_1}{w_1 + 1} \quad (23)$$

Solving *22* and *23* simultaneously, eliminating w_1, the unit series impedance becomes,

$$v_1 = v/z = s\frac{ks - 1}{k} = s(s - r) \quad (24)$$

where $v_1 = v/z$, $w_1 = w/z$, and $r = 1/k$.

Multiplying each side of *equations 22* and *24* by *z*, the full impedance values of the network parameters are obtained as

$$v = zs(s - r) \quad (25)$$
$$w = rs/(1 - rs) \quad (26)$$

The transmission loss of the network is

$$db = 20\,Log_{10}\,[s(1 + z/w)] \quad (27)$$

For the special case of a network of this type when $Z = z$, or $s^2 = 1$, equations *21, 22, 24, 25, 26* and *27* reduce to

$$k = 1 + z/w \quad (28)$$
$$w/z = 1/(k - 1) = r/(1 - r) = n \quad (29)$$
$$v/z = (k - 1)/k = 1 - r = M \quad (30)$$
$$v = Mz \quad (31) \qquad w = nz \quad (32)$$

and the transmission loss becomes

$$db = 20\,Log_{10}\,(1 + z/w) \quad (33)$$

where $n = 1/(k - 1)$ and $M = (k - 1)/k$.

Minimum Loss For L-Taper Type 1 Networks

To have a minimum loss for this network, the shunt impedance in the limiting condition must equal infinity. Using equation *26*, then,

$$w = rs/(1 - rs) = \infty \quad (34)$$

from which condition, we find that

$$k = s \quad (35)$$

The minimum transmission loss is therefore

$$db = 20\,Log_{10}\,s = 10\,Log_{10}(Z/z) = 10\,Log_{10}\,k^2 \quad (36)$$

From equations *24* and *35*, the unit series impedance is

$$v/z = s\,(s - r) = (k^2 - 1) = (s^2 - 1) = (Z - z)/z \quad (37)$$

from which the full value of the series impedance for the case of minimum transmission loss becomes

$$v = Z - z, \text{ the difference between the terminating impedances.} \quad (38)$$

The minimum loss condition has degenerated the L-taper into a simple series resistance or impedance having the value specified by either equations *37* or *38*. The tabulated function, k^2, given in *Part 1* may be used to determine directly by inspection what ratio of impedances must be used for a given loss. An interesting comparison which illustrates the difference between dealing with identical sets of conditions utilizing the insertion loss theory, versus the power transmission loss theory, may be made by using a simple example. Assume that the ratio of terminating impedances, $Z/z = 4$, and that $k = s$. Equation *5* gives the unit impedance $u/z = 5$ on an insertion loss basis, and equation *37* gives $v/z = 3$ on a transmission loss basis. Substituting these values in equations *3* and *36*, respectively, the loss obtained for both cases is *6.02* db. Thus, if the basis for calculation were not taken into account, some confusion might arise which apparently would give two entirely different values of impedance in the same kind of circuit having the same configuration and the same terminations.

[*To Be Continued in Dec.* COMMUNICATIONS]

DIRECTIONAL ANTENNAS

(*Continued from page 38*)

was considerably less than the cost of disassembling and reassembling. All material needed, except the skids, track and blocking, which were leased, was purchased new and charged to the job.

AIRCRAFT RECEIVER DESIGN

(*Continued from page 54*)

a small knob so the shaft can be rotated by hand if desired. The receiver, less the band change mechanism dust cover and main dust cover, in shown in Figure 5.

In order that the user might obtain

(*Continued on page 88*)

OHMITE

RESISTORS and CHOKES

for Radio Frequency Applications

Ohmite Dummy Antenna Used in Testing Critical Transmitting Equipment

Here's what *COLLINS RADIO CO.*, well-known transmitter manufacturer, says: *"Within its power range . . . the most convenient to use, the most stable and the most accurate Dummy Antenna we have encountered . . . Used successfully for testing and measuring power output . . . Gives long life without detectable deterioration."*

Proved by use before war came . . . Ohmite R.F. Units today are performing vital functions in the production and operation of vital war equipment. An interesting example is the use of Ohmite hermetically-sealed, glass-enclosed gas-filled dummy antenna resistors by Collins Radio Company, and other well-known manufacturers for testing and measuring power output.

Other Ohmite Units doing specialized jobs in radio frequency applications are Vitreous Enameled Non-Inductive Power-Size Resistors, Parasitic Suppressor and R.F. Plate Chokes.

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VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y. GEORGE H. CLARK, Secretary

De Forest Testimonial

ON September 13, 1944 our association tendered Doctor Lee de Forest, our honorary president, a testimonial dinner commemorating his 71st birthday (which occurred August 26), in the Yacht Room of the Hotel Astor, New York City. Invited were the VWOA officers and directors and early associates of Doctor de Forest. We were proud of this opportunity of paying tribute to one of America's outstanding electronic scientists.

At the Dr. de Forest testimonial, seated, left to right: Charles B. Cooper, one of the early workers with Dr. de Forest, now with Cooper-Di Blasi; Robert H. Marriott; William J. McGonigle, president of VWOA; Doctor Lee de Forest; George H. Clark, secretary of VWOA and historian of radio; and Arthur H. Lynch. Standing, left to right: Raymond F. Guy, radio facilities engineer NBC; Frank Orth, technical supervisor CBS; E. N. Pickerill, one of the pioneers with Doc, now with RCAC; Thompson H. Mitchell, vice president and general manager RCA Communications; Haraden Pratt, vice president and chief engineer Mackay Radio and Telegraph Company; Charles D. Guthrie, director VWOA, and Radio Supervisor War Shipping Administration; J. F. Rigby, personnel director RCAC, and life member VWOA; William E. Beakes, chairman of the board of Tropical Radio and Telegraph Company, and life member VWOA; Roscoe Kent, one of Doc's early proteges, now with Gemex Company; Mr. Roe, program manager RCAC; Wm. C. Simon, director, treasurer and executive secretary VWOA; J. R. Poppele, secretary and chief engineer WOR, director of VWOA; E. J. Simon, also with Doctor de Forest in his pioneering days, now pioneering in aircraft radio devices; A. F. Wallis, Mackay Radio; and Gerald F. Tyne, Bell Laboratories.

Appreciation

FROM Rear Admiral Joseph R. Redman, Director of Naval Communications, we have a note saying, in part: "I have received the certificate and membership card extending to me an honorary membership in the Veteran Wireless Operators Association, Inc. It is a pleasure to be associated with the members of this splendid association, and please extend to them my appreciation of the honor they have conveyed to me."

Meeting Notes

THE Fall get-together was held at 77th Division Club, 28 East 39th Street, New York City, Wednesday, October 25, 1944. . . . Remember that VWOA celebrates its twentieth anniversary in February 1945 with a V-Day Dinner-Cruise, Hotel Astor, New York City.

Boston Personals

ARTHUR STOCKELLBURG, past chairman of the Boston chapter of VWOA reports that Art Erickson at present connected with the Boston Naval Laboratory, was married recently. . . . Guy Entwistle, organizer of the Yankee chapter tells us that many of the local members of VWOA are now on the staff of the Naval Training School (Radio) of the Massachusetts Radio and Telegraph School in Boston and that Francis C. W. Lazenby, formerly attached to the school, is now Chief Warrant Officer out in the Southwest Pacific. . . . Out of Boston, but now one of the world's largest manufacturers of communications receivers, with headquarters in Chicago, Bill Halligan has been doing an outstanding production war job. His organization has built world famous SCR299, and SCR399, the Army's radio equipped trucks. Bill's organization has won the Army-Navy "E" Award for the fourth time. VWOA recently acknowledged the outstanding accomplishments of Bill Halligan by awarding the Marconi Memorial Medal of Achievement. We now extend heartiest congratulations to Bill and his Hallicrafters, many of whom are likewise pioneers in wireless, for the grand job they are doing in bringing victory ever closer. Bill is a life member of VWOA.

The Mailbag

WE received a letter from Australia recently that should interest everyone: "The other day a letter lay on my table, a letter from America in an unknown handwriting. For quite a while I turned it over, speculating on whom it was from. Then I saw the postmark and realized at once that it was from "Doc" Forsyth.

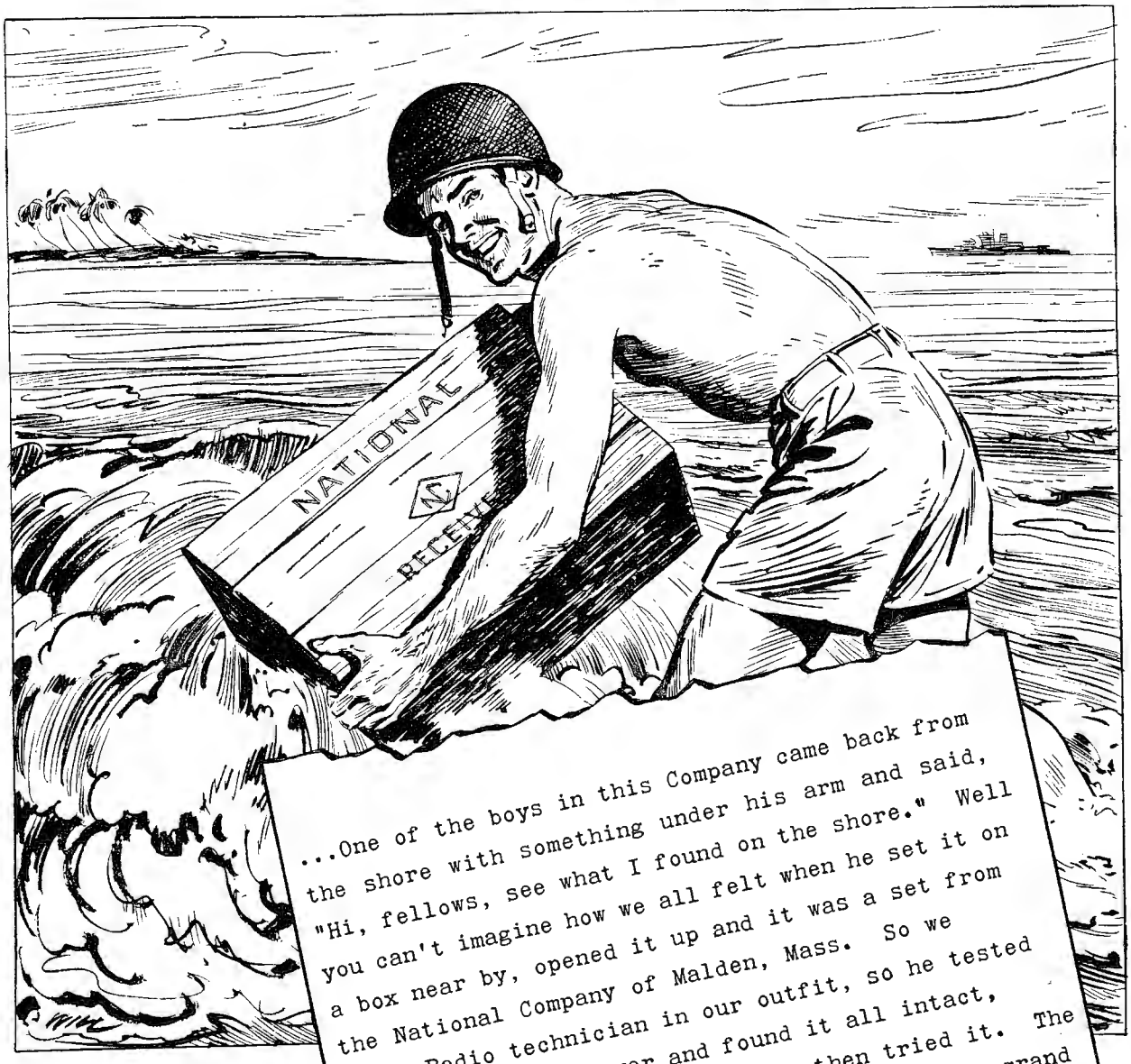
"I have been a subscriber to COMMUNICATIONS for the years and reading your appeal for someone to write him, I did so for I know something of the utter loneliness of the blind. I knew how thrilled he would be to hear from someone in far-off Australia.

"He did'nt say much but, believe me, he is terribly lonely for news of some of his old associates. He tells me that he is a member of the Veteran Wireless Operators Association and has suggested I join. As you are probably aware we cannot send currency out of Australia owing to war conditions.

"Now I have a suggestion to make, and that is, at one of your New York Dinner-Cruises you arrange for him to be present, if this is at all possible. It would certainly be a grand gesture, and so I hope you can see your way clear to do so."—C. A. Cullman, chief engineer broadcast station 7XE.

We deeply appreciate this letter from our Australian associate in wireless.

"HI, FELLOWS, SEE WHAT I FOUND"



...One of the boys in this Company came back from the shore with something under his arm and said, "Hi, fellows, see what I found on the shore." Well you can't imagine how we all felt when he set it on a box near by, opened it up and it was a set from the National Company of Malden, Mass. So we had a Radio technician in our outfit, so he tested it, looked it all over and found it all intact, closed it up again, grounded it, then tried it. The salt water had not hurt it one bit—it gave us grand reception and each night, we, or about 12 of us, listened in and it seemed like a message from home.

(Excerpt from a letter we received from a soldier in the Pacific.)

NATIONAL COMPANY, INC.

MALDEN MASS, U. S. A.

NATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD

CAA FOREIGN ROUTE INSTALLATIONS

(*Continued from page* 35)

tinued on its way to North Africa. To provide the engineering assistance that would be required in commissioning this facility, Coupland, who was then in the closest proximity to the North African project, was dispatched by special Army plane from London to Algeria by way of Gibraltar. This was during the thick of activities in the African campaign. Upon his arrival in Algeria, much to his surprise, Coupland found reposing in a temporary hut closely resembling a pig sty, one very dilapidated and non-operating radio-range transmitter, powered by a small engine generator power plant housed in a tent nearby—the same transmitter that he had several months previous, carefully decommissioned and packed in Lafayette, Indiana, for a destination somewhere in Scotland. Fortunately, he was able to improvise repairs to the transmitter and commission the range without delay, and then return to England to complete his projects there. Coupland was later assigned to Africa and Arabia where he supervised the installation of radio-range equipment at several other projects. To supply the MRL-Z type equipment installed in the United Kingdom, domestic facilities were shipped from such points as Utica, New York; Montpelier, Vermont; Saginaw, Michigan; Ottumwa, Iowa; and Jacks Creek, Tennessee.

A typical CAA installation as made on the domestic Federal Airways would consist of an SRAZ-DT (simultaneous radio range and voice plus v-h-f station location marker with distant control and teletype service) facility located from two to four miles from the airport proper and remotely controlled from that point by Strowger switching (more commonly identified as the telephone dial system) over a single pair telephone line. The control station or DT station would consist of the usual control facilities plus a number of receivers and teletype printers attended by CAA communicator personnel on a 24-hour basis. A *Z* Marker (station location marker) would also be located at the range-transmitter site and serve to supplement the normal cone-of-silence common to the low-frequency radio range, with a v-h-f marker signal. This signal actuates a visual indicator on the pilot's instrument panel and marks his location as directly over the radio-range station. Supplementing the two facilities located at the radio-range site (at our larger terminal stations) would be outlying v-h-f radio aids known as fan markers. These facilities are usually located on all or at least the more regularly used range courses of these more important range facilities at points 20 to 30 miles out from the radio-range site and emit a fan-shaped signal across, and at right angles, to the radio range on-course path of flight, thus positively locating the aircraft for a position fix, or for *holding* or *let-down* purposes. In Figure 3 are sketched the relative positions of the directional signals emitted by these different facilities. (Course alignment computations for the adjustment of directional radio-range facilities will be covered in detail in a paper by CAA engineer Brewer, scheduled to appear in an early issue of COMMUNICATIONS). The facilities transferred from our domestic service and reinstalled at foreign sites for the AAF were made as closely identical to the foregoing typical layout as possible; only a comparatively small number, however, were equipped with fan markers. The installation of certain additional Signal Corps radio equipment such as point-to-point, air-to-ground, and direction-finding facilities were made at the various foreign projects with CAA engineering assistance.

The first contingent of engineers to enter the field following Coupland's

(*Continued on page* 82)

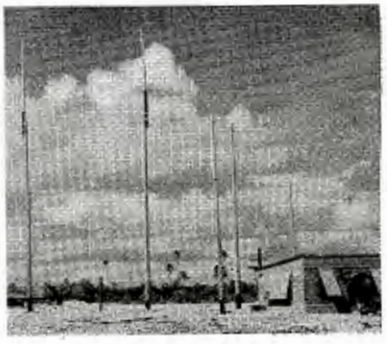


Figure 4
Spliced poles at South Pacific project.

The Stirring Drama of the Men who Built America

Here is a story wrought from the muscle and sinews of our nation! The thrill-filled romance of a man who fought his way to power and riches . . . and the girl who believed in his dreams!

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AN American Romance

starring **BRIAN DONLEVY**

with ANN RICHARDS · WALTER ABEL
JOHN QUALEN · HORACE McNALLY

Screen Play by Herbert Dalmas and William Ludwig
Produced and Directed by KING VIDOR · A Metro-Goldwyn-Mayer Picture

(*Continued from page* 80)

initial work in England in early 1942, were a group of fourteen engineers sent to the Crimson Airway. This airway starting at The Pas, Manitoba, and touching at Churchill, Southampton Island, Frobisher Bay, Baffin Island, and Fort Chimo, Quebec, consisted of standard type SRAZ-D (simultaneous radio range and voice plus v-h-f station location marker and remote control) together with point-to-point and air-to-ground communications and weather reporting stations. Starting in the early fall as it did, this program was conducted under the most severe Canadian and Arctic winter weather. In spite of such weather handicaps, all stations were completed by February of 1943. Much credit for the success of this program is due to radio engineer R. E. Lee of the 3rd Region and civil engineer D. J. Mackie of the 7th Region who supervised, respectively, the radio and civil engineering work on this airway. Radio engineers A. E. Peterson and J. V. Ells of the 7th Region, F. A. Simons of the 5th Region, F. N. Gros of the 2nd Region, M. Keplinger of the 4th Region and W. L. Curtiss of the 3rd Region accomplished excellent work under most unfavorable conditions at their respective projects. Civil engineering work on this airway was carried out by CAA engineers R. J. Alpher, I. L. Ledbetter and H. R. Wendorf of the Washington office and W. L. Mathews and H. C. Orville of the 3rd and 6th Regions, respectively. Radio-range equipment for the Crimson Airway was supplied from such domestic locations as Abilene, Texas; Chanute, Kansas; Duluth, Minnesota; Pierre, So. Dakota; and Peoria, Illinois.

The rehabilitation program on the Northeast Airway starting at Presque Isle, Maine, and including stations in Labrador, Greenland, and Iceland, required the services of 14 radio engineers from early fall of 1942 until the middle of 1943. Under the field supervision of radio engineer Richard P. Battle of the 1st Region, this program embraced the rebuilding of communications and weather reporting facilities at six widespread projects throughout this area. Both high-frequency and low-frequency communication channels were installed at all stations, thus spanning the North Atlantic with dependable communication channels notwithstanding the magnetic storms which so often raise havoc with high-frequency transmissions in this region.

The Southeast Airway started with a communications project at Nassau in the Bahamas Islands where preliminary surveys were made by 7th Region radio engineer C. S. Fuller and the writer in 1942, and included SRAZ-D facilities at projects in Trinidad, British Guiana, Brazil, Ascension Island, African Gold Coast, and on across Africa and India. Under the supervision of such CAA engineers as J. S. Turner of the 4th Region, W. S. Lehman of the Washington office, Robert Hoffer of the 5th Region and Ralph Gaebe of the 7th Region, radio-range sites were literally hewn from the jungle forests of British Guiana and Brazil and carved from the volcanic ashes of the bleak mid-Atlantic outposts of Ascension Island. In less than six weeks after work commenced on Ascension Island, Africa-bound bombers and transports were hitting Ascension *on the nose,* thanks to the CAA directional radio beam.

Every effort was made to meet military deadlines on commissioning dates. As an example, when it was learned that the towers destined for an SRAZ-D facility in British Guiana had been misrouted, thereby delaying the commissioning date of this important facility, a special coupling unit and loop antenna harness was dispatched by air from CAA's Central Depot at Fort Worth, Texas. Radio engineer Turner improvised coupling arrangements and by using the carrier channel of the SRA-type transmitter for r-f power, he was able to place a radio range on the air in less than ten days from the date the military request for this temporary facility was first received. It was often necessary for installation engineers to improvise repairs to equipment received in damaged condition. Copper tubing r-f leads were salvaged from wrecked aircraft fuel lines, and numerous coil supports and forms were necessarily repaired with substitute insulating materials salvaged from the most unusual sources common to a military base. Where antenna supporting poles were too short, additional lengths were spliced on, **Figure 4.**

The Southeast Airway continued through Africa and into India and included stations in Nigeria; Morocco; Mauritania; Egyptian Sudan; Eritrea; Aden; Egypt; Arabia; and throughout India. The radio-range equipment for stations on the Southeast Airway was from such domestic stations as Sheridan, Wyoming; Scotts Bluff, Nebraska; Charleston, West Virginia; Evansville, Indiana; Muscle Shoals, Alabama; Aber-

deen, South Dakota; Garden City, Kansas; Pensacola, Florida; Acomita, New Mexico; Elkins, West Virginia; Rochester, New York; Needles, California; and Morman Mesa, Nevada. In addition to the engineers mentioned above, radio engineers V. M. Clayton and L. E. Clark of the 5th Region; H. L. Cox of the 1st Region; R. E. Meyer and W. L. Curtiss of the 3rd Region; and F. M. Fiolle of the 4th Region installed stations on this airway. Civil engineers Harry Bender and J. B. Blatt of the 5th Region; Robert Boyles of the 2nd Region; and Sam Fritz and Robert Strong of the 4th Region, also contributed materially to the successful completion of this airway.

The foreign program was not without its humorous incidents. Radio engineer Hoffer spent several weeks looking for the switchboard and control cabinet for the 12½-kva engine generator plant on a South Pacific Island project, only to find it partially installed in the base's photographic laboratory. Upon inquiry as to what they were doing with his engine generator equipment, he was told: "Why, that arrived here several months ago and the best we can figure is that it is our new film drier, but we haven't received instructions for hooking it up so we haven't got it going yet." Hoffer convinced the photographers that this particular piece of equipment would work much better in the radio range power plant than it would in their photographic lab.

A classic report submitted by Engineer Coupland is worth quoting at least in part. On many of the foreign projects especially in Africa, Arabia and India, it was necessary to utilize native laborers. For instance, Engineer Meyer's payroll on an African project looked something like this: "Monhagi Ba; Alhadgi Daw; Magatte Nohele; Amadon M'Boop; Siekh Mbengue; M'Bar Jaw; etc." Coupland's report, which follows, covers the results of using a native askari (soldier) as a night watchman at the radio-range project then in the process of being constructed in Arabia:

"An incident has just taken place at this station which could possibly culminate in grave international complications, the full significance of which is not yet clear. A detailed report is, therefore, being furnished you herewith so that you will be conversant with the events leading up to this tragedy. It is first necessary that you he given a picture of events leading up to the serious mental derangement of an askari of the guard of the Sultan of Oman and Muscat.

"This character, a Bedouin tribesman, is assigned to the duty of protecting our radio-range station from pilferers and intruders. He is a fierce man with sharp penetrating eyes, stony of countenance, extremely dignified and tight-lipped. He is black, bearded and barefooted, and dressed in a nightgown that was once white but which has since faded to the color of the desert, due to a shortage of Maytags in this part of the world. About his middle he wears a bandolier of cartridges, some of which fit his antiquated Enfield rifle, the others being carried just for show. Also around his waist is a belt containing two knives in scabbards; one of them a horrible looking Arab meat-ax, and both of them, plus the rifle, ornate with finely designed silver trimmings. He is dignity incarnate.

"Late yesterday afternoon the ventilator fan was connected up; it is situated less than twelve inches to the left of the door leading into the transmitter room. And late last evening the remote control unit was connected to the control line at the control tower. The ventilator fan motor is connected to the remote control equipment dialing system in place of the marker transmitter. The boys in the control tower had tried the control unit out when it was connected.

"This morning when I went to the range I was met at the gate by a very worried and highly agitated askari; he was so excited that

(*Continued on page* 84)

Figure 6

U-h-f directive radiating system; part of radio control link at New Orleans intercontinental station of CAA.

closed eyes—and despite the fact, also, that the building was tightly locked. Next, he heard the dialing mechanism operating, the bang of relays closing and the sound of white men's voices (modulator reactor) faintly coming from within the building. The voice ceased, relays banged again and once more all was normal.

"He crept stealthily toward the door, perhaps a little nervously. By laying his face flat against the bottom sill of the door he could see beneath the door and, to his amazement, two brilliant eyes—one a brilliant red and the other bright green—(**Test** and **Main** indicator lamps of the Z-Marker) stared directly back at him. As he stared in wonderment at this awesome visage which faced him from the dark interior of the building, there was a **v-r-r-m** (sound of siren) right beside him and his nightgown was caught up in the suction of the ventilator fan and almost torn from his body. I'm afraid this was a bit startling for our lonely and nervous guardian, for he took off like a . . . down the road toward the village of Salala, for reinforcements.

"Returning to the range plot with the reinforcements he could not get them to go nearer to the building than the gate leading into the plot, for he had described with such vividness the awesome gremlin which he had seen staring at him from within the darkened building, and the succession of unhappy events which had followed, that he could not prevail upon them to come nearer. The shock of having his nightie almost torn from his body as he was already nervously eyeing the weird thing inside the building, did not contribute to his own bravery; so he and his pals had spent the night near the gate in earnest discussion of this haunted contraption which the "Merican Sahib" had, for three weeks, been working on in the hot desert sun. The re-

(*Continued from page* 83)

he was waving his arms wildly and his command of Arabic must have been something to marvel at, judging by the speed with which an uninterrupted flow of words was coming forth. His eyes were rolling about and he would interrupt the tirade with a buzzing, whistling sound with rising inflection, similar to the sound of a fire siren. He was obviously upset and appeared to be so agitated that I returned the three miles to the base for an interpreter. This is the story of events as related to the interpreter by the askari.

"The askari was lying on his back with his eyes closed when, suddenly, he heard someone inside the building dialing the equipment as he had seen me dialing it for the preceding three or four days. Even as he lay there, the light atop the center pole began to glow; once more he heard the dialing mechanism operating and the light went out again. Three or four times consecutively this light lit up and was extinguished, as he lay there wondering just how he could trap the intruder who had sneaked inside the building despite his vigilance—a vigilance usually exercised with

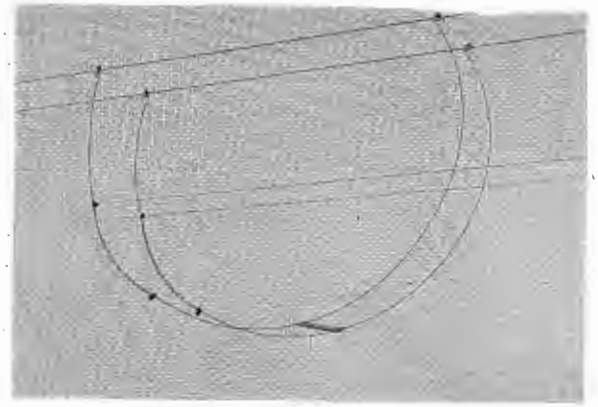


Figure 5

Reentrant network on transmission line used at a CAA transoceanic communications station.

inforcements had deserted him at daylight and he had been waiting by the gate alone for two and a half hours for me to arrive, so that he could render his report on the night's proceedings.'

"The interpreter explained to him what had taken place and a demonstration was made by calling the towerman and having him dial certain functions which were predicted, in advance, to the askari.

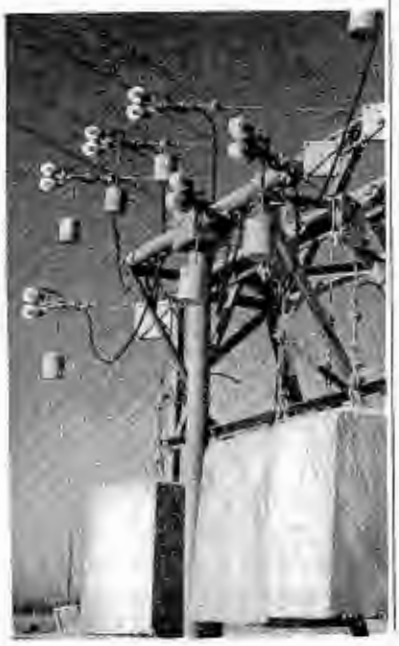
"Except for a deep seated aversion to that ventilator fan, I think he will recover to a certain degree, but just in case you hear the story through diplomatic channels, this account of events will familiarize you with the circumstances which led up to the tragedy of one mentally deranged askari."

A special project rightfully labeled by the Signal Corps as an *Expedition* was dispatched to the bleak Cape Harrison region of Labrador in late September of 1943. CAA radio engineer C. C. VanCott earned the highest praises of both the Army Air Forces and the Signal Corps for supervising the radio portion of this project, consisting of a complete SRAZ-D facility plus point-to-point and air-to-ground communication facilities, which was completed in the record time of 29 days.

Work on the Southwest Airway was started in late 1942 when CAA radio engineers John Lewis and J. D. Mitchell of the 3rd Region and F. L. Geissler and E. T. Anderson of the 2nd Region were assigned to projects in Australia and several remote islands in the South Pacific. The above engineers were later supplemented by civil engineer Samuel H. Englander of the Washington office and engineers Turner, Hoffer and Gaebe, the latter three having previously completed their portion of the Southeast Airway. Under the field supervision of Turner, Englander and Gaebe and working in close cooperation with the 7th Army Airways Communications Region and the Signal Corps, it was possible to complete the South Pacific Airways in early 1944. A number of CAA radio ranges and items of Signal Corps communications equipment were installed under

(*Continued on page* 86)

Figure 7
Counterweight arrangement on receiving antenna at a typical CAA transoceanic station.



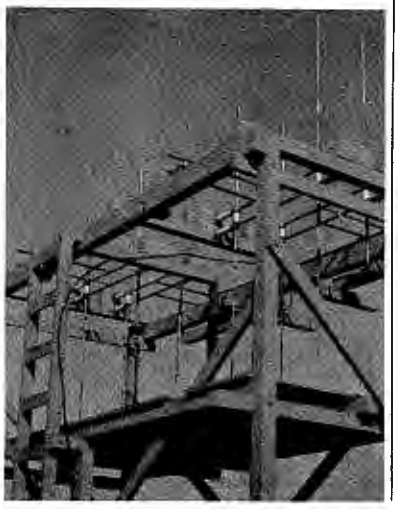
(*Continued from page* 85)

CAA supervision from Canton Island to New Zealand and Australia, including Guadalcanal and Munda and the tropical paradise of Tahiti. The usual outstanding support of the Seabees, so characteristic of that organization, eased tremendously the problems faced by CAA engineers working on Navy and Army projects in both the Pacific and Aleutian areas.

CAA activity in the Aleutian area was carried on under supervision of the CAA's 8th Regional office in Anchorage, Alaska. Marshall C. Hoppin, regional manager, together with Walter P. Plett, Superintendent of Airways, and Glen Goudie, Chief of the Signals Branch, all of the 8th Region, made initial survey trips to the Aleutian areas and made recommendations to both the Army and Navy for project locations to best serve the program at hand. CAA foresight had produced well-equipped airways on the mainland so that military operations over the routes were practically unrestricted when the war began. The important ferry route to Russia was nearly finished before Pearl Harbor. Al Hulen, then Chief, Communications Branch, at Anchorage, and Glen Goudie, Chief of the Signals Branch, developed a communications system throughout the territory that assures maximum service where communications previously were very unreliable. Construction and installation work continued through winter months under extremely adverse weather conditions. Sub-zero temperatures accompanied by high winds failed to stop antenna installations. In the Aleutian Islands, Harvey Aldrich, Goudie's assistant, landed with the troops at Amchitka and Goudie himself was on Adak while Japanese soldiers were still being flushed out of the brushes. Radio engineer Lewis E. Danes of the Anchorage Office was secretly slipped onto an island located between two Jap held islands to start radio installation work.

Engineering assistance to the various Aleutian projects was also furnished through the Airway Extension Sections in Washington. Outstanding work in this connection was performed during 1943

Figure 8
U-h-f directive array in use at New Orleans intercontinental station.



A radio-range tower.

at such strategic projects as Adak, Attu, Amchitka, Umnak and Atka by radio engineers John Lewis, Robert E. Lee and Reedal Ogilvie of the 3rd Region and civil engineers George Barr, Stanley D. Triplett, J. C. Paul and A. O. Durham of the Washington office. The Aleutian projects were completed in early 1944 and are becoming of ever increasing importance in the Air Forces operations against the Kuril Islands.

The CAA having pioneered aeronautical communication and the practical use of radio aids to air navigation on its 35,000 miles of the most scientifically designed and elaborately equipped airways in the world, supplemented these facilities in 1940 with the first of the present five high-powered transoceanic and intercontinental communication stations. These stations, located at Sayville, L. I.; Miami, Florida; New Orleans, La.; San Francisco, California; and Everett, Washington; were born, again of CAA foresight—foresight to plan for the part aviation and aeronautical communications were bound to play in the global expansion of world-wide air commerce. With the entrance of the United States into the war, the facilities of these stations were made available to the Army Airway Communications System and they now serve as key stations for the intercontinental point-to-point and ground-to-air operations of that service. Capable of maintaining direct contact with planes in flight to all parts of the globe, these high-powered radio stations are landmarks to CAA engineering initiative and skill and may well be credited with a great part in helping to hasten the victorious end of the war.

The CAA is grateful to the many branches of the military service with which its personnel were associated in working out the problems of the foreign airways program. There was always excellent liaison between the Navy, the Army Airway Communications System, the Airway Services Branch of the Signal Corps and the CAA. The cooperation of officers and men of these military branches facilitated greatly the accomplishment of urgent and specialized work by our civilian engineers. The opportunity afforded the CAA to directly serve the war effort is considered a patriotic privilege.

Figure 9

San Francisco trans-Pacific communications facilities under construction.

AIRCRAFT RECEIVER DESIGN

(Continued from page 76)

the greatest possible satisfaction from the operation and maintenance of this receiver, we attempted to anticipate the need for as many desirable features as possible, and to this end the following were incorporated:

(*1*)—Two test jacks, one for each output channel, located on the front panel. This enables the operator to test the output of the receiver directly at the receiver.

(*2*)—A right-angle drive mechanism allowing the remote control tachometer shaft to be brought away from the receiver at right angles to variable condenser drive shaft.

(*3*)—An extra variable condenser gang, allowing the use of a low- or high-impedance loop antenna.

(*4*)—Provisions for operation of the receiver on either twelve or twenty-four volts at will by merely using the proper dynamotor and band change mechanism.

(*5*)—Power connector at the rear of the receiver. This makes it necessary to remove from the front panel only the two antenna connections, the loop cable and the remote tachometer shaft, in order to withdraw the receiver from its rack.

Early in the design of the receiver, it was found that the switch wafers in the oscillator circuit had to be made of ceramic material to prevent the oscillator from drifting frequency and thereby going out of track with the other tuned circuits. All bakelite terminal boards used in any part of the receiver were very carefully wax impregnated to cut the moisture absorption to a negligible value. With these precautions, no undue trouble was experienced with the receiver after it had been subjected to 95% humidity at 50° C for forty-eight hours as specified by the Civil Aeronautics Administration. For those who are not intimately acquainted with the provisions of CAA Manual 16, covering performance of equipment, it might be interesting to itemize the various tests, both mechanical and electrical, to which this receiver had to be subjected to prove it acceptable for use in scheduled air transport service, and eligible for Type Certification.

The receiver was placed in a temperature cabinet and the air temperature lowered to —35° C and maintained for a sufficient period to insure that all portions of the receiver were cooled to this temperature. It was then turned on and checked for normal operation as to sensitivity, selectivity, and power output as well as ease of tuning. To further check the operation of both the dynamotor and the band change mechanism under this extremely low temperature, the voltage was reduced 10% below normal. Then we made a study of the band-change motor, to see that it functioned correctly. We also checked the dynamotor to see that it started normally, and the variable condenser, to be sure that it could be tuned without undue effort. With the performance acceptable at —35° C, the temperature of the cabinet was raised to +55° C and the receiver was operated for a period of one hour at a battery voltage 20% above normal. At the end of this period, it was observed that no damage had been done to the receiver and there was no evidence of any overheated resistors or other components.

THE 1944 ROCHESTER FALL MEETING

[*November 13 and 14, Sheraton Hotel (formerly Sagamore) Rochester, N. Y.*]

Monday, November 13

9:30 A.M. "The Reactance Theorem for a Resonator"; *W. R. MacLean, Polytechnic Institute of Brooklyn.*
"A Resonant Cavity Method for Measuring Dielectric Properties at Ultrahigh Frequencies"; *C. N. Works, T. W. Dakin, F. G. Boggs, Westinghouse Electric & Mfg. Company.*
"The RCA Laboratories at Princeton"; *E. W. Engstrom, Radio Corporation of America.*

2:00 P.M. "Low Frequency Compensation of Multistage Video Amplifiers"; *M. J. Larson and A. E. Newlon, Stromberg-Carlson Company.*
"Trends in Receiving Tube Design and Application"; *L. R. Martin, Radio Corporation of America.*
"Standardization of Capacitors for Civilian Equipment"; *J. I. Cornell, Solar Manufacturing Corporation.*

8:15 P.M. "One Look Backwards—and Two Ahead"; *K. W. Jarvis, Sheridan Electro Corporation.*

Tuesday, November 14

9:00 A.M. "Report of RMA Director of Engineering"; *W. R. G. Baker.*
"The Organization of Research in the Radio Industry after the War"; *Rupert Maclaurin, Massachusetts Institute of Technology.*
"Electronic Tube Trends"; *R. M. Wise, Sylvania Electric Products, Inc.*

2:00 P.M. "Silicone Products of Interest to the Radio Industry"; *Shailer L. Bass and T. A. Kauppi, Dow Corning Corporation.*
"Designing Thoriated Tungsten Cathodes"; *H. J. Dailey, Westinghouse Electric & Mfg. Company.*

6:30 P.M. Banquet. *F. S. Barton—Toastmaster; Major-General Roger B. Colton—Speaker.*

CATHODE-RAY TUBE TESTS

(*Continued from page 60*)

megohms. Current flow due to electrical leakage will cause a voltage drop across these resistors and spot shift. To check such leakage on the test set, the beam must be focused to a small spot. One at a time, each lower value resistor is momentarily replaced with a 10-megohm resistor. If any of the plate circuits have electrical leakage, the spot will be deflected toward that plate, due to a greater voltage drop across the 10-megohm resistor.

Other objectionable features of c-r tube screens such as stray emission, haze and halation are also checked on the test equipment. These all tend to increase background illumination and reduce contrast.

Haze is usually due to secondary electrons caught in the high potential

(*Continued on page 102*)

TECHNICAL NOTES

Excerpts from New Home Study Lessons Being Prepared under the Direction of the CREI Director of Engineering Texts

Circuit Equivalents

The November issue of CREI NEWS continues with a discussion of Circuit Equivalents.

First the meaning of physical realizability is taken up and examples of circuits are given that are physically realizable in one form of configuration and not in another. Then the general problem of network synthesis and analysis is discussed so that the reader will be able to appreciate what is meant when it is desired to have one circuit equivalent to the other on a two-terminal basis or on a four-terminal basis.

Part II together with Part I which appeared in last month's issue will enable the reader to understand more completely the significance of the practical examples that are to follow in subsequent issues.

In case you are not aware, these articles, which appear in the CREI NEWS, monthly house organ of the Capitol Radio Engineering Institute, are examples of the material appearing in our advanced lesson section that we believe will be of interest to practicing engineers and students alike. If you have not already written for a free copy, do so now and become better acquainted with our activities.

These articles are available free of charge. Simply write to the Institute and request the November issue of "THE CREI NEWS" containing the article on "Circuit Equivalents."

The subject of "Circuit Equivalents" is but one of many that are being constantly revised and added to CREI lessons by A. Preisman, Director of Engineering Texts, under the personal supervision of CREI President, E. H. Rietzke. CREI home study courses are of college calibre for the professional engineer and technician who recognizes CREI training as a proven program for personal advancement in the field of Radio-Electronics. Complete details of the home study courses sent on request . . . *Ask for 36-page booklet.*

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NEWS BRIEFS

FCC ALLOWS CLEVELAND CABS TO TRY RADIO

The Federal Communications Commission has granted the Yellow Cab Company of Cleveland, Inc., special temporary authority, for a period not to exceed three months, to operate one portable station at a fixed location in the vicinity of Cleveland, Ohio, and two portable-mobile stations on taxicabs. Two-way radio communications will be utilized for the purpose of collecting information regarding the application and usefulness of such a system in the practical operation of a taxicab business.

The stations will use f-m, on the experimental frequency of 118.65 mc, with 15 watts. The portable station will employ a motorola FSRT-15-B transmitter, and the portable-mobile stations will consist of two Motorola FMRT-15-B transmitters to be installed on taxicabs.

The operational data collected by the applicant will be presented to the Commission at the frequency allocation hearings.

* * *

NATIONAL TELEVISION COUNCIL FORMED

To keep the public informed of the latest developments in television and to exchange ideas and experience in the field, the National Television Council, has been formed in Chicago. Richard H. Hooper, regional manager of advertising and promotion for the RCA Victor Division of Radio Corporation of America, has been elected president of the NTC.

Permanent headquarters have been set up in the La Salle Hotel.

Besides regular sessions in Chicago, regional meetings may be held in cities throughout the South and Midwest. The Council also will function as a clearing house for television speakers.

Members of the council include Commander William Eddy, as vice president; Ross Metzger, secretary-treasurer; Don McNeil; Burr Tillstrom; Charles Lyons; and F. K. Starbird.

* * *

DAN FAIRBANKS DEAD

Dan Fairbanks, sales manager of the jobbing division of Cornell-Dubilier Electric Corporation, died recently at the age of 36. He joined Cornell-Dubilier in June of this year after seventeen years with IRC in a similar capacity.

* * *

H. D. MYSING TO HEAD RCA AUTO RADIO SALES ENGINEERING

Herman D. Mysing has been named manager of sales and engineering service for RCA's auto radio department.

Mr. Mysing, whose headquarters are in Detroit, joined RCA in 1935.

* * *

DR. F. B. JEWETT RETIRES FROM BELL LABS

Dr. Frank B. Jewett, vice president in charge of development and research of the American Telephone and Telegraph Company, retired recently, after four decades of service with the Bell System. He also resigned as chairman of the Board of Directors of Bell Telephone Laboratories.

Dr. Jewett announced that he now will devote full time to his work as president of the National Academy of Sciences and as a member of the National Defense Research Committee

of the Office of Scientific Research and Development, as well as to allied war research activities. He will occupy offices at NDRC headquarters in the Empire State Building, dividing his time between New York and Washington.

In honor of Dr. Jewett, A. T. & T. have established a trust fund to finance post-doctorate fellowships in physical science.

Five fellowships will be awarded annually. The fellowships provide an annual honorarium of $3,000 to the holder and $1,500 to the institution at which the recipient elects to do research.

Dr. Mervin J. Kelly, director of research of Bell Telephone Laboratories, has been elected executive vice president of the Laboratories.

Alva B. Clark and Dr. Reginald L. Jones have been elected vice president of the Laboratories.

Dr. Kelly and O. B. Blackwell have been elected to the board of directors of the Laboratories. Mr. Blackwell, formerly vice president of the Laboratories, has been named assistant vice president of A. T. & T.

* * *

CHATTEN NOW WPB RADIO-RADAR DIRECTOR

L. J. Chatten has been appointed director of the WPB Radio and Radar Division, succeeding Ray Ellis, who has returned to General Motors Corporation in New York City. Mr. Ellis has been on leave from General Motors Corporation, since July 1, 1941. He has agreed to continue his association with WPB as a consultant.

Mr. Chatten has been an assistant director of the Radio and Radar Division, with which he has been associated for about 16 months.

* * *

LAFAYETTE RADIO CHANGED TO CONCORD RADIO

The Lafayette Radio Corporation of Chicago and Atlanta, will hereafter be known as the Concord Radio Corporation.

Personnel remains the same with Samuel J. Novick as one of the principals. Addresses are 901 West Jackson Blvd., Chicago 7, Ill., or 265 Peachtree Street, Atlanta 3, Georgia.

The company recently inaugurated a hospital and medical protective insurance plan for all its full-time employees. Over 80% of the employees are said to have availed themselves of the plan.

S. J. Novick

NEW STUDIO FOR DU MONT TELEVISION

The Du Mont television station WABD now has a large studio, two reviewing rooms, a theatre with projected screen images, general offices, dressing rooms, prop room and other accommodations on the second floor of 515 Madison Avenue, N. Y. City.

In the new setup, the control room is raised three feet above the studio floor. Vibrations from the subway under the building have been eliminated by special shielding. These prevent picture shifting, whenever a magnetic field is set up by a subway train. Coaxial cables have been snaked up through conduits from the second floor to the transmitter on the 42nd floor.

* * *

KEN HATHAWAY JOINS WARD LEONARD

Ken Hathaway has been appointed manager of the radio distributor division of Ward Leonard Electric Company. He will be located at 53 West Jackson Blvd., Chicago, Ill.

Mr. Hathaway has been with the WPB Radio and Radar Division for the past 2½ years.

* * *

OTTER AND EICHELBERGER BECOME PHILCO DIVISION MANAGERS

John M. Otter has been appointed sales manager for the home radio division, and Walter H. Eichelberger, sales manager for the refrigerator division of Philco Corporation.

Mr. Otter, with Philco since 1926, has been the company's midwest sales manager for the past four years. Mr. Eichelberger has been with Philco since 1936, most recently as manager of the Atlantic division.

* * *

TEN NEW RMA MEMBERS

Ten new members were approved by the RMA

(*Continued on page 92*)

NEWS BRIEFS

(*Continued from page 91*)

board of directors at its recent meeting in New York. They are: Arpin Manufacturing Company, Orange, N. J.; Airadio, Incorporated, Stamford, Conn.; C. G. Conn, Ltd., Elkhart, Ind.; Fada Radio & Electric Co., Inc., Long Island City, N. Y.; General Laminated Products, Inc., Chicago; Harvey Radio Laboratories, Inc., Cambridge, Mass.; Micro Switch Corporation, Freeport, Ill.; Ohmite Manufacturing Company, Chicago; Panelyte Division, St. Regis Paper Company, New York, N. Y.; and United States Radium Corporation, New York, N. Y. A new associate member is Wesley Block & Company, New York City.

* * *

RADIO INDUSTRY COMMITTEE TO RAISE FUNDS FOR KISCH MEMORIAL LABORATORIES

A radio and allied industries committee has undertaken to raise $50,000 for the Kisch Memorial Laboratories. This memorial project is designed to establish laboratories for electrical and industrial engineering at the Hebrew Institute of Technology in Haifa, Palestine, as a memorial to Brigadier General Frederick H. Kisch, late chief engineer of the British Eighth Army. The national goal is $500,000, needed for the building of the laboratories.

Field Marshal Bernard L. Montgomery is honorary chairman and Professor Albert Einstein is chairman of the sponsors committee for the project.

* * *

ANSONIA ELECTRIC WINS "E"

The Ansonia Electrical Company, Ansonia, Connecticut, has been awarded the Army-Navy "E".

Rear Admiral Wat T. Cluverius, USN, retired, president of the Worcester, Mass. Polytechnic Institute, presented the flag to William J. Weaver, vice president.

* * *

HAMILTON RADIO ANNOUNCES OLYMPIC DIVISION

A separate operating division, Olympic Radio and Television, has been formed by Hamilton Radio Corporation. The division will handle marketing, advertising and sales promotion relating to the Olympic line of domestic household radio receivers and radio-phonograph combinations.

Jack F. Crossin is head of the Olympic unit.

* * *

HALLICRAFTERS APPOINTS R. B. FRANK

Raymond B. Frank, formerly Naval inspector in charge of radio in zone 3 of the Chicago area, has joined the advertising department of the Hallicrafters Company, Chicago.

He is technical assistant advertising manager in charge of all publications including postwar catalogs.

* * *

TBA APPOINTS COMMITTEE CHAIRMEN FOR FIRST ANNUAL CONFERENCE

The first annual conference of the Television Broadcasters Association, Inc., which is scheduled to be held at the Hotel Commodore in New York City in December, will have eight committee chairmen. They are: Allen B. Du Mont, Du Mont Laboratories (speakers); James McLean, G. E., chairman, and T. J. Bernard, RCA Victor, James Shouse, Crosley, Leonard Cramer, Du Mont Laboratories, and James Carmine, Philco, co-chairmen (displays); Robert L. Gibson, G. E. (reception); Douglas Day, Buchanan & Co., (budget); Ralph Austrian, RKO Tele-

*

VETS TRAIN AT LEWYT

Six discharged warriors from several battlefronts being taught new skills in the Training Center at Lewyt Corporation, Brooklyn, N. Y., to equip them for important jobs in the Lewyt plant.

vision, Worthington Miner, CBS, and William Morris, William Morris Agency, co-chairman, (program); Paul Raibourn, Television Productions, Inc., (awards); Dorman D. Israel, Emerson Radio and Phonograph Company, (panel meetings); William Baltin, Television Broadcasters Association, (publicity).

* * *

WARD PRODUCTS WINS "E"

The Ward Products Corporation has received the Army-Navy "E".

At the presentation ceremonies, R. N. Wiesenberger, president, received the pennant from Major P. E. Murray, Signal Corps.

At Ward "E" presentation, left to right: Major P. F. Murray; H. R. Wiesenberger, vice-president in charge of sales; R. N. Wiesenberger and Flight Sergeant Alory who spoke at the ceremonies.

* * *

R. H. LASCHE NOW FAIRCHILD ENGINEERING DIRECTOR

Russell H. Lasche has been appointed director of engineering and research for the Fairchild Camera & Instrument Corp., New York.

Mr. Lasche has been with the Fairchild company 15 years, and was formerly in charge of the company's sound equipment division.

R. H. Lasche

* * *

POSITION OF JOBBER SECURE IN POSTWAR ERA, SAYS S. W. BERK

The position of the jobber in the postwar era will change materially for the better, according to Sol W. Berk, manager of Concord Radio Corp., 901 W. Jackson Blvd., Chicago.

Mr. Berk said, "With the war came the problem of obtaining small quantities of radio components fast, and the jobber has been the mainstay of the industry in this situation. Many a manufacturer, faced with virtual stoppage of his experiments, and even his production lines, has turned to the jobber for

(*Continued on page* 94)

RAILROAD RADIO FIELD LAB

Rock Island Railway's field laboratory. Inserts show Hallicrafters S-36 used to maintain communication with engine.

NEWS BRIEFS

(*Continued from page 93*)

items which would take months to obtain through former sources.

"This has led to a gradual education of the manufacturer that the jobber is the logical supplier for these items. As a potential source of what heretofore has been termed, samples, the jobber bids fair to replace the so-called short-order departments of many plants. The added cost of doing business with the jobber versus that of buying small orders directly is more than overcome by the speed of delivery."

S. E. Berk

* * *

ELECTRO-VOICE NAME CHANGE

The Electro-Voice Manufacturing Co., Inc., South Bend, Indiana, will hereafter be known as Electro-Voice Corporation.

* * *

GENERAL RADIO IN NEW OFFICE BUILDING

The new office building of the General Radio Company at Cambridge, Mass., is located at 275 Massachusetts Avenue.

The new building is located next door to the manufacturing plant and is connected to it by passageways on each floor.

* * *

NEW JERSEY ZINC LUMINESCENCE CATALOG

A 28-page catalog on the principles and practical applications of luminescence has been issued by the New Jersey Zinc Company, 160 Front Street, New York 7, New York. The catalog, entitled "The ABC of Luminescence," contains a number of charts, tables, diagrams and photographs which illustrate the characteristics, properties, limitations and applications of inorganic luminescent pigments, as well as the terms applicable to this industry.

* * *

MASS & WALDSTEIN COMPANY EXPANDING

The Mass & Waldstein Company of Newark, New Jersey, has purchased a tract of land adjacent to its plant for expansion.

* * *

DIETZ OF W. E. RECEIVES HONORARY DEGREE

Purdue University has awarded an honorary degree of doctor of engineering to J. W. Dietz, industrial relations manager of Western Electric Company's manufacturing department. Mr. Dietz at present is on leave for wartime service with the government.

* * *

G. G. DAVIDGE RETURNS TO HOFFMAN CORP.

G. Gifford Davidge, on active duty with the Navy reserve for the past two years, has rejoined the Hoffman Radio Corporation of Los Angeles, as assistant to the president.

* * *

KEOGH NOW WITH WEBSTER PRODUCTS

Ray J. Keogh has joined the engineering staff of Webster Products, 3825 West Armitage Avenue, Chicago 47. Mr. Keogh was previously with Colonial Radio Corporation.

* * *

EQUITABLE BEARING FOLDER

A 4-page folder has been released by The Equitable Bearing Company, Inc., 4631 Cottage Grove Avenue, Chicago, 15. The folder tells where and how Euitable bearings are being used in the war today. Six special precision bearings for civilian use are illustrated and described also.

* * *

SOUTH BEND PRECISION LATHE CATALOG

An 8-page catalog, No. 150, which illustrates and describes engine lathes, toolroom lathes and precision turret lathes, has been published by the South Bend Lathe Works of South Bend 22, Indiana. The engine and toolroom lathes described have 9", 10", 13", 14½" and 16" swing, with bed lengths from 3' to 12'. The precision turret lathes have 9" and 10" swing with ½" and 1" maximum collet capacity.

* * *

DE GRAW OF HAZELTINE ELECTED TO CONTROLLERS INSTITUTE

Lincoln H. DeGraw, acting controller of Hazeltine Electronics Corporation, New York City, was recently elected a member of the Controllers Institute of America.

* * *

TBA FORMS TELEVISION SPEAKERS BUREAU

A television speakers bureau has been established by the Television Broadcasters Association, Inc., to fill the demand for expert technical and non-technical television lecturers. A list of these speakers may be obtained by writing to Will Baltin, Secretary-Treasurer of TBA, Suite 1038, 500 Fifth Avenue, New York 18.

* * *

BURKE ELECTRIC MOTOR-GENERATOR DATA

A 8-page illustrated bulletin describing d-c motors and generators, a-c syncronous motors and generators, induction motors, motor generators, and ten types of terminal blocks, has been issued by Burke Electric Company, Erie, Pennsylvania.

A separate 4-page folder on the Burke hand-operated generators, which details the several applications of this instrument, has also been released by the company.

* * *

WARD LEONARD PROMOTIONS

Leonard Kebler, president of the Ward Leonard Electric Company for 40 years, has become chairman of the board of directors.

Dawson J. Burns, vice president of the company since 1909, has been elected to succeed Mr. Kebler as president.

Arthur A. Berard has been elevated to executive vice president and general manager, having served successively as salesman, general works manager, and general sales manager. Mr. Berard joined the company in 1920 and was made a director in 1927.

Frank G. Logan has been elected vice president and manager of research and development.

* * *

SCHOTTENBERG, DOYLE AND STARK TO DIRECT ASTATIC SALES

Ray T. Schottenberg, William J. Doyle and Allen J. Stark will direct sales for the Astatic Corporation of Conneaut and Youngstown, Ohio, during the ensuing year.

Mr. Schottenberg will continue as sales manager of the jobber and public address parts

●

WAR DEPT. HONORS TO MOTOROLA

Irene Kesner of Galvin receives the Certificate of Achievement to the Radar-Radio Industries of Chicago in behalf of her company, at ceremonies in Wrigley Field. With Miss Kesner are (from left to right) Mayor Edward J. Kelly; Real Admiral A. S. Carpender, commandant of the Ninth Naval District, and Colonel Chester F. Fordney of the U. S. Marine Corps.

division. Mr. Doyle will be in charge of sales to radio set manufacturers, and Mr. Stark will direct sales in the radio cable connector division.

* * *

PRESS WIRELESS PROMOTES KERRIGAN

E. J. Kerrigan, former assistant managing engineer and rate specialist, has been elected vice president of Press Wireless, Inc. Mr. Kerrigan has been associated with the company for over eight years.

Other new appointments include James Humphry, Jr., former assistant to the general manager of the Christian Science Publishing Society of Boston, Mass., treasurer; J. E. Denning, general attorney of Press Wireless, secretary; director of communications, D. K. de-Neuf, former vice president in charge of traffic; director of manufacturing, Ray H. dePasquale, former assistant general manager; director of research and development, Philip D. Zurian, former vice president in charge of engineering; and director of public relations, Paul Darrow Paddock.

* * *

BOWERS AND BARTLETT JOIN LAWRANCE

Walter Bowers was recently appointed vice president and treasurer of the Lawrance Aeronautical Corporation, Linden, New Jersey.

Thomas Bartlett has joined the staff of the Lawrance Aeronautical Corporation as operations manager.

Walter Bowers

Thomas Bartlett

* * *

RMA MAY HOLD 1945 PARTS TRADE SHOW

Revival in 1945 of the RMA parts trade show by next April or before was recommended both by the parts division executive committee and that of the transmitter division, both unanimously, contingent upon the early defeat of Germany, at a recent RMA meeting. The last RMA trade show was held in 1932.

* * *

NRI CELEBRATES 30TH ANNIVERSARY

The National Radio Institute, 16th and U Sts., N. W., Washington, D. C., celebrated its 30th anniversary recently with a luncheon for the employees.

The entire staff of the Institute was present at the luncheon. Speakers included J. E. Smith, president; E. R. Haas, vice president; J. A. Dowie, chief instructor; Joseph Kaufman, director of education, and Louis L. Menne, graduate service director.

* * *

G. MAY BECOMES ASSISTANT ENGINEER AT HALLICRAFTERS

Glenn May, wounded veteran of the United States Marine Corps, has been appointed assist-

(*Continued on page 96*)

●

BLOWPIPE AS PRODUCTION TOOL

(*Courtesy Westinghouse*)

Before a vacuum pump sucks all air out of a tube, tube's glass exhaust pipe and larger glass support piece must be joined by heating their tips to a pliable state. At the height of heating, channel is kept open by blowing air gently through a pipe.

NEWS BRIEFS

(*Continued from page* 95)

ant engineer in the production department of the Hallicrafters Company, Chicago.

* * *

WCEMA HOLDS INDUSTRY SHOW

The West Coast Electronics Manufacturers' Association held its first annual Electronics Industry Show in the Elks Temple, Los Angeles, recently.

The industry was represented by set manufacturers, radio parts and electronic suppliers with booth displays ranging from tubes to transmitters. Lew Howard, of the Peerless Electric Mfg. Co., Los Angeles, headed the show committee assisted by Bill Gudie, secretary of the association, Sol Smith, secretary of the Los Angeles council, and Herb Becker, of Eitel-McCullough, Inc., secretary of the San Francisco council.

H. L. Hoffman, of the Hoffman Radio Corp., and president of the association, presided at a luncheon.

WCEMA, organized a year ago, now has 55 members.

* * *

IRWIN APPOINTED BY SOUND EQUIP'T

Howard M. Irwin has been named sales and advertising manager of Sound Equipment Corporation, 3903 San Fernando Road, Glendale 4, California.

Norman S. Lawson is president of the company, Delmar Wright is general manager, and David H. Jones, chief engineer.

H. M. Irwin

* * *

ELECTRICAL WHOLESALERS TO MEET IN 1945

The National Electrical Wholesalers Association, 500 Fifth Avenue, New York, will hold its 37th annual convention during the week of April 22, 1945, at The Stevens, Chicago, Illinois.

* * *

DU MONT RECEIVES ATS AWARD

Allen B. DuMont, president of Allen B. DuMont Laboratories, received the American Television Society Award recently, for the year's outstanding contribution to commercial television. The award was presented by Dan D. Halpin, president of ATS, at its opening Fall meeting held in the Museum of Modern Art auditorium.

* * *

RAULAND ADDS VISITRON

The Rauland Corporation of Chicago has purchased the phototube division (Visitron phototube producers) of GM Laboratories, Inc., Chicago.

* * *

AMERCOAT CATALOG

A 16-page catalog describing Amercoat plastic coatings, has been released by the American Pipe and Construction Co., P. O. Box 3428 Terminal Annex, Los Angeles 54, California.

* * *

ADELMAN JOINS CLAROSTAT

Leon L. Adelman has been appointed advisory

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HANDIE-TALKIE AIDS PLANE MAKERS

Lieutenant H. W. Nelson of Douglas Aircraft Police Department receiving message via Motorola handie talkie, to be broadcast over Douglas police radio-telephone system to Douglas police patrol car three miles away.

sales manager of Clarostat Mfg. Co., Inc., Brooklyn, N. Y. Mr. Adelman will also act as metropolitan New York sales representative, serving the jobbers in that area.

* * *

WESTINGHOUSE TO BUILD HOME SETS AT SUNBURY, PA.

The Westinghouse Electric and Manufacturing Company plant at Sunbury, Pa., now devoted to the manufacture of war communications equipment, has been selected as the site for production of home receivers.

* * *

HURLEY AND MARA NOW BENDIX EXECUTIVES

William A. Mara of Detroit, former director of personal airplane sales and service for the Consolidated Vultee Aircraft Corporation, has joined Bendix Aviation Corporation as a staff executive.

Roy T. Hurley has been elected vice president of Bendix Aviation Corporation.

The new responsibilities which Hurley, formerly staff executive on production matters, will assume deal particularly with the corporation's requirements for plants and facilities, factory layout and tooling of the corporation's products.

* * *

RECEIVER ADVISORY COMMITTEE HOLDS WASHINGTON SESSION

An organizational meeting of the industry advisory committee representing manufacturers of receivers was held in Washington recently with the Office of Price Administration.

Members of the committee offered advice and information to OPA as to the various factors affecting the pricing of new radios.

Members of the industry advisory committee include: Benjamin Abrams, Emerson Radio and Phonograph Corp., New York, N. Y.; R. C. Cosgrove, Manufacturing Division, The Crosley Corporation, Cincinnati, Ohio; J. J. Nance, Zenith Radio Corporation, Chicago, Ill.; J. M. Spain, Packard-Bell Company; A. B. Wells, Wells-Gardner and Company, Chicago, Ill.; P. S. Billings, Belmont Radio Corporation, Chicago, Ill.; P. V. Galvin, Galvin Manufacturing Company, Chicago, Ill.; E. E. Lewis, Radio Corporation of America, New York, N. Y.; F. A. Nicholas, Farnsworth Radio and Television Corp., Fort Wayne, Ind.; and Fred D. Williams, Philco Corporation, Philadelphia, Pa.

* * *

SYLVANIA TO SPONSOR SIXTH WAR LOAN CONTEST

Sylvania Electric Products, Inc., have announced that they will offer over 500 war bond prizes to retail radio stores and service shops participating in a national display contest to promote the sale of war bonds during the sixth war loan. The contest will be directed by the war advertising council at the request of the United States Treasury.

War bond prizes for the best window or lobby displays devoted exclusively to the sixth war bond drive and featuring a $100 war bond will be awarded on a state, sectional and national basis.

Retail radio stores participating in the contest, which will begin with the announcement of the opening of the sixth war bond drive by the United States Treasury, will make photographs of their displays and send them to the

(*Continued on page* 98)

●

RECEIVING FROM FRANCE

The Press Wireless receiver setup for messages from the press, somewhere in France.

NEWS BRIEFS

(Continued from page 97)

Sixth War Bond Drive Display Contest Committee, care of Display World, Cincinnati 1, Ohio.

* * *

PHILCO PROMOTES LESLIE WOODS

Leslie J. Woods, who joined Philco in 1925, has been named manager of the industrial radio division of Philco Corporation with headquarters in Detroit.

Martin F. Shea, who has been with Philco since 1930, has been appointed assistant manager of the industrial radio division.

The industrial radio division will handle the development and sale of auto radios to the motor car industry and also sales of aircraft radio and radar equipment and other industrial electronic devices.

In 1942 Mr. Woods became vice president and general manager of National Union Radio Corporation.

* * *

BAKELITE PLASTIC BOOKLETS

Two new booklets on plastics have been released by the Bakelite Corp., 300 Madison Avenue, N. Y. 17, N. Y. One is entitled the "Catalog of Bakelite and Vinylite Plastics," and contains 24 pages of data on molding and extrusion compounds; laminating plastics; sheets, sheeting, and film; rods and tubing; cast resins; glues and adhesives; bonding materials; coating products; impregnating, sealing, and calendering materials; and special copolymer resins.

The other booklet is entitled "Bakelite Resin Baking Coatings," with 28 pages of data on phenolic resin baking coatings. It includes technical information on the types of surfaces which can be coated with these finishes; methods of application; baking methods and equipment; the properties of bakelite resin baking finishes; and a list of tested and approved applications.

* * *

WESTERN ELECTRIC MAGAZINE

Publication of a 36-page magazine, "The Western Electric Oscillator," was recently announced by Western Electric. Editor is Will Whitmore, with Vance Hilliard, assistant.

Articles include "Radio Fights Its First War," by George de Mare, "FM Goes to War," "You Can't Win a War Without Radio," "A. T. & T. Plans for Television" and "Seventy-Five Years of Pioneering by Western Electric".

* * *

LOFTING METHOD DATA

A 14-page brochure, "Precision Lofting," has been issued by the Template Reproduction Company, 401 North Broad Street, Philadelphia 8, Pennsylvania.

Described are methods affording mechanical reproduction of full-size detail drawings directly on tooling materials.

* * *

LOUISVILLE USING MUNICIPAL 2-WAY F-M

The City of Louisville, Kentucky, is now operating a 2-way f-m police system, designed and installed by Motorola.

The installation consists of a central station with antenna mounted on a 220-foot high self-supporting steel tower with the remotely controlled f-m transmitter and receiver units housed in a building at the base of the tower. One hundred mobile f-m transmitting and receiving units are installed in the police patrol cars and automobiles of city officials.

* * *

BROOKLYN POLYTECHNIC OFFERS RESEARCH COURSES

Fourteen courses covering electrical funda-

ON THE MARSHALL ISLANDS

(Official U. S. Marine Corps Photo)

Transmitting from Radio Kwajalein, in the Central Pacific. Station was constructed and is operated by members of the Fourth Marine Air Wing.

mentals, electronics, communications, microwaves, and industrial applications are now being offered by the Polytechnic Institute of Brooklyn as a part of the ESMWT program. The courses began in the early part of October and will run from nine to twelve weeks. George B. Hoadley, assistant professor in the graduate electrical engineering department, is supervisor of the courses.

* * *

AMERICAN PHENOLIC CONNECTOR BULLETIN

A 28-page booklet describing procedures used in the manufacture and assembly of AN connectors, has been published by the American Pheonolic Corporation, Chicago 50, Illinois. Analyzed are safety wiring methods, flexible conduits, waterproofing, high-frequency cables and connectors, processing beaded cables, soldering, cable clamps, ferrule crimping, etc.

* * *

N. J. FOOT JOINS HALLICRAFTERS

Norman J. Foot has been appointed development engineer of the Hallicrafters Company, Chicago.

Mr. Foot will design new u-h-f and v-h-f equipment.

* * *

UNITED ELECTRONICS WORKER HONORED BY WPB

Mrs. Katherine Schmitt, a top sealing operator at United Electronics Company, Newark, N. J., has been awarded a Commendation for Production Ideas by the Board of Individual Awards of the War Production Board.

* * *

WHITE STAR ADDED TO SYLVANIA "E" FLAG

A white star was recently added to the "E" flag of the Boston Street and Danvers plants of Sylvania Electric Products, Incorporated.

* * *

B-L RECTIFIER BULLETIN

Characteristics and applications of selenium rectifiers appear in a 4-page bulletin, R 41, released by the Benwood Linze Company, St. Louis, Mo. Data supplied include ratings, typical rectifier circuits and regulation charts.

* * *

TIMETER FOLDERS

A 4-page folder describing a quick-reset timeter and its applications has been published by the National Instrument Company, 246 Walnut Street, Newtonville 60, Mass.

* * *

G.R. PROMOTES SINCLAIR

Dr. Donald B. Sinclair has been appointed assistant chief engineer of the General Radio Company, Cambridge, Mass. He will be in charge of circuit development.

* * *

G.E. INSTRUMENT TRANSFORMER GUIDE

A 54-page guide covering ASA accuracy standards for potential and current transformers, and selection information, has been published by G. E.

There are two sections to the guide. The first is devoted to the ASA subject, wherein the difference between the ASA and the NEMA standards are explained; the second includes catalog numbers and prices on G. E. trans-

(*Continued on page* 100)

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GOLF COURSE BROADCASTS

(*Courtesy Galvin*)

Relaying play-by-play during a recent golf tournament, via the handie-talkie.

NEWS BRIEFS

(*Continued from page 99*)

formers that meet ASA standards. Definitions, curves and tables are presented to assist the analyses.

* * *

SWEEP CALIBRATION DATA

A current issue of the "DuMont Oscillographer" contains a discussion of sweep calibration with low frequency standards, prepared by Alexander Sandow, Washington Square College of Arts and Science, N. Y. City.

* * *

WHITE STARS TO PHILCO UNITS

The storage battery division of Philco Corporation, Trenton, N. J., has been awarded a fourth white star for its Army-Navy "E" pennant.

The Simplex Radio and the Chicago divisions of Philco have also won additional white stars.

* * *

DIRECT CAPACITANCE MEASUREMENT DATA

In the September issue of the "General Radio Experimenter" appears an analysis of a method for measuring small direct capacitances. Offered are the theory of the method, sensitivity of balance, examples of measurements, etc. It was prepared by Ivan G. Easton.

* * *

BYRNE APPOINTED MECK AD MANAGER

Harry T. Byrne, formerly of Majestic Radio & Television Corporation, has been appointed advertising and sales promotion manager for John Meck Industries, Plymouth, Indiana.

* * *

ANDREW BULLETIN ON COAXIAL TRANSMISSION LINE

Bulletin No. 29, describing ⅜" diameter coaxial transmission line type 83, and the various accessories and terminals available for this line, is being distributed by the Andrew Company, 363 East 75 Street, Chicago 19, Illinois.

* * *

LIEUT. COL. THOMPSON H. MITCHELL NAMED V-P AND G-M OF RCAC

Lieut. Col. Thompson H. Mitchell has been elected vice president and general manager, and a director of RCA Communications, Inc. He succeeds the late William A. Winterbottom, who had served as vice president and general manager of RCAC since formation of the company until his death on July 8.

Colonel Mitchell, who first joined RCA seventeen years ago, recently has served as Chief of the Traffic Operational Engineering Section of the Engineering Branch of the U. S. Army Communications Service, Washington, D. C.

William H. Barsby has been appointed traffic manager, succeeding the late vice president John B. Rostron, who served as traffic manager of RCAC from 1929 until his death on June 12.

* * *

COOGAN OF SYLVANIA CELEBRATES 25TH YEAR IN FOREIGN SALES

Walter A. Coogan, director of the International Division of Sylvania Electric Products Inc., recently reached the quarter-century mark in his years of foreign sales service. In the 25-year interval he has held just three positions.

From 1919 to 1929 Mr. Coogan was with the Baldwin Locomotive Works. Then he joined the

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SIGNAL CORPS TRAINING

(Signal Corps Photo)

Signal Corps radio instructor discussing f-m walkie-talkie unit with student.

Arcturus Radio Tube Company, opening its export department. In February, 1933, he joined Sylvania, initiating this company's foreign sales, and ten years later, when the work was reorganized as Sylvania's International Division he became director.

* * *

AMPHENOL SYNTHETIC DATA LEAFLET

An 8-page leaflet describing polystyrene, acrylics and Amphenol 9476 flexible synthetic tubing has been released by the American Phenolic Corporation, Chicago 50, Illinois. Property charts and mechanical data also appear in the leaflet. Also featured are fabricating suggestions.

* * *

NEW BUILDING FOR AUDIO DEVELOPMENT

Audio Development Company of Minneapolis, Minnesota, has just completed construction of a new building which now houses the general and engineering offices, experimental and design laboratory and the model shop.

Floor space formerly occupied by these units will be taken over by the production department.

* * *

VAN TASSEL AND FARRELL PROMOTED BY G. E.

K. R. Van Tassel has been appointed manager of General Electric Company's industrial control division; and John J. Farrell has been named engineer of the transmitter division of G. E.'s electronics department.

* * *

ERLANGER TOURING DISTRIBUTORS FOR WALSCO

Claude M. Erlanger, sales and service manager for the jobber's division of the Walter L. Schott Company, Beverly Hills, California, is on a tour of distributors and dealers, surveying postwar requirement.

* * *

DR. CONDON BECOMES MEMBER OF NAS

The National Academy of Sciences announced the election recently of Dr. Edward U. Condon to membership in the society. Dr. Condon, associate director of the research laboratories at Westinghouse Electric & Manufacturing Company, received the honor for his outstanding contributions to the field of theoretical physics.

* * *

SPRAGUE KOOLOHM RESISTOR CATALOG

A 28-page catalog, 10E, with specifications and engineering data on koolohm wire-wound resistors, has been released by Resistor Division, Sprague Electric Company, North Adams, Mass. Various koolohm types not included in previous publications are listed. Among the types presented are both standard and hermetically-sealed power wire-wound resistor types up to 120 watts; 10- and 15-watt voltage divider sections; bobbin-type resistors; hermetically-sealed precision meter multipliers; and megomax high-voltage, high temperature resistors.

* * *

LOHNES AND CULVER OPEN CONSULTING UNIT

George M. Lohnes and Ronald H. Culver, engineers formerly associated with Jansky & Bailey, have organized a consulting engineering firm at 922 Munsey Building, Washington, D. C. The company's service includes general radio engineering, a-m and f-m broadcasting, television, and related communication and electronic fields.

* * *

BURNET AND McEVOY JOIN SYLVANIA

Raymond Kenneth Burnet, formerly associated

(*Continued on page* 102)

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CLARK JOINS AERO NEEDLE

Steven S. Clark, recently appointed vice president of Aero Needle Company, Chicago, (center) with Burton Browne, president of the company, (right) and Fred Williamson, chief engineer.

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NEWS BRIEFS

(*Continued from page* 101)

with Walter E. Heller & Co., banking firm, has been appointed to the radio tube equipment sales staff of Sylvania Electric Products Inc.

Mr. Burnet will make his headquarters at 135 South LaSalle Street, Chicago.

E. Bruce McEvoy, Jr., formerly with Kenrad Incandescent Lamps and recently given a medical discharge after seeing service at Casablanca, has been appointed assistant to L. S. Raynor, radio tube equipment sales manager for the eastern division of Sylvania Electric Products Inc.

Mr. McEvoy will locate at 500 Fifth Avenue, New York City.

* * *

WALKER REELECTED APCO PRESIDENT

Frank W. Walker of the Michigan State Police was reelected president of the Associated Police Communications Officers, Inc., at the recent 11th annual conference in Toledo, Ohio.

Other reelections included Ray S. Groenier of Madison, Wisc., first vice president; bulletin editor Capt. J. M. Wherritt, Missouri State Patrol, Jefferson City; and secretary-treasurer Ero Erickson of the Illinois State Police, Chicago. Sergeant D. J. McFarlane of the Boston Metropolitan Police is the new second vice president and 1944 conference chairman, Sgt. C. H. Knudel of Toledo was chosen sergeant-at-arms.

Left to right, Frank W. Walker, Michigan State Police; Ero Erickson, Illinois State Police; Sgt. Donald J. McFarlane, Metropolitan Police, Boston, Mass.; Capt. J. M. Wherritt, Missouri State Patrol, and Sgt. C. H. Knudel, Toledo (Ohio) Police Department.

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CATHODE-RAY TUBE TESTS

(*Continued from page* 89)

field and sprayed on the screen. Figure 10 shows the effect on contrast.

Stray emission is often caused by cold primary emission due to getter deposits and may show as a localized spot of illumination when the grid is biased to beam cut off. It may also be present while the beam is tracing a pattern on the tube face.

Halation is evidenced by a ring or rings of various sizes concentric with the focused spot as in Figure 12. Halation is present in all tubes but it must be kept to a minimum for most satisfactory tube characteristics. That the greater part of halation is caused by light reflection from the outer surface of the tube face, may be shown by the simple experiment of covering the spot with a black crayon or china markers. The halo almost completely disappears as the black spot approaches half the halo diameter. It would thus appear that by a non-reflection treatment of the tube face, halation may be eliminated for all practical purposes.

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Figure 12

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THE INDUSTRY OFFERS . . . —

W. E. THERMISTORS

Thermistors, small circuit elements made of a mixture of metallic oxides (semi-conductors), which are pressed into discs, extruded into rods, or formed into tiny beads, characterized by high negative-temperature coefficients of resistance, have been announced by Western Electric. In these components, a development of Bell Labs, the electrical resistance of the semi-conductor decreases rapidly as its temperature rises and conversely the resistance increases as it temperature falls. Temperature coefficients of resistance as great as 5% per degree centigrade are available.

Thermistors may be used in electrical circuits wherever temperature changes can be produced. There are three basic ways of varying the temperature; externally, directly, and indirectly. If the ambient temperature rises, the resistance falls accordingly. If a current is passed through a thermistor, heat is produced internally, the temperature rises and the resistance lowers. If a small coil of wire is placed very close around the thermistor and a current is passed through it, heat is produced by the coil which in turn warns the thermistor and lowers it resistance. The unit is then said to be indirectly heated. Thus by suitable electrical connections, changes in the thermistor resistance may be used for measurement or for control of ambient or circuit conditions as desired.

One of the older types of thermistors, the 1C, typifies the operation of the 30 to 40 types now in manufacture. This is a directly-heated type of thermistor and consists of a minute bead of oxides suspended on fine wires and enclosed in a nitrogen-filled glass bulb with two wire terminals. This assembly is further encased in an insulating tube with metal contacts on the ends, much like a fuse housing. The overall length of the completed unit is approximately $1\frac{1}{16}$", and the outside diameter is about $\frac{1}{4}$".

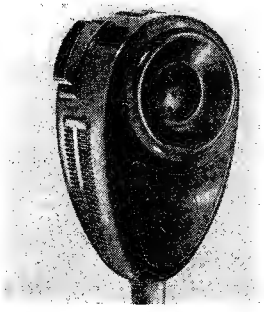
A 1C thermistor, at room temperature, has a resistance of approximately 50,000 ohms. As current flows through the oxide bead, the unit is heated and its resistance decreases. To demonstrate the extent of the decrease brought about by the resistance versus power characteristics of the unit, let us raise the power input to 18 milliwatts. At this point the resistance of the unit will be approximately 18,000 ohms, showing a decrease of approximately 32,000 ohms. When 100 milliwatts is applied, the resistance will be approximately 500 ohms.

* * *

ELECTRO-VOICE MICROPHONE

A portable microphone, 600D, for police, airport, utility, mobile communications and portable public address installations, has been developed by Electro-Voice Manufacturing Corporation, South Bend, Indiana.

Microphone is said to feature a press-to-talk switch which opens the microphone and closes the relay simultaneously, if desired. Withstands temperatures from —40° to +185° F. The frequency response of 600D is said to be from 50 to 8,000 cycles per second with an output of —57 db; 0 db=1 volt/dyne/cm². Complete with 8' cable. Panel mounting bracket is on the rear of the microphone. Weighs 9 ounces.



* * *

ACRO CHASSIS CRADLE

A chassis cradle, that is said to hold assemblies in an easy-to-get-at position for quick inspection or repair is now being produced by Acro Tool and Die Works, 4892 N. Clark Street, Chicago 40, Illinois. Manufacturer says that assem-

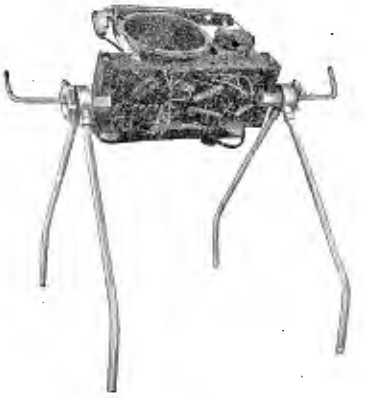
(*Continued on page* 104)

THE INDUSTRY OFFERS . . . —

(*Continued from page* 103)

blies can be rotated and locked in position by a flick of the finger.

The cradle is made of cadmium plated steel and white metal, consisting of the supporting legs and locking clamps. Equipped with an automatic stop.

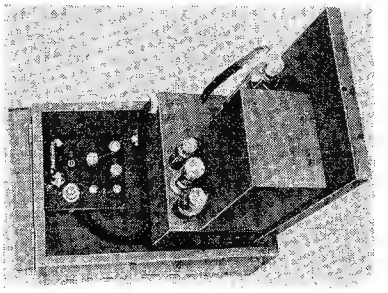


* * *

EI TIMING UNIT

An electric timing unit for controlling resistance welding operations has been developed by Electrical Industries, Inc., 42 Summer Avenue, Newark 4, New Jersey.

A single knob is said to provide instant time control from 1 to 28 cycles in steps of one cycle. This device handles welding powers of from ½ to 5 kva.



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STANDARD MACHINERY TACHOMETER

A 2¼" diameter tachometer weighing 5½ ounces with a direct rpm reading scale has been produced by Standard Machinery Company, Providence, Rhode Island.

The range of the instrument is from 500 to 3000 rpm. Device has a pointed contact spindle for use with shafts that are centered. An elastic tip is furnished that will slip over the pointed spindle for use on shaft ends that are not centered. Scale is enclosed in a plastic tube.

* * *

CENTRALAB HIGH-VOLTAGE CERAMIC CAPACITORS

Three new types of capacitors particularly useful in high-frequency power circuits are now available from Centralab. Capacitors have been numbered CRL 855, 854, and 853 and are available with axial screw style and axial lead terminals.

All units have the general double-cup design. Plates are pure silver fixed to the ceramic. Standard terminals are silver-plated brass or bronze.

* * *

SELENIUM RECTIFIERS

Dual sealed-in electrode selenium rectifiers have been announced by Selenium Corporation of America, 1719 W. Pico Blvd., Los Angeles 15, California. The dual seal is provided by a set of springs assembled in such a way that the selenium electrode is totally enclosed but the spring action is fully maintained.

This method of assembly is claimed to have the following advantages: maximum contact areas at increased pressure; added protection against moisture and corrosion; undisturbed electrical contact after application of surface coating; permanence of rectifier characteris-

tics and full plate efficiency; shock and vibration-proof operation; complete interchangeability with all conventional selenium rectifiers.

These rectifiers can be used in temperatures from —55° C to +75° C. Available in assemblies up to 5000 amperes.

* * *

SHALLCROSS PORTABLE KILOVOLTMETER

A portable 2-scale d-c kilovoltmeter, covering 0-2 kv and 0-20 kv is now available from Shallcross Manufacturing Company, Jackson and Pusey Avenues, Collingdale, Penna.

Other Shallcross kilovoltmeters include a complete line of both fixed and portable units for measurements from 1½ kv to 30 kv. Both a-c and d-c models are available as well as combination instruments designed for use on both alternating and direct current.

* * *

G. E. LECTROFILM CAPACITORS

Lectrofilm capacitors, available in case —60, —65, and —70 types, which are mechanically interchangeable with mica capacitors types CM60, 65 and 70 as listed in American War Standards C75.3, have been announced by G. E. Lectrofilm is a new synthetic dielectric material developed especially for capacitors and made from materials available in the United States.

Lectrofilm capacitors are suited for radio-frequency blocking and bypass applications.

The capacitors are supplied in green, low-loss plastic cases.

Capacitors are described in bulletin GEA-4295.

* * *

N. A. PHILIPS QUARTZ X-RAY UNIT

X-ray equipment to adjust frequency of quartz oscillator plates downward has been announced by North American Phillips Company, Inc.

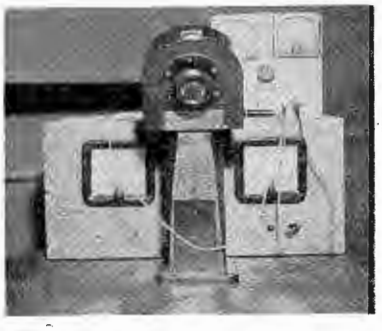
Apparatus features a rotary fixture that exposes one crystal to the beam while another crystal is being loaded into a second holder.

The holder in front of the x-ray window is connected, by means of its electrodes and a system of contacts, to a pair of insulated external leads. These may be connected to an oscillator. In this manner the downward drift of the frequency can be accurately measured; thus, the crystal may be removed from the beam when the necessary change has been accomplished.

Depending on the original characteristics of the plate, frequency may be lowered in the x-ray unit at a rate of 30 to 50 cycles per second, per minute. It is said to be possible to change the frequency of plates in the 6 to 8 megacycle-per-second range from 2 to 3 kilocycles per second total; this is the saturation value of such crystals. Higher frequency plates can be changed over a large range.

The crystal holder is arranged so all crystal sizes from .4" x .4" up to .75" x .75" can be accommodated. Two crystals of each size may be placed in each holder; one is rotated to the x-ray beam while the other is being loaded. In this manner, oscillator plates may be placed successively into the beam giving complete protection to the operator. There are two crystal holders, one for each window of the x-ray tube.

The x-ray unit has a rated output of 60 kv at 25 ma. It is a full wave assembly, utilizing two rectifier tubes. X-ray tube is water cooled.



* * *

SPRAGUE GLASS-TO-METAL SEALS

Glass-to-metal seals for use in capacitors and resistors have been announced by the Sprague Electric Company, North Adams, Mass. In the case of capacitors, the usual ceramic terminals are supplanted by those of glass. These glass bushings are then sealed direct to the metal capacitor container. Manufacturer states that this process eliminates need for adjacent metal rings with "matched" temperature coefficients of expansion. On koolohm resistors, the

(*Continued on page* 106)

THE INDUSTRY OFFERS . . .

(*Continued from page* 105)

resistance unit is encased in a special glass tube which is sealed directly to the metal ends.

Seal sizes range from very small up to 3" in diameter. They are said to work equally well on practically any metal including steel, brass and monel metal. Capacitors and koolohm resistors utilizing glass-to-metal seals are said to be available in 8,000 different electrical characteristic combinations.

* * *

LITTELFUSE FUSE PANELS AND SWITCH BREAKERS

A universal fuse panel, 1505, that can be placed at accessible points, rather than a central junction box, has been announced by Littelfuse, Incorporated, 200 Ong St., El Monte, California, and 4757 Ravenswood Ave., Chicago 40, Illinois.

Circuit can be opened by pulling out a metal bar from the clips, with insulated pliers. Thus an ammeter can be inserted at this point for a temporary reading.

Panel 1505 is for Littelfuse 3 A G and 3 A B, 4 A G and 4 A B, and 5 A G and 5 A B aircorps type of fuses and clips. One number covers the mounting.

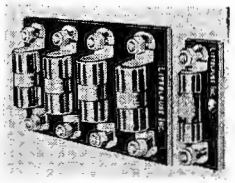
A new circuit breaker, 1560, that is said to be relatively free from the effects of extreme high and low temperatures has also been announced by Littelfuse, Incorporated.

The actual trip temperature of the new breaker without flow of current is said to be 350° F, ambient temperature.

A bi-metal is used as the finger that pulls the trigger. No appreciable mechanical load is said to be exerted on the bi-metal as it trips the breaker.

The range is 5 to 50 amperes at 32 volts, a-c or d-c. It is capable of breaking 2500 amperes on short circuit. It is said to meet the requirements of holding for one hour at 115% of rated current.

Enclosed in black-bakelite case; panel-mounted by two 6/32 screws, ¼" long, for 1/16" thickness of panels. Overall size 2⅛" x 2" deep below panel, x ¾" wide.



Fuse Panel

* * *

MACHLETT 2,000,000-VOLT X-RAY TUBE

A constant potential, two-million volt x-ray tube suitable for operation sealed-off, has been developed by Machlett Laboratories, Inc., Springdale, Conn.

The new tube was developed for use by the High Voltage Laboratory at the Massachusetts Institute of Technology.

Tube affords satisfactory radiographic results of heavy steel objects.

Fine focusing is achieved by a constant accelerating field over the entire cathode to target distance. To accomplish this the tube has 180 accelerating sections, to provide uniform accelerating steps of 12,000 volts each.

Glass to metal seals are used in the accelerating column.

A combination of gas flame and high frequency induction heating is used in the sealing technique, in combination with specially developed means for detecting and eliminating glass strains of small magnitude and Kovar

●

TBA DIRECTORS MEETING

Directors of the Television Broadcasters Association listening to an explanation of the "Lighthouse" tube by B. W. Cruger, G. E. television engineer. From left to right: Paul Raibourn, Paramount; F. J. Bingley, Philco; R. L. Gibson, G.E.; Allen B. Du Mont; Worthington Miner, CBS; Mr. Cruger; Jack Poppele, Mutual, and William Baltin, TBA secretary and treasurer.

rings of special configuration to assure complete and homogeneous bonding of metal to glass.

* * *

IN-RES-CO TROPI-PRUF RESISTORS

Resistors that are said to provide two-way protection against deterioration and resultant failure in tropical or humid locations are now available from Instrument Resistors Co., 25 Amity Street, Little Falls, New Jersey. Each component is enclosed in a bakelite case. After complete dehydration the resistor is sealed in a special compound, and further made impervious to atmospheric surroundings with bakelite cap machined to fit the bakelite case. Leads are bare at the point of entrance through the case, and are permanently and hermetically sealed.

After completion of the unit, it receives a non-toxic fungicidal coating that is said to meet all Signal Corps 71-2202-A specifications, and remains effective for about one year.

* * *

CARTER SMALL DYNAMOTORS

A dynamotor providing 3,000-volts d-c at .05 ampere to run from a 12-volt battery primary source, has been announced by Carter Motor Co., 1608 Milwaukee Ave., Chicago.

The unit is 11½" long, 2½" diameter and 5" high, and weighs less than 18 pounds without filter. The input to the motor portion of the dynamotor can be had in voltages ranging from 12-volts to 115-volts d-c.

It is possible to furnish the unit with two 1,500-volt, 0.05 ampere outputs, instead of the 3,000-volt one. Because of the high voltage and the tendency towards sparks and corona effects, the ends of the unit, where the brushes are located, are enclosed in explosion-proof covers.

The first of a series of very small dynamotors, the "multi-output micro-magmotor," has also been announced by Carter.

The unit has a permanent-magnet field, and furnishes outputs totaling up to 100-watts. This wattage may be divided over two or even three different voltages, and also one of the outputs may be a-c.

A typical unit would be one with a 350-volt, 50-milliampere output; a 250-volt, 25-milliampere output, and a 6.3-volt a-c (100 cps), 2-ampere output.

In dual outputs the upper limit is 350-volts d-c, but if a single output should be desired, voltages as high as 500-volts are available.

Input voltages are from 5.5 volts d-c through 115-volts d-c. Average unit weighs 5 pounds.

* * *

BURNDY TOOL

A hytool that is said to eliminate the need of a separate pair of dies for each thimble used on insulated cable, such as is required in hydraulic presses, is now available from Burndy Engineering Co., 107 Bruckner Blvd., New York 54, N. Y. The "spade" of the new tool carries a series of holes or "dies" which provide for the installation of a number of thimble sizes.

The Burndy hyseal thimble, with which this new tool is used, is the integral combination of the Navy thimble and a shroud for sealing

(*Continued on page* 108)

THE INDUSTRY OFFERS . . .

(*Continued from page* 107)

the end of the cable. When this shroud is compressed a seal is formed, which prevents the entry of water even under high pressure.

Two sizes of the new hytool are available. The smaller, MYG15ON, is used for installing hyseal thimbles on Navy cable types DHFA, THFA and FHFA, sizes 14 through 150 and also on types SHFA and SHFL, sizes 4 through 125.

The larger hytool, MYG400N, installs thimbles on Navy cable types DHFA, THFA and FHFA, sizes 200 through 400, and also on types SHFA and SHFL, sizes 150 through 400.

* * *

AMP SOLDERLESS WIRING COMBINATION TOOL

A 6-purpose tool, that includes a wire cutter and an insulation stripper with the correct stripping length clearly indicated, has been announced by Aircraft-Marine Products Inc., 1951 North Fourth St., Harrisburg, Penn. Terminal stud hole sizes are marked on the tool for quick checking.

Three types of AMP terminals, for wire sizes 22 to 10, are crimped by the tool—the AMP flag type, AMP standard (type B), and the AMP one-piece terminal. Cramping notches are marked to correspond with terminals they will crimp and stripping notches are marked with Navy shipboard and commercial AWG wire sizes.

* * *

ELECTRIX RUBBER PLUGS

Production of rubber plugs and cube taps will soon be resumed by Electrix Corporation, Pawtucket, R. I.

Orders are being accepted by the Wire Division, United States Rubber Company, 1230 6th Avenue, New York 20, N. Y., selling agents for Electrix.

* * *

ROWE LINEAR OHMMETER

A production test ohmmeter, type LM21, with a linear scale calibrated directly in ohms is now available from Rowe Radio Research Laboratory Co., 2422 North Pulaski Road, Chicago.

Length of leads to the resistance under test are said to have negligible effect on the accuracy of instrument.

Units are available for practically any full scale value of resistance including fractions of an ohm. Standard units are battery operated but can be had with a power supply if required.

The instrument is in a black wrinkle-baked enamel-finished case approximately 11" long by 8" high and 8" deep.

* * *

ATLAS SPEAKERS

The double reentrant permanent-magnet loud speaker design is featured in the DR-12 speaker announced by Atlas Sound Corporation, 1443-1451 39th Street, Brooklyn 18, N. Y. All internal parts of the horn are die cast. The critical air column exponential expansion areas are said to be held to ±.005.

Bell diameter 7"; overall length 7½"; voice coil impedance 16 ohms; power 15 watts. Shipping weight, 6 lbs.

* * *

NOBUR ANGLE BRACKET

An angle bracket that is said to convert a drill press into an all-purpose machine for angle drilling, polishing, buffing, tapping, reaming, burring, grinding, etc., has been announced by the Nobur Manufacturing Co., 910 North Orange Drive, Los Angeles.

The angle bracket is available for all popular models of drill presses whose construction embodies a round tubular column. Available for drill presses with 2¾" to 3 29/32" tubular columns.

* * *

BEVIL CUT-OFF WHEELS

Bevil diamond-impregnated cut-off wheels that are said to cut all non-metallic materials of dense, brittle structure such as quartz, vitreous and ceramic wares, porcelain, tile and glass, easily, quickly and without chipping or cracking, have been introduced by Cryco, Inc., 1516 Mission Street, South Pasadena, Calif.

The Bevil process, used in the manufacture of these cut-off wheels, is said to produce a union of diamonds and metals in a precision blade. Instead of the usual physical bond used for bonding the rim to the body of the blade, the patented Bevil process employs a fusion bond which actually flows the rim and body together, it is claimed. This fusion, according to the manufacturer, prevents the rim on a Bevil cut-off wheel from pulling loose.

Recommended minimum speeds for the wheel are 5000 to 6000 S. F. M. Wheels are made in 3", 4", 6", 8", 10", 12" and 14" sizes. Diamond impregnation is ⅛" on all wheels.

* * *

DIAMOND INSTRUMENT COAXIAL CONNECTORS

Coaxial connectors are now available from the Diamond Instrument Company, Wakefield, Massachusetts. Connectors known as DICO

(*Continued on page* 111)

THE INDUSTRY OFFERS . . . —

(*Continued from page* 108)

type, have silverplated bodies and beryllium-copper contacts.

* * *

STURTEVANT TORQUE WRENCH

A sensory torque wrench that is said to embody sound and feel has been announced by the P. A. Sturtevant Co., Addison, Illinois.

A trigger finger is provided which can be set at any desired signalling point. As torque is applied with the wrench, and at the instant the set torque is reached, a loud and distinct click is heard and, in addition, an impulse is imparted to the hand.

* * *

TECHNICAL APPARATUS 4000-VOLT DIELECTRIC TEST SET

For flash and breakdown testing of capacitors, Technical Apparatus Company, 1171 Tremont Street, Boston, Massachusetts, have developed the TAC 1031-R dielectric test set. It is provided with a built-in high-voltage cutoff relay which operates in conjunction with a remote control switch to apply test potential only while the remote switch is closed. The test set delivers up to 4000 volts d-c, continuously adjustable by means of a primary variac. An output indicating meter shows the voltage being applied to the specimen.

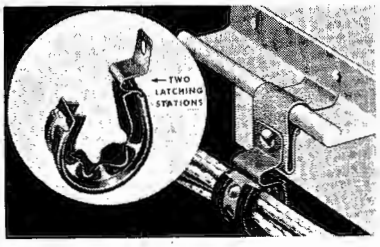
An additional feature of this instrument is the provision for automatically discharging capacitive test specimens through a bleeder resistor when the remote switch is released.

* * *

LATCHING WIRE HARNESS CLAMPS

Wire harness clamps with a latching finger for various types of wiring installations have been developed by Tinnerman Products, Inc., 2012 Fulton Road, Cleveland 13, Ohio. These clamps open and close independently of the attaching screw. Manufacturer says that any or all of the wires may be removed or replaced without loosening the screw that holds the clamp in position. They remain snapped over the wires during transportation to final assembly location. They also serve as the mounting means for attaching wiring to panels, sheets, or other structures.

Made of parkerized spring steel with two coats of lacquer and then cushioned with extruded synthetic rubber channels which have integral resilient ribs to absorb variations in diameter of the wire bundles. Each clamp has two different latching stations. Six sizes are available to accommodate wire bundles ranging in sizes from $\frac{1}{8}$" to $1\frac{3}{8}$".



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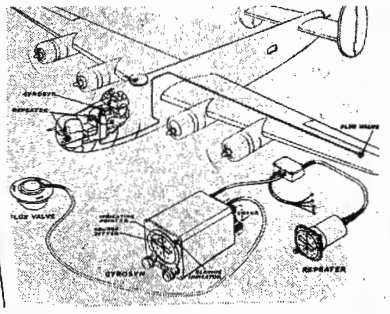
SPERRY GYROSYN COMPASS

A directional gyro synchronized with the magnetic field of the earth has been announced by the Sperry Gyroscope Company.

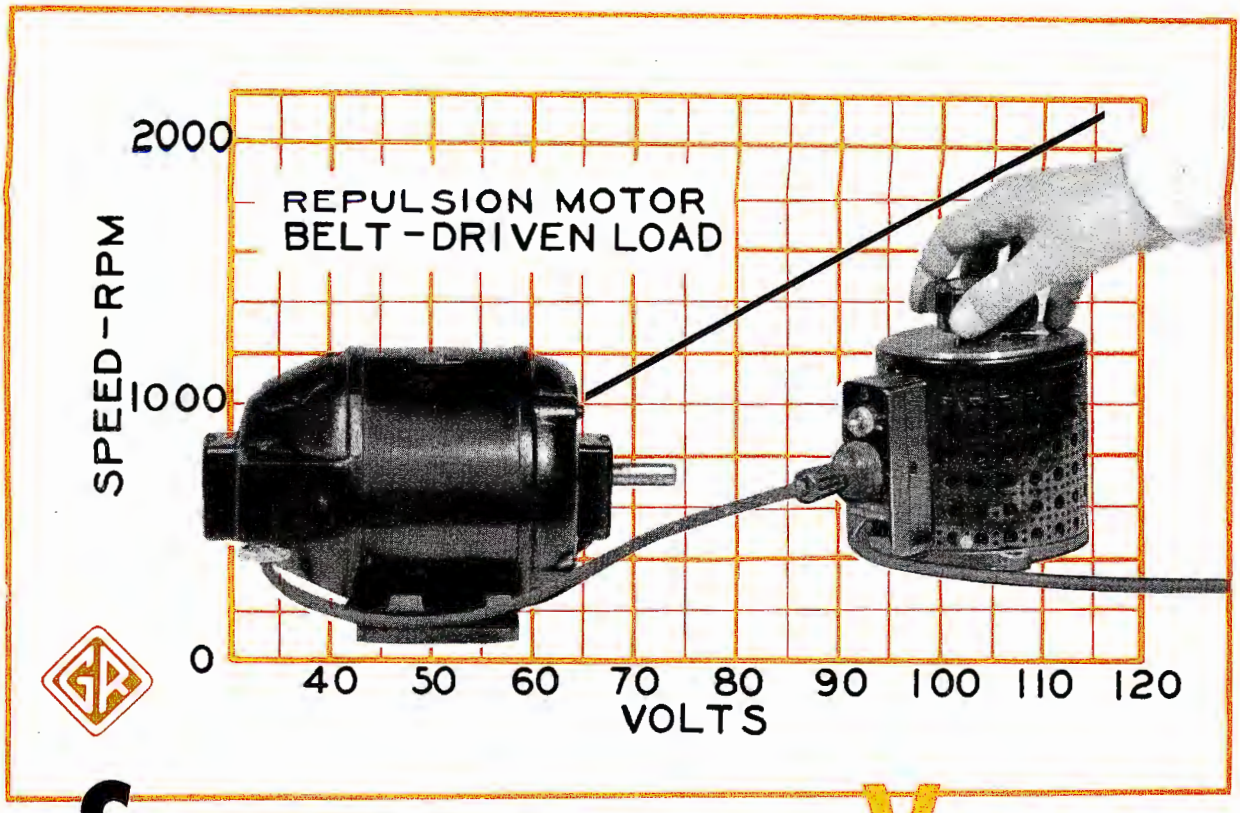
The compass, known as the gyrosyn, is an electrically driven directional gyro controlled by a flux valve. The latter is the "stand in" for a magnetic compass because it detects the direction of the earth's magnetic field. Small, hermetically sealed and with no rotating parts, the flux valve may be rigidly mounted in a wing tip safely removed from the disturbing influences of the cockpit.



ADVERTISERS IN THIS ISSUE*

COMMUNICATIONS—OCTOBER, 1944

*Due to paper restrictions several advertising pages had to be omitted from this ...



SPEED CONTROL—WITH VARIACS

VARIAC continuously adjustable auto-transformers are widely used to control the speed of fractional horsepower motors. They provide exceptionally smooth control with very low power losses. This type of control, however, cannot be used successfully with all a-c motors; both the type of the motor and the type of load determine whether the variable auto-transformer can be used.

For example, repulsion and series motors can be controlled over a wide range of speeds; induction motors do not lend themselves to voltage control, except with a fan-type load where the effective load varies greatly with speed.

The split-phase motor with automatic cut-out cannot be controlled successfully. Repulsion-start induction motors can be controlled only during the time that the repulsion-start system is cut in, and if the repulsion winding is designed for continuous duty.

Variacs are incorporated in so many motor-operated devices that many manufacturers now consider the adaptability of this control when choosing or designing the motor to be used.

A detailed discussion of Variac motor speed control appears in a recent issue of the G-R EXPERIMENTER. May we send you a copy?

MADE ONLY BY

VARIACS are available (with suitable priority rating) in power ratings between 170 va and 7,000 va; prices are $10.00 to $100.00.

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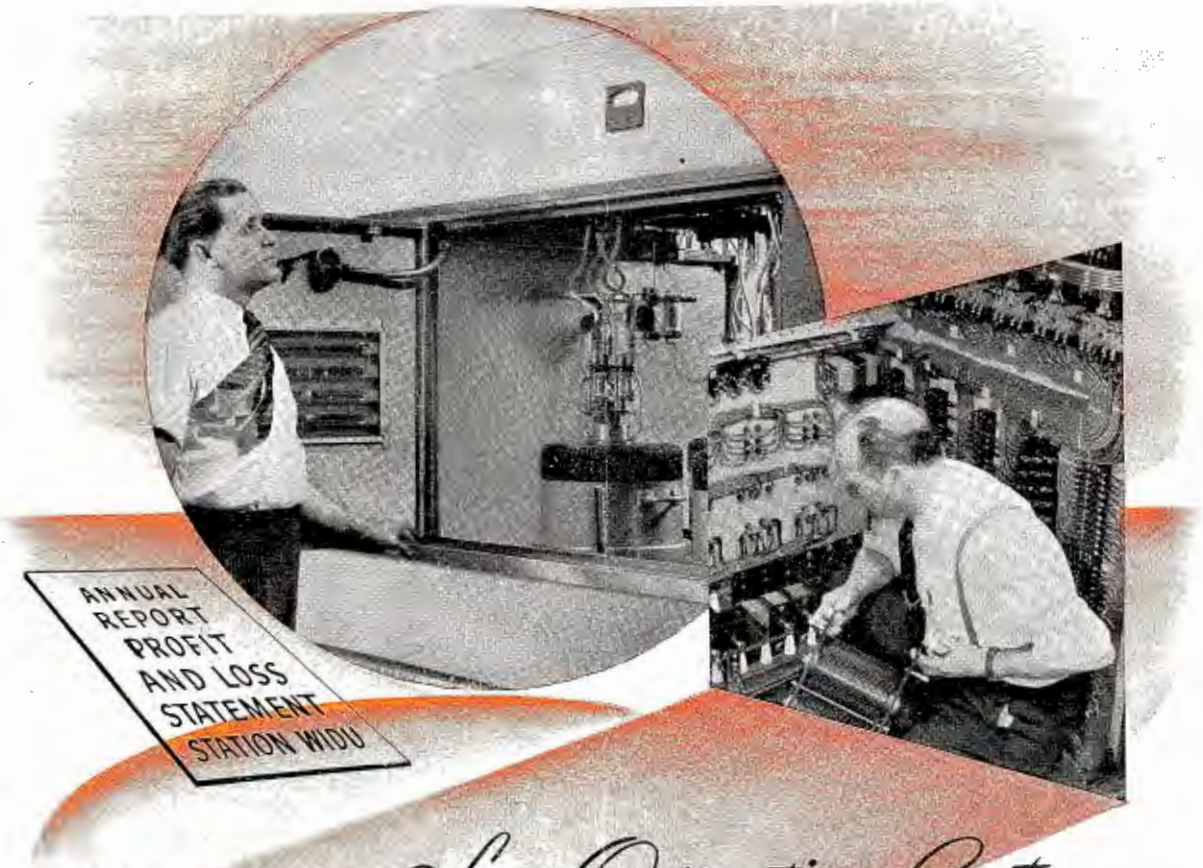

CONSIDER *Low Operating Cost* WHEN YOU SELECT A NEW TRANSMITTER

In selecting a new transmitter, naturally you will take a good, hard look at operating costs. They have an embarrassing way of turning up every month where they *have* to be considered.

Westinghouse Transmitters are designed to keep operating costs at a very low minimum. For example:

1. Air-Cooled Tubes—featured by Westinghouse, eliminate the expense of water cooling. Air which cools the tubes can be used to heat the building.
2. Metal Plate Rectifiers—also featured by Westinghouse, seldom require replacement. Their life is practically unlimited.
3. Conservative Operation of All Tubes—results in long life and low upkeep cost.
4. Class C Operation—of all radio frequencies provides higher efficiencies and lower power consumption than any other type of circuit.

These are only a few of the advantages Westinghouse Transmitters offer. Others include: ***Simplicity of Control, Continuity of Operation, High Fidelity Signals, Ease of Maintenance.***

PLACE YOUR ORDER NOW FOR YOUR POSTWAR TRANSMITTER

By placing your order today for a Westinghouse transmitter, you assure yourself of the fastest possible delivery following the lifting of wartime manufacturing restrictions. We are scheduling deliveries in the sequence in which orders are received. For details, write Westinghouse Electric & Mfg. Company, Dept. 1NB, P. O. Box 868, Pittsburgh 30, Pa.

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