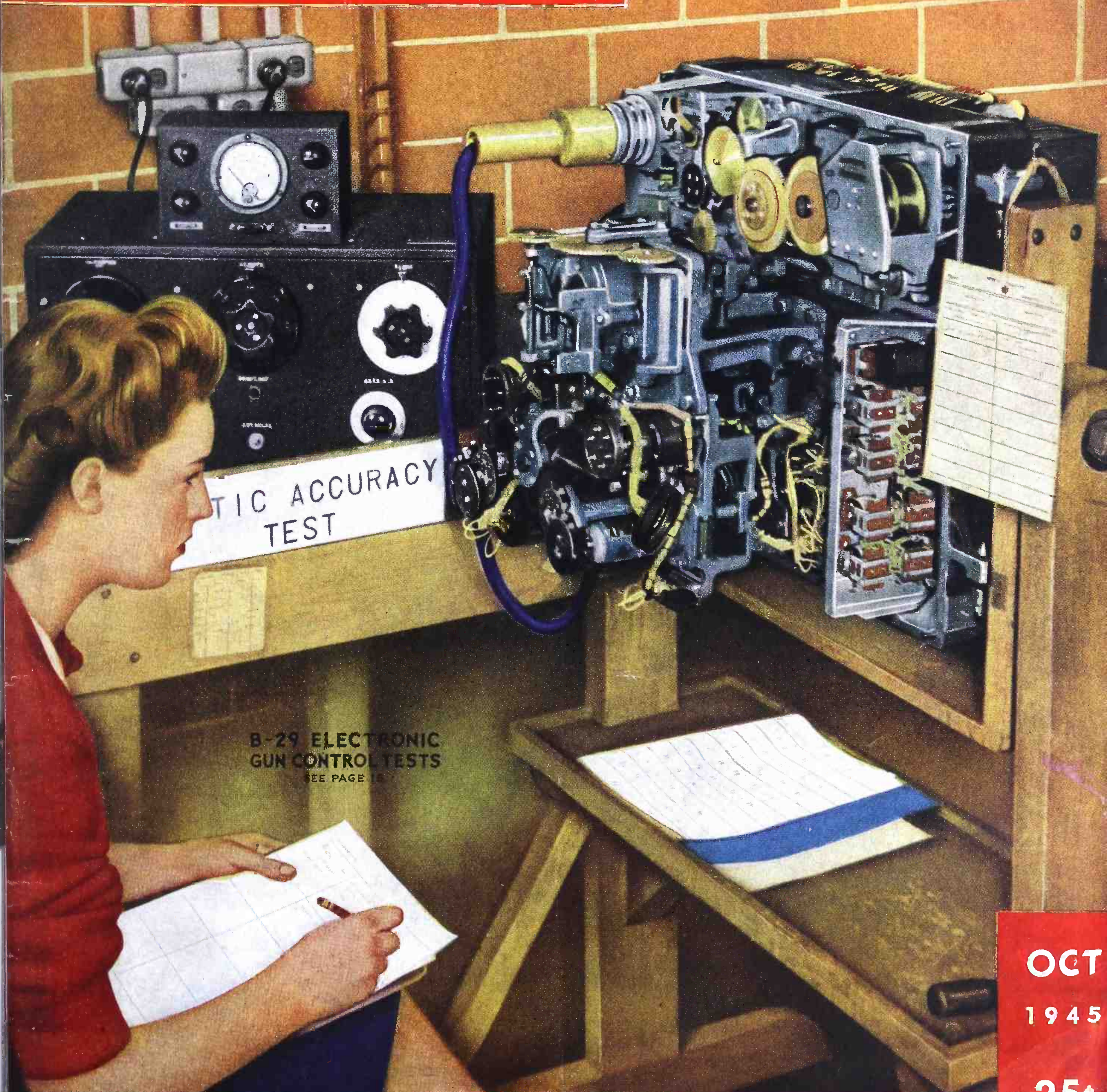
RADIO CRAFT

HUGO GERNSBACK, Editor



B-29 ELECTRONIC GUN CONTROL TESTS

SEE PAGE 18

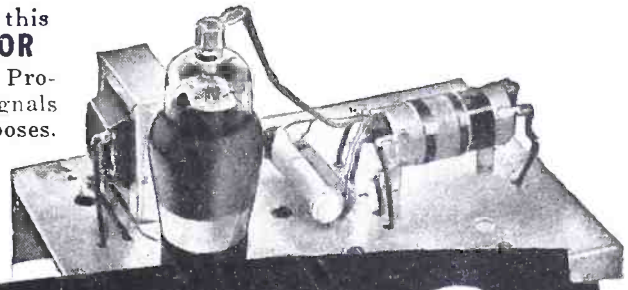
OCT 1945

25¢

CANADA 30¢

RADIO-ELECTRONICS IN ALL ITS PHASES

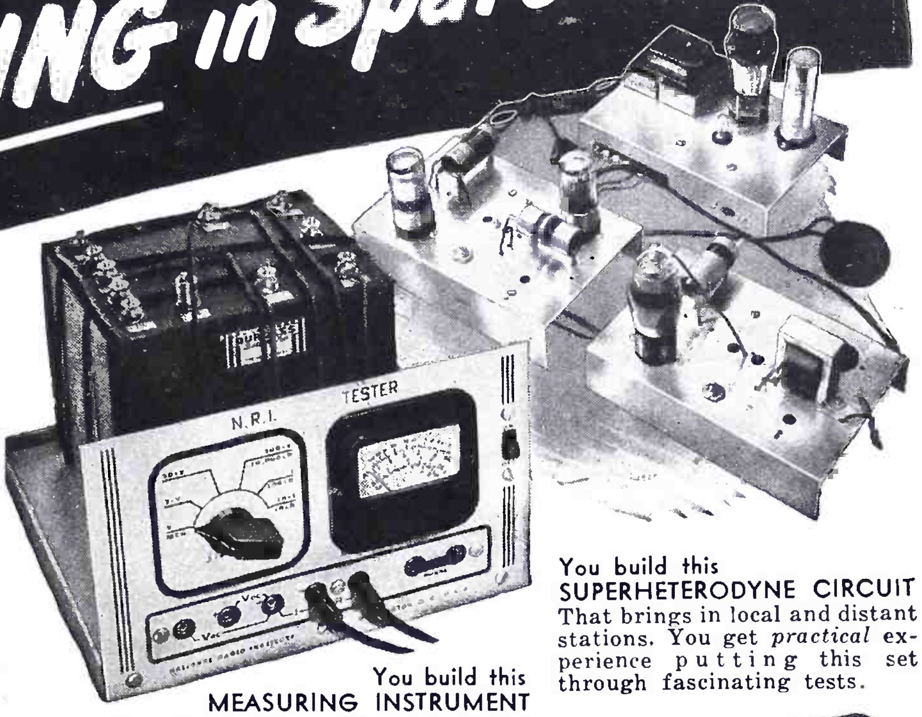
Building this
A. M. SIGNAL GENERATOR
gives you valuable experience. Provides amplitude-modulated signals for test and experiment purposes.



RADIO SERVICING
pays many good money for full time work. Many others make $5, $10 a week EXTRA fixing Radios in spare time.

Learn RADIO by PRACTICING in Spare Time

with 6 Big Kits of Radio Parts I Send You



You build this
SUPERHETERODYNE CIRCUIT
That brings in local and distant stations. You get *practical* experience putting this set through fascinating tests.

You build this
MEASURING INSTRUMENT
yourself early in the course—use it for practical Radio work on neighborhood Radios to pick up EXTRA spare time money!

Let me send you facts about rich opportunities in Radio. See how knowing Radio can give you security, a prosperous future. Send the coupon for FREE 64-page book, "Win Rich Rewards in Radio." Read how N. R. I. trains you at home. Read how you practice building, testing, repairing Radios with SIX BIG KITS of Radio parts I send you.

Future for Trained Men is Bright in Radio, Television, Electronics

The Radio Repair business is booming NOW. There is good money fixing Radios in your spare time or own full time business. Trained Radio Technicians also find wide-open opportunities in Police, Aviation, Marine Radio, in Broadcasting, Radio Manufacturing, Public Address work, etc. Think of the boom coming when new Radios can be made! Think of even greater opportunities when Television, FM, Electronics, can be offered to the public!

Many Beginners Soon Make $5, $10 a Week EXTRA in Spare Time

The day you enroll I start sending EXTRA MONEY JOB SHEETS to help you make EXTRA money fixing Radios in spare time while learning. You LEARN Radio principles from my easy-to-grasp Lessons—PRACTICE what you learn by building real Radio Circuits with Radio parts I send—USE your knowledge to make EXTRA money in spare time.

Mail Coupon for Free Copy of Lesson and 64-page Illustrated Book

I will send you FREE a sample lesson, "Getting Acquainted with Receiver Servicing," to show you how practical it is to train for Radio in spare time. With it I'll send my 64-page, illustrated book, "Win Rich Rewards in Radio." Just mail coupon in an envelope or paste it on a penny postal. **J. E. Smith, President, Dept. 5KX, National Radio Institute,** ***Pioneer Home Study Radio School,*** **Washington 9, D. C.**

My Course Includes Training in
TELEVISION • ELECTRONICS
FREQUENCY MODULATION

BE A SUCCESS in RADIO
I Will Train You at Home

Sample Lesson FREE

Gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeakers, I.F. Transformer, Gang Tuner, Condenser, etc., 31 illustrations. Study it—keep it—use it—without obligation! Mail coupon NOW for your copy!

GET BOTH 64 PAGE BOOK / SAMPLE LESSON **FREE**

MR. J. E. SMITH, President, Dept. 5KX
NATIONAL RADIO INSTITUTE, Washington 9, D. C.

Mail me FREE, without obligation, Sample Lesson and 64-page book, "Win Rich Rewards in Radio." (No Salesman will call. Please write plainly.)

Age ....

Name ....

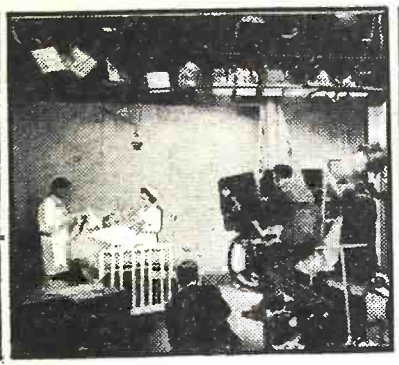
Address ....

City ....Zone......State..........4FR

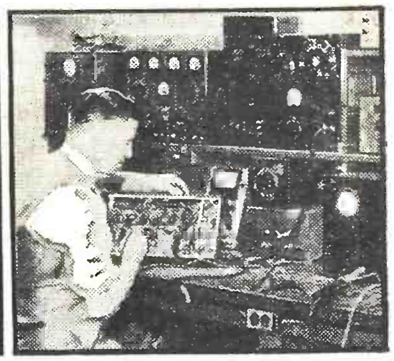
I'LL SHOW YOU HOW TO SUCCEED IN RADIO

Here's the right training for Big Post-War Pay!

A RADIO SERVICE BUSINESS OF YOUR OWN



A GOOD JOB IN RADIO & TELEVISION BROADCASTING



RADIO-ELECTRONIC SERVICE ENGINEER

F. L. Sprayberry, one of the country's foremost Radio Teachers.

BE A RADIO ELECTRONICIAN

I SUPPLY A FULL RADIO SET for practical easy LEARNING

NOW! YOU CAN PREPARE AT HOME IN YOUR SPARE TIME FOR THE AMAZING OPPORTUNITIES AHEAD IN RADIO — ELECTRONICS — TELEVISION

The offer I make you here is the opportunity of a lifetime. It's your big chance to get ready for a wonderful future in the swiftly expanding field of Radio-Electronics INCLUDING Radio, Television, Frequency Modulation and Industrial Electronics. Be wise! NOW'S the time to start. Opportunities ahead are tremendous! No previous experience is necessary. The Sprayberry Course starts right at the beginning of Radio. You can't get lost. It gets the various subjects across in such a clear, simple way that you understand and remember. And, you can master my entire course in your spare time. It will not interfere in any way with your present duties. Along with your Training, you will receive my famous BUSINESS BUILDERS which will show you how to make some nice profits while learning.

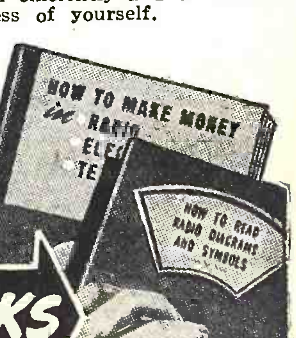
Prepares You for a Business of Your Own or Good Radio Job

My training will give you the broad, fundamental principles so necessary as a background, no matter which branch of Radio you wish to specialize in. I make it easy for you to learn Radio Set Repair and Installation Work. I teach you how to install and repair Electronic Equipment. In fact, you'll be a fully qualified RADIO-ELECTRONICIAN, equipped with the skill and knowledge to perform efficiently and to make a wonderful success of yourself.

Just Out! FREE!

"How to Read Radio Diagrams & Symbols"

. . . a valuable new book which explains in simple English how to read and understand any Radio Set Diagram. Provides the quick key to analyzing any Radio circuit. Includes translations of all Radio symbols. Send for this FREE book now, and along with it I will send you another big FREE book describing my Radio-Electronic training.



SPRAYBERRY TRAINING GIVES YOU BOTH TECHNICAL KNOWLEDGE • SKILLED HANDS

There's only one right way to learn Radio Electronics. You must get it through simplified lesson study combined with actual "shop" practice under the personal guidance of a qualified Radio Teacher. It's exactly this way that Sprayberry trains you . . . supplying real Radio parts for learn-by-doing experience right at home. Thus, you learn faster, your understanding is clear-cut, you acquire the practical "know how" essential to a good-paying Radio job or a Radio business of your own.

I'll Show You a New, Fast Way to Test Radio Sets Without Mfg. Equipment

The very same Radio Parts I supply with your Course for gaining pre-experience in Radio Repair work may be adapted through an exclusive Sprayberry wiring procedure to serve for complete, fast, accurate Radio Receiver trouble-shooting. Thus, under Sprayberry methods, you do not have one cent of outlay for manufactured Test Equipment which is not only expensive but scarce.

Read What Graduate Says "One Job Nets About $26.00"

"Since last week I fixed 7 radios, all good-paying jobs and right now I am working on an amplifier system. This job alone will net me about $26.00. As long as my work keeps coming in this way, I have only one word to say and that is, 'Thanks to my Sprayberry training' and I am not afraid to boast about it."—ADRIEN BENJAMIN, North Grosvenordale, Conn.

DON'T PUT IT OFF!

Get the facts about my training—now! Take the first important step toward the money-making future of your dreams. All features are fully explained in my big, illustrated FREE Catalog which comes to you along with another valuable FREE book you'll be glad to own. Mail Coupon AT ONCE!

GET FREE BOOKS

SPRAYBERRY ACADEMY OF RADIO
F. L. Sprayberry, Pres.
Room 20105
Pueblo, Colorado

Please rush my FREE copies of "HOW TO MAKE MONEY IN RADIO, ELECTRONICS and TELEVISION," and "HOW TO READ RADIO DIAGRAMS and SYMBOLS."

Name .... Age ....

Address ....

City .... State ....

Tear off this coupon, mail in envelope or paste on penny postcard.

RADIO CRAFT

▼ AND POPULAR ELECTRONICS ▼

Incorporating
SHORT WAVE CRAFT TELEVISION NEWS
RADIO & TELEVISION

MEMBER AUDIT BUREAU OF CIRCULATIONS

IN THE NEXT ISSUE

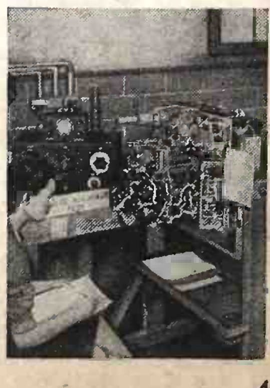
Betatron—Giant Atom Smasher
Hold-in-Hand Signal Tracer
A Dual Tone-Control System
Four-Tube Bicyclist's Radio
Bridged-T Filter Circuits

Published by Radcraft Publications, Inc.
Publication Office: 29 Worthington Street, Springfield 3, Mass.
Editorial and Advertising Offices: 25 West Broadway, Tel. RE2-9690, New York 7, N. Y.
Chicago Advertising Office: Radio-Craft, 308 W. Washington Street, Suite 1413, Chicago 6, Ill. Tel. Randolph 7363.
Cleveland Advertising Office: 405 Erie Bldg., Cleveland, Ohio. Burdette Phillips, Manager. Tel. Main 9645.
Los Angeles Advertising Office: 606 South Hill Street, Los Angeles 14, Calif. Ralph W. Harker, Manager.
San Francisco Advertising Office: 582 Market St., San Francisco 4, Calif. Ralph W. Harker, Manager. Tel. Garfield 2481.
New England Office: Bridgewater, Conn., W. D. Ward, Manager.
Michigan Advertising Office: 10 Highland Ave., Highland Park 3, Michigan. Harry R. Lipson, Manager.
RADIO-CRAFT is published monthly on the 25th of the month preceding that of date. Subscription rates: United States and possessions, Mexico, Central and South American countries, $2.50 a year, $4.00 for two years, $6.00 for three years. Canada, $3.00 a year, $5.00 for two years, $7.50 for three years. All other foreign countries, $3.25 a year, $5.50 for two years, $8.25 for three years. Special rates for members of the Armed Forces in U. S., or those addressed by A.P.O. or F.P.O. mail, $2.00. Entered at the post office at Springfield as second-class matter under the Act of March 3, 1879. All communications about subscriptions should be addressed to: Circulation Manager, Radio-Craft, 29 Worthington St., Springfield 3, Mass.

Notice of CHANGE of ADDRESS should reach us at least one month in advance. When ordering a change, please furnish an address stencil impression from a recent wrapper if you can. Address changes cannot be made without the old address as well as the new.

Foreign Agents
London—Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, Fleet St., London, E.C. 4.
Melbourne—McGill's Agency, 179 Elizabeth St., Australia.

Contents October, 1945 Volume XVII, No. 1



ON THE COVER

Our cover this month shows one of the tests made on the big B-29's electronic computing gunsight. Part of the remarkable computer mechanism—seen out of its case for the first time—is supported on the frame at right. The test now under way is for accuracy of the sight's "correction circuits."


"RADAR FOR SLEEP-WALKERS? ECHOPHONE IS SURE TO BE WIDE AWAKE ON NEW GADGETS FOR USE ON THE CITIZENS' RADIOPHONE BAND"*

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

Five times cited for distinguished wartime service.

.... NOW in Peace

you can count on Sprague—just as the nation counted on Sprague in war!

FOR SALE—38, 01A, 57, 1v, 70, 40, 89, 84, 37, 32, 50, 59, 34, 82 and 12A boxed tubes, 50% off list. C. Cassel, 321 Sixth Ave., McKeesport, Pa.

WANTED—Good used communications receiver. Sgt. Robert E. Herman, 13114460, F-197-61, I.R.T.C., Camp Blanding, Fla.

SALE OR TRADE—RCA BP-10 camera type portable radio needs batteries and slight repairs. Want meters or test eqpt. Melvin Kelch, 1625 Natura Rd., Towson 4, Md.

FOR SALE—Jackson sig. gen. and 54 tubes, 50L6, 3Q5, 35Z5, 12SK7, H5, 1N5, 3S4, 1T4, etc. Also condensers, resistors, etc., and Kelnor soldering iron. $100 for lot. Cpl. H. O'Neill, Box 593, Tonopah, Nev.

FOR TRADE—Older Bausch & Lomb microscope low & high power plus oil emersion with case. Want 3" or 5" oscilloscope. E. W. DeLong, Capt. MC, 0-486849, 1600 S. Third St., Alhambra, Calif.

URGENTLY NEEDED — 1N5G, 1A7G, 1H5G, 1A5G new tubes. Will trade 1—12SQ7GT/G and 1—35L6GT/G for 1N5G. For sale—3" electro dynamic speaker with output transformer. Clarence Goodall, Jr., Greenfield, Ill.

FOR SALE—Radio City sig. gen. #702, $33; and 50 one of a kind tubes. George H. Horst, 317 Linden Ave., Glenside, Pa.

FOR SALE—Tubes, adapters, condensers, wire, etc. Write for list. Finich Radio & Electric Co., Arkadelphia, Ark.

URGENTLY NEEDED—Rider manuals, service manuals, test eqpt.; meters, parts, tubes, wire, etc. Joseph Schwartz, 118-02 Liberty Ave., Richmond Hill, N. Y.

FOR SALE—Long list new tubes, 10% off O.P.A. ceiling. Reaves Electric Service, Box 246, Bishopville, S. C.

WILL TRADE—Detrola PeeWee in good condition for Echophone EC-1 receiver. Pvt. Samuel Santoro, 33084035, Co. C, 6th Bn. 2nd Regt., I.R.T.C. Camp Gordon, Ga.

FOR SALE—Superior #1130-S sig. gen. 6 wave bands, rf & af band switch, modulator, leakage tester and shielded leads, with two 6A7 tubes, $30. J. E. Derrickson, 422 Marsh Road, North Hills, Wilmington 281, Del.

WANTED—Late Service mags; Gernsback Radio Hand Book and Refrig. Manual Vol. 2; Simon's Radio Service Trade Kinks. Cash or will swap what you need. Fred Wittich, Middle Village, N. Y.

SELL OR TRADE—Triplett master tube tester #1210. Want ready wired output meter. Clarence Williams, 49 S. Nicholas Terrace, Apt. 26, New York 27, N. Y.

FOR SALE—Weston tube checker #676R, $12; Supreme tube and set tester #800, $35 and about 85 pieces non-working radios, chassis, portables, car radios, etc. Irving Tessler, 6B Brooklyn Ave., Freeport, L. I.

WANTED—Tube tester and set tester; sig. gen. Riders 6 to 11 and tools. Robert L. Weil, 78 West St., Albany 5, N. Y.

FOR SALE—Supreme #599 tube and set tester; also 37 new hard-to-get tubes. Frank M. Pulson, 182 Cottage Park Road, Winthrop, Mass.

WANTED—Philco #030 dynamic tester. Edward Vockeroth, 1746 N. Campbell St., Chicago 47, Ill.

SELL OR TRADE—Good used tubes, 1A7, 6A7, 6A8, 6H6, 7B7, 7B8, 7A4, 24A, 27, 80, etc., reasonable. Radio Hospital, 789 Bank St., New London, Conn.

FOR SALE—BR-44 resistance-capacity bridge $30; #015 Philco dry battery tester new $8.50. Kling's Radio Service, Blairs Mills, Pa.

SELL OR TRADE—V-O-M, miscellaneous radio parts and hard-to-get tubes. Want phono oscillator & 117L7GT tube. Don Spaan, 1308 Muscatine St., Iowa City, Iowa.

FOR SALE—RME 69 communications receiver with crystal filter and noise limiter circuits, 8" speaker with baffle. $90 f.o.b. Phil Rose, 3906 Pinkney Road, Baltimore 15, Md.

FOR SALE—Shure crystal mike chrome finish #70H; 6AD7, 6J7, 6F6, 1T4 and 1G6 tubes in original cartons. George Blake, Jr., 1212 Ann St., Winfield, Kans.

SELL OR TRADE—Sun-Kraft ultraviolet ray lamp. Want radio, washing machine, camera or what have you? Mitchell Metzarek, Bensenville, Ill.

FOR SALE—Supreme #563 audio oscillator, $49.50. C. C. Baines, 912-914 S. Second St., Louisville 3, Ky.

FOR SALE—Used 8"-10" speakers, power transformers, transmission wire, Jewell analyzer, etc. What do you need? S. J. Shimshak, 13 Fulton Ave., Jersey City 5, N. J.

FOR SALE—Kenyon T-659 plate transformer, T-166 choke, T-510 choke, B-31 audio transformers; Taylor T-21 tube and small parts including variable and mica condensers, RF chokes, dials, etc. F. Sherwood Martin, Greene, N. Y.

SELL OR TRADE—Philco "R" tube tester with modernizer and RCA station allocator #171. Cash or good sig. generator. Paul R. French, 128 Utah St., Baytown, Texas.

WANTED—Pocket V-O-M and other late test eqpt. Have parts, speakers, transformers, etc., to trade. J. W. Landon, Box 6425, Pittsburgh, Pa.

URGENTLY NEEDED—Three 12A6, 1—1N5G, 1—1H5G tubes. Bob Porter, R.M. 2/c, % F.P.O., San Francisco, Calif.

FOR SALE—Weston d-c voltmeter, #301; and Weston thermo-galvanometer. Want Philco or G-E record player. F. H. Perau, Batavia, N. Y.

FOR SALE—Ranger pocket V-O-M. Cash or exchange for small mantel Superhet. George Chouinard, 4599 Papineau Ave., Montreal, P.Q., Canada.

FOR SALE—Philco H-R-Z home recording attachment complete and 110v rim drive motor 9" turntable and pickup for record player. Chas. P. Tully, 19 Beomley Ave., Binghamton, N. Y.

WILL TRADE—Slightly used radio parts, condensers, resistors, i-f transformers, tubes, etc., for level winding bait casting rod and reel. Ernest F. Johnson, Route #1, Jonesboro, Tenn.

FOR SALE—One Airline and one Silvertone battery operated radio set with batteries and tubes. Want tube tester. Glen E. Cruzan, Osgood, Ind.

FOR SALE—1500 new radio tubes. 175 different types for sale as one lot. Harold's Radio Shop, 206 Main St., Huntington Beach, Calif.

SELL OR TRADE—Hearing aid battery $1.35 or trade for 35Z5 or 50L6 tube. William Colburn, 3134 N. Odell Ave., Chicago 35, Ill.

FOR SALE—Three NR50 tubes used, $4. Ted Dietenhofer, 1060 Cockran Ave., Los Angeles 35, Calif.

WANTED—Recorder with or without play back and sig. gen. Will sell meters 0-200 & 0-500 microamperes 0-5 & 0-20 milliamperes d-c; one 2½-meter transceiver and 25-watt mobile amplifier. George W. Purnell, Box 641, Sandusky, Ohio.

SALE OR TRADE—Philco auto radio #AR-10 and late sig. gen. Want table radios, electric drill and antenna for '41 Ford. Felix Laurechis, R.F.D., Box 42, Brooklyn, Conn.

WANTED—New 6N6-G or 6B5 tube and used milliammeter, any range. Cash or will trade 01A, 24A, 36, 1D8 GT, 70L7GT, 27, 80, etc., tubes. Radio Labs, Inc., 112 West 33rd St., Erie, Pa.

FOR SALE—30-watt P.A. system with two 12" speakers, new Turner mike and stand and hand mike. $75. What tubes do you need? Academy Radio Service, 1901 Mott Ave., Far Rockaway, N. Y.

FOR SALE—Battery operated sig. gen. $15 and radio books. Ralph Hunter, 12 North St., Catskill, N. Y.

FOR SALE—New Kek-O-Kut 16" turntable. Robert Butterfield, R3, Mt. Vernon, Wash.

FOR SALE—Gov't surplus a-c 0-150 voltmeters, 3" for panel mounting, $1.50. Kingsley Radio, Chestertown, Md.

WANTED—New or used 12, 25, 35, 50 and 70 volt tubes. Edward Howell, R. No. 2, Dillon, S. C.

SELL OR TRADE—Six to 8 watt amplifier and complete photo electric set. George Blake, Jr., 1212 Ann St., Winfield, Kans.

FOR SALE—Supreme sig. gen. No. 580; oscilloscope No. 535 and diagnometer No. 585; $200 for lot. DeLuxe Radio Service, 221 N. 14th St., Columbus, Miss.

WANTED—12SA7, 958 and a 47 radio tube. S. M. Watts, Route 3, Mauston, Wisc.

FOR SALE—V-O-M multitester, d-c volts to 500, ma. to 100, a-c volts to 1000, with instructions $15. C. K. Sharar, 142 View St., Oakmont, Pa.

WANTED—National or other good communication receiver. C. Jansen, 325 E. 163 St., New York 56, N. Y.

FOR SALE — Hallicrafters S-39 with slightly used 100 hr. batteries. Carl's Radio Service, Jonesboro, Ga.

WANTED—Riders manuals 1 to 13 excluding 9. Brown's Radio & Electric Service, Childersburg, Ala.

FOR SALE—51 new tubes and Crosley 1942 table radio. Clyde B. Daniels, Fairfield, Hydo Co., N. Car.

URGENTLY NEEDED—Several 01A, 71A and 45 tubes. Tom Bassett, 1012 N. Vermilion St., Danville, Ill.

SELL OR TRADE—Clough Brengle OC sig. gen. ac-dc, 6 bands. Want camera, photo eqpt. or what have you. E. Schmitka, 1481 Shakespeare, New York 52, N. Y.

FOR SALE—Rider's 1 to 5 and Utah Y290E power transformer, $25. R. C. Dole, Rutland, Vt.

WANTED—Two inverters 6v d-c to 110v a-c. C. T. Fernald, 24 Alaska St., Roxbury 19, Mass.

SELL OR TRADE—Mimeograph No. 90 with mimeoscope and other eqpt. $120 or will trade for test eqpt. William Raymond, 1 Shady Hill Square, Cambridge 38, Mass.

YOUR OWN AD RUN FREE!

For three wartime years, the Sprague Trading Post helped radio men sell, trade or buy needed materials. Now, with the advent of Peace, this free advertising service will continue as long as the need exists.

We'll gladly run your ad free in the first available issue of one of the 5 magazines in which the Trading Post appears. All we ask is that it be written clearly and concisely, that it be confined to radio materials, and that it fit in with the spirit of this service.

As always we know we can count on you to use Sprague Condensers and Koolohm Resistors—and to ask for them by name!

HARRY KALKER, Sales Manager

Dept. RC-105, SPRAGUE PRODUCTS CO., *North Adams, Mass.*

Jobbing Distributing Organization for Products of the Sprague Electric Co.

SPRAGUE CONDENSERS
KOOLOHM RESISTORS

TM. REGISTERED U. S. PATENT OFFICE

Obviously, Sprague cannot assume any responsibility, or guarantee goods, services, etc., which might be exchanged through the above advertisements

With the new RCA lifeboat radio, shipwrecks need no longer take a terrible toll of lives.

A two-way radiophone—for lifeboats!

Here's when a telephone comes in rather handy . . . when you can "get your party" and hear "We'll be there to get you in a couple of hours!"

With the new RCA compact lifeboat radio, that's exactly what happens. A kite, or a balloon, takes the antenna up 300 feet.

Turn the power-generating cranks and out goes an SOS—along with a direction-finder beam so shore stations can figure your exact location.

But even more amazing, shipwrecked mariners can talk with the men on their way to the rescue. They can "pick up" ships, airplanes, and that wonderful place called "land"—even if it's 1000 miles away!

Endless research, such as went into developing this lifeboat radio, goes into all RCA products.

And when you buy an RCA Victor radio, or television set or Victrola, you enjoy a unique pride of ownership in knowing that you possess one of the finest instruments of its kind that science has achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20. • *Listen to The RCA Show, Sundays, 4:30 P.M., E.W.T., over the NBC Network.*

Joseph McDonald and Donald Kolb (holding balloon) are the Radiomarine engineers who developed this lifeboat radio. Here is the balloon that is inflated with helium and carries the antenna as high as 300 feet into the air.

RCA

RADIO CORPORATION of AMERICA

Atomic Energy and Radio

. . . . Atomic power which has already revolutionized warfare will change everything on earth—including radio . . . . powerful broadcast stations in brief-cases, "wrist-talkies" and other wonders are on the way . . . .

HUGO GERNSBACK

THE coming of the new atomic bomb must be considered as the starting point of an entirely new era in man's history. The changes in our civilization which atomic power will bring about are so incredible and breath-taking that they will bewilder and astonish people for years to come.

The vast and manifold implications of atomic power will shake our lives and our mode of living as nothing up to now has ever been able to do. Not even the invention of gunpowder, the steam engine and electricity, can be compared to the reign of the coming atomic age.

All our previous concepts of the word "power" must go into the discard. The reason for this is that atomic power is so vastly greater than any other form of energy known heretofore that the mind is not able to grasp the astronomical figures necessary to describe it. It is as if we tried to compare the strength of a gnat with the inherent energy of Niagara Falls.

Scientists for many years have pointed out that if we could realize the latent energy in a single one-cent copper piece, we could drive the mightiest battleship across the seven seas and have energy left to spare. This should give an inkling of the vast potentialities of atomic power.

Thirty-five years ago I predicted that some day we would have "one horsepower in a watch," meaning thereby that in the confines of a pocket watch could be stored the power normally exerted by one horse. With atomic power this will be exceeded many thousand-fold. It is certain that not only a single horsepower, but many thousand horsepower can be locked in a space as small as a wrist-watch. Automobiles and other vehicles will no longer require the big engines and fuel tanks which we use today. The whole motor will be minuscule, just as the atomic bomb itself measures only a small fraction of the size of the usual blockbuster bombs.

Atomic energy built our universe. Our own sun as well as the myriads of other suns could not function without atomic energy.

When man first started out, he had practically no energy except his own muscles. Later on, when he knew how to use fire, he was given a new form of energy which lightened his work. Much later, fire was used to make steam, which again helped him in his emancipation from drudgery. Then came electricity, and the energy of steam could be converted into electrical current. About the same time the power of waterfalls could be transformed into electricity, and by overhead wires the electric current could perform important work at a distance. Thus, the power of Niagara Falls runs trolly cars at Schenectady and other distant cities. Then came the internal combustion engine, making the automobile possible, and man again advanced by leaps and bounds. But all this was child's play. These forms of energy are as crude as using mere manpower in building a Boulder Dam.

The unlocking of the atom will change everything on earth. Future man will have for the first time an abundance of cheap power which can be used instantly wherever it is wanted. Instead of burning coal and using falling water to run our electric motors, a few pounds of specially prepared material will give us electricity, light and heat and air-conditioning in our homes—*on the spot,* whenever it is needed or wanted. It will no longer be necessary to subscribe to electric light and power service. All this—within a few generations—will be a thing of the past. You will generate your own power on the spot, just as you generate power in your automobile today. The resulting heat and power will cost the merest fraction of present day costs. There will be no smoke, no quantity of ashes to cart away the next morning, because your atomic generator will use up its materials and practically no waste will remain—no more than from your electrical motor today. You will get your heat and power exactly at the time when and where you need it. Your atomic generator will be a small compact affair that can be placed anywhere in the house—even in the living room if necessary. It will work silently and there will be no smoke and no smell.

Just what substance you will feed into your "atomic furnace" cannot be revealed now, because it has as yet not been perfected. The chances are, however, that it will be a metallic composition. There will be a *primer—the spark-plug of the atomic generator.* Just as you need a spark-plug to start your gasoline engine today, just as you need a detonator to explode T.N.T. today, so we will need a primer *(Continued on page 70)*

Radio Thirty-Five Years Ago

In Gernsback Publications

FROM the October, 1910, issue of MODERN ELECTRICS:

Radiotelephony, by *Wm. E. Smith.*

A Variable Slide-Plate Condenser, by *Richard Barker.*

New Electrolytic Detector.

Egner Holmstrom Transmitter.

Novel Wireless Recorder.

Helices, by *D. E. McKisson.*

90 Miles With a One-Inch Coil, by *Chas. D. Herrold, E.E.*

Automatic Aerial Switch, by *H. R. Darling.*

How to Construct a Non-Inductive Potentiometer, by *William Klaus.*

Adjustable Slider.

Muffled Spark Gap.

A New Slider.

Construction of a Hot-Wire Ammeter.

Simple Detector.

Helix Clip.

Sensitive Detector Stand.

HUGO GERNSBACK

Founder

Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Radio-Craft	1929
Short-Wave Craft	1930
Wireless Association of America	1908

Some of the larger libraries in the country still have copies of Modern Electrics on file for interested readers.

Radio-Electronics

Items Interesting

AMATEUR operators are back on the air! Operation after the enforced wartime lay-off was authorized by the Federal Communications Commission at its meeting on August 22. First to be opened was the 112-115.5 megacycle band, with the expectation that lower and higher frequencies would soon be declared open to "ham" operation.

No permission to operate in bands offering international contacts was anticipated in the immediate future at the time the order to resume was issued. Station licenses which were valid between the dates of December 7, 1941, and December 15, 1942, and which have not subsequently been revoked are good until the FCC makes new arrangements for licensing.

CONSTRUCTION of new FM and AM broadcasting facilities begins October 7, the FCC revealed last month. In a statement of policy issued 60 days before the "thaw-out" the Commission reported that more than 800 applications are on hand for processing. It was estimated that more than 1,000 more would be filed in the 60-day period.

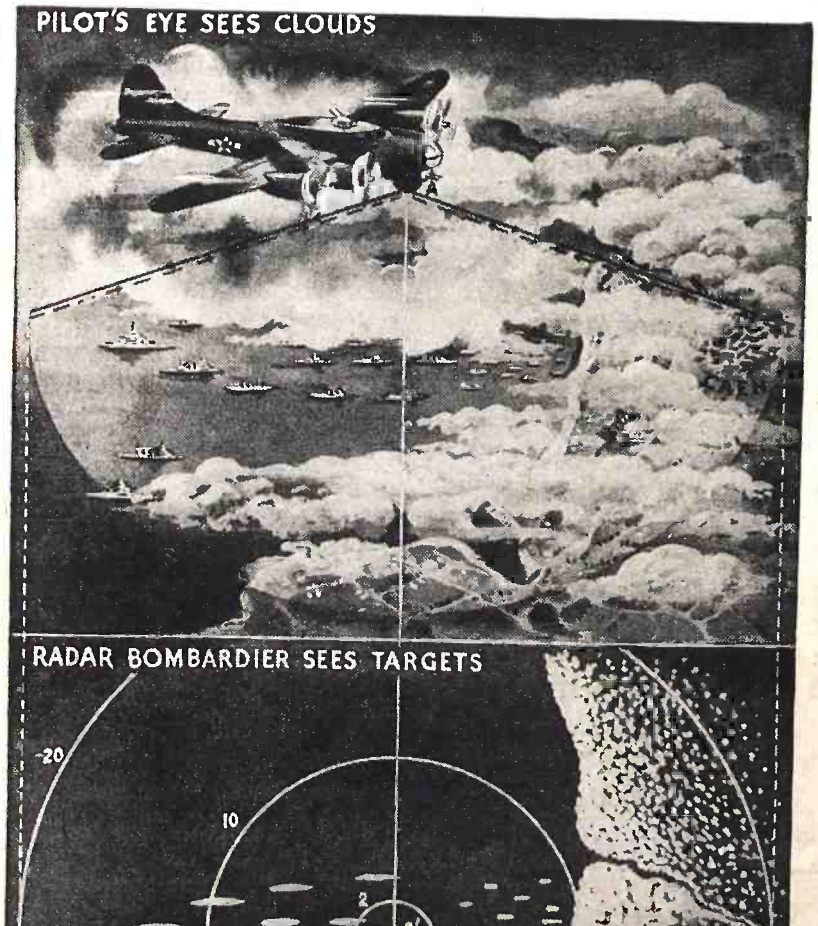
Applications will be granted strictly on a merit basis, according to Paul A. Porter, FCC chairman. "FM and television grants will not be made on a first-come, first-served basis," he declared. "We hope that in most communities there will be enough channels for all qualified applicants—where that is not the case, grants will be made, after hearing, to those best qualified, not to those under the wire earliest."

A MINIMUM of ten hours broadcasting daily for FM stations—instead of the six hours tentatively proposed by the FCC in its regulations—was urged last month by E. I. Godofsky, former president and general manager of Radio WLIB, Brooklyn, in a memorandum submitted to the FCC.

The memorandum also declared that "ownership, operation or control of both AM and FM stations serving the same area would constitute a concentration of control inconsistent with democratic objective," and suggested that the FCC should issue a "sense of the Commission statement" to that effect, meanwhile postponing any regulations on the subject till the 1950 census would indicate whether the number of FM sets is likely to exceed or approach the number of AM receivers in any community. If such should be the case, Mr. Godofsky believes that ownership of both an AM and FM station would constitute dual ownership to an extent exactly equal to the ownership of two AM stations in the same community, a practise not now permitted.

FULL-POWER operation of all broadcast stations was ordered to resume October 1. FCC order 107, which required readjustment of all United States broadcast transmitters to a level one decibel below their full output, has been revoked. Order 107-A, rescinding the earlier order, stated that "on and after September 1, 1945, at the option of the licensee, transmitting operations may be conducted with full operating power during daytime hours only, and on and after October 1, 1945, Order No. 107 shall be revoked, and all licensees shall be required to operate in accordance with the provisions of Section 3.52 of the Rules and Regulations."

Order 107, which called for the one-decibel drop in output, was passed November 6, 1942, with the object of conserving transmitter tubes and other parts. Since the War Production Board has advised that no obstacles now stand in the way of replacements and the parts and tubes will be generally available, rescinding order 107-A was issued.



This drawing, released by Philco Radio Corp. last month, shows bomber equipped with radar bombsight flying above the Normandy coast 30 minutes before invasion landings. The scene below is the image on the cathode-ray tube screen. The eye of radar sees a clear picture of territory beneath, invisible to the men in the plane. It was due to radar-controlled bombing that the Normandy coast defenses were knocked out entirely before our men landed.

GIFT of an FM broadcast station, including towers and studio equipment, to the University of Oklahoma, was announced last month by the president of that institution, Dr. C. I. Pontius.

The educational FM transmitter, presented by W. G. Skelly, owner of Radio KVOO, Tulsa, Oklahoma, will be installed in a new radio building to be constructed on the university campus, bringing the total value of all broadcasting facilities at the school to more than $100,000.

This is believed to be the first donation of an educational FM station to any institution in the United States.

RURAL FM may be detrimentally affected by FCC regulations requiring directional antennas to avoid invasion of urban areas, declared Major Armstrong in testimony before the Federal Communications Commission last month.

Such aerials, the Major said, might cut off as much as 50 percent of a rural station's service area, merely to avoid competition with town or city stations to whom it would offer no substantial competition, if the urban stations put out programs with real listener appeal.

Questions of interference between high-powered rural stations and metropolitan or community installations—as well as problems of adequate rural coverage—could be solved, Major Armstrong believed, by allocating positions on the lower end of the band to these high-powered country broadcasters.

In reply to a question as to the length of time required to change to the new high frequencies, he estimated eight months, though this period might depend somewhat on the time taken to develop a new high-frequency, high-power tube. Meanwhile it would be necessary to build FM receivers to cover both bands, he stated.

Monthly Review

to the Technician

POSTWAR buyers of radio receivers are by no means sure where they intend to purchase their new sets, according to a survey released last month by John Meck Industries. Sixty-four percent of those queried "Where will you buy your new radio" said they didn't know, were undecided. Of those who had made up their mind, the majority (25 percent of the total) planned to buy in an established radio shop. Five percent planned to get their new receiver in a music or furniture store and 6 percent in department stores.

The survey indicated that there would be a market of between 250 million and 500 million dollars worth of radio sales. The opportunity for radiomen to supply the lion's share of the undecided 64% of radio buyers as well as the 25% already secured to them, was sharply pointed up in a message to radio distributors which accompanied the survey report.

PRICES of new radio receivers may be up 20 to 30 percent, according to statements made last month by manufacturers.

Manufacturers were practically unanimous in declaring that production of table models would be stressed at the start, with possibly a few consoles. FM receivers would come a little later.

Estimates of price increase range from "30%," by Dorman D. Israel, vice-president of Emerson, and "one-third higher," by Arthur Freed, vice-president of the Freed Radio Corporation, through "20%" by Larry F. Hardy, head of the Philco Corporation's radio division, to "slightly" by Joseph B. Elliott of RCA.

An unknown factor which might have a great effect on prices is the heavy competition expected in the postwar period. It is estimated that no less than 50 new receiver manufacturers will enter the field.

COMPULSORY radar installations on all ships was urged last month by Commodore George J. Barendse, retiring skipper of the Nieuw Amsterdam. As an example of the application of radar to navigation, the Commodore described a recent wartime arrival at New York in dense fog, which would normally have required anchoring and waiting for clear weather:

"We were traveling in one of the thickest fogs I have ever experienced," he said. "I relied strictly on my radar and kept the Nieuw Amsterdam (a 36,287-gross ton ship) at full speed. As we approached the Ambrose Lightship we were exactly on course. When we reached the appointed position for taking on the pilot, there he was right off the starboard bow.

"The ship continued, picking up the channel markers, buoys, etc., right on through the anti-submarine nets and up the Hudson River. We were off the pier's head before the people on the dock were aware of the ship. It was not luck nor a hit-or-miss chance, we came in on our radar and knew exactly where we were every foot of the time—and this in a dense fog."

Savings realized by maintaining schedules and avoiding accidents would more than pay for the installation costs and maintenance of ship radar, in the opinion of the Commodore.

(The use of radar as a navigational aid is fully described in the article "Electronic Navigator" on page 16.)

TWO-BAND FM receivers are not in the public interest, the FCC informed the Radio Manufacturers Association last month. "The only reason that has been advanced for the manufacture of receivers covering the old FM band as well as the new is that by building such receivers demonstrations of FM reception to prospective customers will be possible," wrote the Commission chairman to RMA's president R. C. Cosgrove. "This does not appear a valid reason. We anticipate that very shortly the Commission will announce its standards for FM broadcasting in the higher band. As soon as this is done, FM stations will be required to take steps to begin operation in the new band as soon as possible, so that by the time receivers are available all stations will be operating in the new band."

If necessary, the Commission letter hinted it might put an end immediately to FM transmissions in the old band, to protect the public from an unnecessary expense and to insure that the change to the permanent FM band should not be delayed.

APPOINTMENT of Justin Miller to the presidency of the National Association of Broadcasters was hailed last month as an excellent omen by opponents of "plug-uglies" in news broadcasts. The St. Louis *Post-Dispatch*, one of the leaders in the national campaign against middle commercials in news programs, quotes in its editorial columns a letter received from Justice Miller some months ago:

"There is no more reason why a newscast should be interrupted for a plug-ugly than that such ads should be inserted in the middle of news stories or editorials in a newspaper; especially when the interruption—deliberately or unconsciously, whichever it may be—is in nauseating contrast to the subject under discussion by the commentator."

Appointment of a man of such beliefs, says the *Post-Dispatch*, implies that station operators are resolved to remove the abuses which have crept into radio.

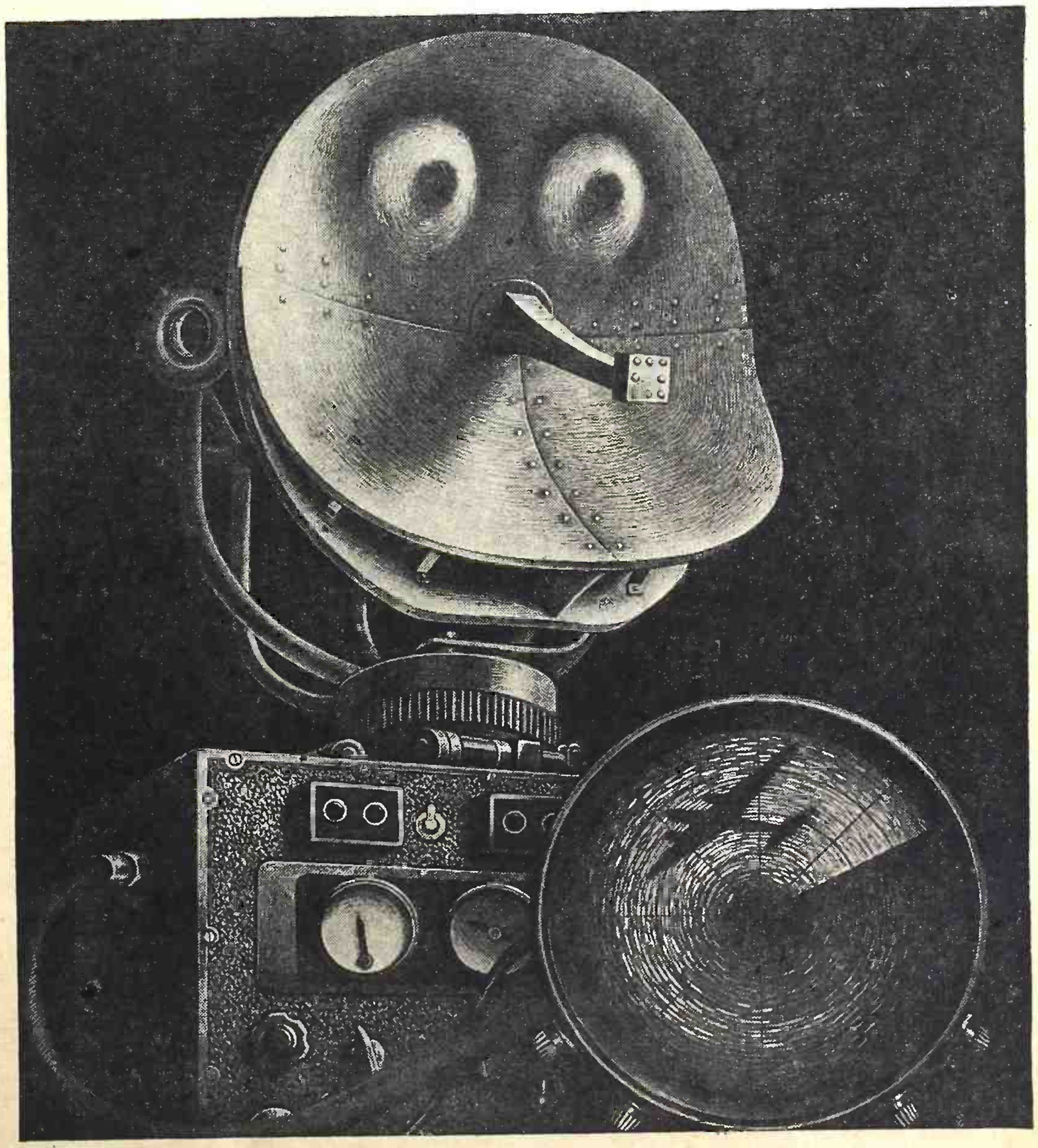


Photo courtesy TIME

Renowned artist Boris Artzybasheff envisions that electronic sniffer, Radar, whose metallic nose detects enemy planes and ships afar off. *Time* magazine ordered this picture for its cover, but Japanese surrender forced it inside and made radar a peace-time instrument.

Radar—Secret Weapon No. 1

Its Many Applications Won War for United Nations

By **FRED SHUNAMAN**

RADAR is no longer a (complete) secret. A flood of information on the hitherto mysterious war-time instrument was released on the eve of Japanese surrender. Many rumors of near-incredible applications have been proved facts, and applications undreamed of by the layman are now openly described.

We learn that stories of "Mickey" or the "black box" which were supposed to provide the pilot of a plane with practically a television view of the country over which he was flying, were no exaggerations. Rumors of ships being attacked and sunk at night, in total darkness by means of radar, without ever being sighted visually, are confirmed. Radar's role as the decisive weapon in the Battles of Britain and the Atlantic is established.

What was not generally known is that ground radar installations were also used as super-efficient aerial navigation aids. Used in conjunction with VHF telephonic communication, they guided pilots to intercept enemy bombers without waste motion in searching for them, steered them on long runs over enemy territory, and even signalled the exact moment to drop their bomb loads. Neither was it known that radar—by means of a special electronic identification device—could distinguish friendly from hostile aircraft or ships, a feature without which was absolutely necessary in night attacks.

The underlying principles of radar were described in *Radio-Craft's* April and May (1945) issues, (Radar Principles, by R. L. Smith-Rose). These articles detailed the fundamental type of radar operation, which has been so improved in some cases as to be almost unrecognizable from descriptions of earlier, simpler apparatus. An excellent brief outline of radar principles appeared in the bulletin *"Radar,"* released by the British Information Service, under the head, "How Radar Works," extracts from which follow:

Radio waves have many of the properties of sound waves, especially radio waves of the shorter wave-lengths or higher frequencies. They travel at the same speed as light—approximately 186,000 miles a second—and can be reflected or "echoed" from a great variety of objects—as Herz demonstrated as long ago as the end of the last century.

As radio waves travel at a constant speed, the distance of an object from which a radio echo is reflected can be determined from the time the echo takes to return to the point from which the original wave was transmitted.

For example, let us assume that we have sent out a radio wave from a radar station and that the echo has come back to the receiver in 1/500th part of a second. We know that radio waves travel at 186,000 miles a second. Therefore, the distance *out and back* from the aircraft must be $\frac{186,000}{500}$—that is 372 miles. If we halve that distance for the single journey, we find that the aircraft is 186 miles away from that station.

Such short intervals of time are measured by that well-known instrument, the cathode ray tube, in which a beam of electrons is made to sweep across a fluorescent screen in somewhat the same way as a hand sweeps across the clock face.

Just as the second hand of a clock completes its sweep of the face in sixty seconds, the electron beam can be made to travel across any desired portion of the fluorescent screen in some predetermined interval of time.

As a simple illustration, let us suppose that the beam is made to travel across the screen—leaving a straight horizontal line of light—in 1/500th of a second.

This line will represent the time taken for a radio wave to travel 186 miles out and back. So we can write "0 miles" at the beginning of the line and "186 miles" at the end. As the waves travel at a constant speed, we can subdivide the whole line into a scale of miles.

In sending out our radio waves we must be careful to keep them in very small bursts or "pulses"—not lasting more than a few millionths of a second. The reason for this is that, otherwise, they would "drown" the returning echo. (If we want to get an ordinary sound echo we give a short, sharp cry, so that we can hear the echo when it comes back. If we keep up a long yell we shall not be able to hear the echo. The same principle applies to our radar "shouts" or "pulses".)

The returning radio echo is picked up by highly sensitive receivers and made momentarily to deflect or dip the electron beam as it sweeps across the flucrescent screen. This makes a V-shaped depression or "blip" in the line at a point representing the time taken for the echo to return.

Courtesy General Electric Co.

Fig. 1—This radar tube screen shows a "television" picture of the surrounding territory.

We have already marked off a scale of miles above the line of light, so by reading the number of miles opposite the "blip" we can tell instantly how far the aircraft is away.

Of course the process is continuous. Many pulses are being transmitted every second—with sufficient interval between each to allow the echo to return from the greatest distance the instrument is designed to measure. The electron beam is also sweeping up and down the line many times a second and is being deflected by a constant succession of returning echoes.

All this happens too rapidly for the human eye to see anything but a steady, glowing line of light with a blip in it. If the aircraft is approaching, the blip will slowly move in the direction of "0 miles." If it is going away it will move toward "186 miles." In this way the aircraft's movements can be watched continuously.

In the older types of radar, which used fixed antennas, special techniques were necessary to determine the direction and altitude of approaching aircraft. Modern "searchlight" equipment uses a rotatable aerial which is turned to the horizontal and vertical angle at which strongest signals are received, thus determining direction and altitude angle automatically.

Use of "television technique" marked a great step forward in the versatility of this new instrument. The use of the very high frequency technique for the detection of low-flying aircraft had made it practicable to mount the whole aerial system (now smaller because of the shorter wavelength) on a turntable and to concentrate the energy into a beam rather like a widely dispersed searchlight. This beam could sweep the horizon if necessary through the whole 360 degrees, and by suitable devices on the cathode ray tube line the display *could be made to rotate in synchronism.*

If the signal returned from an aircraft were made to brighten the line instead of deflecting it, the position of any aircraft encountered by the beam could be shown in plan in a bright spot on the circular face of the tube which could then have a map of the surrounding terrain superimposed on it. This technique is known as P.P.I. (Plan Position Indicators), See Fig. 1.

Moreover, by other almost fantastic developments, it became possible to project optically the map, aircraft indications and handwritten plots all together on a translucent screen. The dream of many commanders is realized in this—the power to sit in a room at headquarters and see all the movements of hostile and friendly aircraft displayed before them on a map.

GROUND-CONTROLLED FIGHTERS

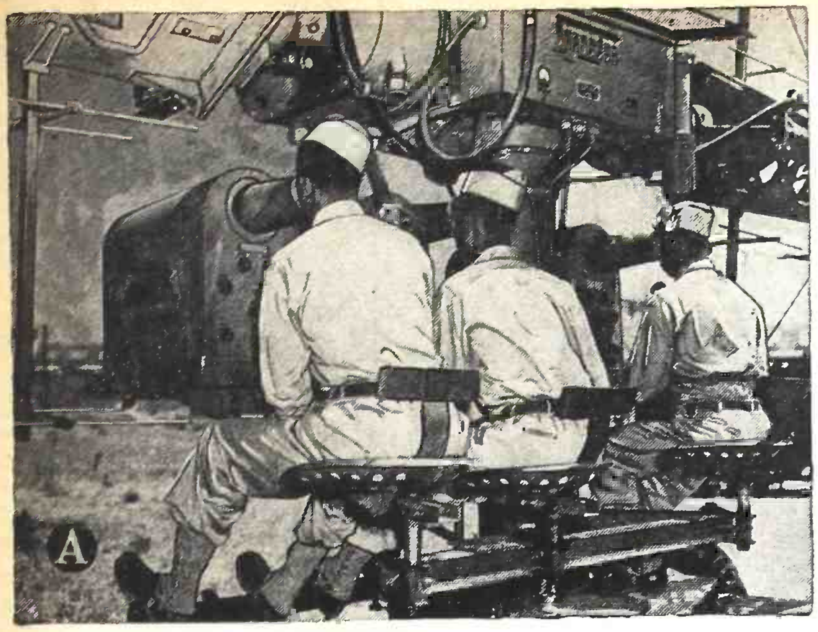
Radar alone made it possible for the pitifully inadequate RAF to meet the hordes of German raiders and turn them back. One of its earlier special applications was the so-called GCI (ground-controlled interception). A controller at a fixed installation watched movements of friend and foe on the screen of a Plan Position Indicator, sending special instructions called "vectors" to the plane under his control. A VHF communications system which employed a shorter wave-length than any before used was an important feature in GCI.

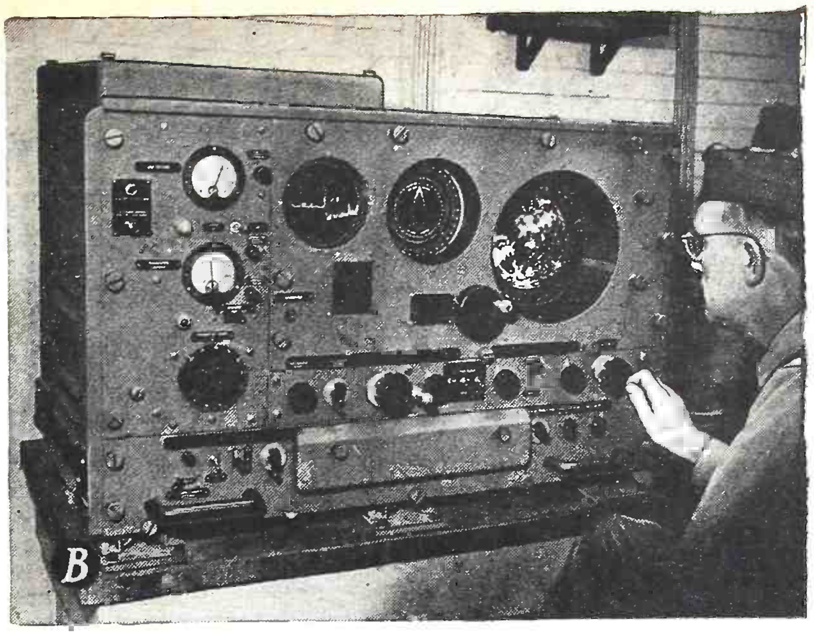
The ground controller was able to note the relative positions of the enemy plane or planes and that of the planes under his control. By means of the "vector" directions, his planes could then be maneuvered directly toward the enemy. The pilots, informed when and where to expect the enemy, had a great advantage over him—so great an advantage that the small RAF was able not only to turn back vastly superior forces of raiders but to shoot down what to the Germans seemed to be altogether disproportionate numbers of them.

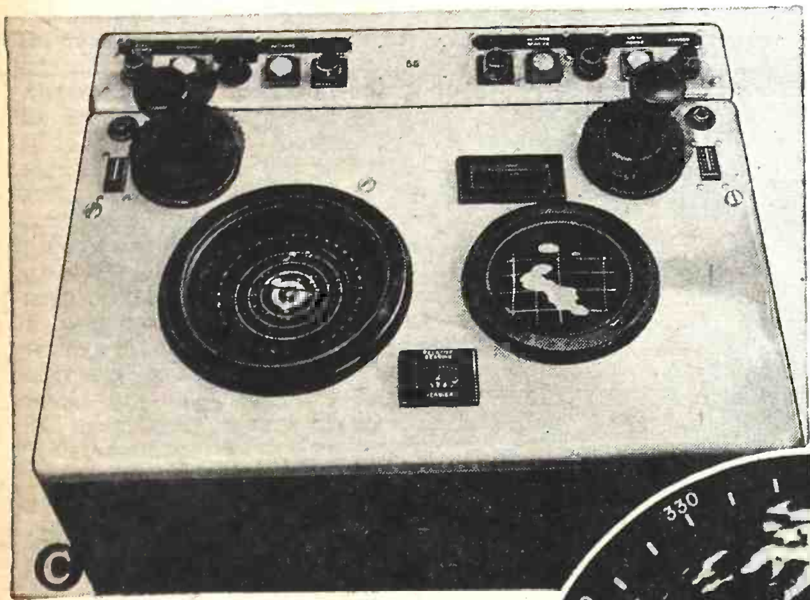
Two months of uniformly high losses discouraged the Nazi day raiders and they turned to night bombing. Hitherto the GCI had simply brought the defending planes into the path of the oncoming raiders, then left them to the exercise of their own vision and judgment. In night fighting, the controller would pick out a particular Nazi plane as target and bring his controlled craft up to the point where the pilot could just see the enemy as a dark mass ahead. The British fighter could usually then finish off his adversary before being himself sighted.

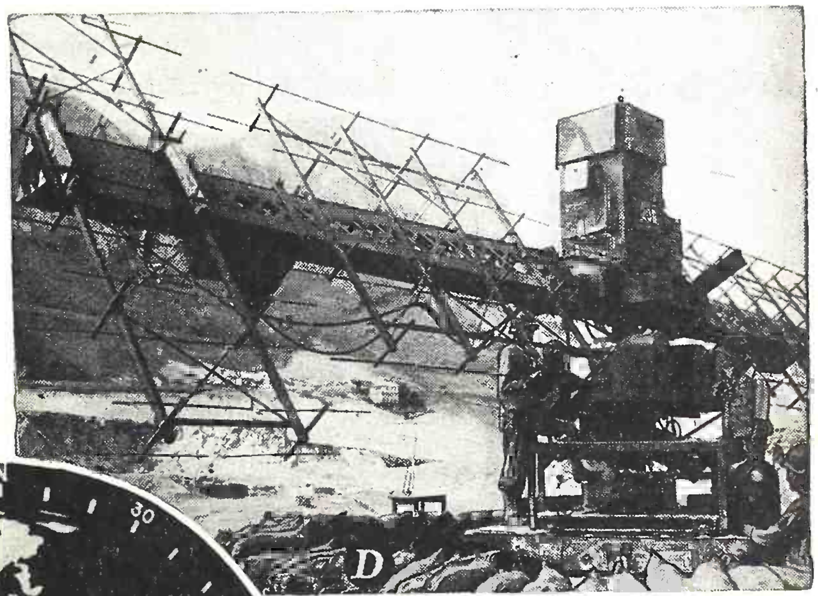
A still later development was the smaller AI, or Aircraft Interceptor, a short-range radar *which is carried in the plane.* The fighter receives "vectors" from his ground-control station till within AI range of the enemy, and is then directed to "flash his in-

(Continued on page 50)





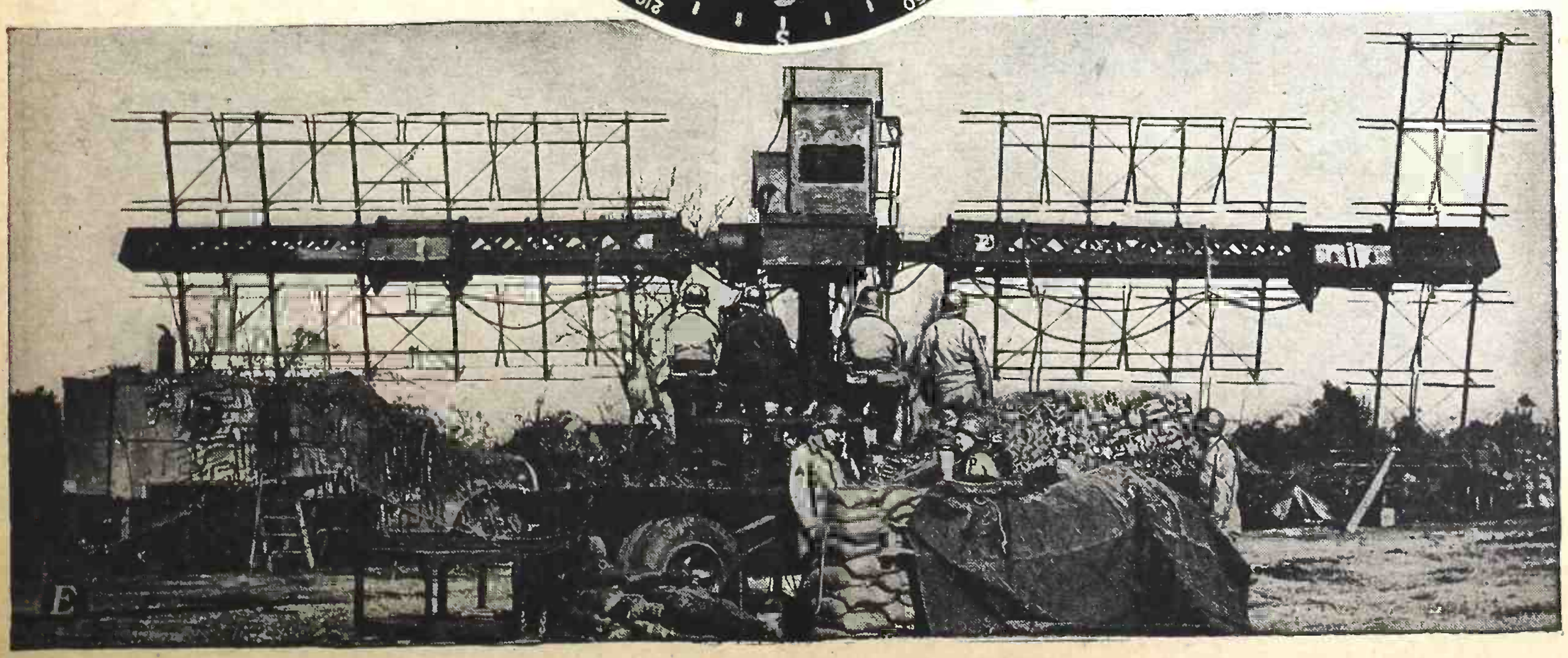




A—Radar crew at work. One calls off the target's altitude while the other gives its range. The third man plots direction. B—A precision radar indicator in use. C—Radar repeater, to reproduce information from the main set. D—A mobile "early warning" mobile radar, photographed to show the directional aerial.

E—Clear picture of a mobile radar. This set-up was able to pick up Nazi aircraft invisible through overcast, to be picked off by guns just outside the picture. Center—Typical pattern of a radar Cathode-ray screen.

Picture credits—A, D, and E—Signal Corps photos of Western Electric radar apparatus. B, C, and Center—Raytheon Manufacturing Co.



ELECTRONIC NAVIGATOR

More important to the safety and speed of navigation than any other single invention is this new application of radar

FIRST of the many peace-time applications of radar is an "electronic navigator" which can detect through darkness, fog and storm the position of any above-water obstacles, lighthouses, shorelines or other ships. The instrument, which works along the lines of the Plan Position Indicator described elsewhere in this issue, is so sensitive that it can detect metal objects as small as ordinary buoys. A ship, instead of lying outside a harbor for days, waiting for fog to lift, can navigate up the channel by the buoys on each side, meanwhile "seeing" any other craft in the same area.

Dr. W. R. G. Baker, General Electric vice president in charge of electronics, who had much to do with the development of television in its present form, predicts that the new device will revolutionize "thick weather" navigation, providing the mariner with an instrument to plot a safe course, even though his normal visibility is strongly limited by natural conditions.

A working demonstration of the apparatus, held recently in Long Island Sound, showed how, in the dead of night, it is possible for a ship to operate safely and accurately through any kind of thickened overcast condition, with the radar mechanism giving the ship's navigator a bird's-eye view of the surrounding waters, his own ship being always in the center of the field.

During the demonstration in the waters off Long Island, such objects as other ships, channel markers, lighthouses and land masses were shown in their relative positions, and both distance and bearing were automatically plotted on the face of the viewing screen. The distance of objects from the ship was shown in true proportion, being measured by a series of concentric "marker rings" electronically superimposed on the picture screen. According to General Electric engineers, the measurement of distance so given is accurate to the point of one percent.

Basis of the "electronic navigator," is a rotating antenna, located on the top deck of the ship and analogous to a searchlight, in that it sends out beams to locate obstacles in the ship's path. The difference, however, is that beams from the radar antenna, which are actually powerful radio microwaves, are capable of penetrating fog or any other atmospheric conditions without hindrance. They are sent out as "pulses" or surges of extremely short duration and at a very rapid rate.

As the radar waves locate an obstacle in the surrounding waters, they bounce off and are scattered, no matter of what material the object is. Some of these echoes—or scattered waves—will return to the rotating antenna, which also acts as the receiving antenna during the time intervals between the outgoing pulses. After being amplified, these echoes are made to appear as bright spots on the face of a cathode ray tube, which is somewhat similar to a television screen tube. The image thus formed gives the operator a "radar picture" of the obstacle, and the marker rings tell him how far away it is.

By controlling internal circuits, the operator may change the scale of the field to cover either a 2-, 6-, or 30-mile radius. Thus, when a ship is sailing in the open sea, the operator will use the 30-mile range until an object approaches to within 6 miles. Then, by turning a knob on his radar set, he is immediately presented with a larger scale chart, the outer radius of which is 6 miles. For very close work another turn of the knob provides a 2-mile radius chart on which objects may be observed down to about 200 yards.

Radar waves sent out from the ship's antenna travel with the speed of light—186,000 miles per second—and therefore require only about a millionth of a second to make a round trip to an object 200 yards away. Since the measure of distance to an obstacle is given with extreme accuracy by the marker circles, the system must be able to measure time down to one hundred-millionth of a second.

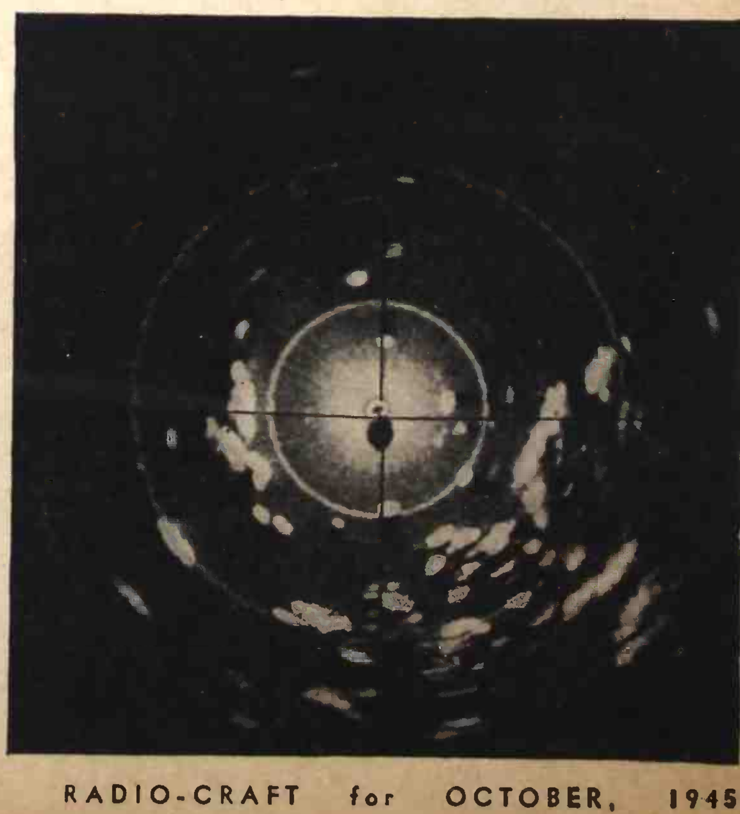
In 1943, more than four million gross tons of cargo space were lost on the Great Lakes alone as the result of fog. Out of this, two million tons were lost through serious and hitherto unavoidable accidents such as collisions and groundings. The major part of lost cargo space was caused by fog delays. In 1943, as many as 100 boats at a time were fog-bound at the Soo Locks. Adverse conditions such as these sometimes delayed vessels as much as 30 hours at a time.

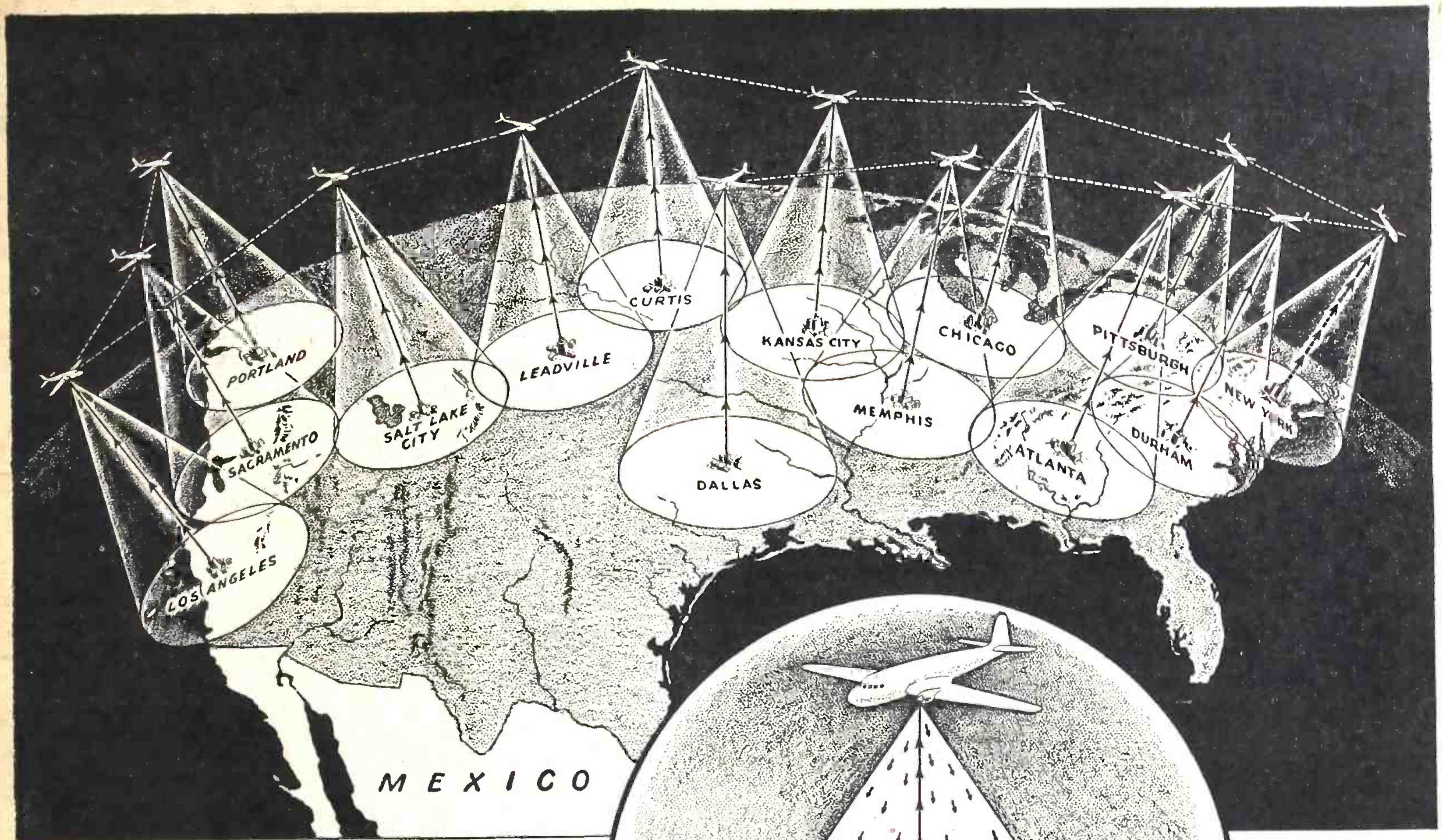
The new electronic device will permit the lake navigator to maneuver and direct his ship with utmost safety—in the thickest weather, in the heaviest storm and static, in darkness—or in any combination of all these. Under any adverse weather condition, it will enable the navigator to locate ships, buoys, icebergs, derelicts, and shore lines. It will help him locate river mouths, break-waters, docks and bridges. During storm and blizzard, it will enable him to hug a lee shore and proceed safely, even at times when the time-honored method of echoing the sound of ship's whistle against shore becomes ineffective. The cramped quarters, short runs, and—on the Great Lakes—frequent fogs or storms, make the electronic navigator even more valuable for inland navigation than for deep-water shipping.

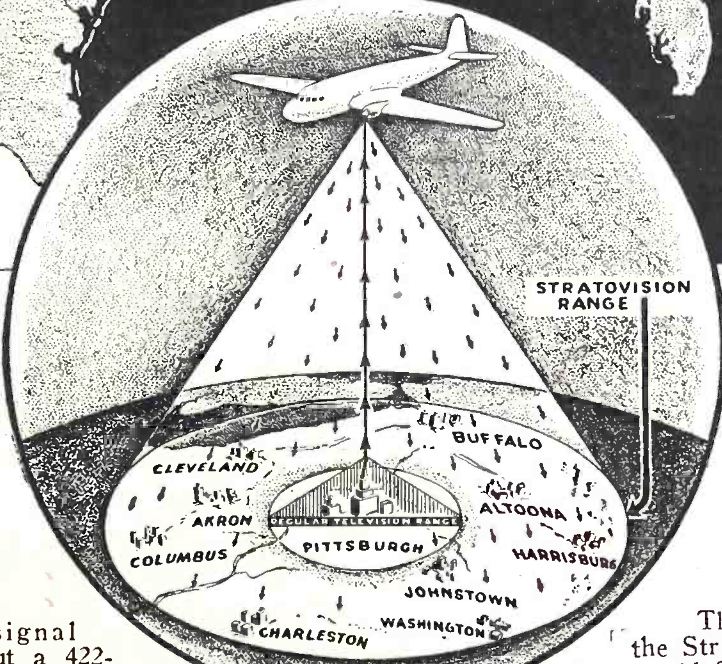
Despite the complexity of circuits within the radar system, which such accurate timing makes necessary, demonstrators declared that sets are as easy to operate as a large home radio receiver. A few minutes' instruction will enable an operator to grasp the fundamentals of operation, and in a few hours of practice he can learn safe recognition of various types of objects, as well as their bearing with respect to the course and position of his own ship.

Left—Using the Electronic Navigator in a demonstration aboard the "American Mariner." Right—Map of the area on the screen of the cathode-ray tube, as it appears to the pilot.

Photos courtesy General Electric Co.







Above — The United States covered by 14 airplane stations. Left — Detail of one plane's broadcast service territory, centering on Pittsburgh.

Fourteen transmitters in planes 30,000 feet up can cover the United States with FM and television programs from metropolitan nets

STRATOVISION

A REVOLUTIONARY new plan which—if found practical—will cut the number of steps for a trans-continental television relay from 100 steps to eight, was revealed recently by Westinghouse. The same plan would increase the coverage of a television or FM station from a 50-mile radius to more than 200 miles. The proposed new system, originated by C. E. Nobles, 27-year-old engineer from Texas calls aviation in to help electronics, and has been given the name of *Stratovision*.

The Stratovision system simply puts the antenna and transmitter in an airplane flying in lazy circles 30,000 feet above the earth, out of sight of human eyes. The short waves sent out from this airborne antenna would blanket the earth's surface like a great inverted ice cream cone; covering an area 422 miles across or equal to about the combined area of New York, Pennsylvania and New Jersey.

Reception of Stratovision broadcasts would be practically free from interference and distortion, caused normally by reflected ground waves and the numerous amplifications or relaying stages required by any previously proposed system to carry television and FM broadcasts over a comparable area.

As the height of a television or FM antenna is increased, the amount of power required to deliver a usable signal to a receiver is sharply reduced. To provide a useable signal throughout a 422-mile wide receiving area covered by a plane-borne transmitter 30,000 feet in the sky, would require only one-fiftieth as much power as is needed by a 50 kilowatt transmitter on the ground covering an area only 100 miles in diameter.

The Stratovision system would employ a low-powered ground transmitter to send television and FM broadcasts to a specially-designed high-altitude plane circling slowly overhead. The plane would be equipped with receivers and transmitters for re-broadcasting these programs to the earth. As now conceived, the plan would employ four television and five FM transmitters on each plane.

A coast-to-coast network for relaying television and FM programs from plane to plane between New York and Hollywood would simply require stationing eight such stratosphere planes above strategic areas spanning the continent. To provide comparable service by ground installation, it is estimated, would require approximately 100 costly relay towers and hundreds of transmitters; or a coast-to-coast coaxial cable network which would cost at least $100,000,000.

The eight planes in the Stratovision relay system would fly over New York, Pittsburgh, Chicago, Kansas City, Curtis (Nebraska), Leadville (Colorado), Salt Lake City and Los Angeles, linking logical talent centers in New York and Hollywood. By adding six more planes over Durham (North Carolina), Atlanta, Memphis, Dallas, Sacramento and Portland (Oregon), it would be possible to provide Stratovision coverage for 51% of the nation's area and 78% of its population.

Programs would be originated in conventional ground studios connected with plane transmitters by a special beamed-type ultra-shortwave radio link, much like those used in radar. Similarly beamed plane-to-plane connections would be employed to form the nation-wide high-altitude relay network.

The advantage of mounting several transmitters in the same plane is greater choice of programs and economy of operation, since each transmitter would function as a separate station.

Contributing to economy of the system is the fact that as the height of a television or FM antenna is increased, the amount of power required to deliver a useable signal throughout its line-of-sight area is sharply reduced. One kilowatt of power will be sufficient to provide a useful signal throughout the 422-mile range

(*Continued on page* 45)

COVER FEATURE:

B-29 ELECTRONIC GUN CONTROL TESTS

By T. E. HOLLAND*

THE "static accuracy" test is one of many the B-29 electronic gunfire control system computer must pass before it is accepted for use by the Army Air Forces. In practice it is usual to separate the various component functions that enter into the total correction turned out by the computer so that each one may be tested independently of the others. In the final tests every effort is made to simulate actual operating conditions with a specified attack problem.

Electronically-controlled turret of a B-29.

One may easily visualize what is meant by static correction by assuming that the bomber and target are at rest on the ground and subjected to a high velocity wind. Now if the sighting station is sighted at the target, the azimuth and elevation input follow-up systems in the computer will "align" themselves with the sight. If the guns were fired at this point, the bullets would miss the target, however, because of the parallax between the sighting station and gun turret, the deflection of the bullets by the wind, and the drop of the bullets due to gravity. Thus it is evident that even for a problem involving no lead correction, the computer must introduce "static" corrections which vary with azimuth and elevation sight position as well as with windage and range.

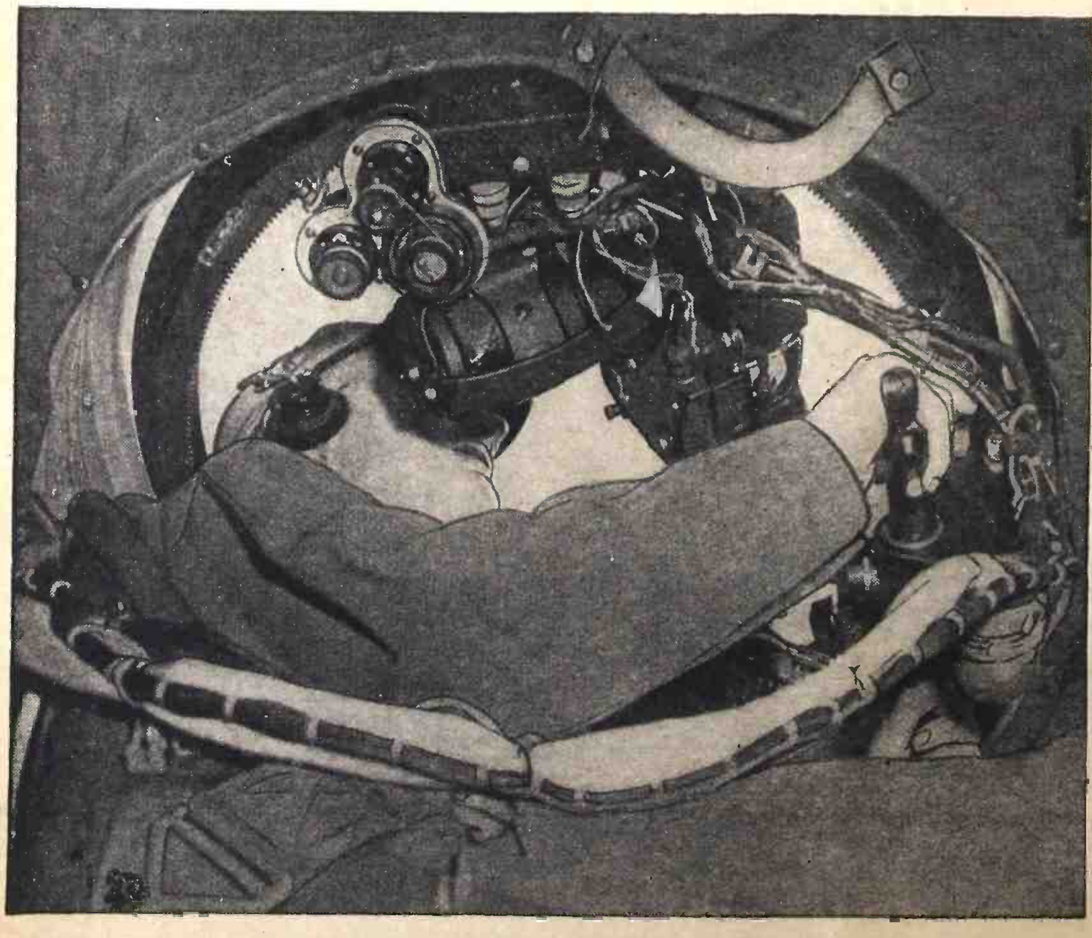
In the complete fire control system aboard the plane, the navigator sets indicate air speed, temperature, and altitude into the "Altitude and Air Speed Handset Unit." It is evident that the air speed and air density affect the amount of windage correction the computer must turn out. Air density, however, is a function of altitude and temperature so that the three quantities mentioned above furnish sufficient data for the computer to calculate windage correction. The "handset unit" combines the various inputs, operating a potentiometer follow-up system, thus introducing the windage input signal to the ballistic unit in the computer. This unit is simulated electrically in the test panel by calibrating the output of a potentiometer so that a definite voltage corresponds to a certain combination of settings on the "handset unit." The output of the potentiometer is, of course, fed into the ballistic unit of the computer.

The position of the sight and the range of the target both influence the amount of ballistic and parallax corrections. In the complete fire control system, selsyns mounted on the sight send signals (corresponding to the azimuth and elevation angle of the sight) to the selsyn follow-up system in the computer. This data is fed into both the parallax and ballistic correction units. Range information is obtained from a range potentiometer on the sight which is geared to the range knob. The gunner rotates the range knob to bracket the target wing tips with a movable circle of dots. The range potentiometer operates a potentiometer follow-up system in the computer which transmits the range data to the parallax and ballistic correction units. In the test panel, two selsyns are calibrated to give signals corresponding to the signals obtained from the azimuth and elevation selsyns on a sight. Similarly, a potentiometer is arranged in the panel and calibrated to give signals corresponding to the signals from the range potentiometer on the sight for various ranges.

All of the above inputs are introduced into the computer which solves the problem mechanically and reconverts the correction into electrical signals in azimuth and elevation. These signals then position the gun turret to the point where the bullets would hit the target if the guns were fired.

In practice the computers are tested at several points in azimuth, elevation, and ranges for specified settings of the altitude and air speed handset units. The static corrections turned out by the computer are read on the azimuth and elevation correction dials and are compared with the calculated theoretical values.

*Aeronautics & Marine Eng. Div., General Electric Company, Schenectady, N. Y.



Gunner manipulating the sight. Its adjustments are translated as voltages to the computer.

RADIOPHOTO IN COLOR

FIRST transmission of a radiophoto in full color was announced last month by a Chicago newspaper. The photo was sent through Army Signal Corps channels from Germany. Details of the method for making and transmitting color photographs by radio were also perfected by the Signal Corps. The transmission was made by sending three separate pictures, one for each of the "color plates" used in printing. Colors transmitted were not the primary light colors red, green and blue used in color television, but the "primaries" of the color printer, red, yellow and blue.

HOW RADAR OPERATES

Resumé of All Technical Information Released to Date

PRACTICALLY every radar set is made up of the following major parts or components:

1—A modulator; 2—A radio-frequency oscillator; 3—An antenna with suitable scanning mechanism; 4—A receiver; and 5—An indicator.

While the physical form of each of these components may vary widely from one kind of radar set to another, each radar must have this complement of parts in order to function.

1—The *modulator* is a device for taking power from the primary power source (which may be the commercial power line, a special engine or motor-driven generator, or storage batteries) and forming suitable voltage pulses to drive the R.F. oscillator in its bursts of radio frequency oscillations. In other words, it is the modulator which turns on the radio frequency oscillator to oscillate violently for a millionth of a second or so, turns it off sharply and keeps it in repose until time for the next burst.

2—The *radio-frequency oscillator* is a vacuum-tube of suitable design, or a group of such tubes, which will oscillate at the desired radio frequency and give the desired bursts of radio frequency power when connected to the modulator. The development of suitable oscillator tubes has been one of the major achievements of the radar art. It is a relatively simple job to produce a radio frequency oscillator which will give oscillations of any desired frequency provided one is satisfied with a power of only a few thousandths of a watt. In the receiving part of a radar circuit this amount of power is adequate. A practical radar transmitter, however, must generate during its momentary bursts of oscillation a power which may run into hundreds of kilowatts. Since the oscillator is turned on a small fraction of the time, the average power is usually hundreds of times less than the peak power, but even the average power may run up to the order of one kilowatt. Thus, practical radar equipment requires extremely high frequency oscillators running at powers thousands of times greater than was thought possible a few years ago.

3—The problem of *antenna* design is also one of the major problems in radar, incomprehensible as this may seem to the operator of a home radio receiver, who finds a few yards of wire strung up on his roof adequate for his purpose. A suitable radar antenna must have the following characteristics:

a. It must be directional; that is, it must concentrate the radio energy into a definitely defined beam, since this is the method by which the direction to the objects detected is determined;

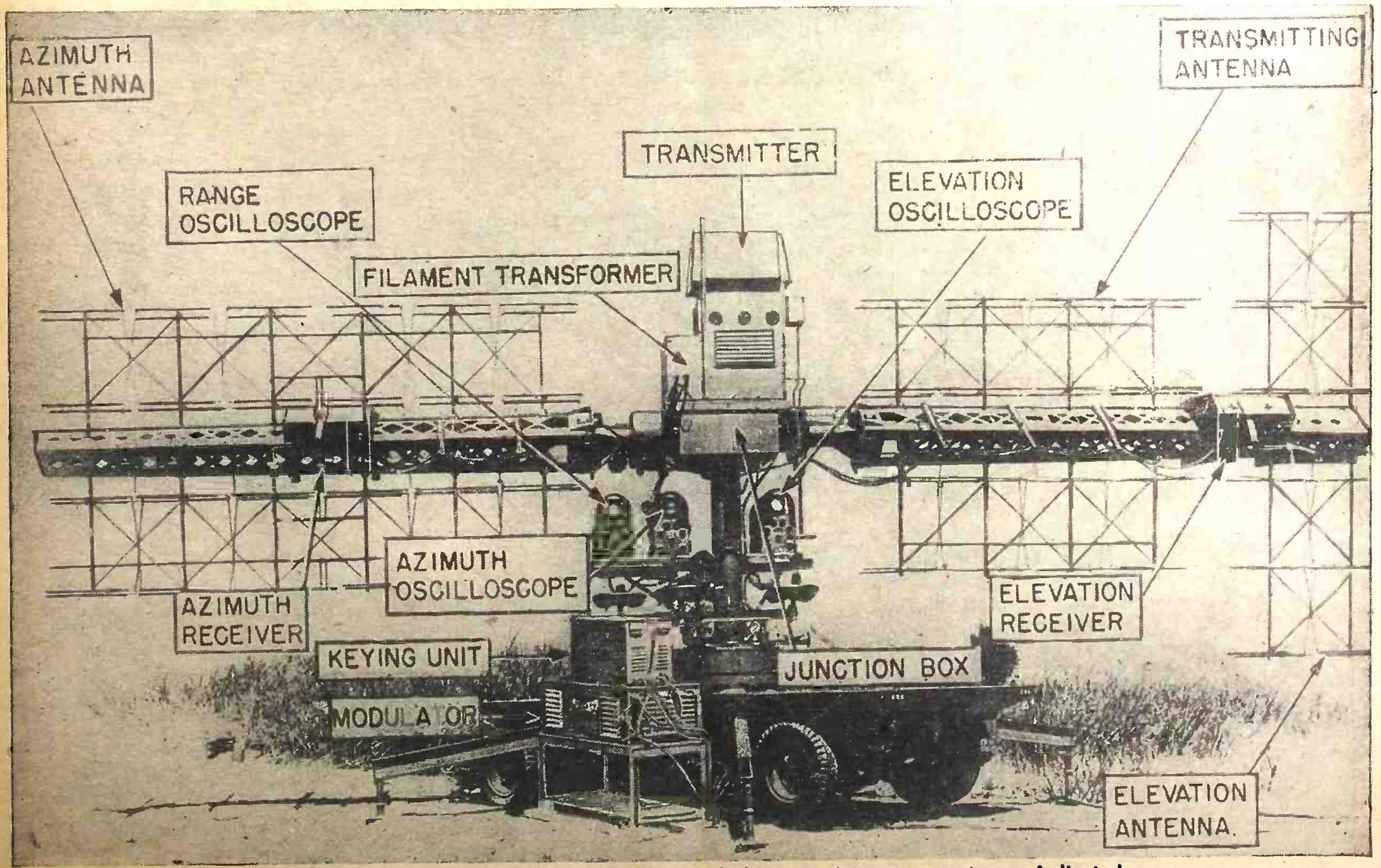
b. It must be highly efficient. All of the generated power must go into the beam and none must leak off into "side lobes" in other directions, since such side lobes may often be fatally confusing; and,

c. The radar antenna must be capable of being directed or scanned from one point in space to another, and on shipboard and in aircraft it must frequently be stabilized to take out the motions of the ship or airplane itself.

An antenna may be made directional either by building it up of an array of small antennas or dipoles, suitably spaced and phased to concentrate the energy in one direction, or it may be built on the searchlight principle of spraying the energy into a large parabolic "mirror," which focuses the energy into a beam. In either case, the larger the antenna, the sharper the beam for any given wave-length. Sometimes antennas may be longer in one direction than the other, giving a beam which is sharper in the first direction and thus fan shaped.

The *scanning* of the portion of space which the radar set is intended to cover must usually be done by mechanical movement of the antenna structure itself. This means that

(*Continued on page 30*)



A typical mobile radar installation. Functions of the more important parts are indicated.

A COMBINATION 10-TEST PANEL

By CHARLES H. McELROY*

Charles H. McElroy was born in Liverpool, England, in 1904. Soon after moved to Winnipeg, Canada, where he received his entire education. Came to Los Angeles in 1923.

From 1923 to 1927 was associated with Westinghouse. For the next ten years with the Los Angeles Gas and Electric Corporation, first as electrical mechanic, then in maintenance work on distribution system protective networks and as operator of power distribution stations.

Continued with the Los Angeles Department of Water and Power when it took over the electric holdings of the Gas and Electric Corp., first as power distribution station operator, then in the Testing Laboratories, his present position.

RADIO has been his chief interest since 1916. Carries on service work in a semi-professional capacity, though his main interest is in the design and construction of test equipment.

EACH one of the units used on this test panel can be assembled and operated individually. The complete panel can be built a little at a time, and at such times as it may be convenient to the pocket-book.

This group of ten circuits are all fed into one master control or selector switch and arranged in the order which I believe to be the most convenient. The whole arrangement is built around a Weston Model 301, 0-1 milliammeter, which uses resistors of 1000 ohms per volt.

Three D.P.D.T. toggle switches are connected in the meter circuit. The one closest to the meter is used as a meter reversing switch. The two others are used to select the A.C. or D.C. positions. An instrument rectifier of the full wave type is used for rectification purposes. The blades of the D.P.D.T. switch furthest from the meter are fed from the blades on the first and second decks of the master selector switch. Whether the top or bottom deck is used as the first deck is a matter of preference.

THE INDIVIDUAL UNITS

The first unit is a voltmeter circuit and will measure D.C. voltage directly and A.C. voltage through the use of an instrument rectifier. The ranges are 10/100/200/300/400/500/750 and 1000 volts. If these voltage ranges do not meet your approval, it is a simple matter to change them to suit your needs by using multiplier resistors of 1000 ohms per volt, multiplied by the full scale value desired. To operate the circuit, turn the master selector switch to the No. 1 position, set the A.C.-D.C. switches in the desired position, and insert a pair of test leads into the tip jacks for that purpose. Set the voltmeter range switch to a range that is fairly high (about 500 volts). If the pointer of the meter moves the wrong way, move the meter reversing switch to the opposite position, or reverse the test prods at the source of voltage. Then adjust the range switch in order to bring the pointer to approximately ½ or ¾ full-scale.

The second unit is a milliammeter circuit. It will measure D.C. directly and A.C. through the use of an instrument rectifier. The ranges are as follows: 10/100/200/300/400/500/750 and 1000 milliamperes. It will be noticed that the milliampere ranges are identical in value to the voltmeter ranges, and the operation of the circuit is almost the same. The master selector switch is turned to the No. 2 position.

The third unit is an ohmmeter circuit of two ranges. The circuit was found in "Modern Radio Servicing" by Alfred A. Ghirardi. The first range is from 0 to 245 ohms. The second is from 0 to 100,000 ohms. To operate the ohmmeter circuit, set the master selector switch in the No. 3 position. To use the low range close the S.P.S.T. switch in the battery circuit, and place the high-low switch in the low position. Adjust the meter for full scale reading by regulating the variable resistance.

The meter can easily be calibrated with a number of resistors of known value. A graph can be made of the low-range ohms scale, or it can be marked directly on the meter dial. Be sure to open the S.P.S.T. switch in the battery circuit when through with the low range. To use the high range, plug the test leads into the pin jacks numbered 2 and 3. Close the S.P.S.T. switch in the battery circuit and place the high-low switch in the high position. Adjust the meter for full-scale reading by shorting the leads and regulating the variable resistance. The test leads can now be placed across a resistor and the value of the resistance read directly on the high-range scale. When a 3-volt battery is used in the circuit the 2500 ohms point should be located exactly in the center of the dial.

DECADE RESISTANCE BOX

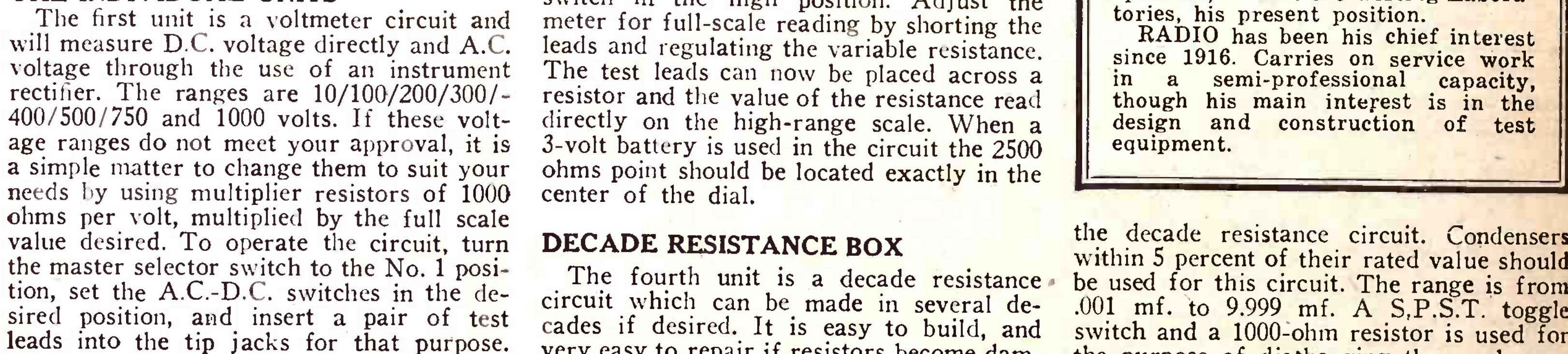
The fourth unit is a decade resistance circuit which can be made in several decades if desired. It is easy to build, and very easy to repair if resistors become damaged due to an excessive current flow. Only resistors of the insulated and semi-precision type should be used. The unit illustrated has a range in 100-ohm steps, from 100 ohms to 999,900 ohms, with a normal capacity of one watt per decade continuous, or five watts per decade in momentary overloads. To operate the decade resistance circuit, set the master selector switch in No. 4 position. Plug one end of a pair of test leads into the pin jacks, attach the other end to the circuit in which the required resistance is to be connected and operate the various range switches.

The fifth unit is a decade capacitance circuit, and operates in the same manner as the decade resistance circuit. Condensers within 5 percent of their rated value should be used for this circuit. The range is from .001 mf. to 9.999 mf. A S,P.S.T. toggle switch and a 1000-ohm resistor is used for the purpose of discharging the condensers after use on a high voltage D.C. circuit. Set the master selector switch in the No. 5 position, plug the test leads into the pin jacks and connect the other end of the leads across the circuit under test.

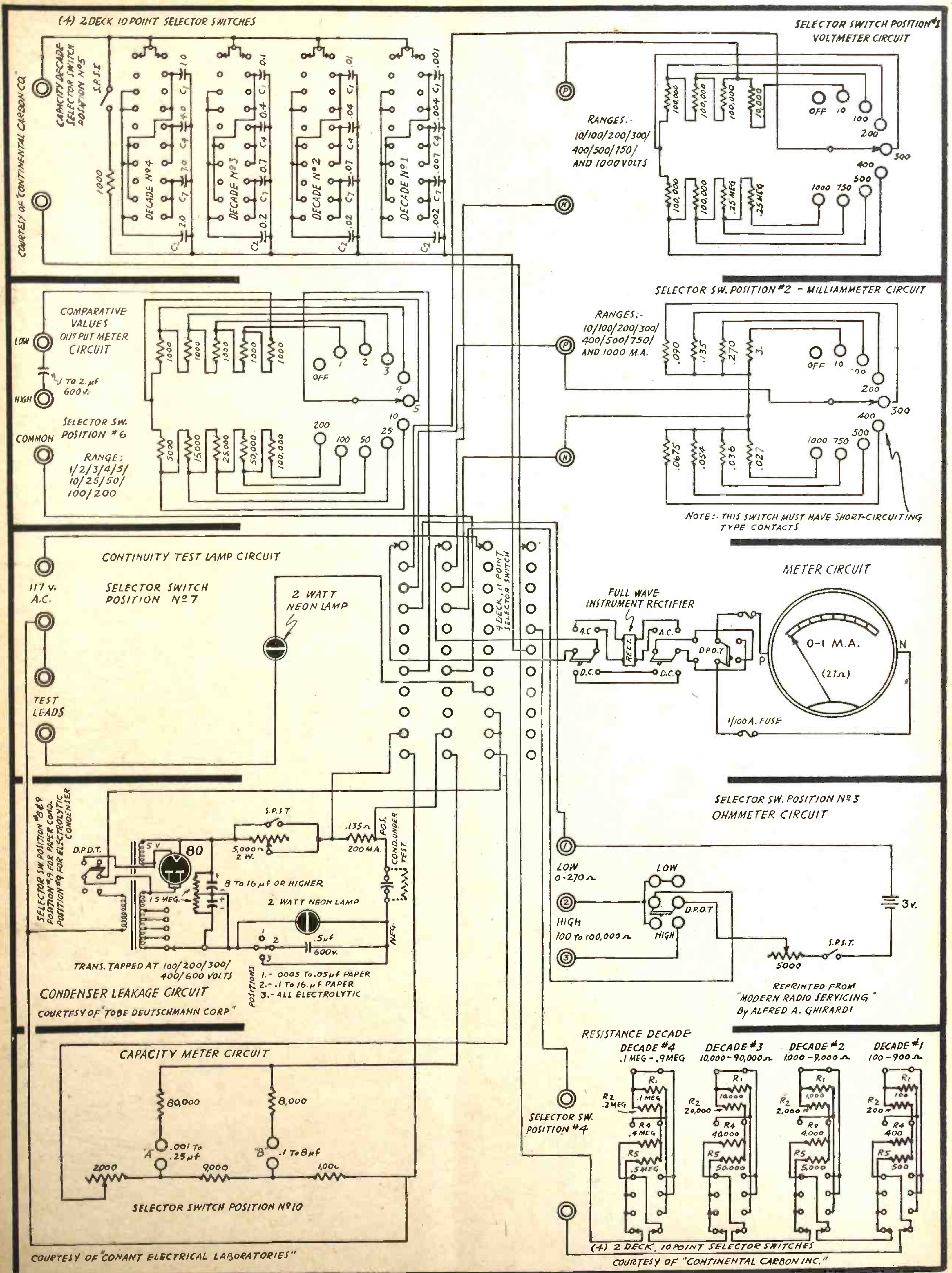
The sixth unit is an output meter circuit using comparative values (not calibrated in decibel units). It will measure the low voltages that are impressed across the secondary of an output transformer in some one of the low ranges. The readings are really A.C. voltage component readings with values of 1/2/3/4/5/10/25/50/100 and 200 volts, providing the source of voltage under test is connected to the pin jacks marked

(Continued on page 40)

*Department of Water and Power, Los Angeles, California.



Front and rear views of the 10-in-1 combination testing unit which practically puts a complete laboratory behind a single panel.



A voltmeter, milliammeter for A.C. and D.C., multi-range ohmmeter, decade boxes for resistance and capacity, an output meter, leakage testers for paper and electrolytic condensers, a lamp unit for continuity checking and a capacity analyzer are contained in this unit.

MICROWAVES

PART III—Antennas and Radiators

By **MAJOR EUGENE E. SKINNER***

MICROWAVE systems pose relatively simple antenna problems. They can use practically any type of antenna that has been developed for any other system, but in a much less weighty and cumbersome form. Applying the same principles, but due to the extreme shortness of wave length, a microwave system can use a few feet of cable and a few inches of metal rod to do what, for a long-wave system, would require a tremendous array, possibly covering several acres. In addition to the previous types of antennas, two additional types designed especially for microwave applications may be used. One is the horn, which looks much like a funnel. The stem is a hollow waveguide, and the bowl flares gradually from this into an opening that is several wavelengths across.

Construction problems in an antenna like this require a greater knowledge of sheet-metal work than of anything else. If a highly directional beam is to be broadcast or received using the horn type antenna, an exponential horn may be used, but for most purposes, a simple type similar to that shown in Fig. 1 is satisfactory. In this type, the directivity can be controlled by varying the flare angle. Using this method, the beam is wide at 0° (straight cylinder with no flare), narrows considerably at 20°, and becomes sufficiently narrow for most purposes at 60°. At 90°, however, the pattern is very wide and somewhat erratic. For the ham, it is suggested that an adjustable horn like that of Fig. 2 would be simple to construct. One fixed at 60° would be yet simpler, and probably would be very satisfactory, since beams or radar-type sharpness are not required.

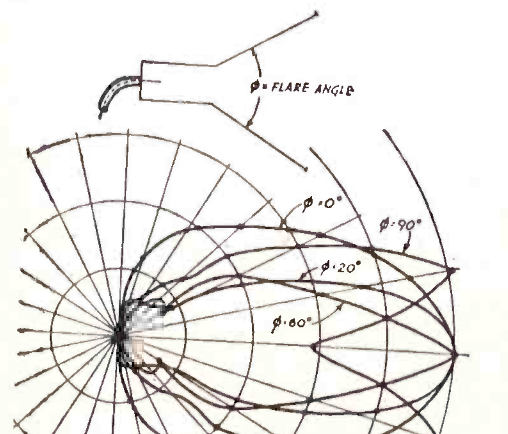
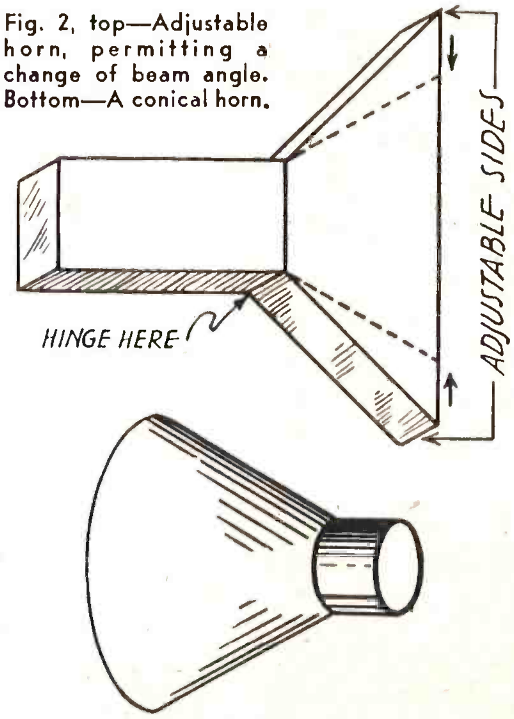


Fig. 1—Radiation angles for horns of different flare angles, all other factors being equal.

Probably the most used form of microwave antenna for present-day applications is a short dipole, together with a parabolic reflector of metal, which looks like a large wash-bowl, but which is very accurately designed. The more accurate the reflector, the more efficient the antenna, but an amateur with knowledge of sheetmetal work and simple mathematics involving parabolas can easily construct a fairly accurate and very simple reflector. The antenna is placed at the focal point of the reflector, and were it of infinitely small size, a sharp beam depending on the size of the reflector could be formed. However, the dipole does have a definite length, depending upon the frequency used. Since this length becomes shorter as the wave length is decreased, the beam becomes sharper until only a few degrees wide.

Actually an application of this sort shows the similarity of microwaves to light very well, for if the reflector were a mirror, and the antenna were a source of light, the light would be beamed in the same manner as the microwaves. A sealed-beam automobile headlight is a good example of this.

Fig. 2, top—Adjustable horn, permitting a change of beam angle. Bottom—A conical horn.



This type of antenna is practically usable only at microwave frequencies due to the physical dimensions involved. Using a focusing type of antenna makes it unnecessary to have an excess of power to allow for waste, since most of the power is condensed into the beam. Of course, an antenna sends energy away from the reflector as well as into it, causing a waste of energy by scattering. This is usually eliminated by placing a semi-cylindrical cup in the position shown in Fig. 3, which forces all the energy into the reflector for forming into the beam.

A focusing effect similar to that given by the solid metal parabolic reflector, but not as efficient, is possible by placing parasitic wires in position to form a parabolic curve, and a great variety of shapes and patterns are possible by various arrangements of reflectors, directors, and corner reflectors. These are much too numerous to discuss individually.

At microwave frequencies, coaxial conductors are not satisfactory for transmission of energy from one spot to another except for very short distances, therefore another type of conductor is used. This is the waveguide, which is made in a wide variety of forms.

Major Eugene E. Skinner was born on a farm near Kaufman, Texas, in 1919. He constructed the first television transmitter and receiver in the American Southwest while doing post-graduate work at Dallas Tech-

nical High School. After a course at the American Television Institute in Chicago, he entered the University of Texas, from which he graduated as Bachelor of Science in Electrical Engineering in 1941. He is now on leave to the armed services from the Commonwealth Edison Co. of Chicago.

Major Skinner was one of the first Radar officers in the Army Air Forces, having been assigned to the RAF and RCAF when the United States entered the war. He graduated from the RAF radar school at Prestwick, Scotland, in 1942, and later from the Army Air Force School at Boca Raton Field, Florida. He has engaged in development, maintenance, operation, installation, instruction and staff work with the AAF, and is now assigned to Headquarters, Army Air Forces, Special Projects Branch.

If a radio wave is projected from the earth into the atmosphere, it strikes the ionisphere and is reflected back to earth, where it is reflected again to the ionosphere. This reflection between these two layers continues until the wave is dissipated, which might occur in only one reflection, or several. Similarly, by placing two metal plates close together with an antenna between them this radiation will be reflected between them several times at angles depending upon their distance apart, until it is reflected out at the edges of the plates. If the two plates are placed with another pair of plates, so that they form a square or rectangular pipe, and one end sealed, with the antenna mounted on it in the proper position, all the energy is confined within the pipe, and may escape only out the one open end. This waveguide may be square, rectangular, circular, or even elliptical in cross section. Generally speaking the opening must be equal to or greater than the wave length in order to permit the guiding of waves, making it extremely impractical for use with longer wave lengths. With this as a rough guide, it is readily seen that there is a maximum wave length for any given waveguide, and for greater wave lengths the guide acts as a high-pass filter. However, any wave length shorter than this critical value will pass through very readily. More exact formulas may be found in any good text on microwaves, together with elaborate discussions of the electrostatic and electromagnetic fields within the guides. Discussions of this type are very lengthy and

(Continued on page 64)

*Hq. AAF, Office Asst. Chief of Air Staff, Training Aids Division.

TUBE REPLACEMENTS

PART IV — Replacements with small characteristic differences

By I. QUEEN

PREVIOUS parts of this article have discussed: (1) replacement with a tube requiring no change (2) change involving filament power (3) change involving socket connection. In general these changes make available a tube which is very similar to the defective tube originally in use and no further change is necessary to accommodate it.

In some cases, the tube may have a relatively great difference in some characteristic and may require further circuit changes. The set owner may also require the optimum in performance and may request whatever change is necessary to bring the set up to its former efficiency. The following suggestions will aid the serviceman in such cases.

PLATE CUTOFF

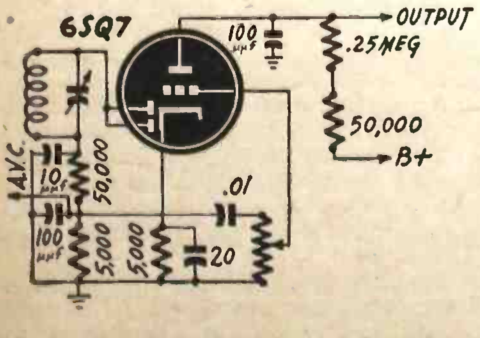
Distortion may occur on loud signals when the new tube has a sharper cutoff. If it is one of a series of tubes originally of remote cutoff, the new tube should be installed in the first socket, where it will handle the smallest voltage. For example, an I.F. amplifier may consist of three similar remote cutoff tubes. If one must be replaced with a sharp cutoff tube, it should go into the first socket. Taking the A.V.C. system off this tube will help further.

Steps may be taken to prevent overloading due to loud signals which may be received from nearby stations. A series condenser in the antenna circuit may be switched in only when strong signals are present. Another effective method is the installation of an auxiliary volume control which varies the screen voltage applied to the sharp cutoff tube. Including a fixed series resistor in the screen circuit (where one does not already exist) also helps. A further step is decreasing of the AVC resistor through which the rectified current flows.

Replacement of a remote cutoff amplifier or detector tube for a sharp cutoff may result in loss of sensitivity and poor detection. An increase in grid bias will help somewhat. Some servicemen have changed the circuit to grid-leak detection, increasing sensitivity at the cost of adding to distortion.

AMPLIFICATION CONSTANT

High-mu tubes are associated with small voltage-handling capacity and vice versa. A high input may cause overloading. Trouble is apt to occur in the first A.F. stage due to insufficient I.F. filtering (Fig. 1).



Low-mu triodes have low plate resistance and vice versa. Resistance coupling should be used with high plate resistance tubes and transformer coupling with low plate resistance tubes. Typical tubes similar except for their mu and associated characteristics are the following:

Tube	*Grid*	*Plate Ma.*	*Mu*	*Rp*	*Gm*
6SQ7	—2	.9	100	91000	1100
6SR7	—9	9.5	16	8500	1900

The first can handle only a small signal and should be resistance coupled. Note that a change of cathode resistor will be required when changing from one type to another.

OUTPUT LOAD

The output load of a power amplifier determines not only the power transferred to the speaker but the tone quality. If a different value is recommended for a new tube type, the best method of providing it is by using the proper impedance tap on the output transformer. A multi-tap output transformer is not usually available, however.

Assume a receiver using a 6F6 power amplifier. This requires a 7000-ohm primary, and we may assume an 8-ohm speaker. Now, if a 6V6 is the only available replacement, note that it requires a different load, besides the change in filament current and cathode resistance.

Tube	Ep	Eg	Es	Is	Ip	Load	Output	Rk
6F6	250	−16.5	250	6.5	34	7000	3.2	400
6V6	250	−12.5	250	4.5	45	5000	4.5	250

For optimum tone quality and power output the load should match the transformer output and this particular transformer has a ratio of 7000/8. The new arrangement will still be correct if the speaker load has a resistance of 5.7 ohms instead of 8. This may be accomplished by shunting the speaker with a 20-ohm resistor of about 2 watts. While this incurs a loss of energy the fidelity will be better and more of this power will be delivered to the secondary of the transformer. A more efficient arrangement

(*Continued on page* 39)

Table of Rectifier Tube Characteristics

TUBE TYPE	FILAMENT VOLTAGE	FILAMENT CURRENT	CATHODE TYPE	MAX. RMS (WITH CONDENSER INPUT)	MAX. D.C. OUTPUT	FULL OR HALF-WAVE
OZ4		cold		325	30-75	F
1V	6.3V	.3 A	(H)	350	50	H
2W3	2.5	1.5	(F)	350	55	H
2X2	2.5	1.75	(H)	4500	7.5	H
5R4GY	5.0	2.0	(F)	1000	150	F
5T4	5.0	2.0	(F)	450	225	F
5U4G	5.0	3.0	(F)	450	225	F
5V4G	5.0	2.0	(H)	375	175	F
5W4	5.0	1.5	(F)	350	100	F
5X3	5.0	2.0	(F)	1275	30	F
5X4G	5.0	3.0	(F)	450	225	F
5Y3 / 5Y4	5.0	2.0	(F)	350	125	F
5Z3	5.0	3.0	(F)	450	225	F
5Z4	5.0	2.0	(H)	350	125	F
6H4GT	6.3	.15	(H)	100	4	H
*6H6	6.3	.3	(H)	150	8	F*
6W5G	6.3	.9	(H)	325	90	F
6X5	6.3	.6	(H)	325	70	F
6Y5	6.3	.8	(H)	325	60	F M
6Z5	6.3 / 12.6	.8 / .4	(H)	325	60	F
6ZY5G	6.3	.3	(H)	325	40	F
*7A6	6.3	.15	(H)	150	8	F
7C4	6.3	.15	(H)	117	5	H
7Y4	6.3	.5	(H)	325	60	F
7Z4	6.3	.9	(H)	325	60	F
12A7	12.6	.3	(H)	125	30	H
*12H6	12.6	.15	(H)	150	8	F
12Z3	12.6	.3	(H)	235	55	H
14Y4	12.6	.3	(H)	325	60	F
25A7	25.0	.3	(H)	117	75	H
*25X6	25.0	.15	(H)	250	60	F
25Y4	25.0	.15	(H)	125	75	H
*25Y5	25.0	.3	(H)	250	85	F
25Z4	25.0	.3	(H)	125	125	H
*25Z5	25.0	.3	(H)	235	75	F
*25Z6	25.0	.3	(H)	235	75	F
28Z5	28.0	.24	(H)	325	100	F
32L7	32.5	.3	(H)	125	60	F
35Y4	35.0	.15	(H)	235	100	H
35Z3	32.0	.15	(H)	235	100	H
35Z5	35.0	.15	(H)	235	100	H
*35Z6	35.0	.3	(H)	235	110	H
45Z3	45.0	.075	(H)	117	65	H
45Z5	45.0	.15	(H)	235	100	H
*50Y6	50.0	.15	(H)	235	75	F
*50Z7G	50.0	.15	(H)	235	65	F
70L7	70.0	.15	(H)	125	70	H
80	5.0	2.0	(F)	350	125	F
81	7.5	1.25	(F)	700	85	H
82	2.5	3.0	(F)	450	115	F M
83	5.0	3.0	(F)	450	225	F M
83V	5.0	2.0	(H)	375	175	F
84	6.3	.5	(H)	325	60	F
117L/M7	117	.09	(H)	117	75	H
117N7	117	.09	(H)	117	75	H
117P7	117	.09	(H)	117	75	H
*117Z6	117	.075	(H)	235	60	F

Notes: M denotes mercury vapor

Tubes marked (*) may be used as voltage doublers if RMS maximum voltage is halved. For choke input, RMS voltage is greater.

"DESIGN ENGINEERS" OF THE U. S. FORCES

By CAPT. M. M. CAROTHERS, Signal Corps

Captain Carothers is editor of a Signal Corps technical magazine which is distributed to Signal Corp troops and communications troops generally, as part of his duties in Special Activities Branch, Office of the Chief Signal Officer, Washington, D. C. He is on leave from his civilian po-

sition as editor of the state American Legion newspaper in Ohio, but before that he was in newspaper and public relations work in Columbus, Ohio, for twenty years. A veteran of World War I, in which he served as a private of Engineers, he volunteered in September 1942, was graduated from the Signal Corps officer candidate school in April 1943, and has served since then in his present location.

A CONSCIENTIOUS radio manufacturer, intent upon producing a better set than his competitors, would be delighted with the flow of helpful criticism which the Army Signal Corps receives from its own "best customers"—Signal Corps, Infantry, Artillery, Engineer and Ordnance soldiers in combat areas around the world.

The Guidon radio as adapted for foxhole use.

A sergeant of Infantry, reporting to his command post as the sun went down over a Southwest Pacific island, carried the famous "cracker box" radio transmitter-receiver known as the handie-talkie, and he had a gripe.

"Sir, we got through on the patrol and got the information you wanted, but it was a narrow squeak a couple of times," he told the captain. "We were shot at twice by Nip snipers, and I'm sure they wouldn't have spotted us if the sun hadn't glinted off the antenna of this outfit. Ain't there something we can do about it?"

"That's the third complaint I've heard about those shiny antennas," replied the captain, "You and the other men with that kind of set be sure and smear the antenna with charcoal or mud before you start out after this. I'll put a note in my report about the problem."

The captain's criticism was one of many on the same subject reaching the Office of the Chief Signal Officer in Washington. As a result, a bulletin went out to all users of handie-talkies telling them how to apply a suitable camouflage material to shiny antennas. At the same time, the Signal Corps laboratories were put to work devising a non-reflecting, low-visibility finish for the telescoping "whips." Replacements with the new dull-finish antennas have been made in quantity.

All organizations using ground signal equipment are provided with "Unsatisfactory Equipment Report" forms which invite the operators and repairmen to tell what they find wrong with radios and other devices, both when the equipment is unpacked and after it is placed in operation.

THE MAINTENANCE WORK ORDER

Those who fill out the reports in the field are requested to be explicit. It does no good to report that "reception was lousy," or that the soldiers "could not make it work," or that the equipment is "inadequate" in some vague respect. The man reporting has to state exactly what model of an equipment is unsatisfactory, give the testing procedures used and the shortcomings encountered, and outline the inadequacies in detail, as well as include his recommendations. If the investigation of the report by the Signal Corps laboratories indicates that changes can be made in the field to effect better operation, a War Department "Modification Work Order" probably will be prepared for distribution to all troop units which, according to the records, have the kind of equipment affected.

Shiny radio antenna, at right, made operators easy targets for enemy snipers. Dull-finished antenna, at left, blends into the bushes 15 feet behind.

Signal Corps Photos

An "M.W.O.," as these instructions are called, is the soul of terseness. In one-two-three order it states what models of what equipments should be altered in the field for corrective purposes, the part to be modified and the aim of the modification; whether or not drawings are required and, if so, where they can be procured; new or substitute parts needed, how to requisition them and the probable date they will be available; special tools required and who should have them available, and, finally, special instructions and remarks. The special instructions tell who is qualified to do the work, the time it should take to do it, the step-by-step procedure, what to do with discarded parts, and whether, in the opinion of the Signal Corps, the job should be done immediately or as conditions permit. The "remarks" section winds up with instructions for maintenance after the modifications have been completed.

To the communications man in the field, this kind of W.M.O. is an order which says: "If you have this equipment and are having the kind of trouble with it that is described, go ahead and make this modification, because the War Department says it's O.K."

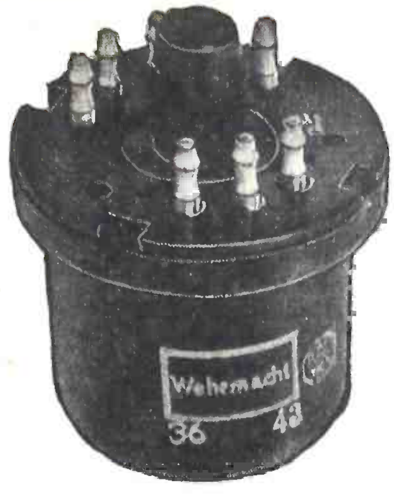
As the war progresses and troops in the field are called upon to adapt and expand the usefulness of existing equipment to meet different tactical needs, dozens of new

(*Continued on page* 55)

Nazi Morale Radio

Presents Interesting Contrasts to U. S. Sets

By ALAN JAY

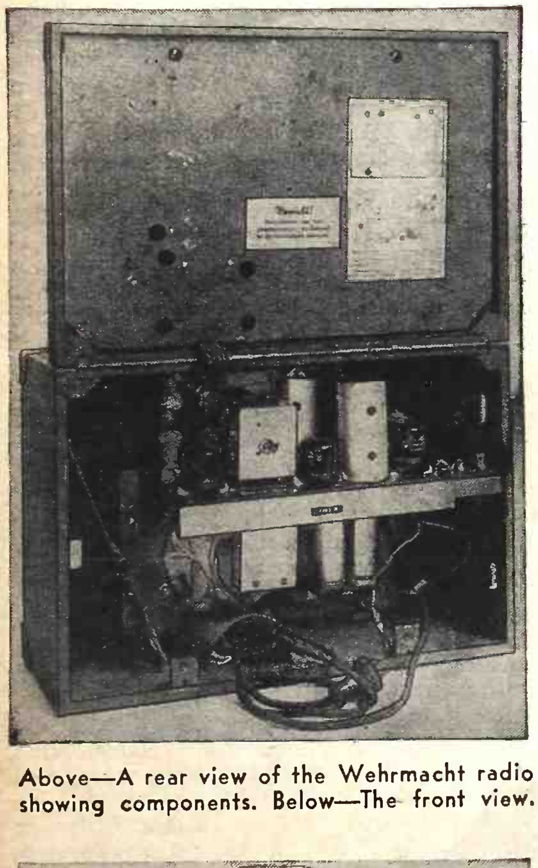


One of the metal tubes from the receiver.

THE Nazi Air Force, in a last minute effort to boost the morale of the German soldier, supplied him with the latest word in radio reception. It is a three-band "morale receiver," vaguely similar to R-100/URR U. S. Army "morale" set, and was distributed to the soldiers for their entertainment.

The receiver was "liberated" by an 8th Air Force member and given to Sgt. Joseph Ferrara of the U. S. Army Infantry. It operates on either dry cells, wet batteries or 120 volts D. C., and is housed in an Army cabinet, portable style. When it is considered that the Germans have worked with "ersatz" materials for so long and have found them so "satisfactory," many features of its design are noteworthy. On the other hand, there are more bad points than good from the customary American standpoint.

The speaker has an unusually large magnet, when its total size is considered. The cone is approximately 6 inches, and the magnet is 2 inches in diameter and 2 inches in depth. The cone is supported by an "independent" spider such as has been found on some of our speakers. Adjustments in centering are accomplished on the outside, by means of two bolts fastening the spider to the speaker frame. A dust cover is placed over the speaker. This is nothing more than a piece of cloth, wrapped twice around the frame and tied in the rear. The voice coil leads are covered with what appears to be silken braid, and are brought through a rubber bushing or grommet. This is radically different from our standardized method of bringing them to insulated lugs on the speaker frame and then extending another pair of leads to the output transformer. The German method seems fraught with disaster, for, since the leads are exposed, a slight pull or accidental tug on them might carry the voice coil out of the cone to a place where it could readily be examined visually for defects in construction!



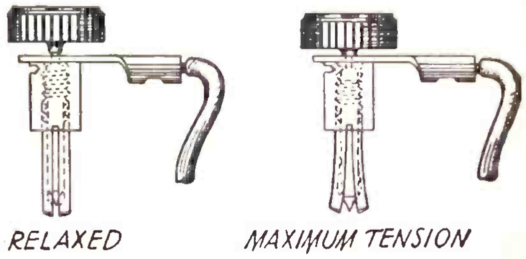
Above—A rear view of the Wehrmacht radio showing components. Below—The front view.

ALL VALUES INDICATED

All condensers and resistors are marked with their values. This is considerably better than the system now in effect here (as has been brought out in numerous articles). On the other hand, there is an attempt in this construction to use altogether too many chassis. The electrolytic condensers are mounted on an independent chassis, as are the trimmer condensers. The bracket on which the electrolytics are mounted is easily seen in the rear-view photo. An entire network of condensers and resistors for several circuits is mounted in a little sheet-metal case. Leads to the proper circuits are then brought out through bushed holes in the sides of the cans. While this might facilitate assembly it does nothing towards making servicing any easier. Trimmers for all circuits as well as the padder condensers are all mounted on one strip. This includes the trimming condensers normally found on the top of the variable condensers in our receivers. The R.F. and antenna coils are mounted on the back of these strips. All coils in this receiver are wound on what appears to be plastic or possibly polystyrene forms, and are all tuned with an iron core (permeability tuning). The variable condenser is enclosed in an aluminum can, possibly. This tends to prevent tampering with the condenser and at the same time, both shields the variable condenser and protects the plates from possible damage. A fibre or plastic chassis is used instead of a metal one.

The I.F. coils are wound on plastic forms. Low-temperature-coefficient condensers similar to some of American manufacture are mounted on a terminal strip inside of the can and connected across the primary and secondary of the coil respectively. These are fixed condensers rather than adjustable, as our I.F trimmers are. The coils have an iron core in the center which can be adjusted through a hole provided for this purpose in the side of the can.

The can itself is made of heavy-gauge aluminum and is fastened by in an unusual manner. A slot is cut in the top of the can to accommodate a semi-circular strip of fibre. This in turn has a small rectangular slot cut into it. A fibre wedge is inserted into this slot and driven in until the can is fastened securely. The good feature of this is its easy accessibility. Just knock out the wedge, and the I.F. coil is available for inspection. This same wedge principle is used throughout as a convenient method of fastening without the use of nuts and bolts, and it is applied to the battery plugs as shown in the illustration, Fig. 1. As the knob is turned in, after the pin plug is inserted into the battery terminal, the wedge spreads the sides of the split banana plug, forcing them into tight contact with the sides of the battery terminal jack. The entire set can be lifted by this plug once the connection is tightened. This would seem to constitute a considerable improvement over our conventional snap-on buttons, binding posts, etc.



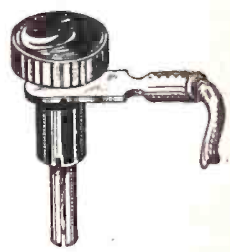


Fig. 1—This connector is absolutely secure in position once inserted and screwed down tight. The shell is crimped in near the top (see notch) thus making impossible removal of center screw.

The tubes are the most interesting feature of this set. They are metal tubes roughly similar to ours in appearance, but approximately one-half the height and twice the diameter. The pins, as can be seen in the diagram, are of the locking type, yet the tubes are surprisingly easy to remove. This is accounted for by the fact that they also employ a wedge principle. They are tapered gradually instead of sharply as in the locking pin on American loctal tubes. The tubes are mounted on felt cushions to protect them from shock, as can be seen in the photograph.

An unusual feature is the total lack of glass in the tubes, with the exception of the seal of the pins to the base. Fig. 2 shows the method. This system has been used in special American war-time tubes, but is not yet commonly employed here. The tubes are evacuated after the assembly of the entire tube has taken place, with the exception of basing. A copper tube is brought

(Continued on page 48)

BROADCAST EQUIPMENT

Part XII—Broadcast Antenna Towers

By DON C. HOEFLER

PROBABLY all of the antennas used in early broadcast practice consisted of some form of multi-wire arrangement, such as the T, inverted L; though sometimes a single vertical wire, all of these were operated above their natural fundamental frequency. These were suspended between two tall structures (usually self-supporting steel towers), spaced some distance apart. Later, as the advantages of vertical polarization were discovered, experiments were made with various types and sizes of vertical steel towers, which themselves acted as the radiators.

Most of the developments in tower design have occurred since 1927. For several years, the guyed cantilever ("cigar-shaped") structure was considered to be the very last word in broadcast antenna design, and a number of them are in use today. Then, development work reverted to the broad-based self-supporting type, and most recent practice favors the uniform-cross-section structure, which may be either guyed or self-supporting.

EFFICIENCY OF PROPAGATION

The directivity in the vertical plane of a vertical antenna is determined in part by its natural wave length. Current distribution in straight single-wire vertical radiators of various heights is shown in Fig. 1. In broadcast work it is desirable to have as much of the radiated power as possible be emitted as ground wave, with an absolute minimum of high-angle radiation. This will increase the primary service area, and reduce fading and interference at remote points. Practical experience has proved that best results are obtained when the radiator is either approximately one-quarter wave length or slightly over one-half wave length.

Ballantine demonstrated that the optimum condition of power efficiency, considering maximum ground-wave radiation and maximum sky-wave suppression, occurs when the effective antenna height is around 0.50 to 0.56 wave length. This corresponds to an actual physical height of 0.62 wave length. This indicates that the advantage of initial cost in a quarter-wave antenna is not as great as might first appear, for while the effective height of the half-wave structure is roughly 85½% of the physical height, the effective height of the quarter-wave vertical radiator is only 64% of the actual height.

Up to the condition of optimum efficiency, the effective signal strength available at a receiving antenna is determined by the meter-amperes at the transmitting antenna. This figure is the product of the effective antenna height in meters and the effective antenna current in amperes. This does not indicate any factor of the antenna power, but is an arbitrary figure which demonstrates that the effective signal increases with the antenna height. This fact holds true up to the optimum condition, but beyond that the second lobe of the standing wave would be in phase opposition with that of the first half-wave section, as shown in Fig. 1 (D).

Attempts to approach the optimum radiation condition while avoiding the expense of a fully optimum-height tower have led to some rather interesting developments in tower construction. Fig. 2 shows the current distribution for several common types of antenna towers operating under optimum conditions. When the tower is insulated from ground, the exciting voltage is simply applied between the base and ground. The grounded antenna employs a somewhat different method of excitation, to be discussed presently.

THE TOP-LOADED TOWER

The capacity-top arrangement permits the height required for optimum operation to be reduced somewhat, but when used alone this is hardly enough to be practicable. However, the sectionalized tower with series inductance permits a reduction in total height of 20% to 30%. There is an additional advantage in that it is possible to vary the effective height of the tower by adjusting the series inductance without involving expensive structural changes. The disadvantages are the additional expense of sectionalizing the tower and the losses of energy occurring in the inductance. Station WABC, New York, uses a combination of these two types of construction, known as "top-loading." A site in Long Island Sound known as Columbia Isle (formerly Pea Island) was selected because of the excellent coverage that a transmitter located there would provide. However, due to the proximity of New York Municipal airport, Flushing Airport, and Westchester County Airport, a tower of optimum height would create a hazard to the large volume of aircraft traffic. Top-loading proved to be the solution. Since the theoretical optimum of a broadcast tower is predicated upon a current distribution which places the current maximum at a point 0.375 wave length from the base of the tower, designers attacked the problem of a smaller tower for optimum operating conditions by attempting to establish electrical control over this anti-node by some means other than altering the tower size. It was found that since the L/C ratio along the length of the tower determined the location of the loop, this value could be varied by connecting a variable amount of lumped capacity or inductance near the top of the tower. Hence the term "top-loading." The WABC system represents the latest advance in broadcast antenna design in the use of a uniform cross-section tower. This enables the electrical characteristics of such a radiator to be calculated accurately, whereas any structure involving a taper introduces variables which can often be determined only by actual experimentation, a method which may prove very costly.

THE SHUNT-EXCITED TOWER

The shunt-excited antenna is a vertical tower with its base grounded, and which is excited at some point above ground. This system makes use of a loop formed by the ground and the exciting transmission line attached to the tower at a point above it. The coupling arrangement at the antenna end is simply a variable condenser in series with the exciting conductor. This wire runs from the coupling unit to the antenna, is usually inclined at an angle of about 45 degrees and is tapped on to the tower at a point corresponding to approximately 20% of the height. A connection at this point has a resistance of 100 ohms or less, which permits a concentric type transmission line to be matched to the tower. The loop thus formed is tuned to the carrier frequency by the series condenser, and carries a large circulating current. This develops sufficient voltage across the section of the tower included in the loop to excite the remainder of the tower. Since the tower itself is grounded, much less trouble with program interruptions due to lightning and other static discharges is encountered. As a result, the cost of lightning-protection devices is saved. Another saving is in the elimination of the large and expensive base insulators. All tower radiators have the advantages of simplicity, low cost, and high efficiency.

PROBLEMS OF GROUNDING

The ground system surrounding the tower base is a problem of exceedingly great importance, for upon it largely depends the overall efficiency of the radiation system. If the earth exhibited a characteristic even approaching perfect conductivity, any firm connection to it would provide a satisfactory termination. However, all soils, including even salt-water marshland, are poor conductors at radio frequencies. Therefore, the ground system associated with the tower must make the best possible contact with the existing terrain. Although it was at first believed that a ground system

(Continued on page 47)

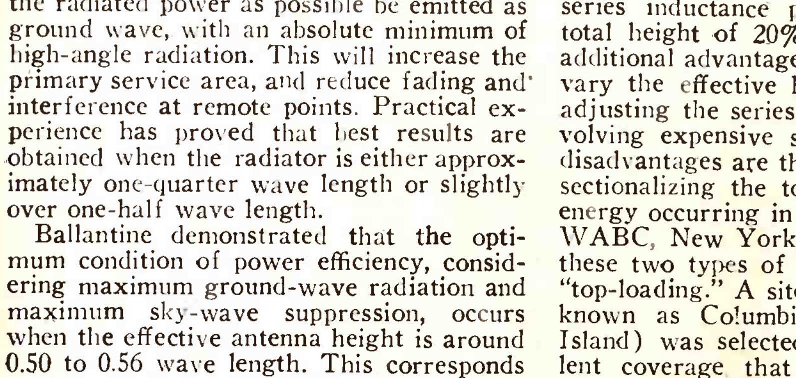
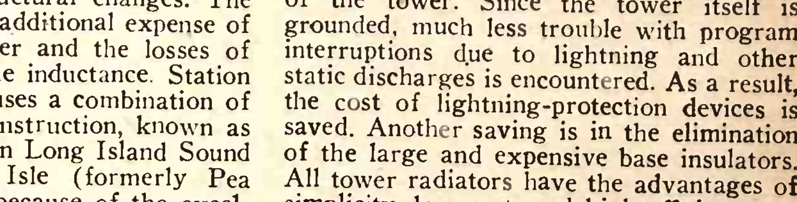


Fig. 1, left—Current distribution on various heights of straight-wire vertical broadcast antennas. Fig. 2, right—Current distribution on several types of broadcast towers under optimum conditions.



Scrambled Speech For Radiophones

By JOHN B. PARCHMAN

John B. Parchman was born near Clarksville, Texas. After graduating from the local high school with honors, he entered the Rice Institute in Houston, Texas, where he was awarded a degree in Electrical Engineering. Among the various occupations in which he has been engaged are: Radio sales and service, rural electrification and power line construction work, laboratory equipment installation and maintenance and teaching. He was also employed for some time with the Texas Co. of geophysical exploration for oil.

In the early part of 1942 he became associated with the Development Section of the Engineering Division of Sylvania Electric Products, Inc., in Emporium, Pennsylvania who were engaged in research and development work on electronic equipment for the armed services. Recently he was transferred to the new engineering group for that concern, located at Sylvania Center on Long Island.

Mr. Parchman is an Associate member of the American Institute of Electrical Engineers, a member of the Institute of Radio Engineers, Statistical Quality Control Engineers, and Safety Engineers.

His hobby—you probably guessed it—RADIO!

PRIVACY of communication has presented a problem since the first methods of signalling were developed in medieval days. A message which may be transmitted and received in private has been the goal of many radio men. The "scrambled speech" apparatus described in this article provides a simple system which effects a certain degree of secrecy. It is simple enough to be constructed in a very few hours from junk box parts by any radio fan and will provide hours of entertainment. The theory necessary for understanding such a system is reviewed briefly and two practical circuits are described.

Wartime restrictions have turned many old-time amateurs to various fields but the urge to experiment lingers on. Many have found an outlet for this energy in the carrier-current communications field. Many who have never owned an amateur license have also turned to "wired wireless" or carrier current communications for hobby or business purposes. Many inter-office communications sets operate on this principle.

Such systems have the advantage of using existing power lines, as well as simplicity, economy, and portability. The chief disadvantages are line hum and a lack of privacy. There is nothing to prevent any individual from coupling a receiver or inter-communicator to the power line and eavesdropping on the conversation.

Privacy in radio-telegraphy may be secured by high speed transmission, substitution, codes, sequence codes, etc., but radiotelephony brings up many more complicated problems. Speech involves the transmission of continuously complex signals of various amplitudes which may not be separated or coded. Moreover, the final received speech needs to be of fairly good quality.

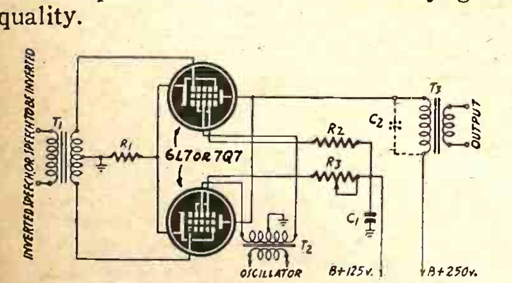


Fig. 1—A practical speech inverter circuit.

Probably the best known of the privacy systems used in speech transmission are "scrambled" speech or frequency inversion systems. Most junk boxes will yield enough parts to build a simple speech inverter and a demodulator for "scrambled" speech. A review of the theory involved in such an apparatus should be considered before actual construction is begun. The following article is divided into theory, speech inversion, and circuits.

THEORY OF SPEECH INVERSION

Speech "scrambling" or inverted speech is based primarily on the principles of modulation and side-band transmission. Amplitude modulation for voice transmission is the process by which the amplitude of the radio frequency wave is varied in accordance with sound waves actuating the microphone. The degree of modulation is described in terms of the amplitude variation of the transmitted wave and is usually given as a decimal modulation factor.

The process of modulation produces additional radio frequencies in pairs either side of the carrier frequency, which are called side bands. These frequencies are essentially the carrier plus the audio-modulating frequency and the carrier minus the audio frequency. Therefore, the frequency occupied by the transmission band will be twice the highest modulation frequency. Distortion in the wave-form will also cause further side bands to be generated. This is one of the chief reasons the Federal Communications Commission prohibits overmodulation.

Consider such a system in which a carrier frequency slightly higher than the maximum speech frequency is modulated by the speech. The modulated signal then will consist of several frequencies made up of the carrier plus and minus the speech band.

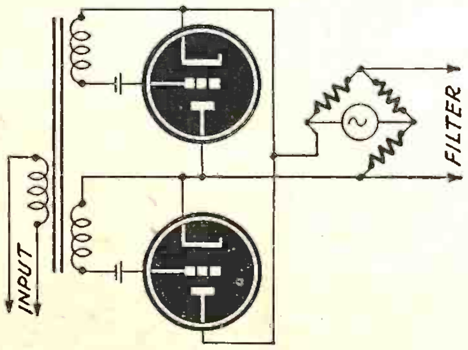


Fig. 2—A resistance-bridge type modulator.

If a carrier of three thousand cycles per second were modulated with a speech band composed of frequencies between five hundred and twenty-five hundred cycles per second, the following frequencies would be transmitted:

1. The carrier 3,000 cycles per second.
2. The lower side band of frequencies composed of the carrier minus the speech frequency or 3,000 minus 500 = 2,500 cycles to 3,000 minus 2,500 = 500 cycles.
3. The upper side band which consists of the carrier plus the speech frequency or 3,000 plus 500 = 3,500 cycles per second to 3,000 plus 2,500 = 5,500 cycles per second.

An examination of the above frequencies will show that the minus terms are in effect inverted, i.e., 2,500 became 500 and vice versa. Also it will be noticed that the upper side band has just been shifted upward by the amount of the carrier frequency, i.e., 3,000 cycles per second.

The intelligence contained in the modulated wave is contained in the side bands. Some of the broadcast transmissions today call for the transmission of the carrier and both side bands. It is also possible to communicate by means of suppressed carrier transmission employing only the two side bands, with the carrier suppressed and only one side band, or by the carrier present and one side band.

Actually the carrier is useful in beating with the side band to reproduce the audio signal. Because of this, the carrier may be supplied at the receiver and only the side band transmitted. If both of the side bands were transmitted, the missing carrier would have to be supplied at exactly the same frequency and phase as that of the transmitter. If only one side band is transmitted, the missing carrier may be supplied to within plus or minus approximately 20 cycles without objectionable distortion of speech provided the carrier is less than 10 megacycles.

CARRIER SUPPRESSION METHODS

To obtain the objective of "scrambled" speech the carrier must be suppressed. Various circuits may be used for this purpose. A few of the more common circuits are:

1. A balanced modulator with push-pull input and parallel plate output. Fig. 1.
2. A resistance bridge type modulator using the internal resistance of two triodes as one arm. Fig. 2.
3. A modulator applying the speech in parallel with the carrier via the grid of an amplifier to the input terminals of a bridge type instrument rectifier.
4. A modulator of the Van der Bijl type using the principles of non-linear impedance to suppress the carrier. Fig. 3.

The process of inversion can probably best be described by following Fig. 3 of the speech inverter unit using the Van der Bijl type non-linear impedance principle to suppress the carrier. The carrier and the signal source are connected in series and applied to the grid of a negatively biased tube, a 7N7 in the circuit shown. By connecting two of these in push-pull, the carrier is suppressed and the two side-bands

(Continued on page 52)

DETECTOR CIRCUITS

Part III — Detectors for F.M. Circuits; The Limiter Stage; Principle of the Seeley-Foster Discriminator; The Travis Circuit

By ROBERT F. SCOTT

THE detector employed in the superheterodyne type of F.M. receiver is somewhat different from the conventional detectors used for A.M. reception because of the methods of modulating the carriers are entirely different in principle. With amplitude modulation, the modulating frequency is impressed upon the carrier and the amplitude of the carrier is changed in accordance with the shape of the modulating envelope. When frequency modulation is correctly applied, the amplitude of the carrier remains constant but the frequency of the transmitter is modulated within limits.

THE LIMITER STAGE

With the frequency modulated system, there must be no change in the amplitude of the signal either at the transmitter or within the receiver. To assure a signal of constant amplitude being fed to the detector of the F.M. detector, an overloaded amplifier, called a "limiter" is connected between the I.F. amplifier and the detector. The limiter is simply an amplifier tube which operated at low plate potential so that the tube reaches its saturation point at very low grid voltage input. Thus the output is constant over a very wide range of voltage input to the grid. It is well to simply remember that the limiter is just an amplifier whose output is constant regardless of frequency or voltage input.

Fig. 1 shows a single limiter coupled to the detector, or discriminator, as it is called in F.M. and automatic-frequency-control circuits.

FOSTER-SEELEY DISCRIMINATOR

The circuit of the discriminator shown is the simplest effective circuit in popular use today. It will be seen that this circuit resembles a full-wave diode detector with each diode having its own load resistor. The primary and secondary of the interstage transformer are tuned to the intermediate frequency, at which the phase difference between the primary and secondary is 90 degrees and the ends of the secondary are 180 degrees out of phase with respect to the center-tap.

If the center-tap is connected to the plate end of the primary through a blocking condenser, the diodes are effectively connected to the primary winding in series with one half of the secondary winding. Hence, at the resonant frequency, the voltage applied to the diode plates will be equal and of opposite polarity and the voltage drop across the combined load resistors will be the algebraic sum of the output of both diodes, of zero. With no modulation impressed on an F.M. carrier, its frequency is constant, and there is no output from the discriminator.

When the input signal is modulated, the frequency is no longer at the resonant frequency of the transformer but swings about this point. During these excursions about the center frequency, the phase difference between the primary and secondaries is no longer held to 90 degrees and the voltage applied to the diodes will be unequal. The output of the diodes will then be proportional to the applied R.F. voltage. This A.C. voltage will have the same frequency of the modulating voltage and its amplitude will be proportional to the deviation of the signal from the intermediate frequency. This circuit is called the Foster-Seeley discriminator.

Robert F. Scott was born August 10, 1918. Studied mathematics, chemistry and physics at Claflin College, Orangeburgh, S. C. Studied two years in electrical engineering at the Agricultural and Technical College, Greensboro, S. C.

Discontinued studies due to failure of his eyes. Took up radio servicing and electrical repairs. Acquired amateur license, call W4FSI, operating his station on 40 and 80-meter CW. Spent 1939-40 as special student at Delaware State College, in physics and math. Took flight training until his eyes failed again. Went to Dover Airport as Student Pilot and apprentice mechanic.

Enlisted in October 1940. Sent to Cavalry Detachment of U. S. Military Academy at West Point, N. Y. After a course in Cavalry Communications and radio maintenance at Fort Riley, Kansas, returned to West Point as Communications Sergeant, his present position.

Post-war plans: To get two years' more training in electronics, then to qualify for a limited commercial pilot's and instructor's rating. Hobbies: radio, flying and photography.

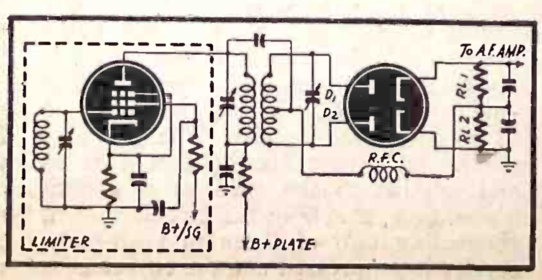


Fig. 1—Limiter and discriminator circuit.

The Travis discriminator, Fig. 2, uses a transformer having three tuned windings.

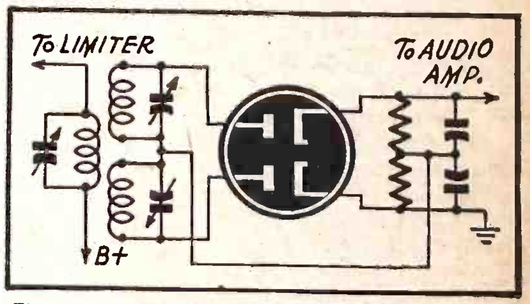


Fig. 2—Travis discriminator. Diodes are tuned above and below the carrier frequency.

The primary is tuned to the intermediate frequency and one of the secondary windings is tuned lower than the primary by a small amount. The remaining secondary is tuned higher than the primary by the same frequency difference. The ends of the secondary windings are connected to the plates of diodes which have their load resistors so connected that the voltage drop across them will have opposite polarity. When the signal being received is at the I.F. mid-frequency, each secondary receives an equal voltage. The output of the diodes will be equal and opposed and the net voltage drop across the loads in series will be zero. When the input frequency swings, giving more signal first to one secondary, then the other, the output voltage from the diodes will be unequal. The net voltage across the output of the circuit will be the algebraic sum of the two voltages and will have the polarity of the greatest voltage.

The chart shown in Fig. 3 illustrates how the output of the two diodes will vary with frequency change.

Another system of frequency modulation detection, developed by G. L. Beers, RCA engineer, uses a narrow-band discriminator somewhat similar in principle to the Travis type. A special oscillator tube following the intermediate frequency stages heterodynes the signal to one-fifth the I.F. Thus a 200-Kc intermediate frequency is reduced to 40 Kc for the detector. One of the discriminator's tuned circuits is tuned to 840 and the other to 900 Kc, for an 860-Kc carrier. This system is said to obviate the necessity and to improve adjacent-channel selectivity greatly.

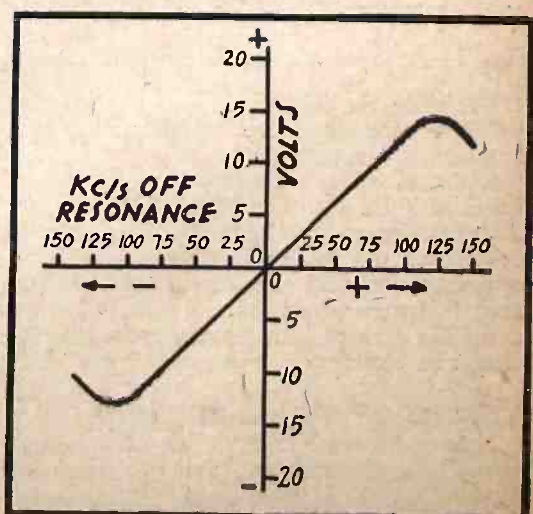


Fig. 3—Chart shows variation of diode response with carrier shift from zero frequency.

the structure, whatever its size, must swing around or up and down to direct the beam in the necessary direction. In certain cases where one needs to scan only a small sector, techniques have been worked out for rapid electrical scanning not requiring the motion of the whole antenna structure itself. So far, however, there has been no method for extending this rapid electrical scanning to cover more than a relatively small sector. Radars for directing guns which need accurate and fast data in a small sector are making use, however, of this valuable technique.

To carry the radio-frequency energy from the oscillator to the antenna, and the echo from the antenna to the receiver, wires and coaxial cables are used at ordinary wave-lengths. For microwaves, however, it is more efficient to use wave guides, which essentially are carefully proportioned hollow pipes—and the transmission system hence is often called "plumbing."

4—The problem of the *receiver* for radar is also a complex one. In practically all radars the superheterodyne principle is employed, which involves generating at low power a radio frequency fairly close to that received, and "beating" this against the received signals. forming an intermediate frequency, which is then amplified many times. Curiously enough the crystal, used as a detector and mixer, has again come into its own in microwave receivers. The peculiar characteristics of pulse signals re-

HOW RADAR OPERATES

(Continued from page 19)

quire that receivers be built with extremely fast response, much faster even than that required in television. The final stages must prepare the signals for suitable presentation in the indicator. The receiver normally occupies a relatively small box in the complete radar set, and yet this box represents a marvel of engineering ingenuity. A particularly difficult piece of development is concerned with a part closely connected with the receiver. This is a method of disconnecting the receiver from the antenna during intervals when the transmitter is operating so that the receiver will not be paralyzed or burned out by the stupendous bursts of radio frequency energy generated by the transmitter. Within a millionth of a second after the transmitter has completed its pulse, however, the receiver must be open to receive the relatively weak echo signals; but now the transmitter part of the circuit must be closed off so it will not absorb any of this energy.

5—It is the *indicator* of a radar that presents the information collected in a form best adapted to efficient use of the set. Nearly (but not quite) all radar indicators consist of one or more cathode-ray tubes. In the simplest or "A" type of presentation the electron beam is given a deflection proportional to time in one direction—say, horizontally — and proportional to the strength of the echo pulse in the other—say, vertically. If no signals are visible, then one sees a bright horizontal line (the "time base") across the tube face, the distance along this line representing time elapsed after the outgoing pulse. A returning echo then gives a V-shaped break in the line at the point corresponding to the time it took the echo to come back. The position of the "pip" along this line measures the distance to the reflecting object. There are many variations of this type of indicator for special purposes, but most radars have an A-scope, even when other types are also provided.

Many types of radar whose antennas "scan" various directions employ the PPI tube. Here the time base starts from the center of the tube and moves radially outward in a direction corresponding to that in which the antenna is pointing. This time base rotates in synchronism with the antenna. The returning signal, instead of causing a break in the time base, simply intensifies its brilliance for an instant. Hence each signal appears as a bright spot of light at a position corresponding to the range and bearing of the target. Thus a maplike picture of all reflecting objects appears in the cathode-ray tube face.

Since the antenna can usually be rotated

(Continued on page 47)

A GLOSSARY OF RADAR TERMS

A.I.	Air Interception—sets used in aircraft, especially night-fighters, to detect and attack enemy aircraft.
Asdic	Apparatus for detecting submarines (*not* radar).
A.S.V.	Air to Surface Vessel—sets used in aircraft to detect and attack ships and surfaced submarines.
A.W.S.	Aircraft Warning Set—of general application to long-range detection apparatus.
"Blip" or "Echo"	The visual indication on the "scope" given by the reflected impulses from the object located. Also referred to as the "Break." The use of the second named term led to the adoption of the tune "Little Sir Echo" as the theme song of the radar operators.
B.T.O.	Bombing Through Overcast.
Cathode Ray Tube or "Scope"	The Cathode Ray Tube or Oscilloscope used in radar sets as an indicator unit.
Centimeter Waves	Radio waves of very short wave length (only a few centimeters) and of extremely high frequency.
C.D.U.	Coast Defence Units for the protection of coastal and harbor installations for sea attack and for assistance of fire control of shore batteries.
Display	Methods of showing the radio echo on the cathode ray tube.
Electron	An electrical particle.
"Floodlighting"	Covering a wide area with radar waves in a wide fixed beam.
G.C.I.	Ground Control Interception — an apparatus specially designed for the control of fighters in the interception of enemy aircraft.
"Gee"	Radar navigational aid, by which bombers are guided from the home field.
"Gen Box"	See "Mickey."
G.L.	Gun-laying sets designed specifically for gun control.
"Headlight Sets"	Radar sets operating in a similar manner to a searchlight.
Heaviside Layer	The lowest reflecting layer in the ionosphere.
I.F.F.	Identification, Friend or Foe—sets carried in friendly aircraft to give a special radar response which will identify them as friendly aircraft.
Ionosphere	Is that portion of the earth's upper atmosphere in which reflecting layers exist.
M/C	Megacycle—a measure of frequency —representing one million cycles or oscillations per second.
"Mickey"	Special type of Plan Position Indicator used by planes to survey the terrain below.
"Oboe"	Improved form of "Gee."
"Pip"	Same as "blip." "Pip" is the American term.
P.P.I.	Plan Position Indicator.
"Pulse"	A transient burst of radio energy sent out by the radar transmitter.
Racons	Radar beacons used to assist friendly aircraft in navigation and homing and for blind landing.
Radar	Term coined in the U. S. A. to signify *Ra*dio *D*irection Finding *A*nd *R*anging, now in common use.
Radar Altimeter	A device giving a constant indication of the height of the aircraft above the surface of the ground.
Radiolocation	Term first generally used in the British Services to describe this development.
RCAF	Royal Canadian Air Force.
R.D.F.	Reflection Direction Finding — the initials used in Britain in the early days to describe radar.
S.L.C.	Searchlight Control Radar Set—familiarly known as "Elsie."
T.W.S.	Tail Warning Sets—used to give warning of approach of other aircraft from the rear.

New Radio Products

LIMITS BRIDGE

Associated Research, Inc.
Chicago, Illinois

MODEL 81 Low Range Limits Bridge is one of a series of units for the rapid comparison of large quantities of resistors having comparable values. It is adapted to volume testing of resistance values up to 2,000 pieces an hour—particularly for testing motor windings, transformer primaries or secondaries, rheostats, potentiometers, lamps, shunts, multiplier resistors and similar applications.

One of the outstanding features of the instrument is extreme flexibility through use of an external reference standard. A combination test fixture and automatic control switch adds to this characteristic; also binding posts at the right side of the unit for connection to user's test fixture where desired.

The instrument is battery-operated. The overall adjustable range is from ¼ ohm to 10,000 ohms, with adjustable ratio arm, sensitivity control, production type test fixture with automatic on-off switch. The sensitivity control range is from ±¼% to ±10%. The indicator is a sensitive zero center galvanometer.—*Radio-Craft*

MULTIMETER

The Triplett Electrical Instrument Co.
Bluffton, Ohio

MODEL 625-N Volt-Ohm-Milliammeter gives maximum testing facilities plus greater sensitivity.

D.C. voltage ranges with dual sensitivity (10,000 and 20,000 ohms per volt) provide double the number of full scale readings of the average tester. 0-1.25-5-25-125-500-2500 D.C. volts, at 20,000 ohms per volt; and 0-2.5-10-50-250-1000-5000 D.C. volts, at 10,000 ohms per volt.

Current ranges 0-50 D.C. microamperes; 0-1-10-100-1000 D.C. milliamperes and 0-10 D.C. amperes, at 250 M.V.

Resistance ranges 0-400 ohms (60 at center scale); 0-50,000 ohms (300 at center scale); 0-10 megohms (60,000 ohms at center scale).

Direct reading Output Level Decibel ranges —30 to +3, +15, +29, +43, +55, +69 db. A condenser is in series with A.C. volt ranges for output readings.

The black, molded case, 6 x 5½ x 2½ inches, is furnished with leather strap handle for portable use. Test leads and accessories furnished.—*Radio-Craft*

DUAL AMPLIFIER

Operadio Manufacturing Co.
St. Charles, Illinois

THE soundcaster, a new 40-watt dual amplifier designed for either plant broadcasting or public address service, has been recently introduced. A standard feature on all three models (530, 531 and 1335) is a switch for easy selection of public address mixing or plant broadcasting service. For plant broadcasting performance, a panel switch permits pre-set volume selection of voice-paging, music or remote microphone.

The basic Soundcaster, Model 1335, is engineered for continuous use wherever commercial or industrial requirements demand a quality, heavy duty amplifier. Automatic record changing mechanism or manually-operated record turntable may be added.

Model 531 incorporates a 2-speed, manually-operated, record player for ten- and twelve-inch commercial recordings, or sixteen-inch transcriptions. Model 530 features an automatic record-changing mechanism for either 12 ten-inch, or 10 twelve-inch recordings.

Soundcaster is finished in blue-gray wrinkle and weighs approximately 45 pounds. Recessed pilot lights illuminate panel controls for microphones, recordings, paging, and bass and treble response.—*Radio-Craft*

DOUBLE-BEAM C-R TUBE

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

TYPE 5SP Cathode-Ray Tube provides two complete "guns" in a single glass envelope, both aimed at or converging, on the single screen for simultaneous and superimposed traces.

This double-beam cathode-ray tube removes such previous limitations the necessity of having to use two tubes for a simultaneous comparison of two phenomena, or having to use an electronic switch in order to present first one phenomenon and then the other on the same tube screen in rapid succession.

The two independent "guns" are contained in a 5-inch envelope. There is complete and independent control of the X, Y and Z axis functions for each beam. Adequate shielding between "guns" and "plates" minimizes "cross-talk" particularly at high frequencies. Deflection plate leads are brought out through the glass envelope wall, minimizing shunt-input deflection-plate capacitance and lead inductance, and also preventing interaction between signals caused by coupling between long leads. Second-anode leads are also brought out through the envelope wall in order to provide better insulation and longer leakage paths.—*Radio-Craft*


ALWAYS SPECIFY
Centralab
CRL
• Volume Control
• Selector Switches
• Lever Action Switches
Old Man Centralab urges you today, as he has for the past two decades, to "always specify CENTRALAB" Replacements.
Your jobber or supplier has comparatively ample stocks of the famous RADIOHMS, Selector Switches (Bakelite or Steatite insulation) in kit form or standard completely assembled and individually cartoned Tone Switches and Lever Action Switches.
. . . and because there is no substitute for quality be sure to "always specify CENTRALAB"
Send for Catalog No. 24.
NAVY
Centralab
CRL
Division of GLOBE-UNION INC., Milwaukee
Producers of: Variable Resistors • Selector Switches • Ceramic Capacitors, Fixed and Variable • Steatite Insulators and Silver Mica Capacitors.

World-Wide Station List

Edited by ELMER R. FULLER

A NEW SEASON is at hand for short wave reception and also for the world. Now that peace is here we hope, forever—new heights in radio reception should be attained. It will be a great day when the thousands of amateur stations throughout the world get back on the air again. When this is so, we will endeavor to devote part of our small space to them.

The Australians have added a new call and a new frequency in their North American service. VLA4 is heard at 1:10 to 1:40 am on 11.710 megacycles. Also in the North American service from "down under" is VLC5 on 9.540 (8-8:45 am); VLC6 on 9.615 (11-11:45 am); VLC3 on 11.710 (11-11:46 am and 9:45-10:45 pm); VLC4 on 11.840 (1:10-1:46 am and 11-11:45 am) and VLC4 on 15.315 (9:45-10:45 pm, 1:10-1:45 am).

Canadian stations CHTA on 15.220 at 7 am to 4 pm and CHOL on 11.730 at 4:15 to 7 pm are located in Montreal and are owned and operated by the Canadian government. Each uses 80,000 watts power.

A complete revision of the schedules of the B.B.C. has been made in this issue and will be found quite accurate until late fall or early winter. Then GRC on 2880 megacycles will again be added to the frequencies in use.

We would like to hear from our former observers who have been serving the country and may now have time again for radio. Also from those of our observers overseas who are still able to correspond with us. Several were in territory occupied by our enemies; one in particular was Charles LeRasle, co-owner of the home station F8UE of Rouen, France. The last letter from this fellow was written from Paris about three or four days before it fell to the Germans. Another was J. M. Ruiz of Manila who has not been heard from since the outbreak of the Japanese war in late 1941. There are several others and if anyone should know of their whereabouts, please contact *Radio-Craft*. Several Englishmen were also among our observers. One, I have learned from reliable sources, was lost at sea while going to Africa early in the war. Others no doubt were in the armed services.

At the time of going to press, the matter of the Japanese and other Asiatic short wave stations was in doubt. However, it is expected that they will be heard as before, probably under control of the Allied Supreme Commander. Any information you hear regarding them or other stations will be greatly appreciated. As soon as the paper situation improves, we hope to have more space available again for this department. In the next issue, we will have some news for you regarding the future of this page. Be sure and see it, as it will be of interest to everyone interested in short wave radio of any phase. New items are being planned for you.

All time in this list is Eastern War Time. We will use this for some time even though it may be discontinued by the time you receive this. It will take us some time to revise our entire list back to Standard Time. Address all communication to the Short Wave Editor, *Radio-Craft*, 25 West Broadway, N. Y. 7, N. Y.

Freq.	Station	Location and Schedule
9.030	COBZ	**HAVANA, CUBA;** 8 am to midnight.
9.082	CNR3	**RABAT, FRENCH MOROCCO;** 1 to 4 am; 3 to 6:45 pm.
9.120	——	**BALIKPAPAN, BORNEO;** heard 6 to 7 pm.
9.125	HAT4	**BUDAPEST, HUNGARY.**
9.130	HI2G	**CIUDAD TRUJILLO, DOMINICAN REPUBLIC;** heard at 10 pm.
9.270	COCX	**HAVANA, CUBA;** heard at 1 am.
9.340	PJY9	**WILLEMSTAD, CURACAO.**
9.360	CBFX	**MONTREAL, CANADA;** 7:30 am to 11:30 pm.
9.365	——	**HAVANA, CUBA;** heard at 6:30 pm.
9.380	OTC	**LEOPOLDVILLE, BELGIAN CONGO;** 3 to 5:30 pm.
9.410	GRI	**LONDON, ENGLAND;** African beam, 1:30 to 3:30 am; 6:30 to 8:45 am; 11:30 am to 2 pm; 3:30 to 6:30 pm. European beam, 1:30 to 3:45 am; 6 to 8:45 am; 11:15 am to 5 pm; 5:30 to 6:30 pm.
9.440	FZI	**BRAZZAVILLE, FRENCH WEST AFRICA;** off at 7:45 pm; female announcer.
9.440	KNBI	**SAN FRANCISCO, CALIFORNIA;** Oriental beam, 5 to 10:45 am.
9.465	TAP	**ANKARA, TURKEY;** heard at 1 and 4 pm. in French and English.
9.480	——	**MOSCOW, U.S.S.R.;** heard 8:10 to 8:50 pm.
9.490	WCBX	**NEW YORK CITY;** Brazilian beam, 5 to 11:30 pm.
9.490	KNBI	**SAN FRANCISCO, CALIFORNIA;** Oriental beam, 5 to 10:45 am; East Indies beam, 11 am to noon.
9.490	GWF	**LONDON, ENGLAND.**
9.500	XEWW	**MEXICO CITY, MEXICO;** 9 am to 3 am.
9.510	TAP	**ANKARA, TURKEY;** 1 to 2 pm.
9.510	GSB	**LONDON, ENGLAND;** Near East, midnight to 2:15 am; 1:30 to 5 pm; South America, 5 to 10:45 pm; Italian beam, 1 to 4 am; 1:30 to 5 pm.
9.520	——	**COPENHAGEN, DENMARK;** heard 8 to 11 pm.
9.520	——	**PARIS, FRANCE;** 6 to 7 pm; 10:30 to 11:15 pm.
9.525	GWJ	**LONDON, ENGLAND;** Near and Middle East beams, 12:45 to 1 am; 4:30 to 5 pm; African beam, 4:30 to 5 pm; European beam, 12:30 to 2:45 am; 6 to 9 am; 11:15 am to 12:30 pm; 1 to 5 pm.
9.530	WGEO	**SCHENECTADY, NEW YORK;** South America beam, 6 pm to midnight.
9.535	JZI	**TOKYO, JAPAN;** heard at 2 and 11:30 pm and 3 am.
9.535	——	**BERN, SWITZERLAND;** to North America at 9:30 to 11 pm.
9.538	——	**"RADIO SHONAN" AT SINGAPORE;** heard at 7:25 to 7:30 am.
9.540	CJCA	**EDMONTON, CANADA;** heard at 10:30 am; afternoons.
9.540	VLG2	**MELBOURNE, AUSTRALIA;** Asiatic beam, 8 to 10 am.
9.540	VLC5	**SHEPPARTON, AUSTRALIA;** North American beam, 8 to 8:45 am.
9.550	GWB	**LONDON, ENGLAND.**
9.550	KGEI	**SAN FRANCISCO, CALIFORNIA;** East Indies beam, 5 to 11:45 am.
9.555	XETT	**MEXICO CITY, MEXICO.**
9.565	——	**MOSCOW, U.S.S.R.;** 6 to 6:45 pm; 7:40 to 8:30 am.
9.570	KWID	**SAN FRANCISCO, CALIFORNIA;** Oriental beam, 3:45 to 4:45 am; 5 to 11:45 am; South American beam, 8:45 pm to midnight.
9.570	WBOS	**BOSTON, MASSACHUSETTS;** European beam, 1 to 6:15 am.
9.580	GSC	**LONDON, ENGLAND;** Central and South America beam, 5:15 to 10:15 pm; Indian beam, 9 to 9:15 pm.
9.580	VLG	**MELBOURNE, AUSTRALIA;** Indian beam, 10:35 to 10.45 am.
9.590	WLWO	**CINCINNATI, OHIO;** European beam, 4:15 to 5:45 pm; South America beam, 7 pm to 1:15 am.
9.590	VUD4	**DELHI, INDIA;** 9 to 11:50 pm; 2 to 5 am; 6:30 to 8 am; 8:30 am to 4:45 pm.
9.590	WCBX	**NEW YORK CITY;** European beam, 3:30 to 5:45 am.
9.595	——	**ATHLONE, IRELAND;** 5:10 to 5:30 pm.
9.600	XEYU	**MEXICO CITY, MEXICO;** heard late afternoons and evenings.
9.600	GRY	**LONDON, ENGLAND;** Africa beam, 1:15 to 5 pm; Near East, 3:30 to 5 pm; Middle East beam, midnight to 2:45 am; Australian beam, midnight to 4 am.
9.608	ZRL	**CAPE TOWN, SOUTH AFRICA;** 10 to 11:45 am.
9.610	PY0S	**RIO DE JANEIRO, BRAZIL.**
9.610	MCH	**LUXEMBOURG;** heard irregularly at 5:30 pm calling New York.
9.615	VLC6	**SHEPPARTON, AUSTRALIA;** North America beam, 11 to 11:45 am; Philippine beam, 5 to 6 am; Asiatic beam, 6:15 to 7:45 am; 9 to 10:15 am; Indian beam, 10:35 to 10:45 am.
9.615	TIPG	**SAN JOSE, COSTA RICA;** heard at 9 pm.
9.615	XERQ	**MEXICO CITY, MEXICO;** evenings.
9.625	XGCA	**SOMEWHERE IN CHINA;** 7 to 8:45 am.
9.625	GWO	**LONDON, ENGLAND;** Africa beam, 1 to 2:15 am. Middle East beam, 1:15 to 1:30 am; 2:30 to 3 pm; 5:15 to 5:30 pm; European beam, 1 to 1:30 am; 2 to 3:45 am; 6 to 8:30 am; 11 to noon; 1 to 2:30 pm; 3 to 6:45 pm.
9.630	CBFX	**MONTREAL, CANADA;** evenings till 12:05 am.
9.640	GVZ	**LONDON, ENGLAND;** North America beam, 5:15 pm to 12:45 am; New Zealand beam, 1 to 5 am.
9.646	XGOY	**CHUNGKING, CHINA;** East Asia and South Seas beam, 7:35 to 9:40 am; North America beam, 9:45 to 11:40 am; European beam, 11:45 am to 12:30 pm; East Asia and South Seas beam, 12:30 to 1:45 pm.
9.650	KRHO	**HONOLULU, HAWAII;** Philippine beam, noon to 3 pm.
9.660	GWP	**LONDON, ENGLAND;** African beam, midnight to 2:15 am; Far East beam, midnight to 4:45 am; North African beam, 2 to 3:45 am.
9.670	WRCA	**NEW YORK CITY;** Brazilian beam, 8 to 11:30 pm.
9.670	WNBI	**NEW YORK CITY;** South America beam, 6:45 to 8:45 am.
9.675	JVW2	**TOKYO, JAPAN;** 3 to 6 am; 6:30 to 8:15 am; 8:30 to 10:40 am; 10:55 am to 12:40 pm; 1 to 2:40 pm; 5:30 to 7:45 pm.
9.675	GWT	**LONDON, ENGLAND;** African beam, 2:45 to 3:15 pm; Canary Islands beam, 2:30 to 2:45 am; 3:15 to 3:30 am; 4 to 4:30 pm; European beam, 2 to 3 am; 6 to 8:30 am; 11:15 am to 1 pm; 1:30 to 2:30; 3:15 to 5 pm.

(*Continued on page* 68)

Radio Term Illustrated

Suggested by: F/o Melville R. Pyne, Charlottetown, P. E. I., Canada

"Thermocouple"

THROUGH THE N. U. EQUIPMENT PLAN SERVICE DEALERS RECEIVED 60,000 PIECES OF FINE TEST EQUIPMENT

Authorized RADIO-VIDEO ELECTRONIC Service

Since 1930, National Union has been the only radio tube and parts manufacturer whose entire merchandising program has been designed 100% to support the "*service* side of radio row" exclusively!

You know how the N. U. Equipment Plan brought 60,000 pieces of the finest test equipment to radio service dealers—free! You know how N. U. national and cooperative advertising, promotions, literature, displays and other business-builders helped dealers and jobbers prosper.

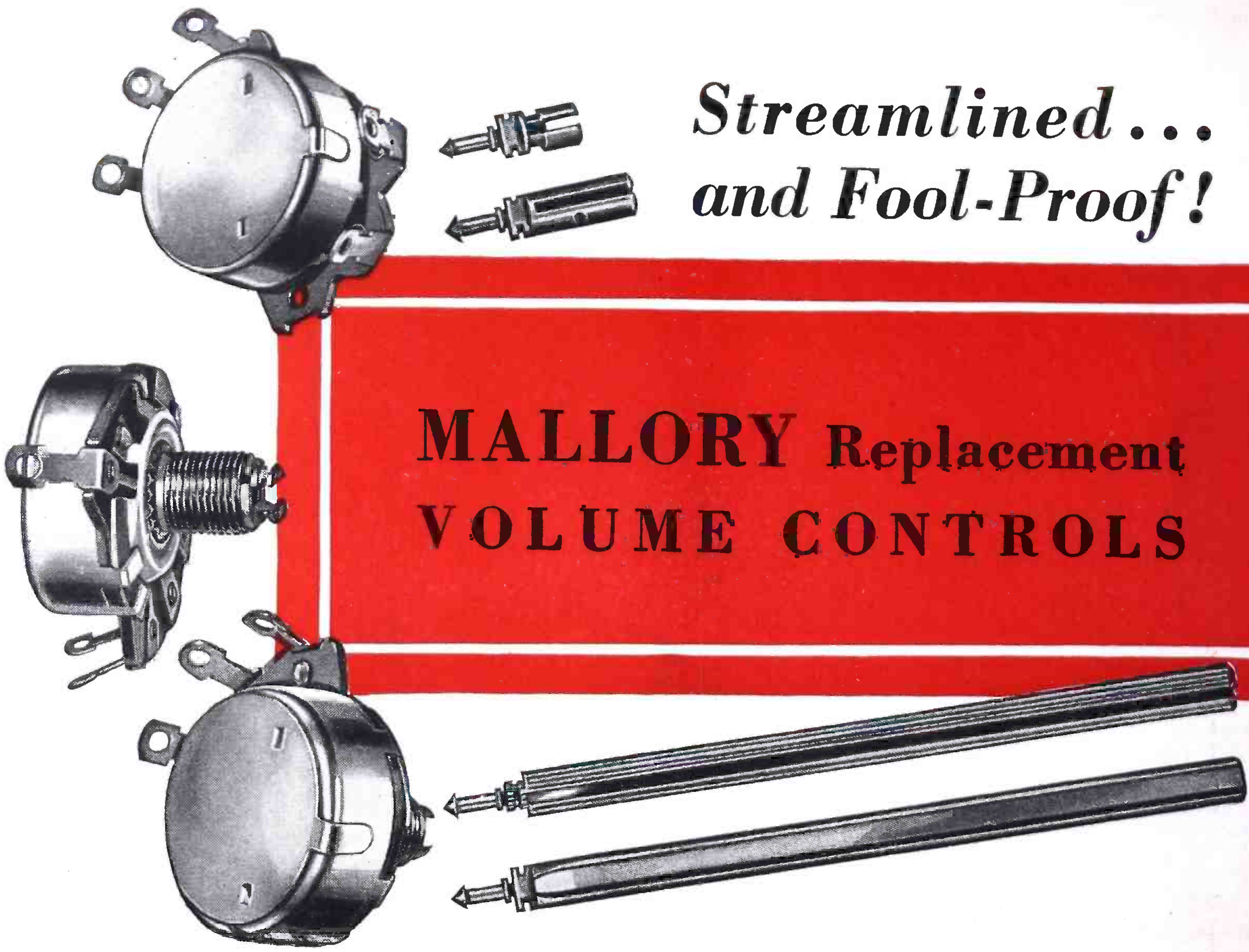
AFTER THE WAR... MORE THAN BEFORE!

Count on National Union for even more help . . . a wider selection of tubes and parts, even better equipment deals, powerful new merchandising plans, more technical service information . . . to make business prosperous for all "on the service side of radio row"!

NATIONAL UNION
RADIO AND ELECTRON TUBES

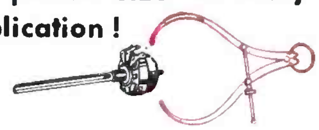
Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs

Streamlined... and Fool-Proof!



MALLORY Replacement VOLUME CONTROLS

The perfect size for every application!



Precision-built like a fine watch!

Rugged strength for years of service!

The A-C switch that snaps on and stays on!

MALLORY Tapped Volume Controls have put an end to confusion and worries. Together with a surprisingly small number of plug-in shafts, they not only replace original controls but *duplicate* them mechanically and electrically. In fact, 16 controls fill approximately 85% of your replacement requirements!

Installation is easy and fool-proof, too! The plug-in shafts can't pull or twist loose. The A-C switch *snaps* on. There's no assembly work required!

What's more, Mallory controls mean quiet operation and gradual increase or decrease of volume. And they require a lower inventory investment than any other controls on the market! See your Mallory distributor. Have him help you select a streamlined kit to answer nearly all your service needs.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

ARMY E NAVY

More than ever—ALWAYS INSIST ON

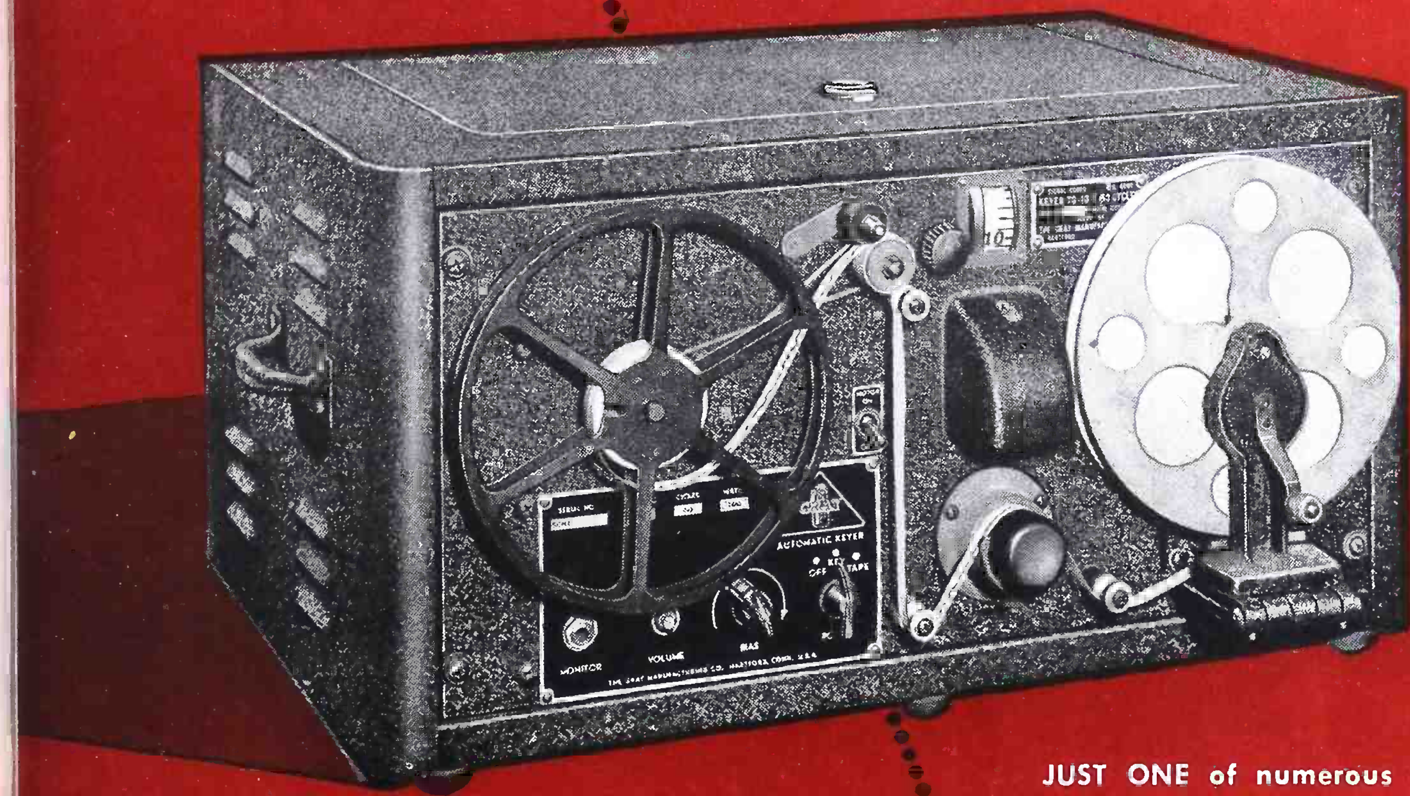
P. R. MALLORY & CO. Inc.
MALLORY
APPROVED PRECISION PRODUCTS

**VIBRATORS • VIBRAPACKS* • CONDENSERS
VOLUME CONTROLS • SWITCHES • RESISTORS
FILTERS • RECTIFIERS • POWER SUPPLIES**

ALSO MALLORY "TROPICAL"* DRY BATTERIES, ORIGINALLY DEVELOPED BY MALLORY FOR THE U. S. ARMY SIGNAL CORPS, NOT PRESENTLY AVAILABLE FOR CIVILIAN USE.

*Trademarks

JUST ONE



JUST ONE of numerous government radio and electronic items now available through the Hallicrafters Co., Chicago, agent for Reconstruction Finance Corporation.

This is a Keyer TG-10-F, an automatic unit for providing code practice signals from inked tape recordings. Excellent for group instruction, sufficient power to operate up to 300 pairs of head phones. Can be adapted as amplifier of 10 to 15 watts output for use with crystal mike or phono pick up. Completely checked and reconditioned by Hallicrafters engineers. Send coupon for further details and lists of other available items.

THESE VALUABLE ITEMS *Available Now*

or very soon. Write, wire or phone for further information

· head phones · test equipment · component parts · marine transmitters and receivers · code practice equipment · sound detecting equipment · vehicular operation police and command sets · radio beacons and airborne landing equipment

hallicrafters RADIO

HALLICRAFTERS CO., AGENT OF RFC UNDER CONTRACT SIA-3-24

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT

CLIP THIS COUPON NOW

RFC DEPARTMENT 111, HALLICRAFTERS
5025 West 65th Street • Chicago 38, Illinoi

☐ Send further details and price on Keyer TG-10-
☐ Send listings of other available items

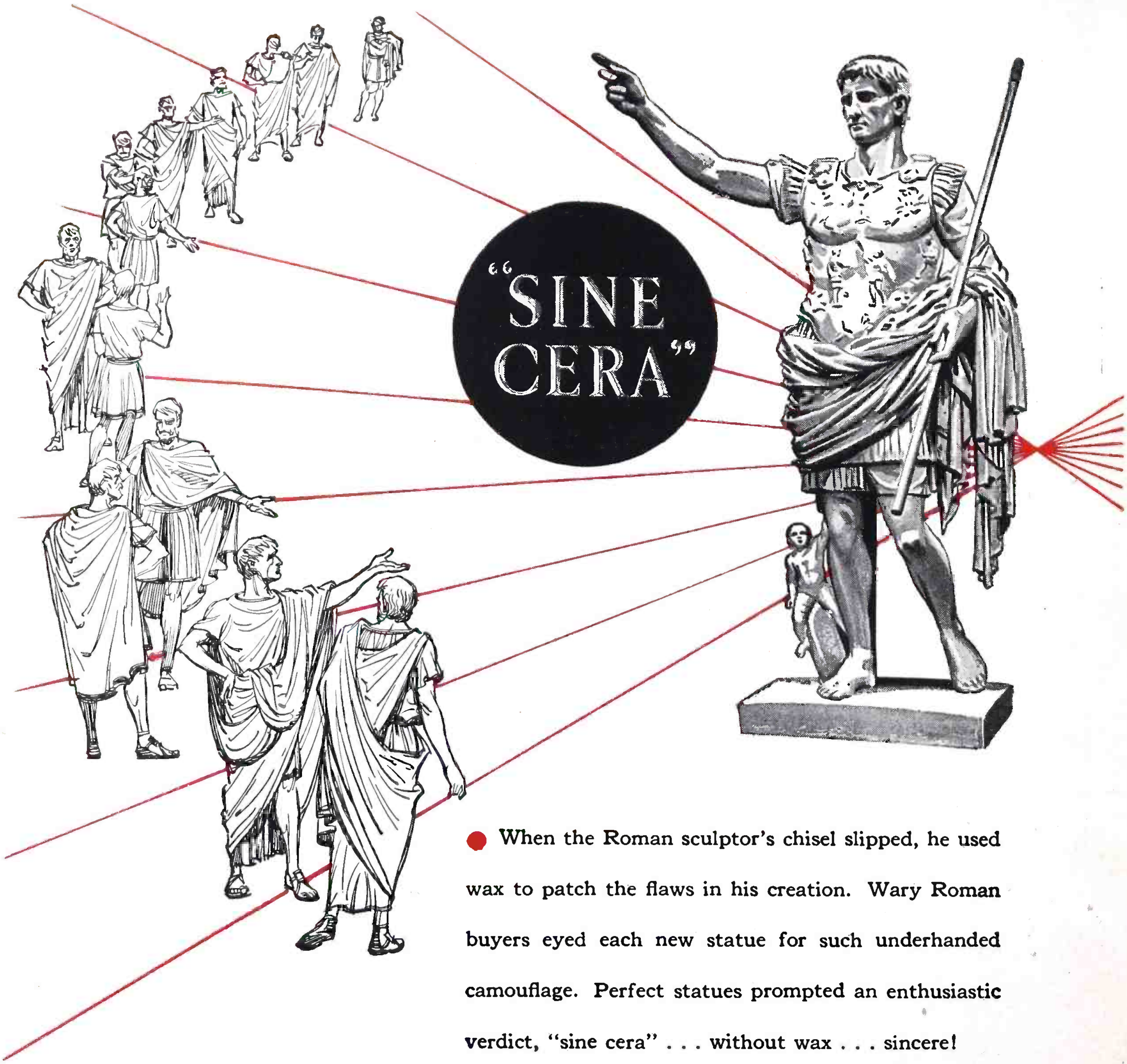
Especially interested in____________________

NAME____________________

ADDRESS____________________

CITY____________________ZONE____

STATE____________________



When the Roman sculptor's chisel slipped, he used wax to patch the flaws in his creation. Wary Roman buyers eyed each new statue for such underhanded camouflage. Perfect statues prompted an enthusiastic verdict, "sine cera" . . . without wax . . . sincere!

Sincerity produces perfection in the Detrola radio receivers, automatic record changers and other electronic instruments expressly created for the world's foremost merchants and their customers.

DIVISION OF INTERNATIONAL DETROLA CORPORATION DETROIT 9, MICHIGAN

TUBE REPLACEMENTS

(Continued from page 23)

is the use of a 20-ohm speaker in shunt with the 8-ohm speaker (Fig. 2). Both efficiency and tone will be optimum and the receiver will be improved since the new tube has a larger power output which can be distributed among the two speakers.

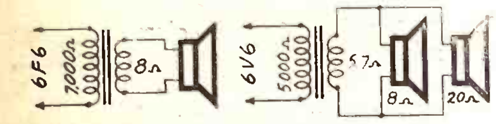


Fig. 2—Output adaption for lower plate load.

A similar procedure may be used where the new tube has a higher load requirement. An additional speaker or resistor may be added in series with the original speaker.

ELEMENT VOLTAGES

Otherwise similar tubes may have different recommended maximum plate or screen voltages. These should be decreased to come within the tube requirements. A resistance may be connected in series with the plate or screen which requires the lower voltage, or a voltage divider may supply the lower voltage. For example, replacing a 3S4 with a 3Q5GT, note that the latter

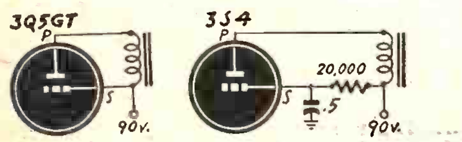


Fig. 3—How screen voltages may be lowered.

requires a lower screen voltage (Fig. 3).

Rectifier tubes should be replaced with another which has characteristics as close as possible to the original. The more important are:

a—maximum applied RMS voltage
b—maximum plate current
c—whether mercury-vapor or vacuum type
d—whether cathode or filament type

Short life will result when the first two are exceeded. A mercury-vapor tube may cause interference in receivers or amplifiers unless proper filtering is used. A cathode type tube permits the rectifier to come up to operating temperature more gradually and therefore limits the voltage output until the other slow-heating tubes of the radio can make use of it. If the replacement is capable of providing much more current than the original, it will be only lightly loaded. Its use may provide higher voltages throughout the set and may damage components and tubes.

The rectifier tube list gives their most important characteristics. Note that condenser input limits the permitted RMS voltage. Therefore, a lower RMS voltage tube may be substituted only if a filter choke is put ahead of a condenser input circuit.

•

Freedom of communications is essential to a free world, declared James Lawrence Fly at the University of Chicago last month. Instantaneous communication by radio to all parts of the earth was one of the prerequisites for such freedom, he stated. Governmental bottlenecks, such as the one which channels radiotelegraph messages to all parts of the British Empire through London, must be eliminated. Television should be developed on an international scale as part of the international broadcasting service.

A COMBINATION 10-TEST PANEL

(*Continued from page 20*)

"common" and "low" and a suitable multiplier is used. With these connections the D.C. blocking condenser is not used. Readings of a much higher value can be read if the test leads are inserted in the pin jacks marked "common" and "high," but in this case no definite value in voltage is indicated. To operate this circuit set the master selector switch in the No. 6 position, and the A.C.-D.C. switches of the meter circuit in the A.C. position. The test leads are then inserted in the pin jacks of the range desired and the other ends of the leads connected across the source of output.

The seventh unit is simply a series test lamp or continuity tester. It is shown using a 2-watt neon lamp, though any lamp of any wattage can be used. It is well to remember that if a large wattage lamp is used it is possible to receive a severe shock if you should accidentally come in contact with the bare ends of the test leads. The master selector switch is set in the No. 7 position and the test leads inserted in the pin jacks marked for them. Do not forget to plug the supply cord into a convenience outlet or you may wonder why the lamp will not light.

CONDENSER LEAKAGE TESTER

The eighth unit is a leakage tester for paper insulated condensers. The degree of leakage is indicated by the number of times the neon lamp flashes per minute. The length of time between flashes for a condenser having a low leakage current will be much greater than that of a condenser having a high leakage current. To operate this circuit, set the master selector switch in the No. 8 position and throw the D.P.D.T. switch in the primary circuit of the transformer to the "ON" position. A wide variation in voltage is obtained for rectification purposes by adjusting the voltage tap switch located in the high-voltage secondary circuit.

The condenser to be tested for leakage is connected across the pin jacks marked for that purpose. The S.P. three-position switch should be set in that position which corresponds nearest to the size of the condenser under test. The S.P.S.T. switch connected across the 5000-ohm variable resistor should be left open, and the variable resistor used as a voltage regulator.

This circuit was originated in its original form by the Tobe Deutschmann Corp. and the only difference is that it has the S.P.S.T. switch across the variable resistor and a milliammeter is used for testing the electrolytic type of condensers instead of the neon lamp. When the D.P.D.T. switch used in the primary circuit of the transformer is closed to the left hand side it will immediately discharge both the filter condenser used in the rectifier unit and the condenser under test, so that the condenser can then be safely removed without receiving a nasty shock. It is suggested that two high-voltage condensers of 450 volts to 600 volts be connected in series for the filter condenser of this unit. This will eliminate possibility of condenser breakdown caused by the high D.C. voltage obtainable from the rectifier circuit. Remember to turn this circuit off by throwing the D.P.D.T. switch to the left or "OFF" position.

The ninth unit is a leakage tester for electrolytic condensers. It uses a milliammeter for leakage indication instead of a neon lamp, inasmuch as the meter is already available, and a definite leakage current tolerance can be held to. Operation of this circuit in the ninth position is almost identical to the eighth position. The master selector switch is set in the No. 9 position and the D.P.D.T. switch in the primary circuit of the transformer thrown to the right or "ON" position. Set the switches of the meter circuit in the D.C. position. The condenser to be tested is connected to the pin jacks for that purpose. The S.P. three-position switch is placed in the No. 3 or electrolytic position. The voltage tap switch is set to a voltage near that of the condenser value. The S.P.S.T. switch across the variable resistance is left open while the condenser under test is charging. Then close this switch and read the milliammeter reading. One milliampere per microfarad is suggested as the maximum amount of leakage current allowable for electrolytic condensers, whereas one half a milliampere per microfarad is more desirable. 200 milliamperes should be the full scale reading of the meter while tests are being made in the ninth position. Remember to turn this circuit off when through by closing the D.P.D.T. switch to the left hand or "OFF" position.

A CAPACITY METER

The tenth and last unit is a capacity meter circuit, and works directly from the 117-volt A.C. lines. To operate this circuit turn the master selector switch to the No. 10 position. Set the A.C.-D.C. switches of the meter circuit in the A.C. position. Plug a pair of test leads into the pin jacks which are in the probable range of the condenser under test and short the other ends of them together. Adjust the meter for full-scale reading with the 200-ohm variable resistance. The shorted ends can now be placed across the condenser and its capacity read directly, providing of course that you already have the dial calibrated for capacity. It can be calibrated by using a few condensers of good quality as standards.

On either side of the meter three tube sockets are mounted on the panel along with eight regular phone jacks. These are connected in series with the leads connecting to a receptacle socket which accommodates a 10-lead cable. Ten tip jacks are also used which are connected parallel to each one of the leads. Of these ten jacks one is used to transfer the chassis connection to the panel of the set under test. By the use of these sockets, series and parallel jacks, and a 10-conductor cable with the necessary plugs on each end voltage tests may be made from any two elements or current tests may be made by plugging into the series jacks. Since few may desire this unit no circuit was included. Those who desire it may obtain all the necessary data from any tube manual.

If the description of the analyzer is not complete enough every effort will be made to make it so if those who desire it will write me about it and include a stamped and self-addressed envelope.

The list of parts needed are as follows:

UNIT 1

1—Yaxley tap switch. No. 1311 single circuit. 1 to 11 points.
1—Yaxley bar knob. No. 366.
2—Yaxley tip jacks. 1 No. 420 (Red), 1 No. 421 (Black).
8—IRC meter multiplier resistors. ½ watt. 1-10,000 ohms, 5-100,000 ohms. 2-250,000 ohms.

UNIT 2

1—Yaxley tap switch. No. 1211 single circuit. 1 to 11 points.
1—Yaxley bar knob. No. 366.
8—Meter shunts. One each of the following resistance values. 3 ohms, .270 ohms, .135 ohms, .090 ohms, .0675 ohms, .054 ohms, .036 ohms, .027 ohms.
2—Yaxley tip jacks. 1 No. 420 (Red) 1 No. 421 (Black).

(Continued on page 43)

Radio-Electronic Circuits

HOME BROADCASTER

Figure 1

The diagram shows the circuit of a one-tube oscillator that may be used as a home broadcaster. The mike used in this circuit is an old microphone button from a telephone handset. The coil used in this case will cover the high-frequency end of the broadcast band.

CARL RAINWATER,
St. Simons Island, Ga.

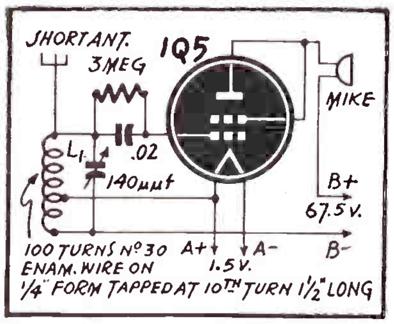


Figure 1

(This circuit could be considerably improved if a mike transformer were used in the input circuit. A 2-inch speaker with a matched output transformer might make an excellent mike in this case.—*Editor*)

S-W CONVERTER

Figure 2

This diagram for a short-wave converter is just about the simplest and most economical converter that can be built. Under favorable conditions it will easily pick up London or San Francisco when connected to the antenna binding post of any five-tube superhet.

The converter has its own power supply, and on account of the low drain almost any tube may be used as a rectifier—provided, of course, that proper considerations are given to heater requirements.

All the values for the components are shown on the diagram. None of them are critical. In some cases the line by-pass condenser and the input filter condenser may be unnecessary.

If oscillation does not occur, it may be necessary to increase the feedback by moving the oscillator coil tap away from ground. No more than one additional turn should be required.

Y. MUKAI,
Hunt, Idaho.

Radio-Craft welcomes new and original radio or electronic circuits. Hook-ups which show no advance on or advantages over previously published circuits are not interesting to us. Send in your latest hook-ups—*Radio-Craft* will extend a one-year subscription for each one accepted. Pencil diagrams—with short descriptions of the circuit—will be acceptable, but must be clearly drawn on a good-sized sheet of paper.

CAPACITY METER

Figure 3

The diagram shows a simple capacity meter which I use around the shop for general condenser checking. Using a 0-1 milliampere meter, the range of this tester is .01 to 4 mfd. By using a 5-volt winding for the filament, thermionic effects are eliminated. Usually this thermionic effect causes the meter to show a reading with the Cx terminals open. This effect can be noticed more readily with meters of greater sensitivity than 1 milliampere.

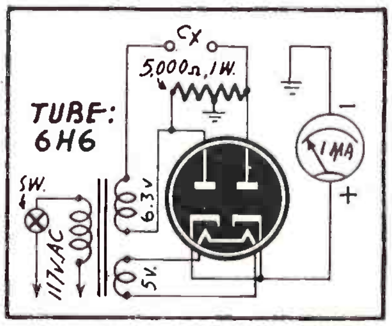


Figure 3

The meter shown in the drawing may be shunted to extend the range if higher capacities are to be measured. This meter was calibrated by using marked, tested condensers.

DAN W. DAMROW,
Chicago, Ill.

3-TUBE RADIO

Figure 4

This circuit is a fairly common regenerative using an electron-coupled oscillator. The tube complement is somewhat out of the ordinary. I use a small audio transformer as a choke in the power supply, and all grids of the 25L6 are tied to the plate. The output voltage is about 150 volts, and it remains pretty constant under load. The values for the coil and tuning condenser are not shown as this will vary with the needs of the user.

Desiring to tune in the BBC and the Army Expeditionary Force stations around here, I wound 10 turns of bare wire, evenly spaced, on a one-inch coil form. My cathode return was taken off at the third turn from the ground end. The entire unit is mounted in a cigar box.

PFC. BILL CHRISTIANSEN,
New York City.

10-200 METER SET

Figure 5

This circuit uses a 6J7 regenerative detector and a 6J8 as an amplifier and half-wave rectifier. All other parts are from the junk box.

By using standard plug-in coils, bands from 10 to 200 meters can be covered. Regeneration is controlled by the 15,000-ohm potentiometer. If the condenser C7 is placed in the circuit temporarily so that it can be disconnected at will, it makes an excellent tone control. This set brings in London, South American stations, aircraft, ship and CW with plenty of wallop.

F. MACADAM,
Sudbury, Ont.

PHONO OSCILLATOR

Figure 6

This phono oscillator can be built cheaply and is so compact that it will easily fit into a record player.

When it is operated in conjunction with or near a sensitive receiver, no external antenna is needed but in most cases, a short wire about 7 or 8 feet (or a small loop), will give best results.

The coil consists of 150 turns of No. 28 enamelled wire, wound on a 1-inch form, and tapped at the 50th turn. This coil and the leads from it should be shielded from the 110-volt A.C. line, so as to prevent pick-up and consequent 60-cycle hum.

RALPH DAY,
Moncton, New Brunswick.

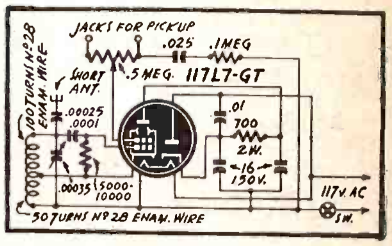


Figure 6

PORTABLE RADIO

Figure 7

This novel receiver is for local reception only. Although it can be built in much smaller space I purposely made it this large so that the loop would be bigger and have more pickup.

The circuit is straight regenerative, even though the method of feedback is slightly unconventional. It is unusually stable and can be carried around while in operation. It is highly directional and has enough power on locals for pleasant headphone reception.

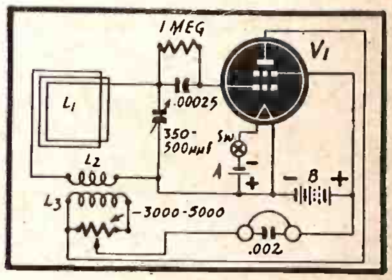


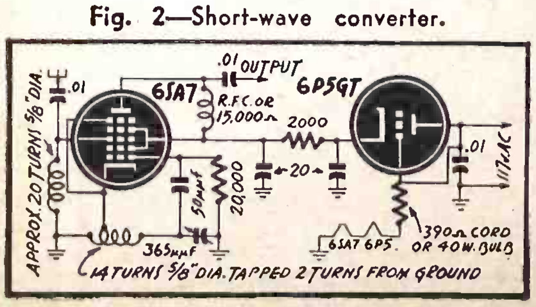
Figure 7

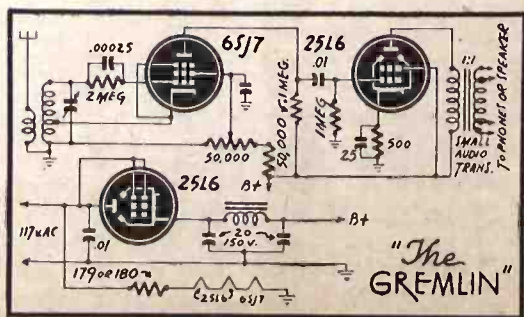
Almost any small tube available may be used, such as the 1S5, 1A5-G, 1N5-G, which all work equally well. The only trick is to have enough turns on L_3 so the set will regenerate at any spot on the dial.

L_1 is a spiderweb loop with approximately 30 turns roughly 3 x 6 inches. L_2 is 20 turns on a 1-inch tube, and L_3 is 35 turns wound directly over L_2. Battery "A" is a 1.5-volt flashlight cell and "B," 15 to 45 volts of B battery. Any one of the tubes work very well on 22½ volts, and many on less.

HAROLD J. SHAFFER,
San Francisco, Calif.

Fig. 2—Short-wave converter.





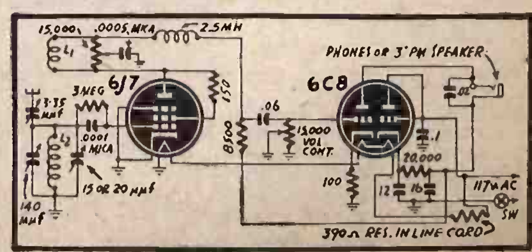


Fig. 4, left—3-tube radio.
Fig. 5—A plug-in receiver.

A COMBINATION 10-TEST PANEL

(Continued from page 41)

Meter Circuit

1—Model No. 301 Weston 0-1 DC Milliammeter.
1—Instrument rectifier. Full Wave.
3—H & H Toggle switches. D.P.D.T. ⅜ inch.
2—Littelfuse mountings. Panel type.
2—Littelfuse fuses. 1/100 amp.

UNIT 3

3—Yaxley tip jacks. No. 421 1-(Black), 2-(Red). No. 420.
1—H & H Toggle switch. D.P.D.T. ⅜ inch.
1—Electrad No. 234 5000-ohm wire wound rheostat with switch.
1—3-volt battery.
1—Yaxley bar knob. No. 366.

UNIT 4

4—Yaxley tap switches. No. 1221. two circuit. 1 to 11 points.
16—1-watt resistors. One each of the following values: 100/200/400/500/1000/2000/4000/5000/10,000/20,000/40,000/50,000/.1 Meg./.2 Meg./.4 Meg./.5 Meg. (all values are in ohms)
2—Yaxley tip jacks. No. 421 (Black)
1—Yaxley bar knob. No. 366.

UNIT 5

4—Yaxley tap switches. No. 1221. 2 circuit. 1 to 11 points.
16—Condensers. One each of the following values. .001/.002/.004/.007/.01/.02/.04/.07/.1/.2/.4/.7/1.0/2.0/4.0/7.0/M.F.
2—Yaxley tip jacks. No. 421 1-(Black) 1-(Red) No. 420.
1—H & H Toggle switch. S.P.S.T. ⅜ inch.
1—1000-ohm fixed resistor. 1 watt.
1—Yaxley bar knob. No. 366.

UNIT 6

1—Yaxley tap switch. No. 1311. single circuit. 1 to 11 points.
10—Meter multiplier resistors. ½ watt. of the following values. 5-1000/1-5000/1-15,000/1-25,000/1-50,000/1-100,000.
1—Yaxley bar knob. No. 366.
3—Yaxley tip jacks. 2-No. 420. (red) 1-No. 421 (black)
1—Condenser (paper insulated) .1 to 2 M.F.

UNIT 7

1—2-watt neon lamp.
1—Lamp socket.
2—Yaxley tip jacks. No. 421.
1—Insulated terminal mounting strip (For sub-base mounting)

UNITS 8 AND 9

1—Potential transformer, with tapped high potential secondary winding and one 5-volt secondary winding.
1—H & H Toggle switch. D.P.D.T. ⅜ inch.
2—Aerovox compact can type, universal mounting, double section condensers 8-8 M.F.
1—Electrad rheostat. Wire wound. 5000 ohms.
1—H &H Toggle switch. ⅜ inch. S.P.S.T.
1—Resistor of .135 ohms. 2 Resistors of 1.5 megohms.
2—Yaxley tip jacks. 1-No. 420 (Red) 1-No. 421 (black).
1—2-watt neon lamp.
1—S.P.T.T. switch.
1—80 tube.
2—Yaxley bar knobs. No. 366.
1—Lamp socket.
1—.5 M.F. Condenser.
1—Eby moulded socket. 4 prong.

UNIT 10

4—Resistors. 1 watt. one each of the following values. 1000/8000/9000/and 80,000 ohms.
1—2,000-ohm wire wound Electrad rheostat. No. 232.
4—Yaxley tip jacks. No. 421 2-(Black), 2-No. 420 (Red).
1—Yaxley bar knob. No. 366.

Selector switch unit.

1—Yaxley four gang tap switch. No. 1341, four circuits. 1 to 11 points.
1—Yaxley bar knob. No. 365.

PANEL MATERIAL

Either metal or Masonite pressed wood, etc. ⅛ x 15 x 24 inches.

To the following manufacturers and publishing companies goes my sincere appreciation for their kind permission in allowing me to use circuits and reference data compiled by them.
Conant Electrical Laboratories.
Continental Carbon, Inc.
Tobe Deutschmann Corp.
Alfred A. Ghirardi.

•

Television cathode-ray tubes with flat screen ends instead of the present curved surfaces have been developed by the Allen B. DuMont Laboratories, Inc. Television pictures can now be viewed from any angle without the distortion of image formerly present. The laboratories claim that this will result in a far superior picture.

RESISTOR AS REPAIR TOOL

NOW that new, or even used, parts are so scarce, many substitutions are in order. In fact, they are the only answer in many cases. I have found the lowly one-watt resistor, duly accompanied by a coupling condenser, to be of invaluable assistance in quick replacement work.

Some time ago, a job came in with a burnt out I.F. transformer. Not being able to replace it in time to satisfy the customer, I substituted a 15,000-ohm, 1-watt resistor for the transformer winding, and connected a .0001 mfd. condenser from the plate of the tube to the grid of the next tube. That is to say, the condenser was connected between the "plate" and "grid" terminals of the I.F.T. It was found necessary to realign the I.F. stage due to differences in load, etc. Much to my surprise, the results were excellent, except for the faint sound of "birdies" on certain spots of the dial.

Use of the above combination is well-known on audio jobs, but less so for R.F.

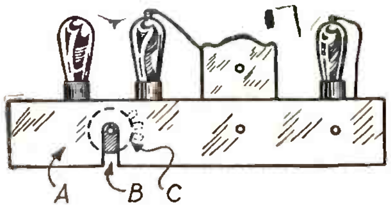
•

Merger of the international communications services of the thirteen companies at present operating in the field into one privately-owned corporation was advocated recently by the Secretary of the Navy. The plan would, it was believed, maintain national sovereignty in the face of competition from foreign communications organizations, which are practically all under government control and ownership.

TRY THIS ONE!

CONTROL REPAIR

Here is a labor saving tip which has saved me many hours of tedious work and which may benefit some radiomen. Most of the small sets and also the large ones, seem to be built on the principle of first placing the volume controls, switches, etc., in position on the chassis and then placing coils, condensers and resistors as close as possible to these controls. When a simple repair is needed, instead of removing the control from the radio and repairing it in a few minutes, you unsolder numerous coil leads, resistors, etc., and proceed to remove the rest of the radio from the volume control.



A—Front of chassis. B—Cut-out section. C—The volume control.

This method usually terminates in a headache for the serviceman, a radio that needs rebalancing, a condenser or resistor with a lead pulled, and a customer who forever after thinks you are a gyp.

When I get one of these outlaws to repair, I remove the volume control lock nut and washer, push the control back as far as possible, and then with a fine hacksaw cut a small slot in the apron of the chassis the same width as the shaft. It is then quite easy to unsolder the few leads to the control and remove it by pulling down and out without disturbing the other component parts that are placed close behind it. After the control is repaired and placed back in position, I tin the strip and solder it back in its original position, tighten up the lock nut, and the chassis is just as strong as it ever was. It has the added advantage that, if the same set comes back for a volume control or switch repair, it is very easy to unsolder the strip again and repair it by the same method.

Frederick Box
Courval, Sask.

ELECTRIC IRON REPAIR

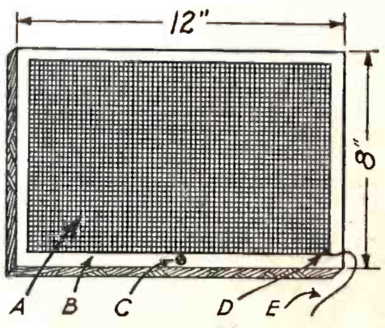
A number of the newer electric irons use a ribbon type heating element. When the element burns out a new one cannot always be procured. A quick repair can be made by drilling or grinding a small hole in each end of the burned-out ribbon and riveting the two ends together, using a nail for a rivet. This makes a quick repair which will last for a long time.

R. S. Havenhill,
Josephtown, Pa.

Radio-Craft wants original kinks from its readers, and will award a seven-month subscription for each one published. To be accepted, ideas must be new and useful. Send your pet short-cut or new idea in today!

"PORTABLE ANTENNA"

Many customers have asked me to install some form of "portable" aerial in their radios as outside aerials are forbidden in some hotels. I obtained a sheet of copper mesh from a discarded screen door and cleaned this with a stiff wire brush. Then I cut it into pieces 11 x 7 inches. I then cut a number of plywood boards, 1/8 of an inch thick into pieces 12 x 8 inches, and mounted each section of mesh to a board. The jagged ends of the mesh were covered by strips of plywood and a short piece of lead-in wire was soldered to one corner of the mesh. This goes to



A—Copper screening. B—Strips of plywood. C—Mounting screw. D—Solder. E—Lead to Ant. post.

the aerial of the set. I also provided each aerial with a wood screw for mounting on window sills, backs of radios, etc. Cost per aerial is almost nil, and it works well.

Gerald Samkofsky,
Brooklyn, N. Y.

DOOR BUZZER

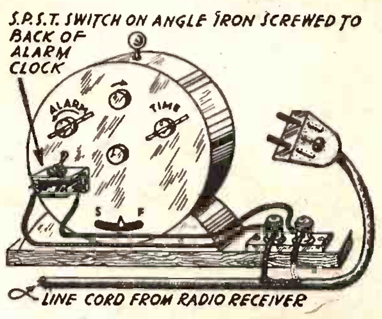
I took an old car radio speaker and used the field coil to make a very good door buzzer with very little effort. I used a straight lamination from an old transformer for the armature. This kink will only work on A.C.

Melvin Youngman
Oak Park, Illinois

(With the shortage of radio parts as severe as it is today, it might be more advisable to procure an old door buzzer and make a car radio speaker out of it! Has any reader an idea on this?—*Editor)*

AUTOMATIC OFF SWITCH

This is for the benefit of those who listen to late programs in bed and do not want their radio to go on playing all night if they should fall asleep.

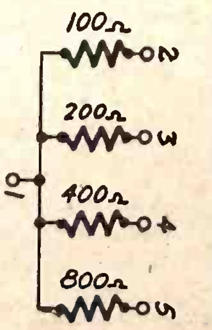


Merely set the clock to ring at the end of your favorite program. When it goes off, the wing nut turns the switch to "off" automatically.

Robert L. Bevard,
Conway, Pa.

RESISTANCE BOARDS

I have several resistance boards that cover a wide range of values—but I'll just give one as an illustration. I used 10-watt resistors for greater flexibility. Mount them on a board with five terminals and a jumper wire. I type a list of values and terminals on a 4 x 6 index card and mount it in a celluloid holder right on the board.



The accompanying diagram is self-explanatory and a complete table of values is given for one of the boards. This "post-office" circuit gives numerous values.

For example—if 280 ohms are needed, connect one lead to terminal 3 and the other lead to terminals 2 and 4.

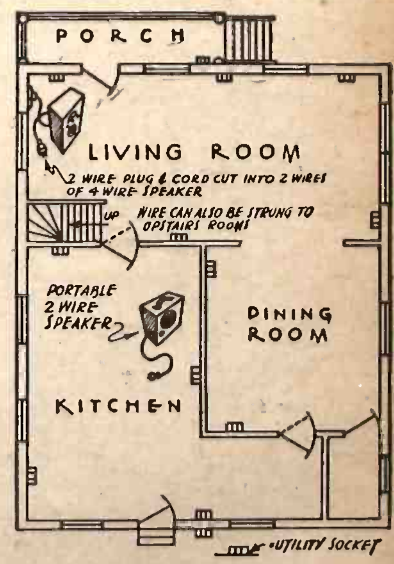
Value	*Terminals*
54 ohms	1 and 2345
57 "	1 " 234
61 "	1 " 235
66 "	1 " 23
73 "	1 " 245
80 "	1 " 24
88 "	1 " 25
100 "	1 " 2
114 "	1 " 345
133 "	1 " 34
160 "	1 " 35
200 "	1 " 3
214 "	2 " 345
233 "	2 " 34
260 "	2 " 35
266 "	2 " 35
273 "	3 " 245
280 "	3 " 24
288 "	3 " 25
300 "	2 " 3
366 "	2 " 45
400 "	1 " 4
461 "	4 " 235
466 "	4 " 23
488 "	4 " 25
500 "	2 " 4
560 "	4 " 35
600 "	3 " 4
800 "	1 " 5
857 "	5 " 234
866 "	5 " 23
880 "	5 " 24
900 "	2 " 5
933 "	5 " 34
1000 "	3 " 5
1200 "	4 " 5

Right column of terminals means that those numbered terminals must all be tied together to form one lead.

Al Drain,
Bowling Green, Ohio.

SLAVE RADIOS

I read in the Why-not column of the April issue of *Radio-Craft* of having a master radio in one room with so-called slave radios throughout the house. I have in my home at the present time a hook-up similar to that but much simpler in operation. I have cut in on my main speaker with two leads, and have run



wires throughout the house terminating in each room with a utility plug. I have a small PM speaker which I can carry anywhere and plug into a socket in any room I happen to be in. A small volume control and switch is built into the housing of each speaker.

I have even used such an extension to operate a speaker in a neighbor's house.

Robert D. Vosbury
Binghamton, N. Y.

STRATOVISION

(Continued from page 17)

of an antenna located 30,000 feet in the air. Thus power to operate all nine transmitters and all monitoring and relaying equipment can be provided by each plane's engines.

Still another advantage of the plan—one of special interest to engineers concerned with television and FM relay systems—is the fact that Stratovision will drastically reduce distortion resulting from repeated amplification.

Each repeater station adds its quota of distortion to a television or FM program, and any ground system, because of its many repeaters, would build up a great amount of accumulated distortion. By cutting the number of relay stations to a minimum, such distortion would cease to be an important factor.

GETS RID OF GHOSTS

The system would bring not only television and FM to millions of new viewers and listeners, its proponents claim, but, in addition, would greatly improve these services for audiences—old and new.

Best reception requires that the antenna of each receiver have directional characteristics and be pointed directly toward the transmitter antenna. This means that, for best results, the antenna for each ground receiver must be movable, and each receiver equipped with a mechanical device for bringing its antenna to bear exactly on the transmitter of each new station from which a program is desired.

Stratovision eliminates this need since one fixed antenna installation at the receiver can be beamed so as to cover the entire small-circle course of one plane flying at 30,000 feet, keeping it constantly in "view." Such an installation will insure access at all times to all programs of every station operating a transmitter in that plane.

Another distinct improvement in service would result from Stratovision's high-altitude operation and the fact that its antennas will be in constant motion. This is in the matter of "ghosting," the annoying out-of-register viewing which occurs when receivers pick up programs by two different waves—one arriving by the most direct path between the transmitter and the receiver, the other by a reflected path.

Stratovision reduces the possibility of such reflection because its high-altitude operation will enable receiver owners to point antennas into the air—above mountains and other ordinary sources of ground reflection.

In addition, movement of the plane will make any reflection which might occur of only very brief duration—so brief, perhaps, as to be undetected by the eye.

By cutting costs, it is hoped, the Stratovision system will place television and FM transmission on a sound and economically justifiable business footing for the first time. It would preclude the tedious city-to-small-town growth necessarily envisioned by all earlier plans, and it promises to make both services available to isolated rural homes which could not expect them for years—if ever—by any other system.

Early experiments show that the system is completely workable in any of the several television and FM frequency allocations which were recently announced by the FCC. Operation actually improves in the higher frequencies. This means that the system may hasten the day of practical color television.

THE AVIATION ANGLE

According to high officials of the Glenn L. Martin Co., Stratovision presents no radical problems of aircraft design or operation.

Four planes would be assigned to each broadcast location. Two would be in the air at all times—one handling programs, the other standing by to take over in case of any emergency. Planes would fly over the center of assigned areas and relief planes would be sent aloft sufficiently in advance of shift changes to insure uninterrupted operation. The 30,000-foot level is tentatively proposed as giving the widest practical range, and as being well "above the weather" which might cause problems at lower altitudes.

"One of the most unusual features of the Stratovision system," pointed out William K. Ebel, Martin's vice-president, "is its need for a slow airplane. After years of striving for progressively greater speed in all our design and construction it is intriguing to be asked to build a huge heavy-load plane to fly only fast enough to remain safely aloft at very high altitudes. Yet by the very nature of its operation, that is all the system requires."

In addition to its four high-altitude planes, each broadcast location would have a smaller plane equipped to act as a flying remote pickup unit. This plane would be available to cover any special event or emergency within the location's 103,000 square mile area, relaying television and FM programs to the parent plane for local broadcast or for nationwide network presentation.

THE QUESTION BOX

SUPERHETERODYNE

Kindly publish a diagram of a four- or five-tube superheterodyne, using the following tubes (list given).—P.D.S., Philadelphia, Penna.

A. The diagram printed here incorporates the tubes you desire. Any standard antenna coil may be used if your tuning condenser has a maximum tuning capacity up to 365 mmf. or 500 mmf. (See Fig. 1)

The combination of oscillator coil and oscillator padding and tuning condenser will depend on the items you have available. The intermediate frequency of 456 kc. is in turn dependent upon the oscillator frequency, so the oscillator components must be selected with that also in mind.

None other than the usual precautions need to be observed in construction. You should be able to obtain excellent reception with the hook-up shown.

GUITAR AMP

I would like to build an amplifier for a guitar, using a 6J5, 6SJ7, 39, 78, 42 or 6F6. I have most of the necessary parts for this. Any of these tubes can be used, or others can be obtained.

—W. E. P., State Farms, Va.

A. The amplifier shown is suitable for a guitar. All parts and values are as marked and none other than the usual precautions should be necessary. The grid bias on the first tube is obtained by means of contact potential, and should be ample for your application. (See Fig.2)

The Question Box is forced to discontinue answering questions until further notice. We have had great difficulty in securing skilled labor for this work, and in many cases recently have been forced to refund remittances. We will continue to print questions of general interest till those already answered and on hand have been exhausted or till we are again able to handle questions for readers.

CAPACITESTER

On page 281 in the November 1939 issue of Radio-Craft *there appeared a schematic of an excellent capacitor tester. I constructed this instrument a few years ago and at that time I did not realize the importance and versatility of this tester. I attempted to obtain the diagram or the issue in which it appeared and was not successful. Can you publish this once more?*

—S/Sgt. T. E. L., N. J.

A. As issues of November, 1939 *Radio-Craft* are no longer available, we are reprinting the diagram you requested, for your information and that of those who might also be looking for, or desire, a diagram of such an instrument. (See Fig. 3.) This is a push-button operated unit which makes rapid measurements of capacity, leakage, power factor and insulation resistance. It will measure condensers ranging in capacity from 10 mmf. to 240 mfd.

CONVERTER

I need a 32-volt power pack with which to service 32-volt radios. This power pack must operate from a 110-volt A.C. supply line, and should be able to supply from 24 to 40 volts in succeeding steps. Can you publish a circuit diagram and a list of parts to be used as a guide in building?

—R. G. B., Carpenter, Wyo.

A. Fig. 4 is a diagram of a 117-volt A.C. to 20-40-volt D.C. converter. This is considered to be the most satisfactory arrangement for a converter of the type you desire. Values are given in the diagram. It would be possible to omit the power transformer and apply the 110-volt A.C. directly to all four 83 plates in parallel, giving half-wave output. Condenser input to the filter would then be needed, giving rise to some objections such as more filtering needed and exceptionally high accumulated voltage on the filter condensers when no load is on the inverter. If this condition were to remain, there would be the danger of perhaps flashing tubes in the set under test when it is plugged into the converter. A low-resistance bleeder reduces this danger.

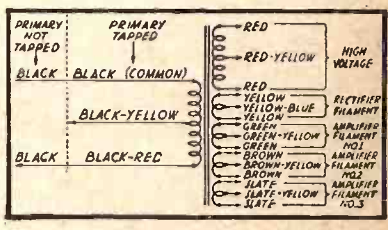
Note that choke input is used. This will give almost uniform voltage output whether you have a light load or close to full load. Another choke and condenser may be added if more filtering is needed.

R_1 is not necessary unless fine adjustment of the output is required.

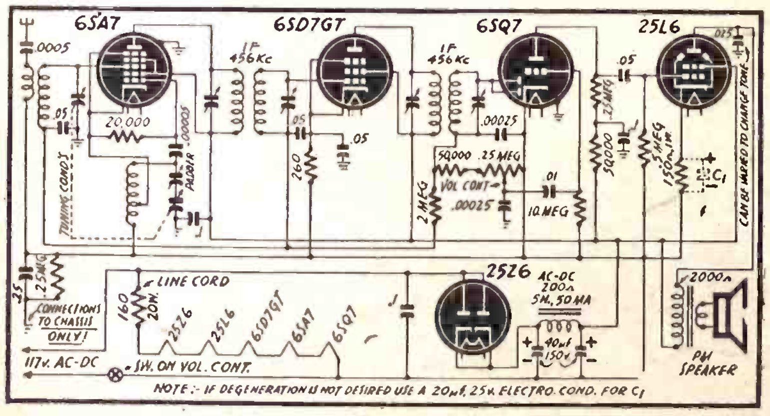
COLOR CODING

I have been watching your monthly issues for the color code for R.F., I.F. and power transformers but have not seen them. I hope that you will print these in a future issue.—B.J.H., Brooklyn, N. Y.

A. While these are available in standard texts, and often in manufacturers handbooks, it will be helpful to many readers to reprint them here.



There are still old sets in use which follow other codes. Replacement parts for these may follow the original coding. The Serviceman is warned to be sure that the coding of a part is standard before taking it for granted. Green usually runs to grid and black to ground, when other leads are non-standard.



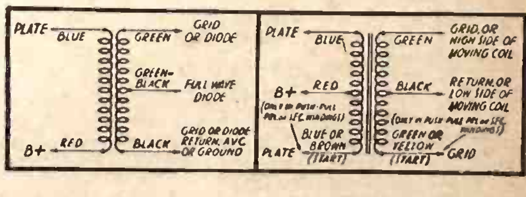
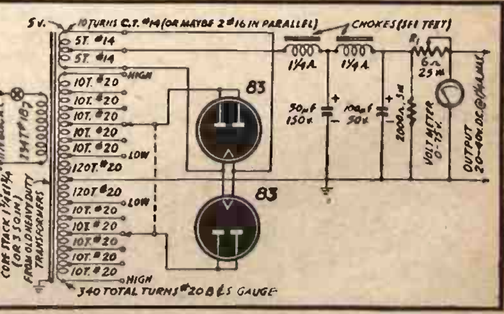
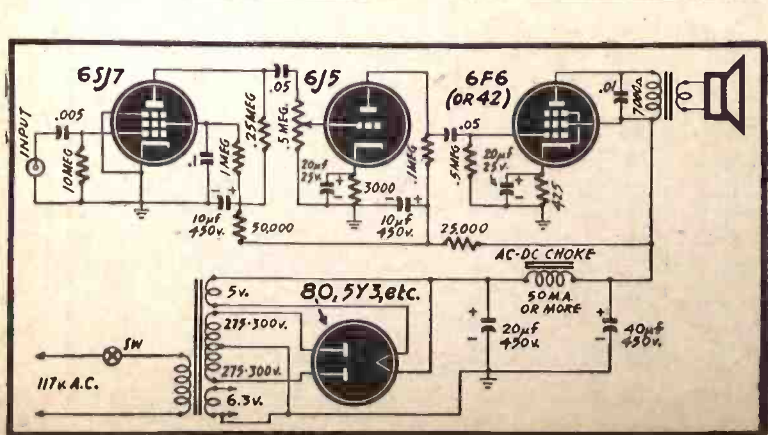
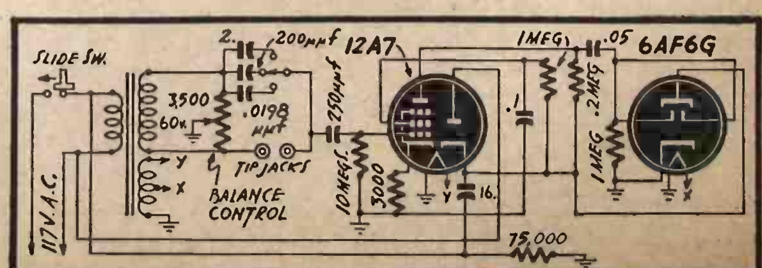


Fig. 1, left—A 5-tube super. Fig. 2, left below—Amplifier for guitar. Fig. 3, lower right—Capacitor tester. Fig. 4, middle right — Converter from 117 volts A.C. to 24-40 volts D.C. for use in servicing 32-volt receivers.







BROADCAST EQUIPMENT

(Continued from page 26)

extending to the practical limits of the induction field was sufficient, it has been found that, in order to serve effectively as a reflecting surface for the downward radiation, the ground system must extend outward considerably beyond this distance.

The ideal ground system would be a solid sheet of some material having a high conductivity and covering an extensive area in all directions surrounding the base of the tower. Although such a system would be prohibitively expensive, much theoretical and experimental work, due to Brown[1], has resulted in certain definite standards for the design of broadcast tower ground systems which approach the ideal. 120 buried radial conductors, spaced 3 degrees apart, and extending outward from the base of the tower in straight lines not less than one-half wave length at the operating frequency comprise such a "near-ideal" broadcast ground. This length is quite necessary, for when it is less the ground losses increase considerably even when the physical height of the antenna is small.

OTHER CONSIDERATIONS

In most instances it is necessary to provide the tower with a system of aircraft-warning lights. In order that the radiated energy will not be shunted to ground through the 60-cycle power line, it is necessary to supply the lights through a low-pass filter inserted in the line. This consists simply of an R.F. choke in series with each side of the line, and a condenser across the line at each end of the chokes.

Steel buildings, trolley wires, guy wires, and other conductors in the vicinity of the tower will alter its radiation pattern, so an antenna site must be chosen with care. Guy wires must be as few as possible, and they must be broken up by insulators into lengths that are a small part of a half wave length. Transmission lines must approach the radiator at right angles for minimum couplings.

In northern climates, where trouble is encountered due to sleet and ice, a de-icing system must be installed. This consists of a means of passing a heavy 60-cycle heating current through the tower itself to melt the formations. Since it is desirable that this function may be carried out while the station is "on the air," a low-pass filtering system, similar to that used with the warning lights but more elaborate, must be employed.

[1]Brown, G. H., "The Phase and Magnitude of Earth Currents Near Radio Transmitting Antennas," *Proc. I.R.E.*, February, 1935; "Ground Systems As a Factor in Antenna Efficiency," *Proc. I.R.E.*, June, 1937.

HOW RADAR OPERATES

(Continued from page 30)

only slowly (e.g., from 1 to 20 r.p.m.) and since the light from an ordinary cathode-ray tube fades away almost instantly, one might expect not to see a "map" at all, but only bright flashes at various spots as the antenna revolves. Some way had to be found to make the brightness of these flashes persist for many seconds after they were produced. Special screens were developed which continue to glow for some time after being lighted by a signal. Thus the whole map is displayed at once.

The above article is directly reprinted from *Radar, a Report on Science at War*, released by the Joint Board on Scientific Information Policy for the Office of Scientific Research and Development, the War Department and the Navy Department. The Glossary follows that in the bulletin *Radar*, issued by the British Information Services.

CORRECTION

The screen-grid in the drawing on page 597, *Radio-Craft*, June, 1945, is connected directly to ground. This would of course make the circuit inoperative. This drawing appeared in the article "Tuning on the U.H.F." The line which connects the filament with the screen-grid side of the screen resistor in the drawing should be taken out, leaving the screen-grid connected to high voltage through the resistor.

Our thanks are due to Mr. Davilo R. Reyes, of Gamboa, Canal Zone, who pointed out this error.

NAZI MORALE RADIO
(Continued from page 25)

out from the base, and the evacuating pumps attached to this. The air is then apparently pumped out and the copper tube sealed and crimped. A metal deflector plate is welded to the top of the inside crown of the tube. The elements, as is common in European manufacture, are laid on their sides, in contrast to our method of standing them up.

The line is fused in all cases, but the customary interlocking switches are conspicuous by their absence. A giant loop antenna is enclosed in the back cover of the "box" or cabinet.

Band coverage is from 15 to 50 meters, 200 to 550 meters, and 800 to 2000 meters, in addition to provision for phonograph attachment on the side of the carrying case, and a phono position on the band-change switch.

The dial is unusual in comparison to our dials. All stations are listed by the names of the cities or towns of origination. Calibrated markings on the top and bottom in meters merely serve as indicating devices rather than dependent tuning markings. The dial is made of glass, painted black on the inner surface with cut-outs where the station indicator windows appear. It is backed with a white drop, for easy reading. The grille cloth on the speaker is of a cream color which contrasts sharply but neatly with the black plastic trim and dial, contrasting almost ludicrously with the drab, army-gray field case.

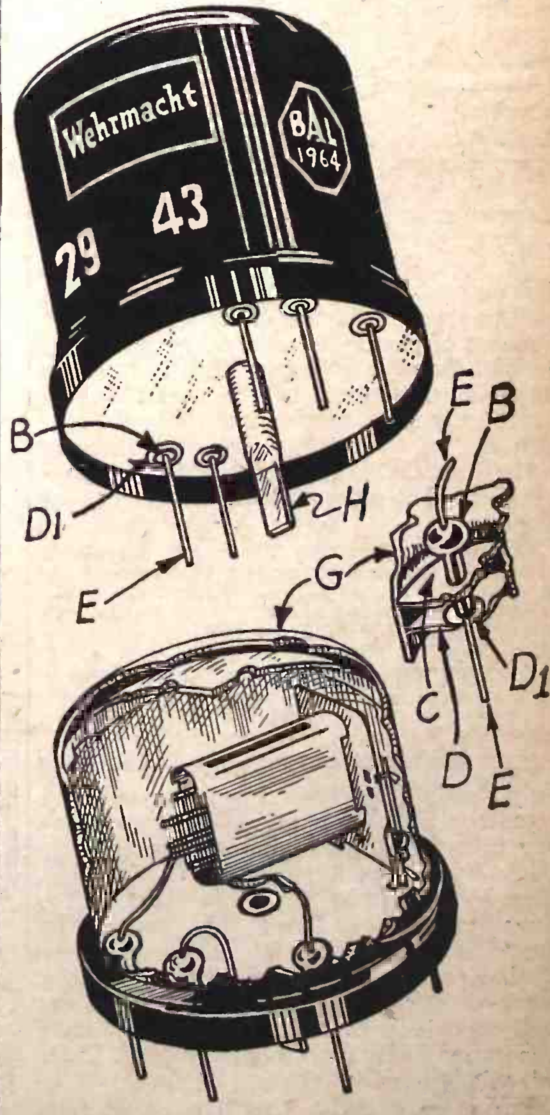


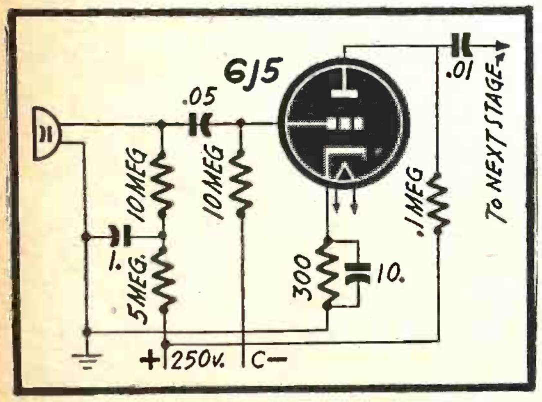
Fig. 2—Wehrmacht tube. B—Glass insulating bead. C—Upper platform. D—Lower platform. D1—Metal-to-glass header ring. E—Lead to interior elements. G—Shell. H—Copper tube shown crimped after sealing-off.

A WALNUT MICROPHONE

By CARL BURKETT

A WALNUT shell, a cord, a little cotton batting, a piece of tinfoil and a few odds and ends were all the material needed for this novelty condenser mike.

To make it, you need first a large walnut. Clean it out thoroughly with a small pocket-knife, drill several holes in one side and one hole through the center of the other side. The cork is just long enough so that when placed in the half-shell, it will not project past the center line. It is drilled through the center, and partly countersunk. A flat-head brass bolt is next run through the cork. It must be long enough to pass through the hole in the shell and permit placing two nuts and a washer on it outside. The head of the screw is one plate

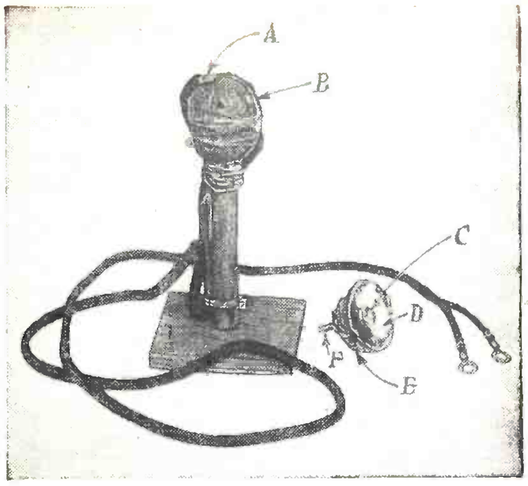


of the microphone condenser, and the resiliency of the cork makes it possible to adjust its spacing from the other plate.

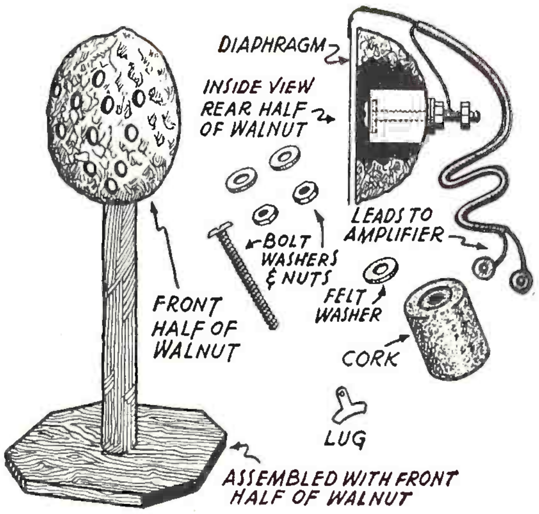
For the diaphragm, first cut a piece of thin brass or copper like the one marked "Lug" in the diagram. This is to make connection to the diaphragm itself, which may be of thin copper foil or tinfoil. The stiff kind, such as used to be used on cards of buttons, is best, the soft tinfoil (or rather lead foil) used on chocolates being the worst.

The flat head of the bolt is now adjusted so that it is just below the edges of the shell and the foil stretched carefully over the half-shell. The lug is carefully inserted so the curved part fits between the curved edges of the shell and the straight part sticks out. The other half of the shell is then put on. Shell and tinfoil may be fastened together with coil cement, taking care to keep it away from the lug, which must make good contact to the foil. A few turns of silk thread wrapped around the nut and doped with coil cement will secure the microphone. The part of the lug sticking out of the shell may be bent over and the lead soldered to it. The other lead is the end of the screw which forms the stationary plate of the condenser.

A condenser microphone must be connected as shown in the figure, with a high polarizing voltage, (taken from the amplifier power supply). It is necessary to make a careful adjustment, bringing the screw-head condenser plate as close to the diaphragm as possible without danger of shorting on loud sounds. I was surprised at the performance of this little mike. It needs plenty of amplification, but the quality is as good as that of any commercial microphone I have ever heard.



Above—The microphone assembled. Below—Exploded view showing all components.



The Radio Bomb Did Exist

ON August 17th, the War Department announced a series of new weapons. Its spokesman, General H. H. Arnold, disclosed among others the following: Atomic bombs which will be guided by television and find their targets by radar.

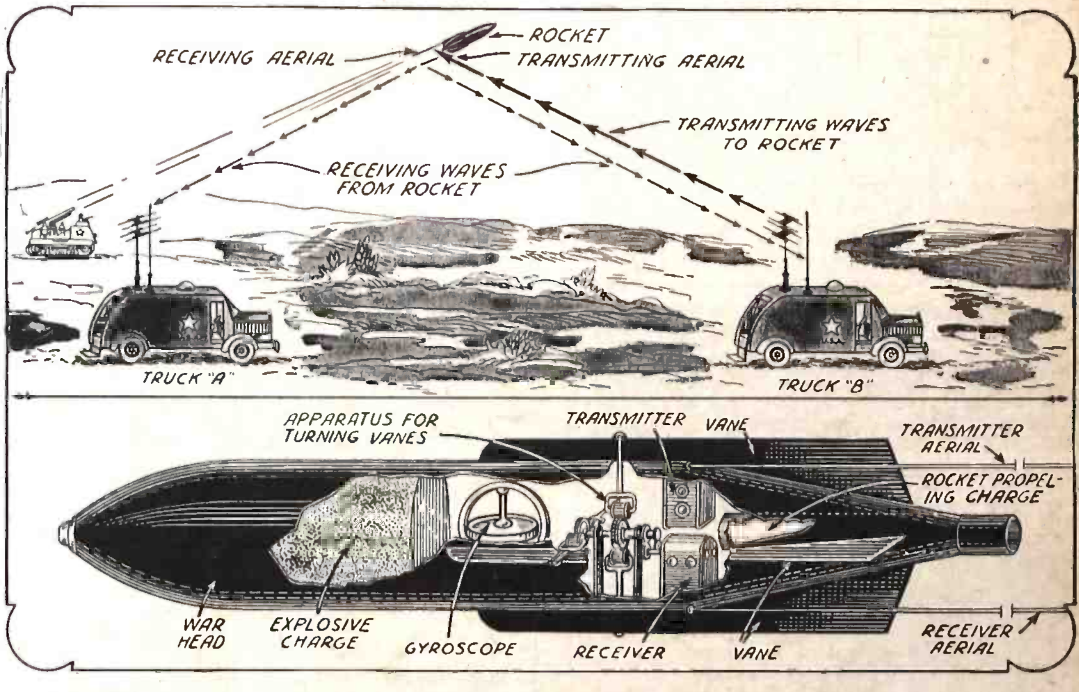
He further stated that television guided missiles, which will pack atomic warheads, will find their targets electronically.

General Arnold went on to state that some of these weapons have been experimented with for about a year. There was, however, no statement that they have been in production.

The above statement is of interest to readers of *Radio-Craft* who have read the article "The Radio Rocket" in the July, 1944, issue, by the Editor, H. Gernsback. Here is an excerpt from that article from which it will be noted that it covered all the new weapon's specifications over a year ago.

The Radio Rocket may be equipped with a transmitting and receiving aerial which trails behind, as shown in the illustrations. This, however, is not absolutely essential and it is probable that in the perfected Radio Rocket, actual aerials may be dispensed with. One of our illustrations shows the construction of the rocket, which in addition to its warhead, also contains a gyroscope, necessary to keep it on its course. In addition, it carries a radio transmitter and a receiver.

Both the transmitter and receiver are very light and are operated by means of special batteries installed in the rocket. At the moment of launching, the transmitter goes into operation automatically. On a special short wave, it transmits a pulsating frequency which is easily picked up by two ground radio units, shown in our illustration. Using automatic triangulation means, the radio truck "A" and truck "B" plot the course of the rocket accurately during its flight. With electronic instruments the actual flight of the rocket can be observed visually on a special map whereby a moving light-spot illuminates the exact course the rocket is taking. Should it get off its pre-determined path, its flight is instantly corrected from the ground radio truck "B." This truck sends out a special radio wave—also on a short wave frequency—continuously from the instant the rocket is launched. If the light-spot on the map indicates that the rocket drifts over to the right and consequently is off its course, an automatic correction impulse to the rocket instantly corrects its flight. This can be accomplished wholly automatically by electronic means, such as special photo-electric cells, actuated by the moving light-spot. The flight correction is done by radio remote control, whereby either the movable elevators or horizontal rudders of the rocket can be deflected. This will then steer the rocket again on to its correct course. The radio technicians in their radio truck visually observe if the flight of the rocket has been corrected sufficiently, If it has not, it can then be further corrected if necessary.



The radio-controlled rocket bomb, predicted in the July, 1944, issue of *Radio-Craft*.

RADAR — SECRET WEAPON NO. 1

(Continued from page 14)

strument" and proceed on his own. An ingenious adaption permitted the pilot to see the image of the opposing fighter reflected on his windshield. As he approached, the enemy image became broader—"grew wings." By centering the image dead ahead, the flyer could approach till the actual plane was seen, superimposed on its own image. Again the advantage of knowing just where the enemy would appear gave the defending plane an immense advantage in the darkness, and the luckless Nazi's first warning of the presence of fighters might be a fatal burst of fire.

A further refinement of GCI enabled operators in England to guide individual bombers to enemy positions in cross-Channel occupied territory, leading them exactly to the bombing point, then signalling for the bombs to be dropped. This was one of the methods by which the big guns on the invasion coast were destroyed before D-day. Mine laying operations by airplane were carried on with greatest accuracy by the use of radar. The planes were piloted by a ground-controller with the aid of a Plan Position Indicator and instructed as to the exact point to drop each mine.

HIGHER FREQUENCIES

Further improvement of the instrument came through the use of higher and higher frequencies. During the Battle of Britain, 200-megacycle waves were considered extremely good. Even at these frequencies, low-flying aircraft could come in without detection, losing themselves in the mass of reflections from hills, tall buildings and other landscape features. A shorter wave length for the radar waves would mean greater relative size for the antenna, thereby permitting better beaming and clearer definition. Where greater definition is not absolutely essential, small aerials may be used, making radar more practical for aircraft. Present-day radar is based on centimeter waves—of just what length cannot even yet be revealed. The microwave radar was a step forward almost comparable to Plan Position Indicator.

With the new aircraft apparatus further developments became possible. Extremely high-definition Plan Position Indicators were installed in "pathfinder" planes, which led squadrons of bombers over enemy targets in night raids, or in daytime expeditions when visual bombing was all but impossible because of the continuous bad winter weather over northern Europe. One "pathfinder" plane equipped with radar led a formation of bombers over the target. The radar operator, viewing the scene below on his cathode-ray screen, dropped flares or colored-smoke bombs to mark the spot. Then the bombers could come in for the kill. This device was the "Mickey" or "gen box" concerning which rumors appeared in the press a few months ago.

RADAR GOES TO SEA

Even more important to the United States was the use of radar for naval offense and the defense of merchant shipping. In early 1942 German submarines on both sides of the Atlantic created such havoc with merchant shipping as to leave the issue of the Battle of the Atlantic in doubt. Supersonic methods of detecting submarines, though rapidly improved, were unable to curb the destruction.

The first step to combat the menace was installation of radar detection equipment on airplanes. Submarines have to surface to charge their batteries. Surfaced at night or lying awash in the daytime with engines off, they were reasonably secure from sonic and supersonic detection devices. Radar soon put an end to this security. Planes appeared from nowhere, dropping bombs and depth charges. The number of U-boat sinkings took a jump that challenged the attention of Nazi technical specialists. Submarines were fitted with an anti-radar device—a receiver which picked up the signals sent out by the radar transmitter, giving the sub warning in time to permit it to submerge and get going before the plane arrived.

Radio Term Illustrated

Suggested by: F/o Melville R. Pyne, Charlottetown, P. E. I., Canada

Efficient Hookup

Ironically, the Nazis "solved" the plane radar problem just as the Navy was swinging from 200-mc radar to much higher frequencies. Depending on their radar defense receivers, submarines surfaced and were blown out of the water. Suspecting everything but radar, they tried various expedients, including the sending out of two scientific expeditions, by submarine, equipped with instruments to detect almost any type of radiation. Neither of these investigating parties lasted two weeks, and finally the Germans decided that if subs were to survive, they must stay beneath the surface. A breathing tube (euphonically referred to as a "Schnorkel") permitted taking on fresh air to run Diesels and charge batteries underwater.

By this time radar and the convoy system had made them well-nigh ineffective. In convoys, radar-equipped escort vessels were able to detect and destroy the "wolf-packs," giving such effective protection that sinkings dropped to one-tenth of one percent. Not only did radar prevent raids, but solved the old "sitting-duck" problem which was the chief cause of losses in earlier convoys. Ships forced to drop out of the convoy, or which strayed away from it some dark night, were sure victims of the U-boats. By daylight, when the convoy could be checked, it was too late to do anything about it.

As soon as escort vessels were equipped with radar, the position of all vessels in the convoy could be known at all times.

(Continued on following page)

RADAR—SECRET WEAPON NO. 1

(Continued from previous page)

If a ship were forced to drop out of convoy on a dark night, an escort could immediately be at its side to guide it back to safety, or to remain with it and take it to a safe port, should it be impossible to regain the convoy.

RADAR GUN COMPUTERS

Further development of radar led to an adaption which could be attached to the Norden bombsight or to gun computers, thus eliminating the human element in sighting guns and bombs. Without this, our ships would have been at a loss indeed when attacked by the Japanese "Kamikaze" bombers. By the time a suicide bomber could be sighted it would be too late to attempt to aim anti-aircraft guns. With the radar-controlled gun-sights, fire was directed at the enemy crash-bomber as soon as he came within range, and in very few instances did he live through it, to reach his objective.

Another important application of radar-directed gunnery was in fire-control on Naval vessels. Not alone the anti-aircraft guns but the ships' main batteries were directed by radar. It is known that in more than one case Japanese ships were sunk often in dark nights, without ever having been visible to the attacking ship. A special device worked out early in the war by the British and called IFF (Identification, Friend or Foe) was very important in such actions. This is an electronic counterpart of the identification marks carried by aircraft or the flags flown by surface vessels, registering on the radar instead of visually. Danger of sinking friendly ships was thus avoided, and battle by radar became a possibility.

Acknowledgement is made to *Radar, A Report on Science at War*, distributed by the Office of War Information, and *Radar*, put out by the British Information Services, from which most of the information printed here was obtained.

SCRAMBLED SPEECH FOR RADIOPHONES

(Continued from page 27)

pass through. Now that the carrier has been eliminated, a suitable filter to remove the undesired side-band must be constructed. The single side-band method of transmission has been used to effect economy of power capacity, energy consumed, and space in the frequency spectrum. The single side-band also gives a possible improvement of 9 db over a double side-band and carrier system. Six decibels of this gain is obtained by omitting the carrier and three by reducing the width of the band.

The wave has now been modulated, the carrier suppressed, and the undesired side-band filtered out. The single side-band affords a slight degree of secrecy because the carrier must be supplied to obtain intelligible speech. To invert the speech, the carrier is introduced at the wrong side of the band. Inversion causes high frequencies to become low and low frequencies to become high, as explained under the process of modulation earlier in this article.

Many complicated systems are used by commercial communications companies to further break up the inverted speech, but their theory and circuits are beyond the scope of such an article as this. See references at end of article.

CIRCUITS FOR SPEECH INVERSION

In constructing such an apparatus, the band of frequencies from 200 to 3000 cycles was selected as giving good intelligibility. To simplify the construction, a carrier of 3000 cycles was selected because the side bands would be 3000 plus signal and 3000 minus signal. The oscillator used was a variable frequency Wien bridge R-C tuned oscillator. This made the adjustment for the same carrier for both inversion and demodulation much simpler. By eliminating the carrier in the balanced modulator and the upper side-band in the low-pass filters, the lower side-band is inverted without additional equipment being used.

A microphone with a suitable coupling transformer was connected as shown in the grid circuit of the 7F7. The other grid of the 7F7 was connected to the carrier oscillator. The output of the 7F7 was connected to an input transformer. A type 7N7 was connected as a balanced modulator to suppress the carrier wave of 3000 cycles. The potentiometers were placed in the grid circuits to simplify the balancing of the grid voltages. The output of the 7N7 was resistance-coupled to the 7A4 amplifier. The output of the amplifier is then coupled to the filter section. The output of the filter is connected to a final 7C5 power output tube.

The constants for the filter and the circuit are shown in Figure 5. The characteristics of the completed filter are shown on Figure 6.

Fig. 3—Circuit of non-linear impedance or a balanced modulator inverter with filters.

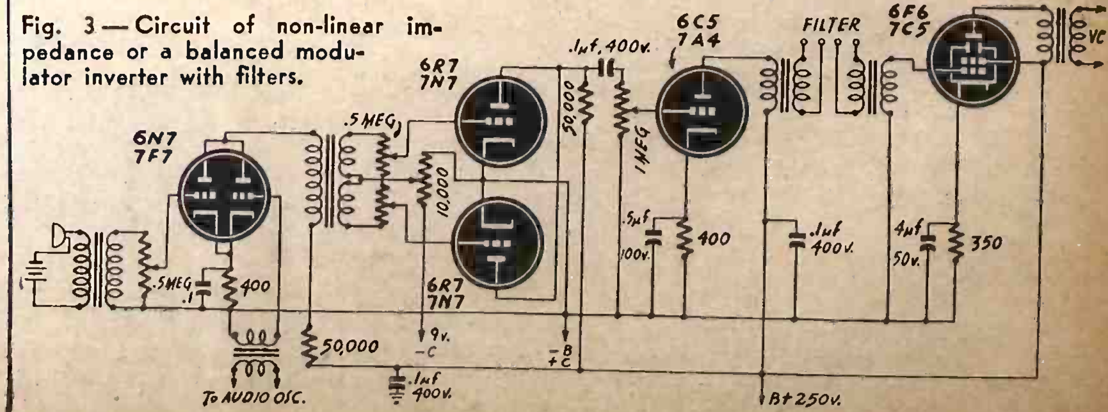


Fig. 1 shows a typical circuit of the balanced modulator type for speech inversion or for de-modulation. The device which inverts speech will make a scrambled signal clear if the scrambled signal is fed into the input. Transformer T1 is any class A input transformer designed to operate from the output of the available receiver or source of signal. It should also be capable of feeding the two grids in push-pull. The actual output obtained is due to unbalance between the two tubes hooked in a version

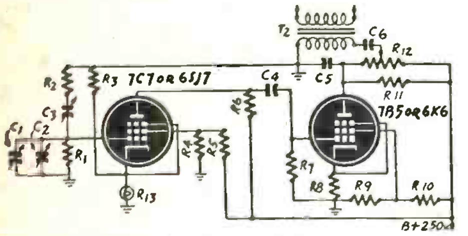


Fig. 4—Audio Oscillator, Wien Bridge Type.

of the push-push frequency multiplier circuit. Balance is obtained by adjusting R3 for a minimum of oscillator tone with R15 about half on.

The filter section described previously may be connected to this circuit. In some cases if a high-impedance transformer is used at T3 (an ordinary 3:1 audio or grid-to-line connected backwards), shunt capacitors across the primary will provide sufficient high frequency attenuation to erase the undesired upper side band. Usually a value between .02 mfd. and .001 mfd. will do the trick.

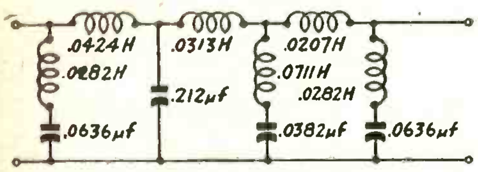


Fig. 5—3,000-cycle low-pass sideband filter.

Transformer T2 may be any available single plate to push-pull grid audio transformer to which the oscillator can be connected without too much loss. The power supply with either circuit is simple and straight forward. Any available supply which has a suitable rating may be used.

CHECKING THE INVERTER

When the unit has been completed it may be checked as follows: Test the audio oscil-

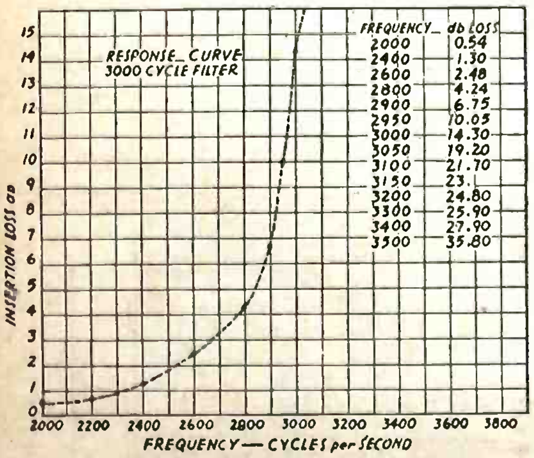


Fig. 6—Response curve, 3,000-cycle filter.

lator with head phones or speaker for proper oscillation. Adjust R3 for a minimum oscillator tone in the output. The capacity used as a shunt on T3 can be partially determined by adjusting R3 until a tone is heard in the speaker and then setting the audio frequency at a slightly higher frequency than desired, i.e., 4000 cycles.

To put the apparatus to work, connect the input or T1 to the output of a receiver

(Continued on following page)

SCRAMBLED SPEECH FOR RADIOPHONES

(Continued from previous page)

tuned to a scrambled speech broadcast. Carefully tune the audio oscillator over the range until the frequency is located which corresponds to that of the carrier oscillator at the transmitter. A careful readjustment of all components will give better tone.

In case such a receiver is not available, a microphone may be connected to T1. When an ascending musical scale is whistled into the microphone, it should be reproduced as a descending tone. Or a record player pick-up may be connected in place of the microphone. If the proper equipment is available, a recording may be made of a speech read into the microphone. When played on an ordinary phonograph it should be totally unintelligible and sound like gibberish. If played back through the unit, the output should be an intelligible signal hampered only by the quality of the transmission components normally present in any transmission and reproduction.

A lot of fun can be had at parties, etc., with such a unit by letting the local "hot-shot" make a speech or sing a song for recording or amplification when a "scrambler" unit is attached.

PARTS LIST

Figure 1

T1, T2, T3—See text	R3—10,000-ohm pot.
R1—250 ohms	C1—0.25 mfd.
R2—2000 ohms	C2—See text

Oscillator connected to injector grids.

Figure 4

R1—150,000 ohms	R10—10,000 ohms
R2—150,000 ohms	R11—20,000 ohms, 2 w.
(Above units matched)	R12—20,000-ohm pot.
R3—2500 ohms	R13—3-w. 115-v lamp
R4—50,000 ohms	C1—5-50 mmf.
R5—50,000 ohms	C2, C3—800 mmf. each
R6—500,000 ohms	C4—0.5 mfd.
R7—500,000 ohms	C5—0.5 mfd.
R8—750 ohms, 5 w.	C6—0.25 mfd.
R9—50,000 ohms	T2—See text

C2 and C3 may be an old 4-gang broadcast variable condenser.

Figure 5—Coil Specifications

All coils cut to fit 3/8 x 3/8 inch laminated cores cut from old transformers. Length of coil winding 1¼ inch.

2—674 turns No. 28 enamelled, .0282 Henries
1—578 turns No. 26 enamelled, .0207 Henries
1—711 turns No. 28 enamelled, .0313 Henries
1—827 turns No. 28 enamelled, .0424 Henries
2—1072 turns No. 30 enamelled, .0711 Henries

Condensers may be picked by the use of a capacity bridge or may be approximated by parallel and series connections of standard components. Resistors are 1-watt type except where otherwise noted. It is recommended that 600-volt condensers be used.

BIBLIOGRAPHY

1. A Privacy System Using Frequency Translation—J. B. Parchman, *District 7, AIEE*, April 1941.

2. Privacy System—*Radio News Radionics Department*, October 1943.

3. Silver, McMurdo *QST*, 27, 3, 16. (1943).

4. Telephonic Secrecy. *Electrician*, 110, 801, (1933).

5. Gill, A. J. *Post Office Electrical Engineers Journal*, 26, 224. (1933).

6. Matsuyaki, T. *Radio Research Reports of Japan*, 2, 187. (1932).

7. Cope, S. T. *Marconi Review*, 59, 1. (1936).

8. Niwa, Y. and Hayashi, T. *Radio Research Reports of Japan*, 2, 195. (1932).

9. British Patent Number 215164.

10. Tomituka, T. *Electrotechnical Journal of Japan*, 5, 3, 43. (1941).

11. Marro, M. *London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 28, 248. (1939).

12. ————Ibid., 29, 205. (1940).

13. Tigerstedt. British Patent Number 133704.

14. Carr. British Patent Number 287673.

15. Chiba, S. *Radio Research Reports of Japan*, 3, 267. (1933).

16. Guanella, G. *Brown Boveri Review*, 28, 397. (1944).

17. Chiba, S. *Journal of the Institute of Electrical Engineers of Japan*, 474, 53. (1928). Japanese, with English Abstract. *Experimental Wireless and Wireless Engineer*, 5, 343. (1928).

18. Chireix, M. *Comptes Rendus des Travaux de la 9e Section du Congres International d'Electricite*, 189. (1932). French.

19. "Device to Insure Secrecy." *Scientific American*, 138, 545. (1928).

20. "Electric Brain a Success." *Radio World*, 13, 9. (1928).

21. Fayard, G. *Bulletin de la Societe Francaise des Electricians*, 4e Serie, 9, 98, 1146. (1929). French.

22. ————Ibid., 10, 328. (1920) French. Iinuma, H. *Circulars of the Electrotechnical Laboratory of Japan*, 101, 1. (1935). Japanese with English Abstract. *Experimental Wireless and Wireless Engineer*, 13, 153. (1936).

23. Kujirai, T. And Sakamoto, T. *Radio Research Reports of Japan*, 2, 175. (1932).

24. Marro, M. *London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 22, 847. (1936).

25. ———— *Electrician*, 118, 3057, 5. (1937) Richardson, A. McD. and Brown, A.G.A.W.A. *Technical Review*, 5, 4, 125. (1941).

26. "Secret Radio Telephony." *Nature*, 134, 58. (1934).

27. Villem, R. *L'onde Electrique*, 11, 427. (1932). French.

RADIO TERM ILLUSTRATED

Suggested by: Ted Berthiaume, Worcester, Mass.

Wave Trap.

"DESIGN ENGINEERS" OF THE U.S. FORCES

(Continued from page 24)

auxiliary devices, ranging from fairly simple gadgets to equipments which radically alter the range or increase the efficiency of specialized radio or other sets, are being designed and produced. The uses of such devices, and instructions for attaching them to the older components, are explained in detail in another kind of Maintenance Work Order.

NO UNAUTHORIZED TINKERING

One of the prime gratifications of being a radio amateur in pre-war days was the privilege of tinkering with the outfit to get better results. The Signal Corps frowns on hit-and-miss tinkering by operators and technicians in the field, for the reason that no chances may be taken with equipment that is supposed to be always ready for instant use. However, the Signal Corps notes carefully all suggestions and requests for "how-to-do" information, and goes ahead busily making laboratory tests, experimenting and standardizing. The results of such experiments and tests, which involve no additions to equipment, generally are given to the men in the field in the form of War Department Technical Bulletin—called "TB Sigs" when they emanate from the Signal Corps.

TB Sigs have a variety of uses, but two of the most important are to pass along information concerning the technical operation or adjustment of specific equipments and to furnish data that is applicable in the maintenance or repair of a number of equipments using similar components. Men in the field are thus enabled to take advantage of the latest recommendations without loss of time.

For instance, a TB Sig was published to inform troops of simple field measures for camouflaging the whip antennas of certain portable radio sets, mentioned earlier in this article. Another tells how rolls of teletypewriter paper may be treated in the field to prevent an excessive amount of linting. One TB Sig outlines a general procedure for weather-proofing

(Continued on following page)

Meters as well as field sets are repaired in this G. I. service shop, as note lower right.

Parachute radios for use between novice jumpers and instructors on the ground have been built in a 4 x 4 x 5 inch metal cabinet. The little sets contain a complete transmitter and receiver.

(Continued from previous page)

wire equipment, but others have been issued to cover the similar job for specific radio sets. They deal with such diverse subjects as the recommended spark gap settings on all power units procured by the Signal Corps, and with the recommended alternative use of radio tubes and resistors when the specified tubes and resistors are not available.

Those old enemies of communications equipment—moisture and fungi—figure in many of the reports from the field, particularly from the humid Pacific regions. In fact, complaints led to initiation of an all-inclusive program of moisture and fungus-proofing of equipments, causing manufacturers to install new processing systems and placing in the hands of signal depots overseas all the necessary materials and instructions for protecting the precious radio sets and components, telephones and other devices.

Sometime complaints result in engineering changes which may temporarily slow up production lines, but which insure better or longer operation when the improved equipment goes into service.

There was the case of the failure of power unit circuit breakers in a field radio set, due to moisture and humidity, with consequent corrosion of springs and coils. Signal Corps engineers went to work on the problem and came up with improved breakers which substitute beryllium copper springs for piano wire and are better protected against moisture.

Not only complaints but sometimes both the complaints and their answers originate in the minds and skilled fingers of soldiers at the fronts, in depots or in training. The result may be what the Army terms a "field expedient," or it may be a full-fledged permanent improvement which any using organization in the field could duplicate. In either case the Chief Signal Officer is interested in hearing about what happened, so that the information may be passed along as an official M.W.O., or a less-official what-to-do suggestion.

MECHANICAL RUGGEDNESS

Above all, Army communication equipment, in addition to performing as expected, must be rugged, because it must withstand long truck hauls, the jogging pace of men and mules carrying it on their backs, the jolts it receives in tanks, half-tracks and jeeps, and the concussion of guns belching steel toward the enemy. The problems arising from transportation, handling and operation are minutely examined and painstakingly solved.

An Engineer GI, unpacking mine detectors in Italy, called the attention of his sergeant to the number of detectors that were damaged in transit. It seemed to the GI that the chests containing the devices weren't strong enough or weren't built right. The sergeant agreed, and in due time their observations and complaints reached the Signal Corps. Result: A sturdier chest was built and arrangements were made to replace the old-type boxes previously shipped overseas.

When field reports told of persistent breakage of a toggle switch and fuse holder on the rectifier unit of a receiver, the Signal Corps laboratories began redesigning the rectifier to eliminate the switch, fuse holder, and other units.

Speaker cones of a set-up used for artillery fire control were being shattered by the concussion of nearby gunfire. This problem was met in the production of many of the sets by the installation of a manually-operated shutter which damped the blast waves, but methods had to be devised to protect the cones of sets previously built. The Signal Corps and Field Artillery are collaborating on further improvements to be applied to future production.

Ground force users of the guidon radio transceiver, which was primarily designed for horse cavalry, voiced a real gripe when they found that the supporting rod under the transmitter isn't adapted to concealment in a fox hole. Why not, they asked, make the set with a detachable guidon staff, so that the entire outfit could be made less conspicuous? O.K. said the Signal Corps, thereupon revising the procurement instructions and also preparing orders to permit modification of the set in the field.

While it might be assumed that the development of brand-new radio outfits is practically frozen at this stage of the war, such is not the case. Occasionally the ground forces come through with a request for a new set to meet special needs. One such calls for lopping ten pounds off the weight of a widely-used equipment, which means simply that a new model is being developed.

The variety of the complaints and suggestions is almost endless, and the most tentative action taken, according to a recent Signal Corps report to the field, is to state that investigation has been initiated, and to recommend some field expedient. However, it should be noted that not every complaint is justified, and one isolated case of trouble is not interpreted to mean that drastic measures are necessary.

It seems likely that thousands of military and naval communications men will leave their services with highly critical attitudes toward the radio and other communications equipment they will find in civilian life. As customers, they will be pleased with some of the civilian refinements, but probably quick to detect advertised fakery. Above all, they are likely to demand that radio sets must live up to their representation.

As radio service men, salesmen and dealers, these ex-GI's will exhibit that same critical attitude, plus a lively curiosity about commercial sets and an urge to make them perform according to advance notices. Their frankness may at times be embarrassing, but it can also be enlightening. Manufacturers and set designers may well harken to the remarks of these men, both informally and by means of written questionnaires and the civilian versions of the armed services' "unsatisfactory equipment reports."

The end of this war and the return home of this multitude of technically-trained personnel—many of whom before the war never looked inside a radio set—may point to the practical end of hokus-pokus in radio advertising, the end of an era in which a gullible public swallowed the claims for new radio and revolutionary "miracles."

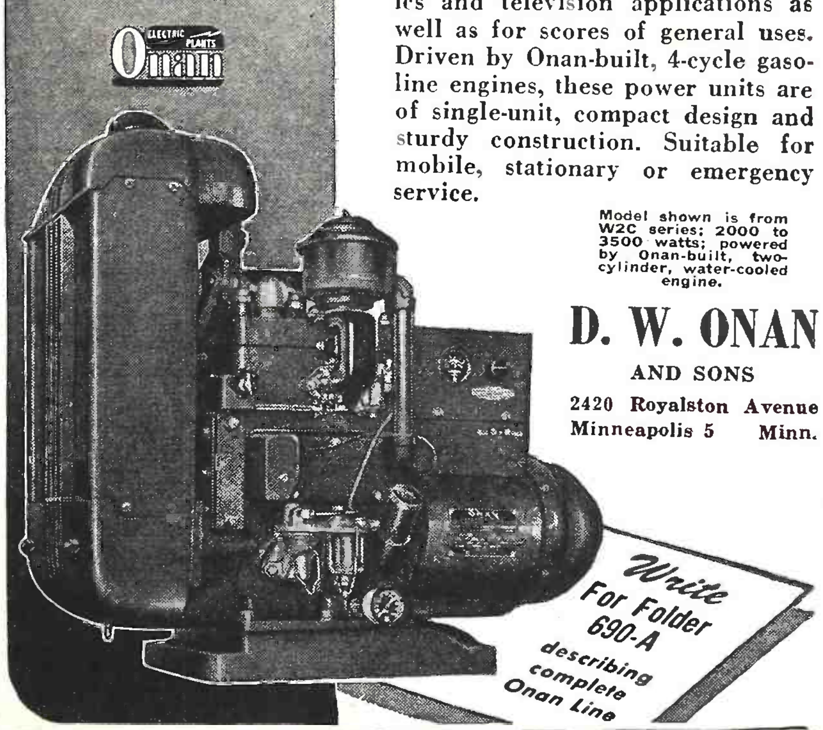
Book Review

SEEING THE INVISIBLE, by Gessner G. Hawley. Published by Alfred A. Knopf. Stiff cloth covers. 5 x 7½ inches, 195 pages. Price $2.50.

As the electron microscope unfolds the mysteries of the minute world, so this treatise unfolds the mysteries of the electron microscope in turn. Its intricacies are explained in carefully chosen language so that the reader with no previous knowledge of microscopy or of electronics can understand to a great extent the hows and whys of this contribution to the advancement of science.

The details and functions of the instrument are woven, warp and woof, with an interesting story of the development of this window to another world. Its disadvantages (and there are a few, not too well known by the average individual), are also presented to the reader for judgement. An interesting comparison with the optical microscope serves to enlighten the reader as to the scope and magnitude of this "all-seeing eye." The Preview (pages XIII, XIV, and XV) is an original and interesting piece of work.

Altogether an interesting, semi-technical book, written in a sensible, down-to-earth style; possibly not important to engineers or technicians, but of value to the layman who wants to know "how it works."



POCKET-SIZE TUBE TESTER

By **HOMER L. DAVIDSON**

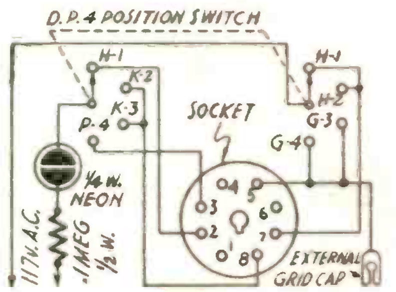
THIS small A.C. pocket tube tester is primarily designed for short checking in places where a tube checker may not be available.

It will check for troubles such as open filaments, heater to cathode, cathode to grid, and grid to plate shorts. Practically 85% of the most common tube types can be tested by using these home-made adapters.

The adapters are made as illustrated with an eight-prong octal tube base for the plug-in side and a four, five, six, or seven prong wafer socket mounted on the other end.

The eight-prong octal tube bases are taken from burnt out vacuum tubes, and the wafer sockets were picked up from the scrap box. The wiring method is shown below.

To test an ordinary vacuum tube, it is first placed in its correct adapter or eight prong socket. Then the adapter is inserted into the tester. For example: If a number 30 tube were to be tested, it would first be plugged into the 4 prong socket and this adapter would then be placed in the tester. The A.C. power cord is then



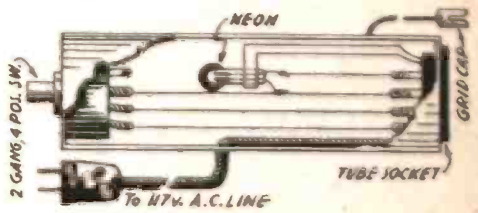
connected to the line with the double-pole four-position switch on H. This designates the filament test. If the neon tube lights up, tube filaments are good. If not lit, this would indicate that the filament is open and the tube is, of course, defective. The switch is next turned to the K, G, and P positions. The neon bulb might flicker on some of these tests, but that does not indicate a defective tube. A direct short will light the neon tube and keep it lit as long as the switch is maintained in that position. Incidentally, when testing for shorts, the tube should be tapped to check for intermittents. A handy item to have around when conducting these tests is a tube manual.

This particular tube tester was constructed within an electrolytic condenser can. First, the top aluminum cap was removed. Then the case was heated slowly over a gas flame. Soon the impregnated wax began to run and was poured out. The condenser foil unit was next removed. The can was then left to cool and washed out with a strong soapy solution. At the bottom of the can, where the leads were before removal, the double pole four position switch was mounted. The condenser mounting screw was sawed off. A lock nut was used to hold the switch in place. The entire unit was wired completely before being inserted into the can, except for the grid cap which was soldered in later. A small wire was inserted through a one-eighth inch hole and the grid cap soldered to it. The A.C. line plug was fastened to the cord in the same manner. The eight prong octal socket was bolted to the metal can. The neon tube is placed in position in front of the small in-

dicator hole. It is mounted by means of a small metal bracket which is glued to the bulb.

The small 1/4-watt neon bulb is connected in series with a 100,000-ohm resistor. This will drop the line voltage to the correct value.

When the switch is thrown in the H position the neon bulb is in series with the heater or filament of the tube being test-

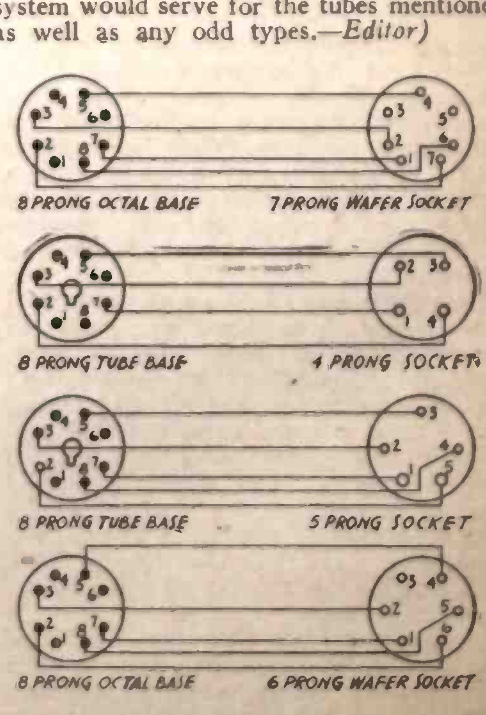


Internal construction of the pocket tester.

ed. The bulb will light brilliantly if the filament is good. The switch in the K position is for use in testing a short between heater and cathode. There should be no glow indication. The same procedure applies to the other two positions. If the neon glows, that would indicate a short between the two elements being tested. Be sure that none of the wiring comes in contact with the case. All wiring can be done with No. 18 stranded insulated push-back wire.

This little tester will fit in one's pocket when traveling. The six-foot A.C. cord can be wound tightly around the case when not in use.

(This circuit can be further amplified if desired, by using a switch with 8 positions and by making connections to the eight prongs for purposes of checking all interelectrode short possibilities. Adapters can be made for the Loctal and peanut tube types as well as those mentioned in the article. However, since many types are not standardized completely, it is necessary to refer to a tube manual to know what you are testing. In this case, the more desirable procedure is to number the switch positions from one to eight. This numbering system would serve for the tubes mentioned as well as any odd types.—*Editor)*



Adapters for 4, 5, 6 and 7-prong sockets.

TUBE REJUVENATION

By MYRON G. ALBIN

SINCE writing the article on "Tube Reactivating," which appeared in the June, 1945, issue of *Radio-Craft*, the writer has received numerous inquiries from servicemen which he will answer as fully as possible, also describing how to use the apparatus in filament welding.

The main inquiry from servicemen seems to be: can they use *their own tube testers* in the process. The answer is, Yes—a majority of tube testers can be used to obtain the filament voltage for the process, provided that certain precautionary measures are taken. First, it is assumed that you can plug jumpers into the sockets of your tester at the filament terminals without disturbing any other circuit in the tester. In other words you must have complete control of the filament, isolated from any other circuit in the tester. Second, you must be absolutely sure that you plug the low or zero side (designated as B in the diagram) into the correct terminal of your tester; because (as will be noted in the diagrams), the cathode and the B minus side of the high-voltage transformer all hook up to this low or zero side. Better still, it may be possible to add 2 jacks on your tester; connecting one jack to the low or zero side of the filament transformer and the other jack to the arm of the filament switch. In case this cannot be done you must add a filament transformer.

Therefore, in the circuit as shown in the figure, you are simply eliminating the filament transformer shown in the June issue diagram and using the transformer in your tester to provide the necessary filament voltage required for processing.

FEW CHANGES NECESSARY

A few more jacks have been added, all other parts and wiring beyond the jacks has been eliminated, even the switches, and now it becomes nothing more than an Analyzer Adaptor, with its floating filaments and cathodes.

The sockets in Fig. 1 are left unwired to simplify the diagram. Wire all sockets to the corresponding jacks, using RMA numbering code. This will eliminate confusion when referring to a tube manual. Fig. 1 is a complete wiring hook-up for reactivating a type 6K7 tube. Note the jumpers from jacks A and B to filament and cathode jacks respectively. Always bear in mind that tubes of the cathode type, whether single or double cathodes, require a jumper from the low or zero side to the cathode associated with the plate and grids that are undergoing the high flash voltage. All other tubes do not require this cathode jumper. At this point the writer wishes to state most emphatically that tubes of the same type do not always respond the same. For instance, after stepping up the voltage to the highest flash, and the tube does not respond, in order to get a break-down and get the tube started, it may become necessary to inject a low flash voltage on plate and control grid or screen-grid and control grid. Try it in such cases.

SUCCESSFUL WELDING

Of course, now with the adaptor and the high-voltage transformer with its micro-switches, you can do a very good welding job, too, on broken or burnt-out filaments.

Have you ever watched a blacksmith tempering steel; how, after heating and shaping the steel, he lets it cool off gradually, to retain a certain temper? Well, this is the same procedure that is required on tube filaments—this "cooling off process," otherwise the spot that is welded will become brittle, and is very apt to blow again. But if you let the tube cool off by degrees, the tube will have a better chance to stand up. Here is how it is done. First, install the tube in correct socket of adaptor; then insert one lead from micro-switch and the B (minus) lead from high-voltage transformer into the filament jacks leading to tubes. Second, press micro-switch until the tube lights (increasing high voltage if necessary), then, while the tube is hot, quickly transfer the tube to your tube checker (where the filament has been previously set). Then slowly decrease the voltage by degrees until the tube cools off.

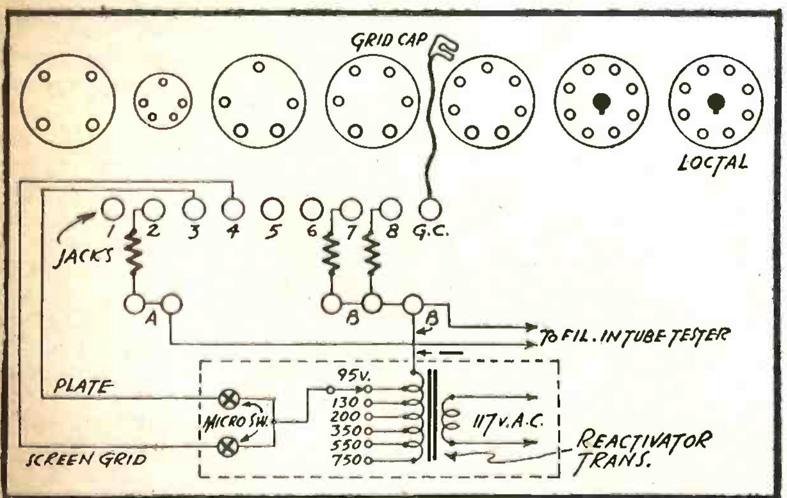


Fig. 1—By suitable connections the serviceman's own checker may be used as a filament supply for the tube reactivator.

You will also find that the high-voltage transformer and micro-switches have many other uses, such as clearing shorts and welding open field-coils and transformers. (Always follow the procedure as set forth in the previous article before trying this.) That is why the writer has tapped his high-voltage transformer, as shown in the figure, to get approximate voltages of 95, 130, 200, 350, 550, and 750 in order to reactivate any type tubes, metal or glass, successfully. Note: The circuit in the large square on page 579, June issue, represents a 2A5 or similar six-prong tube hook-up for reactivating.

•

Two-way television was proposed to permit a bed-ridden woman to testify in a Los Angeles court trial.

Taxis Have Two-way Radio

RADIO in taxicabs—in the opinion of officials of the Yellow Cab Company of Cleveland—is likely to become an economic postwar necessity to all taxi companies in the United States. This conclusion was reached after a test with part of the Cleveland company's fleet. Results were so good that the company has applied to FCC for permission to install units in 100 additional taxis.

FM radio at a frequency of 118 megacycles has been used. One remote control station located in the cab dispatcher's office is sufficient to cover the entire Cleveland area. With 15-watt units, "talk-back" from the cab drivers is clear and distinct.

As may be seen from the photo to the right, the whole Motorola receiver-transmitter unit is mounted in the taxi's rear compartment. The power supply—which operates from the car battery—is in the foreground, with the transmitter to its left. Farther back is the FM receiver, and on the side wall—behind the operator's hand — the little 118-Mc. converter, which makes it possible to use standard lower-frequency FM receivers on this high waveband.

All photos courtesy Galvin Mfg. Co.

Only a small unit, with switch, volume control and pilot lights, is required at the driver's operating position. This is seen in the photo below, left. A convenient handset is used by the driver, which when not in use is suspended in the dashboard socket just ahead of the right side of the steering wheel.

The central control station consists also of a 15-watt transmitter, the receiver, and the remote control coupling unit. It is located on the top floor of the 350-foot Union Commerce Building on the roof of which the co-axial antenna is mounted. All operation is from the remote position at the cab dispatcher's office.

Economically, the new system is extremely effective. A sharp reduction in the number of cabs needed is immediately possible, for the driver can call the dispatcher's office as soon as he discharges his passenger, and report that he is at liberty. He is then in a position to proceed at once to pick up his next passenger, whose position is radioed to him from the dispatcher's office. Not only are fewer cars necessary, but fuel and maintenance costs are cut for those that remain in service, as unprofitable "cruising" mileage is cut down.

The taxi installation is only one of a number of mobile systems now demonstrating the value of 118 megacycles for short-range mobile communication. Similar apparatus has been used in police radio, where it may entirely supplant the lower-frequency equipment now standard, if the postwar estimates of a number of engineers and police communications officers are correct.

Other experimental installations have been made in locomotives. Although much railroad work has been dependent more on available equipment than on theory as far as choice of equipment is concerned, the 118-megacycle frequency is also indicated as being the most probably suited for this type of mobile work as well. Much apparatus now in use may be converted to, and postwar equipment designed for, the 118-Mc frequency.

Available Radio-Electronic Literature

Manufacturers' bulletins, catalogs and periodicals.

A NEW SERVICE FOR RADIO-CRAFT READERS: In order to save your time, postage and incidental work in writing a number of letters to different manufacturers to secure the various bulletins offered, proceed as follows:

On your letterhead (do not use postcards) ask us to send you the literature which you designate. *It is only necessary to give us the numbers.* We will then send your request directly to the manufacturers, who in turn will send their bulletins or other literature directly to you.

182—POWER POINTS. Catalog issued by D. W. Onan and Sons.

This leaflet tells the story of the Onan power plants and their applications in industrial and military work.—*Gratis to interested users.*

183 — FUNGUS-PROOFING FOR THE ELECTRONIC INDUSTRY.

Published by the Insl-x Company. Two leaflets describing the proceedure of fungus-proofing and specifications of their coatings which might prove of help to those interested in this type of protection.—*Gratis*

184—EL MENCO CAPACITORS, METHODS OF MARKING.

Distributed by the Electro Motive Manufacturing Company. A single sheet covering the systems of marking or color-coding small mica capacitors is available to radiomen.—*Gratis*

185—RADIO AND ELECTRIC COMPONENTS.

A catalog put out by the Cambridge Thermionic Corporation. This catalog (No. 100) issued by a manufacturer of lugs and terminal strips, is illustrated throughout with sketches, data sheets and photographs of lugs, terminal strips, and strip mountings.—*Gratis to interested parties.*

186—CATALOG "C."

Published by the Radionic Equipment Company. This bulletin would be of value to the serviceman and the set builder. It is similar to many other parts catalogs now and heretofore available to the servicing industry.—*Gratis*

187 — HERMETICALLY SEALED INSTRUMENTS.

An illustrated brochure announced by the Marion Electrical Instrument Company. Describes the tests performed on these hermetically sealed instruments, and outlines their constructional details as well.—*Available gratis to interested parties*

188—CATALOG.

Published by the Alden Products Company. A selection of data sheets and information pages stapled together to form a booklet. The sheets cover constructional features and dimensions on a complete line of plugs, connectors and adapters.—*Gratis*

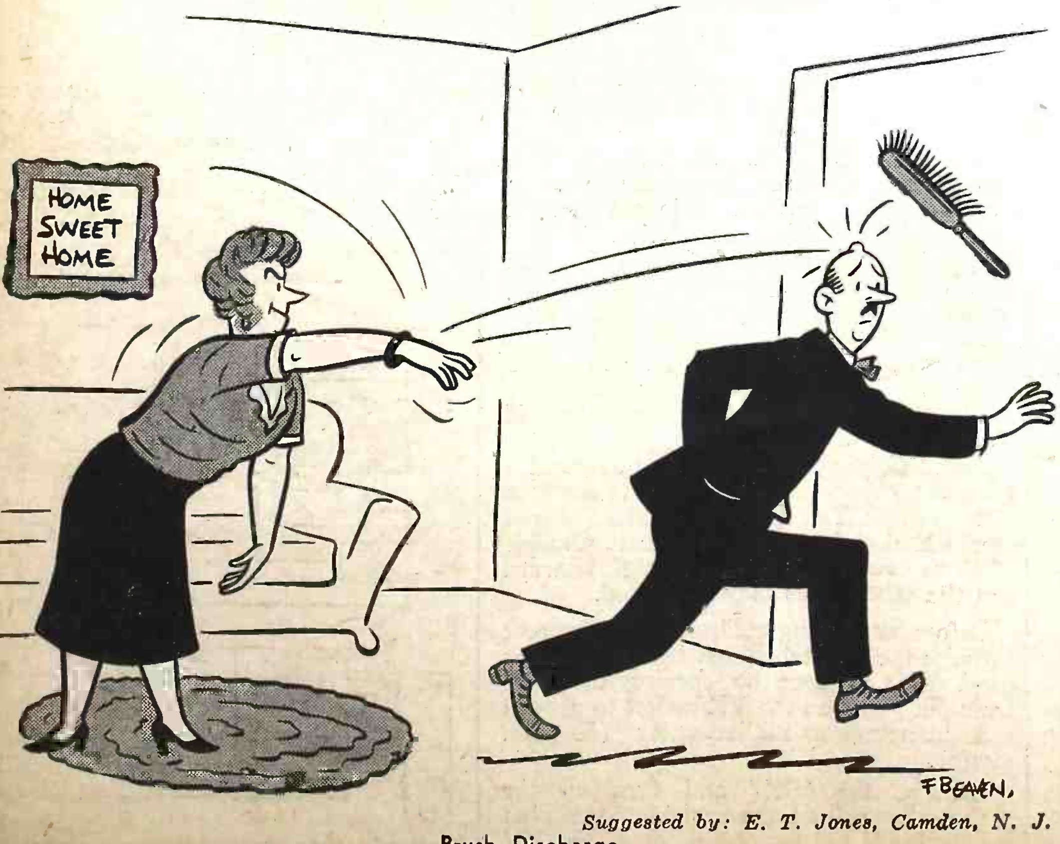
189 — INSTRUMENT TRANSFORMER ACCURACY STANDARDS.

Published by the General Electric Company. This is a combined catalog of transformers for various applications and a short booklet on the ASA and NEMA standards. A number of interesting graphs and charts are also included.—*Gratis*

190 — D.C. RESISTANCE MEASUREMENTS.

Offered by the Leeds and Northrup Company. This is a 36-page booklet on resistance bridges and accessories. All types of galvanometers, telescope-and-scale reading devices, etc., are covered in detail. Prices are included. Available to scientists, teachers and test engineers or technicians. —*Gratis*

TECHNICAL TERM ILLUSTRATED



Suggested by: E. T. Jones, Camden, N. J.

Brush Discharge

A BALANCED V.T.V.M.

By WM. B. MILLER

THE following is a description of a thoroughly practical vacuum tube voltmeter. The design is the result of much experimenting. A bridge circuit is used with feedback for stability.

In the original model a 6SN7 twin triode was used, which is the same as two 6J5's. Almost any triode with a separate cathode will serve. It was found that increased sensitivity resulted from the use of power tubes such as 6V6's and 6K6's connected as triodes. Two volts full scale was all that was wanted, so a 6SN7 and a 500 microamp meter were used.

More sensitivity may be obtained from the circuit being described by substituting a 5,000-ohm resistor in place of the 24,000 one from P.2 to ground. This reduces the feedback, however, and the meter loses some of its stability. Those lucky enough to possess a more sensitive meter, can use 6V6's in this circuit and get full scale deflection with a small fraction of a volt. There is one important thing to remember if other tubes are substituted, and that is they must be operated on the straight portion of their Eg-Ip curves. If this precaution is not observed the meter deflections will not be linear.

ACTION OF THE METER

The operation of the circuit is as follows: P.2, the 500 ohm potentiometer in the cathode circuit, is the balancing control. By varying this the cathode currents may be exactly balanced so that the meter pointer rests at zero.

When a voltage is applied to the grid of the active triode the balance is upset, because more current will then flow in the cathode circuit of this tube, creating a difference in potential between the two cathodes which is registered on the meter.

In constructing the meter almost any layout that fits an available chassis and cabinet will do. Where the meter is to be used near strong external fields which might influence it, a grounded metal cabinet should be used. The plate and cathode resistors should be fairly well matched so that the zero balance potentiometer will not lose its range of control.

Filtering of the plate voltage supply is of very minor importance. Any small choke or wire wound resistor will do in combination with a pair of 4 mfd. electrolytics. Regulation, however, is highly desirable. If a VR tube is not to be had though, a large bleeder current will help. Longer tube life will be realized if the heater voltage is reduced about ten percent; a 2-ohm, 5-watt resistor in series will produce the required drop.

The only critical wiring is the input grid circuit; the 3 meg. resistor should be mounted right at the socket and as short a wire as possible used to connect to the arm of the switch. The test prod and lead should be shielded right up to the switch. Outside of these everything else is straightforward and the other leads may be cabled.

Before attempting calibration the current through the VR tube must be set, if one is used. This is done by opening the wire from pin No. 2 on the VR socket to ground and inserting a milliammeter (50 Ma. range).

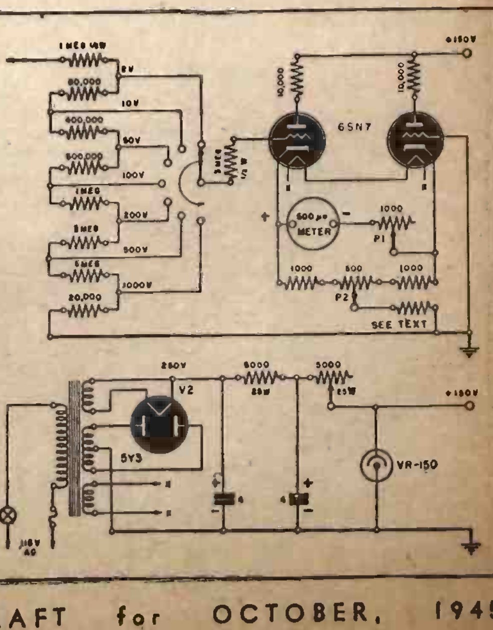
Remove the 6SN7 and turn on the power, then adjust the variable 5,000 ohm resistor until the current through the VR tube is well within its operating range, preferably about 20 Ma. Now the 6SN7 may be replaced and allowed to warm up. The voltage regulator tube will hold the plate voltage at 150 volts, plus or minus 1 volt, and will take care of normal line fluctuations.

CALIBRATION AND ADJUSTMENT

The only way to calibrate a meter of any kind is to have some kind of a standard for comparison; either a known voltage or a meter of known accuracy. The first operation after the tubes have warmed for about twenty minutes and the meter has been exactly zeroed by means of P.2, is to adjust for the basic 2 volt range. Set the range switch to the first position and apply a small voltage, starting with about 1 volt. Gradually increase until a full 2 volts is applied. Watch the meter needle as the voltage is applied—increasing the resistance of P.1 if it tends to go off scale. With the 2 volts feeding in, vary P.1 until precisely full scale is registered on the meter. Now remove the external voltage and recheck the pointer for zero position. If it has shifted reset it and repeat the full scale adjustment.

When this operation is complete, the other ranges will depend for their accuracy on the precision of the multiplying resistors. Precision resistors are extremely hard to obtain now, so part of each range section may be made variable for adjustment. If this is done adjust each range for full scale reading, starting with the 10 volt position and working up to the 1000 volt. Repeat the operation at least once as the total resistance from the prod to ground is just as important as the resistance between taps. Twenty percent of each range made adjustable will allow plenty of variation.

When all the resistances have been set, a drop of Duco cement on the potentiometer shafts right at the bushings will hold them from unintentional shifting. P.2, being the Zero Adjustment, is on the front panel as it should be checked each time the meter is put into use. P.1, the 2-volt adjustment, is on the chassis and should be sealed after being set. It is only necessary to check each range at full scale as the meter is linear. If 1 or 2 watt resistors are used for the voltage divider they will have no noticeable variation with temperature and will only change because of aging.



?? WHY NOT ??

Why not encourage radio set manufacturers to install removable bases on the cabinets of their table model radios? With the receiver inverted and the base plate removed, many service jobs could be acomplished without removing the chassis.—*Ralph D. Webster, Long Beach, Calif.*

●

Why not have radio parts such as tubes, marked with a code system similar to the RMA resistor and condenser color codes but with numbers instead of colors. Simply by glancing at the number on the tube, the radioman could tell the filament voltage, plate voltage and other voltages required. This would eliminate the need of having to look for the needed information in the manual and thus save many steps and much time. Although this would necessitate an entire new system of coding, it would be useful for the reasons stated above.—*George Baker, Bonham, Texas.*

(The system now in general use is somewhat similar. Tubes are marked according to filament voltage, type of operation or use, and number of elements in tube. For example: A 50L6 would tell the serviceman that the filament voltage is 50 volts. The tube is used as an amplifier [L for amplifier] and there are six elements inside of the tube, including the filament. There are many other designations not very well standardized. A is sometimes used as an amplifier, Y for rectifier, etc. For every item that proves this rule, however, one can be found to disprove it.—*Editor)*

●

Why not have resistors, condensers, etc., in small cases with two prongs. Then all wiring would be under the chassis and all component parts would plug in above the chassis as tubes are plugged into their sockets.—*John W. Pierce, Brandon, Manitoba.*

●

Why not have a universal variable tube? It can have a rheostat controlled from the outside to vary the filament resistance for any voltage from 1.4 volts up to 117 volts. The plates and grids can be controlled from the outside also by moving them closer together or further apart. The universal tube can have ten elements, all connections being brought out to pin jacks on a terminal strip on the side or base of the tube. Thus any element can be plugged into by means of a phone tip, and the tube can be adapted to any and all circuits.—*W. Alan Jay, New York City.*

THE ELECTRON VOLT

The electron-volt is becoming almost as common a term as the older foot-pound, says *Science Service*, now that atomic fission has put it on the front pages of every newspaper in the land.

The electron-volt is a measure of energy. The energy of a moving automobile—the force with which it might hit another object—depends on both the weight of the car and the push or the force with which it is impelled. In the same way, the electric energy of an atomic particle depends upon its mass and the potential or the push which impels it.

The energy of the automobile is measured in foot-pounds. In the case of the atomic particle, the unit is the electron-volt, which is the push given to a single electron by an electrical force amounting to one volt. The push that lights your electric lights is usually 110 volts. Millions of volts are used in artificial lightning and atom research.

Comic strips are now being televised over W6XYZ, station of Television Productions, Ltd., in Hollywood. Among the strips televised are "Boots," "Freckles," "Captain Easy" and "Our Boarding House." Experiments are being made with both character voices and standard comic-strip "baloons."

Oscar Hammarlund, chairman and founder of the Hammarlund Mfg. Co., makers of communications radios, died August 25 at Brooklyn. Born in Sweden, Mr. Hammarlund studied at the Technical University in Stockholm, coming to the U. S. to work under Elisha Gray.

MICROWAVES

(Continued from page 22)

are not of sufficient interest to the average reader to warrant discussion here. Figures 4, 5 and 6 show typical waveguides of the square, rectangular, and circular types. Figure 4 shows a square waveguide with a stub antenna in the form of the end of the center wire of a coaxial cable projected into the end of the waveguide.

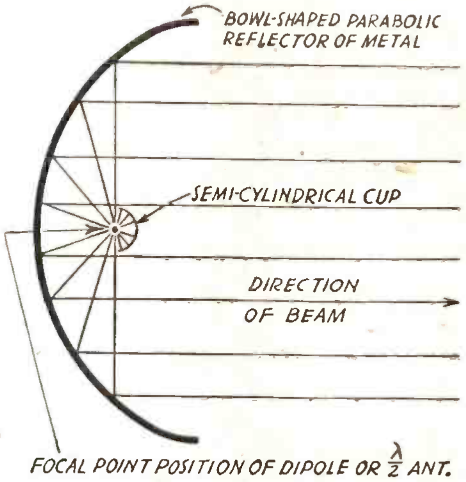


Fig. 3—Antenna with parabolic reflector.

Another method of exciting the waveguide is shown in Fig. 5, which shows the same type input, except that it is into the side of a rectangular type waveguide, and near the end. It is the usual thing for this type to be injected into the wider side. End type injection is commonly used with cylindrical waveguides.

More elaborate inputs may be used, such as pairs of stubs properly placed, or dipoles, or with even more elements, but only the simplest are shown here, as they are adequate.

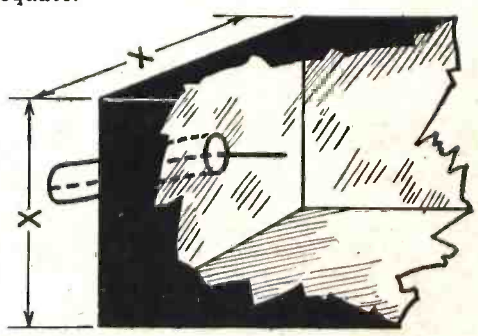


Fig. 4—Square waveguide, fed from the end.

COUPLING TO THE WAVEGUIDE

To take energy from the waveguide, if an electrode is used, it must be of the same type as that used at the input, and must be oriented in the same direction. Since this is true, it is actually possible to use several types of waves within the

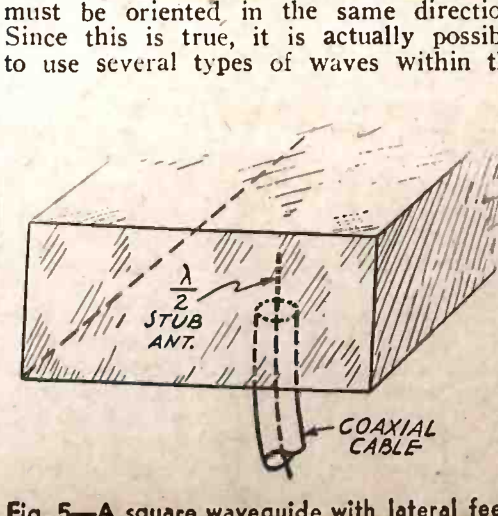


Fig. 5—A square waveguide with lateral feed.

same waveguide at the same time, and sort or filter them out by the various input and output methods! Waveguides may be terminated in the electromagnetic horns previously described. If coaxial cables and an electromagnetic horn are to be connected, a short waveguide is used as coupling.

For experimental purposes, a slot may be left, through which a probe connected to a detector arrangement may be placed in order to determine the field distribution within the waveguide.

Waveguides can be constructed by the amateur very easily from sheet metal, making possible a wide range of experimentation with very little investment. As a matter of fact, the whole microwave field is open to the amateur with relatively low outlay. The only commercially manufactured items which are necessary are the basic oscillator tubes and some cable. A good power supply, waveguides, and antennas can be made by the ham—and nothing more is needed, other than the shop facilities that practically all amateurs have readily available. Several excellent books are available on microwaves and ultra-high-frequencies, and it is recommended

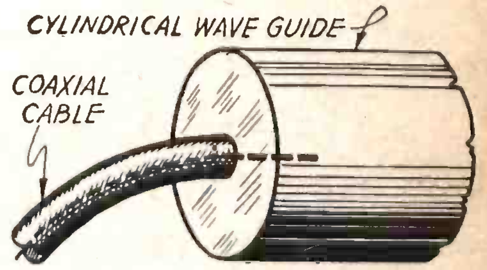


Fig. 6—Cylindrical waveguide with end feed.

that those who wish to pursue the subject of Microwaves further, investigate these.

REFERENCES

1. Introduction to Microwaves, by Simon Ramo (McGraw-Hill).
2. Ultra-High Frequency Techniques, by Brainerd, Koehler, Reich, & Woodruff (D. Van Nostrand).
3. Basic Radio, by Hoag (D. Nostrand).
4. UHF Radio Simplified, by Milton S. Kiver (D. Van Nostrand).
5. Radio at Ultra-High Frequencies (RCA Institutes Technical Press).
6. Klystron Technical Manual (Sperry Gyroscope Company).

●

Tests on the intelligibility of words lead to some strange results. Few people would offer the word "strawberry" as the most easily understood in the English language. Yet experiments conducted by Dr. Harold Westlake of Northwestern University prove just that. Other easy words to hear are tablecloth, bump, yes and ouch. A really hard word is "squeak" which has to be transmitted at three times the loudness of "strawberry" to be as often understood.

Psychological as well as phonetic factors appear to enter into the "hearability" of words. Otherwise how account for the fact that the simple word "no" is classified in the hard-to-hear group?

The tests were made by reading lists of words to a group of 25 listeners at gradually increasing volume levels, and noting which words were heard by given percentages of the listeners at each level.

TECHNOTES

.... 6F6 SUBSTITUTE

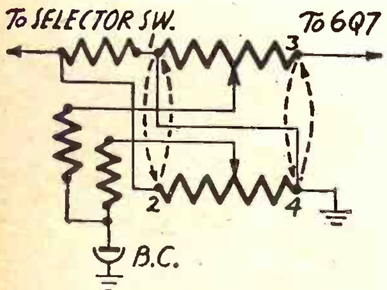
I have a tube substitute for a type 6F6 power amplifier tube used in A. C. sets. The substitute is a 6AD7G, which is a 6F6 and a triode in the same envelope. The connections on pins 1 and 6 are omitted. I found this to work very well in a push-pull stage that employed two 6F6's.

MILFORD THOMAS,
Canebrake, W. Va.

.... HOWARD MODEL 302R

Complaint: Intermittent reception. The trouble was traced to the dual mixer and microphone gain control. Low resistance end on each control was worn. Replacement was not obtainable immediately. By reversing connections to terminals shown in sketch by dotted arrows, operation was acceptable to the customer until a new part could be obtained and installed in the set.

RALPH D. WEBSTER,
Long Beach 4, Calif.



.... SPEAKER REPLACEMENT

When replacing a cone on a speaker it is very important to remove all particles clinging to the pole piece. When the field coil is from 1000 to 2500 ohms, I connect it directly to the 110-volt A. C. line, which demagnetizes the particles, while tapping the pole piece causes the particles to drop out. On lower resistance field coils, a 6.3-volt filament transformer may be used. This same procedure works on speakers with a cone, except that you have to be more careful that the cone remains undamaged after the particles have been removed. I have not yet worked out a system to perform this same operation on the permanent magnet type of speaker. Some other time, perhaps!

DAN W. DAMROW,
Chicago 32, Ill.

.... BIAS CELL REPAIR

Noise from bias cells may be eliminated in some cases by cementing the terminal wires solidly to the case at the point where they pass through the insulated holder. Be sure to use a non-conductive cement for this, as otherwise, you will have an additional resistance path to ground.

RALPH D. WEBSTER,
Long Beach 4, Calif.

.... GRIGSBY-GRUNOW TELEDIAL

I always have trouble with the pilot lights in this set. I finally solved the difficulty by disconnecting the lead of each pilot light socket and re-connecting them on the inside of the dial drum. Now as the drum turns, the pilot light sockets have plenty of length in the leads and do not short to the drum as before.

H. ELLIOT,
New York City

.... TROUBLE-LOCATOR

A simple wiring trouble-locator can be made from a piece of iron and a coil such as the primary winding of an R.F. transformer. One end of a coil of antenna wire is fastened to the antenna of the receiver. The other end is connected to the locator. The set is then turned on at full volume and detuned. By walking around the room with the locator and bringing it near suspected appliances, shaking the wiring of the appliances as you do so; you can detect any trouble by its effect on the set.

WRAY E. WYCKOFF,
Ingleside, Nebraska

.... LATE MODEL BATTERY SETS

Under this classification is included those radios released not later than 1938. With the introduction of the 1.4-volt tubes, the use of dry electrolytic condensers as B supply filters in these sets became almost universal. As they dry out, the capacity decreases and the resistance increases. An odd variety of effects have been noted, which cleared up when the filter was shunted with a new one. Now we replace the filter first in nearly all of these sets.

THOMAS C. RUMNEY
Toronto, Ontario

.... 12A8 SUBSTITUTION

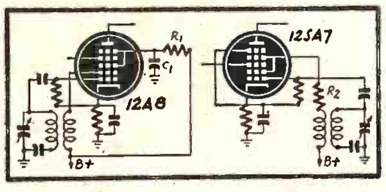
Here is a method which I have used on different occasions to replace a 12A8 with a 12SA7. It may help someone who is having the same difficulty.

12A8 socket	*12SA7 socket*
Grid cap	No. 8 pin
No. 1 pin	No. 6 pin
No. 6 pin	No. 4 pin
No. 8 pin	No. 6 pin
No. 4 pin disconnected	

Numbers 2, 7, 3 and 5 remain the same.

1—When making the change R and C on the 12A8 diagram must be removed, as the 12SA7 has no screen (used as oscillator plate).

2—If there is a tendency to oscillate at the low end, insert R2—valued at 500-1000 ohms—in the oscillator plate (12SA7 screen).



3—Using the 12SA7 suppressor as a screen is not satisfactory because of possible secondary emission. Oscillation and low gain might result in some cases.

E. J. FIALA, RCAF
Halifax, Nova Scotia

.... VICTOR 94T, G-E G-40

To avoid hiss on full volume setting on weak stations, replace the original .0025 mfd screen by-pass condenser with .05 mfd. Many of these sets did not have the No. 1 or shell contact of the 6A8 socket grounded to the chassis. This is all right when using the 6A8G, but if the metal or GT tube with metal ring is substituted, oscillation will occur. Better ground it.

THOMAS A. RUMNEY
Toronto, Ontario

Columbia University will establish a "College of the Air" with an FM station.

Communications

CRYSTALS AND THE INTERFLEX CIRCUIT

Dear Editor:

I read with interest the article "Yesterday's Circuits" by J. W. Straede, which appeared in the July issue of *Radio-Craft*. I agree with him on many points and would like to see more of his articles in the future. Many good ideas are being forgotten (more or less temporarily, I hope). However, he goes a bit too far in claiming that most modern receivers have a little Interflex. Obviously he has never tried this little sleeper. The results are striking not only in volume, but also in sensitivity. I believe this is due to the direct coupling used. A crystal detector coupled to an amplifier by means of the ordinary audio transformer does not give such results.

The explanation lies, I believe, in the fact that the crystal works into a high impedance—the grid of the tube—and so delivers the greatest possible voltage. A solution for the circuit's inherent damping might be tapping the crystal down on the antenna inductance, to load it less. This might improve the Q of the coil so much that there would be very little overall loss due to reduction in coupling.

My experience with the Interflex dates back many years, but I think it has great possibilities as the first modulator for UHF supers. Perhaps I'll find out enough about this to write an article for you, though I would rather read about it in *Radio-Craft*. At present I am too busy to play with it.

Why don't you scrape together all the data you have on the subject and have your staff write it up? Include the regenerative types and, if possible, the theory. I might be wrong about why it works as it does. If so, I want to know it.

If you haven't much dope on it, perhaps you could experiment enough to answer such questions as these: Why does it make so much difference what spot you pick for the ordinary use of crystals, and so little when used in the Interflex? When bias is fed through the crystal, how much actually appears on the grid, i.e.: have we a case of the "floating" grid here? Does shunt feed of bias (through a leak) make any appreciable difference? What effect has the input capacity of the tube, given a fixed mu and Gm? How about the capacity of the xtal and holder itself, especially in the UHF region? What kind of modulator does it make? Does any regeneration take place accidentally? Do you get the carrier and sidebands you'd expect at the tube grid? How does it detect FM? (It might, either in a modified discriminator, or by detuning).

I've been unable to find any zincite-bornite detectors, or anything other than galena and silicon. For the ultra-shorts, sulphating the tip or the wire itself might be simple and easy. I intend to try this, and seal the element into a short length of glass tubing for permanence. Perhaps a carbon or silver contact plate would work well. By the way, what was that special crystal your EI Co. used to sell, synthetic FeS_4.

With a citizen's band coming up, I think there will be room for the Interflex once more.

J. K. Bach,
Lawrenceville, N. J.

RADIO ALARM WITH SIMPLE GAS TUBES

Dear Editor:

In reference to the editorial entitled "The Radio Alarm," which appeared in the August, 1945, issue of *Radio-Craft*, I want to call your attention to the OA4-G gas triode tube, which is described on page 45 of the *RCA Tube Manual*. One hundred to two hundred microamperes is required to trip the relay. This is too much, but no doubt refinements are on the way.

Henney, in his *Principles of Radio* describes the tube and mentions that it has been used to turn on a set from a distant station. He states: "The implications of the use of such a service in case of national emergency are obvious."

I have been reading your magazines since I learned to read with any degree of skill. Before that I gloated over the pictures. No fooling, I distinctly remember pictures of loose couplers and spark gaps of Manhattan Co., when I was 11 years old.

W. A. Gott,
Milwaukee, Wisconsin

MORE ON THE DIRECT-COUPLED AMPLIFIER

Dear Editor:

The letter from Mr. Frank Gue, published in the "Communications" department of your July issue, gave me the idea that you might perhaps be interested in the experiences I have had with Mr. Shaney's 10-watt Direct-Coupled Amplifier. I built up one of these units about a year ago, for the purpose of playing records and find that it works very nicely.

Not wishing to be bothered with a push-pull input I added a 6SC7 as a phase inverter, as per the information in Mr. Shaney's Amplifier Manual. There is an error in the diagram of this single-ended input and it won't work properly if hooked up with the resistor values shown. The 50,000-ohm resistor from the grid of the second section of the 6SC7 to ground should be replaced with one of 16,000 ohms. This value was obtained experimentally with the aid of the oscilloscope and gives a perfectly-balanced input signal to the grids of the 6J7's.

Due to the high gain of the amplifier with the extra input stage added, it was necessary to use 2-meg attenuating resistors between the high side of the volume control potentiometers and the coupling condensers from the 6SC7 plates. These are arranged so they can be shorted out by a D.P.S.T. switch if the full gain of the amplifier is needed for a low-level microphone. An additional attenuator circuit was also incorporated in the input to the 6SC7 so that the volume control on the record player could be operated about mid-scale for improved quality.

What Mr. Gue says about the 100,000-ohm plate resistors for the 6J7's is correct. However, his suggested solution would be going at it in the hard way. A simpler solution is to use an adjustable bias on

(Continued on following page)

the 6J7's. This, in my case, consists of a 200-ohm wire-wound potentiometer with the two ends connected to the cathodes of the 6J7's and the variable contact grounded through a 650-ohm fixed resistance. With this circuit, the bias on the 6L6's can be balanced perfectly. The 100,000-ohm resistors should be selected to be as closely matched as possible with an ohmmeter and then the bias adjustment will take care of any further discrepancies. By connecting a voltmeter across either the two cathodes or the plates of the 6J7's, the bias adjuster can be rotated until no voltage difference is noted. This adjustment, by the way, does away with the last vestige of hum.

ALVIN L. CAMPBELL,
Innisfail, Alberta.

NOT THE ENCYCLOPEDIA

Dear Editor:

Having become quite an enthusiastic reader of your publication during the past three years (in spite of its scarcity), I am prompted to make several comments.

First, in glancing through the readers' criticisms, it is obvious that the one-tube experimenter wants less technical news while the technically-minded want less one-tube experiments. Each wants a magazine of special interest to himself—a "custom copy"—for only a quarter. I feel that the amount and variety of information is so extensive that any one interested in radio, generally, should receive more than their money's worth. *Radio-Craft* can be compared with such a work as the *Encyclopedia Britannica,* in that *it does not require the reading of every item to prove its worth.*

May I offer a suggestion that articles be followed by references as to where further information can be obtained on the subject—where practical. I call your attention to an article published in the April, 1945, issue entitled "Radar, Bats and Supersonics" by Dr. Robert Galambos. What books are available on the subject?

SGT. N. K. SMITH, R.C.A.F.,
Toronto, Ontario, Canada.

(Can some reader help out on this?—*Editor)*

BRICKBATS AND BOUQUETS

Dear Editor:

I have the following bouquets and brickbats for your magazine.

I find the Question Box, Radio Electronic Circuits, and Try This One! departments very interesting. I feel, however, that you publish too many audio amplifier circuits in this department. Very satisfactory amplifiers can be designed by the experimenter from readily available information (tube manuals, books, etc.).

I am interested in the Flewelling Radio circuit on page 582 of the June, 1945, issue. I plan to construct this as soon as I can get the 1D8-6T tube.

JOSEPH E. STEMBEL,
Kentland, Indiana

BACK TO EARTH AGAIN?

Dear Editor:

Regarding the letter "More Simple Servicing" by William J. Morgan, which appeared on page 605 of the June issue, *it expresses my sentiments exactly.*

YOU ARE GETTING TOO DARNED TECHNICAL.

Let's get down to earth, so us common folks can understand you.

C. L. ROBESON,
Tampa, Florida

Civilian RADIO JOBS *Wanted*

FREE WANT-AD SERVICE

CIVILIAN RADIO JOBS WANTED

By Former Soldiers, Sailors, Marines

Radio-Craft **offers its help-wanted columns free for the use of honorably discharged men in the armed services. State the type of position you seek, preferred locality, your experience, education, and other details. Confine ad to 50 words, or less. Supply name and address. Army veterans send section number or photostat of discharge paper. Navy men send photostat of discharge paper. Address RADIO-CRAFT, Classified Ad, Dept. 25, West Broadway, New York 7, N. Y. Your ad will contain a box number and replies will be forwarded to you.**

AVAILABLE

RADIO PRODUCTION MAN, exp. in 10,000 watt, N. Y. ind.; seeks position in advertising agency or station, also newsroom, continuity background. Bernard Harverod, 507 Hegeman Ave., Brooklyn 7, N. Y.

RADIO—YOUNG MAN, college graduate; wishes to break into radio announcing; have had some experience; will accept any offer. Address: N. S., 82 Leo Avenue, Brooklyn, N. Y. Phone Ev 7-2899.

RADIO PARTS salesman with retail and industrial experience, with large N. Y. radio parts concern. A Sternman, 1644 E. 2nd Street. Brooklyn 30, N. Y. DE 9-3933.

RADIO OR TELEVISION, 25; 32 mos. overseas doing radio repair; willing and able; job with future. Milton Witlen, 3908 Lyme Avenue, Brooklyn 24.

OPENING of the first direct radiotelegraph circuit between the United States and Bulgaria was announced last month by officials of RCA Communications, Inc. The new New York-Sofia circuit will handle traffic at the new European rate of 20 cents per word, 13 cents less than pre-war rates.

BRITISH television will get under way next January, stated representatives of English television interests last month. An all-inclusive three-year plan proposes seven transmission centers in the country. There are already 15,000 television receivers in England, all of them in the London area.

WORLD-WIDE STATION LIST

(Continued from page 34)

9.680	XEQQ	**MEXICO CITY, MEXICO**: evenings.
9.680	VLC2	**SHEPPARTON, AUSTRALIA**: Northern Asiatic beam, 3:30 to 4:30 am; British beam, 12:15 to 12:45 pm.
9.685	TGWA	**GUATEMALA CITY, GUATEMALA**: Sundays at 7:55 pm.
9.690	GRX	**LONDON, ENGLAND**: Australia beam, 1 to 5 am.
9.700	KCBR	**LOS ANGELES, CALIFORNIA**; Oriental beam, 6 to 11:45 am.
9.700	WRUS	**BOSTON, MASSACHUSETTS**: Central America beam, 7:30 pm to 2 am.
9.700	KNBI	**SAN FRANCISCO, CALIFORNIA**; East Indies beam, 3 to 4:45 am.
9.705	——	**FORT DE FRANCE, MARTINQUE**; heard at 6:30 pm.
9.720	PRL7	**RIO DE JANEIRO, BRAZIL**; 4:10 to 9:50 pm.
9.730	XGOA	**CHUNGKING, CHINA**: 1:30 to 2:40 am; 6:30 to 10 am.
9.735	CSW7	**LISBON, PORTGUAL**; 9 to 10 pm.
9.735	CXA15	**MONTEVIDEO, URUGUAY.**
9.750	WLWRI	**CINCINNATI, OHIO**; North African beam, 6:15 to 7:15 pm.
9.750	KCBF	**LOS ANGELES, CALIFORNIA**; South America beam, midnight to 2 am; Oriental beam, 5 am to 1 pm; Philippine beam, 3 to 4:45 am.
9.750	WNRA	**NEW YORK CITY**; European beam, 6 to 8 am.
9.785	OTC	**LEOPOLDVILLE, BELGIAN CONGO**; relays BBC at 9:30 pm to 12:45 am.
9.810	——	**VIENNA, AUSTRIA**; heard at 3 pm.
9.825	GRH	**LONDON, ENGLAND**: North America, 5:15 pm to 12:45 am.
9.855	KWIX	**SAN FRANCISCO, CALIFORNIA**; New Zealand beam, 3:30 to 4:45 am; Australian beam, 5 to 6:45 am.
9.855	WNRA	**NEW YORK CITY**; European beam, 4:15 to 7:15 pm.
9.897	WBOS	**BOSTON, MASSACHUSETTS**; European beam, 5:45 to 9 pm.
9.897	KROJ	**LOS ANGELES, CALIFORNIA**: Alaska beam, midnight to 2:45 am.
9.915	GRU	**LONDON, ENGLAND**: African beam, 1:30 to 4:30 pm; 4:45 to 5:45 pm; Mediterranean beam, 4:45 to 5:45 pm; North African beam, 1:30 to 4:30 pm; India beam, 12:15 to 1:15 pm.
9.930	SVM	**ATHENS, GREECE**; heard 2 to 7 pm.
9.958	HCJB	**QUITO, ECUADOR**; Afternoons and evenings.
10.000	WWV	**WASHINGTON, D. C.**: U. S. Bureau of Standards; frequency, time and musical pitch; broadcasts continuously day and night.
10.050	SUV	**CAIRO, EGYPT.**
10.130	HH3W	**PORT-AU-PRINCE, HAITI**; 1 to 5 pm; 7 to 11:30 pm.
10.220	PSH	**RIO DE JANEIRO, BRAZIL**: evenings.
10.338	HE04	**BERN, SWITZERLAND**; North America beam, 3:45 to 4:14 pm except Saturdays; South America beam, 7:30 to 9 pm.
10.350	LQA5	**BUENOS AIRES, ARGENTINA**; 7:15 to 7:35 pm.
10.400	YPSA	**SAN SALVADOR, EL SALVADOR**; heard evenings.
10.780	SDB2	**STOCKHOLM, SWEDEN**: about 11 am or noon.
10.840	KWV	**SAN FRANCISCO, CALIFORNIA**; Hawaiian beam, 3 to 9 am; 11:30 am to 3 pm.
11.040	CSW6	**LISBON, PORTUGAL**: Brazilian beam, 6:45 to 8:45 pm.
11.090	——	**PONTA DEL GADA, AZORES**; heard at 2:45 pm.
11.115	MCH	**LUXEMBOURG**; heard with Army Hour for New York.
11.145	WCBN	**NEW YORK CITY**; European beam, 3 to 7:15 pm.
11.145	WOOW	**NEW YORK CITY**; European beam, 7:30 to 9 pm.
11.405	——	**DAKAR, FRENCH WEST AFRICA**; 2:45 to 4:55 pm.
11.616	COK	**HAVANA, CUBA**; noon to midnight.
11.645	——	**BELGIAN NATIONAL RADIO**; evenings about 8:30.
11.680	CMCY	**HAVANA, CUBA**: Afternoons and evenings.
11.680	GRG	**LONDON, ENGLAND**; Far East beam, 10 to 11:15 am; Middle East, 1 to 3:15 pm.
11.690	XGRS	**SHANGHAI, CHINA**: 11:15 am to 12:30 pm.
11.696	HP5A	**PANAMA CITY, PANAMA**; 8 am to midnight.
11.700	GVW	**LONDON, ENGLAND**; Africa, 11:30 am to 5 pm.
11.700	PRL8	**RIO DE JANEIRO, BRAZIL.**
11.705	SBP	**STOCKHOLM, SWEDEN.**
11.705	——	**MONTEVIDEO, URUGUAY**; heard at 8 pm.
11.705	CBFY	**VERCHERES, CANADA**: 11 am to noon.
11.710	WLWS2	**CINCINNATI, OHIO**: South America beam, 6 to 8:15 pm; 8:30 to 10:30 pm.
11.710	WLWK	**CINCINNATI, OHIO**: South America beam, 6:45 to 8:15 am; European beam, 8:30 am to 5:30 pm.
11.710	VLG3	**MELBOURNE, AUSTRALIA**: North America beam, 11 to 11:45 am; 9:45 to 10:45 pm; Tahiti beam, 2 to 2:40 am; British beam, 2:55 to 3:25 am; Northern Asiatic beam, 3:30 to 3:55 am.
11.718	CR7BH	**MARQUIS, MOZAMBIQUE.**
11.720	PRL8	**RIO DE JANEIRO, BRAZIL**; 9:35 to 10:45 pm; off Sundays.
11.720	CKRX	**WINNIPEG, CANADA.**
11.725	JVW3	**TOKYO, JAPAN**; heard at 2 pm.

Index to advertisers

RADIO SCHOOL DIRECTORY

11.730	KGEI	**SAN FRANCISCO, CALIFORNIA;** Oriental beam, 1:20 to 4:45 am; Southwest Pacific, noon to 1:15 pm.
11.730	WRUL	**BOSTON, MASSACHUSETTS;** Mexican beam, 8:30 to 9:15 am; 7:30 pm to 2 am; North Africa beam, 6 to 8:15 am.
11.730	WRUW	**BOSTON, MASSACHUSETTS;** European beam, 3 to 6 pm; Caribbean beam, 6:15 to 7:15 pm.
11.730	GVV	**LONDON, ENGLAND;** Far East beam, 1 to 5:45 am.
11.730	CHOL	**MONTREAL, .CANADA;** European beam, 4:15 to 7 pm.
11.740	KROJ	**LOS ANGELES, CALIFORNIA;** Southwest Pacific beam, 3 to 4:45 am; Alaska beam, noon to 1:45 pm.
11.740	COCY	**HAVANA, CUBA;** afternoons.
11.750	GSD	**LONDON, ENGLAND;** South America, 5 to 10:15 pm; Africa, 1 to 4 am; 11:30 am to 5 pm; South 4 am; 11:30 am to 5 pm; Mediterranean beam, 3 to 4 am; 5 am to 5 pm; North African beam, 3 to 4 am; 5 am to 4:30 pm.
11.770	KCBA	**SAN FRANCISCO, CALIFORNIA;** South America beam, midnight to 2 am; 5 to 11:45 pm; Philippine beam, 3 to 4:45 am.
11.770	VLA4	**MELBOURNE, AUSTRALIA;** North America beam, 1:10 to 1:40 am.
11.775	——	**GENEVA, SWITZERLAND;** 4 to 4:30 pm; 4:45 to 6 pm.
11.780	GVU	**LONDON, ENGLAND;** Indian beam, midnight to 2:15 am; Australian beam, midnight to 2:15 am; European beam; 6 to 8:45 am; 11:15 am to 2:15 pm; African beam, 6:30 to 7:45 am; 8:15 to 8:45 am; 11:30 am to noon; 12:30 to 2 pm.
11.780	HP5G	**PANAMA CITY, PANAMA;** evenings; sometimes afternoons.
11.785	FZI	**BRAZZAVILLE, FRENCH WEST AFRICA;** about 3 pm.
11.785	——	**BELGIAN NATIONAL RADIO;** heard at 6:30 to 7 pm; 9 to 9:15 pm.
11.790	WRUS	**BOSTON, MASSACHUSETTS;** European beam, 6 am to 7:15 pm.
11.790	KGEX	**SAN FRANCISCO, CALIFORNIA;** Philippine beam, 3 to 5:45 am.
11.800	——	**MOSCOW, U.S.S.R.;** heard at 7:25 pm.
11.800	GWH	**LONDON, ENGLAND;** African beam, 2:45 to 3 am; 8 to 8:15 am; Canary Island beam, 2:30 to 2:45 am; European beam, 2 to 3 am; 6 to 8:45 am; 11:15 am to 1 pm; 1:30 to 2:30 am.
11.800	JZJ	**TOKYO, JAPAN;** heard at 1:45 pm.
11.810	WLWLI	**CINCINNATI, OHIO;** European beam, 6 to 7:45 am; South American beam, 3 to 9 pm.
11.820	GSN	**LONDON, ENGLAND;** New Zealand beam, 1 to 2 am; African beam, 2 to 5 pm.
11.826	WCRC	**NEW YORK CITY;** European beam, 6 to 11:30 am.

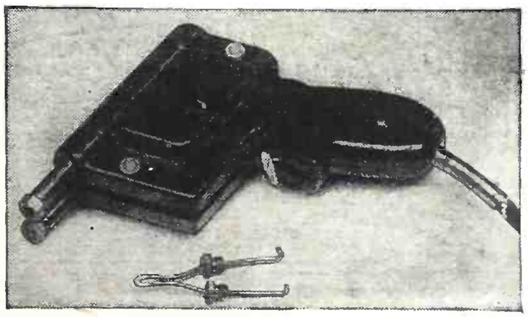
11.830	WCRC	**NEW YORK CITY;** Brazilian beam, 11:45 am to 12:45 pm; European beam, 1 to 5:30 pm; South American beam, 6 pm to midnight.
11.840	GWQ	**LONDON, ENGLAND.**
11.840	VLG4	**MELBOURNE, AUSTRALIA;** North American beam, 1:10 to 1:45 am; 11 to 11:45 am; New Caledonia beam, 4:10 to 5 am; Southwest Pacific beam, 5:30 to 6:15 am; Asiatic beam, 6:15 to 7:45 am.
11.840	VLC7	**SHEPPARTON, AUSTRALIA;** Tahiti beam, 2 to 2:40 am.
11.847	WGEA	**SCHENECTADY, NEW YORK;** European beam, 6 am to 4:45 pm; Brazilian beam, 5 to 11:30 pm.
11.847	XMHA	**SHANGHAI, CHINA;** 9 to 10 am.
11.850	CE1185	**SANTIAGO, CHILE;** heard at 1:30 am.
11.855	——	**SINGAPORE, STRAITS SETTLEMENT;** heard at 7:30 am.
11.860	GSE	**LONDON, ENGLAND;** Near and Middle East beam, 12:45 to 6 am; 2:30 to 3 pm; Africa beam, 4:30 to 5 pm; European beam, 12:30 to 2:45 am; 6 to 9 am; 11:15 am to 12:30 pm; 1 to 5 pm.
11.870	WNBI	**NEW YORK CITY;** South American beam, 7:30 pm to midnight.
11.870	KWID	**SAN FRANCISCO, CALIFORNIA;** Oriental beam, 12:15 to 1 am.
11.870	WOOW	**NEW YORK CITY;** European beam, 4:15 to 6 am; 6:15 am to 7:15 pm.
11.880	LRR	**ROSARIO, ARGENTINA;** heard at 8:30 pm.
11.885	——	**MOSCOW, U.S.S.R.;** 6:45 to 7:25 pm.
11.890	KWIX	**SAN FRANCISCO, CALIFORNIA;** Hawaiian beam, 6:45 to 11:45 pm.
11.893	WRCA	**NEW YORK CITY;** Brazilian beam, 6:45 to 7:15 am.
11.897	JVU3	**TOKYO, JAPAN;** 6:15 to 8:15 pm.
11.893	WNBI	**NEW YORK CITY;** European beam, 3:15 to 5:45 pm.
11.900	XGOY	**CHUNGKING, CHINA;** Allied Forces in the Far East, 8 to 9 pm; Asia, Australia, New Zealand beam, 6 to 6:30 am; East Russia beam, 6:30 to 7 am; Japan beam, 7 to 7:30 am.
11.900	CXA10	**MONTEVIDEO, URUGUAY;** heard at 8:15 pm.
11.930	GVX	**LONDON, ENGLAND;** North America beam, 6 to 8 am; 3:30 to 5 pm; 5:15 to 10 pm; India beam, 11:30 am to 1:15 pm.
11.940	——	**MOSCOW, U.S.S.R.;** 8:10 to 8:50 pm.
11.950	——	**MEXICO CITY, MEXICO;** heard evenings.
11.955	GVY	**LONDON, ENGLAND;** European beam, 6 to 8:30 am; Near East beam, 2 to 5 pm.
11.970	FZI	**BRAZZAVILLE, FRENCH WEST AFRICA;** noon to 8:50 pm; 1 to 2:30 am.
11.995	CSW	**LISBON, PORTUGAL;** heard about 8:30 am.

QUICK-SOLDERING "GUN"

A SOLDERING iron that heats in seconds—and which draws no current until the operator is ready to put it into use—is what the manufacturers of the illustrated soldering tool claim their device to be.

The pistol grip conceals a step-down transformer which drops the line voltage to approximately one-half volt. Heavy current at this voltage passes through the hairpin-shaped loop, heating the tip to the solder-melting point in considerably less than half a minute. A trigger-like switch in the handle turns primary current on and off. When released, it remains in the "off" position.

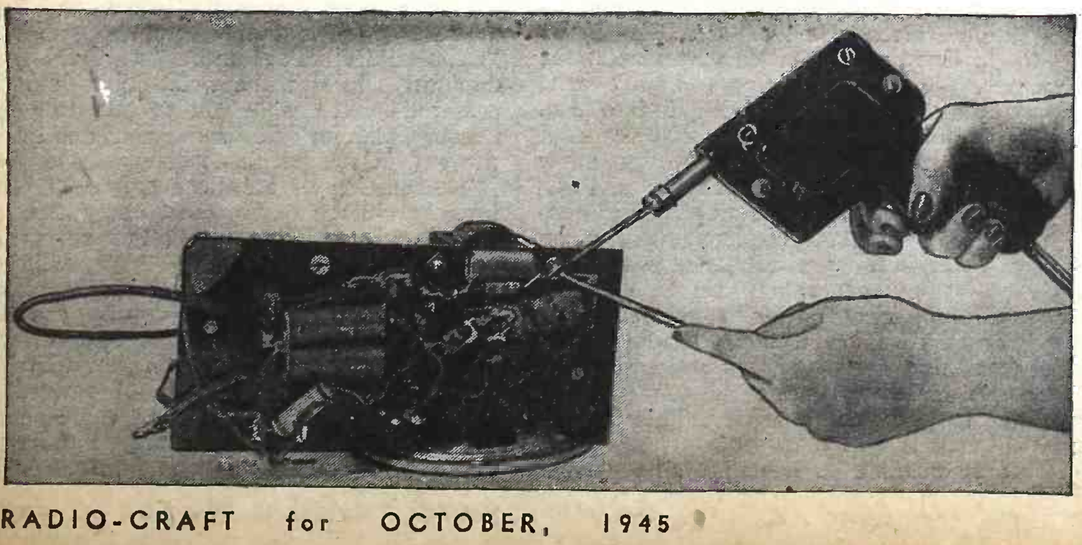
The tip is a piece of heavy copper wire, the ends bent to fit in two small holes in the "pistol." Two nuts are screwed up to make the perfect contact necessary at the low voltage. The tip has a special advantage in that it can be bent or shaped to get into odd corners and the usual run of "difficult places" in a radio receiver. Tips burn out rather rapidly, but of course are very easily and quickly replaced. Tinning is automatic with the copper-wire tips.



Photos Courtesy Weller Manufacturing Co.

The instrument is rated at 100 watts, 60 cycles, a rating comparable to that of the average iron used in a radio shop.

This type of iron will be welcomed by the serviceman or experimenter whose work calls for intermittent use of an iron, and who may have to keep the ordinary tool hot all day, though there may be periods of an hour or more in which it is not used.



RADIO SCHOOL DIRECTORY

PREPARE NOW FOR POST-WAR RADIO AND ELECTRONICS

MAKE a place for yourself in a new world of radio and electronics—a world in which revolutionary electronic developments will require highly specialized technical knowledge. Take a good course now to fit yourself for a good paying job. The training you need can be supplied by one of the schools advertised in this publication.

ATOMIC ENERGY AND RADIO

(Continued from page 11)

to start off the future atomic engine. The reason why we did not have atomic energy before was simply because we had no suitable "detonator" to start off atomic "chain action." As an example, give a savage a block of T.N.T. He can hammer it and throw it about; he can even put a flame to it, but nothing happens. Now equip it with a fulminate of mercury detonator, and the T.N.T. will go off with a roar, moving the side of a mountain. But the savage did not know how to use the primer-detonator. Indeed, he did not know what it was. So we, for thousands of years, did not have the necessary primer to unlock the vast inherent energy of every substance that abounds in nature—whether it is a stone, a metal coin, a piece of wood—in fact, any material you can imagine—all these substances have locked in themselves vast amounts of atomic energy. Now for the first time man will be able to use that energy and rise to new heights. To be sure our scientists have only made a start—not with common materials, but so far only with the precious Uranium. But the cheaper materials will follow in due time.

In any discussion of atomic power, it must be realized that it would take volumes to describe all of its potentialities. For instance, we already know that radium by its atomic energy, gives off a vast amount of power. We also know that radium over a stretch of 2500 years turns finally into lead. But in doing so during the 2500 years of its life, radium generates (among other things) electricity spontaneously and *directly*. In effect, radium is an electrical generator itself—without mechanisms or wires.

It seems very probable, therefore, that future atomic generators can be made to furnish electrical power, *even without a motor* as we know it today. From this it appears that such tiny, but powerful generators will not contain moving parts in order to generate electricity. This in turn will revolutionize many industries. It will thus be possible to have portable electric generators which will give a vast amount of electrical power, yet be minute in size. You will be able to carry on your person a "flashlight" which will give millions of candle power—should anyone need such a vast amount of illumination.

Those who have read about the dreadful rays (causing fatal burns, etc.) which radium and other similar compounds give out, while disintegrating, probably wonder how anyone would be able to carry such a dangerous article on his person. The answer again is in the "detonator." *Nothing happens till you release the energy.* A revolver too carries high power and stored destruction. Then too, you need so little of the atomic stuff that a quantity the size of a pinhead will give actually thousands upon thousands of horsepower. As to the destructive emanations (while the action occurs), lead or similar "insulation" will stop the deadly rays so they can't harm you.

As for comforts, atomic power will give man his promised millennium. No longer will you freeze in temperatures below zero, or broil in a 100-degree heat. You will carry with you on your person a small atomic generator which will either give you sufficient heat through woven-in wires in the clothing to keep you warm in Arctic temperature—or in a tropical summer, you will be able to keep comfortably cool by similar wires, except that in this case they will be made of bismuth and antimony alloys, respectively. These wires cross each other at certain points and at the juncture a freezing temperature is generated—the so-called Peltier effect. The wires are simply connected to your atomic electric generator and you will be comfortable even if the temperature goes to 120 degrees.

To give another example of many thousands, your radio set will no longer be dependent upon external supply current or even batteries. Indeed, *your radio tube will be its own atomic generator.*

In this connection, radio men will be interested to note that the present atom generator appears to be akin to our radio tubes. Referring to the isotope of uranium from which the material for our atomic bombs is obtained, General David Sarnoff, President of Radio Corporation of America, points out: "It is this metal that has for the first time, under special electrical bombardment *in a vacuum tube* (italics ours) released some of the energy of its atoms." So atomic power is another branch of vacuum-tube technique!

I described in the April, 1944, issue of *Radio-Craft* magazine, merely as an April-Fool joke, the *Radium-Radio Tube.* This described in detail how a tube powered by a mere speck of radium furnishes the entire radio set with all its energy, having sufficient left over so that the power actually would have to be throttled down! This was a far-fetched idea at that time and therefore was treated humorously. It now becomes a distinct possibility.

The handie-talkie of the present and immediate postwar future will become the "wrist-talkie." Far more powerful—yet diminutive in size, the wrist-talkie—atomic powered—will enable you to talk to your nearby home, or friends thousands of miles away (via the telephone companies).

The coming of atomic energy will profoundly change our present conception of radio receivers. The multiple-tube sets from four to a dozen tubes and over, will no longer prevail. One or two tubes at most (multiplier types) will suffice even for the most powerful sets. *All will be "portables,"* that is, non-dependent upon any outside wire connection to a source of power.

To be sure all this will not come about this year or next—but we are on the way to it, in the not very distant future.

In any emergency, your message gets through when your railroad is equipped with a Motorola F-M two-way radiotelephone system. Relying on neither tracks nor wires, Motorola equipment delivers time-saving, money-saving, life-saving orders and directions to railroad crews throughout the nation. This is two-way train talk that counts—yardmaster to switching crew, engineer to caboose, train to train.

The famous "Handie Talkie," the two-way portable radiotelephone set used by our armed forces everywhere, is a notable Motorola Radio *first.* Motorola Radio engineers are also noted for their famous two-way F-M police radiotelephone systems installed in 34 states and in over 1000 communities. For an intelligent appraisal of your own communications problem—**Write today for full details.**

GALVIN MFG. CORPORATION • CHICAGO 51

F-M & A-M HOME RADIO • AUTO RADIO • AUTOMATIC PHONOGRAPHS • TELEVISION • F-M POLICE RADIO • RADAR • MILITARY RADIO