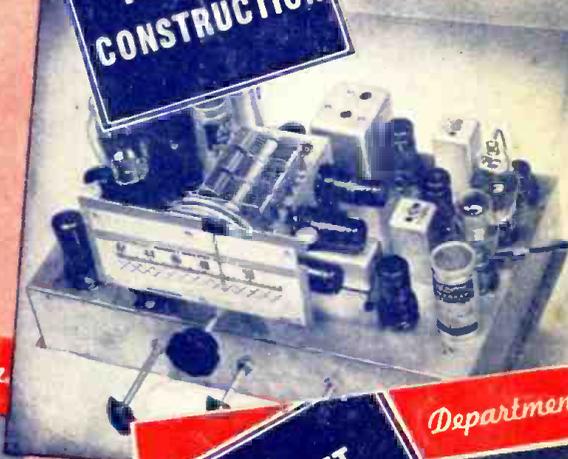


RADIO & TELEVISION

RADIO CONSTRUCTION

Department



ELECTRICAL EXPERIMENTS

Department



TELEVISION NEWS

Department

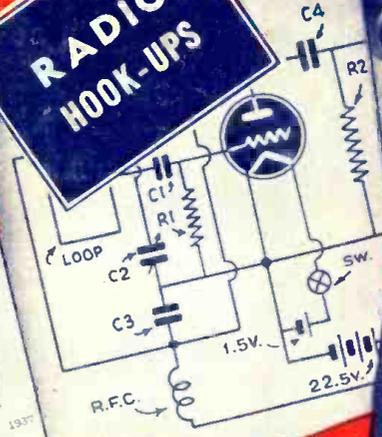


EASY SET BUILDING

Department

RADIO HOOK-UPS

Department



RADIO PATENTS

Department

2,224,919
H. F. OLSON
LOU-SPEAKER
Filed March 23, 1937

Dec. 17, 1940.



MARCH OF RADIO

Department



AMATEUR RADIO

Department



RADIO KINKS

Department



25¢

CANADA 30¢

HUGO GERNSBACK
EDITOR

AMATEUR & EXPERIMENTAL RADIO

MAR.

CONSTRUCTIVE RADIO ARTICLES

1941

NATIONAL RECEIVERS



HRO

National Receivers give maximum performance in every price range, at all frequencies. There is the HRO which has become the standard of comparison among fine communication receivers for performance, versatility and reliability. There is the little SW-3 which is still a favorite after ten years, noted for three-tube simplicity combined with proven capability.

There is the brand new NC-200, which is making a reputation for itself week by week. There are older favorites like the NC-100 and the NC-44, each bringing top performance to its price class.

For ultra high frequencies, the One-Ten with coverage from one to ten meters, is still the receiver for work at 112 Mc. and 224 Mc. The de luxe NHU brings communication receiver performance to the 5-meter band as well as 10 and 20 meters.

This is the roll call of National Receivers for amateur use. Different models in each of the above types make a total of more than twenty receivers to choose from. Regardless of your needs, you will find a National Receiver to fill them.

NATIONAL COMPANY, INC.

MALDEN, MASSACHUSETTS



NC 200



NC 100 X A



NC 44



SW-3



ONE-TEN



NHU



Is this what you want to know?

I will answer these questions for you—show you how to become a **SUCCESS IN RADIO**

If you know all the facts listed above—there is a real future for you as a Radio Technician. But if you do not—whether you've been in Radio for years or are just thinking of getting into this growing field—I can teach them to you at home nights in your spare time—train you to be a Radio Technician.

Why Many Radio Technicians Make \$30, \$40, \$50 a Week

Relatively few persons can quickly locate and fix the troubles which arise in a modern, complicated home or auto Radio; few can operate or maintain broadcasting, aviation, commercial or experimental Radio stations, loud-speaker systems, commercial electronic devices or handle many of the other jobs which require a Radio Technician's specialized knowledge. That's why so many Radio Technicians enjoy good pay, steady jobs—why there are opportunities for Radio Technicians to hold other jobs and make good money—from \$5 to \$10 a week—in spare time.

Many Make from \$5 to \$10 a Week In Spare Time While Learning

The N.R.I. Course teaches you the fundamentals of Radio and Television—gives you practical experience building circuits, making experiments with real Radio parts which are furnished. Also, it teaches you many practical Radio jobs that you can cash in on while learning. Many hold their regular jobs and make \$5 to \$10 a week extra in spare time fixing Radios while learning.

You Get a Professional Servicing Instrument

The N.R.I. ALL-WAVE, ALL-PURPOSE Set Servicing Instrument makes practically any test you will be called upon to make in Radio service work, on both spare time and full time jobs. It can be used on the test bench, or carried along when out on calls. It measures A.C. and D.C. voltages and currents; tests resistances; has a multi-band oscillator for aligning any set, old or new.

Draft Registrants!

If you **ARE** called and are then a Radio Technician, you'll be eligible for a communications branch of the service; in line for technical ratings with extra pay.

If you **ARE NOT** called, you now have an opportunity to get into Radio at a time when the Government is pouring millions of dollars into the Radio industry to buy Defense equipment, on top of boom civilian Radio business.

Either way—it's smart to train for **RADIO NOW!**

Find Out How We Teach Radio and Television

Act today. Mail coupon now for Sample Lesson and 64-page book. They're **FREE**. They point out Radio's spare time and full time opportunities and those coming in Television! tell how you can train at home nights in spare time to be a Radio Technician; show more than 100 letters from men successful in Radio who started this way. Mail coupon in an envelope or paste it on a penny postcard—**NOW**.

J. E. Smith, President
National Radio Institute, Dept. 1CB3
Washington, D. C.

1. How to read diagrams and analyze them.
2. How to use test instruments.
3. How to get started in professional Radio.
4. Hints on how to run your service business profitably.
5. How to install P.A. equipment.
6. How to install inter-communicating systems.
7. How to figure charges.
8. What servicing instruments to buy.
9. How to locate parts in a chassis with and without service data.
10. How to know the cause of receiver trouble from observed effects.
11. How to make tests which isolate the defective stage and parts.
12. How to check for defects in a chassis.
13. How to align receivers without reference to service manuals.
14. How to appraise receiver performance from a circuit diagram.
15. How to plan your service bench and shop.
16. How to develop a time-saving servicing technique.
17. Short cuts in servicing midget universal receivers.
18. How modern electronic television receivers operate.
19. How to install and service television receivers.
20. How to practice servicing Radios to gain needed experience.
21. Practical demonstrations that show how basic Radio circuits operate.

Sample Lesson **FREE**

I want to send you a sample lesson, "Broadcast, All-Wave and Television Superheterodyne Receiver Principles." It covers the basic Interference in superhets and how they are rectified. It brings out the importance of the preselector, mixed first-detector, local oscillator, intermediate frequency I. F. amplifier, tracking, deak and band pass adjustments, band switching and modification for adapting to television reception. All subjects covered with special emphasis on servicing. You can get this lesson **FREE**. Just mail the coupon.



GOOD FOR BOTH 64 PAGE BOOK **FREE** SAMPLE LESSON

J. E. Smith, President, Dept. 1CB3
National Radio Institute, Washington, D. C.

Mail me **FREE**, without obligation, Sample Lesson and 64-page book "Rich Rewards in Radio," which tells about Radio's opportunities and explains your 50-50 method of training men at home. (No salesman will call. Write plainly.)

I AM doing Radio work I am NOT doing Radio work

Name Age.....

Address

City State 23FR2

RADIO & TELEVISION

The Popular Radio Magazine

March — 1941
Vol. XI No. 11

HUGO GERNSBACK, Editor
H. WINFIELD SECOR, Manag. Editor
ROBERT EICHBERG, Television and Digest Editor

In April Issue

How to Erect Television Receiving Antennas to Prevent Interference—Thornton Chew
A Real "High-Fidelity" Phono Amplifier—Milton T. Putnam, Chief Engineer, Station WDWS
A Simple "Signal Tracer"—H. L. Carpenter
Construction of a Short-Wave "Signal-Booster"—Charles R. Leutz
Pull-Swing Frequency Modulation-Set Construction—Ricardo Muniz, E.E., Donald and Warren Oestreicher
Latest Television News
"Airplane Spotting" by Super-Sensitive Sound Receiver

In This Issue

GENERAL FEATURES

Editorial—	
Hugo Gernsback	645
MARCH OF RADIO	
Multiplex Facsimile	646
Radio Goes to the Races	647
Research Labs 40th Anniversary	648
NYA Builds Fine Police Radio in Maine	650
INTERNATIONAL RADIO REVIEW	
How to Use a Neon Tube as a Photo Cell	652
Hook-up for a Crystal Receiver	652
An Automobile Superhet Receiver	653
A Compact, High-Fidelity 20-Watt Amplifier, Harry D. Hooton, W8KPX	657
A 5-Tube Compact Superhet Receiver, R. W. Baetz	660

RADIO CONSTRUCTION

A "Home" Frequency Modulation Receiver, L. M. Dezettel, W9SFW	654
A High-Fidelity 20-Watt Amplifier, Harry D. Hooton, W8KPX	657
Compact 5-Tube Superhet, R. W. Baetz	660
Adapting Mobile Equipment to the New Regulations, H. G. McEntee, W2FHP	662
A New F-M System for Amateurs, Ricardo Muniz, E.E., Donald and Warren Oestreicher	670

Building a "Bamboo" Beam Antenna, R. M. Blanchard, W4FIC	676
The "Duette"—1-Tube Battery-Operated Receiver for Beginners, Wm. J. Vette	692

Heavy Duty Switches	694
Wind Velocity Indicator	695

AMATEUR RADIO

Modulator for Ham Transmitter ..	657
5 & 10 Meter Mobile Equipment, H. G. McEntee, W2FHP	662
"CQ"—News of the "Hams," Larry LeKashman, W2IOP	666
Plaque Winner for Best "Ham Station" Photo	669
Frequency Modulation Transmitter for Amateurs, Ricardo Muniz, E.E., Donald and Warren Oestreicher	670
Ham Station Layout Hints, Larry LeKashman, W2IOP	674
Bamboo "Light Weight" Beam Construction	676

TELEVISION NEWS

W2XB—New Television Studio ..	649
Scophony Demonstrates "Theatre Size" Television	679
Television Travels 190 Miles Over Wires	680
Television Patents	696

MISCELLANEOUS

National Youth Administration—Radio Activities	650
"CQ"—Larry LeKashman, W2IOP	666
This Month's Plaque Winner for "Ham Station" Photo	669
Book Review	673
How Frequency Modulation Works, F. L. Sprayberry	681
Radio Hook-Ups	686
Question Box	688
Radio Kinks	690
Easy Set Building	692
Electrical Experiments	694
Radio Patents	696
New Radio Apparatus	698
What Do YOU Think?	703

NEW FEATURES

Television News	679
Applied Radio—Principles of Frequency Modulation, F. L. Sprayberry	681
Radio Hook-Ups	686
Easy Set Building	692
Electrical Experiments	694
Radio Patents	696

ELECTRICAL EXPERIMENTS

Experiments with Radioactivity, I. H. Walker	694
--	-----

Cover Composition by Hugo Gernsback and Thomas D. Pentz

RADIO & TELEVISION—Published monthly on the tenth of the month. Entered as second-class matter Feb. 15, 1938, at the post office at Springfield, Mass., under the act of March 3, 1879. Trademarks and copyrights by permission of H. Gernsback. Text and illustrations are copyright and may not be reproduced without permission. Subscription price \$2.50 a year in the United States (In foreign countries, 75c additional per year to cover postage; Canada 50c additional). Make all subscription checks payable to Popular Book Corporation.

Published by Popular Book Corporation, Publication Office—29 Worthington St., Springfield, Mass. Editorial and Executive Offices—20 Vesey St., New York, N. Y. HUGO GERNSBACK, President; EMIL GROSSMAN, Director of Advertising. European Agents: Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, Fleet St., London, England; Brentano's—London and Paris. Australian Agents: McGill's Agency, 179 Elizabeth St., Melbourne.

Copyright 1941 by H. Gernsback



Certified Circuits

When you see this seal on a set it is a guarantee that it has been tested and certified in our laboratories, as well as privately in different parts of the country. Only constructional—experimental sets are certified.

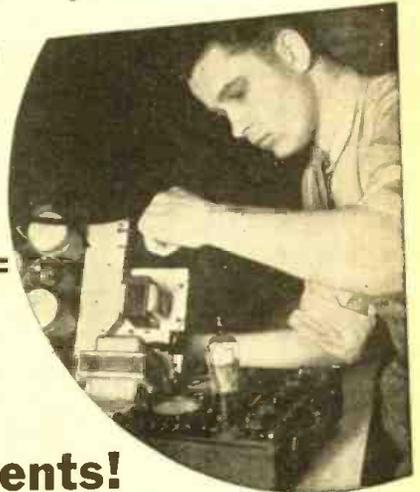
You need not hesitate to spend money on parts because the set and circuit are bona fide.

This is the only magazine that renders such a service.



There's Only One Way
to Learn Anything

DO IT!



SPRAYBERRY RADIO TRAINING
Gives You **FULL EQUIPMENT** to
Do Over 100 Practice-Giving Experiments!

You Get **PRE-EXPERIENCE Right At HOME!**

Sprayberry Training is specially designed to help you make fast progress. It starts right at the beginning of Radio . . . unfolds each subject in a simplified, logical, understandable style. You easily learn Television, Frequency Modulation, Signal Tracing, Mobile Radio (Auto-Tank), Aviation Radio, Electronics, Facsimile Radio, Radio Set Repair and Installation Work. You learn quickly in your spare hours . . . **AT HOME OR AT CAMP.**

Training Prepares You for a Business of Your Own
. . . or Good Radio Jobs at Excellent Pay!

The great, fascinating and progressive field of Radio and Television offers limitless opportunities to the man who wants to get ahead. There is good money to be made. My Training is designed to give you quick access to these opportunities. **SPRAYBERRY Methods** are thorough and practical. Your Training will not interfere with your present work.

YOU GET PROFESSIONAL TEST EQUIPMENT
. . . PLUS EXPERIMENTAL OUTFITS

. . . Includes 146 **RADIO PARTS** for building a complete Receiver, **RADIO TOOLS** and a modern **TESTER-ANALYZER**. You also receive 8 **BIG SHIPMENTS OF RADIO EQUIPMENT** for conducting actual experiments with your own hands. I show you how to create Radio defects . . . how to correct them. **ALL EQUIPMENT BECOMES YOUR PERSONAL PROPERTY!**

NO PREVIOUS EXPERIENCE NEEDED . . . EARN WHILE YOU LEARN

It makes no difference what your education has been. I can fit you quickly for a good-paying Radio job. I make it easy for you to grasp Radio principles and remember them. Your success is my full responsibility. My **BUSINESS BUILDERS** will show you how to put your Equipment to actual use in handling money-making Radio Service Jobs shortly after you begin Training.

REMEMBER— THE **SPRAYBERRY COURSE IS SOLD**
UNDER MONEY-BACK AGREEMENT

LEARN MORE ABOUT THE
SPRAYBERRY METHOD . . . complete details of my Fundamental Course and Advanced Training Course—all features are fully described in my new, valuable 52-page **FREE Book**. Send for your copy. No obligation.

READ What These Fellows Say
About the Practical Sprayberry Training!
"SO MUCH FOR SO LITTLE"

EARNED \$250 SINCE STARTING



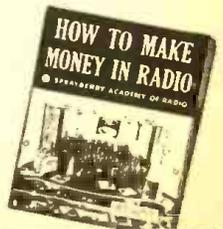
"I have only completed one-third of the Sprayberry Course and I find it very interesting, which makes it easy to learn."

"By devoting several hours of my spare time daily to studying and servicing, I have made about \$250 gross since starting the Course." Earl W. Hostetter, R. No. 4, Lebanon, Pa.



"Now just a few words about your Course—the more I get from it, the more I wonder how you can give so much for so little."

"I believe it to be the finest of its kind obtainable, and I would urge any one wishing to study Radio seriously to take your Course." George W. Elliott, 521 Elwyn St., Nelson, B. C., Canada.



RUSH THIS COUPON **FREE**
for BIG FREE BOOK

SPRAYBERRY ACADEMY OF RADIO
F. L. Sprayberry, Pres.
445-C University Place, N. W.
Washington, D. C.

Please send me **FREE** copy of "HOW TO MAKE MONEY IN RADIO."

Name Age

Address

City State

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

"I guarantee you the best deal!"

HARRISON • RADIO • COMPANY
 • 12 WEST BROADWAY • NEW YORK CITY

Dear Friend:

If you are going to buy a Communications Receiver or other Radio Equipment, every word of this letter is of importance to you. I am an Authorized Distributor of all Amateur apparatus, and can supply you with everything you need. I deal direct with every manufacturer and can give you the latest and best at lowest prices. I have one of the most complete stocks in the country. My prompt delivery service, very liberal trade-in allowances, easiest and simplest time payment terms, and my personal attention to your every wish is sure to please you!

I have all available latest model Hallicrafters, Hammarlund, RME, National, RCA, Howard, Echophone, etc, receivers in my stock for immediate shipment. (From the factory if you prefer) You need send only a \$5.00 deposit with your order. Try it for ten days and if you don't like the receiver your money will be returned.

Also all Hallicrafters, National, Thordarson, Abbott, RTL, UTC, Stancoor, etc, Transmitters and Kits are offered. We wire and test kits in our Shop at reasonable rates.

You can buy everything from me on my easier credit terms for your convenience. Receivers, Transmitters, Kits, etc. Down payment can be as little as 10% of the cash price. The balance in easy monthly payments. Your entire cost for credit is only 6% on the balance. The larger your down payment, the smaller your interest.

I take your old receiver or transmitter in trade. Tell me make, model, age, and condition. Also mention what allowance you feel would be fair to us both.

I also buy modern transmitters, receivers, and complete stations for cash. I always have some good values in reconditioned equipment. It will pay you to communicate with me.

Send to me for prompt delivery of any item you see in any catalog or advertisement at the lowest price shown. I know you'll like doing business with me because I really want every one of my customers to be completely satisfied. Send me your orders; you, too, can depend upon my fullest cooperation and help. I want you to be my customer and friend, and I promise to always give you the very fairest and squarest deal.

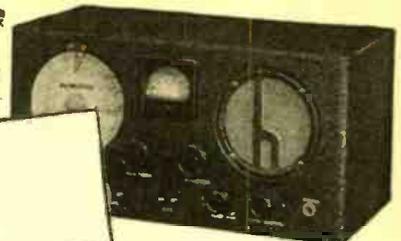
Sincerely yours,

'73

Bill Harrison

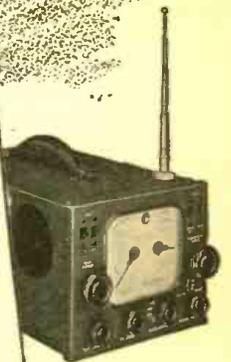
W2AVA

HARRISON HAS IT!



Improved Sky Buddy Model S-19-R \$29.50

HIGHEST TRADE-IN ALLOWANCES



Traveler S-29 \$59.50

EASIEST TERMS



NEW 1941 Super Skyrider Model SX-28 \$159.50

"Order your Receiver today — from me!"

10 DAY FREE TRIAL



Sky Champ Model S-20-R

SHORT WAVE SPECIALISTS SINCE 1928

EVERYTHING IN RADIO ELECTRICAL AND ELECTRONIC EQUIPMENT

TELEPHONE WORTH 2-276

hallicrafters receivers + Harrison Service = Your complete satisfaction



RADIO & TELEVISION

— Editorial —

RADIO, the Unknown

By HUGO GERNSBACK, Editor

● DESPITE the fact that the average man believes that everything about radio is known or pretty well understood, we sometimes should stop and consider how vast and almost limitless the area of the unknown in radio really is.

We frequently fail to consider that in this material world we only know an infinitesimal percentage of what has yet to be known, and indeed it is quite within the realm of possibility that we shall never know the ultimate of most of the world that surrounds us.

It is true that we do know many things, when it comes to the theory and application of materials and forces in nature, but when we come to the real fundamentals, nature seems to interpose an almost insurmountable barrier. As electricity is used in radio at every turn, naturally we should start at that point. So if we ask the old question—*what is electricity?*—we are baffled just as were the early investigators of the phenomenon known as electricity. Almost every year a new theory is propounded, but as yet we have not progressed very far and know little or nothing of what the electrical current really is. We glibly talk about electrical effects, electrified particles, electrons that move about a conductor—and we talk learnedly on other similar points, but the real fact is that very little, if anything, is known and that one theory can be refuted by another one with equal ease.

It is equally true of radio—of which we know practically nothing. True enough we know how to build radio transmitters and radio receivers—but what goes on inside them and how the waves travel, is still an unknown quantity. We can design all sorts of radio circuits but what the radio waves themselves are we know but little. Certainly, not much more than when Heinrich Hertz first demonstrated radio waves way back in 1886. Hertz certainly knew as much about radio waves as anyone knows nowadays and our total knowledge of radio waves from the days of Hertz has not greatly changed.

Hertz first demonstrated his radio oscillator and was able, by using a single loop of wire, to make sparks jump between the two ends of the wire. No ground was used. Later on when Marconi came along, a ground connection was used for better results. Right now we are going back to Hertz and are beginning to discard the orthodox *ground* connection. As the sensitivity of our radio sets increases, a ground is no longer necessitated. Thus in automobiles, airplanes, etc., no real ground is used. You will say that we use an artificial ground by “grounding” one of the connections to the frame of the car or the airplane, as the case may be. But the point is that we use no real ground connection. Indeed Nikola Tesla pointed out many years ago that the engineers’ conception of radio was all wrong, and that a radio ground on an airplane worked simply as one electrode of a condenser. According to Tesla, therefore, a radio set is nothing but a condenser which you charge and discharge by means of radio waves, which pass through open space. Whether this view will prevail in the end no one knows.

The whole subject becomes very much involved, as the following will show: As everyone knows the earth (ground) and ocean water are excellent conductors. Not only for electricity but radio waves as well, yet it is possible to receive powerful radio signals and operate radio sets far underground, and modern submarines receive and transmit radio signals when deeply sub-

merged in the ocean. According to the best theories the ground and salt water certainly should *short-circuit* the radio waves, but they do nothing of the sort. This demonstrates how little we know of the subject.

We might ask quite properly—*when is an insulator?* An ordinary bakelite tube for all practical purposes is an insulator. Yet it has been demonstrated that under certain conditions a bakelite or other insulating tube will make an excellent conductor for radio waves, and it is now possible to pipe radio waves through insulated tubes, just as you would pipe water through a metal tube. This is merely another instance of how little is known about the subject of radio.

And when it comes to radio waves in open space, our knowledge is practically nil. What happens for instance to the radio wave after it leaves the radio station’s aerial, until it strikes your aerial, we have only the slightest of notions. Engineers will talk learnedly of reflected waves, standing waves, refracted waves, and many others but none can give you a very concrete idea of just what the wave is composed of, as it travels through the air or through your set. Is it an electrical charge composed of electrons? Is it an oscillating current or series of currents? No one really knows. Then again it is one thing to predict that long waves behave in one way, and quite another thing when we consider for instance *micro-waves*. While we do know that as the waves get shorter and shorter they behave like light, we do not know much about it; finally—when it comes to light—we know still less, because nothing much about the ultimate composition or nature of light is known.

The shorter radio waves are supposed to follow certain rules; for example, a six meter wave is not supposed to go further than the horizon. Yet these same waves have been received across the Atlantic Ocean, for reasons unknown, as they certainly are not supposed to bend around the surface of the earth as do the longer waves, 15 meters and upwards.

Ever so often we have complete revolutions in radio, simply because we change our minds as to what we think radio waves are or are not—are supposed to do but don’t.

Only a few short years ago, we talked constantly about “low-loss” coils, a term entirely in the discard today. Every radio engineer could prove to you that a coil for a radio set would have to be at least three inches in diameter and at least that high. A tuning coil for a radio set not coming within these dimensions, was simply unthinkable, because to the radio engineers a smaller coil would have too great losses.

Look at the coils in any receiving set today and what do you find? They have shrunk to the size of a pencil—less than an inch high. There is indeed no reason why they cannot be even much smaller than this, and strange to say these microscopic tuning coils work better than the earlier vintage. What has become of the high losses inherent in these small coils? Evidently no one cares, and it is not even good manners to talk about it, because it seems to make so little difference. So as we go along we change our ideas, not because we know any more, because we really don’t, but we proceed mostly by the “hit and try” method which seems to get results.

All of which goes to prove how little we really know and why there are such unlimited possibilities in radio—the unknown!

“Editorials” by our readers
will appear next month.

GOLDSMITH GETS I.R.E. MEDAL

For "his contribution to radio research, engineering and commercial development, his leadership in standardization, and his unceasing devotion to the establishment and upbuilding of the Institute and its proceedings," Dr. Alfred Norton Goldsmith, famed radio consulting engineer, was awarded the 1941 medal of honor of the Institute of Radio Engineers. Dr. Goldsmith has secured numerous patents, on radio, television, facsimile, and photographic equipment and methods. His most recent, a means of using numerous small tubes to build up a single large image, was described in the last issue of RADIO & TELEVISION. Dr. Goldsmith has received numerous other honors, such as an honorary degree of Doctor of Science from Lawrence College, the National Pioneer Award for achievement in the field of science, and many other degrees. He is a former professor of electrical engineering at C.C.N.Y. and later was vice-president in charge of engineering for RCA.



Honored by Institute

NEVER A DULL MOMENT AT THE FCC

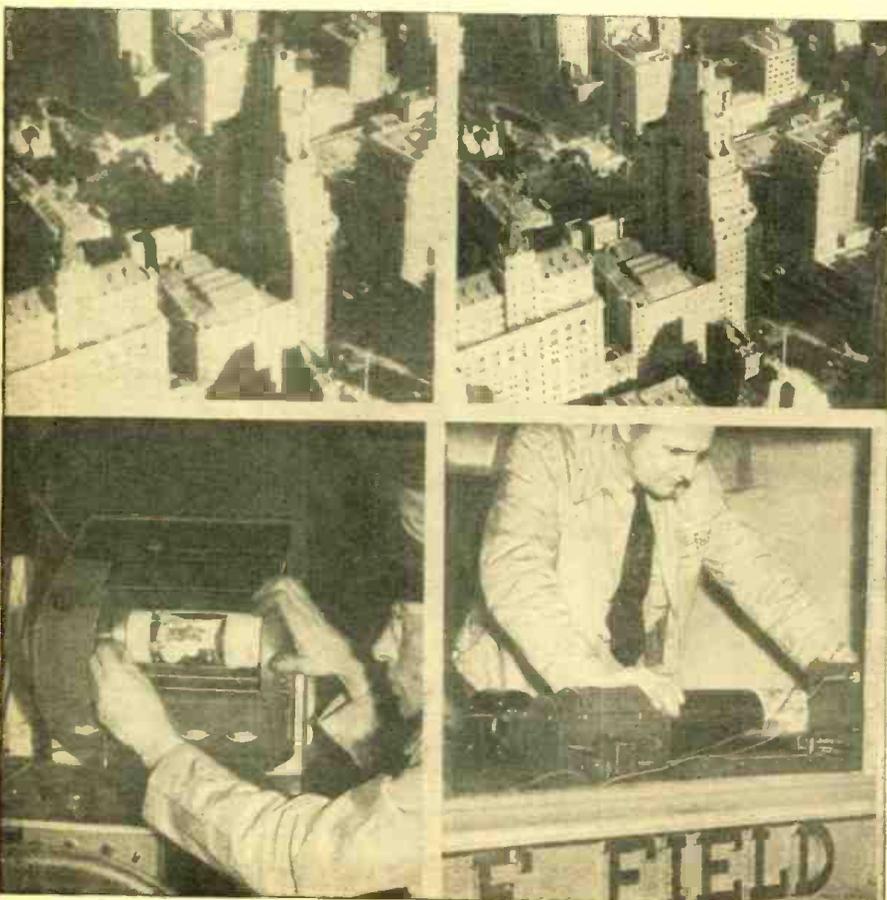
Some time ago the east coast was put in a turmoil by an SOS. No ship was found in trouble and the FCC began an inquiry. They found that a New England amateur had sent this signal as part of a dramatic program he was presenting for fellow Hams. The Commission said, "Naughty, naughty."

In response to an inquiry from Indiana, the Commission makes it known that while there is no regulation to prohibit the reception of police calls, it is unlawful for any

unauthorized person to use the intercepted information for his own benefit.

As you may recall, Jimmy Stewart was assigned KHJIM for his private airplane, and a couple of other stars have received similar consideration. The latest is Robert Taylor, who was given KHASB. According to the Commission, the last three letters are the initials of Taylor's real name, "Arlington Spangler Brough." Some ardent movie fans may question the accuracy of the name as given by the FCC.

FINCH DEMONSTRATES 2-WAY MULTIPLEX FROM PLANE TO GROUND



NEW CALL SYSTEM FOR FM

A new system of call letters with interposed numbers has been adopted for frequency modulation broadcasting. The first letter—in some cases the first two letters—of the call will indicate the station's nationality; the United States, under international agreement, has been assigned K, N and W. N is reserved for the exclusive use of the Navy and Coast Guard, while K will be used for stations west of the Mississippi and W for those east of this great river. If any FM station does not fit in with this system you will know it was licensed before the system was put into effect.

Following the first letter or pair of letters will be a number to indicate the frequency assignment. This is possible because all FM stations are in the 42 to 50 mc. band, and all frequencies are assigned on the odd hundreds in kilocycles. Thus, the first figure and last two figures of the assignment can be dropped. For example, if a station is assigned 43,500 kc., its number should be 35.

The second letter, or a combination of second and third letters, will indicate the location of the station. For example, stations in Boston will terminate with the letter B, while those in New York will end with NY, those in the District of Columbia with DC, etc.

So if you see station K43SF, you will know it is a San Francisco station operating on 44,300 kc.

Stations with the letter E in their calls will be non-commercial educational stations, for which 5 channels are open.

The transmission of news and pictures simultaneously with voice, using a 2-way multiplex radio system between a plane in flight and a ground station, was recently demonstrated by Finch Telecommunications, Inc. The voice was carried on an FM system. According to Mr. Finch, he is able to transmit an entire news report at a speed of 300 words per minute along with news and pictures.

The signals were carried by radio from the plane to the ground station and thence by direct wire to a remote point. One advantage claimed by this system is that positive pictures, ready for reproduction, are taken off the receiving end.

One test was made over the Times Square area of New York and the illustrations herewith show, first, how the camera recorded the terrain below in the plane and, second, how the facsimile receiver reproduced it on the ground. The pictures were processed in the plane and transmitted over 250 watt station KHWGF on 1305 kc. They were picked up at Bendix Airport and sent by wire to the Finch plant in Passaic, New Jersey. The other illustrations show one of the transmitters installed in the flying laboratory and at the field.

NEW FM STATIONS COMING

Seven additional FM stations authorized by the FCC will provide programs in Connecticut, Rhode Island, about half of Massachusetts, part of Tennessee, and the Pittsburgh, Chicago and Metropolitan New York areas.

LAMP 1/5 AS BRIGHT AS SUN

A mercury vapor lamp 1/5 as bright as the surface of the sun has been developed by engineers of Westinghouse. The picture herewith shows Dr. S. G. Hibben, director of the company's Applied Lighting



Division, setting a piece of paper afire at some distance away from the lamp. In order to confine the heat as much as possible, the entire lamp is surrounded by a water jacket through which running water continually circulates in order to keep it cool. Despite this protection, enough infrared escaped to fire the paper.

RADIO GOES TO THE RACES

After a month's search, government inspectors tracked down an unlicensed radio transmitter which was used at a Charleston, West Virginia, race track to broadcast sure tips to favored bettors while the horse races were still being run. About three weeks before the two operators were arrested, FCC field men discovered that two portable transmitters were being used illegally. One man in the grandstand at the track had a transmitter concealed under his coat and used it to relay tips on the races to a colleague in a nearby shack. This second man used another and more powerful transmitter to flash bulletins on the race to subscribers at outside receiving stations.

The whole business was carried out in code. At the start of the race, the man at the transmitter would whistle on a certain frequency followed by the words, "Oh Johnny," repeated several times, and then a few bars from such songs as "Beer Barrel Polka" and "Maryland, My Maryland." Towards the end of the race, the voice suddenly cut in with a number, repeated several times, after which a stronger signal on another frequency (from the transmitter in the cabin) would repeat the same number a dozen or more times followed by such expressions as "testing," or "testing for modulation."

On checking the race results, the investigators discovered that the number repeated was that of the winning horse! The man in the grandstand had the transmitter under his overcoat with the microphone concealed in his cuff, and would raise his hand to scratch his neck when he wished to speak into it. The transmitter in the cabin was concealed in a trunk and used a hidden antenna. Nevertheless, the FCC scouts were able to track down the equipment and make the arrests.

Another case of this kind, in which a woman figured, was described in R. & T. some months ago.

for March, 1941

ANOTHER LOOK AT THE FCC MAIL

Even Christmas did not bring peace to the FCC. One Californian went so far as to ask the FCC to do something about the radio interference caused by a flash unit a neighbor was using on his Christmas tree lights. "No can do," said the FCC.

The same answer was given to another chap complaining of interference from Mexican stations. However, he was told that the North American Regional Broadcasting Agreement goes into effect on March 29th, and after that reception should be better.

Other complaints which got "no" for an answer were from a Schenectady man who complained that a station is using the national anthem as part of a commercial continuity, a Philadelphian who objects to certain programs which he feels "appeal to greed," and an Indianapolis music fan who wants a station compelled to carry a certain classical program.

Still the Christmas woes poured in. One kind lady in Louisiana wants the stations cautioned not to infer that there is no Santa Claus, because it may disillusion children.

And besides that, the FCC had to make a tour of television stations late in January! But they saw some remarkable developments and got a free lobster dinner, though.

BROADCASTS FROM ARMY CAMP

Brigadier General Clifford R. Powell speaks into the new WOR microphone specially designed for use in a new weekly series, "This is Fort Dix." General Powell



is commander of the 44th Division and the army post at the Fort.

This is an adaptation of MBS's World's Fair microphone (in which the mike was made to represent the perisphere). And that was an adaptation of the famous Westinghouse "8-Ball" mike.

INTERNATIONAL ALLIANCE

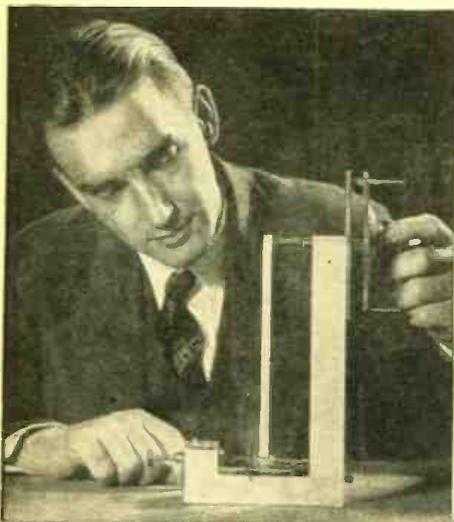
Despite the fact that their countries are at war—or in some cases making faces at each other—the four young ladies shown herewith got together in peace and amity to broadcast holiday greetings to their families abroad over WGeo and WGEA. They were part of a group of 80 girls who broadcast such messages. After the trans-

mission, these four were televised together with a world globe in which each was able to find her country—or what was left of it. Left to right are Vassar students Joyce Hallinan, of London, and Zosia Znamiecka of Poland; Bennington student Marion Krentz from Germany; and Russell Sage student Sumiko Yamaguchi from Japan.

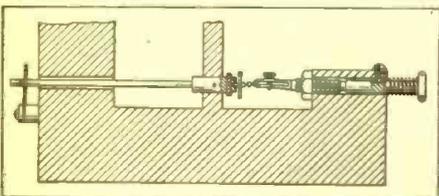


LOW VOLTAGES FORM FILAMENTS

That air breaks down and becomes conductive at voltages lower than sparking potential was proven in experiments conducted by G. L. Pearson of the Bell Telephone Labs. At voltages as low as 15 volts



it was found that tiny particles of metal were torn from small electrodes to form a conducting bridge. However, the potential at even these low voltages was actually about 10,000,000 volts per centimeter of electrode area. As the metallic bridge formed, the resistance across the electrodes dropped greatly. Various types of electrodes were used, experiments being conducted with gold, steel and carbon. Separation was extremely minute, being on the order of millionths of an inch. At these small separations, voltages were gradually applied



until the metallic filaments were formed and the breakdown occurred. The accompanying pictures show Pearson with the equipment and, in the drawing, a diagram of the apparatus.

NBC ANTENNA GOES ON TRIPLE SHIFTS

The big television and FM aerial NBC operates atop the Empire State building in New York City is being given a new set of special filters.

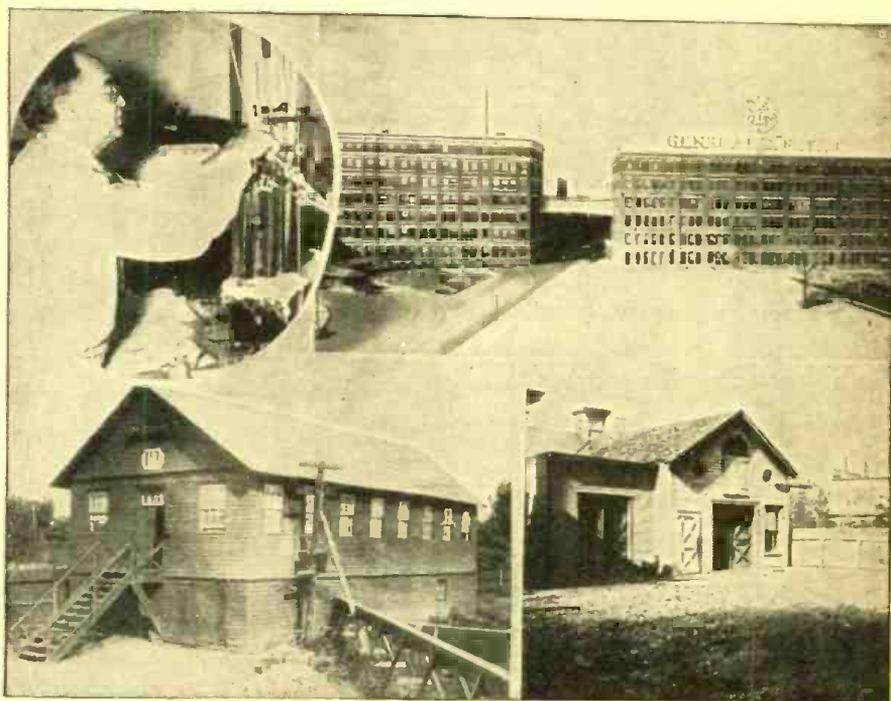
Within a short time a third transmitter, used for cue transmissions, also will be hooked into the system, and the three signals, on separate frequencies, will travel through the same antenna without impinging on each other.

By thus eliminating the temporary FM antenna in use up to this time, reception of FM programs will be improved in many sections of the metropolitan area, as the big main antenna over which these programs are now transmitted delivers the FM signals with equal strength in all directions.

RESEARCH LABS CELEBRATE 40TH ANNIVERSARY

Forty years ago Albert G. Davis, then head of G.E.'s patent department, and Dr. Charles P. Steinmetz, noted scientist, suggested to E. Wilbur Rice, Jr., then vice-president in charge of engineering and manufacturing, that the company should have a research laboratory. He concurred and the laboratory was voted into being by the Board of Directors. Dr. W. R. Whitney, then professor of M.I.T., was engaged as director. The lower right picture below shows the barn used as the first laboratory.

It was at the rear of Dr. Steinmetz's house, but was burned down some time in 1901. After the fire the lab was moved to the old G.E. standardizing laboratory, also pictured, and remained there until floods drove it out shortly thereafter. It moved again and again, finally landing in its present home, the two massive brick buildings shown. The oval picture illustrates Dr. W. R. Whitney, the first laboratory head, as he appears now at the age of 70. He is vice-president in charge of research for the company.



HAMS HELP OUT IN AN EMERGENCY

When wire lines went out in Amarillo, Texas, amateurs Tex Smith and Fred Trotter moved the former's portable short-wave transmitter to the office of the Amarillo Globe News. Then, when the power failed, they borrowed a gasoline generator from E. W. Glenn and kept Smith's sta-

tion, W5CYX, running. For several hours it was the only communication between the city of Amarillo and the rest of the world. In addition to handling messages for the paper, Tex (left) and Fred handled several hundred messages for public utilities and private citizens during the shut-down.



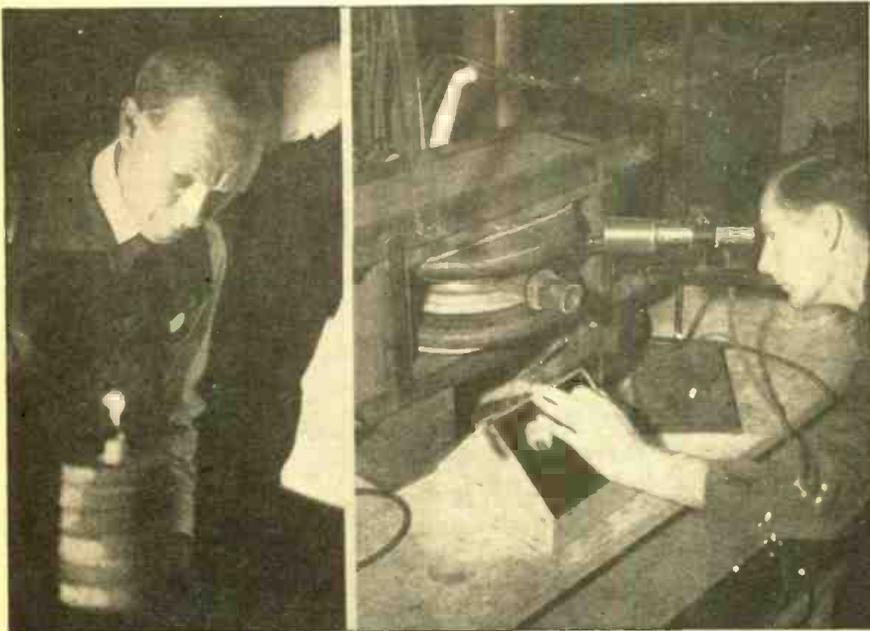
REVIEWS RADIO'S 1940 DEVELOPMENTS

In a year-end roundup, Dr. W. R. G. Baker, manager of General Electric's radio and television department, summarized the industry's advances for the past year. Two of these are illustrated below.

In the first picture, an engineer is seen observing the invisible—a shadow shows carbon dioxide gas (which cannot be seen by the human eye) snuffing a candle as it is poured from a beaker. The other illustrates an engineer observing the action of an induction electron accelerator which gives to these minute particles a velocity almost equal to that of light.

Summarizing Dr. Baker's address, TELEVISION has been through a tempest in 1940, and a national committee sponsored by the

RMA is soon to submit suggestions on acceptable standards, in the hope that the FCC will then permit commercial operation; FREQUENCY MODULATION made many advances, a large number of commercial, educational and other stations being allocated to some 35 channels; STANDARD RECEIVERS have developed, particularly as to the mid-get portable models, de luxe high-fidelity models, FM receivers and FM-AM combinations; ANTENNA ELIMINATION also received more attention from the manufacturers. Also getting a great deal of attention, but not much publicity, are the advances in reception and transmission for military purposes. FACSIMILE has also made some steps forward.



W2XB BUILDS NEW TELEVISION STUDIO IN CLUBHOUSE

Although some authorities in the industry do not believe that the real television boom will come until after the war has ended, the General Electric Company has taken over a large clubhouse in Schenectady, which it is remodeling into a mammoth television studio layout. Work on the building has already started and company engineers hope that it will be ready for operation by late spring or early summer. When completed the station will be devoted exclusively to television, embodying many special features, impossible to undertake in buildings previously used for such purposes.

Features of the installation will include an antenna 125 feet high for relaying programs to the main transmitter in the Helderberg mountains 12 miles outside of Schenectady. This antenna will be heated electrically in winter to prevent ice formations which might interfere with the successful operation of the station.

The main studio will be 70 feet long by 46 feet wide by 18 feet high and will occupy virtually the entire main floor.

All windows of the main studio will be blocked off, and illumination for the room will be provided by three-phase water-cooled mercury lights using the midget

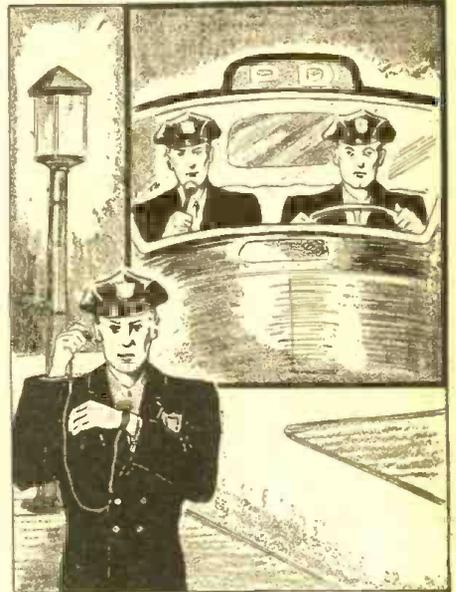
cigarette-type of lamp newly developed by G.E. These lights will provide 1000 foot-candles of illumination at any point within the room where action is going on during the televising of a program.

The ground floor or basement of the station will be occupied by the staff offices, scenery shop and modern heating equipment. The entire building will be air conditioned.

There will also be a large rehearsal room and adequate dressing room facilities for men and women.

NEW YORK POLICE USE SECRET SETS

To enable detectives entering or keeping suspicious premises under surveillance, the New York Police Department, in cooperation with RCA, has developed port-



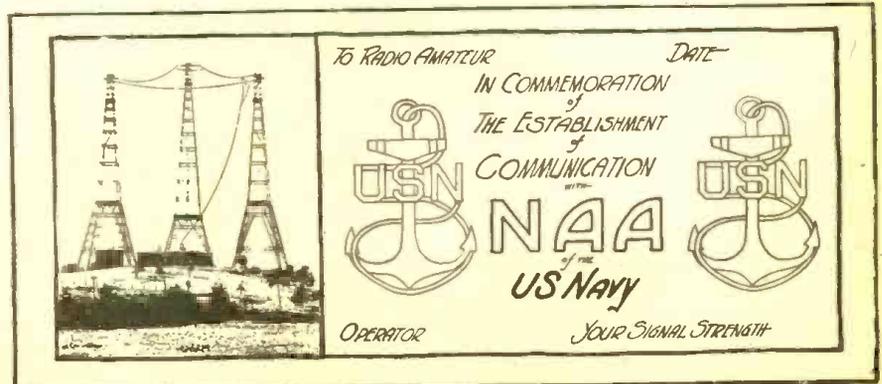
able transmitting and receiving equipment with which a man on foot may keep in communication with radio cars in the vicinity. This apparatus is so small and compact that it can be worn under the clothing, where it is invisible to passers-by. The microphone is strapped to the operator's wrist, much like a wrist watch, and is always convenient and inconspicuous.

The whole apparatus weighs but 10 lbs., and is capable of a transmitting range of about 1/4 mile. Its cost is approximately \$175 for the complete unit.

The equipment was demonstrated to New York City's Mayor La Guardia, who expressed deep interest in the project which was developed under the supervision of Superintendent Gerald S. Morris of the Police Telegraph Bureau. Some three years have been required to bring it to its present state of perfection.

NAVY ISSUES QSL CARD

The Navy Department, which is communicating with amateurs throughout the United States four times weekly, has designed an attractive card for QSLs. The first contact made was with WIAW, operated by George W. Bailey, president of the ARRL in West Hartford, Conn.





Top left photo—instructor is pointing out to the student on the blueprint, that the short parallel lines in the circuit diagram indicate the condenser he is pointing to with his right hand.

Radio station WIMII was the only "connecting link" between Eastport, Me., and the mainland, during the hurricane storm of last spring. This station was constructed and is now operated by the boys.

Photo at left shows one of the NYA radio students making resistance tests.

NYA Builds Fine Police Radio in Maine

● CORNERSTONES in the nation-wide radio project of the *National Youth Administration* are the units in the State of Maine. There, young people employed by the NYA have already set up the pivot of a nation-wide shortwave radio network of amateur stations. There, also, NYA youth are constructing a state-wide network for the State Police, with the first two units already completed, and they are helping other public agencies to improve their radio communications facilities.

The nucleus of radio work being carried on in Maine is the National Youth Administration's regional project located at Quoddy Village, Eastport. Here approximately 500 needy young men from the New England States, New York, and New Jersey live, work for wages, and get practical experience in a variety of occupations. Eastport is a small village in northeastern Maine, just south of the Canadian border and adjacent to Passamaquoddy Bay. When work was stopped on the Passamaquoddy Bay Tidal Power Project, a model village constructed by the U. S. Army Engineers was left with no occupants. The National Youth Administration, taking advantage of the availability of these facilities, has established at this village a regional work center, designed to enable young men who are unable to find jobs in private industry to work for wages and acquire the practical experience they will need to get private employment. Young men between the ages of 18 and 24, inclusive, are given the opportunity to get practical experience in a number of occupations by doing productive work. Radio has been one of the most popular and most successful of the types

of work offered at the Quoddy NYA center.

Beginning with a nucleus of station WIMII at Quoddy Village, which was licensed by the FCC, effective April 23, 1940, NYA youth have already established a series of amateur club stations which form a link down the entire Eastern Seaboard of the United States, including the strategically important island of Puerto Rico. In addition to the Quoddy Village radio club, five NYA youths at the project hold individual private amateur licenses.

Quoddy radio has already demonstrated its value to the public in furnishing emergency communications. In April 1940 a 68 mile easterly gale and blizzard destroyed the electric and telephone facilities in this part of the State, including the near-by Canadian islands. Near-by wharves and local shipping suffered heavy damage. Quoddy radio was the only link to the outside world. On the first day of the storm messages were relayed by amateurs down the coast at Millbridge, Ellsworth, and Southwest Harbor. On the second day of the emergency one of the partially built State Police car transmitters, powered by storage batteries, was placed in operation and was used to relay messages to the Quoddy Head Coast Guard station and thence down the coast. Messages were also relayed to the Coast Guard cutter *Travis*. Messages were also relayed for the Eastport Weather Bureau, which was important in compiling data for mariners at sea. A father in Canada, whose daughter had died at Eastport, got his sad but important message through the facilities of the Quoddy radio project.

"You can't do it" was what various radio

experts told Sam Freedman, the National Youth Administration's Radio Engineer for Maine, when it was proposed that a relatively inexperienced crew of boys from the Quoddy radio unit undertake the construction of a state-wide network for the Maine State Police. The NYA Engineer had proposed to begin the system with two fixed transmitters, one at Wells and one at Thomaston, operating on frequencies of 1642 kcs. and 39,900 kcs., and providing communications with 15 mobile units. It was planned to operate the Thomaston station WSTR with 300 watts power and the Wells station WSWD with 100 watts power.

"How are you going to get enough signal strength with that low power? It ought to be kilowatts, instead of watts. How are you going to overcome the poor ground conductivity without an elaborate network of buried ground wires?"

By utilizing the enormous sensitivity inherent in super-regenerative receivers, the distances were covered very successfully with low power. Signals which were entirely inaudible on a superheterodyne receiver came in full power on the super-regenerative receiver. Although a super-regenerative circuit is the most sensitive circuit known, it is not generally used, due to the fact that it is broad-tuning. This defect was of no great importance in the State of Maine, however, since there is very little traffic on ultra high frequencies in that State.

Sam Freedman stuck to his contention that he had enough power, and, as for the poor ground conductivity, that was easy. The answer was to use no radial ground

wire system at all, but instead to use a few driven copperweld ground rods made of steel and coated with copper, which were buried alongside the mast and attached to the mast. It would have been physically impossible to have a radial wire ground system, because buildings, driveways, highway, and private property intervened.

When the word got around that the NYA planned to install a guyed mast, instead of a self-supporting one, and that there would be 18 guys with about a mile of wire involved, many experts were certain that by the time the vertical mast, which acts as the aerial, radiated its signal through the guy wires, the latter would absorb so much energy that there would be nothing to listen to. This was solved by inserting 300 insulators in the guy wires, so that they were broken up into conducting lengths of such dimension that they would not respond to any wavelength being used, or to any harmonic or fraction of that wavelength. The first 15 feet of the three top guy wires were left uninsulated and made part of the mast radiator, so that the actual antenna was supplemented by the first 15 feet of three different guy wires. This resulted in 3 x 15 feet of top-loading, which caused a tendency for the radiated signal to keep more of its sky wave signal component closer to the earth and available, rather than dissipated in space at heights or distances beyond the pick-up of cars and other stations.

After plans for solution of the various technical difficulties involved in the project were explained, the argument that "This was no job for a bunch of green kids" was advanced.

But the people of Maine had faith in the ability of these NYA youth. They had seen it demonstrated at Quoddy and elsewhere in the State that these young people were good workers, and that all they needed was a chance. The State agreed to be the "guinea pig" in this experiment and was willing to venture \$10,000 (the approximate amount needed to buy materials and equipment) that it was guessing right. So in February 1940, while critics were saying, "Heaven help the State Police by the time they get these sets and try to make them work with a bunch of green NYA kids building them," work was started on the State Police network.

In spite of the dire predictions of the calamity croakers, the NYA youth com-

pleted all work on schedule, and the equipment when finished could not be distinguished from a factory job from the standpoint of appearance and performance. This proves again the contention so often voiced in NYA administrative circles that the sole limitation of excellence of production is the supervisor who directs the work and not the youth who performs it.

Under the cooperative arrangement between the State of Maine and the National Youth Administration, the State was to supply all materials and equipment, knocked down, and NYA youth were to do the assembly, construction, and installation work. The first unit in the system provided for the two fixed transmitters at Wells and Thomaston and 15 mobile units operating with 10 watts power on 39,900 kcs. for two-way operation, installed in police scout cars. This made possible car-to-car communication of an 80-mile radius, operating via one of the headquarters or direct car-to-car communication up to distances of 20 miles.

The antenna system for the fixed transmitters includes a 205 foot tower, founded on a steel plate which is kept in place by bolts protruding from a cement foundation. Several driven copperweld ground wires around the foundation were used to ground the steel plate. All lighting conduit and coaxial transmission lines go into the transmitter building underground with allowance for frost. This method was used because overhead conductor material might have disturbed the radiation pattern with a condenser effect between the overhead lines in relation to the earth.

The mast is a 101 wind charger type and was delivered to the NYA in about 6000 pieces. A crew of seven NYA youth, although without previous experience in this type of job, assembled the mast absolutely correct at the rate of one running foot every half minute.

The first part of the system, which included station WSTR at Thomaston and seven mobile units, was completed in Au-

gust 1940, and the second part of the system, which included WSWD at Wells and eight mobile units, was completed in October 1940. The success of the work done was such that in November 1940 Governor Barrows of Maine requested expansion of the system, with a new fixed transmitter at Augusta. This will be a 1000 watt transmitter and will operate on 1642 kcs. for one-way transmission and will include two-way facilities on 39,900 kcs. There will also be additional mobile units.

On the basis of its work for the Maine State Police, the National Youth Administration has been asked to undertake a project for the installation of four frequency modulation stations for the city of South Portland, Maine, and a system of seven frequency modulation stations for the city of Bangor. The system proposed for Bangor will be a coordinated one, serving possibly the adjacent communities of Brewer, Orono, and Old Town. There is also under consideration a proposal to build ten stations of 25 watts output for a NYA chain in Maine.

Starting in January 1941, the NYA in Maine is setting up a new radio unit at Bangor which will give up to 60 young people experience in construction, repair, and communications work. Frequency modulation work has already started for NYA youth in Maine, and that is what they are going to tackle on a bigger scale in the future.



The three photos show—left, interior of the "fixed" S-W police radio station at Thomaston, Me., built by NYA members; right, below, portable transmitting and receiving equipment in rear deck of police car, controlled by flexible cable; installation built for state police use by NYA boys. Photo, right, shows NYA operator tuning a Hallcraft receiver. This station's call is WIMII and the composite transmitter was built by the NYA group in Maine.



Simple Improved Crystal Set

● A CRYSTAL set for which great things are claimed ("It is the last word in efficiency.") has been designed by L. T. Moore and is described in *The Australasian Radio World*. He says that by manipulating the various tuning controls, one can obtain the best results possible from a crystal receiver.

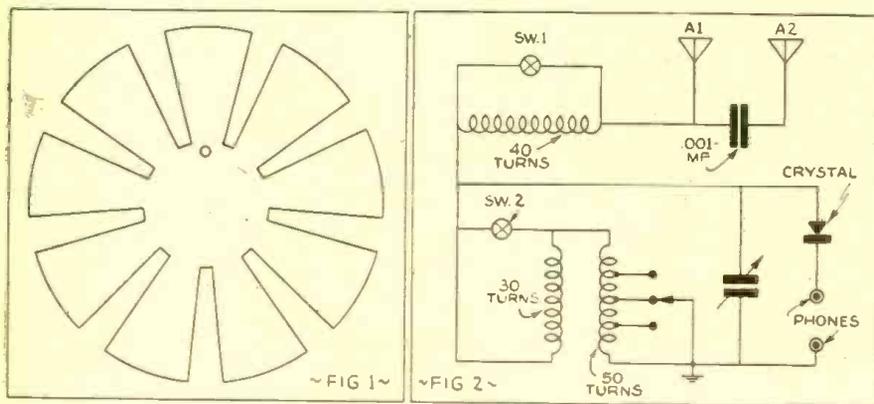
The first step is the construction of the

and twisted to provide a tap; then 10 more turns are wound and another tap made. The winding is continued until a total of 50 turns have been wound with a tap at each 10 turns so that you have 50 turns, with 4 taps and 2 ends. The coil is finished by punching a hole in the vane and threading a wire through it once or twice, leaving 6 inches for connections.

wound it is given a coat of some adhesive (such as collodion or nail polish) and removed from the form. An 8 inch end should be left.

The .0005 or .00035 mf. variable condenser is mounted on the panel and, by means of a strip of wood, the tapped spider coil is mounted with its axis vertical and its face parallel with the panel. The other spider coil is mounted on an arm so that it can be brought closer to or further from the tapped coil. The 30-turn coil is fastened on the base directly under the two spider web coils, which must be mounted high enough to clear it. A strip of wood placed across the coil will hold it down very nicely. A tap-switch on the panel is connected to the taps on the 50 turn coil, and separate switches are provided to short the 40 turn and 30 turn coils when desired.

The crystal may be of the inexpensive cat whisker type or the slightly more expensive and convenient fixed detector. An efficient outdoor aerial is used. It should preferably be from 25 to 50 feet long, but the author states that he was able to pull in 5 stations with only an 8-foot wire lying on the floor. Some stations will be received better with the antenna in position A1, and others with a connection as at A2. Some experimenting in tuning will be necessary in order to secure best results. (This reviewer suggests that connecting a .00025 mf. fixed condenser across the phones may also increase the set's efficiency.) The variable condenser is connected across the tapped coil for tuning in the stations.



Above—Coil form and also hook-up for a simple "crystal" receiving set.

tapped spider web coil, which is made on a form 5½ inches in diameter and shaped as shown in Fig. 1. This coil is wound with No. 22 enameled wire which is started in the small hole shown under the bottom of one of the vanes. Every turn must be pressed down to the bottom of the slot. When 10 turns have been wound on, the wire must be doubled back for about 1 inch

The 40 turn coil is wound next on a separate, identical form, using No. 18 enameled wire. There are no taps in this coil—it merely has 40 turns.

The 30 turn coil is now wound not on a spider but on a tubular form 3½ inches in diameter. This may be a round bottle or a cardboard tube. No. 20 enameled wire is used for this coil, and after it has been

SIMPLIFYING TONE CONTROL

● AN extremely simple phono tone control is described in *The Australasian Radio World*. It consists merely of a specially wound coil, a 50,000 ohm variable resistor and a .01 mf. condenser. It is for use with moderate priced mechanical pick-ups, most of which says the author, A. Earl Read, have a prominent resonance peak at about 3,000 cycles. The control is claimed to level it off without unduly increasing the highs, and also to reduce needle scratch greatly.

The parts required are a panel about 3 x 4 inches, 50,000 ohm potentiometer, a .01 mf. tubular condenser, a "4-pie" bobbin for use as coil form, 1 oz. of No. 42 enameled wire, 8 banana jacks and 5 banana plugs. The bobbin is held in the clinch of a hand drill which is clipped to the device, and 1,600 to 2,000 turns of the wire are wound in each section of the bobbin. Taps are brought out at each end and between each pair of "pies." It is not necessary that the turns be accurately counted as the variable resistance has sufficient range to compensate for errors.

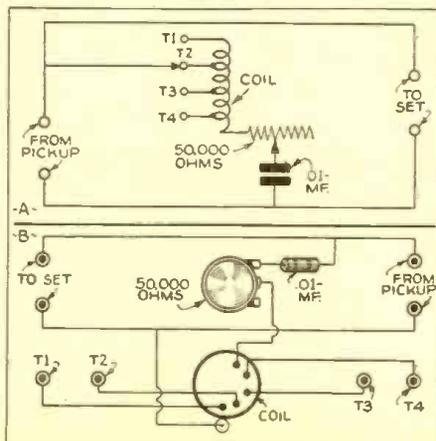
In use, the pick-up is plugged into one pair of jacks and the output to the other pair. The jacks across the bobbin afford taps so that the impedance load in parallel with the pick-up and input can be varied. Cut-off can be had at approximately 3,500, 2,500 and 1,500 cycles by moving the banana plug from one type to another. In operation, the resistance is placed at maximum and the banana plug inserted in various jacks until the tone is most greatly improved, after which the resistor is adjusted.

The output of the pick-up will be slightly reduced at all frequencies so that a moderate increase or stepping up of the volume control will be necessary. However, experiments can be carried out by substituting other values for the tubular condenser. The author suggests anything from .002 to .1 mf.

IN NEXT ISSUE!

How to Get ELECTRONIC Music Through Your Radio Set

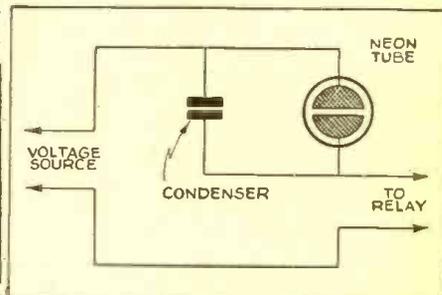
by H. G. Cisin, M.E.



A simplified tone control circuit.

NEON TUBE AS PHOTO CELL

● A WRITER in a British publication—*Electronics and Television and Short-Wave World*—brings up an interesting phenomenon whereby a gas filled discharge



Hook-up of Neon tube used as a photo cell.

tube, such as a Neon lamp, can be used as a photo-electric cell. He points out that tubes of this sort are often used to discharge a condenser automatically when the voltage between the plates of the condenser has risen to a pre-determined value. Under observation such circuits have sometimes been found to operate differently in various locations or at various times of the day. He explains this, saying "the striking potential of the tube depends, among other things, on the amount of light that falls on the tube. Thus, a tube designed to have a striking potential of 90 volts in daylight may not strike until 123 volts are reached in complete darkness." He suggests that the striking voltage can be stabilized at the daylight

figure by putting a small dab of radium-activated luminous paint on the outside of the bulb. It can also be stabilized at the night figure by putting the tube in a light-proof container or painting it black.

However, these characteristics bring

forth an interesting basis for an experiment. If a tube having such characteristics is given an applied potential of say 115 volts and is shielded from the light, it will not strike, but if a beam of light is then permitted to fall upon it the tube will become

conductive and current will flow in its circuit. This characteristic could be made use of to actuate a relay in order to start apparatus functioning when a beam of light is directed upon the tube. Many other experiments will suggest themselves.

Wavelength Checking Centre

● THE task of checking and reporting on the wavelengths of European broadcasting stations, which has for many years been carried on at Brussels by the *Union Internationale de Radiodiffusion*, was abruptly terminated by the German invasion of the Low countries. M. Raymond Braillard, the director of the Brussels checking center,

was faced with the task of evacuating the apparatus or risking its destruction.

We now learn from the Bulletin of the U.I.R. (says *The Wireless World*, London), that the task of evacuation was successfully accomplished. On May 16th it was removed from Brussels and eventually, after many vicissitudes, it arrived safely at

Geneva, the headquarters of the Union. Some of the expert staff of the Brussels center were able to resume their observations, and reports have been sent out to all members of the U.I.R. and to the various Administrations through the intermediary of the International Telecommunications Union at Berne.

Superheterodyne for Automobiles

● AN extraordinarily sensitive and selective superhet for use in automobiles has been designed by the engineers of the *Laboratorios UCOA* and is described in the latest issue of Argentine's *Radio Revista*. The circuit is a simple one as shown in the diagram. Filaments of the two 6K7's, 6A8, the 6Q7 and 6K6G are connected in parallel, drawing their current from the starting and lighting battery. The "B" power is derived from a vibrator pack and, while the one specified is of South American make, any equivalent domestic eliminator may be substituted.

The specifications as given in the South American magazine are as follows: Inter-

mediate frequency 252 kc.; antenna filter built in; automatic sensitivity control; special antenna coupling to permit the use of any type of auto antenna; sensitivity about 15 milliwatts, better than half a microvolt; high power output due to the use of the 6K6.

As an inspection of the diagram shows, the circuit includes one stage of RF followed by an 6A8 frequency converter after which is the intermediate stage. Both the IF and RF stages make use of 6K7's. The modulator and automatic sensitivity control and audio pre-amplifier are obtained from the use of the 6Q7, and finally the power stage appears in the 6K6G. The loudspeaker

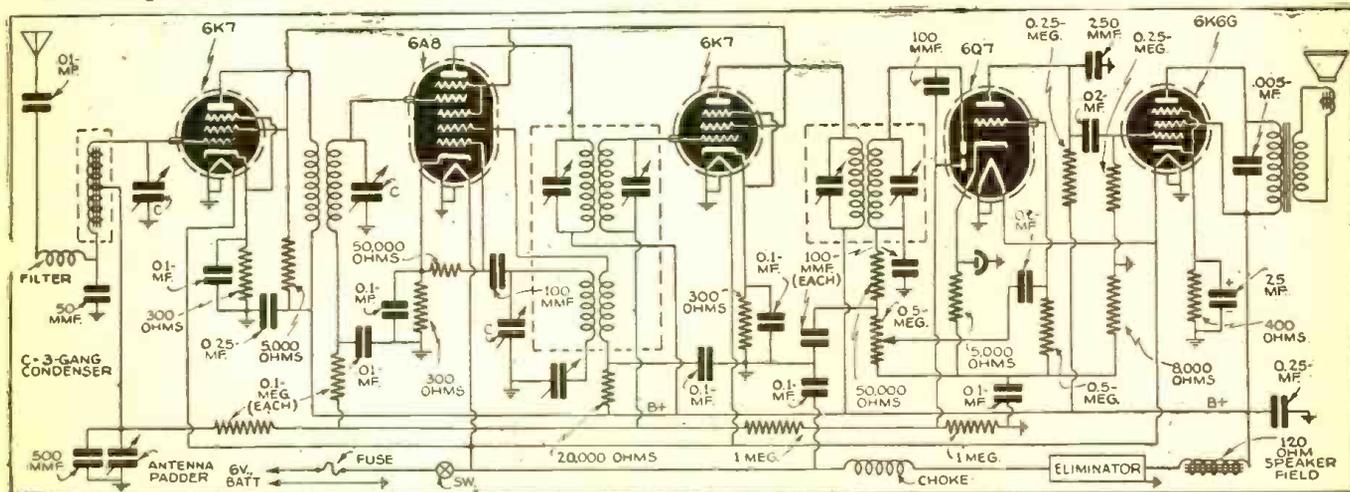
used is of the new permanent magnet type.

While the antenna coupler is of a special type, this need not be used, and any standard antenna coupler available on the American markets may be substituted.

The construction of the set is simple and straightforward, the usual precautions as to short and direct leads being observed. As all the cathodes are indirectly heated, it is not necessary to watch polarity on the heaters as is necessary when low voltage, direct heating filament tubes are used.

A list of the parts follows:

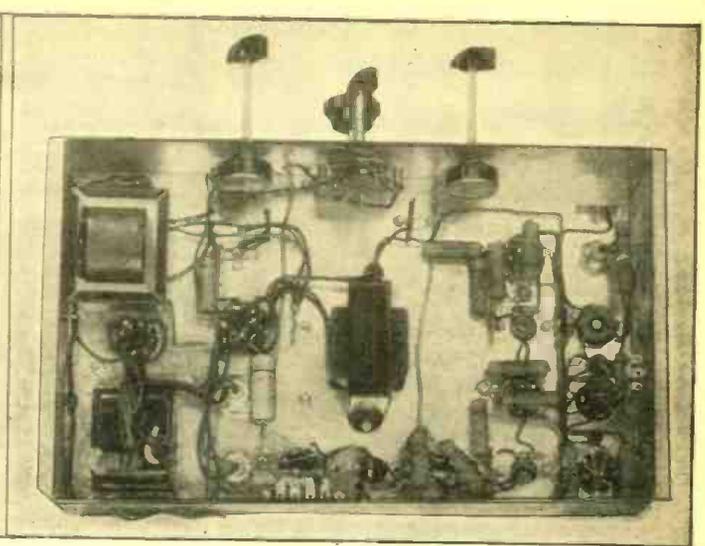
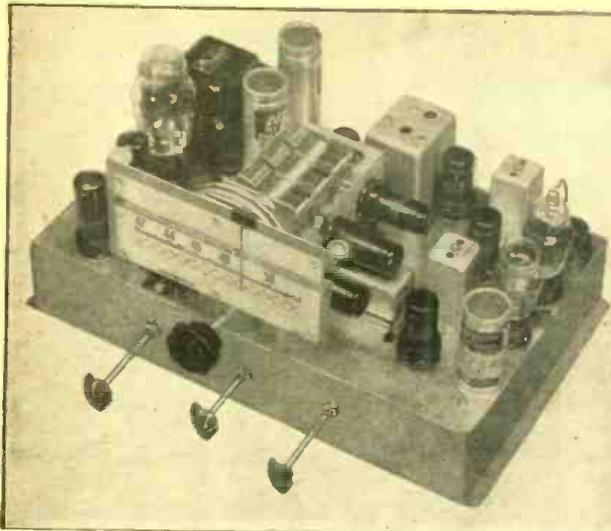
5 octal sockets; 1 vibrator type B eliminator, loudspeaker; 1 3-gang .00041 mf. condenser with trimmers; 1 metal cabinet;



- 1 chassis; 1 remote control with dial; 1 volume control; 5 tubes 2-6K7, 1-6A8, 1-6Q7 & 1-6K6G; 3 cond. .01 mfd. 400 v.; 5 cond. .1 mfd. 400 v.; 2 cond. .25 mfd. 400 v.; 1 cond. 5 mfd. 200 v.; 2 cond. .62 mfd. 500 v.; 1 cond. .005 mfd. 600 v.; 1 cond. .00005 mfd. mica; 1 cond. .0005 mfd. mica; 1 cond. .00025 mfd. mica; 4 cond. .0001 mfd. mica; 2 cond. .25 mfd. Elect. 25 v.; 3 Resistors, 300 ohms ¼ w.; 2 Resist. 100 M. ¼ w.; 1 Resist. 20 M. 1.0 w.; 1 Resist. 15 M. 1.0 w.; 1 Resist. 5 M. ¼ w.; 1 Resist. 8 L. ¼ w.; 2 Resist. 1 meg. ohms ¼ w.; 2 Resist. 50 M. ¼ w.; 2 Resist. 50 M. ¼ w.; 2 Resist. 250 M. ¼ w.; 1 Resist. 250 M. ¼ w.; 1 Resist. 500 M. ¼ w. 1 Resist. 400 ohms ½ w. A fuse protects the circuit as the diagram shows.

Can YOU Answer These Radio Questions?

1. Who demonstrated multiplex facsimile recently and where? (See Page 646)
2. What practical use was made of the apparatus built by Maine NYA youth? (See Page 650)
3. How can a Neon tube be used as a photo-electric cell? (See Page 652)
4. Can you explain simply how to connect several loudspeakers having different impedances across the output of an amplifier? (See Page 659)
5. Can you describe briefly how to align intermediate frequency stages of a superhet? (See Page 660)
6. What was the real story behind the fake S.O.S. report recently investigated by the FCC? (See Page 666)
7. What is the purpose of the crystal control oscillators in the Muniz system of "pull-swing" frequency modulation? (See Page 670)
8. Name three important factors to be watched in laying out a "Ham" station. (See Page 674)
9. In the Scophony large image television system, is the picture projected from behind or in front of the screen? (See Page 679)
10. Can you draw a diagram showing how to modernize an old Pilot receiver, to use the modern metal tubes? (See Page 688)



F-M Receiver for the HOME

L. M. Dezettel, W9SFW*

● MOST FM articles in the past have been based upon the construction of an adapter which may be used for existing AM receivers. The presumption has been that the audio system in your present radio is of high enough fidelity to warrant the

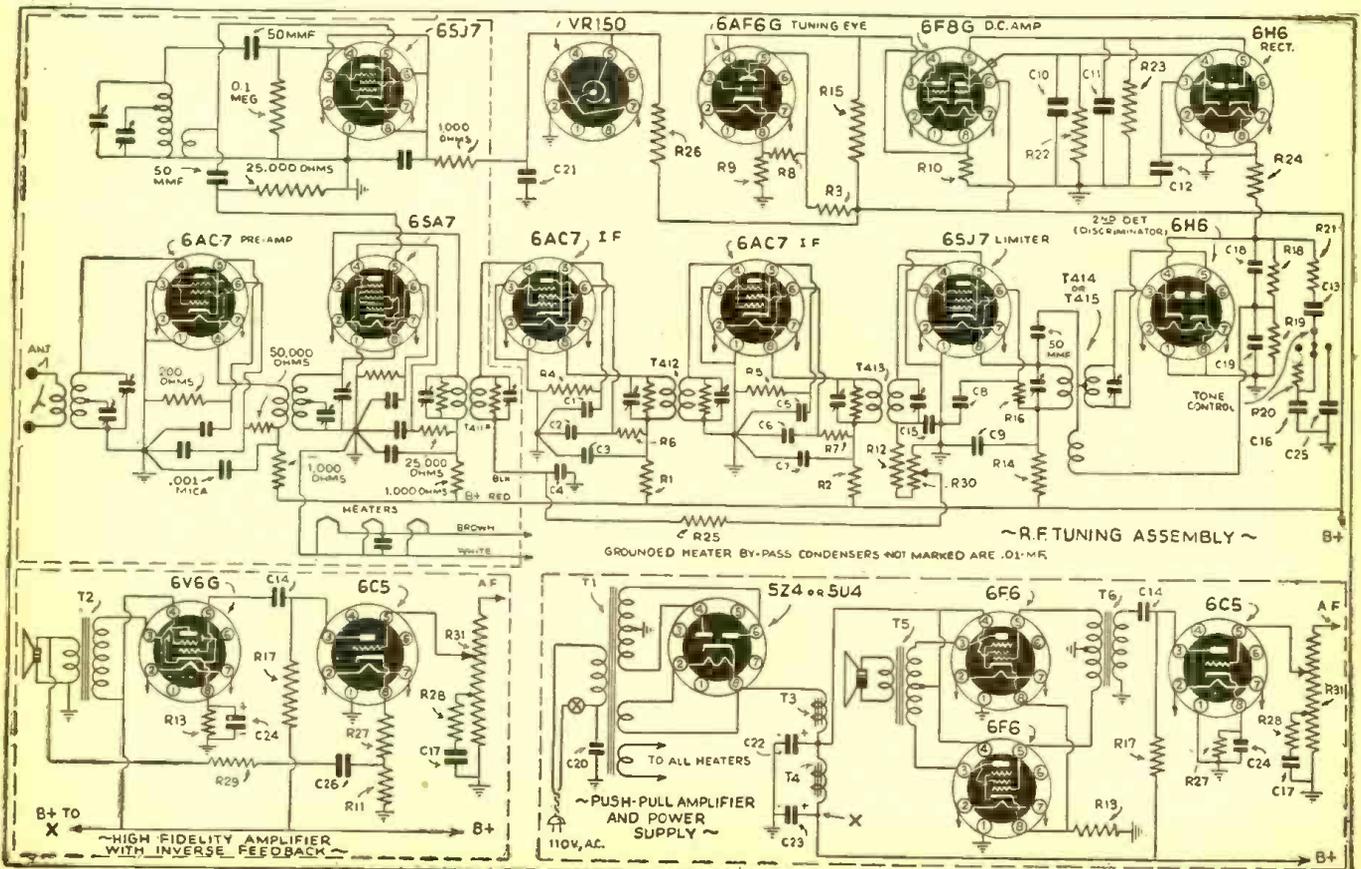
addition of an FM adapter. This is a false presumption, however, as the manufacturers of AM receivers have never taken into consideration the reproduction of musical notes whose frequencies exceed 5,000 cycles per second. The construction of the FM receiver which we are about to de-

scribe was undertaken because of the many requests received by the author for a complete receiver.

You are already acquainted with the many features of FM transmission and reception. The higher fidelity and absence of noise made possible by this method of

*Engineer, Allied Radio Corp.

Diagram of the Frequency Modulation Receiver.



reception has been proven to be so far superior to the AM method now used that the interest is sweeping the country like wild-fire.

R.F. Pre-Amplifier

While this set has a few innovations not found in receivers described previously, fundamentally it is straight-forward and very much standard as to circuit and parts used. The 6SA7 converter tube is preceded by a 6AC7 pre-amplifier to help build up the signal level above the first detector tube noise generally encountered and to reduce response to images. Two 6AC7 I.F. stages further amplify the signal at 4300 kc. The 6AC7 tubes are high-gain pentodes especially developed for television work where design considerations were similar to that in FM. A 6SJ7 tube adds a little to the amplification, following the I.F. stages, although used principally as a limiter, levelling out the carrier strength and taking out all noise both above and below the carrier level. This tube is followed by 6H6 second detector, or a discriminator, as it is called in a FM receiver. The signal for the tuning eye is taken off at this point, rectified, directly coupled to a 6FAG tube which acts as a D.C. amplifier for the 6AF6G dual tuning eye. Also following the 6H6 discriminator is a tone control network and the audio system. The tone control has four positions, the first of which is *no control* which, due to the method of transmission of FM signals, amounts to boosting the higher frequencies. The second position is a slight attenuation of high frequencies, the net effect of which is to give a flat frequency response. This would be the *normal* position for average reception. The next two are two increasing steps of high attenuation which give music the bass boost effect that most people seem to prefer. A choice of audio channels is shown, both of which were tried and found successful. For highest possible fidelity we suggest the use of push-pull 6F6's.

As punched and drilled chassis are available for this receiver, assembly is very simple. All parts should be mounted as shown in the photograph with the exception of the high frequency tuner. This is left for the last in order to avoid possible damage to the dial and the gang condenser. Obviously, you may make up your own layout as long as you keep in mind that short leads from one part to another are essential and that the power supply and audio channel are well isolated from the R.F. circuit. The layout used in this receiver was carefully planned with these considerations in mind.

Possible to Build It Yourself

A diagram shows the complete wiring circuit, and the values of resistors and capacities for the various components are listed at the end of this article. Although we use a special Carron R.F. tuning assembly which is available completely assembled and wired and with six leads coming out of it for connection to the rest of the circuit, the values used in the R.F. tuning assembly are shown in the diagram; and it should be possible for you to build your own. The value of extremely short leads cannot be stressed too much in a receiver of this type. The peculiar horizontal mounting of the tubes used in the high-

frequency portion of the set was used because of the necessity for having very short leads in this portion of the circuit. Even the I.F. channel operates at a fairly high frequency; so care is required in wiring this part of the circuit also. The long lead from the 6H6 discriminator to the tone control is a single-conductor shielded wire, as is also the lead from the grid return of the first 6AC7 I.F. circuit to the center arm of the R30.

The electric tuning eye is wired with five flexible leads out of a hole in the top of the chassis. These leads may be as long as necessary to locate the electric eye on your cabinet, according to your own choice.

Alignment Is Simple

Now we come to the problem of alignment. The success or failure of proper FM operation can be determined upon the way the set is aligned. Yet, in spite of the importance of this procedure, it is not at all difficult to do. In this receiver adjustment of the R.F. tuning assembly is eliminated by purchasing the completely wired and aligned factory assembly. I.F. coils, too, are pre-tuned at the factory to 4300 kc. It is best, however, to re-trim them just a little. If possible, this should be done with a signal generator as it is best accomplished with an amplitude modulated carrier input. In the absence of a signal generator, the broadcast station carrier can be used instead. Connect a 0-1 ma. meter in the grid return of the 6SJ7 limiter stage. This would be between I.F. transformer T413 and resistor R12. Now, tune in the station until a reading is obtained on the milliammeter, and carefully trim each of the I.F. transformers for maximum reading on the milliammeter. Do not touch the discriminator coil, however. At this point it might be well to say that for good limiter action there should be at least .4 ma. of current in this circuit. If you cannot obtain this much of a reading on the milliammeter, and assuming that the receiver is properly wired, it means that you are located too far from the FM station or that you require a higher or better antenna.

During these adjustments you will be hearing a signal in the speaker from the amplitude modulated signal generator. Turn down the signal generator until the tone is barely audible and adjust the primary of the discriminator transformer (T414) for maximum output in the speaker. Now adjust the secondary trimmer on the discriminator transformer until *no* signal is heard in the speaker. It is important that you get an absolute null point in this adjustment.

That's all there is to the adjustment. If a station signal is used for these adjustments the results will be the same up to the point of adjusting the secondary of the discriminator transformer. At this point you cannot get a null from a frequency modulated carrier. You simply adjust for best tone quality, checking your adjustment by rocking the main tuning condenser back and forth and observing whether or not the rushing sound each side of the peak carrier setting is equally spaced on the dial.

Incidentally, we found that the usual bone or fiber neutralizing condenser was not satisfactory for adjusting the discriminator transformer. A neutralizer made of polystyrene was the only thing that would



DEALERS SERVICEMEN
BUILDERS AMATEURS

All Agree!

"Here's the Big Book of
RADIO VALUES"

FREE
GET IT NOW!
212 PAGES!



EVERYTHING IN RADIO!



85 NEW
Knight
RADIOS

See them all—1941's Radio Hits! Models for every purpose—at every price. Plastic and wood models; world-wide sets; "Personal" and mantel models; Recorders and Phono-Radio 3-way Portables; Farm Radios; Amateur Combinations; Auto Sets; all at new low prices! See them in this greatest of Radio Catalogs!



Save money on
EVERYTHING IN RADIO

24 NEW SOUND SYSTEMS, complete P.A. listings; all new Amateur receivers and complete Ham gear selections; parts, tools, test equipment, books—more than 15,000 quality radio items—you'll find Everything in Radio at Lowest Prices in your ALLIED Catalog!



RADIO BUILDERS!

BUILD YOUR OWN! Count on ALLIED for the latest low-cost kits and for help in building any type of radio circuit. ALLIED is Headquarters for Radio Builders!

The "Radio Builders' Handbook"—valuable beginners' book on radio; easy to understand. Illustrated. Only 10c



New! "Radio Dictionary." Compiled by experts, under ALLIED supervision. Gives concise, easy-to-understand definitions of all commonly used radio terms and words. Only 10c



DON'T MISS THE BARGAIN SECTION!

ALLIED RADIO

833 W. Jackson Blvd. Dept. 3-C-1
Chicago, Illinois

- Send me your FREE 1941 Radio Catalog.
- I enclose 10c for New Radio Dictionary.
- I enclose 10c for Radio Builders' Handbook.

FREE CATALOG

Name

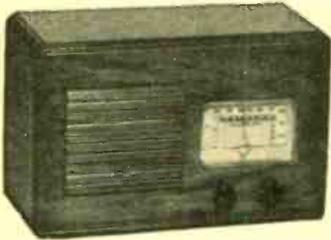
Address

City State

For Your
Personal Enjoyment

buy a *Symphony*

direct from the manufacturer and SAVE



MODEL MB
12" long, 7 3/4" high, 6" deep, 8 1/2 lbs.

Check the **NUMBER** of advantages

- ✓ Custom built
- ✓ RCA licensed
- ✓ Superheterodyne
- ✓ 5 tubes
- ✓ Illuminated dial
- ✓ Automatic volume control
- ✓ Built in loop — no aerial or ground necessary
- ✓ Tunes from 530 to 1650 K.C.
- ✓ Walnut finish and best of all

FULLY GUARANTEED FOR ONE YEAR

Note our low price (F.O.B. N.Y.) **\$7.95**

Symphony

PORTABLE PLAYMATE

3 way radio

MODEL G

9 1/2" long, 6 3/4" high, 4 1/2" deep



The smallest Portable ever made

- ✓ Operates on batteries or AC-DC 110 volt house current.
- ✓ Costs only 5c to replace A battery.
- ✓ Longer Battery life and lower operating cost.
- ✓ 5 tubes do the work of 7—1A7—1T5—1N5—1H5—35Z5.
- ✓ 4" Heavy P.M. Speaker.
- ✓ Magic antenna.
- ✓ Superheterodyne circuit.
- ✓ Easy reading dial.
- ✓ Automatic Volume Control.
- ✓ Automatic power switch.
- ✓ New Oscillator Circuit.
- ✓ Chamber speaker grill.
- ✓ Two tone fan grained cabinet with simulated leatherette.
- ✓ Weatherproof case.

On account of its light weight, it may be carried and played anywhere. It's a real pal. Weight only 8 1/2 lbs. Price complete **\$11.95** with batteries

Symphony

Automatic Record Changer

(not illustrated)

- ✓ Plays 12, 10 inch or 10, 12 inches records.
- ✓ 3 tube AC amplifier.
- ✓ 6 inch Dynamic Speaker.
- ✓ Walnut polished cabinet.
- ✓ 5 watt output.
- ✓ No attachments necessary.
- ✓ Weight, 18 lbs.

Price complete **\$23.95**

As everything we offer above is fully described, no catalog is issued. To insure prompt delivery, send your order NOW.

RECORD-O-VOX INCORPORATED

80 Cortlandt St. (Dept. 341) New York City

not give a capacity effect when touched to the trimmer condenser.

We found this arrangement of a tuning indicator to be one of the best. The shadow angles are minimum when you are tuned to exact station resonance. This is important for best program fidelity.

The importance of using a good speaker for full realization of the high fidelity transmissions made possible by FM cannot be over-emphasized. Until recently, even quality speakers lacked the ability to reproduce frequencies above 5,000 cycles. Now, however, the better speaker manufacturers are producing speakers whose cones are designed to carry a very wide band of audio frequencies.

If you are not located very close to a FM station, it will be necessary for you to exercise extreme care in constructing a good antenna for your receiver. FM antennas are available commercially which have low impedance, properly matched feeders, and are the best type to use. Erect the antenna as high as possible. If it is of the simple di-pole type, it should be erected so that its length is vertical to the plane of the direction of the FM station. Directional type antennas will further increase the signal strength. In general, follow the same procedure that amateurs use for operating on the ultra high frequencies, except that the length of the antenna must be equal to one-half wave length of the transmitting frequency, as measured in meters.

Parts List

- 1—Complete R.F. Assembly (shown within dotted lines on schematic) Carron T156
- 1—4300 kc. interstage I.F. transformer
- 1—4300 kc. output I.F. transformer
- 1—4300 kc. discriminator transformer
- 1—Single pole, 4 contact rotary switch
- 1—Calibrated slide rule dial, Carron T158
- 1—9 1/2" x 15" x 3" chassis (available punched)
- 13—.05 mf. 400 volt tubular condensers, C1, 13
- 3—.001 mf. mica condensers, C15, 16, 17
- 2—.001 mf. mica condensers, C18, 19
- 1—4 mf. 450 volt upright electrolytic condenser, C21
- 1—.002 mf. mica condenser, C25
- 3—1000 ohm, 1/2 watt resistors, R1, 2, 3
- 2—200 ohm, 1/2 watt resistors, R4, 5
- 3—50,000 ohm, 1/2 watt resistors, R6, 7, 21
- 2—10,000 ohm, 1 watt resistors, R8, 9
- 1—500 ohm, 1/2 watt resistor, R10
- 1—10,000 ohm, 1/2 watt resistor, R12
- 1—25,000 ohm, 1/2 watt resistor, R14
- 1—200,000 ohm, 1/2 watt resistor, R15
- 6—100,000 ohm, 1/2 watt resistors, R16, 17, 18, 19, 20, 28
- 4—1 meg., 1/2 watt resistors, R22, 23, 24, 25
- 1—4000 ohm, 3 watt resistor, R26
- 1—25,000 ohm potentiometer with switch, R30
- 11—Octal sockets
- 1—Tuning eye assembly
- 1—.1 mf. 600 volt tubular condenser, C14
- 1—.01 mf. 600 volt tubular condenser, C20
- 1—8 mf. 450 volt upright electrolytic, C22
- 1—16 mf. 450 volt upright electrolytic, C23
- 1—10 mf. 25 volt tubular electrolytic, C24
- 1—250 ohm, 3 watt resistor, R13
- 1—2000 ohm, 1/2 watt resistor, R27
- 1—1 meg. potentiometer, R31
- 1—Power transformer, 750 V.C.T., 150 ma., 5 V., 3 A., 6.3 V., 5 A., T1
- 1—Input choke, 8 hy., 150 ma., 200 ohms, T3
- 1—Filter choke, 30 hy., 110 ma., 200 ohms, T4
- 1—Output transformer, 14,000 P to P: 6-15 ohms, 40 ma., T5
- 1—Input transformer, single plate to PP grids, Class A, T6
- 15—Tubes, per diagram, and miscellaneous hardware

D'ARSONVAL PASSES AWAY

● PROFESSOR JACQUES ARSENE D'ARSONVAL, famous French scientist, recently died on his estate near Limoges at the age of 89 years. Professor D'Arsonval was well known throughout the world for his many contributions in the fields of electrical measuring instruments and electrotherapeutics. By the early use of Tesla high frequency coils, D'Arsonval developed a series of therapeutic apparatus, as reported in the *New York Times*, which have not been modified in principle in more than 40 years, but have been used more extensively each year in the treatment of various physical elements.

As far back as 1890 he saw possibilities in the apparatus devised by another physicist, Hertz, to prove the existence of the waves that we now use in radio. Strange to say, it was with medical apparatus devised by D'Arsonval that Ferris in 1898 sent wireless signals from the Eiffel Tower in emulation of Marconi.

D'Arsonval, when experimenting with alternating current in 1888, noticed that, with a constant strength of current, the more rapidly the interruptions occurred, the more vigorous were the resulting muscular contractions. When, however, a frequency of from 2,500 to 5,000 excitations a second was reached, a decrease in the vigor of the contractions occurred and progressively decreased with the increased frequency of excitation.

At this time the instruments at D'Arsonval's disposal did not permit a further increase of frequency, but two years later, by employing the wireless apparatus of Hertz, he obtained what he called "billions of oscillations a second." With these frequencies he was able to pass a current of

two or three amperes through the human body, without producing any muscular contraction or other sensation than that of heat, and thus obtained the clinical high frequency currents.

D'Arsonval in 1882 introduced the first reflecting *moving-coil* galvanometer. It consisted of a light rectangular coil of fine wire, suspended by the thinnest possible wires between the poles of a vertical horseshoe magnet. (The forerunner of the meter construction used everywhere today.)

In 1891 D'Arsonval presented his data, gathered from his experiments during the three preceding years, to the Société de Biologie. His material also included references to the use of currents with frequency higher than 1,000,000 cycles per second.

After he had conducted numerous experiments to determine the physiologic effects of these currents, D'Arsonval made experiments on unicellular organisms such as yeast and bacteria, and found that these, as well as vegetable cells, could be killed by the current. He was also able to attenuate the toxins secreted by the micro-organisms.

"This fact," he stated, "is important in that it holds out the hope that this attenuation can be made to work inside the body of the patient."

While D'Arsonval finally concluded from his own experiments that "high frequency currents penetrate profoundly into the body, instead of accumulating on the surface," medical men did not make use of his work in Europe nor of Tesla's in America until, in 1906 and 1907, men like de Kraft, von Berndt and Nagelschmidt added to the knowledge of the effect of the current, and the World War finally gave impetus to its therapeutic use.



A Compact, High-Fidelity 20-Watt Amplifier

Harry D. Hooton, W8KPX

Here's a high-fidelity audio amplifier with plenty of power, which may be used with a radio tuner for general reception or for public address work. Hams will find it interesting for use as an inexpensive plate modulator for the amateur transmitter. A pair of 6L6G's is used in the push-pull class A output stage.

● THE "HF-20" amplifier answers the need for an extremely compact audio system capable of considerable power output with high fidelity. Giving a full undistorted output of 20 watts this amplifier is excellent for phonograph or radio amplification, or for general public address work. It may also be used as an inexpensive plate modulator for the "rig" running 200 watts or less input to the final. For modulator application it is, of course, necessary to use the proper type plate or cathode modulation transformer in place of the output transformer shown in Fig. 1.

The tube lineup consists of a 6SJ7 input voltage amplifier, a 6SC7G intermediate amplifier and electronic phonograph mixer, a 6SC7G phase inverter and a pair of 6L6G's in the push-pull class A output stage. Cur-

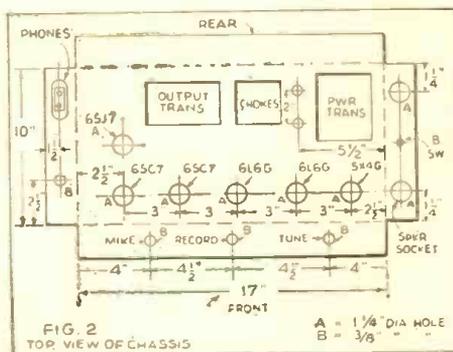
rent requirements for these tubes fall within the power capability of a single 5X4G rectifier. The 6SJ7 tube has its control grid conveniently located at the bottom, elimin-

inating a long grid lead to the top of the tube as necessitated by the older type 6J7.

Two Input Circuits

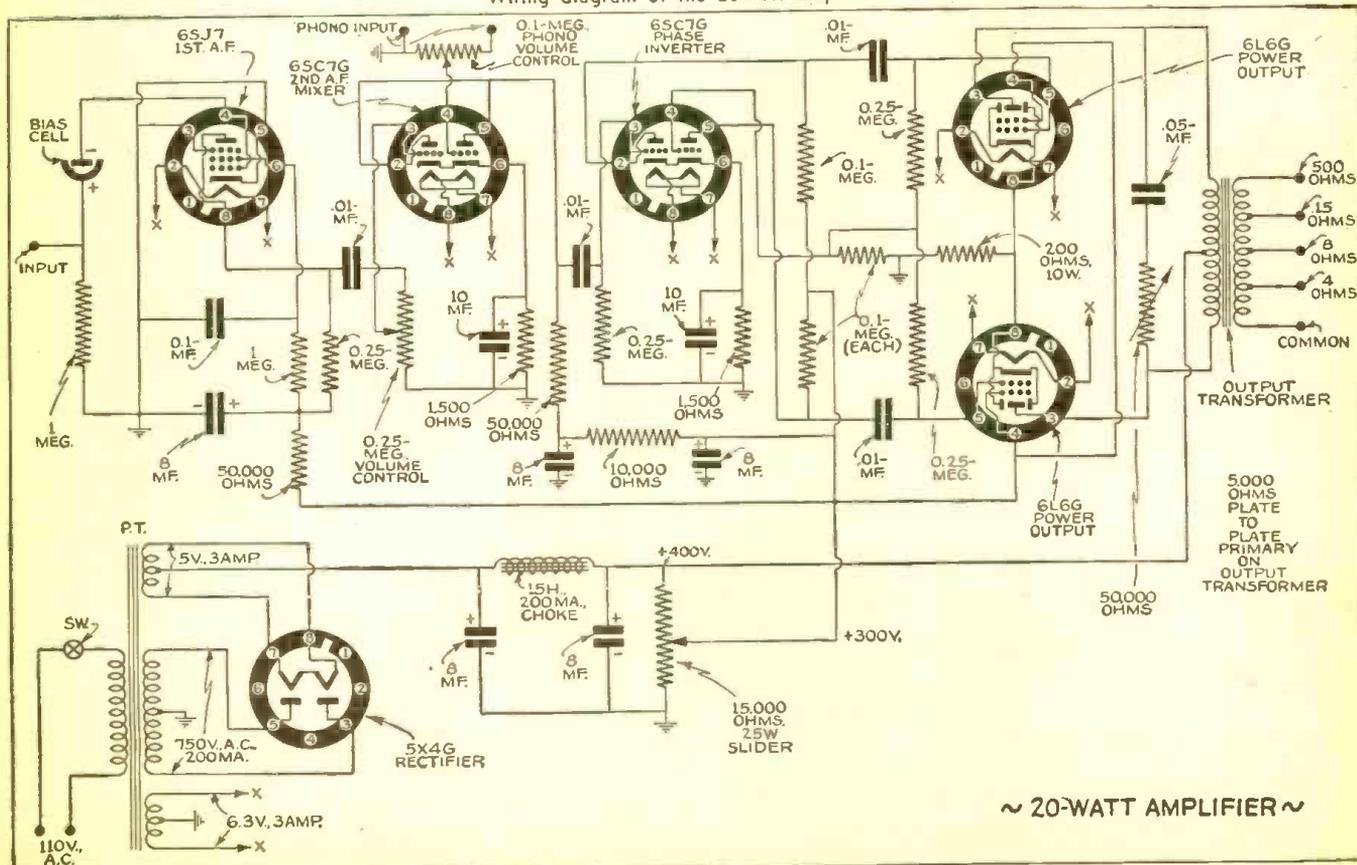
Two input circuits are provided. One is a high impedance, low-level input for dynamic, velocity or crystal microphones; the other is a high impedance high-level input for phonograph pickups. The frequency response is practically flat (within ± 2 db.) from 60 to 15,000 cycles per second. If an extremely high-level microphone is used, such as the Brush "HL" and similar types, the 6SJ7 input stage may be omitted, the mike being connected directly to the first 6SC7 grid. The space normally occupied by the 6SC7 may then be devoted to a peak limiting circuit for automatic percentage modulation control.

In the construction of this amplifier, it should be pointed out from a hum level standpoint it is advantageous to bring all ground circuits to a common point on the chassis. This is easily accomplished by connecting all component grounds to a grounding bus wire, which is connected to the chassis at one central point. This precaution will eliminate the possibility of high gain



Details for laying out chassis.

Wiring diagram of the 20-watt amplifier



HENRY RADIO SHOP

BUTLER, MISSOURI

We have in stock RCA, National, Hallcrafters, Hammarlund, RME, Howard and other makes of receivers at lowest net wholesale prices.

Our long experience selling receivers and apparatus, of all makes, enables us to help you get the proper equipment for your use. I will cooperate with you to see that you are satisfied.

You get best trade-in for your receiver. Get my offer.

I finance all terms myself so that I can give you better terms with less cost—less red tape—quicker shipment. Write me for terms.

You get ten day free trial of any receiver. Immediate shipment from our world's largest stock or shipment from the factory if you prefer.

Write to me for any communications equipment in any catalog or ad. I guarantee you can't buy for less or on better terms elsewhere. Write me about your needs and wishes. Tell me what you want and how you want everything handled.

73,

Bob Henry
W9ARA

P.S.: We have Reconditioned Guaranteed Receivers of nearly all models cheap. Terms and ten day free trial on these, too. Write for free list.

EAGLE Minuteman

2 1/2-5-10 METERS
Amateur Band Receiver
for Consistent reception
on the loudspeaker.

MINUTEMAN KIT

Complete with 3 Coils \$4.75

2 Tubes 6CS & 42 \$1.25

WIRING CHARGE \$1.25
OPTIONAL

Just the receiver for duplex work. The most sensitive and selective super regenerator receiver known—uses metal and glass tubes. The last word in performance and simplicity of design. The 1st 2 1/2 to 10 meter receiver ever offered to the amateur at such ridiculously low price. No license necessary to operate it.

THE EAGLE WIRELESS PHONO CONTROL



Will play your records or transmit your voice through your broadcast receiver from distances up to 500 ft., without wires or any attachments to your radio. No aerial required. Your transmission will be received clearly and with ample volume. No government license necessary. Mystify your friends with this amazing invention.

Complete Phono Kit \$1.95

Self powered A.C.-D.C.
2 Tubes—50c each
Wiring \$1.00 extra

MAIL ORDERS FILLED PROMPTLY.
\$1.00 Deposit, Check or Money Order. Balance C.O.D.

EAGLE RADIO CO.

84 Cortlandt Street, Dept. 3, New York City

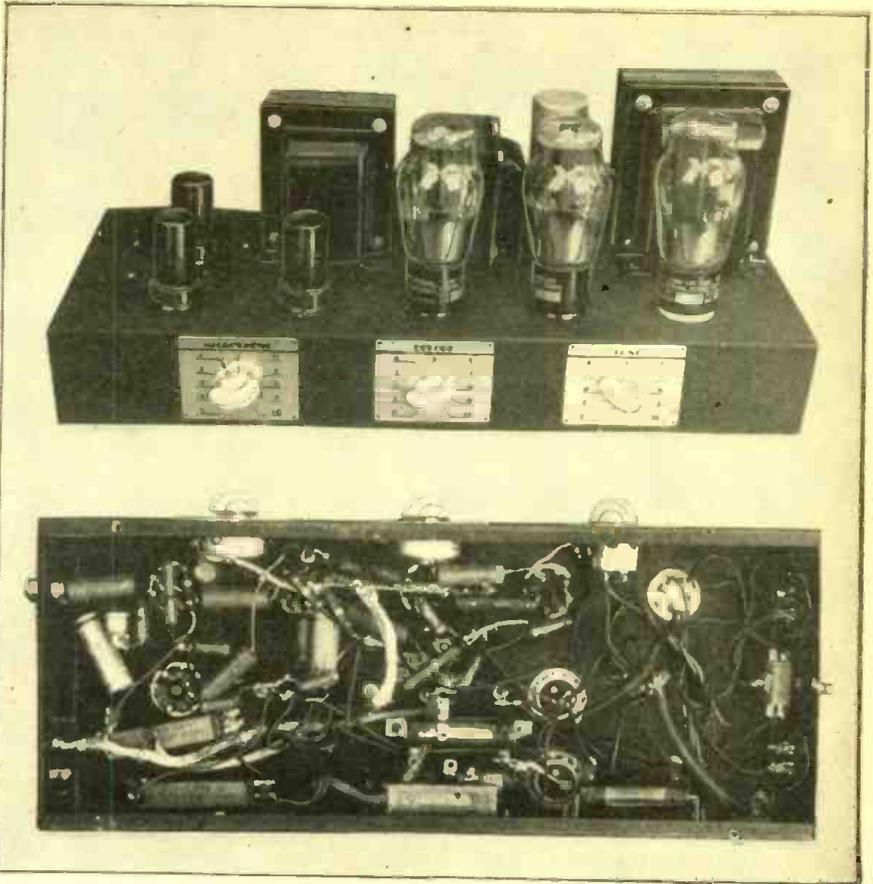
GOLDENTONE...50% OFF



DEAL DIRECT FACTORY PRICES... Over 60 models to choose from—4 to 12 tubes. Portables \$8.08 up. Farm sets \$8.98 up. Car sets \$8.98 up. Foreign band sets \$8.08 up. Samples 50% off. Quantity discounts. Free 1941 Bargain catalog gives details of 10-day FREE

Free Catalog RCA LICENSED

Mail agent's proposition and discounts. Mail postcard. GOLDENTONE RADIO CO., DEPT. RT, DEARBORN, MICH.



Two photos above show front and bottom views of the audio amplifier.

circuits amplifying small A.C. circulating currents on the chassis.

Matching Speaker Impedances
One or more speakers may be connected

to the output of the amplifier, as long as the combined voice coil impedances conform closely to those offered by the output transformer. For instance, two 8 ohm speakers of the permanent magnet type may be con-



At left — Two views taken from opposite ends of the 20-watt amplifier here described by Mr. Hooton. The tube lineup in this amplifier consists of 6SJ7 input amplifier, a 6SC7G intermediate amplifier and phono-graph mixer, a 6SC7G phase inverter, and a pair of 6L6G's in the push-pull class-A output stage. The rectifier tube is a 5X4G. The amplifier has frequency response practically flat from 60 to 15,000 cycles per second.

nected in parallel across the 4 ohm impedance output, or two 15 ohm speakers may be connected in parallel across the 8 ohm output. On the other hand, if desired, two 4 ohm speakers may be connected in series across the 8 ohm output, or two 8 ohm speakers may be placed in a series connection across the 15 ohm output. Any single speaker of 4, 8 or 15 ohms may be connected directly to these respective impedances offered by the output of the amplifier. In the event that a 5000 ohm output is desired, connection to the two plate ends of the output transformer through 0.1 mf., 600 volt condensers, as shown in the diagram, may be made.

Regardless of the particular service for which this amplifier is used, use only the best quality parts throughout. This is especially true of the output transformer and the associated speaker. The author used a type PM15B Jensen for phonograph record reproduction although almost any good make of 10 to 18 inch permanent magnet dynamic speaker will be satisfactory. The auxiliary speaker shown in the photograph is small 8 inch type designed to handle about 8 watts.

List of Parts

KENYON (Transformers)

- 1—Power transformer, 750 v. A.C. center-tapped, 200 ma., 5 v. at 3 amp. and 6.3 v. at 3 amperes
- 1—Filter choke, 15 henries, 200 ma.
- 1—Output transformer, 5000 ohms primary; secondary 4, 8, 15 and 500 ohms

I.R.C. (Resistors)

- 2—Metallized fixed resistors, 1 megohm, 1/2 watt
- 4—Metallized fixed resistors, 1/2 megohm, 1/2 watt
- 2—Metallized fixed resistors, 50,000 ohms, 1/2 watt
- 3—Metallized fixed resistors, 100,000 ohms, 1 watt
- 2—Metallized fixed resistors, 1500 ohms, 1 watt
- 1—Metallized fixed resistor, 10,000 ohms, 1 watt
- 1—Wire-wound bleeder, 15,000 ohms, 25 watts. Slider type
- 1—Wire-wound bleeder, 200 ohms, 10 watts
- 1—Volume control, 1/2 megohm
- 1—Volume control, 100,000 ohms
- 1—Volume control, 50,000 ohms

MALLORY (Condensers)

- 4—Paper tubular condensers, .01 mf., 600 volts
- 1—Paper tubular condenser, .05 mf., 600 volts
- 1—Paper tubular condenser, .1 mf., 600 volts
- 3—Electrolytic condensers, 8 mf., 450 volts. Card-board
- 2—Electrolytic condensers, 8 mf., 450 volts. Can. heavy duty
- 2—Electrolytic condensers, 10 mf., 50 volts. Tubular

PAR METAL

- 1—Black crackle steel amplifier chassis foundation 10 x 17 x 3" with bottom plate

CROWE

- 3—Knobs
- 3—"Mike," "Phono" and "Tone" dial plates

AMPHENOL

- 6—Octal sockets
- 2—4 prong sockets
- 1—Microphone chassis connector

In the Next Issue

How to Erect Television Receiving Aerials so as prevent interference and distorted images, by Thornton Chew.

LEARN RADIO

at HOME in SPARE TIME

The Complete Ghirardi Course in ONE Handy Volume TRAINS YOU QUICKLY for a good-paying job in Radio or Television

THOUSANDS HAVE STARTED SUCCESSFUL RADIO CAREERS FROM THIS ONE BIG BOOK

Your Big Chance — Take It!

NOW—at last—you can get your start in radio. You can prepare for a good-paying job in any branch, without expensive schooling or lengthy study. Here, in one inexpensive 972-page volume, is a complete Radio Education for you.—everything is illustrated and explained clearly—right from basic electrical theory up through television—36 different Chapter-Sections in all—36 separate self-instruction courses condensed into one easy-reading home-training book.

Ghirardi's Clear Explanations Make Course as Easy as A.B.C.

RADIO PHYSICS COURSE is as easy to read as your daily newspaper—makes every phase of radio so clear and so simple that you understand it immediately. It's as easy as A.B.C. to learn from this book. That's why leading radio schools the world over use it as the text in their courses.

YOU LEARN AT HOME

The beauty of it is, you learn all by yourself, without leaving the comfort and convenience of your own home—checking your progress every step of the way with the 856 Review Questions. You'll be surprised and delighted at the rapid progress you will make when you study radio this way.

All You Need to Know About Radio Is Between These 2 Covers— Basic Fundamentals—Practical Applications



Never before has it been possible to master the fundamentals of the whole science of Radio so easily, so quickly, so economically. Just imagine a book that really gives you a thorough grounding in every phase of this fascinating field! Take Electricity alone, for example—no textbook ever written will give you a clearer picture of electrical theory and principles. Ghirardi brings out his simple explanations with such vivid clarity you'll never forget all that you learn. Radio broadcasting and television—and all equipment—are explained to you in full detail. Over Five Hundred diagrams, drawings and photos illustrate the graphic descriptions he gives you. This great book will give you the basic knowledge that is essential for landing any kind of a radio job—in Broadcasting Studios, in Radio Service Organizations, in Plants Manufacturing Radio Equipment, in Aviation Radio, Police Radio, etc.—and give it all to you quickly and easily.

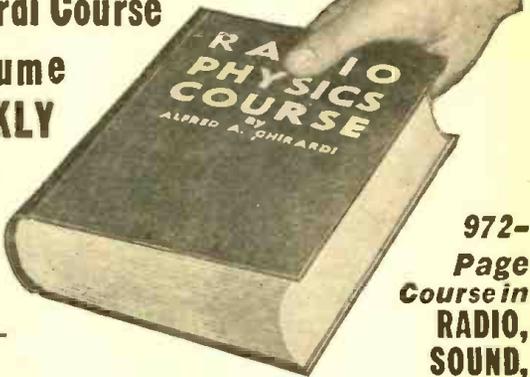
LEARN TELEVISION TOO!

Yes, this course also gives you a solid background in television fundamentals. SOUND, too, with all its different branches—Microphones, Public Address Systems, Sound Films, etc. You'll master the intricacies of Cathode-Ray tubes and Photoelectric Cells as easily as if it were child's-play. And though all this knowledge is at your command, it is but a fraction of the book's content! There's Testing and Servicing; Automobile and Aircraft Radio; Short-Wave Reception; and still that isn't all! Just to visualize the scope of this gigantic home-study course, you'll really have to send for the book yourself and thumb through the pages at your leisure.

YOU SAVE MONEY!

Believe it or not, this inexhaustible storehouse of radio knowledge is yours to own and use for the price of an ordinary hat! You would have to pay at least Fifty Dollars for radio instruction like this elsewhere—and even so you could never duplicate Ghirardi's clear explanations. Because this book is head and shoulders above all others, it is now used by more radio schools and students than any other radio textbook in the world. Buy it—only \$4 you can get your practical radio training at home, the very same way thousands of others have, who are today earning good money in a constantly ever-broadening career. Follow their example, seize this opportunity. Check over the list of 36 Chapter-Sections in the next column—see what the RADIO PHYSICS COURSE will teach you. Then, ... send for your copy now—without delay!

Get Started - RUSH COUPON NOW!



972-Page Course in RADIO, SOUND,

ELECTRICITY, TELEVISION, CATHODE-RAY TUBES, ETC.

36 Volumes in 1

RADIO, ELECTRICITY and SOUND Complete Plus Many Other Valuable Special Features Are Covered in These 36 Big Chapter-Sections, 972 Pages, 508 Diagrams, Charts and Photos. 856 Review Questions.

- | | |
|---|--|
| 1. Radio Broadcasting System | 19. Construction Features of Vacuum Tubes |
| 2. Sound, Speech and Music as Related to Broadcasting | 20. Vacuum Tube Detector and Amplifier Action |
| 3. Electron Theory, Electric Current | 21. Radio Frequency Amplification |
| 4. Electrical Units, Ohm's Law, Resistance | 22. Superheterodyne Receivers |
| 5. Electrical Circuits, Batteries | 23. Design of R.F. Amplifiers and Tuning Coils |
| 6. Magnetism | 24. Audio Amplification |
| 7. Electromagnetism | 25. Loud Speakers |
| 8. Electromagnetic Induction | 26. Battery Operated Receivers |
| 9. Inductance and Inductors | 27. Power Supply Units |
| 10. Capacitance and Condensers | 28. Electric Receivers |
| 11. Alternating Current Circuits | 29. Automobile and Aircraft Receivers |
| 12. Electric Filters | 30. Phonograph Pickups and Sound Amplifier Systems |
| 13. Electrical Measuring Instruments | 31. Short Wave Reception |
| 14. Electromagnetic Radiations | 32. Vacuum Tube Applications and Photoelectric Cells |
| 15. Radio Transmission the Broadcasting System | 33. Television |
| 16. The Receiving Station, Detection with Crystals | 34. Antennas and Grounds |
| 17. Elementary Study of the Vacuum Tube | 35. Testing and Servicing |
| 18. Vacuum Tube Characteristics | 36. Sound Motion Pictures, Appendices (Charts, Tables) |

972 Pages

Boeing "Aero" School Praises It!

"We have found Ghirardi's Radio Physics Course to be an extremely valuable training aid and, as a matter of fact, have considered it as the 'Bible' for several of the courses we are giving here."—E. J. Krenz, Boeing School of Aeronautics, Oakland, Calif.

"PRICE INSIGNIFICANT", this man says!

"I have never seen a textbook as complete, as easy to understand, and as helpful as this one. The price I paid for the book is insignificant in comparison to the value of the knowledge gained."—Tom W. Danielson, Lockland, Ohio.

USE IT 5 DAYS — OUR RISK

You can't possibly lose—for our Money-Back Guarantee protects you 100%. Send for the book. Read it for 5 days. If you're not fully satisfied, return it in good condition. We will refund your money at once—no fuss—no trouble. Take us up on this offer—fill out and mail this coupon—AT ONCE!

\$4 Only

RUSH COUPON TODAY!

RADIO & TECHNICAL PUBL. CO. Books Shipped Dept. R&T-31 Postpaid Anywhere

Enclosed find \$4 (\$4.50 foreign) for my copy of Ghirardi's "RADIO PHYSICS COURSE" (2nd Edition) with your 5-day Money-Back Guarantee.

NAME _____

ADDRESS _____

CITY _____ STATE _____

Please send me free descriptive literature about "RADIO PHYSICS COURSE."

A 5-Tube Compact Receiver

R. W. Baetz

The author has done considerable experimenting with different type tubes in superhet circuits and here gives the benefit of his experience. This set comprises a 5-tube superhet hook-up, using a 6K8 as the mixer-oscillator, followed by a 6K7 I.F. stage; a 6C8G second detector—B.F.O., followed by a 6V6GT output stage, feeding a 5-inch PM speaker. A 5W4 rectifier tube is used.

their original settings for long periods of time despite severe changes in temperature.

I.F. Alignment

In order to properly align the I.F. stage, a signal generator must be used. The procedure is simple but care should be taken to get the setting right on the nose.

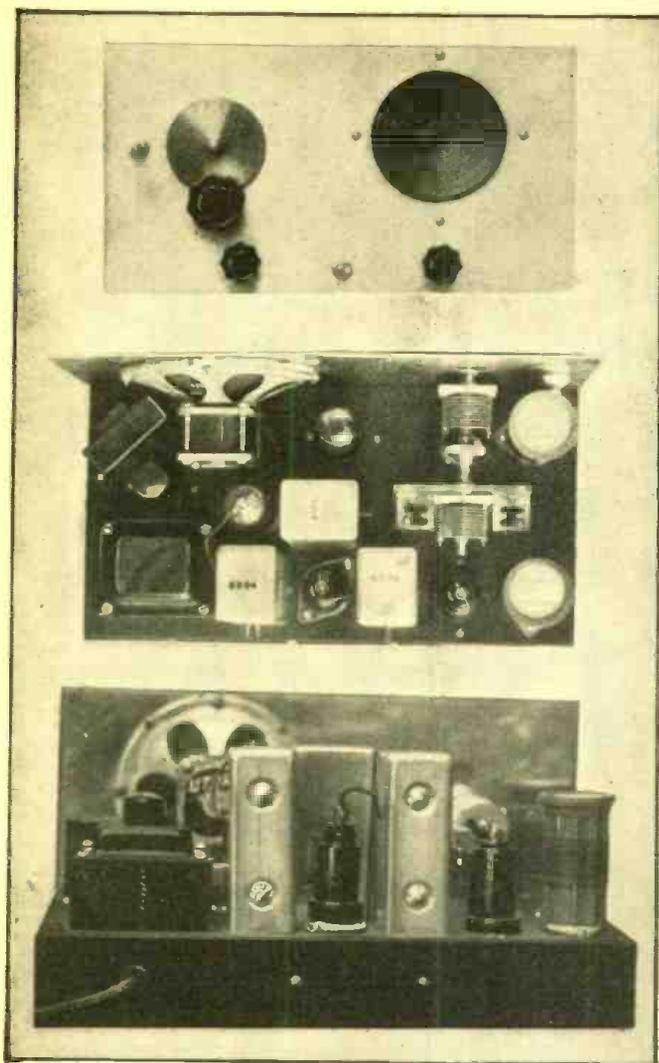
The detector and oscillator coils are plugged in so as to prevent open grid oscillation during the lining up. The signal generator is set at 465 kilocycles and the modulated-unmodulated switch is thrown to the modulated position. The ground lead of the generator is clipped to the chassis of the receiver and the R.F. lead is clipped to the grid of the 6K7. An output meter is hooked up in conventional manner in the output of the 6V6GT and the actual alignment can now be started.

Both receiver and generator are turned on and the trimmers on the last transformer are adjusted until a modulated signal is heard on the speaker and is finally peaked as indicated by a maximum voltage reading on the output meter. As the circuits come into line and as the signal increases in intensity, the attenuator on the signal generator is backed off.

The R.F. lead is then taken off the 6K7 and clipped to the grid of the 6K8. The trimmers on the first transformer are then adjusted and when peaked the last transformer is given a going over again. This is done several times so as to make certain the circuits are in resonance.

Set Operation

After the set has been turned on and has been permitted to heat for a few minutes, the volume control is advanced and the small detector condenser is rotated until a definite hiss is heard in the speaker. The tuning dial is then turned until the desired



Left—front, top and rear views of the 5-tube compact superhet—a very neat and particularly efficient job.

● FOR a period of years the author has experimented with numerous multiple purpose tubes with only partially satisfying results. The manufacture of the 6K8 seemed to fill a definite need in a converter tube and gives much better all-around service than the older 6A8.

A 6K8 was therefore chosen as the mixer-oscillator tube of this compact receiver followed by a 6K7 I.F., 6C8G second det.-B.F.O., 6V6GT output feeding the 5 inch PM speaker and a 5W4 rectifier.

The parts are substantially mounted on the standard 7x13 inch black crackle chassis. A glance at the accompanying chassis photo will clearly show the location of all above-chassis parts. Directly behind the ganged tuning condenser is the 6K8 and midway between the two edge-mounted I.F. transformers is the 6K7 followed by the 6C8G to the right of the BFO transformer. The 6V6GT is mounted in front of the BFO transformer and the 5W4 rectifier is directly in front of the power transformer. It was necessary to mount one of the small filter chokes above the chassis and at an angle so as to make room for the small speaker.

The two 100 mmf. tuning condensers are ganged by means of a flexible coupling and the front section is mounted directly to the front panel while the rear is mounted on a piece of Mycalex, simply because this was on hand. A piece of aluminum might

have been more efficient due to its shielding properties but the author experienced no difficulty due to insufficient isolation of the detector and oscillator sections of the converter tube.

A glance at the photo of the front panel will readily show location of parts. Just below the speaker is the A.C. switch-volume control, next in line is the BFO toggle switch. The small trimmer is next, just below the tuning dial and finally the feed-through insulator to the left of the tuning dial.

The receiver was primarily built for overseas reception and therefore no effort was made to get a broad band-spread. The coils, located on the extreme left of the chassis cover from about 16-32 meters. No additional coils were wound for other bands as most European reception comes through in this frequency range.

All parts are standard and little difficulty should be had with the wiring and the set should play immediately after completion provided the diagram has been carefully followed.

For best results it is suggested that the I.F. transformers be lined up in the conventional manner—that is by the use of a signal generator set at 465 kc. Incidentally, the I.F. transformers are the new permeability tuned, iron core type and once set to the proper frequency they will keep

signal is heard. The dial should be turned slowly as the set has no real band-spread and the stations are fairly close together.

The setting of the detector trimmer will vary with the setting of the tuning dial and so will have to be changed slightly when tuning over a large portion of the dial.

Parts List

RCA (Tubes)

- 1—6K8 tube
- 1—6K7 tube
- 1—6C8G tube
- 1—6V6GT tube
- 1—5W4 tube

CENTRALAB (Resistors)

- 1—100,000 ohm, 1/2 watt resistor
- 1—300 ohm, 1/2 watt resistor
- 1—50,000 ohm, 1/2 watt resistor
- 1—500 ohm, 1/2 watt resistor
- 1—500 ohm, 2 watt resistor
- 1—10,000 ohm, 1/2 watt resistor
- 3—50,000 ohm, 1 watt resistors
- 2—1000 ohm, 1 watt resistors
- 1—500,000 ohm volume control and switch

THORDARSON

- 1—T13R11 power transformer
- 2—T13C28 filter chokes

AMPHENOL (Sockets)

- 2—Bakelite octal sockets
- 3—Isolantite octal sockets
- 1—4-prong isolantite socket
- 1—5-prong isolantite socket

SICKLES

- 2—465 kc. I.F. transformers, #6504
- 1—BFO transformer, #6577

CARDWELL

- 2—100 mmf. variable condensers, ZU100AS
- 1—25 mmf. variable condenser, ZR25AS
- 1—Flexible coupling

MALLORY

- 3—8 mfd. 450 volt electrolytic condensers, BB61
- 2—10 mfd. 50 volt electrolytic condensers, BB13

CORNELL-DUBILIER (Condensers)

- 10—.1 mfd. 400 volt tubular condensers
- 1—.05 mfd. 400 volt tubular condenser
- 1—.006 mfd. mica condenser
- 1—.0001 mfd. mica condenser
- 1—.004 mfd. mica condenser

UTAH

- 1—5-inch PM speaker

MISCELLANEOUS

- 1—Rubber covered line cord
- 1—Dial (ICA)
- 3—Knobs
- 1—S.P.S.T. toggle switch
- 3—Grid caps (National)
- 1—7x13x2 crackle chassis (Bud)

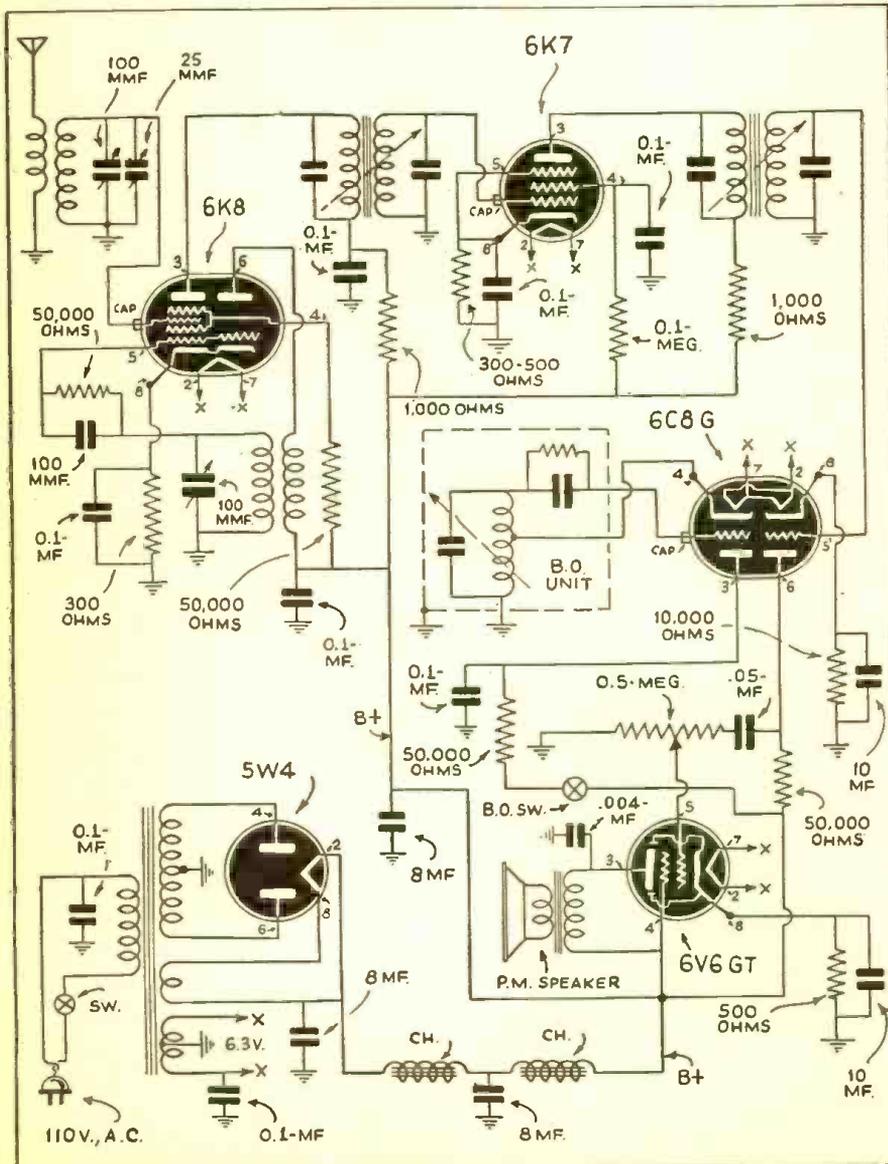
Coil Data

All coils are wound on Hammarlund SWF forms.

- Detector—8 turns #22 enamelled for grid
4 turns #34 dsc for antenna winding
- Oscillator—8 turns #22 enamelled for grid
5 turns #34 dsc for tickler

The coils cover the range from about 16-32 meters. Coils for other frequency ranges can be readily wound and no difficulty should be experienced here.

Diagram of the compact 5-tube superhet receiver is given below, and can easily be followed by the average set-builder. Method of aligning the I.F. stage is explained.



STACK-MOUNTING *Heavy-duty* CAPACITORS



Above, the largest size of Type 1940 capacitor, with medium size or Type 1940 at right. Choice of 5 sizes.

● Yes, these commercial-grade capacitors, heretofore limited to professional radio workers, are now available to amateurs and experimenters. Ideal for grid, plate blocking, coupling, tank, and by-pass functions. Special cylindrical low-loss glazed ceramic case. Long creepage path between terminals. Corona losses eliminated inside and outside. Cast-aluminum terminal ends for low-resistance connections between units. Finest grade India ruby mica sections. Made to closest tolerances to equalize loading of series-connected sections.

Available in Five Sizes

Type 1940: Overall dia. 9"; Overall height 10"; .00001 to .01 mfd.; 15,000 to 35,000 test volts eff.

Type 1950: Overall dia. 3-13/16"; Overall height 2 1/2"; .00001 to .02 mfd.; 3000 to 6000 test volts eff.

Type 1960: Overall dia. 5"; Overall height 3"; .00001 to .25 mfd.; 1000 to 15,000 test volts eff.

Type 1970: Overall dia. 6 1/2"; Overall height 4"; .00001 to .5 mfd.; 1000 to 20,000 test volts eff.

Type 1980: Overall dia. 6 1/2"; Overall height 5 1/2"; .00001 to .05 mfd.; 5000 to 35,000 test volts eff.

Max. current in amps., at max. ambient temperature of 60° C., stated for 3000, 1000, 300 and 100 kc.

Ask Your Jobber . . .

● We will gladly give you the specifications and prices on these capacitors, and also on other commercial-grade capacitors now available to you.



Adapting Mobile Equipment to New Regulations

Howard G. McEntee, W2FHP



In the accompanying discussion, Mr. McEntee describes how he improved the 10 meter mobile transmitter, described some months ago in this magazine, so that it could be used for both 5 and 10 meters. Only part of the mobile unit has to be re-wired, following the information and diagram provided herewith, the R.F. Section.

THE ten meter mobile installation described in this magazine about a year ago had been in service several months when the new regulations drastically curtailing 10 meter mobile work were announced. Due to press of other business the equipment was set aside for a time, but later work was begun to change the apparatus so that it could be used both for 5 and 10 meters. Five meters was then, and of course still is, unhampered by operating regulations of the type imposed on 10. Still it was felt that the latter band *might* some time be usable and of course it is useful under certain conditions for emergency work, so the decision to use the outfit on both 5 and 10 was arrived at.

For the *converter* the same chassis, panel and control circuits as specified in the aforementioned articles were used, only the R.F. circuits being rebuilt.

The first layout used a 7G7 mixer and a 7A4 oscillator. These tubes are of loctal design and seem well fitted for high frequency work. The results on 10 were considerably better than with the 6J8G previously used, but on 5 the output was rather mediocre.

The next step was to use an 1852 mixer with the same 7A4 oscillator. To give better input circuit conditions the mixer grid was tapped down a few turns on both grid coils. The circuit with values used is here reproduced. This layout seemed somewhat better on both bands than the previous one (although possibly mainly due to the down-tapped grid of the mixer—a system not tried on the 7G7). As the illustration shows, the two tubes were mounted side by side with the 7A4 next to the tuning condenser, and with the oscillator coils on a polystyrene rod between the two. The band switch was placed on the front panel in the spot originally occupied by the mixer grid tank condenser. The two 30 mmf. grid coil trimmers were mounted on the case side on an insulating strip and were screw-driver tuned.

The band switch is a four-position double-throw type and with the circuit used there was no section available for changing the primary coils. These were therefore connected in series directly to the antenna switch. No particular disadvantage of this series connection could be noticed when each primary was connected in circuit alone,

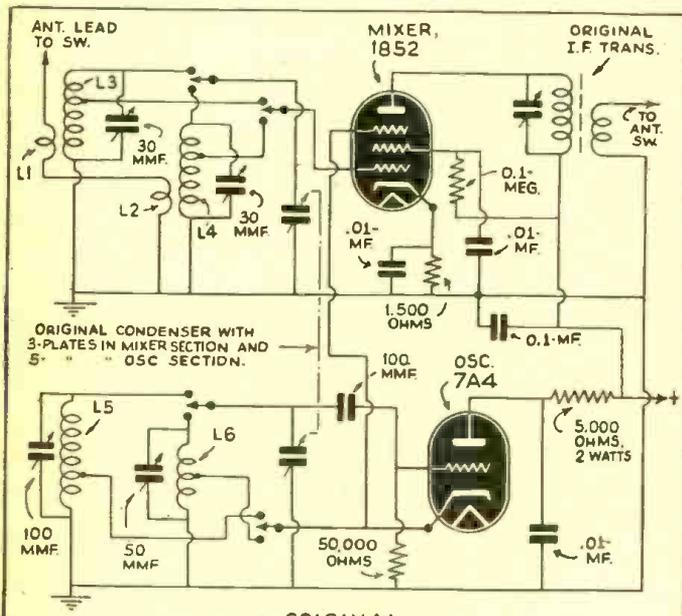
so the idea seems satisfactory. The primaries were wound with ordinary push-back wire coiled small enough to slip inside the ground end of the secondary, with the turns held together by duco.

After using this rig for a while the urge to use the ultimate in U.H.F. tubes was felt and hence a third version was built up using an RCA 954 mixer and RCA 955 oscillator.

A cut of this is shown as well as the circuit. Considerable time was spent in condensing the layout so as to obtain short leads, with the result that the band switch was mounted at the rear of the set and the antenna trimmer went back to its original place on the panel. As a result the leads are about as short as possible considering the physical "shape" of the converter. The whole thing was cleaned up as far as possible in order to cut down stray capacity.

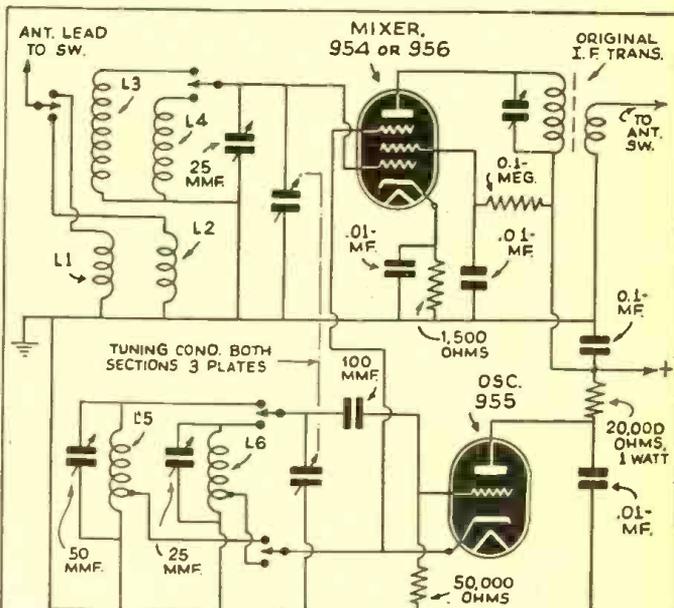
The results were worth the trouble, as the final version is much more sensitive than the others, besides being more stable. The oscillator "pulling" on 10 meters is negligible and is not too bad on 5, while with the conventional tubes it was rather troublesome on both bands.

Wiring diagrams of the original as well as the latest revised model of the 5 and 10 meter mobile converter.



~ ORIGINAL ~

L1 = 4 TURNS, L2 = 3 TURNS, INSIDE L3 & L4 RESPECTIVELY. L3 = 15 TURNS, 1/2" DIA., 1 3/8" LONG, TAP 4 TURNS FROM GRID END. L4 = 5 1/2 TURNS 3/4" LONG, TAP 2 TURNS FROM GRID END. L5 = 6 1/2 TURNS, 1" LONG TAP 1 1/2 TURNS FROM GND. L6 = 3 1/2 TURNS 5/8" LONG TAP 1/4 TURNS FROM GND.
ALL NO. 16 BARE TINNED COPPER WIRE.



~ REVISED ~

L1 & L2 = SAME DATA AS IN "ORIGINAL"
L3 = 15 TURNS, 1/2" DIA., 1 1/4" LONG. L4 = 6 TURNS 1 1/8" LONG
L5 = 9 3/4 TURNS, 1 3/16" LONG - TAP 1 1/2 TURNS FROM GND. END.
L6 = 5 TURNS 1/2" LONG - TAP 1/2 TURNS FROM GND. END.

The acorn version is also noticeably more quiet as far as hiss goes, so much so in fact that the writer was rather disappointed when the set was first tried as it sounded so dead. Doubts soon disappeared, however, when signals began to roll in, for then the high signal-to-noise ratio could be appreciated.

The mixer tube is mounted almost directly over the antenna tank condenser while the oscillator is set on edge. The latter is placed backwards in its socket as this gives the shortest lead arrangement. The mixer goes into its socket with its grid (the short end) down. The grid dip is soldered directly to the condenser stator, so that when the tube is correctly seated in its socket the grid makes proper connection as well.

As in all the different layouts, the oscillator coils are mounted on an insulating pillar for stability while the mixer coils are self-supporting. The hot ends of the latter connect directly to the switch lugs and all the coils are of No. 16 tinned copper wire. The 10 meter mixer coil has several "lines" of duco along the turns to stiffen them, and the 5 meter coil is held by strips of celluloid cemented on. The primaries are of push-back inside the ground end of the secondaries as before. They should not be pushed too far into the secondary or the antenna loading will cause the grid circuit to become overly broad.

There is not much to placing one of these converters in operation if the coils are made as shown. With the tuning dial at midscale, rotate the oscillator band-setting or tank condenser until a signal of the desired frequency is heard. Then peak the mixer grid circuit with its tank condenser. The best way to do this is to use some external noise such as a vacuum cleaner or auto ignition at a point on the dial where no regular signal comes in. There will, of course, be two points on the oscillator tank condenser where the same signal can be gotten in, corresponding to the signal frequency plus or minus the I.F. (the latter is around 1500 kc.). Usual practice is to have the oscillator higher in frequency than the mixer on 10 and lower on 5 but there is not much difference one way or the other. Troublesome images due to commercial or police stations adjacent to the amateur bands can be eliminated by selection of the proper oscillator tuning point.

The high voltage on the converters shown was 180 V. and the only precaution to observe is to keep the mixer screen voltage rather low. About 40 V. seemed optimum for the 954 but an RCA 956 that was tried became noticeably noisier and less sensitive with the screen higher than 20 V. Both tubes seemed about equal in operation with proper voltages.

In line with the rebuilding, the antenna cable fittings were replaced from converter to transmitter chassis with the same type, using polystyrene insulation and high grade flexible coaxial cable was used for this lead and for that to the antenna itself.

It was found during tests that the antenna, which is mounted on the rear bumper of the car, should be more than the theoretically proper 1/4 wave for best results. At 10 meters it was pulled to its full length of 10.5 feet and worked well even up to 12 feet. For 5 meters, of course, the lengths are halved. The coaxial cable gave a very

COMPLETE RADIO COURSE \$1.95
"I am well pleased with the Radio Course. I am at present doing part time radio service work for a radio store."
 S. T. Alexander, Elroy, Wis.

PLACED ME IN MY RADIO JOB
 "The R.T.I. Course reprint is a complete education in Radio servicing. It put me in my present job at a well known radio shop." James P. McIntyre, Houston, Tex.

VERY MUCH SATISFIED
 "I am very well pleased with the Radio Course purchased from you a few weeks ago." M. F. Anderson, Denver, Colo.

HELPS ANY SERVICEMAN
 "The R.T.I. Course is worthy of space on any radtomian's shelf. He can get the value of the cost in an hour's reading." Wm. C. Mitchell of Parchman, Miss., goes on in his letter to compare this course to resident training costing over \$300.00.

WELL SATISFIED
 "I am so satisfied with your Radio Technical Institute Course, that I have to congratulate you. . . . This course is worth its price by several times." J. M. Ocasio, New York, N. Y.

AMAZING REDUCED PRICE
 Exact reprint of the regular \$39.00 Radio Technical Institute course is offered for only \$1.95, the full price. This is the latest radio course complete in every way and exactly the same as the much higher priced original lessons. Become a radio expert almost for nothing. Act today while the offer lasts.



You quickly learn radio with this simplified training. You really get three courses in one: (1) Elements of Radio and Electricity, (2) Practical Radio Servicing, and (3) Advanced Training.

LIMITED OFFER
 No-risk free-trial given. Write to us today while this offer is in effect. Limited quantity of courses printed to sell at the reduced price.

FOR HOME-STUDY
 Get ahead in Radio with this practical training. The lessons are clear, interesting, easy to understand and use. Final exam and diploma available after course is finished. Look the course over without any risk.

10 DAYS FREE EXAMINATION

SUPREME PUBLICATIONS, Room 636, 3727 W. 13th St., Chicago, Ill.
 Ship the complete course on approval without any obligation to buy. I may keep the course for 10 days. If, for any reason, I am not pleased, you guarantee to refund my money.
 I will pay \$1.95 and 15c postage to the mailman.
 I am sending \$1.95, the full price, ship postpaid.

Name: _____
 Address: _____

In The March 1941 Issue of RADIO-CRAFT
 Fluorescent Lighting — Latest "Sideline" for Serviceman—Part II
 Radio Service Data Sheets
 Recent Improvements in F.M. Receiver Design
 A General Utility Tester for Servicing Electrical Appliances
 Vacuum-Tube Voltmeters—Theory and Practice
 Build Your Own Versatile Modern Multi-Tester
 Sound Engineering
 Home Recording—Theory and Practice of "Sound-on-Disc"
 Vacuum-Tube Oscillators and How They Work
 New Circuits in Modern Radio Receivers
 Operating Notes
 Modern Microphone Technique —Part II, The Microphone and Its Relation to the Manufacturer
 Independent Power Supplies Improve Audio Output
 The "Acceletron" Generates Energy of 2,300,000 Volts!
 Robeson Technique of Acoustics Control

★ **PERSONAL SERVICE**
 By *Bill Harrison*

RECEIVERS
AMATEUR EQUIPMENT
 Fastest service—lowest prices—most liberal trade-in allowances—easiest time payment terms—in the country!
 It will pay you to write to me about any Radio Apparatus you need. I guarantee you complete satisfaction and my personal attention.
 73, Bill Harrison, W2AVA
 *Send stamp for my latest list of
NEW AND RECONDITIONED RECEIVERS

HARRISON RADIO CO.
 12 WEST BROADWAY - NEW YORK CITY

Whatever YOU WANT In A HEADSET

 You'll find in a Cannon-Ball Guaranteed Headset: Sensitivity. Clarity of tone. Dependable performance. Quality at fair price. Folder T-21 illustrates complete line. Write Headset Headquarters.
C. F. CANNON COMPANY
 SPRINGWATER, N. Y.

These Are the 6 Best Selling Short Wave Books . . . SEE THEM AT YOUR DEALER!

YOU buy parts, tubes, kits, accessories from your local radio dealer—that's what countless thousands of short-wave fans do. Through a nation-wide distribution service our numerous books are available at your favorite radio dealer—right where

you buy other radio equipment. It's more convenient, saves time and you can inspect the books before you buy. Ask your dealer to show you all the books advertised on this page—they're always in stock.

101 SHORT WAVE HOOK-UPS
Compiled by the Editors of **RADIO & TELEVISION**
Here is a worthwhile book that every short wave listener, every short wave amateur fan, and every short wave enthusiast has wanted for a long time. It gives you the 101 best short wave hook-ups which have appeared heretofore.
100 Illustrations 50c
72 Pages

HOW TO BUILD AND OPERATE SHORT WAVE RECEIVERS
Including
Receivers for the Beginners
Short Wave Converters
S. W. Superheterodynes
Super-Regenerators
Television Receivers
This is the best and most up-to-date book on the subject. It is edited and prepared by the editors of **RADIO & TELEVISION** and contains a wealth of material on the building and operation, not only of typical short wave receivers, but short wave converters as well.
150 Illustrations 50c
72 Pages

HOW TO GET BEST SHORT WAVE RECEPTION
M. HARVEY GERNSBACK tells you everything you have ever wanted to know about short wave reception. The author, a professional radio listener and radio fan for many years, gives you his long experience in radio reception and all that goes with it.
40 Illustrations 50c
72 Pages

10 MOST POPULAR SHORT WAVE RECEIVERS HOW TO MAKE AND WORK THEM
The editors of **RADIO & TELEVISION** have selected ten outstanding short wave receivers and these are described in the new volume. Each receiver is fully illustrated with a complete layout, pictorial representation, photographs of the set complete, hook-up and all worthwhile specifications.
75 Illustrations 25c
40 Pages

How to Become an AMATEUR RADIO OPERATOR
and secure a U.S. Government License
By Lieut. Myron F. Eddy, whose experience in the amateur field has made him pre-eminent in this line. If you intend to become a licensed code operator, if you wish to take up phone work eventually—this is the book you must get.
150 Illustrations 50c
72 Pages

THE SHORT WAVE BEGINNER'S BOOK
Including Complete Instruction in Short Waves for Beginners. Details for Making S. W. Aerials, etc.
Here is a book that solves your short wave problems leading you in easy stages from the simplest fundamentals to the present stage of the art as it is known today. It is the only low-priced reference book on short waves for the beginner.
75 Illustrations 25c
40 Pages

LOOK FOR YOUR NEAREST DEALER

For convenience the publishers list below dealers in all parts of the world where our books are available. On your next shopping trip be certain to examine these volumes. You're sure to want them for your technical library.

- ALABAMA**
Walker Bros., Montgomery
- ARIZONA**
Sam's Clear Store, Phoenix
- CALIFORNIA**
Electric Supply Co., Oakland
Radio Supply Company, Los Angeles
Radio Television Supply Co., Los Angeles
Pacific Radio Exchange, Inc., Los Angeles
Western Auto Supply, Los Angeles
Zack Radio Supply Co., Los Angeles
Wroman's Book Store, Pasadena
Western Radio & Elec. Co., San Diego
Scott Wholesale Radio Co., Long Beach
Offenbach Electric Co., San Francisco
Technical Book Co., San Francisco
Zack Radio Supply Co., San Francisco
Radio Specialties Co., San Jose
- COLORADO**
Interstate Radio Supply, Denver
- CONNECTICUT**
The Edward P. Judd Co., New Haven
- DELAWARE**
Wilmington Elec. Spec. Co., Inc., Wilmington
- FLORIDA**
Radio Accessories Co., Orlando
- GEORGIA**
Radio Wire Television, Inc., Atlanta
- ILLINOIS**
Allied Radio Corporation, Chicago
Walter C. Braun, Inc., Chicago
Chicago Radio Apparatus Co., Chicago
A. C. McClurg & Co., Chicago
Midwest Radio Mart, Chicago
Newark Electric Co., Chicago
Sears, Roebuck & Co., Chicago
Max Stein & Co., Chicago
Montgomery Ward & Co., Chicago
Radio Wire Television, Inc., Chicago
- INDIANA**
Van Sickle Radio, Indianapolis
- MASSACHUSETTS**
DeWolfe & Fiske, Boston
The Personal Book Shop, Boston
Radio Wire Television, Inc., Boston
Library Book House, Springfield
Tremont Elec. Supply Co., Boston

- MICHIGAN**
Rissl Brothers, Detroit
- MINNESOTA**
St. Paul Book & Stat. Co., St. Paul
- MISSOURI**
Burstlein-Appletree Co., Kansas City
Radio Labs., Kansas City
Walter Ashe Radio Co., St. Louis
Van Sickle Radio Co., St. Louis
- NEBRASKA**
Radio Accessories Company, Omaha
- NEW JERSEY**
Radio Apparatus Co., Newark
United Radio Co., Newark
Radio Wire Television, Inc., Newark
- NEW YORK**
Fort Orange Radio Dist. Co., Albany
Radio Wire Television, Inc., Albany
Haglo Wire Television, Inc., Jamaica, L. I.
Harrison Radio Co., New York City
American News Co., New York City
Baker & Taylor Co., New York City
Blah, the Radio Man, New York City
Adams Radio, New York City
Earle Radio Co., New York City
Federated Purchaser, Inc., New York City
Radio Circular Co., New York City
G. E. Siebert & Co., New York City
The Stelger Co., New York City
Sun Radio Co., New York City

- NEW YORK**
Terminal Radio Corp., New York City
Thor Radio Co., New York City
Try-Mo Radio Co., New York City
Van Riemensdyck Book Stores, New York City
Radio Wire Television, Inc., New York City
H. W. Wilson Co., New York City
Radio Parts & Equipment Co., Rochester
M. Schwartz & Son, Schenectady
- OHIO**
News Exchange, Akron
United Radio, Inc., Cincinnati
College Book Exchange, Toledo
- OREGON**
J. K. Gill Co., Portland
- PENNSYLVANIA**
The 437 Store, Philadelphia
M & H Sporting Goods Co., Philadelphia
Radio Electric Service Co., Philadelphia
Cameradio Co., Pittsburgh
- UTAH**
Radio Supply, Inc., Salt Lake City.
- WASHINGTON**
Seattle Radio Supply Co., Seattle
Wedel Co., Inc., Seattle
- ARGENTINA**
Radio Revista, Buenos Aires

- AUSTRALIA**
McGill's Authorized Agency, Melbourne
- BELGIUM**
Emil Arens, Brussels
- CANADA**
T. Eaton & Co., Winnipeg, Man.
Electrical Supplies, Winnipeg, Man.
Wholesale Radio Supply, Winnipeg, Man.
Canadian Electrical Supply Co., Ltd., Toronto, Ont.
Radio Trade Supply Co., Ltd., Toronto, Ont.
Wholesale Radio Co., Ltd., 1133-35 Bay St., Toronto, Ont.
Canadian Electrical Supply Co., Ltd., Montreal, P. Q.
- BRAZIL**
Agencia Soave, Sao Paulo
- CHINA**
China News Co., Shanghai
International Booksellers, Ltd., Shanghai
- ENGLAND**
Gorrings' Amcr. News Agency, London
- FRANCE**
Toute La Radio, Paris
- GERMANY**
Rehr G.M.B.H. SW15, Berlin NW No. 7
- HOLLAND**
Radio Peeters, Amsterdam, Z.
- INDIA**
Empire Book Mart, Bombay
- MEXICO**
American Book Store, Mexico, D. F.
Central De Publicaciones, S. A., Mexico, D. F.
Jaques Salvo, Mexico, D. F.
- NEW ZEALAND**
Johns, Ltd., Auckland
James Johnston, Ltd., Dunedin
Te Aro Book Depot, Ltd., Wellington
- SOUTH AFRICA**
Technical Book Co., Cape Town
Central News Agency, Johannesburg
International House, Johannesburg
South African Radio Publications, Johannesburg

IF YOUR DEALER DOES NOT CARRY THESE BOOKS, ORDER DIRECT FROM US. FILL OUT COUPON BELOW. SHIPMENT WILL BE MADE IMMEDIATELY.

POPULAR BOOK CORP.
20 VESEY STREET, NEW YORK CITY. R&T-3-41

Gentlemen: I enclose herewith my remittance for . . . for which please send me the following books:

Name

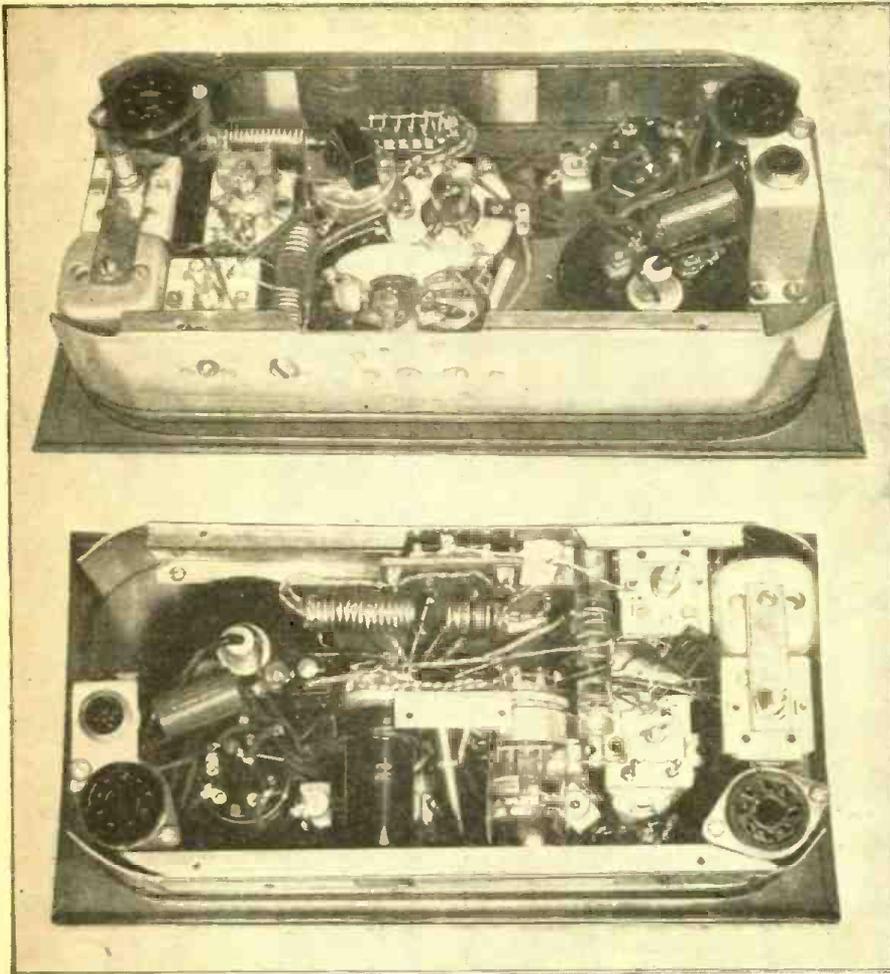
Address

City State

(Send remittance in form of check or money order. If letter contains cash or unused U. S. postage stamps, register it.)

POPULAR BOOK CORPORATION

**20 VESEY STREET
NEW YORK, N. Y.**



Top—Final version of the mobile converter with Acorn tubes. Bottom view—Original set with 1852 mixer.

near perfect match between antenna and set when the original No. 12 center wire was replaced by No. 18.

Not much was done with the transmitter but to cut a 5 meter coil to the proper size. Three turns 1 1/8" diameter and 7/8" long are about right. The coil is interchangeable with the ten meter tank coil since they are both on plug-in bases. The same antenna coupling coil is used for both.

The power output was increased somewhat by using an HY61 in place of the HY60 originally used. This allows the plate current to be run up to 65 ma. with greatly increased output. The tube acts as a doubler on 5 meters, of course, and much better doubling may be had by raising the power amplifier grid-leak to 50,000 ohms; operation on 10 meters is hardly affected by this change.

The revamped outfit is a better performing one all around and has in addition the advantage of both 5 and 10 meter operation.

The parts shown include tubes and sockets used for all the various converters, but of course only two of each are used for any one circuit. Many parts of the original converter were used, only strictly new parts being listed.

List of Parts

- BUD**
 1—5 meter coil (OCL5)
 1—25 mmf. variable condenser (LC1642)

- RCA**
 1—954 acorn tube
 1—955 acorn tube

for March, 1941

- HAMMARLUND**
 2—Acorn tube sockets (S900)

- AMPHENOL**
 2—Loctal sockets (#54-8L) for 7G7 and 7A4
 1—Cable end with cap (93-M15 and 90-15) for antenna cable
 1—Chassis connector (93C) for antenna
 1—Cable connector (93M)
 Coaxial cable as needed for particular installation (72-12W)
 Coaxial receiving cable to converter (76-22S)
 2—Connectors for above (80M with 912 insulation)
 2—Chassis connectors (80C with 912 insulation)

- NATIONAL UNION**
 1—7G7 mixer tube
 1—7A4 oscillator tube

- HYTRON**
 1—Power amplifier (HY61)

- MALLORY**
 1—Four-position, double-pole switch (3242 J)

NEXT MONTH—

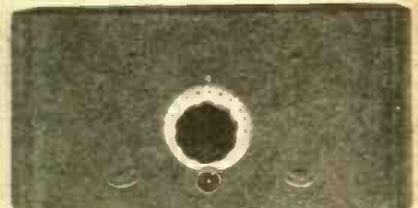
Inexpensive Test Instruments for the Experimenter and Amateur—by William J. Vette

New "HAM" Circuits and Kinks "CQ" by Larry LeKashman, W2IOP

—And a Host of New Ideas for the Junior HAM

HARVEY'S

Headquarters for
 High Fidelity
 Reception Equipment



**HARVEY'S
 FM TUNER KIT**

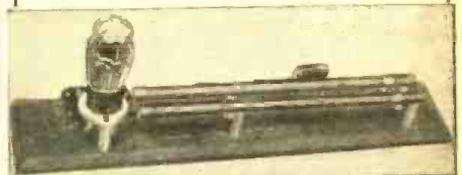
covering all of the
 newly assigned frequencies

Kit consists of all necessary components plus punched and drilled chassis and latest circuit diagrams.

AMAZINGLY LOW PRICED

Less power supply, tubes, and cabinet\$12.95

LINEAR TANK



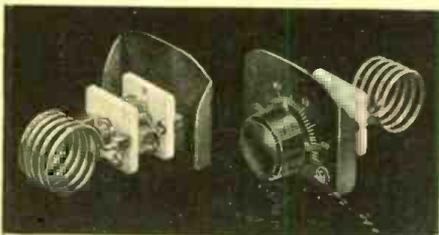
2 1/2 meter oscillator using a 6E6 tube. Completely wired. Measures 18 1/8" x 3 3/4". Less tube\$3.50 net

- W2IJL W2LJA W2KWY
 W2JKR W2PL

OUR *Best* VALUE IS OUR RECORD OF LOYAL SERVICE

HARVEY
 Radio Company of New York

103 WEST 43rd STREET • NEW YORK, N. Y.
 CABLE ADDRESS: "HARADIO"



MIDGET FREQUENCY METERS

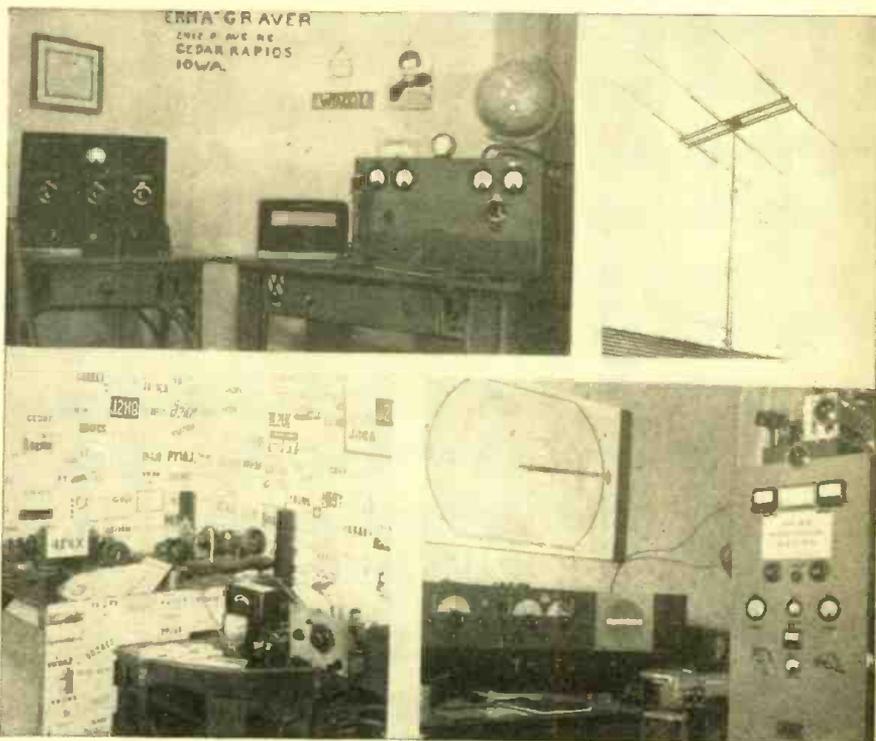
Many amateurs and experimenters do not realize that one of the most useful "tools" of the commercial transmitter designer is a series of very small absorption type frequency meters. These handy instruments can be poked into small shield compartments, coil cans, corners of chassis, etc., to check harmonics; parasitics; oscillator-doubler, etc., tank tuning; and a host of other such applications. Quickly enables the design engineer to find out what is really "going on" in a circuit. Sold in sets of 4 in handy protective case or individually.

90605	Range 2.8 to 9.7 mc.	\$1.65
90606	Range 9.0 to 28 mc.	1.65
90607	Range 26 to 65 mc.	1.65
90608	Range 50 to 140 mc.	1.65
90600	Complete set of four, in case	6.50

JAMES MILLEN MFG. CO. INC.
150 EXCHANGE ST. MALDEN, MASS.

"CQ"

Larry LeKashman, W2IOP



Top left: An R9 YL station, W9ZQI of Cedar Rapids, Iowa. Top right: The neat looking 3 element beam belongs to W2LKC. Lower left: W4EVX, Lawrenceburg, Tenn. Low power DX is a specialty with 96 countries worked using under 50 watts. Lower right: The station of W8OXO, SCM of West Virginia. The map and pointer are for Tab's rotary.

LEARN CODE

the way you'll be using it
by SOUND



The best way to learn to read code is by listening to code. The best way to learn to send code is by hearing your own sending repeated back to you. With the new All-Electric Master Teleplex Code Teaching Machine, you learn code the natural, easy, fascinating way. Only instrument ever produced which records your sending in visible dots and dashes—then SENDS BACK your own key work at any speed you desire. That's why practically every school teaching code uses TELEPLEX. We furnish complete course, lend you All-Electric Master Teleplex, give you personal instruction with a MONEY-BACK GUARANTEE—all at a surprisingly low cost per month. Write today for FREE catalog S3. No obligation.

TELEPLEX COMPANY
67-69 Park Place, New York

In Canada write:
CANADIAN ELECTRONIC INST., TORONTO, ONT.

PRECISION CRYSTAL CONTROL
FOR ALL AMATEUR BANDS

BLILEY CRYSTALS Now \$3.35 UP
BLILEY ELECTRIC CO., ERIE, PA.

● UNLIKE cooks, too many authors can't spoil the broth. When "CQ" was first introduced, it was stressed as a column of, by, and for all radio fans. So far, with the exception of two or three dozen amateurs and several SWL's, "CQ" has been a personal diary. Don't be surprised if "CQ" becomes "QRT."

The *Amateur Radio Defense* reports on a FCC investigation of a fake SOS. Considerable work revealed a W1 amateur as the offender. The SOS was part of a program by the ham, put on for code practice. This particular case may, or may not, have been malicious, since there are countless cases on record of signals getting out without any antenna on the transmitter. Using nothing but a *Signal Shifter*—without any connections, within 50 feet of the ECO output, *I have worked 50 to 100 miles!*

Now above all times we should take every precaution against operating violations. Under no circumstances should the distress call be sent for mere amusement. Unless code practice is being sent in the prescribed manner on the air, it is best to use a code oscillator—not the oscillator stage in the transmitter!

Aside from accidental infringements of current regulations, there has been a deliberate and serious type of offender working the DX bands. These offenders, and there are many, have been working Central and South Americans, and in some instances even Europeans. Not quite as serious, but also offenders, are the DX men working old friends out of the country with blind

transmissions. At this stage of the game, regardless of personal feelings and desires, any deliberate violation of the law is extremely serious. Amateurs overheard violating rules should be reported to the ARRL, who will take appropriate action. The feeling, or attitude, that you are talking out of turn is foolish, since failure to prevent such violations will soon result in wholesale revocation of amateur tickets.

If I don't put this in, life won't be worth living—at least near W2JEH. Ed is a father—the lucky harmonic—Andrea Lois. The event took place 15 months ago, but this will serve as official notification to the public at large.

W4GNQ, ex-W2ESO, surprised most of the gang by taking for himself an XYL.

NCR members throughout the country are being called up for active duty. Since most of them are amateurs it is a splendid example of the genuine service amateur radio is actively performing.

The Arc from Asheville, North Carolina, continues to prove a fertile and amusing source of material. W4FSE is still editing *The Arc* and doing a mighty fine job. We have reprinted below an editorial from the last issue of W4FSE's publication, which should be of interest to all amateurs.

"How do you feel when you read little items such as this: 'Still, if our 55,000 radio amateurs enable spies to operate radio safely, why not close the amateur stations for the duration?'"

This "gem" came from *Quillen's Quips* by Robert Quillen. Could it be that such

homilies as, "Better not sneer at those who believe in the old platitudes. For some reason, they hold most of the big jobs," or "To argue about rights in times like these is madness, yet one must defend his rights while another threatens them," came from the same pen.

Now, don't answer the first question with a mad tongue or a hot pen . . . I felt the same way as you feel. You will notice that, although this so called "quip" is put in the form of a question and supplies its own "if," such a thought, given circulation, bodes no good for the amateur in the eyes of the public.

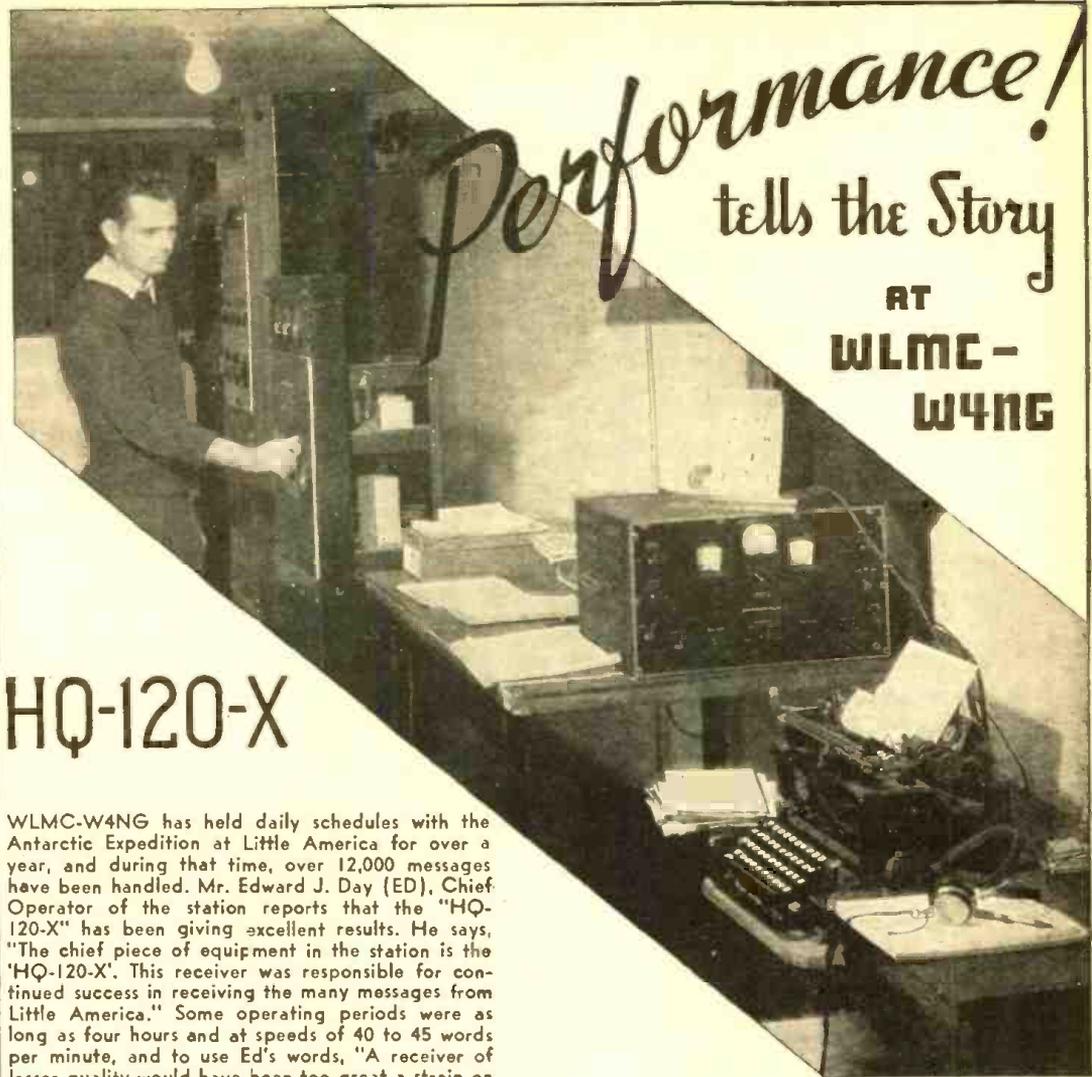
Ask yourselves this question: "Have my actions or any actions of my fellows in radio-communication been the means of enabling any spy to safely operate, to the detriment of the United States?"

The willingness of the FCC to leave us on the air seems to answer both questions, but it does not follow that we shall be allowed to continue to operate if the answer to the first question reverses itself.

One can find an innumerable of intolerance in an utterance which bears an implication arousing doubt.

There are many amateurs. By the end of 1940 the number will probably reach 60,000; perhaps, in a decade, there will be 100,000 or more! The more amateurs there are, the stronger they are in organization, in unity, the greater their worth. On the other hand, the fewer the number, the less important they become. Don't worry about room for them on their frequencies; progress will take care of that. The FCC and the governing powers are not fools; they continue to license amateurs and they recognize the worth of the amateurs and the need they fill.

If people who give voice to such intolerances would draw themselves abreast of the facts, they would realize that the efforts of amateurs have made it possible for them to push a button and listen to music and voices from around the corner or from far away. But maybe such people do not listen "to the radio" . . . perhaps they have retired with their indignation . . . so, let's put it down to dyspepsia—and let go at that.



Performance!
tells the Story

AT
WLMC -
W4NG

HQ-120-X

WLMC-W4NG has held daily schedules with the Antarctic Expedition at Little America for over a year, and during that time, over 12,000 messages have been handled. Mr. Edward J. Day (ED), Chief Operator of the station reports that the "HQ-120-X" has been giving excellent results. He says, "The chief piece of equipment in the station is the 'HQ-120-X'. This receiver was responsible for continued success in receiving the many messages from Little America." Some operating periods were as long as four hours and at speeds of 40 to 45 words per minute, and to use Ed's words, "A receiver of lesser quality would have been too great a strain on the operators."



The "HQ-120-X" is the last word in receiver engineering and we think it is the greatest dollar value ever offered to the amateur. Just operate an "HQ-120-X" and you will immediately see the difference, or ask the ham who owns one and he'll tell you it's tops in every respect. Altho the average ham doesn't operate 40 to 45 words per minute hours on end, he will appreciate the smooth, stable performance of the "HQ-120-X".

WRITE DEPT. RT-3 FOR "HQ" BOOKLET



HAMMARLUND MFG. CO., INC.

424-438 WEST 33rd ST., NEW YORK



EXPORT OFFICE: 100 VARICK STREET, NEW YORK CITY

W2MXK is building a new receiver to accompany his 6L6. W2DUP is busy with an electronic "word counter" for his bug. W2JZH is deserting 160 for 80 CW. W2HNS is still off the air. W1KKS lost his rig in the SS—no it didn't wear out, just blew out! W2LR is doing active duty with the NCR, ditto W2PL with the Army. W2CLH is taking the fatal step shortly. W3FLA is working for the FCC in Michigan.

SS scores are probably still of interest since official results don't appear for many

a month. We quote from W9BRD's letter—"SS scores are still good gabbing on the air. I can vouch for some of the Chicago gang, many representatives of which were contributing very generously to the neck deep QRM. W9's UTB and YFV each hit about 80,000. W9BRD scraped up 87,000, by the grace of God, etc. 9's MUX, DUX, and ERU are reported to have 'whoppers' for totals, but I haven't heard the bad news yet. Downstate, W9GFF stuck by his 40 meter gun and reeled off around 60,000 for a snazzy one-band score, and sez he's

RADIO OPERATORS

WANTED

The National Defense Program is creating innumerable openings for Commercial Radio Operators—Now is the time to capitalize on your radio training and experience by obtaining a Commercial Radio Operator's License and taking advantage of the many opportunities presented.

The "RADIO OPERATORS' LICENSE GUIDE" has been especially prepared as a Guide for those radio men having the necessary training and experience who are unaware of the exact requirements for a Commercial Radio Operator's License—Containing over 1,250 questions and answers to the new type examinations, it will enable you to successfully pass the tests.

Only \$3.00 Postpaid—Send check or Money Order.

INLAND WIRELESS PRESS

411 - 7th St.
Belle Plaine, Iowa.

LEARN RADIO TELEVISION

500 LICENSED graduates placed in past 7 years in shipping, broadcasting, aviation, police, etc.; we also teach radio servicing and repairing; new beginners' class now forming; 60-page catalog free; oldest, largest and best equipped.

MASS. RADIO SCHOOL

18 BOYLSTON ST., BOSTON, Mass., Est. 1899

RADIO-TELEVISION

Oldest, largest Radio-Television school in West trains you for good pay job. Complete instruction including Radio Construction and Service, Broadcast Operating, Sound, Talking Pictures, Television, Public Address, etc. Flexible plan to meet specific needs of those with or without jobs. Transportation allowed to L.A. Earn room and board while learning. Request Free Catalog.

NATIONAL SCHOOLS

Dept. 3-RT
Los Angeles

RADIO COURSES

Mid-Term Classes Now Starting

- RADIO OPERATING—BROADCASTING
- RADIO SERVICING—a practical course
- RADIO AMATEUR CODE • TELEVISION.
- ELECTRONICS—1 yr. day course 2 yrs. eve. Day and Evening Classes. Booklet Upon Request.

New York Y.M.C.A. Schools
6 W. 64th Street New York City

RADIO TECHNOLOGY

RCA Institutes offer an intensive course of high standard embracing all phases of Radio and Television. Practical training with modern equipment at New York and Chicago schools. Also specialized courses in Aviation Communications, Radio Servicing and Commercial Operating. Catalog Dept. RT-41.

RCA INSTITUTES, INC.
A Radio Corporation of America Service
75 Varick St., New York. 1154 Merchandise Mart, Chicago

RADIO ENGINEERING

broadcasting, aviation and police radio, servicing, marine radio telegraphy and telephony, Morse telegraphy and railway accounting taught thoroughly, 48 weeks' Engineering course equivalent to 3 years of college radio work. All expenses low. Catalog free. School established 1874. Dodge's Institute, Turner St., Valparaiso, Ind.

going to use three bands next time, so warns all to beware! As everyone probably knows by now, 3BES hit the jackpot, and I hear that a half dozen or so W3's hit in between 80 and 90 thousand. W3GKO, W3's most consistent TFC bug, rang in at 84,000 and O.O. 3EEW piled up 72,000 on 40 and 80. W2LZR, NYC Tfc reliable, made 72,000 points and promises a better wallop next year (who doesn't?). W5LW bids for Oklahoma with over 50,000 on 7-14 mc. 5AAN claims 72,000, which sounds good for a Texas high. Up in Minnesota another Traffic fiend, 9NCS, amassed 51,000.

"DX men, stripped of their branch of the hobby, were abundantly proportioned in the SS ranks. A few who will groan at the light bills are 2BHW, 8BTI, 8OQF, 4BPD, 2HHF, 8LEC, and 2ZA, and many others who were adding to their logs quantity, if not quality in QSO's."

W9GSA is on ten meter phone from the same QTH as 9SG who works 40 CW. 9KIO of Evanston took his 807 rig apart and has run into difficulties rebuilding. 9KFY has 100 watts, ECO, and a 20 meter Zepp in attic. 9ZHM in Wilmette is tinkering with an ECO and KW on 20/40 meters. 9VNW, Evanston, sports 1/2 KW on 40. 9VES is recuperating from SS difficulties. 9VFZ putters on all bands, both phone and CW, and worked phone division in SS. 9MFY has an 807 on all bands from 160 to 20. 9AI works both coasts with 15-35 watts on 20/10 phone and keeps in trim of 40 CW. 9BRD worked all districts on 160 meter CW in one week and has QSL's to prove it. 9VDA occasionally enhances QRM on low end of 40.

W6DUC continues to schedule all the YL's on the air who will give him a tumble. 2KEZ takes his pick of either 14, 7, or 3.5 mc. CW when not punching tape for WCX/WJS/WBN. Anytime you want a snappy ragchew and some hot code practice, just mention it to KEZ, as he can "sizzle" you with his tape! 6BPM burns up a 14 mc. beam with a KW on 40/20 meters and also has a tape. Code practice via W7YG comes through like a commercial on the low end of 40. But so do the Spanish-speaking phones. 9IBC donates CW practice of LF end of 40.

The Forty Traffic System bunch is battling against 10-meter skip and 'phones between 7200 and 7250 KC. Some of the fellows have had to resort to 80 for TFC handling. For those who wish to give 6DUC competition, there are plenty YLRL members active around 3600 KC. 9CRK in Milwaukee is heap big traffic man now, as is ex-DX'er W2AV. W9EYH sold his 100 watt final to CRK and is now taking a rest from hamming while he masters 40 w.p.m. on his mill. 9CS is battling rheumatics in Clinton, Iowa, says 9AXD who shoves out a mean signal with a 25 watt 6L6GX xtal oscillator on 40. 160 meter phones active on the North side of Chicago are numerous and include 9MCM with 80 watts and a T40, 9KYX has a Stancor 10-P, 9HDC with 65 watts into an 807, 9LPS 12 watts, 9LNE 10 watts, and 9BZJ 60 watts.

W6HGE of Lawndale, California, boosts RCC on 14 MC. He sports an 8JK beam, 100 watt RK20 final and an SX24, 3JAZ of Norfolk just got on 7 MC with 40

watts. 1AQT moves for shorter SS periods and has 200 watts on 20. 7HBB in Portland has QRP'd from a KW to 250 watts for the duration, and sulks on 20. SCM 8AQ puts his 40 watt emergency rig on 160 meter CW when there's a lull in 80 TFC. 160 CW sounds like 40 on a Saturday night. Guess the boys are tuning up for the coming 160 meter WAS party. All three KC4's can frequently be heard with whopping signals around supertime on 14 mc phone. KD4GYM is still making the boys hop for a contact.

Back to 9BRD's fine letter. Rod put into words something that more than adequately expresses my sentiments, and probably by far the largest percentage of radio amateurs. What do you think? "Say, I wonder who the bird was who wrote in and asked how you felt about the ARRL. It could only have been a newcomer, perhaps not even a ham. Heck, the ARRL IS amateur radio. All we are enjoying now in this hobby is due to the League and without it the commercials and broadcasters would have had our beloved bands long ago. Some of these young squirts now getting on the air seem to think that ham radio is sponsored and put forward by the government, and that the ARRL is just another radio organization making a living off the hams. The truth of the matter is that ham radio is only tolerated by the government, and it's up to the league to sell it, and keep selling it to Uncle Sam."

What a question. "What do you think about the ARRL?" What can anyone mean by such a question? Does he want to abolish it? Does he want to throw it out and put up another one? Both are preposterous in view of the fact that the present organization is deeply imbedded in all the traditions of the art and enjoys the respect and cooperation of the government. Perhaps the questioner is of the opinion that with a more aggressive League we would now have been using bands twice their present size, etc. On the contrary, a too aggressive League could easily have convinced the government that our hobby was a pain-in-the-neck and a bother.

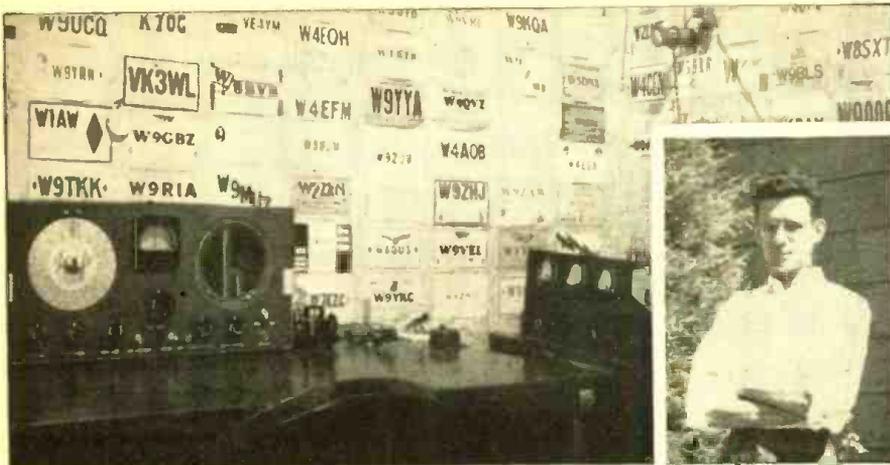
Throughout the years to come, amateur radio's perch will become more and more precarious as more and more commercials clamor for our frequencies and our removal from the air. Therefore, we must take advantage of the present circumstances. The U. S. Government recognizes the American contingent of amateurs as an unlimited source of radio operating manpower; green, perhaps, as compared with top-notch army men, but diamonds in the rough, so to speak, who, with a little polishing will give our country a signal corps second to none and radiomen for any capacity. Hence the League policy of code proficiency which serves notice to Uncle Sam that we hams are doing our part in the preparedness program.

NEXT MONTH!

Don't miss article describing

A "Real Hi-Fi Phono Amplifier"

by Milton T. Putnam,
Chief Engineer, Station
WDWS



Very business-like is this amateur station, operated by Donald Perazzo of Sioux City, Iowa.

"Honor" Plaque Awarded To Donald Perazzo, W9YQY

For Best HAM Station Photo

Editor:

W9YQY has been on the air since the spring of 1937. The present set-up uses a Stancor 10-P transmitter on 160 meter phone, and a home-made 70 watt rig on 40 meter CW. The line-up of the CW rig is a 6L6 crystal oscillator, with an 807 in the "final." The receiver is a 1939 Halli-crafter Sky Champion. A bug, handkey, and "standby" switches are mounted on top of the operating table. The microphone is sus-

ended on a hook on the right side of the operating table when not in use. A total of 47 states and 8 foreign countries have been contacted and the station is A.R.R.L.—V.A.C.—S.W.L.—R.C.C.

The operator is 19 years old and studying for a first-class commercial telephone license.

DONALD PERAZZO, W9YQY,
3130 Pierce St.,
Sioux City, Iowa

Here is the new "Award of Honor" Plaque which measures 5" x 7" in size. It is handsomely executed in colors on metal, and is framed, ready to hang on the wall. The name of the winner will be suitably inscribed.

Note These Important Rules

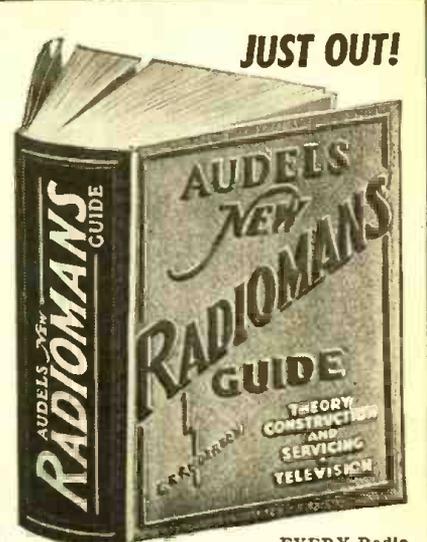
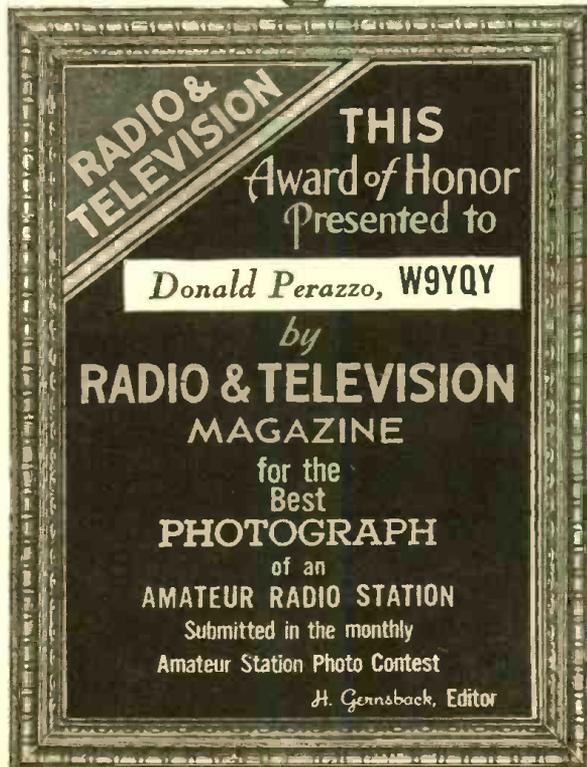
Attach a brief description not longer than 300 words, describing the general line-up of the apparatus employed, the size, type and number of tubes, the type of circuit used, name of commercial transmitter—if not home-made, watts rating of the station, whether for c.w. or phone or both, etc., also name of receiver.

State briefly the number of continents worked, the total number of stations logged or contacted, and other features of general interest. Mention the type of aerial system and what type of break-in relay system, if any.

Important—Enclose a good photograph of yourself, if your likeness does not appear in the picture!

You do not have to be a reader of RADIO & TELEVISION in order to enter the contest.

Address all photos and station descriptions to Editor, Ham Station Photo Contest, c/o RADIO & TELEVISION, 20 Vesey Street, New York, N. Y.



JUST OUT!

RADIO

EVERY Radio Mechanic—Service Man & Student Needs "Audels Radiomans Guide"—Just Out!

The whole subject of Modern Radio—covering the Basic Principles—Construction & Operation—Service—Repairs—Troubles—All Easily Understood. Over 750 Pages, 400 Illustrations, Parts & Diagrams—LATE TELEVISION DATA—Valuable for REFERENCE AND HOME STUDY.

To get this practical information in handy form for yourself fill in and mail coupon today.

COMPLETE • PAY ONLY \$1 A MO.

AUDEL PUBLISHERS, 49 W. 23rd St., N. Y.

Mail AUDELS NEW RADIOMANS GUIDE for free examination. If O. K. I will send you \$1 in 7 days; then remit \$1 monthly until price of \$4 is paid. Otherwise, I will return it.

Name: _____
Address: _____
Occupation: _____
Reference: _____

EASY TO LEARN CODE

It is easy to learn or increase speed with an Instructograph Code Teacher. Affords the quickest and most practical method yet developed. Available tapes from beginner's alphabet to typical messages on all subjects. Speed range 5 to 40 WPM. Always ready—no QRM.

MACHINES FOR RENT OR SALE

The Instructograph Code Teacher literally takes the place of an operator-instructor and enables anyone to learn and master code without further assistance. Thousands have used and endorse the Instructograph System. Write today for full particulars and convenient payment and rental plans.



INSTRUCTOGRAPH COMPANY

Dept. RT, 4701 Sheridan Rd., Chicago, Ill.

Representatives for Canada

Radio College of Canada, 54 Bloor St. West, Toronto.

AMATEUR RADIO LICENSES

Study for your licenses the "rhythm" way, the A.R.I. way. Acquire code proficiency in from 3 1/2 to 8 weeks. Theory taught in understandable, non technical language. Classroom courses in New York, home study courses for outside students. Write for list of calls of hundreds of licensed students now on the air.

AMERICAN RADIO INSTITUTE

1123 BROADWAY, NEW YORK, N. Y.

START RIGHT

with Nilson & Hornung's book

RADIO OPERATING QUESTIONS & ANSWERS

Contains Essential Facts for Beginners

Nilson & Hornung's new edition covers all FCC commercial license exam elements. Standard handbook 20 years. \$2.50 postpaid. Money back if not satisfied and book returned in 10 days. Send check or money order . . . not cash. Free circular on request.

NILSON RADIO SCHOOL

Book Dept. 51 E. 42nd St., New York, N. Y.

A "Pull-Swing" Frequency Modulation System for the Amateur

Part 2—Modulation Unit

Ricardo Muniz*; Donald Oestreicher**; Warren Oestreicher***

The editors are pleased to present herewith the second installment of the article on the "Pull-Swing" Frequency Modulation for the amateur. A great deal of special research work has been carried out by Mr. Muniz and his associates in the development of this simplified system of FM, which provides surprising stability.

parallel resistances R_p (plate resistance) and R_l (load resistance). The plate resistance is constant. When the load resistance is very high the amplification factor will approach its maximum value (given in the tube tables of the manufacturer). In Fig. 6 is shown how the amplification factor μ varies when the load resistance (or reactance) is varied. It will be noticed that this curve is not linear. In order to raise the curve more sharply at the top, the inductance may be made resonant at the highest frequency to be amplified. This causes a peak in the curve as in Fig. 7 and raises the response. At the same time, through proper design, the frequencies above the point of resonance may be sharply attenuated. The circuit was designed to have maximum amplification at 5,000 cycles. To resonate at this frequency a 2 henry choke shunted by 500 mmf. capacitance is required. At 100 cycles (the lowest frequency to be amplified) the choke will have a reactance of about 1200 ohms. This means

$$R_p R_l$$

that $\frac{R_p R_l}{R_p + R_l}$ will be about 1,000 ohms and

the amplification factor will be about one-fiftieth of its maximum value (70 for a 6K5-G). This is about 1.6. At 5,000 cycles per second the impedance of the resonant circuit comprised of the 2 henry choke and the 500 mmf. capacitance is quite high—in the order of 60,000 ohms. This value of load will give about half the maximum μ (or 35). We thus have a ratio of about 30 to 1 over the spectrum 5,000 C. P. S. to 100 C. P. S., and this has proved satisfactory. The 2 henry reactance (X_L) in the diagram is not very critical—it may be between one and three henries with .001 mf. and 300 mmf. shunt capacitances, respectively. The 150, 200 or 500 ohm winding



Mr. Muniz is seen at the left of the accompanying photo, with one of his associates, together with RCA signal generator, a cathode-ray oscillograph, together with the FM apparatus thus far constructed.

THE preceding article gave some of the theory of frequency modulation and a discussion of the principles applying to the "R. & T." modulator unit. In the following article the design and construction of a complete modulator rack, including audio and R.F. stages, will be discussed. This unit is adaptable to any properly designed amplifier and is itself a low-power FM transmitter. Several innovations in amateur design will be noticed and special mention will be made of them as we discuss the transmitter.

From the first article the reader is undoubtedly aware that in "Pull-Swing" Frequency Modulation an audio amplifier modulates a pair of crystal oscillators in amplitude, 180 degrees out-of-phase. These crystal oscillators (control oscillators) then are made to pull the grid circuit frequency of an electron-coupled oscillator back and forth over the desired spectrum.

Audio System

The audio system had to have sufficient "gain" to work from a dynamic microphone (-56 db.) to a load of approximately four watts. At the same time it must have an overall amplification proportional to the audio frequency (i.e., the amplification at 5,000 cycles must be about 50 times that at 100 cycles and approximately linear between). A three-stage amplifier with a high gain pentode (6SJ7); as speech amplifier, a high- μ triode (6K5-G) as control amplifier and a 6L6-G as amplitude modulator was finally decided upon.

Speech Amplifier

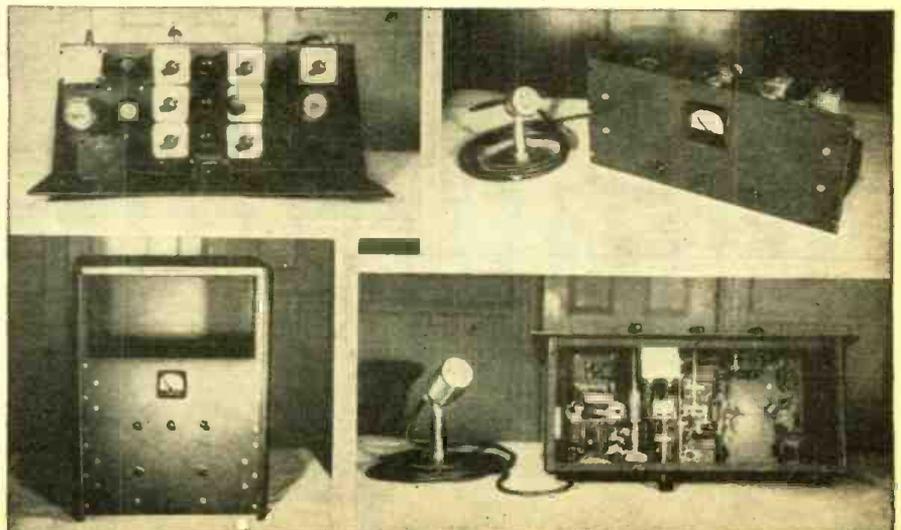
The 6SJ7 speech amplifier is conventional in all respects. It is transformer-coupled to the 500 ohm line and the gain control is a

500,000 ohm potentiometer in the grid circuit. The potentiometer is placed near the 6SJ7 socket, in order to eliminate extra wiring in this critical part of the circuit, and it is controlled through a shaft and coupling.

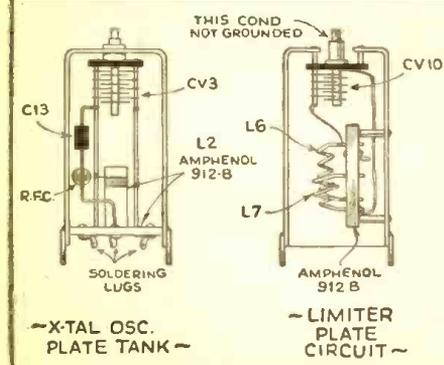
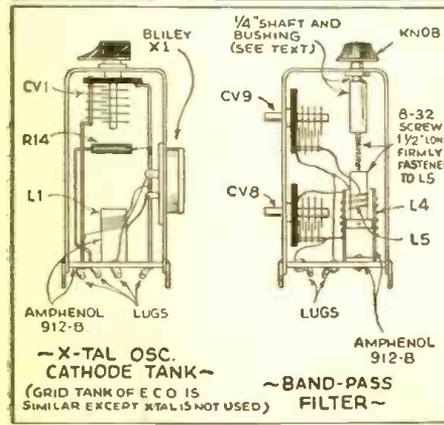
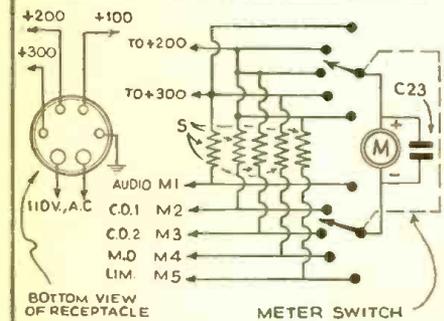
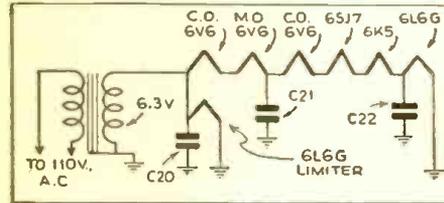
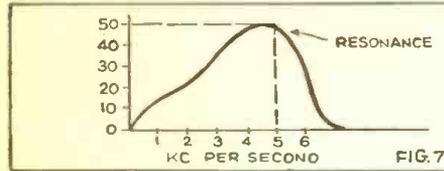
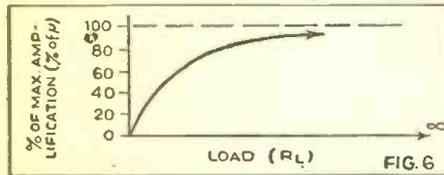
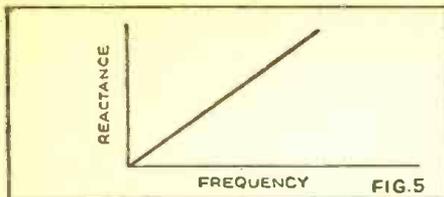
Control Amplifier

The next stage is most important. It is in this stage that the frequency-amplification ratios are established. In Fig. 5 is the curve representing the reactance (effective resistance) of an inductance with respect to increasing frequency. This curve is linear. The output of a vacuum tube (triode) is $\mu \times E_o$, where μ is the amplification factor and E_o is the input voltage. The amplification factor is proportional (in a triode) to the value of the

Top photos in the group herewith show top and front views of the modulator rack unit for "pull-swing" FM; bottom photos show unit assembled in rack and also "mike," together with a bottom view of the unit.



*Radio Instructor, Brooklyn Tech. H. S., Eng. WYNE.
**Student, Electrical Eng., Brooklyn Polytech., W2LOE.
***Student, Electrical Eng., Cooper Union, Night.



Diagrams showing FM action, as explained in the text, and also details of crystal oscillator coil units. for March, 1941

LAST CHANCE

that you will have to buy

Crosley CHATTABOX
INTERCOMMUNICATION SYS. \$14.95
TEM OF TWO UNITS FOR
LIST PRICE—\$59.50 A PAIR

Complete two-way wireless loud speaking system. Perfect performance. Plug into any 110 volt house socket A.C. or D.C. Equipped with Call-Listen-Talk switch and volume control. No installation charges. Modulated carrier signal travels over the electric light lines.

IDEAL FOR OFFICES, STORES, FACTORIES, SCHOOLS, LIBRARIES, HOMES AND WHEREVER INTERCOMMUNICATION IS DESIRED. EXCELLENT SPEECH CHARACTERISTICS.

Each unit is housed in beautiful 2 tone veneered cabinet with grided speaker front.

This Coupon is worth \$1.00 if mailed to us with order BEFORE APRIL 15th.

Name _____
 Address _____
 City _____

KORROL MFG. CO.
 350 GREENWICH ST. (DEPT. RT-341)
 NEW YORK CITY

of a "universal" type transformer should be in the desired range of inductance. The condenser is fairly critical and should be adjusted to fit the value of the choke, so that the circuit may resonate at about 4,500-5,000 cycles. The stray capacitance in the circuit should be taken into consideration as they may run as high as 50 mmf.

Amplitude Modulator

The 6L6G amplitude modulator tube is operated in class A. It is possible that in some cases more power will be needed from this stage. If this is so, operation at 500 volts with a suitable bias is permissible since all of the low frequencies, in which most of the power of a signal is contained, are well attenuated. The output transformer available did not have a center tap. A network of two 10,000 ohm resistors and 2 mf. condensers was provided so that plate voltage could be applied to the oscillators at a neutral audio point.

R.F. Circuits

On this 8" x 17" chassis are three oscillators and a limiter—all working at the same time and all doubling in the output circuits. This means that there are seven different frequencies present in a small space! Obviously some shielding had to be done, or at least the signals had to be sharply attenuated outside their proper circuits. The method of completely shielding the tank circuits was borrowed from commercial practice and contrary to expectations, presented little difficulty in either mechanical or electrical design. In addition, shunt or parallel feed was used in the plate circuits of all but the highest frequency stages, and there is no high voltage exposed at any place. The neat, commercial appearance of the finished job is evident from the photographs. (The cans come from "bargain counter" I.F. transformers and only added a dollar to the cost of the rig. All cans are 2" x 2" x 4" high and are made of 1/32" aluminum.)

Coil Construction

In the drawings (Figs. 1-4) is shown the general construction of the tank circuits. All components associated with these circuits are inside the shield can when it is mechanically possible. The insulation of the tank circuits is all Amphenol 912-B. The

TRAIN NOW!

FOR THE ARMY, NAVY OR COMMERCIAL FIELD

You, too, can qualify in half the usual time for your amateur or commercial license and a good rating by training in your own home with the Candler System. Candler teaches you code by a simple, practical method—the same easy-to-learn Candler System that has taught thousands including world famous speed champions.

The Candler System has, for over a quarter of a century, shown how easy it is to learn code in your own home and secure a steady, good paying job. Over 5000 expert radio operators will be enlisted by the Communications Reserves of the U.S. Navy. You can qualify for this now—the Candler way!



FREE Candler's New Book of **FACTS**
 Tells you all the inside tips—
 Get your free copy Now—Drop a post-
 card today!

CANDLER SYSTEM CO.
 DEPT. S-3
 Asheville, N. C., U. S. A.

WAVE METER

Band switching is used to provide complete coverage from 10 to 160 meters.

This BUD Wave Meter is particularly useful for tuning up frequency multiplier stages, for neutralization adjustments, and for antenna adjustments.

YOUR NET PRICE\$4.35

BUD
BUD RADIO, INC.
 CLEVELAND, OHIO

USED Correspondence Courses

COMPLETE HOME-STUDY COURSES and educational books, slightly used. Sold, rented, exchanged. All subjects. Money-back guarantee. Cash paid for used courses. Full details and illustrated 72-page bargain catalog FREE. Write today!

NELSON COMPANY, 500 Sherman, Dept. C-210, Chicago

coils are wound on this material and then painted with 912-B coil dope. The mounting base is made of 912-B sheet, $\frac{1}{8}$ " thick. (It actually pays to use this material. We wound the cathode coil of one of the control oscillators on "low-loss" bakelite, and with the oscillator running at 100 volts on the plate the coil form—not the coil—got very hot. That's one reason for *frequency drift* and *power loss*. With amphenol 912-B this trouble immediately disappeared.)

The winding data for the coils and the tank components is given in the following tables.

On Amphenol miniature forms—

- L1—15 turns No. 24 S.C.E.—closewound
- L2—12 turns No. 24 S.C.E.—closewound
- L3— 9 turns No. 24 S.C.E.— $\frac{5}{16}$ " long
- L4— 9 turns No. 14 Enam.—1" long
- L5— 9 turns No. 18 Enam.— $\frac{5}{8}$ " long
 $\frac{3}{8}$ " max. outside dia. (see text)
- Airwound (supported on 912-B strip)
- L6— 9 turns No. 14 Enam.— $\frac{1}{2}$ " dia.
 $1\frac{1}{2}$ " long
- L7— 2 turns No. 12 tinned— $\frac{3}{4}$ " dia.
coupled to L6

L4 and L5 comprise the variable band-pass filter. The width of the pass band depends on the coupling. Coupling is varied by sliding L5 in and out of L4 by means of a screw. To the $\frac{1}{4}$ " shaft, shown in the drawing, is soldered a bushing $1\frac{1}{4}$ " long with an 8-32 tapped hole through it. An 8-32 machine screw is fastened to the L5 coil form and threaded into the bushing. The L5 coil form has a projection which rides in a groove cut in the L4 coil form, to keep L5 from rotating. By turning the knob the bushing draws the screw and L5 upwards and decreases the coupling between L5 and L6.

The *limiter* coil is air-wound and mounted on a strip of 912-B. The strip is supported from the can by bushings. The condenser is mounted upon two bushings fastened to the ceramic front plate and the shaft projects through a hole, which gives $\frac{1}{8}$ " clearance all around. This stage, operating at 59.2 megacycles, is the only one in which the plate circuit is series fed, as it is undesirable to depend on R.F. chokes at these frequencies.

Control Oscillators

There is little to be said about the *control oscillators*; they are the familiar tri-tet circuit. The screen grids are connected to the 100 volt tap on the power supply. They are therefore quite well stabilized. The plate circuit alone is modulated and the crystal is, therefore, always oscillating so that the critical condition (where the feed-back is low) is never reached.

Master Oscillator

The *electron-coupled oscillator* is also conventional. The plate voltage is about three hundred, in order to provide a strong signal, but if any instability results, the voltage may be lowered.

The 10 mmf. variable condenser is brought through the panel and is used for minor frequency adjustments.

Limiter

By referring to the first article of this series you will find that a *limiter* should be operated at low plate voltage, and with no grid bias and should be greatly over-driven, so that saturation and cutoff occur during each cycle. The plate voltage and screen voltage is 200 and the quarter-meg-ohm grid-leak insures that the exciting

voltage will be high enough. The output of this stage is taken from a flexible amphenol concentric line attached to the chassis.

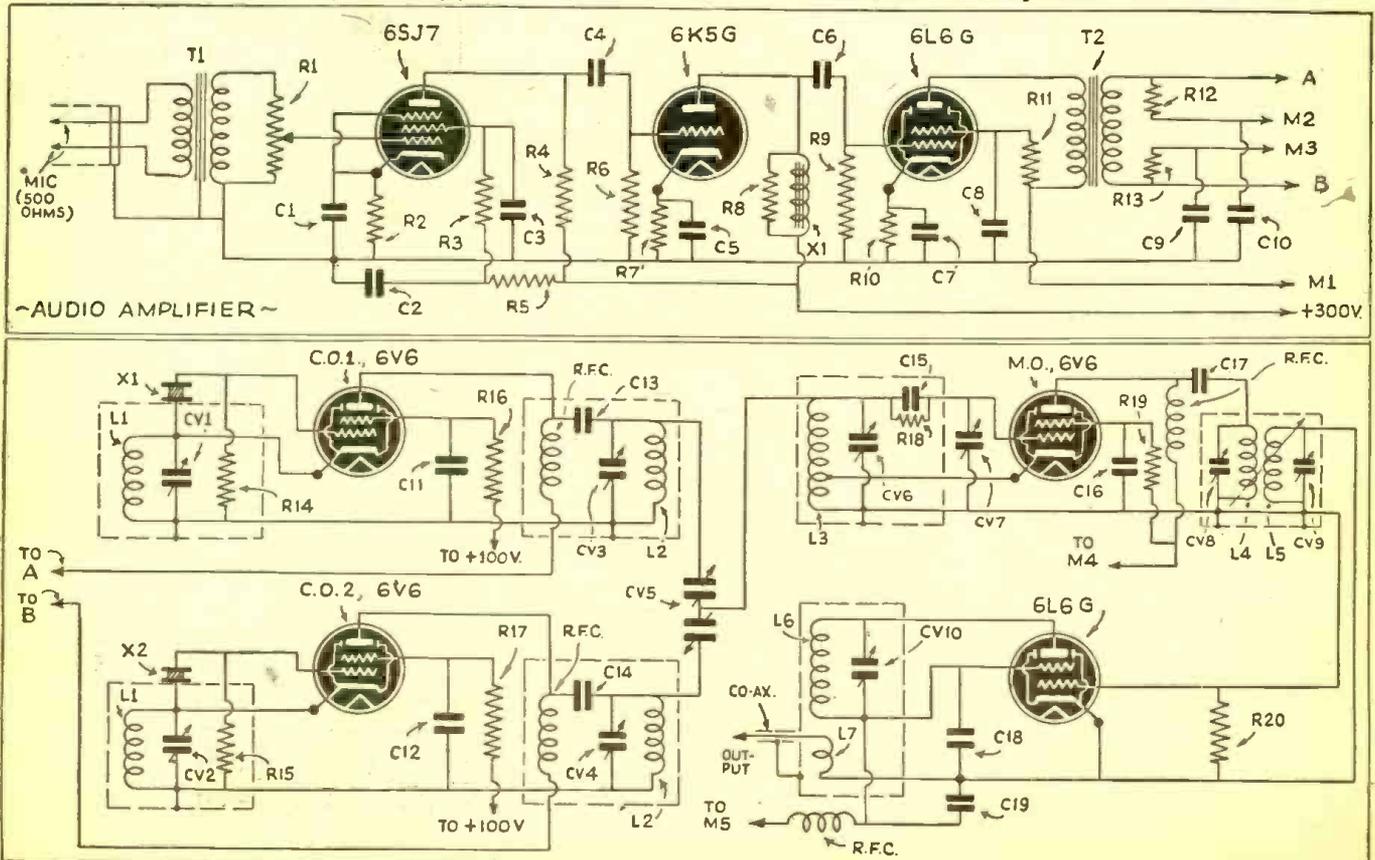
Layout

The photographs show the mechanical layout quite well. Tube sockets should be placed so that the grid and plate lugs are nearest to their respective circuit components. The wiring is very simple with the type of coil construction used. Flexible stranded wire and tinned No. 18 solid wire were used in connections.

Metering

The *meter-switching* system is quite convenient, since it allows a check to be made on all stages by just turning the knob. The shunts are easily made from resistance wire. First the shunt is carefully removed from the meter. This is quite simple as it is only soldered in. A flashlight cell and a low resistance rheostat (about 1000 ohms) are needed. The shunt just removed is soldered to the switch as in the diagram, and the meter is wired to the rotor lugs. The battery (in series with the rheostat) is connected across the shunt and the rheostat adjusted so the meter reads 100 ma. A length of wire is now soldered across two other contacts and the meter turned to that position. If the needle does not read 100 ma. when the battery is across the new shunt, then change the shunt. Make it shorter if the needle reads high, and longer if the needle reads low. The shunts are about 1.5 ohms, so that you will need at least 10 ohms of wire. (It is very cheap.) When all the shunts are made, coil them on a pencil and fasten them into the switch permanently. (There is no need for extreme accuracy—but try to make the shunts for the two control oscillator

Wiring diagram of the FM modulator unit described this month. All shield boxes are grounded.



circuits exactly equal.)

In the next article of this series the power-supply for the transmitter (shown in photographs) will be shown and discussed. At the same time information on testing and operating the frequency modulator unit will be given.

Parts List

KENYON (Transformers)

- 1—T-2, low imp. to grid
- 1—T-491, used to distribute audio to control osc's
- 1—T-351, fil. trans. 6-3 v. 3 amp.

PAR-METAL PRODUCTS CORP.

- 1—3604, 8 1/4" steel rack panel
- 1—15281, 8" x 17" x 3" steel chassis
- 1—SB-78, mounting brackets for 8" chassis

BUD RADIO, INC.

- 4—CH-920, 2.5 mh. 125 ma. R.F.C.

TRIPLETT ELEC. INSTRUMENT CO.

- 1—Model 327—TRJW, 0-100 ma.
- 5—Shunts 100 ma. Shunt removed for above.

BLILEY ELECTRIC CO.

- 1—BC-3, 7416 kc. exact.
- 1—BC-3, 7396 kc. exact.

INTERNATIONAL RESISTANCE CO.

(Resistors)

- 2—BT-1, 250 m. 1 w.
- 3—BT-1, 500 m. 1 w.
- 3—BT-1, 25,000 52 1 w.
- 1—BT-1, 1 meg. 1 w.
- 3—BT-1, 50,000 52 1 w.
- 1—BT-1, 850 r 1 w.
- 1—AB, 20,000 r 10 w.
- 1—BT-1, 1000 r 1 w.
- 1—BT-1, 10,000 r 1 w.
- 1—AB, 200 r 10 w.

- 2—AB, 10,000 r 10 w.

NATIONAL UNION (Tubes)

- 2—6L6G
- 1—6C5
- 1—6SJ7
- 3—6V6

AMERICAN MICROPHONE CO.

- 1—D8T, 500 ohm dynamic microphone

AMERICAN PHENOLIC CORP.

- 1—76-22S, 6 feet coaxial cable
- 7—SS8, Steatite octal sockets
- 6—24, 912-B miniature plain coil forms
- 1—65-125, sheet 912-B Polystyrene
- 1—PF6-7, 6 contact side cable outlet
- 1—PM6, 6 contact plug
- 1—SS6, 6 contact socket
- 1—PC3F, mic. connector to chassis

INSULINE CORP. OF AMERICA (I.C.A.)

- 4—1249, brass extension rods
- 2—2143, Isolantite flex. shaft coupling
- 1—5252, hardware assortment

P. R. MALLORY & CO.

- 1—SRP 252, 500 m. carbon voc. control
- 2—TS 102, 25 mfd. 25 v. elect. cond.
- 1—TS 108, 50 mfd. 50 v. elect. cond.
- 5—TP 418, .1 mfd. 600 v. paper cond.
- 12—366, bar knobs
- 1—151-L, "Hamswitch"

CORNELL-DUBILIER ELECTRIC CORP.

- 2—DY-6200, 2 mfd. 500 v. paper cond.
- 4—IR-5DZ, .002 500 v. mica cond.

ALLEN D. CARDWELL

- 3—ZU-100-AS, 50 mmfd. var. cond.
- 2—ZR-50-AS, 50 mmfd. var. cond.
- 3—ZR-25-AS, 25 mmfd. var. cond.
- 1—ZR-10-AS, 10 mmfd. var. cond.
- 1—EU-100-AB, 100 mmfd. var. cond.

BOOK REVIEWS

RADIO OPERATING QUESTIONS AND ANSWERS, by Nilson and Hornung. Flexible cloth covers, 5 x 7 inches, 416 pages, illustrated. Published by McGraw-Hill Book Co., New York, N. Y.

The questions cover all the phases of radio, including diagrams, theory, FCC and International rules, etc. The opening chapters deal with basic theory and practice, and the answers when necessary, are accompanied by diagrams. The answers are given in very clear, short form so that they can be easily assimilated by the student, and should enable him to answer any of the questions which he meets with in the FCC examinations for license.

Successing chapters take up the radio telephone, advanced radiotelephony, radiotelegraphy—both elementary and advanced, etc. An appendix is given covering the international "Q" signals, a copy of the Morse code, rules governing commercial radio operators, extracts from the radio laws, and a very complete index of subjects.

THE METER AT WORK, by John F. Rider. Stiff cloth covers, size 5 1/2 x 8 1/2 inches, 162 pages, illustrated. Published by John F. Rider, Publisher, New York, N. Y.

A new and novel arrangement has been made in the mechanical make-up of this book, the pages being cut through the middle and arranged in two halves, as it were. The diagrams appear on the upper pages and are numbered progressively. Let us suppose the reader is studying the book and is interested particularly in Fig. 79 as referred to in the text. He simply takes the ribbon attached to the book and places it at the diagram page numbered Fig. 79. If he laid the book down and referred to it a little later, the text and corresponding diagram are instantly located—also the ribbon serves as a "book mark."

The various chapters describe the different types of meters, including moving iron and dynamometer types, characteristics of meters, rectifiers and thermo-couples, practical application of meters, etc. An excellent book for every radio student and service man.

THE RADIO AMATEUR'S HANDBOOK, Eighteenth (1941) Edition, by the Headquarters Staff of the A.R.R.L. 552 pages, including 8-page topical index and 96-page catalog section of amateur radio equipment. Approximately 830 illustrations and 90 charts and tables (Spanish edition available). Published by the American Radio Relay League, Inc., West Hartford, Conn.

The 32 chapters in the new Handbook constitute a very complete exposition of practical amateur operating and constructional data. First, there are two introductory chapters, intended for the newcomer first learning about amateur radio (including the code). There are four chapters on principles and design, covering the essential elements of radio theory in understandable fashion.

There are fourteen chapters in the construction and adjustment section, ranging from workshop practice through to the elimination of broadcast interference. In these chapters dozens of modern, proved units of high-performance amateur stations are described in detail. There is a section in which complete transmitters, laid out down to the last power connection, meter and switch are shown.

The remainder of the book is literally a number of separate Handbooks combined into one. The antenna section contains five chapters alone, covering the field from basic principles to the design and construction of elaborate long-wire and rotary arrays. The ultra-high frequency section, too, contains five chapters. An entirely new section on the important subject of "frequency modulation" has been added.

FESSENDEN—BUILDER OF TOMORROWS, by Helen M. Fessenden. Stiff cloth covers, size 6 x 9 inches, 362 pages with a frontispiece of Professor Fessenden. Published by Coward-McCann, New York, N. Y.

Helen M. Fessenden deserves a lot of credit for at last coming out with this complete history of the radio inventions of Professor Fessenden. Not so well known to the young radio students and engineers of today, perhaps, Professor Fessenden was one of the shining lights in the realm of American radio invention for over 30 years. In fact, he first thought of "wireless" inventions some years before the dawn of the century.

This very interesting book gives the early personal history of Professor Fessenden, covering his school and college days and the details of his first official radio researches carried out in conjunction with the U. S. Weather Bureau in 1900. No thorough student of radio should fail to read this remarkable book, as it not only sets forth the complete history of the first big American radio company—the National Electric Signaling Company—but it also discloses some of the early basic radio inventions of Mr. Fessenden.

Professor Fessenden took out some 500 patents in various fields, particularly in the transmission of light, sound and electrical waves. In 1906, using his system of transmission and reception, "two-way" trans-Atlantic radio-telegraphic service was first established between Brant Rock, Mass., and Machrihanish, Scotland.

The "first" radio broadcast in the world took place from Fessenden's Brant Rock Station on Christmas Eve and New Year's Eve of 1906, which was heard by ships along the Atlantic seaboard, as far south as Guantanamo Bay, Cuba. Among his inventions other than radio were the underwater "oscillator," the "fathometer" or Sonic Depth Finder, the "radio compass" and other submarine signaling devices. Professor Fessenden at an early date brought to the attention of the large electrical manufacturers the value of the "turbo-electric drive" for battleships. This was later adopted, without credit to him, however, as the author points out.

Pocket Tester FOR THE AMATEUR

TRIPLETT
Model 666-H



\$14.50

Net Price

Size:
3-1/16"
x 5/8"
x 2/8"

5000 VOLTS SELF-CONTAINED

Model 666-H Volt-Ohm-Milliammeter is a complete pocket size tester—with AC and DC Voltage ranges to 5000 Volts (self-contained); AC and DC Voltage at 1000 ohms per volt 0-10-50-250-1000-5000; DC Milliamperes 0-10-100-500; Resistance 0-300 ohms; shunt type circuit; 10 ohms reading at center scale; 0-250,000 ohms, series type circuit, 3700 ohms at center scale. Higher resistance measurements available by using external batteries. Selector switch for all instrument readings. The ideal Pocket Volt-Ohm-Milliammeter for amateurs, radio technicians, industrial engineers, research, Black Molded Case and Panel, Completely Insulated . . . with RED & DOT Lifetime Guaranteed Measuring Instrument . . . Dealer Net Price . . . **\$14.50**

"For full cooperation with the National Defense Program, Triplet engineering and production facilities are being rapidly expanded to continue the service and delivery to which our trade is accustomed!"

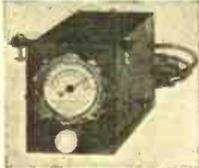
WRITE FOR CATALOG!

Section 283 Harmon Avenue

THE TRIPLETT ELECTRICAL INSTRUMENT CO.

Bluffton, Ohio.

SHORT WAVE CONVERTERS FOR CAR RADIOS



Can be attached to any car radio.

MODEL 600-A covers 49-31.25-20-19 and 18 meter bands. Designed for American and Foreign short wave broadcast. Distance range 5,000 to 10,000 miles. List Price \$24.95

MODEL 700 long wave covers 135 to 410 KC. Receives Gov. weather reports, etc. List Price \$24.95

POLICE UNITS

MODEL 100-100-A with fixed condensers, covers 1600 to 2600 kilocycles. \$12.50

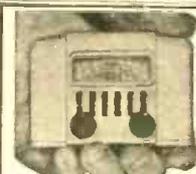
MODEL 800 Super Sensitive police converter with fixed condenser. Covers 1500 to 2600 kc. Two metal tubes, exceptional distance range. List Price \$15.95

MODEL 300 with variable condenser, covers 1550 to 6000 kilocycles. List Price \$17.95

MODEL 500-A with variable condenser, covers 1550 to 6000 kilocycles. Exceptional distance range. List Price \$21.95

Jobs and Dealers Wanted

ABC RADIO LABORATORIES 3334 N. New Jersey St., Dept. RT-3, Indianapolis, Ind., U.S.A.



NEW! 1941 MODEL!

NO TUBES NO BATTERIES NO PLUG-IN

DURABLE PLASTIC CABINETS

DUAL BANDS—MAGICTENNA—MICRODIAL. Fits your pocket or purse—Wt. 6 ozs. Small as cigarette package. Receives standard & some short wave. PATENTED POWER RECTIFIER. No tubes, no batteries. Hi-ratio easy tuning slide "MICRODIAL."

M. L. OF ILL. SAYS: "MIDGET RADIO WORKS FINE!"

ONE YEAR SERVICE GUARANTEE!

Sent complete ready to listen with instructions & tiny phone for use in homes, offices, hotels, in bed, etc.

SIMPLE TO OPERATE—NO ELECTRICITY NEEDED!

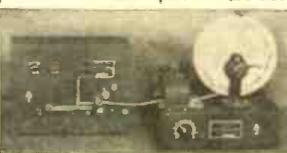
SEND NO MONEY! Pay postpaid \$22.99 plus postage charges on arrival or send \$2.99 (Check, M.O., Cash) and yours will be sent postpaid. A MOST UNUSUAL VALUE! ORDER NOW! FREE PLUG-IN!

"MAGICTENNA"—ELIMINATES OUTSIDE WIRES!

MIDGET RADIO CO., Dept. RT-3, Kearney, Nebr.

Do YOU want to be a Government radio operator?

Additional operators are needed NOW.



Why not learn to be an operator quickly and easily with the Ayers Automatic Code Machine a 11 electric, 50,000 word practice tapes available, low monthly rental.

TAPES FOR MAC AUTOS, RECORDING SLIPS AND RECORDING INKS

Write AYERS AUTOMATIC CODE MACHINES
711 Boylston St., Boston, Mass.

Setting Up

An Amateur Radio Station

Larry LeKashman, W2IOP

● PLOUGH through the myriad of material on amateur gear and you'll find so much, it becomes—if nothing else—confusing. Perhaps the trial and error method will bring satisfactory results in the end, provided you have the necessary money and time to follow this approach to a final solution. The point is, all of us have seen pictures of amateur stations that we admire and long for. All of us probably wish we could start our stations over again,

with the original investment intact, but with all the knowledge we had accumulated through hours of sweat and study. What has anyone done about it? Not much—and that is the point of this series.

We are going to try and take you through the trials and tribulations that befall all amateurs who are new in the game. Suggestions, photographs, hints and kiinks—all with the idea of showing you how to get the best layout first is the Herculean

job cut out for us. While the famous "junk box" is an old tradition of amateur radio, it is expensive and unnecessary.

Where to start becomes a difficult problem, since to the best of our knowledge no one has set any pattern for such an all inclusive essay. What is the ideal station? How can one produce a good looking station and stay within a budget? What type tools are best for the "kitchen mechanic"? What make equipment is best looking and best performing? How much money is wasted on "beautifying" the average rig?

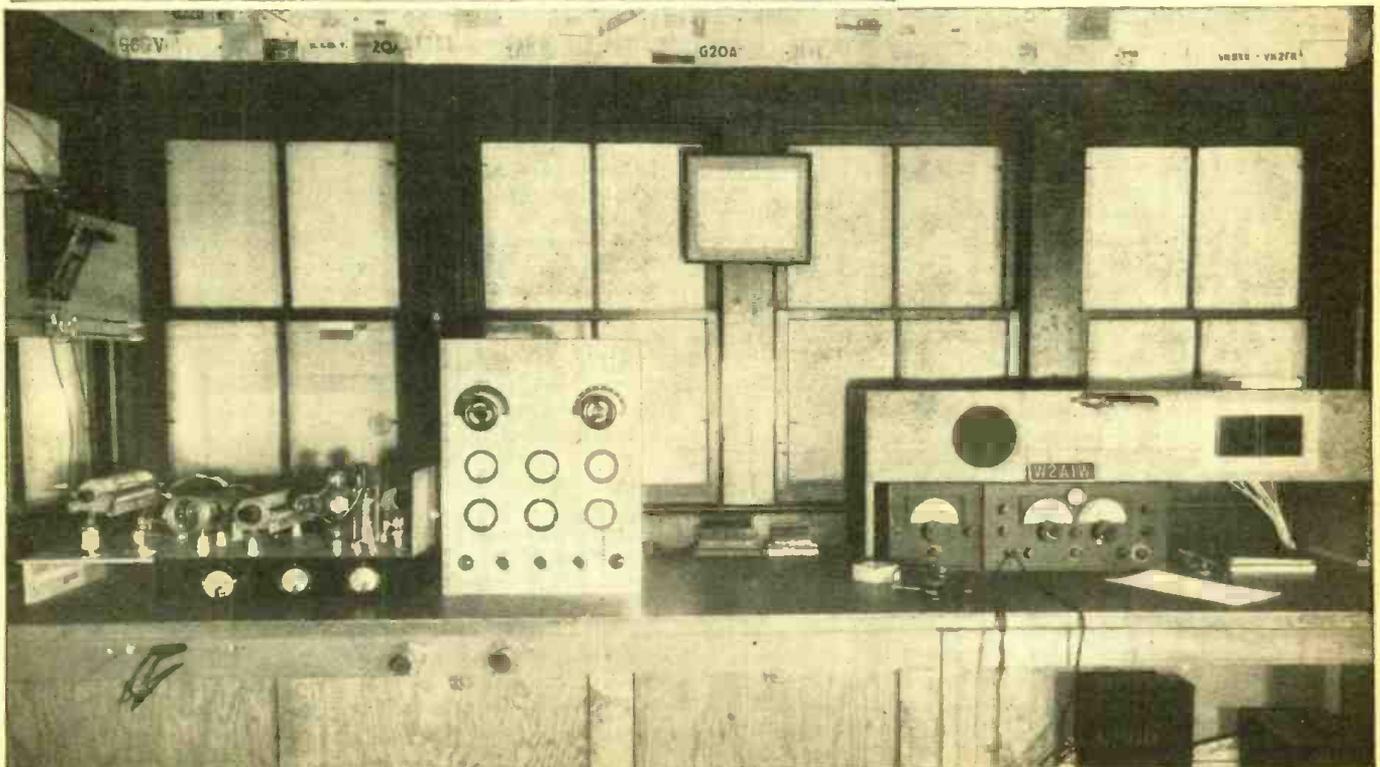
The most important questions: "Is it possible to construct a good looking station, at a minimum expense, with no sacrifice on the part of actual equipment?" can be answered with an emphatic "yes!" Take for example any of the commercial kits on the market. The Stancor or Thordarson kits are fine examples of maximum watts per dollar value. In fact such kits have greatly changed the complexion of amateur radio in recent years. But more about that later.

Before delving into the subject at any great length let us examine what we consider the essentials of a good amateur sta-



Left—A very neat Ham station layout—that used by the author at W2IOP.

Below—Handsome station layout at W2AIW; transmitter at left and receiver at right. Loudspeaker or phone reception provided; auxiliary apparatus in cabinet under table.



tion. No one will dispute the fact that a receiver, transmitter, and antenna system are essentials. Then what? Well, what do you consider the perfect ham station. Injecting the proverbial "needle" into my arm I'll tell you what I would like. A single dial kilowatt, which would control the frequency and all following stages. The KW would be band-switched by push buttons. There would be separate beams for all bands which would be selected by the same button that selected the frequency. On the wall a glass map would light up with the direction the beam was covering. The receiver could be any of the standard communication receivers, such as a 101X, Super Pro, etc. A good bug and straight key, real high-fidelity speech with FM available for the UHF, and a neat modernistic room make up my perfect ham shack. Of course I am a long way from that stage of the game even now, but you can't stop a man from dreaming.

Back to the question of what else after the "essentials." The CW man can't very well use an over-modulation indicator; nor can the phone man use an electronic-key. I only mention this to point out that there are such things as *useless* accessories. Invaluable aids in any amateur station would include such equipment as ECO's; monitors, wavemeters, bugs, field-strength meters, universal testers, etc. On the transmitter alone, for example, there are many so-called "extras" which can be eliminated, although for safety's sake some are almost essential. Overload and underload relays; separate meters in each stage; band-switching; separate pilot lights in each circuit—these are non-essentials when trying to squeeze the old buffalo.

Look over the photographs of amateur stations accompanying this article. Pretty nice aren't they? From this point on, re-

member you too can be the envy of every amateur in your town.

Let's list a few cautions for the real beginner, and some old-timers too, might well take heed. Be careful of "bargains" available at any radio stores but the most reputable houses. Don't ever be high-pressured into buying equipment you haven't got implicit faith in! And most important—don't over-build on a limited budget. More specifically, spend money on good standard parts for a low-power rig, rather than buy junk for higher power. In the end you'll be rewarded! In radio, like anything else, *you get just what you pay for.*

In order to keep our main topics of discussion intact we are going to lightly touch on several relatively unimportant hints. An excellent one is to use masonite panels wherever possible, unless you have a well-equipped machine shop. Contrary to general belief masonite is just as good looking as steel and is far easier to work with. Invest money in good tools. Every ham should have at least one good pair of cutters and long-nose pliers; at least a 75 watt soldering iron; a good chassis knock-out punch; some sort of good drill capable of handling up to 1/4" bits and some sort of ream; at least several assorted files; screw-drivers; a heavy hammer and a cold chisel. A circle-cutter, center punch, and good box of assorted hardware complete the list of equipment that makes it possible for any half-way handy ham to turn out a really finished rig.

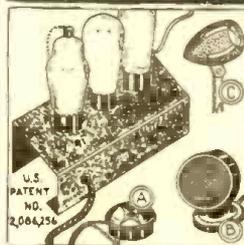
In the next article we shall start and perhaps finish an analysis of communication receivers. Nothing startling is promised, but you might get some good ideas. It is interesting to note the fact that a large percentage of hams on the air are using commercial receivers. There is a reason and next month we shall go into it.

Have You VAC?

● THE handsome 9" x 12" VAC Certificates are still available and will grace any DXer's wall. To be eligible for this DX honor, a phone QSL is needed from each of the 6 continents, Asia, Africa, Europe, Australia, North America and South

America (Java and Philippines count as Asia). Send in these six QSL's with 25c for handling and costs; after checking, the QSL's will be returned with certificate. Address *V.A.C. Editor, RADIO & TELEVISION, 20 Vesey St., New York, N. Y.*

WIRELESS TRANSCASTER



HUNDREDS

of practical applications. Will broadcast voice or music from any room or floor in home, office or store and connections. **WITHOUT CONNECTING WIRES!** Operate from any lighting socket. Transmit your favorite recordings thru any radio without connections between radio and phonograph. Your radio becomes a Public Address or inter-communication system wide in Transcaster.

Home broadcasting without wires. Great fun for parties, auditions. Use as a detective device to listen to secret conversations. A few other uses include wireless nursemaid, pipe line tracer, mind reader, trick ventriloquist, binocular announcer, talking dog, etc. Impossible to enumerate many other uses in this limited space.

TRANSCASTERS are available in **FIVE** models, all completely wired, laboratory tested and ready to use. All fully guaranteed as to materials and workmanship and also against damage in transit.

STANDARD MODEL Excellent beginner's outfit. Permits use of carbon or small mag. speaker as microphone, or only high impedance magnetic or crystal pickup record player. **POWERFUL**, not to be confused with one-tube toy-type outfits. Priced amazingly low. Works from a.c. or d.c. Price, complete with 3 tubes, ready to use (less mike) **\$2.95**
Earphone Mike (Fig. A) 95c additional

DE LUXE MODEL TRANSCASTER-TRANSMITTER Powerful, high-gain device engineered so that it will transmit high-fidelity music without connection wires to remote rooms, no sacrifice of quality or power. Operates from a.c. or d.c. Same frequency range as Senior Model, but greater db. amplification. Price (less tubes and mike) **\$4.95**
Set of 4 Matched Tubes for DeLuxe Model ..\$1.95

H. G. CISIN, Chief Engineer
ALLIED ENGINEERING INSTITUTE
Dept. S-73
85 Warren St., New York, N. Y.



FLIGHT

THE PICTORIAL FLYING REVIEW

Brings you all the phases of world aviation and aeronautics in a non-technical yet educational manner—exciting articles which catch your breath, yet give you the fundamentals of flying and ALL related subjects. **FLIGHT** keeps you abreast of all the major developments as they appear anywhere.

Now when planes and flying are of vital importance to all, you just can't do without this highly absorbing yet instructive publication. You must be "in the know."

Attractive three-color cover, numerous illustrations. **15c** copy

Partial Contents of the March Issue: Stratosphere Fighting! Armament of Modern Bombers. The Secret of the "Rocket" Plane. AIR WAR as Seen Through German Eyes. The HE 111-K Nazi Bomber. Details of the RAF "Spitfire" Bombing by Stop-Watch. So You Want to Fly! Question Box. Flight Digest. Bombers vs. Submarines. Formation Flying.

FLIGHT MAGAZINE
20-T Vesey St., New York, N. Y.

Subscription price \$1.50 year (Canada and foreign \$2.00).

RADIO EVERYTHING IN RADIO



This one big book serves your entire radio needs. It includes sets, parts and supplies, public address systems, amateur equipment, testers, kits and fluorescent lighting. You'll find the nationally known favorites at the lowest possible prices. Get your copy of this big **FREE CATALOG** today.

BIG FREE CATALOG



BURSTEIN-APPLEBEE COMPANY
1012-14 MCGEE STREET, KANSAS CITY, MISSOURI

GEOPHYSICAL PROSPECTING OUTFITS



BLUE PRINTS and INSTRUCTIONS

For Building the Following Treasure Finders and Prospecting Outfits

- Folder No. 1. The "Radiofactor Pilot"—consists of a 2-tube transmitter and 3-tube receiver. Principle: radiated Wave from transmitter loop is reflected back to receiver loop. Emits visual and aural signals. Tubes used: two 1A5G—two 1N5G—one 1H5G.
- Folder No. 2. The "Harmonic Frequency Locator"—Transmitter radiates low frequency wave to receiver, tuned to one of Harmonics of transmitter. Using regenerative circuit. Emits aural signals. Tubes used: one 1G6G—one 1N5G.
- Folder No. 3. The "Beat-Note Indicator"—Two oscillators so adjusted as to produce beat-note. Emits visual and aural signals. Tubes used: Three type '30.
- Folder No. 4. The "Radio-Balance Surveyor"—a modulated transmitter and very sensitive loop receiver. Principle: Balanced loop. Emits visual and aural signals. By triangulation depth of objects in ground can be established. Tubes used: Seven type '30.
- Folder No. 5. The "Variable Inductance Monitor"—a single tube oscillator generating fixed modulated signals and receiver employing two stages R.F. amplification. Works on the inductance principle. Emits aural signals. Tubes used: six type '30.
- Folder No. 6. The "Hughes Inductance-Balance Explorer"—a single tube Hartley oscillator transmitter and sensitive 3-tube receiver. Principle: Wheatstone bridge. Emits aural signals. Tubes used: two type '30—one type '32—one type '33.
- Folder No. 7. The "Radiodyne Prospector"—a completely shielded instrument. Principle: Balanced loop. Transmitter, receiver and batteries enclosed in steel box. Very large field of radiation and depth of penetration. Emits aural signals. Tubes used: two 1N5G—one 1G4G—one 1H5G—one 1Q5—one 1G4.

With any one of the modern geophysical methods described in the Blue-Print patterns, Radio outfits and instruments can be constructed to locate metal and ore deposits (prospecting); finding lost or buried treasures; metal war relics; sea and land mines and "duds"; mineral deposits; subterranean water veins; oil deposits (under certain circumstances); buried gas and water pipes; tools or other metallic objects sunken in water, etc., etc.

Each set of blueprints and instructions enclosed in heavy envelope (9½" x 12½"). Blueprints 22" x 34"; eight-page illustrated 8½" x 11" folder of instructions and construction data ... **50¢**
Add 5c for postage

The complete set of seven folders..... **\$3.00**
Shipping weight 2 lbs. (add 25c for shipping anywhere in U.S.A.)

TECHNIFAX

RT-341 1917 S. STATE ST. CHICAGO, ILL.

TECHNIFAX 1917 So. State, Chicago, Ill.

Enclosed herewith \$..... for which mail to address below:

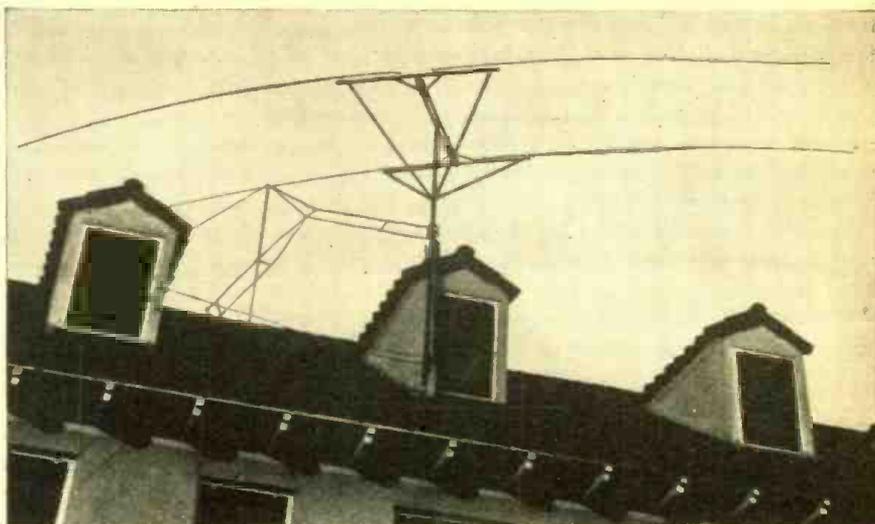
Treasure Finder No. 1, 2, 3, 4, 5, 6, 7.
Complete set of seven folders.

NAME

ADDRESS

CITY STATE

RT-341



Appearance of Mr. Blanchard's bamboo beam as installed on the roof.

Bamboo Beam

By R. M. Blanchard, W4FIC

● KNOWING that I would not be satisfied until I had tried out a close spaced beam on twenty meters and not wanting to put any money into the construction of one, I began looking about for ways and means. I finally decided to build one by using bamboo poles, with wire taped along them for the elements.

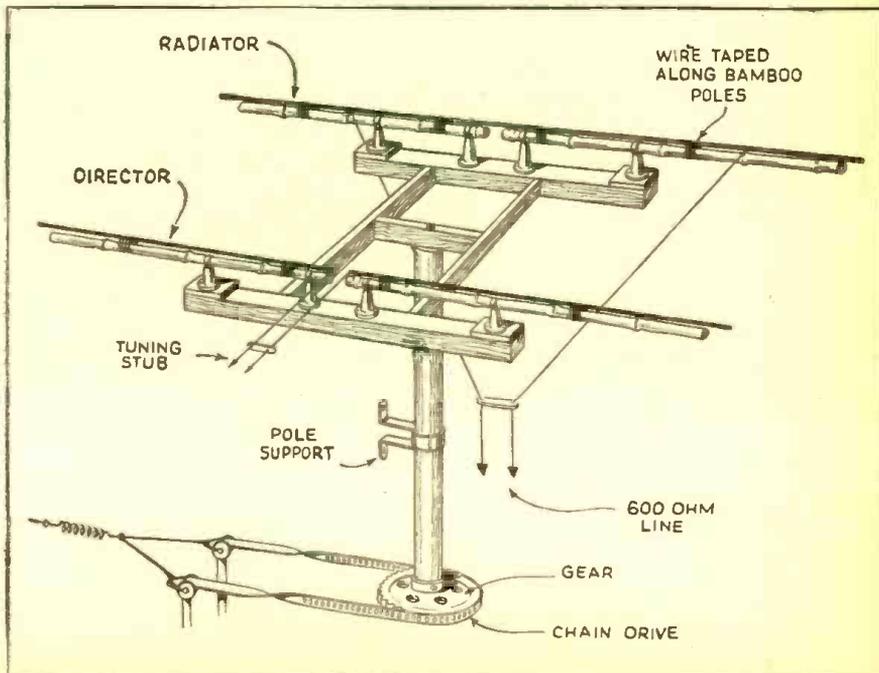
Four straight bamboo fishing poles, each about fifteen feet long, were procured and six stand-off insulators were dug out of the scrap-box. The elements are mounted with a spacing of six feet, eleven inches for twenty meters.

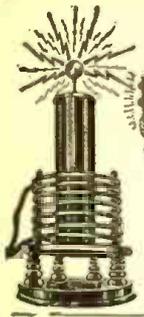
Next, the four bamboo poles were mounted on the frame. This was done by fastening each pole to two stand-off insulators. The stand-off insulators on each element

support of the frame were mounted to give them maximum separation (three feet will give ample support) and leave about six inches between butt ends of each adjacent pole. The poles were fastened to the insulators by small pieces of strap aluminum, bent and drilled to form an encircling strap. The outer insulators of each pole should be mounted on one-inch blocks to minimize a slight sag in the poles. Also, it is a good idea to varnish the poles before mounting them in order to keep out the weather.

At this time the element wires should be cut to their proper lengths. The approximate proper length for the radiator was found to be 34 feet 8 inches, and for the director 31 feet, plus a 12-inch tuning stub. After having done this the wire is stretched along

Constructional details of the bamboo beam.





Astonish YOUR FRIENDS!

Pass 500,000 Vts. Thru the Body! Light Lamps, etc.

NEW! 5-ft. Spark Oudin Coil, Condenser & 4 k.w., 40 k.v. Transf. data. net 75c

DATAPRINTS

Drawings & Construction Data Show You How
20c Each in Order for 10

TESLA-ODUIN HI-FREQ. COILS

- (Data and Drawings only; no parts included)
- 36" Sp'k Tesla-Oudin Coll.40c
(1 K.W. Exc. Trf. Data. Included FREE!)
 - 8" Sp'k Tesla-Oudin Coll.40c
(1/4 K.W. Exc. Trf. Data included FREE!)
 - 8" Sp'k Oudin, 110 Vt. "Kick Coll" type.40c
 - 8" Sp'k Tesla Works on Ford Sp'k Coll.40c
 - 1" Sp'k Violetta Hi-Freq. Coll.40c
- FREE with order for \$1.00 or more—20 Tricks with Hi-Freq. Coils" (40c separate)

TELEPHONE—Records on Steel Wire 40c
20 ELECTRIC PARTY AND LODGE TRICKS! Loads of Fun!

How to Do 'em!40c
New Electric Ore & Pipe Locator40c



Solenoid & Magnet Data—Get Our List!

20 Telephone Hook-ups—Build Your Own .. 40c



RADIO CONTROL FOR MODEL BOATS, PLANES
Data 40c
Phonophone; Data 40c

S-W DIATHERMY (Artificial Fever)

Dataprint giving Constructional data for Small, Medium and Large size App. (All 3) ...40c



"MIND READING" Radio Act40c

"Fry Eggs" on cake of Ice! Data 40c

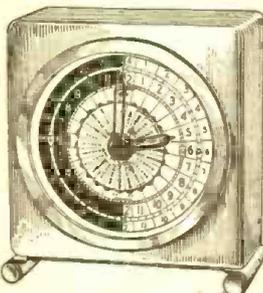
LOOK at these DATAPRINTS !! 40c Each.

- See Special Prices below
- 20 A.C. Problems and their Solutions. Welding Trans. 2 K.W. Rewinding Armatures.
 - 1/2 Meter Transm. & Rec. Water Wheels
 - 5 Meter Super-het. Water Turbines
 - 100 Mechanical Movements. Wheatstone Bridge.
 - 20 Motor Hook-ups. Photo-cell and Relay Data
 - Electric "Inductor" Organ 20 Simple Bell Circuits.
- Special Prices: 4 prints \$1.00; 10 for \$2.00; 40c each, single orders. Get New List 100A

The DATAPRINT Co.

Lock Box 322A RAMSEY, N. J.

LAST CALL at this LOW PRICE. Short-Wave fans need this **WORLD-TIME CLOCK** The Only Clock for Universal Use Throughout the Entire World!



A REGULAR CLOCK with A.M. and P.M. divided dial

A WORLD-TIME CLOCK Instantly indicating time in all 24 zones

INTERNATIONAL CLOCK with A.M. and P.M. 24 hour dial

Indispensable for Short Wave Fans.

Electric (for A.C. 110-120 volts, 60 cycles) \$5.95
Spring Model \$4.95

P.P. Prepaid in U.S.A. Remit by check or money order; register letter if you send cash or unused U. S. postage stamps.

GOLD SHIELD PRODUCTS

350 Greenwich Street, Dept. RT-341, New York City

the bamboo poles and taped in place. A delta matching section is then fastened to the radiator so that the Y is spread seven feet at the top and is seven feet from the center of the antenna to the point where the V of the delta joins the transmission line. The array is fed with a 600 ohm transmission line. The one foot tuning stub on the director can be made from heavier wire than the number 14 wire used on the antenna proper and mounted on stand-off insulators to give greater rigidity.

In tuning the array a second person's help is almost mandatory. It is also necessary to have a field-strength meter. The beam should first be mounted in place and all tuning adjustments made from there. The field-strength meter should be mounted about 50 yards away from the beam with a makeshift antenna strung to it. This antenna should be cut to approximately the correct frequency and erected parallel to the elements of the beam. The shorting stub is removed from the director and the radiator is pruned until a maximum reading is obtained in the field-strength meter. Next the shorting bar is replaced on the director tuning stub. With the transmitter on and very loosely coupled to the antenna, the shorting bar is run up and down the stub, until a maximum or minimum reading is obtained on the field-strength meter, depending on whether the director or radiator is toward the meter. This is the permanent location for the shorting bar and it should be soldered in place. While this tuning adjustment is being made it is necessary to wear thick leather gloves in order not to get bitten by the R.F. present. After this has been done the beam should be rotated and the front-to-back ratio checked. This ratio should be in the neighborhood of eight to one. The delta matching, if carefully measured, need not be adjusted further as the match can be considered close enough for effective operation.

There are many effective methods of rotating the beam. The system used by the writer was one of ropes and pulleys. An old bicycle drive was fastened to the base of the pole, on which the beam was mounted, just above a short plug which fitted into the inner race of a ball bearing. The bearing in turn was securely mounted on a wooden base. A bicycle chain was used to rotate the beam. A rope was fastened to each end of the chain and run through pulleys to the operating room. A stout circular metal band slightly larger in diameter than the pole was mounted about six feet above the base of the pole, to act as a support and yet permit the pole to rotate. The feeders were run to slip-rings and kept tight by small springs.

So far the beam has performed admirably. It has been up about two months and withstood varied weather conditions. Its superiority over several other types of antennas tried at this location was immediately noticed. Using 150 watts input, stations have been worked in the Philippines, Guam, and Little America. One hundred percent schedules have been kept with stations in the Hawaiian Islands. It has certainly justified the small amount of effort put into it. It is believed that this type of beam would perform equally as well on ten meters and be extremely simple to construct.

Home Recorder FREE!



Put this Radio-Phono Chassis in Your Present Cabinet...
FACTORY-TO-YOU SAVES UP TO 50%

Thrilling World-Wide Foreign News DIRECT!
UP TO \$25 TRADE-IN (On many models up to 18 tubes)
ENJOY listening to fine recordings on electric phonograph—delight in amazing ocean-spanning radio. Make records on Home Recorder (sent FREE for a limited time). Big FREE catalog pictures beautiful 1941 Factory-To-You radio chassis and console values—from 6 to 18 tubes—up to 5 Bands—including Automatic Record-Changing Radio-Phonographs; Home Recorder, etc. Liberal Trade-In! Write today.

MIDWEST RADIO CORPORATION
DEPT. 14231 CINCINNATI, OHIO



COMPLETE PLATING KITS

FOR Industrial plants, repair shops, radio shops, mechanics, craftsmen and home use. For repairing, replating or plating—nickel, cadmium and other finishes. Radio and electrical shops can now silver plate electrical connections on radios, testing instruments, sound systems, etc. (Silver plated connections do not require cleaning and have better conductance than any other metal.) Worn spots on horns, saxophones and other instruments can be replated without disassembling.

Covered by U.S. & Foreign Pats.
ALL KITS GUARANTEED
Silver kits\$2.50 and up
Nickel or cadmium\$2.00 and up

Send for catalog folder and other information
RAPID ELECTROPLATING PROCESS, INC.
1414 S. WABASH AVE. Dept. R-2 CHICAGO, ILL.

FILMGRAPH VOICE AND MUSIC RECORDINGS

Lengthy or continuous recordings now possible with newly patented "FILMGRAPH". Over 13 hours of indexed voice, radio, code, telephone recording on a single 500 ft. reel of film costing \$3.00 and up. No other expense. INSTANTANEOUS and PERMANENT play-back, Office Dictation, Recording Conferences, Speeches. Can easily be synchronized with motion pictures. Bulletins free.

MILES REPRODUCER CO., INC.
Dept. RT 812 Broadway New York City

FREE! THIS IS YOUR OPPORTUNITY TO SUBSCRIBE TO RADIO & TELEVISION'S SISTER PUBLICATION

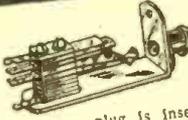
RADIO PARTS AND ACCESSORIES

RADIO-CRAFT

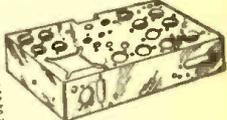
AND RECEIVE VALUABLE PREMIUMS!

HERE is some real BIG NEWS for you! Through a fortunate arrangement which we have been able to make, we can now offer you FREE premiums of such extraordinary value that they overshadow anything we have ever offered in the past with subscriptions to RADIO-CRAFT Magazine.

NEVER BEFORE, in the 11 years' history of the magazine, have we offered such worthwhile premiums. All of these radio parts and accessories can be used to good advantage by the "ham" or constructor in his daily experiments.



TELEPHONE JACK
Substantial long frame phone jack. 2-circuit filament control type. Flanges 2 circuits, closes when plug is inserted. Can be used for control purposes in radio and telephone work.
3rd when plug is inserted.
2 3/4" long, 1" high. Ship. weight 4 oz.
Premium No. 1 (3 Pts.) Val. 35c.



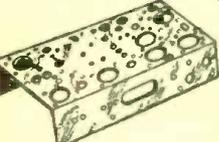
PUNCHED CHASSIS
Heavy plated steel chassis with holes punched for 11 tubes, power transformer, speaker plug and tuning dial. Great for large experimental sets, transmitters, etc. Reinforced construction. 13"x7 1/2"x2 1/2". Ship weight 3 lbs.
Premium No. 2 (5 Pts.) Val. 25c.



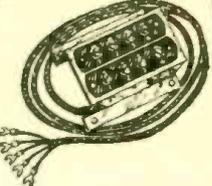
TWO GANG POTENTIOMETER
Well-made Yaxley 2 gang wire wound potentiometer. 2 units are insulated from each other. One is 5000, the other is dual action volume control (antenna and bias in broadcast receivers).
Also useful in experimental circuits. Ship. weight 1 lb.
Premium No. 3 (5 Pts.) Val. 25c.



ALLOY CHASSIS
Medium weight alloy metal chassis punched for power transformer and 8 tubes, as well as numerous mounting holes. Easily drilled metal. Open ends. Well made.
10 3/8"x6 5/8"x2 1/2". Ship. weight 2 lbs.
Premium No. 4 (5 Pts.) Val. 25c.



7 TUBE CHASSIS
Alloy metal chassis punched for 7 tubes, condensers, etc. Ideal for building small sets or simple apparatus. Metal is easy to drill.
Size: 10 1/2"x5 3/4"x2". Ship. wt 2 lbs.
Premium No. 5 (5 Pts.) Val. 25c.



CONNECTING CABLE & TERMINAL
Unusually well made. Philco 8 foot, 5 wire cable with spade terminals at one end and terminal block with 8 positions at other end. Wires color coded. Well insulated. May be used for remote control or battery connections, etc. Terminal block 3"x3"x3/4". Ship. weight 1 lb.
Premium No. 6 (6 Pts.) Val. 35c.



LOUDSPEAKER UNIT
Kellogg magnetic loudspeaker unit for use with horn speaker. Has adjustable diaphragm. May be used as pillow speaker or attached to acoustic phonograph. Also useful as sensitive microphone for voice reproduction. Threaded (3/8" diam.) throat. Size 2 1/2" diam., 1 1/2" deep. Ship. wt., 2 lbs.
Premium No. 7 (10 Pts.) Val. 75c.

These parts are given to you IN ADDITION to the cut-rate subscription prices we list below:
7 mos. for \$1 (saving you 75c over the single-copy price)
16 mos. for \$2 (saving you \$2 over the single-copy price)
24 mos. for \$3 (saving you \$3 over the single-copy price)

And, of course, the longer your subscription runs, the more merchandise you obtain FREE. As we expect a tremendous response to this offer, we would suggest that you send your remittance without delay, as our supply of parts is limited and we won't be able to duplicate this offer again.

IF YOU ARE A RADIO EXPERIMENTER, AMATEUR OR SERVICEMAN, TAKE ADVANTAGE OF THIS MARVELOUS OPPORTUNITY NOW!

A SHORT while ago we were informed that one of the largest surplus houses in the East was ready to sacrifice a huge quantity of radio parts and accessories which cost the original manufacturers thousands of dollars. We entered into an agreement with this house whereby we suggested to them to allow us to offer these parts to our readers in connection with subscription offers. The surplus house enthusiastically endorsed our plan. We—the publishers—pay the surplus house cash for each of these parts, and you—the reaper of this fortunate arrangement—will get these valuable radio parts and accessories ABSOLUTELY FREE. This is positively the first time that we have been enabled to make such an unprecedented offer which in many ways sounds too good to be true. Nevertheless, we vouch for it in every way and we know you will not be disappointed. This special arrangement enables us to offer you this valuable merchandise FREE with your subscription to RADIO-CRAFT magazine, at a price which is already a tremendous saving over the newsstand cost. This is how the plan works:—Next to the premium number of each item, we show its point value.

- For each 7 months' subscription (\$1.00) you receive 15 points' worth of merchandise free.
- For each 16 months' subscription (\$2.00) you receive 30 points' worth of merchandise free.
- For each 24 months' subscription (\$3.00) you receive 45 points' worth of merchandise free.

For instance, if you send us a seven months' subscription at \$1.00, you are entitled to 15 points' worth of free merchandise. You may order one No. 4 (5 points) and one No. 7 (10 points). Or if you wish, one each of numbers 2, 3 and 4 (each 5 points), or any other combination which totals 15 points. Similarly, if you send us a 16 months' subscription (\$2.00) you may order any combination of merchandise which totals 30 points. On a 24 months' subscription (\$3.00), any combination totalling 45 points. Due to the high cost of the merchandise, we cannot ship the articles

prepaid, therefore we show the weight of each piece, packed. If you wish your free parts sent by parcel post, please add to your remittance a sufficient amount to cover postage. Or, if you would rather have us send the parcel express charges collect, we will be glad to do so. Please remember that we do not sell these articles. You cannot buy them from us at any price. In order to make sure that you receive your parts promptly, ORDER TODAY. Fill out the coupon, clip and mail to us together with the proper remittance.

ALL RADIO PARTS ARE NEW AND UNUSED. Many are in their Original Packing

IMPORTANT TO PRESENT SUBSCRIBERS
If you are already a subscriber or have recently subscribed to the magazine, this offer still holds good for you, too. We merely will lengthen your subscription for either 7 months, 16 months or 24 months, as the case may be. There is a place on the coupon which provides for this.

RADIO-CRAFT, 20 Vesey Street, New York, N. Y. RT-341

Please enter my subscription to RADIO-CRAFT for

7 months—\$1.00. Plus 15 points' worth of FREE radio parts. Canadian and foreign countries add 32 cents for \$1.00 subscription; 72 cents for \$2.00 subscription; \$1.08 for \$3.00 subscription.

16 months—\$2.00. Plus 30 points' worth of FREE radio parts.

24 months—\$3.00. Plus 45 points' worth of FREE radio parts.

I enclose my remittance for \$....., which includes parcel post charges on the FREE parts I am ordering.

Please send the merchandise to me express charges collect.

I am a new subscriber. Extend my present subscription for months.

I am circling the numbers of the parts I wish to have you send me Free.

Nos. 1 2 3 4 5 6 7

Name Address

City State

(Send remittance in form of check or money order. If you send cash or unused U. S. postage stamps, be sure to register your letter.)

DON'T MISS THIS OPPORTUNITY! WE ASSURE YOU THAT YOU WON'T BE DISAPPOINTED. ORDER TODAY! SIMPLY FILL OUT THE COUPON. PROMPT SHIPMENT ASSURED!

RADIO-CRAFT
20 VESEY STREET
NEW YORK, N. Y.

Scophony Demonstrates "Movie-Size" Television

Britain's leading proponent of optical-mechanical scanning, Scophony Limited, demonstrated movie-size television images to the press in New York after but three months in America, during which time their system was changed from the somewhat lower European standards to conform with the American standard of 60 frames per second at 441 lines. An audience of about 100 saw pictures 9 ft. x 12 ft. projected on a translux screen from the Scophony apparatus located about 12 ft. behind the screen. The system makes use of a 120 ampere arc as its light source. From here the light is passed through a "supersonic cell" about which more later. It then is projected upon a rotating mirror drum, which provides the horizontal scan, and thence to a second drum which causes the image to be scanned vertically. From this second mirror drum the light is projected onto the screen.

The pick-up was accomplished in a small studio on the same floor of the building where the demonstration was held and carried by wire to the receiver. The fact that engineers rather than studio technicians conducted the demonstration is said to have accounted for rather uneven illumination of the subjects being televised, and certain injuries which the apparatus suffered in transit from war-torn England to the United States were given as the cause of some wavering of the image.

The brilliance of the screen, while comparable to that of home-movies, does not

approach that of a directly viewed cathode-ray tube. While the eye failed to differentiate very much between the cathode-ray and the projection screen, light measurements showed the decrease to be about 8 to 1.

The supersonic light modulator cell, one of Scophony's major patents, uses a light storage principle, so that instead of each "dot" (or picture element) appearing on the screen at a given instant, a complete scanned line is on the picture simultaneously. This, of course, increases the brilliance to a point greatly in excess of that possible with the old Kerr cell method of light modulation.

The company also demonstrated a number of smaller receivers. Among these was apparatus using a 4 ft. screen, designed for installation in hotels, bars, restaurants, etc.; one with a 2 ft. screen, and another with an 18 inch screen, both intended for home use. It is interesting to know that the usual curvature of the cathode-ray tube is absent, the screen being perfectly flat. This, for a size of 18 inches and over, is a marked advantage. Spokesmen of the company also pointed out that the apparatus uses no costly replaceable elements and operates at voltages only a small fraction of those required for image projection with cathode-ray tubes.

The managing director of the company, Solomon Sagall, expressed the hope that the Federal Communications Commission would permit the advance of television in

Two top pictures (below) show Scophony large image television screen, with loudspeakers on either side, and mirror drum projection scanner used in reproducing these images. Two lower photos show Scophony "home-model" television receiver, and a larger size receiver intended for public halls, stores, etc.



VERTROD THE NEW LEADER!

For the **FIRST TIME**—
an **ANTENNA** designed for
COMMUNICATIONS RECEIVERS

such as HALLICRAFTERS, NATIONAL, HAMMARLUND, HOWARD, SARGENT and others.

Our engineers have long recognized the IMPORTANT part played by the antenna in ELIMINATING NOISE and INTERFERENCE. After years of study and experimentation our model No. 103 is the answer—peaked at 10, 20, and 40 meters.



OTHER MODELS
No. 100
HIGH FIDELITY BROADCAST
No. 101
BROADCAST & S.W.
No. 102
BROADCAST S.W. & F/M
No. 104
A/M—F/M
Write for Catalog

VERTROD ANTENNAE

can be mounted anywhere at any angle... only a screwdriver is required.

VERTROD MFG. CO.

Dent. 341
132 Nassau St., New York, N. Y.

RADIO DESIGN POCKET TYPE VOLT-OHM-MILLIAMMETER

1000 ohms
per volt



3" square, D'Arsonval meter, accurate within 2%.

A highly dependable and practical volt-ohm-milliammeter for field use by servicemen, complete with batteries. RANGES: D.C. Volts:—0/10/50/250/500/2500 volts; D.C. Current:—0/1 amp. /100 ma/ 10 ma/ 1 ma. Resistance:—0/2000/20,000/200,000 ohms. In wood case. 6 1/2 x 2 1/2 x 1 3/8".

At Your Jobber or order direct from ... **\$5.95**

RADIO DESIGN COMPANY

1353 Sterling Place

Brooklyn, N. Y.

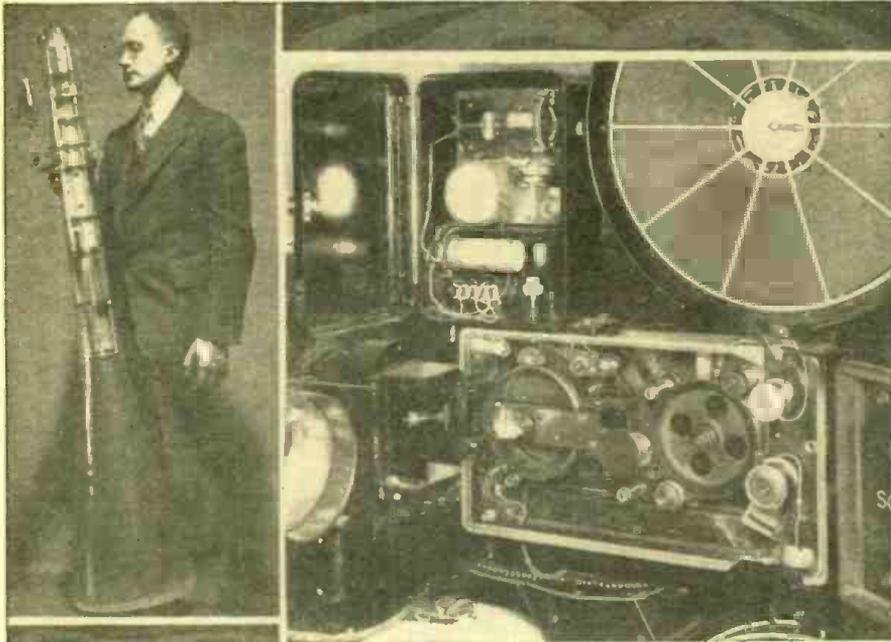
the United States, and that industrial concentration upon war-time production would not be so great that the manufacture of television apparatus would be seriously curtailed.

The accompanying pictures show the 2-foot screen home receiver, the 4-foot screen outside location receiver (flanked left and right by the scanner and the receiver—amplifier respectively), the screen used with the 9 x 12 foot receiver, and the large scanning apparatus which projects the image onto it. In both of the pictures where figures are shown on the screen, the images have been inserted; they are not image photographs.

Latest *Television News* as well as hints for the experimenter, will appear in the next issue. Don't miss the special article by Thornton Chew, describing in great detail how to properly locate the television receiving antenna, so as to minimize interference and prevent "ghost" images.

Television Travels

190 Miles Over Wires



Giant television receiving tube of special design, used in the latest Bell Laboratories demonstration of television over 190 mile coaxial circuit. Photo at right shows film television scanner.

● TELEVISION over an all-wire circuit had its longest-distance public demonstration when a program taken from motion-picture films was transmitted from Bell Telephone Laboratories in New York over the coaxial telephone cable to Philadelphia and back to the Hotel Pennsylvania, a 190 mile loop. Observers compared this with the same scene locally transmitted across a few miles in New York City. The scenes were reproduced on a special television receiver-tube developed in Bell Labs.; and when viewed from the usual distance of five or six feet from the tube the difference between local and long-distance cable transmission was imperceptible.

Motion pictures were scanned at the laboratories and the video signal was transmitted either directly to the Hotel Pennsylvania or to the hotel after having been sent to Philadelphia and back over the cable. Between Philadelphia and New York there are two coaxial cables inside a single lead sheath. (About 90 per cent of it is underground.) This cable system was installed in 1936 by the Bell Telephone System for use in its experiments primarily on the transmission of speech but also on the long distance transmission of television signals. One of the coaxial cables in the sheath had been used last summer for transmission of television views of the Republican Convention from Philadelphia to New York. In the present demonstration the two cables in the sheath were joined at Philadelphia to form a loop circuit back to New York. Each of the coaxial cables consists of a copper tube about the size of a lead pencil with a copper wire held centrally in it by disc insulators $\frac{3}{4}$ inch apart. About every five miles along the line there is a

three-stage vacuum tube amplifier in each coaxial, making a total of 120 tubes in the loop. So large a number is required because the losses in the coaxial are enormous—2100 decibels for the round trip. That figure means that the signal is reduced in the ratio of 1:10 followed by 210 ciphers. If the energy which the earth receives from the sun were reduced in the same ratio, there would not be enough left to light a flashlight.

From the special transmitter which scans the motion picture there emerges a "video" signal current. The components of this signal which were within the range from 40 cycles to 2,700,000 cycles were sent over the coaxial cable to Philadelphia and back, and then through three intermediate amplifiers to the hotel. Because a coaxial cable is not suitable for the transmission of the lower part of this range of frequencies, the signal current was shifted about 300,000 cycles in the frequency spectrum and was transmitted over the cable as a

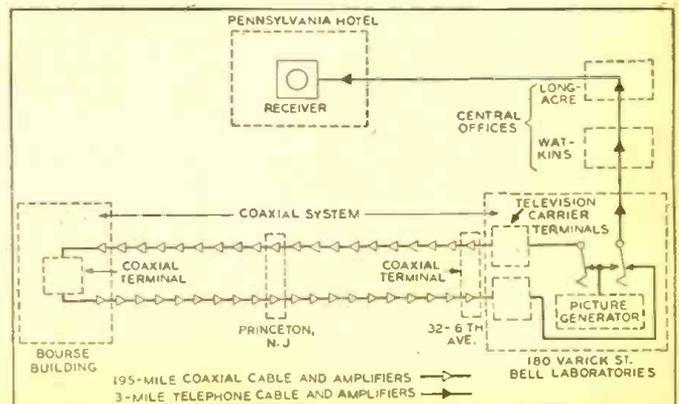
band of frequencies between 300,000 and 3,000,000 cycles. When the signal current arrived at New York on its return trip it was remodulated to occupy again the range about 40 cycles to 2,700,000. A television image corresponding to this video current was then produced at the hotel by a special cathode-ray tube. This tube was developed for purposes of testing television transmission by Dr. C. J. Davisson, recent Nobel Prize winner, and his associates in the Bell Laboratories.

In the direct transmission from the film scanner to the hotel the entire frequency range of the complex "video" signal was transmitted. This extends from about 35 to 4,000,000 cycles, and occupies a wider range than was transmitted over the cable system. Despite this difference in range, motion picture scenes under the two conditions of transmission were generally agreed to be imperceptibly different.

Both the cathode-ray tube and the transmitter which were used in the demonstration were developed primarily as testing instruments for use in the Bell engineers' study of television transmission, since their interest in television is primarily in being able to transmit programs from point to point in the same general way as they provide such interconnecting facilities in radio broadcasting of sound programs. So as to have a wide range of subjects available for their transmission studies, motion picture films are used rather than direct pick-up from a television studio. The film transmitter passes 60 fields a second, corresponding to the conventional television system which transmits 30 pictures a second, each consisting of two "interlaced" fields—i.e., a given strip across the scene is viewed only on alternate fields. Because standard motion pictures are taken at 24 fields a second, it was necessary either to make new films or, as it was decided to do, to use prints from selected negatives, "stretched" by printing alternately two frames and three frames from each frame of the negative. By running the "stretched" film $2\frac{1}{2}$ times as fast as the original, the apparent motion in the picture is left unchanged.

(There is a 200 mile 4-coaxial cable between Stevens Point and Minneapolis.)

Diagram at right shows 190 mile coaxial circuit from New York to Philadelphia and return over which television images were transmitted and received in a recent demonstration in New York City. 441 line images were shown of superior quality and brilliancy, thanks to the new "square spot" cathode-ray tube illustrated above.

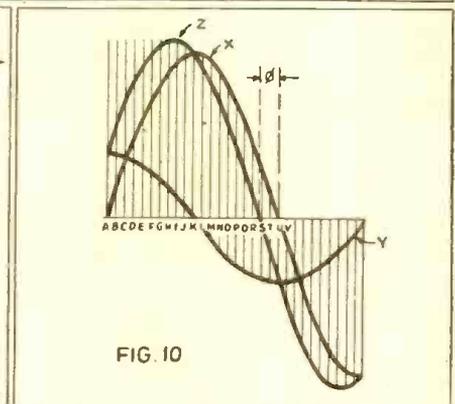
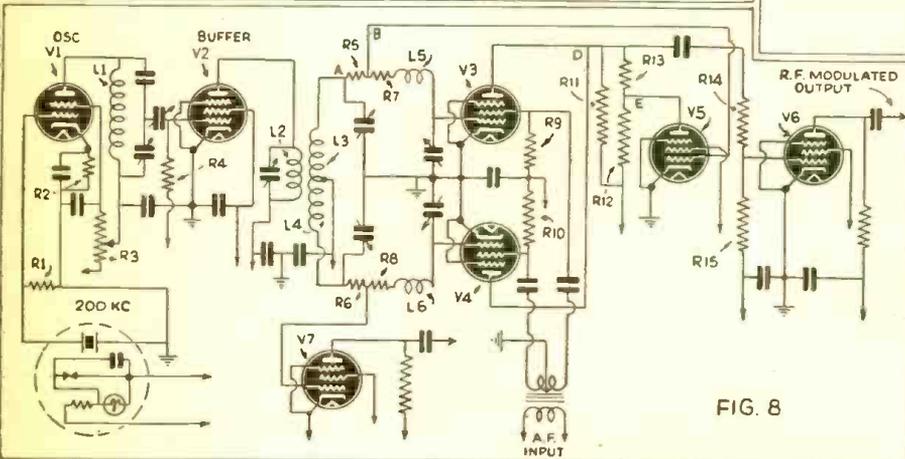
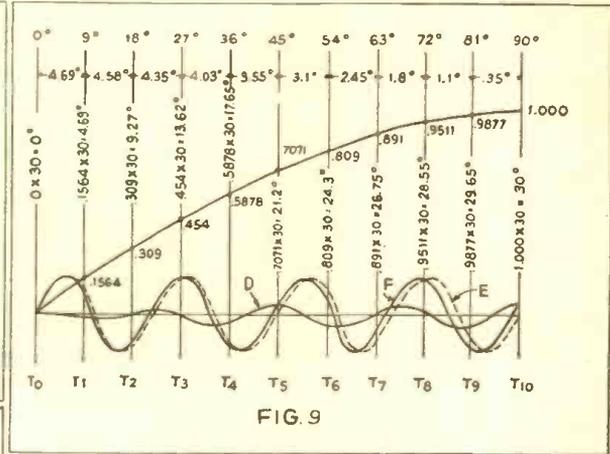
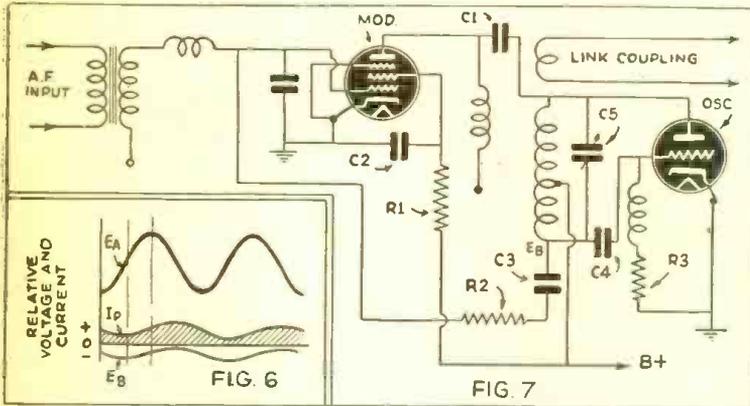


Principles of

Frequency Modulation

Part 2

F. L. Sprayberry*



The diagrams above, in connection with the accompanying text, will serve to give the student an intelligent idea of what Frequency Modulation is all about.

● COMING now to Fig. 6, we find that as we apply a plate voltage E_a to the 6L7 tube in Fig. 3 and a grid voltage E_b lagging it by $83^\circ 22'$ we have a plate current essentially lagging E_a by $83^\circ 22'$. This condition corresponds exactly to an inductance with a resistance in series with it.

The A.C. current drawn by the plate circuit is, of course, limited by the A.C. plate resistance of the tube which we have assumed as 1 megohm. The impedance (L and R in series) which these figures indicate may be specified as usual as—

$1,000,000 / 83^\circ 22'$ Note: The phase angle is positive in this case, indicating inductive reactance

and is, therefore, equivalent to components of—

$$\begin{aligned} \text{resistance} &= 1,000,000 \cos 83^\circ 22' \\ &= 1,000,000 \times .1161 \\ &= 116,100 \text{ ohms and a} \\ \text{reactance} &= 1,000,000 \sin 83^\circ 22' \\ &= 1,000,000 \times .9932 \\ &= 993,200 \text{ ohms} \end{aligned}$$

Inductive reactance $X_L = 2\pi fL$ and hence

$$L = \frac{X_L}{2\pi f}$$

Thus solving for an inductance value here we have—

$$L = \frac{993,200}{2\pi \times 2,000,000} = .0788 \text{ h or } 78.800 \text{ microhenries}$$

Now let us assume that L_2 of Fig. 3 has a value of 60 microhenries which would be appropriate for the oscillator shown. Being in parallel with the inductance represented by the tube, the total inductance L_t would be found as follows:

$$L_t = \frac{L_1 L_2}{L_1 + L_2}$$

and substituting values we have—

$$L_t = \frac{78,800 \times 60}{78,800 + 60} = 59.95 \text{ microhen. approx.}$$

Naturally, there is no mutual inductance because the tube has no appreciable magnetic field and does not store energy as for a regular inductance. The formula as above for uncoupled inductances is, therefore, an accurate expression for the sum of the two.

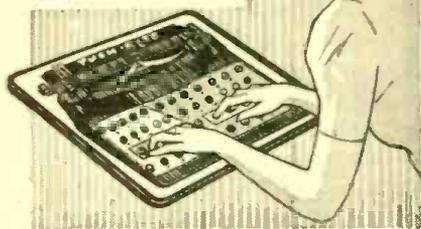
The inductance value of 78.8 mh. which the tube forms artificially is true only for one value of control grid voltage. As the control grid (No. 3 from the cathode) becomes more negative, less plate current can flow and the A.C. plate resistance is increased. Likewise, as it becomes positive, the A.C. plate resistance is reduced and the artificial reactance is reduced.

Let us assume that the inductance represented by this tube (6L7, Fig. 3) can be varied from 7880 microhenries to 788,000 mh. These two values separately considered in parallel with 60 mh. will give totals of— 59.5 mh. for 7880 mh. Note: These values 60 mh. for 788,000 mh. are considerably greater than we would find in practice and are given only as examples.

Now, if a coil of 60 mh. will tune to 2000 kc. with any condenser combination and it

*President, Sprayberry Academy of Radio.

SPEED
Up Your Work!
Learn to Type
without
A Typewriter



Master the Touch System—Quickly—
Accurately Get the "Feel" of Typing
Before Investing Your Money

Now, you don't have to own a typewriter to learn how to type. The ingenious, patented "Tuch-Rite" board gives you all the practice you need for speedy, accurate typing. It teaches you the touch system—the real, professional way universally used in business.

You may have been a "hunt-and-peck" typist for the longest time or you may never have used a typewriter before—it doesn't matter, because the "Tuch-Rite" teacher will soon permit you to master it.

"Tuch-Rite" is a scientific substitute for a typewriter. It is a life-size counterpart of a standard keyboard, which is real as to size, position, and "feel". Each key has a depression in the $\frac{1}{4}$ " thick board, in which the black plastic buttons slide. Printed under each key is a number which indicates the finger of each hand which strikes it—simple as A B C.

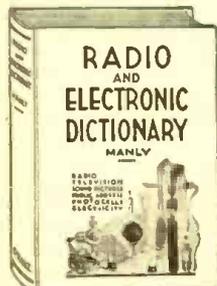
"Tuch-Rite" is highly recommended by the Principal of Horace Mann School; Director, Bureau of College Research, Columbia College; American Foundation for the Blind; Professor of Experimental Education, New York University; Director of Scarborough School, Scarborough-on-Hudson.

An 8-page illustrated book of instructions will show you how best to use the "Tuch-Rite" teacher. Weight 3 lbs. Add postage **\$2.00**

GOLD SHIELD PRODUCTS

350 Greenwich Street Dept. RT-341 New York, N. Y.

**RADIO AND ELECTRONIC
DICTIONARY** Containing
3,800 Definitions



THIS RADIO AND ELECTRONIC DICTIONARY, written by Harold F. Manly, explains the meaning of 3,800 words used in radio, electronics and other closely allied fields. It includes new terms used in radio transmission, sound pictures, television, public address, aviation radio, navigation and industrial control; photo-electricity, photocell application, telephotography, etc. This dictionary permits learning every new expression whether you hear it or read it. Alphabetically arranged for quick reference, 550 illustrations augment definitions in the text.

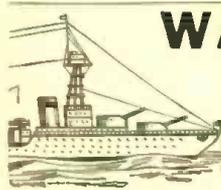
The book is recommended for students, instructors, engineers, service men, experimenters, salesmen and everyone in any way associated with radio. ONLY

BOOK OF ITS KIND—HANDY—EASY TO USE—AND TIMELY. The **RADIO AND ELECTRONIC DICTIONARY** is new, authentic and printed in a single volume of 300 pages, size 6 x 9 inches. The book weighs two pounds and is bound in durable cloth. SHIPPED ANYWHERE **\$2.50** IN U. S. A. POSTPAID Price

Mail remittance by check or money order to

RADIO PUBLICATIONS

20 VESEY STREET NEW YORK, N. Y.



**WARSHIP
MODEL
PRINTS**

- 56—10,000 ton U.S. Navy 37" Cruiser. Model. Blueprints . . . \$3.15 (Complete Kit, all fittings . . . \$7.25)
- 54—U.S. Destroyer: 39" exact model; Blueprints . . \$1.60 (Hull constr. Kit \$5.60; complete Kit \$33.50)
- 53—"Constitution" (Old Ironsides 28" Model. Blueprints) . . . \$2.20 (Complete Kit \$35.00; Hull Kit. \$6.50)
- 57—"Rob't. E. Lee"—Mississippi River Steamboat: 28" long. Blueprints . . . \$2.60 (Complete Kit \$22.00; Hull Kit \$8.50)
- 52—"Clermont"—1st steamboat (blueprints) . . . \$1.10 (Complete Kit for 18" Model—\$7.00 prepaid)

DATAPRINT CO.

Box 322, Ramsey, New Jersey

is changed to 59.5 mhz., the frequency will rise. This is made true because the frequency varies as the square root of the factor of inductance change. The latter is: 60/59.5 or 1.0084 the square root of which is 1.0042. At 2000 kc., therefore, the frequency change would be $1.0042 \times 2000 = 2008.4$ kc. or a change of 8400 cycles. Half of this would be 4200 cycles and if the oscillator is set at 2000 kc. after the reactance tube is added, and the latter is adjusted at its correct bias (signal control grid) the frequency may be made to swing from 2000 + 4.2 kc. to 2000 - 4.2 kc., or from 2004.2 kc. to 1995.8 kc.

This frequency shift may take place at any audio frequency because A.F. is fed into the No. 3 grid of the 6L7 tube and the A.C. plate resistance of the tube is changed at A.F. and in accordance with the voice or music wave form.

While this FM wave as described might be transmitted without further equipment, we shall see later that, for satisfactory reception, the actual numerical frequency swing of an FM wave must be at least as great as the highest A.F. used in modulation, and preferably, as much higher as practicable. For example, if we desired to use modulation components as high as 10,000 cycles, we must have a frequency deviation of at least 10,000 cycles and preferably 50 to 60 kc.

With the apparatus described as a start, we can achieve this by frequency multiplication of the carrier. Let us assume that we use two frequency tripler stages and one frequency doubler which will multiply every frequency by $3 \times 3 \times 2$ or 18. Considering now, the carrier and maximum deviation both above and below it, we will have at the transmitting antenna—

$$2004.2 \times 18 = 36,075.6 \text{ kc. carrier} + \text{positive deviation}$$

$$2000 \times 18 = 36,000 \text{ kc. carrier}$$

$$1995.8 \times 18 = 35,924.4 \text{ kc. carrier} + \text{negative deviation}$$

The carrier frequency is raised to the ultra-high frequencies at 36 mc. while the frequency deviation is 75.6 kc. each side of the carrier on audio peaks.

Postponing the study of frequency multipliers we now refer to the disadvantages of this type of frequency modulator. Shunting the inductance of the oscillator is a rather low D.C. resistance in the form of the resistance component of the modulator tube. This has been shown in our example to be about 116,100 ohms. This value changes with modulation, thus varying the load on the tank circuit. This action causes amplitude modulation of the oscillator as well as frequency modulation. The lower the plate resistance of the modulator the more pronounced becomes this undesirable effect.

It should be obvious also that crystal control of the oscillator is not possible with this type of modulation. This means that any instantaneous frequency change of the oscillator not controlled by the modulator will produce additional modulation, which is undesirable.

To avoid a more involved discussion than the preceding, we have not considered certain other factors in this problem such as, for example, the effect of the amplified grid signal on the H.F. voltage applied to the

plate, the input grid admittance, factors other than capacitance, etc.

More recent work on the reactance tube modulator indicates that it is possible to adjust the phases of the grid and plate voltages in such a way as to do away with the resistance component.

If instead of attaching the grid feeder connection at Ea as in Fig. 3, we attach it to point Eb as in Fig. 7, the phase difference between the applied H.F. plate voltage to the modulator and the grid voltage will be between 90 and 180 degrees. If we disregard any phase change due to C3 in Fig. 7, the phase will approach 180° as R2 is reduced. As we know, in this type of oscillator circuit voltages Ea and Eb are substantially 180° out of phase, and of course, the presence of R2 allows a reduction of phase difference with adjustment of R2. This resistance corresponds exactly with resistance R4 in Fig. 3.

Now, if the modulator behaves as an inductance with a phase angle of 83°22', all we need to do is to adjust R2, Fig. 7, until we establish a plate to grid phase of 96°38' which will average exactly 90° as $83^\circ 22' + 96^\circ 38' = 180^\circ / 2 = 90^\circ$. The modulator will then act as a pure reactance and will not "resistance load" the tank circuit at all but will be electrically a part of it. Such a reactance tube modulator produces no measurable amplitude modulation, allows the use of a power tube as an artificial reactance, permitting much greater frequency swing and is more efficient in operation. The circuit represents a very considerable advance in FM development. (Credit—C. F. Sheaffer, Proc. I.R.E., February, 1940.)

So far this type of modulator has reached practical application only in amateur and laboratory communication but it has much future possibility in low powered and particularly portable or mobile transmitting equipment.

The Armstrong Modulating System

In this system of FM, we start our study with a crystal controlled (constant frequency) master oscillator. Usually it operates at 200 kc., chosen simply as a convenient and practical value. Any stable oscillator circuit of the crystal controlled type may be used.

The oscillator in combination with the frequency modulation circuit is shown in Fig. 8. The 200 kc. carrier generated by the crystal controlled oscillator, excites a buffer stage V2 to insure a constant load on the oscillator and this buffer stage in turn excites the grids of a circuit which we call a balanced modulator. It consists of two tubes V3 and V4, having their grids operated in push-pull fashion (phase opposition) and their plates connected directly together.

At point A at one side of the grid input circuit a 200 kc. signal is fed to the grid of V3 and V5. With V5 a resistance only is involved while with V3 an inductance is involved. Both signals are reduced by R5 but more important than this, the voltage at C leads that at B by about 90° because of the inductance L5. We may, therefore, expect any signal at the plate V5 to be 90° out of phase with that at the plate of V3.

As long as tubes V3 and V4 have identical characteristics there will be no output at V3, because it will be neutralized or completely compensated by an equal and oppo-

site signal at the plate of V4. The screens of these tubes, however, are fed A.F. in reverse phase so that the balanced modulator is unbalanced first in one direction, then the other; as one screen voltage is increased and the other correspondingly reduced, the output of the tube having the greater screen voltage overcomes the other and there is a net output at both the V3 and V4 plates which is transferred to the grid of amplifier V6 by the coupling means shown. The output of V5, however, is continuously fed into the same grid by means of the delta resistance network connecting plates V3, V4 and V5 with the plate supply voltage.

At point D in the circuit tubes V3 and V4 simply produce a type of amplitude modulated 200 kc. signal. It is a wave which is proportional at every instant to the A.F. voltage fed to it, being zero for no modulation but having no carrier frequency changes whatever. Tube V5 supplies an unmodulated 200 kc. carrier 90° out of phase with the one just described to the same point (D) in the circuit. Being supplied from the same oscillator buffer stage the two waves are exactly in synchronism always remaining 90° out of phase, and they are added or combined and applied to the V6 grid. Tube V7 is simply a carrier frequency monitor and may be omitted from this study.

A careful analysis of the two waves at D in Fig. 8 and how they combine is the story of how frequency modulation is acquired. We will, therefore, turn our attention to this matter. Refer to Fig. 9.

The sine wave voltage E of Fig. 9 is the same as that created at point E in Fig. 8, and is due to the amplified signal at the plate of V5. Wave D in Fig. 9, due to V3 and V4 produced at D in Fig. 8, is a wave of constant frequency (200 kc.) and constant phase with respect to E; namely, 90° leading. It never changes either phase or frequency at any time of transmission, but does change amplitude. Its amplitude is proportional to the A.F. or modulating wave.

Wave D in Fig. 9, starting from zero amplitude at the left and rising to about 1/3 the amplitude of wave E is what results from the first quarter cycle of A.F. introduced into the screens of V3 and V4, Fig. 8. Just as the A.F. rises from zero to maximum in the first quarter cycle, so wave D does the same. D is simply an amplitude modu-

lated wave but starting from zero instead of from an average carrier value.

When these two voltages (waves E and D of Fig. 9) are joined in a single circuit, they add and form a third wave F (corresponding to point F in Fig. 8) or, in fact, at D also. Wave D has had the effect of merely shifting the phase of E without materially affecting its amplitude. Note in Fig. 9 that there is a successive phase "slip" or "shift" from right to left of F with respect to E. At the left (time T_0) where D is zero, E and F are in phase but at the right where D is maximum, F has slipped to the left about 30° in phase. This slip in phase grows larger from left to right, or as time progresses from T_0 to T_{10} .

Many more carrier cycles are involved than appear in Fig. 9 for this "phase slipping" action but this graph is only symbolic of what actually happens.

In order to clarify this principle of superposition, refer to Fig. 10. Here we have shown a sine-wave carrier X and a phase changing wave Y of lower amplitude. For this study, Y has a constant amplitude of about 1/3 that of X (39% in this case). Waves X and Y are divided horizontally by vertical lines into 9° intervals starting at A. Thus, point B is 9°, C is 18°, D is 27°, etc. The numerical values of amplitude or height of waves X and Y are added at each interval and points are placed at the sum of these two at each interval. These sum values when connected form wave Z.

For example, at A the value of the amplitude of X is zero, while that of Y is 1.17 inch. At B, X is .4695 inch high, while Y is 1.155 inch high. At C, wave X is .9275 inch high, while wave Y is 1.112 inch high and so on.

The sum of the X and Y values at A are $0 + 1.17$ inch = 1.17 inch and at B their sum is $.4695 + 1.155$ or 1.6245 inch. These sum values such as 1.17 and 1.6245 are the heights of the wave Z at the corresponding points A, B, etc. A complete table showing all values for every 9° interval for more than 1/2 cycle follows. It is in no sense essential to learn this, as we have enough information in Fig. 10 for our purpose. It is included for those who desire to pursue the study further.

It must be noted that the measurements 3" and 1.17" are purely arbitrary and may be changed to other values without altering the idea intended.

TABLE 1

θ°	Peak X = 3"		θ1	Sin θ1	Peak Y = 1.17"	
	Sin θ	3 Sin θ			1.17 Sin θ1	3 Sin θ1
A	0	0	90	1.0000	1.1700	1.1700
B	9	.1564	99	+.9877	+1.1550	+1.6245
C	18	.3090	108	+.9511	+1.1120	+2.0395
D	27	.4540	117	+.8910	+1.0420	+2.4040
E	36	.5878	126	+.8090	+.9460	+2.7080
F	45	.7071	135	+.7071	+.8275	+2.9475
G	54	.8090	144	+.5878	+.6875	+3.1125
H	63	.8910	153	+.4540	+.5320	+3.2020
I	72	.9511	162	+.3090	+.3600	+3.2110
J	81	.9877	171	+.1564	+.1830	+3.1430
K	90	1.0000	180	0	0	+3
L	99	.9877	189	-.1564	-.1830	+1.7770
M	108	.9511	198	-.3090	-.3610	+2.4890
N	117	.8910	207	-.4540	-.5320	+2.1380
O	126	.8090	216	-.5878	-.6875	+1.7375
P	135	.7071	225	-.7171	-.8275	+1.2925
Q	144	.5878	234	-.8090	-.9460	+.8160
R	153	.4540	243	-.8910	-1.0420	+.3200
S	162	.3090	252	-.9511	-1.1120	-.1854
T	171	.1564	261	-.9877	-1.1550	-.6855
U	180	0	270	-1	-1.1700	-1.1700
V	189	-.1564	279	-.9877	-1.1550	-1.6245
W	198	-.3090	288	-.9511	-1.1120	-2.0395

NOTE: θ is used for X measurements while θ1 is used for Y measurements.

Social Security Name Plate
Only **35¢**

Bronze Plate with your Name & Number on it

and This **GENUINE LEATHER BILLFOLD** without Extra Charge

For the nominal amount of 35c we will send you the following values:

1. One duo-tone imperishably etched Bronze Name Plate, size 3x1 1/2 inches with your Social Security number and name permanently stamped upon it.
2. One Genuine Leather Billfold, size 8 1/2 x 3 inches in natural brown color, with four compartments, as per illustration above.

This Pocketbook is our free present to you. Absolutely no strings of any kind. We make you this gift because we expect you to do us a favor by showing your name plate to your friends, to interest them in ordering one for themselves. That's all. Help us and you will profit yourself.

ACT NOW! Mail the coupon below and enclose 35c in Billfold will be forwarded to you at once.

PREMIUM DISTRIBUTING SERVICE
Wrigley Bldg., Chicago, Dept. RT-341

Enclosed find 35c for which mail to the address below, my Social Security Bronze Plate and the Genuine Leather Billfold without extra cost, as per your order.

My Social Security Number is

NAME

ADDRESS

CITY STATE

FREE **Cash In!** **88 PAGES**

300 Ways to Make Money

MAIL ORDER PLANS TESTED MONEY MAKERS BUSINESS SECRETS SUCCESS SCHEMES

25 CENTS

MARVEL BOOK OF THE YEAR!

40,000 WORDS in TEXT!

In "CASH IN!" you get ALL the real money-makers — dozens of profitable tested mail order plans, confidential business secrets, dozens of practical tested formulas, successful tested schemes—actual experiences of men who have started on a shoestring—with less than \$10 capital.

Buyers of This Book Tell Us—

"Biggest value I've yet to see. Book is worth at least a dollar." S. Buda, Elwyn, N. Y.

"Your book is as good if not better than others selling at \$1.00." George Brunet, Montreal, Can.

"CASH IN is the best value I have yet to see in the mail order field." Lawrence Fox, Brooklyn, N. Y.

"CASH IN" contains only tested ideas covering every type of full- or spare-time enterprise—it's a "masterpiece" in business ventures.

BOOK CONTAINS NO ADVERTISING. SENT FREE TO YOU. NO STRINGS TO THIS OFFER. NO FURTHER OBLIGATIONS TO YOU!

Send 3c U. S. stamp to pay for mailing charges

NATIONAL PLANS INSTITUTE
246-T Fifth Ave., N. Y. C.

Your attention in Fig. 10 is called to the fact that wave Z leads wave X by about 20° and has a peak just a trifle higher than wave X. Its peak is a little to the left of point I while the peak of X is at K. Since wave X crosses the base line at U while wave Z crosses it a little to the left of S, the two waves are displaced a little more than two of the 9° intervals, in other words, more than 18°, which we estimate at about 20°. This phase difference is indicated as ϕ in Fig. 10.

With another graph, we could show that as the amplitude of wave Y is reduced, the phase between X and Z would be reduced correspondingly. In fact, there is a substantially linear relationship between the amplitude of Y and the phase between X and Z for small angles—that is, up to approximately 30°.

It should be obvious that if Y were 180° from the phase shown, that Z would lag X in phase instead of leading it as in Fig. 10, all other conditions being equivalent.

Now we must determine what connection this phase shift has with frequency modulation. For this purpose, let us return to Fig. 9 and note a part of the graph

which we have not as yet discussed.

Curve G is the first quarter cycle of a sine wave and simply represents the manner in which the average amplitude of wave D increases. On the necessarily small amplitude scale on which D is actually drawn, it is not at all obvious that D is actually an R.F. wave having a 1/4 cycle A.F. envelope. This quarter of an audio wave is also divided into 9° intervals, T₀-T₁, T₁-T₂, T₂-T₃, etc. At T₀ wave D does not exist or is at zero, at T₁ it is 15.64% of its maximum amplitude, at T₂ it is 30.9%, etc. These percentages are shown on wave G as factors of 1, that is 15.65/100 or .1564 for T₁, etc.

The R.F. (200 kc.) and audio (100 cycle) waves shown in Fig. 9 are not shown in proportion. Actually the time T₀ to T₁₀ which is 1/4 cycle of a 100 cycle audio wave is only 1/400th second. During this time the 200 kc. wave actually produces 200,000/400 or 500 cycles instead of the 4 cycles of it shown by the wave E.

Phase shift between E and F must correspond to the average amplitude of D. E and D in Fig. 9 of course correspond respectively to X and Y in Fig. 10 while

F in Fig. 9 corresponds to Z in Fig. 10. In Fig. 9, we are going to limit the maximum shift in phase between E and F to 30°. This helps insure that the phase change between E and F will be automatically proportional to the amplitude of D.

Then if wave D increases from zero to .1564 in the first 9° of the audio cycle the phase shift between E and F will be .1564 x 30° or 4.69°, which is the average phase shift between E and F approximately for the first 9° of the audio cycle. From T₁ to T₂, wave D increases from .1564 to .309 and the corresponding phase angle changes to .309 x 30 or 9.27°. During this interval the phase shift will be an additional 4.58° (9.27 - 4.69°).

From these figures it is obvious that from T₀ to T₁, the phase between waves E and F (Fig. 9) changes the greatest amount per unit time or most rapidly, while from T₀ to T₁₀ the phase change is minimum. The frequency deviation from the carrier is proportional to this rate of change of phase between E and F and hence is maximum in the interval T₀ to T₁.

Tabulating all intervals to T₁₀ we have in Table 2 at left:

If wave G, for example, should represent an audio wave of 100 cycles this quarter cycle shown would require only 1/400th second for transmission and a 9° interval of this quarter cycle being only 1/10th of the quarter cycle (90°) would take place in 1/4,000th second.

Furthermore, if as indicated, the phase between E and F changes 4.69° in this time, namely 1/4000th second, in one second, at the same rate it would change 4000 x 4.69 degrees or 18,750 degrees. Dividing this by 360 to get the total number of cycles represented in 18,750 degrees as there are 360 degrees in one cycle, we have 18,750/360 or 52.2 cycles increase in carrier frequency whatever the primary carrier frequency may be. If it is 200 kc., then the carrier, during the time interval T₀-T₁ is 200,052.2 cycles and, as we have seen, this is the maximum frequency deviation of the carrier for a modulating frequency of 100 cycles under the conditions assumed above.

Let us now trace the carrier deviation for the other time intervals as we have done for this one to determine the carrier deviation during each 9° audio interval at 100 cycles modulation. Arranging the above calculations in one equation, we have—

$$F = \frac{1}{\frac{1}{4} \times 1/10 \times 1/100} \times \phi$$

$$F = \frac{1}{1/4000} \times \phi$$

$$F = \frac{360}{4000 \phi} \quad F = 11.1\phi$$

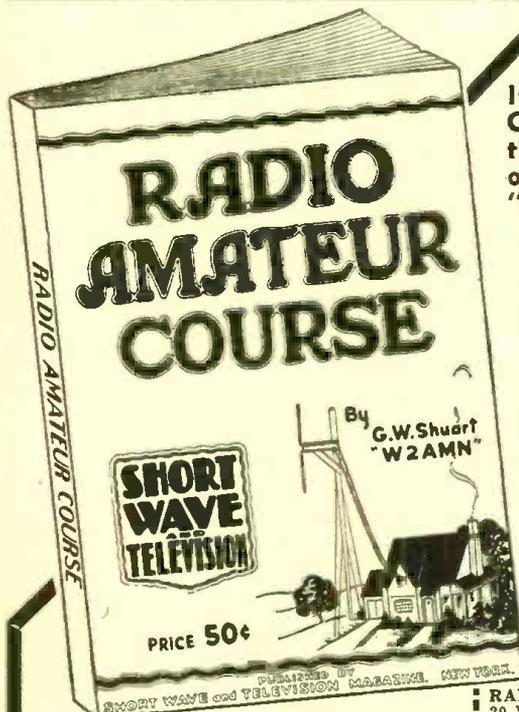
F = frequency deviation of carrier
 ϕ = rate of change of phase (E and F) in degrees per unit of time

and tabulating all 9° values of ϕ we have the results recorded in Table 3, next page.

The values of deviation frequency shown here as well as the carrier values might be considered averages for the time units given and are quite accurate enough for all practical work. In the interest of exactness, however, it must be stated that the rate of

TABLE 2

Time	Degrees Audio Cycle	Average Amplitude of D or Audio Amplitude	Degrees Max. Phase	Total Phase Shift of E and F	Increase in Phase Angle Per. 9° Time Interval
T ₀ -T ₁	9°	.1564	30°	4.69°	4.69°
T ₁ -T ₂	18°	.309	30°	9.27°	4.58°
T ₂ -T ₃	27°	.454	30°	13.62°	4.35°
T ₃ -T ₄	36°	.5878	30°	17.65°	4.03°
T ₄ -T ₅	45°	.7071	30°	21.2°	3.55°
T ₅ -T ₆	54°	.809	30°	24.3°	3.1°
T ₆ -T ₇	63°	.891	30°	26.75°	2.45°
T ₇ -T ₈	72°	.9511	30°	28.55°	1.8°
T ₈ -T ₉	81°	.9877	30°	29.65°	1.1°
T ₉ -T ₁₀	90°	1.0000	30°	30°	.35°



Your Money Back—

If the RADIO AMATEUR COURSE does not represent the greatest book value ever offered to the radio "fans" for 50c

To convince you that there isn't a better book buy today, the publishers of the RADIO AMATEUR COURSE make the sensational offer of a money-back guarantee on such a low-priced book. Stop in at any of the many dealers handling this book and examine it. See for yourself if the RADIO AMATEUR COURSE isn't just the book you've always wanted.

Printed on the finest coated paper—well illustrated attractive 4-color cover—complete with radio information you must have. It contains a step-by-step program for obtaining a short-wave radio education.

Written by George W. Shuart, W2AMN, foremost short-wave authority

RADIO AND TELEVISION
20 Vesey Street, New York, N. Y.

Gentlemen: I enclose herewith my remittance of Fifty Cents (50c) for which please send me POSTPAID, my copy of the RADIO AMATEUR COURSE. (Remit by check or money order; register letter if you send cash or unused U. S. Postage stamps.)

Name

Address

City State R&T-3-41

148 PAGES

6 1/4 x 9 1/2 INCHES

OVER 150 RADIO DIAGRAMS AND TECHNICAL PHOTOGRAPHS

See Page 664 for list of our dealers.

RADIO AND TELEVISION
20 Vesey Street New York, N. Y.

TABLE 3

Time Interval	Rate of Change of Phase (ω°)	Deviation - Cycles (ω° Times 11.11)	Actual Carrier Cycles
T ₀ -T ₁	4.69	52.2	200,052.2
T ₁ -T ₂	4.58	51.0	200,051.0
T ₂ -T ₃	4.35	48.3	200,048.3
T ₃ -T ₄	4.03	44.8	200,044.8
T ₄ -T ₅	3.55	39.4	200,039.4
T ₅ -T ₆	3.1	34.4	200,034.4
T ₆ -T ₇	2.45	27.2	200,027.2
T ₇ -T ₈	1.8	20.0	200,020.0
T ₈ -T ₉	1.1	12.2	200,012.2
T ₉ -T ₁₀	.35	3.88	200,003.88

θ = rate of phase change in the interval $\left(\frac{1}{N}\right)$

phase shift in every interval varies throughout the entire interval. Thus, while it averages 4.69° in the interval T₀-T₁, it is slightly greater than this at T₀ and slightly less at T₁. We have taken a small enough interval here to obtain good accuracy but there are other means of obtaining exact values at any single time interval.

One means of doing this makes use of mathematics which is beyond the scope of this course and is in no way essential to the practical study as given above. It is included here, however, for those students who may possibly make use of it and for those who desire to pursue this study in advanced technical literature. The work includes calculus which is not essential to the above understanding of this subject.

We first convert the above formula for frequency deviation into an expression with which we may solve for any particular value—that is, a formula of what we may call “continuous functions.” This formula is as follows:

$$F = \frac{\theta \sin 2\pi f m t}{2\pi t}$$

in which θ is the maximum carrier phase shift, $f m$ is the audio frequency and t the time under consideration.

The similarity of this to the former equation will be shown by making the same substitution in it as in the other expression. We first convert the “angle” 2π into degrees as we know this to represent 360 degrees or an entire “circle” or “cycle.” This gives us—

$$F = \frac{\theta \sin (360 f m t)}{360 t}$$

Now if, as above, t is to be 1/4000 second, we may express this decimally for convenience as .00025 second. Also, we have seen that we desire a maximum carrier phase shift of 30 degrees so θ would be 30°.

For the same audio frequency of 100 cycles, $f m$ would equal 100 cycles. Our substitution would therefore be—

$$F = \frac{30 \sin (360 \times 100 \times .00025)}{360 \times .00025}$$

Solving for this we have— $360 \times 100 \times .00025 = 9^\circ$ and $360 \times .00025 = .09$. The sine of 9° as given in Fig. 9 is equal to .1564 and hence we have—

$$F = \frac{30 \times .1564}{.09}$$

$$F = \frac{4.69}{.09}$$

$$F = 52.2 \text{ cycles}$$

It is obvious that this formula expresses the same ideas. In this form, however, it may be used to further advantage. Expressed in this way we no longer have a fixed time interval such as T₀-T₁ but a variable time element t . We may decrease the time factor t indefinitely until it is

zero and in this way find the rate of change of phase for any particular time instead of for a time interval or continuously for the entire time.

So as to make the denominator the same as the sine function in the numerator in the formula we multiply both numerator and denominator by $f m$ obtaining—

$$F = \frac{f m \theta \sin 2\pi f m t}{2\pi f m t}$$

these must be alike to compare them in the expression given—and factoring for convenience we may write—

$$F = f m \theta \frac{\sin 2\pi f m t}{2\pi f m t}$$

In this expression as the value t is made indefinitely small, the entire value of the expression approaches—

$$F = f m \theta \frac{\pi}{180} \cos 2\pi f m t \quad (\text{We do not undertake to show the process by which this formula is derived.})$$

The smallest possible value t can have is zero, and assuming it to be zero here; $\cos 0^\circ = 1$ and—

$$F = f m \theta \frac{\pi}{180} \times 1 \text{ and substituting our values as before we have—}$$

$$F = \frac{100 \times 30 \times \pi}{180} \times 1$$

$$F = \frac{100\pi}{6}$$

$$F = 52.3 \text{ cycles approx.}$$

The accuracy of this figure at time T₀ in Fig. 9, where the time is zero, depends only on how far we desire to carry out the

$$\text{decimal places in—} \frac{100\pi}{6}$$

Any and all other values of t from T₀ to T₁₀ may be used here to find exact frequency deviations. A table such as that above may be arranged to show these values if desired.

It will be noted from the above work as well as from the preceding that in the interval T₀-T₁ the deviation of the carrier is maximum or more exactly at time T₀ in the latter calculation.

Simplifying our original equation—

$$F = \frac{4000\theta}{360} \text{ and converting it to enable}$$

other substitutions, we may write—

$$F = \frac{N f m \theta}{360} \text{ in which—}$$

N = number of parts per cycle for each time interval

$f m$ = modulation frequency

or, more exactly at time T₀, we observe that $t = 0$ and $\cos 2\pi f m t = 1$. Hence by the more exact formula—

$$F = \frac{f m \theta \pi}{180}$$

Here we find the factor $\pi/180$ to be constant and to have a value of .01745 permitting us to write—

$$F = .01745 f m \theta$$

It is this formula that has very great importance, for it shows what factors determine the maximum amount or degree of modulation. We shall return to it shortly.

In the meantime, take notice that wave F in Fig. 9 is actually changing frequency in accordance with this figure in the last column in Table 3. Just because waves E and F are “in phase” at T₀ this does not mean that they have the same frequency at this or any other point. We know from previous studies that the phenomenon of beats or heterodynes is caused by two waves changing phase continuously, and at every cycle of the beat, the two beating waves are exactly in phase at one instant although they are never of the same frequency. In this type of frequency modulation, we have the effect of two waves changing phase not continuously but in accordance with a sine wave or, as we say, “sinusoidally.” There is, of course, only one wave but its changes are considered with respect to the reference wave of constant 200 kc.

At T₁₀ in Fig. 9 actually waves E and F are of exactly the same frequency although of different phase by 30°, while at T₀ they are of the same phase but differ in frequency by 52.3 cycles.

Referring back to Fig. 8, we must realize that the wave at D is first applied from V3 and then from V4 as the A.F. changes from plus to minus. The carrier that is impressed at D from V4 is in reverse phase of that at V3 and its phase is made to advance beyond the 200 kc. carrier as a reference and as a phase slip occurs, this produces a lower carrier by as many cycles as it was above it before.

Repeating again this very important formula—

$$F = .01745 f m \theta$$

We find that the deviation frequency depends entirely on the modulation frequency and the total phase change θ which is chosen in the design. We have seen, however, that the total phase shift θ is controlled by the modulating voltage and moreover we have determined to not let this exceed 30° for reasons mentioned. However, we desire that the audio voltage be sufficient to produce a phase shift of θ or 30 degrees maximum for every frequency. For example, let us assume that 10 volts is required at the screens of the balanced modulators to produce a phase shift of 30 degrees of the modulated carrier as referred to the original carrier. Then regardless of its frequency, every audio signal must reach a maximum of 10 volts to produce this phase displacement.

But we have the term, $f m$, in this formula which represents the modulation frequency.

(To be continued)

FREE! ONE or ALL of these books

THE publishers of RADIO & TELEVISION give you the opportunity to add three outstanding books to your technical radio library. They make the offer even more attractive by giving these books to you absolutely FREE. A subscription to RADIO & TELEVISION for seven months at the cost of One Dollar gives you a choice of either of the three books shown in this advertisement. For Two Dollars you receive RADIO & TELEVISION for fourteen months and you receive any two books absolutely FREE. To get all three books FREE, enter your subscription for twenty-one months for only Three Dollars.

ANOTHER SAVING FOR YOU—THE PUBLISHERS PAY POSTAGE ON THE BOOK OR BOOKS YOU CHOOSE.

All of the books contain numerous photographic illustrations and diagrams and have stiff, flexible covers.

ABC OF TELEVISION



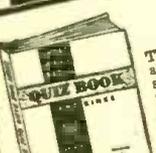
Contains latest material on television developments. It covers the theory of scanning; the photo-simplis; neon lamps; how the eye sees; the electric cell; width of channel; need for high-fidelity transmission of signals; cathode ray tube and television receivers; Farnsworth system of television; transmission; and other important features.

SHORT WAVE GUIDE



Covers hundreds of short-wave questions and answers; illustrates popular short-wave kinks; for building instructions for explicit simple short-wave receivers; instruction on the best type of antenna installation; diagram and construction details for building transmitters.

S. W. RADIO QUIZ BOOK



This book covers questions and answers on transmitters, short-wave receivers, ultra short-wave receivers, practical kinks, wrinkles and coil winding data; novel hook-ups for experimenters; how to "hook-up" converters, noise silencers, beaters, noise modulators, beaters, antennas, pre-oscillators, 5-meter receivers, selectors.

RADIO AND TELEVISION,
20 Vesey Street, New York, N. Y. R&T-8-41

Gentlemen: Enclosed you will find my remittance of \$..... for which enter my subscription to **RADIO AND TELEVISION** as checked below; also send me, postpaid, the book or books which I have marked below.

ABC OF TELEVISION
 S. W. RADIO QUIZ BOOK AND KINKS
 SHORT WAVE GUIDE

7 months—\$1.00—choice of any one of three (3) books. (Canadian and foreign—\$1.30)
 14 months—\$2.00—choice of any two (2) of the three (3) books. (Canadian and foreign—\$2.60)
 21 months—\$3.00—all three books. (Canadian and foreign—\$3.90)

If you are a subscriber now, we will extend your present subscription.

New subscriber Old subscriber

Name

Address

City

State

Send your remittance by check or money order. If you send cash or unused U.S. postage stamps, please be sure to register your letter for your own protection.

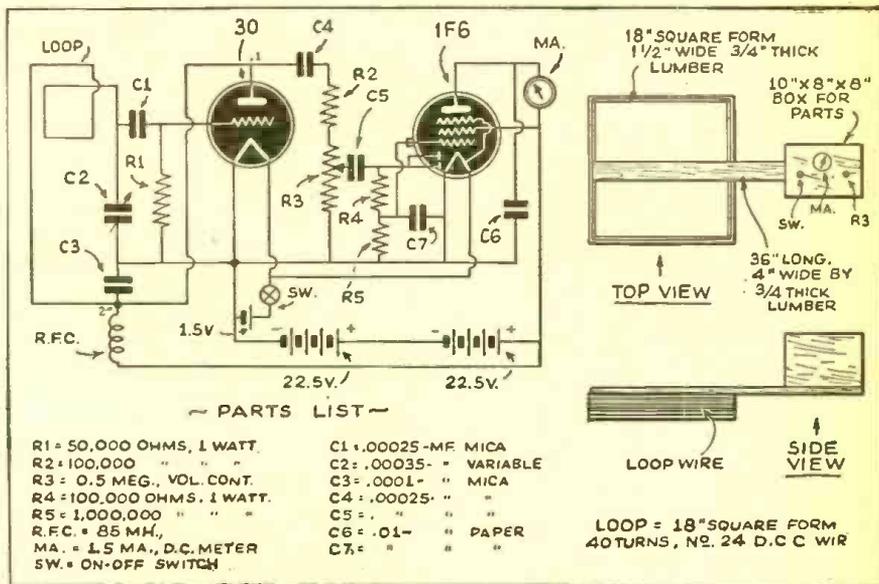
See Pages 691 and 701 for other valuable premiums offered FREE to subscribers.

Diagrams of Interest

This is a new department. If you have a new Hook-Up, send it along; a pencil diagram will do. Be sure to include a brief description.

All diagrams and descriptions accepted and published will be paid for at regular space rates. Diagrams may be for receivers, adapters, amplifiers, etc. Send them to Hook-Up Editor, RADIO & TELEVISION, 20 Vesey St., New York City.

LOOP ABSORPTION TREASURE FINDER COVER DIAGRAM



● THIS type of "treasure finder" operates on the principle that there will be absorption of energy by metal objects (due to eddy currents) in the field of a coil which is carrying radio frequency current.

When using a treasure-finder the operator should first have an idea of about where to look, otherwise it would be like searching for a needle in a haystack. Also the operator should realize that even the best of treasure-finders have definite limitations and should be considered as an experimental project. A treasure-finder will only cover a certain amount of ground, and works best on a dry day over dry sandy soil, as moist soil tends to conceal the effects of the metal.

Only the highest grade parts should be used in the construction of a treasure-finder, and these parts should be arranged and wired carefully to secure the best results.

This instrument employs a Colpitt type of oscillator. The greater the intensity of oscillation the larger the R.F. voltage between points 1 and 2.

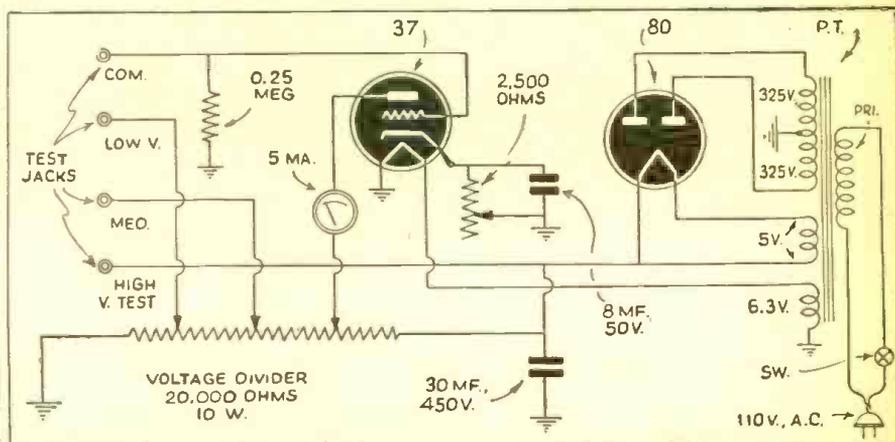
The presence of metal in the field of the coil will cause the voltage to decrease, as indicated by a decreased reading of the milliammeter.

When using the "finder," first turn on switch SW and allow the tubes to heat up. When you have no metal in the field of the coil, adjust R3 and C2 until the meter reads about mid-scale. Then place a large metal object under the loop and adjust C2 until the greatest change in meter reading is obtained.

It is the amount of change in meter reading which indicates the presence of metal; therefore it is essential that C2 be adjusted for maximum change in reading. Considerable experience must be had to interpret the readings correctly. To gain experience the constructor should experiment with various types and sizes of metal, buried at different depths in the earth.

This treasure finder is ideal to use at a beach party to locate treasure buried by the host.—*H. R. Wilkening, Loomis, Sask., Can.*

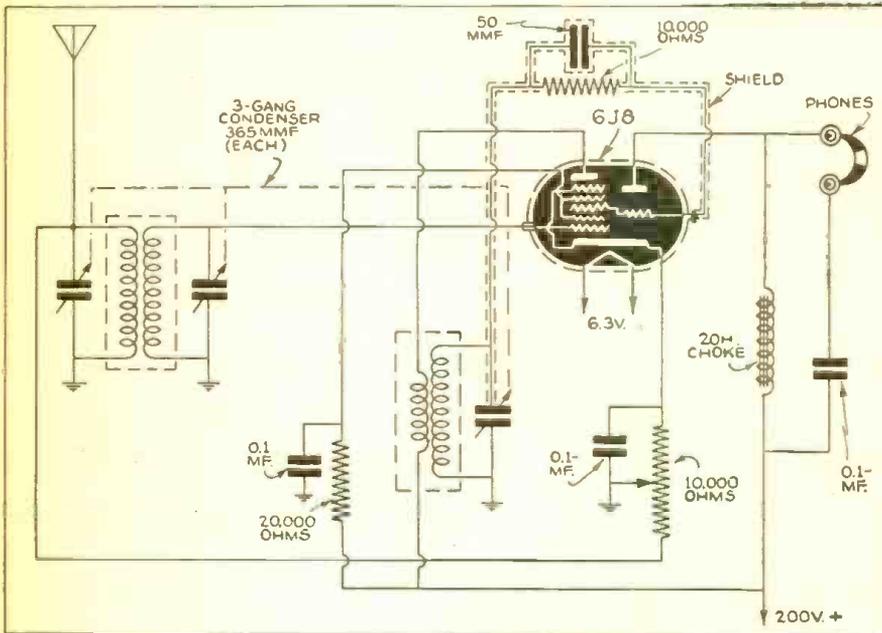
CONDENSER LEAKAGE TESTER



The diagram herewith shows "a condenser leakage" tester, which the contributor, C. P. Foster, 1512 21st Street, N.W., Wash., D.C., says he has found very handy. A leaky condenser cancels out the negative control grid bias, causing plate current to rise. Open-circuit condensers are indicated by no deflection; good condensers will give a momentary deflection.

to the Radio Experimenter

One-Tube Super-TRF Receiver



"Puzzle" Diagram—Is this 1-Tube working as a super-het? Let's hear your opinion!

● THE single tube used in this circuit is a 6J8 (Sylvania) Triode-Heptode-Converter, designed for service as an autodyne tube in a super-het circuit. Its function, however, in the present circuit is widely different from what the tube was originally intended. This will become apparent as we go along.

Starting at the antenna: The incoming signal is first taken care of by a band-pass tuner. This tuner is of the same general design as the kind used on an I.F. transformer, except that it is actually constructed like a R.F. coil. The coupling between the two coils is made adjustable by having one coil slide back and forth over the other. The coupling must be made quite loose in order to avoid *double-spot* tuning.

This type of hook-up at the antenna delivers a strong signal to the control grid of the heptode-half of the tube 6J8.

Consider the oscillator circuit: The tuning condenser of the oscillator grid circuit tunes in-step with the first two tuning condensers, so that the oscillator current always has the same frequency as that of the incoming signal.

The amplifying action in the heptode-half of the tube is two-fold. First, the signal delivered by the control grid is amplified in the usual manner. Second, the oscillator current, being in the same electron stream, and having the same frequency as the incoming signal, and also being in phase, now becomes added arithmetically to the signal, so that the final amplification is two-fold.

The oscillator serves two purposes: Additional amplification and higher selectivity. This may look like the old bottle called *regeneration*, only with a new label—but is it?

This brings us to the triode-half of the tube. Though originally designed to serve as an oscillator, the triode is now used as

a combined detector and output tube. Direct coupling is secured by the connection of the two grids within the tube—the output from the heptode is detected, further amplified, and then delivered to the head-phones—sweet music!

The reception at the phones has good fidelity, and every station on the broadcast band comes in with good volume. Some of the stronger locals are often too loud and have to be turned down to lower volume.

The selectivity is about the same as obtained by an equal number of tuned stages in a regular TRF circuit.

All this circuit needs to make it "bug-less" is to have the super-control feature added to the tube, so as to prevent *cross-modulation*.—*Ralph W. Martin*.



ELEMENTARY MATHEMATICS

EASY — SIMPLIFIED — PRACTICAL

HERE is a book for the business man, the technician and craftsman explaining and answering every operation and meaning with interpreting illustrations and examples. It is the key to a simple understanding of many perplexing problems in daily life. In clear, positive and definite language, the author popularizes and clarifies every subject and helps the reader to overcome any apparent difficulty in the study of mathematics. A real home study-course in mathematics for the student or the man who wants to achieve proficiency or desires to brush-up on his knowledge.

Entire Chapter on Special Mathematics for the Radio Technician

CONTENTS OF BOOK

- CHAPTER I. Arithmetic—Addition—Subtraction—Multiplication—Division.
- CHAPTER II. Factoring and Cancellation—Fractions—Decimals—Percentage—Ratio—and Proportion.
- CHAPTER III. The Metric System.
- CHAPTER IV. How to Measure Surfaces and Capacity (Geometry).
- CHAPTER V. Powers and Involution—Roots and Evolution.
- CHAPTER VI. Mathematics for the Manual and Technical Craftsman—Thermometer—Conversions—Graphs or Curve Problems—Logarithms—Use of the Slide Rule.
- CHAPTER VII. Special Mathematics for the Radio Technician.
- CHAPTER VIII. Commercial Calculations—Interests—Discounts—Short Cut Arithmetic.
- CHAPTER IX. Weights and Measures—Useful Tables.

ONLY 50c POSTPAID

"Elementary Mathematics" can be carried readily in your pocket. Send Stamps, Cash or Money Order.

TECHNIFAX

1917 S. State St. RT-341 Chicago, Ill.

GREATEST SLIDE RULE VALUES EVER OFFERED



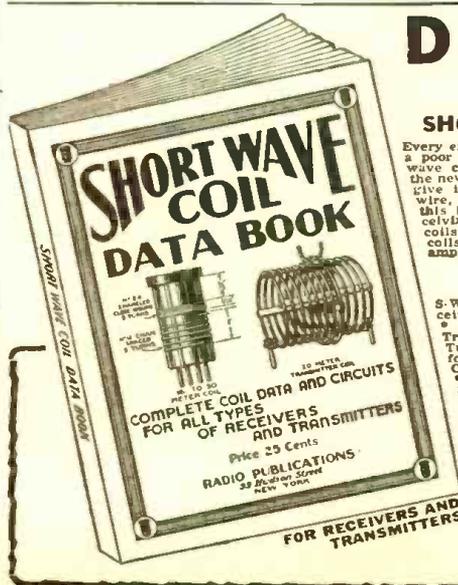
10 inch enameled slide rule, made of zinc, dried seasoned hardwood, has auxiliary removable magnifier with pins to fit (cursor) runner. This rule has inch, millimeter, sine, log and tangent scales. Packed in individual carrying case. This rule is equal in performance to a \$10.00 rule. Our special Price, P.P. prepaid anywhere \$1.00

- LAWRENCE 10-inch white enameled slide rule with clear glass magnifier in Black Box. Includes 36-page instruction book. Prepaid... 60c
- 8" Slide Rule 25c
- 36 Page Illustrated Book of Instructions 10c
- 36 Page Book Stanley's Slide Rule Practice, 300 Fascinating Examples and Answers ... 10c
- Secret Code slide rule, with 16-page book. 2 for 50c ... 30c

Postage Prepaid

GOLD SHIELD PRODUCTS

Dept. RT-341 350 Greenwich St. New York



DON'T FAIL TO GET THIS

SHORT WAVE COIL DATA BOOK

Every experimenter knows that the difference between a good and a poor radio set is usually found in the construction of short-wave coils. Coil winding information is vitally important and in the new coil book all "dope" appears. There're illustrations which give instructions on how to wind coils, dimensions, sizes of wire, curves and how to plot them. Every experimenter needs this book—it also contains complete data on all types of receiving coils, together with many suitable circuits. Using these coils. Also complete data on various types of transmitting coils with many transmitting circuits such as exciters and amplifiers using the various coils described.

Contents Briefly Outlined

- S-W Tuning Inductance Charts • Coil Data for T. R. F. Receivers • One Tube Oscillodyne • Two Tube Bandspreader • The Mono-Coil • 2-Tube Old Reliable • 2-Tube Glohe Trotter • 2-Winding Coils—10-500 Meters • Doerle 3-Tube "Signal Gripper" Electrified • 3-Tube Bandspreader for the Ham • General Coverage Coils on Ribbed Forms • Coil Data for Superhet or S-W Converter • Ultra S-W Coils • Switch Coils for S-W Superhets • Experimental Coils • S-W Antenna Tuner • Most Popular S-W Tuning Circuits • Self-Supporting Transmitting Circuits Employing Coils Described • All Band Antenna Tuner for Transmitting • Plug-in Coils for Exciters • Frequency-Wavelength Conversion Chart.

PRICE 25c PREPAID

For a copy of this handy book send 25c in U.S. Coin or stamps to

RADIO PUBLICATIONS

20 VESEY STREET NEW YORK, N. Y.

Edited by Herman Yellin, W2AJL

Modernizing Old Pilot Set

Q Can you advise me if I can change over my battery operated Pilot Super-Wasp receiver to use more modern tubes?—C. Small, Ruxton, Md.

A. We show a diagram of this old and popular Pilot all-wave receiver, with the modern metal tubes. All the original parts have been incorporated, including the coils and condensers. The only additions necessary will be the sockets, tubes and a few resistors and condensers. Note that the old audio transformers have been used, but that a new output transformer will be needed. Although not shown on the diagram, on the broadcast band, a primary or antenna coil is used, while on all the short-wave bands, capacity coupling is employed from the antenna to grid coil.

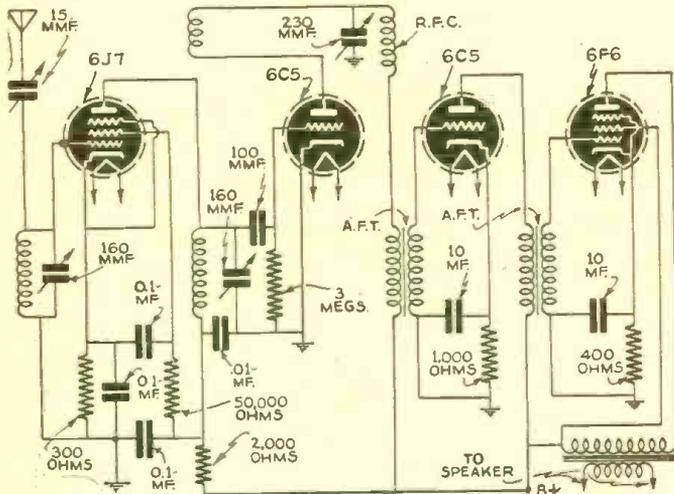


Diagram above shows how to re-vamp one of the old Pilot all-wave receivers for use with modern tubes. (No. 1248)

Economy Transmitter

Q How many crystals are needed to operate on all bands with the Economy transmitter described in the July issue? What is meant by the switch contact marked "Pent."?—P. Bowen, Llanerch, Pa.

A. Two crystals can be used for all-band operation, since there is sufficient output, even when quadrupling in the oscillator, to adequately drive the buffer amplifier. When the switch is on the "Pent." or Pentode tap, the cathode coil and condenser is shorted out, enabling the oscillator to act as a pentode oscillator and delivering output on the crystal's fundamental frequency.

Signal Tracer

Q I wish to use an A.C.-D.C. TRF set as a signal tracer. How can I also trace the various I.F. stages? Can I use untuned stages?—B. Axelrod.

A. Probably the simplest way would be to arrange the coils to be plug-in and use a coil with sufficient inductance to tune to the I.F. frequencies. However, for ease in operation, it is desirable to incorporate some method of switching from one band to the other. Untuned stages are not at all desirable for any kind of effective work. Use tuned R.F. stages by all means. Incidentally, coils suitable for this type of work and small enough to be mounted on a switch can be procured commercially.

Output of Amplifier

Q What is the output wattage of the one tube amplifier shown on page 496 of the December issue? What kind of speaker is used?—E. Meyer, Union Hill, N. J.

A. This little amplifier will deliver 55 milliwatts and should use a small speaker of the 3 inch or 6 inch type. Its output transformer should have an impedance of 4000 ohms. A magnetic speaker can also be used. Remember that this amplifier has quite low gain and is therefore suitable as a phono amplifier and not for use with low-level microphones.

"Call Letter" Identity

Q The other night I copied code station JFMD but could not make out what he was saying as many of the letters were unfamiliar, and it seemed as though he was using a special code.—Rev. R. W. L. Mark, Hawley, Penna.

A. JFMD are the call letters of a Japanese ship and he evidently was using the Japanese code. Since the Japanese alphabet contains 40 letters, some of their letters will have different dot-dash combinations than are used in the English alphabet. These extra combinations will contain more symbols than the letters we are used to, thereby making their code slower to send. Incidentally Japanese operators all learn both the Japanese code and the regular International Morse code, which makes his training much more difficult than ours, and puts to shame those students who protest against learning our code.

Antenna Problem

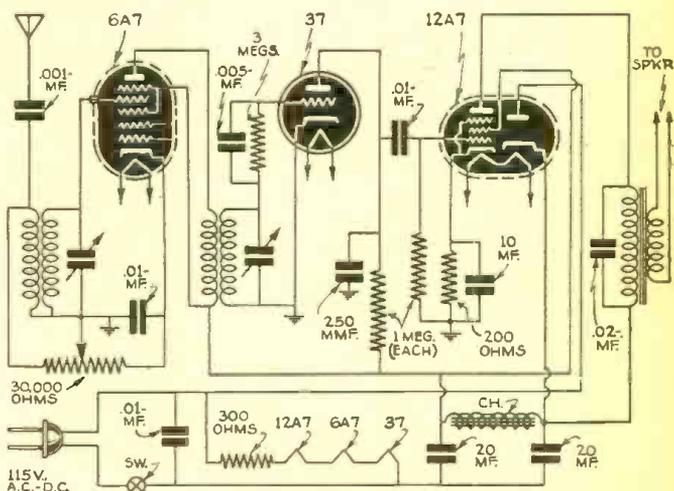
Q I wish to construct an antenna for the 80 meter band, but have only 70 feet of roof space available, with a lead-in distance of about 30 feet. Can you recommend an antenna for use on this band, as well as on the 40 meter band?—W. Deans, Brooklyn, N. Y.

A. You can use an end-fed antenna, half-wave for 80 meters, which will be about 130 feet, including lead-in; make the flat-top portion as long as possible. If you cannot get in the entire 130 feet of antenna and lead-in, use an inductance in series with the lead-in at the transmitter end, and vary the amount of inductance until the antenna loads up the final to the maximum. Thereafter, loading of the final can be adjusted by varying the point at which the series coil is tapped onto the final coil. Remember that there is high R.F. voltage at the end of the lead-in, so use adequate insulation to prevent leakage.

Small A.C.-D.C. Receiver

Q Can you show a small A.C.-D.C. set using 6A7, 37 and 12A7 tubes?—G. Sarmiento, New York.

A. A simple T.R.F. receiver is shown. It has adequate volume to operate a small loudspeaker and is simple to build. Either one of the small A.C.-D.C. filter chokes can be used or a 5000 ohm, 5 watt resistor can be used, with the choke preferred. A regular resistance type line cord can be used, or a 300 ohm, 25 watt resistor incorporated in the set itself; whichever is available to you.



Hook-up for small A.C.-D.C. receiving set of the T.R.F. type. (No. 1249)

Queries to be answered by mail (not on this page) should be accompanied by fee of 25c (stamps, coin or money order). Where schematic diagram is necessary, our fee is 50c up to 5 tubes; for 5 to 8 tubes fee is 75c; over 8 tubes, fee is \$1.00. No picture diagrams can be supplied.

"Time Signals" Where Heard

? Can you furnish me with information on how to build a simple receiver to tune in the NAA time signals on 113 kc., or information on how to tune the signals in on a short-wave receiver?—B. Stratton, Ridley Park, Pa.

A. There is no need to build a special receiver in order to pick up NAA. Time signals are sent out almost every hour on the short-waves, and can be picked up with any short-wave (or all-wave) receiver. Their 9425 and 9250 kc. transmissions are perhaps the most easily heard in all sections of the country.

Untuned R.F. Stage

? I have a 6-tube short wave super-het, with a 2-stage preselector. I would like to know if an untuned R.F. stage would further increase the sensitivity and selectivity.—J. T. Smisek, New Prague, Minn.

A. Untuned R.F. stages give practically no gain whatever on the short waves. Their only value lies in their ability to isolate the antenna from the tuned circuits. They are sometimes used ahead of the detector to eliminate "dead-spots" in tuning, caused by the natural frequency or harmonics of the antenna falling in the particular portion of the frequency spectrum one wishes to listen to. Untuned R.F. stages are particularly valuable with regenerative receivers, since they prevent radiation from the detector. This can be particularly bothersome to other listeners.

24 Vt. Lighting Plant & Radio Problem

? I am operating a boat that is powered with a 100 H.P. Diesel engine. The electric system on this motor consists of a 24 volt starter and generator. The lighting system on the boat consists of six screw-base 12 volt lights (1 don't know the wattage on these lights), three 32 C.P., and three 3 C.P. automobile pin-base lamps, 12 volts. I have been cutting in these lights over half of my 24 volt battery but this causes an uneven drain over half of the battery.

Also I have a 15 watt Transceiver hooked up to ¼ of this 24 volt battery.

I would like to know how to change this hook-up, by inserting the proper resistors in the positive leads, so that I could hook both the lights and the vibrapack across all of my 24 volt battery, getting an even drain across all of my battery.

The power-supply for the radio is a vibrapack that came with the set. It is marked: TYPE 6 V.P. VOLTS 6. I don't know the current drain of this vibrapack.—John Smithson, New York, N. Y.

A. Your lighting problem can be solved quite readily. First, let us assume that 24 volt bulbs for lighting are unavailable; if they are, we would strongly recommend their use. However, lacking 24 volt bulbs, the six screw-base bulbs should be connected in series-parallel.

If you cannot rewire your lighting system to this series-parallel arrangement, the next best thing would be for you to connect

Lowest Priced Publications for Experimenters

10 FOR 50c

Here is a large number of radio, short-wave, and mechanical "how-to-make-it" designs. Each is a special publication originated by masters in their respective fields. For the low price of 50 CENTS, you buy TEN complete pamphlets with photographic reproductions, complete mechanical layout, and full description to make it possible for anyone to build the project in question.

PLEASE ORDER EACH PROJECT BY ITS PUBLICATION NUMBER, and use the special coupon below. We accept money-orders, cash, checks or new U. S. stamps. (No foreign stamps.) If you send cash or stamps, register your letter. Money refunded if you are not satisfied. ANY TWENTY-FOUR PUBLICATIONS FOR ONE DOLLAR.

SHORT-WAVE RECEIVER PUBLICATIONS

- HOW TO MAKE THE "OSCILLODYNE" I TUBE WONDER SET.....No. 101
- HOW TO MAKE THE "19" TWINPLEX (ONE TUBE PERFORMS AS TWO) RECEIVER.....No. 102
- HOW TO MAKE THE WIZARD I-TUBE 50-WATT TRANSMITTER.....No. 103
- HOW TO MAKE THE IMPROVED 3-TUBE DOERLE SET FOR BATTERY OPERATION.....No. 104
- HOW TO MAKE THE "GO-GET-EM 2" RECEIVER FOR THE BEGINNER.....No. 105
- HOW TO MAKE THE I-TUBE-ALL-ELECTRIC OSCILLODYNE.....No. 106
- HOW TO MAKE THE 2 TO 5 METER TWO-TUBE LOUDSPEAKER SET.....No. 107
- HOW TO MAKE THE 3-TUBE BATTERY SHORT-WAVE RECEIVER.....No. 108
- THE BRIEF-CASE SHORT-WAVE RECEIVER AND HOW TO BUILD IT.....No. 109
- HOW TO BUILD THE POCKET SHORT-WAVE RECEIVER.....No. 110
- HOW TO BUILD THE CIGAR-BOX I-TUBE "CATCH ALL" RECEIVER.....No. 111
- HOW TO BUILD THE "DUAL-WAVE" SHORT-WAVE BATTERY RECEIVER.....No. 112
- HOW TO BUILD THE I-TUBE "53" TWINPLEX RECEIVER.....No. 113
- HOW TO BUILD THE PORTABLE MINIDYNE SHORT-WAVE BATTERY SET.....No. 114
- HOW TO BUILD THE HAM-BAND "PEE-WEE" 2-TUBER.....No. 115
- HOW TO BUILD THE DUO-AMPLIPLYNE.....No. 116
- HOW TO BUILD THE "MONO-COIL 2".....No. 117

RADIO BROADCAST RECEIVER AND SPECIAL RADIO PUBLICATIONS

- HOW TO MAKE THE A.C.-D.C. "CASH BOX" RECEIVER.....No. 118
- HOW TO MAKE BEGINNER'S 2-TUBE ALL-WAVE SET.....No. 119
- HOW TO BUILD THE "RADIO-LAMP" 4-TUBE TABLE RECEIVER.....No. 120
- HOW TO BUILD A SUPER-SENSITIVE ALL-WAVE CRYSTAL SET.....No. 121
- HOW TO BUILD THE 2-TUBE "PENTODE PORTABLE" BROADCAST SET.....No. 122
- HOW TO BUILD THE RADIO "TREASURE" FINDER.....No. 123
- HOW TO BUILD THE GERMS-BACK ONE-TUBE PENTODE LOUDSPEAKER SET.....No. 124
- HOW TO BUILD THE WORLD'S SMALLEST ONE TUBE BATTERY RADIO.....No. 125
- HOW TO BUILD A 6-TUBE BATTERY ALL-WAVE "FARM PORTABLE" SET.....No. 126
- HOW TO MAKE AN A.C.-D.C. ONE-TUBE "OEAF AID".....No. 127
- HOW TO BUILD A PIANTRON.....No. 128
- HOW TO BUILD THE ONE-DOLLAR RADIO.....No. 129
- HOW TO MAKE A VARIABLE-TONE CODE PRACTICE SET.....No. 130

MECHANICAL PROJECTS PUBLICATIONS

- HOW TO MAKE A SOUTH SEA OUTRIGGER CANOE.....No. 131
- HOW TO BUILD A PEE-WEE AUTOMOBILE.....No. 132
- HOW TO BUILD A DUAL-CONTROL GLIDER.....No. 133
- HOW TO BUILD A HOUSEBOAT ON PONTOONS.....No. 134
- HOW TO MAKE A BAND SAW FROM OLD AUTO PARTS.....No. 135
- HOW TO BUILD A REAL LATHE FOR \$5.00.....No. 136
- HOW TO BUILD A SAIL CAT-BOAT.....No. 137
- HOW TO BUILD A SIMPLE PORTABLE REFRIGERATOR.....No. 138
- HOW TO BUILD A XYLOPHONE.....No. 139
- HOW TO BUILD THE ROWMOBILE.....No. 140
- HOW TO BUILD LARGE TESLA AND OUDIN COILS GIVING 18 INCH SPARKS.....No. 141
- HOW TO MAKE AN ARC WELDER.....No. 142
- HOW TO USE AN A.C. ARC WELDER.....No. 143
- HOW TO MAKE YOUR OWN MICROSCOPE.....No. 144
- HOW TO MAKE A WIMSHURST ELECTROSTATIC MACHINE.....No. 145
- HOW TO MAKE A POWER DRILL PRESS FROM SCRAP PARTS.....No. 146
- HOW TO BUILD A GOOD LATHE FOR \$1.00.....No. 147
- HOW TO MAKE AND EXPERIMENT WITH AN ELECTROPHOROUS.....No. 148
- HOW TO MAKE AN ELECTRIC ARC WELDER FROM AN AUTOMOBILE GENERATOR.....No. 149

RADIO PUBLICATIONS • 20 Vesey Street • New York, N.Y.

RADIO PUBLICATIONS, 20 Vesey Street, New York, N.Y. R&T-3-41

I enclose \$..... for the publications listed by number, at right, at the rate of 50c FOR ANY TEN PUBLICATIONS. NO ORDER FOR LESS THAN 50c ACCEPTED. \$1.00 for 24 publications. These publications are to be sent to me postpaid. I have placed a circle around each number which I want.

Name	Address	101	102	103	104	105	106
City	State	107	108	109	110	111	112
		113	114	115	116	117	118
		119	120	121	122	123	124
		125	126	127	128	129	130
		131	132	133	134	135	136
		137	138	139	140	141	142
		143	144	145	146	147	148
							149

your string of six screw-base bulbs across one-half of your 24 volt battery, and the string of six auto pin-base lamps across the other half of the 24 volt battery. This system will not give you an even drain across the entire battery.

Hooking up your Transceiver is somewhat of a problem. Connecting a resistor in series with your vibrapack and placing the two across the 24 volt battery is very uneconomical, since the power drawn by the resistor is wasted and will be three times as great as the power taken by the vibrapack. Why not try changing the 6 volt vibrapack for a 24 volt unit or a 12 volt unit. If you must use a series resistor with the 6 volt vibrapack, you will have to know the amount of current drawn by the vibrapack. The value of the resistor in ohms will be equal to 18 divided by the current in amperes. If a 12 volt vibrapack is used, the value of the series resistor will be 12 divided by the current in amperes. In either case the

resistance will be in the order of a couple of ohms and should be capable of dissipating quite a bit of heat, about 50 to 100 watts.

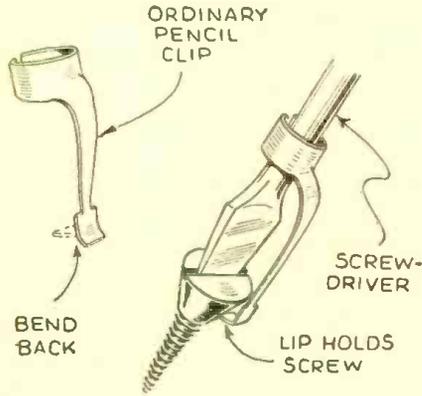
Converting Set for Short Waves

? How can I change a 5-tube car radio into a short-wave receiver to pick up the 160 meter amateur band?—B. J. Moore, Eastland, Texas.

A. If the receiver is of the T.R.F. type, it should be very simple to remove about one-third of the turns from each R.F. coil. This will enable the receiver to tune to the higher frequency. A superhet can have the same operation performed, but will necessitate some careful pruning of the coils, in order to get the detector and oscillator to "track" at the new frequencies. In removing turns, remember that the oscillator is much more critical than the detector, so prune the oscillator coil carefully.

**The Cover Kink
First Prize Winner
Screw Holder**

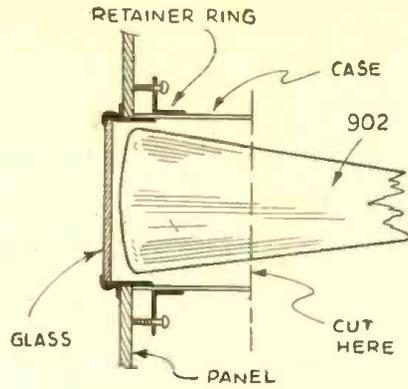
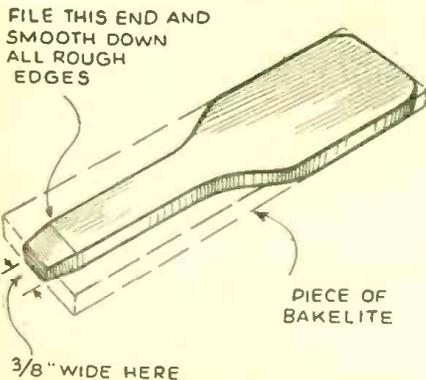
It is often very convenient to use one of those gadgets for holding a screw on the screw-driver. The attachment may be made out of a pencil clip of the commonest variety. All that is necessary is to bend down the tip as shown in the diagrams. There is less danger of breaking the tip off if it is first heated in a blowtorch or even a candle flame. Of course, if it is heated, it should be re-tempered after the bending operation.—*Melvin Levine.*



Neutralizing Tool

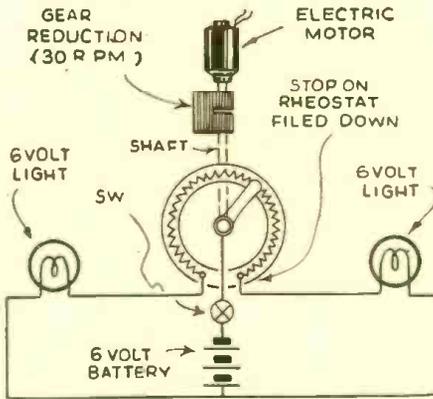
Frequently there comes to the Ham the problem of tuning the neutralizing condensers in the "final" without the error of the capacity of a metal shank screw-driver. Not only is this kink a good neutralizing tool, but it can be used wherever high voltage might be encountered.

First find a piece of bakelite about one by ten inches in size. Take an old coping saw and cut it to the shape shown in the diagram, making the shaft about three-eighths inch wide. This should prove strong enough for the average job. Now, file the end of the shank down to a flat point, just like a point on a screw-driver. Thus you have a high voltage capacity-less screw-driver at no cost at all. If you want to spend more time and do a better job, you can build out the handle to suit yourself, but this is not necessary.—*George C. Michaelis, W9DUI.*



Oscilloscope Screen

Recently I built an oscilloscope using a 902 two inch cathode-ray tube. The problem of making a neat hole in the panel of the oscilloscope for viewing the screen presented itself. The solution to the problem was found in the case of a two inch panel meter. The inside diameter of the case was just a trifle over two inches and was, therefore, just right to accommodate the viewing screen of the 902. The back of the case was sawed off as shown, and the retaining ring used to keep the case in the hole, thus making a very neat looking viewing screen.—*Carl Helber.*



Rotary Lamp Dimmer

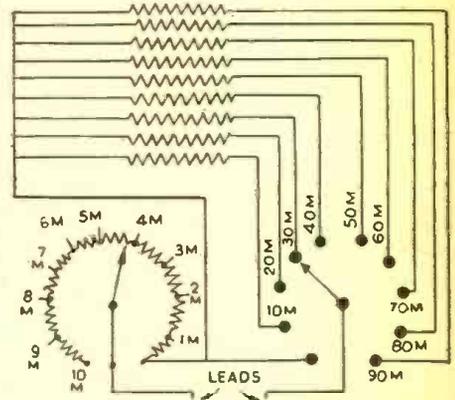
The accompanying diagram shows how to make an interesting "dual-circuit" lamp dimmer, to be rotated with a motor, so that when one lamp is dimming, the other lamp is becoming brighter, etc. I took an old rheostat and filed down the stop so that the arm could rotate continuously over the resistance wire; the rheostat was then mounted so as to be driven by a motor, geared down to rotate the arm at about 30 r.p.m. For larger lamps a rheostat with heavier wire will have to be used. For a more elaborate lamp display, several coils of German silver or other resistance wire may be wound and provided with rotary arms, a gang of such units being employed if necessary and driven by a motor.—*Roy Loughary.*

Resistance Indicator

As I have accidentally burned out several factory indicators, I devised a plan shown which makes the instrument easy and economical to repair, as only one resistor and potentiometer are in use at any one time. With a selection of good resistors and a good ohmmeter, the instrument can be calibrated accurately. A fuse may be placed in one of the lead wires to guard against accidental overload. The parts required are:

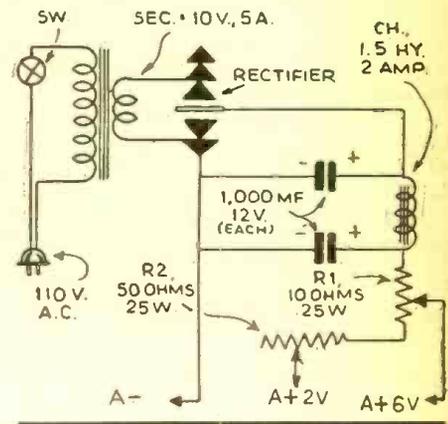
- 1—10 point selector switch
- 1—60M ohm resistor
- 1—70M ohm resistor
- 1—10M ohm resistor
- 1—80M ohm resistor
- 1—20M ohm resistor
- 1—90M ohm resistor
- 1—30M ohm resistor
- 1—10M ohm potentiometer
- 1—40M ohm resistor
- 1—50M ohm resistor

—*John Ralph Amos.*



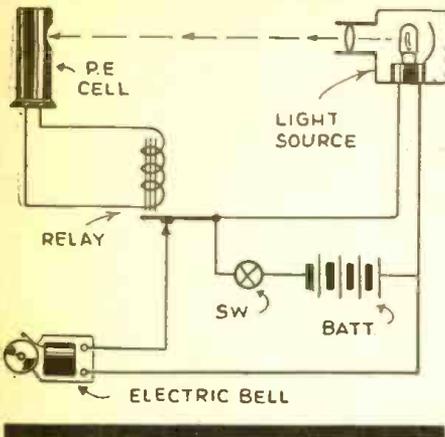
Low Voltage Power Supply

The diagram shows a low voltage power supply which many experimenters frequently have need of. The rectifier employs dry-disc copper-oxide units, obtained from an old battery charger. This rectifier I obtained was a 2 ampere, 6 volt type, which rectifies the low voltage A.C. obtained from a step-down transformer. Rheostat R1 regulates the 6 volt output, and R2 the 2 volt output, using a load of at least 4 ohms resistance.—*Alban F. Hatzell.*



RADIO KINKS

published on these pages will win their senders 8 months' subscription to RADIO & TELEVISION. The best kink published each month will win a 2 years' subscription. Read these kinks; they will be of real use to you, besides indicating what is wanted. Send a typewritten or ink description with sketch of favorite to the Kink Editor



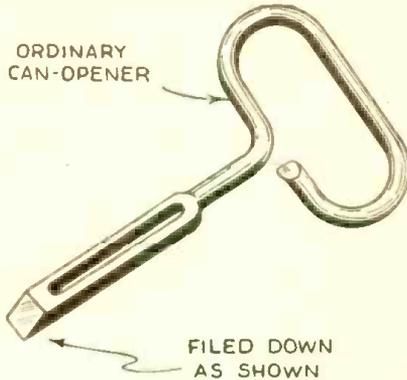
A Simple Burglar Alarm

A simple yet efficient burglar alarm can be made as illustrated. A photo-electric cell is wired to a sensitive electro-magnet fitted with a soft iron core, wound full with No. 36 enamelled wire. A very light armature is pivoted directly beneath the core, and is just held up by the magnetism generated by the current from the photo-electric cell. When the pencil-light beam is interrupted, the armature falls, completing the bell-circuit. The light is operated from the bell batteries; to reset, the armature is lifted. A master switch is incorporated, by which the apparatus is controlled.—*Colin Hojem.*

Emergency Screw-Driver

At some time or other, I know every Ham and experimenter has been at a loss

for a small screw-driver. One can be very easily made from an ordinary can-opener key. Just file down the end and there you are—with a very efficient emergency screw-driver.—*Tes Powers, W5JED.*



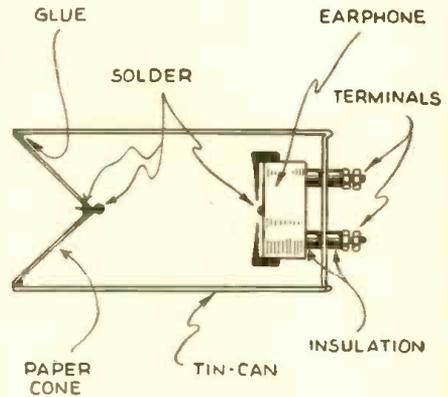
Code Practice Idea

Instead of building a separate code practice oscillator, I found that my receiver (SW5) would do just as well. First I inserted a key in series with one of the output leads of the receiver. Closing the switch on the key, I tuned to some station that was on the air. Then by tuning slightly off the station, I got the whistle which is characteristic of most sets, and "keyed" that. With the regeneration and by tuning, you can change the "pitch" of the tone to suit yourself. This gives more realism to the tone, static, fading, etc. An automatic

sender can be used to just as good advantage.—*Walter Gabsa.*

Improved Mike

Usually the quality of an earphone mike is quite poor. The quality can be greatly improved by providing a paper cone to receive the sound to be transmitted. The case for the improvised mike is a tin-can, slightly greater in diameter than the earphone. The cone is made of heavy paper and is connected to the earphone diaphragm by means of a stiff piece of copper wire. The wire is soldered to the diaphragm and connected to the cone by means of a drop of solder on each side of the vertex. The edge of the cone can be fastened to the edge of the can by means of glue.—*Carl Helber.*



FREE - THIS BEAUTIFUL AND USEFUL 2-WAY LAMP

ALTHOUGH we have offered many fine premiums in the past, we have never before found one that can be as universally useful to everyone as this highly decorative two-way lamp, which we now offer free to our readers. Two-way lamp? Yes, because it can be used as either a vanity or occasional lamp in its normal position, then, with a mere turn of the swivel it becomes a bracket lamp, which can be attached to the wall or woodwork of any room. A useful lamp of this type is highly welcome in any home—including your own. Just think what a handsome gift you can make of it to some friend or relative. Here is the way to receive this beautiful prize. Fill in the coupon in the left-hand corner—clip it out and mail it to us together with your remittance of \$2.50. You will receive a full year's subscription (12 issues) to RADIO & TELEVISION—the world's most popular radio magazine. In addition, we will send you absolutely FREE one of these wonderful two-way lamps. Old subscribers may renew their subscription now for another year following expiration of their present one and still receive this fine gift. There are only a limited number of lamps available, therefore take advantage of this offer without delay, in order to insure receiving yours.



Above. Used as a wall-lamp, by the simple twist of the swivel. Round shade with colorful ribbon design.

This beautiful little lamp is an asset to any room. The shades are gayly decorated and are made of strong lasting materials. The base is a combination of pressed glass, polished wood and plated metals. Height of lamp, 12 1/2"; shade 8".

At Left. Lamp in normal position for use on vanity or any other piece of furniture. Fluted shade with attractive flower design.

HOW TO ORDER YOUR LAMP—

Simply fill in the coupon at the left and mail together with check or money order. Register letter if cash or unused U. S. postage stamps are sent. To cover shipping charges on the lamp, add to your remittance the amount indicated: If you are located east of the Mississippi, add 15c; west of the Mississippi, add 24c; foreign countries, add 40c.

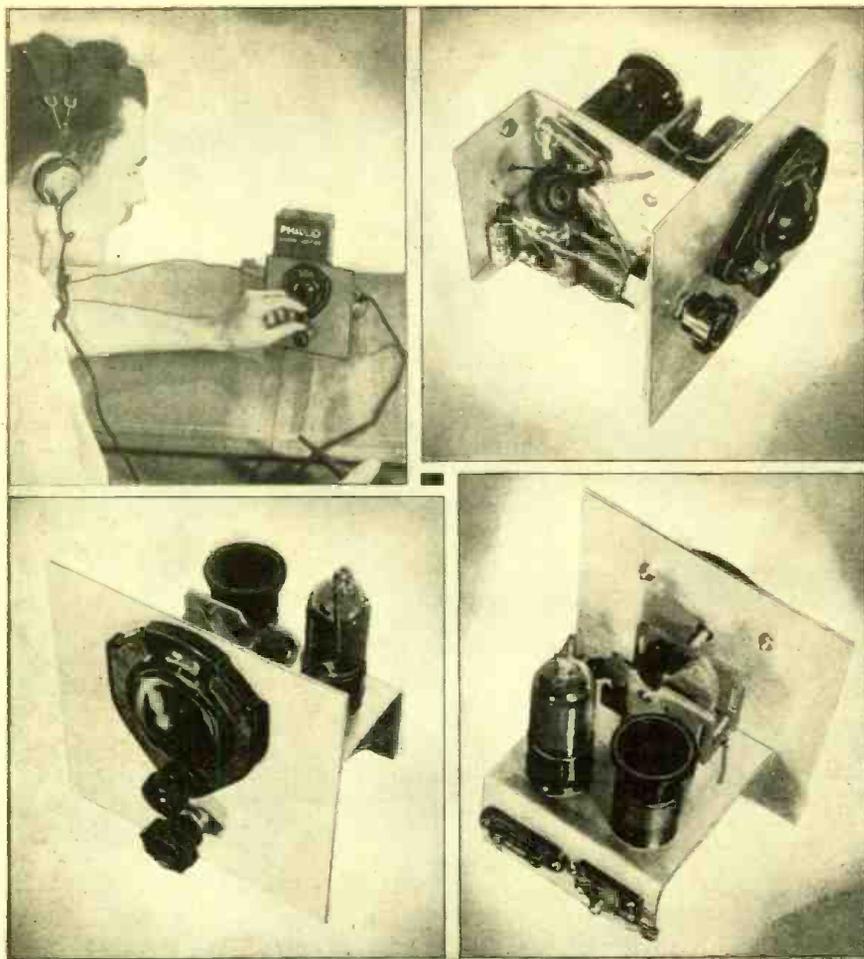
RADIO & TELEVISION, 20 Vesey St., N.Y.C.

RADIO & TELEVISION, 20 Vesey Street, New York, N. Y.

Gentlemen: Enclosed you will find my remittance of \$2.50 (plus cents shipping charges) for which enter my subscription for RADIO & TELEVISION for one year (12 issues). This amount entitles me to a Two-Way Lamp FREE, with fluted shade; round shade. (See Paragraph next to coupon for shipping charges on lamp.) I am a new subscriber. Extend my present subscription.

Name Address
City State RT-341

MAIL THIS COUPON TODAY!



The four photos at the left show:—the Duette one-tube battery-operated receiver in operation—a bottom view of the receiver—a close-up front view and finally a rear view, showing the plug-in coil and tube.

detector, making a very sensitive arrangement, while the triode is used as a single stage of audio amplification. Regeneration is controlled by varying the screen voltage applied to the detector section, making for very smooth control, with a minimum effect upon the tuning when the regeneration is varied.

This single tube receiver will appeal to the "short-wave" beginner and it may also be built as a "broadcast" receiver, using suitable plug-in coils to cover the band. The circuit provides a sensitive regenerative detector and one stage of audio amplification. A smooth-working regeneration control is provided; while intended for head-phone reception, strong stations may be received on a sensitive PM type loudspeaker.

Standard two-winding plug-in coils may be used, or the constructor may build his own from the data with the drawing.

No special precautions need be observed in the building of this set other than to make certain that all leads are as short as possible, and check carefully all wiring before

The "DUETTE" — 1-Tube Battery-Operated Receiver

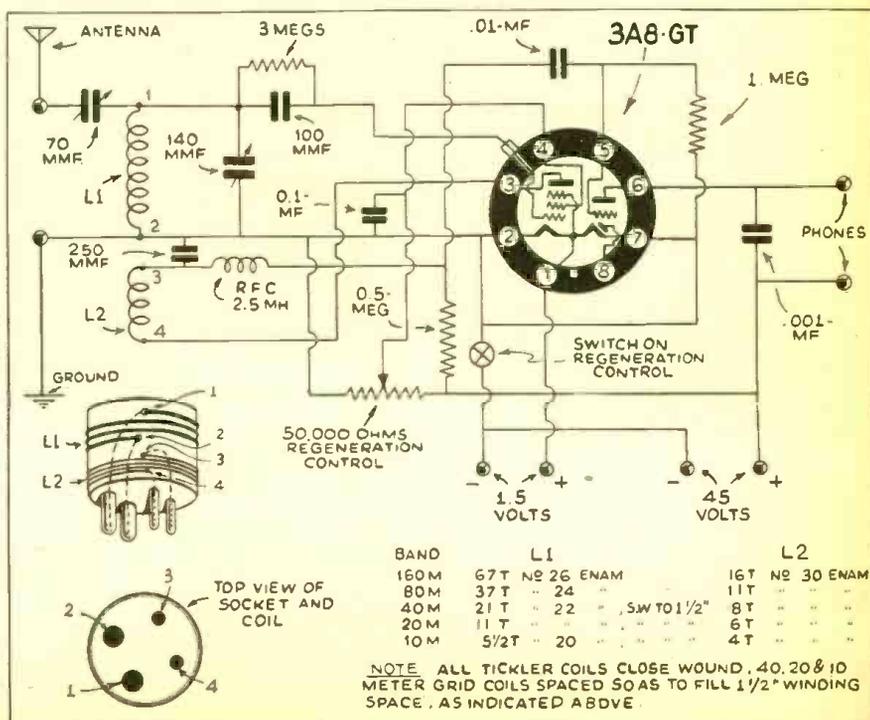
William J. Vette

● HERE is a little job that is the very ultimate in one-tube receivers. Making use of one of the most recent tube types, the 3A8-GT, in a very simple circuit, performance is all that could be expected from any two-tube set.

Requiring an absolute minimum of parts, this little receiver can be quite easily built in a very short time—and at surprisingly low cost.

The necessary power supply is quite simple, as the tube is designed to operate with only 1.5 volts on the filament, and a single 45 volt "B" battery supplies the plate current for both sections of the tube. Thus, the set can be made very compact and it makes an ideal portable set.

The tube consists of two separate sets of elements, a pentode and a triode. In this circuit, the pentode section is used as the



Wiring diagram for the one-tube receiver which performs two functions, is shown at the right. The single tube serves as a regenerative detector and one stage of audio. The "broadcast" band may be tuned in, by using a plug-in coil with more wire on it: 126 turns of No. 28 for L1 and 28 turns of No. 34 for L2.

trying the set out, to be sure that no errors have been made in connections, which might cause the tube to burn out.

The tube is designed with a double filament, to permit of operation on 1.5 volts, as shown in the diagram, or, by a series arrangement, on 3 volts. In the latter arrangement, prongs 2 and 7 are used for the filament connection, with no connection to prong No. 1. For 1.5 volt operation, hook up as shown in the diagram, prongs 2 and 7 connected together as the negative terminal, and No. 1 as the positive. In the series arrangement, prong No. 7 is the negative terminal, No. 2 the positive.

The tube also includes a diode section, at the negative end of the filament. In this set, we make no use of this diode, so prong No. 8, to which it is connected, is left blank, with no connection to any part of our circuit.

The antenna for use with this set may be very short, only about 20 or 30 feet being needed; too long an antenna may block the detector and not permit smooth control of the regeneration; in fact, if the antenna is much too long, the detector may refuse to oscillate.

Although shown in the diagram, an external ground connection is not absolutely necessary. In some cases you may find stronger reception *without* the ground connection, so it is better to try it both with and without the ground, and use it whichever way works out best in your case.

Be sure to connect the switch as shown in the diagram, between the negative terminal of the set and the common negative connection of both "A" and "B" batteries, for if the "B" battery is not thus disconnected when the set is not in use, the regeneration control will soon run the battery down.

Connections to the socket as shown in the drawing are looking at the *bottom* of the socket.

If you use standard coils other than those shown, be sure that your tickler is properly connected, otherwise the set will refuse to oscillate, and no reception can be had. In such a case, try reversing the leads to the tickler.

With reasonable care in wiring, this little set will provide you with most excellent reception, and will undoubtedly surprise you with its ability to pull in stations from far and near with ease.

Parts List

- 1—Set tuning coils (see diagrams)
- 1—Socket to fit coils
- 1—Tuning condenser, .00014 mf.
- 1—Antenna coupling condenser, .00007 mf. max.
- 1—Grid condenser, mica, .0001 mf.
- 1—Feedback condenser, mica, .00025 mf.
- 1—Bypass condenser, .1 mf., 100 volt
- 1—Coupling condenser, .01 mf., 100 volt
- 1—Bypass condenser, .001 mf., 100 volt
- 1—500,000 ohm resistor, 1/4 watt
- 1—1 megohm resistor, 1/4 watt
- 1—3 megohm grid-leak, 1/4 watt
- 1—Variable regeneration control, 50,000 ohm
- 1—Octal socket for tube, bakelite
- 1—Slow tuning vernier dial
- 1—Knob for regen. control
- 1—Small grid clip
- 2—Binding posts, "Ant" and "Gnd"
- 1—Pair of tip-jacks for phones
- 4—Binding posts for battery connections
- 1—Panel and sub-base to fit layout
- 1—Solder, hook-up wire, etc.

Accessories

- 1—3A8-GT tube
- 1—1.5 volt dry cell
- 1—45 volt "B" battery
- Headphones, aerial, etc.

10 BEST RADIO BOOKS 10¢ ea.

RADIO FANS EVERYWHERE—these fine ten cent text books give you an excellent foundation for the study of RADIO. They are clearly written, profusely illustrated and contain over 15,000 words in each book. You'll be

amazed at the wealth of information contained in these handy books. Excellent for reference—ideal for every technical library. **YOUR MONEY BACK** if you are not satisfied. **PROMPT SHIPMENTS**

No. 1
HOW TO BUILD FOUR DOERLE SHORT WAVE SETS
Thousands of radio fans have built the famous DOERLE Short Wave Radio Receivers. So insistent has been the demand for these receivers, as well as construction details that this book has been specially published. Contains **EVERYTHING** that has ever been printed on these famous receivers.



No. 2
HOW TO MAKE THE MOST POPULAR ALL-WAVE 1- AND 2-TUBE RECEIVERS
This book contains a number of excellent sets—some of which have appeared in past issues of RADIO-CRAFT. These sets have been carefully engineered. They are not experiments. Not only are these sets described in this book, but it contains all of the illustrations, hookups, etc.



No. 3
ALTERNATING CURRENT FOR BEGINNERS
This book gives the beginner a foothold in electricity and Radio. Electric circuits are explained. Ohm's Law, one of the fundamental laws of radio, is explained; the generation of alternating current; sine waves; the units—volts, amperes, and watts are explained. Condensers, transformers, A.C. instruments, motors and generators.



No. 4
ALL ABOUT AERIALS
This book explains the theory underlying the various types of aerials; the inverted T, the Doublet, the Double Doublet, etc. It explains noise-free reception, how low-impedance transmission lines work; why transposed lead-ins are used. It gives in detail the construction of aerials suitable for long-wave broadcast receivers, for short-wave receivers and for all-wave receivers.



No. 5
BEGINNERS' RADIO DICTIONARY
Are you puzzled by radio language? Can you define Frequency? Kilocycle? Tetrad? Screen grid? Baffle? Anode? Triode? Pole? Ionization? Joule's Law? Harmonic? Gravity Coil? If you cannot define these very common radio words and dozens of other, more technical, terms used in all radio magazines and instruction books, you need this book in your library.



No. 6
HOW TO HAVE FUN WITH RADIO
Stunts for Parties. Practical jokes, scientific experiments and other amusements which can be done with your radio set are explained in this fascinating volume. It tells how to make a newspaper talk—how to produce silent music for dances—how to make visible music—how to make a "silent radio" unit usable by the deafened—how to make toys which dance to radio music, etc., etc.



No. 7
HOW TO READ RADIO DIAGRAMS
All of the symbols commonly used in radio diagrams are presented in this book, together with pictures of the apparatus they represent and explanations giving an easy method to memorize them. This book by Robert Eichberg, the well-known radio writer and member of the editorial staff of RADIO-CRAFT Magazine, also contains two dozen picture-writing diagrams of simple radio sets that you can build.



No. 8
RADIO FOR BEGINNERS
Hugo Gernsback, the internationally famous radio pioneer, author and editor, whose famous magazines, RADIO AND TELEVISION and RADIO-CRAFT are read by millions, scores another triumph with this new book. Any beginner who reads it will get a thorough ground work in radio theory, clearly explained in simple language, and through the use of many illustrations. Analogies are used to make the mysteries of radio clear.



No. 9
SIMPLE ELECTRICAL EXPERIMENTS
Over 100 interesting and practical electrical experiments are described in this book, covering every branch of electricity—from simple experiments with magnets to high frequency "stunts". All of the experiments described can be carried out with simple apparatus, most of which can be found about the home.



No. 10
TELEVISION
Every one is asking the question: How does television work? This book explains all of the different systems of television from the simplest to the most complex. It describes in A-B-C style just how the image is scanned, how the scene is picked up by the television camera and broadcast to your home, etc. Various types of television systems are described.



BOOKS ARE ALL UNIFORM

Every book in the GERNSBACK EDUCATIONAL LIBRARY has 32 pages—with illustrations varying from 30 to 66 in number. Each title volume contains over 15,000 words. Positively radio's greatest book buys! If you do not think these books worth the price asked, return them in 24 hours and your money will be instantly refunded.

RADIO PUBLICATIONS • 20 VESEY STREET • NEW YORK, N. Y.

RADIO PUBLICATIONS, Dept. RT-3-41
20 VESEY STREET, NEW YORK, N. Y.
Gentlemen: Please send immediately, POSTPAID, the book numbers circled below. I am enclosing cents—each book being 10c.

1	2	3	4	5	6	7	8	9	10
								NEW	NEW

Send FREE listing of 48 new 10c publications.

Name Address

City State

Remit by check or money order—register letter if you send cash or unused U. S. postage stamps.

MAIL COUPON TODAY!

Experiment with

RADIOACTIVITY!

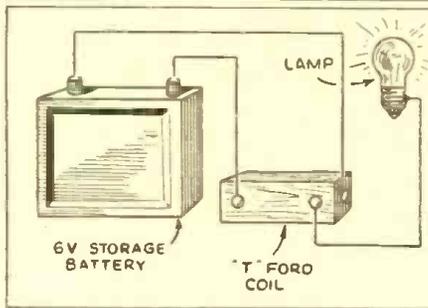
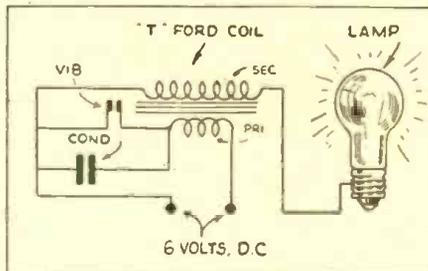
Ivan H. Walker

● PLEASE don't allow the title to frighten you with visions of X-ray tubes and other high priced apparatus. All that is needed is only a few things that, if you do not have them, may be obtained at the local hardware store.

Of course radium is one of the few elements which have the natural property of releasing part of their mass by radiation of energy. However, it is possible to cause other, less costly materials, to emit radiations. The gas in the ordinary electric lamp bulb lends itself admirably to this purpose.

The diagram is self-explanatory. The parts used are: an electric bulb containing Argon gas, and a power-supply, consisting of a six volt storage battery, which operates an ignition coil from a Model T Ford (or similar high voltage induction coil).

When the voltage is fed to the Argon you will notice a blue fluorescence, which, as you can easily guess, is caused by ionization of the gas, similar to the operation of



How spark coil is connected to lamp bulb.

neon signs. This is readily noticeable in daylight, but complete darkness is necessary to observe the radioactivity. After the gas has "percolated" for a minute or two, turn off the current and hold the bulb close to the eye. You will notice a dim radiance coming from the bulb, which lasts as long as ten to fifteen minutes, depending upon the degree of excitation of the gas.

The explanation of this artificially induced radioactivity is:

In 1933 it was discovered that by bombarding certain nuclei with atomic particles, a sort of hybrid nucleus could be built up which was unstable and soon broke down, in much the same way as do the nuclei of the naturally radioactive elements such as radium. Atomic physics is in its infancy as yet. Who knows what part it will play in the world of tomorrow?

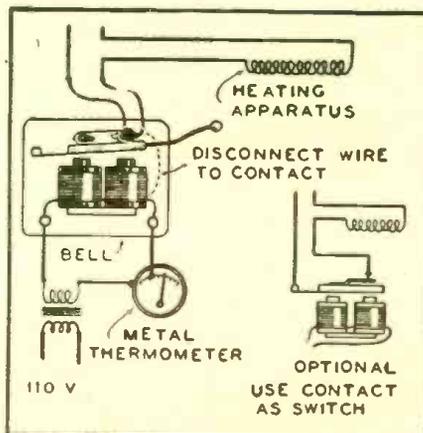
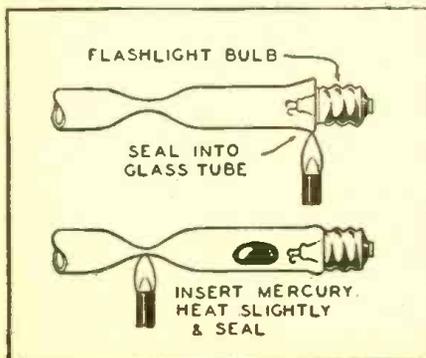
The editors will be very glad to hear from other readers of RADIO & TELEVISION who may have made simple yet very interesting experiments, like that here described. Photos are desirable but sketch will do.

More Useful Electrical Ideas

HEAVY DUTY SWITCHES

● OFTEN it becomes necessary to close an electrical circuit in the laboratory carrying current amounting to several amperes. However, delicacy of the controlling instrument may not permit such heavy load. When this occurs it is advisable to use a second relay. The diagrams illustrate two methods. The first shows the construction of a mercury switch from an old flashlight bulb, glass tubing and mercury. The second illustrates how the unit is connected into the circuit and gives an optional circuit. In this illustration a 5- and 10-cent store thermometer is used as a thermostat. This has a small contact fitted in the proper position to close the circuit at a predetermined temperature and is connected in series with an electric bell in which the circuit has been changed to eliminate the interrupter. If the mercury switch is mounted on the armature of this bell, this switch can be used to interrupt heavy currents.

In the optional arrangement the circuit breaker of the bell is used to make and break the heavy current.—*Courtesy Science Observer.*



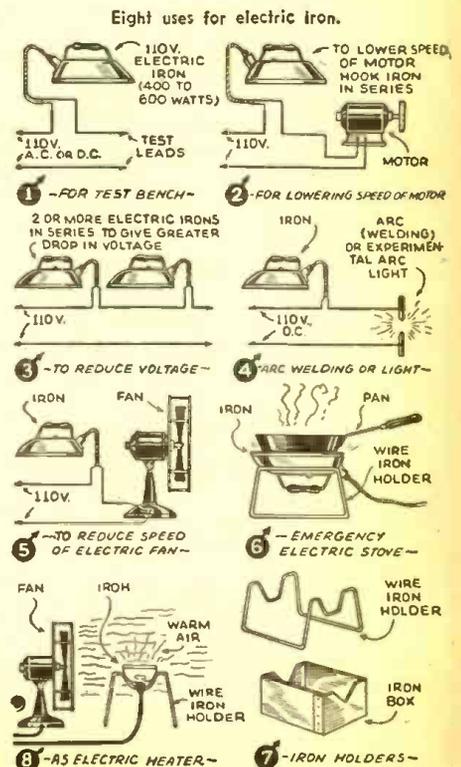
Simple remote control switch—also see below at left.

ODD USES FOR ELECTRIC IRON

● THE electrical experimenter often needs a resistance unit to connect in series with 110 volt test leads and the family electric iron comes in handy for the purpose. The average electric iron consumes about 400 watts and will therefore pass about 4 amperes at 110 volts A.C. or D.C. The picture No. 2 shows how an electric iron may be used to reduce the voltage fed to a motor where it is desired to have the motor rotate at a lower speed. Diagram 3 shows how two or more electric irons may be connected in series to give a still further reduction in voltage for test or other purposes. A simple electric welder made up with a couple of arc carbons and an electric iron connected in series as shown at Fig. 4. (Don't forget to wear heavy black glasses to protect your eyes.) An electric iron (or part of the resistance from an old burned

out iron) can be used to reduce the speed of a fan motor as indicated in Fig. 5.

Fig. 6 shows how to use an electric iron as an emergency stove by turning it upside-down and Fig. 7 illustrates the construction of two simple supports to hold the iron in an inverted position. An emergency warm air supply may be made by placing an electric iron in front of a fan.



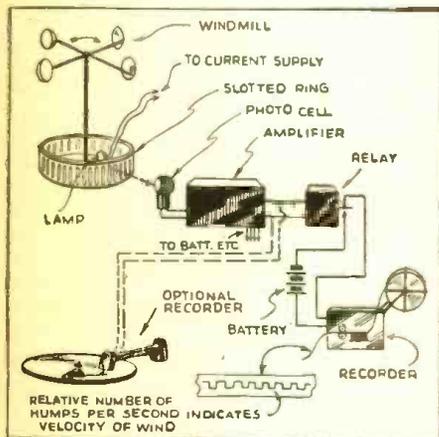
SUPER SPECIALS

WIND VELOCITY INDICATOR

THE photo-cell has found a new use as shown in the accompanying sketch where it is put to work by C. E. Delbos of *Ciencia Popular* for the purpose of graphically indicating the velocity of the wind. As the set of four cups arranged in the usual fashion rotate at a speed depending upon the relative velocity of the wind, they also cause a slotted disk to rotate. Each time the slot passes through the beam of light projected upward from the battery lamp towards the photo-cell, a pulse of current is produced and sent through the amplifier. This causes the relay to be energized and its local circuit actuates a tape recorder, similar to those used for radio and telegraph signals.

The experimenter may devise some other type of recorder, and if desired an old phonograph might be used, the magnets operating a pen or pencil recorder on a circular paper chart placed on the turn-table. By noting how many pulses occur in the record in a given time, the relative velocity of the wind can be calculated. If a large number of humps appear on the record in a period of one second for example, then the wind velocity is high; if only a small number of humps appear in the same time period, then the wind velocity is low.

Many other variations of this apparatus will suggest themselves, such as sunlight recorders (using photo cells). Rain recorders can easily be devised, etc.



The simple arrangement illustrated will prove interesting as a home-made "wind velocity" indicator and recorder.

ELECTRICAL ARTICLES WANTED!

IF you enjoy this department be sure to send us a description of your favorite piece of electrical apparatus. We want articles on simple electric motors and methods of using them, electric meter test set-ups, high frequency furnaces, home-made battery chargers, home-made measuring instruments and bridges, etc. All articles accepted and published will be paid for at regular space rates. Be sure the photos are sharp and clear.—The Editors

All of the attractive items listed here are brand new. ALL are in PERFECT WORKING ORDER. In many cases, the parts alone total more than the price we are asking. 100% satisfaction guaranteed or your money refunded. ORDER FROM THIS PAGE. Use the convenient coupon below. Include sufficient extra remittance for parcel post charges, else order shipped express, collect. Any excess will be refunded. C.O.D. shipments require 20% deposit. If full remittance accompanies order, deduct 2% discount. Send money order, certified check, new U. S. stamps. No C.O.D. to foreign countries.

ORDER TODAY LIMITED QUANTITIES PROMPT SHIPMENTS ASSURED

2-SPEED PHONOGRAPH TURNTABLE



Adapts any phonograph for both 33-1/3 and 78 R.P.M. This ingenious device, by simply replacing your present turntable, automatically modernizes your machine to play 33-1/3 R.P.M. high-fidelity transcription records as well as the standard 78 R.P.M. records. Quickly installed by anyone. Complete instructions furnished. Felt-covered turntable measures 12" in diameter and fits all standard phonographs. Packed in original box. Original price \$3. Ship. Wt. 3 lbs. ITEM NO. 89 YOUR PRICE **\$1.95**

2-WAY LAMP

Ornamental dual purpose lamp. Can be used as a table or vanity lamp in one position. By turning swivel base it becomes a bracket lamp which may be mounted on wall.



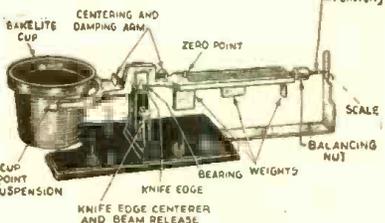
Flanker in base is provided for this handsome design. Base made of pressed glass, polished wood and plated metal stand. Comes with round shade colorfully decorated with ribbon design, or more elaborate fluted shade with flower design. Height of lamp 12 1/2"; shade 8". Complete with cord. Shipping wt. 2 lbs.



ITEM (Plain Shade) NO. 120 98c
YOUR PRICE
ITEM (Fluted Shade) No. 121. YOUR PRICE **\$1.05**

BENNETT LABORATORY BALANCE

A compact laboratory balance made of finest quality tested materials. Extreme sensitivity (to 2-100ths gram or 2-7ths grain). Weighs to one decimal pt. further



than usual low priced counter scale. Will handle up to 100 grams (about 4 oz.). Bakelite pan; tool steel knife edge; sapphire bearing for long life and accuracy. Ideal for photographic work and lab use. Handsome streamline design. Graduated either in metric or apothecary system. SHIPPING wt. 2 lbs. ITEM NO. 122 YOUR PRICE **\$7.20**

100 POWER TELESCOPE LENS KIT



Make your own high powered 6 ft. telescope! Now you can thrill to a closeup view of the worlds out in space. See the rings around Saturn, the mountains of the moon! Kit contains 3" diam., 75" focal length, ground and polished objective lens and 2 astronomical eye-pieces, magnification 50x and 100x. Complete kit with full instructions. ITEM NO. 123 YOUR PRICE **\$1.95**

New Catalog

JUST OUT
A POSTAL CARD BRINGS IT TO YOU
SEND FOR IT TODAY

HUDSON SPECIALTIES CO., 40 West Broadway, N. Y. C.

IT'S EASY TO ORDER—CLIP COUPON—MAIL NOW ORDER FROM THIS PAGE.

HUDSON SPECIALTIES CO., 40 West Broadway, Dept. RT-341, New York, N. Y.

I have circled below the numbers of the items I'm ordering. My full remittance of \$..... (include shipping charges) is enclosed.

OR my deposit of \$..... is enclosed (20% required), ship order C.O.D. for balance. No C.O.D. order for less than \$2.00. (New U. S. stamps, check or money order accepted.)

Circle Item No. wanted: 86, 87, 89, 97, 120, 121, 122, 123, 124, 125

Name Address

City State

Send remittance by check, stamps or money order; register letter if you send cash or stamps.

AMAZING BLACK LIGHT!



Powerful 200 Watt Ultra-Violet Bulb
The best and most practical source of ultra-violet light for general experimental and entertainment use. Makes all fluorescent substances brilliantly luminescent. No transformers of any kind needed. Fits any standard lamp socket. Made with special filter glass permitting only ultra-violet rays to come through. Brings out beautiful opalescent hues in various types of materials. Swell for amateur parties, plays, etc., to obtain unique lighting effects. Bulb only. Size of bulb. Ship. Wt. 1 lb. ITEM NO. 87 YOUR PRICE **\$2.00**

ULTRA MAGNET

LIFTS MORE THAN 20 TIMES ITS OWN WEIGHT



LITTLE GIANT MAGNET. Lifts 5 lbs. easily. Weighs 4 oz. Made of ALNICO new high-magnetic steel. Complete with keeper. World's most powerful magnet ever made. The experimenter and hobbyist will find hundreds of excellent uses for this high quality permanent magnet. Measures 1 1/2" x 1 1/2". Ship. Wt. 3/4 lbs.

ITEM NO. 86 YOUR PRICE **\$1.00**



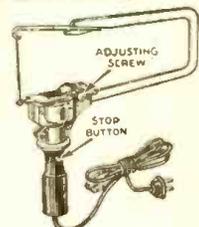
ELECTRIC TURNTABLE

A sturdy electric turntable, ideal for eye-catching window displays. A MUST for alert retailers. Frame made of 18 gauge steel. 18 in. steel turntable makes three revolutions per minute. Turntable supports load of 200 lbs. Ballbearing construction. Rich black enamel finish. Operates on 110 v. A.C. Current cost only 1/2¢ a day. Size: 5 1/4" high, base 8" square. Shipping wt. 14 lbs.

ITEM NO. 124 YOUR PRICE **\$8.95**

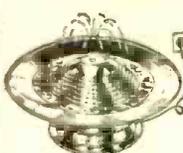
NEW ELECTRIC MOTOR-SAW

Now you can have all the fun of fine, fast jigsaw work without any of its difficulty. Simply steer the lightning-fast blade and see it seemingly melt its magic way through wood, plastics and building board. 7200 STROKES per MINUTE! Average cutting speed 1 foot per minute through 3/4" medium hard wood. Works 3 times faster than any free-hand saw. Operates on 50-60 cycle 110 v. Alternating Current. Screw adjusts blade stroke from 1/4" to 5/16". On-On Switch built in handle. Complete with 6 ft. power cord and 3 saw blades.



ITEM NO. 97 YOUR PRICE **\$4.85**

ELECTRIC HUMIDIFIER FOUNTAIN



Adds healthful moisture to the air in winter. Evaporates as much as a pint of water in 24 hours. Fountain is 14" in diam. Sprays 8 streams of water 3" above fountain head. Made of spun aluminum. Comes in five colors: Bronze, chrome, copper, red, green. No water connections required. Just plug into 110 volt, 60 cycle

A.C. outlet. Current consumption few cents a month. Complete with base switch and 8 ft. power cord. Shipping wt. 9 lbs. List price \$14.95. Only a limited supply on hand.

ITEM NO. 125 YOUR PRICE **\$4.95**

Interesting Radio Patents Issued Recently

Cover Patent

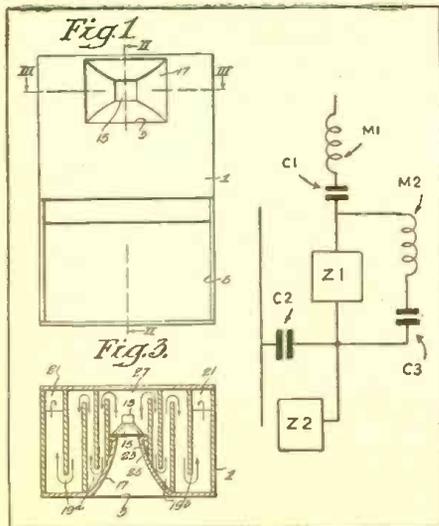
Loud-Speaker Design

2,224,919—Issued to Harry F. Olson, Audubon, N. J.

● ONE of the objects of this invention is to provide an improved loud-speaker of the compound horn type, which will reproduce the high frequencies in a satisfactory manner, and not permit them to suffer serious attenuation or reflection. Another point is to provide improved acoustic filters for discriminating between the length of frequencies supplied by the respective high and low frequency systems of the loud-speaker. Furthermore the design permits of a reasonably simple construction and has proved highly efficient in use.

In accordance with my present invention, I provide a cabinet having upper and lower openings in one of its walls and divide the cabinet into two chambers or compartments. A small, straight axis horn adapted to particularly transmit high frequencies is placed in the upper compartment and fits into the upper openings, while a long, folded, low frequency horn is disposed partly in the upper and partly in the lower compartment and terminates at the lower opening, a single driver feeding both horns. The small horn is arranged at substantially the level of the listeners' ears, whereby very little loss of high frequencies is obtained as a result of absorption and reflection. If desired, the small horn may be omitted and the cone or diaphragm of the single driver arranged to feed directly into the atmosphere as a direct radiator. In either case, the low frequency horn is preferably provided with an acoustic filter which efficiently passes only the low frequencies, and the high frequency horn, in the first modification referred to above, may be provided with an acoustic filter which efficiently permits transmission of only the high frequencies.

Figure 3 is a sectional view taken on the line III—III of Fig. 1.



New loud-speaker design combining the use of a horn and a "folded" low-frequency sound expansion chamber.

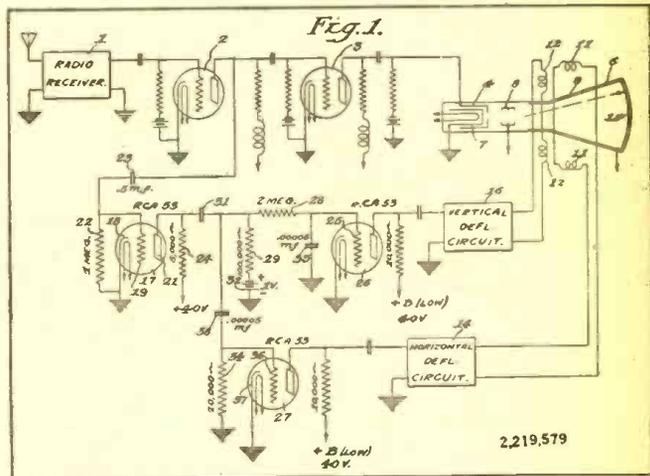
Television Synchronization

● WALDEMAR J. POCH of Collingswood, N. J., recently devised a new system of television synchronization and patent No. 2,219,579 has been issued to him covering this subject. This patent covers an improved means for applying synchronizing impulses of substantially uniform amplitude to the deflecting circuits in a television receiver.

tical deflecting channel, substantially to the exclusion of the horizontal synchronizing impulses. The other network permits the passage of the horizontal synchronizing impulses to a vacuum tube in the horizontal deflecting channel, to the exclusion of the vertical synchronizing impulses.

Preferably, the above-mentioned vacuum

Diagram at right is taken from patent covering an improved means for applying television synchronizing impulses, of substantially uniform amplitude, to the deflecting circuits in a television receiver.



tubes are so adjusted that the negative synchronizing impulses which are impressed upon their control grids, drive them beyond cut-off. This adjustment may be accomplished by applying a voltage to the plates of the tubes which is much less than the rated voltage for the tubes.

In the above-described circuit the separating tube is so negatively biased that it clips the synchronizing impulses at a level near their base, while the succeeding amplifier tubes clip them at a level spaced away from the first clipping level, whereby all synchronizing impulses are given the same amplitude.

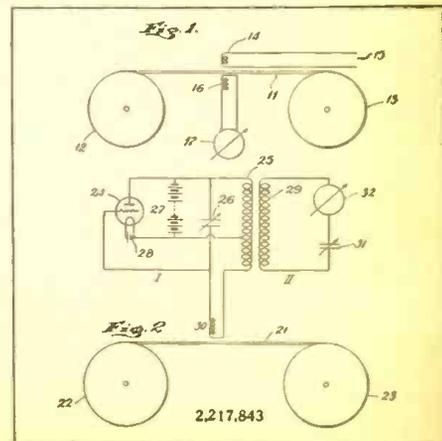
Another object is to impress upon a vertical deflecting circuit vertical synchronizing impulses which are free from irregularities. In one of the phases covered by this patent, after the transmitted carrier wave has been received and demodulated, the composite signal comprising picture signals and synchronizing impulses is impressed upon a grid-leak biased separating tube, with the synchronizing impulses having a positive polarity. The synchronizing impulses are then impressed upon two frequency separating networks, one of which permits the passage of vertical synchronizing impulses to a vacuum tube in the ver-

Film Density Measurement

● NICHOLAS LANGER of New York recently received this patent No. 2,217,843 for an improved method for measuring or indicating the relative density of a film, such as photo film, whether developed or undeveloped; his system works as follows:

Broadly stated, according to the principles of the invention, an electro-magnetic field of alternating character is provided and the film to be integrated is passed in proximity to or through said field. All photographic films, both in finished and unfinished condition, embody finely distributed metallic particles in the form of emulsions. These metallic particles, constituted in most cases of silver in finely distributed form, will absorb a portion of the electro-magnetic energy present in the electro-magnetic field which is employed. Thus, the field will be varied or distorted by the presence of the metallic particles, and the variations caused in the intensity or distribution of the field may be employed as an indication of the amount of silver particles on the surface of the film under measurement. Since the

amount of silver present or remaining on the surface of the film determines the transparency thereof, the measurement of light permeability or translucency is reduced or converted into a measurement of electro-magnetic character.



ELECTRON MICROSCOPE

● **MARTIN PLOKE** of Dresden, Germany, recently received this patent, No. 2,219,113, on an improved system of electron-microscopy. One of the principal improvements made by Mr. Ploke is that he avoids the production of heat which accompanies the bombardment of an article with electrons. Therefore, this invention has as its object a method of producing primarily an image of the subject on a photo cathode, and then enlarging this image by electron optics. The further object is to produce this enlargement of the cathode image by means of electrical or magnetic lenses. Also in Mr. Ploke's invention the subjects can be changed rapidly and without difficulties, as contrasted with present methods in which the subject or object has to be positioned within a vacuum chamber. Another idea incorporated in the patent is the production of the image of the subject on the photo cathode by rays of short wavelength, X-rays for instance, thus avoiding eventually any projection by long wave light rays, which are visible. When employing X-rays, one method advocated is to use thin metal foils (Lenard windows) as a photo cathode.

Electron microscope improvement by which the production of heat is eliminated.

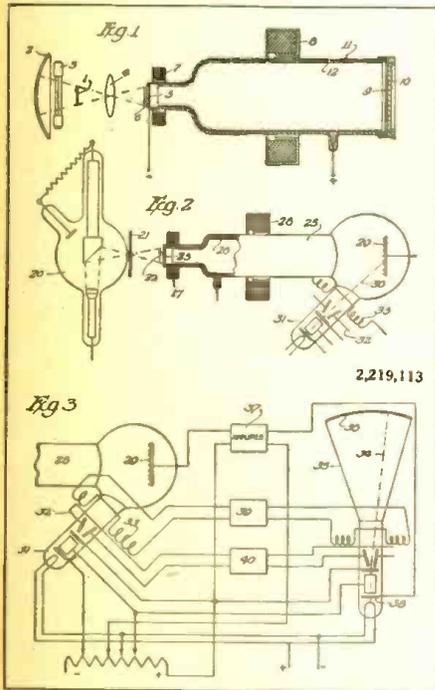


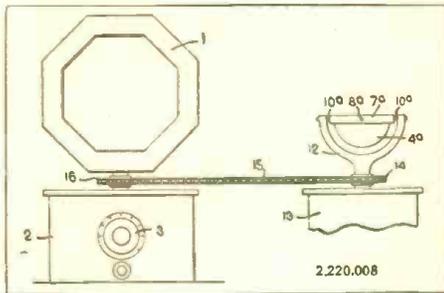
Fig. 1 shows one arrangement where the subject is illuminated by ultra-violet rays. Fig. 2 shows the arrangement for use of X-rays, and Fig. 3, the transmission of the scanning impulses to a cathode-ray tube.

RADIO DIRECTION FINDER

● **WILLIAM L. WOODWARD** of South Yarmouth and **Marcus G. Limb** of West Yarmouth, Mass., were recently awarded this patent No. 2,220,008. This radio direction finder comprises a directional loop antenna, adapted to be manually rotated about a vertical axis, a radio receiver to receive the signal picked up by the antenna and give an audible indication thereof, and a compass element associated with the loop antenna and by which the direction of the

latter—and consequently the direction of the radio beam—can be determined when the antenna is set for minimum signal reception.

One object of the invention is to provide means which facilitate the reading of the compass when the loop is thus adjusted for minimum reception. A further object



Novel radio direction finder.

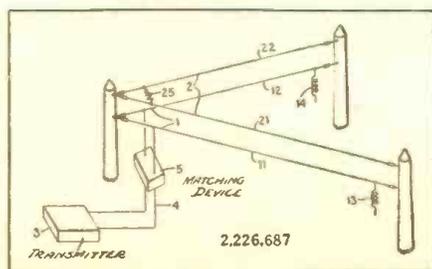
is to provide a novel device constructed so that the person who is manually adjusting the loop antenna can easily read the compass when the antenna has been brought into the position of minimum signal.

One way of accomplishing this object is by mounting the compass element direction on the loop antenna so that the compass bowl, with its lubber line, will rotate with the antenna when the latter is adjusted. The position of the compass bowl about its vertical axis is thus fixed, with respect to the antenna, and the compass card will thus indicate at all times the direction of the antenna, and consequently the direction of the radio beam.

V-TYPE ANTENNA

2,226,687—Issued to Andrew Alford, San Mateo, Calif.

● THIS patent covers an improved type of V-antenna which will radiate a substantial unidirectional wave pattern and which moreover is simple and inexpensive to erect. A further object is to provide a V-type antenna system, in which the combined action of an exciter antenna and a reflecting antenna serve to eliminate radiant action in the backward direction; further the system is claimed to be substantially aperiodic. The free ends of the exciter antenna are terminated through coils as shown. The reflector antenna adjacent to the exciter section neutralizes the backward radiant action introduced by such reflection by creating a second backward wave out of phase with, but of substantially the same amplitude as, and traveling in the same direction and along the same path as, the backward wave of the exciter antenna. A resistor connects the limbs of the reflector antenna.



New directional antenna.

A Spot or Floodlamp you will be proud to own



In beautiful black crackle finish with **UNIVERSAL BRACKET** that may be moved and locked in any position desired. Complete as illustrated, ready to plug into A.C. or D.C. house current. Includes tripod, bulb and rubber cord. Total weight 12 lbs. \$5.50 When ordering specify whether spot or floodlamp is desired.

Separate Units

Spotlamp, black crackle finish, fitted with Westinghouse frosted bulb, 6 ft. rubber cord with plug for A.C.-D.C. house current. Wt. 7 lbs. \$3.00

Floodlamp, black crackle finish, fitted with No. 1 G.E. Floodlamp, 6 ft. rubber cord with plug for A.C.-D.C. house current. Wt. 7 lbs. \$3.00

Tripod, 4½ ft. high with bronze fittings. Weight 6 lbs. \$1.65

Adjustable Tripod, made of selected straight grained hardwood fitted with sturdy clamps, large thumb nuts and solid metal prongs. Adjustable from 44" to 84". Standard head screw to fit any camera. Weight 6 lbs. \$3.00

All prices quoted FOB, New York.

GOLD SHIELD PRODUCTS

Dept. RT-341
350 Greenwich St. New York

PATENTS—TRADE MARKS

Booklet concerning Inventions & Patents Form "Evidence of Conception" with instructions for use and "Schedule of Government and Attorneys Fees"—Free

LANCASTER, ALLWINE & ROMMEL

Registered Patent Attorneys
436 Bowen Bldg. Washington, D. C.

Inventions Wanted Patented or Unpatented

We have been successfully selling inventions, patented and unpatented, since 1924. Write us, if you have a practical, useful idea for sale.

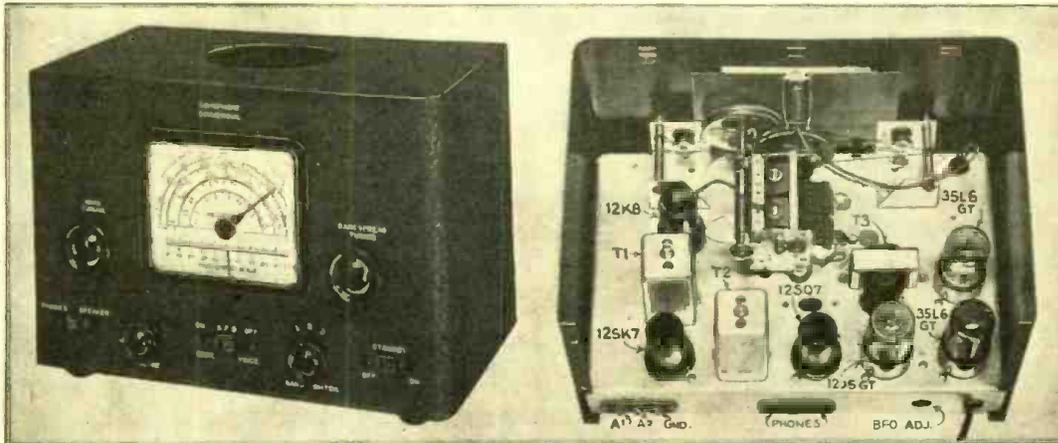
CHARTERED INSTITUTE of AMERICAN INVENTORS
Dept. 109 Barrister Building, Washington, D. C.

A New

"Semi-Communications"

Receiver

Holmes Webster



A new receiver intended for the short-wave fan who wants the BC band included, along with a beat oscillator and other "trimmings" found on the professional communications type receivers.

● Front and rear views of the Echophone "Commercial" receiver for S-W fans and junior Hams.

● THERE are many radio enthusiasts who find the ordinary BCL receiver lacking in some of the features which they desire, yet the various refinements found in many receivers of the "communications" type are more than they require. Moreover, if they are out to purchase a receiver these refinements may cost more than their pocket-books will stand; or if they plan to build a receiver, unnecessary complications are introduced.

The circuit presented here is one which will prove suggestive to many home constructors who can readily "lift" some of its circuit ideas to apply to their own pet designs, or even to their existing receiving equipment. Then, too, the fact that this Echophone "Commercial" receiver is available in built-up form, ready for use, will undoubtedly be of interest to many short-wave listeners, budding hams, and the like, because it provides the special features needed for these types of service and at the same time is highly inexpensive.

Actually this design might be said to combine the merits of a good little all-wave BCL receiver with a number of the features usually found only in communications receivers. While it is small in size (10 $\frac{3}{8}$ " wide, 7 $\frac{1}{2}$ " high and 7 $\frac{3}{8}$ " deep) the layout of parts is "open," avoiding the constructional and electrical disadvantages of undue crowding.

Communications Features: Briefly, its features, not usually found in other small models, include: a beat-frequency oscillator for use in locating weak signals, bringing in C.W. code signals and code practice; electrical band-spread with a separate band-spread knob and slide-rule tuning scale; speaker-headphone switch which permits instant switching from the built-in speaker to headphones, the latter being left connected to phone-tip jacks at the rear of the chassis; stand-by switch; main tuning dial fully calibrated and with large scales; 7 to 1 step-down ratio between main tuning knob and dial pointer; A.V.C. off-on switch for improved C.W. reception (combined with B.F.O. switch); trimmer adjustment to vary B.F.O. pitch, etc., etc.

Continuous coverage of the range from 550 kilocycles to 30.5 megacycles is provided in three switch-selected bands of 550-2100 kc., 2.1-8.15 mc., and 7.9-30.5 mc. This means that every type of service is available: amateur, police, broadcast, commercial, etc., right down to below 10 meters. Operation is from any A.C. or D.C. line within the voltage range of 115 to 125 volts.

Referring to the circuit, it will be seen that provision is made for the use of a doublet antenna with the A1 and A2 terminals isolated from ground. The connection shown between A2 and Gnd terminals is an external jumper used when an "L" type antenna is connected to A1. Primaries as well as secondaries, are switched by the 4-gang, three-position band-switch. The tuning capacity consists of the two-gang main tuning unit, while band-spreading is accomplished by single rotor plates which mesh into the stators of the main condensers.

No attempt will be made to discuss the entire circuit in detail, as it is basically sufficiently conventional to make fundamental treatment unnecessary. Among the special features is the standby switch, located in the common cathode return of the first two tubes. By opening up this lead, the tubes are disconnected from B-, making the re-

ceiver inoperative but returning to operation instantly when this switch is again closed. Such provision is an essential where the receiver is used in a "ham" station, and it is also useful to momentarily silence the receiver when the telephone rings, etc.

The beat-frequency oscillator, tuned to the 455 kc. I.F., is a separate tube which is cut in and out as needed by the switch located in its B-plus lead. Another section of this same switch cuts out the A.V.C. system when the B.F.O. is turned on. This is done to avoid the time-delay action of the A.V.C. system which tends to put "tails" on the dots and dashes and to create additional interference in crowded C.W. bands. The B.F.O. tube is grid-connected to the diode detector through a 10 mmf. capacity.

The headphone circuit is completely isolated from the high voltage and from the line voltage by connecting it to the secondary of the output transformer. The shunting resistor insures proper loading of the output tube circuit, even when crystal phones are employed. The simple switching arrangement silences the headphones when the speaker is cut in and vice versa. It is of interest, incidentally, that in this receiver the PM speaker is mounted in the top of the metal cabinet, rather than in the conventional front-panel position. This allows room for a large tuning dial with easily read calibrations.

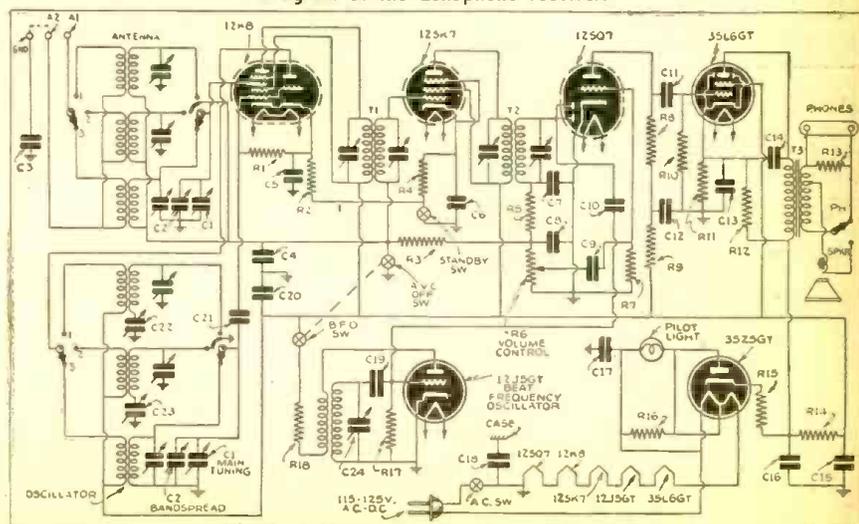
All tube filaments draw .15 amp. and can therefore all be connected in series. The tubes are so selected that their total rated voltages add up to 118. For this reason no additional series resistance is required. The pilot lamp and shunt resistor across one leg of the 35Z5GT rectifier is a con-

ventional arrangement recommended by the tube manufacturers, and has the advantage that a burned out pilot lamp does not prevent operation of the set, as would be the case were its filament connected in series with the tube filaments.

This model is housed in a metal cabinet, a rather unusual proceeding for an A.C./D.C. receiver. To make this practical and avoid all chance of a shock, the chassis is completely isolated from the cabinet by rubber mountings at its ends. The chassis has no front apron, but instead the various controls are mounted directly on the cabinet, avoiding the possibility of accidental shorting of the chassis to the cabinet through the control shafts. The top and bottom plates of the cabinet are removable to permit inspection and alignment. To facilitate removal of the top (to which the speaker is attached) the speaker is connected into the circuit by a plug.

This little Model EC-1 "Commercial," while relatively new on the market, is enjoying tremendous popularity among short-wave listeners who appreciate the advantages of its special features; among new hams because it not only provides the features important to their station operation, but doesn't crimp the budget too much; among those who desire to learn the code as part of their preparation for service in the country's armed forces, and among students taking the various radio vocational courses. It is interesting to note that a telegraph key connected in series with the headphones, with the B.F.O. "on" and the receiver tuned to a broadcast carrier, permits practice with the key. When this is done the "sending" is heard in the headphones precisely like a C.W. signal coming in over the air.

Diagram of the Echophone receiver.



New Radio Apparatus

List of Parts

Resistors

No.	Ohms	Wattage
R1	50,000	1/4
2	300	1/4
3	2,000,000	1/4
4	400	1/4
5	50,000	1/4
6	500,000	1/4
7	10,000,000	1/4
8	250,000	1/4
9	100,000	1/4
10	500,000	1/4
11	150	1/4
12	7,500	1 1/2
13	15	1/4
14	750	1 1/2
15	25	1/4
16	300	1/4
17	50,000	1/4
18	500	1/4

Condensers

No.	Capacity	Voltage	Type
C1	530 mmf	Main tuning	
2		Band Spread	
3	.01 mfd	400	Paper
4	.05 mfd	200	Paper
5	.02 mfd	400	Paper
6	.05 mfd	200	Paper
7	100 mmf		Mica
8	100 mmf		Mica
9	.005 mfd	200	Paper
10	10 mmf		Twisted Pair
11	.01 mfd	400	Paper
12	.05 mfd	200	Paper
13	20. mfd	25	Elect. Filter
14	.01 mfd	400	Paper
15	30. mfd	150	Elect. Filter
16	40. mfd	150	Elect. Filter
17	.02 mfd	400	Paper
18	.25 mfd	200	Paper
19	150 mmf	Section of C24	
20	.05 mfd	200	Paper
21	50 mmf		Mica
22	600 mmf	Pad	No. 1 Band
23	1,900 mmf	Pad	No. 2 Band
24	450 mmf	BFO	Trimmer

Junior VoltOhmyst Radio Test Meter

• THE Rider VoltOhmyst circuit, providing a convenient push-pull electronic D.C. Voltmeter-Ohmmeter with a resistance range ratio wide enough for engineering and servicing requirements



New test instrument of value to set-builders, servicemen and radio engineers.

for years to come, has been applied to a compact, low-cost instrument known as the RCA Junior VoltOhmyst.

The instrument incorporates every feature required for the ideal testing unit of its type. It is extremely useful for servicing radio and television receivers, transmitters, aircraft radio, sound amplification and reinforcement systems, facsimile and other types of equipment. Its features are similar to the laboratory type RCA 163 VoltOhmyst.

for March, 1941

COMMERCIAL NOTICES 10¢ A WORD

Under this heading only advertisements of a commercial nature are accepted. Remittance of 10¢ per word should accompany all orders. Copy should reach us not later than the 10th of the month for the second following month's issue.

INSTRUCTION

\$15.00 STEAM ENGINEERING Course—8 vols. \$4.50; Radio and Electrical text-book bargains—get Hist. Life of Napoleon, 3 de luxe volumes \$3.00. \$10.00 New Cyclopaedia of Science, 1300 pp. \$4.50; Hopkins' "Experimental Science," 2 vols. \$3.50. Harry Ackerson, Box 322, Ramsey, N. J.

MOTORS

RECONDITIONED MOTORS, 1/50 HP, AC-DC, Nickel \$1.50; 1/30 HP, black \$2.50. Fully guaranteed. F.O.B.

New York. Wonderful value limited quantity. Act Promptly! Gold Shield Products, Dept. 341, 350 Greenwich St., New York City.

PATENT ATTORNEYS

INVENTORS — PROTECT YOUR rights before disclosing your invention to anyone. Form "Evidence of Conception"; "Schedule of Government and Attorney's Fees" and instructions sent free. Lancaster, Allwine & Rommel, 436 Bowen Building, Washington, D. C.

QSL—CARDS—SWL

SWL's-QSL's. COLORFUL—ECONOMICAL. W9KXL 819 Wyandotte, Kansas City, Mo.

RADIO

SOMETHING EVERY RADIO dealer and serviceman should have. There is something you don't know about radio tubes. Send fifty cents for rejuvenator. Money back if not satisfied. Vance Lind Radio Service, St. Paul, Nebr.

FOR SALE (NON COMMERCIAL) 3¢ A WORD

Under this heading we accept advertisements only when goods are offered for sale without profit. Remittance of 3¢ per word should accompany all orders. Copy should reach us not later than the 10th of the month for the second following month's issue.

DON'T BUY A RECEIVER UNTIL you get my free list of reconditioned, guaranteed Receivers! Practically all models at money saving prices. Traders. Time Payments. Send for list.

W2AVA, 12 West Broadway, New York.

RECONDITIONED GUARANTEED communications receivers cheap. Free

trial. Terms. Hamcrafters, Nationals, Hammarlunds, RMEs, RCAs, Howards, and all other makes and models at lowest prices. Write for free list. W2ARA, Butler, Missouri.

BARTER AND EXCHANGE — 1¢ A WORD

NO ADVERTISEMENT TO EXCEED 35 WORDS, INCLUDING NAME AND ADDRESS

Space in this department is intended solely for the benefit of our readers, who wish to BUY or EXCHANGE anything in the Radio, Television and Photographic fields for Radio, Photographic and other merchandise; therefore we charge only 1¢ a word. Each name and address is counted. Remittance should accompany order.

Only one advertisement can be accepted from any reader in any one issue.

Copy should reach us not later than the 10th of the month for the second following month's issue.

We cannot accept responsibility for any statements made by the readers.

All dealings MUST be above board. Remember you are using the U. S. mail in all these transactions and therefore you are bound by the U. S. Postal Laws. Describe anything you offer accurately and without exaggeration. Treat your fellow men the way you wish to be treated. We welcome suggestions that will help to make this department interesting and helpful to our readers.

WANTED: ALL TYPES OF MECHANICAL television equipment, i.e., diodes, motors, neon bulbs, etc. Send complete description. Roy Tucker, 2175 N. Star, Columbus, Ohio.

WANTED: A MIDWEST RT-16 1934 model receiver. Need this model for parts. Please state the price you wish for this model. Will pay cash. Theo LaForest, 83 Columbia St., Adams, Mass.

HAVE SUPERIOR AND READRITE tube testers. Superior Xray-Ometest analyzer, C-B oscillator (all-wave), Rider's Manuals, books, magazines. What have you? W. Kay, 129 N.W. 32nd St., Miami, Fla.

WANT UNCANCELLED HONG Kong Walter Z. Scott stamp. Name what you require new radio parts. W. R. Carroll, 3057 E. 95 St., Seattle, Wash.

WOULD LIKE TO COMMUNICATE with fellows who have experimented on electronic instrument of the Novachord and Solovox type. Edward Sulak, 5321 West 30th Place, Cicero, Illinois.

HAVE WESTON 0-150 V.A.C. meter, midjet receivers, All-Star Jr., personal radio, 6L6s, 866, 25L6s and hundreds of fine radio parts, etc., to swap for other radio parts, stamps, etc. John Kasperak, Baldwin Court, E. Hemstead, N. Y.

WILL PAY CASH FOR PHONE OR CW xmitter, fifty watts or more. Prefer commercial or kit type. Carl J. Nelson — W9KRB, Cheyenne Wells, Colorado.

TWO STAMP COLLECTIONS started 20 years ago. Approx. 300 different U.S. Wanted: 15-20 amp. or parts, P.M. speaker, automatic shotgun. Write for particulars. No stamp dealers. Earle Williamson, 231 Pleasant St., So. Weymouth, Mass.

WANTED: IRON CORE I.F.S. and other parts for short wave and ultra-short wave experimenting. Have earphones, National and other vernier dials, complete QST's in yearly binders. My list for yours. Will answer all letters. Moe Shanker, 32 Goodale Rd., Mattapan, Mass.

HAVE 8 VOLT GENERATORS, phono oscillator, rotary one cylinder magnet, electric razor, metal engraving pen, drafting set, gas engine, cylinder ridge reamer. Need Browning frequency monitor, Rider's Manuals, typewriter, microphone. O. Link, High Bridge, Wisconsin.

HAVE NEW HALICRAFTERS Sher Deant, complete value \$85; three half acre lots near Seattle, Wash., value \$250. Want home movie equipment; Reflex camera; home recorder outfit; Thrill Box. H. Cooto, Riverbank, Calif.

HAVE SUPERIOR SIGNAL GENERATOR and laboratorimeter. Dayrad R.F. oscillator and Jackson tube tester. Want Rider's Manuals or anything in Radio. Eugene Patterson, 745 South West, Winchester, Indiana.

TRADE COMPLETE HAM STATION for Presto or Fairchild recorder, movie camera and projector, outboard motor and racing shell, service equipment. W4AIS, care WSPA, Spartanburg, S. C.

TRADE: \$50 SUPREME MODEL 3 1/2 inch oscilloscope with book of instructions for good (Stradella Bass) piano accordion. Address: Edward H. Koch, Station Complement, Camp Grant, Rockford, Illinois.

SIGNAL GENERATOR WANTED. Send description. Have tube and set tester; power transformers; new tubes; I.F., E.F.O. transformers; plug-in coils; speakers; variable condensers; chokes; National dial. Send for list. Daniel Platek, 449 Hopkinson Avenue, Brooklyn, N. Y.

SWAP SPRINGFIELD MOD. 56 22 cal. six shot repeater with attached Moseburg Telescope sights. A-1 condition. Want A.C. 5M. transceiver, good receiver, or combination tube tester and voltmeter. Frank Habermann, Box 408, Clementon, N. J.

WIRE TO DISPOSE OF LARGE stock of radio parts purchased new for my own personal use. Some never used. Thordarson, Stanco, National, Aerovox, R.C.A., Billey, Triplett, Cardwell, etc. Write Box 1433, Oakland, California, for list.

WILL ACCEPT ANYTHING OF value, send list. Have meters, tubes, checkers, receivers, adaptors, kenomotors, magazines, handbooks, speakers, transformers, pickups, xtals, buzzers, 41 Mauser, trombone, miscellaneous. Norless write—Roby, 6305 Kenwood, Chicago.

HAVE 1939 6T PUSH BUTTON mantel Crosley. Lists \$17.95. Swap for nearly new model 1240 Superior Tube Tester. A. Penquite, Marshalltown, Iowa.

HAVE DOERLE 7C RECEIVER, crystals, power supplies, tubes, electrolytics, radio parts, magazines, metal cabinets, microphone. Want test equipment. Sarah Pfanzter, 29 Bartlett St., Brooklyn, N. Y.

MODULATOR, 8X10 CAMERA, transceiver, Vibrapack, meters, parts. Want IFTs, receiving, transmitting parts. W8SBP, Blanchester, Ohio.

WANTED COMMUNICATIONS RECEIVER. Will trade Gernsback's Manuals V, VI, VII, IV in good condition. E.E. course for what? James Notaris, Amherst, Pa.

SWL EXCHANGE

This department is for the benefit of all short wave listeners who wish to exchange SWL cards. Remittance of 1¢ a word for each word in the name and address should accompany order.

UNITED STATES

PAUL ANKERMAN, 404 Lima Street, Wapakoneta, Ohio.

G. BARNESON, Box 6332, Los Angeles, California.

WALTER L. MONK, 51 Vineyard Street, Providence, R. I.

CLYDE MOSS, Jr., 588 Lynn St., Chillicothe, Ohio.

STEVE SIDOR, 228 Nutt Road, Phoenixville, Pa.

RICHARD THURBER, Lewis Run, Penna.

HAWAII

Kovel Tamara, K68SWL, 250A-Kinoole St., Hilo, Hawaii.

The new instrument offers many of the features of the 163 VoltOhmyst, with the addition of an isolated A.C. voltmeter circuit. Its most appreciated feature is the complete meter overload protection on the D.C. voltage and Ohm scales. No damage can be done if the probe slips to a high voltage point when a low D.C. voltage is being measured.

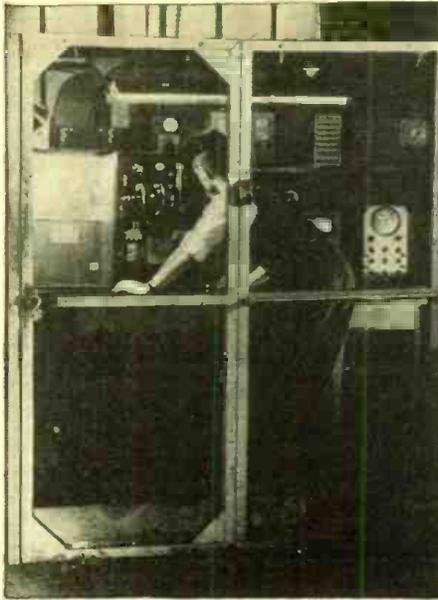
The input resistance for measuring D.C. voltages is constant at 11,000,000 ohms, allowing voltages to be read in high resistance circuits. On the 3 volt scale this gives a meter with a sensitivity of 3,666,666 ohms per volt! This feature permits the serviceman to read AVC, FM Discriminator, and many other voltages which are

impossible with the ordinary meter. A Signal Tracing type probe lead is provided.

The D.C. voltmeter circuit has six ranges—0 to 3, 10, 30, 100, 300, and 1000 volts. It is not necessary to guess what scale is required before the leads are connected. The leads can be put in place, and then the range switch may be turned until the meter reads "on scale." Considerable saving in time results.

Aside from the electronic D.C. voltage and ohms measuring circuits, the Junior VoltOhmyst is equipped to make isolated A.C. voltage measurements as well. These are read on five scales: 0 to 10, 30, 100, 300 and 1000 with a sensitivity of 1000 ohms per volt.

New Radio Apparatus



at the radio set and at the source of noise. Detailed circuits are shown for various types of noise filters, including the capacitive, capacitive-inductive and capacitive-resistive type, with information as to how to determine which of these types will best meet the requirements of any given installation.

For those who are interested, a request will bring, without charge, the past and future issues of the "C-D Capacitor" in which these articles are appearing. Write to Service Dept., RADIO & TELEVISION, and ask for bulletins series CD-100.

Picture at left shows special test room with wire screen shield, in which various circuits and apparatus for radio noise elimination are checked in the Cornell-Dubilier Laboratories.

Noise Elimination

● FOR years exhaustive investigation of radio noise elimination has been going on in the Cornell-Dubilier labs, and in outside field tests conducted by its engineers. It will interest many servicemen and others to know that these investigations have been summarized in a series of articles written by the C-D engineering staff, beginning in the September issue of the "C-D Capacitor," monthly bulletin of this company.

These articles are of particular interest in that they suggest simple and common-sense methods for analyzing noise, for locating sources without complicated equipment, and for determining the practical effectiveness of different remedies, both

● THE 1629 is a high-vacuum, heater-cathode type of tube designed to indicate visually, by means of a fluorescent target, the effects of a change in the controlling voltage. The tube, therefore, is essentially a voltage indicator and as such is particularly useful as a convenient and non-mechanical means of indicating accurate adjustment of a circuit to the desired conditions. Because of its 12.6-volt heater and its 7-pin base, the 1629 is particularly suitable for service in aircraft radio equipment. In this equipment and other equipment subject to vibration and shock, the 7-pin base provides ample friction to hold the base in its socket.

The 8000 is a transmitting triode having a maximum plate dissipation of 150 watts under ICAS conditions. In self-rectifying oscillator circuits, such as are often used in therapeutic applications, two 8000's are capable of delivering a useful power output (at 85% circuit efficiency) of 550 watts. The 8000 is rated for operation with full input at frequencies up to 30 megacycles, but it may be used with reduced plate voltage and input at higher frequencies up to 100 megacycles.

Tentative Characteristics and Ratings	
Filament voltage (A.C. or D.C.)	10 volts
Filament current	4.5 amps.
Amplification factor	16.5
Direct interelectrode capacitances:	
Grid-plate	6.4 mmf.
Grid-filament	5.0 mmf.
Plate-filament	3.3 mmf.
Bulb	T-20
Plate cap	Medium Metal, Skirted
Grid cap	Medium Metal
Base	Jumbo 4-Large Pin

As R.F. Power Amplifier and Oscillator Class C Telegraphy

Key-down conditions per tube without modulation		CCS		ICAS	
D.C. plate voltage	2000 max.	2250 max.	volts		
D.C. Grid voltage	-500 max.	-500 max.	volts		
D.C. plate current	250 max.	275 max.	ma.		

D.C. grid current	40 max.	40 max.	ma.
Plate input	500 max.	620 max.	watts
Plate dissipation	125 max.	150 max.	watts
Typical operation:			
D.C. plate voltage	2000	2250	volts
D.C. grid voltage:			
From a fixed supply of	-195	-210	volts
From a grid resistor of	8100	8400	ohms
From a cathode resistor of	710	700	ohms
Peak R.F. grid voltage	370	400	volts
D.C. plate current	250	275	ma.
D.C. grid current (approx.)*	24	25	ma.
Driving power (approx.)*	8	9	watts
Power output (approx.)	375	475	watts

As Self-Rectifying Oscillator CCS

A.C. plate voltage (RMS)	2500 max.	volts
D.C. grid voltage	-500 max.	volts
Peak R.F. grid voltage	750 max.	volts
D.C. plate current	160 max.	ma.
D.C. grid current	25 max.	ma.
Plate input	450 max.	watts
Plate dissipation	125 max.	watts

Typical operation in push-pull circuit at 30 mc.

Unless otherwise specified, values are for 2 tubes

A.C. plate voltage (RMS)	2500	volts
Grid resistor	5000	ohms
D.C. plate current	320	ma.
D.C. grid current (approx.)	40	ma.
Power output (approx.)	650	watts
Circuit power output (85% circuit efficiency)	550	watts

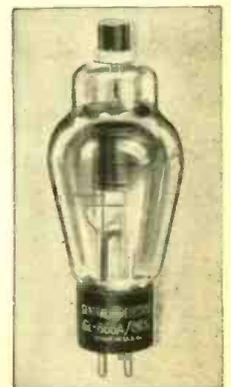
*Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should be capable of delivering considerably more than the required driving power.

New Rectifier Replaces GL-866 and GL-866A

● A NEW mercury-vapor rectifier, bearing the type number GL-866A/866, has been added to the General Electric Company tube line for amateur and commercial service. Completely interchangeable with present-type GL-866 and GL-866A rectifiers, the new tube makes possible the higher rating of the GL-866A at the price of the GL-866.

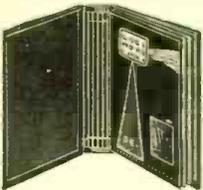
The GL-866A/866 has a spiral edgewise-wound cathode with its axis vertical and surrounded by a heat-conserving shield which is at cathode potential. The glass envelope is of the dome type with the anode placed at the lower end of the small portion of the dome. Thus there is a very small space between the edge of the anode and the glass, minimizing ionization at the back of the anode and near the anode lead. The anode lead is also enclosed in a glass "pantleg." The tube has a standard medium four-pin base, and is of unusually sturdy construction.

The rating of the new tube is: filament voltage, 2.5 volts; filament current, 5 amperes; maximum inverse peak plate voltage, 10,000 volts; average plate current, 0.25 ampere; maximum instantaneous plate current, 1.0 ampere.



New mercury vapor rectifier.

TRANSFER YOUR 1940 MAGAZINES INTO A "JIFFY"



Magazine Binder

Sturdily built and covered with black fabricoid. Has two stamped metal ends with 12 spring wire separators. Magazines can be inserted and removed in a jiffy. No fuss—no lost time—no labor.

No. 1, 12" x 9 1/4", with 2-inch back for Radio-Craft, R.&T., Radio News, etc.—	\$1.50
No. 2, 10 1/2" x 7 1/2", with 3-inch back for QST, Radio, Popular Mechanics, etc.—	\$1.25
No. 3, 8 1/2" x 6 1/4", with 3-inch back for Reader's Digest, etc.	\$1.00

P.P. Prepared in U.S. and Canada

GOLD SHIELD PRODUCTS

Dept. RT-341, 350 Greenwich Street, New York City

6 COPIES OF R & T FOR 50c

For a limited time only, and as long as they last, we will send you six back numbers of RADIO & TELEVISION assorted, your choice, for 50 cents.

The usual price for six copies would be \$1.50, and most publishers charge a higher price for back numbers over one year old.

We can supply only the following back numbers: Sept., 1931; Sept., 1934; Aug., Oct., 1935; 1936—all issues except Apr., May and Oct.; 1937—all issues except Feb. and Aug.; 1938—all issues except March and Nov.; 1939—all issues except Jan., March and April;

1940—all issues except Jan. and April; 1941—all issues to date.

If you do not specify copies, we will send assorted numbers to fill your order. Note, we cannot exchange the copies for ones that have been sent to you.

Every copy of RADIO & TELEVISION contains information which you should have. Here is a chance to get those copies.

As only a small supply of back numbers is on hand, this offer will be withdrawn as soon as they have been sold.

We accept U. S. stamps, U. S. coin, or money order. Rush your order today.

RADIO & TELEVISION 3-41
20 Vesey Street, New York, N. Y.

Gentlemen: I enclose herewith 50c (Foreign: Add 25c for postage), for which you are to send me six back numbers of RADIO & TELEVISION as follows:

Name

Address

City State

THE FINEST RADIO BOOK FREE WE EVER OFFERED :- the 1940-41 Radio-Television Reference Annual With \$1.00 subscription to RADIO & TELEVISION

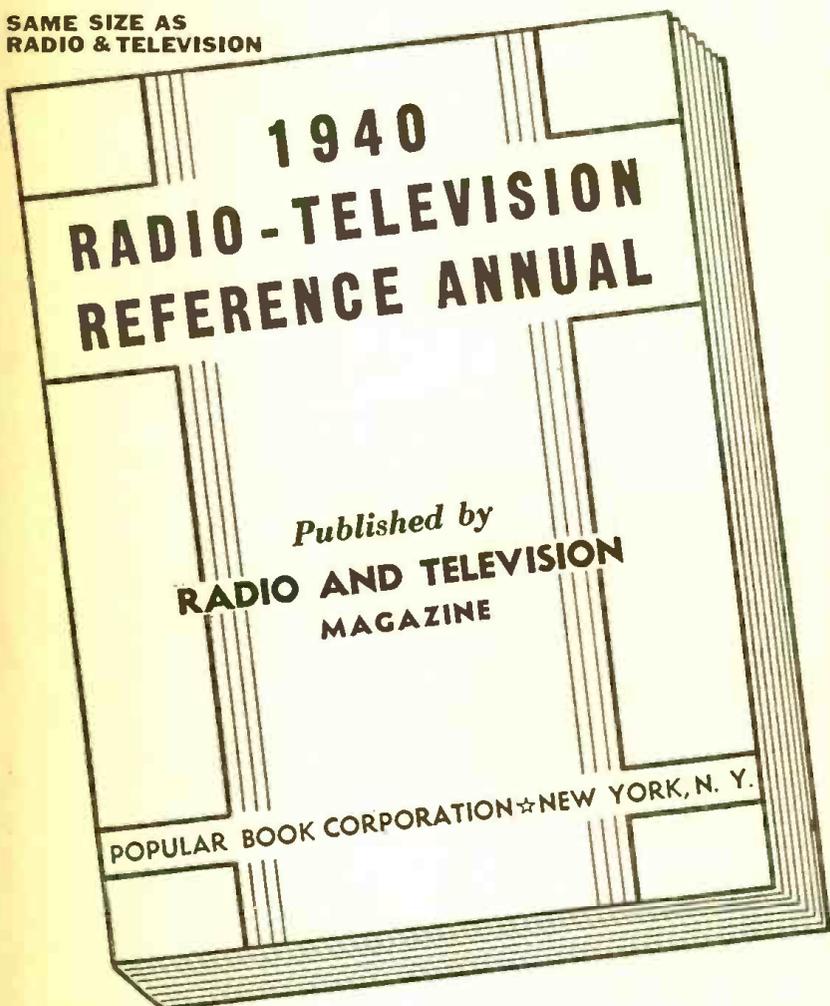
WITH our compliments, we want to send a copy of the 1940 RADIO-TELEVISION REFERENCE ANNUAL to you FREE. If you will simply take advantage of RADIO & TELEVISION magazine's special subscription offer NOW. This offer is being made for a limited time only.

The 1940 RADIO-TELEVISION REFERENCE ANNUAL has 68 pages, large size 8 1/2 x 11 1/2, with over 170 illustrations. The contents of this book has never appeared before in handy book form. Its pages cover practically every branch of radio sound, public address, servicing, television, construction articles for advanced radio men and technicians, time and money-saving kinks, wrinkles, useful circuit information, "ham" transmitters and receivers, and a host of other data.

The Annuals have always been regarded as a standard reference work for every practical branch of radio operation and service. This 1940 edition ably sustains this reputation. Every radio man wants a copy of this valuable book. Just as this book will be of unquestionable value to you, so, too, will every monthly issue of RADIO & TELEVISION. This magazine brings you big value every month. It keeps you intelligently informed about new developments in radio and television. You want the news, want it fully but concisely, want it first—that is why you should read RADIO & TELEVISION regularly.

This very special offer is made for just one purpose—we want you as a regular subscriber. The Annual, whose contents appears at the right, is not sold, but a copy is FREE to you if you subscribe now.

**SAME SIZE AS
RADIO & TELEVISION**



THIS COUPON BRINGS YOU THE ANNUAL

RADIO & TELEVISION • 20 VESEY STREET • NEW YORK, N. Y.

Gentlemen: Enclosed you will find One Dollar for which enter my subscription to RADIO & TELEVISION Magazine for Eight Months. Send me ABSOLUTELY FREE and POSTPAID, my copy of 1940 RADIO-TELEVISION REFERENCE ANNUAL.

This is a new order Extend My Present Subscription

NAME ADDRESS

CITY STATE

DON'T DELAY — MAIL TODAY! RT-341

**Read the summary of contents
in this FREE BOOK!**

THE 1940 RADIO-TELEVISION REFERENCE ANNUAL contains a collection of the best and most important articles. Covering as they do nearly every branch of radio, they form a handy reference works. In addition, many time and labor-saving kinks, circuits and wrinkles, tried and tested by practicing Servicemen, experimenters and radio fans have been included. This book cannot be bought anywhere at any price. Yet it is yours by merely subscribing. Use the convenient coupon below.

**BEGINNER'S SIMPLE INEXPENSIVE
CONSTRUCTION ARTICLES**

Beginner's Breadboard Special • a 1-Tube High-Gain All-Wave Receiver—Wiring Pointers for Radio Beginners—A Watch Charm Size 1-Tube Set—Beginner's Simple Volt-Milliammeter—Making a 1-Tube Broadcast Loop Receiver—A.C.-D.C. Power Supply for Battery Portables—A 1-Tube Short-Waver with Band Coil Switching.

MORE ADVANCED SET CONSTRUCTION

The "High-Seas 4" Broadcast Lamp Radio—How to Build a 6-Tube 1.4-Volt Short-Wave Superhet for the "Ham" or Short-Wave Fan—Build the "Lunch Box 5" Super Set - a Broadcast Battery Portable—How to Build a Plug-Together 8 Tube Broadcast Set—The "5-in-4" All-Wave Radio for A.C. Operation—An Easily-Built 3-Tube Midset Broadcast Superheterodyne Receiver.

THE SERVICEMEN'S SECTION

Bass Tone Control—Simplified Variable Selectivity—Practical Servicing Pointers—Servicing Universal A.C.-D.C. Receivers—Killing the "Intermittent" Bug—A Service Shop A.C. to D.C. Power Supply—Sideline Money for Servicemen—Adding A.V.C. to any Screen-Grid T.R.F. Receiver—Iron Particles in Speaker Air Gap.

TEST INSTRUMENTS

A Useful Neon Lamp Tester—An Inexpensive Output Meter—Making Milliammeter Multipliers—Home-Made Frequency Modulator—The Busy Servicemen's V.T. Volt-Meter.

PUBLIC ADDRESS AND AMPLIFIERS

Build this Combination A.C.-D.C. Radio and Inter-Communicator—Speaker Placement in P.A. Work—The Design and Construction of an Inexpensive All-Push-Pull 10-Watt Amplifier—Obscure Sources of Hum in High-Gain Amplifiers—How to Build a High-Fidelity 5-Watt Versatile Amplifier.

"HAM" SECTION

Ultra-High Frequency Antennas—The Beginner's Low-Cost Xmitter—Modulator Meter—Phone Monitor—The Beginner's "Ham" Receiver—2 1/2 Meter Acorn Transceiver.

TELEVISION

How to Build a 441 Line T.R.F. Television Receiver—Useful Notes on Television Antennas.

MISCELLANEOUS

Simple Photo-Cell Relay Set Up—Making a Burglar Alarm—How to Build A.C.-D.C. Capacity Relay—How to Make a Modern Radio Treasure Locator.

USEFUL KINKS, CIRCUITS AND WRINKLES

Making a Flexible Coupler—Two-Timing Chime—A Simple Portable Aerial—An Improvised Non-Slip Screw-Driver. NOTE: The book contains numerous other useful Kinks, Circuits and Wrinkles, not listed here.

(approximately)

45 ARTICLES

(approximately)

170 ILLUSTRATIONS

68 BIG PAGES

**RADIO & TELEVISION
20 VESEY STREET
NEW YORK, N. Y.**

FREE CATALOGS and INFORMATION

By carefully reading the advertising columns, you will find many offers to furnish literature containing valuable technical information that will help you in your work. Use this list freely.

Firm	Business	Offer	No.	Cost	Ado. Page
ABC Radio Laboratories	Set Mfr.	Information		Free	673
Aerovox Corporation	Parts Mfr.	Catalog		Free	661
Allied Engineering Institute	Kit Mfr.	Circulars		Free	675
Allied Radio Corp.	Mail Order	1941 Radio Catalog		Free	655
		New Radio Dictionary		10c	
		Radio Builder's Hand-book		10c	
American Radio Institute	Radio School	Booklet		Free	669
Audel, Publishers	Book Publisher	Information		Free	669
Ayers Automatic Code Machines	Code Machines	Information		Free	673
Bliley Electric Co.	Parts Mfr.	Circular	D-2	Free	666
		Engineering Bulletin	E-6	10c	
		Bulletin	E-7	Free	
		Circular	A-7	Free	
Bud Radio, Inc.	Parts Mfr.	Literature		Free	671
Burstein-Applebee Co.	Mail Order	1941 Catalog	57	Free	675
Candler System Co.	Code Course	Book of Facts		Free	671
Cannon, C. F., Co.	Parts Mfr.	Folder	T-21	Free	663
Chartered Institute of American Inventors	Inventors Organization	Booklet		Free	697
Dodge's Institute	Radio School	Catalog		Free	668
Eagle Radio Co.	Kit Mfr.	Information		Free	658
Goldentone Radio Co.	Set Mfr.	1941 Bargain Catalog		Free	658
Gold Shield Products	Mail Order	Catalog		Free	671, 77, 82, 87, 97, 700
Hallicrafters, Inc.	Set Mfr.	Literature		Free	B.C.
Hammarlund Mfg. Co.	Set & Parts Mfr.	"HQ" Booklet		Free	667
Harrison Radio Co.	Mail Order	Information—List		Free	644, 663
Harvey Radio Company	Mail Order	Information		Free	665
Henry Radio Shop	Mail Order	Information		Free	658
Hudson Specialties Co.	Mail Order	Catalog		Free	695
Inland Wireless Press	Book Publisher	Information		Free	668
Instructograph Company	Code Machine	Information		Free	669
Lancaster, Allwine & Rommel	Patent Attorneys	Booklet		Free	697
Mass. Radio School	Radio School	60-Page Catalog		Free	668
Midget Radio Co.	Set Mfr.	Information		Free	673
Midwest Radio Corp.	Set Mfr.	1941 Catalog		Free	677
Miles Reproducer Co.	Sound Recording	Bulletins		Free	677
Millen, J., Mfg. Co., Inc.	Parts Mfr.	Catalog		Free	666
National Company, Inc.	Set & Parts Mfr.	Literature		Free	I.F.C.
National Radio Institute	Radio School	64-Page Book		Free	641
National Schools	Radio School	Catalog		Free	668
Nelson Co.	Used Courses	72-Page Catalog		Free	671
New York Y.M.C.A. Schools	Trade School	Booklet		Free	668
Nilson Radio School	Radio School	Circular		Free	669
Radio & Technical Publ. Co.	Radio Textbooks	Circulars on each book		Free	659
Radio Design Co.	Test Equipment	Information		Free	679
Radolek Company	Mail Order	Radio Profit Guide		Free	703
Rapid Electroplating Process, Inc.	Electroplating Kits	Catalog Folder		Free	677
RCA Institutes, Inc.	Radio School	Catalog		Free	668
RCA Manufacturing Co., Inc.	Set & Parts Mfr.	Literature		Free	I.B.C.
Record-O-Vox, Inc.	Set Mfr.	Information		Free	656
Sprayberry Acad. of Radio	Radio School	52-Page Book		Free	643
Supreme Publications	Publisher	Information		Free	663
Telex Co.	Code Machines	Catalog	S-3	Free	666
Triplett Electrical Inst. Co.	Parts Mfr.	Catalog		Free	673
Vertrod Mfg. Co.	Parts Mfr.	Antenna Catalog		Free	679

**Complete Your Short-Wave Library!
Six Outstanding Books on All Phases of
Short Waves. See Page 664.**

New Emergency Searchlight

● JACKSON BURGESS of the Burgess Laboratories has developed one of the brightest portable battery lights in the world. Even though it is so powerful that it is possible to read a newspaper by its light half a mile away, it is smaller than a man's head.

This new lantern produces 180,000 maximum beam candlepower and is 180 times as powerful as the best two-cell flashlight in common use today.

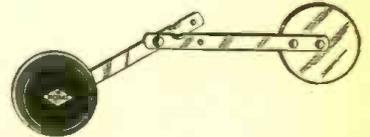
The spot of light cast by the lantern is 45,000 foot-candles at arm's length which is 4½ times as bright as sunlight on a spot of the same size. It has 180 foot-candles at 100 feet, which is equal



to the average office light. The fire and police departments may use this light as emergency "standby" lights. They may also be carried in planes to be used in "emergency." The light is not intended for everyday use but for special standby or emergency purposes only. The battery will maintain the light at peak brilliance for about six minutes, after which time the light output diminishes over a period of twenty minutes or more.

Loop Checker

● THE "Check-A-Loop," an efficient service instrument for checking loop antenna alignment is announced by the F. W. Sickles Company. By its ability to raise or lower the inductance of a loop, it quickly shows whether trimming capacity should be increased or decreased. A handy tool for the design engineer, for radio production set alignment, and for the radio service man.



Unique Police Radio System on Bridge

● ONE of the most unusual police radio systems ever installed has been placed in service on the Philadelphia-Camden Delaware River Bridge, one of the most heavily traveled spans in the country. The two-way mobile communication system is called upon to meet the unusual conditions imposed by the steel construction of the bridge, which absorbs radio signal energy, and the necessity for providing dependable coverage over its entire 1.7-mile length.

The problem was solved by the RCA engineers who designed the equipment by installing the fixed transmitter and antenna atop one of the two 385-foot high towers which support the huge bridge. The elevation permits complete coverage of the bridge, its approaches and surrounding area. To insure maximum flexibility, dual control facilities are provided in the headquarters building of the Delaware River Joint Commission, and in one of the toll houses.

Tied in with a police teletype system which blankets eight surrounding states, the new police radio system provides a ready emergency "blockade" against criminal suspects.

Mobile transmitting and receiving apparatus is installed in the bridge police patrol cars; motorcycles are equipped with receivers. Another unusual feature is the provision made for keeping a foot traffic patrolman stationed on the Philadelphia approach posted on all radio calls. A highly directional RCA loudspeaker has been mounted on the bridge structure in such a way that it directs sound down on the spot where the patrolman is on duty. He hears the calls, but the loudspeaker's construction keeps the sound out of the surrounding neighborhood.

What Do YOU Think?

FROM ARMY AMATEUR RADIO STATION W7FSH

Editor:

Back in the year 1933 I became interested in short-wave by reading your magazine *SHORT-WAVE CRAFT*. I usually bought it from the newsstands and also subscribed for it at times.



ALBERT RYAN

It was the means of getting me started on transmitting; I finally got an amateur license on March 14, 1936, and have been operating on C.W. ever since. It has given me much pleasure in my old age.

We later exchanged pictures and I have yours (the editor's) hanging up in my operating room, and many of the Hams have inquired who it was. I have told them that you were the inspiration of my getting on the air.

I am now 64 years old and hope to live long enough to see the end of this war, as I am confident it will last ten years, and be plenty tough for a long time afterwards.

I first built the "one lung" 45 TNT that you showed in the September issue of *SHORT-WAVE CRAFT*, 1933, and have it yet. Then I built the push-pull 45 TNT shown in the October issue. August 1937 I sold the P.P. 45 TNT to Ralph L. Price, W7EIC, in Polson, Montana. Recently I had a QSO with him for the first time in nearly three years. He is still using that old P.P. 45 TNT and has been "getting out" all over the world. He told me he is using both an end-fed Hertz 80 and 40 meter voltage-fed antennas and putting 60 watts on the plate.

I have always had a yearning to try out high-power on a push-pull TNT, so I am going to build one for an experiment. I have a very fine 2000 volt D.C. 500 mill power-supply, well filtered and choked, also all the parts for the experiment as I was getting ready to put a kilowatt amplifier on my rig.

At present I am using a 6L6G xtal osc. into a T-55, with 1050 volts on the final plate. My receiver is an RME-69.

I have kept the bills of all the stuff I have bought for radio, and when I counted them up recently I found I have spent about \$700 on my hobby.

ALBERT H. RYAN,
4445 51st Avenue Southwest,
Seattle, Washington.

A BRITISH SWL SPEAKS

Editor:

I am writing to you to congratulate you on your very fine magazine which I have read for several years, and it sure is the best radio mag. in the world. I have just received the September issue, and enjoyed the article on F.M. Principles, by Ricardo Muniz.

I have been a SWL for about two years, and during that time I've heard all States on 20 meter phone, and verified 26 of them. I've also heard and verified all continents on 20 and 31 meters. The RX used here is an 8 tube "Radio-gram," and is used with a 20 meter center-fed doublet, which runs N.E.-S.W. I've tried several other antennas but find this is most reliable for 20 meter DX reception.

My SWL card may be of interest to your readers, and if any SWL cares to exchange cards I'll be pleased to do so 100%, with anyone in the world (that goes for Hams, too).

During my SW listening I've found that U. S. Hams are the best for QSLing, and they really do appreciate a good report from SWL's. Conditions on 20 meters at present are very poor here, only one or two W 1's and 2's coming through on 20 meter Ham phone, but the International short-wave stations WGEA, WRUL, and

WCBX still put through a good signal. Australia is coming through at R8-9 on 25 meters at 0830 B.S.T.

I'll close, wishing your magazine continued success, and hoping to hear from some of the Hams and SWL's who read your swell paper. 73.

E. J. ROBERTS,
B.L.D.L.C. Member 6679
179, Whittington Road,
Bowes Park, London, N.22.
England.

AN EMBRYO HAM

Editor:

I want to commend you on your fine magazine. I get quite a kick from the letters sent in by readers. Your articles on combination phone and CW. xmitters interest me the most at the present time, as I am planning to make a small 40 and 20 meter rig. Say, let's see some diagrams like these.

At present I'm an SWL. I have a Hall-crafter Skybuddy S19. I am going to use a doublet antenna; I am now using a short aerial in the attic and this contraction picks up too much hash to be practicable. Well, anyway I have logged 25 states in amateur phone bands; this was on 20 meters, mostly. I'll QSL 100%.

Well, 73 and keep the "Kink" department going.

FRANK GUYER,
Calverton, L. I., N. Y.

RADOLEK'S NEW 1941

FREE!

"RADIO PROFIT GUIDE"

Brings You Hundreds of BARGAINS Like This One!



GET THIS BIG FREE BOOK OF EVERYTHING NEW IN RADIO AT Bargain Prices!



RADIO PARTS, KITS



1941 RECEIVERS



SOUND SYSTEMS

Shows hundreds and hundreds of up-to-the-minute radio parts, sets, accessories, ham gear, electric appliances and supplies. Indispensable to every amateur, experimenter, set builder, sound engineer and serviceman. Keep up with radio and all its phases—send for the big FREE Radolek Profit Guide now! DON'T WAIT—SAVE MONEY AT RADOLEK. Address Dept. T-52.

Special Value!

Professional Type HOME RECORDING DISCS (Heavy Metal Core—Non Flammable)

10" only 19c each

Made by foremost manufacturer. Proven equal or superior to any discs of this type regardless of cost. These blanks have very slight imperfections but guaranteed to make perfect recordings or your money back. Coated on both sides. Big savings! 6" Discs—10c; 8"—14c; 10"—19c; 1c less in 25 lots.

Send no money—shipped C.O.D. plus postage.

RADOLEK COMPANY

601 West Randolph Street
Chicago, Illinois

Order Today!

Index to Advertisers

A	
ABC Radio Laboratories	673
Aerovox Corporation	661
Allied Engineering Institute	675
Allied Radio Corporation	655
American Radio Institute	669
Audel, Publishers	669
Ayers Automatic Code Machines	673
B	
Barter & Exchange Ads	699
Bliley Electric Co.	666
Bud Radio, Inc.	671
Burstein-Applebee Co.	675
C	
Candler System Co.	671
Cannon, C. F., Co.	663
Chartered Institute of American Inventors	697
Commercial Notices	699
D	
Dataprint Company	677, 682
Dodge's Institute	668
Eagle Radio Co.	658
F	
Flight Magazine	675
For Sale Ads	699
G	
Goldentone Radio Co.	658
Gold Shield Products	677, 682, 687, 697, 700
H	
Hallcrafters, Inc.	Back Cover
Hammarlund Manufacturing Co., Inc.	667
Harrison Radio Co.	644, 663
Harvey Radio Company	665
Henry Radio Shop	658
Hudson Specialties Company	695
I	
Inland Wireless Press	668
Instructograph Company	669
K	
Korrol Mfg. Co.	671
L	
Lancaster, Allwine & Rommel	697
M	
Mass. Radio School	668
Midget Radio Co.	673
Midwest Radio Corporation	677
Miles Reproducer Co.	677
Millen, James, Mfg. Co., Inc.	666
N	
National Company, Inc.	Inside Front Cover
National Plans Institute	683
National Radio Institute	641
National Schools	668
Nelson Co.	671
New York Y. M. C. A. Schools	668
Nilson Radio School	669
P	
Premium Distributing Service	683
R	
Radio Amateur Course	684
Radio & Technical Publ. Co.	659
Radio-Craft	678
Radio Design Co.	679
Radio Publications	682, 687, 689, 693
Radio-Television Reference Annual	701
Radolek Company	703
Rapid Electroplating Process, Inc.	677
RCA Institutes, Inc.	668
RCA Manufacturing Co., Inc.	Inside Back Cover
Record-O-Vox, Inc.	656
S	
Sprayberry Academy of Radio	643
Supreme Publications	663
T	
Technifax	676, 687
Telex Co.	666
Triplett Electrical Instrument Co.	673
V	
Vertron Mfg. Co.	679

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

FROM A CANADIAN S.W.L.

Editor:

Just a line to let you know how much I enjoy reading RADIO & TELEVISION. From among your swell articles and diagrams, I have built a 3-tube all-wave receiver using a 57, 56 and 2A5, and have logged numerous stations, thanks to your S-W listening tips.

I have been a SWL about 2 years and have high hopes of becoming an amateur in the near future.

I would like to hear from any "Hams," "Hams-to-be," SWL's, and YL's between the ages of 17 to 19 who are interested in stamps, coins and any other hobbies as well as radio.

I sincerely promise to QSL 100% to anybody, anywhere, so let's hear from you.

LOUIS GOLD,
257 Beatrice St.,
Toronto, Ont., Canada.

HERE'S YOUR CHANCE, HAMS

Editor:

I recently purchased your December, 1940 RADIO & TELEVISION issue and read your editorial "Amateur Intolerance." Yes, I am one of those would-be prospects. I wonder if you could help me. I've been an SWL for quite some time and believe me, I think I'd cherish those call letters if a Ham helped me along, as you suggest. I am appealing to you, my good friend, or probably you know of a licensed amateur who would work with me, until success is accomplished. I've always wanted to talk into a mike for enjoyment, or as a hobby, or actual service. Yes, I would like to become one of those 200,000 radio amateurs, too, if there is a Ham to do so.

JOSEPH ZUKAUSKAS,
513 W. Susquehanna Ave.,
Philadelphia, Pa.

Single Television Image Tube Held Simplest

That the present single cathode-ray tube television technique is simplest and probably cheapest, is the opinion held by Allen B. DuMont, television manufacturer.

"Of course I am interested in the multiple cathode-ray tube television technique proposed by Dr. Alfred N. Goldsmith, whereby the image is assembled by an array of (small) tubes instead of the single large tube used today," states Mr. DuMont. "I fully appreciate that the motivating urge is economy, and that the belief behind the suggestion is that small cathode-ray tubes might be mass-produced on much the same basis as radio tubes and at correspondingly low prices.

"It is interesting to note that the late Dr. C. Francis Jenkins, with whom I was associated in some of the earliest television work, also had the idea of a multiple screen. He was likewise influenced by the moving-letter electric sign boards. At that time, when mechanical scanning was in use, Dr. Jenkins demonstrated a large checker-board of tiny electric incandescent bulbs which, as they were turned on or off, could weave the image pattern of lights and shadows. The present suggestion of Dr. Goldsmith is, of course, quite different in details, in that it utilizes small cathode-ray tubes instead of lamps, with each tube scanning a portion of the total image rather than supplying just a single picture element.

"Still, I am afraid that the contemplated economies can hardly be realized with a multiple cathode-ray tube receiver. Our own practical experience, in producing cathode-ray tubes in all sizes and types, indicates that there is not the proportional difference in cost, based on size, that might be expected. A smaller tube does not necessarily effect considerable economies. We abandoned the 2-inch tube because we found it to cost as much or even more than our 3-inch tube.

"If Dr. Goldsmith purposes to use a battery of tiny tubes, it is my personal belief that the cost of such an array will be equal to or even greater than that of a corresponding single tube, providing the same image size. I cannot see any marked

advantages in the economic sense. There may be a saving in the other components, due to lower operating voltages for the smaller tubes, but this may well be wiped out by the addition of the required switching or transferring means, whereby to cut in the multiple tubes in proper sequence.

"Our own long experience is that a single large tube provides the best economic and technical solution thus far. We pioneered the first large-screen television receiver with a 14-inch tube, and more recently the 20-inch tube. Aside from the cost of the glass blanks, the production costs run pretty nearly alike between these two sizes, since the internal details are virtually the same for both.

"To my way of thinking, marked economy in television reception must come through a more widespread demand for receivers based on good and adequate program sources, followed by the justification of mass-produced equipment, which alone can bring down the cost to popular levels. Once we feel justified in putting large cathode-ray tubes on continuous exhaust and other automatic machines, our costs and prices will fall rapidly. Likewise the remainder of the receiver. The problem today is mainly economic. It's for the businessmen to make the next move, since we engineers have done all the playing thus far."

* * *

Asked to comment on Mr. DuMont's opinions of the multiple projector tube system, Dr. Alfred N. Goldsmith said: "I think Mr. DuMont's comments express a viewpoint to which he is fully entitled. I have good reason to believe, from the past history of vacuum tubes and cathode-ray tubes that the system I have proposed for large-screen television will find increasing favor and economic justification. When the normal pictures of the future in the home, from 20 inches to 50 inches in width, become the vogue. I am satisfied that either methods of the type which I have proposed or projection-tube methods will best meet the public needs and commercial requirements."

A NEW RECTIFIER WITH A LONGER LIFE!

RCA
866-A/866

HALF-WAVE
MERCURY-VAPOR
RECTIFIER

\$150

Amateur Net



RCA engineering scores again! Not only does the new RCA-866-A/866 half-wave, mercury-vapor rectifier handle higher voltage at lower initial cost, but its truly great life means even greater value for your money. Once installed in your rig you can forget rectifier tube problems for a long, long time to come.

This new tube supersedes the 866 and 866-A and may be used in equipment designed for these types. An exclusive RCA development, it combines the ability of the 866 to conduct at relatively low plate voltage with that of the 866-A to withstand a high peak inverse voltage—and, in addition, gives you a *plus* performance that makes it far and away the greatest rectifier value RCA has ever offered.

Secret of the 866-A/866 is another top notch RCA engineering achievement—an edgewise-wound coated ribbon filament, illustrated at right, of great mechanical strength and providing more cathode area for the same filament power rating. This filament utilizes a new alloy material that not only has tremendous electron-emitting capabilities, but also holds the key to greater life. Important among other features of the tube is the special filament shield which makes practical the use of a very low starting voltage. A ceramic cap insulator and new dome-top bulb minimize danger from bulb cracks caused by corona discharge and resultant electrolysis. Get more for your money! Make sure your new rectifiers are RCA-866-A/866's.



Unique New
Filament
Design Used in
the 866-A/866

RATINGS

Filament Voltage (A-C)	2.5 volts
Filament Current	5.0 amperes
Peak Inverse Voltage	10,000 max. volts
Up to 150 cycles per second	5,000 max. volts
Up to 1,000 cycles per second	1.0 max. ampere
Peak Plate Current	0.25 max. ampere
Average Plate Current	15 volts
Tube Voltage Drop (approx.)	

SENSATIONAL PERFORMANCE

... at a New Low Price!

- **LONGER LIFE**—Assured by radically improved new filament, dome bulb and insulated plate cap.
- **HIGH RATING**—10,000 volts, peak inverse voltage. 1000 ma., peak plate current.
- **ENORMOUS EMISSION RESERVE**—Provides ability to withstand high peak loads.



Transmitting Tubes

PROVED IN COMMUNICATION'S MOST EXACTING SERVICES

RCA MANUFACTURING CO., INC., CAMDEN, N. J. • A Service of The Radio Corporation of America

In Canada: RCA VICTOR COMPANY LIMITED, MONTREAL

Dependable communications reception



MODEL SX-25

Hallicrafter engineers have included every worthwhile advancement in the Model SX-25 to assure all the good reception requirements with a tuning range of from 540kc. to 42mc. in 4 bands. 12 tubes—2 stages of preselection—Separate cali-



MODEL SX-24

The Model SX-24 represents the best value in the communications field. 9 tubes—4 bands—Frequency range from 540kc. to 43mc.—Frequency stability throughout a wide range of line-voltage, temperature and humidity variations—DC operation socket—battery or vibrapack. Complete with tubes and crystal. \$69.50

brated bands—spread dial for 10, 20, 40 and 80 meter amateur bands—Six step variable selectivity—S meter calibrated in "g" and "DB" units—Push-pull output stage furnishes 8 watts of audio—Ten inch heavy duty PM dynamic speaker—110 volt 50-60 cycle AC—provision for DC operation. Complete with speaker, crystal and tubes. \$99.50

the hallicrafters co.
CHICAGO, U. S. A.

USED BY 33 GOVERNMENTS • SOLD IN 89 COUNTRIES