SHORT WAVE RADIO

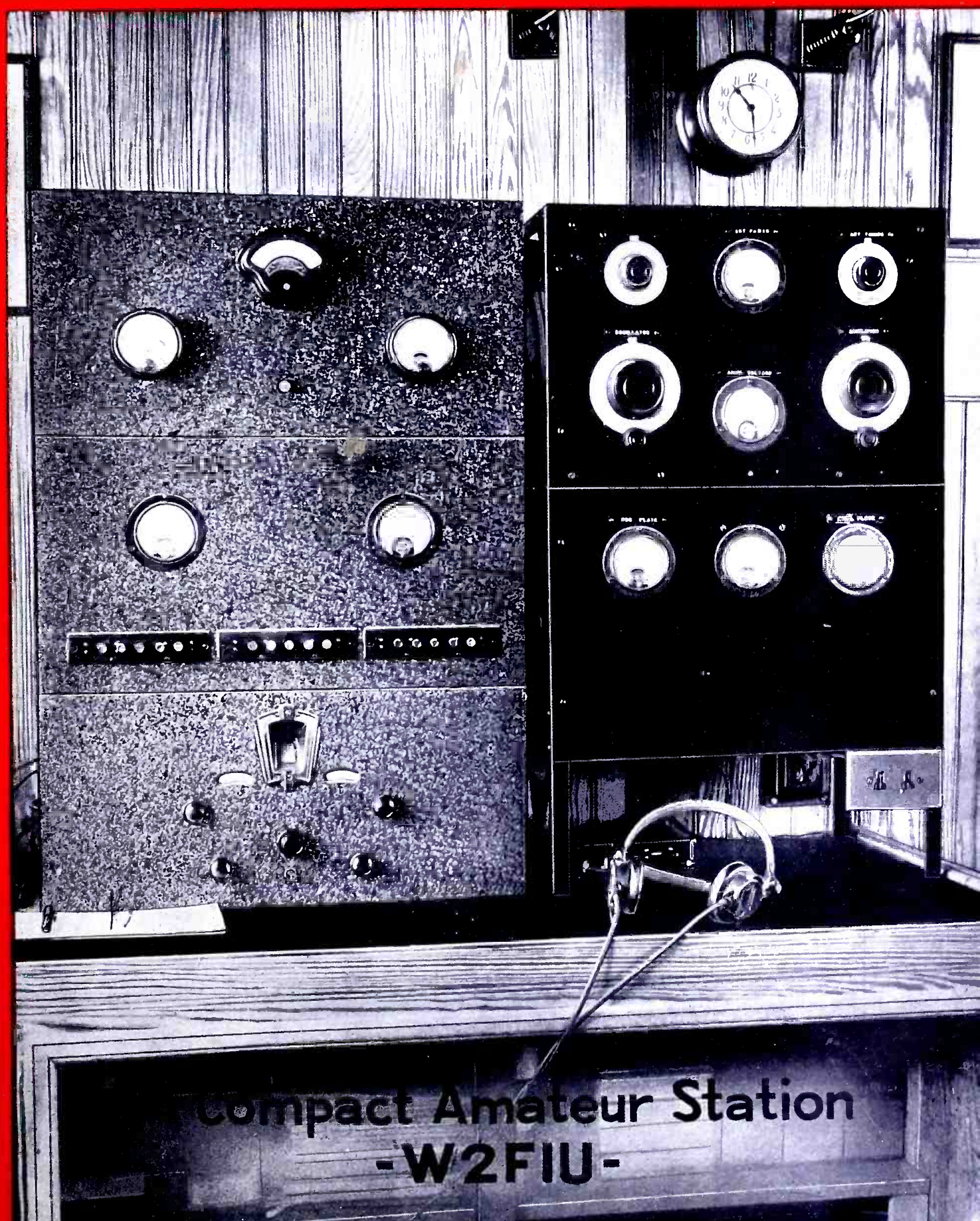
December 1933

NRA MEMBER U.S. WE DO OUR PART

Edited by
Robert Hertzberg and Louis Martin

IN THIS ISSUE:

25¢ IN CANADA 30¢



Compact Amateur Station
-W2FIU-

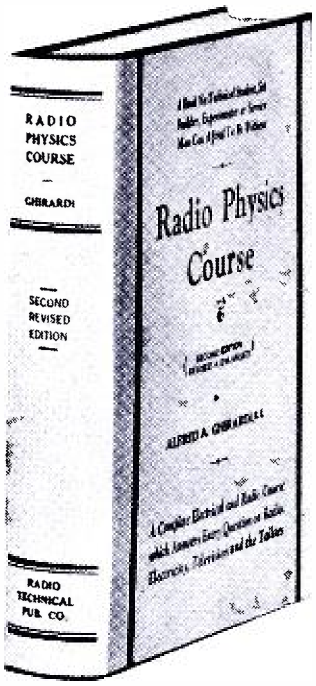
you must see the new

RADIO PHYSICS COURSE

Including Short Waves, Television and Sound Pictures

(Second Enlarged and Revised Edition)

by ALFRED A. GHIRARDI



The Radio Physics Course contains 992 pages and over 500 illustrations. Two Inches Thick! Cloth Bound

Price

$4.00

Postpaid anywhere in U. S. A.

Haven't you often felt that you would like to get hold of a book that would explain very carefully, step by step, and in a really interesting manner, everything there is to know about modern radio?

The new, revised second edition of the RADIO PHYSICS COURSE does just that—and more! It now contains, in addition to the most popular radio course ever written, a complete course in sound and electricity as applied to radio. Written in the same clear, simple style which has won the author great popularity as a writer for technical and radio magazines, and as a teacher of radio and electricity, this part of the new edition will be welcomed as a refreshing departure from the old electrical texts now in use. Free use of the modern electron theory has been made without going beyond the grasp of even the most non-technical student. You will be surprised at the ease and simplicity with which this modern tool of science, in the hands of so capable a writer as Mr. Ghirardi, has been utilized to clear up the many mysteries of electricity which have always troubled students. Electricity has not been treated as a "mysterious flow of something or other," but as a definite movement of vibrant electrons which have been skillfully made to create an absorbing interest in the subject.

Nothing is taken for granted, everything is explained simply, clearly and completely, with the aid of hundreds of carefully prepared diagrams and illustrations which the author has found invaluable in his practical experience in teaching this subject.

All chapters, including those on Vacuum Tubes, Superheterodynes, Electric Receivers, Short Waves, Television and the Talkies, have been brought right up to the minute, with complete descriptions of all the new developments brought out during the past year. We feel the chapter on Television to be the most sensible, complete and up-to-date explanation of this latest marvel of radio ever published. Even the new Cathode-ray television system is explained!

•

Remit by post office money order or bank check. Your copy mailed same day your order is received; no waiting.

Radio Technical Publishing Co., 45-R Astor Place, New York, N. Y.

I will help You
start a Spare Time or Full Time
Radio Service Business
without capital

J. E. SMITH, *President National Radio Institute*

The man who has directed the Home-Study Training of more men for the Radio industry than any other man in America.

Here are a few examples of the kind of money I train *"my boys"* to make

$50 to $75 a Week

"The National Radio Institute put me in a position to make more money than I ever made in good times. I am in the radio service business for myself, where it is possible for me to make from $50 to $75 a week. Service work has increased because people, who in normal times would buy a new Radio, now are contented to have the old one 'pepped up'."—BERNARD COSTA, 150 Franklin St., Brooklyn, N. Y.

$500 a Year Extra in Spare Time

"Although only doing spare time Radio work, I averaged about $500 extra a year in addition to my regular income. Full-time Radio work would net me many times that amount. My example and that of hundreds of other N. R. I. graduates should convince any skeptical person of the superiority of N. R. I. training."—EDWARD H. FAWCETT, Slough Road, Ladner, B. C., Canada.

Averages $80 per Month in Spare Time

"I am getting along well in my Radio work, always being kept very busy. Since enrolling I have averaged around $80 a month working on Radio just part time, since I am still holding down my regular job." — JOHN B. MORISSETTE, 733 Somerville St., Manchester, N. H.

My Free book gives you many more letters of N. R. I. men who have made good in spare time or full time businesses of their own.

The world-wide use of Radio sets for home entertainment has made many opportunities for you to have a spare-time or full-time Radio business of your own. I give you instructions early in your Course for doing 28 Radio jobs common in almost every neighborhood. Many N. R. I. men make $5, $10, $15 a week extra in spare time almost at once. I show you how to install and service all types of receiving sets. I give you Radio equipment and instructions for conducting experiments, for building circuits and testing equipment, and for making tests that will give you broad, practical Radio experience. Clip the coupon below and get my free 64-page book, "Rich Rewards in Radio"—it gives you a full story of the success of N. R. I. students and graduates, and tells how to start a spare-time or full-time Radio business on money made in spare time while learning.

Free Book Tells How Mail Coupon!

Many N. R. I. Men Make $5, $10, $15 a Week Extra in Spare Time Almost at Once

Many of the seventeen million sets now in use are only 25 per cent to 40 per cent efficient. I will show you how to cash in on this condition. I will show you the plans and ideas that have enabled many others to make $5, $10, $15 a week in spare time while learning. Ford R. Leary, 1633 Davison Road, Flint, Mich., wrote: "My part-time earnings while taking the N. R. I. Course were $651."

Get Ready Now for a Radio Business of Your Own and for Jobs Like These

Broadcasting stations use engineers, operators, station managers, and pay up to $5,000 a year. Radio manufacturers use testers, inspectors, foremen, engineers, servicemen and buyers, and pay up to $7,500 a year. Radio dealers and jobbers employ hundreds of servicemen, salesmen, managers, and pay up to $5,000 a year. Radio operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. Talking Movies pay as much as $75 to $200 a week to the right men. My book tells you of the opportunities in Radio Loud Speaker Apparatus, Set Servicing, Aircraft Radio, Television, Police Radio, Short Wave, and other fields. Get it.

I Will Train You at Home in Your Spare Time

Hold your job until you're ready for another. Give me only part of your spare time. You do not need a high school or college education. Hundreds with only a common school education have won bigger pay through N. R. I. J. A. Vaughn jumped from $35 to $100 a week. J. E. McLaurine increased his earnings 100 per cent. The National Radio Institute is the Pioneer and World's Largest organization devoted exclusively to training men and young men by Home Study for good jobs in the Radio industry.

You Must Be Satisfied

I will give you an agreement to refund every penny of your money if you are not satisfied with my Lessons and Instruction Service when you complete my Training. And I'll not only give you thorough training in Radio principles, practical experience in building and servicing sets, but also Advanced Training in any one of five leading branches of Radio opportunities.

Free Book of Facts

Mail the coupon for "Rich Rewards in Radio." It's free to any ambitious fellow over 15 years old. It tells you about Radio's spare-time and full-time opportunities; about my training; what others who have taken it are doing and making. Mail coupon now.

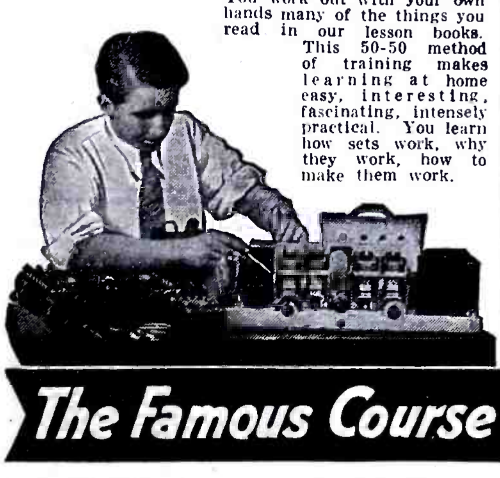
Get my new book It points out what Radio Offers You

J. E. SMITH, Pres.
Dept. 3NS8
National Radio Institute
Washington, D. C.

NRA MEMBER U.S. WE DO OUR PART

SPECIAL Radio Equipment for Broad Practical Experience *Given Without Extra Charge*

My Course is not all theory. I'll show you how to use my special Radio equipment for conducting experiments and building circuits which illustrate important principles used in such well-known sets as Westinghouse, General Electric, Philco, R. C. A., Victor, Majestic, and others. You work out with your own hands many of the things you read in our lesson books. This 50-50 method of training makes learning at home easy, interesting, fascinating, intensely practical. You learn how sets work, why they work, how to make them work.



Special Free Lesson

Act now and receive in addition to my big free book, "Rich Rewards in Radio," this Service Manual on D.C., A.C., and Battery operated sets. Only my students could have this book in the past. Now readers of this magazine who mail the coupon will receive it free. Overcoming hum, noises of all kinds, fading signals, broad tuning, howls and oscillations, poor distance reception, distorted or muffled signals, poor Audio and Radio Frequency amplification and other vital information is contained in it. Get a free copy by mailing the coupon.

THIS COUPON IS GOOD FOR ONE *FREE* COPY OF MY NEW BOOK — mail it TODAY

J. E. SMITH, *President*,
National Radio Institute, Dept. 3NS8
Washington, D. C.

Dear Mr. Smith: I want to take advantage of your Special Offer. Send me your two books, "Trouble Shooting in D.C., A.C. and Battery Sets" and "Rich Rewards in Radio." I understand this request does not obligate me. (Please print plainly.)

Name .... *Age* .....

Address ....

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

M

The Famous Course That Pays For Itself

SHORT WAVE RADIO

December, 1933

Vol. 1, No. 2

devoted to short-wave transmission and reception in all their phases

Robert Hertzberg, *Editor*

Louis Martin, B.S., *Technical Director*

General Advertising and Editorial Offices, 1123 Broadway, New York, N. Y.

IN THIS ISSUE:

IN FUTURE ISSUES:

AND NOW, THE ANGSTRÖM UNIT?—Short Waves are getting shorter and shorter, wavelengths are becoming correspondingly shorter, and frequencies higher. If we go down short enough, the question of just what we shall call the unit of wavelength or of frequency becomes a problem. Our views are laid bare in this interesting article. Of course, you can use the terms you like, but we feel that the Angström will settle the question.

OSCILLATORS—AND THEIR CHARACTERISTICS.—We are all pretty much fed up on the operation of oscillators. Time and time again dignified authors have expounded their views on just why their pet oscillator circuits should be used to the exclusion of all others. Meanwhile, the mind of the innocent reader labors. We will attempt to relieve this somewhat chaotic condition by publishing an unbiased technical version of just what makes the wheels go 'round in the standard types of oscillator circuits. In the first of a series of articles, the simple feedback will be discussed—and how!

IT IS ONE THING TO BUILD A SMALL transmitter on a breadboard and quite another to spend $25,000 to pump the ether full of waves. XIG, known throughout the world as one of the most excellent "ham" stations on the air, will be described—and what a description! This is one of the few descriptions that will either make you open your bankroll or make you close up shop.

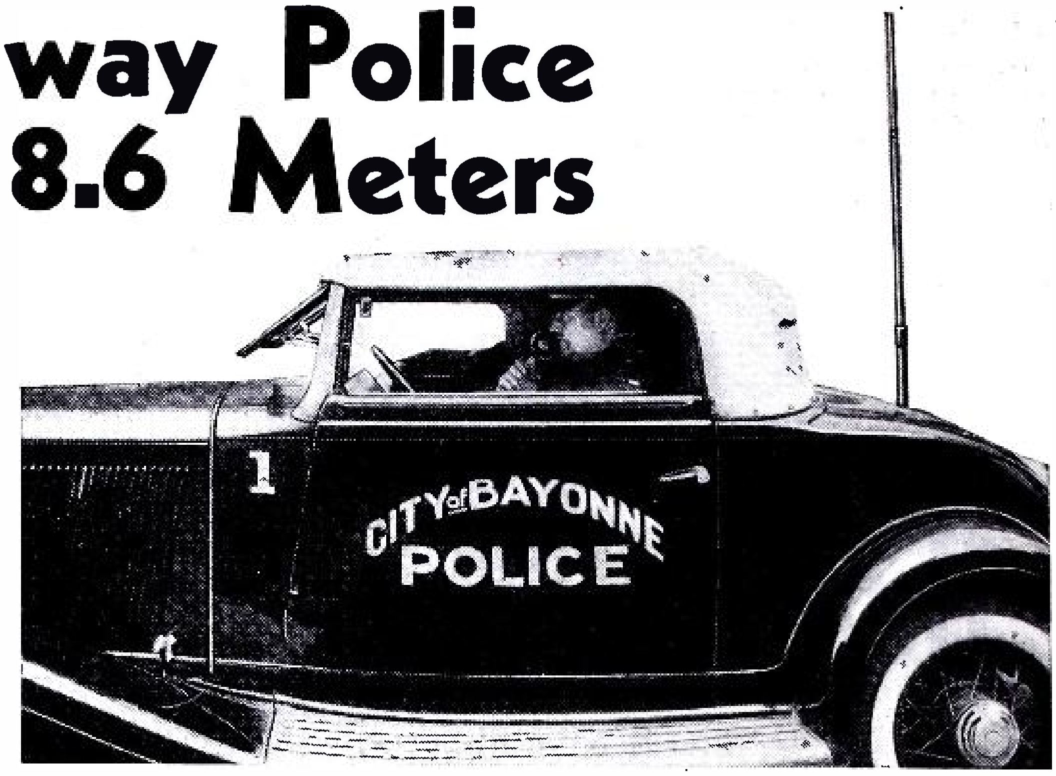
KRUSE CONTINUES WITH HIS REALLY authoritative dope on 5-meter phone work. Do you ever contemplate hitting the 5-meter band with a mike? Then don't miss this series of articles, which has been specially prepared for SHORT WAVE RADIO.

SINGLE SIDE-BAND PHONE is the latest thing on the air. The confusion and congestion existing at present can only be minimized by cutting the band spread of each station in half. Hy Levy, a boy who "knows his onions" on this filter business, is going to give us a few articles on just what to do to your present transmitter to enable single side-band transmission. This is not one of those standard treatises on filter circuits; for such information, we recommend any network book to you. This is a simple, practical article on single side-band transmission—nothing more and nothing less.

SHORT WAVE RADIO—Monthly. Entered as second-class matter September 15, 1933, at the post office at Chicago, Illinois, under the Act of March 3, 1879.

SHORT WAVE RADIO is published on the first of every month preceding date of issue. Subscription price is $2.50 a year in the United States and possessions; Canada and foreign countries, $3.00 a year. Individual copies, $.25 in the United States and possessions; Canada and foreign countries, $.30. Published by Standard Publications, Inc., 4600 Diversey Avenue, Chicago, Illinois. Editorial and advertising offices, 1123 Broadway, New York, N. Y. Louis Martin, President; Robert Hertzberg, Secretary-Treasurer. Send all manuscripts to SHORT WAVE RADIO, 1123 Broadway, New York, N. Y.

First Two-way Police Phone on 8.6 Meters



The City of Bayonne has the honor of being the first city in the United States to equip its police cars with two-way radio phone systems. This system operates on a wavelength of 8.6 meters, and marks a milestone in the progress of radio

By H. G. Cisin, M. E.

RADIO equipped police cars are commonplace in most American cities, but *two-way* radio telephone communication between moving police cars and police headquarters is a modern innovation which doubles the value of radio for police work.

Successful installations of this nature, operated on the ultra short waves, have recently been completed at Eastchester, N. Y., and also at Bayonne, N. J. New York and New Jersey are at present the only two states in the Union utilizing this kind of apparatus; but, judging from the success of the first two experiments, two-way radio communication will soon become a vital adjunct of the police machinery of every community.

The installation at Bayonne, which is practically identical with that at Eastchester, N. Y., comprises a central headquarters station and nine specially equipped police department motor cars. The communication system makes it possible for police officers cruising the streets in squad cars to talk with headquarters or with other police automobiles by speaking into special close-talking Universal hand microphones, which are part of the auto-radio equipment.

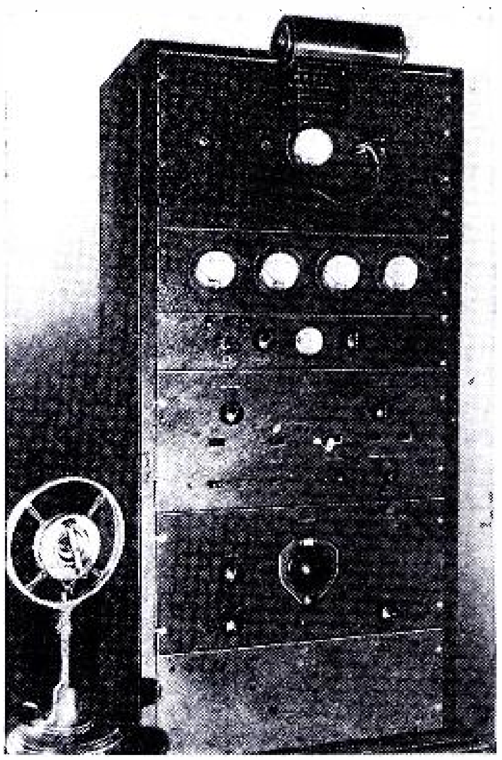
The phone messages are transmitted on an experimental frequency that is definitely outside the band regularly assigned for police service.

The headquarters station and the nine automobile sets are tuned and locked on a frequency of 34,600 kilocycles, corresponding to a wave length of 8.6 meters.

This experiment is being conducted under the watchful eyes of the Federal Radio Commission, and as soon as sufficient data have been gathered to prove the adaptability of the ultra-high frequencies to this type of service, the Commission will undoubtedly allocate a new channel for police work, somewhere around Bayonne's experimental frequency. This will relieve the overloaded condition of the channel at present reserved for police radio in the neighborhood of 2400 kilocycles. When this is done, police departments everywhere will be enabled to confine the messages to their respective communities at a minimum cost. This is a feature of the ultra-short wave communication of considerable importance.

Bayonne is the first city in the United States to apply to the Federal Radio Commission for a two-way communication system license.

The only other two-way system, installed in Eastchester, Westchester County, New York, while employing identical apparatus, utilizes only two cruising cars. The Eastchester installation was made after police officials of that city witnessed Bayonne's experiments.



THE TRANSMITTER AT W2XCJ
The transmitter used by the City of Bayonne.

The central transmitting and receiving station at police headquarters operates on a power of only 25 watts—about the same power required to light a small incandescent lamp. The transmitting apparatus in each of the nine automobiles requires 4.5 watts. All transmitting and receiving equipment at the headquarters station and in the nine cars was built and installed by the Radio Engineering Laboratories, Inc., of Long Island City, N. Y. This equipment represents a cost of $4,995, which is less than one-half the cost of an average one-way system on the lower frequencies.

There are five panels on the switch board at police headquarters. (See illustration.) From top to bottom these are the modulator panel, the meter panel, the pre-amplifier, or "mike" panel, the power control panel, the headquarters receiver, and the filter panel.

The meter on the top panel is the modulation plate current voltmeter. The four meters on the second panel from left to right are the plate voltmeter, the filament voltmeter, the power amplifier plate-current meter, and the battery plate-current meter. On the power control panel there is a switch for throwing on the power, and another switch for changing from transmitting to receiving. There are, also, voltage control rheostats. The headquarters receiver panel is fitted with a regulation tuning dial and with a gain control for the loudspeaker. The filter panel has no controls, all apparatus being mounted on the rack behind the panel. A standard double-button microphone, mounted on a small desk stand, is used at police headquarters.

The police cars, similar to the one illustrated, are equipped with a small ultra-short wave transmitter which is housed in a single unit and with a separate receiver and power-supply

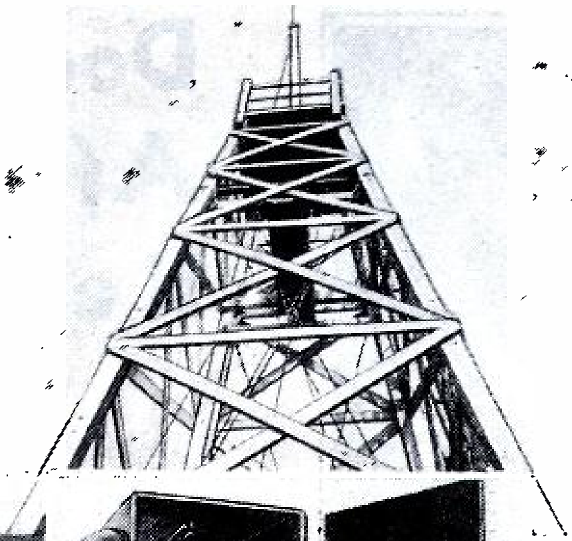
BELOW: APPARATUS SET IN THE RUMBLE SEAT OF THE POLICE CAR

The oscillator is shown fastened to the antenna pole, and the combination receiver, speech amplifier, and modulator is shown bolted to the bulkhead.

RIGHT: THE MAST AT W2XCJ

In the mast, near the top, is located the fixed-tuned oscillator which is modulated by the apparatus below, in the building. See opposite page.

CENTER: THE FIXED-TUNED OSCILLATOR LOCATED IN THE MAST.

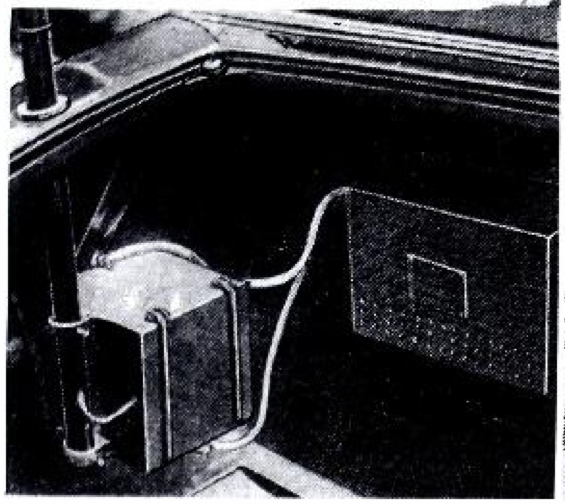


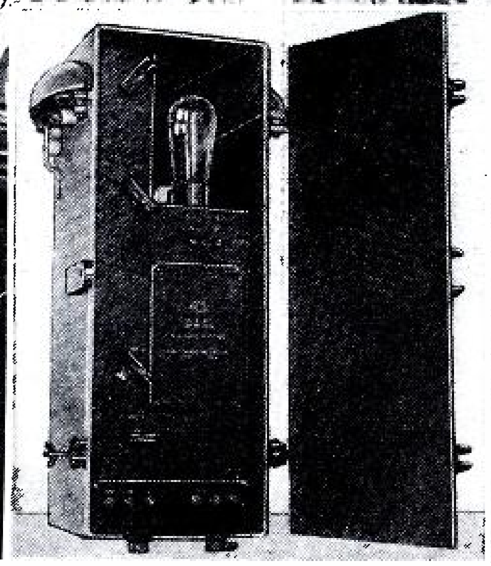
BELOW: THE COMBINATION RECEIVER AND CONTROL BOX

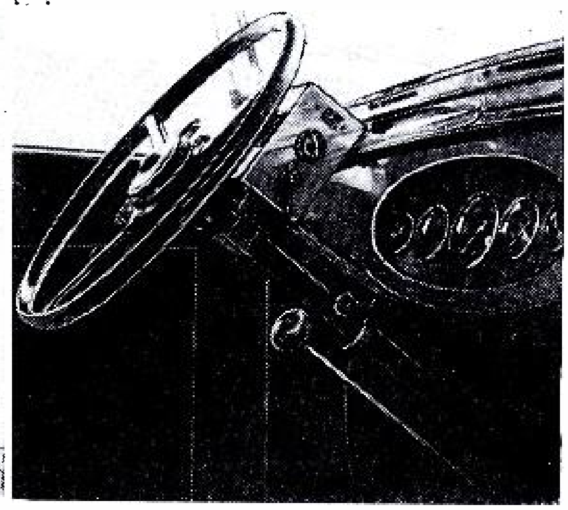
Mounted on the steering column of the car are the loudspeaker and control units. Because the receivers are fixed-tuned, no tuning dial is required.

LOWER PHOTOGRAPH: A COMPOSITE OF THE ENTIRE CAR INSTALLATION

The loudspeaker, fixed oscillator in the car, the combination receiver, speech amplifier, and modulator, and the power unit are shown.





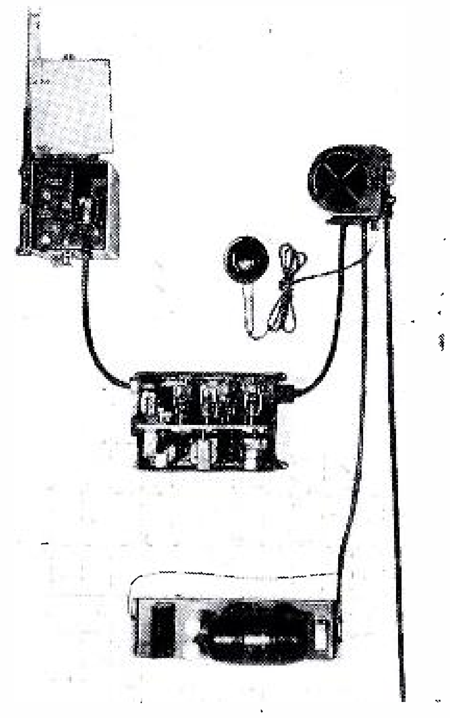


unit. These are all stowed away in the rumble seat. The control unit is mounted on the steering post, and this contains a volume control, a tuning dial, change-over switch, and power switch. The loudspeaker is mounted on the steering wheel and, with the volume control turned full "on," can be heard at a distance of fifty feet from the car. The power supply utilizes a motor-generator operated from the 6-volt battery of the car. The hand microphone is of special type, permitting close talking and eliminating external interference.

The equipment in the automobiles takes up no more room than an ordinary automobile broadcast receiver, and it weighs less. Transmitting and receiving is done by throwing one switch. The "receive" position is maintained for the most part, all the stations always being on the alert for any message that may be transmitted.

Ability of cruising cars to maintain conversation with headquarters and with other cruising cars at once makes the value of this system apparent, for at all times the precise location of each of the machines is known to the occupants of the other cars as well as to the headquarters operator.

Criminals fleeing the scene of their crimes may thus be quickly surrounded and apprehended; for, with all the cruising machines brought into the chase and detailing their progress to each other, trails are not crossed, and intelligent, instead of haphazard, pursuit may be made.



A recent test brought a radio car to the scene of a reported hold-up in twelve seconds, and one minute and five seconds later the hold-up automobile was captured by a radio car.

The speed with which the radio-equipped automobiles are able to reach the scene of trouble has apparently also acted as a deterrent; for even false fire alarms have shown a decrease since Bayonne's radio system was installed. The operator at headquarters, counting the taps of the fire bell, refers to the fire box chart in front of him and dispatches a cruising police car to the scene. Since in most cases the radio car is much closer than the nearest fire house, a person having pulled a false alarm is usually caught before the fire apparatus is in sight. Since the lives of firemen and pedestrians are endangered whenever a fire engine leaves its quarters, and since every false alarm is estimated to cost the city about $150.00, a considerable saving is quickly made.

An outstanding feature of the Bayonne two-way system is the lack of interference from other stations. On the regular police frequencies, stations in other cities may have the air when it is needed by a neighboring department. Confusion in such cases is avoided only by sharing time or by sending some distinguishing signal, such as blowing a whistle or ringing a bell.

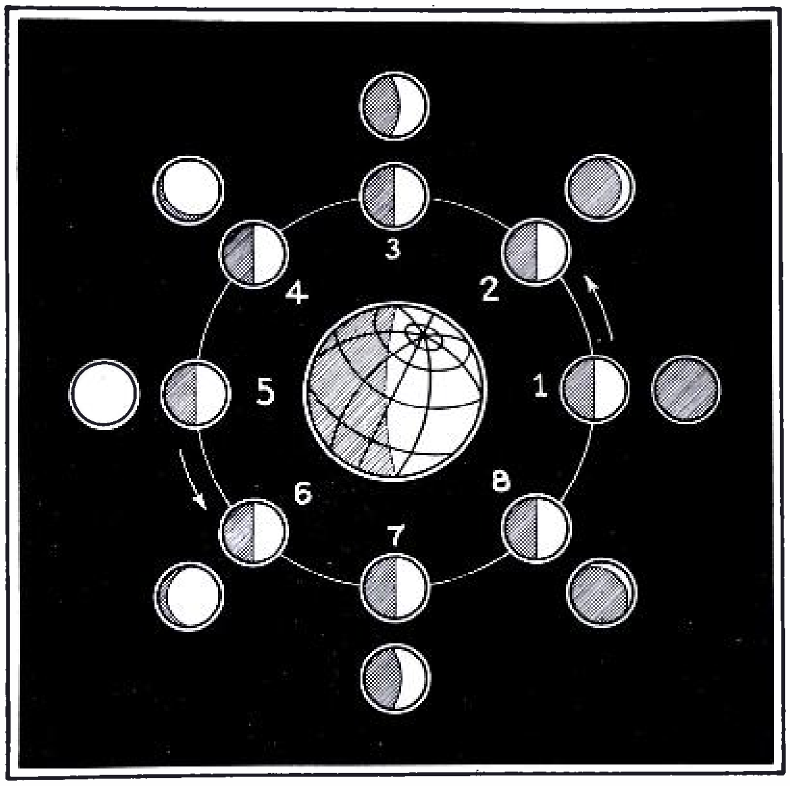
Steel structural work, such as bridges, elevated structures and even street cars, offers a good deal of trouble to reception on the 2,400 kilocycle band, whereas the ultra-high frequencies, such as the one used in Bayonne, are immune to all these shortcomings.

Static, the bane of all radio, does not affect the ultra-high frequencies as it does the regular police frequencies. Bayonne headquarters and all cars have worked through several severe electrical storms with no static interference whatsoever. So-called dead spots, another source of trouble on the regular channels and even to large broadcast stations, are few and far between in Bayonne.

To cite a few instances wherein Bayonne Police Radio was very useful, let us begin with a brawl three blocks from where a police car was parked for testing purposes. The

(*Continued on page 38*)

Does the Moon Affect Radio Reception?



POSITION OF MOON WITH RESPECT TO THE EARTH
With the moon at (1), an observer on earth does not see any moon; at (3), he sees a quarter moon; at (5), he sees a full moon; and at (7), a three-quarter moon. The moon requires one month to revolve around the earth; the outer rings of the moons are what we see from the earth.

SUMMARY: *The effect of the moon on short-wave reception is more marked than is usually thought. Signals which come in with tremendous loudspeaker volume on some nights are only mediocre or disappear altogether on other nights. Some of the variations in intensity are, no doubt, due to variations in the height of the Kennelly-Heaviside layer, variations in the degree of ionization of the layer, etc.; but there is no doubt about the fact that some part—perhaps in some cases the greater part—of the variation in signal strength is due to the location of the moon with respect to the earth and the sun.*

Capt. Hall in the U. S. and Mr. Reading in England have made observations on the effect of the moon, and we take pleasure in reporting their findings for the benefit of readers.

By Louis Martin

IT SEEMS that this business of short-wave reception gets more and more complex as time goes on. First, we are told that the height of the Kennelly-Heaviside layer determines the maximum distance that it is possible to receive under given conditions, such as frequency, location, angle of radiation, etc. Second, the star gazers give us to understand that the height of this layer depends to a large extent upon sun spots, and so we conclude that we must consult Ol' Sol when we want to find out how signal conditions will be in the next ten years. And now we find that the moon, which has stood more or less in the background during the discussion, bursts forth and demands to be heard.

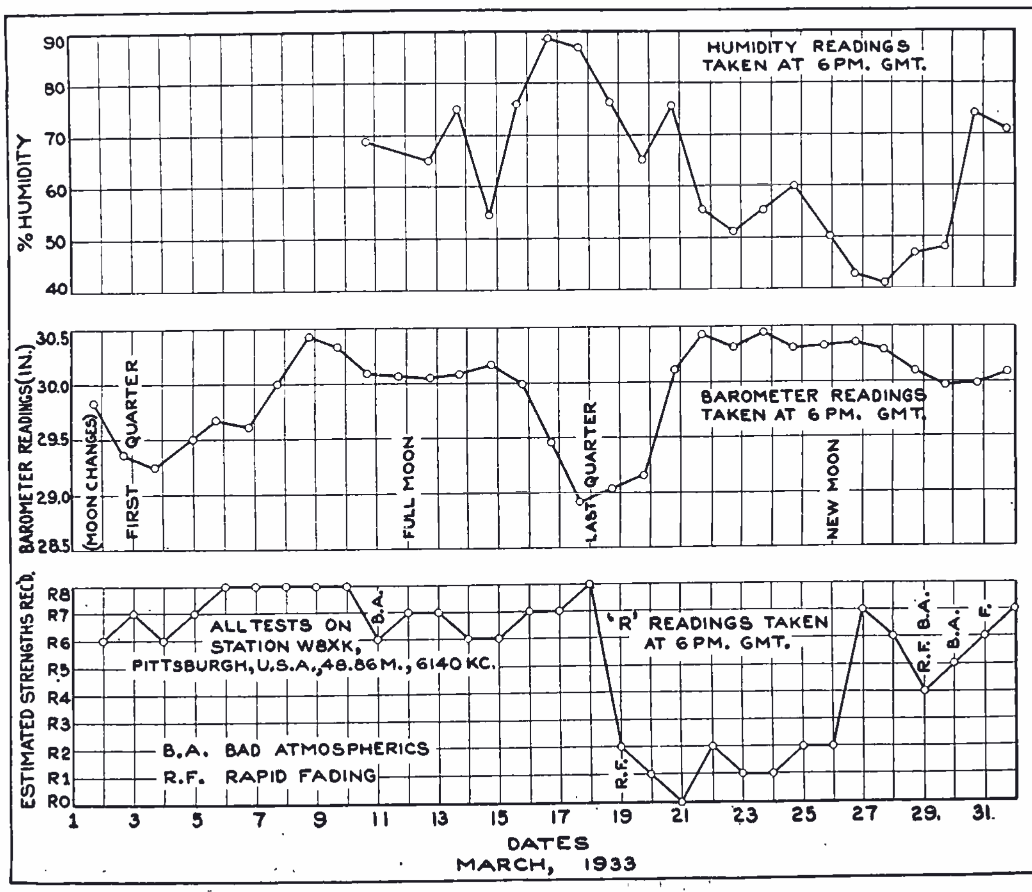
Variations Recorded Before

Variations in short-wave radio reception caused by lunar variations are not uncommon, such variations having been recorded time and time again; only, the results have been kept from the listening public by virtue of the fact that the variations are so complex that only a statistician is able to separate the wheat from the chaff.

For listening purposes it is not necessary to have charts and diagrams strewn all over the walls and floor in order to tell when best reception conditions prevail; all that is required (maybe!) is a knowledge of when we have a new moon, quarter moon, full moon, etc. Furthermore, after being given a few hints, every listener can collect his own data. In fact, it is our purpose to get as many reports as possible from people all over the world, so that we may collect and tabulate the data.

Your editors never gave a thought to lunar variations insofar as they affected short-wave reception conditions. We knew that they existed, of course, but we were waiting for some combination astronomer and short-wave fan to come along with a story outlining in detail his observations. (You readers have no idea of the amount of time it takes to collect *good* information of this sort, and there is *so* much information to collect.) Capt. H. L. Hall made the first suggestion to us.

Capt. Hall is not an astronomer, but a seafaring man of the old school. In relating some of his experiences to the editors, he made it



VARIATION OF RECEPTION OF W8XK IN ENGLAND BY MR. READING
Humidity and barometric pressure are also listed for completeness.

To All Listeners

WE are starting an active campaign to determine the effect of the moon on short-wave reception conditions. Because we have no extensive laboratory equipment to actually make precise measurements, we ask every listener, regardless of where he lives, to collect data and send it in for compilation.

As stated in this article, we have a hunch that signal strength varies with the position of the moon—excellent signals when the moon is full, and poor signals when the moon is new. We would like to verify this hunch so that listeners may, if the thing works out, know just what parts of the month are best suited for radio reception.

Your own interest in short-wave reception will increase tenfold while you do the collecting. It's much nicer to know why signals are weak than to hunt and hunt in vain. There are no rules or regulations: simply collect the dope as outlined in this article and shoot it in. Let's go!

quite clear that a good, working knowledge of astronomy is an essential part of the training of a master mariner. The Captain dropped down to the office one rainy afternoon and started on what promised to be a real, healthy sea story. He didn't get very far before the moon came into the picture. "And, by the way," he declared, "I've been noticin' some interestin' variations of signal strength that I tied up with the moon." We quizzed him for a while and went up to his home to examine his log. His results follow:

When there is no moon visible at all—technically, when there is a new moon—signal strength from all foreign stations is very poor. Stations that usually come in like locals are hardly audible on the phones. Interference from static is bad and station announcements are unreliable—if you do not know the station you are listening to, better wait for another announcement.

When the new moon is just starting to show, the signal strength begins to increase, static becomes less, and reception in general is better. After the first quarter has appeared, signal strength is good. Stations from all over the world are heard, and the Captain starts his real DX-ing. Signal strength continues to build up gradually until the moon becomes full, at which time the signal strength is at maximum.

The signal strength continues excellent until the moon starts into its last quarter, at which time signals again start to decrease in strength. The signals are weakest when there is a new moon—no moon visible.

An excerpt from Capt. Hall's log for four days during changes in the moon is interesting:

On Saturday, September the 9th, 1933, the moon was full; signals from Germany, England, Rome, Spain, and France were very good—R9, in fact.

On the 10th the moon started toward the last quarter. All foreign stations were heard, but the signal strength dropped to R3.

On the 11th the moon was in its last quarter; the signals from some stations were about R2; Rome was completely out.

On the 12th the moon was disappearing; reception on all of the stations mentioned above was R2 except Germany, which was R4; Rome could not be heard at all; Spain was so weak that it was not even considered.

The weather conditions in New York during these days were excellent. It was cool and sharp, and anyone would be led to believe that China could be heard with a crystal. The interesting part of the whole business is that many people—at least, in New York—were wondering what had gone wrong with their receivers. They really expected good results, and got nothing.

A Report From England

A report of reception conditions from England was received by Capt. Hall. This report had to do with variations in reception conditions due to variations of the position of the moon. Mr. L. F. Reading, who compiled the information in England, drew a curve showing the variations in signal strength; we reproduce it here.

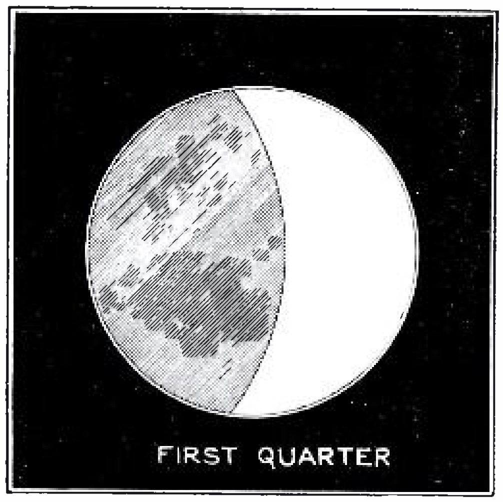
Mr. Reading's information is especially enlightening. First, he records the actual temperature and humidity along with the signal strength. Second, he shows the variations of the strength of a *single, good station.* It is essential to record only the strength of good stations, for the simple reason that poor ones frequently change their adjustments, power, frequency, etc., so that it is impossible to know whether or not a signal changes strength because of changes at the transmitter or changes in cosmic conditions.

Note, also, that Mr. Reading's results correspond to those of Capt. Hall. From the time the moon enters the first quarter to the time it goes into the last quarter, signal strength is good. Just before the new moon appears, the signal strength is low, but increases rapidly as the new moon comes up.

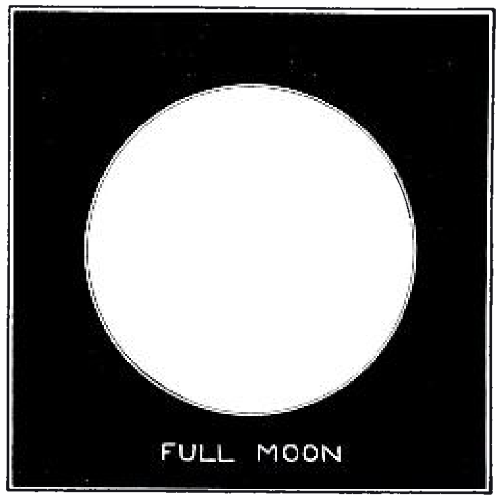
It is difficult to check up on the effect of humidity and barometric pressure on signal strength from a single curve. For an accurate compilation, a number of such curves

(Continued on page 45)

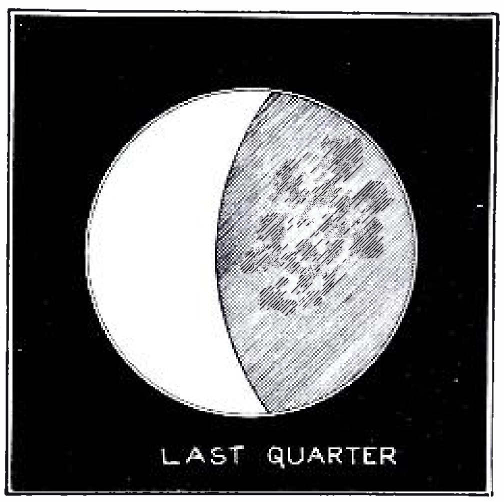
Reception is poor, erratic, and cannot be relied upon for consistent work.



Signal strength starts to rise, and receiving conditions begin to improve.

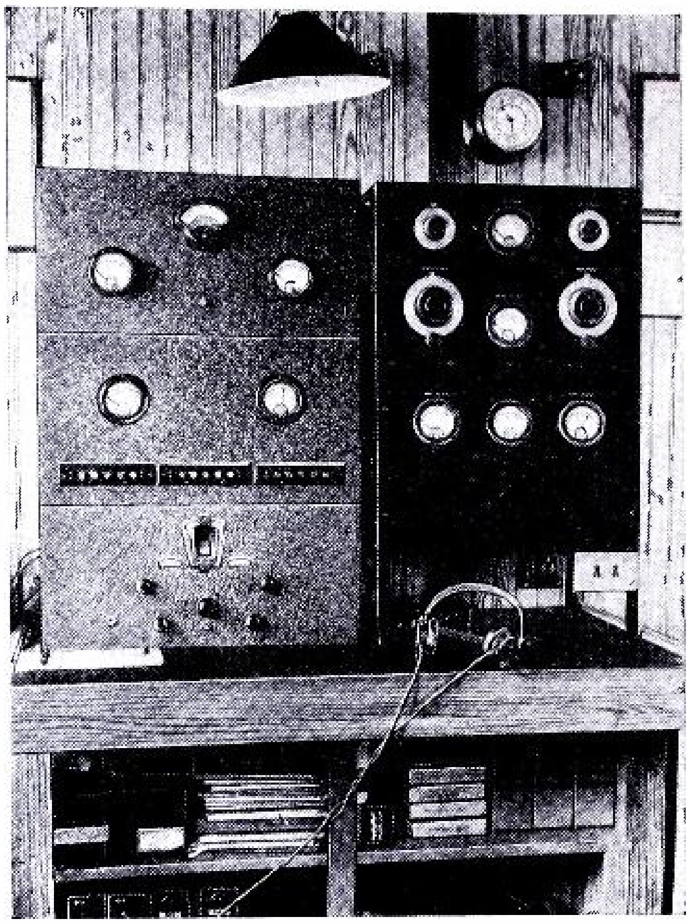


Receiving conditions best, and general reception conditions excellent.



Signal strength starts to drop again as the moon starts from its last quarter.

A Compact Amateur Station—W2FIU



SUMMARY: *One of the most complete and at the same time one of the most successful amateur stations in the East is W2FIU, owned and operated by Fred Parsons, a ham of the old school. Essentially, as may be seen by referring to the photograph to the right, the station consists of a "Pro" receiver—above which is mounted a control panel—and a simple, but effective, crystal-controlled transmitter.*

The transmitter itself is not fancy—it uses a straightforward circuit, amply protected and carefully tuned to the second harmonic of the crystal. And the mast! Just glance at the drawings and photographs. It was completely assembled by Parsons and raised with the aid of three men and a block and tackle.

Even though the station is not on the air consistently, the following countries worked are all "meat": all U. S. districts; Canadian 1st, 2nd, 3rd and 4th districts; Mexico; Costa Rica; New Zealand; Australia; Belgium; Portugal; and French Indo-China.

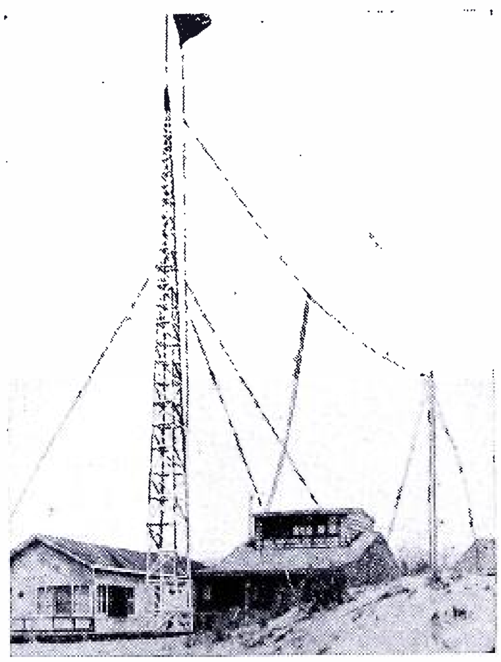
By Robert Hertzberg

W2FIU is a good example of what can be accomplished in a very limited amount of space. No ham ever has as much room as he likes; but after a long period of building, tearing down, and rebuilding, he finally evolves a general station layout that has all the desirable attributes of a good amateur outfit—namely, operating convenience and comfort, neat appearance, ease of control and adjustment and overall operating effectiveness.

The builder, owner, and sole operator of W2FIU is Frederick A. Parsons, for more than twenty years one of the leading amateurs of the Bronx, New York. Parsons has built actually dozens of transmitters, ranging from breadboard models to outfits that covered two sides of a room measuring 20 feet square. His present station, W2FIU, represents a tremendous amount of accumulated experience of this kind. He has eliminated many unnecessary frills and has concentrated his efforts on producing an outfit that really works, not one that merely looks pretty.

The station as pictured on the front cover and in the accompanying illustrations is located in a small attic-like room, built on the top of a one-story summer bungalow at Rockaway Point, Long Island. As the house is only about a hundred feet from the Atlantic Ocean at high tide, a very serious difficulty was produced by the all-pervading salty atmosphere, which quickly raises the devil with poorly soldered joints and the like. The room measures about 8 by 10 feet and, like so many other radio shacks, is also the sleeping quarters of the owner—when he does sleep. The operating table on which the receiving and transmitting apparatus is mounted is only 4 feet long and about 2½ feet deep. The station is arranged in the form of two main units: the receiver, on the left, and the transmitter, on the right.

The receiver proper, shown in the lower left-hand section, is a standard Hammarlund Pro. Mounted directly above this is a control panel, by means of which power for the receiver and the additional audio amplifier is controlled and various switch-overs between receiver, amplifier, and various loudspeakers are made. The uppermost panel covers a separate 45 push-pull amplifier stage which takes the output from the Pro. This receiver, going full blast, is truly something to hear. The location is a phenomenally good one—the land is perfectly flat and there is salt water on two sides—and stations from every point on the face of the earth roar in with unbelievable strength. The receiving antenna is simply a single piece of wire only about 40 feet long, running to a point on the mast about 20 feet above ground.



The antenna system at W2FIU as viewed from the edge of the Atlantic Ocean

The transmitter is of the master-oscillator-power-amplifier type, with crystal control, and operates exclusively on 7080 kc. (in the so-called 40-meter band). While there is nothing radically unusual about its fundamental electrical circuit, it recommends itself because of its utter reliability and general efficiency. Refer to the schematic diagram and we will follow the circuit from start to finish.

Tube V1, of the 2A5 type, is the oscillator, being energized by a 3540 kc. crystal. Inductor L1 and condenser C8, in the plate circuit of this tube, are, of course, tuned to the crystal frequency. The output of the oscillator is coupled to tube V2, of the 10 type, through coupling condenser C3. This tube acts as a doubler—that is, it is an amplifier, but it amplifies the second harmonic of the oscillator, in other words, 7080 kc. Inductor L2 and condenser C8 are, therefore, tuned to this higher frequency.

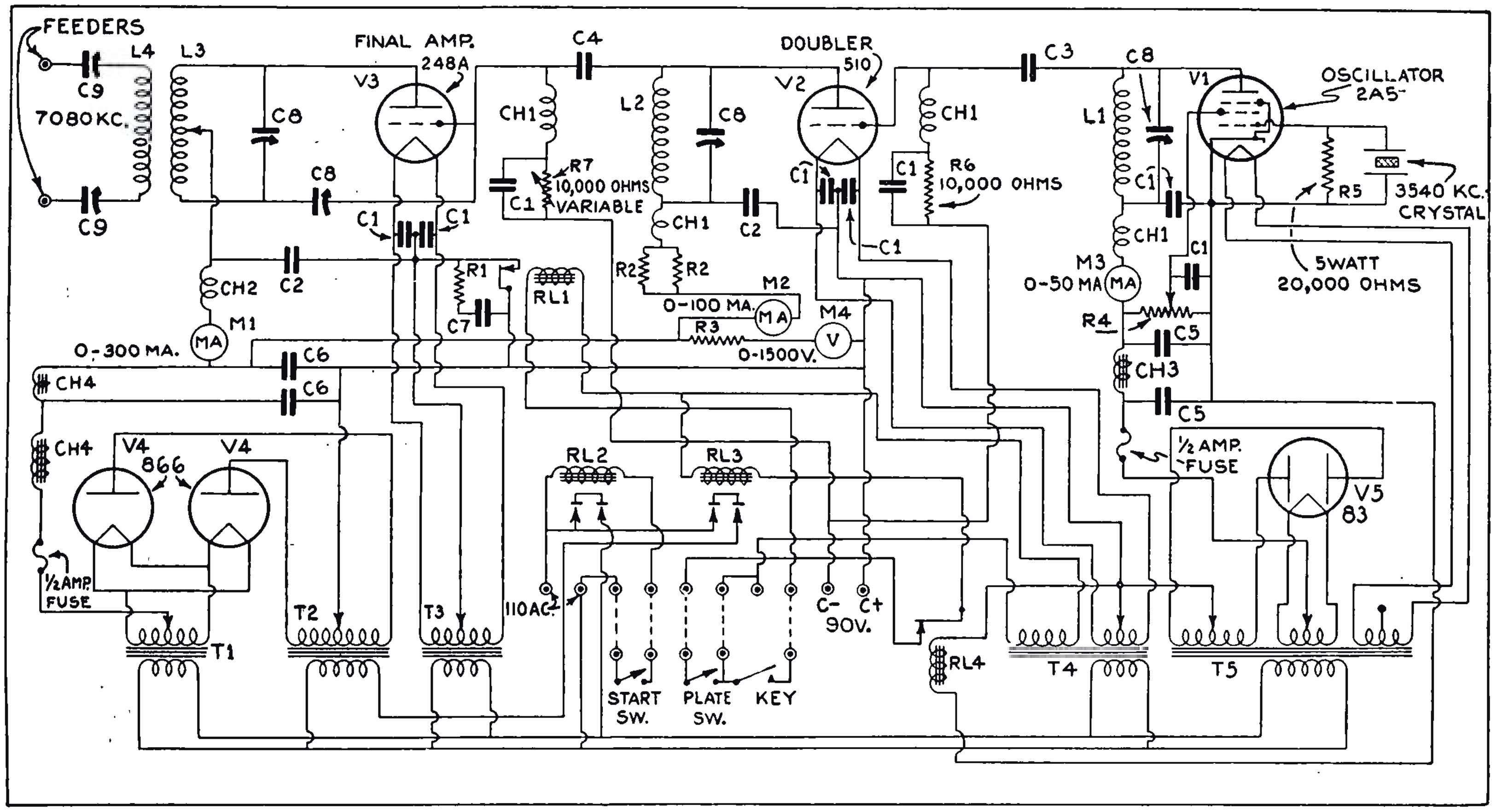
The output of V2 is then coupled through condenser C4 to tube V3, which is a final amplifier of the 248A type. This is a Western Electric tube of the so-called 50-watt class. Inductor L3 and condenser C8 are, of course, also tuned to 7080 kc. This stage is neutralized, to prevent feedback from the plate to the grid, by means of the small neutralizing condenser C8, connected between the grid of V3 and the bottom of inductor L3

A regulation 2-wire Zepp feeder is energized through L4, which is in simple inductive relationship to L3. The feeder system is tuned to resonance by means of the series condensers C9. This takes care of the entire radio frequency .portion of the transmitter.

The oscillator has its own power supply unit, consisting of the power transformer T5, rectifier V5 (which is an 83), the filter system CH3, condensers C5, and the output potentiometer R4. An 0-50 ma. milliammeter, M3, indicates the plate current of this tube.

Another completely separate power pack supplies plate voltage for V2 and V3. This consists of power transformer T2, two type 866 mercury-vapor rectifiers (which have their own filament transformer T1), and a filter system consisting of chokes CH4 and condenser C6. Tubes V2 and V3 are provided with individual filament transformers as a matter of safety, as the power transformer T2 develops a maximum of 3000 volts and leakage between the high voltage winding and a number of low voltage windings on the same core would be inevitable. Transformer T4 has two 7½-volt secondaries, one to light the filament of V2 and the other to operate the keying relay, RL1, and the plate relay RL3.

An ingenious delay system makes it impossible to turn on the high voltage to the power tubes V2, V3, and V4 before they have had a chance to warm up. As many amateurs have learned to their sorrow, a delay system of this kind is exceedingly important; if the high voltage is thrown on the tubes while they are cold, the usual result is a bunch of punctured filter condenser or wrecked tubes. Parsons has gotten around this problam by placing in the cathode return circuit of the oscillator tube (V1) a simple d.c. relay, RL4. Let us turn on the set by closing the switch "Start SW" and see what happens. This switch energizes the relay RL2, which, in turn, puts 110 volts a.c. into the primaries of transformers T1, T3, T4 and T5. Note that the high voltage transformer T2 is not energized, because this is controlled by the switch marked "Plate SW" through



COMPLETE SCHEMATIC DIAGRAM OF THE TRANSMITTER USED AT W2FIU

PARTS LIST

C1—.001 mf. Sangamo standard fixed condensers.
C2—.001 mf. Sangamo 2500-v. fixed condensers.
C3—.0001 mf. Sangamo standard fixed condensers.
C4—.00025 mf. Sangamo 5000-v. fixed condensers.
C5—2 mf. 750-v. filter condenser.
C6—2 mf. 1500-v. filter condenser.
C7—1 mf. 500-v. key click suppressor condenser.
C8—50 mmf. Cardwell variable condenser.
C9—100 mmf. Cardwell Mid-way Transmitting condensers.
CH1—Hammarlund 8 millihenry r.f. choke.
CH2—Hammarlund 5.3 millihenry heavy-duty r.f. choke.
CH3—30-Henry single choke, 100 ma. capacity.
CH4—Double 30-Henry choke 250 ma. capacity.
RL1—Ward Leonard a.c. 7.5-v. No. 507-508 relay (keying).
RL2—Ward Leonard a.c. 110-v. No. 507-510 relay (keying).
RL3—Ward Leonard a.c. 7.5-v. No. 507-508 relay (keying).
RL4—Small d.c. relay to operate on 15 to 20 ma.
T1—866 Fil. Transformer 2.5-v. sec. 10 amp.
T2—866 Plate Transformer 1500-0-1500 v.
T3—50 watt final fil. transformer 10-v. 10 amp. capacity.
T4—Doubler fil. transformer 2-7.5-v. sec.
T5—Osc. power supply trans. 1-2.5-v., 1-5-v., and 1-350-0-350 secondaries.
M1—0-300 ma. Weston 301 flush mounting d.c. meter.
M2—0-100 ma. Weston 301 flush mounting d.c. meter.
M3—0-50 ma. Weston 301 flush mounting d.c. meter.
M4—0-1500-v. voltmeter Weston 301 model flush mounting.
M5—0-3 amp. thermgalv. Weston—can be placed in either feeder.
R1—500 ohm. 5-watt resistor.
R2—Two 22,000 ohm, 100 ma. resistors in parallel.
R3—Weston multiplier for 1500-v. voltmeter.
R4—15,000 ohm. bleeder and voltage divider.
Note: Voltage on screen grid of osc. should be about 25% of plate voltage.
R5—20,000 ohm. 5-watt resistor.
R6—10,000 ohm. 25-watt resistor.
R7—Power Clarostat 80-watt, 200-100,000 ohms.
L1—24 turns No. 16 wire double spaced 2" diameter.
L2—12 turns No. 16 wire double spaced 2" diameter.
L3—12 turns 3/16" copper tubing 3" diameter 3/16" between turns.
L4—9 turns 3/16" copper tubing 3" diameter 3/16" between turns.
V1—2A5.
V2—10.
V3—248A, or standard 50-watt tube.
V4—866 mercury-vapor rectifier.
V5—83 mercury-vapor rectifier.
Tap on L3, 5 turns up from bottom.
Neutralizing variable condenser, 50 mmf. small transmitting type variable condenser able to withstand high voltage (3000 v.). Hammarlund double spaced.

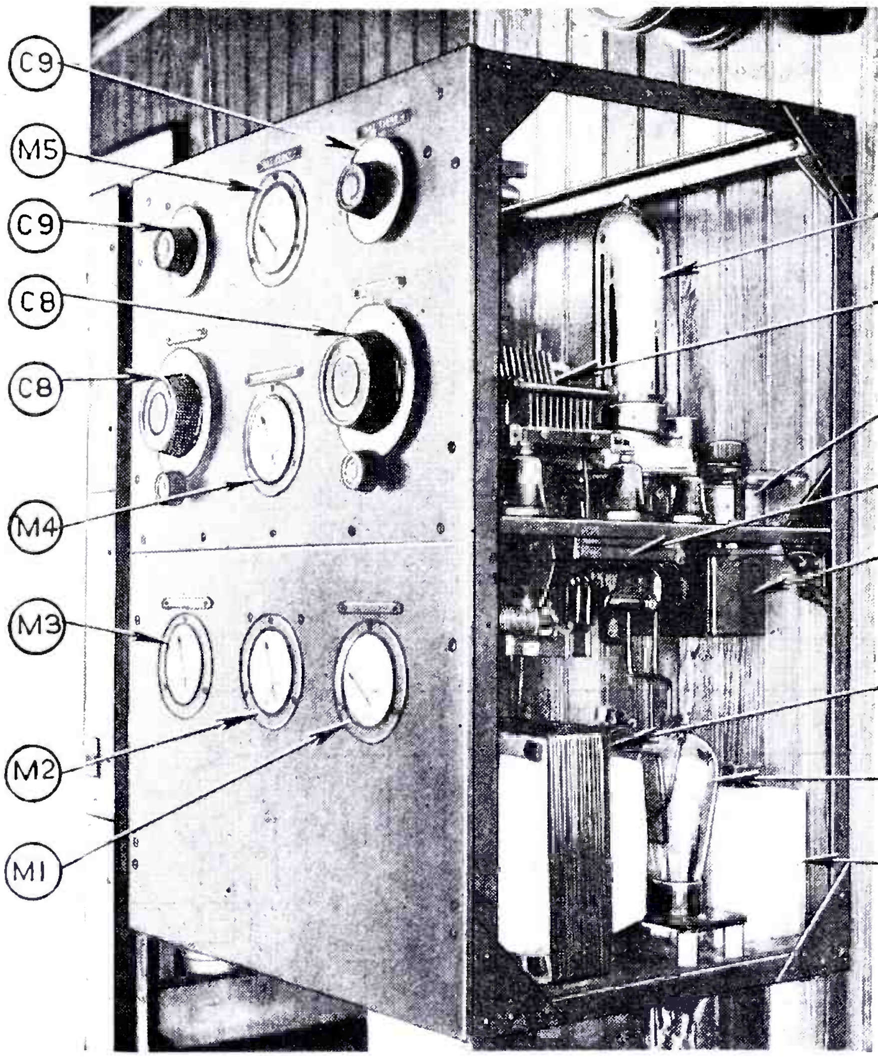


FIG. 1—PANEL OF THE TRANSMITTER
The lettering corresponds to that of the schematic circuit.

the relay RL3. If, by accident, this switch should be closed at the time the start switch is closed, relay RL3 still will not close for the reason that its energizing coil is in series with the contacts of the relay, RL4. Now, RL4 will remain open for an appreciable length of time, about 20 seconds, until the oscillator tube has heated up thoroughly and the plate current, therefore, built up to normal. Tubes V2, V3, and V4, being of the filament type, heat up more quickly, but the 2A5 oscillator is of the cathode-heater type and builds up comparatively slowly.

The Relay System

This relay system sounds very complicated on paper, but it is really beautifully simple in practice, since it is entirely automatic. It is quite a revelation to sit at this outfit and to hear relay RL4 click shut after the start switch has been turned on. The slight cost of the additional relays is very cheap insurance for the very much more expensive power and rectifier tubes. Of course, once the tubes are warmed up, they are left running and the plate switch is simply opened during reception periods if the local signals set up by the oscillator and the doubler interfere with the reception.

Keying is accomplished by means of a regular hand-telegraph key which operates relay RL1. The contacts of this relay simply open and close the plate circuit of the final amplifier tube V3. Keying thumps are entirely eliminated by the filter consisting of R1 and C7, connected across the relay contacts. There is absolutely no sound of W2FIU's signals in an extremely sensitive broadcast superheterodyne located only about seven feet directly under the transmitter. A keying relay in a powerful transmitter of this kind is an absolute necessity. It would be extremely dangerous to bring out the plate leads directly to an exposed key on the operating table.

Various other details of the circuit make themselves clear upon study. V3 has its own plate milliammeter, M1, while tube V2 has its own meter, M2. A 0-1500-volt d.c. voltmeter, M4, indicates the plate voltage to the doubler and final amplifier tubes. Resistor R3 in series with this meter is merely the multiplier. The two resistors marked R2, connected in parallel with each other but in series with the high-voltage lead to V2, drop the voltage to a respectable value for this tube.

Radio frequency coupling between the tubes V1, V2, V3 and the power packs is prevented by the choke coils CH1, CH1 and CH2 in the respective B plus leads. The final amplifier neutralizes very easily, and the whole system works with perfect stability.

The mechanical features of the assembly are shown in detail in the three accompanying illustrations, Figs. 1, 3 and 4. The layout of the framework as constructed by Parsons is shown in Fig. 2. Of course, it is not necessary to follow these dimensions exactly, but they are given for the benefit of people who like to get their information accurately.

Panels Used

There are two panels which cover over two individual shelves on the framework. The lower panel and shelf hold all the power equipment and the upper panel and shelf the r.f. units. This logical separation makes both wiring and adjustment easy.

The r.f. units on the top shelf, when viewed from the rear as in Fig. 3, follow the schematic diagram fairly well. In other words, the crystal is on the extreme right, and then across to the left are V1, V2, V3, and the various inductors, condensers, and resistors. Notice that the neutralizing condenser C8 is mounted between V2 and V3 and is not on the front panel. It does not require continual adjustment and, therefore, there is no need for having it occupy good space on the panel.

More for the sake of appearance than anything else, the relays RL2, RL3 and RL4 are enclosed in a small aluminum shield can that is placed between transformers T5 and T3. The keying relay, RL1, is mounted directly under the socket of the amplifier tube V3, so the leads to its contacts are kept very short. The apparatus looks rather jammed up in the illustrations, but actually, everything is laid out in a very logical manner. The symbols of the various parts in both the photographs and the schematic diagram are the same and the parts may be checked from one to the other.

Because of the proximity of the

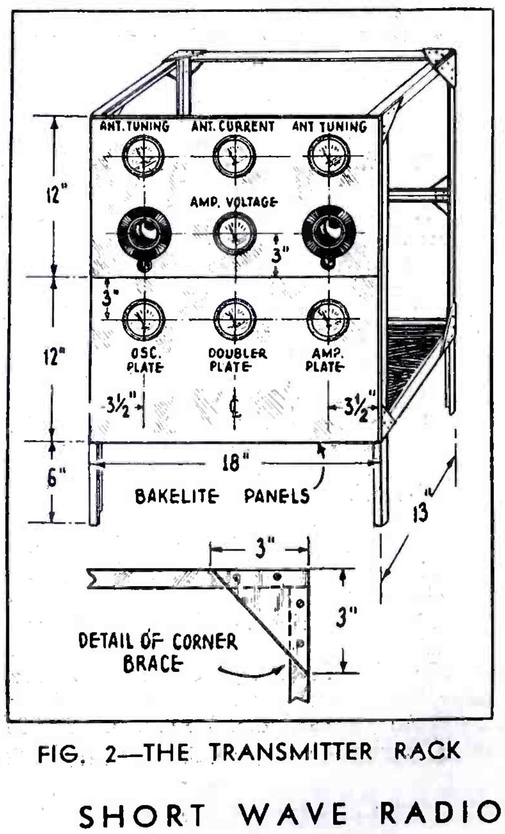


FIG. 2—THE TRANSMITTER RACK

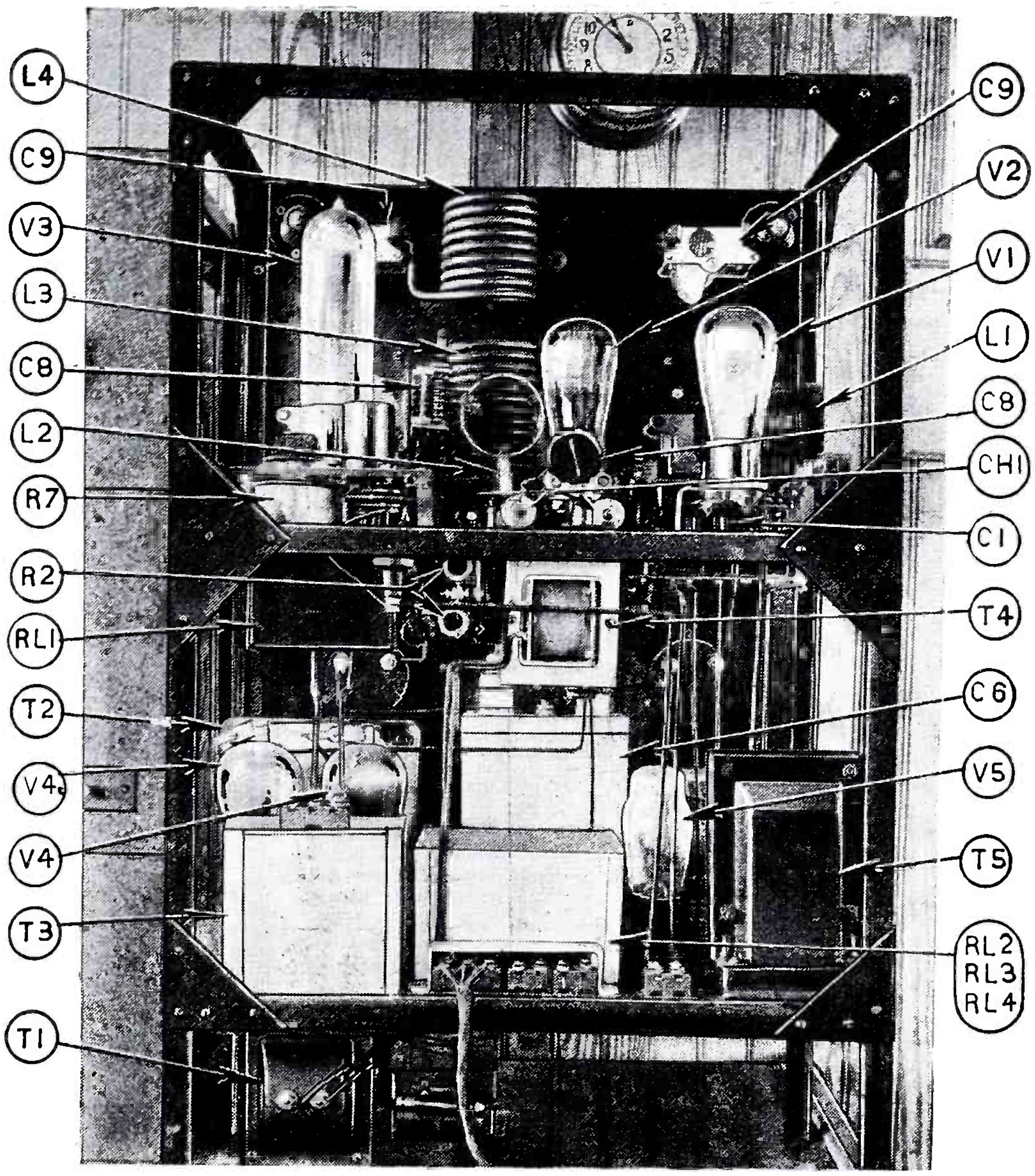
station to the ocean, particular attention was paid to insulation. All r.f. units are mounted on small porcelain stand-off insulators to prevent trouble from creepage. Even so, flashovers occur occasionally. Under these conditions, the various half-ampere fuses were found essential.

Under full load, with the set thoroughly tuned up, V1 has 350 volts on its plate, V2, 600 volts, and V3 1100 volts. These are nominal values and assure long life for the tubes.

The Antenna

The antenna employed at W2FIU is a regular half-wave doublet, current-fed at the exact center. The two flat-top sections are each 34′ 2″ long for the particular frequency used by the station. This wire is held 55′ above the ground by means of one lattice work tower and another straight-up mast. The parallel feeders are 38′ long and are spaced 7″ apart.

The four-legged wooden tower is in itself a very unusual piece of work for an amateur station. With the exception of the job of raising it, Parsons made up the whole thing himself. He has had considerable experience with masts of this kind, having at one time erected a 110′ tower in New Rochelle, N. Y. The present tower is 39″ square at the base and tapers to a point at the top, the aerial wire itself being



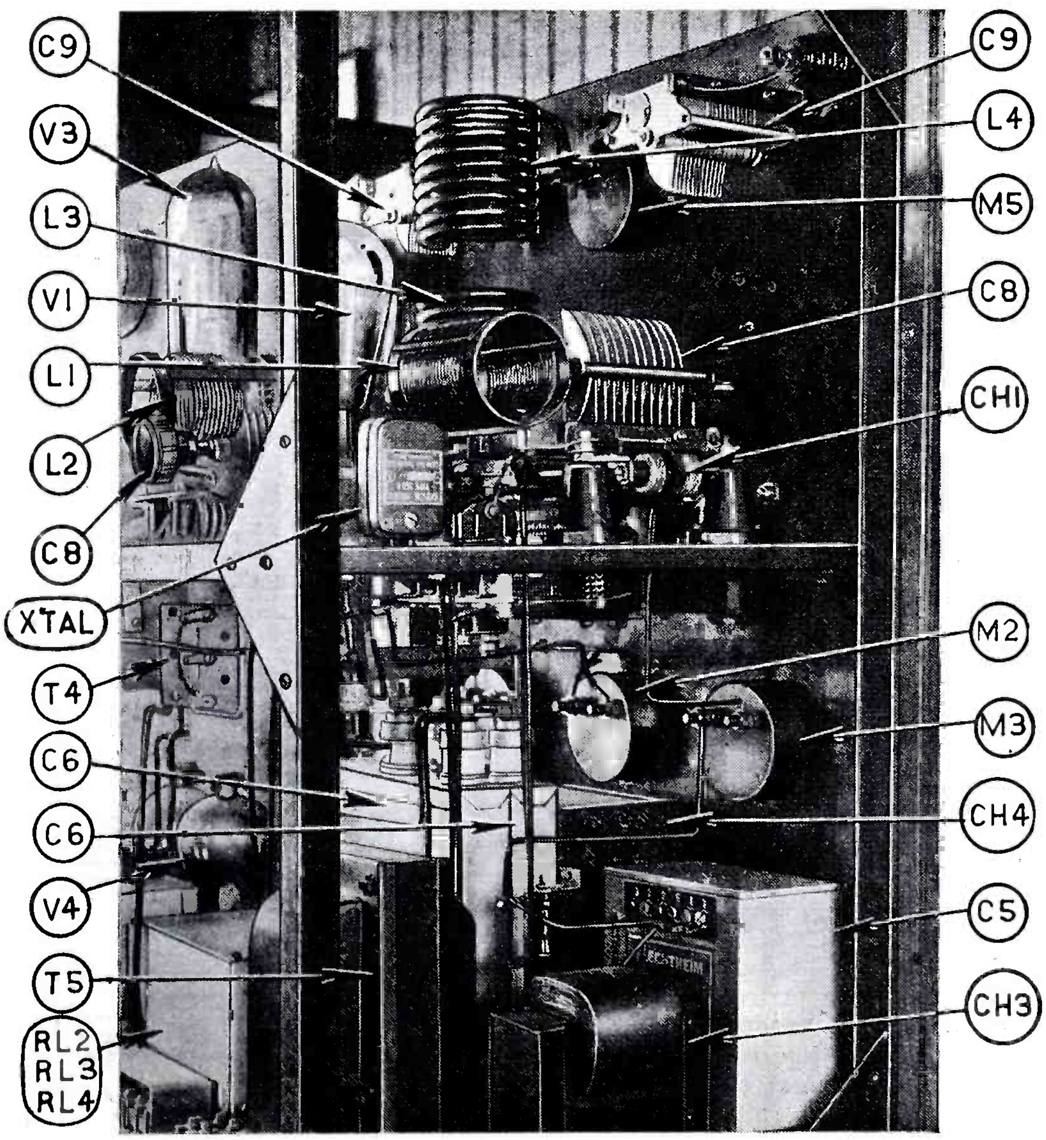


FIG. 3—ABOVE: REAR OF THE XMITTER

FIG. 4—LEFT: SIDE VIEW OF THE XMITTER

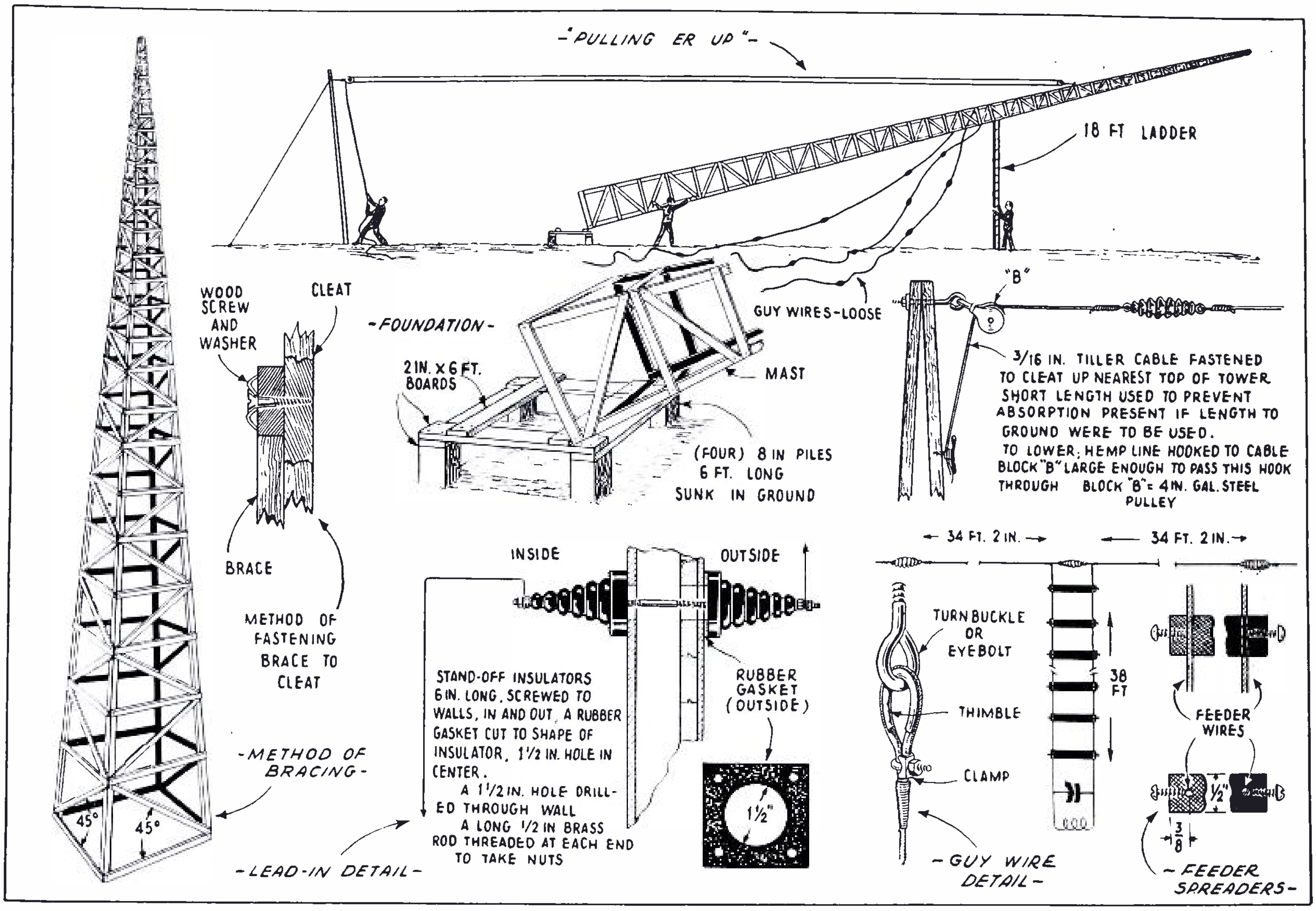
The lettering corresponds to that given in the schematic.

hooked to a flagpole. The legs are of 2″x2″ material, each leg consisting of three overlapping sections bolted as shown. The bracing pieces are 1″ x 2″ material fastened to the legs by means of 2″ galvanized wood screws (not bolts). The diagonal braces are all places at an angle of 45° to the horizontal, thus automatically reducing the size of the panels toward the top.

The guy wires are 5/16″, 7-strand galvanized iron, broken up by strain insulators at 12′ intervals and secured to the tower 33′ from the base. The unsupported, or free end above the guys deflects only about a half-inch under 500 lbs. strain. Some idea of the strength of this home-made tower may be had from the fact that it successfully withstood a 105-mile-an-hour gale during one of the bad storms of this past summer.

A continuous steel band 2″ wide and ⅛″ thick, surrounding the tower at the point where the guys are fastened, prevents the legs from pulling apart at this point.

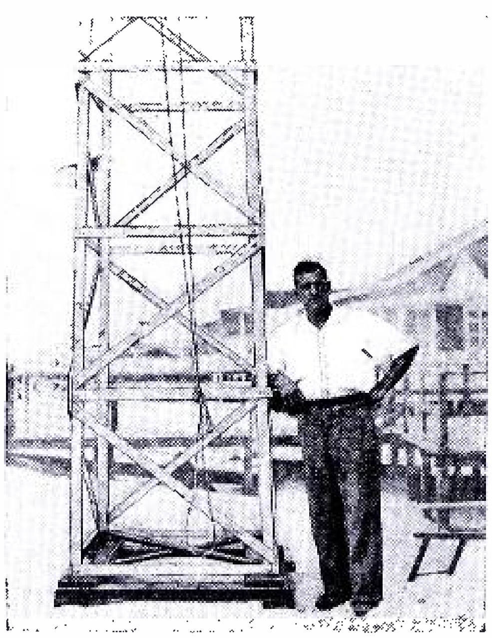
The base anchorage consists of four 8″-diameter wooden logs 6′ long and buried 4′ in the sand. Drifting sand has piled up over the



DETAILS OF THE ASSEMBLY AND CONSTRUCTION OF THE 55-FOOT MAST

base and prevents these logs from showing in the illustrations.

The entire mast was assembled on the ground. The four legs were spliced first. Two of them were laid on a walk 39″ apart at the base and meeting at the top. They were lined up perfectly straight by sighting along each leg and secured in this position temporarily with a few nailed cross-pieces. The 45 degree angle cross-braces were then all put in place. Exactly the same procedure was followed with the other legs.



Fred Parsons at the base of his 55-foot mast.

The two completed sides were placed on edge, the points meeting and with the wide ends 39″ apart. The bottom edges were lined up and held apart by some more temporary strips. The tops of the two sides were then lined up and the permanent 45 degree braces screwed on. The whole tower was turned over 180° and the fourth side completed.

The method by which the tower was hoisted in place (and, needless to say, this was done on a quiet day), is shown in the accompanying illustration. The services of at least three men are required. Of course, the guy wires were fastened in place first. Anyone contemplating the erection of a mast of this kind will have to rent or borrow a block and tackle, and, preferably, avail himself of the advice of a rigger. It is also necessary to have good supports for the guy wires, as there is considerable strain on these.

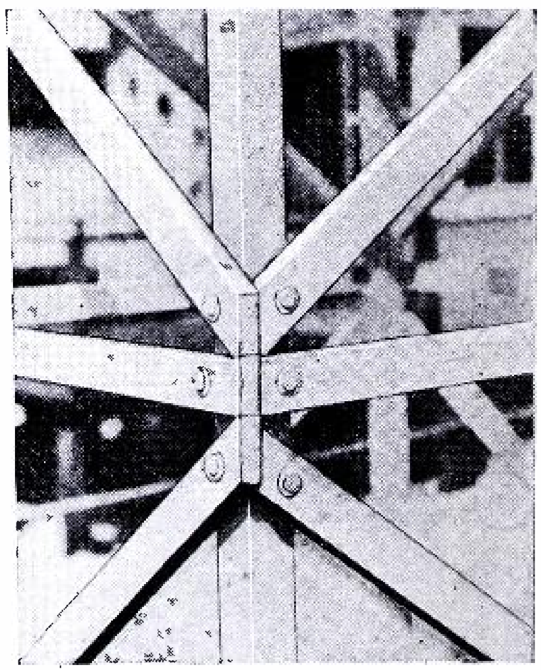
Parsons has great difficulty in convincing people that he designed and built this tower himself. With the exception of the block and tackle, all the equipment he used can be found in any amateur's tool box. The really important requirements are solid foundations.

While it is not likely that many amateurs will attempt to duplicate a mast of this kind, so many visitors at W2FIU have inquired about it that we are running this general dope as a matter of interest.

Editor's Note

The description of this station is typical of what we would like to receive along these lines. Note that photographs are used whenever possible.

We solicit explanations of amateur stations. Make sure, though, that the information is complete and, what is far more important, that the station is actually operating under the same conditions as explained in your manuscript.



View showing the construction of the braces.

Satisfactory Short-Wave Reception

PART II

By Arthur H. Lynch*

As a direct result of the unsatisfactory reception on short-waves, which was very general up to a short time ago, there still remains a large number of people who are missing the extremely interesting programs which may be picked up on the waves below the regular broadcast band.

So much of importance and tremendous interest may be heard on the short-waves which would be unavailable to us otherwise, that it is our purpose to attempt to rectify some erroneous impressions now existing and to make it possible for more people to enjoy short-wave programs. Quite contrary to the general impression held by those unfamiliar with this new field, short-wave receivers are not particularly expensive, and short-wave programs may be received with comparative ease if a few simple rules are followed and ordinary intelligence used.

New Receivers to Be "All-Wave"

As a direct result of the rapidly growing interest in short-waves, nearly all of the large receiver manufacturers are going to introduce so-called "combination," or "all-wave" receivers as major items in their lines this year. Most of these receivers will be capable of operating over a wavelength range from 15 to approximately 600 meters. A suitable switching arrangement provides the shift from one wavelength to another. While there is nothing particularly new in the idea, and while receivers of that type have been available for the past few years, this is the first year that the importance of short-waves has been realized by all of the radio manufacturers, and that the sale of this type of receiver has become so general.

Comparative Performance

In connection with our own experimental work, we have used nearly every type of short-wave receiver, as well as the combination broadcast and short-wave receivers. On the higher grade "combination" receivers, we have been able to secure reception of foreign programs with as good quality and as good volume as we ordinarily get from our local broadcasting stations with an ordinary broadcast receiver.

Naturally, because of the limited number of coils it is possible to use in a receiver of this nature, the stations are not separated as far on the dial as they are on receivers that have been designed for short-wave use exclusively. In our opinion, there is a tremendous field for the "combination receiver," and we believe its performance will satisfy nearly everyone who is casually interested in the short-wave bands. However, where the best short-wave results are desired, we are inclined to agree with Captain H. L. Hall, whose experience in connection with the reception of foreign stations on the short-waves makes his judgment valuable.

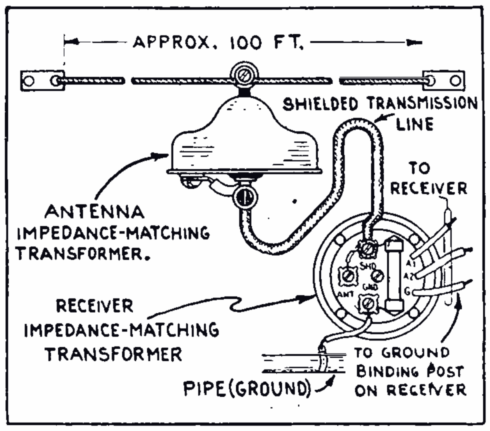


Fig. 1—A suitable broadcast antenna.

For short-wave reception the doublet antenna shown in Fig. 2 below is recommended.

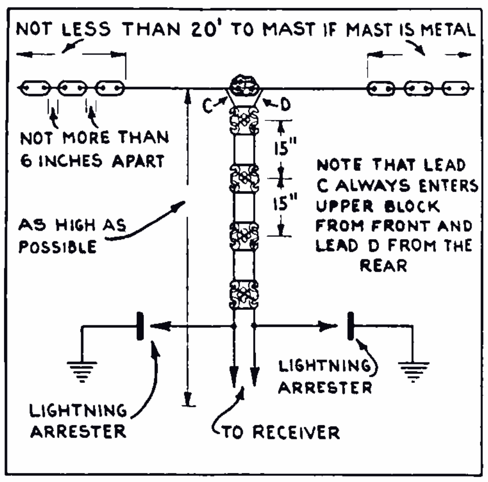


Fig. 2—A suitable short-wave aerial.

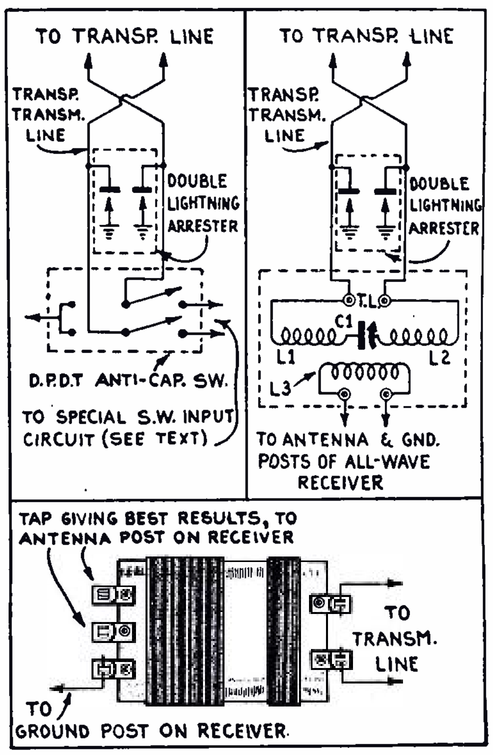


Fig. 3, upper left—Lightning arrester.

Fig. 4, lower—A universal antenna coupler for ungrounded transmission lines.

Fig. 5, upper right—Tuned antenna system.

The Captain has told me repeatedly that he secures very much more satisfactory results from a short-wave receiver which requires 5 sets of coils to cover the wavelength range from 15 to 200 meters than he has been able to obtain from any of the combination receivers. He has also duplicated our own experience, which indicates that the reception of short-wave broadcasting, without interference, is accomplished better when a receiver employing one stage of tuned radio frequency and a regenerative detector is employed than when a superheterodyne receiver is used. By a suitable coupling arrangement between the antenna and the receiver, a razor-like separation is obtained and receivers of this nature are naturally more free of irritating background noises than the supers.

Using the "Combinations"

One of the pioneers in the short-wave field as well as in the introduction of "combination" receivers is Mr. E. H. Scott, of Chicago, the designer of the Scott All-Wave receiver. This particularly high-grade receiver is in use in all parts of the world, and many Scott owners have written to me outlining the exceptional performance they are getting.

Mr. Scott, who is one of the most successful of modern radio manufacturers, has long realized the importance of having a good antenna system. Therefore, his receivers are provided with two distinct antenna input circuits. One is designed for use in the broadcast band and the other is designed for use in the short-wave band.

The ideal combination for use with the Scott receiver is a single horizontal wire, approximately one hundred feet in length, coupled to the receiver by a pair of impedance-matching transformers and a shielded transmission line, as illustrated in Fig. 1. An entirely separate antenna, of the doublet type, coupled to the receiver by a transposed transmission line, as described in my November article, is most suitable for use on the short-wave band. See Fig. 2. The two antennas should be as far from each other as possible to prevent absorption and reflection.

* President, Lynch Mfg. Co.

This Article to Date

The second of a series of practical articles, based upon research work which has been conducted by the author and others.

From Mr. Lynch's November article we learned:

That short-wave broadcast reception of foreign stations can be as good as a local program on the regular broadcast band.

That so-called "bad" locations lose much of their badness, if simple, inexpensive precautions are taken.

That satisfactory short-wave reception depends to a large extent upon the use of a good antenna.

That much interference can be cut out by a simply constructed transposed transmission line.

That the horizontal portion of the antenna can be several hundred yards from the receiver without any noticeable loss of volume.

That the best antenna for picking up the most popular short-wave stations in Europe and Australia is a "doublet" with each half of of the horizontal portion 78 feet long.

That the best directional effect—for receivers located in the U. S.—on European and Australian stations is obtained by running the horizontal portion in a NW-SE direction.

That two four-wire cages, each 39 feet long, are the next best thing to the 78-foot single wire halves of the doublet.

That a suitable antenna will reduce interference caused by passing autos.

That every radio receiver should be protected by suitable lightning arresters.

That Capt. H. L. Hall, who probably holds the greatest collection of verifications of reception from foreign short-wave stations, follows all the rules for long distance reception which Mr. Lynch has promulgated.

In this Article

The author gives directions for applying a good antenna system to all types of short-wave receivers and a few additional pointers for making good installations available to the short-wave fan who lives in a section where interference is high and space is limited.

Next Month

Mr. Lynch will give us a series of diagrams and pictures, illustrating the best method of employing his various antenna systems to fit different sets of circumstances.

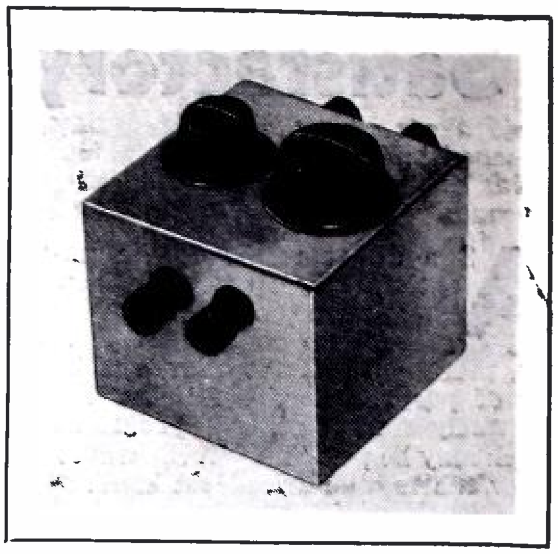


Fig. 6—A new Lynch coupler.

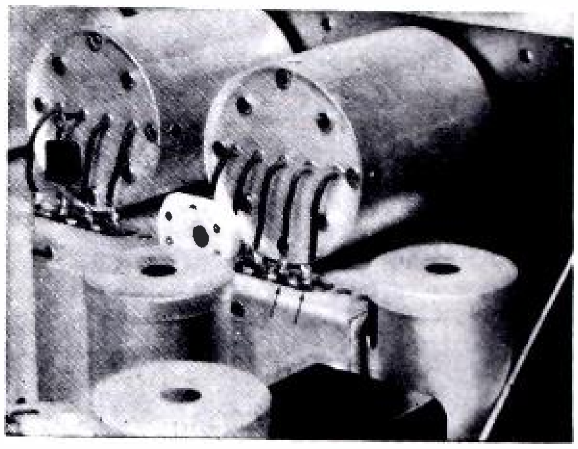


Fig. 7—The doublet is connected to the leads indicated by the arrows.

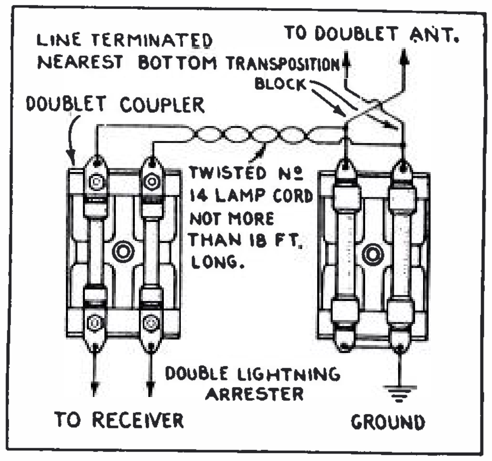


Fig. 8—Doublet coupler and double lightning arrester.

Some Scott users have told me that it is impossible for them to use more than a single antenna, and they inquire as to whether the doublet type antenna and transposed transmission line can not also be used on the broadcast band.

It can—and very easily.

Figure 3 illustrates a double-pole, double-throw switch. The ends of the transposed transmission line come to the two center poles of the switch. Naturally, a double lightning arrester is connected across the transmission line, as illustrated in Fig. 3, to protect both the receiver and the antenna systems from heavy static charges and lightning.

The two left-hand poles of the switch are connected together and a wire is run from them to the regular broadcast antenna post on the Scott receiver. The two right-hand terminals of the switch are connected to the two short-wave terminals.

The most suitable switch for this arrangement is what is known as an anti-capacity key, but almost any double-pole, double-throw switch may be used, provided the insulating material which is used is moisture proof, and the switch itself is mounted so that leakage will not take place across the two ends of the transmission line.

By this arrangement, the doublet actually becomes a "T" type antenna when used on the broadcast band, but is a true doublet when it is used in connection with the short-waves.

This arrangement is very desirable for use in connection with such receivers as the Stewart-Warner, Lincoln, Silver Masterpiece, and all other combination receivers. Most of these receivers are merely provided with the antenna and ground posts and do not have special input circuits for the short-wave band as the Scott receiver does. It is, therefore, desirable to use a coupler between the two right-hand terminals of the anti-capacity switch and the antenna and ground posts of such receivers. A suitable coupler for this purpose is shown in Fig. 4.

While such a coupler is suitable for ordinary purposes, a certain amount of loss develops between the transmission line and the input circuit of the receiver. Much of this loss and a great gain in selectivity is obtained by using the coupling system illustrated in Fig. 5, which is a fundamental diagram of the units incorporated in the tuned coupler, shown in Fig. 6.

The performance of the couplers shown diagrammatically in Fig. 8 is quite simple and provides the best coupling under all circumstances between the doublet antenna and any receiver in which one side of the regular primary of the antenna system is grounded. The ends of the transmission line are carried to the double lightning arrester, as shown in Fig. 8, and then the twisted pair from the lightning arrester is carried to the two binding posts, marked T-L in Fig. 5. The doublet coupler, illustrated in Fig. 8, is unnecessary when the tuned coupler is used. The circuit from the transmission line, connected to the two binding posts, comprises two inductances L1 and L2, divided at their electrical center

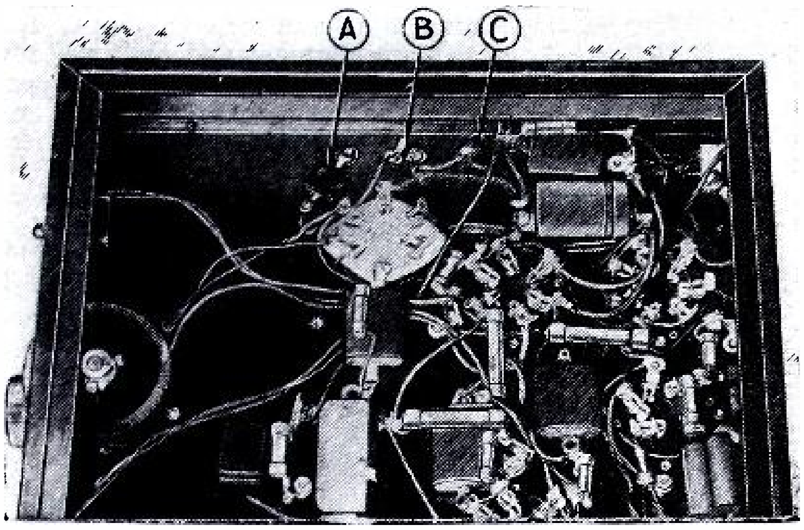


Fig. 9—Short A; break the two lugs at B, connecting the ground to the right one and one doublet wire to the left one; this doublet wire goes through hole C.

This Series of Articles

One of the most important problems in the short-wave business today is that of securing clear, noiseless reception. The editors of this magazine believe that the road toward the solution of this problem lies, in part, in the installation of suitable noise-free antennas. For this reason, we publish a comprehensive treatment of this subject by Mr. Arthur H. Lynch, well known to thousands of radio men, and an authority on receiving antennas for general short-wave receivers.

It is with pleasure, therefore, that we present here the second of a series, to be followed next month by more practical data.

by a small variable capacity, C1.

L3 is a tapped secondary, designed to match the impedance of the input circuit, connected to the antenna and ground posts of the receiver. The tap on this secondary is provided so that the impedance of high and low input circuits may be matched approximately. This matching results in a considerable gain in signal strength. The proper connection is determined by experiment.

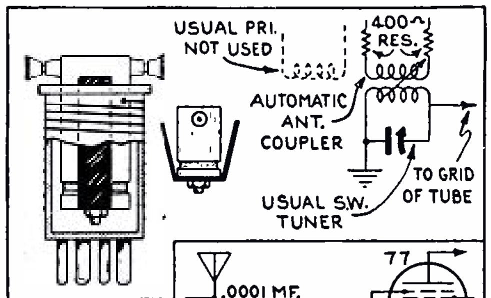
This tapped secondary is made variable with relation to the split primary, which enables any degree of coupling between the transmission line and the secondary of the tuned coupler to be secured. This is very important.

Why a Tuned Circuit?

Naturally, since one side of the secondary of this coupling arrangement is always grounded, the effect on the transmission line varies as the coupling between the primary and secondary varies. This variation in coupling is likely to bring about an unbalancing of the transmission line. That is where the capacity, C1, is utilized. It must be remembered that the noise-reducing properties of the transmission line depend to a considerable degree upon the line being unbalanced.

It will be seen, therefore, that the coupling arrangement provided by the circuit illustrated in Fig. 5 enables us to secure any degree of selectivity, as well as providing us with complete control of the balance of the transmission line itself.

When such receivers as the National AGS, the National FB7A and the Hammarlund-Pro are employed for short-wave broadcast reception, the twisted pair coming from the top of the lightning arrestor, as illustrated in Fig. 8 is connected to the two antenna posts provided for this purpose. The doublet coupler is not necessary when these receivers are used for broadcast reception. The doublet coupler is desirable for use with these receivers when they are used for communication purposes.



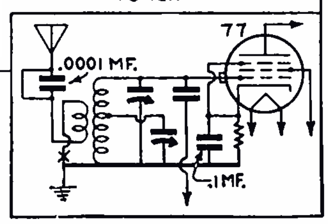


Fig. 10, right—Break as shown at X, Fig. 11, above.

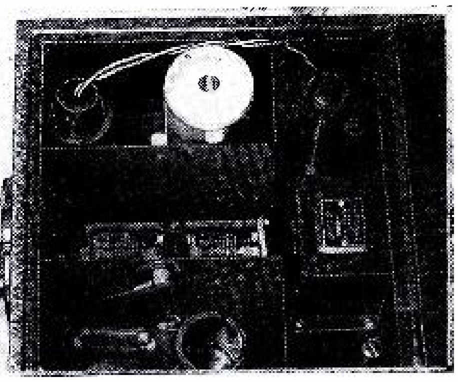


Fig. 12—Photograph of an all-wave coupler in a National SW3.

Some of the first National AGS receivers and FB7 and 7A receivers were provided with the usual type of antenna input circuit, having one side of the primary connected to the ground. It is a simple matter to change these receivers. The two ends of the transmission line may be connected directly to the antenna primary, without the possibility of the receiver becoming unstable because it is ungrounded.

To utilize the transposed transmission line most effectively with the AGS receiver, it is but necessary to remove the aluminum dust cover, which leaves the receiver as illustrated in Fig. 7. You will note that there are three aluminum shields extending from the front of the panel. The first of these shields carries the antenna system. All of the connections coming from the first left-hand shield are run to a bakelite terminal strip which may be seen in the illustration. The two left-hand wires coming to this strip are unsoldered and the transposed transmission line, or the twisted pair, connected directly to them. The receiver remains grounded through the connection made between the chassis itself and the power supply line.

Coupling to the FB7

As may be seen from the illustration in Fig. 9, it is but necessary to remove the metal bottom from the older model FB7 receiver by removing the screws from the four corners and it will be seen that the binding posts marked ANT lead to a small fixed condenser. The opposite end of the condenser is connected to the antenna coil housing. The other end of the antenna primary is connected directly to the chassis, and a wire is run from the chassis to the binding post marked GND. The simplest procedure is to place a soldering iron against the two lugs on the chassis; when the solder is soft, the two lugs may be pushed apart with a screwdriver. The wire running from the socket which houses the antenna coil is then run to the post marked GND, and a separate wire about a foot long is soldered to the lug which remains fastened to the chassis, so that the receiver may be grounded in order to maintain stability. The necessary changes in this circuit are shown diagrammatically in Fig. 10.

Coupling to Receivers Employing "Open End" Coils

Where we desire to couple to a short-wave receiver in which open end coil forms are employed, such as the National SW3, SW5, SW45, SW34, SW58, and various receivers which were introduced by the Pilot Company and the Short Wave & Television Corporation, as well as the receivers described by Mr. Denton and Mr. Hertzberg in the November number, a special and very simple

(*Continued on page* 43)

Building and Calibrating an All-Purpose Monitor

SUMMARY: *One of the most important pieces of laboratory equipment that can be constructed and used by every owner of a receiving or transmitting station is the frequency monitor. This device can be used as a wavemeter, simple receiver, as a calibrating oscillator, as a temporary oscillator for superheterodynes, etc. One of the main difficulties with such test equipment is calibration—the average man finds it difficult to calibrate the device once it is built.*

For this reason, this article is divided into two parts: the first deals with the construction of the monitor, and the second with its calibration. The method of calibration is especially complete inasmuch as a comprehensive treatment of the use of harmonics is given.

We urge everyone interested in this phase of radio to read this article which was especially prepared to let you know what's what.

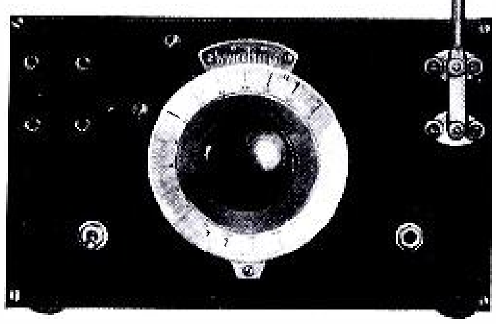
By Louis Martin

IN many respects, technically speaking, transmitting and receiving amateurs have a lot in common, and on one point these two classes of amateurs meet and merge—frequency measurement. Because of financial limitations, experimenters are forced to combine the functions of two or more pieces of apparatus into a single unit that is both economical and accurate, and it is our purpose here to describe a simple electron-coupled oscillator suitable for transmitting and receiving purposes.

Essentially, the prime function of an oscillator is to generate oscillations; but there is no good reason why it cannot be calibrated for use as a wavemeter, and arranged for use as a monitor for transmitters. The number of uses to which such a piece of equipment can be put are innumerable, so only the major ones will be listed.

As an oscillator: The characteristics of electron-coupled oscillators are such that the frequency is independent of load conditions and the signal is about as steady as a rock. As an oscillator, its signal is replete with harmonics, which may or may not be an advantage. This point will be discussed later. The calibration of such an oscillator will hold over a long period of time, a fact which will be appreciated by those who have had the experience of having oscillator calibrations change every time a switch is thrown.

Oscillators may be used to line up r.f. stages in receivers, as local oscillators in receivers, as the oscillator in m.o.p.a. systems, as an oscillator for adjusting the frequency of transmitters, and for determining the frequency of signals received.

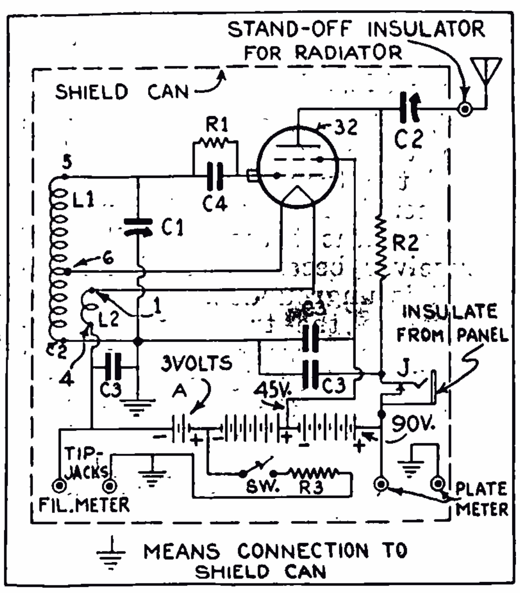


PANEL VIEW OF THE MONITOR

As a frequency monitor: If the plate circuit of the oscillator is broken and a pair of phones inserted, the oscillator is really an oscillating receiver. Under such conditions, the transmitter signal may be picked up and checked.

No doubt, many of you are familiar with the handling of such equipment, so that we will pass directly to a description of our frequency meter.

The photographs and schematic diagrams tell the whole story. The panel view of the monitor shows the tuning dial and the tip jacks for measuring filament and plate voltage from the panel, obviating the necessity of removing the cover every time you want to check the batteries, which are, incidentally, housed in the metal box. The 18-inch antenna to the right of the panel is used for radiating. If two leads are brought out, as is usually done, then the oscillator load on the device into which the signal is fed may be sufficient to change the characteristics of tuned circuits. Hence, it was found more desirable to use a small antenna to do the radiating, and have a pick-up coil or the regular antenna lead absorb some of the energy. The toggle switch opens or closes the A battery circuit, and the jack to the right is in the plate circuit of the tube and is used for phones.



SCHEMATIC OF THE MONITOR

Antenna Used

The "antenna" is a piece of ¼-inch brass tubing, flattened at one end for a support. The detail of mounting the antenna is given in a sketch.

The view of the inside of the monitor shows the location of the major parts. Note the two insulators on the front panel. The bottom insulator terminal connects to the plate of the tube through the small, postage-stamp condenser, while the upper stand-off insulator is dead. It is used merely as a support for the antenna. The two batteries toward the rear are 45-volt B batteries, and the narrow battery near the front panel to the left is a special A battery of 3 volts.

The tube and the coil are shown to the right, and are mounted on a special sub-base. Under this base are the wiring, the necessary bypass condensers, resistors, etc. These details are shown in a third photograph. Note, also, that the condenser C2 is fastened by means of a bakelite rod mounted on the right-hand side of the cabinet. This method of mounting keeps the condenser rigid, so that its adjustment will stay put, once set. The drilling layouts and other incidental mechanical details are shown in additional sketches.

List of Parts

C1—100 mmf. Hammarlund variable condenser.
C2—Hammarlund "postage stamp" condenser.
C3—Aerovox .01 mf. fixed mica condensers.
C4—Sangamo .00025 mf. fixed mica condenser.
R1—100,000-ohm grid leak.
R2—50,000-ohm non-inductive resistor.
R3—15-ohm wire wound resistor.
J—Closed circuit jack.
SW—Toggle switch.
A battery is a 3-volt special General dry battery, type P-2-X (one required).
B batteries are General type V-30-AA, small 45-volt units (two required).
1—National 4-prong socket.
1—National special 6-prong socket.
Aluminum chassis as shown in drawings.
1—18-inch piece of brass tubing, ¼-inch in diameter.

Calibration

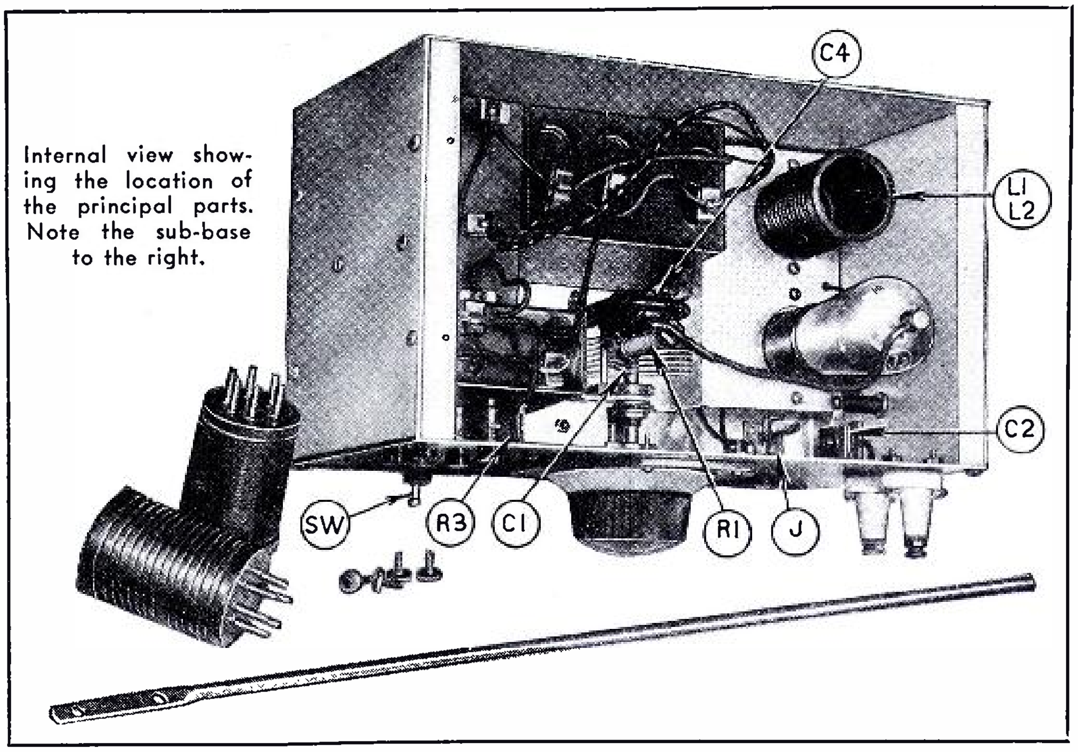
The toughest part of the whole job is to calibrate the oscillator. Now, anyone can calibrate an oscillator if one has a good wavemeter; but if we had a good wavemeter, we probably would not need an oscillator—maybe! Our job, therefore, is to tell you how to calibrate the job without the use of a wavemeter.

There is one difficulty. Because of the preponderence of harmonics, you are never sure what harmonic you are working on—if you are working on any harmonic! How do you tell? That's easy if you follow instructions carefully.

The first thing to do is to put your 20-40 meter band coils in your receiver and tune in about ten good stations whose frequencies are known. Record the dial readings and the corresponding frequencies of the stations on a sheet of paper. Repeat the operation with the 10-20, 40-80, 80-100, and 100-200 meter coils. When you are finished, you will have the entire receiver calibrated. Then draw a curve of frequency against dial settings as shown in one of the illustrations.

Now, do not be too impatient. It may take a long time to get some of the station announcements or find their frequencies in a call list, but you will not wait in vain if the station is a good one. Do not bother with a station whose frequency you are in doubt. It may take you one, two, or even three days to do the job, but when you are finished, you will have something. The accuracy of the whole business depends upon the accuracy with which you calibrate your receiver. Fortunately, many commercial receivers have calibration curves pasted on the cover of the set. In many cases, these curves are very accurate, although it is best to check the calibration by tuning in several crystal-controlled transmitters of known frequency.

Let us suppose, now, that you have a calibration curve of your receiver, that your oscillator works, but that you do not know what harmonic you are working on. What next?

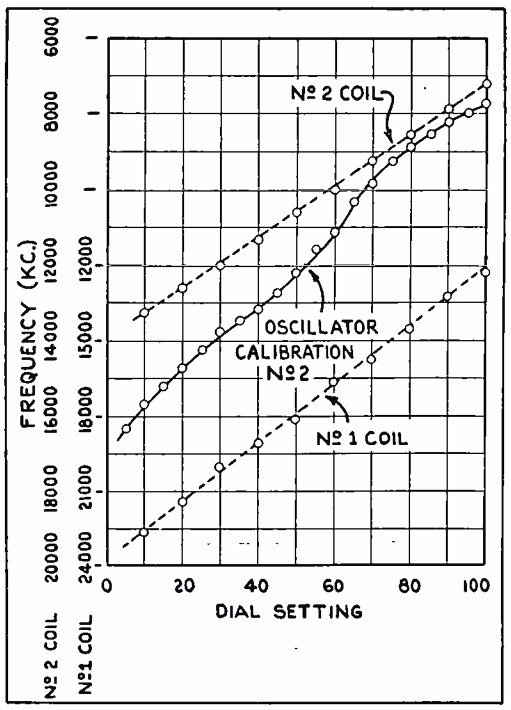


Internal view showing the location of the principal parts. Note the sub-base to the right.

A Practical Example

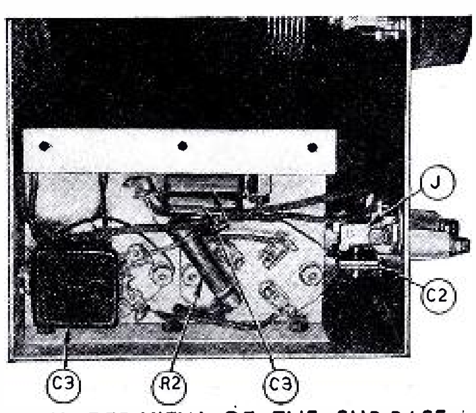
Set the oscillator at 100 with one of the coils—say, the 20-40 meter coil—in the oscillator and tune in the oscillator with your receiver. Note the dial setting of the receiver and look up the corresponding frequency from the calibration curve described previously. Now, leaving the oscillator setting exactly the same—*be sure not to touch it*—retune the *receiver* to a higher frequency until the oscillator is again picked up. Suppose the *first* signal tuned in—at the lower frequency setting—is one harmonic, then this last signal *must* be the next higher harmonic because there is nothing else in between. Look up the frequency corresponding to this last setting. The difference between the two frequencies is the fundamental frequency of the oscillator; and if you should tune to that frequency, then you will pick up the oscillator stronger than ever. Let us explain this with figures.

We set our oscillator at 100 on the dial and tune it in. We look up the frequency corresponding to the dial setting of the receiver and find that it is, say, 15,000 kc. We retune the receiver until the oscillator is picked up again, and find that the frequency is 22,500. The fundamental frequency of the oscillator is, then 7500 kc. Why? Listen.



TYPICAL CALIBRATION CURVE

The dotted curves are for the set, and the solid for the monitor. Read the left scale for the oscillator calibration.



UNDER-VIEW OF THE SUB-BASE

If the fundamental frequency of our oscillator is 7500 kc., then it will have harmonics at 15,000, 22,500, 30,000, etc. kc., corresponding to 2, 3, and 4 times the fundamental. When we tuned in a harmonic at 15,000 kc, we *had* to tune in the next harmonic at 22,500 kc. since it was the *next* higher frequency. The difference in frequency between any two successive harmonics is always equal to the fundamental, so that the difference between the two dial settings of our receiver represents the fundamental of our oscillator.

Of course, the frequency of a short-wave oscillator may be in the neighborhood of 10,000 kc., so that the setting of our receiver necessary to pick up the next higher harmonic is usually beyond the range of the receiver. In such a case, it is necessary to change the coils in the receiver to facilitate picking up the harmonic. Hence the necessity of calibrating all bands of the set in order to calibrate one band of the oscillator.

Next, we set the oscillator at 90, tune it in on the receiver, and look up the corresponding frequency on our receiver calibration curve. We then tune in the next higher harmonic and again note the corresponding frequency. The difference between the two is the fundamental frequency of the oscillator at a setting of 90. This operation is repeated for every ten degrees on the dial. When finished, we draw a calibration curve of the oscillator. The calibration curve of two of the coils used in the receiver employed in the tests made by the author is shown; in this same diagram is shown the calibration curve of the oscillator.

Using Harmonics

If you make one coil suitable for the 160-meter band, then harmonics of the oscillator may be used for any of the other higher frequencies. Personally, I do not like the harmonic method; I prefer to use the fundamental frequency at all times. The only change necessary, then, is to make a different coil for the oscillator for each band used. The coil data for each band are given underneath a sketch of the coil connections.

In tests made with this oscillator, we found that the fundamental is so much stronger than the harmonics that there was no need to make the adjustment for the next higher harmonic, as outlined previously, as the fundamental was easily recognized. We really did, however, check the fact that we were on the fundamental by means of the difference frequency method.

After we finished calibrating a coil of the oscillator, we checked by tuning in the fundamental—or what we had calculated to be the fundamental—and then retuned the receiver carefully to a frequency *lower* than the fundamental. We could, of course, *find no signal*, for the simple reason that, by definition, the fundamental is the *lowest* frequency generated. We then backed up on the tuning, passed the fundamental, and stopped at the next oscillator signal. We were correct—this signal had twice the frequency of the fundamental; therefore we had the second harmonic tuned in.

No Meter Used

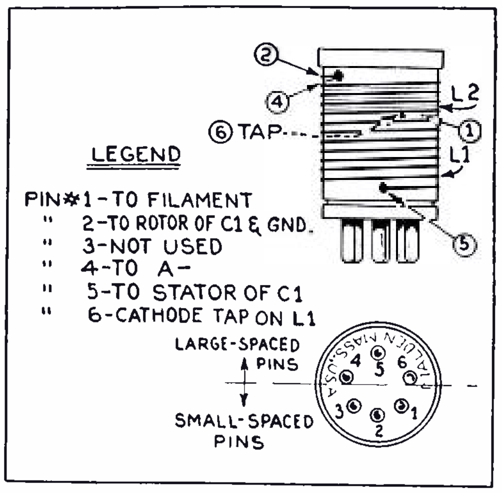
There is no meter used in this monitor for two reasons: first, we wanted to keep the cost down; and second, by plugging phones in the plate circuit of the monitor we could detect resonance by means of the beat method. Another oscillator was set up and tuned in on the monitor. The frequency of the monitor was adjusted to zero beat, and the frequency read off the calibration curve. Incidentally, when tuning in the monitor with the receiver while calibrating, be sure to adjust for zero beat, otherwise you will be off frequency by the amount of the beat note.

It is significant to note that this monitor—or oscillator—uses a different plug-in coil for each band. No doubt the use of harmonics would simplify matters considerably, but their use is not to be desired—in our opinion. First, the amplitude of the harmonics gets smaller and smaller as the harmonic gets larger. This means that down around ten meters the sensitivity of the receiver must be raised to a high level, with its attendant high noise level, before a reasonable signal can be heard in a reasonably sensitive receiver. Second, suppose you do not know the range of a certain tuned circuit and resort to the oscillator to find out. It is reasonable to suppose that some doubt might exist as to the exact harmonic tuned in; but if the oscillator has the greater portion of its output in the fundamental, then you don't have to be in doubt—you'll know!

Now our oscillator has harmonics, and it takes several good filters to get rid of them; but the fundamental is so much stronger than the harmonics that it can be quickly recognized. The fact remains, though, that no matter how weak the harmonics may be you may still pick one up *and not know it is a harmonic*. Then what happens? Watch this, now.

If the circuit under test is not variable, then tune the monitor until

(*Continued on page* 43)



ABOVE AND BELOW—COIL DATA
Complete winding and connection data are given here.

7.5 to 18 meters (40,000 to 16,670 kc.): L1, 3 turns No. 14 enameled wire, spaced 7/32"; cathode tap, 1 turn from the grounded end of L1.

15 to 37.5 meters (20,000 to 8,000 kc.): L1, 11¾ turns No. 18 enameled wire, spaced 5/32"; cathode tap, 4¼ turns from grounded end of L1.

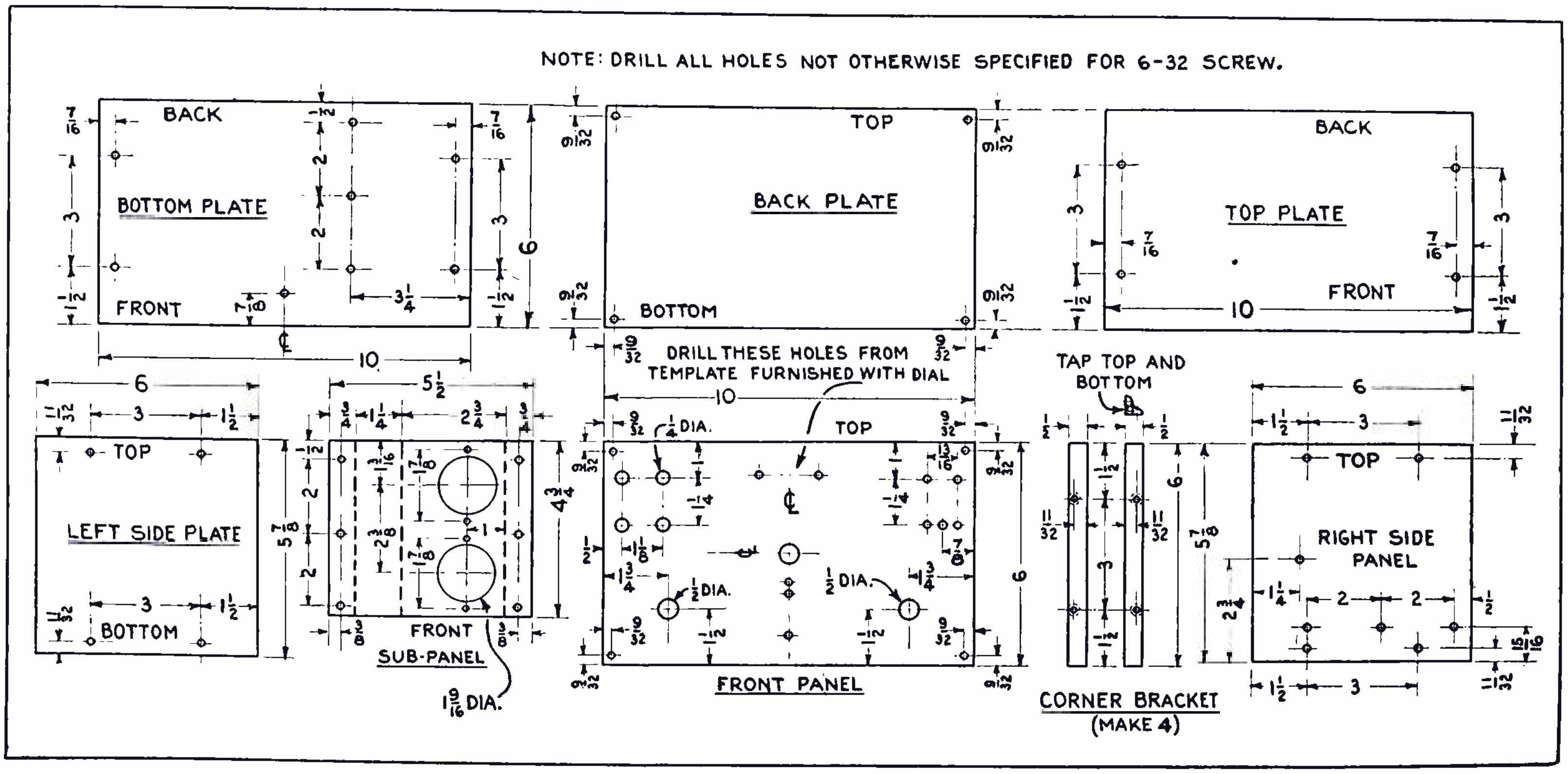
35 to 75 meters (8560 to 4000 kc.): L1, 19¾ turns No. 18 enameled wire, spaced 3/32"; cathode tap, 6 2/3 turns from grounded end of L1.

75 to 120 meters (4000 to 2500 kc.): L1, 34¾ turns No. 24 enameled wire, spaced 1/16"; cathode tap, 11¾ turns from the grounded end of L1.

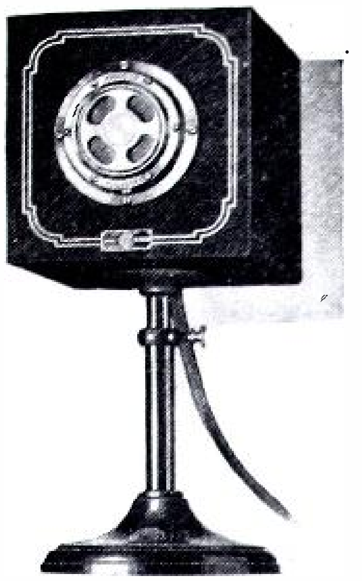
115 to 200 meters (2600 to 1500 kc.); L1, 62¾ turns No. 24 enameled wire, spaced 1/32"; cathode tap, 21 turns from the grounded end of L1.

L2: for all coils: wound with No. 24 silk-covered wire interwoven between the grounded end of L1 and cathode tap with turns equal in number to the turns of L1 between grounded end and cathode tap.

The actual range covered by a particular coil is not precise, as given above. Rely only upon your own measurements. The coil forms are regular National 1½" diameter units, with six prongs.



COMPLETE MECHANICAL DETAILS OF THE PANEL, BOX, AND SUB-BASE OF THE MONITOR



A typical condenser mike and head amplifier (Shure).

A Review of Present-day Microphones

SUMMARY: *Within the past year or so, two radically new types of microphones have been introduced to the trade—the velocity, or ribbon, microphone, and the dynamic microphone. These two new types bring the total number of different kinds in use to four. The author, an authority on microphones, has kindly consented to make a comparison of these four types so that either users or prospective users of microphones may be in a position to choose the one best suited to their purpose. A table, comparing the salient features of each type, is included. Construction and general operating data is given in the discussion of each type of microphone.*

By Ralph P. Glover*

A CENSUS of all the microphones in use at the present time would undoubtedly show that two types are predominant—the carbon microphone and the condenser microphone. Because of its earlier commercial development and certain economic advantages, the carbon microphone is by far the more popular type. Recently, however, the ribbon, or "velocity" type, and the moving-coil type—two versions of the magnetic microphone—have finally appeared in commercial form, although they had been suggested and recognized in principle a great many years ago. It seems opportune to examine and compare the principles, performance, and special features of these microphones.

Carbon Microphone

The carbon microphone depends for its operation on the varying resistance of a carbon element when subjected to varying pressure. Sound is composed of waves which are characterized by changes in pressure above and below atmospheric, and these pressure changes will cause a diaphragm placed in the sound field to vibrate accordingly. In the carbon microphone, the motion of the diaphragm produces corresponding changes in the resistance of the carbon element. This carbon element and the diaphragm are made part of an electric circuit which includes a local battery and a transformer, as indicated in Fig. 1, and thus the variations in resistance result in a varying current which flows through the transformer primary. This induces an alternating speech voltage in the secondary which may be impressed on an amplifier or line.

Actually, there are two carbon elements in the familiar double-button microphone, one being arranged on either side of the diaphragm. Since the buttons change resistance out of phase, a push-pull system exists, and even harmonics generated in the microphone itself are cancelled out, just as this occurs in push-pull vacuum-tube operation. A transformer with a center-tapped primary is necessary to complete the balanced circuit. The carbon elements are composed of thousands of small granules which are specially treated. These granules are confined in cup-like chambers on either side of the diaphragm.

The diaphragm is stretched and air damped to obtain a uniform frequency characteristic. Any diaphragm will resonate at some particular frequency determined by its mass and stiffness. By the use of a very thin special alloy metal, stretched nearly to the elastic limit, the resonance can be placed at about 6,000 cycles per second. The resonant peak is flattened out by air damping, which is accomplished by placing a metal plate quite close to the diaphragm so that the intervening air film has a cushioning effect when the diaphragm tends to vibrate at high velocities.

Unlike any other type of microphone in practical use, the carbon microphone is an *amplifier* as well as a converter of acoustic energy into electric energy. In other words, the power delivered to the electric circuit is greater than the acoustic power at the diaphragm. This accounts for the relatively high output level of the double-button carbon microphone, which, therefore, requires less amplifier gain than other electro-acoustic transducers.

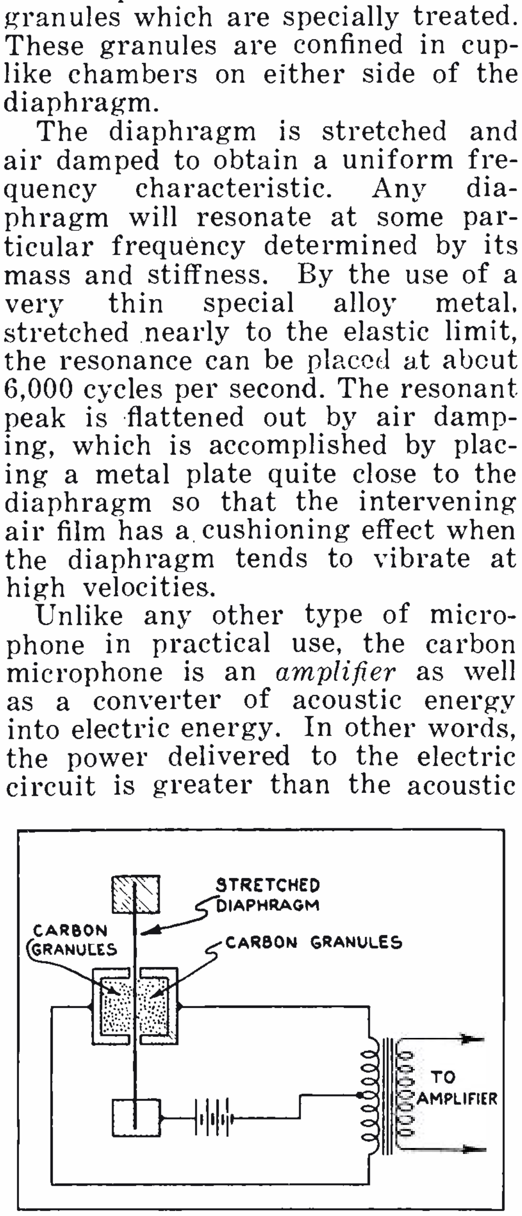


FIG. 1: CARBON MICROPHONE
Simple cross-section and diagram of a carbon microphone.

Unfortunately, all carbon microphones produce some hiss or noise. In well designed microphones, the "hiss" has a very low level, but for some purposes this background noise is objectionable. Part of the noise may be due to thermal agitation within the granules; but the greatest disturbances are probably due to local heating where the granules are in contact. As current passes through the button, some heat is produced which tends to drive gas out of the porous surface of the granules. Random variations of resistance accompany this gas emission, giving rise to non-periodic noise.

Condenser Microphone

The diaphragm of the condenser microphone constitutes one of the plates of a variable air condenser, while the back plate, which is separated from the diaphragm by a film of air about one one-thousandth of an inch thick, acts as the other plate. Figure 2 shows the construction schematically. Capacity variations are produced by the changing distance between diaphragm and back plate as the diaphragm vibrates in response to the sound pressure fluctuations before it. The capacity of the assembly is approximately 200 micromicrofarads, and the maximum variation in capacity is only about 0.01 per cent. Once the condenser is charged, no current will flow as long as the capacity remains constant. If the capacity increases, the condenser will be capable of holding a greater charge, and charging current will flow until the greater charge has been accumulated. Similarly, the condenser must lose a portion of its charge if the capacity decreases, and this produces a flow of current in the opposite direction, *out*

*Editor, The Shure *Technical Bulletin*.

of the condenser, until equilibrium has been established. Due to the minute changes in capacity which take place during operation, the variable charging currents are extremely small, and the sensitivity of condenser element is, consequently, very low.

Obviously, the lower output of the condenser microphone must be overcome by the use of additional amplification, but for a number of reasons it is not feasible to lump all of the required gain in the main amplifier. First of all, it is not practical to transmit such minute currents over lines of appreciable length, due to the probability of inductive interference or noise pickup. It is thus necessary to amplify the signal close to the point of origin so that any stray interference will be negligible. Secondly, the capacity shunted across the condenser element must be kept down to the absolute minimum or the output will be reduced and the high frequency transmission impaired. The practical solution is to incorporate an amplifier as an integral part of the microphone assembly. The connecting leads to the grid of the first tube are only a few inches long at most, and lead capacity and exposure to noise field are practically eliminated.

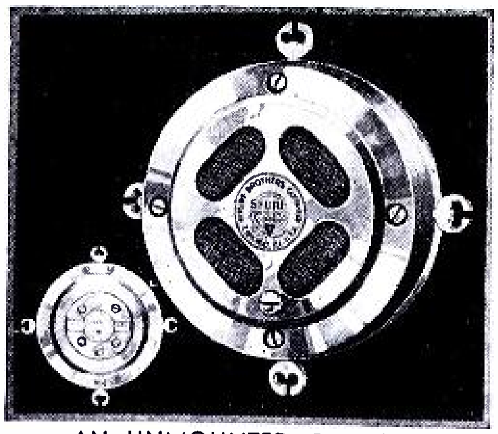
The head amplifier consists of one or more stages with sufficient gain to bring the signal level up to that of a double-button microphone. Batteries are often used as the source of polarizing potential for the condenser element and for filament and plate supply for the amplifier tubes, although it is perfectly feasible to construct a satisfactory power supply unit operating from the a.c. line. At least one such power supply is already on the market.

The condenser microphone diaphragm is made of special alloy metal approximately one one-thousandth inch thick, which is thinner than the material used for carbon microphones. The principles of air damping and stretching are carried out as for the carbon microphone, which accounts for the fact that in quality microphones, there is little to differentiate the two types in regard to frequency characteristics.

Ribbon Microphone

When a conductor moves through a magnetic field, an e.m.f. is generated in the conductor which is proportional to the length of the conductor, the field strength, and the conductor velocity *at right angles* to the direction of the field. In the ribbon microphone, the diaphragm is a long, narrow corrugated strip of thin hardened metal which is supported at its ends between the pole pieces of a permanent magnet, as shown in Fig. 3. This strip serves the dual purpose of diaphragm and conductor.

Since the diaphragm mass is extremely low, excellent response may be obtained at frequencies extending



AN UNMOUNTED CARBON MICROPHONE (Shure)

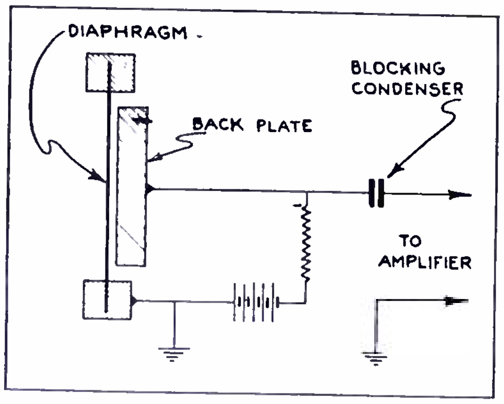


FIG: 2: CONDENSER MICROPHONE

Diagrammatic representation of a condenser microphone. Note the relation between the diaphragm and back plate.

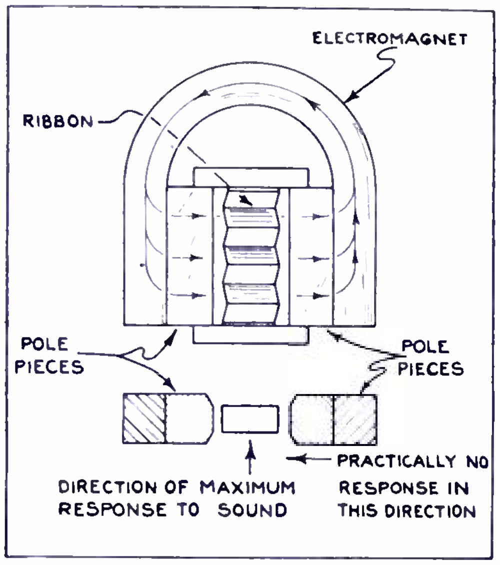


FIG. 3: RIBBON MICROPHONE

A sketch showing the relative arrangement of the important parts of a ribbon, or velocity, microphone. Note the shape of the ribbon.

well beyond the limits of conventional stretched diaphragm transmitters, which are useful only to about 10,000 cycles per second. A correctly designed ribbon will add approximately one octave to the response in the high-frequency region. These "ultra" high audio frequencies, while not important in the reproduction of speech, contribute a great deal to the character of some musical instruments, and are important components of such noises as handclapping, the jingling of keys, and similar sounds. If the remainder of the system is capable of transmitting faithfully over this wide band, then this extended range of pickup is very much worth while, although it should be remembered that nothing is added to the intelligibility of speech.

The shape of the ribbon, combined with the shielding effect of the pole pieces, results in a very directional pickup, with maximum response in the direction indicated in Fig. 3, and practically no response at right angles to this direction. The pickup is likewise quite directional in the vertical plane, so that a great deal of study and experimentation will be needed before pickup technique is well understood. Highly directional pickup is advantageous for many purposes, and a disadvantage for others.

The output level of the ribbon microphone is very low, and approximates that delivered by the condenser transmitter. However, the impedance of the device is so low that it is perfectly feasible to place the preamplifier in any convenient location, adequate shielding of the connecting cable being the only important requirement for transmission of the ribbon output. Present broadcast practice involves the use of a two-stage preamplifier to bring the output up to carbon microphone level, or about -30 db. The construction of the microphone is such that quiet operation is inherent.

Moving Coil Microphone

The moving coil microphone is also a member of the magnetic microphone family, but the diaphragm and conductors function distinctly as contrasted with the combination of these two parts in the ribbon pickup. Figure 4 shows the construction, which is fundamentally the same as for the dynamic unit loudspeaker. The diaphragm is made of thin duraluminum which is pressed into a dome shape for stiffening to secure piston action over the audio frequency range. The moving coil is made from thin aluminum ribbon cemented to the diaphragm, and moves in the air gap between the pole piece and the top plate. The magnetic structure is composed of cobalt alloy steel, which will remain magnetized for a long period of time.

The moving coil microphone is quite rugged and is absolutely unaffected by climatic conditions. Its output level is approximately 10 db higher than that of the condenser head, or about -50 db. As is the case with the ribbon microphone, the low output impedance makes it feasible to locate the preamplifier at a considerable distance from the microphone itself.

The frequency characteristic is stated to be quite uniform from 35 to 10,000 cycles per second. The microphone construction is very rugged and no noise is produced by the microphone itself.

Comparison

Table 1 indicates how the four types of microphones compare in re-

TABLE 1

	DOUBLE BUTTON CARBON	CONDENSER	MOVING COIL	RIBBON OR "VELOCITY"
Output Level	*-30db*	*-60db head -30db amp. output*	*-50db*	*-60db*
Noise Level	Rather high	Low	Very low	Very low
Normal Frequency Characteristic	Reasonably uniform	40-10,000	Reasonably uniform 35-10,000	Characteristic extends well above 10,000 cycles
Polar Response Characteristic	Non directional below 1,000 cycles Somewhat directional at higher frequencies			Sharply directional and practically independent of frequency
Internal Output Impedance	200 ohms	Head only, of the order of 25 megohms. Amplifier output commonly 200 or 50 ohms	25-50 ohms	of the order of 1 ohm.
Stability	Poor	Very stable	Excellent	Quite stable
Maintenance	Requires repacking at regular intervals	Occasional dehydration needed. Battery maintenance for amplifier	Require practically no maintenance	
Ruggedness	Must be handled with care	Quite rugged	Very rugged	Quite rugged
Size	Quite small	More bulky than carbon due to integral amplifier	About the same as carbon mike.	Intermediate to carbon and condenser

gard to output level, normal frequency characteristic, polar response characteristic, noise level, internal impedance, stability, maintenance problems, ruggedness, and size. All of these and perhaps other points must be taken into account when deciding on the microphone to use for some particular application.

A number of important applications of microphones are listed below, with comments indicating types which would be suitable.

Broadcasting: The refinement in methods and equipment, which is continually taking place in broadcasting, is assurance that apparatus giving extended reproduction at the high frequencies will come into widespread use. Magnetic microphones will probably come into quite general use as more information on their use becomes available. The condenser microphone, with its wide-angle pickup, quiet operation, and good frequency characteristic, will no doubt retain a definite place in broadcasting for general purpose use. The carbon microphone is principally relegated to temporary remote control pickups, where, due to its high output level. the size and weight of associated amplifying equipment can be kept at a minimum.

Public Address: The carbon microphone is entirely suitable for most public address equipment. Less amplifier gain is required than for other microphones. If low background noise is important, the condenser microphone will usually fulfill even the most exacting requirements. The ribbon type will, due to its directional pickup, have an important advantage in systems where feedback or singing is experienced. The tendency to feedback is diminished as the directional properties of the electro-acoustic transducers are increased.

Amateur Transmitters: The carbon microphone—preferably the double-button stretched diaphragm type—appears to be ideal for amateur radiophone transmitters if economy in first cost is the deciding factor. Its frequency range is more than sufficient for good quality speech transmission, and the high output level means fewer stages in the speech amplifier. Some consideration, however, should be given to the fact that frequent overhauling is required to keep the performance up to standard, for the carbon buttons are likely to become packed, with resulting loss of sensitivity and quality. This expense is avoided with the condenser microphone, which, with its integral amplifier, has about the same output level. It should be remembered that crisp, high quality speech is just as important a factor in making phone contacts as high percentage modulation. A strong signal isn't of much use if the intelligibility is poor!

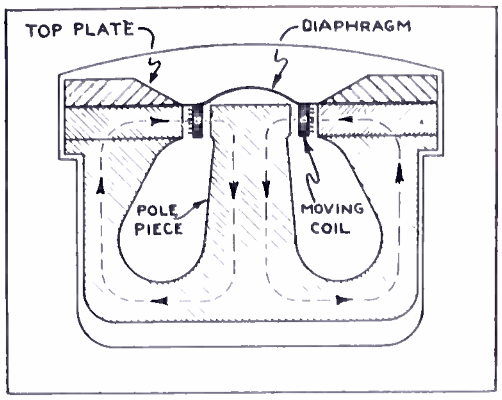


FIG. 4: DYNAMIC MICROPHONE

The construction and operation of the dynamic microphone is similar to that of the dynamic speaker.

Recording: Low noise level is very important in recording on film or disc. Condenser microphones, where non-directional pickup is desired, or ribbon microphones for narrow angle pickup, are suitable. The moving coil microphone has been reported to produce about 6 db. less wind noise than the condenser microphone on out-of-door work.

Sound Measurements: The most important characteristic of a microphone for quantitative sound measurements is stability of performance over a long period of time. This requirement automatically eliminates the carbon microphone from consideration. The condenser microphone seems to be well suited for permanent measuring equipment installed indoors, but for outdoor work under all sorts of weather conditions, which well describes the probable type of service for noise measuring equipment, some form of the magnetic microphone is to be preferred. Usually a non-directional pickup is best adapted for this work. The actual frequency characteristic required depends entirely on the particular problem.

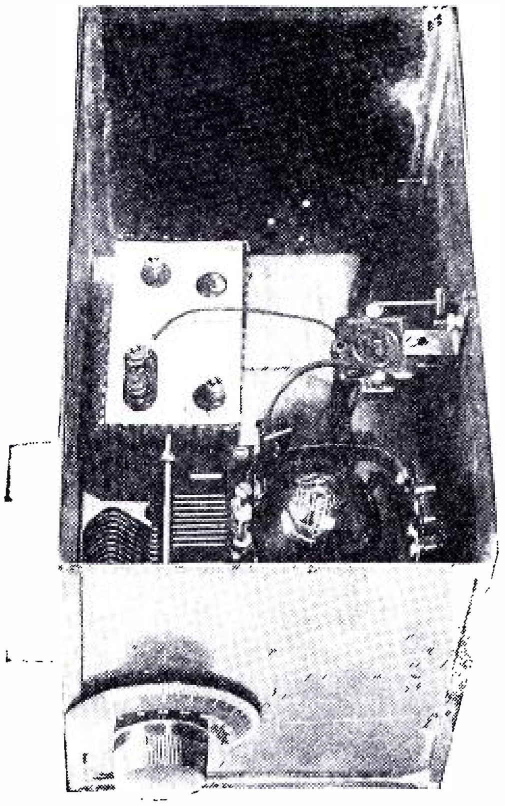
Editors' Note

It might seem a bit out of place to have a microphone article in a short-wave magazine, but the truth of the matter is that such an article is *not* out of place at all. First, amateur phone work has been a reality for many years, and the more progressive amateur will make it his business to keep up with all advances in the field.

Because of the many items that make up an amateur phone transmitter, it may be impossible for many hams to keep up with the many changes that take place daily; for this reason, we have asked Mr. Glover to prepare this symposium.

The increase in use of recordings of stations' programs is another reason why microphone work is of vital importance. Those of you who do record short-wave programs undoubtedly use the same apparatus for home recording.

Incidentally, one of the best ways to get a veri from a tough station is to send them a recording of their own program!



Shielded 5-watt, 5-meter, master oscillator.

Replacing Obsolete 5-Meter Modulated Oscillators

SUMMARY: *This is the first of a series of articles treating the operation of 5-meter phone apparatus. In this article the author shows that when the oscillator itself is modulated, the possibility of frequency drift is very great—in fact, prohibitive. The author then goes on to show the steps that must be taken in order to minimize drift, etc.*

A 75-watt screen-grid amplifier is then added to the 5-meter oscillator and is modulated 100%. The frequency shift was then measured and found to be approximately 5000 cycles; after some further changes, the shift was reduced to ½ of 1 kilocycle.

The importance of preventing frequency shift because of temperature changes is another question considered by the author. A method of mounting the apparatus used in the oscillator described here allows the entire oscillator, including the coils, to heat up at nearly the same rate, thus reducing the time required to bring the set to operating temperature. The importance of feedback is discussed in detail.

By Robert S. Kruse, E. E.*

STRANGELY enough, we have, in these last two years, been offered many descriptions of 5-meter receivers and transmitters of types which are refused as obsolete by everyone in the 20, 40, 80 and 160 meters bands. Each month current publications present transmitters with self-excited oscillators directly coupled to the antenna—and even modulated. Seldom, indeed, is a 5-meter transmitter shown with an output amplifier— much less a buffer.

Work done some years ago showed that there is nothing impossible, or even difficult, about a 5 meter r.f. amplifier; hence, it only remained to work up a piece of apparatus which would reduce that fact to 1933-34 terms.

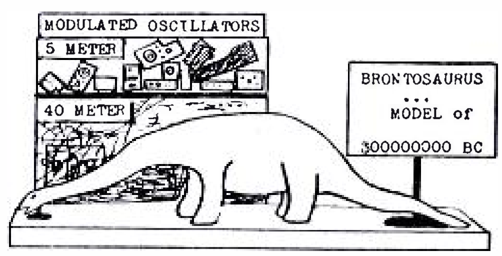
Oscillators vary enormously in frequency stability; but, in general, the stability goes down as the output goes up, the same tube being considered. Thus, we are off to a bad start when undertaking to feed directly from the oscillator to the antenna—for then we have no chance to amplifiy, and *must* have high oscillator efficiency—therefore (usually) low frequency-stability. A cursory examination of the 5-meter transmitter descriptions of the last year has disclosed few which seem to worry about frequency stability, though they do use a little more shielding than in 1927. About 18 months ago several were built up from current descriptions and found to change frequency by as much as *two thousand kilocycles* when the plate voltage was doubled. This is about 4,000 times the proper allowance. Such a transmitter can't be received decently with a selective receiver—which may explain the prevalence of the super-regenerative 5-meter receiver of negligible selectivity.

While the present intention is certainly *not* to modulate the oscillator, it is still true that such high-efficiency (but unstable) oscillators are "out," even when they are only to feed an r.f. amplifier chain. We need a decent oscillator to start with—then we will worry about an amplifier.

The 5-meter oscillator stability problem had been taken to the mat several years ago in connection with the writer's thesis for the E.E. degree. Stability against voltage changes ("wobbulation") was less of a problem than stability against heating ("drifting"). While there are several ways of combatting drift, one of the best is to make everything come to its final temperature as soon as possible. This means that, instead of fighting drift, one deliberately gets it over with as soon as possible—and then has peace. I assure you it is no trick at all to make a 5-meter oscillator that will drift 10 kilocycles in as many minutes—but we only gradually learned how to make one that would stay put within 200 cycles when running *warmed up* for half an hour, and beating with a harmonic of a temperature-controlled crystal oscillator.

A photograph of such an oscillator (built in 1929) is shown herewith, and may be something of a shock, for it has only the faintest resemblance to current practice. The circuit is of the balanced-Colpitts type due to Hoffman, and its inductor loop and stopping condenser are deliberately placed around the hottest part of the UX-210 tube for reasons already mentioned. During the warmup the drifting is quite terrible (though not as terrible as for the common 1933 type), but the warmup is prompt and terminates! Mechanical stability is gained by building the whole thing up on a Cardwell split-stator condenser. The photograph is misleading as only one stator can be seen. The assembly is a unit and connects with the shield at only one point—the condenser mounting.

The efficiency is low, the tube running quite warm at 220 volts plate supply, which is used to create a thermo-syphon ventilation inside the



BUDDIES
As old as the Brontosaurus.

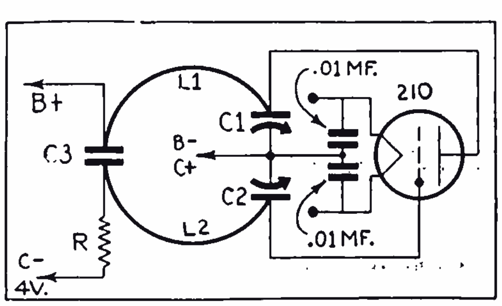


Fig. 1: A simple Hoffman-Colpitts master oscillator of good frequency stability. C1 and C2 are the sections of a 2-part Cardwell receiving condenser, .0005 mf. (almost) per section. C3 is a .01 mf. mica stopping condenser. L1 and L2 are part of the same single turn of SOFT copper strip. R, 5,000 ohms, 15 watts, wire wound.

* Consulting Engineer.

copper shield-box by surrounding the lower part of the 210-tube with a paper tube as a chimney. Thus the entire box soon has a uniform temperature. The copper box is soldered at the corners to facilitate this, and is of fairly heavy gauge for the same reason.

But—does it do the work? To answer that, we again beat with the crystal harmonic and change the plate voltage by steps, measuring the change in the beatnote. The coupling was very loose to avoid any chance of "locking in." It was found that a 25% change in plate voltage caused a beatnote change of about 250 cycles. Above this the change was faster; doubling the plate voltage produced a 2200 cycle shift—about 6/10 of 1% of the shift customary in the "modern" oscillators previously referred to. From this, one might conclude that the oscillator shown would be O. K. for direct modulation—but that is wrong.

Why No Oscillator Should Be Modulated

In the first place, no oscillator can be modulated in the usual way without severe distortion above about 40% modulation. In the second place, modulation changes the average plate input, therefore the average heating, therefore the frequency drifting starts again. That is out—we gave it up years ago in all other bands; why keep it here?

Load Changes

Now suppose that we put an amplifier after the oscillator and try modulating that. Even this isn't modern phone practice, but it is a step nearer.

The second photograph shows a 1929 experimental setup in which the oscillator just described was driving a 75-watt amplifier stage that was being modulated 100%. Probably you are not interested in so costly a tube, but we will later show how all of these findings can now be used with very inexpensive tubes.

Keying the 75-watt screen-grid stage by removing its power supplies entirely (100% downward modulation) produced an oscillator frequency change of about 5,000 cycles, which was too bad for any use whatever—in fact almost 3% of the shift found in some of the "1933" sort we mentioned before. The grid-bias of the amplifier was therefore changed from batteries to gridleak, which reduced the load-change on the oscillator, and dropped the "keying wobble" to about 4,000 cycles.

At this point some step-by-step changes of amplifier voltage were tried, and it was found that the output curve had a queer kink in it due to feedback to the grid-bias-lead of the amplifier. This bias was accordingly changed. The major part was taken from a resistor, and only a small battery bias used for safety in case the oscillator missed fire. The amplifier bias resistor may be seen in the pigeon-house attached to one side of the oscillator can, as may the amplifier grid choke. The smaller resistors in the foreground supply the screen voltage from the plate B plus lead. There is a good reason for doing this, which will appear later. These changes reduced the oscillator shift on keying to about ½ of 1 kilocycle.

The reason for using a screen-grid tube instead of a neutralized triode was a double one. First of all, it was common knowledge that the triode (after very fussy neutralizing) would do the job—Frank Jones and others had transmitted that way in 1926 and earlier—and at wavelengths a great deal shorter than 5 meters. Not only did we want to try something new, but we also wanted to see (and that is our "secondly") whether the reputed poor efficiency of screen-grid tubes at 5 meters is an actuality.

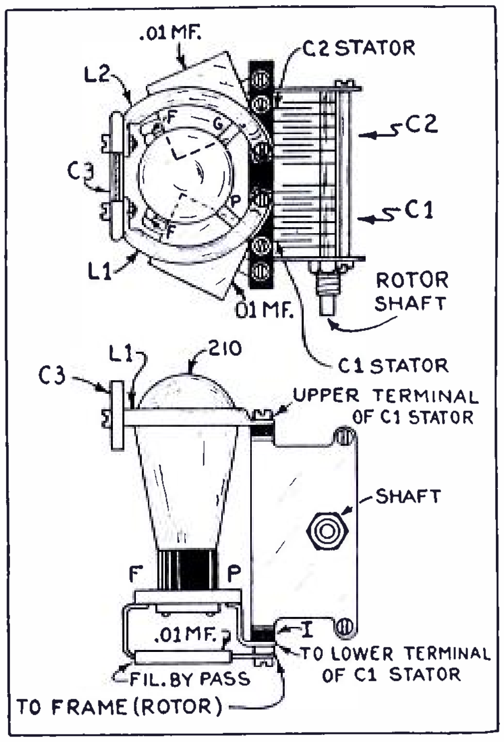
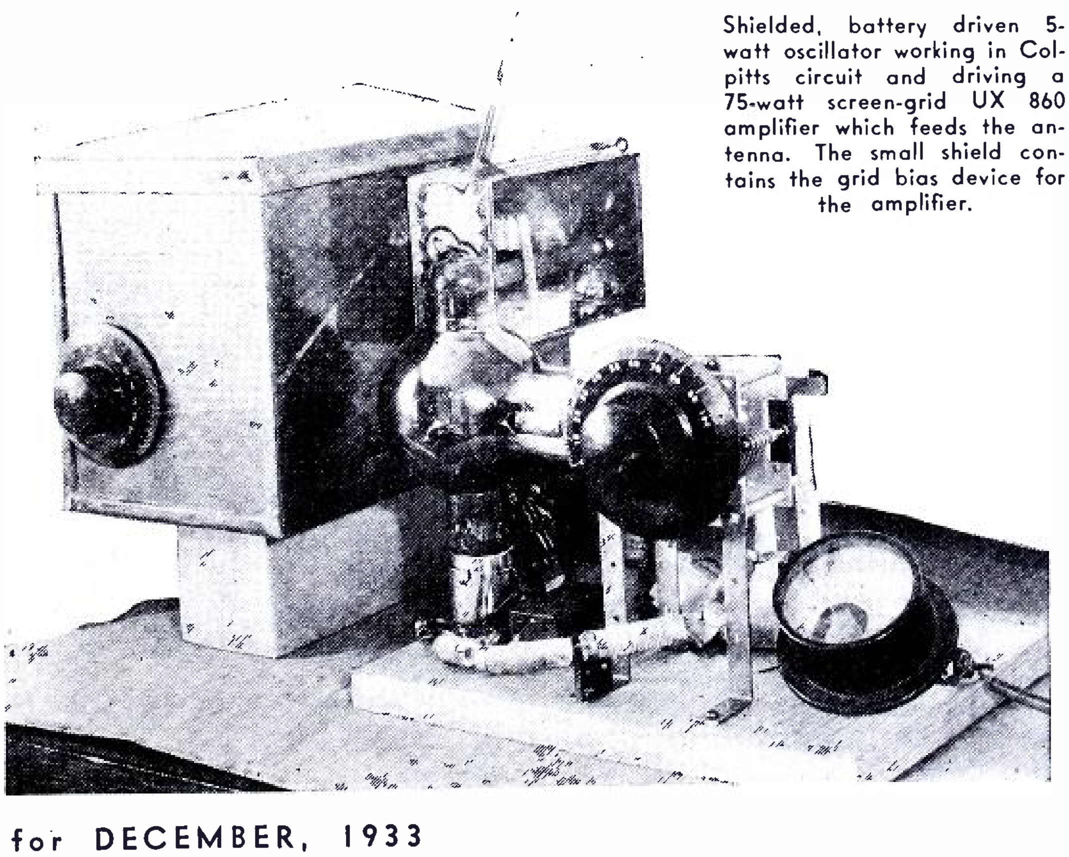


Fig. 2: Physical layout with insulating braces omitted as being optional. In the side view the .01 filament bypasses appear to go to the same condenser terminals as the P and G lugs of the tube socket. Reference to the top view will show that this is not so, there being 5 screws thru the insulating strip I, of which the two end ones connect to frame (rotor), to which the .01 condensers go. The other 4 are stator screws and proper for connecting P, G, L, and L2.

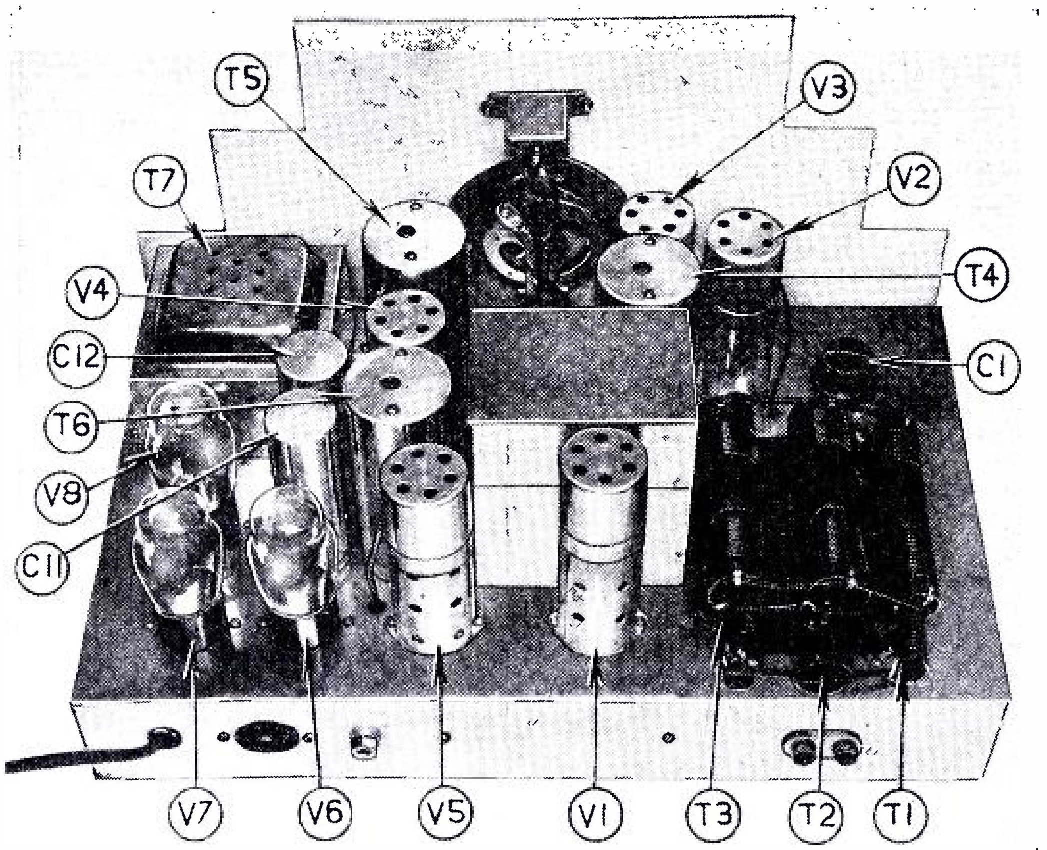
The efficiency of the 860 was found to be quite acceptable and a 75-watt output could be secured—although it is admitted that the tube did not equal its 80 meter performance. The 865 used in the same place gave a much poorer account of itself. However, the 865 has always been something of a misfit and we shall surely see it replaced by another tube in the reasonably near future, now that receiving tubes are to stop hatching for a few months. Meantime—we have another trick for the next installment.

We have now come this far. By replacing the 1933 (or 1924) style of modulated high-efficiency (low stability) oscillator with a more stable oscillator and amplifier, we not only greatly improve stability, but also put ourselves into line for modulation of a final stage whose output will have a good chance of resembling that of a decent transmitter working in more normal wavebands—and not demanding a "zero selectivity" receiver because it will hold still when modulated.

So far we have talked only of tests which prophesied such equipment, but the apparatus exists here, and will be told about in part 2 of this paper.



Shielded, battery driven 5-watt oscillator working in Colpitts circuit and driving a 75-watt screen-grid UX 860 amplifier which feeds the antenna. The small shield contains the grid bias device for the amplifier.



Rear view of the Cosmopolitan Eight, showing the symmetrical arrangement of the parts.

How to Build the "Cosmopolitan Eight"

By Steve Erdel

IN designing and constructing the *Cosmopolitan Eight*, a single purpose has dominated every other consideration—namely, to produce the most efficient short-wave receiver possible, regardless of cost. Strange as it seems, this purpose has been accomplished with a comparatively simple circuit. In fact, it seems as though the simplicity, not only of the circuit, but also of the layout and design, actually contributed to the high efficiency and performance of this receiver. The letter from Mr. G. L. Peters, reproduced here, tells the story. Here is a set which brings in plenty of foreign stations, including Germany, England, France, Morocco, Australia, Spain, Holland, etc. Little more need be said about performance.

Of course, the *Cosmopolitan Eight* has all the features one would expect to find in an up-to-date set. It has automatic volume control, which prevents fading of distant stations; noise suppressor action; a shadow tuning meter; and other conventional features found in high-quality receivers. In addition, it employs fixed short-wave coils, thus eliminating the necessity for plug-in coils. As a result, losses are reduced to a minimum—another excellent reason why no difficulty is experienced in bringing in foreign stations, even in unfavorable locations.

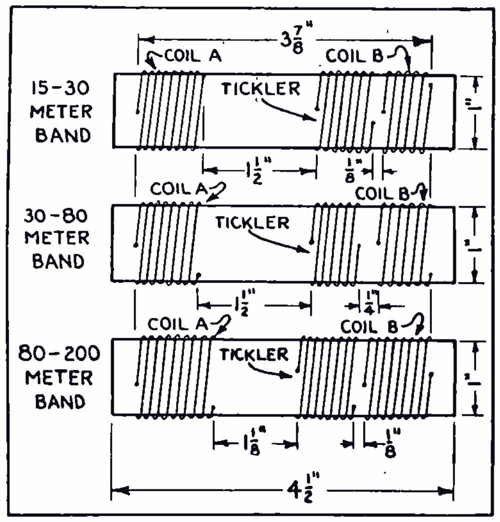
The circuit employs a 57 first detector, a 56 oscillator, two 58 intermediate-frequency tubes, a 55 duplex-diode-triode detector, two 2A5 output tubes, and a fullwave type 80 rectifier. The 57 tube makes a splendid first detector, with its sharp plate-current cut-off with respect to grid voltage.

The general purpose 56 tube has been found by the writer to make the best oscillator. The triple grid, super-control, type 58 tubes are now generally recognized by most engineers as excellent i.f. amplifiers. These variable-mu tubes are especially desirable because of their ability to reduce cross-modulation effects, and also because of their remote cut-off feature.

The 55 tube consists of two diodes and a triode in a single envelope. In this circuit, it is used as a combined second-detector, amplifier, and automatic volume control tube. Half-wave detection is employed with separate automatic volume control and a fixed-bias amplifier. Only one plate is used for half-wave rectification, providing approximately twice the rectified voltage obtained with the full-wave arrangement. For automatic volume control, the rectified voltage depends upon the amplitude of the i.f carrier employed. This voltage is utilized to regulate the gain of the i.f. amplifier stage so as to maintain essentially constant-carrier input to the second detector. The regulation of the i.f. gain by means of the rectified voltage is accomplished by applying the regulating voltage to the control grids of tubes V3 and V4. While there are a number of ways of obtaining the automatic volume control voltage, it is obtained in this particular circuit by utilizing one diode solely for this purpose. This method is particularly recommended, since it confines the sensitivity and the time-delay function solely to the a.v.c. circuit. The sensitivity control action is determined by applying a negative voltage to the a.v.c diode plate of such value as to accomplish the desired reduction.

A single audio output stage coupled to the second detector by means of resistance coupling is used. In this stage, two of the new 2A5 tubes are used in a parallel arrangement. The power handling ability of the 2A5 tube is essentially the same as that of the 59, but it has greater flexibility of application and, hence, has been found to be more suitable. The 2A5 tube has a power output of 3 watts, so that with two tubes in parallel, the combined output is more than sufficient for every requirement. Tone quality is remarkably fine, and background noise is practically eliminated. Many of the distant stations come in with such clearness and volume that they provide enjoyable entertainment comparable with locals.

The specially wound short-wave coils are assembled on a low-loss bakelite mounting platform. They cover the short-wave band from 15 to 200 meters. Only three coils are required to do this. The wave-change switch SW1 is a three-posi-



Winding details of the three fixed coils used in the Cosmopolitan Eight.

15—30-meter band: coil A, 13 turns No. 12 enameled wire; tickler, 10 turns No. 30 silk-cov. wire; coil B, 9 turns No. 14 enameled wire.
30—80-meter band: coil A, 19 turns No. 14 enameled wire; tickler, 12 turns No. 30 silk-covered wire; coil B, 15 turns No. 14 enameled wire.
80—200 meter band: coil A, 32 turns No. 18 enameled wire; tickler, 20 turns No. 30 silk-covered wire; coil B, 26 turns No. 18 enameled wire.

Proof of the Pudding

Gilbert L. Peters, Jr.
Oak Street,
Ramsey, N. J.

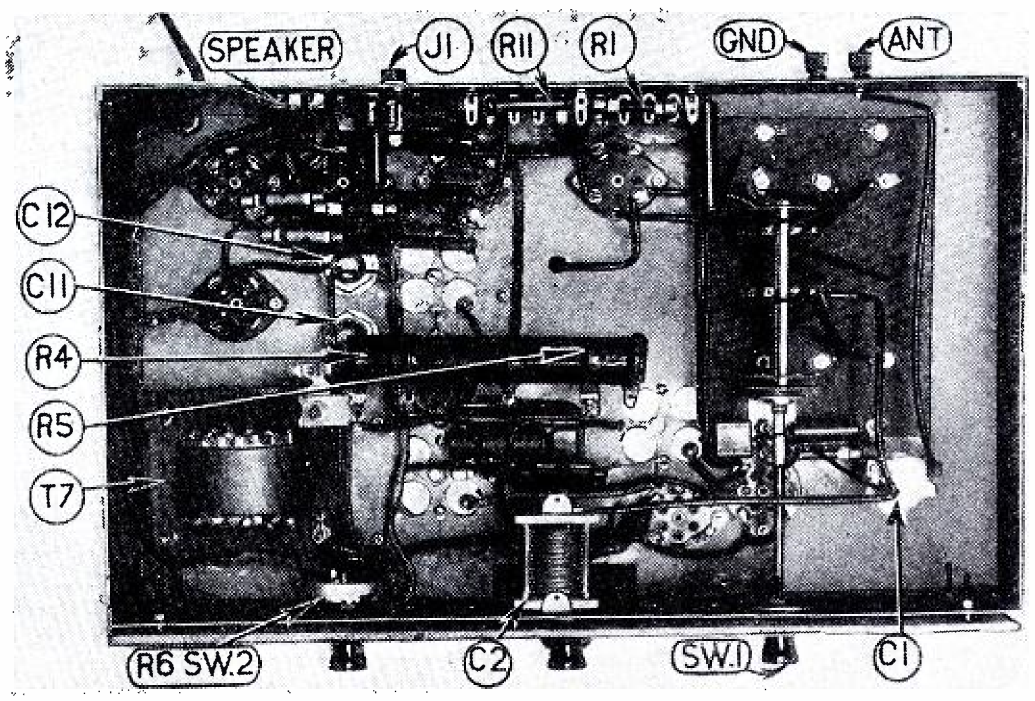
STEVE ERDEL
82 Cortlandt St., New York, N. Y.

Dear Steve:

It gives me great pleasure to inform you that the SW Super I recently purchased from you is giving excellent results. As I am still in the act of calibrating and logging new stations, it is rather difficult to give you a list of stations, together with the approximate dial settings.

The following stations have been received by me in the past week: Zeesen (Germany); Daventry (England); Pontoise (France); Rabat (Morocco); Sydney and Melbourne (Australia); Buenos Aires (South America); Madrid (Spain); Huizen (Holland); ZETE, Mexico City; TI4NRH, Heredia, Costa Rica; I2RO, Italy; VE9JR, Winnipeg, Canada; also numerous stations not identified as yet, due to my unfamiliarity with the tuning range of the set.

Sincerely yours,
(Signed) Gilbert L. Peters, Jr.



Underside of the Cosmopolitan Eight. The various leads carrying direct or audio current are neatly cabled.

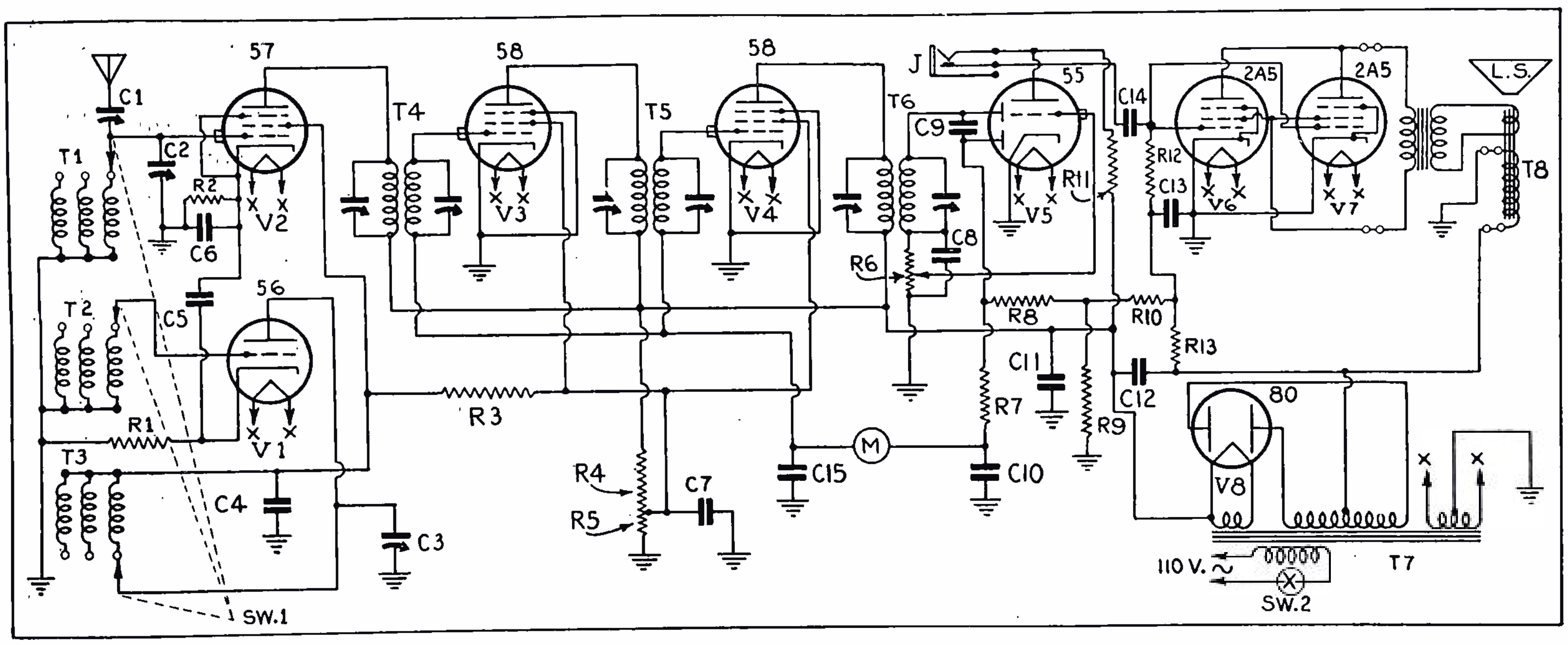
tion, three-gang switch, controlled from the front of the chassis by a long rod in order to obviate the use of long leads. An antenna control condenser is provided by C1. While there are two separate tuning condensers, C2 and C3, the set is essentially single-control, since the oscillator condenser C3 is the main tuning condenser. C2 turns broadly and serves more as a trimmer. In other words, this set is very easy to tune, especially when compared to others of like sensitivity.

The intermediate-frequency transformers are peaked at 465 kilocycles. This frequency has been selected after considerable experimentation, since it has been found to give the best performance, eliminating harmonics, image frequencies, etc. The manual volume control is located at R6. It is smooth and even in its action. A jack, J, is placed in the plate circuit of the second detector, thus providing for the use of earphones if desired. The power switch, SW2, is combined with the manual volume control R6.

A metal chassis 18″ by 10¾″ by 3″ high is used. The first step is to mount the various sockets. The power transformer is mounted next, and then the short-wave coil assembly. Next, the intermediate frequency transformers are mounted. The variable condenser C3 is mounted, and then the two electrolytic condensers C11 and C12, as shown here.

The chassis is now turned upside down and switch SW1 is mounted. Jack J is fastened to the rear chassis wall. The large wire-wound resistors, R4, R5 are mounted on brackets as far from the underside of the panel as possible. The volume control and switch combination is mounted on the front chassis wall, also condenser C2. The other small parts, such as fixed resistors and condensers are fastened in place while the set is being wired.

The wiring follows the usual procedure: filament circuits are wired first, then grids, next plates, then cathodes, bypass condensers, negative returns, etc.



C1—70 mmf. variable Hammarlund.
C2, C3—200 mmf. variable Hammarlund.
C4, C6, C7, C10, C13—.1 mf. tubular bypass condensers, Solar.
C5, C8, C9—1000 mmf. mica condensers, Solar.
C11, C12—8 mf. dry electrolytic condensers.
C14, C15—.01 mf. tubular bypass condensers, Solar.
R1—1000-ohm fixed resistor, 1 watt, I.R.C.
R2—5000-ohm fixed resistor, 1 watt, I.R.C.
R3, R9—40,000-ohm fixed resistors, I.R.C.
R4—R5—5000 ohms each section fixed resistor, 50 watts, Electrad.
R6, SW.2—500,000-ohm volume control and switch, Centralab.
R7, R8—1 megohm resistor, I.R.C.
R10—100,000-ohm resistor, I.R.C.
R11—250,000-ohm resistor, I.R.C.
R12, R13—500,000-ohm resistor, I.R.C.
T1, T2, T3—Coils as per specifications.
T4, T5, T6—Hammarlund 465 kc. i.f. transformers, type ATT465.
T7—Kenyon type K90 power transformer.
T8—Magnavox, 1000-ohm field, 3500-ohm impedance output transformer speaker.
M—Shadow tuning meter, 10 ma.
V1—Type 56 tube.
V2—Type 57 tube.
V3, V4—Type 58 tubes.
V5—Type 55 tube.
V6, V7—Type 2A5 tubes.
V8—Type 80 tube.
SW.1—Triple pole, triple throw rotary switch.
One aluminum chassis 18" x 10¾" x 3".

Fundamental Radio Experiments

SUMMARY: *The simple experiments usually presented for digestion by beginners have been, in the opinion of the editors, entirely unsatisfactory. They have emphasized the theory of operation rather than the practical side of the situation. Enthusiastic beginners are always on the lookout for interesting experiments—experiments that are fundamental, and that at the same time are in accord with the limited experience of beginners. We believe that the first of a series presented below by Mr. Prensky fills a long-felt necessity—that of emphasizing actual radio experience in a manner that is entirely within the grasp of everyone.*

By Sol. Prensky*

THIS is the first of a series of articles on simple radio experiments of a practical nature dealing with the fundamentals of radio. This series is designed to give a better understanding of how radio apparatus works by starting out with a layout of a few basic parts, and, by rearranging these few parts according to simple circuits, to enable anyone to perform many interesting different experiments. *Learning by doing* in this way gives better results than hours of reading not accompanied by actual manipulation of apparatus.

With this idea in mind, the apparatus used in these experiments has been selected to be of a general nature, so that *each part will serve over and over again* in the different experiments. The experimenter, then, by following each test in succession, will be able to build a general utility laboratory with the collection of these flexible parts, and be able to go ahead with his own investigations. If he has spare parts of his own lying about, he can obviously use these to widen his field. In the main, however, we are here trying to avoid the practice of using apparatus that has only one specific use, and which is just so much junk after that use has been investigated. The saving made by use of the general purpose parts makes it possible to have your own laboratory at a very reasonable cost.

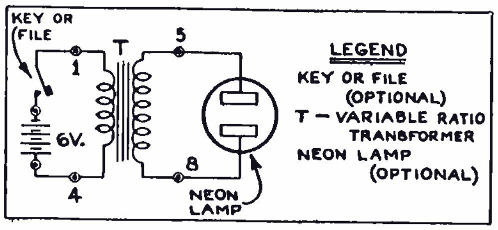
The first three experiments stress that part of radio with which we are most familiar—that is, producing audible sounds. Since all radio work must be accompanied by a healthy respect for high voltages, this is the topic of our first experiment.

Experiment No. 1—Stepping up Voltage

OBJECT: To show how high voltage effects may be obtained by starting with a low voltage:

METHOD: Referring to the circuit diagram for Exp. 1, we connect the 6-volt battery across the primary terminals 1 and 4 of transformer T, which forms our input, and we will investigate the output from secondary terminals 5 and 8 by connecting a neon lamp across these terminals. (Note 1 below gives a method for substituting the fingers for the neon lamp.)

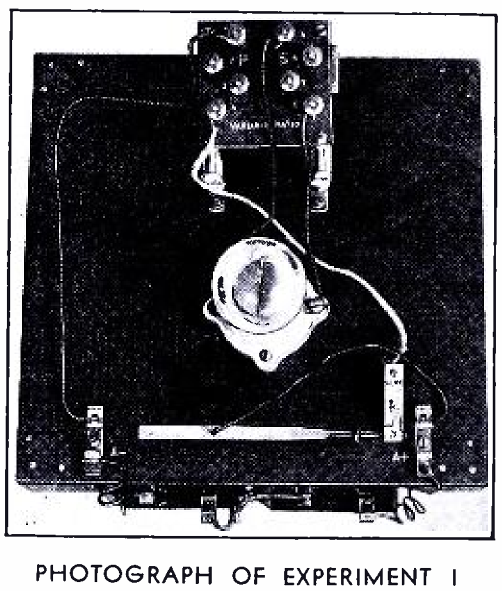
*Instructor in Physics and Radio, Thomas Jefferson High School, New York, N. Y.



EXPERIMENT 1
A transformer is an a.c. device.

CONTINENTAL CODE			
A •—	L •—••	W •——	7 ——•••
B —•••	M ——	X —••—	8 ———••
C —•—•	N —•	Y —•——	9 ————•
D —••	O ———	Z ——••	10 —————
E •	P •——•	NUMBERS	PUNCTUATION
F ••—•	Q ——•—	1 •————	PERIOD •• •• ••
G ——•	R •—•	2 ••———	INTERROGATION ••——••
H ••••	S •••	3 •••——	BREAK(DOUBLE DASH) —•••—
I ••	T —	4 ••••—	WAIT •—•••
J •———	U ••—	5 •••••	END OF MESSAGE •—•—•
K —•—	V •••—	6 —••••	END OF TRANSMISSION •••—•—

THE CONTINENTAL CODE



PHOTOGRAPH OF EXPERIMENT 1

OBSERVATIONS AND RESULTS:

(1a) The neon lamp connected directly across the 6 volts does not light, since the voltage is too low.

(1b) The lamp connected across terminals 5 and 8 gives no results with the current flowing through the primary. This test shows that with direct current flowing, *as long as it is unvarying*, there is no transfer of energy from primary to secondary.

Test 2—Voltage Step-Up

(2a) Keeping the lamp across terminals 5 and 8, break the primary circuit with the key. (For dispensing with the key, see Note 2.) The neon lamp will light as the current is broken. This demonstrates that when the current in the primary circuit changes, electrical energy is transferred (by the variation of the strength of the magnetic field) to the secondary, and is stepped up.

The high voltage effects in this experiment come from the inductive "kick" caused by *breaking* the primary circuit. This phenomenon will be taken up in later experiments. Here, we will concentrate on the stepping up of the voltage by the transformer, which action is dependent on the fact that the secondary has a greater number of turns than the primary.

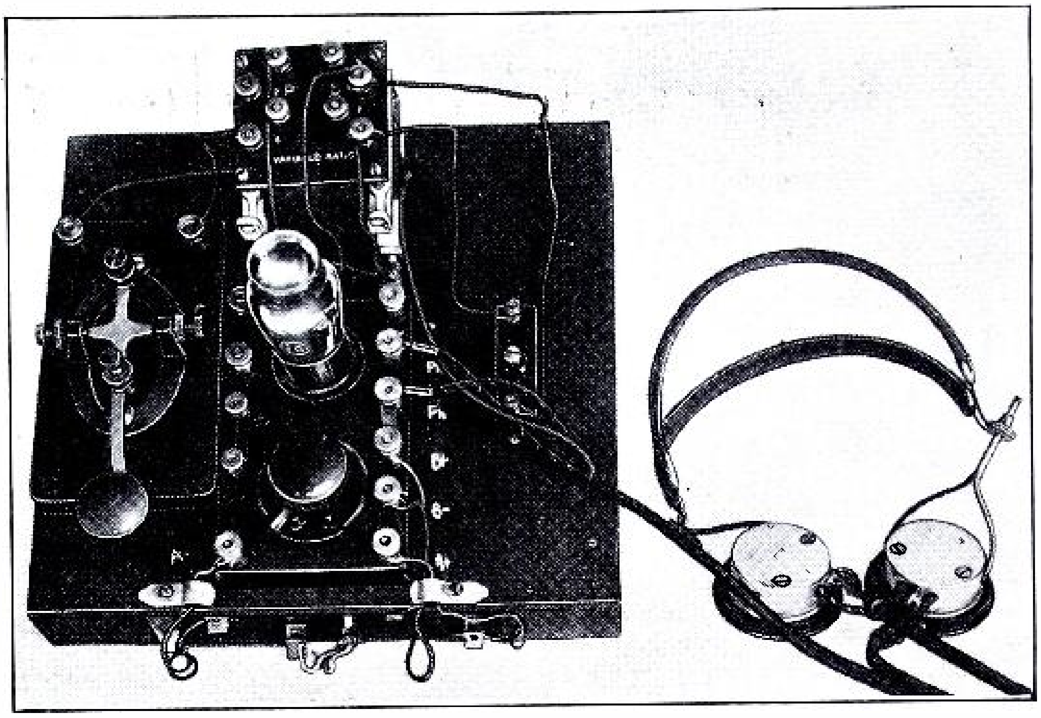
(2b) In order to get a continuous transfer of energy to the secondary, tap the key rapidly; we find that the lighting of the neon lamp will continue as long as this is done. This test demonstrates that in order to have a transformer work on d.c. the current must be continuously varied or interrupted, as in the case of spark coils. When alternating current is used, the transformer needs no additional apparatus to operate, since the current, by virtue of its alternating nature, is continually varying from zero to maximum and back again. This is the case for commercial transformers. We could use 3 volts a.c. in our experiment, but do not use the 110-volt a.c. line directly, as this voltage is excessive for the transformer.

(3) When the neon lamp is connected across secondary terminals 6 and 7, which gives a step-down ratio, there is no effect on the lamp, since the secondary winding between these taps has a smaller number of turns than the primary, and the voltage produced is not sufficient to light the lamp.

NOTE 1—The neon lamp may be dispensed with if the fingers of one hand are placed across the terminals indicated instead of the lamp. This gives the effect by a slight shock (not objectionable) when the voltage is stepped up.

NOTE 2—Instead of a key, the current may be varied by using a file in the circuit, and making contact by scraping a bare end of wire across the file. (See photograph.)

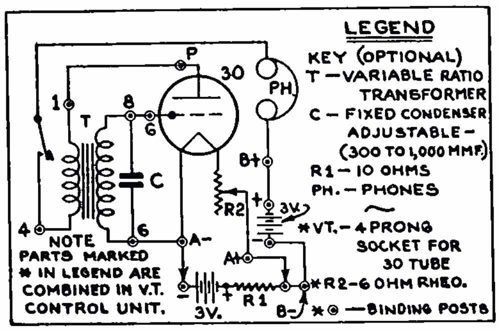
NOTE 3—If a buzzer or bell is used in series with the primary of the transformer, it will act as an interrupter, and the effects of a spark coil or a shocking coil will be obtained from the secondary terminals.



ABOVE: PHOTOGRAPH OF THE SET-UP USED IN EXPERIMENT 2

RIGHT: SCHEMATIC CIRCUIT OF SET-UP IN EXPERIMENT 2

This experiment is designed to illustrate the use of the vacuum tube as a generator of oscillations. The key is used to interrupt the oscillations according to the continental code.



Experiment No. 2—The Vacuum Tube Generator

In the second experiment we add a radio vacuum tube, which is the heart of modern radio, to our basic equipment. We will investigate its action by causing it to produce an audible note by audio frequency oscillation, which can then be used for code signalling purposes. Although signalling can also be managed by a buzzer, the method using a tube is much to be preferred for its flexibility in changing the frequency, and has the obvious advantage of having the sound heard only by the person using the earphones. As explained before, we will also use the tube unit for other experiments later.

For controlling the vacuum tube, we need access to the tube elements by binding posts, as well as provision for connecting the rheostat and the A and B batteries. To do this effectively and conveniently we use the vacuum-tube control unit, shown in the photograph, which has all the requisites mounted on a bakelite base and all the connections brought out to a double row of binding posts. This avoids the sloppiness of spreading the apparatus all over the table with its attendant dangers of bad connections and short circuits, which is the bane of embryo experimenters. The practice of neat arrangement and positive connection of parts is absolutely essential to good experimentation. In this instance, the use of a compact arrangement for controlling the vacuum tube goes a long way in getting the habit of doing a workmanlike job.

OBJECT: To generate an audible note by the oscillation of a vacuum tube.

METHOD: Connect the parts, with the exception of condenser C, as shown in the circuit diagram of Exp. 2. When the 3-volt A battery is connected and the rheostat turned up, the resistors in the circuit cut down the voltage to 2 volts for the type 30 tube. The filament lights up very dimly, and its red glow is not noticeable, except in the dark. The other 3-volt battery, connected in series with the first as shown in the diagram, is sufficient to act as the B battery.

OBSERVATIONS AND RESULTS:

1-*Code signalling.* Close the key. A distinct note is heard in the phone. By tapping the key, the dots and dashes of the Continental Code may be made and used for code practice. (See Note 4 for use by more than one person.)

The explanation of the action of the tube is briefly as follows:

Closing the key completes the plate circuit and allows the electrons to flow from the filament to the plate, and through the primary of the transformer to complete the circuit back to filament again. This *rise* in current flow generates a voltage in the secondary of the transformer—see Exp. 1—and, in a stepped-up form, is fed to the grid of the tube. The voltage variations thus impressed on the grid are amplified by the trigger action of the grid and appear in amplified form in the plate circuit. Since the plate circuit is continually feeding back some of its energy to the grid circuit, the original excitation will not die down, but will be sustained—that is, the tube will oscillate. The frequency at which it oscillates depends on the product of inductance and capacity, and due to the high inductance of the transformer windings and their associated distributed capacities, the oscillation, in this case, is at an audio frequency, which we hear as the pitch of the note in the phones.

(2)—*Varying the frequency.* In order to vary the frequency we can change either the inductance or the capacity.

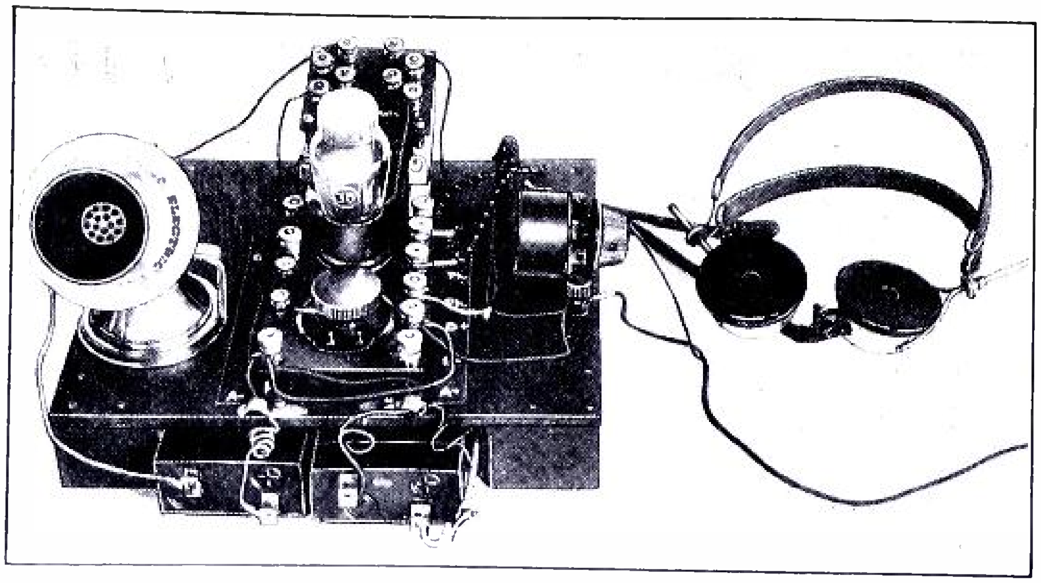
(a) Using terminal 5 of the secondary instead of 6 gives a lower pitch since, by using a greater inductance, we obtain a greater product of inductance times capacity, and the resultant frequency is lower.

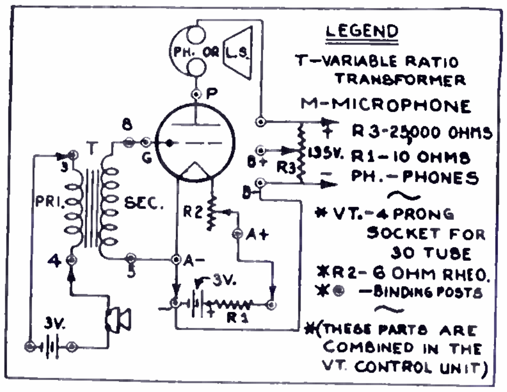
(b) Connect the condenser across the secondary terminals 6 and 8. With an increase in capacity by tightening the screw adjustment the pitch becomes still lower.

(c) For frequencies lower than this, connect the condenser across P and F.

NOTE—4. If we connect two keys in parallel with each other and connect two phones in parallel with each other, the two signallers may be separated by any distance as great as the key and phone cords allow, and each one can then alternately send and receive the signals. Arrangements for the signals to work a loudspeaker are given in the next experiment.

We have used our apparatus to produce sound. We will now arrange a circuit to amplify sound. Since the note coming from the phones is caused by fluctuations of current, we could, if we amplified these electric variations, use the output of our audible generator to actuate a loudspeaker. (See Note 5 for this. For a simple method of using the 60 cycle a.c. hum as the source of





ABOVE: PHOTOGRAPH OF THE SET-UP USED IN EXPERIMENT 3

LEFT: SCHEMATIC CIRCUIT OF SET-UP USED IN EXPERIMENT 3

This experiment is designed to illustrate the use of the vacuum tube as an amplifier. A microphone is used in this experiment.

sound, see Note 6). However, we also have the possibility of amplifying speech. For this purpose, the original sounds must be changed into current variations by means of the microphone, as is done in all telephone systems. We could then hear the conversation in a pair of earphones, or, as we shall do in Exp. 3, we can feed the output of the microphone into the one-stage amplifier and have amplified speech.

Experiment No. 3—Microphone Amplifier

OBJECT: To construct a one-stage amplifier of sound.

METHOD: Referring to the Exp. 3 circuit diagram, the microphone current from the 3-volt battery flows through primary terminals 3 and 4. The stepped-up variations are led to the grid of the tube, which amplifies them, and the sound is then produced at a greater volume in the phones or loudspeaker situated at a distance from the microphone.

OBSERVATIONS AND RESULTS

(1) *Microphone without amplifier*: Connect phones to the secondary terminals 8 and 5 in order to observe results without the amplifier.

(2a) *Characteristics of microphone.* With no sound being made before the microphone, a slight background hiss will be observed which is characteristic of the carbon microphone when current flows through it.

(b) Blowing air gently on the microphone causes a rushing noise in the phones (now connected as shown in the diagram), since the stream of air actually pushes on the diaphragm. This explains the great accentuation over the air of coughing and other breathing sounds.

(c) Tapping the table, or any other mechanical jar to the microphone, results in a greatly emphasized bang in the phones, since this obviously also moves the diaphragm.

(3) *Speech.* The correct technique in speaking into the microphone—not too closely and at an angle of forty-five degrees—may be experimented with. The voice should be heard in the phones clearly enough for the listener to recognize the character of the speaker. For musical reproduction, the quality obtained will depend greatly on the type of microphone used, and is much more involved because of the greater range of frequencies.

(4) *Sound effects with amplifier.* Sound effects may be tried and very interesting results obtained. The following are some suggestions:

(a) Breaking a match stick (wooden) near the microphone to imitate the breaking of a log.

(b) Pouring water into a glass gives a pleasing musical effect.

(c) Crumpling a piece of paper to give battle-field effects.

(d) Siren effect may be obtained by means of a microphonic howl produced by bringing the microphone too close to the loudspeaker so that there is feed-back.

(5) *Dictaphone.* Setting the microphone (connected by a long cord) near people in conversation will give a dictaphone arrangement. The phones may be placed at a distance and connected by a long cord so that the listener is out of earshot.

NOTE 5—To amplify the audible note, connect two wires from the phone terminals of the generator (taking out the phones) to the primary terminals 1 and 4 of amplifier, and connect the phones or loudspeaker in the output of the amplifier.

NOTE 6—For using the 60 cycle hum, connect the 110-volt a.c. line through a condenser (up to 1 mf.) and a 110-volt lamp all in series to primary terminals 1 and 4 of amplifier. Be sure that the current is limited so that the lamp doesn't light.

GENERAL NOTE—While adjusting the circuit, a convenient plan is to place a clock on the same board as the microphone and make adjustments for the loudest ticking heard in the phones. The selection of the microphone is up to the reader. The microphone shown in the photograph is of the type sold at low prices as government surplus stock and works fairly well. It is of the same order as a regular telephone transmitter. Better results can be obtained from commercial type microphones. Care must be taken that the microphone selected does not require a voltage much higher than 3 volts, unless one wishes to use a higher voltage battery and try out different ratios on the transformer. The 3-volt battery shown here is of the same small type as used for filament supply. A C battery may also be used.

The major control for adjustment is the potentiometer across the B supply (which may be as low as 90 and as high as 250 volts). The potentiometer should not be smaller in size than the one shown in the photograph if voltages over 180 are used. In any case, the voltage is adjusted by moving the arm to the best operating point (which in this case was about 135 volts applied) as determined by listening.

Additional experiments will appear at a later date which will also use the vacuum-tube control and the variable ratio transformer, our two basic units, as a nucleus around which to build up other interesting experiments and applications.

List of Parts

T—Leeds Variable Ratio Transformer.

C—Fixed Condenser (X-L), adjustable, 300-1000 mmf.

VTC—Leeds Vacuum-Tube Control (containing the following 3 parts mounted on a bakelite base:

VT—4-prong socket; R2—6-ohm rheostat; 11 binding posts.

R3—25,000-ohm potentiometer (larger than midget size).

ACCESSORIES

Key and Neon Lamp (optional).

1—Type 30 vacuum tube.

Phones or loud speaker.

Single button carbon microphone.

Two 3-volt batteries (flat type—general No. 2-P-X).

R1—10-ohm fixed resistor (externally connected to filament battery).

B supply (anywhere from 90-250 volts,—B eliminator preferable to B batteries in the long run).

Maj. Armstrong Wins Again

THE long-drawn-out controversy over credit for the invention of the regenerative circuit, which is probably the most important single contribution to the radio art, took another turnabout on August 29th, 1933, when the United States Circuit Court of Appeals for the Second Circuit, in New York, rendered a decision in favor of Edwin Howard Armstrong and against Lee de Forest. The actual court action involved the Radio Corporation of America, the American Telephone and Telegraph Company, and the DeForest Radio Company on one side, in a suit against the Radio Engineering Laboratories, Inc., well-known short-wave specialists of Long Island City, N. Y., for alleged infringement of the DeForest patent. The court upheld Armstrong's priority; declared, in effect, that DeForest's patent was invalid; and decided, therefore, that REL was not infringing.

Because of a legal technicality, Armstrong himself was not permitted to be a party in the present action, but he personally financed the REL defense because he saw in the suit an opportunity to regain his position as the rightful inventor. He produced new and important evidence not disclosed in earlier court encounters.

The complexities and contradictions of this famous litigation over a period of twenty years have engaged some of the country's best legal talent and have kept the radio industry in a state of turmoil and uncertainty.

Armstrong's original patent application was filed October 29th, 1913, and his famous patent No. 1,113,149 was granted October 6th, 1914.

Won First Suit in 1921

In 1921 in New York he won a suit for infringement of the patent against DeForest. This action was tried before Judge Julius Mayer, probably the most experienced jurist regarding radio cases on the bench. In 1922 Judge Mayer's decision was affirmed by the United States Circuit Court of Appeals in an able opinion written by Judge Martin T. Manton. In both these decisions the DeForest story was rejected.

Meanwhile in the Patent Office, in a proceeding involving the oscillator where the same evidence was presented, the three tribunals of the Patent Office likewise rejected DeForest's story. In 1924, however, the Court of Appeals of the District of Columbia accepted DeForest's story, deciding in his favor. In actions arising out of this decision in Wilmington and Philadelphia, the DeForest contentions were again accepted and were affirmed in 1927 by the Third Circuit Court of Appeals in a decision written by Judge Wooley. Because of the difference of opinion of the two circuit courts of appeal, the Supreme Court took the matter and in 1928 decided on questions of law to affirm the decision in favor of DeForest. So the matter rested until recently.


© Bachrach

A recent photograph of Major E. H. Armstrong

Since 1924 Armstrong has been in virtual seclusion, has refused interviews and every opportunity for publicity, and has maintained a grim and tight-lipped silence. However, his activity in the REL case and the nature of the evidence he dug up proves that he has been exceedingly busy and that he has spared neither effort nor money to re-establish his standing. Soon after the patent was issued, twenty years ago, his discovery of regeneration and its effect on radio communication were recognized here and abroad by engineering societies; but these honors became somewhat empty as a result of the Philadelphia court and Supreme Court rulings, and since then he has fought tooth and nail to regain his lost prestige.

> The origin of the regenerative circuit has long been a matter of discussion and legal argument. Ever since 1921, when Major Edwin Howard Armstrong won his first decision over Dr. Lee deForest, the issue has gone from one court to another, the decision of one judge reversing that of the preceding one. The entire aspects are told here in an exclusive interview with Major Armstrong.

Money was not Armstrong's object, for he is independently wealthy. He sold his original patent to the Westinghouse Company in 1920 for a considerable sum, and one of the peculiarities of the REL case is that he had to fight RCA, who acquired the Westinghouse rights, because RCA also owns the radio rights to the DeForest patents! RCA bought out the DeForest Radio Company about a year ago, as this company (with which Lee de Forest himself had no personal connection) owned the DeForest patents.

The final bell has not yet rung on the fight, as an appeal by RCA to the Supreme Court is still possible. At the time this was written (late in September, 1933) no appeal had been made. The main point now is that Armstrong's patent of 1914 expired in 1931, while DeForest's patent of 1924 still has eight more years to run, which means that RCA can collect royalties so much longer.

The importance of the patents cannot be exaggerated; radio as we know it today would not have been possible without the oscillating vacuum tube. All vacuum tube transmitters, regardless of operating wavelength, probably 75% of all broadcast receivers, and certainly all short-wave receivers, are covered by one or more features of the patents.

Breaks Long Silence

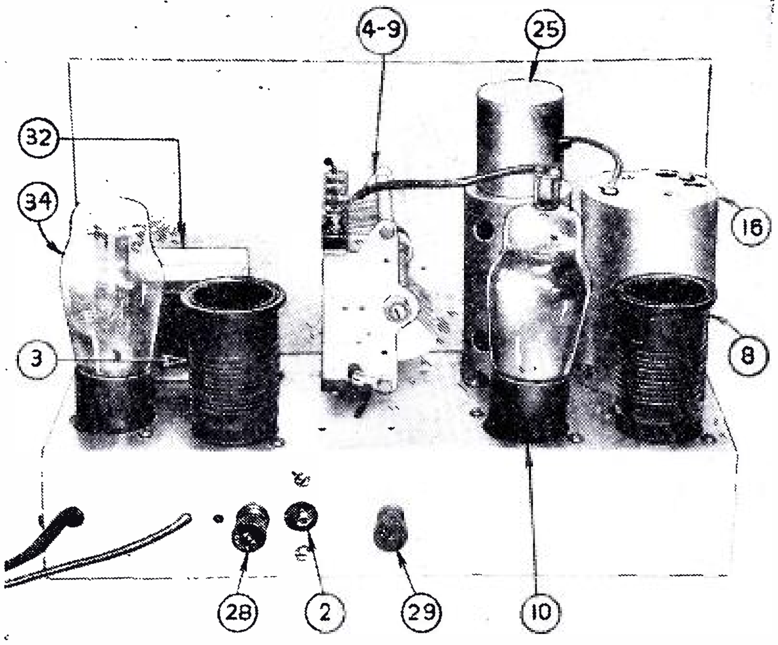
Breaking his long and self-imposed silence, which must have been painful for a man previously noted for his freedom of expression and action, Armstrong seemed extremely happy over the REL court decision when he was interviewed in his home in New York by the editor of SHORT WAVE RADIO.

"The radio world has never had any doubt who was the inventor of the feed-back circuit," he said. "Nevertheless, during the past nine years, I have been defeated in six courts on questions of law or fact in this contest.

"In all that time I have never lost faith that sooner or later the controversy would come before a court with sufficient knowledge of the radio art to understand the fallacies of the DeForest case and sufficient courage to brush aside patent technicalities which obscured the truth and led to decision after decision in which the real issue of the case was never passed on.

"The Court of Appeals for the Second Circuit has justified that faith. The decision handed down by Judge Chase is a tribute to the memory of the late Judge Julius Mayer, who tried this case and de-

(*Continued on page 42*)



TOP VIEW OF THE A.C.—D.C. CONVERTER.

A Universal A.C.—D.C. S.W. Converter

SUMMARY: *Many different types of converters have been described in the past, but few have the possibilities of the one described here. For one thing, it is simplicity itself; second, it is "universal"—that is, it may be operated from either A.C. or D.C. sources.*

We take pleasure in introducing our first converter article to our readers, and we feel sure that you will be more than pleased with its operation.

By H. G. Cisin, M.E.

INTENSIFIED interest in short-wave reception has created a substantial demand for converters which can be used to transform the faithful broadcast receiver into an efficient short-wave set.

That is exactly what the Find-All Pentagrid Converter does. It makes no difference whether the broadcast receiver is a super-het or a tuned r.f. set—the converter works just as efficiently in either case.

In principle, the Find-All Converter consists of a superheterodyne first-detector tuned to the short-wave band, an oscillator, and an intermediate-frequency stage. Connecting this circuit ahead of a tuned r.f. broadcast receiver converts the latter into a superheterodyne. When the converter is connected ahead of a superhet, it merely adds oscillator and another i.f. stage, with detection on the short waves instead of at broadcast frequencies.

Through the use of the new 6A7 pentagrid tube, the functions of detector and oscillator are combined in a single tube. This new tube is a five-grid electron coupled detector-oscillator, especially designed for use in superheterodyne circuits. Acting in the place of separate conventional oscillator and detector tubes, the single tube offers several worthwhile advantages: first, the translation gain (i.f. voltage divided by r.f. signal voltage) is greater in the 6A7 than in the case where separate tubes are used; second, more complete isolation is secured between the r.f., the oscillator, and the i.f. circuits; third, the frequency of oscillation is much more stable with the 6A7, due to the fact that it is independent of the load on the amplifier portion of the tube. A fourth advantage, more mechanical than electrical, consists in the simplification of the circuit through the use of one less tube, thus making the converter easier to assemble and wire.

The output of the 6A7 tube is coupled to the 78 i.f. tube by means of a 465 kc. intermediate-frequency transformer. The 78 pentode tube is well adapted for use in the i.f. stage due to its variable mu and other favorable characteristics.

Both the antenna coupling coil (3) and the oscillator coil (8) are standard plug-in short-wave coils. Direct antenna coupling is employed, so that the primary is disregarded in the case of coil (3). In order to cover the short-wave band from 15 to 200 meters, four different coils are required both at (3) and at (8). Alden coils are color coded, the green coils covering the band from 80 to 200 meters, the yellow coils from 40 to 80 meters, the red coils from 20 to 40 meters and the blue coils from 15 to 20 meters. A dual variable condenser (4,9) tunes both (3) and (8).

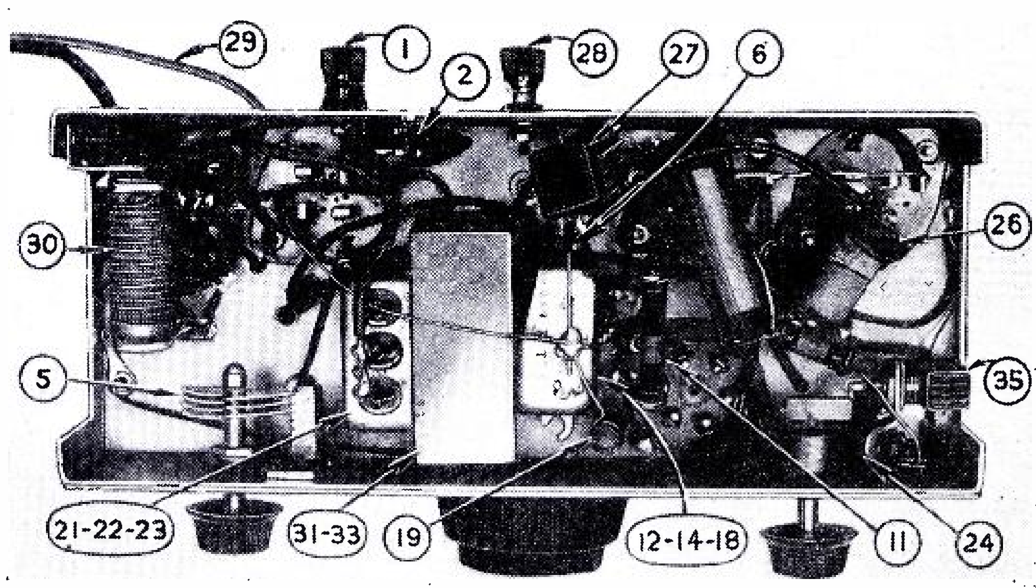
Technical Description

The Find-All Pentagrid Converter uses the Cisin A.C.-D.C. circuit (U. S. Patent Application S.N. 592,-586). Hence, it dispenses with the customary power supply transformer and will work equally well whether the power source is a.c. or d.c. A 25-Z-5 tube (34) is used as a half-wave rectifier. Adequate filtering is accomplished by means of the choke (32), bypassed on either side by the dual electrolytic condenser.

Antenna control is provided by the 5 to 25 mmf. condenser (2), permitting the converter to operate efficiently on any length antenna. The volume control (24) is placed in the cathode circuit of the 78 tube. With only three tubes and with a minimum number of parts, the Pentagrid Converter can be completed with ease and rapidity and without the necessity of previous set building experience.

Starting with the drilled chassis, the five sockets are mounted in their respective positions. Next, the audio choke (32) is fastened to the top of the chassis at the right front. The dual variable condenser (4,9) is mounted at the center of the chassis in a vertical position (with the insulating strips at top and bottom). If a panel is used, the condenser may be fastened directly to the panel.

Holes should be drilled in the chassis deck for the three leads, and the shielded i.f. transformer is then fastened in place. The volume con-



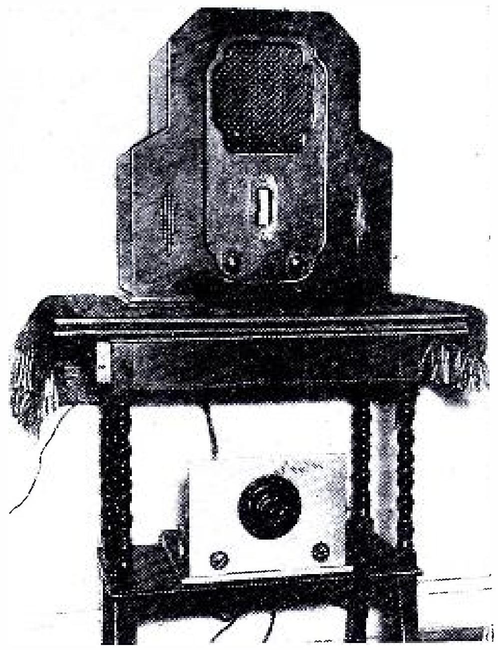
UNDER-VIEW OF THE CONVERTER LABELED FOR CONVENIENCE.

trol-switch is then mounted on the left front chassis wall. The condenser (5) is mounted on the right front chassis wall. The antenna condenser (2) is mounted on the rear chassis wall. A 5/8″ hole is drilled to permit adjustments from the rear of the chassis. Binding posts (1), (28), and lead (29) are mounted next, all being carefully insulated from the chassis. The resistor (30) is mounted under the chassis on a right-angle bracket, being held about 1¼″ from the under side of the deck. Mount the condenser (12, 14, 18); item (21, 22, 23) may be fastened to the inside front chassis wall or to the under-side of the chassis deck. The two mica condensers and the fixed resistors are soldered in place while the set is being wired.

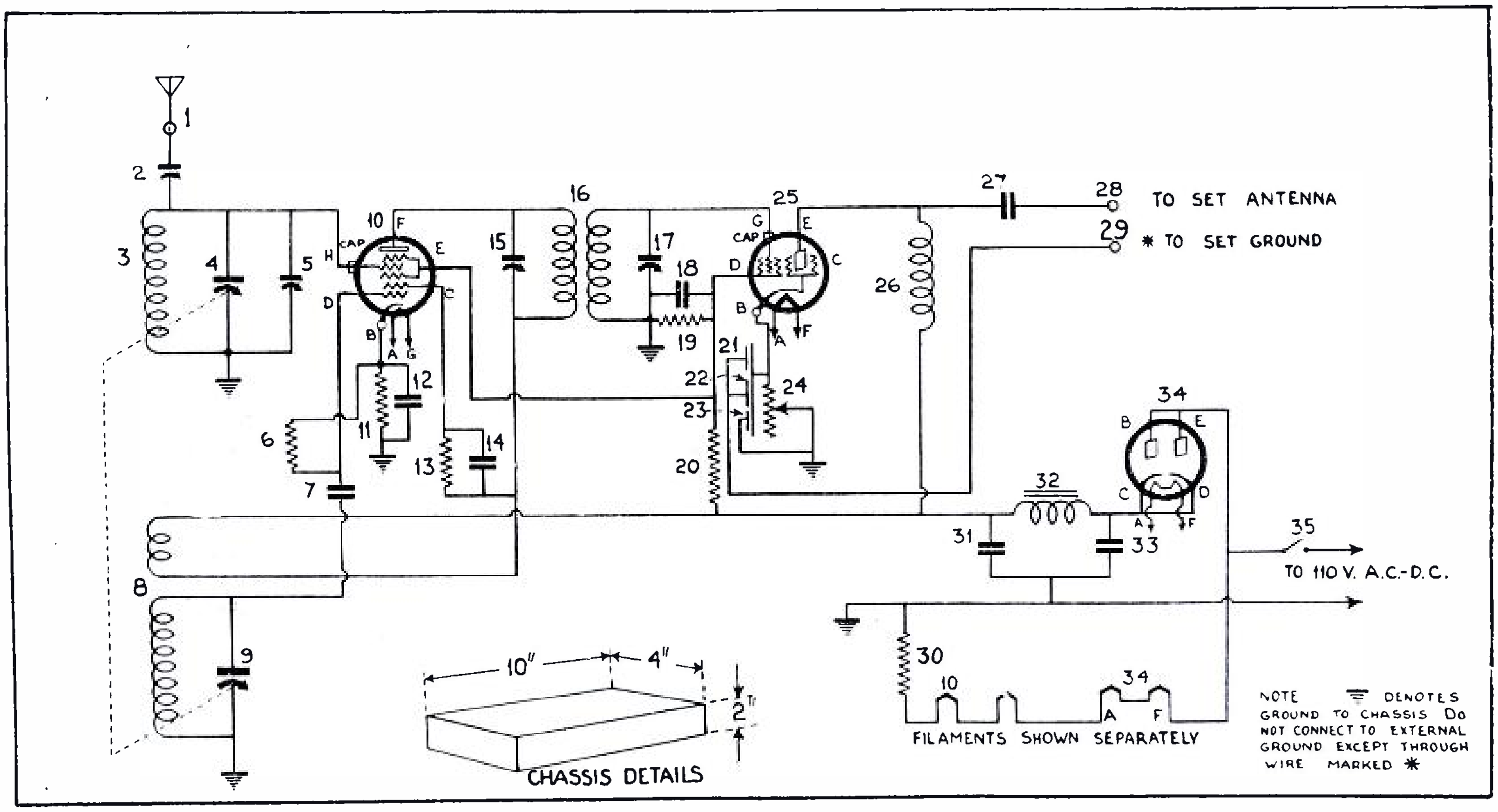
The panel may be fastened to the front of the chassis by means of the mounting nuts on the volume control (24) and the condenser (5). Finally, the dial and the two knobs are fastened in place, thus completing the assembly.

The set should be wired with standard hook-up wire. It is suggested that the filament circuits be completed first. These are drawn in separately on the schematic diagram in order to make this easier to read. In making connections to the tube sockets, note that each terminal shown in the top view is lettered to correspond with lettering on the schematic diagram. For example, socket (10) shows the large filament holes designated by letters A and G. The same letters are used to mark the filament on the diagram. The screen grid clip which goes to the cap of the tube is marked H and this is also marked similarly on the diagram. If the top view and the schematic diagram are studied carefully, there is no reason in the world why anyone should make a mistake in wiring up these three sockets. After completing the filament wiring, the various grid circuits should be wired, and then the plate circuits, next the cathodes, and, finally, the

(*Continued on page* 45)



THE CONVERTER IN OPERATION
Photograph of the converter underneath a standard broadcast receiver.



SCHEMATIC CIRCUIT OF THE TWO-TUBE CONVERTER, WHICH OPERATES FROM A.C. OR D.C.

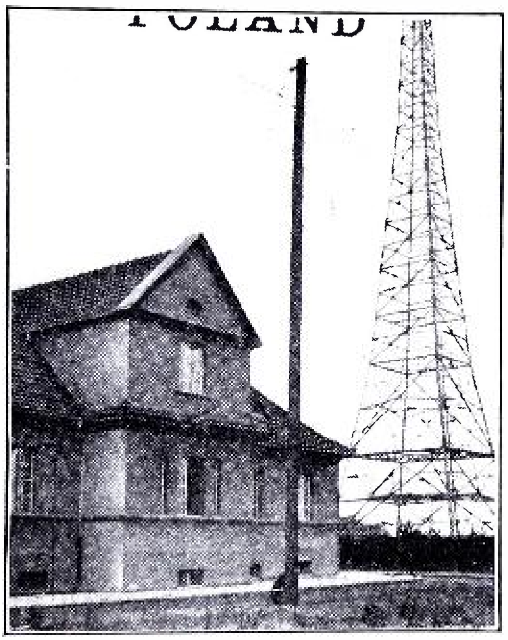
1—.000025 mf. Cardwell Balanced variable condenser, type 607-A, (5).
1—.00015 mf. (ea. section) Cardwell two-gang Midway "Featherweight" variable condenser, type 405-B Dual, (4, 9).
2—Sets of Alden plug-in short-wave coils, four coils to each set, covering short-wave bands from 15 to 200 meters, type 704 SWS, (3, 8).
1—Acratest antenna tuning condenser, 5 to 25 mmf., type No. 2881, (2).
1—Electrad 25,000 ohm potentiometer, type R1-280-P, (24); with switch, (35).
1—Electrad Truvolt 300 ohm, 25-watt wire-wound resistor, type B-3, with sliding clip set at 275 ohms, (30).
1—Electrad wire-wound pig-tail resistor, 350 ohms, 1 watt, type PG350, (11).
1—Aerovox mica condenser, .0001 mf., type 1467, (7).
1—Aerovox mica condenser, .00037 mf., type 1460, (27).
2—Aerovox triple-section, metal case condensers, .1 mf. ea. section, type 260-31, (12, 14, 18) and (21, 22, 23).
1—Aerovox dual-section electrolytic condenser, cardboard container, small size, 4 mf. ea. section, type P5-44, (31, 33).
1—I.R.C. 20,000 ohm, ½-watt metallized resistor, type F-½, (20).
1—I.R.C. 20,000 ohm, 1 watt metallized resistor, type F-1, (13).
1—I.R.C. 30,000 ohm, 1-watt metallized resistor, type F-1, (19).
1—I.R.C. 50,000 ohm, ½ watt metallized resistor, type F-½, (6).
1—Find-All r.f. choke, (26).
1—Find-All shielded intermediate-frequency transformer, 465 kc., (16), with tuning condensers (15, 17) within same shield.
1—Acratest audio choke, 30 henry, 250 ohms, No. 2505 (32).
3—Acratest binding posts, No. 5678, (1, 28, 29).
2—Alden four-prong moulded sockets, type 424, (3, 8).
2—Alden six-prong moulded sockets, type 436, (25, 34).
1—Alden seven-prong moulded socket, type 437-A, (10).
1—6A7 pentagrid tube, (10).
1—78 triple-grid variable mu tube, (25).
1—25-Z-5 rectifier tube, (34).
1—Roll Corwico Braidite hook-up wire—solid core.
1—Drilled metal panel, 10″ x 7″ x 1/16″ thick.
1—Drilled metal chassis, 10″ x 4″ x 2″ high.
2—Acratest screen-grid clips, No. 4173.
2—Acratest knobs, No. 4123.
1—Acratest "Univernier" dial, No. 4117.
1—Acratest screen-grid shield, No. 7173.

Note: Numbers in parenthesis refer to corresponding numbers on diagrams.

Capt. Hall's Department on Foreign Stations

SUMMARY: *We present below the second of Capt. Hall's articles on foreign stations. In this department the Captain will "spill the dirt" on foreign-station information. This month he lists the addresses of the more important stations, so that those interested in sending for verifications may do so. Incidentally, the Captain also gives directions for wording letters so that verifications may be received easily.*

This department is especially valuable to those interested solely in short-wave reception, because the Captain intends to personalize things—make you feel right at home.



THE ANTENNA MAST AT SRI

List of S.-W. Station Addresses Throughout the World

By Capt. H. L. Hall

THE following list was compiled from data taken directly from numerous cards and letters actually received by the writer. It represents all the important and worthwhile stations that go to the trouble of answering reports addressed to them:

All Daventry stations: Broadcasting House, London WC1, England.

Rabat or CNR: Directeur de l'office des Postes, des Telegraphes et des Telephones du Maroc. Rabat, Morocco.

CT1AA: Antonio Augusto de Aguiar, 144 Lisbon, Portugal.

DJA-DJD, etc.: Berlin-Tempelhof, Schoneberger Strasse 11-15, Berlin, Germany.

EAQ: P. O. Box 951; Madrid, Spain.

FZS or "Pontoise:" Ministere des Postes; 103, Rue de Grenelle; Paris, France.

HSP: Post & Telegraph Department; Bangkok, Siam.

HBL and HBP: G. Galarati; Information Section, League of Nations; Geneva, Switzerland.

HVJ: Castine Pio IV, Vatican City, Italy.

HJ2ABA: "La Vos Del Pais en Tunja;" Boyaca, Colombia, S. A.

HJ4ABE: Radiodifusora de Madellin; Madellin, Colombia, S. A.

HJ1ABB: Mr. E. J. Pellet, Director; P. O. Box 715 Barranquilla; Colombia, S. A.

HCJB: Mr. C. W. Jones, Director; Quito, Ecuador.

LSX: Transradio International; San Martin, 329 Buenos Aires, Argentine, S. A.

OXY: Statsradiofonien, Heibergsgade 7; Copenhagen, Denmark.

PRADO: Apartado 98; Riobamba, Ecuador.

PLE: Government Post and Telegraph; Bandoeng, Java.

PHI: N. V. Phillips; Huizen, Holland.

RV59: Radio Centre, Solianka 12: Moscow, U. S. S. R.

SR1: Radjo Poznanskie; Poznan, Poland.

TFU: Icelandic State Broadcasting Service; P. O. Box 547; Reykjavik, Iceland.

TI4NRH: Mr. A. Cespedes Marin, Director; P. O. Box 40; Heredia, Costa-Rica.

VE9JR: Royal Alexandra Hotel; Winnipeg, Manitoba, Canada.

VE9GW: Bowmanville, Ontario, Canada.

VE9DR: Canadian Marconi Company; P. O. Box 1690; Montreal, Canada.

VQ7LO: P. O. Box 777; Nairobi, Kenya Colony, Africa.

VK2ME: 47 York Street; Sydney, Australia.

VK3ME: Wireless House, 167-169 Queen Street; Box 1272L; Melbourne C1, Australia.

YV1BC: Apartado 290; Caracas, Venezuela, S. A.

I2RO: E. I. A. R.; via Asiago N. 10; Rome, Italy.

W8XK: William Penn Hotel; Pittsburgh, Pa.

W3XAL: 711 Fifth Avenue, New York City.

W2XE: 485 Madison Avenue, New York City.

IAC: Mr. A. Nicastro; Coltano, Piza, Italy.

German Ships: Hamburg-American Line; 39 Broadway, New York City.

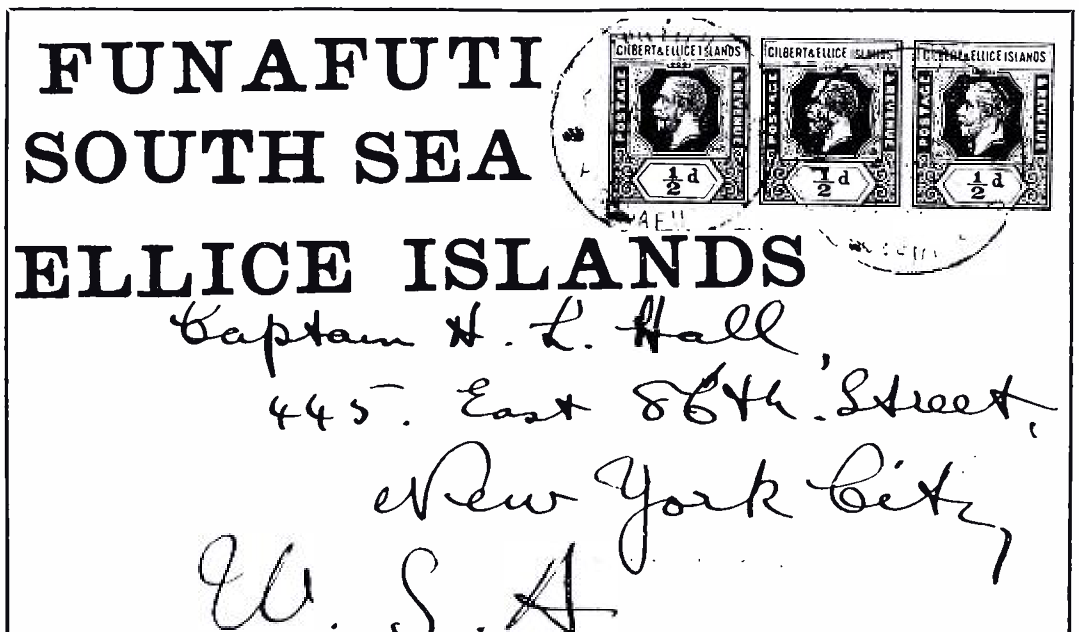
German Ships: North German Lloyd; 57 Broadway, New York City

Italian Ships: "S. S. Rex" and "Conti Di Savoie," Pier 86 N. River, New York City.

OPM: Radio Leopoldsville; Congo, Belge, Africa.

W2XAD and W2XAF: General Electric Co.; 1 River Road, Schenectady, New York.

VK3LR: 59 Little Collins Street, Melbourne C1, Australia.



AN EXTREMELY RARE VERIFICATION FROM ELLICE ISLANDS

This station is on an island so small that it is 800 yards wide at the widest point. It has but three Europeans, and supplies arrive about once every three or four months. And the station? Watch SHORT WAVE RADIO.

English Commercial Phones: The Engineer-in-Chief; G. P. O. "Radio Section," London, England.

French Commercial Phones: 166 Rue Montmartre, Paris, France.

Norwegian Commercial Phones: Bergen Radio; Norway.

YV3BC: Radifusoir Venezuela; "Paseje Ramella;" Caracas, Venezuela, S. A.

VUC: Indian State Broadcasting Service; Irwin House, Ballard Estate; Bombay, India.

Suggested Form to Send When Writing for Verifications

Date, March 11, 1933.

Radio Station VM2ME:

On March 10, 1933, I heard the following program from your station, VK2ME on 31:28 meters.

5.10 a.m. E.S.T.		*Heard station come on the air.*
5.12 a.m.	"	*Orchestral selection, (records).*
5.15 a.m.	"	*Woman singing.*
5.18 a.m.	"	*Several men singing.*
5.21 a.m.	"	*String Orchestra.*
5.24 a.m.	"	*Station announcement followed by identifying signal, Kook-a-burra bird.*

Please check this report with your station log. If correct please send me your verification card or letter.

Your signals were received with good volume, but some fading.

I am enclosing a picture post card of the city in which I received your broadcast.

Enclosed you will find an International Reply Coupon to cover return mail.

Thanking you in advance for your reply, I am,

Very truly yours,

Make your letters very short and to the point. If you heard the station on earphones tell them, but do not go into other details.

It is recommended that you write your letters on a typewriter, as some handwriting is very hard to understand.

International Reply Coupons cost 9 cents at all post offices.

For postal rates to foreign countries consult post office bulletins. The general rate for letters is 5c to Europe, Asia, Africa, England and England's possessions in South America; 3c to South America and Canada.

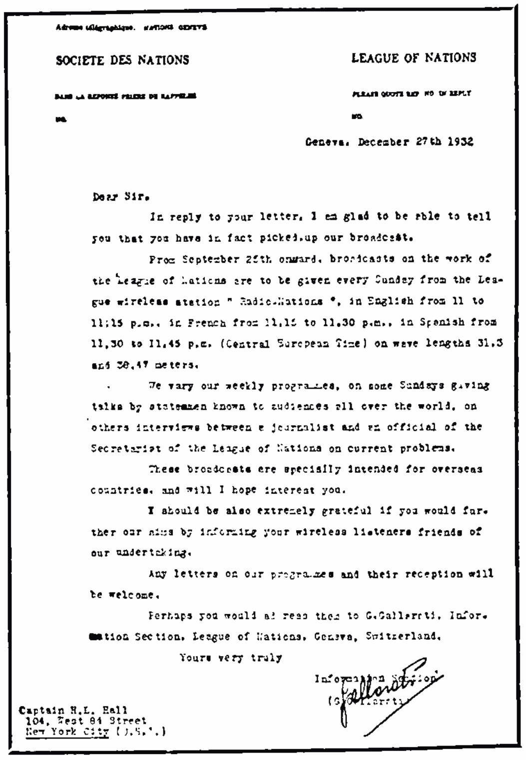
"What Have You Heard?"

SHORT wave fans seem to have established secret signs, words or that peculiar something that makes it possible for them to know each other almost in the dark. Let several of these fans get together and a non-fan might just as well leave the group, because he will be as unnecessary as an eighth tube in a seven-tube receiver. The conversation of fans generally runs along lines and topics which are dear to the heart of all of them. "What have you heard?" "What is your best catch?" "How long have short waves been your hobby?" "How do you get Australia?" "Why does not J1AA, Japan, verify?" These are some of the innumerable questions asked. Let me have my little say on these subjects. We will take each query separately.

To answer the question, "What have I heard," would require a list of stations that any reader might doubt. It was found through contact with fellow fans that the statement made by a short-wave fan, "I heard that," "Yes, I heard this," was neither believed or listened to by the rest of the group. The fan who has his verification from the station need do no talking; his veri speaks for him. It has been my policy never to have much to say about a station until I had received a letter or card of verification from the station under discussion. Right here in the heart of New York City I have heard forty-six countries, and so far have veries from thirty-two of them.

My best broadcast catch was F3ICD, Saigon, Indo-China. Now that this station has gone off the air, it is greatly missed by the old fans and kindly thought of by the new-comers in the field. The best phone catch was Funafuti, Ellice Islands in the South Seas. This station now works on 43-meter phone and is rarely heard, as lately the operator uses the transmitter solely for inter-insular contacts.

Short waves have been my hobby since 1926, when kits were all the rage. Making up one of them in a day or two and tuning in Australia so shocked me that I sold the set and made up another one that never got anything. I passed from them to commercial built receivers, that



Adresse télégraphique. NATIONS GENEVE

SOCIETE DES NATIONS — LEAGUE OF NATIONS

DANS LA REPONSE PRIERE DE RAPPELER No. — PLEASE QUOTE REF. NO. IN REPLY No.

Geneva, December 27th 1932

Dear Sir,

In reply to your letter, I am glad to be able to tell you that you have in fact picked up our broadcast.

From September 25th onward, broadcasts on the work of the League of Nations are to be given every Sunday from the League wireless station " Radio-Nations ", in English from 11 to 11;15 p.m., in French from 11,15 to 11,30 p.m., in Spanish from 11,30 to 11,45 p.m. (Central European Time) on wave lengths 31,3 and 38,47 meters.

We vary our weekly programmes, on some Sundays giving talks by statesmen known to audiences all over the world, on others interviews between a journalist and an official of the Secretariat of the League of Nations on current problems.

These broadcasts are specially intended for overseas countries, and will I hope interest you.

I should be also extremely grateful if you would further our aims by informing your wireless listeners friends of our undertaking.

Any letters on our programmes and their reception will be welcome.

Perhaps you would address them to G.Gallarati, Information Section, League of Nations, Geneva, Switzerland.

Yours very truly

Information Section

(G. Gallarati)

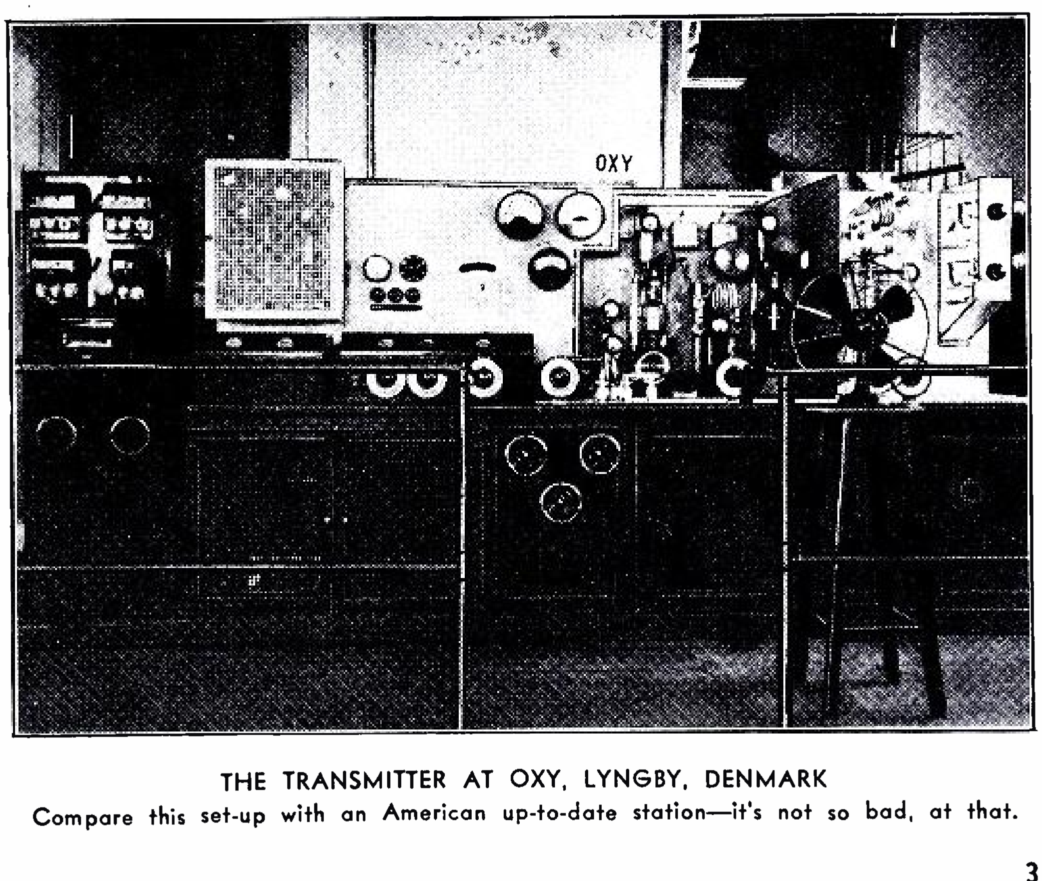
Captain H.L. Hall
104, West 84 Street
New York City (U.S.A.)

A "VERI" FROM GENEVA

A written verification from the League.

were laboratory tested, and have had good luck with them. Never being interested in the technical side of radio may account for my tuning success. Of the many receivers, good and poor, that have come and gone, it has always been a fine idea never to "monkey" with them. Never attempt to improve laboratory-built receivers, no matter how poor a receiver may be, unless you are using it to experiment on the technical side of radio. Never use a screw driver on any part of the interior of your set, because when the average set leaves the laboratory, it has been tuned to the highest pitch. Every manufacturer wants the prospective owner to have success. Then why try and improve on the maker's handiwork? If you

(*Continued on page* 38)



THE TRANSMITTER AT OXY, LYNGBY, DENMARK

Compare this set-up with an American up-to-date station—it's not so bad, at that.

SHORT WAVE RADIO'S

Short-Wave Station List

The following list, conveniently arranged alphabetically according to call letters, represents practically all the short-wave stations of the world, except amateur, that use voice transmission and are therefore recognizable by listeners who do not know the code. In most cases the frequency in kilocycles, the corresponding wavelength in meters, and the location by city are given; the country of origin, where it is not obvious, may quickly be determined from the preliminary list of international call letter assignments. Amateur and some special experimental calls consist of the assigned prefix, followed by a number and usually two or three more letters.

Stations listed as "experimental" change around a great deal and may use code or voice; definite frequencies cannot be given for them.

No attempt has been made to include operating schedules in this list, as a great majority of the stations are experimental in nature, and have the habit of changing announced programs without warning. Up-to-the-minute information on the best stations of the month is contained in another department in this issue.

For the sake of brevity, a number of abbreviations of operating company names are used. These are RCA, Radio Corporation of America; GPO, General Post Office; BBC, British Broadcasting Corporation; CBS, Columbia Broadcasting System; NBC, National Broadcasting Company; GE, General Electric Company; ATT, American Telegraph & Telephone Co.; MRT, Mackay Radio Telegraph Co.

List of International Call Assignments

Block of Calls	Country	Amateur Prefix
CAA-CEZ	Chile	CE
CFA-CKZ	Canada	VE
CLA-CMZ	Cuba	CM
CNA-CNZ	Morocco	CN
CPA-CPZ	Bolivia	CP
CQA-CRZ	Portuguese colonies.	
	Cape Verde Ids	CR4
	Portuguese Guinea	CR5
	Angola	CR6
	Mozambique	CR7
	Portuguese India	CR8
	Macao	CR9
	Timor	CR10
CSA-CUZ	Portugal:	
	Portugal proper	CT1
	Azores	CT2
	Madeira	CT3
CVA-CVZ	Rumania	CV
CWA-CXZ	Uruguay	CX
CZA-CZZ	Monaco	CZ
D	Germany	D
EAA-EHZ	Spain	EAR
EIA-EIZ	Irish Free State	EI
ELA-ELZ	Liberia	EL
ESA-ESZ	Esthonia	ES
ETA-ETZ	Ethiopia (Abyssinia)	ET
F	France (including colonies):	
	France proper	F
	French Indo-China	F1
	Tunis	FM4
	Algeria	FM8
G	United Kingdom:	
	Great Britain except Ireland	G
	Northern Ireland	GI
HAA-HAZ	Hungary	HA
HBA-HBZ	Switzerland	HB
HCA-HCZ	Ecuador	HC
HHA-HHZ	Haiti	HH
HIA-HIZ	Dominican Republic	HI
HJA-HKZ	Colombia	HJ
HRA-HRZ	Honduras	HR
HSA-HSZ	Siam	HS
I	Italy and colonies	I

Block of Calls	Country	Amateur Prefix
J	Japan	J
K	United States of America:	
	Continental United States	W
	Philippine Ids.	KA
	Porto Rico and Virgin Ids.	K4
	Territory of Hawaii	K6
	Territory of Alaska	K7
LAA-LNZ	Norway	LA
LOA-LVZ	Argentine Republic	LU
LZA-LZZ	Bulgaria	LZ
M	Great Britain	G
N	United States of America	W
OAA-OCZ	Peru	OA
OFA-OHZ	Finland	OH
OKA-OKZ	Czechoslovakia	OK
ONA-OTZ	Belgium and colonies	ON
OUA-OZZ	Denmark	OZ
PAA-PIZ	The Netherlands	PA
PJA-PJZ	Curacao	PJ
PKA-POZ	Dutch East Indies	PK
PPA-PYZ	Brazil	PY
PZA-PZZ	Surinam	PZ
RAA-RQZ	U. S. S. R. ("Russia")	RA
RVA-RVZ	Persia	RV
RXA-RXZ	Republic of Panama	RX
RYA-RYZ	Lithuania	RY
SAA-SMZ	Sweden	SM
SPA-SRZ	Poland	SP
STA-SUZ	Egypt:	
	Sudan	ST
	Egypt proper	SU
SVA-SZZ	Greece	SV
TAA-TCZ	Turkey	TA
TFA-TFZ	Iceland	TF
TGA-TGZ	Guatemala	TG
TIA-TIZ	Costa Rica	TI
TSA-TSZ	Territory of the Saar Basin	TS
UHA-UHZ	Hedjaz	UH
UIA-UKZ	Dutch East Indies	PK
ULA-ULZ	Luxemburg	UL
UNA-UNZ	Yugoslavia	UN
UOA-UOZ	Austria	UO
UWA-VGZ	Canada	VE
VHA-VMZ	Australia	VK

Block of Calls	Country	Amateur Prefix
VOA-VOZ	Newfoundland	VO
VPA-VSZ	British colonies and protectorates	
	British Guiana	VP
	Fiji, Ellice Ids., Zanzibar	VP1
	Bahamas, Barbados, Jamaica	VP2
	Bermuda	VP9
	Fanning Id.	VQ1
	Northern Rhodesia	VQ2
	Tanganyika	VQ3
	Kenya Colony	VQ4
	Uganda	VQ5
	Malaya (including Straits Settlements)	VS1-2-3
	Hongkong	VS6
	Ceylon	VS7
VTA-VWZ	British India	VU
W	United States of America:	
	Continental United States	W
	(for others, see under K.)	
XAA-XFZ	Mexico	X
XGA-XUZ	China	AC
YAA-YAZ	Afghanistan	YA
YHA-YHZ	New Hebrides	YH
YIA-YIZ	Iraq	YI
YLA-YLZ	Latvia	YL
YMA-YMZ	Danzig	YM
YNA-YNZ	Nicaragua	YN
YSA-YSZ	Republic of El Salvador	YS
YVA-YVZ	Venezuela	YV
ZAA-ZAZ	Albania	ZA
ZBA-ZHZ	British colonies and protectorates	
	Transjordania	ZC1
	Palestine	ZC6
	Nigeria	ZD
	Southern Rhodesia	ZE1
ZKA-ZMZ	New Zealand:	
	Cook Ids.	ZK
	New Zealand proper	ZL
	British Samoa	ZM
ZPA-ZPZ	Paraguay	ZP
		ZS
ZSA-ZUZ	Union of South Africa	ZT
		ZU

STATIONS ALPHABETICALLY BY CALL LETTERS

—C—

CEC 10,670 kc., 28.12 m.
15,860 kc., 18.91 m.
19,690 kc., 15.24 m.
Santiago, Chile
CFA 6,840 kc., 43.8 m.
Drummondville, Quebec, Canada
CGA 4,780 kc., 62.7 m.
13,340 kc., 22.55 m.
13,750 kc., 21.82 m.
9,330 kc., 32.15 m.
18,170 kc., 16.5 m.
Quebec, Canada
CM6XJ 15,000 kc., 19.99 m.
Central Tuinucu, Cuba
CMCI 6,060 kc., 49.5 m.
Havana, Cuba
CN8MC 6,250 kc., 48 m.
Casablanca, Morocco
CNR 8,050 kc., 37.33 m.
9,300 kc., 32.26 m.
12,880 kc., 23.38 m.
Rabat, Morocco, Africa
CT1AA 6,990 kc., 42.9 m.
9,600 kc., 31.25 m.
Lisbon, Portugal
CT3AQ 11,181 kc., 26.33 m.
Funchal, Madeira

—D—

DAF 8,470 kc., 35.42 m.
12,400 kc., 24.19 m.
17,270 kc., 17.37 m.
Norden, Germany
DAN 11,340 kc., 26.44 m.
Nordeich, Germany
DFA 4,400 kc., 68.17 m.
19,240 kc., 15.58 m.
DFB 18,520 kc., 17.12 m.
DGK 6,680 kc., 44.91 m.
DGU 9,620 kc., 31.2 m.
DHC 11,435 kc., 26.22 m.
DHO 20,040 kc., 14.97 m.
DIH 19,950 kc., 15.03 m.
DIQ 10,290 kc., 29.15 m.
DIS 10,150 kc., 29.54 m.
Nauen, Germany
DJA 9,560 kc., 31.38 m.
Konigswusterhausen, Germany
DJB 15,200 kc., 19.73 m.
DJC 6,020 kc., 49.83 m.
DJD 11,760 kc., 25.51 m.
Zeesen, Germany
DOA 7,230 kc., 41.46 m.
7,390 kc., 37.8 m.
4,430 kc., 67.5 m.
3,620 kc., 82.9 m.
Doeberitz, Germany

—E—

EAJ25 6,000 kc., 50 m.
Barcelona, Spain
EAR110 6,980 kc., 43.0 m.
Madrid, Spain
EAQ 19,700 kc., 15.23 m.
10,000 kc., 30 m.
Alcatda 43—Madrid, Spain
EHY 10,100 kc., 29.7 m.
Madrid, Spain

—F—

F8KR 3,750 kc., 80 m.
F8KR 6,660 kc., 45 m.
Constantine, Algeria
F8MC 6,875 kc., 43.6 m.
Casablanca, Morocco
FIGA 6,000 kc., 49.97 m.
Tananarive, Madagascar
FL 6,120 kc., 49.02 m.
FLJ 9,230 kc., 32.5 m.
Paris, France
FQE 12,150 kc., 24.68 m.
FQO 12,150 kc., 24.68 m.
FRE 18,240 kc., 16.44 m.
FRE 19,400 kc., 15.45 m.
FRO 18,240 kc., 16.44 m.
St. Assise, France
FSR 20,680 kc., 14.5 m.
Paris, France
FTA 11,950 kc., 25.12 m.
FTD 19,830 kc., 15.12 m.
FTF 7,770 kc., 38.6 m.
FTK 15,690 kc., 19.12 m.
FTK 15,860 kc., 18.9 m.
St. Assise, France
FYA 11,705 kc., 25.6 m.
FYA 11,905 kc., 25.16 m.
FYA 15,240 kc., 19.68 m.
Pontoise (Paris) France
FZG 12,000 kc., 24.98 m.
FZR 16,200 kc., 18.5 m.
FZS 11,900 kc., 25.02 m.
FZS 18,310 kc., 16.38 m.
Saigon, Indo-China

—G—

GAA 20,380 kc., 14.72 m.
GAG 18,970 kc., 15.81 m.
GAS 18,410 kc., 16.38 m.
GAU 18,620 kc., 16.11 m.
GBB 13,580 kc., 22.09 m.
GBC 17,080 kc., 17.55 m.
GBC 12,780 kc., 23.46 m.
GBC 9,310 kc., 32.22 m.
GBC 8,680 kc., 34.56 m.
GBC 4,980 kc., 60.26 m.
Rugby, England
GBJ 18,620 kc., 16.1 m.
GBK 16,100 kc., 16.57 m.
9,250 kc., 32.4 m.
11,490 kc., 26.1 m.
Bodmin, England
GBP 10,770 kc., 28.04 m.
GBS 18,310 kc., 16.38 m
12,250 kc., 24.46 m.
12,150 kc., 24.68 m.
GBU 18,620 kc., 16.11 m.
22,300 kc., 13.45 m.
12,290 kc., 24.41 m.
9,950 kc., 30.15 m.
GBW 14,480 kc., 20.7 m.
9,790 kc., 30.64 m.
GPO, Rugby, Eng.
GBX 16,150 kc., 18.56 m.
10,390 kc., 28.86 m.
GCA 9,710 kc., 30.9 m.
GCB 9,280 kc., 32.33 m.
GCS 9,020 kc., 33.26 m.
GCU 9,950 kc., 30.15 m.
GCW 9,800 kc., 30.60 m.
GDS 6,900 kc., 43.45 m.
GDW 4,840 kc., 62.0 m.
Rugby, England
GSA 6,050 kc., 49.58 m.
GSB 9,510 kc., 31.55 m.
GSC 9,585 kc., 31.29 m.
GSD 11,750 kc., 25.53 m.
GSE 11,865 kc., 25.28 m
GSF 15,140 kc., 19.81 m.
GSG 17,770 kc., 16.88 m.
GSH 21,470 kc., 13.97 m.
BBC, Daventry, Eng.
G6RX 4,320 kc., 69.44 m.
Rugby, England

—H—

HB9D 7,200 kc., 41.5 m.
Zurich, Switzerland
HBF 18,900 kc., 15.78 m.
HBJ 14,560 kc., 20.6 m.
Pragins, Switzerland
HBL 9,595 kc., 31.27 m.
HBP 7,800 kc., 38.47 m.
Geneva, Switzerland
HC1DR 6,382 kc., 47 m.
Quito, Ecuador
HC2JSB 8,000 kc., 37.5 m.
Guayaquil, Ecuador
HCJB 8,110 kc., 37.0 m.
5,714 kc., 52.5 m.
Quito, Ecuador, S. A.
HJ1ABB 5,800 kc., 51,75 m.
Barranquilla, Colombia
HJ2ABA 5,880 kc., 51.49 m.
Tunja, Colombia
HJ3ABD 7,400 kc., 40.55 m.
HJ3ABF 6,250 kc., 48.0 m.
Bogota, Colombia
HJ4ABB 7,150 kc., 41.6 m.
Manizales, Colombia
HJ4ABE 5,930 kc., 5.06 m.
Medellin, Colombia
HJ5ABD 6,380 kc., 47.0 m.
Cali, Colombia
HJB 7,470 kc., 40.16 m.
HJY 9,930 kc., 30.2 m.
18,460 kc., 16.25 m.
HKC 6,270 kc., 47.81 m.
Bogota, Colombia
HKF 7,612 kc., 39.14 m.
HKM 6,660 kc., 45 m.
Bogota, Colombia
HKO 5,900 kc., 50.8 m.
Medellin, Colombia
HKX 7,140 kc., 42.02 m.
Bogota, Colombia
HSP2 9,640 kc., 31.1 m.
HSP 17,750 kc., 16.92 m.
Bangkok, Siam
HVJ 5,970 kc., 50.26 m.
75,110 kc., 19.84 m.
15,120 kc., 19.83 m.
Vatican City, Rome, Italy

—I—

I2RO 11,810 kc., 25.4 m.
Rome, Italy
I3RO 3,750 kc., 80 m.
Rome, Italy
IAC 8,380 kc., 35.8 m.
6,650 kc., 45.1 m.
12,800 kc., 23.45 m.
Pisa, Italy
IBDK 11,470 kc., 26.15 m.
S. S. Elettra (Marconi's Yacht)
IRW 19,540 kc., 15.25 m.
Italy

J

JB 6,069 kc., 49.43 m.
Johannesburg, South Africa
J1AA 7,880 kc., 38.07 m.
13,090 kc., 22.93 m.
9,870 kc., 30.4 m.
15,490 kc., 19.36 m.
Tokio, Japan

—K—

K6XQ Experimental
S. S. Lake Miraflores
KAZ 9,970 kc., 30.09 m.
Manila, P. I.
KDK 7,520 kc., 39.89 m.
KEJ 9,020 kc., 33.27 m
Kauhuku, T. H.
KEL 6,860 kc., 43.7 m.
Bolinas, Cal.
KEQ 7,370 kc., 40.71 m.
Kauhuku, T. H.
KES 10,410 kc., 28.80 m.
KEZ 10,410 kc., 28.80 m.
Bolinas, Cal.
KGHO 1,534 kc., 191.1 m.
Des Moines, Iowa
KGJX 1,712 kc., 175.15 m.
Pasadena, Cal.
KGOZ 2,470 kc., 121.5 m.
Cedar Rapids, Iowa
KGPA 2,414 kc., 124.2 m.
Seattle, Wash.
KGPB 2,416 kc., 124.1 m.
Minneapolis, Minn.
KGPC 1,712 kc., 175.15 m.
St. Louis, Mo.
KGPD 2,470 kc., 121.5 m.
San Francisco, Cal.
KGPE 2,422 kc., 123.8 m.
Kansas City, Mo.
KGPG 2,422 kc., 123.8 m.
Vallejo, Cal.
KGPH 2,450 kc., 122.4 m.
Oklahoma City, Okla.
KGPI 2,470 kc., 121.5 m.
Omaha, Neb.
KGPJ 1,712 kc., 175.15 m.
Beaumont, Tex.
KGPL 1,712 kc., 175.15 m.
Los Angeles, Cal.
KGPM 2,470 kc., 121.5 m.
San Jose, Cal.
KGPN 2,470 kc., 121.5 m.
Davenport, Iowa
KGPO 2,450 kc., 122.4 m.
Tulsa, Okla.
KGPP 2,442 kc., 122.8 m.
Portland, Ore.
KGPQ 2,450 kc., 122.4 m.
Honolulu, T. H.
KGPS 2,414 kc., 124.2 m.
Bakersfield, Cal.
KGPW 2,470 kc., 121.5 m.
Salt Lake City, Utah
KGPX 2,442 kc., 122.8 m.
Denver, Colo.
KGPY 1,574 kc., 189.5 m.
Shreveport, La.
KGPZ 2,450 kc., 122.4 m.
Wichita, Kans.
KGTP Various aero frequencies
KGZB 1,712 kc., 175.15 m.
Houston, Tex.
KGZD 2,430 kc., 123.4 m.
San Diego, Cal.
KGZE 2,506 kc., 120 m.
San Antonio, Tex.
KGZF 2,450 kc., 122.4 m.
Chanute, Kans.
KGZH 2,442 kc., 122.8 m.
Klamath Falls, Ore.
KGZI 1,712 kc., 175.15 m.
Wichita Falls, Tex.
KGZL 1,712 kc., 175.15 m.
Shreveport, La.
KGZM 2,414 kc., 124.2 m.
El Paso, Tex.
KGZN 2,414 kc., 124.2 m.
Tacoma, Wash.
KGZP 2,450 kc., 122.4 m.
Coffeyville, Kans.
KGZQ 1,712 kc., 175.15 m.
Waco, Tex.
KGZR 2,442 kc., 122.8 m.
Salem, Ore.
KIO 11,670 kc., 25.68 m.
KKH 7,520 kc., 39.89 m.
KKP 16,040 kc., 18.71 m.
Kauhuku, T. H.
KKQ 11,945 kc., 25.1 m.
KKW 13,780 kc., 21.77 m.
KKZ 14,150 kc., 21.17 m.
KQJ 18,050 kc., 16.61 m.
Bolinas, Cal.
KSW 2,422 kc., 123.8 m.
Berkeley, Cal.
KVP 1,712 kc., 175.15 m.
Dallas, Tex.
KWN 21,060 kc., 14.24 m.
KWO 15,420 kc., 19.46 m.
KWU 15,350 kc., 19.54 m.
KWV 10,840 kc., 27.67 m.
KWX 7,610 kc., 39.42 m.
KWY 7,560 kc., 39.65 m.
KWZ 10,400 kc., 28.8 m.
Dixon, Cal.

—L—

LGN 9,600 kc., 31.23 m.
Bergen, Norway
LQA 9,600 kc., 31.25 m.
LSA 9,890 kc., 30.3 m.
LSA 14,530 kc., 20.65 m.
LSG 19,950 kc., 15.03 m.
LSG 19,906 kc., 15.07 m.
LSL 10,300 kc., 29.12 m.
LSL 21,160 kc., 14.17 m.
Buenos Aires
LSM 21,130 kc., 14.15 m.
Monte Grande, Argentina (Buenos Aires)
LSN 14,530 kc., 20.65 m.
LSN 21,020 kc., 14.27 m.
LSN 20,680 kc., 14.5 m.
LSR 18,960 kc., 15.82 m.
LSX 10,350 kc., 28.98 m.
LSY 20,730 kc., 14.47 m.
LSY 10,410 kc., 28.8 m.
LSY 18,130 kc., 16.55 m.
Buenos Aires

—N—

NAA 16,060 kc., 18.68 m.
NAA 12,045 kc., 24.89 m.
NAA 4,105 kc., 74.72 m.
Arlington, Va. (time signals)
NPO 8,872 kc., 33.81 m.
Cavite, P. I. (time signals)
NSS 12,045 kc., 24.89 m.
Annapolis, Md. (time signals)

—O—

OCI 18,680 kc., 16.06 m.
OCJ 15,620 kc., 19.19 m.
Lima, Peru
OKI 21,000 kc., 14.28 m.
Podebrady, Czechoslovakia
OKIMPT 5,145 kc., 58.31 m.
OKIMPT 5,170 kc., 58 m.
Prague, Czechoslovakia
OPL 20,040 kc., 14.97 m.
OPM 10,140 kc., 29.58 m.
Leopoldsville, Belgian Congo
ORG 19,210 kc., 15.62 m.
ORK 10,330 kc., 29.04 m.
Brussels, Belgium

OXY 15,300 kc., 19.6 m.
Lyngby, Denmark
OXY 6,075 kc., 49.4 m.
OXY 9,520 kc., 31.51 m.
Skamleback, Denmark
OZ7RL 3,560 kc., 84.24 m.
Copenhagen, Denmark

—P—

PCK 7,770 kc., 38.6 m.
18,400 kc., 16.3 m.
PCL 16,300 kc., 18.4 m.
PCV 17,830 kc., 16.82 m.
PDK 10,410 kc., 28.8 m.
PDU 7,830 kc., 38.3 m.
PDV 12,060 kc., 24.88 m.
Kootwijk, Holland
PHI 17,770 kc., 16.88 m.
11,730 kc., 25.57 m.
Huizen, Holland
PK2AG 3,156 kc., 95 m.
Samarang, Java
PK3AN 6,040 kc., 49.67 m.
Sourabaya, Java
PLE 18,200 kc., 15.94 m.
PLF 17,850 kc., 16.8 m.
PLG 15,950 kc., 18.8 m.
PLM 12,250 kc., 24.46 m.
PLR 10,630 kc., 28.2 m.
PLV 9,420 kc., 31.86 m.
PLW 8,120 kc., 36.92 m.
9,480 kc., 31.63 m.
PMB 20,620 kc., 14.54 m.
5,170 kc., 58 m.
PMC 18,370 kc., 16.33 m.
PMN 10,360 kc., 29.25 m.
PMY 5,170 kc., 58.0 m.
Bandoeng, Java
PPG 11,660 kc., 27.73 m.
PPU 19,270 kc., 15.57 m.
Rio de Janeiro
PRADO 6,620 kc., 45.31 m.
Riobamba, Ecuador
PRAG 8,450 kc., 35.5 m.
Porto Algero, Brazil
PSA 21,080 kc., 14.23 m.
PSH 10,220 kc., 29.35 m.
PSK 8,190 kc., 36.65 m.
Rio de Janeiro

—R—

RABAT 12,830 kc., 23.38 m.
8,035 kc., 37.33 m.
Morocco
RAU 15,100 kc., 19.85 m.
Tachkent, Turkestan
REN 6,610 kc., 45.38 m.
RIM 7,630 kc., 39.34 m.
RKI 7,500 kc., 39.97 m.
U. S. S. R.
RV15 4,273 kc., 70.2 m.
Khabarovsk, Siberia
RV59 6,000 kc., 50 m.
Radio Moscow, U.S.S.R.
RXF 14,500 kc., 20.69 m.
Panama City, Panama

—S—

SAJ 6,065 kc., 49.46 m.
Motola, Sweden
SRI 9,570 kc., 31.35 m.
Poznan, Poland
SUV 10,050 kc., 29.83 m.
Cairo, Egypt

—T—

TI4NRH 9,675 kc., 31 m.
Heredia, Costa Rica, C. A.
TIR 8,790 kc., 34.13 m.
14,500 kc., 20.69 m.
Cartago, Costa Rica
TGA 14,500 kc., 20.69 m.
TGW 6,660 kc., 45 m.
6,180 kc., 48.5 m.
TGX 5,940 kc., 50.5 m.
Guatemala City, C. A.

—U—

UIG 10,400 kc., 28.8 m.
Medan, Sumatra
UOR2 6,072 kc., 49.41 m.
Vienna, Austria

—V—

VE9AP 6,335 kc., 47.35 m.
Drummondville, Canada
VE9BJ 6,090 kc., 49.29 m.
St. John's, N. B., Canada
VE9BY 4,795 kc., 62.56 m.
6,425 kc., 46.7 m.
8,650 kc., 34.68 m.
London, Ontario, Canada
VE9CA 6,030 kc., 49.75 m.
Calgary, Alta., Canada
VE9CF 6,050 kc., 49.59 m.
6,100 kc., 49.15 m.
Halifax, N. S., Canada
VE9CG 6,110 kc., 49.1 m.
Calgary, Alta., Canada
VE9CL 5,710 kc., 52.5 m.
6,147 kc., 48.8 m.
Winnipeg, Canada
VE9CS 6,069 kc., 49.43 m.
Vancouver, B. C., Canada
VE9CU 6,005 kc., 49.99 m.
Calgary, Alta., Canada
VE9DR 11,780 kc., 25.47 m.
6,005 kc., 49.96 m.
Drummondville, Quebec, Canada
VE9GW 6,095 kc., 49.17 m.
11,800 kc., 25.42 m.
Bowmanville, Ontario, Canada
VE9HK 6,120 kc., 48.98 m.
VE9HX 6,125 kc., 48.98 m.
Halifax, N. S., Canada
VE9JR 11,720 kc., 25.6 m.
Winnipeg, Canada
VK2ME 9,760 kc., 30.75 m.
10,520 kc., 28.51 m.
Sydney, Australia
VK3LR 9,510 kc., 31.55 m.
5,680 kc., 52.8 m.
Melbourne, Australia
VLJ 9,980 kc., 37.59 m.
VLK 9,760 kc., 30.75 m.
10,520 kc., 28.51 m.
Sydney, Australia
VPD 7,890 kc., 38.0 m.
Suva, Fiji Islands
VPN 4,510 kc., 66.5 m.
Nassau, Bahamas
VQ7LO 6,000 kc., 49.5 m.
Nairobi, Kenya, Africa
VRT 5,050 kc., 59.42 m.
10,070 kc., 29.8 m.
Hamilton, Bermuda
VSIAB 7,195 kc., 41.67 m.
Singapore, S. S.
VUC 6,110 kc., 49.1 m.
Calcutta, India
VWY 18,540 kc., 17.1 m.
Poona, India

—W—

W1XAB 4,700 kc., 63.79 m.
Portland, Me.
W1XAL 11,790 kc., 25.45 m.
W1XAL 6,040 kc., 49.67 m.
W1XAU 1,560 kc., 199.35 m.
W1XAV 1,600 kc., 187.5 m.
Boston, Mass.
W1XAZ 9,570 kc., 31.35 m.
Westinghouse, Springfield, Mass.
W1XG 43,000 kc., 6.52 m.
W1XL 6,040 kc., 49.67 m.
Boston, Mass.
W2XAB 2,750 kc., 109.1 m.
CBS, New York, N. Y.
W2XAC 8,690 kc., 34.5 m.
W2XAD 15,340 kc., 19.56 m.
W2XAF 9,530 kc., 31.48 m.
GE, Schenectady, N. Y.
W2XAK 43,000 kc., 6.52 m.
W2XAK 48,500 kc., 6.18 m.
W2XAK 60,000 kc., 5.00 m.
CBS, New York, N. Y.
W2XAO 17,850 kc., 16.8 m.
W2XBC 25,700 kc., 11.67 m.
RCA, New Brunswick, N. J.
W2XBJ 14,700 kc., 20.27 m.
Rocky Point, N. Y.
W2XBS 2,100 kc., 136.4 m.
W2XBT 43,000 kc., 6.52 m.
W2XBT 48,500 kc., 6.18 m.
W2XBT 60,000 kc., 5.00 m.
NBC, Portable
W2XBX Plane, Experimental
Bell Labs.
W2XCJ Experimental
Police, Bayonne, N. J.
W2XCU 12,850 kc., 23.35 m.
W2XCU 8,650 kc., 34.68 m.
Rocky Point, N. Y.
W2XDJ 21,420 kc., 14. m.
ATT, Deal, N. J.
W2XDO 17,110 kc., 17.52 m.
W2XDO 8,630 kc., 34.74 m.
ATT, Ocean Gate, N. J.
W2XDV Experimental
CBS, New York, N. Y.
W2XE 15,270 kc., 19.65 m.
W2XE 11,830 kc., 25.36 m.
W2XE 6,120 kc., 49.02 m.
CBS, Wayne, N. J.
W2XF 43,000 kc., 6.52 m.
W2XF 48,500 kc., 6.18 m.
W2XF 60,000 kc., 5.00 m.
NBC, New York
W2XM Experimental
W2XN Experimental
Bell Labs., Holmdel, N. J.
W2XO 12,850 kc., 23.35 m.
GE, Schenectady, N. Y.
W2XR 1,600 kc., 176.5 m.
W2XR 43,000 kc., 6.97 m.
W2XR 48,500 kc., 6.18 m.
W2XR 60,000 kc., 5.00 m.
W2XV 8,650 kc., 34.68 m.
W2XV 4,975 kc., 60.30 m.
Long Island City, N. Y.
W3XAD 43,000 kc., 6.97 m.
W3XAD 48,500 kc., 6.18 m.
W3XAD 60,000 kc., 5.00 m.
RCA, Camden, N. J.
W3XAK 2,100 kc., 136.4 m.
NBC, Portable
W3XAL 17,780 kc., 16.87 m.
W3XAL 6,100 kc., 49.15 m.
NBC, Bound Brook, N. J.
W3XAU 9,580 kc., 31.32 m.
W3XAU 6,060 kc., 49.5 m.
CBS, Philadelphia, Pa.
W3XE 9,580 kc., 31.32 m.
W3XE 43,000 kc., 6.52 m.
W3XE 48,500 kc., 6.00 m.
W3XE 60,000 kc., 3.75 m.
Philco, Philadelphia, Pa.
W3XE 8,650 kc., 34.68 m.
Baltimore, Md.
W3XL 6,425 kc., 46.7 m.
NBC, Bound Brook, N. J.
W3XW Experimental
Boonton, N. J.
W3XX 8,650 kc., 34.68 m.
W3XZ 4,795 kc., 62.56 m.
Washington, D. C.
W4XB 6,040 kc., 49.67 m.
Miami Beach, Fla.
W4XG 8,650 kc., 34.68 m.
Miami, Fla.
W6XAC Experimental
Fred W. Christian, Jr., Portable
W6XAH 2,000 kc., 150 m.
Bakersfield, Cal.
W6XAJ 17,300 kc., 17.34 m.
Oakland, Cal.
W6XAO 43,000 kc., 6.97 m.
W6XAO 48,500 kc., 6.18 m.
W6XAO 60,000 kc., 5.00 m.
Los Angeles, Cal.
W6XAR Experimental
W6XAS Experimental
Julius Brunton & Sons Co., Port. & Mob.
W6XD 27,800 kc., 10.79 m.
MRT, Palo Alto, Cal.
W6XP Experimental
Press Wireless, Portable and Mobile
W6XQ 24,000 kc., 12.48 m.
San Mateo, Cal.
W6XS 2,100 kc., 136.4 m.
Los Angeles, Calif.
W7XAW 2,342 kc., 128.09 m.
Seattle, Wash.
W7XC Experimental
Edmonds, Wash.
W7XL Experimental
Northern Radio Co., Portable
W8XAG 8,650 kc., 34.68 m.
Dayton, Ohio
W8XAL 6,060 kc., 49.5 m.
Crosley, Cincinnati, O.
W8XAN 43,000 kc., 6.97 m.
W8XAN 48,500 kc., 6.18 m.
W8XAN 60,000 kc., 5.00 m.
W8XAN 1,600 kc., 176.5 m.
Jackson, Mich.
W8XF 43,000 kc., 6.97 m.
W8XF 48,500 kc., 6.18 m.
W8XF 60,000 kc., 5.00 m.
Pontiac, Mich.
W8XI 31,000 kc., 9.68 m.
W8XJ 5,550 kc., 54.02 m.
Columbus, O.
W8XK 21,540 kc., 13.93 m.
W8XK 17,780 kc., 16.87 m.
W8XK 15,210 kc., 19.72 m.
W8XK 11,870 kc., 25.26 m.
W8XK 6,140 kc., 48.86 m.
Westinghouse, E. Pittsburgh, Pa.
W8XL 17,300 kc., 17.34 m.
Dayton, O.
W8XL 43,000 kc., 6.97 m.
W8XL 48,500 kc., 6.18 m.
W8XL 60,000 kc., 5.00 m.
Cuyahoga Hts., Ohio
W8XN 1,600 kc., 176.5 m.
Jackson, Mich.
W9XAA 6,080 kc., 49.31 m.
Chicago, Ill.
W9XAI Experimental
W9XAJ Experimental
Milwaukee, Wis., Portable
W9XAK 2,100 kc., 142.9 m.
Manhattan, Kans.
W9XAL 2,200 kc., 136.4 m.
Kansas City, Mo.
W9XAM 4,795 kc., 62.56 m.
Elgin, Ill.
W9XAO 11,840 kc., 25.34 m.
W9XAO 2,000 kc., 150 m.
W9XAP 2,100 kc., 142.9 m.
Chicago, Ill.
W9XAT 43,000 kc., 6.97 m.
W9XAT 48,500 kc., 6.18 m.
W9XAT 60,000 kc., 5.00 m.
Dr. G. W. Young, Portable
W9XD 43,000 kc., 6.97 m.
W9XD 48,500 kc., 6.18 m.
W9XD 60,000 kc., 5.00 m.
Milwaukee, Wis.
W9XE 43,000 kc., 6.97 m.
W9XE 48,500 kc., 6.18 m.
W9XE 60,000 kc., 5.00 m.
Marion, Ind.
W9XF 17,780 kc., 16.87 m.
W9XF 11,880 kc., 25.24 m.
W9XF 6,100 kc., 49.18 m.
NBC, Chicago, Ill.
W9XG 2,750 kc., 109.1 m.
W. Lafayette, Ind.
W9XK 2,000 kc., 150 m.
Iowa City, Iowa
W9XL 17,300 kc., 17.34 m.
W9XL 12,850 kc., 23.35 m.
W9XL 6,425 kc., 46.70 m.
Anoka, Minn.
W10XAA Plane, Experimental
Bell Labs.
W10XAC Experimental
Milwaukee, Wis., Port. & Mobile
W10XAF Experimental
Larry L. Smith, Portable
W10XAG Experimental
N. Y. Conservation Dept., Port. and Mobile
W10XAH Experimental
W10XAI Experimental
NBC, Portable and Mobile
W10XAJ Experimental
N. Y. Conservation Dept., Port. and Mobile
W10XAK Experimental
NBC, Portable and Mobile
W10XAL Experimental
CBS, Portable and Mobile
W10XAM Experimental
W10XAN Experimental
W10XAP Experimental
NBC, Portable and Mobile
W10XAQ Experimental
Westinghouse, Portable & Mobile
W10XAY Experimental
Polin, Inc., Portable and Mobile
W10XBA Plane, Experimental
W10XBB Plane, Experimental
W10XBC Plane, Experimental
Aeronautical Radio Inc.
W10XBE Experimental
N. Y. Conservation Dept., Port. and Mobile
W10XBF Experimental
W10XBG Experimental
W. G. H. Finch, Portable & Mob.
W10XBI Plane, Experimental
Roland Reed
W10XBK Experimental
W. G. H. Finch, Portable & Mob.
W10XE Experimental
RCA, Portable and Mobile
W10XI Plane, Experimental
Aircraft Radio Corp.
W10XJ Experimental
Bell Labs., Portable
W10XN Experimental
NBC, Portable and Mobile
W10XT Experimental
RCA, Portable and Mobile
W10XX 43,000 kc., 6.97 m.
W10XX 48,500 kc., 6.18 m.
W10XX 60,000 kc., 5.00 m.
RCA, Portable
W10XY Experimental
NBC, Portable and Mobile
W10XZ Experimental
CBS, Portable and Mobile
WAEQ Various aero frequencies
Elmira, N. Y.
WAJ 13,480 kc., 22.26 m.
Rocky Point, N. Y.

WBA 257 kc., 1,123 m.
Harrisburg, Pa.
WBR 257 kc., 1,123 m.
Butler, Pa.
WCK 2,414 kc., 124.2 m.
Belle Island, Mich.
WCN 5,070 kc., 59.08 m.
Lawrenceville, N. J.
WDX 257 kc., 1,123 m.
Wyoming, Pa.
WEA 10,610 kc., 28.28 m.
WEB 6,940 kc., 43.23 m.
WEC 8,930 kc., 33.59 m.
WEF 9,590 kc., 31.6 m.
WEL 8,950 kc., 33.52 m.
WEM 7,400 kc., 40.54 m.
WES 9,450 kc., 31.74 m.
WGN 5,260 kc., 57.03 m.
WIY 13,870 kc., 21.63 m.
Rocky Point, N. Y.
WJL 257 kc., 1.123 m.
Greensburg, Pa.
WKA 21,060 kc., 14.25 m.
Lawrenceville, N. J.
WKDU 1,712 kc., 175.15 m.
Cincinnati, Ohio
WKF 19,220 kc., 15.61 m.
WKF 4,750 kc., 63.21 m.
Lawrenceville, N. J.
WKJ 9,590 kc., 31.6 m.
Rocky Point, N. Y.
WKK 21,410 kc., 14.01 m.
WKN 19,830 kc., 15.13 m.
Lawrenceville, N. J.
WKU 14,700 kc., 20.27 m.
WKW 19,020 kc., 15.77 m.
Rocky Point, N. Y.
WLA 18,350 kc., 16.35 m.
WLK 16,330 kc., 18.44 m.
WLO 21,400 kc., 14.01 m.
WLO 16,300 kc., 18.4 m.
WLO 10,540 kc., 28.44 m.
ATT, Lawrence, N. J.
WMA 13,390 kc., 22.4 m.
Lawrenceville, N. J.
WMB 267 kc., 1,123 m.
West Reading, Pa.
WMDZ 2,442 kc., 122.8 m.
Indianapolis, Ind.
WMF 14,470 kc., 20.73 m.
Lawrenceville, N. J.
WMI 19,850 kc., 15.1 m.
WMI 9,700 kc., 30.9 m.
ATT, Deal, N. I.
WMJ 2,422 kc., 123.8 m.
Buffalo, N. J.
WMN 14,590 kc., 20.56 m
Lawrenceville, N. J.
WMO 2,414 kc., 124.2 m.
Highland Park, Mich.

WMP 1,574 kc., 189.5 m.
Framingham, Mass.
WNA 9,170 kc., 32.72 m.
WNB 10,680 kc., 28.09 m.
Lawrenceville, N. J.
WNC 19,200 kc., 15.6 m
WNC 14,480 kc., 20.7 m.
WNC 9,750 kc., 30.75 m.
WND 18,350 kc., 16.35 m.
WND 13,400 kc., 22.38 m.
WND 6,753 kc., 44.4 m.
ATT, Deal, N. J.
WOA 6,750 kc., 44.41 m.
WOB 5,850 kc., 51.26 m.
WOF 9,750 kc., 30.77 m.
WOK 10,550 kc., 28.44 m
WON 9,870 kc., 30.40 m.
Lawrenceville, N. J.
WOO 17,110 kc., 17.52 m.
WOO 8,550 kc., 35.09 m.
WOO 6,515 kc., 46.05 m.
WOO 8,630 kc., 34.74 m.
WOO 4,750 kc., 63.13 m.
WOO 4,116 kc., 72.87 m.
WOO 3,124 kc., 96.03 m.
WOP 19,380 kc., 15.48 m.
Ocean Gate, N. J.
WOU 2,590 kc., 115.8 m.
Green Harbor, Mass.
WOX 2,540 kc., 118.06 m.
New York, N. Y.
WPDA 2,414 kc., 124.2 m.
Tulare, Cal.
WPDB 1,712 kc., 175.15 m
WPDC 1,712 kc., 175.15 m.
WPDD 1,712 kc., 175.15 m.
Chicago, Ill.
WPDE 2,442 kc., 122.8 m.
Louisville, Ky.
WPDF 2,442 kc., 122.8 m.
Flint, Mich.
WPDH 2,442 kc., 122.8 m.
Richmond, Ind.
WPDI 2,430 kc., 123.4 m.
Columbus, Ohio
WPDK 2,450 kc., 122.4 m.
Milwaukee, Wis.
WPDL 2,442 kc., 122.8 m.
Lansing, Mich.
WPDM 2,430 kc., 123.4 m.
Dayton, Ohio
WPDN 2,458 kc., 122. m.
Auburn, N. Y.
WPDO 2,458 kc., 122. m.
Akron, Ohio
WPDP 2,470 kc., 121.5 m.
Philadelphia, Pa.
WPDR 2,458 kc., 122. m.
Rochester, N. Y.
WPDS 2,416 kc., 124.1 m.
St. Paul, Minn.

WPDT 2,470 kc., 121.5 m.
Kokomo, Ind.
WPDU 1,712 kc., 175.15 m.
Pittsburgh, Pa.
WPDV 2,458 kc., 122. m.
Charlotte, N. C.
WPDW 2,422 kc., 123.8 m.
Washington, D. C.
WPDX 2,414 kc., 124.2 m.
Detroit, Mich.
WPDY 2,414 kc., 124.2 m.
Atlanta, Ga.
WPDZ 2,470 kc., 121.5 m.
Fort Wayne, Ind.
WPEA 2,458 kc., 122.8 m.
Syracuse, N. Y.
WPEB 2,442 kc., 122.8 m.
Grand Rapids, Mich.
WPEC 2,470 kc., 121.5 m.
Memphis, Tenn.
WPEE 2,450 kc., 122.4 m.
WPEF 2,450 kc., 122.4 m.
WPEG 2,450 kc., 122.4 m.
New York, N. Y.
WPEH 1,712 kc., 175.15 m.
Somerville, Mass.
WPEI 1,712 kc., 175.15 m.
E. Providence, R. I.
WPEK 2,422 kc., 123.8 m.
New Orleans, La.
WPEL 1,574 kc., 189.5 m.
W. Bridgewater, Mass.
WPEP 1,712 kc., 175.15 m.
Arlington, Mass.
WPET 1,712 kc., 175.15 m.
Lexington, Mass.
WPEV 1,574 kc., 189.5 m.
Portable, Mass.
WPFA 1.712 kc., 175.15 m.
Newton, Mass.
WPFC 2,442 kc., 122.8 m.
Muskegon, Mich.
WPFD 2,430 kc., 123.4 m.
Highland Park, Ill.
WPFE 2,442 kc., 122.8 m.
Reading, Pa.
WPFF 2,430 kc., 123.4 m.
Toms River, N. J.
WPFG 2,442 kc., 122.8 m.
Jacksonville, Fla.
WPFH 2,414 kc., 124.2 m.
Baltimore, Md.
WPFI 2,414 kc., 124.2 m.
Columbus, Ga.
WPFJ 1,712 kc., 175.15 m.
Hammond, Ind.
WPFK 2,430 kc., 123.4 m.
Hackensack, N. J.
WPFL 2,470 kc., 121.5 m.
Gary, Ind.
WPFM 2,414 kc., 124.2 m.
Birmingham, Ala.

WPFN 1,712 kc., 175.15 m.
Fairhaven, Mass.
WPFO 2,470 kc., 121.5 m.
Knoxville, Tenn.
WPFP 2,414 kc., 124.2 m.
Clarksburg, W. Va.
WPFQ 2,470 kc., 121.5 m.
Swarthmore, Pa.
WPFR 2,470 kc., 121.5 m.
Johnson City, Tenn.
WRDH 2,458 kc., 122 m.
Cleveland, Ohio
WRDR 2,414 kc., 124.2 m.
Grosse Pt. Village, Mich.
WRDQ 2,470 kc., 121.5 m.
Toledo, Ohio.

—X—

X2GA 7.612 kc., 39.4 m.
Nuevo Laredo, Mexico
XAM 11,540 kc., 26.0 m.
Merida, Yucatan
XDA 5,857 kc., 51.22 m.
11,760 kc., 25.5 m.
14,620 kc., 20.5 m.
XDC 9,400 kc., 31.9 m.
XETE 9,600 kc., 31.25 m.
XEW 6,023 kc., 49.8 m.
XIF 6,167 kc., 48.65 m.
Mexico City, Mex.

—Y—

YNA 14,500 kc., 20.69 m.
Managua, Nicaragua
YV1BC 6,110 kc., 49.1 m.
YV11BMO 6,130 kc., 48.95 m.
YV1BC 6,120 kc., 49.02 m.
Caracas, Venezuela
YV2AM 14,110 kc., 21.26 m.
Maracaibo, Venezuela
YV3BC 6,130 kc., 48.9 m.
9,510 kc., 31.56 m.
Caracas, Venezuela
YVQ 11,690 kc., 25.65 m.
13,500 kc., 22.48 m.
YVR 18,300 kc., 16.39 m.
Maracay, Venezuela

—Z—

ZGE 6,000 kc., 50 m.
Kuala, Lumpur, Malay States
ZL2ZX 6,060 kc., 49.5 m.
ZLT 7,390 kc., 40.6 m.
10,990 kc., 27.3 m
ZLW 12,300 kc., 24.4 m
18,340 kc., 16.35 m
10,980 kc., 27.3 m

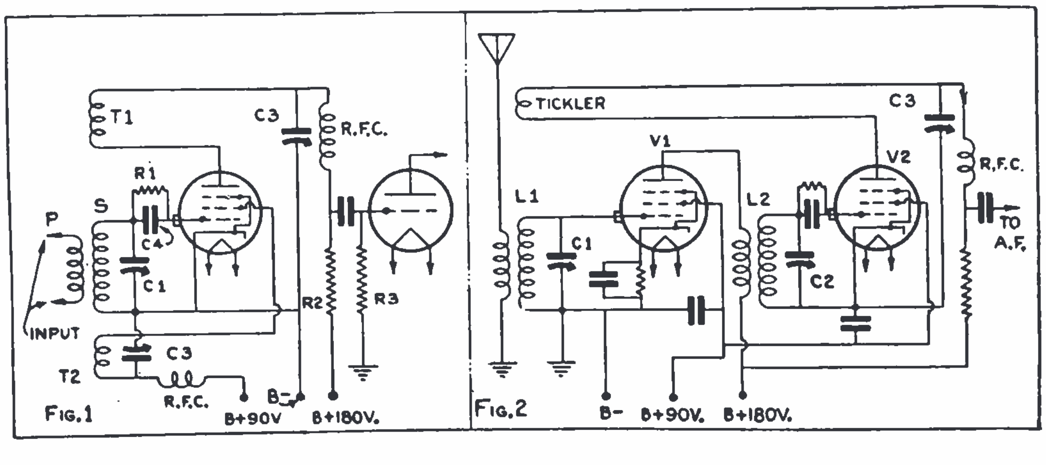
A Few Good Ones

IF YOU want to have a lot of fun some rainy evening, and you have an assortment of small parts on hand, you might try either or both of the two apparently crazy hook-ups shown in Figs. 1 and 2. We have not actually tried these ourselves, but they look good on paper and we are presenting them just from the experimental standpoint.

In Fig. 1 you will observe a more or less straightforward regenerative detector circuit. The windings P, S, and T1 are the primary, the secondary, and the tickler, respectively, of a standard three-winding plug-in coil. There are many designs of different coils of this kind on the market. The primary winding, P, also marked "input," may run to the aerial and ground or to the plate circuit of a preceding r.f. amplifier tube. C1 is the usual tuning condenser, C3 the regeneration control condensers, and C4 the grid condenser. Resistors R1, R2, and R3 are grid-leak, plate coupling and grid-leak units, respectively, of the usual values used with screen-grid tubes. Tickler T1 is connected directly in the plate circuit in accordance with ordinary practice.

Now, in addition to T1, suppose we wind another tickler, T2, over the bottom end of the secondary winding S, and connect this in the screen of the detector tube. Also hook in another variable condenser, C3, which may be of the same capacity as the other condenser C3. The r.f. chokes in the plate and screen leads may be any small short-wave chokes between 2½ and 25 millihenries in value.

Whether or not the extra tickler will give any real increase in signal strength, we cannot say. However, the idea certainly looks good, and is worth trying. It is a very good idea to juggle the plate and screen voltages over a wide range. If you make the screen voltage high enough, the detector tube will cease to act as a tetrode, and may start acting as an ordinary triode. Under these conditions, the plate may have little or no influence on the circuit action. Also, do not be surprised if the screen wires start to get red hot. The screen is much closer to the cathode than the plate, and, therefore, it may be responsible for an exceedingly heavy screen current.



2-Way Police Radio

(*Continued from page* 5)

message was telephoned to headquarters and immediately relayed by radio to the police car, which reached the scene of trouble within thirty seconds. The wielder of a knife was caught in an attempt to take the life of his common-law wife. From his car, the police officer called for the patrol van, and when it arrived, he described to headquarters the number of people arrested and the charges for each arrest.

A riot started at a baseball game and gave the police an unpleasant few minutes until a call from the radio police car brought reserves. Then the patrol van, on a mission in another section of the city, was called and told to pick up the prisoners at the baseball park, thus saving an extra trip from headquarters.

A man, submerged and nearly drowned in Newark Bay, was given artificial respiration by the guard on the patrol van while the driver called from the driving seat of the van and requested an inhalator and an ambulance. The man's life was saved, but things might have been different had the officer been obliged to leave the man to go to a police box to call.

Many minor matters that formerly had to wait until the patrolman on the beat made his regular call from a box are now given by headquarters to the cruising radio cars and either taken care of by the occupants of the radio car in the district or relayed by them verbally to the man on the beat. In either case, a report on the disposition of the matter is immediately made to headquarters.

Capt. Hall's Department

(*Continued from page* 33)

contemplate making any changes in your receiver, get a man who really knows about your set. Don't be guided by the advice of friends. More receivers have been ruined by friends than foes. If you want the latest radio improvements in your set, sell your old one and buy a late model. Many a fan would be a successful tuner if he had not been misguided by one who knows nothing about radio.

Australia a Good Catch

I WOULD probably bring an avalanche of criticism on my head if I were to say that any one with a good short wave receiver and any tuning ability should be able to get both the short-wave broadcasting stations in Australia, VK2ME and her little sister VK3ME. Both these stations have regular schedules and have sufficient power to reach this and other parts of the United States. Most fans are thankful that they are on the air at the time when man-made static is not bothersome. The more distant of these stations is VK3ME, Melbourne, Australia. This station transmits on a wavelength of 31.55 meters, Wednesday and Saturday. At 5.00 a.m. Eastern Standard Time the program begins. By 6.00 a.m. the signal strength has so built up that one would never think the program was coming 9,017 miles over sea and land to New York City. Their programs consists mostly of gramaphone records with announcements given at regular intervals. At 7.00 a.m. they sign off with the news and the statement, "The time here in Melbourne is 10.00 p.m."

VK2ME, Sydney, Australia, operating on 31.28 meters, uses a clever identifying signal, the call of the kook-a-burra bird, which is the native bird of Australia. This station also uses records for programs and is on the air Sunday only. Their schedule for November is: 1.00 to 3.00 a.m.; 4.30 to 8.30 a.m.; and 9.00 to 11.00 a.m. For December: 1.00 to 3.00 a.m.; and 5.00 to 11.00 a.m. All times given here are Eastern Standard Time.

Japanese Radio Restricted

ASIA will always be a land of mystery and the keen desire of every short-wave fan is to hear and have verified at least one station from that distant part of the globe. Japan's short-wave station J1AA relays programs from their long-wave station JOAK. Here is a little story that may explain to some fans who have heard J1AA and written to them for a veri why they never received any reply from them. All radio stations in Japan belong to the Government. This is so in many foreign countries. For anybody in Japan to tune in and listen to a short-wave station it is necessary to obtain a license from the Japanese Government. That is not all. He must also show his complete log, including whatever he has heard on his receiver, to the Minister of Communications Department punctually every month. The listener's license is renewed yearly. This same situation applies also to amateur transmitting. At the present time there is only one legal short-wave listener in Japan.

Anyone in this country who picks up and sends to J1AA for a verification will not receive a veri unless he complies with the rules set down by the Japanese Government. This, as you can see, is an impossibility. We here could not be licensed to listen or send our logs there for that government to inspect. If a Japanese fan should break any of these rules, his receiver would be taken away from him and destroyed.

American short-wave fans are not so badly off when we consider the position of fellow-fans there. As a natural consequence, "bootleg" listening in Japan has gained quite a few followers.

Programs radiating from J1AA are transmitted over various wavelengths. The fans who have heard them best have tuned them in on 30.40 meters. J1AA is best heard from 5.00 to 7.00 a.m. Eastern Standard Time on this wavelength. They have been heard testing with California on 38.70 meters and 19.03 meters. They have no station cards and so far have ignored many reports of reception of their transmissions from American listeners. Their entertainment broadcasts are for the benefit of Japan's colonies. Until the Japanese Government displays more courtesy and decides to verify, it is a waste of time to tune for them, as there are many other Asiatic stations that are now broadcasting programs and are really interested in hearing from us.

WHD Press Schedule

WHD, the active short-wave station maintained by the *New York Times*, transmits press on 8360 kc. (35.89 meters) twice daily at 1800 GMT (1:00 p.m.) and at 0500 GMT, (12 midnight, E.S.T.).

Of course, the messages are transmitted in Continental Code. Short-wave fans possessing a knowledge of the code will find it very interesting to copy this stuff.

New "Ham" Regulations

ON October first of this year the Federal Radio Commission, which is the branch of the Federal government charged with the administration of the Radio Act of 1927, issued a set of revised rules governing amateur radio stations and operators, While most of the changes were made to facilitate the keeping of records and to reduce the enormous amount of clerical work involved, a number of important changes, as far as amateur licensing and operation are concerned, were also made. The complete rules fill a 19-page pamphlet.

For the benefit of prospective amateurs and, also, active amateurs who have not kept up with the changes, we are reviewing them briefly, in many cases quoting directly from the official rule book.

"Normal license periods.—All station licenses will be issued so as to expire at the hour of 3 a. m., Eastern Standard Time.

"The licenses for amateur stations will be issued for a normal license period of 3 years from the date of expiration of old license or the date of granting a new license or modification of a license."

Amateur licenses were formerly good only for a year.

Although the nine amateur call areas remain as before, there are now twenty Federal Radio Commission field officers where examinations are given and the general business of the Commission transacted. The lists are too long to be given here. However, any prospective amateur who is in doubt as to his official radio location is invited to write to the editors of SHORT WAVE RADIO, who have the detailed data available and will be glad to help. In writing to us, be sure to give the county you live in as well as the city and state, and enclose a stamped and addressed envelope for a quick reply.

"Operator's license.—An amateur operator's license may be granted to a person who does not desire an amateur station license, provided such applicant waives his right to apply for an amateur station license for 90 days subsequent to the date of application for operator's license."

"Eligibility for license.—Amateur radio station licenses shall not be issued to corporations, associations, or other organizations; provided, however, That in the case of a bona fide amateur radio society a station license may be issued to a licensed amateur radio operator as trustee for such society."

The idea of this rule is, of course, to keep business organizations out of the amateur channels.

"Mobile stations.—Licenses for amateur mobile stations and portable-mobile stations will not be granted, except for portable-mobile stations located aboard aircraft and capable of operating in the band of frequencies 56,000 to 60,000 kilocycles and 400,000 to 401,000 kilocycles only."

This means that amateur stations cannot be operated in moving automobiles or in motorboats. In this connection, distinguish between "mobile" and "portable."

"Amateur stations not to be used for broadcasting.—Amateur stations shall not be used for broadcasting any form of entertainment."

"Radiotelephone tests.—Amateur stations may be used for the transmission of music for test purposes of short duration in connection with the development of experimental radiotelephone equipment."

The safest thing to do to avoid trouble is not to transmit music at all. If you have a phone transmitter and have to do any testing, use your lungs.

"Amateur stations not for hire.—Amateur radio stations shall not be used to transmit or receive messages for hire, nor for communication for material compensation, direct or indirect, paid or promised."

Watch out for this one! The surest way to lose your license and to get into one grand heap of trouble is to go into competition with the telegraph companies.

"Frequency bands assigned.—The following bands of frequencies are allocated exclusively for use by amateur stations:

1,715 *to* 2,000 *kilocycles*
3,500 *to* 4,000 *kilocycles*
7,000 *to* 7,300 *kilocycles*
14,000 *to* 14,400 *kilocycles*
28,000 *to* 30,000 *kilocycles*
56,000 *to* 60,000 *kilocycles*
400,000 *to* 401,000 *kilocycles"*

"Types of emission.—All bands of frequencies so assigned may be used for radiotelegraphy, type A1 emission. Type A-2 emission may be used in the following bands of frequencies only:

28,000 *to* 30,000 *kilocycles*
56,000 *to* 60,000 *kilocycles*
400,000 *to* 401,000 *kilocycles"*

Type A-1 transmission is straight CW. Type A-2 may be described as tone modulated CW. Tone modulation by means of a buzzer or a chopper is usually necessary on the very high frequencies because of the instability of available receivers on straight CW.

"Frequency bands for telephony.—The following bands of frequencies are allocated for use by amateur stations using radio-telephony, type A-3 emission:

1,800 *to* 2,000 *kilocycles*
28,000 *to* 28,500 *kilocycles*
56,000 *to* 60,000 *kilocycles"*

The 400,000 to 401,000 kilocycle band (so-called three-quarter meter band) opens up extremely interesting possibilities for experimentation. Reflectors for these very short waves can be built fairly easily and can be shifted around for the study of directional effects.

"Additional bands for telephony. Provided the station shall be operated by a person who holds an amateur operator's license endorsed for class A privileges, an amateur radio station may use radiotelephony, type A-3 emission, in the following additional bands of frequencies:

3,900 *to* 4,000 *kilocycles*
14,150 *to* 14,250 *kilocycles"*

"Amateur television, facsimile, and picture transmission.—The following bands of frequencies are allocated for use by amateur stations for television, facsimile, and picture transmission:

1,715 *to* 2,000 *kilocycles*
56,000 *to* 60,000 *kilocycles"*

"Aliens.—An amateur radio station shall not be located upon premises controlled by an alien."

"Authorized power.—Licensees of amateur stations are authorized to use a maximum power input of 1 kilowatt to the plate circuit of the final amplifier stage of an oscillator-amplifier transmitter or to the plate circuit of an oscillator transmitter."

"Transmission of call.—An operator of an amateur station shall transmit its assigned call at least once during each 15 minutes of operation and at the end of each transmission. In addition, an operator of an amateur portable radiotelegraph station shall transmit immediately after the call of the station, the break sign (BT) followed by the number of the amateur call area in which the portable amateur station is operating, as for example:

Example 1.—Portable amateur station operating in the third amateur call area calls a fixed amateur station:
W1ABC W1ABC W1ABC DE W2DEF W2DEF W2DEF BT3 BT3 BT3 K

Example 2.—Fixed amateur station answers the portable amateur station: W2DEF W2DEF W2DEF DE W1ABC W1ABC W1ABC K

Example 3.—Portable amateur station calls a portable amateur station: W3GHI W3GHI W3GHI DE W4JKL W4JKL W4JKL BT4 BT4 BT4 K

If telephony is used, the call sign of the station shall be followed by an announcement of the amateur call area in which the portable station is operating."

"Portable stations.—The licensee of an amateur station may operate a portable amateur station, or a portable-mobile station located aboard an aircraft, in accordance with rule 368, provided advance notice of all locations in which the station will be operated is given to the inspector in charge of the district in which the station is to be operated. Such notices shall be made by letter or other means prior to any operation contemplated and shall state the station call, name of licensee, the dates of proposed operation and the approximate locations, as by city, town or county. An amateur station operating under this rule shall not be operated during any period exceeding 30 days without giving further notice to the inspector in charge of the radio inspection district in which the station will be operated."

This provision does away with the special licenses for portable stations, which have heretofore been required.

"Class of operator and privileges.—There shall be but one main class of amateur operator's license, to be known as 'amateur class,' but each such license shall be limited in scope by the signature of the examining officer opposite the particular class or classes of privileges which apply, as follows:

"Class A.—Unlimited privileges.

"Class B.—Unlimited radiotelegraph privileges. Limited in the operation of radiotelephone amateur stations to the following bands of frequencies: 1,800 *to* 2,000 *kilocycles;* 28,000 *to* 28,500 *kilocycles;* 56,000 *to* 60,000 *kilocycles;* 400,000 *to* 401,000 *kilocycles.*

"Class C.—Same as class B privileges, except that the Commission may require the licensee to appear at an examining point for a supervisory written examination and practical code test during the license term. Failing to appear for examination when directed to do so, or failing to pass the supervisory examination, the license held will be canceled and the holder thereof will not be issued another license for the class C privileges."

Applicants for the class A and class B licenses must appear in person before a representative of the Federal Radio Commission for a written examination. The class C license has been established for the benefit of people living more than 125 miles airline from an examining city. The examination is given by mail.

Prospective amateurs who have neither operator nor station licenses and who apply under the new regulations are required to fill out only a single blank in order to obtain both licenses at the same time. Incidentally, the privileges of amateur radio stations are available only to citizens. There are no restrictions as to age, color or sex.

PROSPECTIVE radio amateurs living within traveling distance of Winston-Salem, N. C., are advised that examinations for all classes of radio operator licenses will be held in the Civil Service Room of the Federal Building in that city on November 4th, 1933, a few days after this issue of SHORT WAVE RADIO appears. The examinations will be held in two sessions beginning at 1:00 p. m. and 7:00 P. M. All applicants desiring to take Amateur Class A, Commercial, and Radiotelephone examinations must appear at 1:00 P. M. Edward Bennett is Acting Inspector in charge.

Maj. Armstrong Wins Again

(*Continued from page* 29)

cided it correctly when it was first presented more than ten years ago, and whose decision, affirmed at the time by the Circuit Court of Appeals in an able opinion by Judge Manton, has now been reaffirmed in this case, where every fact found in the previous decisions has been reproven."

The general attitude of leaders in the radio field is reflected in numerous letters and telegrams received by Armstrong after the present decision was announced. Among those congratulating the inventor were Prof. Michael Pupin of Columbia University, Dr. Irving Langmuir, this year's recipient of the Nobel prize for Physics, Capt. H. J. Round of England, one of Marconi's greatest engineers; Prof. Alan Hazeltine, inventor of the Neutrodyne and himself a veteran of many court battles; Cyril F. Elwell of England, Chief Engineer of the Federal Telegraph Co., at the time DeForest, then Research Engineer of that company, claimed he made the invention, and John V. L. Hogan, consulting engineer of New York. Mr. Hogan's statement is typical:

"The radio art has never had any doubts that this invention was made by Armstrong. I have been familiar with the controversy from its beginning in 1915 and was a member of the Board of Managers of the Institute of Radio Engineers in 1917 when it was awarded the Medal of Honor to Armstrong for his work.

"The art has been puzzled for years by the conflicting decisions of the courts, and it is highly gratifying to find that in the Second Circuit the Court has seen clearly through the fallacies of the DeForest contention."

Defendant Greatly Relieved

Charles M. Srebroff, president of REL, expresses his relief in this manner:

"Naturally, we are tremendously pleased with the outcome of this litigation. For years we have been threatened with suit by the DeForest Company under the so-called DeForest feed-back patents and our business interfered with.

"We knew, as every old-time radio amateur knows, that the invention was made by Major Armstrong. But when suit was finally brought against us by the DeForest Company, the American Telephone and Telegraph Company, and the Radio Corporation, we were not financially able to stand the cost of the litigation.

"We believed, however, that the decisions of Judge Mayer and of Judge Manton in the early litigation in favor of Armstrong were correct, and when Major Armstrong came to our aid with necessary financial assistance we were very glad to help establish the truth by standing suit.

"We do not want to appear before the public in the light of patent busters. We recognize only too well the difficulties and expense of pioneering new developments, having recently placed in operation at Bayonne, N. J., the first two-way communication police patrol system in the United States.* We are ready and willing to recognize valid patents, but we could not recognize those of the character which the court has just declared invalid."

A Romantic Background

To many members of the present generation of radio experimenters, the name of Armstrong is not as well known as the names of many contemporary engineers. Yet Armstrong, in addition to his pioneer work on ordinary regeneration, is also responsible for the super-regenerative circuit, now so popular for ultra-high frequency reception, and also for the superheterodyne, which is universally regarded as the best of all radio circuits.

The first correct explanation of the audion was published by him in 1914. Likewise, the first correct explanation of the nature of the heterodyne phenomena was published by him in 1916. He was one of the first radio amateurs in the United States and was only twenty-two, a student at Columbia University, when he made a vacuum tube oscillate.

He was overseas as a major in the Signal Corps of the A. E. F., and developed the superheterodyne in a laboratory in Paris during the World War. In 1922 he startled an Institute of Radio Engineers meeting in New York with the first demonstration of his super-regenerative circuit, producing loudspeaker results from one tube, a remarkable achievement for those days and no easy stunt even today.

The romantic aspect of Armstrong's career was recognized by Judge Julius Mayer, who presided in the 1921 case, and he commented on it in the decision he handed down. It must be remembered that Armstrong was only a schoolboy, a mere brass-pounding ham when he encountered regeneration and realized what it would mean to radio communication The theory of vacuum tube operation was incorrectly understood at that time, and the Armstrong-DeForest controversy was probably embittered by Armstrong's criticisms of the doctor's explanations and the publication of his own experimental observations and conclusions which disproved the DeForest theory.

* (*Described elsewhere in this issue.*—EDITOR.)

Building a Station Monitor

(*Continued from page 18*)

resonance is obtained and note the frequency of the monitor. Say, for example, it is 2000 kc., the fundamental frequency of the oscillator. What you do not know is whether or not the tuned circuit is resonant to the fundamental or to one of the harmonics.

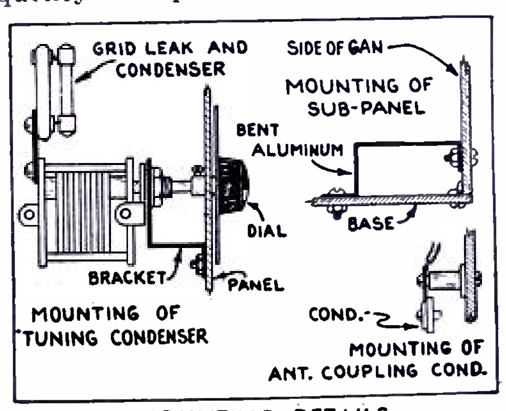
Now, slowly retune the monitor to a *lower and lower* frequency until resonance is again obtained with the tuned circuit. Now the tuned circuit *cannot* be tuned to this new fundamental of the monitor for the simple reason that if it were tuned to the fundamental before, and we have not changed anything in the circuit, it cannot be tuned to the fundamental now. On the other hand, if it were tuned to a harmonic before, it most certainly cannot be tuned to the fundamental now, since we *lowered* the frequency of the monitor. Record this second resonant frequency of the oscillator, which is, say, 1500 kc. Now to what frequency is the circuit tuned?

Since the fundamental frequency of the monitor at the first setting is 2000 kc., its harmonics are 4000, 6000, 8000, 10,000, etc. kc. The second setting of the oscillator has a fundamental of 1500 kc; therefore, its harmonics are 3000, 4500, 6000, 7500, etc, kc. Since the tuning of our circuit under test has remained constant, and since we obtained resonance in both cases, the tuned circuit must be resonant at 6000 kc.; for that is the only frequency common to the two settings of the oscillator.

If by chance the second setting of the oscillator came out to 1000 kc. fundamental, the harmonics would be 2000, 3000, 4,000, 5,000, 6,000, etc. kc. Now we see that the second, fourth, sixth, etc. harmonics of the fundamental corresponding to the *second* setting of the oscillator are the same as the fundamental, second, third, etc. harmonics corresponding to the first setting. Under these conditions, to what frequency is the tuned circuit tuned now?

Recall how we adjusted the oscillator. After the first setting, we lowered the frequency until resonance was obtained again. In between the two setting there is no frequency that produces any harmonics which coincide with those produced by the first setting; if there were any such coincident harmonics, resonance would be obtained before 1000 kc. was reached. *The lowest harmonic of the second setting that corresponds to a harmonic of the first setting is the frequency to which the tuned circuit is resonant, i.e.,* 2000 kc. In this case, then, our circuit was tuned to the fundamental of the first setting of the oscillator. In the first case outlined, our circuit was resonant to the third harmonic of the first setting of the oscillator, *i.e.*, 6000 kc.

From the foregoing, it is clear that the use of an oscillator that has strong harmonics necessitates the use of arithmetical calculations involving a bit of labor. An oscillator with a strong fundamental, on the other hand, gives such a strong resonance indication on the fundamental that it is easily recognized. If you must use harmonics, then proceed as follows: Get resonance on two successive settings of the oscillator; set down the harmonics of each setting; the first two harmonics that coincide is the frequency you are after.



MOUNTING DETAILS

Satisfactory Reception

(*Continued from page 15*)

coupling arrangement may be employed with the greatest satisfaction.

As indicated in Fig. 11, the coupler itself incorporates a small bakelite form which carries a small winding and two fixed resistors. This form is sufficiently small to enable it to be slipped into the open end of the antenna coil itself. It is provided with a fibre spring which holds the coupling coil to the larger coil in any desired position. As indicated by the dotted line, the ordinary primary of the larger coil is not used when the all-wave coupler is employed. Where this coupler is used, the twisted pair shown in Fig. 8 is connected directly to the twisted pair which comes directly from the all-wave coupler itself.

The use of these couplers enables the operator to secure very much better selectivity and any desired degree of coupling. It is particularly helpful when receivers of this nature are used for amateur communication. As a matter of fact, the use of this coupling arrangement with a combination tuned radio frequency and regenerative detector provides the same class of selectivity which is only otherwise obtained by the use of a superheterodyne circuit. This arrangement is ideal for use with the one-tube receiver described by Mr. Denton in the November issue as well as the "Convertible 5" also described in the same issue.

★

Schedule of Radio Transmissions Of Standard Frequency

THE Bureau of Standards transmits standard frequencies from its station WWV, Beltsville, Md., every Tuesday. The transmissions are on 5,000 kilocycles (60 meters). From October to March the schedule is from 10 a. m. to 12 noon, and from 8 to 10 p.m., E.S.T. The service may be used by transmitting stations in adjusting their transmitters to exact frequency, and by the public in calibrating frequency standards and transmitting and receiving apparatus. The transmissions can be heard and utilized by stations equipped for continuous-wave reception through the United States, although not with certainty in some places. The accuracy of the frequency is at all times better than one cycle per second (one in five million).

From the 5000 kilocycles any frequency may be checked by the method of harmonics. Information on how to receive and utilize the signals is given in a pamphlet obtainable on request addressed to Bureau of Standards, Washington, D. C.

The transmissions consist mainly of continuous, unkeyed carrier frequency, giving a continuous whistle in the phones when received with an oscillating receiving set. For the first five minutes the general call (CQ de WWV) and the announcement of the frequency are transmitted. The frequency and the call letters of the station (WWV) are given every ten minutes thereafter.

Supplementary experimental transmissions are made at other times. Some of these are made at higher frequencies and some with modulated waves, probably modulated at 10 kc. Information regarding proposed supplementary transmissions is given by radio during the regular transmissions.

The Bureau desires to receive reports on the transmissions, especially because radio transmission phenomena change with the season of the year. The data desired are approximate field intensity, fading characteristics, and the suitability of the transmissions for frequency measurements. It is suggested that in reporting on intensities, the following designations be used where field intensity measurement apparatus is not used: (1) hardly perceptible, unreadable; (2) weak, readable now and then; (3) fairly good, readable with difficulty; (4) good, readable; (5) very good, perfectly readable. A statement as to whether fading is present or not is desired, and if so, its characteristics, such as time between peaks of signal intensity. Statements as to type of receiving set and type of antenna used are also desired. The Bureau would also appreciate reports on the use of the transmissions for purposes of frequency measurement or control.

A. C.—D. C. Converter

(*Continued from page* 31)

bypass condensers, the filter condensers, and any other unwired parts of the circuit.

Looking at the bottom of socket 8, with the larger holes at the right, the terminal at the top right is for ground connection. The small terminal at the top left is connected to the stator of condenser (9). The large terminal at the lower right connects to the rotor of condenser (15), while the small terminal at the lower left goes to resistor (20), choke (32), etc. Looking at the bottom of socket (3) with the socket in the same position (with the large holes at the right), the small hole at the top left connects to the cap "H" of tube (10). The large hole at the upper right connects to ground (chassis).

The following color code may be used for connecting the Find-All i.f. transformer. Connect yellow to the plate F of tube (10). The red terminal is connected to the plate winding of coil (8). The black wire is grounded to the chassis, while the green wire goes to the cap "G" of tube (25).

After the wiring has been carefully re-checked, the external antenna is connected to post (1), the receiver antenna to post (28), and the receiver ground post to lead (29). No external ground is connected to the converter, but the external ground is left connected to the radio receiver.

The tubes are put in their proper sockets, and the green coded short-wave coils are plugged into sockets (3) and (8). The volume control of the set and also of the converter are turned full "on." The set is then tuned to approximately 550 kc. with switch (35) closed and with the converter plugged into a 110-volt a.c. or d.c. power source. The tuning condenser of the radio receiver is turned slightly until a rushing noise is heard. The tuning condensers (15) and (17) on top of the i.f. transformer (16) should then be adjusted to the point where this noise is loudest. A short-wave station should then be tuned in on the converter and (15) and (17) should be readjusted for louder signal. Condenser (2) should also be adjusted at this time. The converter should then be tested out on the other wave bands by changing the coils at (3) and (8).

Of course, all the usual rules about short-wave operation apply to this converter, as they do to all types of short-wave sets. Between daybreak and about noon, it is best to use the blue coils, which tune between 15 and 20 meters. From noon to about twilight, try the red coils, 20 to 40 meters. After dark, there will still be some activity on 30 meters and higher (EAQ, Madrid, Spain, is a reliable station in this range). However, the yellow coils will yield the best results during the evening, as these cover the very busy 49-meter channel and also amateurs' phones on 75 meters. Berlin and London, to say nothing of numerous Central American stations, will come in with excellent strength.

The green coils, tuning from 80 to 200 meters, will bring in dozens of police radio alarm stations, which are always good for a thrill, and hundreds of amateur phones on the 160-meter band. Airplanes and airport stations around 95 meters will also furnish many interesting hours reception. It is a good idea to keep an accurate "log."

Does the Moon Affect Reception?

(*Continued from page* 7)

are necessary—the greater the number, the better the results. If any of you readers have a barometer and a humidity indicator, use them and send the dope along with the rest of the readings. For the benefit of those of you who have forgotten your physics, 100% humidity means that the air is just saturated with water—rain—while the barometric pressure is measured in inches of mercury, not pounds per square inch!

The object of this discussion is *not* to tell you when to listen in for DX; our object is to tell you what information we already have. We ask you to co-operate with us and collect more information. When you listen in, record in your log (you have a log, haven't you?) the weather condition—either rain, snow, clear, foggy, etc., the signal strength, the station heard, its location, and its frequency.

Collect this data for one month—not necessarily every day, except during the time the moon changes—and send it in. If we can get good reports from listeners all over the world, we may then be in a position to help every listener.

Perhaps the Captain is wrong; perhaps he is correct. When reception is good here, how is it in China, Australia, England, South America? Do variations in the position of the moon affect conditions in Alaska, where the night is about six months long? We could write a whole story by just asking questions. How about helping us with the answers?

And another thing, don't forget to record the time when you pull in the signal—it is very important. You can tell the position of the moon either by looking at it or by consulting any good almanac or calendar.

Amateur Station

LOG SHEETS

Paragraph 386 of the "Rules and Regulations Governing Amateur Radio Stations, issued by the Federal Radio Commission, reads as follows: "Each licensee of an amateur station shall keep an accurate log of station operation in which shall be recorded: (a) the date and time of each transmission; (b) the name of the person manipulating the transmitting key of a radio telegraph transmitter, or the name of the person operating a transmitter of any other type, with statement as to nature of transmission; (c) the station called; (d) the input power to the oscillator, or to the final amplifier stage, whether an oscillator-amplifier transmitter is employed; (e) the frequency band used; (f) the location of each transmission by a portable station.

"This information shall be made available upon request by authorized government representatives."

Be prepared! Lay in a supply of the new and simplified log sheets, as prepared by SHORT WAVE RADIO. These are the most sensible sheets brought out to date for ham use. Plenty of space to write in all the dope required by the F. R. C. Quick and easy to use, and can be filled-in in a hurry while you are "pounding brass."

These new log sheets measure full $8\frac{1}{2}$ by 11 inches, are printed on high grade white paper that will take ink without smudging, are ready punched to fit any standard 3-ring note book binder, and are handier than bound books. You can make rough entries on one sheet, and then typewrite them on another for permanent record. This will make up a really swell log book that you will be proud to show. Nothing like these loose-leaf sheets for convenience.

Loose-leaf log sheets, package of 50, $.50

Postpaid anywhere in U. S. A. United States stamps, Post Office and Express Money Orders accepted. Do not send coins through the mail. These log sheets are carried in stock. Your order sent out same day it is received.

Standard Publications, Inc., 1123 Broadway, New York, N. Y.

No. 651, $2.50

No. 982, $6.00

Get a Globe!

A flat map of the World is worse than useless for figuring distances or showing the relative positions of widely separated points—it is misleading and unreliable. A good globe is the only thing for the short-wave fan to have. Here are two accurate Hammond globes at reasonable prices.

The No. 651 is six inches in diameter and stands $10\frac{1}{4}$ inches high overall on a graceful walnut finished stand. Sphere is of unbreakable composition, with hand mounted map. Price, only $2.50. Add parcel post for 3 lbs.

The No. 982 is nine inches in diameter, and is mounted on a beautiful black bakelite stand, striped with silver. Map is hand mounted and is very detailed. Price, $6.00. Add parcel post for 5 lbs.

Either of these globes makes a stunning and useful decoration for the radio table. Ideal as Christmas gifts for yourself or your friends.

order by number directly from

STANDARD PUBLICATIONS, Inc.
1123 Broadway, New York

Many Entries in Denton Contest

THE Denton Trophy committee reports enormous interest in the DX contest from every corner of the globe. Among the recent entries are Mr. Wah How Lee of Honolulu, Hawaiian Islands; Gustavo Barros y Ruiz, Havana, Cuba; Lascelles Pilling, Campana, Argentina; Shokicki Yoshimura, Moji, Japan; William Warner, Devon, England; Douglas Turner, London, England, and Mathew Sheridan, Castletown, Ireland.

Local DX fans had better look to their laurels as foreign competition promises to be hot and heavy.

For those who missed the information about the Denton Trophy Contest contained in last month's issue of SHORT WAVE RADIO, this contest is to decide who is the best short-wave tuner in the world. The person who sends in the most verifications from different short-wave stations heard between August 1, 1933 and February 1, 1934, will be awarded the Denton Trophy, a handsome silver globe representing the world. The name of the winner will be inscribed on the trophy. Ninety-nine other prizes will be awarded.

Only one verification is needed for each station, unless the station operates on more than one wavelength or uses more than one call sign. Any short-wave station heard broadcasting counts, regardless of whether it is an amateur or a commercial station. It is essential, however, that the verification states that the station was broadcasting a program at the time reported by the contestant. A complete set of rules may be obtained gratis by writing to Mr. Clifford Denton, care of Denton Trophy Committee, 25 Park Place, New York, N. Y.

A *verification* is a letter or a card from a broadcaster, stating that the person reporting the reception actually heard the broadcast.

A Really Good Pilot Light

In view of the high voltages developed by transmitter power packs, it is important that the operator have some very definite indication that the current is on. Ordinary small pilot lights connected across the filament circuit are not nearly conspicuous enough.

Probably the best warning signal is a one-inch neon bulb, fitted with a standard Edison base to fit regular 110-volt lamp sockets. It is connected directly across the primary of the high voltage power transformer, so that it will light when the transmitter is turned on. This neon tube, if placed anywhere on the operating table (a good place is right next to the transmitting key or microphone), will be absolutely unmistakable, as it lights up bright red. Its power consumption is negligible.

SHORT WAVE EXCHANGE

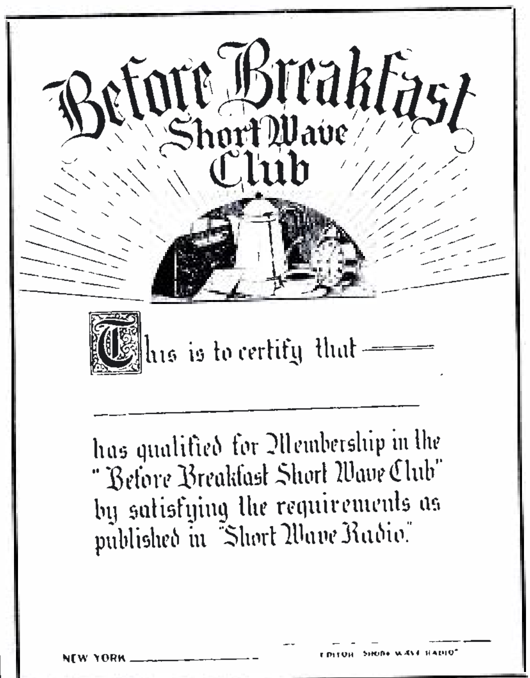
Have you some apparatus to sell or swap, or some special service to offer to other short-wave fans? Take advantage of the low rates of this department to reach other "hams". Only 5 cents per word for amateurs, 8 cents per word for manufacturers or dealers. Name, initial and address each count as one word. Not less than 10 words accepted. Cash, money order or U. S. postage stamps must accompany all advertisements. Please write clearly.

THE ANSWER FACTORY has unsnarled many puzzles of amateur and commercial operators. Prompt quotations, reasonable prices. Robert S. Kruse, RFD No. 2, Guilford, Connecticut.

Join the B. B. S. W. Club!

THE BEFORE BREAKFAST SHORT-WAVE CLUB is unique among short-wave organizations. There are no dues, meetings, minutes, assessments or other parliamentary nuisances. The only requirement for membership is at least two verifications from short-wave phone stations 1000 miles or more from the applicant's location, received any time after 5:00 a.m. and before 9:00 a.m. any day of the week.

Verifications sent in to the Before Breakfast Club will be returned promptly, along with a certificate of membership suitable for framing. A reduced reproduction of this appropriate diploma appears herewith. The coffee pot and the alarm clock more or less symbolize the idea behind the organization.


Before Breakfast
Short Wave
Club

This is to certify that

has qualified for Membership in the "Before Breakfast Short Wave Club" by satisfying the requirements as published in "Short Wave Radio."

NEW YORK

Reduced reproduction of the certificate issued to members of the B. B. S. W. Club

One of the main benefits to be derived from the club is the exchange of valuable short-wave station data contained in the verifications.

There are no fees of any kind involved. Address your verifications and applications for membership to the BEFORE BREAKFAST SHORT-WAVE CLUB, c/o Standard Publications, Inc., 1123 Broadway, New York, N. Y. Enclose a large stamped envelope for their return.

Handy Kinks

Never attempt to remove screen-grid tubes from their sockets by grasping the control grid caps. These are held in place with only a small amount of cement, and will crack off quite easily if mishandled.

* * *

A very simple and effective rest for the hot end of a soldering iron can be made by driving two large nails into a board so that they form a cross.

FOR SALE: Jensen 8" P.M. dynamic, for P.P. 38's, no baffle, new, $3.00. Weston Model 301, 0-15 v. D. C. voltmeter, perfect, $1.50. Unit and stand only, cone missing, of WE-540 AW loud speaker; works ok, $1.50. A Bachner, 3970—48th Street, Long Island City, N. Y.

why not SUBSCRIBE?

Why take the chance of missing the meaty "dope" that will be published in forthcoming issues of SHORT WAVE RADIO? Enter a subscription and have the magazines mailed direct to your home or office. Only $2.50 per year for 12 issues in the United States and possessions; $3.00 in Canada and foreign countries.

The best authors in the short-wave field will be regular contributors. Among these are Clifford E. Denton, Robert S. Kruse, Arthur H. Lynch, Capt. H. L. Hall, H. G. Cisin, and Alfred A. Ghirardi. Keep up with short-wave radio by reading SHORT WAVE RADIO!

SHORT WAVE RADIO

devoted to short-wave transmission and reception in all their phases

edited by
ROBERT HERTZBERG
and
LOUIS MARTIN

Here is a man-sized coupon that doesn't require a magnifying glass

STANDARD PUBLICATIONS, INC.
1123 Broadway, New York, N. Y.

Enclosed is $............ for one year's subscription to **Short Wave Radio.** My full name and address are given at the right. ($2.50 in U. S. and possessions; $3.00 in Canada and foreign countries.)

12-33

Name ____________________

No. and Street ____________________

City ____________________

State ____________________

Call Letters (if licensed) ____________________