SHORT WAVE RADIO

May
1934

Edited by
Robert Hertzberg and Louis Martin

IN THIS ISSUE:

PROGRAMS TO SOUTH POLE

Aided by Special Antennas

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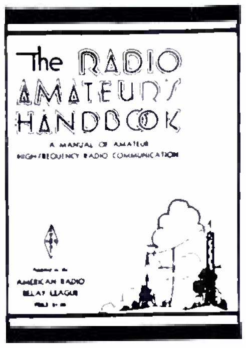
BOOKS FOR THE RADIO MAN

Many of the questions asked daily by radio experimenters, constructors and listeners all over the country are answered completely and clearly in various books. To assist radio men in buying books best suited for their own particular needs, we have made a selection of representative works that we can recommend very highly. These books are all up-to-date and will prove very valuable.

"The Radio Amateur's Handbook"



The RADIO AMATEUR'S HANDBOOK was first published in the fall of 1926. It was in response to a growing demand upon the American Radio Relay League for some sort of a manual of operation for short-wave experimental radio work. The first edition met with great favor and two reprintings were necessary to supply the demand. Since that time ten subsequent editions have been published and more than 215,000 copies have been sold. The latest edition (11th edition, published January, 1934) is approximately 15% larger than the first edition, and represents probably the most comprehensive revision yet attempted. New receiver circuits and designs are presented, together with a thorough treatment of the recently-developed "single-signal" sets. A completely re-written 36-page chapter is devoted to all that is new in the world of transmitters. New circuits and layouts are given, all problems which face the transmitting amateur being discussed in a lucid and comprehensive manner. The radio telephony chapter represents all new material. New designs for Class B modulators and speech amplifiers are featured. Still another new chapter is that on antennas. 238 pages, many illustrations.

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"The Outlook for Television"

How far has television advanced? How far is it from commercial application? What form will this application take? How will it affect broadcasting, advertising, home and theatre entertainment? How will it be used in education, politics, war, and religion?

Mr. Orrin E. Dunlap, the author, tells in detail how television has been developed to date. He explains in clear, simple language the technical and scientific principles on which it rests, the obstacles which must be overcome, the probable future developments of the industry. It is a book not only of facts but of personalities. The author takes us into the television laboratories of such men as Alexanderson, Zworykin, Jenkins, Hammond, Baird, and others, explains the work they are doing, and presents their opinions on the future of television. The book is authoritative.

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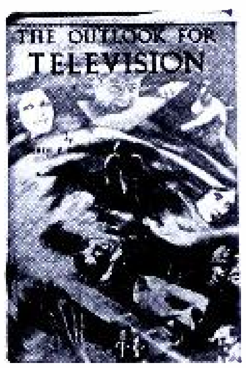

"How to Become a Radio Amateur"

Completely done over in 1934 style, telling all about amateur radio and describing the latest equipment—*push-pull transmitter—bandspread pentode receiver—simplest of monitors.*

The third edition of "How to Become a Radio Amateur" marks another milestone in amateur development. Still the standard elementary guide for the would-be amateur, the simple, inexpensive station described incorporates features which in the past have been confined to the more advanced layouts. The designs have been made flexible so that parts out of the junk box can be readily substituted. The performance of the completed station is such that any amateur can own and operate it with satisfaction and pleasure. It's a real amateur station, with construction and operation described in clear, understandable language.

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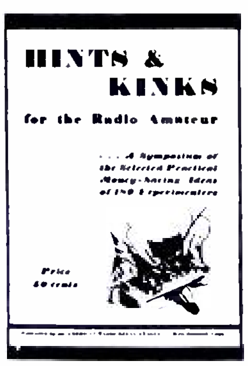
"Hints and Kinks for the Amateur"



For years hams have said that one of the most practical and valuable features of all radio magazines is the experimenter's section. But try to recall when it was you saw that swell (but, alas, only dimly remembered) suggestion for band-spreading, or a key click eliminator. What was needed was a compilation of all the best ideas, brought under one cover, segregated by subjects, and *indexed*. And here it is—an intensely practical book, filled out with selected additional material, with dozens of valuable and workable ideas gleaned from the practical station experience of successful amateurs. Chapters on workshop ideas, receivers, transmitters, amateur, phone QRM elimination, keying, power supply, and so on.

An ever-present help in time of trouble, and worth its weight in crystals when you are desperate for an idea. *80 pages in attractive paper covers.*

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"Radio Amateur's License Manual"

Before you can operate an amateur transmitter, you must have a government license and an officially assigned call. These cost nothing—but you must be able to pass the examination. The License Manual tells how to do that—tells what you must do and how to do it. It makes a simple and comparatively easy task of what otherwise might seem a difficult task. In addition to a large amount of general information, it contains 198 typical questions and answers such as are asked in the government examinations. If you know the answers to the questions in this book, you can pass the examination without trouble.

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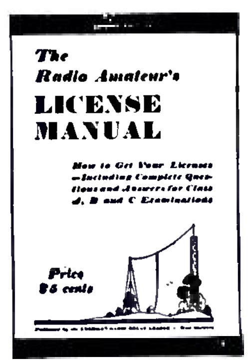

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Standard Publications, Inc., 1123 Broadway, New York, N.Y.

May, 193 Vol. 1, No. 7

SHORT WAVE RADIO

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

Robert Hertzberg, *Editor* Louis Martin, B. S., *Technical Director*

IN THIS ISSUE:

Of General Interest:

Of Explanatory Nature:

For the Constructor:

IN FUTURE ISSUES:

MORE STATION DATA—The increased space that we have given foreign station information has been acclaimed by our readers. We are gathering more data of this kind and expect to embellish it with pictures of some of the more interesting looking stations.

SHIELDING IN S.W. RECEIVERS—In spite of all that has been written on the subject in the past, the functions and correct applications of metal shields in sensitive short-wave receivers continue to confuse and mystify many constructors and experimenters. Robert S. Kruse has prepared a fine explanatory article that will answer many perplexing questions.

LEARNING THE CODE—The astonishing interest in the code displayed by members of the Short Wave Club of New York evidently is not a local manifestation, for "listener" clubs in other parts of the country seem to be just as hungry for code instruction. These people want to learn the code to increase their enjoyment of short-wave reception, and not necessarily with the object of becoming transmitting amateurs. Knowing the code is really a lot of fun! The short article in this issue will be followed by more detailed advice, based on the experiences of the instructor of the New York group, who happens to be your editor.

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YOU'VE WANTED CASCADE PRE-SELECTION

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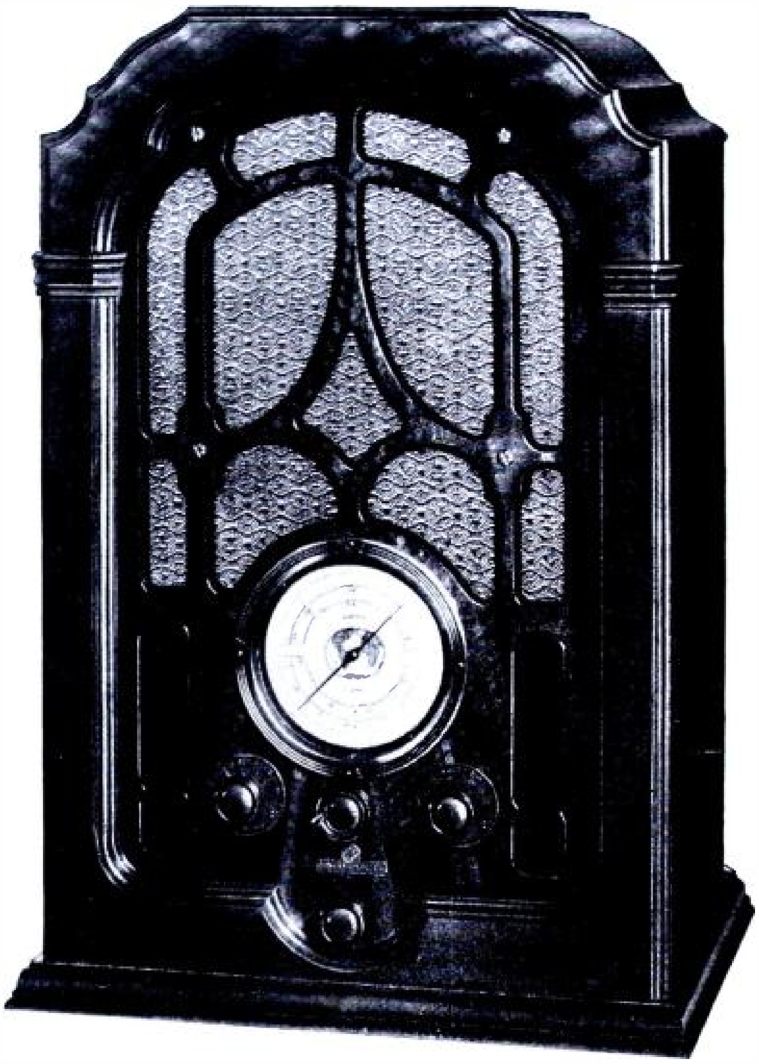

General Electric All-wave Radio Model K-80... Price $92.50.
Price slightly higher in West and South. Subject to change without notice.

IN the past, lack of adequate preselection has limited the efficiency of most short-wave receivers.

Now, however, you can enjoy the perfect reception that cascade preselection gives you. In General Electric's new *all-wave* model, there are two stages of radio frequency (*with a single tuning control*) ahead of the first detector. This assures sharper tuning and minimum images. Both stages are on the 8-18 megacycle band where they're needed to give additional gain in sensitivity; one stage, on the 540-10,000 kilocycle band.

Easy and accurate tuning is made possible by the air-plane type illuminated dial on which all four bands are graduated in kilocycles and megacycles, and short wave broadcast bands are marked in meters.

Model K-80 is a set you can recommend to your friends who are interested in short wave reception. It's easy to operate, and gives the outstanding performance that is expected of a high-quality set.

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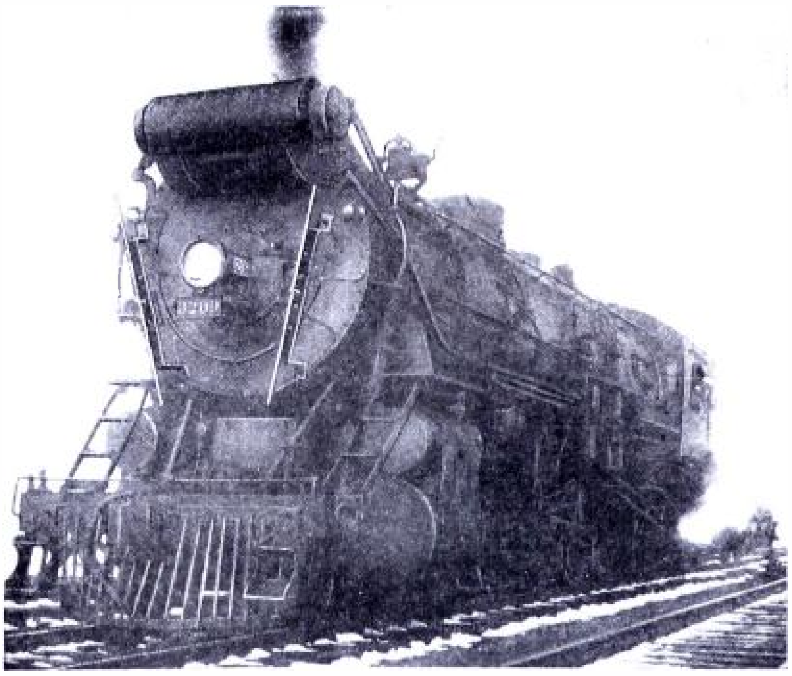
5-Meter Radiophones for Railroads



The newest equipment for the locomotive is radio antennas. Note the straight copper tubes on either side of the headlight.

A description of a five-meter radiophone and receiver designed for operation between the locomotive and caboose of long freight trains. This arrangement permits conversation between engineer and brakeman at all times. The antenna is located on the front of the locomotive and the transmitter proper on the wall directly behind the engineer.

WITH the cooperation of the New Haven Railroad Company, Westinghouse engineers recently installed an experimental 5-meter radiophone system on one of the road's regularly operating freight trains. Complete two-way radiophone equipment is installed on both engine and caboose of the train, permitting the engineer and brakeman to communicate at all times without difficulty.

The equipment consists of an ultra high-frequency transmitter and receiver with microphone and loudspeaker located in the engine cab and duplicate equipment located in the caboose. Separate antennas are used for transmitting and receiving. The two antennas used on the engine equipment are located on the front end of the engine and are connected to the transmitter and receiver located in the cab of the engine by means of two-conductor transmission lines. The antennas for the rear end of the train are located on the two sides of the caboose. The equipment operates from a 6-volt storage battery supply and is capable of about 30 hours operation without recharging.

Long Experiments Made

The Westinghouse Company has been experimenting for many years with railroad radio systems, the first installation being on the Virginian Railroad in 1925. Other installations followed in 1927 and 1928. These earlier installations were on a wavelength of 125 meters (approximately) and equipment was comparatively large and expensive. In contrast to this, the present equipment is extremely simple and small and is relatively inexpensive. New tubes and intensive research on ultra high frequencies have permitted these new sets to be developed and installed experimentally in actual service.

The 5-meter waves have a tendency to follow the tracks, which is very desirable from an operating standpoint and tends to minimize possible interference with other radio services. In addition, these short wavelengths are conveniently limited in their travel even on regular service other than on railroads. A large number of transmitters may be operated on the 5-meter band without interference with one another so long as they are a few miles apart.

The transmitter is started in operation by the pressing of a button located on the hand microphone within easy reach of the locomotive engineer. The receivers of these equipments are kept in continuous operation while in service. A loud speaker operating at high volume is located beside the engineer so as to provide sufficient signal above the noise of the tracks and other trains.

It is expected that many installations of this radio equipment on railroads will follow in view of the tremendous possibilities of this form of communication.

Editor's Note

The use of ultra-high-frequency waves is developing along lines slightly different than the more conventional broadcast frequencies. Although still more or less in the experimental stage, five-meter equipment is now found in regular commercial use, such as described in this article; the broadcast frequencies, on the other hand, developed rather slowly and painfully at first, gathering momentum as time went on. It reached its peak in about 1927. To put the idea more bluntly, industry is finding uses for and advancing five-meter work; the public did the job in the broadcast field.

It is interesting, however, to speculate. At the March 7th meeting of the IRE, Dr. Kolster described some interesting developments on the use of five-meter apparatus for short-range telegraphic communication.—*Tech. Dir.*

The conductor directs his train operation by radio, talking directly with the engineer up front in his locomotive. New railroad radio system perfected by Westinghouse Electric & Manufacturing Company, operating on five meters, passes tests and is placed in experimental operation on New York, New Haven & Hartford railroad.

PROGRAMS TO SOUTH POLE

aided by special antennas

AN antenna which increases the directional power of short-wave transmitter W2XAF 20 times, making this station equivalent to more than 400 kilowatts in effectiveness in one direction, is being used to broadcast special programs to the Byrd Antarctic Expedition in Little America every other Sunday night.

This antenna, known as the Byrd antenna, is Dr. E. F. W. Alexanderson's contribution to the happiness of the expedition's personnel as the men winter through a year of hardships in the Antarctic. In erecting this special antenna, General Electric engineers are bringing to the Byrd broadcasts the latest devices known to the art to promote reliability of reception. While it may be too much to hope that all programs will reach their Polar destination, the chances are very good, as W2XAF was the one station reliably heard by Byrd on his last expedition to Little America.

Sketch of western hemisphere, showing relative positions of W2XAF and Little America.

Horizontal Antenna

The Byrd antenna is of the horizontal checkerboard type. It is one of a dozen or more antennas which sway above General Electric's 54-acre transmitter laboratory at South Schenectady, N. Y. These antennas hang from steel masts from 150 to 300 feet high, from plain wooden masts and from masts with cross bars, not unlike scaffolds in appearance.

The Byrd antenna is actually twelve antennas in one, consisting of two sections of a checkerboard each section made up of three squares. One section is known as a reflector. Only the horizontal wires of the system function as antennas, the vertical wires being for support or power transmission to radiating wires.

The horizontal antenna was developed following years of research along lines suggested by Dr. Alexanderson, consulting engineer and radio expert. The effectiveness and carrying power of horizontally polarized radiation were discovered by Dr. Alexanderson in 1924. When transmitting with horizontally polarized waves the so-called ground wave is quickly absorbed, leaving only the high angle radiation which in its carrying power appears superior to the vertically polarized wave. With the horizontally polarized system it is possible to shoot most of the energy into the air and, with the reflector, to direct the greater part of this energy in any desired direction instead of dissipating it in every direction over a comparatively small area.

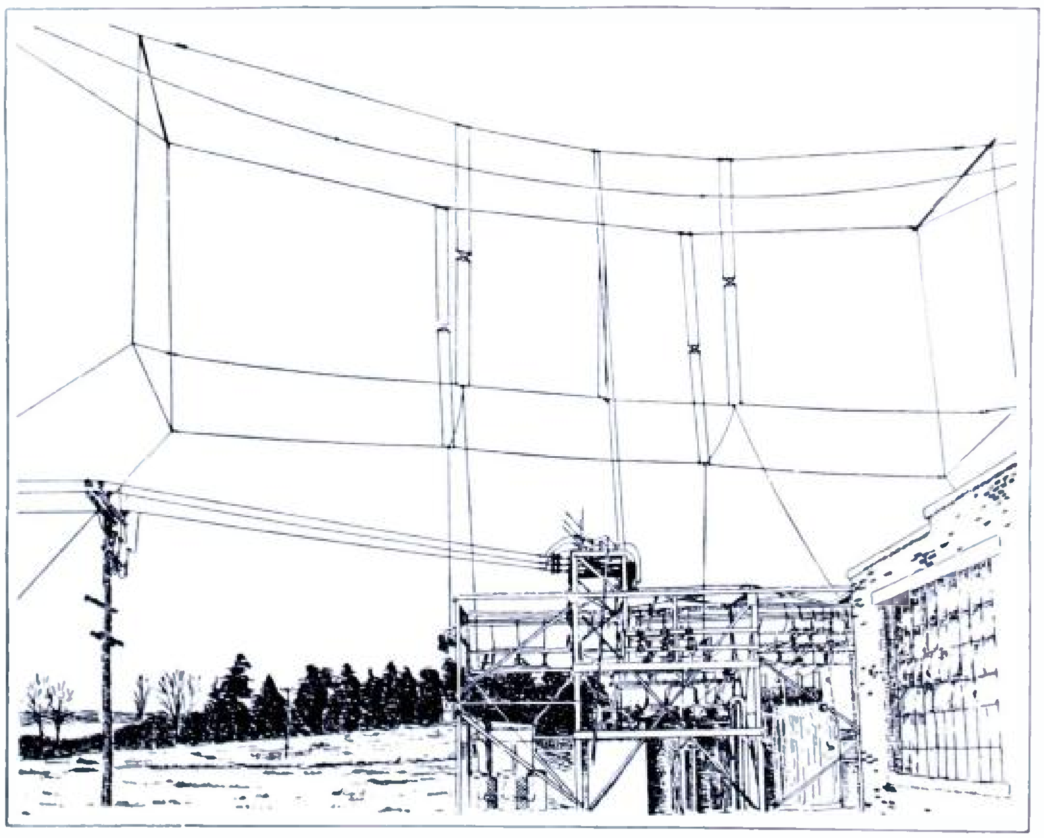
W2XAF operates on a wavelength of 31.48 meters or 9,530 kilocycles. The American public is afforded an opportunity of listening in to these programs to the Byrd expedition through cooperation of the National Broadcasting Company, which broadcasts them over a chain of 51 stations associated with the WEAF or red network. The broadcasts take place every other Sunday night from 11 to 11:30 o'clock, E.S.T., the programs being arranged and sponsored by prominent newspapers all over the country.

Letters Read

Immediately at the close of the popular programs, or at 11:30 o'clock, the long-wave stations are dropped but the short-wave station continues with its radio mail bag. This consists of the reading of letters and messages from relatives and friends of the men on the expedition. It is the only mail they receive, now that they are cut off from all civilization, and the 75 or 100 letters read to them at the conclusion of each program by short waves are eagerly awaited. These letters are read from the studios of WGY in Schenectady, N. Y.

(As further information on Byrd is received, it will be published in SHORT WAVE RADIO. See the January, 1934 issue.—*Tech. Dir.*)

Above: Picture of W2XAF, the short-wave transmitter communicating with Byrd in Little America.



Right: A pen and ink sketch of the transmitting antenna used at W2XAF. It is called the Byrd Antenna, since it was designed especially for communication with Little America.

Tuning For The Foreign Short-Wave Stations— —Advice By An Expert

WHEN I first became interested in short waves, people were terribly excited if they were able to pull in a foreign station with sufficient volume to hear them on earphones. That was in 1925.

A few years went by; and, during these years the splendid experiments made by amateurs, or "hams," and the radio engineers throughout the world advanced the art. Suddenly, we found that we had graduated from the earphone stage to the faint loudspeaker stage. Still, we were not satisfied. Things drifted on until superheterodynes were given us for short-wave reception. The number of tubes seems inexhaustible in this type of receiver.

Reception of foreign locals is an assured fact with atmospheric conditions permitting. One cannot so safely speak about the Spanish speaking stations in South America, Cuba, Mexico, or the small republics down South.

The foreign locals have gone far in their own individual ways by increasing their power, beaming their transmissions towards us, and using wavelengths which they have found to be best for reception at different times of the day and night. These stations, which, by the way, are Government controlled, do not spare time or effort in sending us the splendid programs that they want us to hear.

Unexpectedly Good Results

Reception results here, in the heart of New York City, have reached such unexpected heights that an experiment was tried, and this, also, found successful from an engineering and receiving point of view. What fan that heard the "foreigners" in 1925 on earphones could conceive of the idea of rebroadcasting those same signals to a public accustomed to local programs radiating from our famous chain networks? But so much has been accomplished in a span of less than ten years that this is exactly what we are going to do.

To put the entire thing in a nut shell, I am going to pick up signals radiating from abroad and rebroadcast them over a regular local station. Why am I able to do this? First, I have made a study of antennas which is the heart of a radio receiver. My aerial which has made these rebroadcast tests successful, is of the cage type. There is 312 feet of wire in this antenna, and it is still undergoing changes.

The signals, after being received, are transmitted by land wire to the studios of WBNX, 260 East 161st Street, Bronx, New York, where they will be relayed to their transmitter at Cliffside, New Jersey, and then broadcast to the WBNX listeners. Don't say it can't be done! because we have accomplished every part of this experiment. Knowing little about the technical part, I will not be able to go into detail about it, but will only tell you what I know and understand myself.

Land Line Connection

First, I pick up the signal. It is then put into a portable amplifier, designed by Frank Anzolone, Chief Operating Engineer of WBNX, from which it goes by land wire to the studios of WBNX, where it is then shot into their transmitter at Cliffside. From that point it goes through another amplification process, and, finally, to their new type of antenna, which has a strong ground wave. Their output circuits are perfectly matched and the special transmission line to the vertical antenna is of special construction to insure the widest coverage and the strongest signal.

Dr. Herbert L. Wilson, Consulting Engineer of WBNX and WHOM, has worked hard to put this great achievement over. Because of his tremendous knowledge of radio, from an engineering and practical point of view, he has accomplished this remarkable feat. His aides are also enthused over the whole idea. For instance, Mr. Earl Gordon, the engineer who is to be stationed at my home when these broadcasts take place, said to me when I asked him if all this did not tire him: "Captain, I love it. The trouble with radio is that, when you get into it, it gets in your blood."

By Capt. H. L. Hall

In the short space of a year, Capt. Hall has established himself as what might be termed the champion short-wave listener of the United States. A retired sea captain with plenty of time to devote to his hobby, he enjoys really phenomenal foreign reception in the heart of New York, in a location that previously was notoriously bad. His Saturday column in the New York *Sun*, entitled "Below the Broadcast Band," is eagerly followed by thousands of short-wave set owners in the metropolitan area.

All this is purely uncommercial, but is it being put over so as to prove those people wrong who still doubt the fact that programs from Europe can be heard with any degree of satisfaction. WBNX operates on 1350 kc. from 9.00 a.m. to 5 p.m. and from 6.30 p.m. to midnight. Any change in schedule, in order to transmit a special foreign broadcast between midnight and 1 a.m., will be made.

China at Last

The writer logged a new catch and a fairly good one, if he must say so himself. It was CQN, Macao, China. This is an island off the harbor of Hong-Kong and is a Portuguese possession. One Sunday morning, between 6 and 7 a.m. I was going over the dials when, contrary to all rules and regulations set down by the old-fashioned short-wave tuners, I inserted the coils that covered the fifty-meter band. There I heard a carrier. Very weak, but to the dyed-in-the-wool DX'er there is much more of a thrill in pulling in a weak carrier than the strong ones like the foreign locals. This fifty-meter carrier started to build up in volume, and, within a few minutes, voices were heard.

At first it faded, but the clarity of the signal was remarkable. There was absolutely no interference at all. Then, later the signal became steady. In all, it never became any stronger than R3. I sensed it was an Asiatic. Why? Because this is how I have logged all my Asiatics. To continue with what I heard. Then there appeared to be two men talking, one very faint and the other very loud. All the "louder voiced" man seemed to be saying was *Pe Co Pento* or *Pe, Co, Presto*. This was said over and over again, followed by a pause, and then he would continue. The fainter voiced man started talking in Portuguese and then in Chinese. Then truly Oriental music followed. We had about forty minutes of this program. So CQN was pulled in, and here was another Asiatic snared.

When this station was reported, many fans went after it the following Sunday and several logged it. I first heard about this distant catch in December through my connections with short-wave listeners in the Far East. It is a government-controlled station using 1000 watts of power, and it is being heard very often in Australia and New Zealand.

Several fans said to me when I told them about this station, "How did you identify this station when they did not give their call letters?" and, "It don't seem possible to pull in a fifty-meter station in daylight!"

The first question probably puzzles more fans than the second. Well, this is how to identify stations. Not alone CQN, but nearly every new catch. For example: if you heard a woman talking in Italian on 25.4 meters, followed by an operatic selection, you would know you had heard Rome. But if you waited to identify Rome until the announcer said, "This is 2RO," you would have *some* wait. The same with France or Morocco or a half-dozen other foreigners.

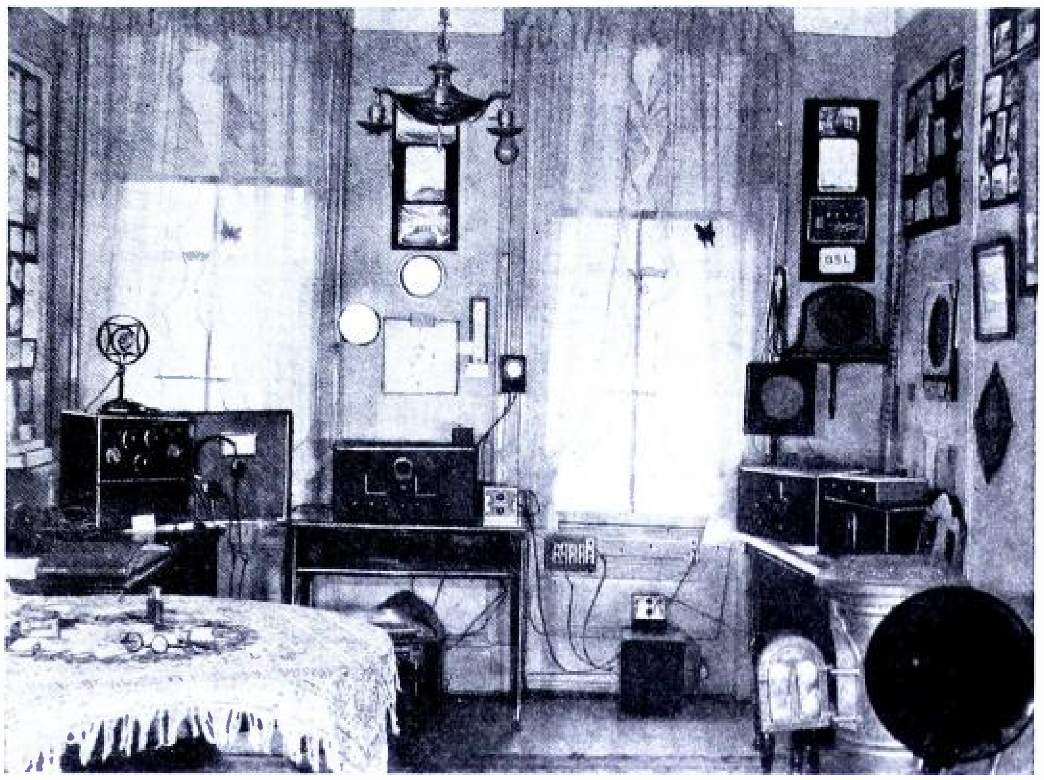
One has to do a certain amount of reasoning in order to identify the stations you hear. Of course, a receiver with well-calibrated dials is part of the job. But calibration of dials does not come in a day or a week, as all fans will tell the newcomer. With CQN, it was easy. Knowing of an Asiatic on 50 meters owned by Portugal and located in China, what more did I need when I picked up their signals?

Some Good Advice

Now about this daylight and night-time "stuff." Here I am going to make a strong statement. All my best catches have been heard (and verified) when I tuned absolutely contrary to what people have told me. Let us take CQN. Some say it is impossible to log the higher waves at that hour of the morning. Why? Because the signal is coming through too much light. But how much light was that signal coming through? Very little. Think! China is to the west of us. When it was 6 a.m. here in New York City, it was 3 a.m. on the Pacific Coast, 12.30 a.m. in Hawaii, 11 p.m. on the 180th Meridian, and about 8.30 p.m. in Macao, China. The only real daylight this signal came through was a distance of about 700 miles, or from New York to Chicago. Why should we not get CQN? No reason at all. My advice to you fans is: *watch your time charts.*

You fellows who are after Asiatic catches leave your "daylight coils" alone in the early hours of the morning; but if you are after European catches, all well and good; but, for the Far East, the *nightime* coils *in the morning.* There are plenty of catches for all.

Now to that always important feature: The Mail Bag. A. L. Mainhofer of the Bronx, New York, writes and says that on January 21 he heard HVJ, "Radio Vaticano," on 50.26 meters. He does not say the time, but although the writer has heard this station many times, he has yet to get them on that wavelength.



A general view of Capt. Hall's modest but famed radio "shack." At the extreme left is the portable line amplifier used for the WBNX rebroadcasts. On the table between the windows is a Postal receiver; along the right table are Hammarlund and National sets. The walls are literally plastered with a prize collection of verification cards, letters and photographs from the four corners of the Earth. The switches under the right window permit a choice of any of several different aerials, of both the straight and transposed-feeder types.

E. R. Callender, Middletown, New York, rushed to the aid of the writer when he read that Frank Gillelin Jr. of San Diego, California, could hardly believe that the European stations were being heard here in the East after dark. This is what Mr. Callender says: "Received veri of a program heard over G6RX, 69.44 meters on February 1st which ended at 9.45 p.m. e.s.t. Heard DJC, Zeesen, on Sunday night, February 25; call letters coming through in English at 9.40 p.m. e.s.t. Listened to the program until 10.50 p.m. e.s.t., at which time it was blanked by local QRM. This particular program, according to the announcer, was for the benefit of North America. G6RX has been coming in every evening for the past two weeks, testing with Montreal. Usually, they use records; last night, however, they put on a play before the records. I believe that any week *some European* station can be picked up in the evening."

HC2RL, Ecuador

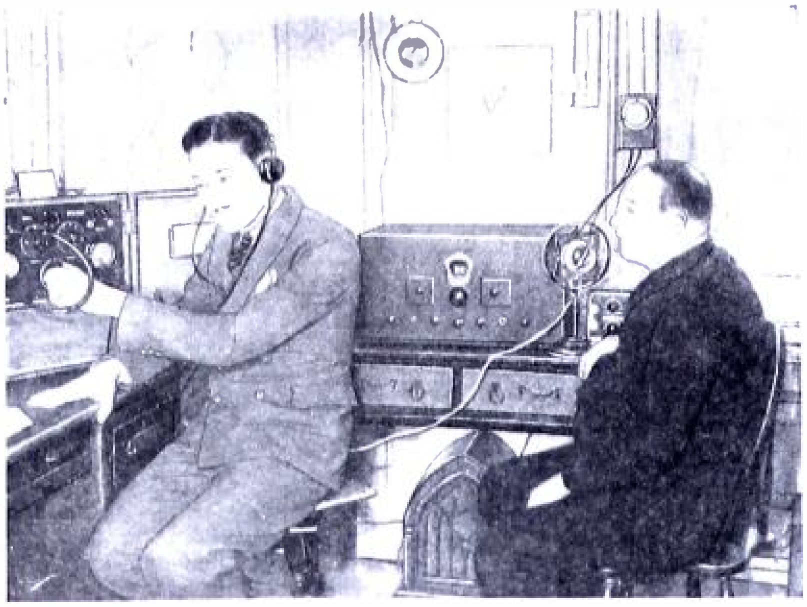
Harold Molin, Darien, Connecticut, heard a station in Ecuador sending a message to the writer. Who was it? That is HC2RL, Guayaquil, Ecuador, on 45 meters. This station is owned and operated by Dr. Robert Levi.

Edward Kirchhuber, Brooklyn, New York, writes, asking about the Cuban station on 50 meters. This is COC, 50 meters, Havana, Cuba. Schedule 4 to 6 p.m., e.s.t. Address all reports to P. O. Box 98, Havana, Cuba.

W. N. Bird says, "I think I have read everything you have published in the last few months and enjoy each one of the articles. I especially enjoyed the one in the new SHORT WAVE RADIO magazine in regards to telling the different foreign stations by their signals." Thank you, Mr. Bird. No one knows how a letter like this is appreciated. It makes us work just so much harder to please all our readers.

Bitten by the "Veri" Bug

But then again we put our hand in the mail bag and get another fine letter. This one from R. W. Chabot, Elwood, Indiana. "Although I have read every issue of SHORT WAVE RADIO, I have never written to you regarding your department, which, in my estimation, should go a long way. I trust that we can look forward to a longer department in the near future. So far, I have logged Daventry, Zeesen, Pontoise, Rugby, Bogota, Caracas, Barranquilla, Buenos Aires, Eindhoven, and Canadian and U. S. from coast to coast. Received VK3ME twice, but reception was so poor I did not log it. Received Byrd's expedition quite frequently with good volume. Ship to shore, amateurs in all nine districts and in Canada are received regularly. My pet stations are EAQ, G6RX, and LSX, which comes in with volume compared to any U. S. station. Have just been bitten by the veri bug, and have received



A scene during one of Capt. Hall's broadcasts over WBNX. The Captain is at the right, facing the microphone. At the left is Earl Gordon, WBNX engineer, at the controls of the portable line amplifier which connects the Captain's "studio" with the WBNX transmitter.

cards from [illegible] and Daventry. Watch my smoke from now on. At present, my aim is to receive Rome and Russia, both of which, so far, have eluded me; but I notice that the magazine just issued gives definite hours for RNE, which should be sufficient."

Dr. David Smith, New York City, sure is doing some fine DX'ing in the heart of New York City (only ten blocks away from the writer, in fact). His list is excellent, having caught "Radio Budapest" the very same Sunday the writer did. And did our telephones get busy? His veri came along in short order. Here is the dope on "Radio Budapest": "The note says that the call letters are HAS and HAT and that two wavelengths, 13.86 meters (6840 k.c.) and 21.92 meters, 13,685 k.c.) are used. The power is 5 k.w. Its antenna is directed to the west, and the station is situated thirty miles southwest of Budapest. Program schedules are irregular; but when they are on the air, it is from 12.45 p.m. to 6 p.m. The address of this rare catch is: Research Laboratories for Electrical Communications of the R. Hungarian Post, Gyali, St. 22, Budapest.

From L. E. Goerner, Oberlin, Ohio: "Fine business on SHORT WAVE RADIO. Incidentally, the veri pictured in it of 1RO and 2RO is identical with mine, date and all. Can now see why my first two veris in 1931 never came. I can't seem to get any response from the southern stations. COC came through in twelve days. I have asked for veris from HJ3ABD, HC2RL, HJ1ABB, etc., for two months. I haven't heard CP5 for some time and am wondering if they are coming through in New York. Also don't get Santo Domingo." Those South American stations take a very, very long time to answer, but they generally do. CP5 states they are broadcasting daily from 7.30 to 10.30 p.m. They also state that they have recently changed their wavelength from 49.3 to 32.8 meters. This information came from G. Clinton Bell, Atlantic City, and Albert Bond, Fall River, Mass.

Philip Nold, Jr., says: "Will you kindly let me know how long it takes to get a verification from RV59, Moscow, Russia. I wrote for one and also sent an International Reply Coupon on December 25." First I hope Mr. Nold did not address his envelope "Russia," as there is no such place. He should have written Moscow, U. S. S. R. Secondly, it takes about two months to get a reply from them. When reports of this station were not running into the hundreds, a fan got an answer in about three weeks; but my last letter from Moscow dated *January 26* said, "We are sorry we have been so long in writing you a letter, but we have had a very large correspondence in connection with our campaign for our listeners. We were very glad of the report on 25 meters which you sent us on *November 27th*. We have already sent you our program for February, but are enclosing another herewith, with correction of the hour of Sunday broadcast. We are now having one more broadcast on 25 meters for English speaking workers in Siberia. We shall be interested to know if you can pick it up in New York, it will be from 6 to 7 a.m., Moscow time." That is, 11 p.m. to 12 midnight, e.s.t. Between you and me and the aerial, I think "Russia" is gone for the season, only to return with a "wow" next winter.

Reception Reports From "Short Wave Radio" Readers

IN response to a request published in the March issue, we have been receiving numerous letters from our readers describing short-wave receiving conditions in various parts of the country. We are publishing a number of these herewith because they contain interesting data.

Montana Results

Dear Captain Hall:

In regards to your request for reports as to short-wave reception I am listing my results of one month's listening.

Above 49 meters: useless for DX, and only of use for aircraft and amateurs.

The 49-meter channel: not very good, no DX. A great deal of static. The best U. S. relays are W8XAL, W3XAL, and W8XK. The reception of these is very poor.

The 31-meter channel: almost useless, even for the U. S. relay stations. The best of the 31-meter U. S. stations are W3XAL and W1XAZ.

The 25-meter channel: this channel is better than the first two. The DX on this channel are 12RO and DJD. The only U. S. station is W8XK.

From 20 meters down to 16 meters: this band seems to be the best. There seems to be less static and more volume and DX. The best U. S. relays are W3XAL on 16 and W8XK on 19.

For stations to report I have listed:

49 m., WBV, Alaska Telegraph, located in Seattle, Wash.: they relay a Seattle broadcasting station which I believe is KRSC. They also test irregularly. They appear to be on all afternoon.

19.36 m., J1AA, Tokio, Japan: commercial trans-Pacific phone. They are on all afternoon. They are as consistently received as the U. S. relay stations and have better volume.

30.40 m., J1AA, Tokio, Japan: commercial. Phone from about 5 to 8 a.m. m.s.t.

18.71, KKP, Kauhuky, Terr. of Hawaii: commercial phone. Irregular, about 2 p.m. mountain time.

39.13, LSL, Buenos Aires, Argentina: commercial phone, about 5 to 7 a.m. m.s.t.

I have had some South American reception on the 20 m. amateur band. OA1B at Negritos, Peru, comes in fine.

Foreign reception is very poor in most cases. Although many stations are received, they have such poor signals that they cannot be identified.

The set I am using is a four-tube job using a 58, a 57, a 2A5, and an 80. I use only a speaker with it.

BOB H. WALKER,
1612 Central Avenue,
Great Falls, Mont.

Some Good "Veries"

Mr. A. L. Mainhofer, 1875 Sedgwick Avenue, Bronx, N. Y., has received a number of unusually good verifications from W8XAL, Cincinnati, Ohio, *Radio Maroc*, Africa, and *Radio Vaticano*, Italy, which are

SEND IN REPORTS

As the United States is a big country, and reception conditions vary markedly in different locations, Capt. Hall would like to receive reports from other short-wave listeners, so that he may collate them for benefit of all readers. Capt. Hall does all his listening in New York, and he is particularly anxious, therefore, to learn what general results are being obtained on the West Coast. Address your letters to Capt. Hall in care of SHORT WAVE RADIO, 1123 Broadway, New York, N. Y.

Please do not ask Capt. Hall to pass opinion on different makes or kinds of radio receivers.

worth reading. The "veri" from *Radio-Maroc* was five pages long and in French. We had it translated and are printing the most interesting parts of it.

Cincinnati

This is to verify your recent report of reception of our short-wave station W8XAL. Station W8XAL operates on a frequency of 6060 k.c. (49.5 meters), and has a power of 10,000 watts.

At the present time this station is not operating on a regular schedule. However, the tentative schedule is as follows:

(Greenwich Meridian Time)
11:30 a.m. to 3:30 p.m.
6:30 p.m. to 8:30 p.m.
11:00 p.m. to 5:30 a.m.

You no doubt know that The Crosley Radio Corporation is just completing construction of a 500,000-watt transmitter to operate on WLW's frequency of 700 k.c. between the hours of 1:00 and 6:00 a.m., Eastern Standard Time. The call letters of this new station are W8XO, and we believe you will enjoy listening to the programs from this station.

Thanking you for your interest in writing to us and trusting that you will enjoy good reception from W8XAL and W8XO, we remain

Very truly yours,
The Crosley Radio Corporation.
J. A. CHAMBERS,
Technical Supervisor,
Stations WLW-WSAI.

Morocco

Sir:

I wish to acknowledge receipt of your letter concerning programs from *Radio-Maroc* and to thank you for the very interesting information it contains.

Following is a description of the short-wave station *Maroc-France*:
FRENCH PROTECTORATE OF MOROCCO,
Manager of Telegraph & Telephone Stations.

This station is located on the outskirts of Rabat at the same place where *Radio-Maroc* is situated. The main antenna consists of two directional arrays supported by three masts 68 meters high and 110 meters apart; one antenna is for 23.38 meters and the other for 32.26 meters. Two secondary antennas, in the form of squares, permit radiation in all directions on the aforementioned waves, with a view to the eventual establishment of communication with Algeria, Tunisia, and French Occidental Africa. The secondary antenna on 32.26 meters permits, in addition, contact with Paris during the even hours when the 23.38-meter wave becomes useless.

The transmitter is crystal controlled, and consists of two master oscillators, functioning on 23.38 and 32.26 meters, and a power amplifier using large water-cooled tubes. Besides, there is an absorption circuit attached to the power amplifier, which may be used for either telegraph keying or telephone modulation.

Plate voltage on the order of 10,000 volts for the big tubes is furnished by a mercury-vapor rectifier. Power for the smaller tubes is furnished by generators and storage batteries. Alternating current for all machines is obtained from the city power system.

The different antennas are energized by feeder lines. The antenna power is 15 kilowatts with telegraphy and 10 kilowatts with telephony.

The radio station at Rabat comprises, in addition to the transmitter described, a separate short-wave receiving station, where a superheterodyne with automatic volume control is employed; and a central telephone control station, whereby local telephone subscribers in Morocco may talk, via the short-wave transmitter, to any telephone subscriber in France. This section adjoins the Rabat telephone central, making interconnections easy.

Automatic sending equipment for telegraph messages permits fast handling of traffic, to a capacity of 50,000 words per day.

Every Sunday, the short-wave station Maroc-France relays the regular programs of the long-wave station Radio-Maroc, which is on 416 meters, according to the following schedule:

1230-1400 g.m.t. (7:30-9.00 a.m. e.s.t) on 23.38 meters.
1930-2200 g.m.t. (2:30-5:00 p.m. e.s.t.) on 32.26 meters.

Schedule of Radio Vaticano Programs

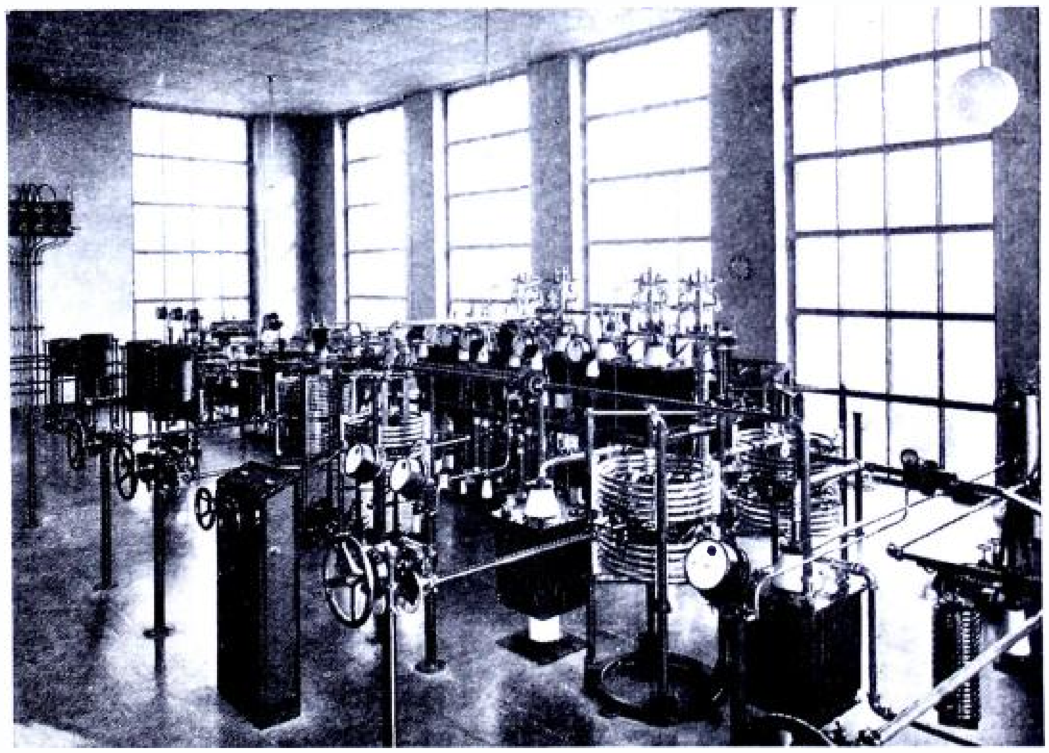
Monday—10.00-10.15 a. m. G. M. T. 15,123 kc. (19.84 m.). Letters from Missions in Italian. 7.00-7.15 p.m. G. M. T. 5,969 kc. (50.26 m.). Vatican's Information and Notices in Italian.

Tuesday—10.00-10.15 a. m. G. M. T. 15,123 kc. (19.84 m.). Letters from Missions in English. 7.00-7.15 p.m. G. M. T. 5,969 kc. (50.26 m.). Vatican's Information and Notices in Italian.

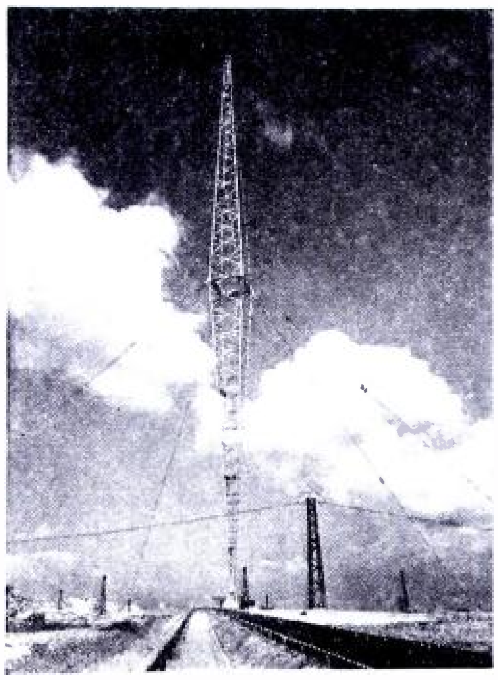
Wednesday—10.00-10.15 a. m. G. M. T. 15,123 kc. (19.84 m.). Letters from Missions in Spanish. 7.00-7.15 p. m. G. M. T. 5.969 ks. 50.26 m.) Vatican's Information and notices in Italian.

Thursday—10.00-10.15 a.m. G. M. T. 15,123 kc. (1984 m.). Lecture of letters from Missions in French. 7.00-7.15 p.m. G. M. T. 5.969 kc. (50.26 m.) Vatican's Information and Notices in Italian.

Friday—10.00-10.15 a.m. G. M. T. 15.123 kc. (19.84 m.). Letters



General view of the transmitting station in Vienna, made by the famous Telefunken Company. Note how all the controls are brought out to large wheels a distance from the actual "live" apparatus. This open type of construction is in marked contrast with American practice, which calls for fully enclosed apparatus with automatically locking doors and elaborate safety precautions.



A beautiful "shot" of the antenna mast of the Vienna broadcasting station. This is the vertical half-wave type, first popularized by WABC of the Columbia Broadcasting System.

from Missions in German. 7.00-7.15 p. m. G. M. T. 5,969 kc. (50.26 m.). Vatican's Information and Notices in Italian.

Saturday 10.00-10.15 a. m. G. M. T. 15,123 kc. (19.84 m.). Letters from Missions in Italian. 7.00-7.15 p. m. G. M. T. 5,969 kc. (50.25 m.). Vatican's Information and Notices in Italian and Latin.

Sunday and every holiday—10.00-10.30 a. m. G. M.T. 5,969 kc. (50.26 m.). Liturgic and Spiritual Lectures for sick people in Latin, French, Italian, and Sacred Music.

It is easy to recognize the station by the clock's ticks in the studio.

RESEARCH LABS. FOR ELECTRICAL COMMUNICATION OF THE R. HUNGARIAN POST.
Budapest, Gyáli—at. 22.

Mr. A. L. Mainhofer,
1975 Sedgwick Ave.,
Bronx, N. Y., U. S. A.

Dear Sir:

Many thanks for the report. We checked it with our station-log and found it OK. So we confirm herewith your reception report of December 3 upon the Hungarian short-wave transmitter.

Here you find some data:

Call letters: HAS, HAT.

Location: Székesfehérvár, 30 miles S-W of Budapest.

Wavelength: 43.86 m.-6840 kc. and 21.92 m.-13,685 kc., quartz controlled.

Power: 5 kw.

Aerial: Directed to West.

Program—schedule irregular; time 5.45—23.00—G. M. T. if any.

We wish you good reception conditions for the future and enjoyment in our programs.

B. MARSHALKÓ,
Director for the Labs.

They Want "Dope"

HUGO KOSKINEN, 843 Third Avenue, New York, N. Y., has received an unusually long verification from the French station outside of Paris, *Radio-Coloniale*. This was accompanied by a questionnaire which indicates that the French are giving serious attention to their short-wave broadcasting service. As a matter of interest, we have had this material translated, and are publishing it herewith. The time schedule has been converted to Eastern Standard Time for the benefit of American listeners.

Time Table of the Government Station *Radio-Coloniale*

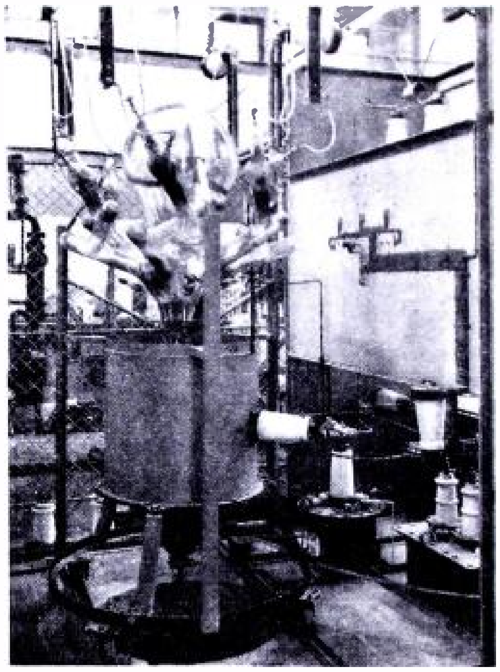
1300—1600 G.M.T. 8.00-11.00 a.m. E.S.T 19.68 meters
1615—1915 G.M.T. 11.15 a.m.-2.00 p.m. E.S.T. 25.20 meters
2000—2300 G.M.T. 3.00-6.00 p.m. E.S.T. 25.20 and 25.60 meters
2315—0002 G.M.T. 6.15-9.00 p.m. E.S.T. 25.60 meters
0003—0005 G.M.T. 10.00 p.m.-midnight E.S.T. 25.60 meters

The government station *Radio-Coloniale* thanks all its listeners for the interest they show in its transmissions. It asks them to advise it exactly where they are located (latitude and longitude) the wave on which they receive the station, the type of receiver, and the hours when they receive best.

By so informing the government station *Radio-Coloniale*, they will make its job easier and permit constant improvement in its programs.

The government station *Radio-Coloniale* asks its listeners to answer the following questions:

1. What is the exact location of the place where you hear *Radio-Coloniale*—longitude, latitude—state—country?
2. Is this location in a mountainous region? Wooded? Dry? Humid? Near the seashore? Altitude?
3. Is reception best at day or at night, and during what season of the year and hour?
4. What kind of a receiver do you use?
5. What other short-wave stations do you hear regularly? What are their wavelengths? Do you hear them better or worse than *Radio-Coloniale?*
6. Are you bothered by atmospheric disturbances? When are they most bothersome? Are they also bothersome on waves above 50 meters?
7. What do you think of the programs of *Radio-Coloniale?*
8. Which programs are heard best?
9. What programs interest you most?
10. How often do you listen? What listening hours are most convenient for you?



This weird looking animal is a ten-foot high mercury vapor rectifier tube used to supply high voltage direct current for the tubes of the Vienna transmitter pictured on the preceding page.

From Youngstown, Ohio

Dear Captain Hall:

Saw your article on short-wave reception in the current issue of SHORT WAVE RADIO. I note mention of a "razz" from a California fan on after-dark reception.

I have listened to the short waves in the Youngstown district for some five years and have never heard a European station under 30 meters after dusk and would probably faint if I did.

I am an E.E. of some 30 years standing, have always had the best possible receivers, and have a receiver today that will perform with the best commercial receiver sold.

This high-frequency failure is common all over the Mahoning Valley. The downtown district of Youngstown is some 185 feet under lake level, that is, Lake Erie, which may or may not have something to do with it.

I was informed by a Westinghouse engineer in a conversation on this subject that high-frequency waves seem to lose their "pep" in passage over the Allegheny Mountains. In addition, there is continual "smog" (smoke and fog) in this steel country, which may also be a cause. At any rate, we don't get them.

I am glad to say that I have enjoyed your articles very much, both for the information and entertainment they contain, and hope you will continue indefinitely.

C. H. LANE,
433 W. Boston Ave.,
Youngstown, Ohio.

Regarding technical inquiries: Capt. Hall is not a radio technician and frankly admits his primary interest in radio is listening. If you have technical questions to ask, please address them to Louis Martin, technical director of this magazine.

Best Short Wave Stations

The list of stations below has been compiled directly from the log of Capt. Hall. The column to the left is the wavelength, the letter to the right indicates the type of transmission, and the location and operating time follow. The operating time is liable to change from day to day, so that those listed may only be used as a guide. All times given are E.S.T.

World wide stations that send programs, B, Broadcast; E, Experimental; P, Telephone stations.

Europe

16.30, P, PCK, Koatwijk, Holland, about 6.30 a.m.
16.86, B, GSG, Daventry, England, 7.30 to 8.45 a.m.
16.88, B, PHI, Huizen, Holland, 7 ta 9 a.m., irregular.
19.55, B, CTIAA, Lisbon, Portugal, Tuesday and Friday, 4.30 ta 7 p.m.
19.68, B, Pontoise, France, 8 to 11 a.m.
19.73, B, DJB, Zeesen, Germany, 7.15 to 11 a.m.
19.82, B, GSF, Daventry, England, 3 ta 5 a.m.
19.84, B, HVJ, Vatican City, Italy, 5 ta 5.30 a.m.
25.00, B, RNE, Moscow, Sunday, 11 a.m. to 12.
25.20, B, Pontaise, France, 11.15 to 2.15 p.m., 3 to 6 p.m.
25.28, B, GSE, Daventry, England, 7.30 to 8.45 a.m. and 4 to 6 p.m.
25.40, B, 2RO, Rome, Italy, 11 a.m. to 1.30 p.m. and 4 to 6.30 p.m.
25.51, B, DJD, Zeesen, Germany, 8 to 11 p.m.
25.53, B, GSD, Daventry, England, 3 to 5 a.m., and 1.15 to 2.45 p.m.
25.57, B, PHI, Huizen, Holland.
25.63, B, Pontoise, France, 3 to 6 and 6.15 ta Midnight.
29.04, Ruysselede, Belgium, 1 p.m. on.
30.00, B, EAQ, Madrid, Spain, 5.15 to 7 p.m.
30.52, B, IRM, Rome, Italy, 2 to 6 p.m.
31.27, B, HBL, Geneva, Switzerland, Sat. 5.30 to 6.15 p.m.
31.30, B, GSC, Daventry, England, 6 ta 8 p.m.
31.55, B, GSB, Daventry, England, 11 a.m. to 1 p.m., 1.15 to 2.45 p.m., 6 to 8 p.m.
43.86, HAT2, Budapest, Hungary, irregular. No time schedule.
45.38, B, REN, Moscow, Russia, 2 ta 6 p.m.
49.40, B, VOR2, Vienna, Austria, 3.30 ta 5 p.m., irregular.
49.50, B, OXY, Skamleback, Denmark, 2 to 6 p.m.
49.59, B, GSA, Daventry, England, 2.45 ta 5.45 p.m., 6 to 8 p.m.
49.83, B, DJC, Zeesen, Germany, 8 to 11 p.m.
50.00, B, RV59, Moscow, Russia, 5 to 6 p.m.
50.26, B, HVJ, Vatican City, Italy, 2 to 2.15 p.m.
60.30, E, G6RX, Rugby, England, 8 to 10 p.m., irregular.
69.44, E, G6RX, Rugby, England, 9 to 11 p.m., irregular.

Asia

16.50, P, PMC, Bandoeng, Java, 3 ta 5 p.m., irregular.
19.03, E, JIAA, Kemikawa, Japan, 4.30 a.m., irregular.
20.03, P, KAY, Manila, Philippine Isl., 5 to 8 a.m.
28.80, P, UIG, Medan, Sumatra, 4 to 5 a.m.
30.40, E, JIAA, Kemikawa, Japan, 5 to 7 a.m.
48.90, B, ZGE, Zula Lumper, Malayan States, Sun., Tues., Fri., 6.30 to 8.30 p.m.
49.10, B, VUC, Calcutta, India, 9 to 12 a.m. and 2 p.m. to 3 a.m.
70.6, B, RV15, Khabarovsk, Russia, 3 to 9 a.m.

Africa

23.38, B, CNR, Rabat, Moracca, Sun., 7.30 ta 9 a.m.
29.58, P, OPM, Leopaldville, Belgian Canga, 9 ta 10 a.m.
37.33, B, CNR, Rabat, Morocco, Sun., 3 ta 5 p.m.
41.60, B, EAR58, Tenerffe, Canary Isl., 5 to 6 p.m.
48.99, B, Johannesburg, South Africa, 4 ta 5 a.m., 12 to 3 p.m., and 8 to 10 a.m.
49.50, B, VQ7LO, Nairabi, Kenya, 11 a.m. to 2 p.m.

North America

16.87, B, W3XAL, Baund Brook, N. J., 10 a.m. ta 4 p.m., irregular.
19.56, B, W2XAD, Schenectady, N. Y., Mon., Wed., Fri. and Sun., 4 to 5 p.m.
19.64, B, W2XE, Wayne, N. J., 11 a.m. to 1 p.m.
19.67, B, W1XAL, Boston, Mass., 11 a.m. to 3 p.m., Sun.
19.72, B, W8XK, Pittsburgh, Pa., 10 a.m. to 4 p.m., irregular.
25.27, B, W8XK, Pittsburgh, Pa., 4.30 ta 10 p.m., irregular.
25.36, B, W2XE, Wayne, N. J., 3 to 5 p.m.
25.45, B, W1XAL, Boston, Mass., Sat., 5 to 11 p.m., and Sun. 6 ta 8 p.m.
31.28, B, W3XAU, Philadelphia, Pa., 1 to 6 p.m.
31.36, B, W1XAZ, Springfield, Mass., 7 p.m. to 1 a.m.
31.48, B, W2XAF, Schenectady, N. Y., 8 ta 11 p.m.
46.69, B, W3XL, Bound Brook, N. J., irregular.
48.86, B, W8XK, Pittsburgh, Pa., 4.30 p.m. to 1 a.m.
49.02, B, W2XE, Wayne, N. J., 6 to 11 p.m.
49.18, B, W3XAL, Bound Brook, N. J., Sat. 4.30 to 12 p.m.
49.18, B, W9XF, Chicago, Ill., 8 to 9.30 p.m.
49.34, B, W9ZAA, Chicago, Ill., 3 to 6 p.m.
49.50, B, W3XAU, Philadelphia, Pa., 8 ta 12 p.m., irregular.
49.50, B, W8XAL, Cincinnati, Ohio, 9 ta 10 p.m.

South America

19.19, P, OCJ, Lima, Peru, 2 p.m. irregular.
25.73, E, PPQ, Rio de Janeiro, Brazil, 7 p.m., irregular.
27.35, P, OCI, Lima, Peru, 10 p.m., irregular.
28.98, E, LSX, Buenos Aires, Argentina, 8 to 9.30 p.m., irregular.
30.03, E, LSN, Buenas Aires, Argentina, 9 to 10 p.m., irregular.
32.00, B, Ti4NRH, Costa-Rica, 7 to 8 p.m.
32.8, B, CP5, Bolivia, 7.30 to 10.30 p.m.
36.65, E, PSK, Rio de Janeiro, Brazil, 8 p.m., irregular.
40.55, E, HJ3ABD, Bogota, Colombia, 9 ta 11 p.m.
41.55, B, HKE, Bogota, Calombia, Mon. 6 to 7 p.m. and Tues. 8 to 9 p.m.
41.60, B, HJ4ABB, Manizales, Calombia, 9 ta 10 p.m.
45.00, B, HC2RL, Quita, Ecuadar, Sun. 5 ta 7 and Tues. 9 to 11 p.m.
45.31, B, PRADO, Riobamba, Ecuador, Thurs. 9 to 11 p.m.
45.60, B, HJ1ABB, Barranquilla, Colombia, 6 ta 10 p.m.
47.00, B, HJ5ABD, Colombia, Thurs., Sat. and Sun., 7 to 9.30 p.m.
48.00, B, HJ3ABF, Bogota, Calombia, 7 to 10.30 p.m.
48.50, B, TGW Guatemala, 6-12 p.m.
48.78, B, YV3BC, Caracas, Venezuela, Evening, irregular.
48.95, B, YV11BMO, Maracaibo, Venezuela, 8 to 11 p.m.
49.39, B, YV5 BMO, Maracaibo, Venezuela, 5 to 9 p.m.
50.20, B, YV1BC, Caracas, Venezuela, 5 to 10 p.m., irregular.
50.20, B, HJ4ABE, Tunga, Colombia, 9 to 10.30 p.m.
73.00, B, HCJB, Quita, Ecuador, Evening, irregular.

Mexico, West Indies, and Yucatan

25.50, P, XDM, Mexico City, Mexico, 8 to 9 p.m., irregular.
26.00, E, XAM, Merida, Yucatan, 6 to 7 p.m. irregular.
32.09, E, XDC, Mexico City, Mexico, 5 to 7 p.m., irregular.
47.50, B, HIZ, Santo Domimgo, 5 to 6 p.m.
47.80, B, HI1A, Dominican Republic, Mon., Wed. and Fri. 12 to 1.30 p.m. Tues., Thurs. and Sat. 7.30 to 9.30 p.m.
B, HIX, Santo Domingo, Tues. 8 ta 10 p.m.
50.2, B, COC, Havana, Cuba, 5 to 6 p.m.
50.2, B, YV4 BAG, Caracas, Venezuela, 12.50 to 1.05 a.m.

Oceania

31.28, B, VK2ME, Sydney, Australia, Sun. 1 to 3 a.m., 5 to 8.30 a.m., and 9 to 11 a.m.
31.55, B, VK3ME, Melbourne, Australia Wed. 5 to 6.30, Sat. 5 to 7 a.m.

Canada

25.60, B, VE9JR, Winnipeg, Canada, 6 to 10 p.m., irregular.
49.10, B, VE9HX, Halifax, N.S., Evening, irregular.
49.22, B, VE9GW, Bowmanville, Canada, 3 ta 6 p.m. daily.
49.29, B, VE9BJ, St. John, N. B., 5 to 10 p.m.
49.42, B, VE9CS, Vancouver, B.C., Fri. 12 to 1.30 p.m.
49.96, B, VE9DR, Montreal, Canada, 8 to 10 a.m., Sun 1 to 10 p.m.

NOTE: All times given are approximate and subject to change.

World List of S. W. Broadcast Stations

BECAUSE of language difficulties, mail delays, and the generally unstable nature of short-wave broadcasting, the compilation of short-wave station lists is probably the most thankless job with which radio magazine editors are faced. Some people want the stations arranged alphabetically by call letters, others by wavelength or frequency, others by countries, and still others by hours of the day.

For the past six issues—November, 1933, to April, 1934, SHORT WAVE RADIO has published an excellent list with the stations arranged alphabetically by call letters, which seems to be the most logical way. This list is unusually complete, and includes hundreds of experimental, commercial, phone and police stations in addition to bona fide broadcast stations. It has grown to the point where it takes up more space than we can give it in every issue, so it is being omitted this month and will reappear when enough changes or corrections have been made in it to warrant reprinting. New readers of SHORT WAVE RADIO who want to see this list can readily obtain copies of the April, 1934, issue from the publishers.

This month we are presenting a convenient list of short-wave broadcasting stations only, arranged according to frequency with subdivisions according to the six international relay broadcasting channels. We hesitate to apply that much abused designation "official" to this list, but it was prepared by the International Relations Section of the Federal Radio Commission of the United States Government, which should mean something.

Some of the calls given follow the assignments in force before January, 1934, but otherwise the list is accurate.

6000-6150 kc. (48.78—50 meters)

Frequency (kc.)	Call Letters	Location
6000		Tananarive, Madagascar
6000	3ZC	Christchurch, New Zeal'd
6000	RW49	Union Soviet Soc. Rep.
6000		Reunion Islands
6000	XGOX	Nanking, China
6005	CMCI	Havana, Cuba
6005	CMDC	Havana, Cuba
6005	VE9DR	Drummondville, Que., Can.
6005	VE9DN	Montreal, Quebec, Canada
6005	HRB	Tegucigalpa, Honduras
6010		Australia
6010	ZGE	Kuala Lumpur, Fedr. Malay States
6015	VE9CX	Nova Scotia, Canada
6020	DJC	Konigs Wusterhausen, Ger.
6030	VE9CA	Calgary, Alberta, Canada
6035	YNA	Managua, Nicaragua
6040		Batavia, Dutch Indies
6040	CMDC	Havana, Cuba
6040	CMCI	Havana, Cuba
6040	W1XAL	Boston, Mass., U.S.A.
6040	W4XB	Miami Beach, Fla., U.S.A.
6045	EAQ	Aranjuez, Spain
6050	VE9CF	Halifax, Nova Scotia, Can.
6050	GSA	Daventry, Great Britain
6060	VE9CL	Winnipeg, Manitoba, Can.
6060		Batavia, Dutch Indies
6060	VQ7LO	Kenya, British Africa
6060	2XZ	Wellington, New Zealand
6060	W3XAU	Phila., Pa., U. S. A.
6060	W8XAL	Mason, Ohio
6065	SASH	Motala, Sweden
6070	EAQ	Aranjuez, Spain
6070	VE9CS	Vancouver, Br. Col., Can.
6072	UOR2	Wien, Austria
6073	ZTJ	Johannesburg, S. Africa
6080	W8XAA	Chicago, Ill., U. S. A.
6080		Takoradi, Gold Coast, Afr.
6090	VE9BJ	St. John, N. B., Can.
6090	OXY	Skamlebak, Denmark
6095	VE9GW	Toronto, Ontario, Canada
6100		Batavia, Dutch Indies
6100	W3XAL	Bound Brook, N. J., U.S.A.
6100	W9XF	Downers Grove, Ill., U.S.A.
6100		Japan
6110	VE9CG	Calgary, Alberta, Canada
6110	EAQ	Aranjuez, Spain
6110	VUB	Bombay, India
6110		Prangins, Switzerland
6110	VUC	Calcutta, India
6115		Warsaw, Poland
6120	W2XE	Wayne, N. J., U. S. A.
6120	NAA	Washington, D. C.
6122.4	ZTJ	Johannesburg, S. Africa
6130	VE9BA	Montreal, Quebec, Can.
6135	YID	Bagdad, Iraq
6140		Australia
6140	KZRM	Manila, Philippine Islands
6140	W8XK	Saxonburg, Pa., U. S. A.
6150	VE9CL	Winnipeg, Manitoba, Can.

9500-9600 kc. (31.25-31.58 meters)

Frequency (kc.)	Call Letters	Location
9500	XGOX	Nanking, China
9510	GSB	Daventry, Great Britain
9510	VK3ME	Melbourne, Australia
9515		Prangins, Switzerland
9520	OXY	Skamlebak, Denmark
9520		Batavia, Dutch Indies
9530	YNA	Managua, Nicaragua
9530	W2XAF	Schenectady, N. Y., U.S.A.
9540		Batavia, Dutch Indies
9545	EAQ	Aranjuez, Spain
9545		Prangins, Switzerland
9550		Japan
9550	NAA	Washington, D. C.
9550		Batavia, Dutch Indies
9555	VE9DR	Drummondville, Que., Can.
9560	DJA	Konigs Wusterhausen, Ger.
9565	VUB	Bombay, India
9570	W8XK	Saxonburg, Pa., U. S. A.
9570	W1XAZ	Springfield, Mass., U. S. A.
9570	KZRM	Manila, Philippine Islands
9570	SRI	Poznan, Poland
9575	VUC	Calcutta, India
9580		Australia
9580	VE9DM	Montreal, Quebec, Can.
9580		Batavia, Dutch Indies
9585	GSC	Daventry, Great Britain
9590	W3XAU	Phila., Pa., U. S. A.
9590	VK2ME	Sydney, Australia
9590	PCJ	Hilversum, Holland
9595		Prangins, Switzerland

11700-11900 kc. (25.21-25.64 meters)

Frequency (kc.)	Call Letters	Location
11705	VE9BA	Montreal, Quebec, Can.
11705		France
11710		Australia
11720	CJRX	Winnipeg, Manitoba, Can.
11730	PHI	Huizen, Holland
11730	NAA	Washington, D. C.
11740	HRB	Tegucigalpa, Honduras
11740	NAA	Washington, D. C.
11750	GSD	Daventry, Great Britain
11760	DJD	Konigs Wusterhausen, Ger.
11770		Batavia, Dutch Indies
11780	VE9DR	Drummondville, Que., Can.
11790	TITR	San Jose, Costa Rica
11790	W1XAL	Boston, Mass., U. S. A.
11800		Japan
11801	UOR3	Wien, Austria
11810	VE9GW	Toronto, Ontario, Canada
11810	EAQ	Aranjuez, Spain
11810	2RO	Rome, Italy
11820	PRAA	Rio de Janeiro, Brazil
11830	W9XAA	Chicago, Ill., U. S. A.
11830	W2XE	Wayne, N. J., U. S. A.
11840	KZRM	Manila, Philippine Islands
11860	VE9CA	Calgary, Alberta, Canada
11860		Batavia, Dutch Indies
11865	GSE	Daventry, Great Britain
11870	W8XK	Saxonburg, Pa., U. S. A.
11870	VUC	Calcutta, British India
11880		Australia
11890	YNA	Managua, Nicaragua
11895	VE9DN	Montreal, Quebec, Can.
11900	XGOX	Nanking, China

15100-15350 kc. (19.54-19.86 meters)

Frequency (kc.)	Call Letters	Location
15110	DJL	Konigs Wusterhausen, Ger.
15130	VE9DR	Drummondville, Que., Can.
15130	NAA	Washington, D. C.
15140	GSF	Daventry, Great Britain
15150		Batavia, Dutch Indies
15160		British India
15190	VE9BA	Montreal, Quebec, Canada
15200	DJB	Konigs Wusterhausen, Ger.
15200		Japan
15210	W8XK	Saxonburg, Pa., U. S. A.
15220	PCJ	Hilversum, Holland
15243		France
15250	W2XAL	Coytesville, N. J., U. S. A.
15265	EAQ	Aranjuez, Spain
15270	W2XE	Wayne, N. J., U. S. A.
15275		Warsaw, Poland
15290		British India
15300		Batavia, Dutch Indies
15310		Australia
15330	W2XAD	Schenectady, N. Y., U.S.A.

17700-17800 kc. (16.85-16.94 meters)

Frequency (kc.)	Call Letters	Location
17760	DJE	Konigs Wusterhausen, Ger.
17760		Japan
17770	GSG	Daventry, Great Britain
17775	PHI	Huizen, Holland
17780		Warsaw, Poland
17780	W8XK	Saxonburg, Pa., U. S. A.
17780	W3XAL	Bound Brook, N. J., U.S.A.
17780	W9XAA	Chicago, Ill., U. S. A.
17780	W9XF	Downers Grove, Ill., U.S.A.
17790	GSG	Daventry, Great Britain
17800	XGOX	Nanking, China

21450-21550 kc. (13.92-13.98 meters)

Frequency (kc.)	Call Letters	Location
21460	W1XAL	Boston, Mass., U. S. A.
21470	GSH	Daventry, Great Britain
21480		Warsaw, Poland
21500	NAA	Washington, D. C., U.S.A.
21520		Japan
21540	W8XK	Saxonburg, Pa., U. S. A.

LICENSED MUNICIPAL POLICE RADIO STATIONS

Location	Call Letters	Frequency (kc.)	Power (watts)
Akron, Ohio	WPDO	2458	100
Albuquerque, N. M.	KGZX	2414	50
Arlington, Mass.	WPED	1712	100
Atlanta, Ga.	WPDY	2414	150
Auburn, N. Y.	WPDN	2458	50
Bakersfield, Cal.	KGPS	2414	50
Baltimore, Md.	WPFH	2414	500
Bay City, Mich.	WPGA	2442	50
Beaumont, Tex.	KGPJ	1712	100
Hackensack, N. J.	WPFK	2430	200
Berkeley, Cal.	KSW	1658	400
Birmingham, Ala.	WPFM	2414	150
Buffalo, N. Y.	WMJ	2422	500
Cedar Rapids, Iowa	KGOZ	2470	50
Chanute, Kans.	KGZF	2450	5
Charlotte, N. C.	WPDV	2458	50
Chicago, Ill.	WPDB	1712	500
Chicago, Ill.	WPDC	1712	500
Chicago, Ill.	WPDD	1712	500
Cincinnati, O.	WKDU	1712	500
Clarksburg, W. Va.	WPFP	2414	30
Cleveland, O.	WRBH	2458	500
Coffeyville, Kans.	KGZP	2450	22
Columbus, Ga.	WPFI	2414	00
Columbus, O.	WPDI	2430	200
Dallas, Tex.	KVP	1712	150
Davenport, Iowa	KGPN	2470	50
Dayton, O.	WPDM	2430	400
Denver, Colo.	KGPX	2442	150
Des Moines, Ia.	KGZG	2470	100
Detroit, Mich.	WCK	2414	500
Detroit, Mich.	WPDX	2414	500
Washington, D. C.	WPDW	2422	400
E. Providence, R. I.	WPEI	1712	50
El Paso, Tex.	KGZM	2414	100
Flint, Mich.	WPDF	2442	100
Ft. Wayne, Ind.	WPDZ	2470	200
Fresno, Cal.	KGZA	2414	100

Location	Call Letters	Frequency (kc.)	Power (watts)
Grand Rapids, Mich.	WPEB	2442	100
Grosse Point Village, Mich.	WRDR	2414	50
Highland Park, Mich.	WMO	2414	50
Honolulu, T. H.	KGPQ	2450	100
Indianapolis, Ind.	WMDZ	2442	400
Jacksonville, Fla.	WPFG	2442	100
Kansas City, Mo.	KGPE	2422	400
Klamath Falls, Oreg	KGZH	2442	25
Knoxville, Tenn.	WPFO	2570	400
Kokomo, Ind.	WPDT	4470	50
Lansing, Mich.	WPDL	5442	50
Lexington, Ky.	WPET	1712	500
Lincoln, Nebr.	KGZU	2470	50
Los Angeles, Cal.	KGPL	1712	500
Louisville, Ky.	WPDE	2442	200
Memphis, Tenn.	WPEC	2470	400
Milwaukee, Wis.	WPDK	2450	500
Minneapolis, Minn.	KGPB	2430	400
Muskegon, Mich.	WPFC	2442	50
Mineola, N. Y.	WPGS	2414	200
New Bedford, Mass. (Fairhaven)	WPFN	1712	100
New Orleans, La.	WPEK	2430	100
Newton, Mass.	WPFA	1712	50
New York, N. Y.	WPEE	2450	400
New York, N. Y.	WPEF	2450	400
New York, N. Y.	WPEG	2450	500
Oklahoma City, Okl.	KGPH	2450	250
Omaha, Nebr.	KGPI	2470	400
Pasadena, Calif.	KGJX	1712	400
Pawtucket, R. I.	WPFV	2470	50
Philadelphia, Pa.	WPDP	2470	500
Phoenix, Ariz.	KGZJ	2430	100
Pittsburgh Pa.	WPDU	1712	400
Port Huron, Mich.	WPGB	2414	50
Portland, Me.	WPFU	2422	100
Portland, Oreg.	KGPP	2442	500
Reading, Pa.	WPFE	2442	100
Richmond, Ind.	WPDH	2442	50
Rochester, N. Y.	WPDR	2458	200
Rockford, Ill.	WPGD	2458	50
Saginaw, Mich.	WPES	2442	50
St. Louis, Mo.	KGPC	1712	500
St. Paul, Minn.	WPDS	2430	500
Salem, Oreg.	KGZR	2442	25
Salt Lake City, Utah	KGPW	2470	100
San Diego, Cal.	KGZD	2430	100
San Francisco, Cal.	KGPD	2470	400
San Jose, Cal.	KGPM	2470	50
Santa Barbara, Cal.	KGZO	2414	100
Santa Cruz, Cal.	KGZT	2470	50
Seattle, Wash.	KGPA	2414	250
Sioux City, Ia.	KGPK	2470	100
Somerville, Mass.	WPEH	1712	100
Swarthmore, Pa.	WPFQ	2470	50
Syracuse, N. Y.	WPEA	2458	400
Tacoma, Wash.	KGZN	2414	100
Toledo, Ohio	WRDQ	2470	200
Topeka, Kans.	KGZC	2422	50
Tulare, Cal.	WPDA	2414	150
Tulsa, Okla.	KGPO	2450	100
Vallejo, Cal.	KGPG	2422	7.5
Waco, Tex.	KGZQ	1712	50
Wichita, Kans.	KGPZ	2450	250
Wichita Falls, Tex.	KGZI	1712	50
Woonsocket, R. I.	WPEM	2470	50
Youngstown, O.	WPDG	2458	150

CONSTRUCTION PERMITS ISSUED FOR MUNICIPAL POLICE STATIONS

Location	Call Letters	Frequency (kc.)	Power (watts)
Aberdeen, Wash.	KGZV	2414	50
Albany, N. Y.	WPGG	2414	100
Binghamton, N. Y.	WPGL	2442	150
Cranston, R. I.	WPGK	2470	50
Hammond, Ind.	WPFJ	1712	100
Lakeland, Fla.	WPFT	2442	50
Lubbock, Tex.	KGZW	2458	50
Miami, Fla.	WPFZ	2442	100
Palm Beach, Fla.	WPFX	2442	50
Portsmouth, O.	WPGI	2430	50
Providence, R. I.	WPGF	1712	150
San Bernardino, Cal.	KGZY	1712	50
Shreveport, La.	WPGE	2430	50
Utica, N. Y.	WPGJ	2414	100

LICENSED STATE POLICE STATIONS

Location	Call Letters	Frequency (kc.)	Power (watts)
Iowa			
Des Moines	KGHO	1534	400
Massachusetts			
Northampton	WPEW	1574	Night–500 Day 1100
W. Bridgewater	WPEL	1574	Night–500 Day 1100
Framingham	WMP	1574	Night–500 Day 1100
Michigan			
E. Lansing	WRDS	1574	Night–1000 Day 5000
New York			
So. Schenectady	WPGC	1534	Night –500 Day 1000
Pennsylvania			
Butler	WBR	190	300
Greensburg	WJL	190	500
Harrisburg	WBA	190	300
W. Reading	WMB	190	300
Wyoming	WDX	190	300
Texas			
San Antonio	KGZE	2506	500

CONSTRUCTION PERMITS FOR STATE POLICE STATIONS

Location	Call Letters	Frequency (kc.)	Power (watts)
Washington			
Portable & Mobile	KGHA	2506	10
Snowplow No. A232 Portable & Mobile	KGHB	2506	10
Snowplow No. A227 Portable & Mobile	KGHC	2506	10
State police car Seattle	KGHD	2506	50
Snoqualmie Pass	KGHE	2506	50

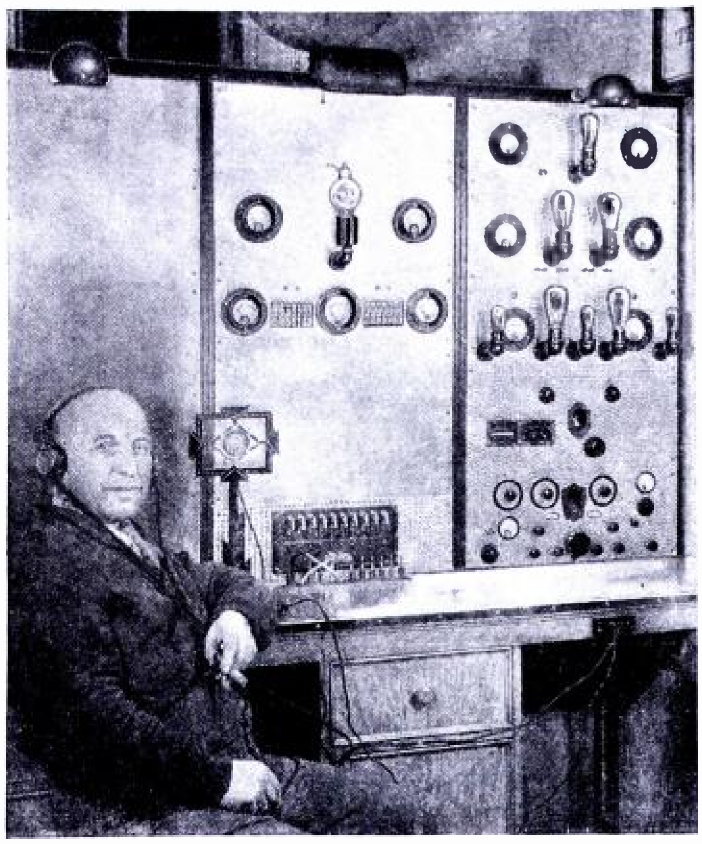
List of International Call Assignments

The international call letter assignments underwent some extensive changes early this year, when the acts of the Madrid Radio Convention of 1932 went into effect. For the most part the changes affect the smaller countries, but one really important shift gives all the R calls to the Union of the Socialist Soviet Republics, ("Russia"). The list as given below incorporates the official changes.

Block of Calls	Country	Amateur Prefix
CAA-CEZ	Chile	CE
CFA-CKZ	Canada	VE
CLA-CMZ	Cuba	CM
CNA-CNZ	Morocco	CN
COA-COZ	Cuba	
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-CXZ	Uruguay	
CWA-CXZ	Uruguay	CX
CYA-CZZ	Canada	
D	Germany	D
EAA-EHZ	Spain	EAR
EIA-EIZ	Irish Free State	EI
ELA-ELZ	Liberia	EL
CPA-EQZ	Persia	
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
EZA-EZZ	Sarre Territory	
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
HPA-HPZ	Republic of Panama	
HRA-HRZ	Honduras	HR
HSA-HSZ	Siam	HS
HVA-HVZ	Vatican City State	
HZA-HZZ	Hedjaz	
I	Italy and colonies	I
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-LWZ	Argentine Republic	LU
LXA-LXZ	Luxemburg	
LYA-LYZ	Lithuania	
LZA-LZZ	Bulgaria	LZ
M	Great Britain	G
N	United States of America	W
OAA-OCZ	Peru	OA
OEA-OEZ	Austria	
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
R	Union of the Socialist Soviet Republics	
SAA-SMZ	Sweden	SM
SOA-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
TKA-TZZ	France and Colonies and Protectorates	
UIA-UKZ	Dutch East Indies	PK
UWA-VGZ	Canada	VE
VHA-VMZ	Australia	VK
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
VXA-VYZ	Canada	
W	United States of America:	
	Continental United States (for others, see under K.)	W
XAA-XFZ	Mexico	X
XGA-XUZ	China	AC
XYA-XZZ	British India	
YAA-YAZ	Afghanistan	YA
YBA-YHZ	Dutch East Indies	
YIA-YIZ	Iraq	YI
YZA-YZZ	New Hebrides	
YLA-YLZ	Latvia	YL
YMA-YMZ	Danzig	YM
YNA-YNZ	Nicaragua	YN
YOA-YRZ	Rumania	
YSA-YSZ	Republic of El Salvador	YS
YTA-YUZ	Yugoslavia	
YVA-YWZ	Venezuela	YV
ZAA-ZAZ	Albania	ZA
ZBA-ZJZ	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

A De Luxe S. W. Receiving Station

Entirely Home-Made Outfit A Model of Careful Design and Workmanship



Frank Frimerman, who is a furrier by trade, built this beautiful outfit entirely himself by hand.

THE unit panel type of construction, which has been enjoying increasing popularity for public address amplifiers and commercial and amateur transmitters, is also starting to find application for straight short-wave receivers. The beautiful outfit illustrated herewith is a good example of this type of construction and also of the skill and workmanship of its builder, Frank Frimerman, 740 Prospect Avenue, the Bronx, New York. It should be understood that Mr. Frimerman is by no means a beginner; he has been active in amateur radio for fifteen years. He operated one of the pioneer amateur phone stations in New York under the call 2FZ, and he expects to return to the air shortly, with the same call, using a powerful phone transmitter of the latest type.

Angle Iron Framework

Mr. Frimerman built a special glass-top table to form a front for three vertical sections of panels, the latter being supported on an angle-iron framework. This framework measures seven feet high and six feet wide. All connections between units are made at the back of the panel structure, which is kept dust-proof by means of a series of tightly locking doors.

The entire right hand section of panels is devoted to receiving equipment. A close-up of the two receivers proper is shown in the lower right hand corner of this page. The bottom unit is a high-frequency receiver tuning from 30 megacycles to 540 kilocycles. It is entirely a.c. operated and employs ten tubes. The circuit comprises one pre-selector r.f. stage with a 58; 57 first detector; 58 local oscillator; two 58 i.f. amplifier stages; one 57 second detector with 2B6 automatic volume control; 58 beat frequency oscillator; and one 2A5 audio output pentode. Plug-in coils are used for wave changing, there being three coils for each of five ranges, a total of fifteen coils.

The coils are inserted and removed from the front of the panel. The openings in the latter are protected by removable aluminum discs which match the rest of the surface in appearance. These coil gates are represented by the three heavy black circles in the accompanying illustrations.

There are twelve separate controls on the front of the receiver, permitting every possible adjustment of the sensitive circuit. Reading from left to right, bottom row; r.f. tuning condenser, a.f. volume control and line switch, tone control, band spread tuning, with local oscillator switch below it, beat oscillator pitch control, a.v.c. on-off switch and i.f. gain control. Second row; plate switch to break B circuit when coils are being changed or during periods of transmission, oscillator tank condenser, first detector tank condenser, crystal filter switch, crystal filter attenuation dial. Three knobs in a row above the center tuning dial are merely the handles for the coil compartment covers.

The meter on the left is a calibrated volume indicator connected in the plate circuit of the second detector; the meter in the upper right hand corner is a visual tuning indicator connected in the plate return circuit of the i.f. amplifier tubes.

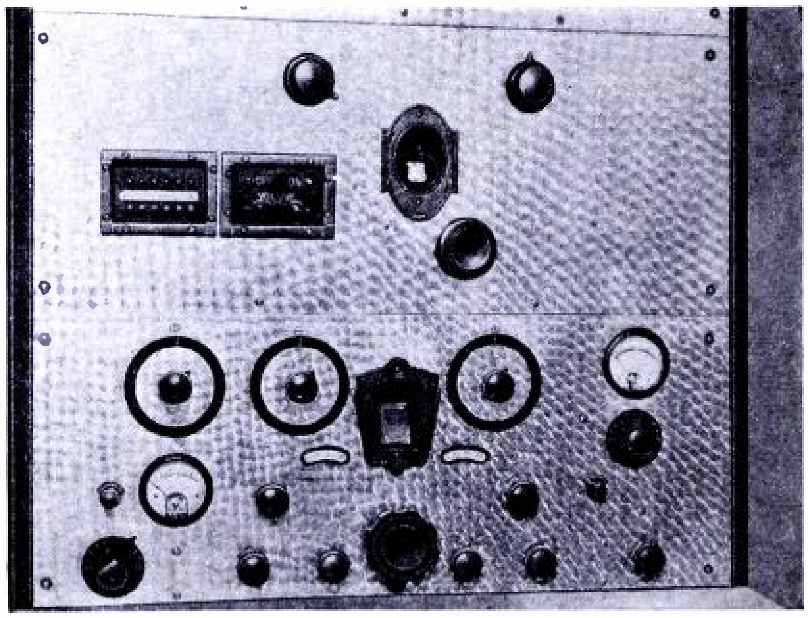
Needless to say, this receiver is not a particularly easy one to operate, as there are enough controls on it to confuse almost anyone. However, when it is tuned up properly it certainly does drag in the signals. The use of the r.f. stage ahead of the first detector eliminates image frequency interference, which is probably the main shortcoming of all ordinary short-wave supers.

Power for the high-frequency receiver is furnished by the uppermost unit of the right hand rack. This is an oversized a.c. power pack using a regular type 80 rectifier, mounted vertically away from the front of the panel by means of special right-angle socket supports.

Remotely Controlled B.C. Set

The receiver immediately above the short-wave outfit is a broadcast set. This is a single control, three-stage t.r.f. job using type 24 tubes in the amplifier positions and a 27 detector. It may be controlled manually directly from the operating table and also remotely from the living room and the cellar of the house, there being separate loudspeakers in each of the latter places, with individual volume controls. The

(Continued on page 45)



Close-up of the two receivers built by Mr. Frimerman. At the bottom is the 10-tube short-wave superheterodyne, above is the 4-tube t.r.f. broadcast tuner, which feeds a separate audio amplifier. The S.W. set looks complicated and is complicated, but produces really marvelous results. The buttons in the rectangular frames next to the dial of the broadcast tuner are the station selectors of the remote control system.

Taking the Mystery Out of the Code

a message to the short-wave broadcast fan

SHORT-WAVE set owners whose primary interest is the reception of foreign broadcasting stations are showing a surprising and altogether unsuspected interest in the code. Heretofore, most "BCL's"—broadcast listeners—have regarded code stations as so much interference, but, evidently, they are discovering that code reception can be just as thrilling as program reception. The great majority of these people have no intention of obtaining government licenses and entering the amateur transmitting "game"; *they merely want to learn the code as a means of getting more pleasure out of the short waves.*

The listener who can read code will never experience a dull moment from his receiver. Broadcast stations may be irregular and musical programs distorted, but there is never any lack of code stations, at any hour of the day or night, any day of the year. The code-wise listener can "spot" standard frequency transmitting stations, of which there are many, and thus calibrate his receiver accurately; he is then in a better position than before to fish for distant phone stations!

Learn Yourself

An individual listener can learn the code all by himself without any trouble at all, as the short-wave bands are full of stations that send slowly and steadily. The best way to learn how to receive code is to learn first how to send it. A small telegraph key, obtainable from any radio supply house, an ordinary door buzzer, and a couple of standard dry cells are all that are needed. These are connected in series as shown in Fig. 1. Screw the key to the table a distance from the front edge of the latter equal to the length of your forearm, so that you can manipulate the knob comfortably. Adjust the armature of the buzzer so that the tone is smooth and high pitched; a wad of paper pushed between the armature proper and the vibrator spring will often help.

The Continental Code, which is internationally used in all radio work, is shown to the right. Now, right at the start, get into the habit of calling the code characters "dits" and "dahs," *NOT* "dots" and "dashes." They sound like "dits" and "dahs," and your brain should automatically register them as combinations of these sounds.

Rest your thumb along the edge of the key knob with the first two fingers on top of it. Adjust the spring tension and contact spacing so that the lever moves up and down freely. Relax your arm and finger muscles and press the knob gently, allowing the spring to push it back up. Don't hit or tap the kep. Of course your movements will be a bit awkward at the start, but will improve with practice.

A dit is a short buzz; a dah is supposed to be just three times as long, so that there will be no confusion between the characters. The spacing between dits and dahs of the same letter is equivalent to the length of dit; between separate letters, the equivalent of about three dits; between words, five dits. At the beginning, count silently to your self as you make combinations of characters; after a while the rhythm will become automatic.

How to Memorize

The simplest way to memorize the dit and dah combinations is by groups. Start with the straight dit group first and practice simple word combinations, such as *is, see, his, she.* Then proceed to the straight dah group, and make up words like *Tom, too, moot.* With these mastered, after a week or so of study, try straight dit and dah word combinations such as *met, miss, him, sit, hem, hot,* etc. Now go ahead with the other combinations and numerals. Note that the latter follow a uniform sequence.

Most beginners at the code make the mistake of trying to learn the whole alphabet at once. Small, steady periods of practice are much more effective than crowded, intensive ones.

Don't attempt to copy actual radio signals until you have first mastered the whole alphabet and the numerals by key practice. If you can get some friend to practice with you, so much the better, as you can then correct each other's mistakes. Many short-wave fans use their wives for practice mates!

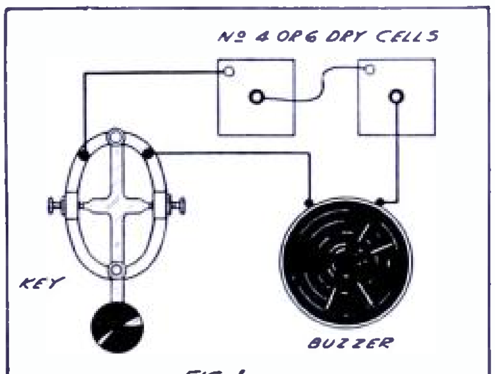


FIG. 1

Simple schematic circuit of a code set. It consists merely of a telegraph key, buzzer, and two dry cells connected in series. It is convenient to mount the whole outfit on a baseboard, with the batteries clamped down, so it can be moved from point to point.

The Continental Code is shown to the right. Punctuation, numerals, and a standard grouping arrangement, suitable for easy memorization, are also given.

Many Powerful Stations

There are dozens of powerful commercial trans-oceanic stations that do nothing for hours on end but transmit series of V's (test signal) and their own call letters. These are fine practice. You will soon notice that all stations, when calling, send the call letters of the desired station, the intermediate signal DE (French for *from*), their own call letters, and a go-ahead signal, either dit-dah-dit-dah-dit or dah-dit-dah. Complete lists of all punctuation marks, special signals and international abbreviations will be found in practically all radio books.

On the crowded amateur channels, you will hear the call CQ repeated hundreds, even thousands of times. This is a general call and means that the operator sending it wants to talk to anybody who hears and answers him. As used by commercial stations, CQ also means "general call," but is followed by press or other matter of general interest; CQ is thus an invitation to listen in.

Foreign telegraph stations pound in with amazing strength. Unless you have a commercial call book, you won't be able to tell their exact location, but you can at least determine the countries of origin by referring to the list of international call letter assignments published elsewhere in this issue. You may not believe your ears sometimes, as stations 5000 miles away may sound a hundred times louder than locals.

R. H.

THE CONTINENTAL CODE

A	• —
B	— • • •
C	— • — •
D	— • •
E	•
F	• • — •
G	— — •
H	• • • •
I	• •
J	• — — —
K	— • —
L	• — • •
M	— —
N	— •
O	— — —
P	• — — •
Q	— — • —
R	• — •
S	• • •
T	—
U	• • —
V	• • • —
W	• — —
X	— • • —
Y	— • — —
Z	— — • •

PUNCTUATION

PERIOD	• • • • • •
INTERROGATION	• • — — • •
BREAK	— • • • —
END OF MESSAGE	• — • — •
END OF TRANSMISSION	• • • — • —

NUMERALS

1	• — — — —	6	— • • • •
2	• • — — —	7	— — • • •
3	• • • — —	8	— — — • •
4	• • • • —	9	— — — — •
5	• • • • •	0	— — — — —

BY GROUPS

E	•	T	—
I	• •	M	— —
S	• • •	O	— — —
H	• • • •	Ch	— — — —
5	• • • • •	O (CIPHER)	— — — — —
A	• —	N	— •
W	• — —	D	— • •
J	• — — —	B	— • • •
R	• — •	U	• • —
F	• • — •	V	• • • —
L	• — • •	4	• • • • —
K	— • —	G	— — •
X	— • • —	Z	— — • •
C	— • — •	P	• — — •
Y	— • — —		
Q	— — • —		

So You're Going to Be a "Ham"!

SUMMARY: *The questions most often asked by advanced short-wave broadcast listeners who want to get into the amateur transmitting "game" are fully answered in this article by a man with a lot of experience. The advice given is frank and honest, and, if followed, will save the beginner much unnecessary grief. The author is a well-known writer who prefers to use his radio call letters rather than his name.*

By W2TY

IN my ten years of amateur radio experience I have been approached by innumerable beginners who wanted to know: (a) the most desirable frequency band; (b) what kind of a receiver to select; (c) the best transmitter circuit; and (d) what kind of an antenna to erect.

Many articles have been published on these topics. But so many suitable circuits are described in these that the newcomer finds it difficult to decide just what is best for him. So the author, who has been "through the mill" (to which statement an attic full of unused parts purchased in early ignorance bears mute testimony), proposes to assume the rôle of "beginner's guide."

Picking Your Band

Choice of band depends primarily upon the time of day at which the transmitter is normally to be operated.

It is my belief that a majority of beginners wish to work DX. Thus, 20 meters is recommended if the station is to be on the air chiefly in daylight, 40 if it is to be used most often after dark. With as little as 25 watts input, it is possible to achieve international contacts in these two bands. The 40-meter band is probably the better of the two for all around utility, transmission being fairly consistent up to about 1000 miles during the day, and DX possibilities unlimited after sundown. Interference is severe, but it is my feeling that this is an advantage to the beginner, as there is always someone on the air who can be worked.

Twenty- and forty-meter transmitters operate with simple, short antennas. And both bands are far enough away from broadcast channels to keep interference at a minimum.

The 80-meter band provides reliable communication up to about 1000 miles with low power input and is not materially affected by the transfer from darkness to daylight. QRM is less severe on 40 and there is no "skipped-over" local area, but it lacks the higher frequency's extreme DX possibilities. In addition, efficient antennas for this band are rather unwieldy and competition with high-power rigs severe. The same advantages and disadvantages apply, heightened somewhat, to the 160-meter band, hence neither is considered so desirable as 20 or 40 for the beginner unless reliable communication between definite, fixed points is the chief object. It seldom is, as the beginner cares little just whom he works so long as he works someone.

The 5-meter band is still in a highly experimental stage. Also, phone is used almost exclusively in this region and phone is not recommended for most beginners. Equipment is relatively expensive and tuning difficult.

Start with code. You have to know it anyway in order to obtain any kind of an amateur license.

A simple receiver will bring in DX code signals on 20 and 40 meters very nearly as well as more elaborate rigs. I use a type 30 triode detector and an overbiased 33 pentode ($4\frac{1}{2}$ volts of C battery keeps phone current within safe limits) with 45 volts plate. Increased voltage produces little additional gain in code signal strength.

More audio amplification could be used comfortably and two type 30 amplifiers are recommended in place of the pentode for beginners who wish to use all-battery operated receivers. A.C. heated tubes give greater gain and many amateurs prefer them. Some use battery plate supply, others obtain high as well as low voltage from the line. My own preference is for battery plate supply, as it is difficult to eliminate *all* the hum from a completely electrified receiver used in a sensitive, oscillating condition; quiet, though relatively weak, signals are preferred to loud, noisy ones. B batteries are cheap and last a long time.

Untuned r.f. amplification keeps calibration independent of antenna length and eliminates dead-spots, but does not produce appreciable increase in code signal strength. It is my opinion, in fact, that because of its broadness, untuned r.f. increases noise out of all proportion to signal. Tuned r.f. gives an increase in code signal gain and helps selectivity, but involves an additional control.

Screen-grid detection is worthwhile despite the loss in audio gain due to the substitution of impedance or resistance coupling for a high-ratio transformer. In addition, a variable resistor in the screen circuit gives smooth, quiet regeneration control. Resistance control of regeneration is preferable to other systems in any ham receiver, as less "interlocking" effect is experienced between the tuned and tickler circuits. Try a triode detector and switch to screen-grid if signals are later considered to be too weak.

I do not by any means wish to discourage the use of more elaborate receivers such as superhets and single-signal sets. While these are rarely necessary for code reception on 20 and 40, they are a good investment if the beginner can spend the money, as they do provide better results and are really indispensable in the lower frequency bands, where simple regenerative detector-amplifiers fall down badly. The gain and selectivity inherent in multi-tube receivers are essential for phone reception on 80 and 160 meters, and sooner or later, most hams wish, at least, to listen in these bands. Such sets also permit good reception of foreign broadcasts.

Selecting the Receiver

Select a receiver with plug-in coils. Sooner or later you will want to listen in bands other than the one to which the transmitter is tuned, perhaps even to work in them. Make sure that the amateur bands can be "spread" at least 30 points on the dial (50 or more on 80), otherwise tuning will be uncomfortable. Calibrate your receiver for the band in which you transmit. This not only allows you to transfer frequency points to the transmitter through the medium of a simple, click-type wavemeter, but also aids in identifying weak DX signals logged at some earlier date. And it makes it easier to locate friends who stick to one wavelength.

Calibration is fixed in sets employing r.f. stages, but even a straight detector circuit can be graphed. My 40-meter coil follows a calibration curve obtained by logging standard frequency signals and commercial stations with RXC at 79, XDE at 22 in the dial. I periodically readjust the antenna series capacity so that these stations always come in at the "reference" points, as tube, battery and antenna conditions change the setting slightly from night to night.

Wind the coils of heavy wire on

rigid forms and varnish or cement them in place. This holds calibration and permits rough handling. "Low-loss" coils are unnecessary, as regeneration nullifies losses to a large extent anyway. This does not mean that the coils can be wound on iron, of course.

Here are a few tips from an old timer on receiver parts: use a .0001 mf. grid condenser rather than the conventional .00025; this prevents blocking by the transmitter signal. Use the highest value of grid-leak with which the set will operate smoothly; this gives a slick-operating regeneration control and also increases detector sensitivity to weak signals. I use a special 20 megohm leak, but 10 is usually O.K. Make sure you buy a good, solidly constructed tuning condenser, even if it is necessary to skimp on other parts; noisy contact with the rotor plates should be avoided at all cost. Use transformers with a ratio of at least 5 to 1, unless you are primarily interested in phone; this will snap up volume considerably and also make it easier to copy through QRM. Put a 100,000-ohm resistor across the transformer secondary; this will remove "fringe-howl" often encountered just as the detector is tuned to the most sensitive regenerative point. And use a good vernier dial with a ratio of about 5 or 6 to 1; much less makes tuning too critical and much more slows down band-coverage after CQ's.

If you operate from a private house 50 feet or more away from others in which electrical appliances may generate noise, an ordinary outside antenna will probably work O.K. Cut the antenna so that it resonates, or a harmonic resonates, just outside the high-frequency end of the band in which you intend to work and it will give increased gain and require less use of the regeneration control when covering the band. If you operate from a building in which electrical noise is severe, it will pay to use a "doublet," or transposed lead-in system, and to locate the antenna itself in the clear. Keep the receiving antenna away from the transmitting antenna and at right angles.

What Transmitter Circuit?

Beginners are urged to start with low power (25 to 50 watts input) and a straight oscillator. Tubes such as the 210 and 45 are recommended. Push-pull and parallel rigs in the hands of inexperienced operators often exhibit tricky characteristics and rarely transmit appreciably better signals. Crystal-controlled and MOPA transmitters are superior but are difficult to tune, relatively expensive and can always be built without much waste at a later date if original equipment is wisely selected.

A simple oscillator, properly designed, *rigidly constructed* and running cool, can produce a fine, clean-cut signal. A 210 with 550 volts on its plate used at W2TY has "Worked All Continents" on 40 meters and is frequently mistaken for crystal or MOPA.

Don't worry about the circuit, as all standard oscillators produce satisfactory results once tuned. The Hartley is extremely flexible and can be adjusted to high efficiency. The tuned grid-tuned plate is easier to tune and has a reputation for steadiness but lacks the Hartley's flexibility of adjustment. The Colpitts substitutes condenser for clip adjustments and other common circuits have their own similar advantages and disadvantages. My personal preference is the Hartley, which is perhaps the simplest to construct and requires a minimum of equipment and space. If it is series-fed, so much the better, as this reduces the importance of chokes.

Use plenty of capacity and a small inductance. (High-C circuit). This lowers efficiency but is conducive to steadiness and much easier to tune to a stable point. Steadiness and clean signals are much more important in the beginner's transmitter than mere "wallop." Panel jobs are not measurably inferior to breadboard layouts if properly designed, but the breadboard layout should be used as a starter if space is available, as it simplifies wiring and lends itself to minor changes and adjustments.

Make rigid coils and fasten everything down solid, even if this must be done at the expense of low-loss construction. The main coil, even if made of heavy copper tubing, may well be threaded on a strip of insulation in which holes have been drilled to prevent any possibility of turn-spacing variation. Rigidity should be the beginner's cardinal rule. "Shimmy" is taboo.

Oversize parts are recommended. These not only insure against overload which can cause unsteady or chirpy signals, but provide a desirable margin of safety. When buying a plate transformer, for example, it is well to select one which will supply nearly double the power actually required if you can afford it. Heat the filament from separate, oversized transformers. This not only eliminates the possibility of chirp sometimes encountered when filament windings are on the plate transformer, due to the increase in load when the key is pressed, but also provides husky, separate units which will fit in admirably at a later date should crystal or MOPA be installed. Buy filter condensers which will stand up under 50 per cent higher voltage than that actually applied. They are not much more expensive and prevent blow-outs on surges. Pick a filter choke which will pass double the oscillator plate current. This keeps power-pack resistance down and removes another possibility of chirp.

Purchase a filament voltmeter which will handle up to 15 volts a.c. Also a plate milliammeter with a 200 to 300 ma. range. Meter operation at or below mid-scale using low power is not crippling, as a simple indication of relative plate currents rather than their actual values is all that is needed to tune. And these oversize meters will come in handy should you ever increase power. Avoid early investment in antenna ammeters. Antenna current is next to meaningless to the beginner and resonance can be determined by watching the plate current.

In the selection of a rectifier, much depends upon whether or not you intend to expand later. I use an 83, capable of furnishing nearly twice the current required by a 210, to insure adequate supply; if you intend to "graduate" to higher power eventually and have the money, 866's are a good investment and will improve even the first rig.

Just as a car capable of attaining a speed of 90 miles per hour runs smoother at 50 than one strained to the limit at this speed, so an oversize power-pack insures smoother operation than one operating near peak.

Here's some straight dope about other transmitter parts: Variable condensers need not be double-spaced until you get up in the 50-watter class. Coils are best wound of 3/16 or ¼ inch copper tubing, which wi'l be heavy enough should you later increase power. Clips can be made of alligator test types with the teeth filed off or bent out straight. Three section r.f. chokes are generally superior to singles. Any good grade of receiving type fixed condenser will do for blocking and grid units, but to be safe put two in series for the blocking job. Use a husky, non-inductive grid-leak. Be sure you use a bleeder resistor that will pass about 15 per cent of the tube plate current across the filter output. Bleeders camouflage a multitude of transmitter sins. And use a filament transformer which will run the tube at rated voltage without the use of rheostats, if possible. If it is necessary to drop the voltage do it in the primary.

Take your time when building the transmitter. Time saved by making a haywire rig is usually spent ten times over trying to get it to "mote" and keeping it that way. Don't be in a hurry to get on the air at the expense of good workmanship. And,

TRANSMITTING DATA

There are so many different transmitting and receiving circuit combinations suitable for amateur work that it is impossible for us to even start publishing elementary diagrams to follow up this excellent article by W2TY. The man interested in high-frequency communication is earnestly urged to acquire a copy of the ham's "Bible," otherwise known as the "Radio Amateur's Handbook." This is published by the American Radio Relay League, the national fraternal organization of transmitting amateurs.

if possible, get some local ham to tune 'er up for you the first time. An experienced operator can teach the beginner more about tuning in an hour than he could learn from even the best of printed matter in a week.

Selecting the "Sky-Wire"

Selection of an efficient antenna system depends upon three factors: (1) The band or bands in which operation is desired; (2) The location of the transmitter with respect to the radiator; and (3) available, clear roof positions or mast locations.

Concentration on one band and the erection of an antenna which will work at peak efficiency in that band are recommended for the beginner who, experience indicates, rarely has much luck with multi-band transmitter construction. It is possible, however, to erect an antenna which will work O.K. in, say, both the 20- and 40-meter bands or in the 80 and the 40. To do this it is simply necessary to erect a radiator which is fundamentally resonant in the lower frequency band and to work it at a harmonic at a higher.

Perhaps the simplest form of a radiator is one in which counterpoise and antenna terminate right at the transmitter, the entire length of wire acting as a radiator. This should only be used where it is possible to locate the transmitter close to an upper floor window so that all but a few feet of the system will be outside in the clear. In most locations this is not feasible, as it makes it necessary to erect the radiator in a semi-shielded position and so feeder systems are generally used. These permit the radiator to be installed some distance from the transmitter in a high, free location, coupling being provided by feeders which themselves radiate little r.f.

Two basic feeder types are available, the current and voltage. Where operation in more than one band is desired, these must be tuned, as harmonics do not always fall exactly within the higher frequency bands. Both types give about the same results once they are properly adjusted and choice depends largely upon the accessibility of radiator current and voltage "nodes," to which feeders must be attached. If, for example, the end of the antenna is closest to the transmitter, then it is convenient to use an end-fed system such as the "Zeppelin" voltage rig. If the transmitter is roughly in the center of the antenna, then the sky-wire is conveniently split at the center with an insulator and two-wire, current-fed at this point. Feeders may also be attached at other convenient voltage or current nodes.

The thing the beginner should keep in mind is that fact that the radiating portion of the system must be kept out in the clear. Select a standard-feed system which makes this possible and best fits physical conditions and then rest assured that it will work just about as well as any other, once it is properly installed and tuned. The author, for example, wanted a 40-meter antenna which could be fed near the center and would attract a minimum of attention on his apartment-house roof. Operation in other bands, or ability to QSY within the limits of 40, was not required. A half-wave fundamental radiator, single-wire voltage fed, served admirably and can scarcely be distinguished from nearby b.c.l. systems. "Distant pastures always look greener," but I have not touched the wire in three years.

The important thing to remember about an amateur transmitting antenna is that it should be located as high as possible and the maximum practical distance from b.c.l. antennas and projections of any sort. Remember that the effective height is its nearest point to ground. If insulators are fastened an inch or two from grounded supports, for example, this is less efficient than if they were four or five feet out. Locate the radiator in the clear even if it is necessary to increase the length of the feeder. Within reason, this doesn't make much difference.

Wire size is not important, even for relatively high power, so long as it is larger than No. 18. Solid, bare copper stuff is just as good as stranded, enameled stock, so far as I have ever been able to determine by practical experiment. Insulation is another thing. Use good insulators, the longer the better. Connect two or three receiving type insulators of high quality material in series, breaking up the support halliard if this is metal. Or use one good insulator well out on tarred rope.

Antenna position is usually dictated by the location but if you have your choice point the wire end to end in the direction in which DX transmission is most often desired. There is some slight directional effect. Vertical antennas are difficult and often impossible to install, but the nearer to vertical you can get the system, still keeping it well above ground, the better it will work 20- and 40-meter DX. There are exceptions.

Solder all connections and bring your lead-in to the transmitter through the best insulation you can rig up through the wall or under the sill. Spacing is more important than the actual insulation quality. Keep your feeder as far away from the building as you can, despite the knowledge that certain balanced systems can occasionally be fastened right against a wall without ill effect, and make sure that neither the radiator nor the feeders can swing. Rigidity is nearly as important in feeders as in the transmitter itself.

Checking Transmitter Frequency

If you have the money to build a good combination monitor and frequency meter, do so at once. These not only permit accurate frequency check but also make it possible to listen to your own transmitter, an extremely valuable aid when striving for a d.c. note and steady signal. Avoid absorption or "click" type wavemeters for anything but temporary use. Even the best of them are too broad for accurate work at the higher frequencies.

If you have a calibrated receiver, recommended in early paragraphs, a click type wavemeter will do to get on the air. Select a point near the middle of the assigned band and tune the receiver to this point. Transfer it to the wavemeter and then transfer the wavemeter setting to the transmitter. Don't attempt to work close to the edge of the band as errors are inevitable when this system is used. And to be doubly certain that you are "on frequency" check with the first amateur station you contact.

In conclusion let me say that I agree in advance with any oldtimer who feels that I have laid down too many arbitrary rules. There is more than one way of "skinning a cat," but I believe *this* way will enable the beginner to get on the air with a minimum of expense and trouble and will also pave the way for later improvement in apparatus.

How To Determine Best Position of Doublet

IN a recent talk before the Short Wave Club of New York, Arthur H. Lynch stressed the desirability of making some sort of preliminary tests before an expensive doublet antenna with transposed feeder transmission line is installed in any particular location. He suggested the use of a portable or semi-portable battery operated receiver and a temporary doublet antenna consisting of two sections each six feet long, the wires being supported on 1 x 1 inch wood strips or similar materials, and the whole thing so arranged that it can be turned readily in any direction.

With the temporary antenna balanced on top of a step-ladder and the receiver set up on the roof, it is a fairly simple matter to try the antenna in different positions and directions, and to determine the best approximate setting at which noise and other interference is at a minimum or absent altogether. The permanent antenna can then be erected in the same position, and the constructor will have some assurance that the system will work satisfactorily.

Mr. Lynch also reported that much of the twisting trouble experienced with cage type doublets is due to slackness. Pulling the wires tight invariably cures the trouble.

Some Explanatory Notes

SUMMARY: *The editorial department of* SHORT WAVE RADIO *is in receipt, from time to time, of suggestions, questions, criticisms, etc. Many of these letters want some particular point cleared up, many want the same type of article, and many have the same criticisms. In this department we shall attempt to take care of these common problems.*

WHILE the actual circuit design of a short-wave receiver is not radically different from that of the usual broadcast receiver, nevertheless there are a few little points which, while adaptable to broadcast sets, cannot be applied to the usual s.w. receiver. One of these points, a discussion of which has been rolling up a lot of interest, revolves itself around the use of the tricky little absorption circuit found in several popular receivers made by the National Company. This little absorption circuit, shown herewith in the schematic, may be recognized as belonging especially to the SW3 and SW58.

The purpose of the little absorption circuit designated by coil L3 and condenser C2 is to align the main tuning unit, C1, with any other main tuning circuits which may be in the receiver, such as the oscillator dial in superheterodynes or the detector dial in t.r.f. receivers.

In the usual broadcast receiver complicated padding circuits are used in the tuned stages in order to keep the condensers in line throughout the entire band from 500 to 1500 kc. In the short-wave receiver, however, the spread is from 1500 to 20,000 kc., and it is almost an impossibility to have a combination of padding units which will keep the main tuning dials in line throughout the entire spread.

Solving the Problem

Many manufacturers and set constructors have gotten around this difficulty by keeping small fixed-variable condensers across each set of coils. All that is required, then, is a padding circuit to take up any apparent discrepancies that may otherwise exist. Such circuits, however, have not met with general approval simply because of the extreme care required and difficulties encountered in lining up this complicated arrangement, the fact that coils must be selected for a particular receiver and cannot be interchanged with any other similar receiver, and the relatively high cost of adjustment and test.

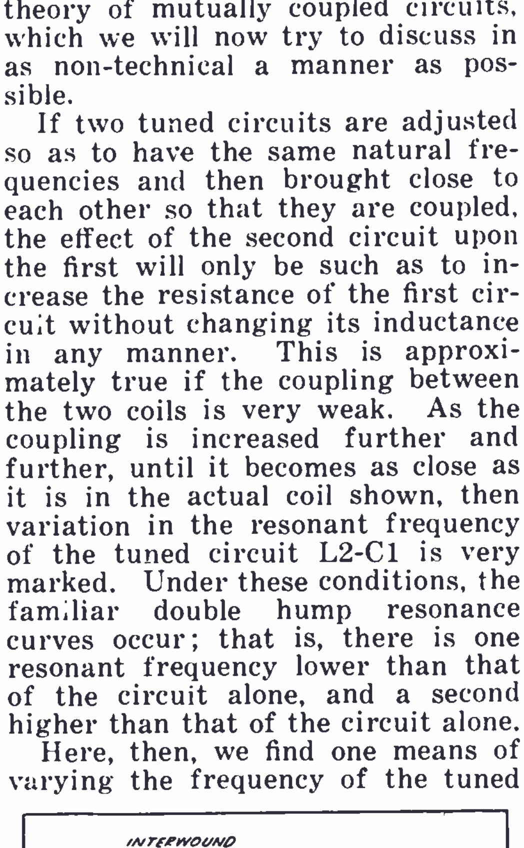
The circuit shown in the schematic, however, possesses the distinct advantage of being adjustable from the front panel and of being capable of lining up the antenna stage even though the lengths of difficult aerials may vary over extremely wide ranges. In other words, when a receiver employing the absorption method of lining up stages is being operated, all one has to do is tune in a signal and adjust the small condenser C2 until the station is loudest.

This condenser C2 is not a volume control. It merely tunes the coil L3 in such a manner as to either add to or substract from the inductance L2, thus bringing the tuned circuit L2-C1 into resonance with whatever other circuits may be employed.

Just exactly how does any variation in C2 vary the inductance L2? First of all, L2 is usually the interwound primary in a three-winding coil, such as shown to the right of the figure. Second of all, the theory of operation is consistent with the theory of mutually coupled circuits, which we will now try to discuss in as non-technical a manner as possible.

If two tuned circuits are adjusted so as to have the same natural frequencies and then brought close to each other so that they are coupled, the effect of the second circuit upon the first will only be such as to increase the resistance of the first circuit without changing its inductance in any manner. This is approximately true if the coupling between the two coils is very weak. As the coupling is increased further and further, until it becomes as close as it is in the actual coil shown, then variation in the resonant frequency of the tuned circuit L2-C1 is very marked. Under these conditions, the familiar double hump resonance curves occur; that is, there is one resonant frequency lower than that of the circuit alone, and a second higher than that of the circuit alone.

Here, then, we find one means of varying the frequency of the tuned circuit so as to align it with any other circuit. All you need do is couple a second circuit tuned to the same frequency as the first until the tuned circuit has its resonant frequency shifted the desired amount. Of course, the gain will be decreased somewhat, merely because the extraneous circuit absorbs energy, which is equivalent to increasing the resistance of the tuned circuit. However, the beneficial effects more than compensate for this slight diminution in gain.



Schematic circuit of the tertiary tuning circuit and the arrangement of the coils.

In our circuit, however, we find no means of varying the coupling between L3 and L2. Furthermore, we know that the circuit L3-C2 is tuned to a higher frequency than the main circuit since its inductance is usually smaller than that of L2 and its capacitance is usually smaller than that of C1. Here, then, we have the case of two tightly coupled circuits, the second tuned to a higher frequency than that of the first. Our problem, therefore, is a bit more complicated. Since the signal frequency induced in circuit L2-C1 is lower than the resonant frequency of our absorption circuit L3-C2, the current in this absorption circuit is limited mainly, or rather, to a large extent, by C2. In other words, the absorption circuit is a capacity circuit. This has the effect on our tuned circuit of adding another inductance in series with L2, making the total inductance of the first circuit higher. Hence, the resonant frequency of L2-C1 decreases. As the value of C2 is decreased, the resonant frequency of the tuned circuit L2-C1 decreases until it is brought in line with any other tuned circuits in the receiver. Hence, the sweeping conclusion of the whole business is that varying the absorption circuit capacity, C2, reduces the natural frequency of the main tuned circuit.

Of course, from this theory it is clear that the natural frequency of L2-C1 can never be increased if the resonant frequency of L3-C2 is higher than that of the main tuned circuit. On the other hand, by making the resonant frequency of L3-C2 lower than that of the main tuned circuit, the resonant frequency of the latter may be increased. Hence, merely adjusting the frequency of the absorption circuit below or above that of the main tuning circuit lines up this stage with any other.—*L. M.*

•• S. W. Receiver Review ••

To assist prospective purchasers of short-wave receivers in selecting equipment most suitable for their own needs, we have established this regular monthly department, in which factory-built sets will be described honestly, accurately, and completely after having been tested thoroughly by us. Readers are invited to suggest particular sets in which they are interested, and we will endeavor to obtain stock samples for test and write-up. Please do not ask us to make comparisons between different receivers.

The Midwest 16-Tube Receiver

MAKE: *Midwest 16-tube Receiver*; manufacturer, Midwest Radio Corp.

MECHANICAL DETAILS: Overall length 20½", height 8½", depth 10¾". Weight of chassis, 29 lbs.; weight of speaker, 6½ lbs.

REQUIRED ACCESSORIES: This receiver is sold complete with tubes and speaker, but, ordinarily, without cabinet. A small finished panel is furnished, as may be seen in the photograph. A variety of cabinets is available.

PRICE: Less tubes, with speaker $59.50; complete with tubes and speaker, $76.45.

TYPE OF SET: A 16-tube superheterodyne intended specifically for all-wave reception. This receiver might be termed an *all* all-wave receiver, in view of the fact that it not only covers the short-wave and broadcast bands, but also the long wave band from 888 to 1875 meters (160 to 375 kc.). There are no plug-in coils—different wave bands are selected by means of a switch having five positions. The first three positions cover the high frequency bands up to about 1500 kc.; the fourth position the broadcast band from 550 to 1500 kc., and the fifth position the very long-wave band The receiver is fully equipped with amplified a.v.c., tone control, and a number of other modern improvements which would interest only the very technical observer.

GENERAL DESCRIPTION: The sixteen tubes in this receiver are utilized in the following manner: one type 6D6 as an r.f. amplifier, one 6C6 as a first detector, one 56 as an r.f. oscillator, two 78 tubes in the i.f. amplifier, one 6B7 as second detector, one 6B7 as a separate amplified a.v.c. tube, one 37 as an audio amplifier, one type 37 as a special noise suppressor, two 37 tubes as a push-pull second a.f. amplifier, four 45 tubes in a parallel push-pull connection as the final audio amplifier, and one 5Z3 as a rectifier.

Looking at the front of the panel, the lower left-hand knob controls volume, the center lower knob is the wave-band selector switch, the extreme right-hand knob is a combination "off-on" switch and tone control, and the upper knob, between the dial escutcheon and the selector switch, is the tuning knob. There is no beat oscillator, as the recever is intended solely for broadcast reception. The large center can, directly behind the front panel, houses three of the tubes and the tuning condenser. The power-supply unit is on the right and the audio amplifier units on the left.

The extreme left-hand position of the selector switch covers the band from about 11.5 to 35 megacycles (about 8.6 to 26 meters); the second position from about 11.5 to 4.5 megacycles (26 to 66 meters); the third position from 4.5 to 1.5 megacycles (66 to 200 meters); the conventional broadcast band is covered by the fourth position of the selector switch, from 550 to 1500 kc. (200 too 500 meters); and the fifth position of the switch covers the very long wave band mentioned previously.

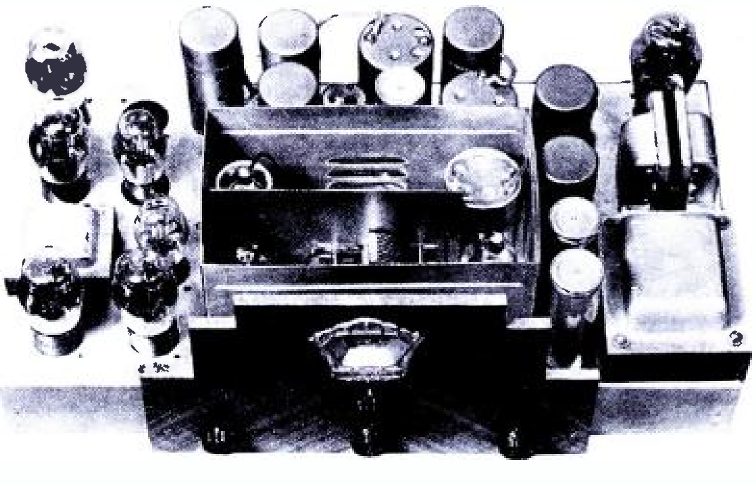
The dial itself is a very unique and ingenious piece of equipment. As may be seen from the photograph, a small section of it is visible through an opening in the escutcheon. The dial is made of some celluloid material and is divided by means of lines into five concentric divisions, each one of which corresponds to a wave band. As the selector switch is moved from one position to another, a dial light, mechanically connected to the selector switch arm, shifts its position so as to illuminate only that section of the concentric ring which is being used. Thus, at any position of the selector switch, a sharply focused spot of light about an inch in circumferential length and about a quarter of an inch high is visible.

The particular frequency to which the receiver is tuned is engraved directly on the dial. Thus, it is entirely unnecessary to resort to any external curves or calibration charts in order to determine the frequency to which the receiver is tuned. It should be mentioned in passing that the calibration of the dial is not extremely accurate—it only affords a means of tuning approximately to the desired frequency. The dial of the receiver which your reviewer operated for several weeks was off approximately .15 megacycle in the 6 megacycle band. However, after a little experience with the receiver, this small discrepancy can easily be compensated for.

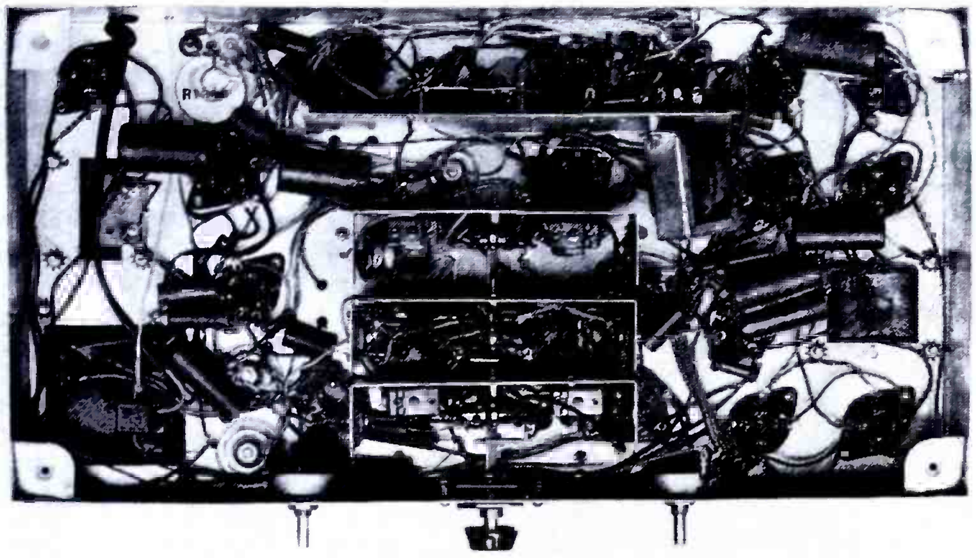
Another feature of the dial is the lettering on it which designates the particular use to which the channels are put. For instance, certain parts of the dial are marked "Aircraft," "Commercial," "Amateur," "Foreigns," etc. This form of calibration is extremely helpful, in that the operator can concentrate his "tuning energy" within definite limits without resorting to external references.

The tuning at the high-frequency end of the receiver is extremely sharp, probably because of the beneficial effects of the pre-selector stage. Like all superheterodynes, though, the set is a bit noisy, but the background drops out completely when a strong signal is tuned in. This is due to the amplified a.v.c., which reduces the sensitivity of the receiver sufficiently to eliminate the noise almost completely.

Very sharp tuning on the short waves is a decided asset in some receivers. It is an asset in this one. The densely populated 49-meter band offered the "acid test." No difficulty



Top view of the Midwest 16-tube receiver described in this article. The shield can directly behind the front panel houses three of the tubes. The remaining 13 tubes are placed on the chassis proper. The power unit is on the right.



Under view of the Midwest 16-tube receiver.

was had in separating W8XAL and GSA. The former is on 6,060 kilocycles and the latter on 6,050 kilocycles. It is recommended that the operator be patient and careful when he tunes the receiver, as otherwise, he will pass up about 90% of the stations that the receiver can receive. A higher ratio dial would probably facilitate tuning.

ANTENNA: For those who are unable to install an outside antenna and who cannot, for some reason, install a convenient indoor antenna, the built-in aerial may be used. This is nothing but a connection to the power line through a .25-mf. mica condenser. The lead protrudes from the back of the set, so that all one needs to do is to connect it to the antenna post. Reception with this built-in antenna will be fairly good on the short waves and more than satisfactory on the regular broadcast band. For reception of U. S. stations in the broadcast band, Midwest recommends an inside aerial of thirty or forty feet in length or the built-in aerial described previously. For short-wave reception, a long outside antenna is recommended. It is not feasible to use the external and built-in antennas at the same time.

For the purpose of reducing the noise level, a control called the "Stat-O-Mit" is employed. This is a 50,000-ohm potentiometer connected in the plate circuits of one of the type 37 tubes. Variation of its value causes a variation in the bias applied to another type 37 tube, which varies the impedance connected across the imput to the first audio amplifier stage. Once the correct setting is established, the noise level remains practically constant because of the automatic functioning of the system.

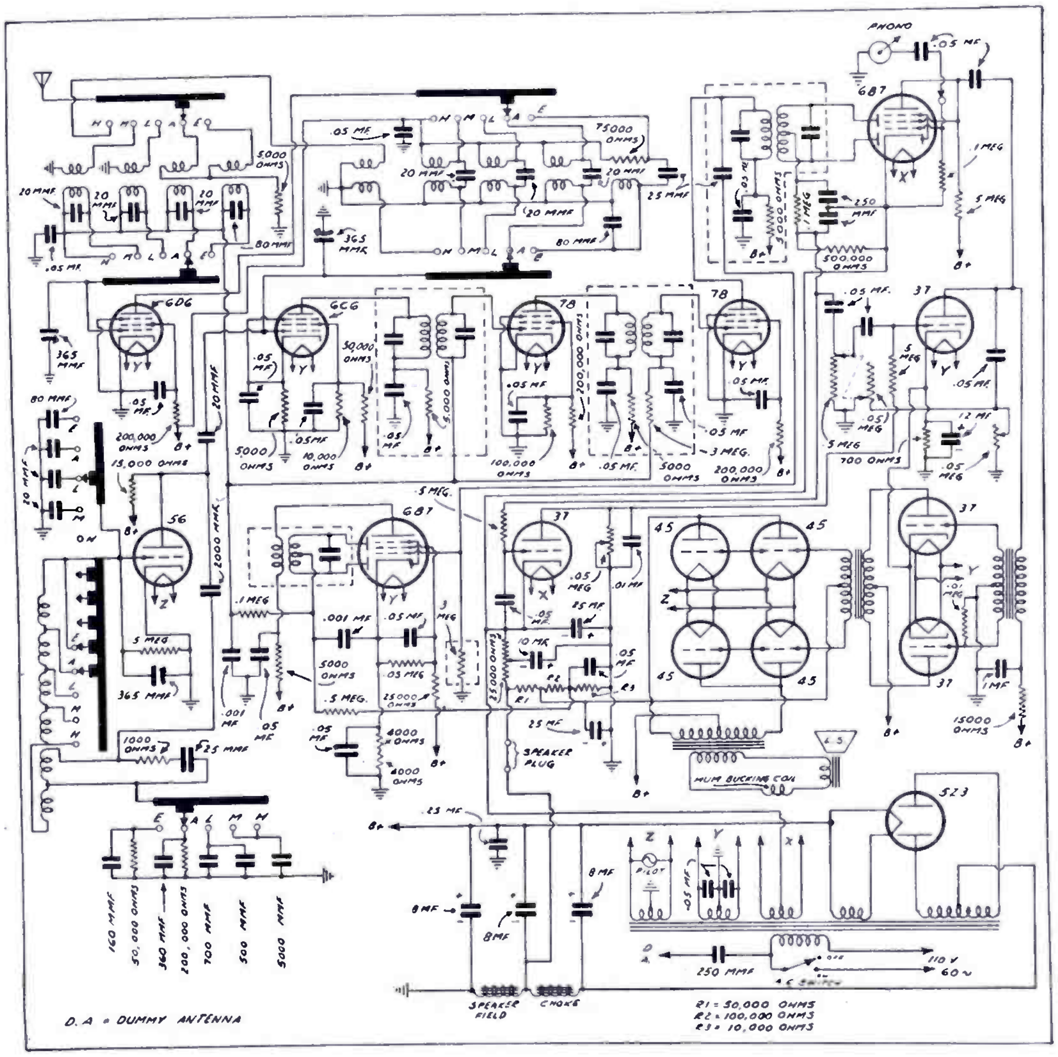
Provision is also made for the use of a phonograph pick-up. As will be seen in the schematic circuit, the pick-up connects between the control grid of the 6B7 second detector and ground. Thus, the pentode section of the 6B7 becomes an audio amplifier for the phonograph, which is fed directly into the two type 37 tubes in push-pull. Note that this pentode section is not on audio amplifier for the signal received through the radio end of the receiver.

OPERATION AND PRECAUTIONS: To place the set in operation, insert all the tubes in their respective sockets, connect the antenna and ground to their respective posts, insert the speaker plug into its socket, and turn the extreme right-hand knob to the right. Of course, the power plug should be inserted in a 110 volt, 60 cycle outlet. The selector switch is then rotated to any desired point and tuning is accomplished by the mere rotation of the tuning knob. It is, perhaps, wise to tune to random stations very carefully and note the peculiarities of the receiver.

One thing will be immediately evident. Upon tuning to a strong signal, the background noise drops out rapidly, and the signal remains clear and strong. This action, as previously stated, is due to the a.v.c. action. It works very rapidly and is thus able to take up any fading within reasonable limits that may be exhibited by the signal.

This point was emphasized to your reviewer in the following manner. The receiver was tried in an apartment house; the next-door neighbor has a dial telephone. A fairly strong station was tuned in and could be heard loud and clear throughout the entire apartment. But, every time the people next door decided to dial, the a.v.c. action took place so rapidly that the signal dropped out in unison with the make and break of the contact points on the dial phone. Between these "makes" and "breaks," the signal came in again! In other words, the loud clicks, due to induction, decreased the sensitivity of the receiver because of the a.v.c. to such an extent that the received signal dropped in volume. This may sound like a disadvantage of the receiver, but it is certainly a pleasure to tune in different stations all over the world and not be bothered by rapid

(*Continued on page 39*)



Complete schematic circuit of the receiver described here.

An explanation of
Grid-Leak Power Detection

By Louis Martin

SUMMARY: *There seems to be a popular misconception to the effect that only grid-bias detectors are "power detectors." Although this idea was true some years ago, it is not true now. Some very excellent theoretical and experimental work has been done on grid-leak power detectors, and it is our purpose here to give you the information.*

The mathematics have been eliminated entirely, and the whole idea is presented both in descriptive and graphical form. The advantages and some of the disadvantages of this "new" method of detection are outlined, and conclusions drawn.

We urge you experimenters to try this system and let us know the results you obtain.

DETECTORS are generally classified under two headings—grid-leak and power. The first type is recognized by the familiar grid leak and grid condenser, while the second is distinguishable because of their absence. In general, grid-leak type detection is associated with weak signals and the "power" method with strong signals. It has also been generally assumed that all forms of power detection are of the grid-bias, or "plate," types.

During the past few years these general definitions have been modified to take care of a new type of power detector employing a grid leak and grid condenser in the conventional fashion. This detector is capable of handling large signals with low distortion and has the further advantage of additional amplification because of the amplification factor of the tube.

The mathematical treatment of this type of detection is extremely complex, and for this reason has not been explained in popular radio magazines to any appreciable extent. However, it is possible to treat the subject graphically and simply, so that the average reader will be in a position to know how this type of detection works, and what advantages, if any, it has over the regular plate "power detector" circuit.

An elementary detector circuit of the grid-leak and grid-condenser type is shown in Fig. 1. There is nothing unusual about it, with the possible exception that it is not essential that the grid return connect to the positive end of the filament in filament-type tubes, a connection which is absolutely necessary when weak signals are to be handled. In any event, no intentional bias is placed on the grid of the tube.

Theory of Operation

The theory of operation is simple. The signal voltage across the tuning condenser C1 is applied to the grid of the tube through Rg and Cg. Since the grid is at zero potential, or slightly positive, with respect to the negative end of the filament, grid current starts to flow on the positive parts of the signal cycles; no grid current flows during the negative parts. Furthermore since the signal voltage is large—this is a *power* detector—the grid current flowing is greater at the peaks of the signal than at any other time of the cycle. This grid current divides at junction *x*, a small part going through the grid leak and the major part charging the grid condenser. During those portions of the signal cycle when no grid current flows, this condenser charge leaks off through the grid leak.

Two main considerations enter at this point. First, the division of current through the leak-condenser combination gives rise to a voltage across this combination whose frequency is the same as the audio voltage impressed on the carrier. Second, the magnitude of this voltage, aside from the magnitude, frequency and percentage modulation of the signal, depends upon how fast the voltage across the grid condenser can discharge through the leak. If there were no grid leak, the condenser would maintain the accumulated charge after the first r.f. cycle, and any successive cycles of signal would produce no *change* in the voltage across the condenser. On the other hand, if the grid condenser were short-circuited, there would be no charge on the condenser at all.

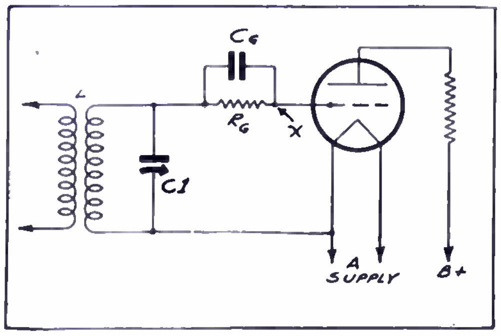


FIG. 1
Simple schematic circuit of a power grid-leak detector discussed here.

Since the current (grid) flows only during the positive parts of the r.f. signal cycle, rectification takes place in the grid circuit; hence the alternative name, grid-circuit rectification.

The status at this time is that the audio voltage of the signal is across the leak-condenser combination, and because the secondary of the r.f. tuning coil, L, offers practically no reactance to the flow of audio currents, this voltage across the combination leak and condenser is connected, as far as audio is concerned, directly from grid to filament. It is this voltage that actuates the plate circuit in a manner exactly analogous to that of any amplifier. Therefore, the output circuit of this method of detection is treated in the same manner as any amplifier.

A Graphical Analysis

Now, suppose the values of Rg and Cg are too large; what would happen? The grid condenser would be unable to discharge fast enough, with the result that by the time grid current would flow again, an appreciable part of the initial condenser voltage would still be present. The *variation* of the voltage across the combination would be small, and the total audio voltage would be small. This idea is shown in the composite illustration of Fig. 2.

The r.f. signal voltage is shown in the lower left-hand side of the diagram; the grid-voltage—grid-current curve is directly above it; the impulses of grid current are diagonally opposite the signal voltage curve. By following the construction lines it is possible to trace those parts of the signal cycle that produce grid current. It will be noted that grid current starts to flow only after an appreciable part of the signal cycle has elapsed, and that the grid current flows in short impulses. An important thing to note is that the straight part of the grid-current—grid-voltage curve is used, so that the grid current, when it does flow, is directly proportional to the grid, or signal, voltage. Hence, this form of detection is *linear*. Note, also that the line IJ corresponds to the line GH, the envelope, *or audio part*, of the signal.

Most of this grid current flows through the grid condenser, giving rise to a voltage across it. This voltage diminishes during the peaks of grid current because the condenser discharges. This point is well illustrated in the upper right-hand part of the diagram, which shows the variation of voltage across the grid condenser during *each cycle* of the r.f. signal voltage. Note that between impulses of grid current, the condenser voltage goes up—it becomes more positive. This, in reality, constitutes a decreasing voltage, since the audio voltage across the grid is always in such a direction as to make the grid negative with respect to the cathode or filament.

This series of curves shows another interesting fact. The line GH represents the audio part of the signal; the line IJ represents the increase in the peaks of the grid current, which correspond in form to GH; the line DF represents the *average condenser voltage.* This average condenser voltage follows the envelope GH, so that DF is the signal voltage that is amplified by the tube itself and appears on the plate circuit.

The pretty theory depicted by the curves of Fig. 2 is based upon the fact that the grid condenser can discharge as fast as the modulation envelope (line GH) decreases. Under these conditions, the distortion will be nil. Suppose the leak and condenser are too large, so that it takes a long time for the latter to discharge, what then? Since the condenser cannot discharge fast enough, it cannot follow the higher audio frequencies; the result is frequency distortion. The smaller Cg and Rg, from this standpoint, the less the distortion. Such is exactly the case.

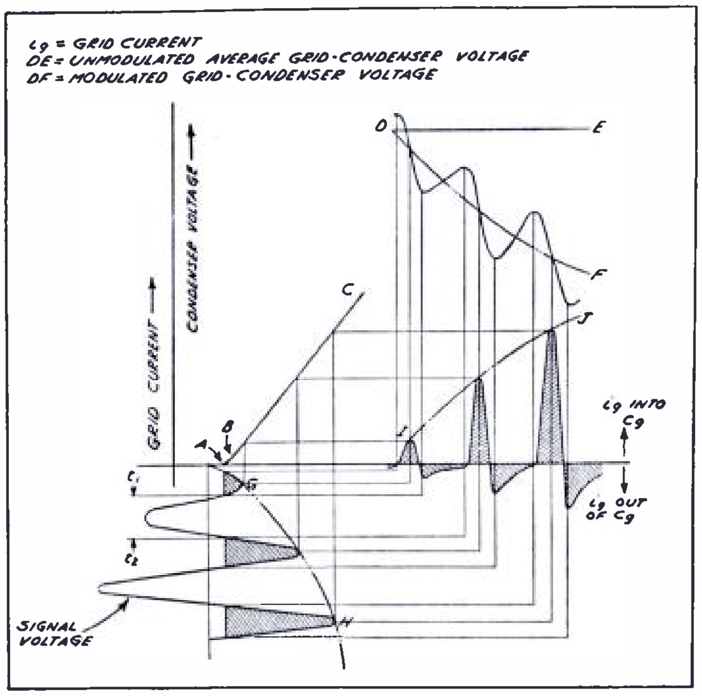


FIG. 2

Graphical analysis of the grid leak type of power detector. Note that the grid condenser starts to discharge after time t_1. If the signal is weak enough to swing the curve from point A to B, then detection follows the square law; when the signal is large enough to swing from point A to point C, the straight part of the curve, then detection is linear. The line DF is the average change in grid voltage, and it follows the envelope of the carrier signal.

Optimum Size

It appears, though, that Rg and Cg cannot be made too small. Note from the diagram of Fig. 1 that, as far as the radio-frequency signal is concerned, the actual voltage on the grid is the signal voltage across the tuning condenser C1 minus the voltage drop across the leak-condenser combination. If the impedance of the combination is very high (Rg and Cg small), then the voltage drop across it will be high, and the actual voltage across the grid and cathode or filament will be greatly diminished.

The problem may be looked at another way. The leak-condenser combination is connected in series with the input tube capacitance to the signal voltage. If the impedance of the combination is made high in order to decrease frequency distortion, then the voltage drop across the tube input capacitance will be small. And a small signal voltage means a small audio voltage.

A good rule to follow, therefore, is to make the size of the grid condenser about five to ten times the value of the tube input capacitance. With ordinary tubes, the grid input capacitance is about 10 to 20 mmf. The grid condenser, therefore, may have a value of about 50 to 100 mmf. With this fixed, the next determination is that of the grid leak. What determines its size?

Its size is determined by the relative input impedance of the tube and the leak-condenser combination, the percentage modulation of the signal, the efficiency of detection, etc., but usually the value in practice is about ¼ to ½ megohm. With a 100 mmf. condenser and a ¼ or ½ megohm grid leak, the discharges of the condenser can follow the modulation envelope quite readily, resulting in good quality and excellent rectification at high signal levels.

The maximum signal that the grid-leak power detector can handle without distortion is limited by the curvature of the grid-voltage—plate-current curve. With high signal voltages, the average grid potential is highly negative, and the plate current fluctuates about the lower *curved* portion of the plate characteristic. Distortion is thus introduced in the plate circuit.

In practice, a tube operated as a grid-leak detector can handle from one-half to one-third the signal that the same tube can handle as an amplifier with the same plate supply voltage. The *audio* voltage which such a tube can deliver compared to the same tube as an amplifier is about .7 the ratio of inputs mentioned in the previous sentence.

The choice of tube suitable for power grid detection is based almost entirely upon the use of the tube as an amplifier. As pointed out previously, the audio voltage appearing across the leak-condenser combination is applied between the grid and cathode or filament of the tube and is amplified in the usual manner. Only in one respect does its mode of operation differ from that of the usual amplifier: the greater the signal, the more negative the grid; and the more negative the grid, the higher the plate impedance, usually. This means that for a given voltage output in the plate circuit, the load impedance must be greater in the grid type of power detector than in any other type.

The plate-circuit distortion, which limits the signal voltage which may be rectified, may be minimized by increasing the plate voltage. This may be safely done until the plate voltage times plate current with *no* signal is equal to the safe power that the tube can dissipate.

This method of detection is more linear than the plate power method, is slightly more sensitive, and is less critical, as far as distortion is concerned, than plate power detection. Its main disadvantage is that the input resistance is rather low, which broadens the tuning of the detector stage and results in a "high loss" circuit.

A Note on Grid-Bias Resistors

WE are in receipt of a number of inquiries on an apparently simple phenomenon that seems to puzzle the wide awake and observant radio man. This point is simply that various commercial or home-built receivers do not use the same values of grid-bias resistors for the same type of tube with the same voltage impressed. In other words, it would seem that it is perfectly logical for a certain tube to use a certain value of grid-bias resistor and it is just as illogical for the same tube in the same electrical position with the same voltages impressed to have a different value of grid bias resistor simply because another individual or manufacturer has made it. Our readers want to know why these discrepancies occur.

This question gives rise to a most important point which has not been sufficiently emphasized in previously published technical dissertations. Suppose a tube such as the 56 is to be used as a detector. What should be the value of its grid-bias resistor? By referring to the chart on page 27 of the March, 1934, issue, we find that the value of the grid-bias re-

(*Continued on page* 40)

Triode Characteristics of the 42 and 2A5 Tubes

THE 42 or the 2A5 when used as a triode in push-pull audio amplifiers gives good power output and low distortion. Operating conditions and performance results are given for these tubes in over-biased push-pull amplifiers having (a) fixed-bias voltage from a battery and (b) self-bias voltage from a cathode resistor. Both driver and output stages use the same tube type connected as a triode.

Optimum performance results for fixed- and self-bias conditions are shown in Figs. 1 and 2, respectively. From these curves, it is apparent that the greatest power output is obtained with the fixed-bias condition. This represents the ideal case because the fixed bias from the low-resistance battery employed minimizes degenerative effects. When the grid-bias voltage is taken from the power-supply voltage divider (semi-fixed bias) or a from a self-biasing resistor, the power output is reduced for two reasons. These are (1) that the bias-voltage fluctuates due to change in d.c. plate current with signal, and (2) that the bypassing of the a.c. component around the biasing resistor may be inadequate. Ordinarily, the power output will be somewhat less with self-bias, because this arrangement generally has the poorest regulation. Semi-fixed bias will give results between the fixed- and the self-biased arrangements. The curves of Fig. 2 show the optimum power output that can be obtained with the self-bias arrangement under the given conditions. In this case, sufficient capacity was used across the cathode resistor to reduce its impedance to a negligible value.

Table I gives the essential data for triode operation of two 42's or two 2A5's as over-biased push-pull audio amplifiers. This kind of amplifier is identified by us as a class AB amplifier. Class AB operation is intermediate to class A and class B operation.

TABLE I

Driver tube: Type 42 or Type 2A5; plate volts = 250; grid volts = -20; screen tied to plate.
Output stage: Two Type 42's or Type 2A5's; with no signal input, plate volts = 350 and grid volts = -38.

	Fixed Bias	Self Bias
Driver plate load	24600	25200 ohms
Interstage transformer ratio: Primary to ½ secondary	1.6 to 1	1.14 to 1
Transformer efficiency	84.5	65.0 P.C.
Peak grid voltage on output tubes (per grid)	63.5	82.15 volts
Peak power input to grids of output tubes	366	300 mw.
Plate-to-plate load	8000	8000 ohms
Power output (5% distortion)	18.4	14.8 watts
Self-biasing resistor	......	730 ohms

Table II gives the characteristics of a 42 or a 2A5 for triode operation as a class A audio amplifier.

TABLE II

Plate voltage	250 max.	volts
Control grid voltage	-20	volts
Plate current	31	ma.
Mutual conductance	2300	micromhos
Plate resistance	2700	ohms
Load resistance	3000	ohms
Power output	650	milliwatts

From Table I, it will be noted that the driver tube is required to supply peak input power of either 366 or 300 milliwatts to the grids of the power tubes. When transformer efficiency is taken into account, the driver must supply 434 and 460 milliwatts peak, or 217 and 230 milliwatts r.m.s., for the fixed- and self-bias conditions, respectively. These operating requirements are well within the capabilities of either the 2A5 or 42, since either type as a driver is capable of supplying 650 milliwatts (see Table II).—*RCA-Radiotron Co., Inc.*

Editorial Note

Is there any such thing as a "short-wave tube"? This question is not as queer as may seem at first thought. Certain tubes—output tubes in particular—are used to a greater extent in short-wave receivers than others—and for a very good reason, too. Power sensitivity, reasonable power output, tube noise, all contribute to the choice of an output tube for short-wave receivers.

The data given here are particularly pertinent. The 2A5 is a favorite tube for s.w. sets; the 42 is the same tube in the 6.3-volt series. This latter tube has been re-rated recently, to work with 250 volts on the plate, and, for this reason, its operation as a triode is important.

The curves given should be studied carefully. Fixed bias vs. self bias is an important question in public-address work; it is no less important for s.w. applications if good quality is desired.

The plate characteristics shown in the figure directly below may be used to compute the characteristics given in Figs. 1 and 2 for any load requirement, except, of course, the grid current characteristics. This computation is of value when the load into which the amplifier is fed is different from that stated on the curves themselves. Study this article carefully.
—*Tech. Dir.*

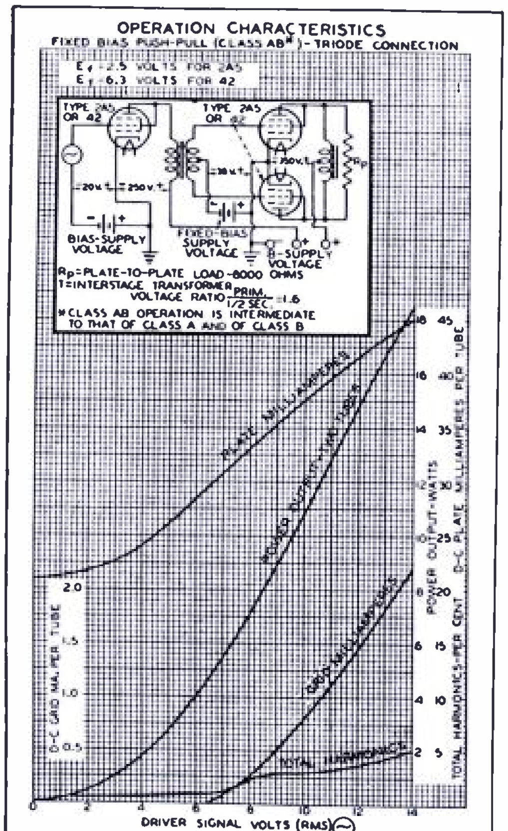


FIG. 1

Characteristics for fixed bias.

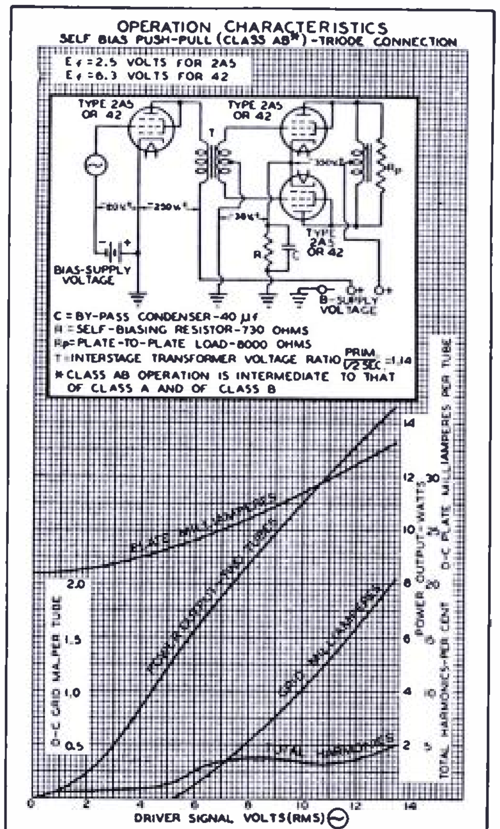


FIG. 2

Characteristics for self bias.

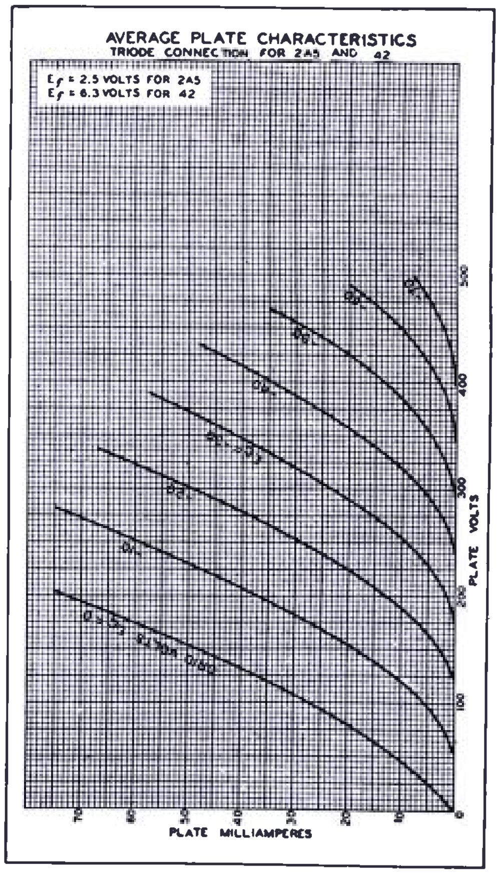


Plate characteristics of the 42 and 2A5.

A Universal A. C.-D. C. Short-Wave Receiver

SUMMARY: *This is one of the few short-wave receivers now available that operates from either a.c. or d.c. This feature, which captured the market in the broadcast field, is now available in the strictly s.w. sets. This set has many other novel features of interest to all.*

Front view. Note that the coils plug in from the front of the panel.

By M. K. Baker*

LACK of a.c. has, hitherto, handicapped many short-wave enthusiasts, but the introduction of a new universally powered short-wave receiver, which can be supplied from either 110 volts a.c. or d.c., batteries, or, with the aid of an adapter, from 220 volts or other a.c. or d.c. lines, and which is described in the following paragraphs, has removed this drawback. Aside from its quiet, universal power supply, this set also incorporates such features as tuned radio frequency, silver wire-wound inductors, 6F7 pentode-triode, and a speaker-cutout phone jack.

Tuned radio frequency was used in preference to other types of circuits in order to attain the greatest possible degree of quiet sensitivity. Here, the 78 r.f. pentode provides ample gain.

The 6F7 is a 6.3 V. heater tube which combines in one envelope a triode and an r.f. pentode of the remote cutoff type. These two units are independent of each other, except for the common cathode. The pentode section functions here as an exceedingly stable regenerative detector, and is impedance coupled to the triode portion (1st a.f. stage), which, in turn, is capacitatively coupled to the 43 (final audio stage). Thus, we have ample sensitivity, selectivity, stability, and good audio quality. Steady plate current is supplied by the 25Z5.

Regeneration is smoothly controlled by variation of the detector screen voltage. An improved type of potentiometer is employed for this purpose. The resistance element is a fused carbon block over which a tiny silver wheel rolls. As a result, very smooth control is effected. This, together with careful selection of the other components in the feedback circuit, results in complete elimination of threshold howl.

It is universally conceded that the plug-in coil method of wave-band changing is most efficient. A new type of front panel plug-in coil was devised for use with the Internationale. The windings are composed of silver wire, wound around the inside of the protective "lo-loss" form. Thus, all danger of damaging the windings when inserting the coils is entirely eliminated and the band changing problem is most satisfactorily solved from the angles of efficiency, convenience, and durability.

The phone-jack circuit will seem puzzling at first glance; but a close inspection will reveal that, when in use, the output terminals are shorted and the phones are connected in the cathode.

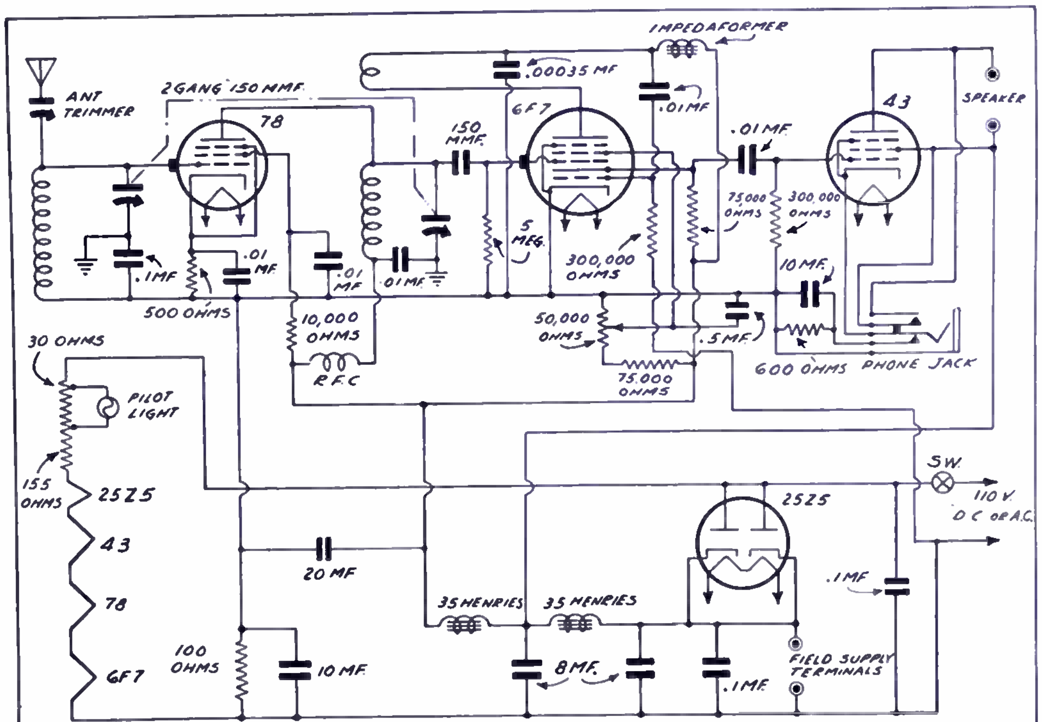
The filter circuit presents several departures from conventional practice. Upon casual examination, the filter circuit would appear to be the usual two section condenser-input arrangement; but the voltage dropping circuit providing grid-bias for

(*Continued on page 46*)

* Alan Radio Corp.

PARTS LIST

- 2—35 H. chokes.
- 1—Impedaformer, 200 H.
- 1—two gang .00015 mf. variable condenser.
- 1—antenna trimmer, 50 mf.
- 5—.01 mf. 400 V. pigtail condensers.
- 3—.1 mf. 400 V. pigtail condensers.
- 1—.5 mf. 400 V. pigtail condenser.
- 1—.00035 mf. mica condenser.
- 1—.00015 mf. mica condenser.
- 2—10 mf. 30 V. electrolytic condenser in aluminum can.
- 1—electrolytic block containing: one 20 mf. and two 8 mf. 200 V. sections.
- 1—500-ohm resistor, 1/2 watt.
- 1—10,000-ohm resistor, 1/2 watt.
- 1—5 meg.-resistor, 1/2 watt.
- 1—75,000-ohm resistor, 1/2 watt.
- 2—300,000-ohm resistors, 1/2 watt.
- 1—75,000-ohm resistor, 1 watt.
- 1—600-ohm resistor, 1 watt.
- 1—100-ohm resistor, 1 watt.
- 1—25-watt vitreous enameled 185-ohm resistor, tapped at 30 ohms.
- 1—Dial and escutcheon.
- 1—78 socket, six-prong.
- 1—6F7 socket, seven-prong.
- 1—43 socket, six-prong.
- 1—25Z5 socket, six-prong.
- 2—coil sockets, four-prong.
- 1—speaker terminal strip.
- 1—field terminal strip.
- 1—ant.-gnd. terminal strip.
- 2—Grid caps.
- 2—small dome type shields.
- 1—large dome type shield.



Schematic circuit and list of parts for the universal A.C.-D.C. operated set.

- 1—off-on switch.
- 3—knobs.
- 1—line cord.
- Wire, solder, etc.

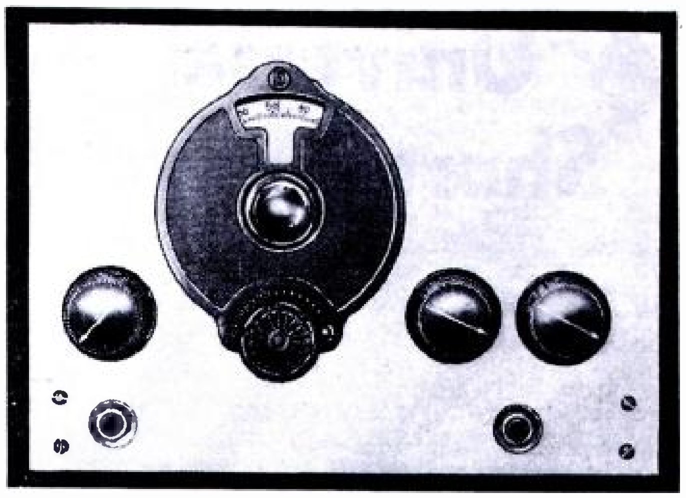
Note: Use specified resistor values in power unit for safety.

- Internationale punched chassis.
- Internationale cabinet.
- Internationale coil housings.
- Set of front-panel plug-in coils.

The "Super Dynatron"

A 3-tube set of unique design

SUMMARY: *We present herewith one of the most uniquely designed three-tube receivers that has come to our attention in a long while. The author makes use of the negative slope of the plate-current curve by balancing it against a positive load. The result is high amplification. This little receiver should find favor among those interested in three-tube sets of this type.*



Panel view of the Super Dynatron receiver. The two jacks and various controls are clearly visible. Note that the tuning dial is not in the center of the panel.

By J. A. Worcester, Jr.

THE receiver described in this article employs a screen-grid r.f. tube used as a dynatron amplifier. Although the use of the dynatron characteristic for the production of oscillation is comparatively well known, its use as an amplifier has received little attention and is probably unknown to the average radio amateur. This state of affairs is somewhat surprising in view of the fact that while the maximum possible amplification in an ordinary amplifier is equal to the amplification constant of the tube employed, the dynatron is capable of a theoretical amplification of infinity.

In practice, of course, neither of these limiting conditions is approached. In an ordinary amplifier the amplification constant of the tube, μ, can only be obtained if the impedance of the r.f. transformer is infinite at resonance. It is, of course, impossible to meet such a condition; as a matter of fact, it is impossible to even approach the plate resistance of the tube., Consequently while the amplification factor of a 58 r.f. pentode is 1280, the actual average gain over the short-wave range that can be obtained from a tuned r.f. stage is generally not more than 20, and for an untuned stage, such as is used in this receiver, not more than unity.

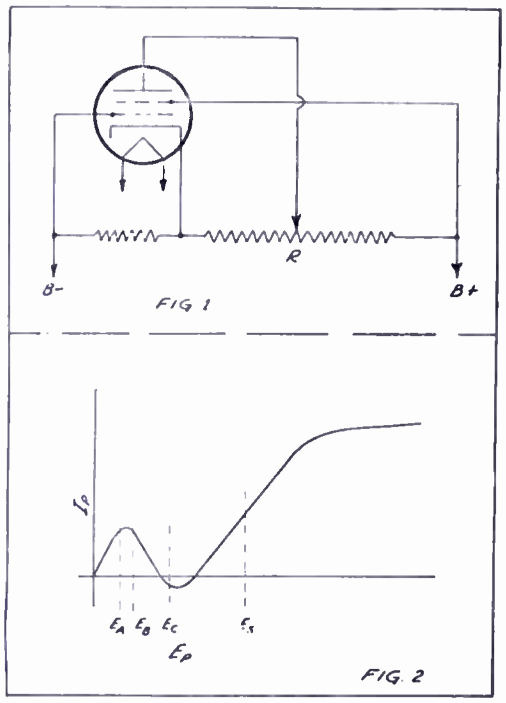
Theory of Operation

In the dynatron amplifier, infinite amplification is not obtained unless the impedance of the output circuit is equal in magnitude to the plate resistance of the dynatron; and when this condition obtains, the tube oscillates. In practice, then, the adjustment somewhat resembles regeneration, in that the plate circuit impedance is increased until the circuit "plops" into oscillation. The amplification possible depends on the stability of the circuit, and, for this reason, the plate resistance of the dynatron is fixed at its most stable point and the equivalent output impedance increased by regeneration in the detector circuit.

It might be advisable to point out that this adjustment differs materially from regeneration as used in an ordinary amplifier, in which the limiting condition produced by regeneration is zero series resistance in the tuned circuit and, consequently, infinite parallel resistance. This makes it possible to more nearly approach the theoretical amplification of μ in this type of amplifier. In the dynatron amplifier, regeneration makes it possible to more nearly match the output impedance to the negative resistance of the tube and, hence, more nearly realize the theoretical amplification of infinity.

Before considering the constructional details of the receiver to be described, we will revert briefly to fundamentals and describe what a dynatron characteristic is, how it is produced, and why it can be employed as an amplifier and oscillator.

In Figure 1 is shown a diagram of a screen-grid tube with a fixed positive potential applied to the screen and a variable positive potential applied to the plate by means of the potentiometer R. By noting the curve shown in Fig. 2, the variation of plate current with change of plate voltage can be seen. As the plate voltage is increased from zero, the plate current at first increases in normal fashion until the voltage E_a is reached. When the plate voltage is increased beyond this value, the electrons attracted to the plate reach a high enough velocity to enable them to rebound, or "bounce," from the plate when they strike. This is known as "secondary emission." Normally, these electrons would immediately return to the plate because of its positive potential, but, with the connection employed, whereby the screen has a potential E_s, an increasing percentage of these rebounding electrons are attracted to the more positive screen. As the plate voltage is increased beyond E_b, the number of rebounding, or secondary, electrons flowing to the screen exceeds the *net* number flowing to the plate, and the curve assumes a negative characteristic, since an *increase* in plate voltage produces a *decrease* in plate current.



Simple schematic showing the manner in which the screen and plate voltages are obtained. The points of operation are shown in the curve.

It is the portion of the plate voltage-plate current curve extending from E_b to E_c that is known as the dynatron characteristic. Above E_c, the plate voltage becomes more nearly equal to the screen voltage, so the latter is not able to attract many of the secondary electrons emitted from the plate, and the plate current increases again in normal fashion until saturation is reached.

Negative Resistance

The important thing to note is that a negative resistance is produced in the region extending from E_b to E_c. If a tuned circuit is connected across this negative resistance, sustained oscillations will be produced if the impedance of the tuned circuit is greater than the negative resistance. If the impedance of the tuned circuit is less than the negative resistance, an amplifying action will occur. The actual mathematics involved is somewhat beyond the scope of this article, but the interested reader is referred to Morecroft's *Principles of Radio Communication*, pages 628 to 631, and Van der Bijl's *The Thermionic Vacuum Tube and Its Applications*, pages 378 to 380, for a complete analysis.

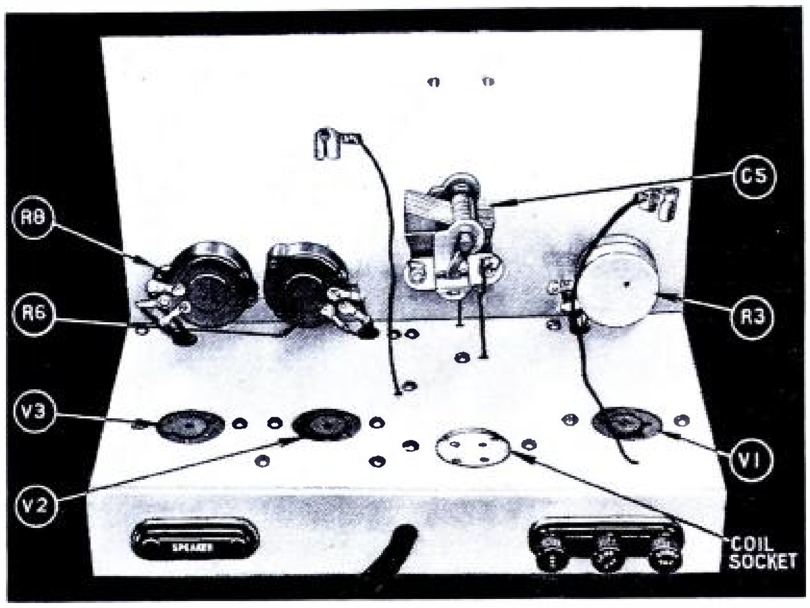
The receiver to be described employs an untuned r.f. amplifier for the sake of simplicity. Ordinarily such an amplifier will not produce any appreciable gain and generally acts as a losser at the higher radio frequencies. It has some advantages over direct coupling of the antenna circuit to the regeneration detector, however, in that "dead spots" are quite effectivelly eliminated and radiation from the detector when in an oscillating condition is impossible.

When using the dynatron characteristic, however, the untuned r.f. amplifier will produce a marked gain and appears to be every bit as good as a tuned r.f. stage. Under some conditions, particularly at the very high frequencies, it may be found advisable to connect the antenna to the binding post B instead of A—Fig. 3—as normally. The receiver is then a normal regenerative detector with the dynatron amplifier across the tuned input circuit. As a matter of fact, this latter connection is the true dynatron amplifier connection.

The tubes employed in this receiver are a 24 dynatron amplifier, a 57 detector, and a 2A5 audio-frequency amplifier. The r.f. pentode tubes of the 57 and 58 types do not seem to have very good dynatron characteristics, even when the suppressor is tied to the screen.

As stated before, the external load impedance and dynatron negative re-

Deck view of the receiver. The volume control is on the extreme left and the regeneration control is located to the right of the v 'ume control; R3 is used to adjust the plate voltage on the dynatron amplifier for best results. Note the battery cable protruding from the rear.



sistance are brought as near as possible to equality by decreasing the effective series resistance of the detector input circuit by means of regeneration. This is produced by the choke L3 in the cathode lead of the detector tube which produces a common capacitative reactance in the grid and plate circuits. Regeneration is controlled by the variable resistor R6, shunted across the choke.

This connection furnishes enough feedback for the purpose and enables the use of a full 22½ volts on the screen of the 57. It was found that controlling regeneration by the usual method of varying the screen-grid voltage resulted in a marked decrease in volume.

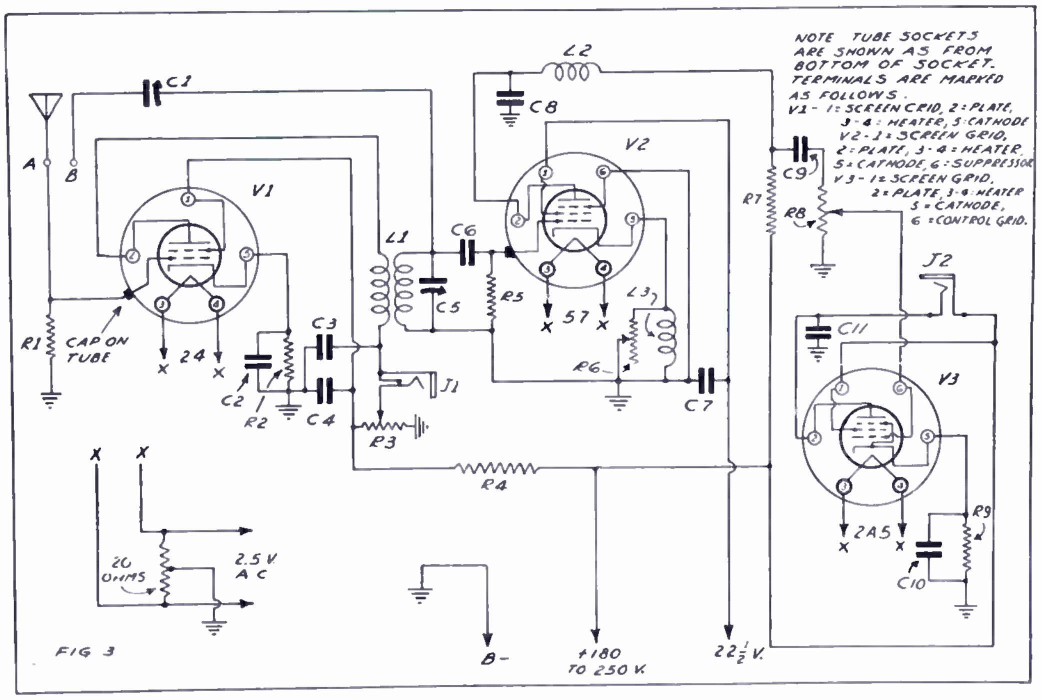
The audio-frequency amplifier is conventional and uses resistance coupling. Volume is controlled by the potentiometer R8.

The chassis for this receiver consists of a 7" x 10" 14-gauge aluminum panel and a subpanel 10" x 5½" x 1½". On the panel are mounted the three potentiometers, R3, R6 and R8, and the tuning condenser, C5, with its associated dial. The potentiometer, R3, is mounted to the left of the tuning dial, while the remaining two are mounted to the right as shown in the photographs. The location of the various parts on the subpanel can be noted from the photographs.

The schematic diagram showing the proper wiring of the various components should be followed when making connections. The coils are wound on 1½" isolantite coil forms and specifications for winding are given in Table No. 1. The primary winding is interwound with the secondary, starting from the bottom end of the secondary winding. When wiring the coil socket, connections should be made so that the bottom

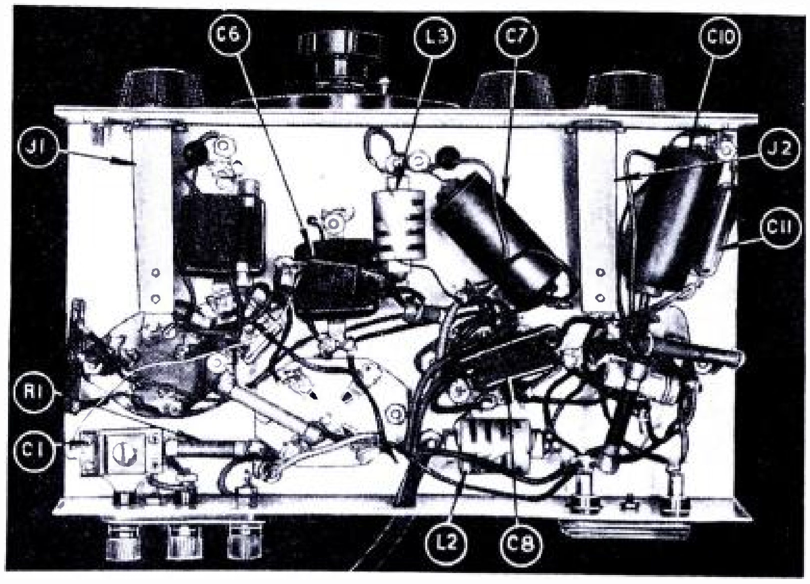
PARTS REQUIRED

C1—Hammarlund EC-3 adjustable mica condenser, 3 to 35 mmf.
C2, C3—Polymet .005 mf. fixed mica condensers.
C4—Solar .0025 mf. fixed mica condenser.
C5—Hammarlund 140 mmf. variable condenser, MC-140-m.
C6—Solar .0001 mf. fixed mica condenser.
C7—Cornell Dubilier .5 mf. tubular bypass condenser.
C8—Aerovox .0005 mf. mica condenser.
C9—Cornell Dubilier .01 mf. tubular bypass condenser.
C10—Cornell Dubilier 25 mf. 25-volt dry electrolytic condenser.
C11—Polymet .002 mf. mica condenser.
L1—4 Hammarlund isolantite four-prong coil forms wound as specified, CF-4.
L2, L3—Hammarlund 8 mh. rf. choke, CH-8.
R1—Lynch 10,000-ohm metallized resistor.
R2—Lynch 200-ohm metallized resistor.
R3—Electrad 50,000-ohm potentiometer, R1-205.
R4—Lynch 30,000-ohm metallized resistor.
R5—Lynch 3 meg. grid leak.
R6—Centralab "Elf" 5,000-ohm potentiometer.
R7—Lynch 250,000-ohm metallized resistor.
R8—Centralab "Elf" 500,000-ohm potentiometer.
R9—Lynch 500-ohm metallized resistor.
1—Blan Chassis, as described.
1—National type B dial.
2—Eby six-prong wafer sockets.
1—Eby five-prong wafer socket.

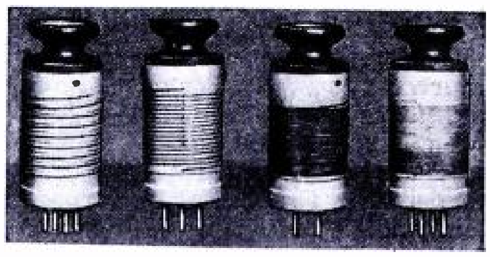


Complete schematic circuit of the Super Dynatron receiver.

1—Hammarlund four-prong isolantite socket.
1—Eby triple binding post assembly.
1—Eby speaker-jack assembly.
1—Yaxley closed circuit jack, J_1.
1—Yaxley open circuit jack, J_2.
1—Roll Belden Hook-up wire.
1—20-ohm center-tapped resistor.
2—National grid clips.
3—Knobs.
1—R.C.A. Radiotron type 24 tube.
1—R.C.A. Radiotron type 57 tube.
1—R.C.A. Radiotron type 2A5 tube.



Underview of the chassis. The major parts are listed for convenience; for their values, see the list of parts on the previous page. The coil data is printed in the table below.



Photograph of the set of coils used by the author with the Super Dynatron receiver. They are wound on Isolantite forms for high efficiency.

TABLE NO. 1—COIL DATA

Wavelength Range	Coil No.	Secondary Winding: No. of Turns	Secondary Winding: Wire Size	Primary Winding: No. of Turns	Primary Winding: Wire Size
18-36 m.	1	8¼	No. 22 en.	8½	No. 35 d.s.c.
35-70 m.	2	17	No. 22 en.	17½	No. 35 d.s.c.
70-140 m.	3	34	No. 22 d.s.c.	21	No. 35 d.s.c.
140-280 m.	4	68	No. 35 d.s.c.	22	No. 38 d.s.c.

of the secondary winding connects to the ground and the top of the primary winding to the plate of the dynatron tube. The remaining coil connections are obvious from an inspection of the wiring diagram.

To put the set into operation, it is first necessary to adjust the plate voltage of the 24 tube to the proper value for dynatron operation by means of the potentiometer R3. To do this, insert a pair of headphones in the jack J1, and adjust R3 until a loud audible note is heard. While this adjustment is being made, it is necessary to remove the 2A5 tube unless another pair of phones is available to keep plate voltage on this tube.

Adjust the potentiometer R3 until it is about in the center of the audible area, then remove the phones from J1, and insert them in the output of the 2A5. Some further slight adjustment of R3 may be found necessary later for most satisfactory results. It should be emphasized here that 24 tubes vary widely in dynatron characteristics and, if possible, several tubes should be tried in this position.

Book Review

SHORT-WAVE RADIO HANDBOOK, by Clifford E. Denton, published by Standard Publications, Inc., New York, N. Y., 6½ by 8½ inches, 128 pages, over 150 illustrations, durable black covers. Price, $1.00.

Theoretically, there is very little difference between the principles of short-wave and long-wave receiver construction; practically, however, the difference is so vast that one versed in the practical side of long-wave receiver construction may possibly fall down completely when it comes to getting a short-wave receiver working properly. The Handbook here described places before the reader a vast fund of short-wave knowledge heretofore not available between the covers of a single book.

The problems of short-wave radio are treated in a logical sequence. The design of special audio systems, detectors and r.f. systems are described in order. The complete absence of complicated and confusing mathematics, and the liberal use of curves, diagrams, and charts, make this book one of the most valuable to the technically untrained short-wave receiving amateur. Nothing is left to the imagination of the reader. Every idea is vividly portrayed by clear diagrams.

The book contains a most comprehensive array of coil data. Various types of windings for different types of tuning condensers are shown in pictorial form. A frequency-wavelength conversion table, complete from one meter to twenty-five thousand meters, is of valuable assistance. Copper wire tables of various sorts for both solid and Litz wire make guess work unnecessary. A very useful chart showing the reactance of standard sized fixed condensers at definite frequencies bring out forcibly the requirements for short-wave filtering.

The book is so full of constructive, practical data that it is difficult to outline all of its features in a single review.

Of special importance is the construction chapter, which describes various forms of short-wave receivers and oscillators of interest to every short-wave enthusiast.

This book should go a long way toward coordinating the knowledge of the short-wave experimenter.

ELECTRONS AT WORK, by Charles R. Underhill, published by McGraw-Hill Book Co., Inc., New York, N. Y., 6 by 9 inches, 354 pages, 220 illustrations, cloth covers. Price $3.00.

The photoelectric art has made some very rapid advances in the last few years, and the usual textbook on this subject becomes obsolete almost as soon as it is off the press. Most textbooks on this subject may be classed as either theoretical or practical. Those stressing the theory usually have a long life, but have the disadvantage of being of service only to a limited number of engineers. On the other hand, those books on photo electricity of a practical nature, although they interest a very large group of people, become obsolete very quickly. For a long time there has been a need for a book sufficiently theoretical to satisfy inquiring minds and, at the same time, be sufficiently practical in a fundamental sense to coordinate the knowledge of the average reader.

This book is a guide to those who desire a general knowledge of the subject of electronics. Mathematics is noticeable by its absence, and so the book may be classed as more or less "popular," although it needs but the addition of mathematics to make it comprehensive.

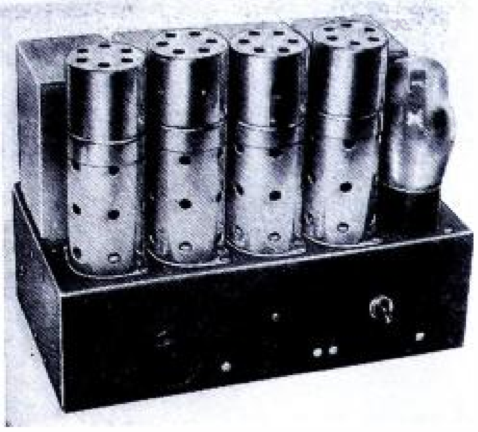
The purpose of the book is stated very briefly and accurately by the author in his introduction: "The book aims to take the mystery out of electronics." Such mysterious terms as electrons, neutrons, protons become a part of one's everyday vocabulary after the first few chapters. This book is without any doubt one of the finest treatments of the subject of electronics that has yet come to the attention of your reviewer.

L. M.

DEFINITE operating frequencies for the *Seth Parker*, the four-masted schooner now on a round-the-world trip (see page 7, April, 1934 issue) have been assigned by the Federal Radio Commission. They are as follows:

6660 kc. (45.05 meters); 6670 kc. (44.98 meters); 8820 kc. (34.01 meters); 8840 kc. (33.94 meters); 13200 kc. (22.73 meters); 13230 kc. (22.68 meters); 17600 kc. (17.045 meters); and 17620 kc. (17.026 meters).

The *Seth Parker* will maintain contact with the United States for rebroadcasting purposes. Voice transmission will be used.



General view of the i.f. amplifier unit.

A New I.F. Amplifier Unit

SUMMARY: *Here is a little device that we believe many experimenters have been waiting for. It is a compact i.f. amplifier designed to tie in after the first detector of a superheterodyne. Not only that—McMurdo Silver incorporated a second detector and final output tube on the same chassis, so that the entire unit as described below is more than half a radio set. The unit itself is described below; next month it will be used in conjunction with a typical tuner in a typical circuit.*

RESTLESS experimenters who believe that they have tried every worth-while version of t.r.f. and regenerative receivers are turning their attention more and more to the superheterodyne type of receiver. This type offers a relatively greater outlet for self-expression, and for this reason is finding favor among the more advanced experimenters.

The superheterodyne consists of three distinct units: (1) the r.f. amplifier and mixer tube; (2) the i.f. amplifier, and (3) the second detector and audio amplifier. The latter two units are more or less standard, their mode of operation having passed the experimental stage several years ago when the broadcast-band craze was rampant. It is the r.f. and mixer-tube circuits that have enough experimental possibilities to satisfy the most hungry constructor.

The unit to be described here is a complete i.f. amplifier, second detector, beat oscillator, and audio amplifier, and paves the way for convenience in experimentation heretofore unattainable. In short, it permits any r.f. tuner equipped with an oscillator and mixer tube to be converted into a superheterodyne—the so-called i.f. unit shown here supplying the remainder of the receiver.

Here are a few ideas which the experimenter or set constructor can try out. Take your t.r.f. or regenerative receiver, gang another tuning condenser to the shaft of the one you already have (if your tuning unit consists of a single condenser, the addition will make it a two-gang affair), wire up another tube as an oscillator, disconnect the entire set *after* the detector, connect the output of the detector to the input of the device shown here, connect the speaker to the output of the device, and away you go! The only thing you must be sure of is that the intermediate frequency is 465 kc.

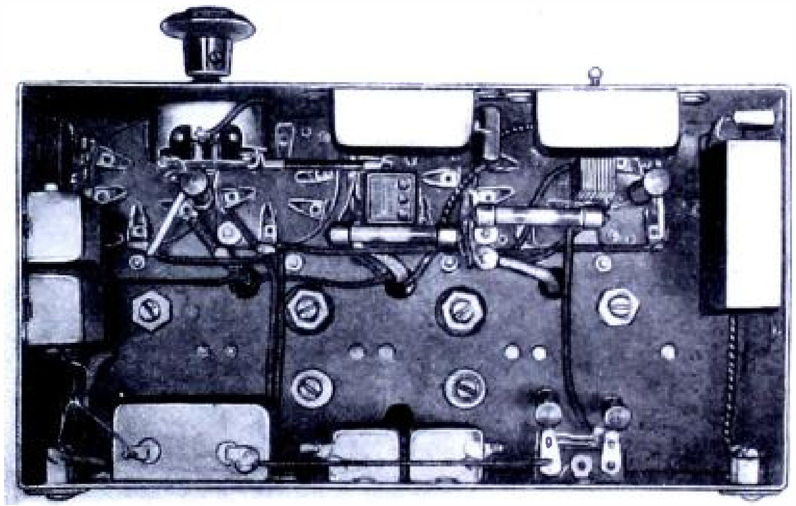
Another test you fellows with home-made supers can make: Simply disconnect everything after the first detector and connect the new unit. You will be amazed at the difference in results—especially if your present amplifier is out of line or poorly designed. If an account were taken of the condition of all the supers in use, it would be safe to say that there are more poorly designed than correctly designed i.f. amplifiers. And yet you complain of supers being noisy!

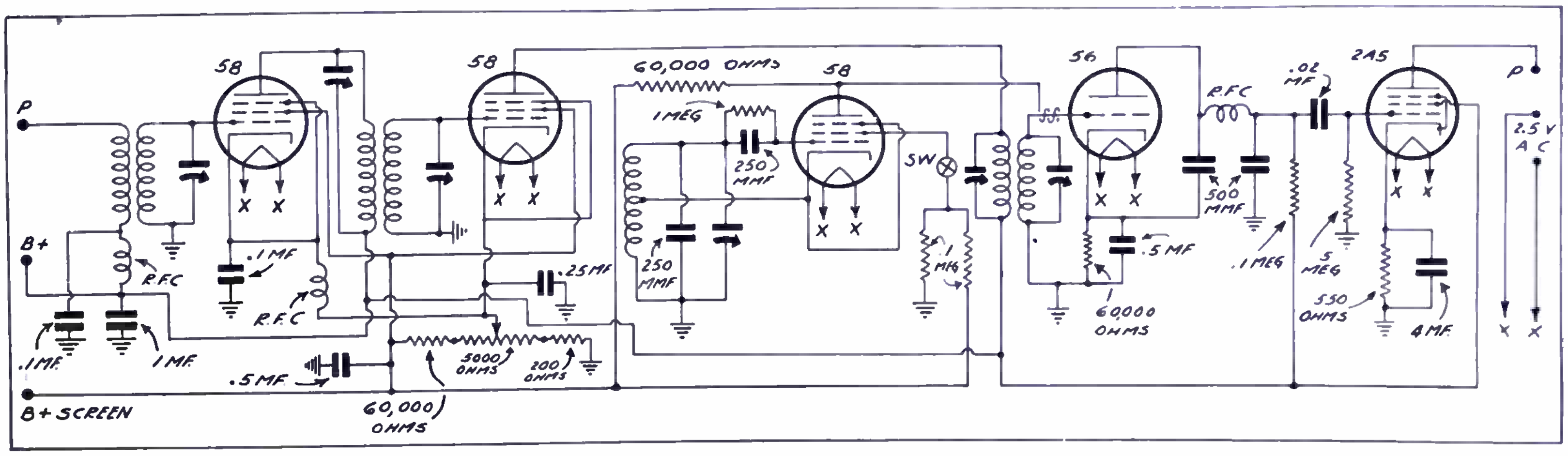
Here is a tip for the man building his first super. You know, there are a lot of tricks to be followed in getting a good super to work properly. Even though you follow printed instructions to the letter, there are many, many details that gum up the works. For instance, coupling between the oscillator and the i.f. amplifier is a major contributing cause to erratic operation. Good filtering in the plate and grid circuits and careful placement of the wiring are as important as good tubes. The i.f. unit shown here eliminates a healthy proportion of the troubles.

In using the new unit, all you have to remember is that as long as you feed it 465 kc., it will work.

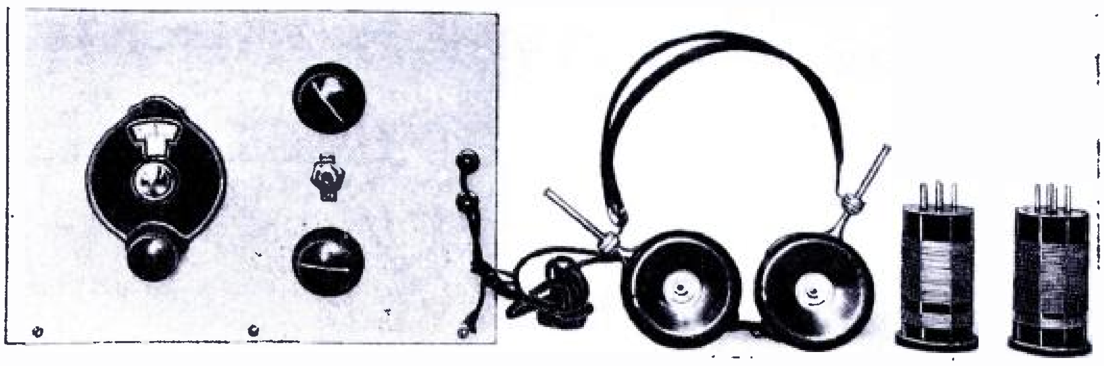
(*Continued on page 38*)

Under view of the i.f. amplifier unit. The wiring is extremely simple, well placed, and direct. The volume-control knob is visible, as is the off-on switch for the beat oscillator. All plate leads to the i.f. transformers are shielded.





Complete schematic diagram of the new McMurdo Silver i.f. amplifier with all values. Five tubes are used in the unit.



The "Sporting Twin"

by Robert Hertzberg

SIMPLICITY of a design, construction, wiring, and operation make the "Sporting Twin" an ideal set for both the newcomer to the fascinating short-wave "game" and the ex-broadcast fan who is now anxious to recapture the thrills of long-distance reception. This neat but effective little instrument will reward its constructor with many long hours of intensely interesting "DX" (distance), as it covers the entire active short-wave region between 16 and 200 meters and is capable of producing comfortably readable earphone signals from hundreds and hundreds of relay broadcasting, airplane, ship, transoceanic, amateur, and police radio stations, all transmitting with voice.

If the owner masters the code, which is not at all a difficult job, he will be unable to keep track of the countless radio-telegraph signals that will literally pour in on him from all over the world. Does this sound exaggerated or patently over-enthusiastic? Not at all! Some of the most marvelous imaginable foreign reception is being accomplished by patient dial-twisters with sets of just this type.

Battery Supply Used

To simplify the power-supply problem and assure quietness of operation, one type 30 tube is used as a regenerative detector and one type 33 audio pentode as an amplifier. These tubes will work very satisfactorily over a considerable period of time with two ordinary No. 6 dry cells lighting the filaments. Three of the smallest size 45-volt B batteries and a small 22½-volt C battery will last nine months to a year. A single storage-battery cell, or any one of a number of special filament batteries designed especially for these popular tubes, will be better than the old-fashioned dry cells, but, of course, costs more. The dry cells are cheap and universally obtainable and are recommended as a starter.

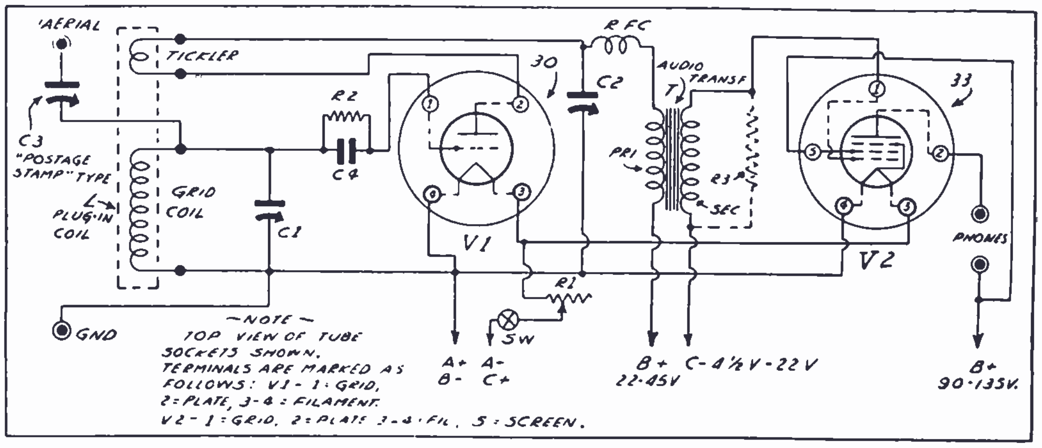
The circuit of the "Sporting Twin" is the most reliable one in all the history of radio—straight regenerative detector with series tickler and condenser control of feedback. No originality is claimed for the circuit as given; the writer has simply dressed it up with the latest tubes and parts and arranged the latter so that the mechanical construction is well within the tool facilities and manual ability of the "average" kitchen mechanic. A type 32 or 34 screen-grid tube is somewhat better than a 30 in the detector position, but this introduces complications of shielding and wiring that the experimenter will be better qualified to tackle after a little experience with the present hook-up.

The type 30 detector (V1 in the diagram) is transformer coupled to the 33 output tube, V2. This combination is responsible for signals of surprising strength.

The receiver is built up on an aluminum panel measuring 7 by 10 inches, which is merely screwed against the edge of a half-inch-thick wood baseboard, 10 inches square. It is important to obtain a piece of hard, well-dried lumber for the latter; soft wood will warp quickly and crack the tube and coil sockets as if they were so many egg shells. The base used in the model illustrated was a breadboard from the 10-cent store, and is excellent for the purpose. As shown, it holds all the required batteries, the particular A unit in this case being a special 3-volt battery intended for portable receivers.

The front panel holds the tuning condenser C1, a midget variable of 140 mmf. capacity; the regeneration condenser C2, a duplicate of C1; the filament rheostat R1; the on-off switch; and two tip jacks for the earphone connections. Condenser C1 is controlled by a small vernier dial; C2 and R1 by plain knobs. The rheostat and the tip jacks must be insulated from the panel as the latter forms the A plus—B minus side of the battery circuits. The tip jacks are already provided with suitable fibre washers; large fibre or bakelite washers for the rheostat can be picked up in plumbing, hardware, electrical, or radio shops.

No detailed drilling layout is

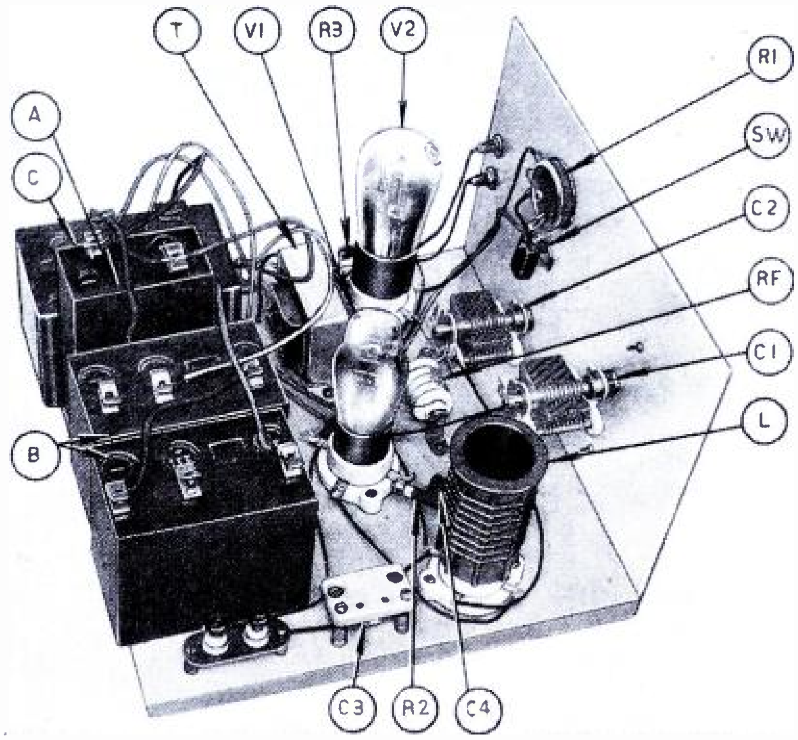


LIST OF PARTS

C1, C2—Midget variable condenser, 140 mmf. (Hammarlund).
C3—"Postage stamp" trimmer, about 20 mmf. (Hammarlund).
C4—Mica grid condenser, .0001 mf. (Trutest).
R1—Filament rheostat, 10 ohms (Electrad).
R2—Grid leak, 2 to 10 megohms (Lynch).
R3—Grid leak, experimental, see text.
L—Set of four two-winding plug-in coils, factory or home wound, see text. (Insuline).
T—Audio transformer, 3:1 ratio (Trutest).
R.F.C.—choke—8 millihenries (Insuline).
Switch—single pole toggle type, with on-off nameplate (Insuline).
Phone tip jacks—Insulated type (Insuline).
Aerial-ground binding post strip.
Sockets—two four-prong, one five-prong, base mounting (Insuline).
Vernier dial for condenser C1 (National).
Bakelite knobs for C2 and R1.
One type 30 and one type 33 tubes (Raytheon).
Batteries as specified in text.
Pair of earphones.
Panel—7 x 10 inches, No. 16 gauge aluminum.
Baseboard—10 x 10½ inches.
Wood screws, push-back connecting wire, incidental hardware.

SUMMARY: *In spite of all advances in the electrical design and mechanical construction of short-wave receivers, there is still a strong demand for exceedingly simple sets that a beginner can make with simple hand tools with a minimum of expense and trouble. The "Sporting Twin" is such a set. We make no extravagant claims for it, but present it merely as a good little outfit that will well justify its slight cost.*

Incidentally, the "Sporting Twin" is a sort of 1934 version of the famous "Junk Box" receiver introduced by the writer through the columns of "Radio News" in July, 1928. The original set used two 201A's and consisted merely of a wooden baseboard, without a panel of any kind. This set probably started more people in the short-wave game than any other similar instrument, more than 50,000 blueprints of it being distributed to constructors all over the world. The "Sporting Twin" uses modern tubes and enough shielding to eliminate hand capacity effects, but otherwise retains the features of simplicity and effectiveness that made the "Junk Box" so successful.



Oblique rear view of the "Sporting Twin," with the batteries in place on the rear edge of the baseboard.

given, as the arrangement is simple, and exact placement of the various parts is not important. Three half-inch No. 6 round head brass wood screws hold the panel against the baseboard. Place the panel flat on an old board, mark all hole centers carefully with a center punch or a sharpened nail, and drill through with an ordinary hand drill or brace. The holes for the condensers, switch and rheostat, which are between 3/8 and 1/2 inch in diameter, can be started with a 1/4-inch drill (usually the largest that will fit most hand drills) and easily enlarged with a rat tail file. Don't file away too energetically; aluminum cuts like cheese and tends to clog the file.

Mounting the Parts

Scrape off all rough edges around the holes, mount all the parts on the panel, and then screw the latter to the bare baseboard. You will then be able to spot the positions for the four-prong socket for the coil L, another four-prong socket for the detector tube V1 and a five-prong socket for V2. By facing the coil and detector tube sockets properly, you will be able to bridge the grid leak and condenser R2-C4 directly between the correct terminals. The r.f. choke fits logically behind condenser C2, while the audio transformer and the V2 socket fill the right edge of the board. Along the left edge (in the foreground in the picture), mount the aerial-ground binding post strip and the antenna trimmer condenser C3. Elevate these parts, by means of short brass collars or little stacks of old nuts and washers, so that their terminals clear the wood. Use small wood screws throughout for mounting purposes.

This part of the job will take about an evening, the coil winding and the actual set wiring another evening. A man with previous set building experience can probably do the whole business in one sitting if he finishes supper early. Don't rush the job; there is just as much fun building a radio set as in using it.

If you buy ready-wound coils, you can wire the set immediately after assembling it. If you want to wind your own coils, delay the wiring until the coils are ready, as you must know where the windings connect in the base of the forms before you can wire up the coil socket.

Four two-winding coils are used. Dozens of different makes of factory-wound coils are available at low prices and will fit in with the other parts without trouble. The particular coils selected for the model receiver are made of molded bakelite, with ribbed sides to support the wire. The forms are 3 inches long and 1½ inches in diameter and are wound as follows:

COIL NO. 1: 16-28 METERS: grid winding 6½ turns No. 18 enamelled wire, spaced 3/16 inch. Tickler, 4 turns No. 24 enamelled, close wound.

COIL NO. 2: 27-45 METERS: grid, 12½ turns No. 18 enamelled, spaced 3/32 inch. Tickler, 8 turns No. 24 enamelled, close wound.

COIL NO. 3: 43-80 METER: grid, 21½ turns No. 20 enamelled, spaced 3/64 inch. Tickler, 10 turns No. 24 enamelled, close wound.

COIL NO. 4: 75-200 METERS: grid, 45 turns No. 24 enamelled, spaced wire diameter, Tickler, 20 turns, No. 24 enamelled, close wound.

On coils 1, 2, and 3, separation between grid and tickler is 1/8 inch; on No. 4, 1/4 inch. All coils are wound in the same direction. It is immaterial whether the grid coil is near the top of form and the tickler at the bottom or vice versa. Run the outside end of the grid coil to the G pin of the base, the inside to the heavy filament pin below it; the tickler to the two remaining pins. Trace the connections through to the socket and mark the latter to avoid confusion in wiring.

For the battery connections, simply run out pieces of flexible wire. The A plus and B minus and the A minus and C plus connections are made right between the batteries themselves. Three B batteries, totalling 135 volts, and one 22½ volt C battery are recommended for best results, although excellent signals are obtainable with 90 volts of B.

The aerial may be of the usual size—50 to 150 feet long. You can even hook on to the regular aerial used with the family broadcast receiver; in many cases this works fine. For a ground, use a steam or water pipe. A good pair of earphones is a good investment, as you'll always use them.

Operating Notes

Leave the aerial off temporarily, snap on the switch, and turn up the rheostat so that the tubes light cherry red. (A small voltmeter is another good investment. Use it to maintain the filaments at two volts. Turn the tuning dial slowly and rock the regeneration condenser C2. If the set doesn't oscillate immediately—you'll quickly learn to recognize the swish and thud of a tube going from regeneration into oscillation—reverse the two wires to the tickler posts of the coil socket. This is almost a certain remedy. Now connect the aerial and adjust the trimmer condenser C3 by means of a small screwdriver to the point where the set will stay regenerating with each of the four coils.

The entire secret of successful reception with a set of this type is a smoothly operating regeneration control. Every set requires a little

(Continued on page 42)

The "Ham Tester"

a simple, inexpensive unit for experimenters

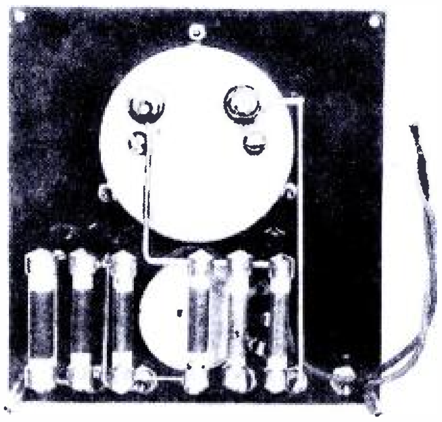
By Jack Grand*

The tester in its card-file case.

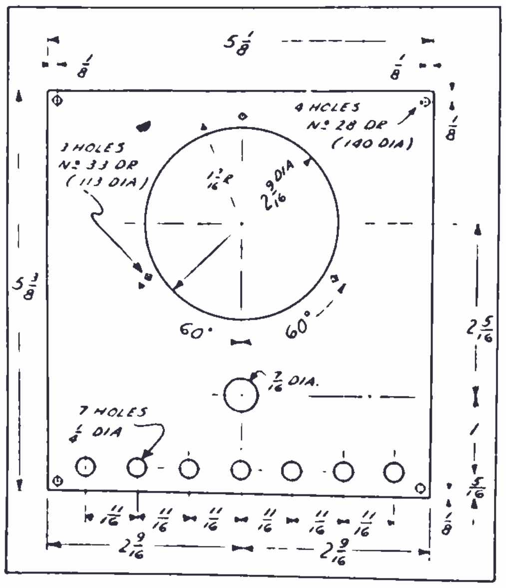
THE "Ham Tester" is a handy and useful accessory that deserves a place in every cellar or attic radio workshop. The set constructor and experimenter will find it extremely valuable for quick testing of parts and circuits, as it performs the functions of a continuity checker, direct reading ohmmeter, and high resistance voltmeter.

The basis of the "Ham Tester" is a 0-1 milliammeter, with its face marked with a series of four scales. The top one is marked "ohms." When a pair of test cords is inserted in the pin jacks on the panel lettered "ohms," the meter is connected in series with a small three-volt flashlight battery, a 1000-ohm variable resistor, and a 2500-ohm fixed resistor. The ends of the test cords are short circuited, and the variable resistor adjusted until the meter reads 0 ohm. If the test cords are then opened and applied to a resistor of unknown value or a circuit or part whose continuity is under suspicion, the meter will indicate the resistance of the unit directly or tell whether the circuit is open or closed.

* Sun Radio Co.



Photograph of the rear of the tester.



The dimensions of the panel are given.

Almost Indispensable

The experimenter who never used a continuity checker of this kind before will wonder how he ever got along without one. The saving in time that it makes possible will quickly make up for the slight cost of the whole outfit.

By the use of a series of fixed "multiplier" resistors connected in series with the meter, five separate d.c. voltage ranges are available. These are 0-50, useful for testing B and C batteries; 0-250 volts, for the usual plate and screen voltages of receiving tubes; 0-750, 0-1500, and 0-2500 volts, which will be found useful for measurements on small transmitters and public address amplifier power packs. While not many experimenters play with power supplies developing 1500 or 2500 volts, these extra high voltage ranges involve only small and inexpensive resistors and might just as well be on tap.

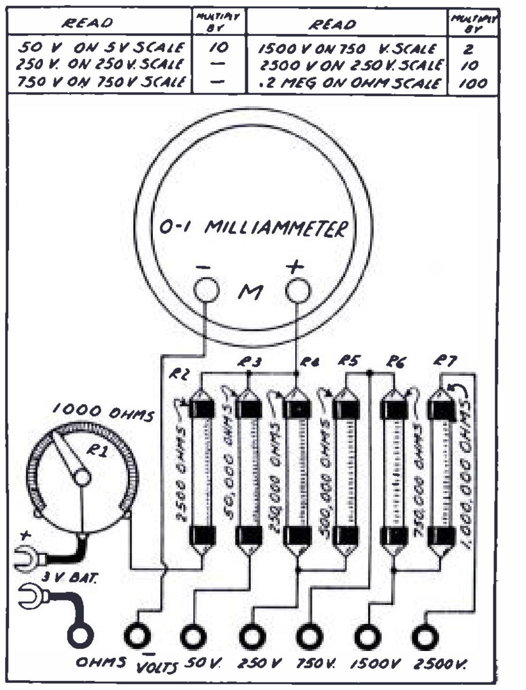
The meter and the seven pick jacks for external connections are mounted on a piece of 1/8-inch bakelite measuring 5 1/8 by 5 3/8 inches. The pin jacks are lined up along the bottom edge, and the variable resistor is placed between them and the meter. On the back of the panel, the multiplier resistors are merely supported by their own connecting wires. Two flexible wires about five inches long are brought out for the battery connections. The required battery is an ordinary small two-cell flashlight unit.

For the protection of the meter and the precision fixed resistors, the whole assembly is mounted in a wooden card file with a hinged top, which was purchased in a stationery store. The box selected for the purpose was made of 1/4-inch hard wood, 5 5/8 inches wide, 6 inches deep, and 4 3/8 inches high, outside overall dimensions. This box was intended for regular 3 by 5 inch cards, and is a standard item. To support the top edge of the bakelite panel, the inside of the box was simply fitted with a thin wooden strip, nailed with very thin brads. The corners of the panel are drilled to pass small round head wood screws which in turn bite into the strip.

The other corners of the panel (near the edge carrying the tip jacks), are fitted with hexagonal brass feet 1 5/8 inches long, held by machine screws. These form a base for the meter assembly when the panel is removed from the box.

The test cords can consist merely of two pieces of ordinary flexible insulated wire, with phone tips soldered to one pair of ends of insulated test prods to the other. A variety of fittings such as alligator clips, spade terminals, etc., is available. These are recommended, as they permit quick and easy connection to binding posts of all sorts, bare or insulated wire, and so forth.

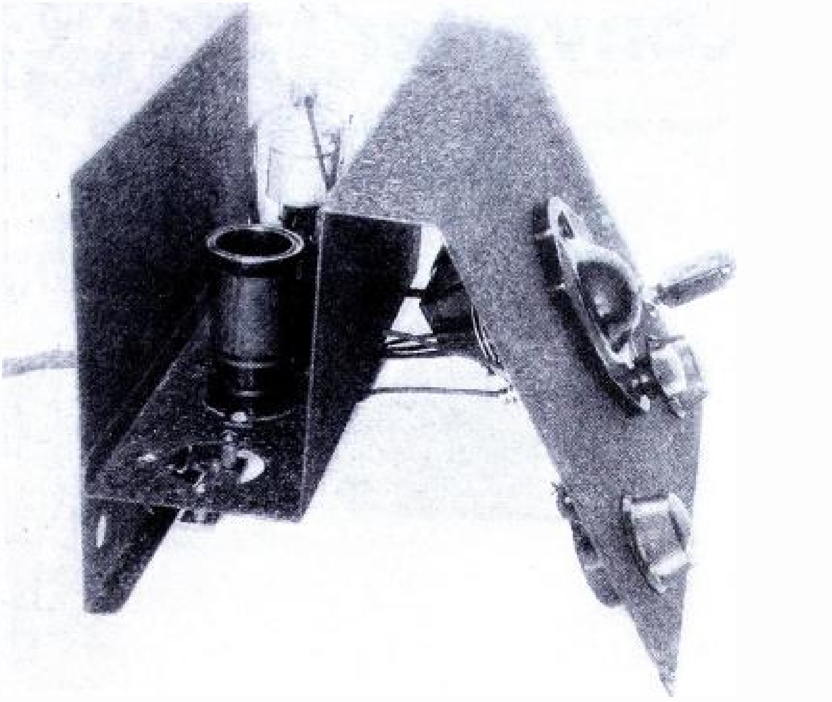
The parts required for the "Ham Tester" are all standard and readily obtainable on the open market. A complete kit of parts, including a ready drilled and engraved panel, can also be purchased.



Complete schematic circuit of tester.

M—Meter, 0-1 milliammeter, with four-range scale (Beede).
R1—1000-ohm potentiometer (Electrad).
R2—2500-ohm precision resistor (Lynch).
R3—50 000-ohm precision resistor (Lynch).
R4—250,000-ohm precision resistor (Lynch).
R5—500,000-ohm precision resistor (Lynch).
R6—750,000-ohm precision resistor (Lynch).
R7—1-megohm precision resistor (Lynch).
Tip jacks, 7 required.
Bakelite panel, 5 1/8 x 5 3/8 x 1/8 inches, drilled as shown (Sun Radio). Bus bar for wiring, screws, etc.
Standard 3 x 5 card file to take panel.

The Two-Tube "Pretzel Bender"



The peculiar shape of the chassis is responsible for the name of this popular little receiver. Note how both the coil and the tubes are well shielded yet are still easily accessible. The sloping front panel makes for ease in tuning.

DON'T be deceived! Merely because the "Uni-Shielded Three" described in the March, 1934, issue of SHORT WAVE RADIO has been facetiously dubbed the *Pretzel Bender* is no indication that excellent results cannot be obtained with it. Quite the contrary. Since the publication of this article, hundreds of unsolicited letters have been received, each reporting in detail the excellent results that have been secured. It is the peculiar shape of the chassis which caused one observer, with a humorous twinkle in his eye, to redub the set; nevertheless, regardless of what it was called before, the Pretzel Bender it is, and the Pretzel Bender it will remain.

The three-tube Pretzel Bender caused quite a sensation, and a demand was created for a two-tube model. It is our purpose, therefore, to describe the new offspring, thus finishing the biography of the Pretzel Bender family.

The photograph shows the arrangement of the parts. It is similar to the three-tube model, and the reader is referred to the March issue for further details on this point. The tubes and coils are housed on the lower shelf of the chassis. The battery cable protrudes from the rear, and the antenna-ground binding post strip is also mounted at the rear. In fact, the chassis of the two-tube model is identical with that of the three-tube, the only difference being in the placement of the parts: the socket ordinarily occupied by V1 in the three-tube Pretzel Bender now houses the antenna tuning condenser. This leaves three small holes in the back of the chassis vacant.

The difference between the two sets, electrically speaking, is only that represented by the difference between three tubes and two tubes. In the two-tube model, one of the type 34 tubes is replaced by a 32; the output tube, which is a 33, remains the same as its big sister.

For the benefit of those readers who did not see the March issue, a brief description of the circuit used here will be in order. As may be seen by reference to the schematic, the antenna is tuned by a small 20-50 mmf. fixed-variable condenser, which is adjustable through the extreme left-hand tube socket. The tuning condenser, off-on switch, and regeneration control are mounted at the front panel together with the phone jack. The plate choke, the r.f. choke, necessary bypass condensers, and small resistors are housed beneath the skirts of the Pretzel Bender.

The circuit itself is perfectly straightforward and standard, and the values of parts have been chosen with an eye to efficiency. Note that a type 32 tube is used as the detector. The control of regeneration is effected by means of variation of the screen-grid voltage, and regeneration itself is accomplished by the aid of the conventional tickler circuit.

The two-tube Pretzel Bender is equipped with the same protective phone jack arrangement as its big relation. When the phone plug is removed from the circuit, the B battery is automatically disconnected, thus making it possible for the constructor to play around with the "inner gizzards" without wearing a rubber suit.

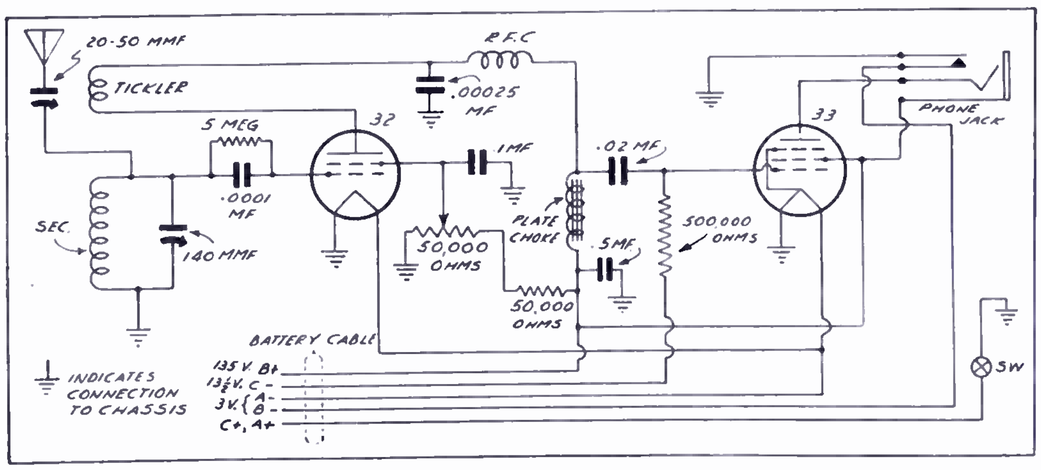
The chassis of the Pretzel Bender is bent into its unique shape for the obvious purpose of providing complete shielding at a minimum of expense. This unique shape, as previously hinted, gives rise to its name. The overall size is comparatively small. It is 10" wide, 8½" deep at the base, 5" deep at the top, and 6½" high. The U-shaped channel housing the coil and tubes is 3" wide.

The receiver may be operated on three different types of A batteries:

(*Continued on page 42*)

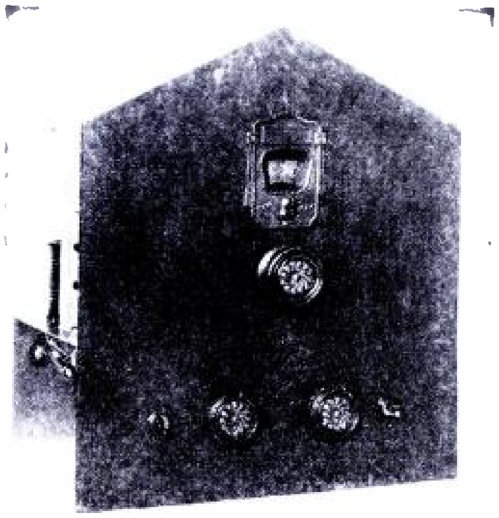
COIL DATA

Wave Length Band	*Secondary*			*Tickler*	
	Number Turns	*Winding Length*	*Wire Size*	*Number Turns*	*Wire Size (Close Wound)*
15-30 Meters	4¾	¾ inch	22 S. C. C.	4¼	26 S. C. C.
30-60 Meters	10¾	1 inch	22 S. C. C.	4¼	26 S. C. C.
60-120 Meters	22¾	1 inch	22 S. C. C.	5¼	26 S. C. C.
120-200 Meters	51¾	1¼ inch	24	6¼	26 S. C. C.



Complete schematic diagram of the "Pretzel Bender." Note particularly how the phone jack automatically controls the B battery circuit.

The "Calvert Converter"



Front view of the converter, showing the arrangement of the controls.

Here is a three-tube, self-powered short-wave converter that will work in conjunction with practically any regular broadcast receiver and produce really satisfactory signals from foreign stations.

SUMMARY: *A special output tuning circuit distinguishes this converter. Maximum energy transfer from the converter to the broadcast receiver is thus assured. Three tubes are used: a 27 local oscillator, a 57 first-detector or mixer, and an 80 rectifier. The substantial construction of the chassis and the neat design of the front panel make this instrument particularly attractive. The unit can be made to fit nicely in a small cabinet.*

By W. J. Grunwald*

THE need for a converter that really works on any receiver of modern design is universally recognized. The long-suffering and patient short-wave fan has had thrust upon him nearly every possible combination of apparatus and multiplicity of circuits that is possible of conception. Little concern has been manifest in the ultimate efficiency of these circuits.

The converter described in this article does not perform miracles, neither will it bring in signals from stations that are not on the air, but it works consistently. Further, one does not need to be an engineer to operate it. Tuning has been simplified to a great extent by careful design of the various parts: all major tuning adjustments are single-dial controlled. Only one additional adjustment will be found necessary, and that is accomplished by the use of the small trimmer condenser across the modulator winding.

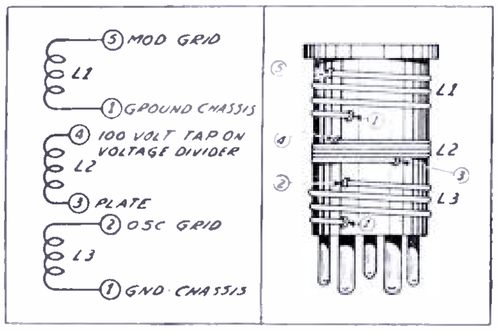
The method of coupling adopted enables the owner of either a t.r.f. or super-het. to enjoy all the advantages of a truly good short-wave set. This combination of apparatus will obviate the necessity of purchasing a separate short-wave receiver when one already owns a good broadcast receiver.

The main reason why most of the existing converter circuits have failed to function was that the method of coupling consisted of the time-worn and impractical condenser-choke combination. It is obvious that, with this hookup, it was necessary to tune the broadcast receiver to a frequency where a fair transfer of energy from the converter was made possible.

Invariably, this particular frequency was the resting place for either a local broadcast signal or one of sufficient volume to make impossible the reception of any short-wave signal. This hit-or-miss process of obtaining a clear transfer frequency has been eliminated by the perfection of a tunable output. It is possible, first, to set the broadcast receiver dial on a clear channel at or near 1500 kc. and then tune the converter output to this frequency. By referring to the diagram, it will be noted that the output of the modulaor tube, the 57, is fed into the plate winding of the transfer coil, around which is shunted a 100 mmf. variable condenser, C5. This condenser enables the operator to tune the output.

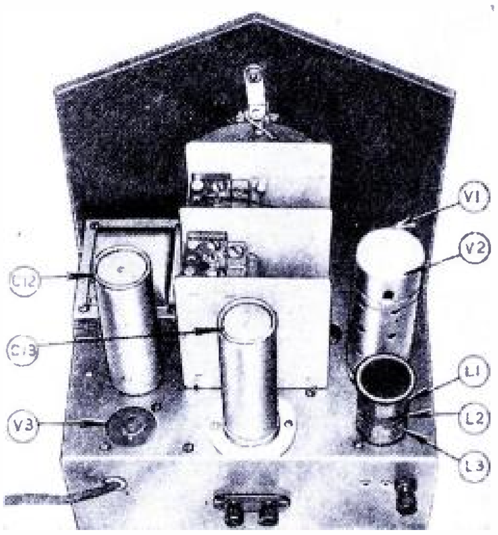
The old controversy regarding the efficiency of plug-in coils versus switches has also been taken into consideration, with the result that this converter uses plug-in coils. All available types of manufactured switches and a few of our own design were tried at various times, but at no time did these various devices match the plug-in coil for downright fool-proof efficiency. It is agreed that the greatest objection to plug-in coils is the use of the great number of coils necessary to cover efficiently the frequency span between 15 and 200 meters. Most short-wave sets and converters use a pair of coils for each band, resulting in a formidable array of coils

*The Radio Shack, East Carroll St., City Island, Bronx, N. Y.

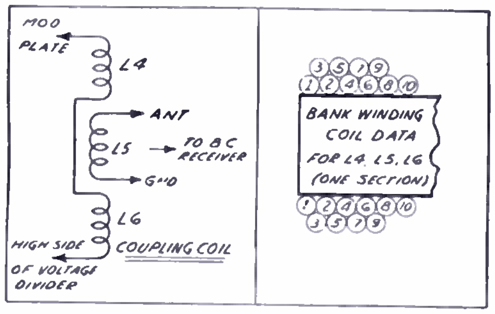


The spacing between the oscillator plate and modulator grid windings is as great as possible. Start the oscillator grid winding 3/16" from the bottom of the coil form, then wind the oscillator plate winding. Now start the modulator grid winding from the top of the coil form, spaced as directed in the coil table. The coil form should be 1¼" in diameter and 2" long. All windings should be in the same direction. Whatever spacing remains between the modulator grid coil and the oscillator plate coil is O.K.

These coils should be wound very carefully, as the success of the converter depends on them to a large extent.



Back view of the completed Calvert Converter. The mixer tube V1 is out of sight behind the shield can for the oscillator tube V2. L1-L2-L3 is the plug-in coil. The aerial and ground connections between the converter and the broadcast receiver are permanent.



The coupling coils L4 and L6 each consist of 45 turns of No. 28 d.c.c. wire bank wound as follows: beginning ½" from the end of a tube 1½" in diameter and 3 inches long, wind 40 turns in four banks as shown in the coil data sketch and then wind 5 turns in a single layer. Space the pickup winding ¼" and wind two bank layers only, exactly as the first one. Space another ¼" and wind a duplicate of the first. L4 will then have 45 turns; L5, 20 turns; and L6, 45 turns. It might be advisable in some cases to increase the pickup winding, L5, to 25 or 30 turns. Note that the end of L4 connects directly to the beginning of L6 as shown on the schematic diagram.

that were always becoming mislaid or lost, not to mention the fact that to change from one band to another rapidly is extremely difficult.

The use of separate plug-in coil forms for oscillator and modulator windings has been eliminated by carefully worked out coil constants, resulting in both windings being on one plug-in coil form. By referring to the data it will be noted that all frequencies are covered with three coils with ample overlap. It will also be found that, in actual operation, the oscillator will track efficiently at all frequencies, without the use of separate padding. Many tests have been made as to frequency stability, and it has been found that the oscillator drift is negligible.

Reference to the diagram will show a variable condenser, C4, of .0001 mf., in series with the antenna input lead. This condenser will enable the operator to compensate for antenna differences, and will help somewhat in tuning-in distant stations. The antenna switch is a panel mount, single-pole, double-throw toggle, while the a.c. switch is the usual type of toggle.

It will be found advisable to use a 20,000 ohm, 50 watt, wire wound voltage divider, connected from the high side of the B voltage to the chassis, in order to hold the maximum voltage to 200 and to insure a steady supply to the oscillator plate.

Use Care in Layout

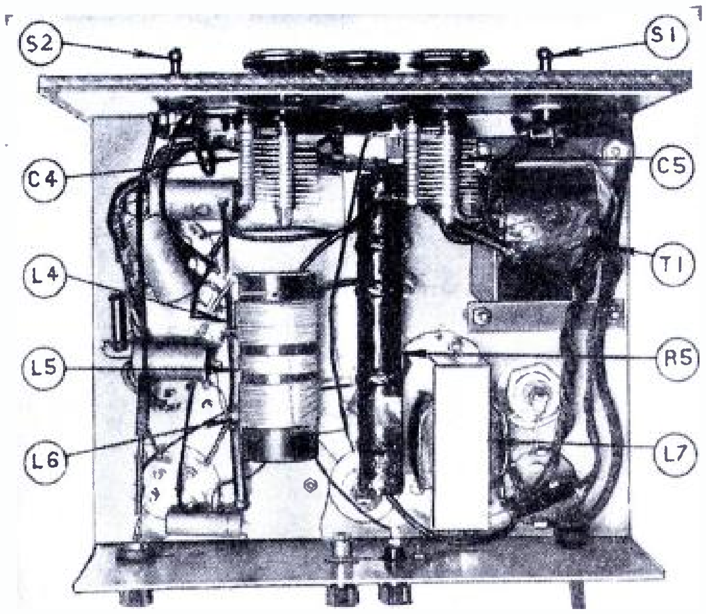
Regarding the layout, the constructor should use care in the location of the various apparatus. Particular attention should be paid the location of the coupling coil in relation to the plug-in coil. It is advisable to locate the coupling coil beneath the chassis, where the wiring will be short and direct. At the same time, there will be little chance of intercoupling between these coils.

The plate of the modulator is connected directly to the coupling coil, across which is wired the small variable transfer condenser, C5. The other end of this winding goes to the high side of the voltage divider. The small interposed winding on this form is connected, as shown, to the antenna control switch and the chassis. The screen is fed through a 50,000 ohm resistor, R3, bled by a 1 watt 50,000 ohm resistor, R2, bypassed by a .1 mf., 400-volt condenser, C7. In order to obtain a proper setting for the oscillator tap, a voltmeter should be used; 100 volts is the proper value for the oscillator plate voltage. This voltage should be measured *at the plate*, not at the voltage divider.

Advisable to Make Tests

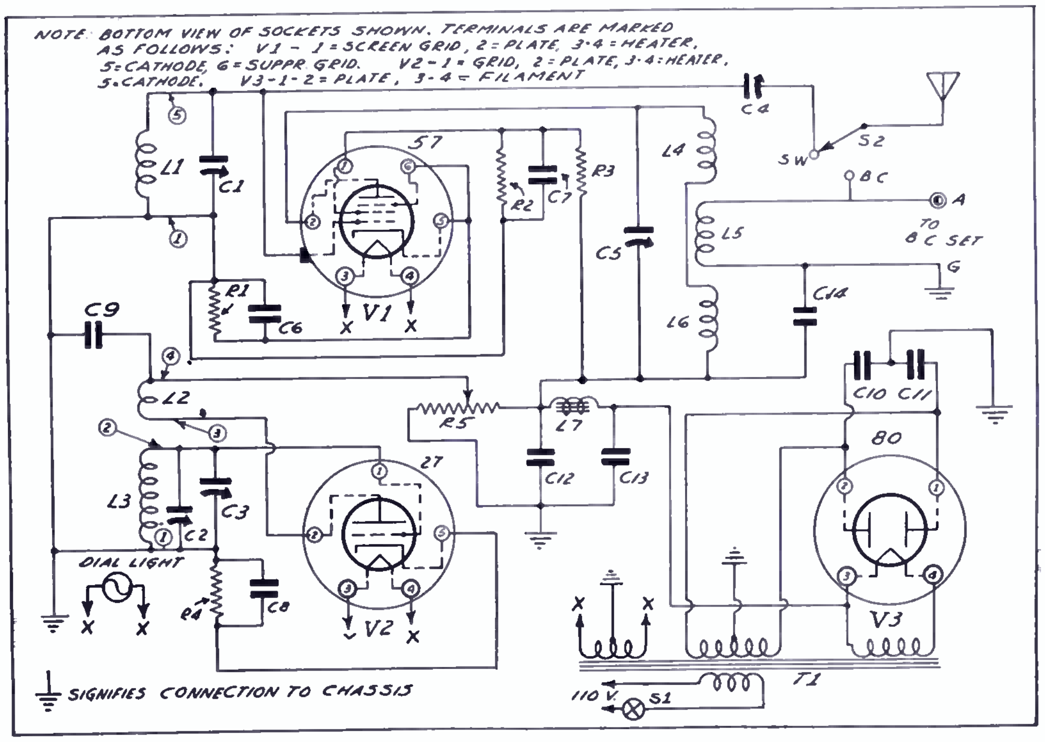
It will be found, by referring to the coil data, that the coils are shown with the windings numbered as to proper sequence; these numbers are again shown on the schematic diagram. This system will prevent the constructor from

Under view of the Calvert Converter chassis. The various parts are lettered to correspond with the markings in the schematic diagram, below. Note that while the chassis is pretty well filled, the parts are neatly laid out and there is no confusion of wiring.



COIL WINDING DATA

Coil Number	*Turns on Osc. Plate Coil, L_2*	*Spacing to Adjust Coil*	*Turns on Osc. Grid Coil, L_3*	*Turns on Modulator Grid Coil, L_1*
15 to 30 meters	4¼— close wound No. 26 d.s.c.	⅛ inch	¾—No. 18 enam. space 3/32"	4¾—No. 18 enam. space 3/32"
30 to 60 meters	8¼—No. 26 d.s.c. close wound	3/16 inch	9—No. 18 enam. spacing equals dia.	8¼—No. 18 enam. spacing equal to wire diam.
60 to 120 meters	21-1/3—No. 26 d.s.c. close wound	¼ inch	27—No. 26 d.s.c. close wound	24¾—No. 26 d.s.c. close wound



List of Parts

R1—20,000-ohm resistor, 1 watt.
R2, R3—50,000-ohm resistors, 1 watt.
R4—300-ohm resistor, 1 watt.
R5—20,000-ohm resistor, 50 watt.
C1, C2—two gang tuning condenser, .00014 mf.
C3—25 to 50 mmf. trimmer.
C4, C5—.0001 mf. variable midget condensers.
C6, C7, C8, C14—.1 mf. fixed condensers.
C9, C10, C11—.002 mf. mica condensers.
C12, C13—8 mf. electrolytic condensers.
T1—power transformer with one high-voltage winding, one 2.5-volt winding, and one 5-volt winding.
L7—75 ma., 200-ohm filter choke.
Two five-prong sockets for plug-in coil and V2.
One four-prong socket for V3.
One six-prong socket for V1.
Three five-prong coil forms, 1¼" in dia. by 2" long.
One tube shield for V2.
S1—Off-on switch.
S2—single-pole, double-throw switch.
Chassis size—7½" by 9¼" by 3¾".
Front panel—10" by 12" three-ply veneer.
One dial for tuning condenser.
Three knobs for C1-C2, C4, and C5.
Three binding posts.
One type 57 tube.
One type 27 tube.
One type 80 rectifier.

making mistakes in placing the wire ends in the connecting pins on the coil forms.

In the final check up, it will be advisable for the constructor to make continuity tests before the a.c. is turned on, as it is quite easy to make mistakes in wiring. In testing the converter, the first step is to set the antenna switch to the short-wave position. Then, with both sets turned on, set the broadcast dial at approximately 1400 kc. or to some adjacent frequency where no broadcast signal is heard. Then, by varying the transfer condenser, C5, you will obtain a setting where the short-wave signals come in with volume. It will be necessary to realign this condenser for maximum response after a definite signal has been tuned in on the short-wave dial. Once a definite setting is obtained for a particular frequency used on the broadcast receiver, it will be unnecessary to touch this control again, provided the operator returns to this same transfer frequency.

If the operator desires to use the broadcast receiver, it is only necessary to throw the antenna control switch to the opposite side, and then tune the b.c. dial as usual.

Number 18 enamelled wire is used to wind the small and intermediate coils, while No. 26 d.s.c. is used on the large coil. Any deviation in the number of turns of wire or the spacing of the windings will result in changes in the condenser settings and misalignment of circuits, and should be avoided. If the data is followed, there will be no "dead spots" and tuning will be sharp over the entire dial on any of the three coils. The two-gang condenser shown in the picture is a conventional short-wave type, .00014 mf. per section, with built-in trimmers. These trimmers will be found extremely useful in lining up the two circuits and compensating for slight difference in coil construction.

Foreign Stations

Station LSX in Buenos Aires, Argentina, which heretofore has operated only as a commercial radiophone, is now broadcasting regular programs on 10,350 kc., or 28.98 meters, from 3 to 4 p.m. E.S.T. The programs consist mostly of national music and news reports.

* * *

Station PLV in Bandoeng, Java, on 38.6 meters, has been heard at irregular hours transmitting phonograph music. Spanish transmission is likely to be scrambled. In most cases phonograph music sent over a station of this kind does not really constitute a broadcast program, but is more likely to be a test signal, to save the operators' voices.

The stations in Java usually talk in Dutch, as their traffic is almost entirely with the mother country Holland.

Oscillator Performance with Pentagrid Converters

By Roger M. Wise*

THE oscillator circuit in receivers employing electron-coupled pentagrid converters, such as the 2A7, 6A7, and 1A6, requires very careful design if entirely satisfactory performance is to be obtained. This is particularly true in connection with all-wave models.

As is the case in any superheterodyne receiver, it is desirable to obtain as nearly as possible uniform oscillation strength over the whole frequency band. This is rather difficult in conventional types of circuits in which no compensation is incorporated, due to the fact that it is not easy to secure sufficient coupling at the low-frequency end of a given band without over-coupling at the high frequency end. A very good means for checking the strength of oscillation over the frequency band is provided by a d.c. microammeter inserted in the grid leak circuit. The product of the current and the resistance will give a voltage proportional to the oscillator voltage.

Two Methods

There are two methods commonly used for maintaining substantially uniform oscillation strength over the whole frequency band. The first circuit incorporates a means for increasing the coupling at the low-frequency end of the band by utilizing a series padding condenser of the oscillator circuit for obtaining increased coupling at the low-frequency end of the band. This makes possible the use of an inductive feed-back at the high frequency end, which is not sufficiently close to cause the generation of parasitic oscillations, while at the same time it allows sufficient feed-back at the low-frequency end to maintain a good degree of uniformity. This is particularly true for the domestic broadcast band where the series padding condenser used is of the correct value for maintaining proper alignment when intermediate frequencies in the range between 175 and 456 kilocycles are used.

It is not always thought desirable by the manufacturer to use a series padding condenser. This is particularly true when specially shaped condenser plates are used in the oscillator section as is quite often done. It should be noted that the strength of oscillation at the low-frequency end is considerably weaker than at the high-frequency end of the band. If adequate coupling is used to bring the low-frequency oscillation strength up to a sufficient value, parasitic oscillations are quite apt to occur at the high frequency end due to over-coupling. An interesting method of overcoming this condition is by inserting a suppressor resistor of 500 to 1000 ohms in series with the oscillator grid. This will reduce the strength of oscillation at the high-frequency end due to the fact that the capacity reactance of the input circuit decreases as the frequency increases. This limits the oscillator amplitude at the higher frequencies to a greater extent than at the low frequency end of the band.

An additional point of interest in connection with the tube performance is revealed by the fact that greater ease in starting oscillations may often be secured by returning the grid lead to ground instead of to the cathode. With changes similar to those indicated above, type 6A7 tubes, which required at least 150 volts on the oscillator anode, requires an anode voltage of only 25 volts to give satisfactory performance.

(Readers are referred to page 44 of this issue for a suggestion regarding the constancy of oscillator performance. It should be noted that Mr. Wise recommends the constancy of oscillator output with respect to frequency, while your technical director recommends the variation of output with respect to signal strength, but independent of frequency.

The ideal arrangement, then, if the suggestion on page 44 is to be followed, would be to have an oscillator whose output is independent of frequency, but varies inversely with signal strength. It is not an easy job, by any means.

—Tech. Dir.)

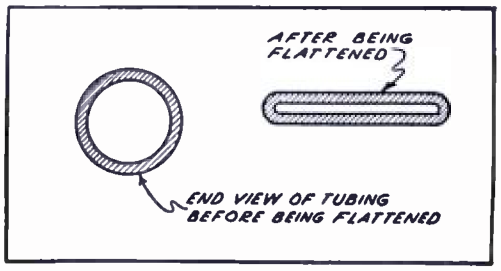
* Chief Tube Engineer, Hygrade Sylvania Corp.

Flattening Copper Tubing

By Wilfred A. Thompson

IN amateur transmitters, the heavy copper tubing used in the final amplifier tank coil is a source of losses which tend to lower the efficiency of the outfit. The losses are due to the capacity between turns in the heavy coil. This may be remedied to a great extent by flattening the copper tubing and then winding it over in the usual manner.

The amateur can pound the tubing flat, but a much neater job may be had by taking the tubing to a tinner's shop and have it rolled out flat. The tinner has a roller for that purpose.

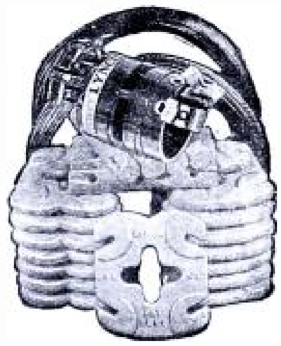


New Short-Wave Equipment

New Antenna Systems

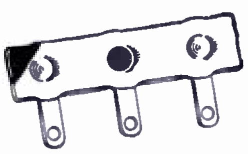
OWNERS of all-wave receivers will be glad to know of a new universal antenna coupler designed to replace the doublet coupler which was made for short-wave sets only. This new coupler will allow any all-wave set to be used with a transposed type of aerial lead-in. The coupler is shown to the left, while a complete antenna kit, of which this coupler is a part, is also shown.

The complete kit consists of 15 transposition blocks, 8 commercial type insulators, 1 universal coupler, 200 feet of "Hi-Mo" antenna wire. The Lynch Manufacturing Co., 51 Vesey Street, N. Y., producers of the coupler and the kit, now recommends the use of two cage aerials, each 20½ feet long, for the aerial. This aerial is turned to the high-frequency section of the short-wave band, where the sensitivity of the usual set is low. This increases the total response. At the lower frequencies, the receiver sensitivity increases, while the antenna efficiency decreases. Thus, the overall sensitivity remains practically constant over the entire range of all-wave operation. This automatic compensation is a logical step toward uniformity in reception. The complete kit is suitable for the usual aerial.



Center-Tapped Resistors

ELECTRAD, INC., 175 Varick Street, New York City, is producing a new line of center-tapped resistors in a convenient small size. They are 1½" long, ⅛" thick, and ⅜" wide. Furthermore, they are color-coded, and made in values from 10 ohms to 200 ohms. The center tap is accurate to plus or minus 1 per cent. These resistors should be especially valuable in power packs, amplifier stages, test equipment, or in any circuit where accuracy in the center tap is necessary to reduce hum. Rigid lugs make mechanical support easy, and obviate hole drilling.



New Large-Scale Meter

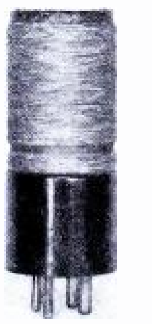
THE BEEDE ELECTRICAL INSTRUMENT CO., of Penacook, N. H., announces a new 3¾" moving-coil meter of fine design. Its long, readable scale and well-balanced movement should make this large meter very valuable to anyone contemplating the construction of equipment which requires a scale that is easily readable. Any desired pointer or calibration is available.

Multipliers and Shunts

MADE in all popular values, individually calibrated, and having 1% accuracy, the new multipliers and shunts illustrated herewith fill a decided need. Further, they are non-inductive, well insulated, and fit standard grid-leak clips. They are made by the Radio City Products Co., 48 West Broadway, New York.

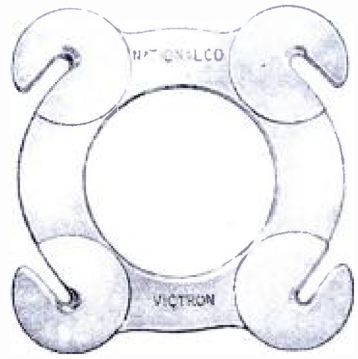
Long Wave Plug-in Coil

BLAN THE RADIO MAN, of 177 Greenwich St., New York, announces a new long-wave plug-in coil which enables the usual short-wave set to tune from 450 to 2000 meters. This coil merely plugs into the usual coil socket and the job is finished. The tuning condenser in the set tunes in its natural manner; small fixed capacitors across the coil adjust the range. The coil is Litz wound in banks. This coil should provide a lot of entertainment



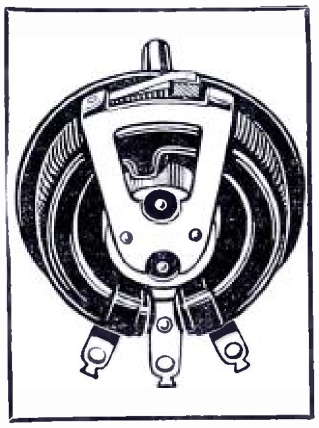
Victron Transposition Blocks

VICTRON, a new high quality, light weight insulating material, is used in the new lead-in transposition blocks now produced by the National Co., Inc., of Malden, Mass. As the illustration here shows, the shape of the blocks and the design of the supporting holes facilitate mounting. There are 76 blocks to the pound.



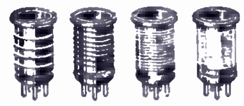
New Power Rheostat

A NEW power rheostat of unique design is made by Electrad, Inc., of New York City. The shaft and bushing are insulated, and the wire is rigidly held in place by vitreous enamel. A metal-graphite contact shoe contacts the wire on the outside. The rating is 50 watts with the total resistance in the circuit. They are made in sizes from 1 to 5000 ohms. They are excellent for amateur transmitters.



Band-Spread Coils

THE Alden Products Co., of 715 Center St., Brockton, Mass., announces a new line of short-wave coils. These are wound on five-prong forms and are equipped with trimmer condensers mounted on each coil for band spread purposes. The No. 705SWB is bandspread on the amateur bands and the No. 705-SWBC are band-spread on the popular short-wave broadcast bands. The No. 705SWS are the same as these coils, except that they are not band-spread and are designed to fit the five-prong sockets of the band-spread coils described above. They are used when band spread is not desired.



705 SWS

A New I. F. Amplifier Unit

(*Continued from page 29*)

The method of converting your old set to a super will be more obvious after a study of the circuit itself is made. (Incidentally, SHORT WAVE RADIO will describe the actual conversion of a standard regenerative receiver in the next issue.) The three posts to the left of the schematic diagram are for the input, and the three to the right are for the output.

The upper left-hand post connects to the plate of the mixer tube, the center post to B plus high voltage—obtained directly from your present receiver—and the lower post to the screen-grid voltage of your present receiver. The right-hand posts: the upper one connects to one side of the output transformer, the other side of the output transformer connects to the B plus high voltage obtained from the center post on the left side of the diagram. The center and lower posts connect to 2.5 volts a.c. for the heaters. The metal case of the amplifier is grounded.

Five tubes are used in all. The first two are 58's and are i.f. amplifiers; the third is the 56 second detector; the fourth is a 58 beat oscillator for c.w. reception; and the fifth is a 2A5 output tube. The protruding knob (see the photographs) is the volume control and the switch cuts the beat oscillator in or out. The circuit is adequately filtered.

The unit comes completely wired (it is made by McMurdo Silver, Inc.), and tested, although it is also available in kit form. The circuit itself is perfectly standard and reliable, so that an accurate comparison with different types of input circuits may be made.

Now, back again to its uses. The main object of this unit is to provide a means whereby any t.r.f. or regenerative set can be converted into a superheterodyne. The next important use is for experimenters who desire to compare different input circuits, since i.f., second detectors, and output stages are more or less alike. The third use is for the set builder who has not had much experience in supers. This unit affords an excellent means of reducing the number and degree of violence of the usual troubles encountered with this type of receiver.

As stated previously, the unit must be fed 465 kc. in order to function. This means that your present set must be divested of all apparatus after the first detector, and an oscillator circuit, whose tuning condenser is ganged with that of the r.f. section, installed. For coil details of a typical r.f. and oscillator stage, see the article, *The Hy-7—A Super*, which appeared in January, 1934 issue of this magazine.

Watch the June issue for details of converting a typical receiver into a superheterodyne using this unit.

New KFZ Studios

THE palatial new studios of KFZ, Little America, were officially opened with the broadcast from the Byrd Expedition on February 24. The Columbia Broadcasting System's most remote unit is housed in a handsome, ultra-modern wooden shack on a spacious plot of ice. It is located in the center of the business and social district of Little America, convenient to all dog sled trails and foot paths. The walls of the entrance lobby are smartly decorated with fur parkas, windproof over-alls and sled harness. This scheme of decoration is carried out throughout the entire building. The motif is occasionally relieved by rows of bunks for the operating staff.

Somewhere among the bunks is the control room, housing the 1000-watt Collins transmitter and the control apparatus. This domain is presided over by John N. Dyer. Somewhere else in the building (probably in another corner) is the broadcasting studio and Charlie Murphy's office. The station is fully equipped with a directional antenna, aimed at Buenos Aires, relay point for the short-wave signals. The "palatial" main building of KFZ measures 15 by 30 feet, which includes everything but the antenna poles.

Condenser Color Code

AT least one radio condenser manufacturer is color-coding its condensers in lieu of marking the values on them. The condensers are coded by means of three dots of particular colors, the colors of the dots designating the value of the condenser. The value of the condenser is given in *micromicrofarads*, and the colors correspond as follows:

Black, 0; brown, 1; red, 2; orange, 3; yellow, 4; green, 5; blue, 6; violet, 7; grey, 8; white, 9.

The method of reading the value is as follows: The first dot corresponds to the first numeral in the value; the second dot, to the second numeral; and the third dot, to the number of zeros after the second numeral. For example, suppose the three dots are brown, black, and brown. What is the value of the condenser? By reference to the key above, it is seen that the color brown corresponds to the numeral 1; the color black, to the numeral 0; and the color brown to the numeral 1. The value of the condenser is, then, 100 mmf. If the colors were brown, black, red, the value would be 1000 mmf. Remember, the third color tells the *number of zeros* after the second numeral. A 250 mmf. condenser would have the colors red, green, and brown.

Receiver Review

(*Continued from page* 21)

and annoying types of fading.

There are no particular precautions to observe in operating this receiver, inasmuch as the designers have made it practically fool-proof. It might be well, however, to quote a paragraph of the instruction notes which accompany this set:

"The buyer of a Midwest All-Wave receiver should not feel disappointed if he does not immediately get foreign stations. Atmospheric and climatic conditions greatly affect reception at such long distances. There are times when such conditions, unknown to the user, prevent clear reception. At other times, foreign stations, thousands of miles away, will come in with amazing clarity and brilliancy. It is anticipated that the purchaser of an All-wave Receiver is familiar with these conditions and will not feel disappointed if he does not immediately secure reception from all over the world. He should carefully follow instructions—a lot depends upon the skill of the operator."

APPLICATION: The Midwest 16-tube Receiver is especially designed for the man interested in the reception of broadcast stations. It is not equipped to receive continuous wave (c.w.) telegraph stations. Its operation is not any more difficult than that of a conventional broadcast receiver. The only difference lies in the patience of the operator.

* * *

A question that is as old as radio itself is, "Must the ground wire be insulated?" The answer is "No." Since the entire object of the ground wire is to make a connection eventually with the ground, there is no particular sense in insulating the wire from the house or any other material that rests on the ground.

* * *

The directional effects of ordinary receiving antennas are not nearly as marked as some radio text books would have us think. This is particularly true of aerials erected on city apartment houses or in any locations where there are large buildings or other structures.

Identifying Stations

We have been receiving numerous letters from short-wave listeners asking us to identify stations from which they have caught random snatches of voice or music.

This is an altogether hopeless job, as there are hundreds of stations on the air at once. The language used by the announcer or the type of music is absolutely of no significance whatsoever, as practically all short-wave broadcast stations announce or broadcast programs in a number of different languages. The only thing the listener can do is to listen again at the same dial settings and to wait patiently for some sort of identifying announcement.

A Note on Grid-Bias Resistors

(*Continued from page 23*)

sistor of a type 56 tube with 250 volts on the plate applied through a resistor of such value as to bring the plate current to .2 ma. with no signal is 100,000 ohms. This corresponds to a grid-bias voltage of -20. Now the point is, why should this same tube have any other value of bias resistance in another set?

It must be recalled that the type 56 tube is so designed that the maximum signal impressed on its grid must never be greater than its grid bias. In other words, in our numerical example here, the peak value of the signal can never be greater than 20 volts, or its effective value can never be greater than about 14 volts.

This limitation immediately restricts the gain, or amplification, that precedes the detector. If a high gain r.f. or i.f. section is used, the signal voltage reaching the grid of the detector, which in our case is a 56, may be well in excess of 20 volts. Under these conditions, the grid draws current, with the usual catastrophic results. The only solution, then, lies in increasing the value of the grid bias of this tube until it is at least equal to the peak value of the signal which the receiver is expected to handle at the detector.

Values Limited

From these instructions, therefore, it is clear that the values of grid-biases specified for any tube regardless of whether it is a detector or amplifier (except classes B and C) are directly limited by the amount of pre-amplification. In a highly sensitive receiver, the value of the grid bias should be much higher than in a receiver not so sensitive. In other words, during the design of the receiver the signal voltage at particular points along the receiver must be accurately measured so that there is no possibility of overloading the detector.

It is clear, therefore, that a given tube in a given electrical connection may *not* have the same value of grid-bias resistance simply because the gain may not be the same in both instances.

The same line of reasoning also holds true for plate circuits. With the signal voltages large, the load impedance cannot be high relative to the tube impedance, otherwise severe distortion will set in. In such cases, if the high gain coincident with high load impedances is to be obtained, extreme care and careful laboratory work are absolutely essential to stable operation. The usual procedure, however, is to reduce the gain by reducing the load impedance to secure the increased stability.

—*L. M.*

Converters vs. Adapters

by Alfred A. Ghirardi

Author of "The Radio Physics Course"

WITHOUT doubt, the superheterodyne system is the best known system for short-wave reception, inasmuch as it is the only one which permits a high order of amplification to be obtained without the insurmountable difficulties encountered in building high-gain short-wave r.f. amplifiers. While it is, of course, desirable to employ a superheterodyne receiver designed especially for short-wave reception, it is a fact that a large proportion of radio enthusiasts already own broadcast-band receivers which may represent a considerable investment. They do not care to purchase a separate receiver for short-wave reception. Where a suitable broadcast band receiver is available, it may be converted into a short-wave superheterodyne receiver by means of a "short-wave converter."

One often hears the terms "S.W. converter" and "S.W. adapter" used interchangeably, while actually there is quite a difference between the two. The term "converter" should be applied only to devices which convert one frequency into another frequency. A converter may be used as the first detector of a superheterodyne arrangement.

A short-wave converter is an electrical arrangement which converts the short-wave signals into corresponding long wave signals so that the short-wave programs can be received on an ordinary broadcast receiver. The r.f. amplifier in the broadcast receiver itself functions as the intermediate-frequency amplifier of the superheterodyne.

Changes Frequency

The short-wave converter is really a frequency changer. It consists usually of a first detector, tunable local oscillator, and self-contained power supply unit, although in some cases it may also have a stage of t.r.f. amplification ahead. The converter is connected to the antenna and ground terminals of the broadcast band receiver. The oscillator output heterodynes with different incoming short-wave signals, resulting in a beat-note or "difference frequency" in the intermediate amplifier, which in this case consists of tuned r.f. stages of the broadcast receiver set at some fixed tuning frequency. Some converters used the filament and B voltages from the broadcast receiver, others are separate batteries, and still others have their own socket-power supply unit.

When the converter is placed beside any standard broadcast receiver by simply connecting the antenna to the converter, one lead from the converter to the antenna post of the receiver and one lead from the ground terminal of the receiver to the ground terminal of the converter and the power plug is inserted in the socket, the full conversion of the broadcast receiver to a short-wave superheterodyne has been accomplished. To eliminate the converter, it is only necessary to shift the antenna lead back to the broadcast receiver again, leaving the ground connection between the broadcast receiver and converter permanently made if desired. This may be accomplished by a simple switching arrangement. These connecting wires should be kept very short to prevent them from acting as antennas and picking up signals direct from broadcast-band stations. In many cases, the antenna lead from converter to set need not be disconnected, although it is desirable to do so.

Set Is I.F. Amplifier

When this connection is made, the r.f. amplifier of the broadcast receiver is tuned to some clear channel in the neighborhood of 1000 k.c., and serves as the i.f. amplifier for the superheterodyne, the broadcast receiver detector functioning as the second detector, and the audio channel operating in the conventional manner. In this manner, the full amplification of the broadcast receiver is utilized at short waves. The tuning of the broadcast receiver is left fixed and is not varied at all when receiving short-wave programs. It is only varied when broadcast-band stations are to be received.

Short-wave signals may also be received with an ordinary broadcast band receiver by using a short-wave adapter ahead. A short-wave adapter, usually, is simply a short wave detector, and its tuning circuit is designed to tune to the short wave signals. No change in frequency takes place in an adapter. By means of a socket plug which is connected to the adapter, connection is made from it to the audio channel of the broadcast receiver by first removing the detector tube from the socket of the broadcast receiver, and then plugging in its place this special socket plug.

In this way, the r.f. amplifier and detector circuit of the broadcast receiver are cut out, and in its place is used merely the short-wave detector unit which comprises the adapter. What we have, then, is a simple short-wave detector circuit followed by the one or two stages of audio-frequency amplification in the broadcast receiver. In some of the older types of broadcast receivers, the radio-frequency amplification is so low that one may just as well use a s.w. adapter instead of a s.w. converter, obtaining almost

(Continued on page 43)

The "Sporting Twin"

(*Continued from page* 31)

tinkering in this regard, as tubes, batteries, and coils vary considerably. If the set plops into oscillation too suddenly or violently, try grid leaks of different value between 2 and 10 meohms (they're cheap), and as little plate voltage as possible. If the action is still too strong, remove a turn at a time from the tickler windings. The ticklers specified are probably a bit too large, but it is much easier to cut out turns than to add new ones, and don't be afraid to experiment.

With some transformers and tubes, a very annoying effect known as "fringe howl" may take place. The set bursts into a terrific shriek just when the signals start to build up, and all the reception is ruined. A fixed resistor of the grid leak type, R3, across the secondary of the transformer, will eliminate the howl very nicely. The size is a matter of experiment; start with 250,000 ohms. The higher the better, as low values drop the signal strength appreciably.

Don't expect to hear China or Australia the first time you turn the set on. At first you will probably skip by dozens of stations, as the tuning is very sharp. If you have never operated a short-wave receiver, your first reaction may be disappointment, but after you've learned the knack of the dials you'll wonder how you managed to miss all those stations before!

The "Pretzel Bender"

(*Continued from page* 33)

the two-volt storage battery, two 1½-volt dry cells, or an Air Cell battery. If a two-volt storage battery is used, it can be connected directly to the tubes' filaments without the use of a series resistor; if an Air Cell is used, a ¾-ohm resistor must be inserted in series with it; if two 1½-volt dry cells are used, a 5-ohm resistor must be connected in series with them. The receiver is designed to operate with three 45-volt B batteries, either standard or of heavy duty size. B battery eliminators are not particularly recommended unless they are very well filtered. For the C battery, three standard 4½-volt units are connected in series.

Little else can be said regarding the receiver itself. Its simplicity and efficiency are its main virtues. It needs but the guiding hand of the operator to solve the mysteries of short-wave reception.

* * *

The use of illuminated dials in dry-cell operated short-wave receivers is not practicable for the reason that the average dial light consumes as much current as two or three tubes.

Converters vs. Adapters

(*Continued from page 41*)

equal results. If properly adjusted, an adapter gives fairly satisfactory short-wave reception, and it has the advantage of having a considerably lower first cost.

Short-wave adapters used with a.c. electric broadcast receivers do not always give satisfactory results, because most of these receivers use plate rectification in which plate voltages as high as 180 volts may be applied to the detector. When the adapter plug is inserted, the same plate voltage is being applied to the tube in the adapter. Also, in many a.c. electric receivers, which use resistance-coupling between the detector and first a.f. tube, the actual effective voltage on the plate of the detector is very low. This causes inefficient operation of the adapter detector.

Since the tendency in modern receiver designs is to do most of the amplifying in the r.f. amplifier and use only one audio stage, short-wave adapters used with these receivers do not usually operate satisfactorily, merely because there is not enough audio amplification provided. These points are important; for, in many cases, poor reception is blamed on an adapter when, in reality, it is due to improper operation of the receiver.

The knack of correctly operating short-wave receivers is usually learned only after considerable experience in tuning a particular set.

Tune Slowly!

Possibly the greatest trouble is caused by the fact that the novice manipulates the tuning controls much too rapidly. Due to the fact that several stations may often be tuned in and out with a movement of a division or two of the tuner dial, it should be turned very slowly when tuning for stations, or they will be passed right by without being heard. Short-wave receivers of the regenerative type should oscillate smoothly over the entire range of the tuning condenser, with each coil. If the set is correctly designed and the batteries (or socket power device) and tubes are in good condition, the fact that usually determines whether or not the set will oscillate is the antenna series condenser.

If the antenna is too long, the set will not oscillate. Instead of cutting the aerial length, a midget condenser with a capacity range of from about .00001 to .00005 mf. may be connected in series with the aerial. Different settings of this condenser should be tried at the various wavelengths until the set oscillates smoothly. Antennas from 30 to 60 feet in total length (including lead-in and ground wires) are usually suitable for short-wave reception.

It is important that all connections be well made and soldered. The ground connection should be made to a cold water pipe or to a separate pipe or plate buried in moist earth. The importance of good ground connections cannot be over stressed, as they are often responsible in a large measure for the good or poor results obtained with an otherwise good receiving system.

Short-wave receivers of the non-regenerative type are tuned in exactly the same way as ordinary broadcast receivers are, only the tuning dials should be rotated more slowly. There are two methods of tuning either short-wave or broadcast receivers of the regenerative type.

In tuning for short-wave signals, set all controls, such as the antenna series condenser, volume control, etc., at the point where loudest signals are heard on local stations. Then, throw the detector into oscillation by advancing the regeneration or volume knob very slowly until you hear a soft rushing sound. As you continue to turn, the noise will build up quickly in intensity and then drop off in an abrupt click.

The condition of the set during the first rushing period is known as "regeneration," and in it the set is extremely sensitive. The condition just beyond regeneration is "oscillation." If you keep the set in oscillation and turn the tuning dials slowly, you will hear a whistle when you run into a broadcast station. With this whistle may be mixed the voice or music. The whistle of "beat-note" is produced by the heterodyning of the incoming signals with the oscillations of slightly different frequency generated by the oscillating detector. To clear up the signal, simply turn back the volume knob until the set crosses the border line and slides back into regeneration.

If the incoming signal is fairly strong, the program will come through free of the whistle. However, if it is weak, the whistle will dominate the voice, as this whistle is caused by the beating or "heterodyning" of the carrier wave of the station and the oscillations generated in the detector circuit. In this case, the "zero-beating" tuning method should be tried. This is always the best for weak signals, although it requires some experience in tuning.

To "zero-beat" an incoming signal, throw the receiver into oscillation by advancing the regeneration control, and then tune it very carefully so that the frequency of the oscillations set up by the detector are exactly of the same frequency as that of the incoming signals to be received. When this exact point is reached, no whistling is heard, since there is no difference in frequency.

Reversed A.V.C.?

THE so-called proper design of an oscillator to be used in the conventional superheterodyne demands that its voltage be as great as possible. "As great as possible" is usually taken to mean a voltage of such strength that, when combined with a good sized signal, the voltage at the grid of the first detector is the maximum permissible for the particular tube used.

This theory is based on the fact that the i.f. output is a product of the strengths of the signal and the oscillator voltage, so that the greater the oscillator voltage, with a given signal, the greater the desired output.

The writer believes that greater output would be obtained if the oscillator voltage were so adjusted so that its value is equal, at all times, to the signal voltage. Under these conditions, the modulation percentage of the voltage at the grid of the first detector would be 100%; hence, maximum i.f. voltage would be obtained at a minimum of total voltage at the grid.

This minimum voltage means lower tube noise, it means that the tube can handle a greater signal voltage without overloading, and it means that the possibility of oscillation is reduced.

Now, how to make the oscillator voltage equal to the signal voltage at all times, *automatically*. Automatic volume control is well known, and we can use it in reversed connection here. According to our brief discussion, a small signal should be accompanied by a small oscillator voltage, and a large signal by a large oscillator voltage. Thus, the oscillator must be so controlled that its output is small with weak signals.

Here is one way to accomplish the thing. With no signal, arrange the oscillator bias so as to be highly negative; its output will then be small. When a signal arrives, the bias on the oscillator is made less negative by a reversed automatic volume control action, its output then rises until its value at the grid of the first detector is equal to that of the signal.

The writer believes that this system could be made to produce some very excellent results. These results, however, cannot be accomplished without some real development work; development work based on measurements, not on speculation.

The experimenter, however, without adequate measurement facilities at hand can try a simple stunt. He can vary the output of his oscillator manually, by means of a potentiometer or some other similar device. A peak should be obtained, at which point the oscillator voltage equals the signal voltage.

Try this scheme, somebody, and let us know the results.

—*L. M.*

A DeLuxe S.W. Station

(*Continued from page* 14)

remote control units are of the pre-set push button type with a motor driven dial actuator. The living-room control is about 40 feet from the radio room, and the cellar control about 15 feet. The installation functions perfectly from any of the three positions.

The detector tube of the broadcast tuner feeds a separate audio amplifier, which occupies the panel immediately above. This amplifier comprises a single 56 stage feeding a push-pull stage using two 56's, which in turn operates a final push-pull stage using two type 250 tubes. When this system is opened up full blast, it is truly something to hear.

Power supply for the broadcast tuner and amplifier is furnished by another individual power unit, using two type 81 half-wave rectifiers. This pack is directly above the audio amplifier panel. The various meters indicate plate, grid and filament voltages and currents.

Central Control Board

The midget switchboard directly next to Mr. Frimerman's left elbow is a central control board by means of which all output and input circuits of the receivers and amplifiers are controlled and mixed through the medium of six-volt battery operated relays. The upper section of the center rack is devoted to a Tunger charger for the relay battery and to a double row of fuses which protect all the six-volt controlled circuits.

The wiring behind the panels is rather complicated and pretty much resembles that of a small telephone switchboard.

All the panels on the racks are machine-ground aluminum, which presents a beautiful appearance. Mr. Frimerman constructed everything in the room by hand, except of course, the tubes, condensers and other small parts. His radio "shack" is one of the show places of the Bronx and has been visited by radio fans from all over the world.

* * *

In one of our recent issues we remarked that the reception of European broadcasting stations in the United States on the regular broadcast band is pretty much of an impossible undertaking because of terrific interference from the 600 or more American stations that jam the 1500 to 540 kc. band from top to bottom. However, a number of listeners in the East report that they are able to hear the French station "Petit Parisien" at about 3 a.m., e.s.t., just after KFI in Los Angeles has signed off. The French station is just then going on the air, it being 8 o'clock in the morning on the other side. Listeners who do not understand French can easily recognize the station because it broadcasts bugle calls.

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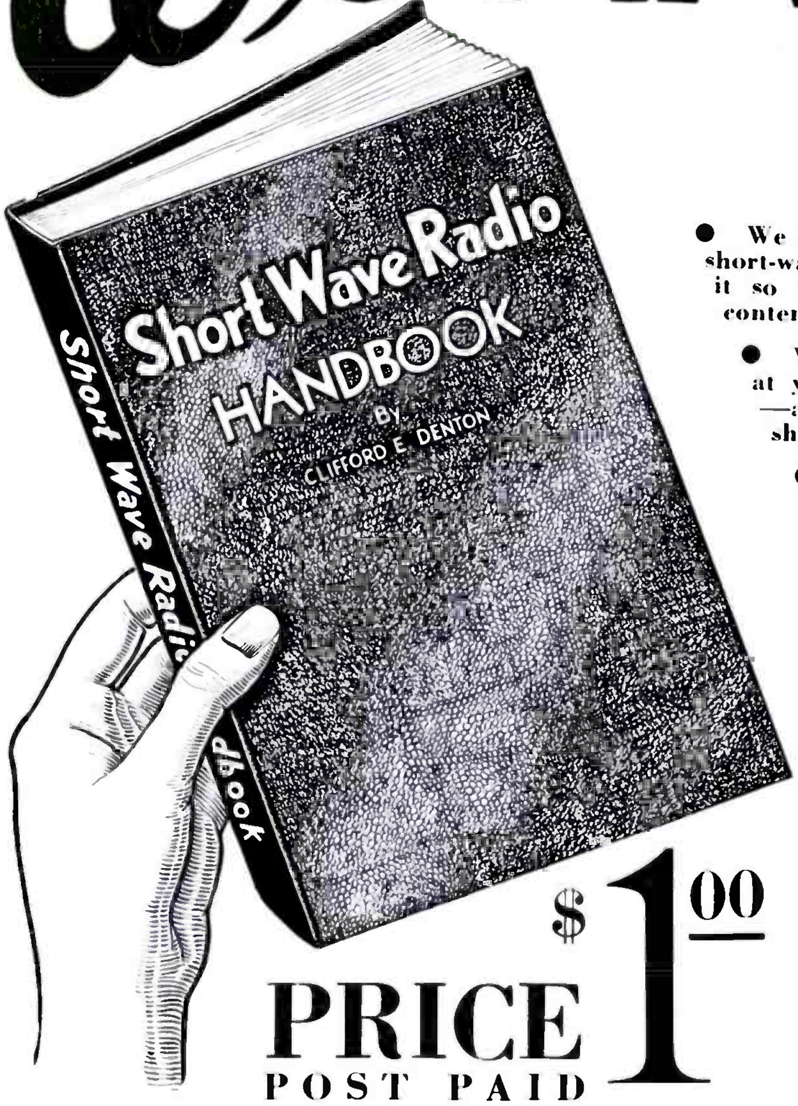

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