HOW TO BECOME A RADIO AMATEUR

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HOW TO BECOME A RADIO AMATEUR

DO YOU remember the old story of Aladdin and his wonderful lamp, and the magic Genie who was its servant? You can be a modern Aladdin, your magic lamp the radio vacuum tube, its servant the mighty force of Amateur Radio.

In Amateur Radio you can have a hobby of tremendous fascination, a power at your command which will annihilate distance and bring you closer to mankind throughout the world. You can build and create if you are so minded, and put these things to work for you to overcome miles and hours and bring back to you pleasure and new-found friends, or you can enjoy the sport of competition with other radio amateurs. With simple apparatus which you build yourself, you may talk around the world to thousands of other amateurs in every country.

Many people to-day are asking how to become amateurs. Three or four years ago they hardly knew what the word meant. But much has happened in those intervening years. The whole world began talking about the marvelous powers of short waves, and the radio amateurs were constantly referred to as the ones who had uncovered this gold mine in the radio spectrum. Exploring and scientific expeditions to the far corners of the earth — and the Byrd Expedition in particular — became front-page material, and throughout the news dispatches the radio amateur was prominently mentioned as an important link in the communication system between such expeditions and civilization. A flood in New England, two hurricanes in Florida, and several other major disasters spread devastation and suffering throughout parts of the country — and the newspapers and Red Cross officials were loud in praise of the splendid emergency communication work that had been carried on by radio amateurs when all other means failed.

Suddenly, large numbers of the public realized that this thing called amateur radio is a widespread and tremendously thrilling hobby, through which in addition to participating in such activities as have been mentioned here they may also talk nightly from their own homes to other amateurs all over the country, across the seas, and into every corner of the globe. And they realized, furthermore, that this fascinating hobby is easily available to them, whether they be sixteen or sixty, and at a minimum of expense and trouble.

Is it small wonder, then, that so many people are now asking, "How can I become a radio amateur?"

Contrary to popular impression, there is nothing at all complicated about the process of becoming an amateur. We might liken it to the business of becoming a broadcast listener. Everyone knows there is nothing hard about that. You build a broadcast receiver, listen in on broadcast programs, and you are a broadcast listener.

One becomes an amateur by following the same method. If you build a short-wave receiver and transmitter, and operate them in the proper wave-bands, you automatically become an amateur. It happens, perhaps, that you have seen pictures of amateur stations, and they looked very complicated and expensive. In consequence, you are inclined to think that

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it is one thing for us to tell you to build an amateur receiver and transmitter, but it is going to be quite another matter for you to actually do so.

Don't let it worry you a minute. There *are* complicated amateur sets, just as there are many complicated broadcast receivers on the market. But that need not affect you. There are plenty of simple amateur outfits, too — far simpler than the average broadcast receiver from the standpoint of both construction and operation — and yet they perform well and transmit and receive signals entirely satisfactorily for thousands of miles.

You may not possess the slightest amount of experience, engineering or technical knowledge, but that will not interfere with your amateur progress. You will still be able to construct a satisfactory amateur station, and operate it to bring you many hours of pleasure.

It is our purpose to describe in the pages of this booklet an exceedingly simple radio sending set, and a correspondingly simple short-wave receiver, and to give easily understandable directions for putting them on the air and using them. A fourteen-year-old boy can do it — many have, in fact. No knowledge of theory is necessary to construct the set or operate it. Some idea of how the transmitter and receiver work is necessary for your government license examination, but in these pages we will also teach you all you need to know on that score. It is necessary to learn the code, but that is not difficult. As for mechanical ability, anyone who can wind a coil of wire, use a screw-driver and follow directions, can complete the entire station in less time than it would take to assemble the average broadcasting receiving set.

And that's all there is to becoming an amateur.

A word of caution: we are going to tell you in this booklet every single thing you need to know in order to become an amateur, get your licenses and put your station on the air, but because of the necessity for including a large amount of information in a few pages, we must warn you that facts will be stated but once and not repeated. Read carefully and don't skip over anything.

If you are starting out in your automobile on a trip to some part of the country several hundred miles away you usually begin — if you are wise — by looking at a map and getting some idea of where your destination is on it. Before we do anything else, let us take a moment to look at the short-wave territory into which we are going to venture, and obtain some idea of where the various amateur "destinations" are in that territory.

The broadcasting band (in the United States) extends from 200 meters up to about 550 meters, as you probably know. When we speak of "short waves" we usually refer to the territory *below* that dividing line of 200 meters. Now there was a time, up to a few years ago, when the amateur was given all the territory below 200 meters, because none of the commercial or government radio people thought that those wavelengths were at all useful. However, after the amateur had shown that these wavelengths were really far more valuable and useful for long-distance communication than the long waves above 200 meters, it became necessary to subdivide the short-wave territory into bands for all the various interests that wanted room to operate there. Government stations, commercial land stations, trans-oceanic radio stations, ships, airplanes, television companies and police radio systems — these and many others, in addition to the amateur, wanted their share of the short waves. So the amateur, instead of having all the wavelengths below 200 meters, was given certain bands in which he could operate, and he must not operate elsewhere.

Suppose we draw a long line to represent the short-wave territory between 5 meters and 200 meters. The various bands in which we, as amateurs, can operate, and their relative widths, will be as shown in our first illustration.

You may wonder why the amateurs have several narrow bands instead of one single band equal to all those narrow ones put together. That is a perfectly good question, and we'll try to explain the reason to you — for there is a good reason. You see, just as the short waves have different habits than the long waves, so some of the short waves behave differently than

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other short waves. For instance, the wavelengths between 100 and 200 meters work best at comparatively short distances — 50 to 400 miles, we might say. Thus, the amateur band marked *A* is essentially a short-distance band.

As our wavelengths grow shorter (which is the same thing as stating that the *frequency increases*) the distance range grows. Band *B*, for instance, is a better long-distance band than *A*. When we get to band *C* we begin to jump across great distances, and find our signals going many thousands of miles under favorable conditions, and in band *D* they go still farther. Ten-meter signals (band *E*) often go too far! This sounds rather strange, no doubt, so an explanation is in order. The reason short waves go to great distances is that they leave the surface of the earth and angle up into the air, are gradually "bent" by refraction in the upper atmosphere, and eventually come down to earth again. Now, the shorter the wavelength, the higher it goes into the air before it starts to bend down. This explains why the 7000-kilocycle band (*C*) is better than the 3500 (*B*) for extreme long-distance work, and why 14,000 kc. (band *D*) is better than the 7000-kc. band. It happens that at 10 meters (band *E*) the wave goes so high into the air that by the time it comes down it is frequently beyond the limits of the earth, and never touches our world again.

Thus, for general amateur use, we will find it most profitable to work in either band *A*, *B*, *C* or *D*. As a matter of fact, due to the greater chance of interfering with broadcast listeners when operating in band *A*, and also because it is really a fairly short-distance band, few amateurs work there, and you will find that most of them work in band *B*, *C* or *D*.

The transmitter described in this booklet will work in band *B*. There are good reasons for this. Band *B* is probably the most valuable all-around band for the amateur. It is the place where most of the emergency work, national relaying, etc., is carried on. It is also one of the widest bands, and therefore desirable for the beginner, because he has less chance of getting outside it through maladjustment of his apparatus, and consequently getting into hot water with the government authorities. It is also somewhat easier to make a transmitter work properly in that band. So our transmitter is designed for band *B*. You will derive much enjoyment from operating it there. You will find it possible to talk with amateurs all over the United States and Canada with the transmitter, and then, after you have learned more about the operation of amateur apparatus, you will be ready (if you so desire) to move down into bands *C*, *D* or *E* and get in on *international* amateur communication. We will tell you, in advance, that you can use the same transmitter that we describe here, except for the changing of the two coils employed in it.

The receiver, of course, is also designed to work in band *B*, but in addition we are building it to include, by the adjustment of a clip, the ability to work in band *A*, for it so happens that in various parts of the country there are some public-spirited amateurs who make a practice of sending code lessons on that band, especially for the beginner, and if you are near one of those amateurs it will be helpful to be able to listen in on the code lessons and improve your code

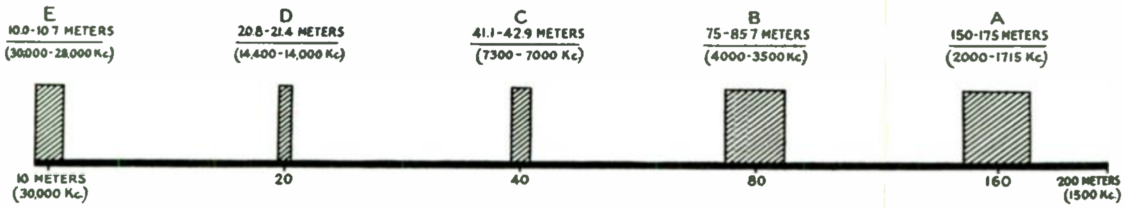

Fig. 1. — The High-Frequency Spectrum, Showing the Relative Widths and the Relative Locations of the Useful Amateur Bands

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speed that way. If you will write to the American Radio Relay League, at Hartford, Conn., we will be glad to tell you if there are any beginner's code stations in your vicinity.

Now let us get to the business of really becoming an amateur.

Learning the Code

THE first thing for you to do is to start learning the code. You can memorize it while you are building your receiver, and then you can use your receiver to listen in and get code practice while your transmitter is being constructed. Thus, by the time your transmitter is finished and you are ready to apply for your licenses, you will probably find your code-speed requirement taken care of.

Learning the code is the first stumbling block for some people. But it has to be learned — the government won't issue you any kind of an amateur license until you know it. Don't let it scare you; it really isn't at all difficult. The entire alphabet can be memorized in one or two evenings. A few weeks' practice listening in to code transmissions with the receiver described herein will develop speed. If you make up your mind to settle down and lick the code within a few weeks, you will be surprised to see how fast you progress.

The alphabet, numerals and punctuation marks are shown in Fig. 2. First of all, memorize these characters. Start by memorizing the alphabet, disregarding the numerals and punctuation marks for the present. There are several ways to memorize the alphabet. One way is to take the first five letters — *a*, *b*, *c*, *d* and *e* — and learn them, and then take the next five, and so on. On the other hand, some people like to group the alphabet into so-called memorizing groups, somewhat as shown in Fig. 3.

Try whichever grouping you think will be easier for you.

Another suggestion: Learn to think of the letters in terms of *sound* rather than their appearance as they are printed. Do not think of *a* as "dot-dash" but think of it as the sound "dit-dah." *B*, of course, would be "dah-dit-dit-dit," etc.

After you have memorized the alphabet

· —	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
· — — — —	1
· · — — —	2
· · · — —	3
· · · · —	4
· · · · ·	5
— · · · ·	6
— — · · ·	7
— — — · ·	8
— — — — ·	9
— — — — —	0
· · · · · ·	PERIOD
· · — — · ·	INTERROGATION
— · · · —	BREAK (DOUBLE DASH)
· — · · ·	WAIT
· — · — ·	END OF MESSAGE
· · · — · —	END OF TRANSMISSION

FIG. 2 — THE CODE

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(don't worry about speed yet) you should memorize the numerals. These are easy. You will observe they follow a definite system, and you will probably learn them very quickly. Then you should learn the signals for the various punctuation marks, always remembering to think in terms of the *sound* the signal makes.

When you feel that you know all these in your own mind, without hesitating over them, you are ready to develop speed.

The best way to develop speed is for two people to learn the code together. If you are fortunate enough to be able to find someone who will help you do this, the two of you should buy a buzzer and key, hook these up to a couple of dry cells, and send to each other. Fig. 4 shows how a buzzer and key should be connected. By taking turn and turn about it is remarkable how soon speed will be picked up.

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

Fig. 3. — The Alphabet in Memorizing Groups

Another good thing about this sort of practice is that it develops ability in sending, too, because the fellow who is receiving will be quick to criticize indistinct and uneven sending.

If you are unable to get someone to practice with you, we would still suggest that you get a buzzer and key (you can always use the key later, in the transmitter) and "send to yourself." This helps at the start. After a little practice along these lines, you should get on the air with your receiver and listen to actual signals being sent out by other amateurs. Most of them will be faster than you can copy — but don't mind that. Every time you hear a letter that you recognize, write it down, even if it is only every fifth or tenth letter. The point is to keep at it and make a real effort to copy every letter you possibly can. Do not be alarmed if you copy several consecutive letters and they don't make sense — many amateurs use abbreviations that will be unintelligible to you, at first.

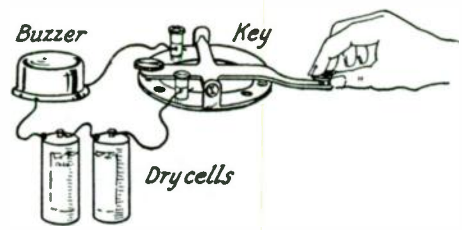

Fig. 4. — Connections of the Practice Buzzer, Key and Batteries, also Showing how to Hold the Key

It is probably safe to say that the majority of the amateurs on the air to-day learned the code by listening on their receivers. Keep at it — try to get in a few minutes at your receiver every day. Before you know it, you will be copying solid sentences.

When you can consistently copy ten words a minute (fifty letters) you are sufficiently well equipped on this score to pass the government code-speed requirement in connection with your amateur operator's license. It is a good thing, of course, to learn to copy a little faster than ten words a minute before you take your license examination, because if you are like most amateurs you will get just a little rattled when you actually go to take your test, and it is wiser to be on the "far" side of ten words a minute than on the "near"!

Practice sending, too. You will undoubtedly find it a lot easier to send than to receive — everybody does. But don't try to hurry your sending. Grasp the key lightly but definitely with the thumb and first two or three fingers

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of the hand, and adjust the key so that there is an up-and-down motion of about one-sixteenth of an inch at the knob. Use a wrist motion. Learn to make the characters evenly and distinctly. *Don't* try to send fast. One of the surest indications of a beginner on the air is the fellow who tries to send rapidly and only makes an unintelligible mess of everything. It is a good idea to keep your sending speed on a level with your receiving speed.

Be particularly careful when sending letters such as *c* to make them "all at once" like this (_ . _ .) and not like this (_ . _ .)

Building the Receiver

IT IS now high time to build the receiver; in fact, it should be started as soon as you start in to learn the code.

The receiving set we describe is of the simplest possible design and construction. It is easy and straightforward to assemble and operate, and yet will readily bring in amateur signals from distant stations with a suitable antenna and ground.

Some of our readers may notice that the circuit is simply the old familiar "three-circuit" tuner so commonly built by broadcast listeners in the early days of broadcasting. Do not think, for this reason, that it is not a particularly good amateur receiver. It may surprise you to know that this tuner, with occasional slight modification, is used in probably 90% of the amateur stations in this country. Most of the international amateur work, Byrd communication, etc., is done with receivers using this circuit. One of the attractive things about amateur radio is that the simplest apparatus suffices for even the greatest distances.

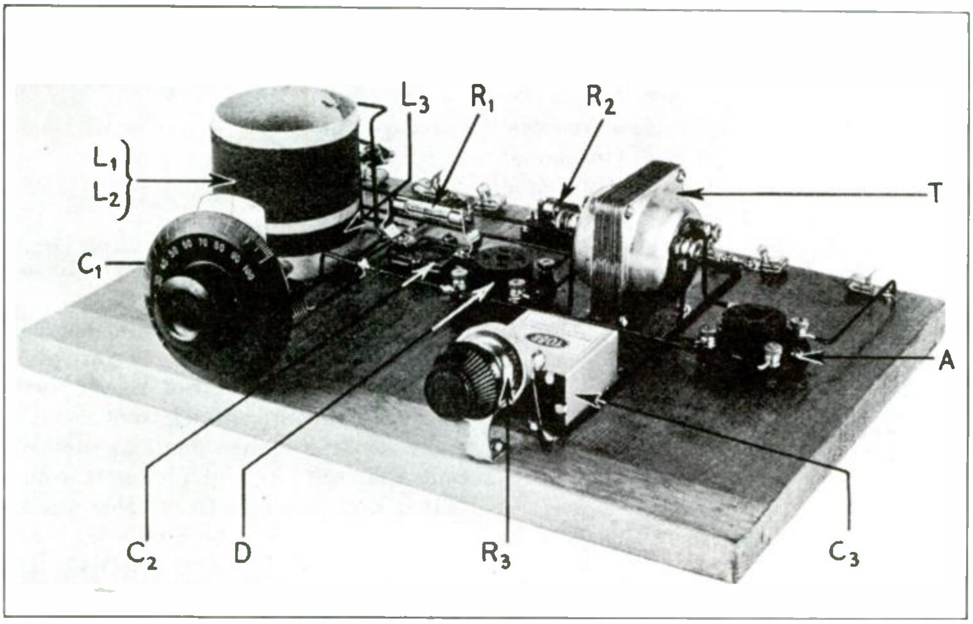

Fig. 5. — A Front View of the Receiver

The wiring diagram is shown in Fig. 6. The view of the set in the photograph, Fig. 5, will give a clear idea of the general arrangement of the parts.

In describing this unit, as well as the others which follow, the use of picture diagrams has been avoided, for several reasons. The first is that such diagrams are not acceptable in license examinations, the use of standard symbols being compulsory. A second reason is that the schematic diagrams, once understood, are far less confusing than picture diagrams. A third is that particular brands of parts must be specified if picture diagrams are used, and as there is no objection to substituting apparatus that may be on hand or more readily obtainable than that used in these particular sets, the picture diagrams would lead to difficulties if such substitutions were made.

A complete list of parts, together with the approximate list price of each, is given below. (*Note:* It is rarely necessary to pay these list prices for parts in this day of cut-price radio stores and mail-order houses, so that the total amount shown can probably be reduced considerably.) Other makes may be used — there is no need of discarding perfectly good apparatus if the correct values are on hand.

1 baseboard, 10 x 14 inches	$ 0.30
1 Pilot 23-plate 100-μμfd. (.0001 μfd.) *midget* condenser (equivalent to a 5-plate condenser of standard size)	1.40
1 volume-control Clarostat	1.50
1 Tobe 1-μfd. by-pass condenser	1.00
1 Pilot 250-μμfd. (.00025 μfd.) fixed condenser with grid-leak clips	0.45
2 Pilot sockets for 4-prong tubes	0.70
1 2-megohm grid leak	0.20
1 audio transformer (any ratio). About	4.00
1 Lynch type-2 Equalizer (assuming that 201-A tubes will be used in the receiver) and mounting for same	1.00
8 Fahnestock clips	0.20
1 2¾" cardboard tube 3 inches long	0.05
1 spring clip	0.05
10 feet covered bus wire	0.40
60 feet No. 22 double-cotton-covered wire	0.25
1 3-inch dial	0.25
Misc. screws, brackets, etc	0.25
Set cost	$12.00
2 UV-201-A tubes	2.50
Total	$14.50

The baseboard should be smoothed with sandpaper and given three coats of Duco clear varnish, sandpapering lightly after each coat except the last. A 14 x 20-inch breadboard makes a good baseboard; saw it in half and use one of the halves for the receiver. The other half should be laid aside to be used in the transmitter later on.

The parts should be arranged on the baseboard in the general manner indicated in Fig. 5. It is *not* necessary to follow this arrangement exactly, nor are the distances between various pieces of apparatus particularly important. The photograph will, however, act as a guide for a suggested arrangement which we have found to be easy and logical to handle.

The tuning condenser C_1 and regeneration control R_3 are mounted on small angle brackets,

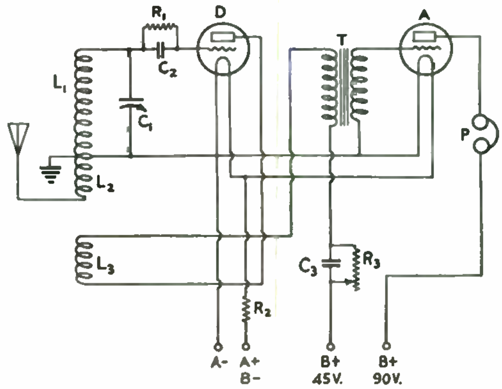

Fig. 6. — THE "SCHEMATIC" DIAGRAM OF THE RECEIVER
(The "A" battery supply is 6 volts)

but if you wish to mount them on small pieces of panel fastened to the front edge of the board you may, of course, do so. If suitable brackets cannot be bought, they are easily made by bending a piece of stiff brass or copper strip to the proper size and shape, and drilling out the necessary holes. The other parts, with the exception of the tuning coil — which is taken up in more detail below — are very easily mounted.

The tuning coil is the only feature of the set which should offer any difficulty, and its construction is clearly shown in Fig. 7. The top and bottom coils on the tube are both wound in the same direction and the connections must be taken off as shown. It is important that the coil be made exactly as in Fig. 7, the only allowable variation being that the cardboard tube may be 2½" or 3" in diameter instead of the diameter specified — though the tuning

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range will be altered slightly under such conditions.

The taps are made by scraping the insulation off the wire at the proper points and twisting the bare part into a loop. Incidentally, if the

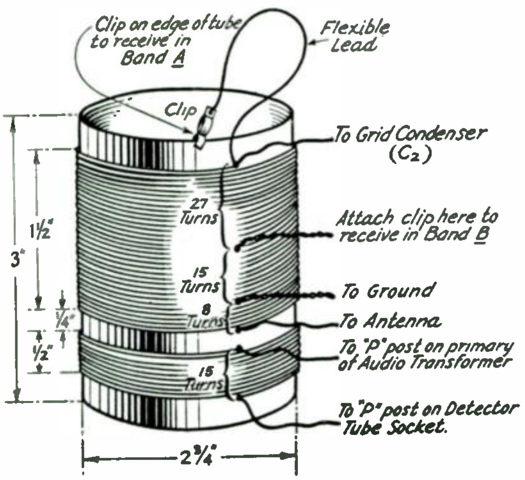


Fig. 7. — Details of the Receiver Coil

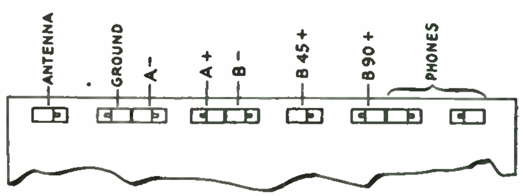
final twisting of these taps is left until the coil is completely wound, it will help tighten the winding. One or two twists will have to be made at first, of course, in order to hold the tap while the coil winding is being completed. When the coil is finished, it should be given a coat of the same clear Duco varnish that we used on the baseboard. This is to prevent loosening of the wire.

Any method may be used to fasten the coil to the baseboard but one of the most satisfactory is to use a thin disc of wood, around which the cardboard tube fits tightly, and screw this to the baseboard. The tube should be glued to the piece of wood. It is possible to cement the tube directly to the baseboard, for that matter. After the parts are fastened down, the set should be wired. Go slowly here. It is best to solder all joints, of course. Soldering is not at all difficult if you use a hot iron, have the parts to be soldered well scraped and cleaned, employ rosin-core solder, and use but little of it at each joint. Follow your wiring diagram carefully. You will probably have no difficulty, for there is very little wiring to be done.

Operation of the Receiver

After the set is completed, connect the batteries, headphones, antenna and ground, as shown in the diagram, Fig. 6. A suitable antenna for this receiver would be 50 to 75 feet long, and as high and clear of surrounding objects as possible. The same precautions as to insulators that you would apply to your broadcast antenna should also be applied to this short-wave antenna. The ground lead should preferably be short — do the best you can with your particular conditions. A ground to a steam radiator or any of the water piping is good. Do not use gas pipes for grounds, as the joints in these lines often are insulated, particularly at the meter.

The tubes should now be put in the sockets, and it is well to leave the "B" batteries disconnected while this is being done. If the "A" battery is connected to the set, the tubes should light up as soon as they are inserted in their sockets. If they do, it is safe to assume that this part of the set is wired correctly, and the "B" batteries may then be connected to their proper binding posts at the rear of the board. If the tubes do not light up (assuming



The Arrangement of Fahnestock Clips at the Rear of the Receiver Baseboard

you know them to be good) you should check over your filament wiring before going any further.

With the filaments of the tubes burning, and everything connected up for operation, the regeneration control knob (the knob on the Clarostat volume control) should be turned as far as possible to the *right*. Then set the tuning condenser at about the middle of the

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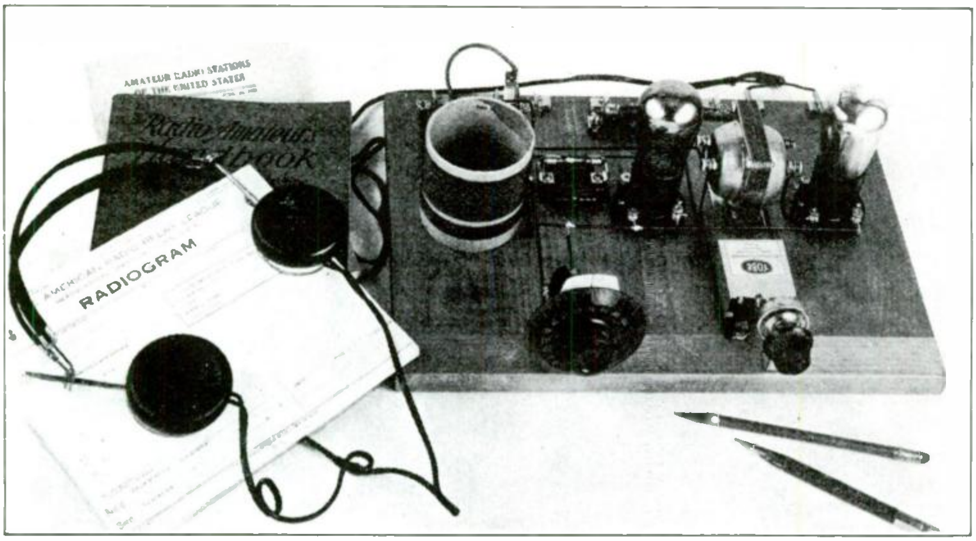
scale, and slowly turn back the regeneration control knob to the *left* until the set goes into oscillation. Most set builders are familiar with this phenomenon, but if not, it is usually easily recognizable by a distinct click, thud or hissing sound. As a test, you can touch your finger lightly to the grid condenser terminal on the coil side; this will cause a very distinct click in the phones if the set is oscillating.

The point where oscillation just begins is the most sensitive operating point at that particular dial setting. If the receiver "clicks" very strongly on going into oscillation, you should substitute a grid-leak of 1½ or even 1 megohm for the 2 megohms specified.

The tuning dial may now be slowly turned, the regeneration control knob being varied simultaneously (if necessary) to keep the set just oscillating. A number of stations will probably be heard. When listening on the 1750-kc. band (band *A*) the clip on the coil is merely fastened to the top of the cardboard tube, to get it out of the way. On the 3500-kc. band (band *B*) the clip is attached to the tap in the middle of the coil. A little practice will make tuning easy. Learn to tune *slowly*, for amateur signals are so sharp, usually, that it is easy to skip right over them if the dial is turned rapidly.

Since most amateurs operate their stations in the evening, it is probable that not very much will be heard during the day. After dark, however, many stations will be heard, particularly in the 3500-kc. band. Comparatively few amateurs operate in the 1750-kc. band, but if you listen to one of the stations sending code practice up there this fact is an advantage since there will be less chance of interference.



Another View of the Receiver, all Ready to Operate

Do *not* expect amateur signals to be loud. On the other hand, do not expect the weakest ones to be the farthest away. Sometimes the most distinct signals are farther away than the weak ones. Listen for the district call (see Fig. 19) to get an idea of how far away the station is — don't try to estimate distance by relative loudness.

If the set refuses to oscillate, no code signals will be heard. It should oscillate easily, however, if the coil is made exactly as shown and the tubes and batteries are good. It sometimes happens that the antenna takes so much energy from the set that it cannot oscillate, this usually resulting in "holes" in the dial where no signals can be picked up. The way to

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cure this is to use a slightly different length antenna, or to put a small variable condenser in the lead-in, thus allowing the antenna wavelength to be shifted. A 250-$\mu\mu$fd. (.00025 μfd.) fixed condenser in the lead-in may be all that is necessary. Another possible remedy is to place a 1000-$\mu\mu$fd. (.001 μfd.) fixed condenser across the primary (P to $B+$) of the audio amplifying transformer.

The set is turned off by disconnecting one of the "A" battery leads from the battery, or from the set, or by removing the Lynch Equalizer from its clips. If desired, a switch (single-pole, single-throw) can be mounted on the table just to the rear of the set to accomplish this purpose. The lead from one terminal of the "A" battery is left permanently connected to its proper Fahnestock clip on the rear of the set. The other "A" battery lead is run to the blade connection of the switch, while a wire from the other filament clip on the baseboard is run to the jaw of the switch.

With an antenna about 50 or 60 feet long, the amateur 3500-kc. (*B*) band will probably be found between about 40 and 75 on a 100-degree dial, and the 1750-kc. (*A*) band between about the same limits, the clip on the coil of course being changed for each band.

Building the Transmitter

AND now, you think, comes the hard part: building the transmitter. You are wrong. The transmitter in this booklet is not only considerably easier to construct than the receiver but it is far easier to put into operation. When you have built the receiver your hardest construction work is finished.

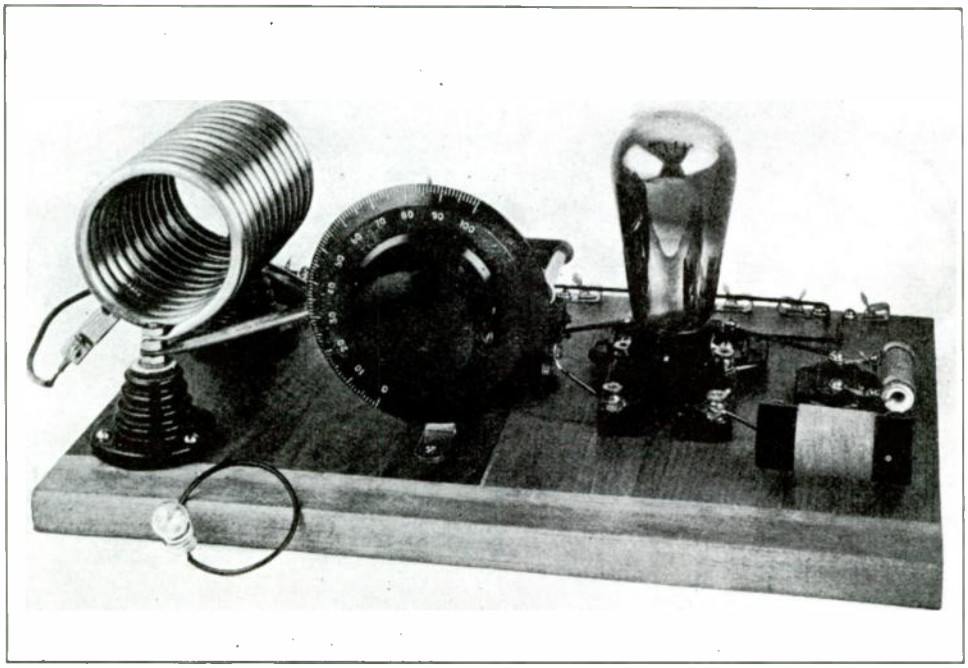

Fig. 8. — A Front View of the Transmitter

It may interest you to know that the transmitter is simply a "high-powered" oscillating receiver. We have previously told you how to keep your receiver on the edge of oscillation when receiving amateur signals. When the receiver is oscillating like that, it sends out a weak "whistle" on the air; it is actually a miniature sending set. In the early days of broadcasting, when most receivers were of this type, it was quite a common thing to hear your neighbor's receiving set "whistling"; it was the same thing, exactly.

Now, when we really want a transmitter we increase the size of the tube and put more voltage on it, and then adjust it so it will oscillate all the time. The result is that it sends out a *strong* whistle, and this whistle is the signal that goes for hundreds and even thousands of miles. By starting and stopping that whistle with a telegraph key we can spell out the letters of the alphabet in "code," and we then say we are *sending*.

We will repeat: whether you want to believe it or not, the fact is that this sending set is quite a lot easier to build and operate than the receiver.

The following material will be needed, the brand name and list price of each part being indicated. Other good makes of apparatus may be substituted, if desired, provided the same values of capacity, resistance, etc., are used.

1 baseboard 14″ x 10″ x ¾″	$ 0.30
2 General Radio stand-off insulators	0.50
1 Cardwell 500-µµfd. (.0005-µfd., 23-plate) variable condenser, type 141-B	5.00
1 4-prong tube socket	.50
1 Silver-Marshall radio-frequency choke coil, type 277	1.50
2 Sangamo .002 µfd. fixed condensers — C_1 C_2	
2 " .005 µfd. " " — C_3 C_3	
1 " .00025 µfd. " " — C_4	
Together, about	3.00
1 Pilot 75-ohm center-tapped resistor	1.00
10 feet ¼″ soft copper tubing	1.00
Piece of 1″ bakelite tubing, 2½″ long	0.30
7 Fahnestock clips	0.20
6 feet covered bus wire	0.20
1 small battery clip	0.10
Misc. brass angles, screws, etc., and about 200 feet No. 30 silk or cotton-covered wire	0.50
Set cost	$14.10
1 UX-210 power tube	9.00
Total	$23.10

As with the receiver, advantage may be taken of bargain-store prices in purchasing the parts for the transmitter, and the actual cost should not be as high as we have listed it.

The first thing to do is to mount the parts. To help in doing this, we have marked every piece of apparatus in the top view, Fig. 10, to correspond with the "labels" in the diagram of Fig. 9. Fig. 8 gives a perspective view of the finished transmitter.

The baseboard is the same size as for the receiver; if you bought a breadboard, the other half may now be put to use. As with the receiver, give the board three coats of Duco varnish, sandpapering lightly between each coat.

With the board in the position shown in Fig. 10, take one of the small porcelain stand-off

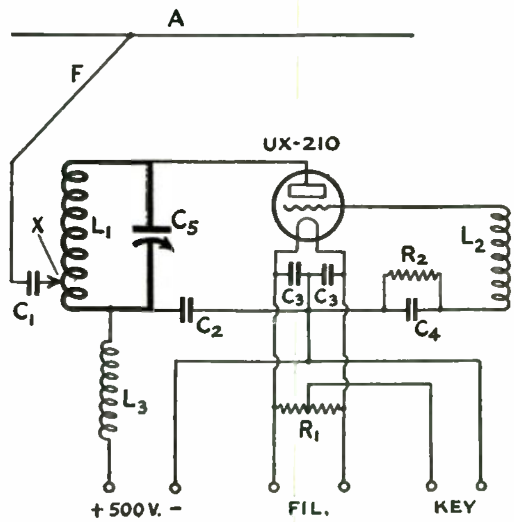

Fig. 9. — The "Schematic" Diagram of the Transmitter

insulators and screw it down with its center about 2 inches from the front and 1½ inches from the left-hand edge. The second insulator is mounted so its center will be exactly 4½ inches to the rear of the center of the first one, the line between the two centers being parallel to the left edge of the board. These stand-off insulators act as supports for the coil, L_1.

Small brass "L" brackets (1″ x 1″ x ½″) serve as the supports for the tuning condenser, C_5. Such brackets are obtainable readily at hardware and ten-cent stores. The tuning condenser, C_5, is placed so that the shaft is about 6 inches from the left edge of the baseboard.

After the condenser is mounted, we are

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ready to make the copper-tubing connections between it and the stand-off insulators. Each piece of tubing must be fitted individually. The ends of each piece are flattened by a hammer, or in a vise, and drilled to fit over the screws in the top of the stand-off insulators at one end, and over the condenser connections (C_5) at the other. One stand-off insulator is thus connected to the rotor connection of the condenser, and one to the stator. It does not matter which. You will notice that the stand-off insulators are furnished with three nuts on each top connection; the pieces of tubing should be tightly fastened between the two bottom nuts, leaving a washer and the top nut for fastening the coil L_1 in place later.

The tube socket may be mounted on the baseboard about an inch from the condenser. It will help in wiring the set if the socket is turned so that the two filament connections are to the rear of the board, leaving the plate connection at the front, to the left, and the grid connection at the front right. This is how the socket shown in Fig. 10 is mounted. The two ten-cent-store brass angles which are used to mount the grid coil (L_2) should be screwed down in such a position that the right-hand one will be about 3/4″ from the right edge of the board, and the distance between the centers of the holes in the two brackets will be 1 3/4″.

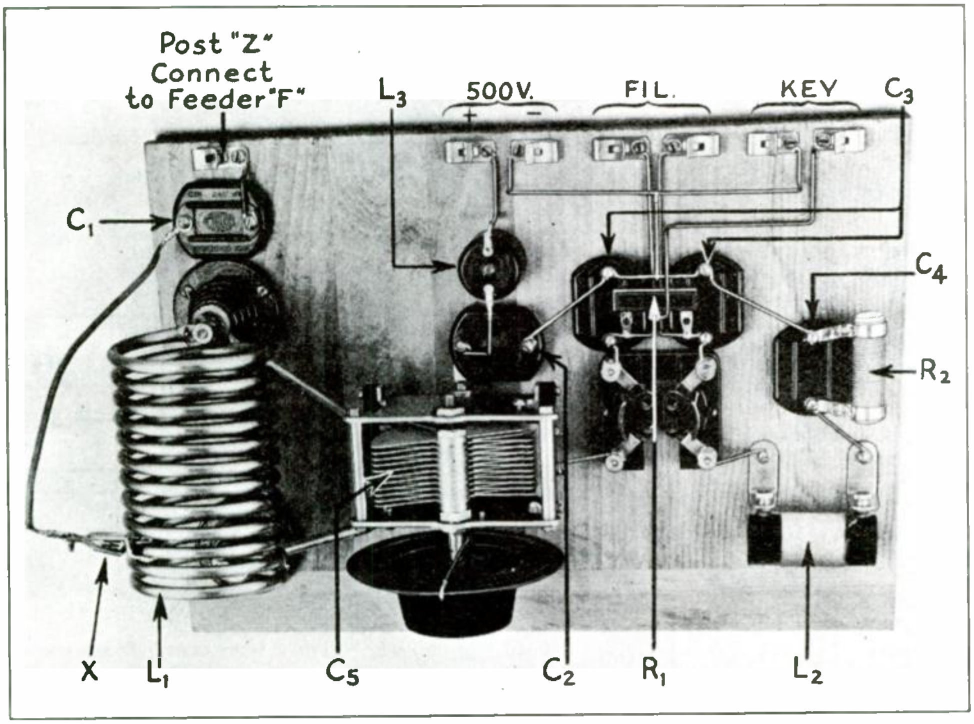

Fig. 10. — Looking Down on the Transmitter

The various Sangamo fixed condensers should now be mounted as shown in Fig. 10. The two .005-μfd. condensers are used at C_3 C_3 for the filament by-pass. One of the .002-μfd. condensers is at C_1, the other at C_2; while the .00025-μfd. condenser is used for the grid condenser C_4. A handy way to fasten this type of condenser to the baseboard is to remove the small machine screws on one side so that the condenser will sit flat on the board, and then run a longer machine screw up through holes in the baseboard to fit in place of those re-

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moved. A little care is necessary to get the holes bored in the right places, but the neatness of such a mounting is worth the slight trouble it takes. A flat-head machine screw should be used, and the hole countersunk on the under side of the board so that the baseboard can sit flat on the table.

The center-tap resistor R_1 is mounted on top of the filament by-pass condensers C_3 and C_3. The wiring to this resistor is sufficient to hold it in place. The two filament wires from the socket to the Fahnestock clips ("Fil.") on the rear edge of the board are run along the board between the by-pass condensers and underneath the center-tap resistor.

The mounting of the radio-frequency choke L_3, grid leak R_2, and the various Fahnestock connecting clips ("500 V. + and − "; "Fil." and "Key") is simple and obvious from the photograph. One caution is to be observed, however: all screws, nuts, etc., should be brass, either plain or nickel-plated, but never iron or steel.

The wiring of the transmitter is extremely simple, and can be easily followed by reference to the diagram, Fig. 9, and the photographs, Figs. 8 and 10.

With all the parts mounted and wired, the only thing remaining before putting the set into operation is to construct the coils, L_1 and L_2. The grid coil L_2 is wound on an insulating tube 1″ in diameter and 2½″ long. Two holes should be drilled in the tubing, with their centers 1¾″ apart. Machine screws are inserted in these holes and form the connection between the coil and the brackets already mounted on the front of the baseboard, seen at the right in Figs. 8 and 10. This grid coil has 60 turns of the No. 30 double-cotton-covered wire, wound tightly and with no spacing between the turns. The direction of the winding is unimportant. The ends of the wire should be run through small holes in the tubing and soldered to the brass machine screws which connect the coil to the brackets. After the coil is finished it should be given a coat of clear Duco.

The plate coil L_1 consists of exactly 12 turns of the ¼″ copper tubing. Such tubing may be obtained from nearly all hardware stores or automobile repair shops, and is not nearly so hard to wind as one might imagine. The best winding form is a 10″- or 12″-length of iron pipe. The outside diameter of the winding form should be 2⅜ inches. To wind the coil, a hole is drilled at one end of the iron pipe, and a similar hole drilled through the flattened end of the copper tubing. The tubing is then temporarily bolted to the pipe by means of a

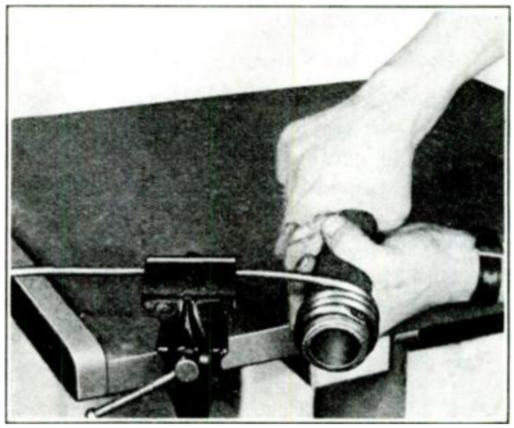

Fig. 11. — Winding the Copper Tubing

nut and bolt, following which the rest of the tubing is wound around the pipe, each turn being pulled as tight as possible. This method of winding is illustrated in Fig. 11. (Any method of winding the coil may be employed, of course, but this has been found to be one of the easiest.)

Although the coil, when finished, will be but 12 turns, it is well to wind about 12½ turns at first, and then adjust the spacing between turns (pulling the ends of the coil lengthwise slightly, if necessary) so that the coil will fit properly on the stand-off insulators forming the mounting, after which the excess half-turn of tubing may be cut off. The two ends should be flattened and drilled to go over the machine screw connections on top of the stand-off insulators.

Before being wound the tubing should be scoured briskly with steel wool, to brighten it. After the coil is finished, the outside of the

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turns may again be polished with fine steel wool, and then thoroughly cleaned with alcohol. If a thin coat of clear Duco is now applied to the coil, the copper will stay bright indefinitely, and make a neat appearance. In putting on the Duco, be careful to keep it off the very ends of the tubing, which make contact with the stand-off insulators.

We are now almost ready to put the transmitter into operation, but before going about this process we had better take up the question of power supply.

The Power Supply

THE best power supply is the one we describe below — if you can afford it. Unfortunately, many people can't afford it at the start, but this will not prevent you from using that transmitter.

Let us suppose we must rule out the power unit shown, for the present, and consider cheaper means of getting our transmitter on the air for the first few months. The first thing to do is to abandon the idea of using a UX-210 power tube in the transmitter, and substitute an ordinary UV-201-A receiving tube. We can then use an Amperite No. 1-A and connect direct to the same 6-volt battery that lights the receiver, for our transmitter filament supply, as shown in Fig. 12. The plate supply for the UV-201-A may be anywhere from 90 volts to 135 volts (preferably the latter), supplied either by "B" batteries or by a "B"-eliminator, and connected as shown in Fig. 12.

Such an installation costs considerably less, both the power supply and the transmitting tube being lower priced. No changes whatever in the construction of the transmitter are necessary. The range of the set will be decreased, of course, but it will still be possible to work several hundred miles under favorable conditions at night, and you will get a good measure of pleasure from operating.

Sooner or later, however, it is probable that you will put in the UX-210 tube and use a

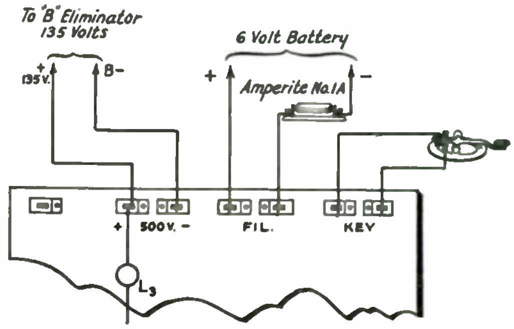

FIG. 12

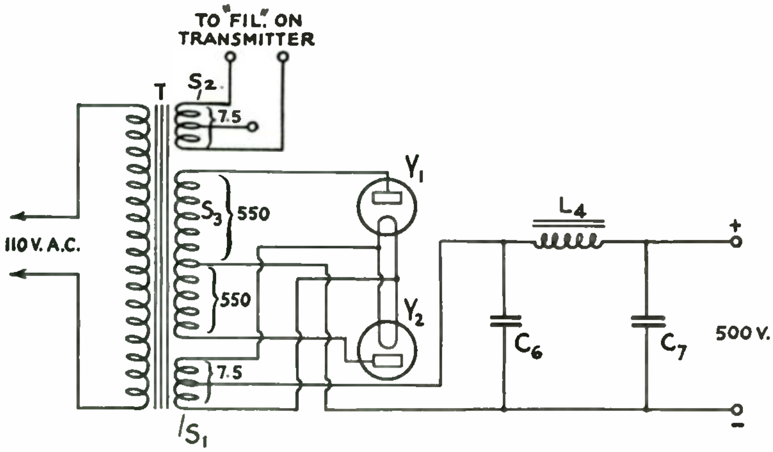

Fig. 13. — THE "SCHEMATIC" DIAGRAM OF THE POWER UNIT

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real high-voltage power supply, so let us now proceed to describe its construction.

As we have already noted, this part of the set is not cheap. Furthermore, it is false economy to skimp in its construction. Low-grade equipment here is almost certain to fail within a short time, and it is better to get adequately-rated apparatus of high quality at the start, and save replacement costs later.

The list of necessary apparatus follows, with approximate *list* prices:

2 UX-281 Rectifier tubes at $7.25	$14.50
1 baseboard 10″ x 14″	0.30
1 Thordarson type T-2098 transformer	20.00
1 Thordarson type R-80 choke coil	5.00
2 Potter 2-μfd. 1000-volt filter condensers	10.00
2 sockets	1.00
4 Fahnestock clips	0.10
Screws, 6 feet covered bus wire, etc.	0.50
Total	$51.40

(Note: In referring previously to prices given for the transmitter and receiver proper, we have mentioned that the list prices indicated rarely need be paid. We wish to emphasize this point particularly in the power-unit cost. At list price, the parts total $51.40, but it is safe to assume that by buying through bargain-rate stores, or from mail-order firms, the cost can be reduced approximately 40%, even though the identical items listed are purchased.)

The power unit is probably the simplest of the three units to build. No particular precautions are necessary in building it as to relative positions of parts, but it is well to keep all the *wiring* well separated. The schematic diagram is shown in Fig. 13, and a photograph of the completed unit in Fig. 14. The placing of the parts shown in Fig. 14 is suggested as good, but can be changed without having any effect on the operation of the unit.

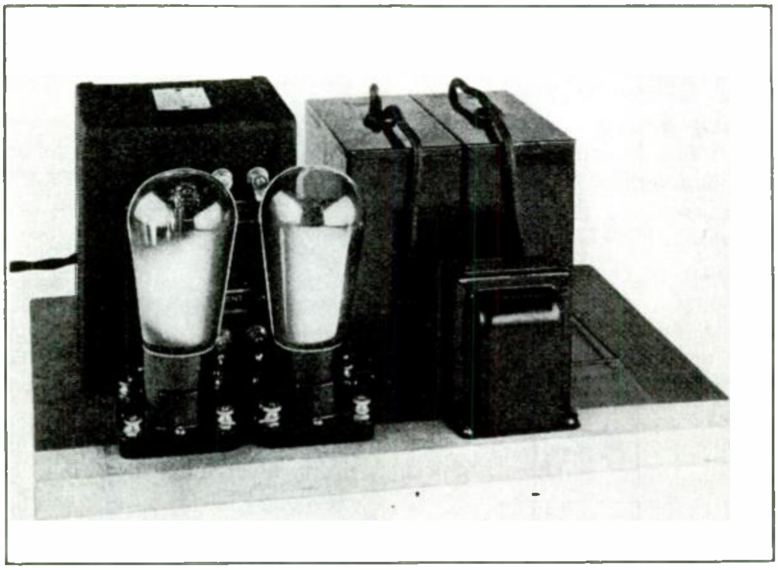

Fig. 14. — The Power-Supply Unit

If you look at the connections on the Thordarson transformer you will see that there is a high-voltage winding and two 7½-volt windings. All the windings have center taps, giving three connections to each winding.

Of the two 7½-volt windings, one is brought out on the same side as the high-voltage winding, and one is on the other side of the case. The 7½-volt winding which is on the same side as the high-voltage winding should be used to furnish the filament current for the two UX-281 rectifier tubes. The center tap of this 7½-volt winding becomes the *positive* ("plus") high-voltage lead. The center tap of the 1100-volt

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winding is the *negative* ("minus") high-voltage lead.

The other 7½-volt winding is used to furnish the filament supply for the UX-210 tube in the transmitter, and is connected to the "FIL." posts of the transmitter (see Figs. 9 and 10). The center tap of this winding is not used.

To make these connections clear, we show in Fig. 15 how the various posts on the transformer are hooked up in the unit.

The wiring is easy and needs no special mention. From the wiring standpoint, in particular, the power unit is the simplest of all.

After the unit is finished and the wiring carefully checked, put the two UX-281 tubes in their sockets and insert the plug on the transformer cord in a convenient house-current outlet. Allow the current to flow for a few seconds *and then pull out the plug.* Now take a wooden-handled knife or screw-driver and

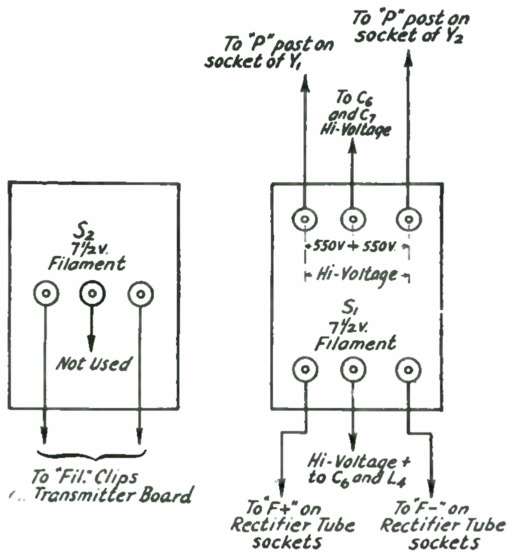

FIG. 15

touch it across the output "plus" and "minus" terminals — touching both terminals at once with the metal blade. A hot spark should jump. This proves that the unit is functioning. *Never make this test when the current is turned on; it will ruin the rectifier tubes.* Good filter condensers will hold a charge for hours after the current is turned off, so it is always well to discharge them before working around the set, as otherwise an unpleasant shock may result.

The Transmitting Antenna

IN A receiver, we are accustomed to think of any piece of wire that may be connected to the "antenna" binding post as the antenna. Our transmitting antenna is slightly different; it happens that the wire we connect to the

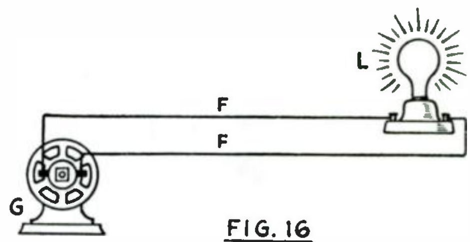

FIG. 16

"antenna" post on the sending set is not the aerial, but merely a connection between the aerial and the set.

To make this clear, look at Fig. 16, which is a simple electric light system. The generator *G* corresponds to the transmitting set. We want to use the energy generated by this generator to light the lamp *L*, some distance away, so we run feeder wires *F* between the generator and the lamp.

Now, in our antenna system, Fig. 17, the antenna proper, represented by *A*, corresponds to the lamp in Fig. 16. We want to use the energy generated by the transmitting set to "light" the antenna, so we connect that antenna to the set by means of the feeder, *F*. This feeder does not of itself send out radio waves, any more than the wires *F* in Fig. 16 emitted light; the feeder simply serves to transfer radio energy from the transmitter to the antenna, where it can be radiated into the air.

The dimensions of the antenna A *must be followed exactly*. See Fig. 17. This length of 127 feet is correct for operation in the 3500-kc. band (band *B*) and will give a frequency in the neighborhood of 3750 kilocycles. Particular care should be exercised in fastening the feeder

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exactly 45 feet 9 inches from one end. No. 14 copper wire should be used for both antenna and feeder. Note that the antenna length is measured between the centers of the holes in the insulators. All joints should be soldered.

The antenna should be as high and clear of surrounding objects as possible. However, in these days of apartment houses and small back yards it is almost impossible to have an "ideal" installation, so you must do the best you can. It is *not* necessary to have the antenna stretched out in a straight line, and if a few bends must be made in order to get the entire length of wire strung up, they may be made without fear

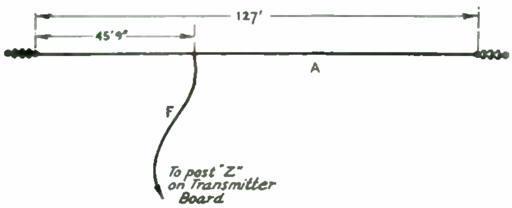

FIG. 17

of losing very much efficiency. Make the bends as "gradual" as possible, of course.

The length of the antenna A must be followed exactly, but the length of the feeder F is not critical. Going back to Fig. 16, the length of the wires F has no particular effect on the brightness of the lamp L. The same is true of the antenna feeder. Put up your antenna in the best position available, install your transmitting set, and then run the feeder between the two to any length necessary. This length may be from a few feet to several hundred feet. The only precaution to observe with the feeder F (Fig. 17) is to keep it as straight as possible, making any necessary bends gradually, and insulating it carefully at all points where it comes in contact with the building, poles, etc.

Tuning the Transmitter

THE only things needed to tune the transmitter and get it operating properly are a small flashlight bulb and a loop of stiff wire.

The wire loop should be about two inches in diameter. One end of the wire is twisted around the screw base of the flashlight bulb (which should be the smallest size obtainable) and the other end is soldered to the connection on the bottom of the base of the lamp. Use but very little solder, and make sure that it does not spill over and make contact with the screw threads, as this would short-circuit the lamp. The complete "lamp-loop" is pictured in Fig. 8 in front of the transmitter.

The power supply should be connected to the transmitter, as should also the key. (See Fig. 20.) Set the tuning condenser C_5 at full capacity — that is, with the plates fully meshed. After being sure all connections are correct, turn on the current, seeing that all the tubes light up, and then press the key. Now while holding the key down, bring the loop slowly toward the front end of the plate coil L_1. The lamp should begin to glow, indicating that the set is working. Do not hold the loop too close when using a UX-210 or the lamp will burn out. In using a UV-201-A it may be necessary to bring the loop quite close to the end of the coil. In all cases the loop should be parallel to the turns of the coil.

If the bulb does not light even when very close to the coil, the key should immediately be released. Several things may be wrong. If the plate of the UX-210 gets red hot, the trouble is probably in the transmitter itself and the connections should be carefully checked, soldered and bolted joints tested, etc. If the oscillator tube does not get hot, probably no plate voltage is reaching it. (This remark does not apply to the use of a UV-201-A with batteries or an eliminator for plate supply, since in this case the plate voltage is hardly large enough to cause the plate of the tube to get red hot under any circumstances.) Be sure the "plus" connection from the power supply is connected to the "500-V. plus" post on the transmitter. The power supply itself should be disconnected and tested as previously described, to be sure that it is working.

As a matter of fact, it is extremely doubtful if there will be any trouble or hitch in the proceedings, if directions have been followed

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carefully, since the whole transmitter assembly has been designed to be practically "fool proof."

The only remaining thing to do now, in order to put the transmitter on the air, is to tune the transmitter to the antenna. This is an extremely simple process, although the description which follows is somewhat lengthy.

After the lamp is glowing properly (the key must be down, of course), the feeder clip (X in Fig. 10) should be clipped on the copper tubing coil (L_1) on the top of the third turn from the end nearest the front of the board, making sure that the clip does not touch any of the adjacent turns. Now hold the lamp-loop steady in a position where it lights with a fair degree of brightness, and — still holding the key down — turn the tuning dial of the condenser C_5 from 100 degrees downward (assuming the reading to be 100 degrees when the plates are fully meshed). *Do this slowly.* As the dial is rotated, the lamp will get dimmer, finally going out entirely — probably around 80 or 90 degrees on the dial. Remember this point. You will note that as the condenser is turned past this point, the lamp will again begin to glow, getting brighter the farther the dial is turned, until the condenser reaches about 50 degrees, where it will probably go out, indicating that the set has stopped working.

Now turn the condenser dial back to that point where the lamp first went out (probably around 80 or 90 degrees) between the two bright positions. The transmitter is now tuned to the antenna.

At this time we bring the receiver into use. Disconnect the receiving antenna and listen in on the *1750-kc.* band, with the receiver oscillating, turning the tuning condenser until the transmitter is picked up in the headphones. The transmitter, of course, is working on the 3500-kc. band, but if we listened for it with the receiver tuned to its true wave, we would get such loud signals that we couldn't tell anything about the "purity" of the note. It is for this reason that we listen for the transmitter at *double* its wavelength, on the 1750-kc. band. It will be quite weak, and will sound much like a station some distance away.

The signal should be a pure, clear whistle, without any growl or "mush." If the note is rough or unsteady, move the antenna clip (X) one turn toward the front of the coil L_1, retuning the transmitter with the loop and flashlight bulb as described above. This should clear up the note. On the other hand, if the note is clear and steady, the clip may be moved one turn toward the *back* of the coil. If this causes the note to "go bad," return the clip to the third turn, and leave it there. However, if it has no effect on the note, you can try still another turn toward the back of the coil, the object being to use as many turns as possible without affecting the note as heard in your receiver. Usually three turns will be just about right, however. Each time the clip is moved, of course, the tuning condenser on the transmitter should be readjusted until it is set on the point where the bulb in the lamp-loop goes out. Moving the clip will probably affect this adjustment slightly.

The transmitter is now ready to send out signals over the air.

No ground connection is used with the transmitter.

Arranging the Station

A GOOD amateur station is always neatly arranged. While more equipment will undoubtedly be added later, the three units described will furnish an excellent start.

A suggested arrangement of the station is shown in Fig. 18. Since the lead-in wires from both the transmitting and receiving antennas will be brought through a window, usually, the operating table should be placed as near a window as possible. The receiver and transmitter should not be too close to each other, as keying will produce loud clicks in the headphones which are unpleasant to the ears. The power supply should preferably be on a shelf or stool under the table, and not too near the transmitter itself. Of course, it should not be so placed that any part of the operator's body can come in contact with it.

A double-pole single-throw switch, of the type that can be bought at almost any radio or hardware store, should be fastened to the side of

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the table where it can be conveniently reached. The plug on the end of the cord furnished with the power transformer should be removed, and the ends of the wires fastened to one side of this switch. A piece of lamp cord is connected to the other side of the switch, the far end of the cord terminating in the plug taken from the transformer cord. This can then be inserted in a wall socket to obtain house-current for the power supply. The power can be very easily turned on or off by this means.

A lightning arrester should be used on the receiving antenna, unless it is entirely indoors. Instructions for installing it are usually furnished with the arrester.

An arrester *cannot* be used on the transmitting antenna. To do so would allow a considerable portion of the energy of the transmitter to leak off. A switch is therefore necessary. A single-pole double-throw lightning switch is best, but one of the same type as used for the power switch will serve. The switch should be screwed to the window frame at the point where the transmitting antenna feeder enters. The blade-connection of the switch is connected to the feeder; one of the jaw connections leads to the "antenna" post on the set, and the other leads to a ground connection, which may be the same one as used for the arrester in the receiving antenna.

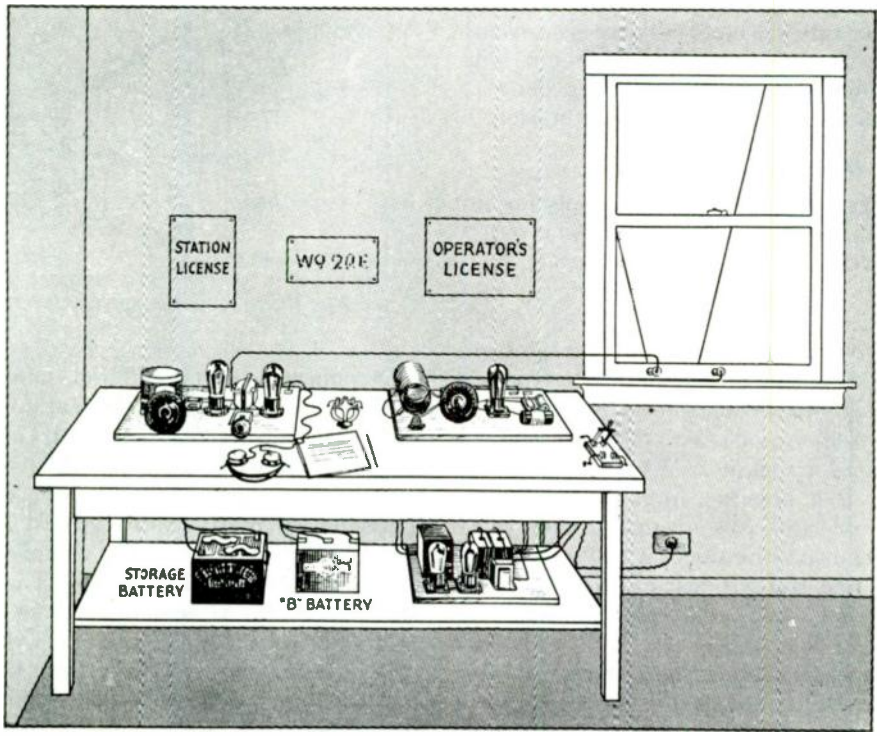

Fig. 18. — AN IDEAL STATION ARRANGEMENT

A good method of bringing the receiving antenna and transmitter feeder wires into the station is to cut a board about 4 inches wide and the same length as the width of the window. Through this board are run two small porcelain insulating tubes of the type used in house wiring, the transmitting antenna feeder wire coming through one and the receiving antenna wire through the other. The board is placed in the window frame and the sash closed down tight

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upon it. The lead-in wires are then fairly well insulated, even in wet weather, and the window can be kept tightly shut.

The porcelain tubes, incidentally, should be run through the board at a slight downward slant (with the "down" end on the outside) to prevent rain water from running down the antenna wires and into the house.

It is an advantage to arrange the station neatly and keep paper, pencils, call books, etc., where they are always handy. There is no excuse for having "haywire" apparatus after it is in permanent form. You should never have to apologize for the appearance of your station.

Operating Procedure

WE ARE now almost ready to apply for our licenses, but before taking this final step it is a good idea to learn just a little bit about the formalities of calling and working another station.

Amateur call signs in the United States are made up of the initial letter "W" followed by a figure to designate the district (refer to Fig. 19) and then a combination of two or three letters of the alphabet, for instance, W1AKZ, W3CDQ, W6EA, etc. It is possible, from the "district" number, to ascertain to some extent from what part of the country the signal is being received.

The very first thing to learn about operating your station is how to call another station. The correct way to do this is to send the call letters of the other station four or five times, followed by the letters DE, meaning "from," and followed by your own call letters several times. This may be repeated three or four times, after which you should "sign off" by sending the letters of the "finish sign," AR (. _ . _ .), meaning that you are now finished sending that particular call. If your station is W1AB and you are calling W8BC, the call would be like this: W8BC W8BC W8BC DE W1AB W1AB W1AB AR. If W8BC heard you he would call you back like this: W1AB W1AB W1AB DE W8BC W8BC W8BC, but after finishing his call would probably send the letter R (. _ .) meaning "OK — I received you" — and then start in on his talk with you. After finishing whatever remarks he had to make to you he would again send your call once or twice followed by DE and his call once or twice and then send the letter K (_ . _) which is used to indicate that you should go ahead.

This keeps on until, we shall say, you have nothing more to say and are through talking with him. In this case, after you have concluded

Fig. 19. — U. S. Inspection Districts

your remarks, sent his call and then yours, you send the AR as before, indicating that that particular call is finished, but, in addition, follow it up with a signal which is used to indicate that the whole transmission is also concluded — in other words, that you have not only finished that call, but have finished talking with him for the time being. This signal is SK (. . . _ . _). After sending the AR and SK, send your own call again *once*. All this tells whomever may be listening to you that you are now through talking to W8BC, and will listen for anybody else who wants to call you and talk with you. For this reason it is a good idea to tune slowly over the band, after concluding such a transmission, and see if anyone *is* calling you, before you start in trying to "land" another station.

Now as to the way to use the call "CQ". In listening in with your receiver you have undoubtedly heard many stations sending out the letters CQ (_ . _ . _ _ . _) followed by DE and then their own call. You may have wondered what it meant. Well, it happens that CQ is generally adopted by amateurs to indicate that they are willing to talk to anyone. They may not want to call any particular station

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but yet give other stations on the air an indication of their willingness to engage in communication with someone. CQ is used for this purpose.

Let us say that you start in for an evening's operating, and want to indicate to any other amateurs who may be listening that you are ready to talk with some of them. You send out the letters CQ several times, just as you would send some other call, follow it by DE, and then your own call repeated a few times. The signal AR should follow, and you then turn off the transmitter, and listen over the band on your receiver for somebody who may have heard you "CQing" and is now calling you.

On the other hand, if you hear some amateur sending CQ, you know that he is willing to talk to anybody who happens to hear him, and you are justified in calling him when he has signed off after his CQ.

A word about abbreviations and the "Q" signals is in order at this point.

All amateurs use at least some of the internationally-adopted "Q" signals, and you should learn a few of the most-used ones if for no other reason than the fact that the license examination will probably ask you to give one of them. These "Q" signals (see list) are internationally-agreed-upon signals by which it is possible to talk to some other radio operator even though you do not know his language. "QRT", for instance, means "Stop sending" whether the man who sends it speaks German, English, Spanish or Russian. Amateurs in America use the "Q" signals among each other because they offer a short and convenient way of giving and requesting pertinent information.

If you give a "Q" signal and follow it by an interrogation mark (..——..) it means that you are asking the question indicated by the particular "Q" signal; if you give such a signal without the interrogation mark, it means that you are giving the answer belonging to that signal.

Some Frequently-Used "Q" Signals

Abbreviation	*Question*	*Answer*
QRG	Will you tell me my exact wavelength in meters (or frequency in kilocycles)?	Your exact wave is .... meters (or ...... kilocycles).
QRH	What is your wavelength in meters (or frequency in kilocycles)?	My wavelength is .... meters (or ...... kilocycles).
QRJ	Are my signals weak?	Your signals are too weak.
QRK	Are my signals good?	Your signals are good.
QRM	Are you being interfered with?	I am being interfered with.
QRN	Are you troubled by atmospherics (static)?	I am troubled by atmospherics.
QRQ	Shall I send faster?	Send faster (........ words per minute).
QRS	Shall I send more slowly?	Send more slowly (........ words per minute).
QRT	Shall I stop sending?	Stop sending.
QRU	Have you anything for me?	I have nothing for you.
QSA	What is the strength of my signals?	The strength of your signals is .... (1 to 5, 5 being maximum signal strength).
QSD	Is my keying bad?	Your keying is bad. Your signals are unreadable.

Now for amateur abbreviations. Some time ago we mentioned that you would hear many abbreviations over the air which did not mean anything to you. All amateurs use them to a greater or less extent. It is not expected that you will use them a great deal at first, but do not try to. A few abbreviations intelligently used are all right. but just as very rapid sending was given as the mark of a rank beginner in a previous paragraph, so unwarranted abbre-

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viating is another trade-mark of the beginner. Do not be afraid to spell out your words full length when you are starting.

Some of the abbreviations used by amateurs on the air are as follows:

ABT	About	GN	Good-night
AC	Alternating Current	GUD	Good
AGN	Again	HAM	Amateur
AMP	Ampere	HI	Laughter
ANI	Any	HR	Hear, here
BI	By	HV	Have
BK	Break, back	HW	How
BTR	Better	MG	Motor-generator
CRD	Card	NIL	Nothing
CD	Could	NR	Number, near
CUL	See you later	NW	Now
DC	Direct current	OB	Old Boy
DNT	Don't	OM	Old Man
DX	Distance	OW	Old Woman
ES	"&"	PSE	Please
FB	Fine business, excellent	SED, SEZ	Said, says
FM	From	SKED	Schedule
FR	For	TKS, TNX	Thanks
GA	Go ahead	TT	That
GB	Good-bye	U, UR	You, your, you're
GE	Good-evening	VY	Very
GG	Going	XMTR	Transmitter
GM	Good-morning	YL	Young lady
		73	Best regards

Getting Your Licenses

THERE remains now only one thing to be done before you can start on your amateur career, and that is the obtaining of your licenses to own and operate an amateur transmitter.

No license of any kind is needed in order to operate your short-wave receiver, any more than you have to have one to operate your broadcast receiver. Before you can send a single letter with your transmitter, however, you must obtain two licenses from the United States government. One of these is a station license, for your transmitting apparatus, and the other is your personal operator's license.

These licenses do not cost anything. The first thing to do towards getting them is to write to or call on your particular government Radio Supervisor asking for application blanks for amateur station and operator's licenses.

For the purpose of radio regulation, the United States is divided into nine districts, as shown in Fig. 19. The address of the Supervisor of Radio for each of these districts is as follows:

First District	Supervisor of Radio, Customhouse, Boston, Mass.
Second District	Supervisor of Radio, Sub-Treasury Bldg., Wall, Nassau and Pine Sts., New York, N. Y.
Third District	Supervisor of Radio, Ft. McHenry, Baltimore, Md.
Fourth District	Supervisor of Radio, Federal Bldg., Atlanta, Ga.
Fifth District	Supervisor of Radio, Customhouse, New Orleans, La.
Sixth District	Supervisor of Radio, Customhouse, San Francisco, California.
Seventh District	Supervisor of Radio, 2116 L. C. Smith Bldg., Seattle, Washington.
Eighth District	Supervisor of Radio, 30th Floor, David Stott Bldg., Detroit, Michigan.
Ninth District	Supervisor of Radio, 2022 The Engineering Bldg., Chicago, Illinois.

By looking at the map you can tell which district you are in. If you live in the same city as the Supervisor for your district, you should go down to the building where he has his office and apply personally for your application blanks. In this case, however, you will take your examination right there at his office, so you should not apply for your licenses under these conditions unless you are ready to pass the examination and have your code speed well in hand. Such a license, issued after you have personally appeared before the Supervisor or one of his assistants, is known as a *First Class* amateur operator's license.

It may be that you do not live in or near the city where the Supervisor is. If this is so, write to him asking that you be sent the proper application blanks. You can do this before you are actually ready to make out the examination papers, because you can take your time (within reason) about returning them. After you have filled in the answers to the various questions, and have sworn before a notary that you are capable of receiving at least ten words per minute, the blanks may be mailed back to the Supervisor, and he will issue you a *Temporary* operator's license. Your temporary license is good for one year, but it is probable that before that year has passed, the Supervisor will notify

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you that he will be in your vicinity to examine you personally and issue you a first class license.

There is no examination in connection with the *station* license. A few questions are asked regarding your citizenship (aliens may not obtain station licenses), your full name, age, etc., and these are quickly answered. You can fill all this out in five minutes and then lay it aside until you have written up your operator's license examination.

For your *operator's* license, whether temporary or first class, you will need to pass a written examination. This examination is not difficult and will give you no trouble if you do four things: (1) learn to draw a complete schematic diagram of your transmitter and receiver, and explain briefly their operation; (2) familiarize yourself with the summary of the important international regulations which is in a table in this booklet; (3) learn a few of the most-used "Q" signals, which we will list for you; and (4) take your time and use your head. The first thing to do in preparing for the examination is to learn how to draw a complete diagram of your transmitter and receiver and explain their operation.

Let us begin with the receiver. You will find its diagram in Fig. 6 and you should learn to draw it this way. "Picture" diagrams are not accepted by the Supervisor, as we have already stated.

After you have learned to draw the diagram of your receiver, you should learn to tell how it functions. It may be you already know this, but in case you don't, we will describe it, briefly.

To begin with, the incoming signals are picked up on the aerial, and pass through the primary coil L_2 to ground. While passing through L_2, however, they set up similar currents in the secondary coil L_1. This secondary is tuned by means of the variable condenser C_1 to any particular wavelength within the range of the receiver.

In the meantime, the tickler circuit (L_3) has been adjusted to bring the detector tube (D) up to the point of oscillation, this adjustment being controlled by the variable resistance R_3.

Now, if a '*phone* signal is being received, R_3 is turned so the detector tube is just *outside* the oscillation point. This adjustment has the effect of increasing the signal strength many times, before the signal is detected. "Detection" is effected in the detector tube due to the action of the grid condenser C_2 and grid leak R_1.

The detected signal goes through the audio amplifying transformer T where it is "stepped

International Regulations You Should Know

1. International law requires that your transmitter send out signals of as constant frequency and as free from harmonics as possible.

2. It is against the law to divulge the contents of any messages you may hear unless they are addressed to you, or are broadcast or transmitted for the use of the general public, or relate to distress calls.

3. Radiograms relating to distress calls hold precedence over all others.

4. If you hear a distress signal (SOS) and have the slightest reason to believe that your station is interfering with it or with stations trying to work it, *stop sending immediately*. It is best to play safe and stop sending anyway. If you hear some other *amateur* sending out an emergency call, you are, of course, justified in trying to get in touch with him, but if he answers some other station you should stop operating to avoid interfering. In all cases, it is wise to continue to listen in on the distress work.

5. The law requires that you use the minimum amount of power necessary to insure satisfactory communication over any given distance.

6. United States amateurs, among themselves, may exchange messages of any kind, but *internationally* their messages must be in plain language and must relate to the experiments in hand, or be confined to remarks of a personal character that would not normally be transmitted by way of a commercial telegraph, radio or cable company.

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up" slightly and passed on to the audio amplifier tube *A* which further amplifies the audio sounds and passes them on to the headphones *P*.

Now, it may happen that instead of receiving a 'phone station, we are receiving a "continuous wave" (or c.w.) code station. In this case the action of the detector tube is somewhat different than just described, and you should be careful to explain that fact in your examination.

Let us go back for a moment to the point where we had the signal (whether it be 'phone or c.w.) tuned in by means of the secondary coil L_1 and the variable condenser C_1 and are ready to pass it on to the detector tube. Before, when we were receiving 'phone signals, the tickler circuit was adjusted to put the tube just on the edge of oscillation — but not quite oscillating. This time, however, we are receiving a c.w. signal, and the tickler circuit should now be adjusted so that the detector tube *is* actually oscillating. (Here again, it is "on the edge" — but where the 'phone adjustment was just *outside* oscillation, the c.w. adjustment is just *in* oscillation.) Having the tube in this oscillating condition, the secondary tuning condenser C_1 is tuned over the scale, and the oscillations generated within the detector tube will "beat" against the incoming signal oscillations, and will be detected as an audible signal — usually a clear whistle. By the time you take your examination you will have done this many times in actual practice with your receiver, and this will help you understand what we have just written.

This audible whistle is passed on to the audio amplifying transformer *T* just as was the 'phone signal mentioned above, and from then on is treated in the same manner.

Now to explain the operation of the transmitter.

The diagram of the transmitter alone is found in Fig. 9. If you are going to use "B" batteries or a "B"-eliminator to supply the power for this transmitter, you need draw only the diagram shown in Fig. 9 and state that the batteries or eliminator are going to be connected at the "plus" and "minus" input ("500 V.") posts.

If, however, you build the power unit described in this booklet, you will have to include it, and the complete diagram will then appear as in Fig. 20, which you will recognize as the transmitter of Fig. 9 added to the power supply in Fig. 13.

Let us start with the operation of this power unit. Current from the 110-volt a.c. house circuit is supplied to the primary *P* of the transformer *T*. This transformer has three secondary windings; S_1 and S_2 step the 110 volts *down* to 7½ volts, while S_3 steps it *up* to 550 volts on each side of the center tap. S_1 supplies current to heat the filaments of the rectifier tubes, Y_1 and Y_2. S_2 is used to heat the filament of the UX-210.

The high-voltage alternating current from S_3 is first run through the two rectifier tubes, is "rectified" and then goes through the filter system (shown within the dotted lines in Fig. 20) to be smoothed out, or filtered. The filter system is made up of the 30-henry choke L_4 and the two 1-microfarad condensers C_6 and C_7. After passing through the rectifier tubes and the filter system, our original 550 volts of alternating current has become about 500 volts of direct current, or "pure d.c." as it is usually referred to.

Now for the transmitter proper. As we have mentioned previously, this transmitter is, fundamentally, simply an oscillating tube circuit. It oscillates because there is "feedback" coupling from the plate circuit back to the grid circuit through the capacity of the elements within the tube. Obviously, we want to be able to control the frequency at which it operates. We accomplish this by the size of the coil L_2 and the size and adjustment of the "tank" circuit (in heavy black lines) composed of the condenser C_5 and the coil L_1. C_4 and R_2 are the usual grid condenser and leak. The two small fixed condensers C_3 and C_3 serve to "by-pass" the radio-frequency energy around the source of filament supply (whether it be S_2 or a storage battery); we also keep radio-frequency from getting into the source of high-voltage by means of the choke L_3 and the condenser C_2.

Our transmitter, let us say, is now in an

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oscillating condition. Obviously, we want to have our antenna get as much as possible of the radio energy which the tube is generating. Since the "tank" circuit contains more of this energy than any other part of the transmitter it doesn't take much figuring to decide that our antenna should be connected to the tank circuit — and that is just exactly what we do, as you can see from the diagram. The feeder to the antenna is tapped off one of the turns of the coil in the tank circuit. C_1 is simply to keep the direct-current high-voltage (which is not the same thing as the much-desired radio energy) from getting on the antenna.

The feeder *F* carries the radio energy to the antenna, *A*, which has been designed to "radiate" energy at a certain definite frequency — about 3750 kilocycles per second, in this case. Since our antenna has been designed to work best at 3750 kc. all we have to do to make our transmitter operate at the same frequency is to tune the transmitter to the antenna.

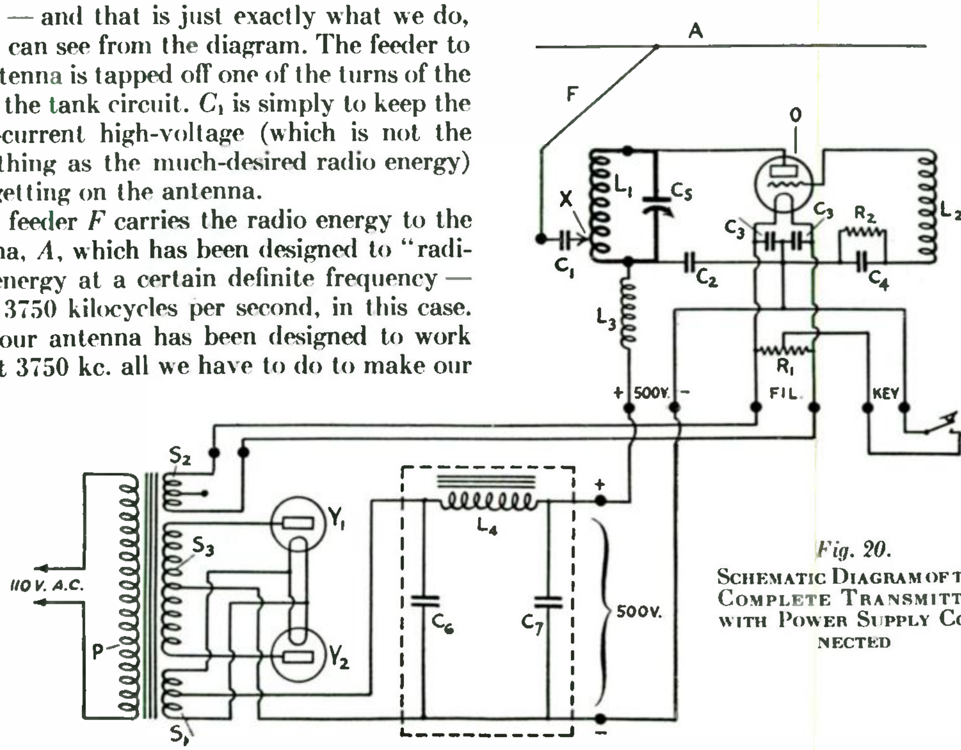

Fig. 20.
SCHEMATIC DIAGRAM OF THE COMPLETE TRANSMITTER WITH POWER SUPPLY CONNECTED

Remember that — you will probably be asked in your license examination how you determine the frequency at which the set will operate. In this set, you determine it by cutting your antenna to operate at a certain frequency (3750-kc.) within the 3500-kc. band (band *B*) and then tuning the set to the antenna. If necessary, explain in detail how this is done (refer to "Tuning the Transmitter").

Drawing the transmitter and receiver diagrams, and explaining their operation, are really the hardest parts of the examination for the beginner. You should, therefore, be well prepared on this score and be sure to know the electrical dimensions of all pieces of apparatus used.

The remainder of the examination will probably give you no difficulty. Be sure to study the summary of important international regulations that you should know. The following facts will probably prove helpful to you, too:

(a) The transmitter in this booklet uses about 25 watts with a UX-210 tube, and about 2 watts with a UV-201-A.

(b) The transmitting antenna described is operated at its fundamental wavelength.

(c) Although, if you follow directions carefully, the antenna and transmitter should operate within 50 kilocycles of 3750 kc., it would be well to ask some amateur what your wavelength is as soon as you get on the air. You can, of course, buy a wave-meter and measure your wavelength that way.

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(d) The government does not require that you operate on any particular frequency so long as you always keep within the limits of the amateur band in which you are working.

After you have taken your exam, you will probably wonder why you ever worried about it. If it *should* happen that you "flunked" on your first try, you can always try again!

Getting on the Air

AND now, after you have built your receiver and transmitter and put them in operating condition, have obtained your licenses, and have learned something of the customs and practices of operating, you are ready to take your final step — the step for which you have worked through all these weeks — your first actual operation on the air as an amateur.

Your station and operator's licenses are displayed on the wall over your operating table, and you sit down for the evening before your receiver and light up the tubes. Tuning in on the 3500-kc. band, let us say, you hear some station (not too far away!) sending a "CQ" and finally signing his own call. You turn on your transmitter, and call that station — somewhat shakily, no doubt. After making a reasonably long call, you sign off and listen for him again. Perhaps he does not come back. Too bad! — but don't be discouraged. While it has happened that amateurs have worked the first station they ever called, this experience is not the rule. Try again. Perhaps you still fail to "connect", and it may be that you will call all that evening without working anybody.

(Among other things, it is a good idea at this time to listen in on your receiver, and see if you can hear your transmitter!)

But you keep on calling the next night, and soon there comes a time when you enjoy that never-to-be-forgotten thrill of hearing the other fellow call your station! And then you talk with him, learn where he is, and hear him tell you how good your signal is at his "shack" and perhaps make a schedule to call him again the next night for another talk. So you start to learn the thrill and pleasure that come from talking to another fellow-being hundreds (even thousands) of miles away, from the privacy of your own home, and with apparatus that you have constructed with your own hands. It is a thrill that never wears off.

It is probable that one of the first things you will be asked, when you begin working other amateurs, is to "Pse send card, OM". What the other fellow is referring to is a custom that has grown to be a part of amateur radio, known as the exchanging of QSL (acknowledgment) cards. Most amateurs have postcards printed up with their call prominently displayed, and other data on their set, leaving space of course, to put the call of the amateur to whom they are going to send the card. When you work some distant amateur, he may ask you (or you may ask him) to exchange cards, as noted above. You then make out one of your cards, address it to him, and mail it, usually receiving one of his in return. Many amateurs have the walls of their operating room literally plastered with QSL cards from all over the world. A typical QSL card form is shown in Fig. 21.

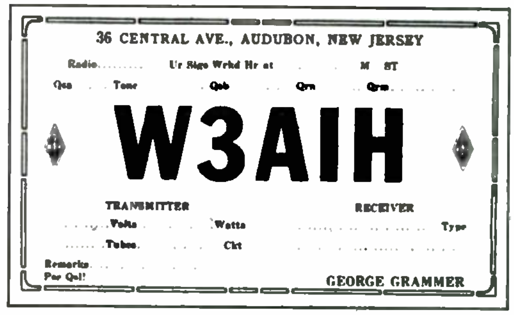

Fig. 21. — A TYPICAL "QSL" CARD

And Now Good Luck!

YOU are now a full-fledged amateur, and ready to take your place in the amateur bands. Do not try to hurry matters building your station or operating it. Be a gentleman on the air, and don't be afraid to admit that you are a beginner. If someone sends too fast for you, tell him so — don't give some lame excuse such as "QRM" or "QRN". A genial request to send slower will practically always get the desired result, and the amateur you are working will think more of you for it.

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This booklet has necessarily been brief, but we think this will give you a start toward that finest of hobbies, Amateur Radio; and once the start is made, growth is rapid.

The American Radio Relay League, at Hartford, Connecticut, which publishes this pamphlet, is a society of and for amateurs, and it will be more than glad to help you out with your problems. It may be that, later, you will wish to become a member of the League. Most amateurs are members. Station ownership is not necessary to membership — you have only to be interested in amateur radio. Dues are $2.50 a year and include a year's subscription to the monthly magazine *QST*, often referred to as the "amateur's bible." If you have never seen a copy on your news stand, a sample copy will be sent you on request.

It has been impossible to go into detail regarding amateur operating procedure, or to describe the history of the amateur, or to give details of operating the set at the lower wavelengths — the international bands. The League has a 16-page pamphlet on amateur history which will prove interesting reading, and will be sent to you for 10 cents if you wish a copy. Ask for "The Story of the A.R.R.L." Another 10-cent pamphlet on the details and intricacies of operating and amateur message-handling is known as "Rules and Regulations of the Communications Department." If you really intend to keep up your amateur work, however, the best thing to do would be to obtain a copy of "The Radio Amateur's Handbook", published for $1, by the A.R.R.L. This contains not only the material listed in the two pamphlets above, but has all the information you will need on building many types of amateur short-wave receivers and transmitters, frequency meters, antenna systems, various kinds of power supply, and a wealth of other material. It is the standard amateur handbook.

You will probably want a call-book, too. Such a call-book, listing amateur stations in the United States and Canada, as well as most other countries in the world, can be obtained from Radio Amateur Call Book, Inc., 508 South Dearborn St., Chicago, Ill., for $1. Be sure to specify that you want the *amateur* call-book. A call-book listing United States amateurs only can be obtained from the Government Printing Office, Washington, D. C., for 25 cents. Do not send stamps or checks for this, however, as the government accepts only coin or money orders.

And now — GOOD LUCK!

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Would you like to know more about the American Radio Relay League?

THE American Radio Relay League, Inc., founded in 1914, is a national non-commercial association of radio amateurs who have banded for the promotion of interest in amateur radio communication and experimentation. The A.R.R.L. coördinates amateur operating activities, holds relays and contests, looks after the amateur's interests in legislation, and maintains a headquarters for assisting members.

The League publishes "QST," oldest radio magazine in America, a monthly devoted exclusively to the kind of amateur radio which has been talked about in this booklet. It is to be found everywhere in the world that short-wave radio is known. Truly "of, by and for the amateur," it is a treasure-house of monthly information on amateur technical developments and amateur activities. Dues in the League include a subscription to "QST."

The League maintains a Technical Information Service for answering the questions of members and helping them in difficulties encountered in practical amateur operation.

These are but a few of the benefits that come to the amateur who belongs to the League. If you'll send in the blank below, we shall be glad to send you further particulars, and a sample copy of "QST," without obligation.

• •

Date____________________

AMERICAN RADIO RELAY LEAGUE + HARTFORD, CONN.

Gentlemen:

I am interested in amateur radio. Please send me a sample copy of "QST" and information about the American Radio Relay League.

____

Name

____

Street or box address

____

City and State

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ADDENDA

1. To assist the constructor, the following identification of the symbols in the receiver diagram (Fig. 6) and receiver photograph (Fig. 5) is made:

   C_1 — Pilot 23-plate midget condenser

   C_2 — .00025-μfd. fixed condenser with grid-leak clips

   R_1 — 2-megohm grid leak

   R_2 — Lynch Type-2 Equalizer (or Amperite No. 112 or 20-ohm rheostat)

   T — Audio transformer

   C_3 — Tobe 1-μfd by-pass condenser

   R_3 — Volume-control Clarostat (500,000-ohm variable resistance)

2. The Resistor R_4 in the transmitter (Figs. 9 and 10) is an Electrad 10,000-ohm 25-watt resistor, Type B-100.

3. In the transmitter description (page 13), the type number of the Cardwell .0005-μfd. condenser should be 123-B.

4. In the map of the U. S. Inspection Districts appearing in Fig. 19 (page 22) the upper peninsula of Michigan is shown as being in the 8th District. This is not correct. The lower part of Michigan is in the 8th District, but the upper peninsula is in the 9th District.

5. The type number of the Thordarson choke coil in the list of parts for the Power Supply (page 17) should be R-196 instead of R-80.

6. On page 17, the list of parts calls for two 2-μfd. Potter condensers, while on page 26 the text specifies 1-μfd. condensers. The list of parts is correct, i.e., two 2-μfd. Potter condensers.

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