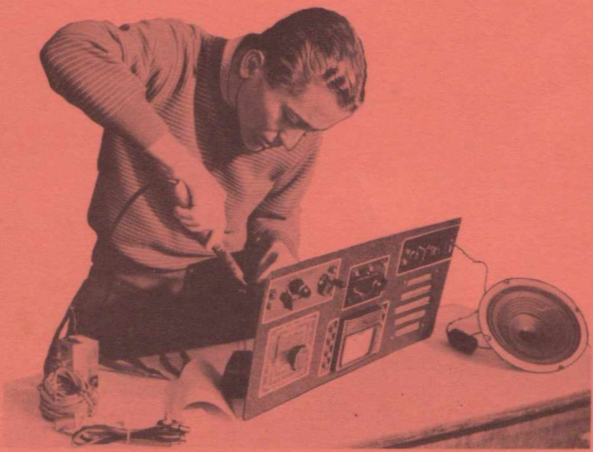
AUSTRALIAN RADIO & TELEVISION COLLEGE PTY. LTD.

PRACTICAL RADIO COURSE



of

HOME PRACTICAL INSTRUCTION

Lesson No. 5

THIS Radio Course of practical home instruction is the result of many years' experience, and months of final experimental work by some of Australia's most competent Radio engineers. It is designed so that you acquire a thorough and most comprehensive practical Radio training by building up the kits which are supplied with these lessons. When the course is finished, and all the kits have been built up into the final unit, you will possess a complete professional outfit of Radio testing apparatus, which in itself is not only worth far more than the money you pay for it, but which will also enable you to earn many times its actual value from the Radio work you can perform with it.

●

CONSTRUCTING AN OSCILLATOR.

This Lesson will show you how to:—

THE MORSE CODE.

HOME PRACTICAL INSTRUCTION

LESSON No. 5.

The material contained in Kit No. 5 will permit you to construct an audio frequency oscillator with which you may test amplifiers or practice the Morse Code if you are interested in learning it.

A list of the material contained in Kit No. 5 is as follows:—

1 Metal chassis.
1 6″ permanent magnet loudspeaker with 5000 ohm transformer.
1 loudspeaker transformer with centre tapped primary winding.
1 small pointer knob.
1 single wafer switch.
2 Plastic terminals.
1 .01 mfd. condenser.
2 ½″ x 5/32 x 1/16″ bakelite washers.
2 dozen ⅜″ x ⅛″ Whitworth bolts and nuts.
4 ½″ x ⅛″ bolts and nuts
2 Soldering lugs.

The circuit diagram of the oscillator which we are about to construct is shown in Figure 1.

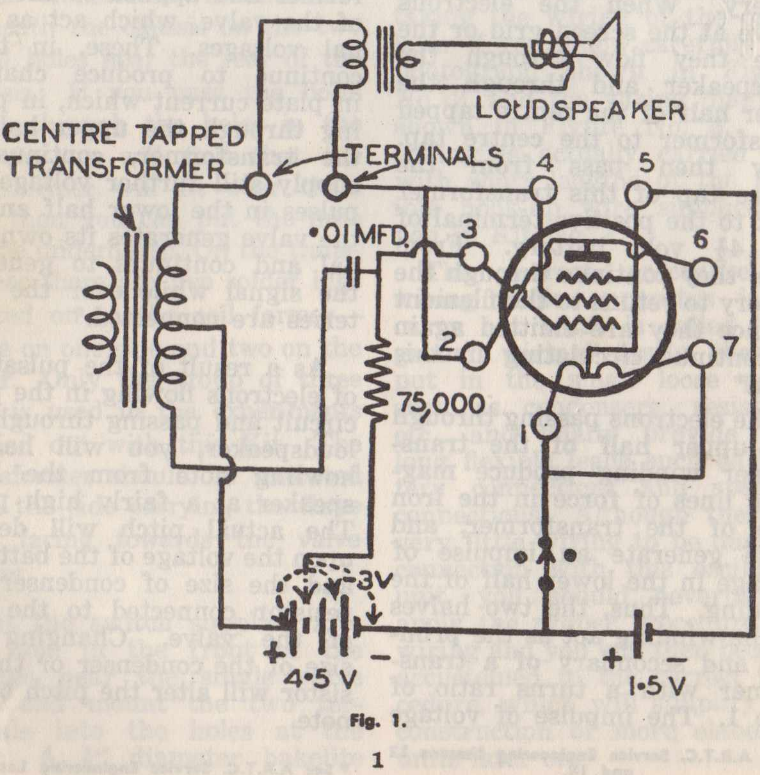


Fig. 1.

The principle of operation is as follows:

When the switch, connected to the filament of the valve, is turned on, electrons from the negative terminal of the 1.5 volt cell flow around through the filament of the valve and back again to the positive terminal of the cell, thus heating both sections of the filament. When the filaments are hot, they emit electrons which are attracted across to the plate and to the screen grid of the valve because both of these elements are connected together and are made positive by the 4½ volt battery. When the electrons arrive at the screen grid or the plate they flow through the loudspeaker and through the upper half of the centre tapped transformer to the centre tap. They then pass from the centre tap of this transformer back to the positive terminal of the 4½ volt battery. From here, they continue through the battery to return to the filament whence they are emitted again to continue circulating in this path.*

The electrons passing through the upper half of the transformer winding produce magnetic lines of force in the iron core of the transformer, and these generate an impulse of voltage in the lower half of the winding. Thus, the two halves of the winding act as the primary and secondary of a transformer with a turns ratio of 1 to 1. The impulse of voltage generated at the bottom of the lower half of the transformer is applied through the .01 mfd. condenser to the grid of the valve. This impulse of voltage, applied to the grid, produces a change in the plate current, and the change in plate current passing through the upper half of the transformer winding produces another impulse of voltage in the lower half, which is again applied around through the .01 condenser to the grid of the valve. Thus, there is a succession of pulsations of voltage, produced in the lower half of the transformer and applied to the grid of the valve, which act as signal voltages. These, in turn, continue to produce changes in plate current which, in passing through the upper half of the transformer, continue to supply still further voltage impulses in the lower half and so the valve generates its own signal and continues to generate the signal while ever the batteries are connected.*

As a result of the pulsations of electrons flowing in the plate circuit and passing through the loudspeaker, you will hear a howling note from the loudspeaker at a fairly high pitch. The actual pitch will depend upon the voltage of the batteries and the size of condenser and resistor connected to the grid of the valve. Changing the size of the condenser or the resistor will alter the pitch of the note.

* See A.R.T.C. Service Engineering Lessons 12 and 18.

* See A.R.T.C. Service Engineering Lesson 47.

ASSEMBLY.

If you examine the metal chassis supplied, you will observe that it has the corners cut away on one edge while the other edge is the full length. The edge of the corners cut away is the front of the chassis and on it will be mounted the switch and potentiometer.

You can mount your valve socket into the hole provided for it near the right-hand end of the chassis, by means of the two small 8BA bolts and nuts supplied.

The transformer mounts underneath the chassis on the two small holes near the rear of the chassis. If you pass the bolts down through the holes in the chassis you will find that the transformer will fit over them and then you can put the nuts on the underneath. On the transformer there are five solder lugs riveted on to the coil former—three on one side and two on the other. Only the group of three lugs is used in the experiments carried out with this Kit. The transformer should be mounted with the side carrying the three lugs facing towards the valve socket.

Fit the switch supplied into the hole in the front of the chassis near the single valve hole and mount the two terminals into the holes at the rear. A ½″ diameter bakelite washer should be placed between the terminal nuts and the chassis so that the terminals are insulated from the chassis. The position of the switch is shown in Figure No. 2.

The speaker itself can be bolted by means of four bolts onto the left-hand end of the main front panel with the transformer upwards so that it will be out of the way of the other parts and protected from damage.

WIRING.

You should not experience any great difficulty in undertaking the wiring of the oscillator if you follow carefully the photograph shown in Figure No. 2, and the wiring diagram shown in Figure No. 3. The wiring is actually carried out with short lengths of the flexible hook-up wire supplied to you in Kit No. 1.

The correct procedure in wiring radio apparatus is to carry out what is called "the ground wiring" firstly, then to put in the small loose parts such as condensers, resistors, etc., and finally provide any long flexible leads such as battery connections and speaker connections. Although there is very little wiring to be done in connection with this oscillator unit, you should nevertheless apply the proper procedure for wiring and you will then become accustomed to the correct procedure, which will simplify the construction of more elaborate units later on.

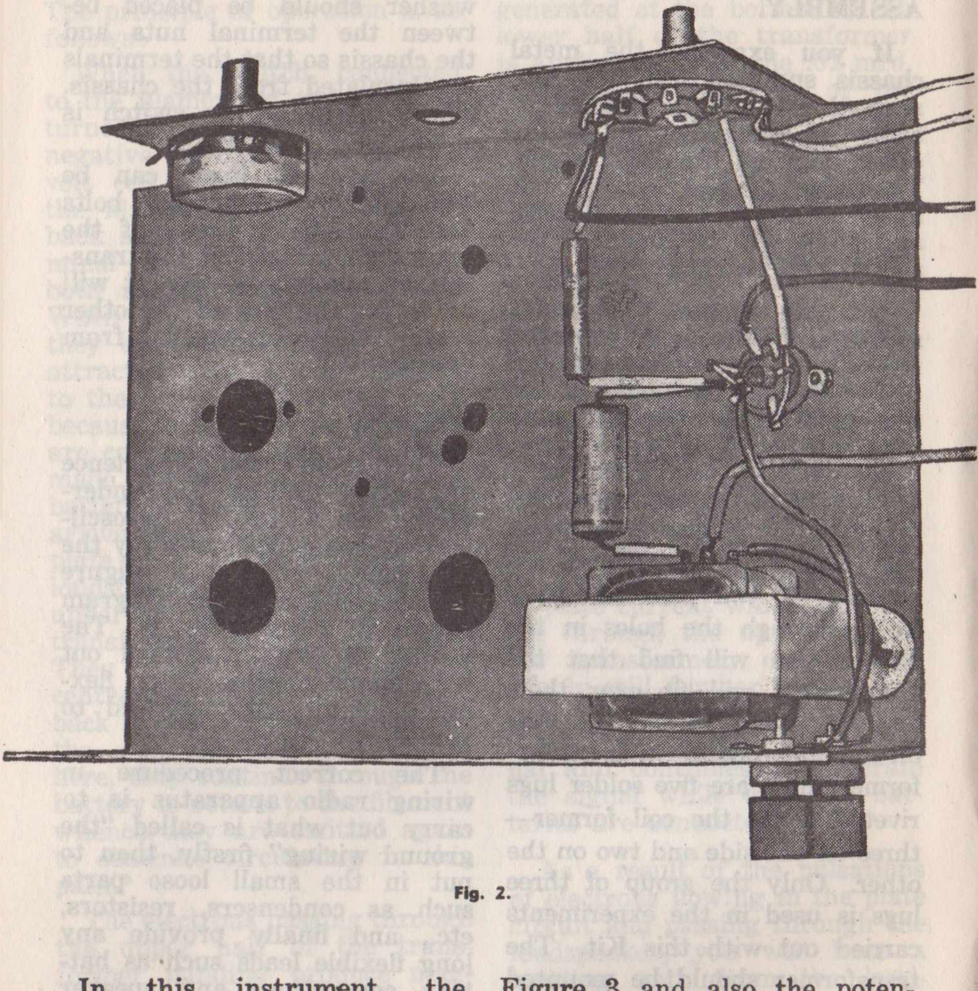


Fig. 2.

In this instrument, the ground wiring consists simply of linking various socket connections to one another, for instance, connect 2 and 4 on the valve socket, also, pins 1 and 7. The wire can then be taken from pin 1 to one contact on the switch. To enable you to follow the connection to the switch contact, the switch in Figure 3 and also the potentiometer have been drawn as though the front flange of the chassis were bent down flat. In this way, you will easily be able to determine the correct switch lug to which to make connection. The lugs have been numbered in an anti-clockwise direction in Figure 3.

If you examine the switch

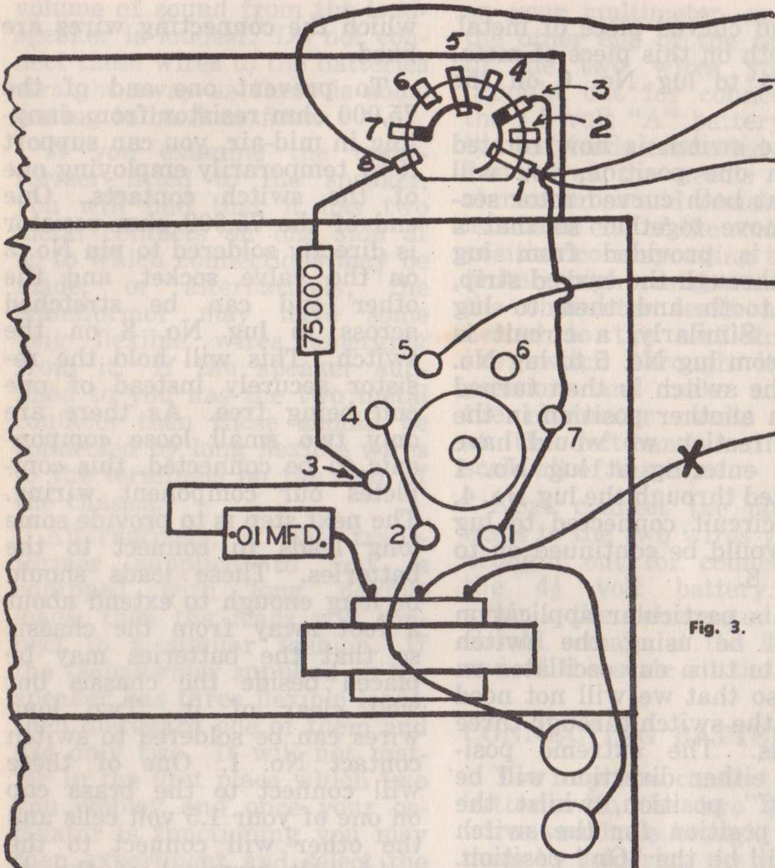


Fig. 3.

carefully, you will find that it is really two switches built together on to the one piece of insulating material or "wafer". In addition to the fact that it is really two switches built together, you will find that the control shaft can be rotated into three separate positions. This means that each switch may be described as a single-pole three-position switch.

If you compare the switch with the diagram in Figure No. 3, you will observe that No. 1 lug is a little longer than Nos. 2, 3 and 4, so that it is able to connect to the curved piece of metal attached to the centre portion of the switch. One end of this curved piece of metal protrudes outward, and, with the switch in the anti-clockwise position, this piece of metal contacts connection No. 2 on the switch.

At the same time, Lug No. 5 is also a long lug connecting to a second curved piece of metal. The tooth on this piece of metal connects to lug No. 6 on the switch.

If the switch is now rotated through one position, you will find that both curved rotor sections move together so that a circuit is provided from lug No. 1, through the curved strip, to its tooth and then to lug No. 3. Similarly, a circuit is made from lug No. 5 to lug No. 7. If the switch is then turned through another position in the same direction we would have current entering at lug No. 1 conducted through the lug No. 4, and a circuit connected to lug No. 5 would be continued on to lug No. 8.

In this particular application we will be using the switch merely to turn our oscillator on or off, so that we will not need to turn the switch through three positions. The extreme position in either direction will be the "Off" position, whilst the middle position for the switch knob will be the "On" position.

A wire from pin No. 1 or 7 on the valve socket should be taken to lug No. 3 on the switch.

The next step in the wiring is to connect in the small components such as the 75,000 ohm resistor and .01 mfd. condenser. In soldering the condenser or any other connection to the transformer, you must make the soldered connections as quickly as possible, otherwise the heat from the soldering iron will melt the plastic material in which the connecting wires are fixed.

To prevent one end of the 75,000 ohm resistor from dangling in mid-air, you can support it by temporarily employing one of the switch contacts. One end of the 75,000 ohm resistor is directly soldered to pin No. 3 on the valve socket, and the other end can be stretched across to lug No. 8 on the switch. This will hold the resistor securely instead of one end being free. As there are only two small loose components to be connected, this completes our component wiring. The next step is to provide some long leads to connect to the batteries. These leads should be long enough to extend about a foot away from the chassis so that the batteries may be placed beside the chassis but well clear of it. Two long wires can be soldered to switch contact No. I. One of these will connect to the brass cap on one of your 1.5 volt cells and the other will connect to the —4.5 volt terminal of the 4½ volt battery. The wire from the centre lug on the transformer will connect to the positive terminal of the 4½ volt battery. For the time being, disregard the "X" shown in this wire in Figure No. 3. A long wire brought away from switch contact No. 8 and therefore from one end of the 75,000 ohm resistor may be tried at different positions on the 4.5 volt battery. You will probably find one particular battery lug on which the volume of sound from the loudspeaker is loudest. Do not connect these wires to the batteries straight away as there is some testing to be done first.

If you examine the transformer fitted to the speaker, you will find that it has two metal contacts on one side of it, to which connections may be made, or alternatively, the transformer may have some long flexible wires emerging from it. If the speaker supplied to you has the two metal contacts then these should be connected by long flexible wires to the terminals on the rear of the chassis.

Alternatively, if the transformer supplied to you is equipped with long flexible leads, then the leads will connect in a similar fashion. If the transformer supplied on the speaker has three flexible leads, then disregard one of them and use only two. It will not matter in the first place which two you employ and once your oscillator is functioning you may then experiment and select the best two out of the three.

TESTING.

Before inserting the valve in the socket and also before connecting the batteries to the battery leads, it is desirable to make some tests to ascertain that you have wired the oscillator correctly as this will prevent any possibility of damage to the batteries or to the valve.

Firstly, insert your test leads into the "High Ohms" sockets on your multimeter, and apply the other end of the test leads to the two wires you have brought out for connection to the 1.5 volt "A" battery. With the test leads connected to these two wires the needle of your ohmmeter should remain at the left-hand end of the scale at the position corresponding to an infinitely high resistance. Whilst the ohmmeter leads are connected to the oscillator, turn the switch through its three positions and make sure that the ohmmeter needle remains at the left-hand end of the scale all of the time.

Next connect the ohmmeter leads to the two wires you have brought out for connection to the 4½ volt battery. Here again, the ohmmeter needle should remain at the left-hand end of the scale all the time.

CONNECTING BATTERIES.

You may now connect the two batteries to the two pairs of wires you have brought out for them by soldering the wires for the 1.5 volt cell to it. The wire from the switch should connect to the centre brass cap on the 1.5 volt cell and the wire from No. 5 pin on the valve socket should connect to the end of the zinc can. The second wire from the switch should connect to the —4.5 volt terminal of the 4.5 volt battery, and the wire from the centre tap of the transformer should connect to the positive terminal. The wire from one end of the 75,000 ohm resistor can be connected at first to the —1.5 volt terminal on the $4\frac{1}{2}$ volt battery.

As a further check on your wiring you should measure the voltage appearing between pins 1 and 5 on the valve socket with the switch turned on. To do this your multimeter test leads should be plugged to the minus socket and to the one marked "+10 volts." A reading of approximately 1.5 volts should be obtained. If the voltage is higher than 1.5 or 1.6 volts this shows that you have connected the A battery leads to the 4.5 volt battery instead of the 1.5 volt battery. As a further test, you should connect the negative test lead to pin 5 on the valve socket and touch the positive test lead to the centre tap of the transformer. In this position you should obtain a reading of approximately 6 volts. Next, touch the positive test lead to pin 2 or 4 on the valve socket and in this position the reading should be between 5 and 6 volts.

If your voltmeter does not show a reading of more than 5 volts when its positive lead is connected to the centre tap of the transformer, then this suggests that either one of your batteries is defective or that you have reversed the connection to one of them. You should check over the wiring very carefully to see that you have them the right way around.

Finally, touch the positive test lead to pin No. 3 on the valve socket. In this position the needle should only move about two or three small graduations across the scale. The small reading at this point is due to the presence of the 75,000 ohm resistor in the circuit.

If all these voltages appear to be in order, then it is safe to firmly insert the valve in its socket. As soon as the valve is inserted you should hear a distinct squealing sound from the loudspeaker. This whistle is known as an "audio frequency oscillation" and is produced by the action explained earlier in this lesson. The pitch of the sound is determined by a large number of factors, particularly the inductance and capacity of the transformer. Other things, however, affect the pitch and you will find, if you make some experiments with the connection from the 75,000 ohm resistor to the 4.5 volt battery, that trying the lead on to various tappings on the battery will not only alter the pitch but also the loudness of the tone.

If no sound is heard when the valve is inserted, then examine the valve itself carefully to see that it is pushed firmly down into the socket and that there are no cracks in the glass. When inserting or removing the valve, it is most important that it be pushed straight down into the socket and pulled straight out from the socket. On no account must the valve be wriggled from side to side, as it is being pushed in or pulled out, as this is almost certain to cause cracks in the glass base around the connecting prongs. Even the slightest crack in the glass of the valve will render it useless. If the oscillator still will not function, even when the valve is firmly in its socket, then remove the valve and test the filament for continuity by applying your multimeter test leads to pins 1 and 7. The other ends of the test leads should be plugged into the sockets marked "High Ohms" on the multimeter. When connection is made you should obtain a reading between 30 and 50 ohms.

If you do not get any reading when you touch the ohmmeter lead to pins 1 and 7, then the valve filament has been burnt out by the application of excessive voltage.

If the valve is in good order, then the next thing to test is the loudspeaker. This may be tested by disconnecting its two wires and touching them momentarily to the positive and minus 4.5 volt tappings on the $4\frac{1}{2}$ volt battery. Just as the connections are made, there should be a distinct click from the loudspeaker, and similarly, at the moment when the connections are broken there should be another click.

By means of the tests described earlier, we have really checked all of the parts in the oscillator and if it still will not function then there must be a mistake in the wiring and you should check this over very carefully.

PENTODE OPERATION.

With the valve socket connections 2 and 4 joined together, this joins the screen and plate of the valve to one another so that the two act as a plate and the valve therefore operates as a triode. You may now see how the valve performs when operated as a pentode. This can be done by removing the wire connecting pins 2 and 4. The lead from the loudspeaker terminal must still connect to pin No. 2, whilst a long lead is connected to pin No. 4. This long lead may then be touched to the various tappings on the $4\frac{1}{2}$ volt battery and the effect of varying amounts of screen grid voltage can be noted. You will observe that the greatest volume is obtained when the wire from pin No. 4 is connected to the positive terminal on the $4\frac{1}{2}$ volt battery and that the signals become weaker when the lead is connected to other points. When the screen is connected to the negative end of the $4\frac{1}{2}$ volt battery or to the minus 3 volt terminal there will probably be no whistle at all because of the fact that with a low screen voltage the plate current is low and oscillation will not be maintained.

LEARNING THE MORSE CODE.

No doubt many of you will have taken up a study of radio with the object of becoming a radio operator. In sending commercial messages to and from ships and to and from aircraft and in various other commercial activities, it is customary to make use of the Morse Code for sending a large number of messages because of the fact that Morse Code communication can be established over greater distances and with greater reliability than is the case with the spoken word. Consequently, if you tune a short-wave radio receiver over the various short-wave bands you will find plenty of Morse Code stations, especially on the 20 metre band, the 40 metre band, the 80 metre band, and, of course, way up on 600 metres. Each one of these series of sounds is conveying some dramatic message from one part of the world to another. It may be battle, murder, or sudden death. Often they may tell of huge dealings in finance, gold—they may carry details of some royal romance or political intrigue. No wonder that Morse Code study is fascinating and is well worth the concentration and effort necessary to be able to unscramble these sounds and determine what they mean.

The oscillator we have just built, especially if operated by a proper Morse Key, provides a most efficient method of learning the Morse Code. All that is necessary is to break the wire from the centre tap of the transformer to the positive terminal of the $4\frac{1}{2}$ volt battery at the point marked "X" on Figure 3. If you insert a Morse Key at this point then you will find that tapping the Morse Key enables you to produce dots and dashes from the speaker. These will sound just like the dots and dashes of Morse Code signals heard on a radio receiver.

Because many of you will want to learn the Morse Code, you will find set out on the following pages a lengthy and thorough description of the Morse Code itself, the symbols comprising it, and how best to memorize them. If by any chance you are not interested in the Morse Code, then you can turn over the next few pages to the heading "Testing Radio Receivers."

THE MORSE CODE.

There is only one code that is used in radio—the International Morse Code. It is used all over the world by radio operators on land or sea. Whether a station is China, France, Germany, Australia, America—the code is the same.

Let us put these sounds in picture form and study them. Here they are:—

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 — — . .

You can see that each letter has its own group of symbols and that group consists of only two things—dots and dashes. Your first step is to firmly implant those symbols in your brain by studying the picture set out above. Once you have done that your next step is to do it by means of your ears. Learn what the letters of the alphabet look like and then after that learn what they sound like, and your Morse Code proficiency is finished except for practice.

It is important that you study slowly but surely in the beginning. Don't be frightened of the apparent complexity of the symbols. Really, it is very simple and once you study it you will soon find out how easy it is.

Start at the letter "A". Now "A", as you can see, consists of one dot and one dash (. —). A dot when properly made is just one-third as long as a dash. Let us find out what "A" sounds like. To do this you must make the sound with your mouth.

Letter A sounds like this: DIT DAH. Try it yourself. The I in the word "DIT" has the same sound as the I in "TIN". The A in "DAH" has the same sound as the A in "FATHER." When you say the sound "DIT" it is very short. The word "DAH" is longer. One thing I will warn you of here, and it is very important. NEVER MAKE THE LETTERS BY THE DOT AND DASH SOUNDS. Never make the sound for A as "DOT DASH". Always make it as "DIT DAH." This of course applies to all letters. As you find that your speed increases you will discover that no progress can be made unless you use the DIT DAH method. You can actually transmit with your mouth at the rate of thirty words a minute by using these symbols. This is impossible by saying "DOT DASH".

Now that you know what the letter A sounds like, I want you to practise it at least fifty times. Make these two sounds over and over again, and at the same time picture that letter in your mind. Commence slowly and in this way you will commence correctly.

Now I have written down the whole alphabet in sound. I want you to practise each one of these letters by making their particular group of sounds with your mouth. Forget that they are dots and dashes and think of them as DITS and DAHS. Make the sounds for the letters as you see them written out and practise each letter at least fifty times before you go on to the next. After that, practise them in groups of five or ten at a time. I want you to get them so that you can write down each letter every time you hear the sound. For example, if you hear "DAH DIT DIT DIT", you should be able to write down the letter "B" and not "Dash Dot Dot Dot". Never, under any circumstances, write down dots and dashes when you are sounding words. That is a habit you must not start. These sounds must represent letters to you and not symbols. When you hear "DIT DIT" you must automatically and immediately think of the letter I. Correct practice will soon give you this habit and it is a habit that will always remain with you.

Here is the whole alphabet written out in sound symbols:—

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

Right here and now I am asking you to study your code where you will not be disturbed. Go to a place where you can concentrate and put in anything up to an hour on it for the first time. Don't do more than an hour at first because you will soon get tired and in this way your study will be less effective. I suggest anything between thirty minutes and one hour to commence.

Get the sounds set in your mind so that you can write down each letter as you hear the sound of it. After that you can start right in on words. Once you start practising with a key and oscillator you will recognise the sounds because that's the way the oscillator will make them. That also is the way they will sound in your radio receiver when they come from a transmitting station. You can see how important it is to learn them correctly at the very beginning.

Learn a few letters in the beginning and practise them during the day while you are working. You can practise them anywhere—while you are walking or any other place where you have a few moments to spare mentally. Patience is necessary, but you will be well rewarded for this virtue. Naturally you will find that you will stumble over some letters and some you will find are hard to retain in your mind. Perseverance is the only way to overcome this.

NUMBERS.

After concentrating on the letters until you know them thoroughly, I want you to learn the numbers. The numbers that are used in Morse Code are 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. These numbers are surprisingly easy. Look at the diagram set out below. Each number consists of five separate characters. When you study them for a minute or two you will see that the numeral "1" is made up of one dot and four dashes. "2" has two dots and three dashes; "3" has three dots and two dashes; and so on up to 5. When you reach 5 you find that this has five dots. "6" has a dash and four dots; "7" two dashes and three dots and so on. The numerals are arranged in the progressive system. This makes them very easy to remember. What you have to do now is to remember them as sounds and not as little picture diagrams.

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

Get these numbers fixed in your mind as sound. Here they are written down as sounds:

1 DIT DAH DAH DAH DAH
2 DIT DIT DAH DAH DAH
3 DIT DIT DIT DAH DAH
4 DIT DIT DIT DIT DAH
5 DIT DIT DIT DIT DIT
6 DAH DIT DIT DIT DIT
7 DAH DAH DIT DIT DIT
8 DAH DAH DAH DIT DIT
9 DAH DAH DAH DAH DIT
0 DAH DAH DAH DAH DAH

Learn these numbers correctly and use them in combination with the letters you have already learned.

I want you to give the numerals set out in this section about thirty minutes to an hour a day practice just the same as you gave it to the alphabet. Remember, however, that concentration and regular daily study and patience are essential for progress and success.

The final group of sounds which you must learn are those for punctuation. The punctuation symbols are set out in two groups. In conversations between amateurs, many of the punctuation symbols, such as colons, semi-colons, etc., are seldom used. Consequently, the first group comprises punctuation and other signs which are frequently used and which must be memorised just as thoroughly as the letters and numbers. Here they are set out for you, both in symbol form and in sound.

Full Stop	(.)	. — . — . —	DIT DAH DIT DAH DIT DAH
Comma	(,)	— — . . — —	DAH DAH DIT DIT DAH DAH
Question Mark	(?)	. . — — . .	DIT DIT DAH DAH DIT DIT
Hyphen or dash	(—)	— . . . . —	DAH DIT DIT DIT DIT DAH
Fraction Bar	(/)	— . . — .	DAH DIT DIT DAH DIT
Double Dash	(=)	— . . . — .	DAH DIT DIT DIT DAH DIT
Error		. . . .	DIT DIT DIT DIT DIT DIT DIT DIT
Wait		. — . . .	DIT DAH DIT DIT DIT
Commencing Signal to precede every transmission		— . — . —	DAH DIT DAH DIT DAH
End of any one message or Cross	(×)	. — . — .	DIT DAH DIT DAH DIT
End of work		. . . — . —	DIT DIT DIT DAH DIT DAH

Learn these in the same fashion that you learnt the alphabet and the numbers.

When practising the code, you will probably be listening to commercial stations sending news items or perhaps you will practise sending articles from a newspaper or magazine. In this work you will come across the other punctuation marks which are set out below. These are not very often used in amateur work, but there are not many of them and you should learn them so that you will recognise them, and so that they will not disturb you when you hear them in listening to commercial transmissions.

Semi-colon	(;)	— . — . — .	DAH DIT DAH DIT DAH DIT
Colon	(:)	— — — . . .	DAH DAH DAH DIT DIT DIT
Apostrophe	(')	. — — — — .	DIT DAH DAH DAH DAH DIT
Quotation or inverted commas	" "	. — . . — .	DIT DAH DIT DIT DAH DIT
Brackets or parentheses	( )	— . — — . —	DAH DIT DAH DAH DIT DAH
Underline ——		. . — — . —	DIT DIT DAH DAH DIT DAH

Before we finish this portion on Code, there are some things I want you to know about sending. It will be desirable for you to get a key and connect it to the oscillator shown in Figure 3 at the point marked "X" so that you can do some actual manual practise. When you tap out the letters on the key you will hear the sounds from the speaker just the same as you made them with your mouth. Tap out all sorts of messages on your key and pay particular attention to the spacing between letters and words. The space between words should be three times as long as the space between letters. Try and make each group of sounds clear cut and distinctive. Remember that I told you that a dot is one-third the length of a dash. You can do some excellent practise on a key by yourself by just perfecting your sending and increasing your speed. If you can practise with a friend you can send to each other and improve your receiving speed.

A very important point in transmission is the proper way to hold your sending key and the placing of your arm. Unless you start off right in this respect, you will develop bad habits that will be detrimental to your accuracy and clarity.

The fingers of the right hand should hold the knob of the key. You should not press the key with the tips of the fingers on the top. This may seem easy when you are starting practise, but I can assure you that you will never get real speed and perfect spacing unless you hold the key the right way. Do not grip the key tightly. Take hold of it firmly and lightly. Your arm and hand and fingers must have a feeling of relaxation. You will never get this easy feeling if you grip your key too tightly.

Place the thumb underneath the knob of the key. The index or first finger should rest on top of the knob. The second finger of your hand should rest partly on top but near the outside edge away from the thumb. Raise your wrist just a trifle, so that it will be free to move.

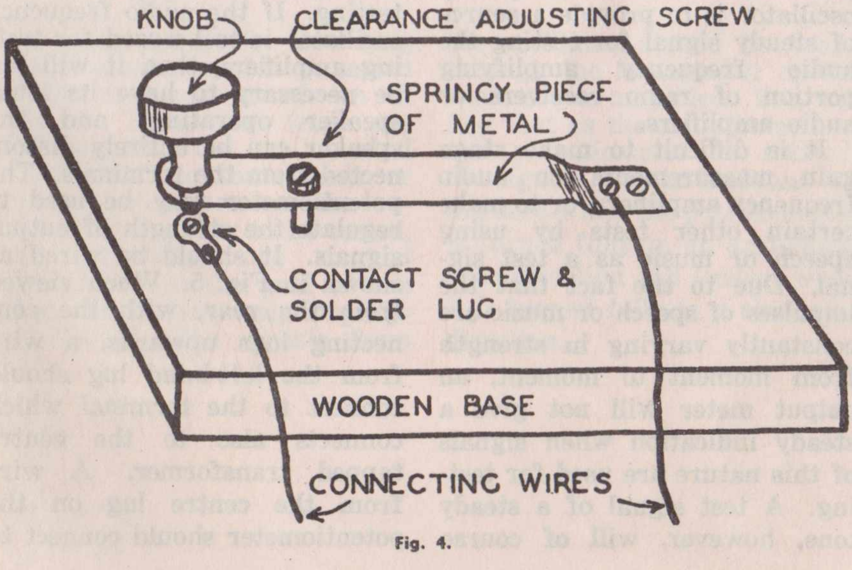


Fig. 4.

The forearm should rest firmly on the table. Now the wrist is free to move up and down. Actually transmission is done from the wrist and not from the fingers. You must hold the key firmly but not grip it.

Keys should be adjusted to fit the hand of the individual user. There are two adjustments on the average key; the spacing and the tension adjustment. The spacing is the distance between contacts. This should be very small to get away from that clicking effect. The tension is adjusted by the lock and spring arrangement to give you just the necessary amount of return action without having to press too firmly on the key to make contact. The easier you have the tension, the easier you will find it to make perfect characters. When you are commencing practise I suggest that you use a little more tension than you will when you are getting up to a respectable speed. If you cannot procure a proper morse key, you will probably be able to make a simple one along the lines shown in Figure 4.

When you begin to feel tired at sending practise, I want you to rest for half an hour or so. It will probably take you some days to get used to consistent sending. Never tire yourself out before you stop.

TESTING RADIO RECEIVERS AND AUDIO AMPLIFIERS.

Apart from learning the Morse Code, another useful application for an audio frequency oscillator is to provide a source of steady signal for testing the audio frequency amplifying portion of radio receivers or audio amplifiers.

It is difficult to make stage gain measurements on audio frequency amplifiers, or to make certain other tests by using speech or music as a test signal. Due to the fact that the impulses of speech or music are constantly varying in strength from moment to moment, an output meter will not give a steady indication when signals of this nature are used for testing. A test signal of a steady tone, however, will of course provide a steady indication on an output meter and this is advantageous in many forms of testing. If the audio frequency oscillator is to be used for testing amplifiers, then it will not be necessary to have its loudspeaker operating, and the speaker can be entirely disconnected from the terminals. The potentiometer may be used to regulate the strength of output signals. It should be wired as shown in Fig. 5. When viewed from the rear, with the connecting lugs upwards, a wire from the left-hand lug should connect to the terminal which connects also to the centre tapped transformer. A wire from the centre lug on the potentiometer should connect to

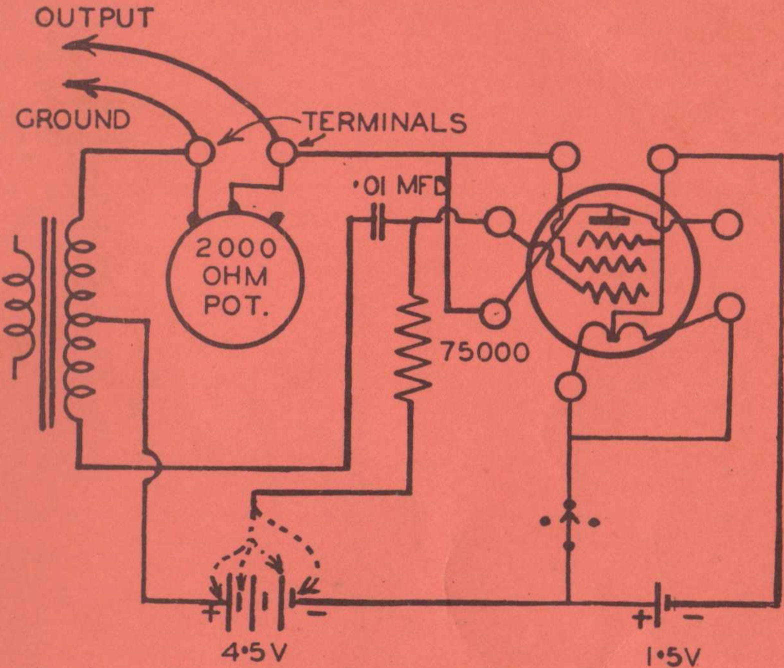


Fig. 5.

the other terminal. Two long "test" leads may be connected to the terminals as shown in Fig. 5. These test leads are then applied, the one marked "GROUND" to the chassis or ground connection on the receiver or amplifier to be tested, and the other one marked "OUTPUT" to the grid of one of the audio frequency amplifying valves. The signals from the oscillator should be heard through the loudspeaker on the radio set or amplifier. You will find that as the control shaft on the potentiometer is rotated, the signals vary in loudness, being zero when the potentiometer is turned fully in an anti-clockwise direction and loudest when it is turned fully in a clockwise direction.

Lesson No. 5

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