The Diagnosis of Radio

By the Technical Editor

IN previous instalments we have outlined the functions of the various components in a radio set. This time we must go a little farther and place some of those components together to build up a circuit.

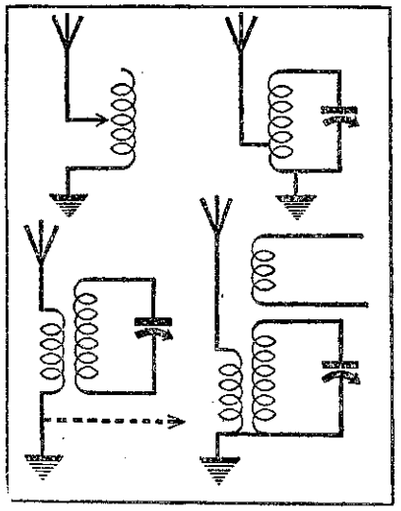
Look for a moment at diagram 1. You will instantly recognise the components indicated by the theoretical or schematic symbols. There is an aerial, a coil, and the earth. The aerial is not brought in to a fixed tapping, but is varied; that is, it can be taken to any tapping upon the coil.

We go a stage further with diagram 2, where the aerial is brought to a fixed tap on the coil. Connected across the coil is a variable condenser. Now we know from our previous talks that, when a coil and a condenser are used together in this manner they can be made to accept or reject certain frequencies. If they are at a value, say, that resonates on 2YA's frequency, they cannot receive any others, or rather, they offer a high resistance to all other frequencies. You will notice in diagram (3) a dotted line near the earth symbol. If we did away with the earth and took a connection along that dotted line to our set, we would have a wavetrap. After a moment's hesitation you will see exactly what a wavetrap does. We adjust the coil and condenser until they offer a very high resistance to the signals from the station we do not wish to receive—in other words, that arrangement will pass all other signals except them, the signals from the interfering station being absorbed in the rejecter circuit.

The next diagram introduces a third coil. We have a coil between the aerial and the earth and near it is a larger coil. This is known as the secondary, for it is not connected with the primary, or, we should say, need not be connected with the primary, for some secondaries are connected to the primary at their lower end. Considering these two coils, then, we have sketched out a species of transformer. As there is no iron in the circuit, the coils are merely placed close to one another, and this is known as a radio frequency transformer.

The coil up at the top is very similar to the aerial coil and is usually placed at the other end of the secondary coil. Its function is to take back high frequency current into close proximity with the secondary coil. Varying the coupling between this coil (the tickler) and the secondary, we can allow a greater or less amount of high frequency current to go from the plate of the valve back into the secondary coil. This high frequency current can then be passed through the valve and magnified. This is known as regeneration.

You know now that, when you see three coils, as drawn, a primary and secondary coil is indicated, the secondary being tuned to admit of any



Four Types of Aerial Coupling.—Top left, a simple tapped coil; top right, a tapped coil tuned with a variable condenser; bottom left, an aerial coupler employing a separate primary; lower right, a regenerative former.

one station, and a tickler coil, which provides for regeneration. The circuit in question must now be termed a regenerative circuit. All of the circuits we have shown, provided they are variable, are classed as aerial tuning circuits, comprise the first section of any receiver.

Crystal Sets

WE are now able to tune the signals to any desired station. It will be remembered, however, that even if we put a pair of phones in this circuit we could not hear anything, because the high frequency current is pulsating too rapidly for the iron of the receiver to respond. It must be slowed down or rectified, and a simple manner of doing this is to insert a crystal in the coil or in an extension of it. By extending the coil to take in the crystal and the phones we are completing a circuit, and the current can now get somewhere. So we have our first simple crystal set. There is a larger variety of crystal sets that all work on the same principle. The difference lies only in the method of coupling the aerial, or, to use technical terms, now that we understand them, in the aerial tuning circuit. If the aerial is connected to a fixed tapping, usually a third from the earth end (it is now auto-transformer), complete the circuit in the usual way, we will get the strongest circuit, but the circuit will be very broad in tuning, that is to say, the local station, although it has a definite peak, will come in when the condenser is turned away from this point. If there are two stations operating in the same town, they will both be frightfully mixed up, so we have to introduce certain losses in order to bring about selectivity (the ability to discriminate between the stations). One method is to use a separate primary coil, or even introduce a third coil, which is connected with the crystal, while the main secondary coil is merely tuned to the condenser.

There are various manners in which the desired effect can be brought about.

In a very simple circuit we could do without a condenser by varying the number of turns in the circuit. This can be done as is shown in figure one.

Now that we have outlined the types of simple aerial tuning circuits, take a pencil and paper and draw the following without reference to the diagram. Aerial tuning circuit employing a separate primary and secondary coil, the secondary being tuned with a variable condenser.

Now draw a crystal set employing an aerial circuit that does not involve the use of a variable condenser.

Draw a three-coil tuner, the secondary coil tuned with a condenser, and having a midget condenser in series with the aerial. When you have done these, look up the diagrams and check up your sketches.

Valve Circuits

HAVING now thoroughly understood the aerial circuit, let us introduce a valve. We might remark here that in any radio set there are four different circuits, the aerial tuning circuit, the high frequency circuit, the detector circuit, and the low frequency circuit. We might re-name two and four, calling them the radio and audio circuits respectively. Two, three, and four differ mainly in the use to which the valves are put.

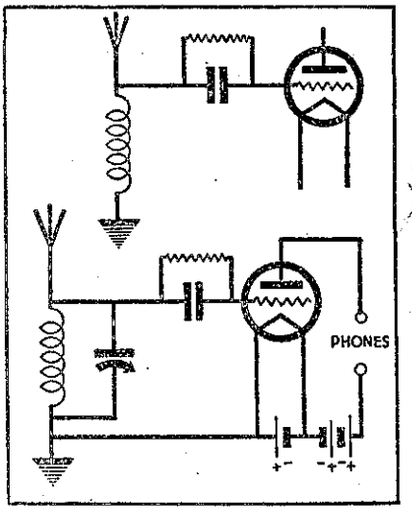
We will deal with number three first, for it is most essential, and, in a simple circuit such as the one-valve set, or even a two-valve set, follows the aerial tuning circuit. We have traced the pulsating current to either end of the secondary coil. We know that if we complete that circuit, passing it through a crystal, we can hear the signals. Now we shall pass it through a valve instead. The top of the aerial coil is taken through a grid-leak and condenser to the grid of the valve destined to be the detector. The grid-leak and condenser are essential if detection is to take place. We shall not pause at this stage to discuss exactly how detection is carried out, that is rather involved, but, whenever you see a grid-leak condenser between the top of the secondary coil and the grid of the following valve you will know that that valve is the detector.

If we take the plate of the valve and continue our circuit as if we had a crystal now instead of the valve, we shall take it through the 'phones and to earth, and to the bottom of the secondary coil. Theoretically the set should function, but in order to make our valve work we must supply current to cause electron flow. A battery is put in the circuit between the 'phones and the earth. The presence of the battery will not make any difference to the high frequency current completing its circuit. It will go through the battery as if it were not there.

Not only do we need a high voltage battery to energise the plate of the valve, but we need a low potential battery between the filaments in order to cause the electrons to flow from the filament to the plate, through the grid and so bring about magnification of the signals. The battery is connected as is shown, and it is usual to connect the negative terminal of the B battery to the negative or positive of the A battery to complete the circuit. These points have already received attention when we dealt with the valve.

Now we have our one-valve set complete. We have an aerial tuning circuit, which collects the signals, we have a detector and 'phones. Because magnification takes place within the valve, the signals received in this one-valve set will be stronger than those from a crystal set.

If we want slightly stronger signals



Upper.—An aerial coil connected with a grid-leak and condenser and the grid of the detector valve. Lower.—A completed one-valve non-regenerative circuit.