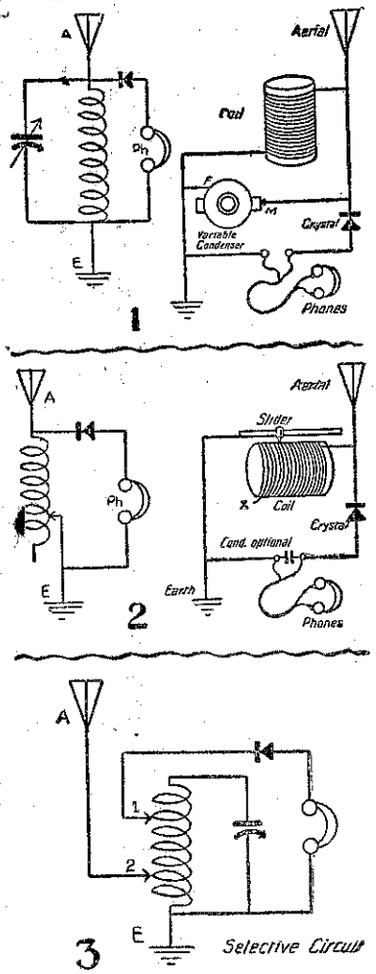


Three Types of Crystal Sets.—(1) A coil tuned with variable condenser. (2) A coil tuned by a slider. (3) A selective circuit using a tapped coil.

we can use regeneration. You will remember what regeneration is—the feeding back of certain of the high frequency currents running in the plate circuit of the detector into the secondary coil. This is brought about by a third coil near the secondary or grid coil. There must be some method of controlling the amount of energy sent back. We can either vary the relationships of those coils, known as the swinging coil method, use a variable condenser, and vary the voltage on the detector valve. These three different methods have their own particular advantage.

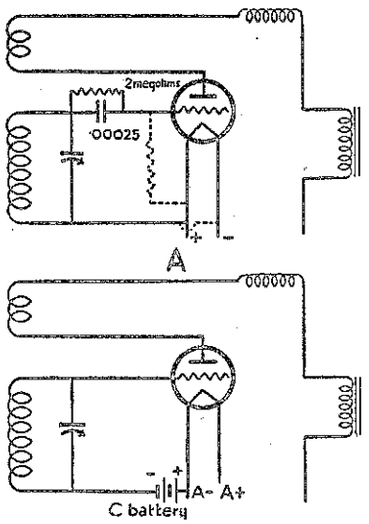
There are other methods of causing a valve to detect. One, the anode bend or power detector, is possibly the next best known to the grid-leak and condenser. Detection is brought about by applying a negative voltage to the grid of the valve, instead of by putting a grid-leak and condenser in series with it. In the low frequency circuit a third, or grid, voltage is applied to the valves and we employ exactly the same circuit for the detector except that a very much higher grid voltage is used. The circuit is illustrated.

A third method of detection, one which seems to be coming very popular, and which possesses many advantages, is the power grid type. This is really a combination of the power detection and grid-leak detection, incorporating certain variations made in the constant.

The Low-frequency Circuit.

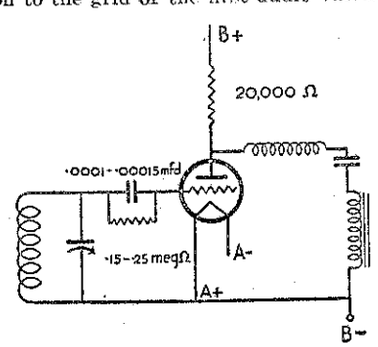
IF we wish to strengthen the signals which have come from the detector, we can do so by employing more valves. It will be remembered that the current flowing in the plate circuit of the detector is of two kinds, direct from the battery and audio, or slow pulsating current from the valve itself, that is, the rectified a.c. This rectified a.c. current must somehow be got to the grid of the next valve. Now there are several ways that we can get at this.

In the first case, unless we employ a special circuit, we cannot allow a direct current flowing in the plate circuit to get on to the grid. That would cause a frightful hum and nothing else, so we must use a combination of stoppers. Probably the most popular method is by using a transformer. As the current is pulsating slowly for audio frequency current, an iron core transformer can be employed. The transformer has the advantage of stepping up the voltage as well as supplying an excellent means of coupling. The primary coil of the transformer is connected in the plate circuit, and takes the place of the phones. If another coil is placed near this, the pulsations will be picked up.

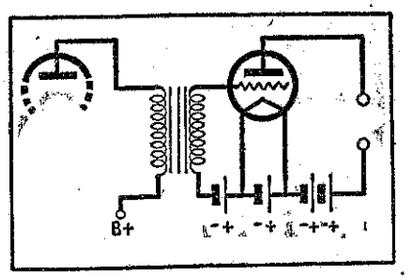


Two Methods of Making a Valve Detect.—Upper, grid-leak; lower, anode bend.

If the second coil is larger than the first they will be magnified to a certain extent. This is exactly what we want. There will be no direct current in the second coil, but audio current only. If we connect one side of this to the grid, and the other to earth, or to earth via a small battery, we shall complete the grid circuit, and be getting the signals on to the grid of the first audio valve.



Detection by power-grid method. A high detector voltage is necessary.



A transformer coupled audio stage. The batteries are, from the left, "C," "A," and "B."

Another method of coupling the detector to the first valve is by resistances and chokes. In the first place a blocking condenser is placed between the plate and the detector valve, and the grid of the audio valve. The blocking condenser will pass the audio frequency current, but stop any direct.

Now the direct current must reach the plate of the detecter valve, but audio current must be prevented from leaving the plate circuit by this path. This is simple enough, knowing what we do about the use of chokes. If we put in an audio frequency choke, the direct current can pass, but not the audio current. So, the direct current reaches the plate, and the audio current, the grid of the next valve. The circuit must now be completed. Inside the valve the electrons cross the vacuum, but externally connections must be made by some other means, and a circuit somewhat akin to the plate circuit of the preceding valve is employed. We must stop the audio frequency current leaving the grid, but must pass what little direct current flows in the grid circuit. This can be done either by using a very high value resistance or a choke. This method of coupling is usually referred to as resistance capacity.

High Frequency Circuit

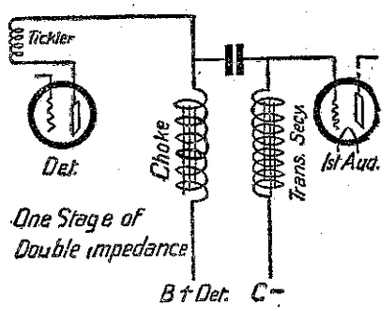
WE have explained how magnification takes place after the detector valve. An even more satisfactory method is to magnify the signals before they are detected, that is, while they are pulsating at a tremendous rate (at the radio frequency). A valve is employed in almost the same hook-up as for the audio stages, but seeing the current is at radio frequency iron core transformers cannot be used, and so they are replaced by radio frequency transformers, or ordinary coils. We have our aerial tuning circuit connected with the grid of the first valve. Notice there is no grid-leak and condenser in this circuit and no high grid bias. High frequency pulsations will jump from the primary to the secondary coil and so on to the grid of the following valve, which may be another high frequency stage, or the detector. Thus it will be seen that the principle of operation is the same as in the audio stages.

Analogous to resistance capacity coupling is the tuned anode system, shown in the accompanying sketch. It will be seen that the direct current gets to the plate of the valve through a radio frequency choke. The current cannot pass through this choke, but can pass through a condenser and so on to the grid coil of the next valve. This method is particularly suitable for the screen-grid valve.

In connecting the screen-grid valve in any one of the circuits mentioned the usual thing is to connect up all the four terminals we have previously commented on to grid, plate, and the two filaments in exactly the same way. The extra terminal is the auxiliary grid. This must be connected to a suitable "B" battery supply. By-pass condensers and chokes are used usually to restrict radio frequency current to their proper circuits and prevent them from wandering around the circuit and causing instability.

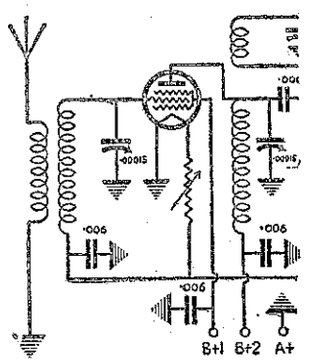
We have now studied the four main portions of the set and explained the functions of the principal components. Others can be added as refinements. For instance, we can use a variable resistance to control the amount of current reaching the filaments of the valves. This is known as a rheostat. It is employed because some valves work better with a little less voltage on them than is delivered by the battery.

Space does not allow us to deal with much more in this series. In the next instalment we hope to talk a little about the refinements of radio, to explain the meaning of push-pull, and



Low-frequency coupling employing chokes and a condenser.

to comment briefly on the power pack and a.c. circuits. If before this time anyone has any further points they want elaborating we shall be pleased to hear from them.



A high-frequency stage which employs a s.g. valve in a tuned anode circuit.

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