A Diagnosis of Radio

The Valve

by

The Technical Editor.

WITHOUT the valve, radio as we know it would not exist, for it has made possible not only receiving, but also transmitting as we know it to-day.

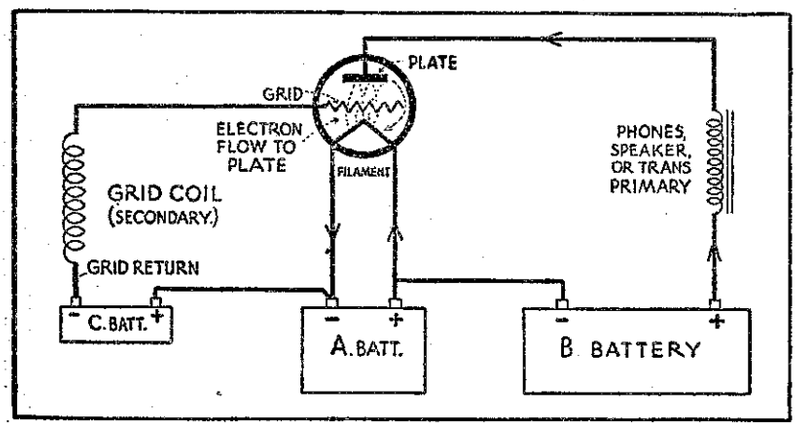
The valve consists of several elements, as we call them, within an evacuated glass tube. That is all, but there can be an infinite variety in the size and arrangement of the elements, and it is this variety which makes possible the large number of types of valves. Looking from the outside it appears just as a glass bulb, usually with a very light silvery coating on the inside of the globe. From underneath the glass protrude four prongs through which connections are made between the set and the internal parts of the valves.

If the glass is removed the valve would appear as is shown in the diagram. The first thing we come to would be a metal shield, and this is called the plate. The size and shape of the plate has a great deal to do with the work the valve is called upon to perform. If we remove the metal plate we see underneath a fine mesh work of wire. This is the grid, and underneath this one sees a fine single thread known as the filament.

The plate of the valve is always connected with a high "B" voltage, while the filament is connected with a low voltage called the "A" supply. The grid is connected into a coil, the bottom of which is usually taken either to "A"—, A+, or a suitable tapping on a grid bias battery.

The uses of a valve are four. The first, amplifying. It is a peculiar phenomenon that if signals are in a certain manner imposed upon the grid of the valve they will be magnified if the valve is operating under correct characteristics, that is to say, the current which comes out from the plate is stronger than that going in to the grid.

The next function is detecting. Detecting we explained when dealing with the crystals. The detector we might call a stripper, for it strips away the high-frequency current and leaves the lower value current, which is audible when used with phones.



The next function is rectifying. This is similar to detecting, for it consists of ironing out or flattening half of the wave that comes from the alternating current of our mains. It turns a.c. current into d.c., and by doing such accomplishes the first big step in making the a.c. current suitable for our radio set.

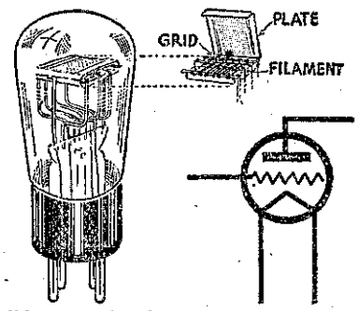


Diagram showing the elements of a three-electrode valve, with their symbolic equivalents.

The last function is that of an oscillator. An oscillating valve is one that will send out radiations. It is the development of the valve as an oscillator that has made the wireless transmitting what it is to-day.

If you look at the sketch of the valve hook-up you will see that three batteries are employed. The "A" for the filament, the "B" for the plate, and the "C" for the grid bias. Here is the way the valve acts. The filament is a piece of wire thickly coated with thorium, an element which when heated gives off electrons or minute negatively charged particles. We need then some means of heating this thorium-coated wire. We could use a bunsen flame, but that, of course, would not be practicable, so we force a fairly heavy current through it and it glows red hot and the electron leaves the circuit.

If there is a positively-charged body in the neighbourhood it will attract those electrons, and this is the function of the plate. To charge the plate positively it must have connected with it the positive of a high voltage battery, so we connect B+ to the plate. Now, it is no good connecting B+ to the plate unless we can connect B— somewhere nearby. Without B— we cannot get current to flow, and without a flowing current we cannot get the high positive potential that is needed to attract the electron.

It is a characteristic of a vacuum that the current will bridge a small space, and so if we put the negative close to the plate the current will flow all right. This is precisely what we do, for we connect B— to the filament. Therefore, the direct current will flow via the positives of the "B" battery to the plate through the vacuum to the filament back toward the "A" battery, and over to B—. That is the d.c. or battery flow. The electrons, remember, flow the other way—from the positive to the plate of the valve. If we put a grid in between the filament and the plate we can intercept this electron flow, and if the grid is positive it will act with the plate and attract more electrons from the filament. If, however, it is negative it will tend to retard them.

In other words, the grid is a control of the number of electrons and that control can be operated by making the grid positive or negative. The grid can be made either positive or negative by inserting in the grid return a suitable battery. If we connect a battery so that its negative will be toward the grid and the positive side to the filament then just as we completed the circuit for the plate current we will have completed a circuit for the grid current. The voltage of the grid battery is very small and, being small, can drive little current through the high resistance of the valve. The "C" battery requires them to supply very little current. The "A" battery requires the most current of all, while the "B" needs primarily a high voltage, but also it must be able to supply a reasonable current and must therefore be of sufficient size to keep up the flow.

The type of valve can be divided in two classes—a.c. and d.c. The a.c. valves are such that their filaments can be run from alternating current. Now we remember that our house current is alternating so that this can in some way be applied to the filament of the valves to feed them. We cannot apply the alternating current to the plate of the valve because the ripple will be noticed in the loudspeaker. In fact, a certain amount of ripple can be transferred from the filament unless it is very heavy and rugged.

In order to overcome this a special heating device is used whereby the filament is indirectly heated. It is next to the heating elements. It is like putting sealing wax in front of a fire to melt it. You do not let the fire touch the sealing wax and so with the valve we do not let the filament touch the cathode which is the electron emitting body.

The plate and grid of the a.c. valves require direct current the same as do the battery valves, and if we are not going to use batteries for this purpose we must smooth out the a.c. current.

You will remember that was one of the functions of the rectifying valve to do this smoothing out process. In the battery valve all filament current is supplied by battery.