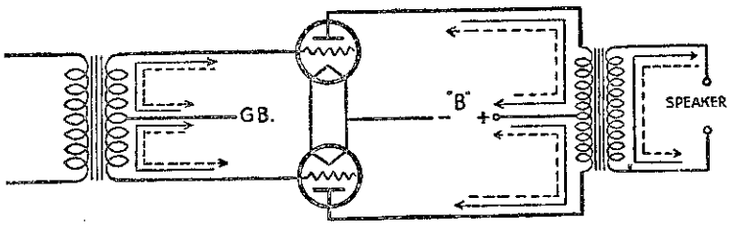
A Diagnosis of Radio

By the Technical Editor

A CORRESPONDENT requests that, before this series be closed, a few notes should be given on push-pull amplification. Others have written on the same subject, one remarking that he does not know the difference between push-pull, pull-push, push-in, pull-out, and so forth, and asking for an explanation.

The explanation of push-pull is a little complicated, but we shall try to keep out technicalities as far as possible.

It must be borne in mind that all radio amplification can be carried out only because of the pulsating nature of the high frequency currents. They surge backwards and forwards similar to the waves breaking on the beach. We have the pulsating movement taking place in the primary of all transformers. This is picked up by the secondaries. If one end of the secondary is connected to the grid of a valve, and the other end connected to earth, as we explained last week, the pulsations on the grid will alternately be high and low. A push-pull amplifier is, on the other hand, one in which the grid voltage changes are applied simultaneously to two valves, not one and the earth, and connected so that increasing grid voltage on one valve is accompanied by decreasing grid voltage on the other valve. The resulting plate current changes, which are opposite in direction for the both valves, are passed through an output coupling device in such a way that their effects are added together. One valve tends to push plate current through the coupler while the other tends to pull it in the same direction, this action accounting for the name of the amplifier.



This sketch illustrates in a general manner how a push-pull amplifier functions.

Let us now look at the component parts of a push-pull amplifier. There are two valves instead of one, and two transformers. We notice that these transformers are slightly different from the ordinary. The first transformer, known as the input, has a centre tap which is connected to grid bias, or what we might, for the time being, regard as earth, as far as high frequency current is concerned. The second transformer (output) likewise employs a centre tapped coil, but this time it is primary, and this centre connection is made to "B+" potential. Let us follow the movement of the electrons.

In the first case we get a surging backward and forward in the primary of the input transformer. This is picked up in the secondary, but, instead of surging taking place from the one extremity to another, it takes place from the extremities to the centre tap. Thus while the electrons are piling up on the grid of the valve, there is a deficiency of them on the grid of the other valve. When the cycle is reversed the high pressure of electrons on the first valve eases off by their passing to earth, but there is a pile of electrons on the valve which previously had a deficiency. Thus the grid voltage rise and fall in the second valve is always opposite to the rise and fall in the first valve.

We know from our study of the valve itself that each alteration in the potential on the grid of a valve is magnified in the plate circuit. Thus, while the electrons are piling up on the grid of one valve, the flow of the electrons from the plate is being restricted. Electrons are negative and tend to inhibit the flow of current from the plate to the filament. When the grid becomes less negative more current flows in the plate circuit.

Now as the valves are "out of phase" we will find that in one plate circuit the high frequency current is flowing one way, while in the other it is the reverse. If we can connect these two plate currents we get a continuous pulsation, and the effect of this can be seen from the diagram. The outputs from the plates of the two valves combine in the split primary of the output transformer, and their combined energy passes to the secondary of the output transformer. In a general way we have now explained how push-pull amplification takes place. Let us see some of the practical factors involved:

Push-pull amplification implies—

1. That the amplifier is able to handle

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