Combining Crystal and Valve

"Cathode" describes some Ingenious Circuits

READERS will remember that the last article in this series closed with a somewhat scanty introduction to the "Sharman" circuit. One feature of this circuit which renders it valuable in some circumstances is that it does not follow strictly the square law which operates in the case of the crystal rectifier more normally connected.

That is to say, when input is halved, the signal strength is not reduced to one quarter as with the normal crystal detector, but falls more in accord with the input. Thus the circuit is particularly useful when signals are on the weak side. It is fairly well-known that, with very weak signals, it is not much use adding audio amplification after a crystal detector. With the Sharman system of connection, however, audio amplification is very effective even with weak signals, so that it is actually possible to increase the range of the receiver by adding audio amplification.

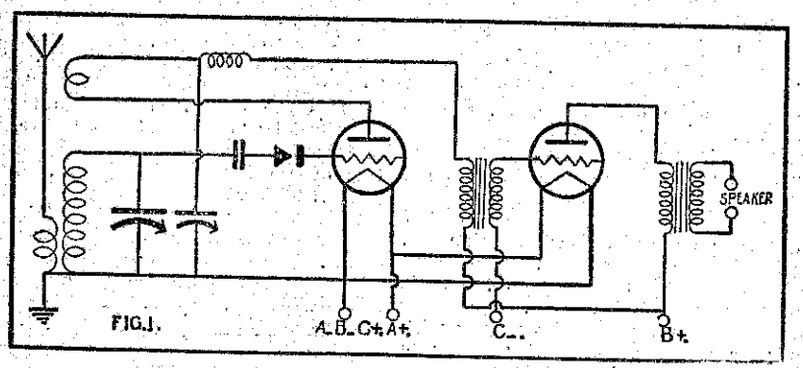


FIG.1.

An Ingenious Circuit.

THIS is only half the story, however. The simple Sharman circuit previously published has been redrawn in Fig. 1 in a rather more elaborate form, and if reference is made to this it will be seen that there is no obstacle to radio-frequency currents between the output of the crystal rectifier and the grid of the first audio amplifying valve. Thus, any radio frequency currents present in the output of the crystal rectifier will necessarily be applied to the grid of the following valve.

Now this is a very important point. It can be taken for granted that radio-frequency currents will be quite strong in the output of the crystal, as no rectifier is perfect and there is only a minute by-pass available for such currents. So the first valve will obviously amplify the radio-frequency currents as well as those at audio frequencies. The amplified r.f. currents will be in phase with those in the tuning coil and it readily occurs to one that it would be a good idea to feed back these amplified currents by means of a coil variably coupled to the tuning coil so as to boost up the incoming signals.

Thus we have a kind of reaction circuit. Reaction is very valuable in any receiver as a means of reducing the effect of damping. And as damping is very pronounced in any circuit employing a crystal rectifier, reaction is correspondingly more valuable in eliminating its effect. Just try this Sharman circuit on long-distance work and see what you think about it yourself.

Winding the Coil.

THE exact arrangement of the reaction circuit is largely a matter of individual preference. Anyone who possesses one of the old three-coil tuners with variable coupling between the tuning and reaction coils will be able to try out this circuit very readily, using the coupling between coils as a reaction control. Alternatively, the reaction coil could be wound on a revolving former housed within the tuning coil after the fashion of the old type of Browning-Drake regenaformer.

The circuit shown in fig. 1 is actually a modified Schnell circuit employing condenser control for the reaction, which has the advantage of being very smooth and easy to handle. A special coil assembly is used and this may conveniently be wound on a former having an outside diameter of three inches, with a length of about five inches. The tuning coil, comprising 50 turns of 24 d.c.c., will occupy about two inches in the centre of the former, while the reaction and aerial coils may each be of about 30 turns of the same or finer wire wound one on each side of the tuning winding and spaced from it about one-eighth of an inch. The tuning winding mentioned (50 turns) is intended for use with a .0005 mfd. tuning condenser, but a .0003 or .00035 condenser may be used if the number of turns is increased to 60. The reaction condenser should be of .00025 mfd. or any larger size.

The small condenser preceding the crystal detector is of great importance in this circuit. What is required is a very small fixed condenser. Unfortunately, the smallest fixed condenser obtainable commercially is of .0001 mfd. and, although this is usable, a smaller condenser is desirable. One way out of the difficulty is to use a midget variable condenser such as is used for neutralising. Another solution is to make a minute fixed condenser, this being readily done by overlapping two lengths of insulated wire an inch or so and binding or twisting them tightly together. The remainder of the lengths of wire can, of course, be usefully employed in making the necessary connections.

Choosing a Crystal.

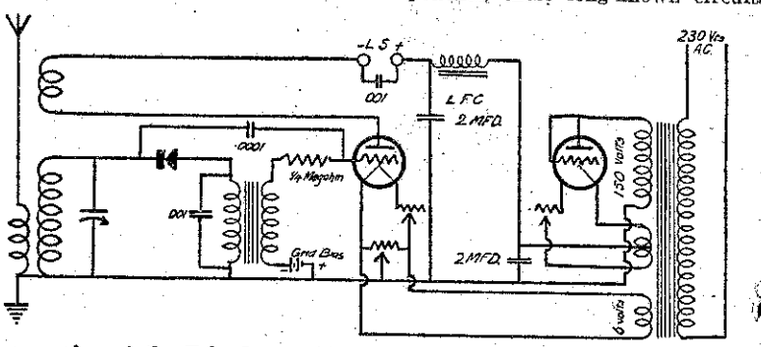
THE remainder of the circuit scarcely needs any explanation. An output transformer is shown in the diagram as, in its modest way, this little receiver is essentially a "quality" receiver and the output transformer, by keeping the plate current out of the speaker windings, assists in maintaining an absence of distortion. However, this component can quite well be omitted if its inclusion is inconvenient.

The crystal detector can be of any recognised type, although the permanent and semi-permanent detectors are a considerable advantage in any valve-crystal combination. The carborundum detector is a very happy choice in this particular circuit, in which it is free from its chief disadvantage, namely, the necessity of providing a 0.7 volt biasing potential to realise proper sensitivity. It is difficult to see exactly why the biasing potential should be unnecessary in this circuit, but there is no doubt about this being the case.

The "Trinadyne"

THE next circuit to which reference must be made is known as the "Trinadyne," in which some readers will recognise a doughty performer of other days.

It is a fact often overlooked that, given the aid of modern and efficient components, these long-known circuits are capable of giving quite surprising results. When the Trinadyne first saw the light of day, the valve having a suitable impedance (6000 ohms or thereabouts) were hampered by amplification factors of about 3 or 4. The difference which a modern valve of similar impedance but having an amplification factor of 15 or 16 will make can readily be imagined.



An a.c. version of the Trinadyne, which readers will recognise as the "crystal and valve with three-valve performance," first published two years ago.

Theoretical Discussion.

IN the "Trinadyne" the application of r.f. currents to the grid of the valve, which occurs almost automatically in the Sharman circuit, is deliberately brought about by by-passing the