

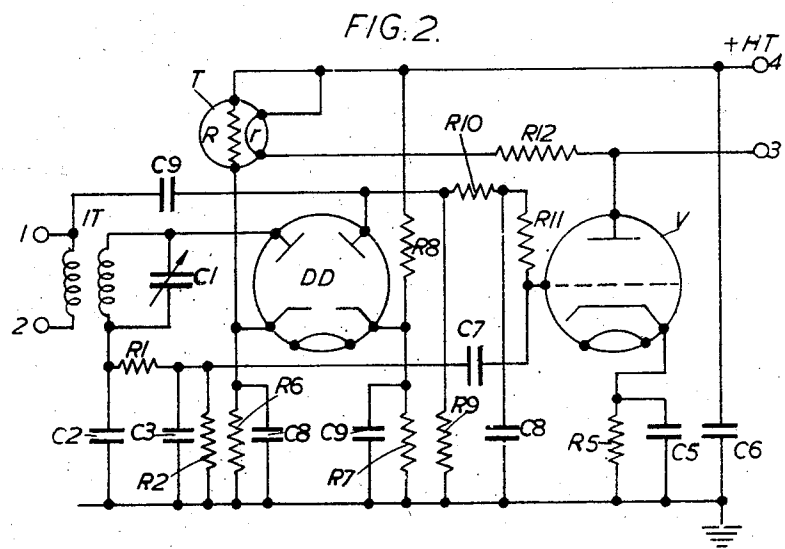
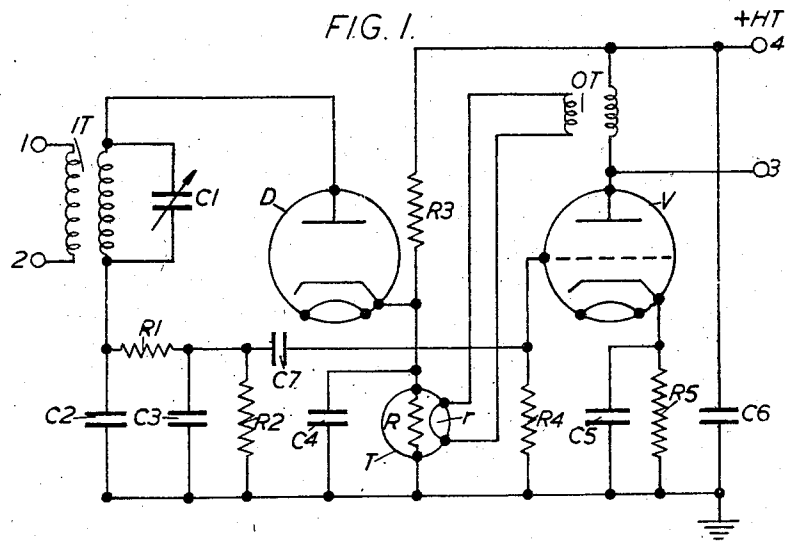
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THERMIONIC VALVE RECEIVING CIRCUIT

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THERMIONIC VALVE RECEIVING CIRCUITS

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The present invention relates to improvements in radio receivers, and in particular to arrangements for rendering such receivers quiescent when no signals are being received. The invention employs for this purpose thermally sensitive resistance devices known as thermistors.

Thermistors have been in use for some years and are characterised by a temperature coefficient of resistance which may be either positive or negative and which is moreover many times the corresponding coefficient for a pure metal such as copper. This property renders thermistors particularly suitable for a variety of special applications in electric circuits.

Various different materials are available for the resistance element of a thermistor, these various materials having different properties in other respects; as one example, a resistance material having a high negative temperature coefficient of resistance comprises a mixture of manganese oxide and nickel oxide, with or without the addition of certain other metallic oxides, the mixture being suitably heat treated.

Thermistors have been employed in two different forms: (a) known as a directly heated thermistor and comprising a resistance element of the thermally sensitive resistance material provided with suitable lead-out conductors or terminals, and (b) known as an indirectly heated thermistor comprising the element (a) provided in addition with a heating coil electrically insulated from the element. A directly heated thermistor is primarily intended to be controlled by the current which flows through it and which varies the temperature and also the resistance accordingly. Such a thermistor will also be affected by the temperature of its surroundings and may therefore be used for thermostatic control and like purpose with or without direct heating by the current flowing through it. An indirectly heated thermistor is chiefly designed to be heated by a controlling current which flows through the heating coil and which will usually, but not necessarily, be different from the current which flows through the resistance element, but this type of thermistor may also be subjected to either or both of the types of control applicable to a directly heated thermistor.

More detailed information on the properties of thermistors will be found in an article by G. L. Pearson in the Bell Laboratories' Record December 1940, page 106.

In radio receiving sets it is sometimes the practice to provide means for reducing the sensitivity or gain of the receiver when no signals

are being received so that the set is quiet during these periods. This is commonly done by negatively biasing the grid of a valve in the circuit so that this valve is substantially cut-off. As soon as signals of reasonable or predetermined strength are received this bias is overcome and the valve then amplifies normally. The objection to this method is that it introduces distortion.

By the adoption of a thermistor according to the present invention this arrangement may be employed without the introduction of distortion to the received signals.

According to the invention, therefore, there is provided a radio receiving arrangement comprising an indirectly heated thermistor, the resistance element of which is associated with the cathode of a thermionic valve in such a manner that the said valve is substantially blocked except when signals having a level exceeding a predetermined level are received.

The invention will be better understood from the following detailed description of embodiments with reference to the accompanying drawing in which:

Fig. 1 shows a schematic circuit diagram of part of a radio receiver embodying the invention; and

Fig. 2 shows a schematic circuit diagram of another arrangement according to the invention.

In Fig. 1 there is shown a detecting diode valve D and the following amplifier valve V. Signals are applied to the diode D through the input transformer IT the secondary winding of which is tuned by the condenser C1. The cathode of the diode D is biased positively from the high tension supply, which is connected to terminal 4, by means of the potentiometer comprising a constant resistance R3 and the resistance element R of an indirectly heated thermistor T, shunted by the usual by-pass condenser C4. The rectified signals are obtained across the load resistance R2 which is in series with the diode, and in front of this resistance is a circuit R1, C2, C3 for by-passing the high frequency so that it is substantially excluded from R2. The rectified signals appearing across R2 are applied to the grid of valve V through the blocking condenser C7 across the grid resistance R4. The cathode of the valve V is biased positively in the usual way by the resistance R5 provided with a by-pass condenser G5. The plate of valve V is connected to the high tension terminal 4 through the primary winding of a transformer OT and the output from the valve V is taken to the next stage (not shown) from terminal 3

which is connected to the plate. C6 is a by-pass condenser for the high tension supply. The secondary winding of transformer OT is connected to the heating coil *r* of the thermistor T.

When no signals are arriving through the input transformer IT, the resistances R and R3 are chosen so that the cathode of the diode D is given a suitable positive potential. Accordingly signals at a low level are unable to overcome this potential and no effect is produced. When however, signals at a level high enough to overcome this positive potential are received the diode begins to rectify and a rectified voltage is obtained across the resistance R2. This is amplified in the valve V and some of the amplified current is transmitted through the transformer OT and heats the thermistor T. The thermistor is chosen to have a negative temperature coefficient of resistance, and accordingly its resistance decreases and reduces the positive potential applied to the cathode of the diode D. This will, in turn, increase the signal current amplified by the valve V which will still further reduce the potential of the cathode. The arrangement will finally stabilise at a suitable point determined by the chosen values of the resistances R and R3, and the incoming signals will then be amplified without distortion because they no longer have to overcome a large cathode potential. So long as these signals are continuously received the thermistor will not cool appreciably and so the operating conditions of the diode D will remain substantially constant. As soon as the signals cease the thermistor will cool and the diode will again ultimately be cut off.

The circuit shown in Fig. 1 differs from a well known circuit only in that the resistance R is a thermistor element and not a constant resistance and also in the provision of the transformer OT for heating the thermistor.

It should be explained that substantially the same results can be obtained with a thermistor having a positive temperature coefficient of resistance if the resistances R and R3 are interchanged. It can be seen that in this case when the incoming signals begin to heat the thermistor the resistance R will increase and will reduce the potential applied to the cathode of the diode, as before.

An alternative arrangement according to the invention is shown in Fig. 2. In this case the changes of resistance of the thermistor are brought about through the changes in the plate current of the amplifying valve controlled by an automatic volume control voltage but the principles of operation are otherwise the same as in Fig. 1. In Fig. 2 the diode is replaced by a double diode DD which comprises two separate cathodes and two separate plates in the same envelope. If preferred, of course, two separate diodes could be used instead.

The left-hand cathode and plate of the diode DD are employed in a similar manner to the diode D in Fig. 1, and are connected in series circuit with the input transformer IT and the diode load R2, the by-passing arrangement R1, C2, C3 being the same as before. The left-hand cathode is biased positively by means of a potentiometer circuit connected across the high tension supply comprising a constant resistance R6, connected this time at the low potential end, and the resistance element R of an indirectly heated thermistor T. C8 is the by-pass condenser for R6. The right-hand cathode and plate of the diode DD are provided for the purpose of obtaining an auto-

matic volume control voltage from the signal. For this purpose the right-hand plate is connected to the input terminal 1 through the blocking condenser C9, and also to the control grid of the valve V through resistances R10 and R11, and to earth through resistance R9. The condenser C8 together with resistance R10 provides a by-passing arrangement for the high frequency. The incoming signal voltage supplied through the condenser C9 produces a negative potential at the control grid of valve V, which potential increases as the signal level increases. This biases the valve V so that the plate current and the gain of the valve are simultaneously reduced when the signal level increases. The plate of the valve V is supplied with high tension from the terminal 4 through the anode load R12, and also through the heating coil *r* of the thermistor T. Thus when no signals are being received the plate current of the valve V will be large so that the thermistor will be hot. If it is chosen to have a negative temperature coefficient of resistance, the resistance R will be low so that the positive potential of the left-hand cathode of the diode DD will be large and this part of the diode will be substantially cut-off. As soon as incoming signals of appreciable level are received the plate current of the valve V will be reduced and the thermistor will cool thus reducing the potential applied to the left-hand cathode of the diode DD, and the left hand portion of the diode will become unblocked in the same way as before.

It will be noted that the thermistor T and the corresponding series constant resistance are respectively reversed in Figs. 1 and 2. This is because in Fig. 1 an increase in signal level produces an increase in the current which heats the thermistor whereas in Fig. 2 it produces a decrease.

It will be evident that by interchanging the positions of the resistances R and R6 in Fig. 2 a thermistor having a positive temperature coefficient of resistance can be used.

It may be pointed out that while in Fig. 1 the thermistor resistance is controlled by the speech signals themselves after demodulation, in Fig. 2 it is controlled by a volume control voltage derived from the incoming signal wave.

What is claimed is:

1. Radio receiver quiescent circuit including a diode, means for feeding received signals thereto, means for biasing said diode to a predetermined potential whereby blocking occurs and only signals exceeding said potential can pass through said diode, an amplifier valve having the input thereof connected to the output of said diode and means acting to reduce said predetermined potential when said signals exceed said potential, said last means including a thermistor having a heater and a resistance, a fixed resistor, means connecting said thermistor resistance and said fixed resistor in series with the means determining said potential and means coupling said heater to the anode circuit of said amplifier valve for transferring heating power current from said anode circuit to said heater in proportion to the anode current of the amplifier valve.

2. Circuit according to claim 1, in which the resistance of said thermistor and said fixed resistor are connected in series across a source of potential supplying said anode circuit, the cathode of said diode is connected to the common junction of said resistance and said fixed resistor, and the anode of said diode is connected via a load resistor to the negative terminal of said

potential source, whereby passage of current through said diode causes current to flow through said anode connection, heat said thermistor and thereby reduce the blocking potential applied to said diode.

3. Circuit according to claim 1, in which said anode connection comprises a transformer having the primary thereof connected in series with said anode and the secondary connected to the heater of said thermistor.

4. Circuit according to claim 1, in which said connection from said heater is made so as to place said heater directly in series with the anode of said amplifier valve, and also including a second fixed resistor also in series with said heater and said anode.

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