May 26, 1931. H. A. GATES 1,806,796

POWER CIRCUIT CONTROL FOR RADIO RECEIVING SYSTEMS

Filed Feb. 13, 1928

Fig. 1

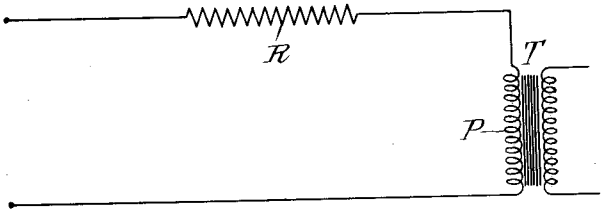


Fig. 2

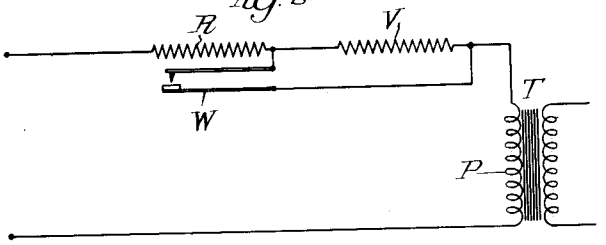


Fig. 3

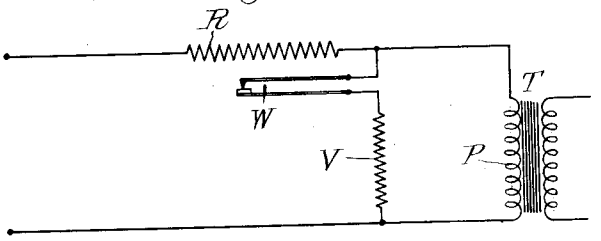
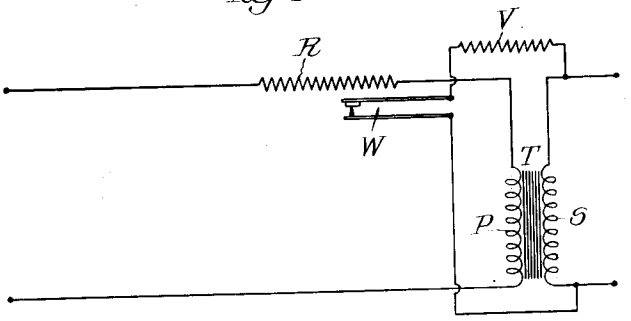


Fig. 4



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UNITED STATES PATENT OFFICE

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POWER-CIRCUIT CONTROL FOR RADIO RECEIVING SYSTEMS

Application filed February 13, 1928. Serial No. 254,094.

This invention relates to power-operated radio receiving systems, and more particularly concerns the control of the power or line circuit.

In power-operated receiving systems, where a fixed resistance is placed in the power circuit to reduce and automatically regulate the current delivered to the primary coil of the power transformer, the initial input of line voltage is only slightly reduced or cut down by the cold resistor, with the result that the transformer is subjected to an undesirably high initial E. M. F. and, until the heating of the resistor has sufficiently increased the resistance, it would be dangerous to subject the delicate elements of the receiving system to the high voltages thus delivered by the secondary coils of the transformer. It is desirable, therefore, in such arrangements, after connecting the power or line circuit, to wait for a time before connecting the receiving circuits, until the resistor has heated sufficiently to develop the proper resistance to lower the current in the transformer to a safe operating degree. The object of this invention is to provide a device which will operate automatically to take care of this initial condition.

In the drawings:

Figure 1 is a diagrammatic view of the power or line circuit connection, illustrating the series arrangement of the resistance element and the primary coil of the transformer;

Fig. 2 is a view similar to Fig. 1, showing one method of applying the present invention; and

Figs. 3 and 4 are views similar to Fig. 1, showing two other methods of applying the present invention.

It is well known that the voltage of public service power circuits varies considerably in different localities and under various circumstances and conditions, circuits rated at 110 volts varying sometimes between 90 and 130 volts, and it is also known that, in circuits of the character here concerned, these variations may be very substantially counteracted and regulated by the automatic action of a resistor or "ballast-coil", the heating and corresponding resistance of which varies with the variations of voltage in the power circuit. While the resistor or ballast-coil constitutes a very satisfactory regulator as soon as a critical temperature has been reached, an appreciable length of time must elapse in raising its temperature to this degree. Accordingly, it may be stated at the outset that this invention is not concerned with modifying the automatic voltage-regulating action of the resistor after working circuit conditions have become established, but is designed to act in the introduction or establishment of such working circuit conditions, acting to control the initial E. M. F. delivered by the power transformer, and being thrown and held out of action automatically upon, and simultaneously with, the establishment of such working circuit conditions. It is to be understood that the drawings are diagrammatic and the ratings employed in the following description, while approximately correct, are used for illustrative and explanatory purposes only.

Referring, now, to Fig. 1, it will be seen that the resistance element R is arranged in series with the primary coil P of the transformer T. The element R may be an ordinary inductive or non-inductive resistance coil (an open coil of wire which will not readily oxidize is very efficient, sturdy, and durable) across the terminals of which the voltage drop increases materially as the heating of the coil reaches a critical temperature, at which critical temperature fluctuations in the voltage of the line circuit will effect corresponding changes in the degree of resistance offered by the coil and thus produce an automatic regulation of the E. M. F. in the circuit passing through primary coil P. Assuming that a 110-volt power or line circuit is to be used and that the ratio of the resistances of the coils R and P is such that, when working circuit conditions have become established, the average voltage drop across the hot coil R will be 40 volts and the voltage drop across coil P will be 70 volts, it will be seen that, upon first closing the power circuit, the coil R will be cold and the resistance thereof will be much lower. With

such an arrangement, the initial voltage drop across the cold resistor R will be approximately 10 volts, and that across primary coil P will be approximately 100 volts. As the coil R heats and the resistance thereof increases in ohmic value, this initial voltage drop of 100 volts across primary coil P will be correspondingly reduced until, when the aforesaid working circuit conditions have become established, the voltage drop across primary coil P will be approximately 70 volts, that across the hot resistance coil R then continuing at approximately 40 volts and varying with fluctuations in the voltage of the power circuit, thus acting to regulate and stabilize the E. M. F. acting upon the primary coil P. It is undesirable, for many reasons unnecessary to mention here, to subject the transformer to the high initial voltage and to the wide voltage variations mentioned.

In Fig. 2, the present invention is shown embodied in the provision of a second resistance element V, interposed in the power or line circuit and arranged therein in series with the resistance element R and primary coil P of the transformer T. A shunt circuit path around element V is controlled by a thermostatic switch W, which is subjected to, and controlled in operation by, the heat radiated from element R. With this arrangement, the switch W is normally open and the resistance of element V is such that the voltage drop thereacross will be approximately 40 volts. Now, upon first closing the power circuit, the voltage drop across element V will be 40 volts, that across the cold resistor R will be 10 volts, and that across primary coil P will be 60 volts. As coil R heats and the resistance thereof increases, the initial voltage drop of 60 volts across primary coil P will be correspondingly reduced until, when the aforesaid critical temperature of coil R has been reached, the voltage drop across coil R will be approximately 40 volts and that across primary coil P will be approximately 30 volts. At this point, the heat from coil R will effect the closing of the thermostatic switch W and resistance element V will be cut out of circuit, thus raising the voltage drop across coil P to approximately 70 volts, and the aforesaid working circuit conditions will have been established without subjecting the transformer T to the aforesaid undesirable high initial E. M. F.

In the alternative embodiment of the invention shown in Fig. 3, the element V is arranged so that it constitutes a shunt resistance, being connected across the leads or terminals of primary coil P through the thermostatic switch W. Switch W is arranged here, as in Fig. 2, so that it is subjected to the heating effect of coil R and is automatically controlled in action thereby, but in this arrangement, the switch W is normally closed, and shunt resistance V is thereby connected to draw additional amperage through resistance R, thus providing for a substantial increase in the initial current flow. As compared with the arrangement shown and described in connection with Figs. 1 and 2, this arrangement of element V, in providing for the aforesaid increase in the initial amperage, increases the initial voltage drop across the cold resistor R from 10 to approximately 30 volts and also accelerates the heating of resistor R. With this arrangement, upon first closing the power circuit, the voltage drop across the cold resistor R will be approximately 30 volts and the voltage drop of 80 volts which would otherwise be carried across primary coil P will be divided between coil P and shunt resistance V. Assuming, for example, that the resistance offered by the two elements P and V are equal, the voltage drop across each will be 40 volts. Of course, the resistance ratio of elements P and V may be calculated differently, according to the results desired or required.

Still continuing with the construction of Fig. 3, when the heating of coil R has increased the voltage drop thereacross to approximately 50 volts and the drop across elements P and V has been thereby reduced to approximately 30 volts each, the hot coil R will effect the opening of thermostatic switch W and throw the shunt resistance V out of circuit. At this point, with the voltage drop of 50 volts across resistance R and with shunt resistance V out of circuit, the voltage drop across primary coil P will be 60 volts, and the reduction in the power circuit amperage effected by the disconnection of shunt resistance V will cause the voltage drop across resistance R to settle back to its normal circuit-regulating rating of 40 volts, and the working circuit conditions will have been established.

Fig. 4 illustrates a still different arrangement of the present invention. The power or line circuit connection is the same as shown in Fig. 1 and the element V is again arranged so that it constitutes a shunt resistance. In this case, however, element V is connected across the leads or terminals of the secondary coil S through the thermostatic switch W. Switch W is normally closed and is subjected to, and controlled in operation by, the heat radiated from resistor R, so that, while the initial voltage drop across primary coil P may be the same as that described in connection with the circuit arrangement of Fig. 1, the correspondingly high and undesirable initial E. M. F. which would otherwise be induced in the secondary coil S is here prevented by the action of the connected shunt resistance V, which remains in circuit with coil S until the hereinbefore described critical

temperature of resistor R has been reached and working circuit conditions have been established thereby, at which point the thermostatic switch W will be opened in the manner already described and shunt resistance V thrown out of circuit. In this arrangement, the ohmic value of the shunt resistance element V will be calculated upon the initial E. M. F. induced in the secondary coil S, but its circuit connection therewith will be controlled by the resistor or ballast-coil R in the power or line circuit connection.

I claim:

1. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections, a transformer having input and output circuits, the input circuit of which is connected with said power circuit connections, a resistance element in the connection of said input circuit with said power circuit connections, a circuit-controlling device thermostatically controlled in operation by said resistance element, and a circuit path connected with said device and acting under the control thereof to control the output of said transformer.

2. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections, a transformer having input and output circuits, the input circuit of which is connected with said power circuit connections, a resistance element in the connection of said input circuit with said power circuit connections, a circuit-controlling device thermostatically controlled in operation by said resistance element, and a circuit path connected through said device with one of the circuits of said transformer, whereby the current flow in the output circuit of said transformer will be varied by the action of said resistance element upon said circuit-controlling device.

3. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections and a power circuit transformer connected therewith, a first resistance element in the power circuit connection with said transformer, a second resistance element normally connected in circuit with said first resistance element, and a thermostatic switch controlled in operation by said first resistance element and controlling the connection of said second resistance element.

4. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections, a transformer having input and output circuits, the input circuit of which is connected with said power circuit connections, a first resistance element in said input circuit, a second resistance element normally connected in said input circuit, and a thermostatic switch controlled in operation by said first resistance element and controlling the connection of said second resistance element.

5. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections and a power circuit transformer connected therewith, first and second resistance elements connected in series arrangement in the power circuit connection with said transformer, and means operating under the thermostatic control of said first resistance element to control the connection and disconnection of said second resistance element.

6. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections and first and second resistance elements in series arrangements therein, and a thermostatic switch controlled in operation by said first resistance element and acting to disconnect said second resistance element from said power circuit connections.

7. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections, first and second resistance elements and an induction coil connected in series with said power circuit connections, and a thermostatic switch controlled in operation by said first resistance element and operating to control the circuit connection of said second resistance element.

8. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections, first and second series connected resistance elements and an induction coil in circuit with said power circuit connections, and a thermostatic switch controlled in operation by said first resistance element and operating to control the circuit connection of said second resistance element.

9. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections, first and second resistance elements and an induction coil connected in series with said power circuit connections, a thermostatic switch controlled in operation by said first resistance element, and a shunt circuit path connected across the terminals of said second resistance element and controlled by said switch.

10. Circuit-controlling means for a power-operated radio receiving system comprising power circuit connections and a power circuit transformer connected therewith, a ballast-coil in the power circuit connection with said transformer operating at a critical temperature to regulate the current passing through said transformer, a resistance element and a shunt circuit path associated therewith, and a thermostatic switch operating to control the connection of said re-

sistance element by controlling said shunt circuit path and operated by the heat radiated by said ballast-coil when said critical temperature thereof has obtained.

In witness whereof, I have hereunto subscribed my name this 10th day of Feb., A. D. 1928.

HOWARD A. GATES.