

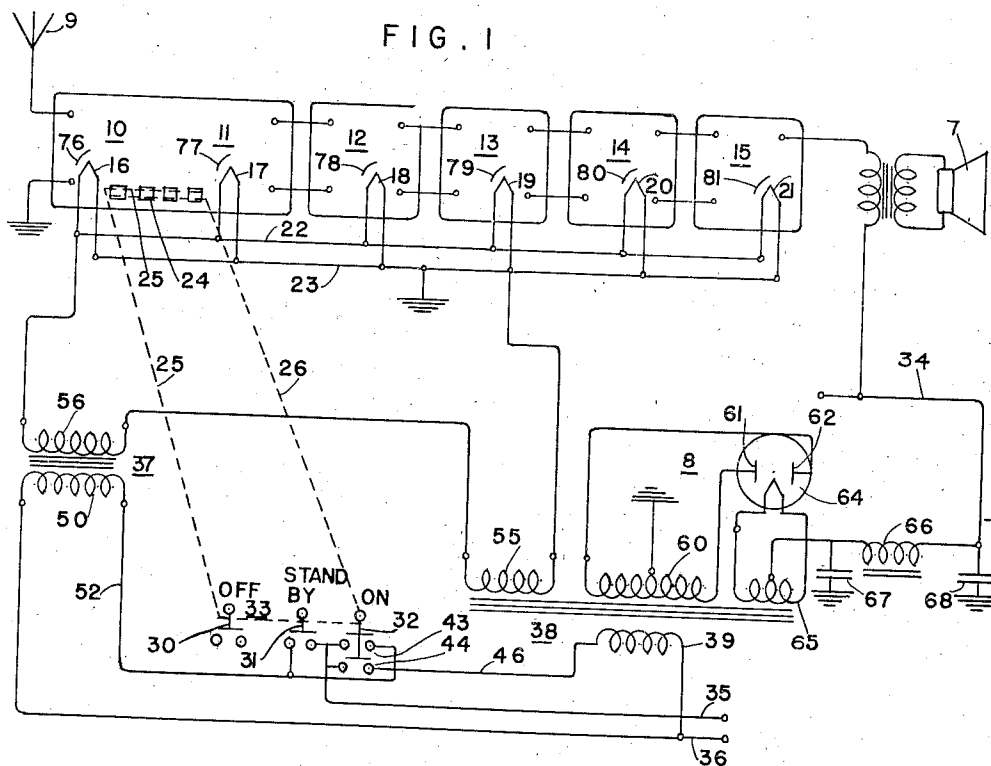
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CONTROL ARRANGEMENT FOR DISCHARGE DEVICES

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CONTROL ARRANGEMENT FOR DISCHARGE DEVICES

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This invention relates to control apparatus for an electron discharge device having a cathode which assumes its normal operating temperature a relatively long time after it is heated initially.

In radio receivers and transmitters wherein the electron discharge devices have indirectly heated cathodes, a relatively long period of time is required to bring such cathodes up to correct operating temperature after the receiver or transmitter is energized with current from an operating source. It is desirable to make such period of time as short as possible so that an operator need not wait a relatively long period of time after closing the power switch before he is able to tune or adjust the radio apparatus.

It is not an uncommon occurrence for people to close the power switch of a radio receiver, then walk away from the receiver and then later hear loud and objectionable sounds or blasts emanating from the receiver as soon as the cathodes in the discharge devices in the receiver have been heated to their normal operating temperatures. Such occurrences are not only objectionable to people in the near vicinity but also detract much from the listening pleasure of the operator. In those instances where the operator is cautious, he must wait a relatively long period of time at the receiver and attentively wait for the cathodes of the discharge devices to come up to substantially normal operating temperature before he leaves the vicinity of the receiver. This, of course, not only consumes some time but also requires some attention, however slight, by the operator, and in some cases is the determining factor whether the receiver is turned on or left inoperative. It is therefore an object of this invention to provide improved apparatus for causing radio apparatus to be operative for normal reception or transmission of signals within a negligible time after the power switch to the radio apparatus is closed, such time interval preferably being in the order of two or three seconds.

Moreover, when the power switch of a conventional radio receiver or transmitter supplied with power from an alternating current source is closed, relatively large surge voltages, dying down to somewhat smaller steady stage voltages, exist across condensers in the rectifying circuit and receiving circuit proper until the cathodes of the discharge tubes come up to normal operating temperature, in which case the resulting conductivity of the discharge devices causes a current flow and consequent lowering of the voltages throughout the rectifying circuit and receiving circuit proper. Since such condensers must not only withstand

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normal operating voltage stresses but also these transient voltage stresses when the power switch is moved from its "off" position to its "on" position, such condensers are in some instances relatively large and relatively expensive. Another object of the present invention is to provide improved control apparatus for circuits including discharge devices such that circuit elements in such circuits are not subjected to unduly large transient stresses when the circuit is connected to a power supply for signal reception.

When a receiving or transmitting circuit having electron discharge devices of the heater cathode type is connected to its power supply, the cathodes and their heaters not only become hot but also expand due to their coefficients of expansion, and, of course, contract when the power supply is disconnected. Switching on and off such a receiving or transmitting circuit not only changes the electron emission of the cathode but also causes motion of the cathode and its related parts. When the cathode and its heater are not subjected to such large temperature gradients their relative movements are reduced and the overall life of the cathode is increased. Another object of the present invention is to provide a control arrangement for circuits including electron discharge devices of the heated cathode type in which the cathode and its heater are not subjected to large differences in temperature when the circuit is changed from its operative condition to its inoperative condition.

Also, in a receiver or transmitter wherein good frequency stability is desired after the receiver or transmitter is connected to an operating source of potential, it is desirable that the cathodes of discharge devices in such receiver or transmitter be preheated so that changes in operating frequency are minimized.

Still another object of this invention is to provide an improved control arrangement for receiving or transmitting circuits having an "off" position, a "standby" position and an "on" position.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. This invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which the single figure shows a radio receiving circuit controlled in accordance with the present invention.

The present invention relates to a circuit including electron discharge devices having heated cathodes, such as indirectly heated cathodes or filamentary cathodes, and for purposes of illustration the invention is shown in relation to a radio receiver of the amplitude modulation type, it being understood, however, that this invention may be used in other circuits with an electron discharge device having a heated cathode; for example, the present invention may be applied to transmitter circuits, cathode ray tube circuits, thyratron tube circuits, et cetera. By the term "heated cathodes" throughout this specification it is realized that such term includes indirectly heated cathodes and filamentary types of cathodes which have heating current passing there-through.

The figure shows an arrangement for heating the cathodes of discharge devices in a pushbutton tuned radio receiver which may be operative for suitable reception of high frequency signals received on antenna 9 a short time after the heaters for such cathodes are energized with normal current.

In the figure is shown a radio receiver of the superheterodyne type including, in cascade, a radio frequency amplifying stage 10, a pentagrid converter or oscillator-modulator stage 11, an intermediate frequency amplifying stage 12, a detecting stage 13, an audio amplifying stage 14, and an audio power amplifying stage 15. Each of such stages includes electron discharge devices having cathodes of the indirectly heated type and being supplied with space current from a common voltage source 8. It is understood that the cathode of such devices may be of the indirectly heated cathode type or of the directly heated heavy filamentary cathode type which heats up slowly to suitable electron emission temperature after normal voltage is applied to the terminals of such heaters or cathodes.

The present invention relates particularly to circuit arrangements for heating the cathodes of those devices such that the cathodes emit sufficient electrons within a very short time, such as two or three seconds, after it is desired to change the radio receiver from inoperative condition to a condition operative for satisfactory reception of signals.

The figure shows a receiver arranged to receive modulated waves on antenna 9 and to reproduce signals corresponding to such modulation in reproducer or speaker 7. The receiver is of the pushbutton tuned superheterodyne type, including variably tuned circuits in a radio frequency amplifying stage, and in the frequency converter or oscillator-modulator stage 11. The tuned circuits, tuned at predetermined frequencies, are inserted by actuating one of a series of pushbuttons 24 in conventional manner.

The fixed frequency output of the oscillator-modulator or frequency converter stage 11 is amplified through a fixed frequency intermediate frequency amplifier 12, and the modulating components of the signal are detected in detector 13, and such modulating components separated from the carrier wave are amplified in the audio amplifying stage 14 and 15 and then applied to speaker 7, so that speaker 7 reproduces those modulating components of a broadcast frequency to which the receiver is tuned by connecting suitable reactances in the stages 10 and 11 by means of one of a series of pushbuttons 24 in conventional manner.

The series of pushbuttons 24 is, in conventional

manner, latched together by means of a common latch bar 25 so that only one of the pushbuttons 24 is in operative position at any one time. In accordance with the present invention, latch bar 25 serves also to hold in latched position one of a series "on," "off" and "standby" pushbutton switches 30, 31 and 32, respectively, in a manner shown in the drawing and more fully described in the copending application of Robert T. Thompson, Serial No. 524,555, filed on even date herewith and assigned to the same assignee. Also, as shown herein and in the copending application, link member 26 extends from the series of pushbuttons 24 to the "on" pushbutton 32 so that the composite radio receiver is made fully operative when any one of the series of tuning pushbuttons 24 is depressed.

The voltage source for supplying space current to the discharge devices in the receiver comprises alternating current rectifying apparatus having the general reference numeral 8. The positive terminal of such apparatus is connected to lead 34 of positive continuous voltage through which the entire space current flows.

In the figure, the heaters 16, 17, 18, 19, 20 and 21 are each connected in parallel circuit relationship with one another so that the voltage existing across the terminals of one of the heaters is substantially the same voltage existing across each of the terminals of the other heaters. For that purpose, one terminal of each of the heaters is connected to a common conductor 22 and the other terminal of each of the heaters is connected to another common conductor 23.

The apparatus to be described now allows three alternating voltages of different magnitudes to be impressed between the conductors 22 and 23, namely, zero voltage, a normal operating voltage and a relatively small voltage in "standby" operation of the receiver.

Heating current for the parallel connected heaters is supplied from lines 35 and 36, carrying, for example, normal household alternating potential through transformers 37 and 38 when the receiver is fully operative and through transformer 37 alone when the receiver is conditioned for "standby" operation.

The primary winding 39 of transformer 38 has one of its terminals connected to line 36 and its other terminal connected to line 35 through "on" pushbutton switch 32 having a pair of normally open contacts 43 and 44, lead 46 of winding 39 being connected to one of the terminals of normally open switch 44 and the other terminal of switch 44 being connected to lead 35.

The primary winding 50 of transformer 37 has one of its terminals connected to line 36 and its other terminal connected to line 35 either through the "standby" switch 31 or through the "on" switch 32, as the case may be. In particular, lead 52 of winding 50 is connected to one of the terminals of normally open switch 31 and to one of the normally open contacts of switch 43 on "on" switch 32, the other terminals of switches 31 and 43 each being connected to lead 35 so that the voltage appearing across leads 35 and 36 is applied across primary winding 50 when either switch 31 or switch 32 is actuated. Also, when switch 32 is actuated, the voltage appearing across leads 35 and 36 is applied across the primary winding 39 of transformer 38.

As explained previously, pushbutton switches 30, 31 and 32 are latched to the series of tuning pushbuttons 24 through latch member 25 so that only one of the pushbutton switches including

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tuning pushbuttons 24 is held in depressed position at one particular time, with the exception that, due to link member 26, "on" pushbutton 32 may be held in depressed position together with one of the tuning pushbuttons 24.

The secondary winding 55 of transformer 38 is connected in series circuit relationship with secondary winding 56 of transformer 37, the unconnected terminal of winding 55 being connected to common conductor 23 and the unconnected terminal of winding 56 being connected to the other common conductor 22.

When the "on" pushbutton 32 is depressed, the total voltage induced in secondary windings 55 and 56, connected in series aiding relationship, is applied between the common conductors 22 and 23 and full normal operating voltage for suitable operation of the receiving circuit exists across each one of the heaters 16, 17, 18, 19, 20 and 21.

When the "standby" pushbutton 31 is depressed, the primary winding 50 only is connected to lines 35 and 36 and the voltage induced in secondary winding 56 alone is applied to leads 22 and 23, the secondary winding 55 in such case constituting a current path for flow of reduced heater current to heaters 16, 17, 18, 19, 20 and 21, a study of the figure reveals that secondary winding 55 must be so wound as to have, when primary 39 is open circuited, a leakage reactance which is small compared to the resistance presented by heaters 16, 17, 18, 19, 20, and 21, in parallel, while at the same time it must provide, when primary winding 39 is energized, sufficient voltage to bring up the heater voltage from the "stand-by" to the full operating value.

When "off" pushbutton 30 is depressed, of course, the pushbuttons 31 and 32 are released and neither transformer 37 nor transformer 38 is energized and consequently no heater voltage exists between leads 22 and 23.

A suitable continuous potential for the anodes and screen grids of the discharge devices in the radio receiver exists on lead 34 only when pushbutton 32 is depressed, in which position full normal heater voltage exists between conductors 22 and 23. Such continuous potential is developed by rectifying and filtering the alternating potential existing across leads 35 and 36 in a manner described now.

Alternating current voltage induced in center tapped secondary winding 60 of transformer 38 when pushbutton 32 is depressed is applied between the anodes 61 and 62 of a full wave rectifying device 64, one of the terminals of winding 60 being connected to anode 61, the other terminal of winding 60 being connected to anode 62 and the center tap being grounded. The filament type cathode of device 64 is heated by alternating current flowing from center tapped secondary winding 65 of transformer 38 through such cathode when switch 33 is in its "on" position, the ends of winding 65 being connected to opposite terminals of the cathode and the center tap being connected to lead 34 through a conventional filter circuit comprising serially connected filter inductance 66 having one of its terminals grounded through filter condenser 67 and its other terminal grounded through filter condenser 68.

With this arrangement in the figure, lead 34 is of suitable positive potential with respect to ground when pushbutton 32 is depressed and the receiver is operative to reproduce the modulated components of the signal waves impressed on antenna 9.

When "standby" switch 31 is depressed, the po-

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tential of lead 34 is substantially zero with respect to ground and reduced heating current flows through the cathode heaters of the discharge devices in the receiver.

The amount of current which flows through heaters 16, 17, 18, 19, 20 and 21 when standby pushbutton 31 is depressed is such as to cause the receiver to become fully operative in two or three seconds after pushbutton 32 is depressed to release pushbutton 31, it being understood that the cathode of rectifying device 64 is of the filament type and that it comes up to correct operating temperature within such time interval of two or three seconds.

In the figure, when pushbutton 30 is depressed, no heating current flows and the potential of lead 34 is zero.

The arrangement shown in the figure is characterized by the fact that the receiver consumes a relatively small amount of power when pushbutton 31 is depressed, thus allowing a user to maintain his receiver in that condition throughout the day without appreciable power consumption in which condition it is effective to preheat the cathodes 76, 77, 78, 79, 80 and 81 such that the receiver is fully operative for suitable reception of broadcast signals two or three seconds after "on" pushbutton 32 is depressed to release "standby" pushbutton 31.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects, and therefore the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

We claim:

1. In combination, a discharge device having a cathode, a heater for the cathode, a first transformer having a primary winding arranged to be energized from a source of alternating potential and having a secondary winding, a second transformer magnetically independent of said first transformer having a primary winding arranged to be energized from a source of alternating potential and having a secondary winding, said heater together with said secondary winding of the first mentioned transformer and said secondary winding of the second mentioned transformer being serially connected, means for selectively energizing only one of said primary windings, and means for energizing the primary windings of both transformers simultaneously.

2. In combination, a discharge device having a cathode, an anode and a heater, a rectifying device, a first transformer having a high voltage secondary winding connected to the rectifying device when supplying space current between the cathode and anode, a second secondary winding on the first transformer connected to the heater for supplying a current to the heater, a second transformer magnetically independent of said first transformer having its secondary winding connected to supply an additional current to said heater, means for selectively energizing only one of said transformers through its primary winding, and means for energizing said transformers simultaneously through their primary windings.

3. In combination, an electron discharge device including an electrically heated electron source having a pair of filament terminals for the flow of heating current, a pair of magnetically independent transformers each having a primary and secondary winding, a source of alternating po-

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tential, said terminals and said two secondary windings being connected serially, means for selectively energizing only one of said primary windings from said potential source, and means for energizing the primary windings of both transformers simultaneously from said potential source.

4. In combination, an electron discharge device including a cathode, a heater for said cathode, a pair of magnetically independent transformers at least one of which has a primary and a secondary winding and both transformers having input and output terminals, the respective output terminals of each transformer having an output winding therebetween and at least one of said output windings being said secondary winding, a source of alternating potential, said heater and said output windings all being connected serially, means for selectively energizing only one of said transformers from said potential source and means for energizing both of said transformers simultaneously from said potential source.

5. In combination, an electron discharge device including an electrically heated electron source having a pair of filament terminals for the flow of heating current, a pair of magnetically independent transformers at least one of which has a primary and a secondary winding and each of which has input and output terminals, the respective output terminals of each transformer having an output winding therebetween, and at least one of said output windings being said secondary winding, a source of alternating potential, said output windings and said filament terminals being connected serially, means for selectively energizing one of said transformers from said potential source, and means for energizing both of said transformers simultaneously from said potential source.

6. In combination, an electron discharge device including an electrically heated electron source

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having a pair of filament terminals for the flow of heating current, and an anode, a first transformer including a primary winding, a high voltage secondary winding and a low voltage secondary winding, a rectifier device connected to said high voltage secondary winding, said rectifier device being connected to supply operating potential between said anode and said electron source, said low voltage secondary winding being connected to said filament terminals to supply heating current to said electron source, a second transformer magnetically independent of said first transformer having a primary and a secondary winding, said secondary winding being connected to supply heating current to said electron source in addition to that supplied by said low voltage secondary winding of said first transformer, a source of alternating potential, means for energizing only the primary winding of said second transformer from said potential source, and means for energizing the primary windings of both transformers simultaneously from said potential source.

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