

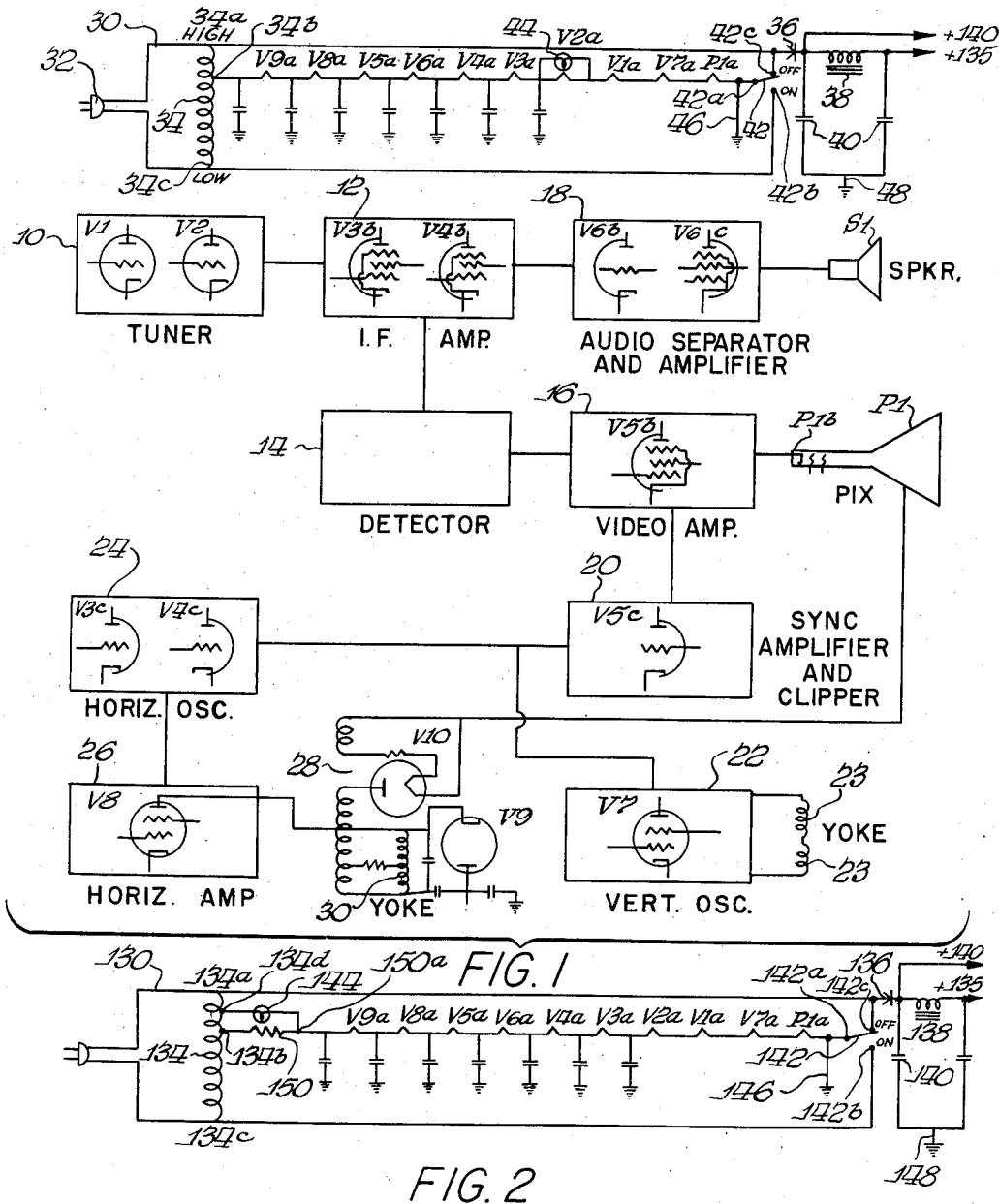
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TV RECEIVER CIRCUIT

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2,872,573

TV RECEIVER CIRCUIT

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7 Claims. (Cl. 250—27)

My invention relates to an improved off-on control circuit for a television receiver which serves to energize the tube heaters at low power level when in the "off" condition.

In a conventional television receiver the tubes, and the heaters for the tubes, are de-energized when the control switch is in the "off" position. As the receiver stands idle, the tube elements fall to room temperature. When the switch is changed to the "on" position full operating voltages are suddenly impressed across the tubes. At this time the tubes heat up to normal operating temperatures.

When the receiver set is turned on after a period of idleness the temperature of the tubes thus increases from the comparatively cool room temperature—say 75° F.—through a wide temperature range to a high operating temperature. The tube elements accordingly undergo substantial thermal expansion. The extent of the expansion varies with the different tube elements because of the different operating temperatures they reach. This sudden expansion, or thermal shock, which is repeated every time the receiver set is turned on, is a major factor in reducing the life of the tubes, as is the similar thermal shock experienced when the set is turned off.

In the present invention the temperature difference of the tubes between the operating and the idle condition of the receiver is greatly reduced by continuously energizing the tube heaters while the receiver set is idle. In brief in, the preferred embodiment shown, the off-on control circuit has an autotransformer across the appliance supply line which may be about 117 volts. The tube heaters—a series string requiring about 80 volts for operation—are connected in series between ground and a tap on the autotransformer. This tap is positioned so that there is a potential of 80 volts between it and the "low" end of the autotransformer, and about 37 volts between it and the "high" end. A single-pole double throw on-off switch selectively connects the grounded end of the series of tube heaters to the "high" or "low" end of the autotransformer. When the switch is connected to the "low" end of the autotransformer the normal heater voltage of about 80 volts appears across the tubes, and normal operation takes place. When the switch is connected to the "high" end of the autotransformer the heaters are subject to about 37 volts and are thus in a warm, but non-operating, condition.

The D.-C. voltage supply for the receiver is interconnected with the off-on switch to be energized when the switch is in the "on" position and de-energized when it is in the "off" position. This voltage supply consists of a rectifier connected to the "high" end of the transformer and thence to ground through the high voltage D.-C. circuits, such as the anode-cathode space paths of the respective tubes.

In use the autotransformer is always energized. With the off-on switch in the "on" position the heaters are connected in series across the 80 volt portion of the

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autotransformer to receive their full operating voltage. The D.-C. voltage supply circuit which is connected between the "high" end of the transformer and ground is energized because, at this time, the "low" end of the transformer is grounded. When the switch is thrown to the "off" position the heaters are connected to the high end of the transformer across the 37 volt portion of autotransformer to receive their standby voltage. This grounds the "high" end of the autotransformer to ground both ends of the D.-C. supply circuit and de-energize that circuit.

Thus a circuit is provided which supplies at least a low standby voltage across the tube heaters while de-energizing the D.-C. supply circuit. This keeps the tubes warm while the set is off and reduces thermal shock to the tubes when the set is turned on. Additionally, the circuit of the present invention significantly reduces receiver set warm-up time. In conventional receivers it may take 45 to 60 seconds for the tubes to reach operating temperature, during which time no signal is available. With a receiver incorporating the present invention the warm-up time may be of the order of 6 to 10 seconds, after which time the aural and video signals are available.

Another advantage of maintaining energization of the tube heaters, while the set is idle, is the elimination of water condensation in the receiver and the incident maloperation and possible damage. Even in humid areas where condensation difficulties have been most acute, supplemental heaters are rendered unnecessary with receivers incorporating the present invention because the warmth of the heaters under "off" condition serves to prevent damaging condensation.

Still another advantage accruing from maintaining the tube heaters at elevated temperatures, when the set is off, is the reduction of oscillator frequency drift associated with abrupt thermal changes in the tubes when the set is turned from "off" to "on." This reduction is of particular value in ultra-high frequency television receivers where the problem of oscillator drift is especially acute.

The heating of the tubes while the set is idle can be achieved at relatively small power expense. In the standby condition the receiver draws only about 12 watts, or about one-sixth the power required for normal viewing operation. This expense is more than offset by the resulting prolonged life of the tubes and other advantages.

It is accordingly a general object of the present invention to provide an improved switch arrangement for a television receiver which in the "off" position maintains the tubes in a warm condition.

It is another object of the present invention to provide a television receiver circuit in which the tubes are maintained in warm condition by voltage impressed across the tube heaters while the set is idle.

It is yet another object of the present invention to provide a television receiver circuit in which the tube heaters are energized at low voltage and the D.-C. supply circuit is de-energized while the set is off.

Yet another object of the present invention is to provide for a television receiver wherein one single-pole double-throw switch serves simultaneously to apply reduced voltage to the heaters and to de-energize the D.-C. supply circuit.

Further it is an object of the present invention to provide an improved television receiver circuit wherein the tubes are switched to a low heater voltage in the "off" condition and the pilot light or other selected part of the heater string is then subjected to little or no energizing voltage.

Further objects of the present invention include provi-

sion of a single switch controlled television receiver wherein the tubes in the off condition are subjected to reduced heater voltage while D.-C. high voltage is turned off; the tube life is increased by reason of the reduced thermal shock; the set warm-up time is lessened because the tubes are initially warmed; condensation in the receiver is reduced by the heater warming power; and in which the foregoing objects are achieved by the use of a simple, reliable and inexpensive circuit.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will be apparent from the following description taken in connection with the accompanying drawings in which:

Figure 1 is a schematic diagram with parts in block form of a complete television receiver constructed in accordance with the present invention; and

Figure 2 is a fragmentary diagram like Figure 1 but showing an alternative construction of the control circuit.

Referring now to Figure 1, the television receiver includes a tuner shown at 10. This may comprise, for example, a radio frequency amplifier utilizing a 3BC5 tube, V1, which is connected to a suitable antenna (not shown) to amplify the television signal. The radio frequency output of this amplifier feeds a mixer and oscillator which may be formed, for example, by the two triode sections of a 6AT8 tube, V2, one section operating as a local oscillator and the other section operating as a mixer.

The signal produced by the tuner 10 consists of radio frequency waves having the intermediate frequency of the receiver and containing both the amplitude modulation of the video signal and the frequency modulation of the audio signal. The intermediate frequency may, for example, be of the order of 44 megacycles.

The signals produced by the tuner 10 are amplified by the two intermediate frequency amplifiers indicated generally at 12. The first stage of amplification utilizes the pentode section of a 6BA8 tube, V3b, which operates as a tuned radio frequency amplifier. The second stage consists of the pentode portion of another 6BA8 tube, V4b, likewise operating as a tuned radio frequency amplifier. In each of the intermediate frequency stages the signal is applied to the control electrode and appears in the anode circuit.

The second detector for the video wave, indicated generally at 14, receives signals from the intermediate frequency amplifier 12. These signals are rectified in the detector circuit to produce a demodulated wave which contains the amplitude modulation of the video wave. This wave is amplified in the video amplifier 16 by the pentode portion of a 6BA8 tube, V5b. The resultant signal is applied to the cathode P1b of the cathode ray picture tube P1. The amplitude modulations of the video wave thus vary the cathode potential of the picture tube and thereby control the intensity of the cathode ray beam as it writes across the viewing screen. Since this writing takes place in a predetermined sequential of horizontal picture lines, the picture is reproduced on the viewing screen.

The signal from the intermediate frequency amplifier 12 is applied to the audio signal separator and amplifier 18. This signal is a frequency modulated signal 4.5 megacycles from one end of the composite television signal. Intermediate frequency amplification of the frequency modulated audio signal takes place in the triode half of a 6AW8 tube, V6b. The amplified I. F. signal is then passed through an FM frequency modulation detector using crystal rectifiers. The resultant audio signal is applied to the pentode half of a 6AW8 tube, V6c. The resultant amplified signal is applied to the speaker S1 to be reproduced as sound.

The video signal is fed from the video amplifier 16 to the sync amplifier and clipper 20. The triode half of a 6BA8 tube, V5c, amplifies this signal and by cut-off action separates the synchronizing pulses from the video wave. These synchronizing signals consist of rather short horizontal pulses having a repetition rate of about 15,000 per second, and the longer vertical synchronizing pulses having a repetition rate of 60 per second.

The synchronizing signals are applied to the vertical oscillator shown at 22. The vertical oscillator is of the type shown and described in the co-pending application of Rex Wilson and Howard Van Jepmond, Serial No. 457,724, filed September 22, 1954, entitled "Cathode Ray Tube Beam Sweep Oscillator," now forfeited. In brief, the oscillator consists of a 12L6 tetrode tube, V7, having a transformer with one winding interposed between the anode and the source of anode bias potential and a second winding interposed between the screen electrode and the source of adjustable positive screen bias voltage. The two windings of the transformer are connected in feedback relationship to provide a positive feedback circuit consisting of the anode, the screen electrode, and the cathode of tube V7 so that when a negative sync pulse is applied from the sync amplifier and clipper 20 through the screen winding to the screen electrode, an oscillatory action occurs which amplifies the initial triggering pulse and ultimately results in the screen electrode losing control of the anode current. Thereafter capacitors charge under control of the control electrode of the tube to generate a saw tooth current wave in the vertical sweep coils 23.

The signals from the sync amplifier and clipper 20 are also applied to the horizontal oscillator 24. This oscillator utilizes the triode portions of two 6BA8 tubes, V3c and V4c, and is triggered by the horizontal sync pulses to execute a saw tooth voltage swing in the time interval between each pair of successive pulses. The resultant synchronized saw tooth wave, of about 15 kilocycles, is applied to the horizontal amplifier 26. This amplifier consists of a 12EQ6 tetrode tube, V8, which develops across the transformer 28 the saw tooth current wave corresponding to the saw tooth voltage applied to the horizontal amplifier 26. A portion of this wave is applied to the yoke 30 which sweeps the cathode ray beam in the horizontal direction. Another portion of this wave, increased in voltage by reason of the windings of transformer 28, is rectified by a 1B3 tube, V10, and applied to the accelerator electrode of the cathode ray tube P1. The fly-back tube V9, which may be a 12AX4 tube, serves to short-circuit the coils on the horizontal deflection yoke 30 for one direction of voltage to prevent the voltage surges that would otherwise appear in the horizontal deflection coils.

The power for the operation of the receiver is obtained from a 117 volt appliance source through appliance cord 30 having appliance plug 32 connected to the source. An autotransformer 34 is connected across the 117 volt line. The "high" end 34a of the autotransformer is connected to a selenium rectifier 36. Unidirectional anode, screen, and other bias voltages for all the tubes except the audio amplifier tube is derived from the 135 volts available from the selenium rectifier 36 in series with the filter choke 38. Unidirectional voltage at 140 volts for the audio amplifier V6 is drawn directly from the selenium rectifier 36. Capacitors 40 serve to reduce the ripple in the D.-C. voltages applied to the receiver.

The autotransformer 34 has a tap 34b positioned so that the potential difference between it and the "low" end 34c of the autotransformer is that required for normal operation of the series connected heaters. In the apparatus shown, this is about 80 volts, leaving a potential difference between the tap 34b and the "high" end 34a of the autotransformer of approximately 37 volts.

The heaters for the tubes, V9a, V8a, V5a, V6a, V4a, V3a, V2a, V1a, V7a, and P1a, are connected in series between the autotransformer tap 34b and terminal 42a of the single pole double throw switch 42. The heater series is grounded through connection 46 at the switch end of the string. Terminal 42b of switch 42 is connected to the "low" end 34c of the autotransformer as shown. The other terminals 42c of the switch 42 is connected to the "high" end 34a of the autotransformer. A pilot light 44 is connected in parallel across heater filament V2a to divide the total heater current flow as required to operate both the pilot light and this heater.

When the television receiver is turned on, the switch 42 is connected from terminal 42a to terminal 42b. This connects the series of heater filaments across the 80 volt portion of the autotransformer, that is, between the tap 34b and the "low" end 34c of the transformer, thus supplying the heater string with full operating voltage. At the same time the circuit comprising the selenium rectifier 36, the filter choke 38 and the filter capacitors 40 is connected between the "high" end of the autotransformer 34a and ground connection 48 and hence supplies full operating voltage to the anode-cathode and other D.-C. circuits.

When the receiver is turned off, the switch 42 connects terminals 42a and 42c. In this position the series string of heaters is connected across the 37 volt portion of the autotransformer 34 between tap 34b and the "high" end 34a. At this time the selenium rectifier 36 is connected directly to the ground connection 46 through the switch 42. Similarly the other side of the filter capacitors 40 is directly connected to the ground connection 48. Consequently when the switch is in the "off" position no voltage appears across rectifier 36 and no D.-C. potential is applied to the receiver.

An alternate construction of the control circuit is shown in Figure 2. In this construction an autotransformer 134 is connected across the 117 volt line 130. The autotransformer has a tap 134b positioned so that the potential difference between it and the "low" end 134c of the autotransformer is the normal heater operating voltage, such as 80 volts. An additional intermediate tap 134d is positioned between the tap 134b and the "high" end of the autotransformer 134a. The heaters are connected in series with a dropping resistor 150 located between the transformer tap 134b and terminal 142a on a single-pole double throw switch 142. The resistor 150 is located at the autotransformer end of the series and a ground connection 146 is located at the switch end of the series. The pilot light 144 is connected between the autotransformer tap 134d and the heater end 150a of the resistor 150. The D.-C. supply circuit consists of the selenium rectifier 136, the filter choke 138, and the filter capacitors 140, connected in the same way as the D.-C. supply circuit shown in Figure 1 and described above. When the switch 142 is in the "off" position, with terminal 142a connected to terminal 142c, the heaters are connected in series across the 37 volt portion of the autotransformer 134 between tap 134b and the "high" end 134a. Since the "high" end 134a is connected directly to ground the voltage drop between the end 134a and the tap 134b will be opposed to the IR drop in the resistor 150. Therefore the potential difference between point 150a and point 134b is wholly or partially offset by the potential difference between tap 134b and tap 134d. Thus the net potential difference between point 150a and tap 134d is insufficient to light lamp 144. On the other hand, when switch 142 is in "on" position the voltage between taps 134b and 134d is in phase with the voltage across resistance 150 to add sufficient voltage to light lamp 144.

Thus with the construction of the present invention it is possible to impress a low-voltage across the heater filaments although no voltage is impressed across the

anode cathode circuit. This makes it possible to keep the tubes warm while the set is in the off or standby condition. In the alternative construction a pilot light is provided which, although it is energized from the heater circuit, will be in the de-energized condition when the heater circuit is in the standby condition.

It should be noted that while an autotransformer 34, 134, is shown to develop the requisite tapped heater energizing voltages, other arrangements may be used to this end. For example, a multiple winding transformer may be used, or a voltage dropping resistor may be applied. Additionally, with either an autotransformer or multiple winding transformer the voltage at the "high" end of the transformer may have a value greater than line voltage to provide greater heater current flow when switch 42, or 142, is in "off" position. Even with a dropping resistance, the voltage between the "high" point 34a and the "low" point 34c may be made less than line voltage by the use of a tap.

It should also be noted that by the use of the additional tap shown in Figure 2 it is possible not only to make the pilot light go out but, if desired, to de-energize or nearly de-energize some other component of the receiver, such as a tube heater, when the switch is in off position.

It will be noted that with the circuit of the present invention the D.-C. voltage applied to the tubes is interrupted simultaneously with reduction of the heater current flow. This not only saves power and reduces the time the components are subject to full D.-C. voltage, but also prevents the accelerated loss of heater life associated with low temperature operation under full D.-C. voltage conditions.

While I have shown and described a specific embodiment of the present invention it will, of course, be understood that many modifications and alternative constructions may be made without departing from the true spirit and scope thereof. I therefore intend by the appended claims to cover all such modifications and alternative constructions as fall within their true spirit and scope.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An off-on control circuit for a television receiver or the like having a plurality of tubes with heaters, anodes, and cathodes and energized from a source of alternating voltage, the circuit comprising: means connecting the heaters to define an energizing circuit having two terminals between which a major portion of the alternating voltage is required for normal operation; an autotransformer connected across the source of alternating voltage and having a tap to produce said major portion of the voltage when measured to one end of the autotransformer; means connecting one terminal of said energizing circuit to the tap; a switch selectively operable to "on" position connecting the other terminal of the said energizing circuit to said one end of the autotransformer for normal operation and to "off" position connecting the other terminal of said energizing circuit to the other end of the autotransformer for standby operation; and means to produce cathode-anode space path voltage for said tubes, said last means being connected across the said other end of the autotransformer and the said other terminal of the said energizing circuit.

2. An off-on control circuit for a television receiver or the like having a plurality of tubes with heaters, anodes, and cathodes and energized from a source of voltage, the circuit comprising: means connecting the heaters to define an energizing circuit having two terminals between which a major portion of the voltage is required for normal operation; an impedance having two end terminals connected across the source of voltage and a tap to produce said major portion of the voltage when measured to one end terminal; means connecting one terminal of the energizing circuit to said tap; a switch selectively operable

to "on" position connecting the other terminal of said energizing circuit to said one end of the impedance for normal operation and to "off" position connecting the other terminal of said energizing circuit to the other end of the impedance for standby operation; and means to produce cathode-anode space path voltage for said tubes connected across the said other end of the impedance and to said other terminal of the energizing circuit.

3. An off-on control circuit for a television receiver or the like having a pilot light and a plurality of tubes with heaters and energized from a source of alternating voltage, the circuit comprising: means connecting the heaters to define an energizing circuit having two terminals between which a major portion of the alternating voltage is required for normal operation, said energizing circuit including a resistance connected to one terminal; an autotransformer connected across the source of voltage having a tap to produce said major portion of the alternating voltage when measured to one end of the autotransformer and an intermediate tap between said first tap and the other end of the autotransformer; means connecting the said one terminal of the energizing circuit to said first tap; a switch selectively operable to "on" position connecting the other terminal of said energizing circuit to said one end of the autotransformer for normal operation and to "off" position connecting the other terminal of said energizing circuit to the other end of the autotransformer for standby operation; and means connecting the pilot light from the intermediate tap to the energizing circuit between the resistance and the heaters.

4. An off-on control circuit for a television receiver or the like having a pilot light and a plurality of tubes with heaters and energized from a source of voltage, the circuit comprising: means connecting the heaters to define an energizing circuit having two terminals between which a major portion of the voltage is required for normal operation, said energizing circuit including a resistance connected to one terminal; an impedance connected across the source of voltage having a tap to produce said major portion of the voltage when measured to one end of the impedance and an intermediate tap between said first tap and the other end of the impedance; means connecting the said one terminal of the energizing circuit to said first tap; a switch selectively operable to "on" position connecting the other terminal of said energizing circuit to said one end of the impedance for normal operation and to "off" position connecting the other terminal of said energizing circuit to the other end of the impedance for standby operation; and means connecting the pilot light from the intermediate tap to the energizing circuit means between the resistance and the heaters.

5. An on-off control circuit for a television receiver or the like having a plurality of tubes with heaters to be energized partially when the receiver is off, a device in circuit with the heaters and to be energized to a greater extent when the receiver is on and to a lesser extent when the receiver is off, the receiver to be energized from a source of voltage, the circuit comprising: means connecting the heaters to define an energizing circuit having two terminals between which a major portion of the voltage is required for normal operation, said energizing circuit including a resistance connected to one terminal; an impedance connected across the source of voltage having a tap to produce said major portion of the voltage when measured to one end of the impedance and an intermediate tap between said first tap and the other end of the impedance means connecting the said one terminal of the energizing circuit to said first tap; a switch selec-

tively operable to "on" position connecting the other terminal of said energizing circuit to said one end of the impedance for normal operation and to "off" position connecting the other terminal of said energizing circuit to the other end of the impedance for standby operation; and means connecting the device from the intermediate tap of the impedance to the energizing circuit between the resistance and the heaters.

6. An off-on control circuit for a television receiver or the like having a plurality of electron tubes with cathodes adapted to emit electrons when heated to predetermined operating temperature and requiring a direct current voltage source for normal operation, the circuit being energized from a source of alternating current voltage having a pair of terminals, the circuit comprising: a first means operable when energized by a major proportion of the voltage between said terminals to heat said cathodes to said predetermined temperature; a second means connected to said first means and defining a point having said major proportion of said voltage with respect to one of said terminals; a switch having a terminal connected to said first means and adapted in one condition to impress said major proportion of said voltage across said second means and in another condition to impress the remaining portion of said voltage across said second means; a third means to supply said direct current voltage from said source of alternating current voltage, said third means being connected between the other terminal of said source and the said terminal of the switch, whereby with the switch in said one condition the electron tubes are heated to normal cathode temperature and said third means is energized and with said switch in said other condition, the cathodes are heated to a standby temperature and said third means is not energized.

7. An off-on control circuit for a television receiver or the like having a plurality of tubes with heaters, anodes, and cathodes and energized from an electric power source, the circuit comprising: means connecting the heaters to define an energizing circuit having two terminals between which the major portion of the voltage of the power source is required for normal operation; a voltage dividing means connected to said power source and having a tap to produce said major portion of the voltage when measured to one end of the voltage dividing means; means connecting one terminal of said energizing circuit to the tap; a switch selectively operable to "on" position connecting the other terminal of the energizing circuit to the other end of said voltage dividing means for standby operation; and means to produce cathode-anode space path voltage for said tubes, said last means being connected across said other end of the voltage dividing means and said other terminal of the energizing circuit.

References Cited in the file of this patent

UNITED STATES PATENTS

1,649,391	Davis	Nov. 15, 1927
1,766,038	Gebhard	June 24, 1930
1,903,420	Badma	Apr. 11, 1933
2,269,989	Root	Jan. 13, 1942
2,658,140	Koch	Nov. 3, 1953

FOREIGN PATENTS

262,190	Great Britain	Dec. 7, 1926
560,001	Great Britain	Mar. 15, 1944