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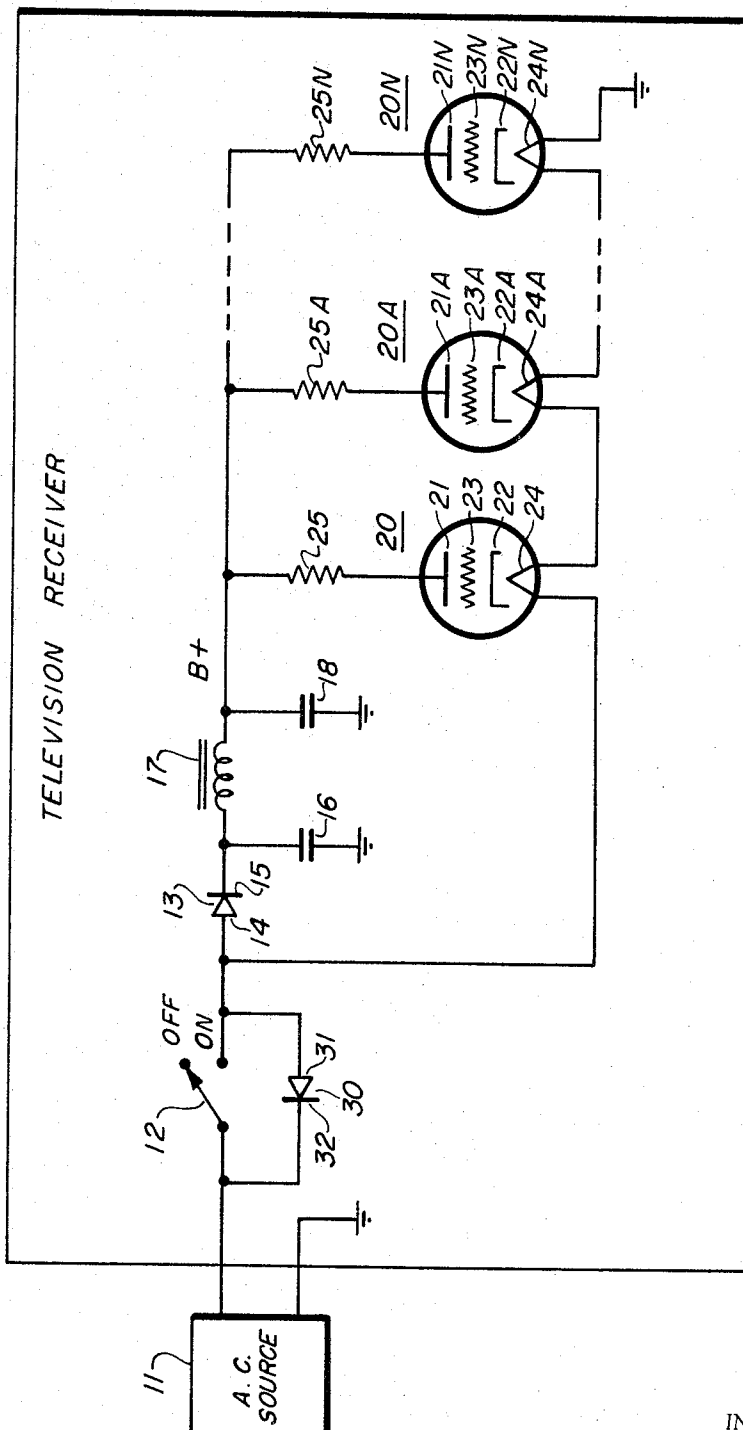
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INSTANT-ON FILAMENT HEATING CIRCUITS

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TELEVISION RECEIVER



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INSTANT-ON FILAMENT HEATING CIRCUITS
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This invention concerns instant-on circuits for electronic apparatus, especially television receivers and the like.

Recently there has been great impetus in the area of providing vacuum tube operated television receivers which no longer require relatively long warm-up times—usually on the order of one minute. It has been proven desirable, from a customer point of view, to manufacture television receivers which are capable of giving substantially instantaneous sound and picture.

Obviously, with vacuum tubes and other temperature dependent devices, there must be provision for maintaining these devices at or near operating temperature for instant operation. A plus factor in the instant-on development is that, if properly designed, vacuum tubes actually experience longer service life since damaging current surges due to cold start-up are eliminated. It is well known that most vacuum tubes employ tungsten filaments which have positive temperature coefficients of resistance. Thus, as temperature increases, the filament resistance also increases. Consequently, when the filament is cold its resistance is low, and the initial current is much higher than normal operating current.

It is not feasible to maintain the vacuum tube heaters at full operating temperature for at least two reasons. The first is that the cathodes unduly age when operated at near normal electron emitting temperatures unless operating potentials on the other tube elements are maintained. This phenomenon has been colloquially called "sleeping sickness." Experimentation has shown that the cathode may be maintained at less than full operating temperatures without presenting any serious problems in this respect. It has been determined that the filaments may be operated at one-half power consistent with substantially instant-on operation and good aging characteristics of the cathode. A second reason is one of simple economics in that it is desirable to minimize the power loss in the receiver during its off condition. Consequently, among the numerous proposals is a circuit type utilizing a diode in series with the heater or filament string for conveniently limiting the current therethrough during off periods.

The diode offers the advantage of current limiting without the power loss attendant upon resistive limiting, or without requiring a tapped down transformer or other voltage reducing device. The advantages accruing as a result of the use of a diode are well known and not claimed as any part of this invention.

Some circuits utilize a separate diode with a switching arrangement for placing the separate diode in the heater string in the off position of the apparatus, whereas others provide for switching the diode which is already present in the receiver power supply into the heater circuit during off time.

The circuit of the invention utilizes a separate diode, but does not have any complicated switching. Further, the diode used need not have the current rating of the power supply diode.

There is an advantage in simplifying the switching in the receiver apart from that of eliminating "stacked" switches and their tendency to mechanical problems. In fact, most on-off television switches are already encumbered with volume controls or the like. Additionally, in color sets, the on-off switch may already have an additional stacked switch thereon for providing so-called automatic degaussing. In some monochrome sets a switch may

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be coupled to the on-off switch for preventing the damaging bright spot in the center of the picture tube which may occur after the set is turned off. Thus there often is insufficient room to place further switching functions on the on-off switch and wholly separate switches may not be practical or feasible economically.

In accordance with the teachings of the invention, a simple diode is connected in parallel with the on-off switch of the television receiver, but in polarity opposition to the diode in the DC voltage supply circuit. When the switch is in the ON position, the diode is effectively short-circuited, and circuit operation is normal. When the switch is in the OFF position, the heater string and the DC power supply are both connected to the source of alternating current potential through the diode. The heater string thus receives rectified AC for operation at lower than normal temperatures, whereas the DC supply circuit is disabled since the additional diode is oppositely poled to the rectifier diode.

Accordingly, the principal object of this invention is to provide an improved instant-on circuit for use with electronic apparatus employing vacuum tubes.

Another object of this invention is to provide an instant-on circuit which may be readily incorporated in existing television receivers of the low B+ type (those incorporating half wave rectification in the power supply).

A further object of this invention is to provide an instant-on circuit which does not require any additional mechanical parts.

Further objects of this invention will be readily apparent upon reading the following specification in conjunction with the drawing which discloses in partial block, partial schematic form the essential circuit elements and configuration.

The drawing shows a block 10 labeled TELEVISION RECEIVER which should be understood to incorporate all of the necessary conventional circuitry for receiving a television signal, detecting the signal, and reproducing both the audio and visual information contained therein on suitable reproducing means. Since the television art is quite well developed and since the present invention does not require the exposition of particular circuit functions, it is not believed necessary to disclose individual circuitry therein.

A source of alternating current 11 is shown having a pair of leads extending into block 10. One lead is connected to a common source of ground potential and the other to a switch 12 having ON and OFF terminals. The ON terminal of switch 12 is connected to a series of heater elements 24, 24A . . . 24N, to ground. (The dashed lines joining tubes 20A and 20N indicate that any number of tubes may be incorporated.) This terminal is also connected to the anode 14 of a rectifier 13. The cathode 15 of rectifier 13 is connected to a conventional filter circuit comprising a pair of electrolytic filter capacitors 16 and 18 bridged by a filter choke 17. The junction of filter choke 17 and capacitor 18 is the B+ point for the television receiver.

The television receiver includes a plurality of vacuum tubes 20, 20A . . . 20N for performing various well known operations on the received television signal. These vacuum tubes all include heater elements and signal processing elements. Vacuum tube 20, for example, comprises an anode 21, a cathode 22, and a control element 23. Heater 24 has already been discussed and a simple load resistor 25 is connected between anode 21 and the B+ point. Similarly, vacuum tube 20A has an anode 21A, a cathode 22A, a control element 23A, a heater 24A, and a load impedance 25A. It should be obvious that many more vacuum tubes are utilized in modern day television receivers to perform the basic functions alluded to briefly

above, but, for purposes of simplicity, only three such tubes are illustrated. It should be further understood that while the illustrated heater elements are shown connected in series they may be connected in any desired arrangements, as long as only one source of supply voltage is required.

An additional diode 30 is connected to switch 12 such that switch 12 short circuits diode 30 when in the ON position. Diode 30 has an anode 31 and a cathode 32 and is arranged to have a polarity with respect to the source that is opposite to diode 13 in the DC voltage supply.

During normal operation, that is with switch 12 in the ON position, alternating current from source 11 passes through series connected heater elements 24, 24A . . . 24N in a complete circuit which bypasses diode 30. The heater element circuit is designed such that when the television receiver is connected to a proper source of alternating current potential, predetermined currents flow there-through, which causes predetermined operating temperatures for their associated cathodes 22 . . . 22N. Simultaneously, the alternating current from source 11 is rectified by diode 13 and filtered by capacitors 16 and 18 and choke 17 to provide a source of direct current for the signal processing elements of the various vacuum tubes in the receiver. Thus, the circuit will be seen to operate in a normal manner when switch 12 is in the ON position.

However, when switch 12 is placed in the OFF position, diode 30 is electrically in series with source 11 and the receiver. Since the heater element circuit and the DC supply circuit are effectively connected in parallel, diode 30 is a common series element in both of these circuits. Now alternating current from source 11 is rectified by diode 30 and the heater elements receive substantially half of the current that they normally receive when switch 12 is in the ON position. Accordingly, their associated cathodes achieve something less than normal operating temperatures.

Since the polarity of diode 30 is opposite to that of diode 13, the alternating current is effectively blocked from the television receiver signal processing elements. Thus, during the off periods, the television receiver heater elements are operated at less than normal operating temperatures, and the receiver B+ circuit is effectively disabled.

This operation has been accomplished by the simple addition of a relatively low power diode connected across the on-off switch. The current rating of the diode is naturally based upon the normal current drawn by the heater circuit and will be approximately one-half normal. The voltage breakdown rating need only be sufficient for the line voltage involved. Hence, a relatively uncritical, inexpensive diode may be used. It will be noted also that many existing electronic apparatus may be readily connected to instant-on operation by the simple expedient of adding a diode across the on-off switch terminals.

What has been described is a simple, efficient circuit for providing instant-on operation in vacuum tube apparatus. While a specific embodiment of the invention has been disclosed for descriptive purposes, it will be appreciated that the scope of the invention is limited only as defined in the claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a television receiver; a plurality of vacuum tubes having heater elements connected in an electrical circuit normally operable from a source of alternating current; a direct current circuit including a first rectifier; an alternating current source; an on-off switch connected between said alternating current source and both said direct current circuit and said heater element circuit; and a second rectifier paralleling said switch, said second rectifier being poled in opposition to said first rectifier whereby when said switch is closed said heater element circuit and said direct current circuit are connected directly to said alter-

nating current source and when said switch is open said heater element circuit is supplied rectified current and said direct current circuit is rendered ineffective.

2. In electronic apparatus, a plurality of vacuum tubes having a heater circuit designed for operation on alternating current; a direct current supply circuit for said vacuum tubes, both said circuits being connected in parallel and forming a power load circuit; an alternating current source; a single pole-two position switch connected between said alternating current source and said power load circuit; said direct current supply circuit including a first rectifier passing one polarity of electrical current; and a second rectifier connected in parallel with said switch and poled to pass the opposite polarity of electrical current whereby when said switch is one position said power load circuit receives normal power from said alternating current source and when said switch is in the other position said heater circuit is energized from said alternating current source through said second rectifier and said direct current supply circuit draws substantially no power from said alternating current source.

3. A power supply for an electronic tube system having a plurality of tubes with heaters being connected to form a heater circuit; a pair of terminals adapted to be connected to a source of alternating current; a filter circuit including a first rectifier; an on-off switch connected to both said filter circuit and said heater circuit for completing a bi-directional current path including said circuits and said terminals when in the ON position; a second rectifier paralleling said on-off switch and poled opposite to said first rectifier whereby when said on-off switch is in the OFF position said heater circuit is in series with said second rectifier, and said first rectifier and said filter circuit are rendered ineffective.

4. In combination with electronic apparatus including a vacuum tube having a heater element normally energizable from a source of alternating current and other elements energizable from direct current; a source of alternating current potential; rectifying means passing one polarity of current for deriving direct current from said source; switching means coupling said rectifying means and said heater element to said source; and a standby circuit for maintaining said heater element operable at less than normal temperature and said other elements at substantially zero potential, said circuit including further rectifying means connected across said switching means and passing the opposite polarity of current whereby said further rectifying means are rendered effective only when said switching means is in its open condition.

5. An instant-on circuit for a television receiver including a plurality of vacuum tubes having heater elements designed for operation on AC and signal processing elements designed for operation on DC; a source of alternating current; an on-off switch; power supply means including a first semi-conductor rectifier connected in circuit with said signal processing elements; circuit means connecting said on-off switch between said source and both said heater element circuit and said power supply means whereby when said switch is in its ON position said heater element circuit and said power supply means are connected to said source for normal operation; and a second low current semi-conductor rectifier coupled across said on-off switch in opposite polarity to said first rectifier whereby when said on-off switch is in the OFF position said heater element is fed pulsating direct current for maintaining said heater elements at less than normal temperature and said power supply means is effectively disabled.

6. An instant-on circuit for a television receiver including a plurality of vacuum tubes having heater elements designed for operation on AC and signal processing elements designed for operation on DC; a source of alternating current; an on-off switch; half wave power supply means including at least one semi-conductor rectifier connected in circuit with said signal processing elements for

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developing a first magnitude DC voltage therefor; circuit means connecting said on-off switch between said source and both said heater element circuit and said half wave power supply means whereby when said switch is in its ON position said heater element circuit and said half wave power supply means are connected to said source for normal operation; and a low current semi-conductor rectifier coupled across said on-off switch in opposite polarity to said one rectifier whereby when said on-off switch is in its OFF position said heater element is fed pulsating direct current for maintaining said heater elements at less than normal temperature and said half wave power supply means is effectively disabled, said low current

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semi-conductor rectifier having a reverse voltage rating slightly greater than said first magnitude DC voltage.

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