

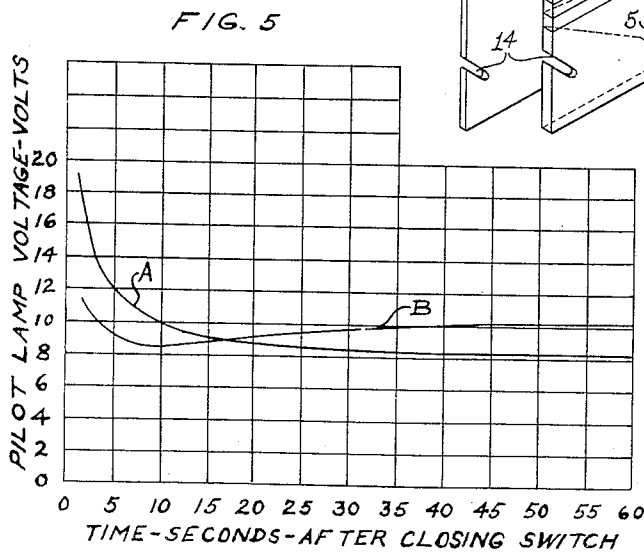
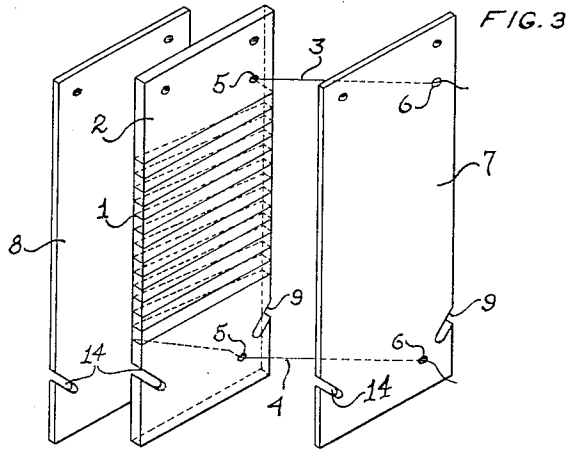
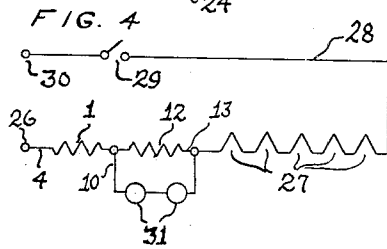
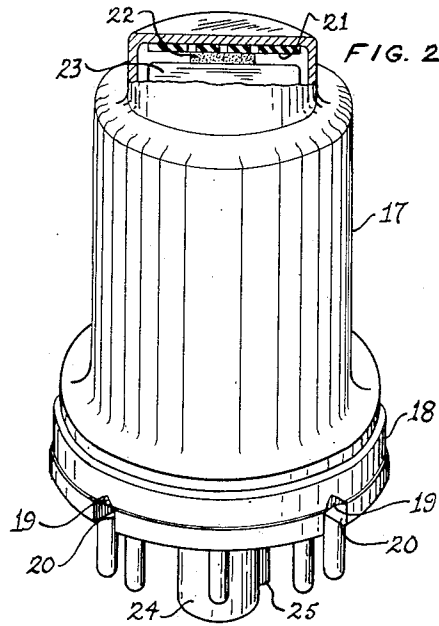
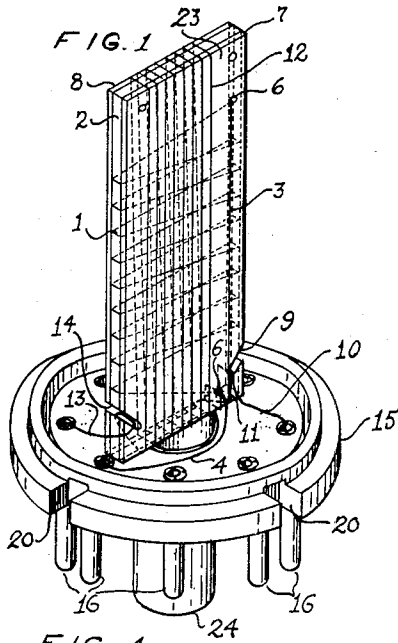
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2,293,045

BALLAST RESISTANCE TUBE

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BALLAST RESISTANCE TUBE

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3 Claims. (Cl. 171-229)

This invention relates to a ballast resistance tube, and more particularly to such a tube from which the pilot lamp voltage for a radio set is secured by a tap on the resistance element of said tube.

When the pilot lamp voltage in an A.C.-D.C. radio-receiving set is taken from a tap on the filament voltage dropping resistor, which usually has no ballasting action, the peak voltage applied to the pilot lamps at the instant the line switch is closed may be several times the rated voltage of the lamps, due to the high initial current drawn by the filaments of the radio-receiving tubes in the radio set. In order to limit this peak voltage to a reasonable value, heretofore resistance tubes have been made with a resistance across which the pilot lamps were connected, which resistance was considerably lower than that required to operate the pilot lamps at their rated voltage with the filaments of the radio-receiving tubes at their elevated operating temperature. Thus with said prior resistance tubes, either the life of the pilot lamps was shortened by the high peak voltage or the final brilliancy was reduced by the low operating voltages, or both of said actions occurred to a certain degree.

An object of this invention is to provide a resistance tube of the type described which limits the peak starting voltage applied to the pilot lamps to a value within the voltage rating of said pilot lamps.

Another object is to provide such a resistance tube in which the running voltage is of sufficient value to provide for full brilliancy of the pilot lamps throughout the operation of the radio set.

The foregoing and other objects of my invention will be best understood from the following description of an exemplification thereof, reference being had to the accompanying drawing, wherein:

Fig. 1 is a perspective view of my novel resistance tube with the outer shell removed;

Fig. 2 is a perspective view of said resistance tube with the outer shell in place and partly broken away at the upper end;

Fig. 3 is an exploded view of the resistance element of said tube partly assembled;

Fig. 4 is a diagrammatic showing of a circuit with which the tube may be used; and

Fig. 5 consists of a set of curves showing the operating characteristic of my novel tube as contrasted with prior resistance tubes.

The embodiment of my invention disclosed in the drawing consists of an inside resistance

winding 1 of a material whose resistance remains substantially constant with changing temperature. For this material I preferably use the nickel chromium alloy known as nichrome. This inside winding 1 should have a relatively high resistance which may be of the order of 120 ohms. The resistance winding 1 is wound upon an insulating plate 2, preferably of mica. The upper end 3 and the lower end 4 of the resistance winding 1 are threaded through holes 5 in the insulating plate 6, whereby the resistance winding 1 is retained firmly in place on the insulating plate 2 without the necessity of having said winding cemented to said plate. The upper and lower ends 3 and 4 are likewise threaded through holes 6 in an insulating cover plate 7 which is adapted to be placed over one face of the insulating plate 2 upon which the resistance winding 1 is wound. The opposite face of the insulating plate 2 is likewise covered with a similar insulating cover plate 8. The insulating plates 7 and 8 are also preferably formed of mica. As shown in Fig. 1, the lower end 4 of the resistance winding 1 is wound around the aligned holes at the lower end of the insulating plates 2, 7 and 8, and said end 4 constitutes one terminal of the resistance unit. The upper end 3 of the resistance winding 1 is wound around aligned slots 9 at one side of the lower end of the insulating plates 2, 7 and 8. A lead 10 is electrically connected to the end 3, and said lead 10 constitutes a tap connection on the resistance unit.

An outer resistance winding 12 is wound around the cover insulating plates 7 and 8 in a direction at right angles to the direction in which the inner resistance winding is wound. In this way the two windings 1 and 12 are insulated from each other. The outer resistance winding 12 consists of a material which has a relatively large positive temperature coefficient of resistance; that is, its resistance is low at low temperatures and increases to a higher resistance at higher temperatures. A suitable material which possesses this property is nickel. The resistance of the outer winding 12 is relatively low as compared to the resistance of the inner resistance winding 1. The range of resistance of the winding 12 may be of the order of from twenty ohms at low temperature to sixty ohms at higher temperature. One end 11 of the outer resistance winding 12 is electrically connected to the end 3 of the inner resistance winding 1. The other end 13 of the winding 12 is wound around aligned slots 14 in the lower portion of the insulating plates 2, 7 and 8. The end 13 constitutes an-

other terminal of the resistance unit. By having the various conductors wound in the slots 9 and 14 and in the aligned openings extending through the insulating plates 2, 7 and 8, the entire assembly is maintained in its assembled relationship without the necessity for using additional fastening elements.

The resistance unit described above is preferably mounted on an insulating base 15 provided with a plurality of contact prongs 16, whereby contact may be made to corresponding elements of a radio tube socket. The conductors 4, 10 and 13 are connected to three of said contact prongs. The resistance assembly itself is surrounded with a metal shell 17 which is retained on the insulating base 15 by means of a lower ring 18 welded to the metal shell 17, said lower ring having portions 19 indented into recesses 20 in the insulating base 15. In order to firmly hold the resistance unit in place within the metal shell, the upper end 23 of said unit is cemented by means of cement 22 to the top of the metal shell 17. In order to insure insulation between the resistance windings and the metal shell, an insulating plate 21, preferably of mica, is also cemented to the lower portion of the top wall of the metal shell 17 between the resistance unit and said top wall. The insulating base 15 may be provided with the usual centering plug 24 carrying an orienting feather 25, whereby the resistance tube may be inserted readily and oriented in a standard radio-receiving tube socket.

Before the metal shell 17 is placed around the resistance unit, it is oxidized on its inner surface to provide a good heat-absorbing surface. The outside of the metal shell 17 is also provided with a good heat-radiating surface. The interior of the shell is not evacuated, and therefore the resistance unit operates in an atmosphere of air. I have found that by this arrangement a considerable amount of heat can be generated within the resistance unit without unduly raising the temperature thereof, due to the fact that this heat is readily conducted away from the resistance unit both by convection currents of air and by being radiated directly to the heat-absorbing inner walls of the metal shell 17, whereupon this heat is then readily radiated from the outer wall of said metal shell.

The tube as described above may be connected in any suitable circuit, one of which is shown, for example, in Fig. 4. In this figure one terminal 26 of a suitable supply of voltage is connected directly to the conductor 4; the other terminal or conductor 13 of the resistance unit is connected in series with a plurality of filaments 27. These filaments are the usual cathode-heating filaments of standard radio-receiving tubes. The other end of said series filament circuit is connected by means of a conductor 28 through a switch 29 to the other terminal 30 of the voltage source. One or more pilot lamps 31 is connected directly across the outer resistance winding 12. Both the filaments 27 and the filaments of the pilot lamps 31 are usually made of tungsten which likewise has a relatively large positive temperature coefficient of resistance. These filaments, therefore, have a low initial resistance which rises to a considerably higher value as the temperature of said filaments increases to its operating value.

In Fig. 5 there are shown two curves which illustrate the difference in operation between prior resistance tubes and resistance tubes made in accordance with my present invention. The

curve A represents the characteristic of a straight resistance tube, while curve B represents the characteristic of my novel resistance tube. In Fig. 5 the voltage which appears across the pilot lamps is plotted along the vertical axis, while the time which elapses after the closing of the main switch 29 is plotted along the horizontal axis.

In a straight resistance tube, when the main switch is initially closed, a large initial current flows through the resistance, due to the fact that the tungsten filaments of the radio tubes have an initial low resistance. This large amount of current produces a high drop across the resistor. Since the pilot lamp voltage is taken across at least a part of this resistance, said partial voltage likewise has a high initial value as shown on the curve A. As the filaments of the radio tubes heat up to their operating temperature, their resistance increases, and therefore the current which flows through them and through the series resistance decreases. This results in a decrease in the voltage across the resistance, producing a corresponding decrease in the voltage across the pilot lamps. This is also illustrated on the curve A. If the initial voltage which appeared across the pilot lamps was kept sufficiently low to prevent burning out of the pilot lamps, the operating voltage across the pilot lamps was too low; that is, the horizontal portion of the curve A represented a voltage which was insufficient to maintain the pilot lamps at their full brilliancy during the steady state operation of the radio set.

My novel resistance tube, however, operates in a different manner and produces the characteristic resistance curve B. In the present instance, when the switch 29 is closed, the elements 12, 31 and 27 all have a relatively low resistance, and therefore the magnitude of the current which flows through the filaments 27 is determined primarily by the resistance 1. This resistance 1 is so designed as to permit a relatively large current to flow through the filaments 27 so that the heating of these filaments may be accelerated. However, since the resistance 12 is low, the initial voltage drop which occurs across it is also low, and therefore the initial voltage applied to the pilot lamps 31 is not excessive, but has the initial value shown on the curve B, which is very close to the actual operating voltage of said pilot lamps 31. The flow of current through the resistance 1 generates heat in said resistance, and quickly raises the temperature thereof. However, due to the fact that the resistance 1 remains substantially constant, this rise in temperature does not produce any appreciable change in the voltage conditions. The insulating plates 7 and 8 introduce a thermal time lag into the device. Thus an appreciable time elapses before the heat generated by the winding 1 passes through the insulating plates 7 and 8, and raises the temperature of the outer winding 12. The thickness of the insulating plates 7 and 8 is so chosen as to permit the temperature of the resistance winding 12 to rise at substantially the same rate as the current through the filaments 27 falls, due to the increasing temperature of said filament and the corresponding increase in resistance thereof. As the current through the filaments 27 decreases, the current through the resistance 17 likewise decreases to a certain extent, and there is initially a small decrease in the voltage appearing across the pilot lamps 31. However, the initial voltage is so chosen as to be slightly greater than

the running voltage so as to quickly bring the lamps 31 to their final brilliancy. Therefore, the initial drop in the voltage across the tubes 31 is desirable. As the temperature of the resistance 12 is raised, due to the heat generated in the resistance winding 1, the resistance of winding 12 increases. This increase in resistance is substantially balanced by the decrease in the current which flows through it, due to the change in resistance of the filaments 27 and the filaments of the pilot lamps 31. The various constants are so selected that there is a slight increase in the voltage across the pilot lamps after the first voltage drop which raises the voltage across the pilot lamps 31 to its final operating value. This operating value is sufficiently great so that the pilot lamps are operated at their full brilliancy. Due to the above operation, it will be seen that the initial voltage supplied to the pilot lamps may be made as low as desired so as to avoid any possibility of initial over-heating the pilot lamps, and furthermore the operating voltage can be made sufficiently high to produce the full brilliancy described.

It will further be noted that due to the low initial resistance in the winding 12, very little heat is generated in said winding, and therefore this heat in itself would be insufficient to raise the temperature of the winding 12 in order to raise the resistance thereof. By my arrangement, however, the heat generated in the resistance 1 is utilized to raise the temperature of the resistance 12, thus giving to my combined resistance unit the desirable characteristics described above.

It is to be understood that this invention is not limited to the particular details of construction or materials as described above as many equivalents will suggest themselves to those skilled in the art. For example, the proper functioning of the heating resistance 1 depends on the proper amount of power being liberated in it. This could be accomplished by having a larger amount of heating current pass through it, and under these conditions the resistance of winding 1 need not be substantially greater than that of winding 12. Also the heating of winding 12 by winding 1 could be accomplished without having said windings connected in series, it being sufficient merely to supply the proper amount of current to winding 1. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. A ballast resistance arrangement comprising a load device having a relatively large positive temperature coefficient connected in series with a ballast resistance, said ballast resistance comprising a resistor having a relatively large positive temperature coefficient of resistance, means for heating said resistor comprising an additional resistor having a relatively low temperature coefficient of resistance connected in series with said first-named resistor and load, and means interposed between said resistors for substantially delaying the transfer of heat from said heating means to said first-named resistor, whereby upon the flow of current through said resistors the resistance of said first-named resistor is raised to a predetermined final value after a substantial initial period of delay.

2. A ballast resistance arrangement comprising a load device having a relatively large positive temperature coefficient connected in series with a ballast resistance, said ballast resistance comprising a resistor having a relatively large positive temperature coefficient of resistance, means for heating said resistor comprising an additional resistor having a relatively low temperature coefficient of resistance connected in series with said first-named resistor and load, and an insulating sheet interposed between said resistors for substantially delaying the transfer of heat from said heating means to said first-named resistor, whereby upon the flow of current through said resistors the resistance of said first-named resistor is raised to a predetermined final value after a substantial initial period of delay.

3. A ballast resistance arrangement comprising a load device having a relatively large positive temperature coefficient connected in series with a ballast resistance, said ballast resistance comprising a resistor having a relatively large positive temperature coefficient of resistance, means for heating said resistor comprising an additional resistor having a relatively low temperature coefficient of resistance connected in series with said first-named resistor and load, and a mica sheet interposed between said resistors for substantially delaying the transfer of heat from said heating means to said first-named resistor, whereby upon the flow of current through said resistors the resistance of said first-named resistor is raised to a predetermined final value after a substantial initial period of delay.

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