United States Patent

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[33] **Japan**
[31] **43/42396**

[54] **DEGAUSSING DEVICE HAVING SERIES CONNECTED PTC AND NTC RESISTORS**
3 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **315/8,** 317/157.5
[51] **Int. Cl.** **H01f 13/00,** H01c 7/02
[50] **Field of Search** 315/8

[56] **References Cited**

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ABSTRACT: A degaussing device for the picture tube of a color television receiver magnetized by terrestrial magnetism causing color-contamination is described. The device comprises a resistor having a positive temperature coefficient of resistance (PTC resistor), a resistor having a negative temperature coefficient of resistance (NTC resistor), and a coil wound on the picture tube for degaussing, the PTC resistor being connected in series to a parallel circuit of the NTC resistor and the degaussing coil, wherein the PTC resistor and the NTC resistor are in good thermal contact. A sufficiently large current for degaussing first flows through the coil and then the PTC resistor, the resistance of which is thereby raised, reduces the current. The NTC resistor heated by the PTC resistor therefore shows a lower resistance than that of the coil. Consequently, a further reduced current flows through the coil which gives little interference with the working of the picture tube.

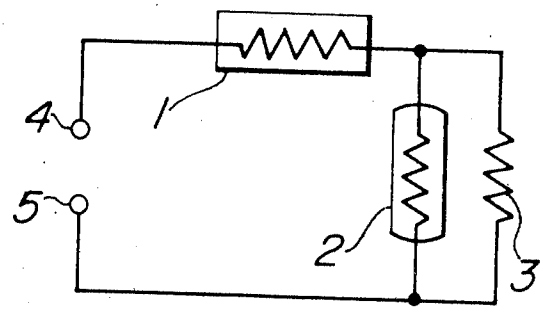


FIG. 1

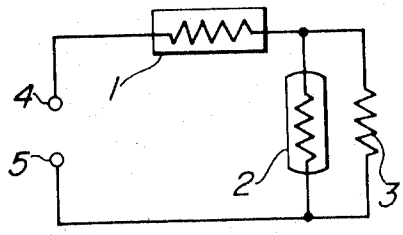


FIG. 2

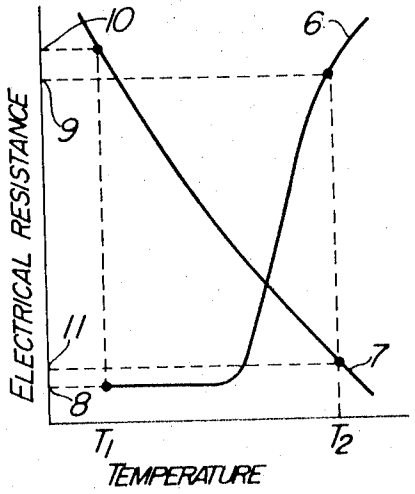


FIG. 3

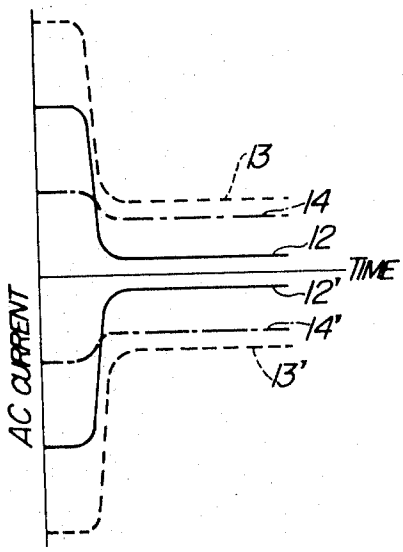
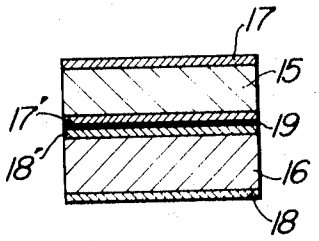


FIG. 4



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DEGAUSSING DEVICE HAVING SERIES CONNECTED PTC AND NTC RESISTORS

This invention relates to a degaussing device for the picture tube of a color television receiver which is magnetized by terrestrial magnetism causing color-contamination. More particularly the invention relates to a degaussing device which comprises a resistor having a positive temperature coefficient of resistance (a PTC resistor), connected in series with a parallel circuit consisting of a resistor having a negative temperature coefficient of resistance (an NTC resistor) and a coil for degaussing, the PTC resistor and the NTC resistor being in good thermal contact.

Two types of degaussing devices have been used in a color television receiver. One comprises an electrical relay contact to be actuated by a bimetal strip which is electrically connected in parallel with a degaussing coil. However, an electrical relay contact is liable to be oxidized by arcing and this causes an imperfect electrical contact. Furthermore, the on-off action of the relay contact gives rise to high frequency interference. This interference is particularly a serious problem for a color television receiver which works quickly after switch-on.

The other comprises a voltage dependent resistor, an NTC resistor, and an ordinary resistor which are electrically connected to a degaussing coil. In case of this type of device, three kinds of resistors require much space and cost.

It is an object of the invention to provide an electrical device for quick degaussing of a picture tube of a color television receiver which has no relay contact.

It is another object of the invention to provide a simpler and less expensive device for degaussing of a picture tube of a color television receiver without using a relay contact.

According to the invention there is provided a degaussing device for a picture tube of a color television receiver comprising a resistor having a positive temperature coefficient of resistance (PTC resistor), a resistor having a negative temperature coefficient of resistance (NTC resistor) connected in series with said PTC resistor and a coil wound on said picture tube, said PTC resistor being in thermal contact with said NTC resistor.

The PTC resistor is a semiconductive barium titanate ceramic having the electrical resistance lower than that of the NTC resistor and an impedance of the degaussing coil at room temperature. The impedance of the degaussing coil is much lower than the resistance of the NTC resistor at room temperature. The PTC resistor shows a rapid and large increase in electrical resistance near the Curie temperature thereof whereas the NTC resistor shows a relatively large decrease in electrical resistance with increasing temperature.

The PTC resistor and the NTC resistor are in good thermal contact.

Temperature-resistance characteristics of the PTC resistor and the NTC resistor and good thermal coupling between the two resistors of the novel device according to the invention cause an abrupt reduction in the current flowing through the degaussing coil for the picture tube of a color television receiver so as to minimize the current during working of the picture tube after degaussing.

Other objects, features and advantages of this invention will become more apparent from the following description of the invention with reference to the accompanying drawings, in which:

FIG. 1 shows a circuit diagram of the current regulating system of the present invention;

FIG. 2 shows temperature-resistance characteristics of a PTC resistor and an NTC resistor;

FIG. 3 shows electrical current variations with time through the PTC resistor, NTC resistor and degaussing coil connected to the present novel current regulating system; and

FIG. 4 shows a cross-sectional view of the present device.

Before proceeding to a detailed description of the construction of the novel degaussing device for the picture tube of a color television receiver, the novel current regulating system will be explained.

Referring to FIG. 1, a PTC resistor 1 is electrically connected in series with a parallel circuit consisting of an NTC resistor 2 and a resistor 3. A voltage is applied to the terminals 4 and 5.

Temperature-resistance characteristics of the PTC resistor and the NTC resistor in the present current regulating system according to the invention are selected to satisfy the interrelation between their resistances as shown in FIG. 2, where the curves 6 and 7 show respectively temperature-resistance characteristics of the PTC resistor and the NTC resistor. In FIG. 2, at a temperature T_1, the resistance of the PTC resistor is represented by a resistance 8 and its notation is Rp_1. The temperature T_1 is supposed to be room temperature. In the same way, the notations are respectively Rp_2 for 9, Rn_1 for 10 and Rn_2 for 11. The temperature T_2 is a higher temperature than T_1, where the PTC resistor shows a high resistance value and the NTC resistor shows a low resistance value compared with the resistor 3.

Applying a voltage to the present current regulating system at the temperature T_1, a large electrical current flows through the PTC resistor 1 and the resistor 3. Only a small current flows through the NTC resistor 2 because of its high resistance at T_1. The PTC resistor is self-heated by the large current and reaches the temperature T_2, whereby the resistance thereof is increased to Rp_2 as shown in FIG. 2. Consequently, the large current is reduced to a lower value. Since the NTC resistor is in good thermal contact to the PTC resistor as will be described later in detail, the resistance of the NTC resistor is reduced to Rn_2 much lower than that of the resistor 3. Therefore, a larger part of the reduced current flows through the NTC resistor and the remainder of the current flows through the resistor 3.

The current flowing through the resistor 3 can be calculated by the following equation at temperature T_1.

$$I_1=Rn_1V/Rp_1(Rn_1+R)+Rn_1R$$

and at temperature T_2,

$$I_2=Rn_2V/Rp_2(Rn_2+R)+Rn_2R$$

where I_1 and I_2 are respectively the current through the resister 3 at T_1 and T_2, and R is resistance of the resistor 3. Thus, a current reduction from I_1 to I_2 is realized by the present novel system.

The present novel current regulating system can be used as a degaussing device for a picture tube of a color television receiver by substituting a degaussing coil for the resistor 3.

The current I_1 should be large enough for degaussing and the current I_2 should be a small one so as to give little interference with a picture tube during working. The current reduction from I_1 to I_2 should take place before the picture tube begins to work.

The PTC resistor, the NTC resistor and the degaussing coil are selected so as to produce the interrelations between their resistances such that the ratio of the impedance of degaussing coil Rz to Rp_1 is from 100:1 to 1:1 and the ratio of Rn_1 to Rz is from 100:1 to 1:1 at room temperature T_1 and the ratio of Rp_2 to Rz is from 1000:1 to 10:1 and the ratio of Rz to Rn_2 is from 10:1 to 1000:1 at T_2.

Time required for the current reduction from I_1 to I_2 depends on the current value, resistance of the PTC and NTC resistors, their size, their thermal radiation and their temperature-resistance characteristics. The time required for the current reduction should be within 5 seconds for usual television receiver. This quick current reduction has recently become significant for a color television receiver which quickly starts to work after switch-on.

The PTC resistor can be made of any semiconductive barium titanate ceramic having an abrupt increase in electrical resistance above a certain temperature. The semiconductive barium titanate ceramic can be prepared by well-known ceramic techniques. For example, 65 to 70 percent by weight of $BaCo_3$, 28 to 30 percent by weight of TiO_2, 0.1 to 3 percent by weight of SiO_2, and La_2O_3, Nb_2O_5, $_{1,2000}°_{SB2}O_5$ or Bi_2O_3 less than 0.5 percent by weight are wet-milled for mixing. The resultant mixture is calcined at 1,2000° C. for 2 hours, pressed into pellets, and fired at about 1,350° C. in air for 1 to 2 hours.

The fired pellets are provided with electrodes by any available method. Preferred electrodes for a ceramic body are silver electrodes made by painting a silver paste on opposite surfaces of the pellet and firing in a nitrogen atmosphere, or a nickel-phosphor alloy electrode made by electroless plating.

The Curie temperature of barium titanate can be shifted to a higher temperature side by substituting lead for barium and to a lower side by substituting strontium for barium, tin for titanium, or zirconium for titanium. The PTC resistor having a low Curie temperature may be used for the degaussing device which quickly reduces the degaussing current. The PTC resistor with a high Curie temperature may be used for the degaussing device which requires a relatively large degaussing current.

The NTC resistor can also be made by well-known ceramic technique. For example, 30 to 38 percent by weight of MnO_2 50 to 60 percent by weight of Co_2O_3, and 2 to 3 percent by weight of CuO are mixed, calcined at 900° C. for 0.5 to 1 hour, and fired at 1,300° C. in air for 1 to 2 hours. These compositions may be modified by incorporating Cr_2O_3, NiO and TiO_2. The fired body is provided with electrodes by similar method to the preparation of PTC resistors.

Referring to FIG. 3, the current variations for degaussing according to the novel device are shown by the curves 12 and 12'. In the figure, current variations through the PTC resistor and NTC resistor are also represented by curves 13 and 13' and 14 and 14', respectively.

Referring to FIG. 4, 15 and 16 designate a disk-type PTC resistor and a disk-type NTC resistor, respectively. The electrodes of the resistors are represented by 17 and 17' and 18 and 18'. In order to keep good thermal coupling between the PTC resistor and the NTC resistor, they are adhered by soldering as shown by 19. Lead wires are soldered to the electrodes 17 and 18. A thin metal sheet is inserted between the electrodes 17' and 18' and it serves as a common terminal of the PTC resistor and NTC resistor for connecting to the degaussing coil.

It will be understood by those skilled in the art that a device according to this invention can be modified in various respects without departing from the essence of the invention and within the essential features of the invention as set forth in the claims annexed hereto.

What is claimed is:

1. A degaussing device for use with a picture tube of the type employed in color television receivers comprising

a. a degaussing coil,

b. a resistor having a negative coefficient of resistance (NTC) connected in parallel with said coil, and

c. a resistor having a positive coefficient of resistance (PTC) connected in series with said parallel connected degaussing coil and NTC resistor, said NTC and PTC resistors being in thermal contact, the resistance of said NTC resistor decreasing rapidly and the resistance of said PTC resistor increasing rapidly with increasing temperature, the ratio at room temperature of the impedance of said coil to the impedance of said PTC resistor varying from 100:1 to 1:1 and to the impedance of said NTC resistor from 1:100 to 1:1; and the ratio at elevated temperatures, after the rapid increase in resistance of said PTC resistor and the rapid decrease in resistance of said NTC resistor, of the impedance of said coil to the impedance of said PTC resistor varying from 1:1000 to 1:10 and to the impedance of said NTC resistor from 10:1 to 1000:1.

2. A degaussing device as claimed in claim 1, wherein said PTC resistor comprises a semiconductive barium titanate ceramic.

3. A degaussing device as claimed in claim 1, wherein said NTC resistor comprises a semiconductive ceramic based on manganese, cobalt chromium, titanium, nickel and copper oxides.

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