

DEGAUSSING CIRCUIT WITH RESIDUAL CURRENT CUTOFF

This invention relates to degaussing circuits for video display apparatus and, in particular, to degaussing circuits that terminate all residual degaussing current after a predetermined period of time.

Cathode ray tubes for color video display apparatus require periodic degaussing, or demagnetization, of the metal parts of the tube and surrounding circuitry in order to prevent degradation of tube color purity. Magnetization can occur due to the presence of the earth's magnetic field or to stray fields produced by motors or electrical equipment operating nearby. Since the orientation of the earth's magnetic field with respect to the tube changes each time the video display apparatus is moved, degaussing may be frequently required, particularly in the operation of computer monitors, which are often moved or rotated to accommodate different users.

A typical degaussing method includes the use of temperature dependent varistors that change in resistance value as they become heated by the flow of degaussing current derived from the AC line. This change in resistance value is utilized by appropriate circuitry to cause the degaussing current to decrease in a desired manner to effect demagnetization of the metallic parts of the tube. This arrangement is economical and provides effective degaussing. However, since the degaussing current does not decay to zero, some residual degaussing current may continue to flow. This residual current may result in some magnetization of the tube. Additionally, in order to provide repeated degaussing, the video display apparatus must be turned off for several minutes to allow the varistors to cool in order that sufficient degaussing current flows when the set is reenergized. This is inconvenient when used in a computer monitor where the monitor may be moved during operation.

Another type of degaussing circuit, known as the resonant type, causes a capacitor to discharge through the

degaussing coil. The resonant circuit, which is determined by the capacitor and the coil, generates a high frequency alternating current that decays as the capacitor charge is dissipated, thereby effecting degaussing of the tube. This arrangement is useful for computer monitors because it permits repeated degaussing while the video display apparatus is in operation. However, it is more complex than the previously described AC line derived degaussing circuit.

It may be difficult to provide effective degaussing for large screen tube, e.g., 25V, using resonant degaussing circuits because of the difficulty in generating sufficient degaussing current for a sufficient length of time. It would be desirable, therefore, to have a degaussing circuit with the economy and degaussing effectiveness of a positive temperature coefficient (PTC) circuit together with the frequent repeatability with no residual current of the resonant degaussing circuit during use.

In accordance with the present invention, a degaussing circuit for a cathode ray tube of a video display apparatus comprises a switch which is operable to cause the current to flow in a degaussing coil located adjacent to the tube, means responsive to this flow of current to cause the current to decrease in the degaussing coil, and a capacitor which is chargeable to cause the switch subsequently to become nonconductive so that the current flow through the degaussing coil is terminated. The capacitor is discharged when the video display apparatus is deenergized.

In the accompanying drawing:

FIGURE 1 is a schematic and block diagram of a portion of a video display apparatus incorporating an aspect of the present invention;

FIGURE 2 illustrates waveforms useful in understanding the operation of the circuit shown in FIGURE 1;

FIGURE 3 is a schematic and block diagram of a video display apparatus incorporating another aspect of the present invention; and

FIGURE 4 illustrates waveforms associated with the circuit of FIGURE 3.

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Referring to FIGURE 1, there is shown a portion of a video display apparatus, which may illustratively be used as a computer monitor, in which a source of AC voltage 10 is coupled to a bridge rectifier 11 and a filter capacitor 12 to develop an unregulated DC voltage. The DC voltage is applied to one terminal of a primary winding 13 of a power transformer 14. Transformer 14 illustratively provides electrical isolation between the circuitry connected to the source of AC voltage 10 and circuitry connected to user accessible terminals, such as luminance and chrominance processing circuit 15, which is connected to red, green and blue video signal input terminal 16. The other terminal of primary winding 13 is connected to a regulator control circuit 17, which controls the current conduction through primary winding 13 in a manner to develop regulated voltages across the secondary windings 20, 21 and 22 of transformer 14. Winding 23 provides a feedback voltage to regulator control circuit 17.

The voltage developed across secondary winding 20 illustratively provides power for horizontal deflection circuitry 24 that in turn produces horizontal or line rate deflection current in horizontal deflection winding 25, located on the neck of a cathode ray tube 26. The voltage developed across winding 20 is also applied to high voltage generating circuitry 27, which may include a high voltage transformer, that rectifies and steps up the voltage to a

level of the order of 30,000 volts to produce the high voltage or ultor potential for cathode ray tube 26.

Winding 21 develops a voltage that is rectified by diode 30 and filtered by capacitor 31 to provide a supply voltage +V that may illustratively be used to power luminance and chrominance processing circuitry 15 which in turn provides red, green and blue video drive signals to cathode ray tube 26 via conductors designated 38. The voltage +V is also applied to a vertical deflection circuit 32 which generates vertical or field rate deflection current in a vertical deflection winding 33, also located on the neck of tube 26.

The voltage developed across secondary winding 22 is rectified and filtered by diode 34 and capacitor 35, respectively, to provide a voltage that is applied to the energizing coil 36 of a degaussing relay 37. The normally open contact 40 of relay 37 is coupled to degaussing coil 41, located in the vicinity of tube 26, via a terminal DG'. The other terminal of degaussing coil 41, designated DG, is coupled via a positive temperature coefficient (PTC) resistor 42 to one terminal of the source of AC voltage 10. The movable contact 43 of relay 37 is connected to the other terminal of the source of AC voltage 10.

The voltage across winding 22 causes current to flow in coil 36 of relay 37 sufficient to cause movable contact 43 to become electrically connected to normally open contact 40. This causes the alternating degaussing current to flow from the AC voltage source 10 through degaussing coil 41 and PTC resistor 42. Current flow in PTC resistor 42 causes it to heat, increasing its resistance and thereby decreasing the degaussing current in the desired manner to effect demagnetization of the tube 26. Although PTC resistor 42 causes the current flow to decrease greatly in magnitude, a finite residual current will continue to flow.

In accordance with an aspect of the present invention, the voltage developed across winding 22 is applied to relay energizing coil 36 via a relay disconnect

circuit 44 comprising the parallel combination of a capacitor 45 and a resistor 46. As the voltage is applied to relay energizing coil 36 at a time t_1 , as shown in FIGURE 2A, the voltage increases to a maximum value at a time t_2 . As the voltage increases, the current flow in coil 36 also increases, as can be seen in FIGURE 2B, so that a magnetic field of sufficient intensity is generated to energize the relay and cause the movable contact 43 to be brought into contact with normally open contact 40.

10 This causes the alternating degaussing current, shown in FIGURE 2C, to flow in degaussing coil 41.

Heating of PTC resistor 42 causes the degaussing current to decrease until a time t_3 , when only the residual current flow remains. The combination of the resistance of coil 36 and capacitor 45 forms an RC network having a time constant that allows capacitor 45 to charge as shown in FIGURE 2D. As capacitor 45 charges, the current in energizing coil 36 decreases until a time t_4 , when the magnetic field generated by the current flow in coil 36 is insufficient to hold the movable contact 43 in contact with normally open contact 40. The relay then "drops out" or becomes deenergized. The residual degaussing current through degaussing coil 41 is therefore desirably terminated. PTC resistor 42 will begin to cool so that repeated degaussing operations may be accomplished without the necessity of maintaining the video display apparatus in a deenergized or "off" state for the length of time necessary for the PTC resistor 42 to cool, as is common with typical prior art degaussing circuits.

30 When the video display apparatus is deenergized, at a time t_5 , capacitor 45 discharges quickly via resistor 46 to enable degaussing to again be performed. Resistor 46 also provides the advantageous feature that current flow through resistor 46 establishes a DC voltage bias level on relay energizing coil 36. This has the effect of increasing the initial current flow in relay energizing coil 36, so that movable contact 43 is held in contact with normally open contact 40 for a longer duration or period of

time than would occur if resistor 46 were absent. This insures that the duration of degaussing current flow is sufficient to provide effective degaussing of cathode ray tube 26; i.e., the duration of relay energization is greater than the necessary degaussing duration.

FIGURE 3 illustrates an embodiment of a video display apparatus having a switched mode regulator incorporating an SCR 50. Elements in FIGURE 3 corresponding to those in FIGURE 1 are designated with the same reference numerals.

Conduction of SCR 50, which is controlled by regulator control circuit 51, causes current to flow via primary winding 52 of transformer 53 from the source of unregulated DC voltage developed across filter capacitor 12 to develop a regulated voltage, designated B+, at the cathode of SCR 50. This regulated B+ voltage is applied to a primary winding 54 of transformer 53 which, by transformer action, develops voltages across secondary windings 55 and 56, and high voltage winding 57. The B+ voltage is also used to power the horizontal deflection circuitry 24. The voltage across winding 55 is rectified and filtered to produce a DC voltage at a terminal 58 that provides a feedback voltage to regulator control circuit 51.

The voltage across secondary winding 56 is rectified by diode 60 and filtered by capacitor 61 to provide a regulated DC voltage at a terminal 62 that is illustratively used to power vertical deflection circuit 32 and chrominance and luminance processing circuit 15. This voltage is also used to energize coil 36 of degaussing relay 37 to effect degaussing of cathode ray tube 26 in a manner previously described.

In accordance with an aspect of the present invention, a capacitor 63 is coupled between relay energizing coil 36 and terminal 62. As the voltage across relay energizing coil 36 increases, from a time t_1 to a time t_2 as shown in FIGURE 4A, capacitor 63 begins to charge, as shown in FIGURE 4B, at a rate determined by the

RC time constant of coil 36 and capacitor 63, so that as capacitor 63 becomes charged the current through coil 36 decreases as shown in FIGURE 4C. The value of capacitor 63 is selected so that the relay 37 remains energized until a time t_3 , when effective degaussing has occurred. At time t_4 , the magnetic field produced by coil 36 is weakened due to reduced current flow and relay 37 becomes deenergized, thereby terminating the residual degaussing current in degaussing coil 41, as shown in FIGURE 4D. For example, for a degaussing relay having a coil resistance of 820 ohms, a capacitor having a value of 2200 μF will provide a time constant that provides a relay energization duration greater than the desired degaussing duration.

When the video display apparatus is turned off, at time t_5 , the load presented by vertical deflection circuit 32 will cause capacitor 63 to rapidly discharge from ground through relay energizing coil 36. The discharge current of capacitor 63 is sufficient to energize relay 37 so that degaussing again takes place, as shown in FIGURE 4D. The degaussing circuit of FIGURE 3 will therefore perform a degaussing function upon both the turn-on and turn-off of the video display apparatus.



CLAIMS

1. A degaussing circuit for a cathode ray tube of a video display apparatus comprising:

means for providing an alternating current when said video display apparatus is energized;

a degaussing coil disposed adjacent to said cathode ray tube;

a source of direct current;

a degaussing relay having a coil which operates a set of contacts to a conducting state which couples said alternating current to said degaussing coil;

means coupled to said degaussing coil and to said relay contacts and responsive to the flow of said alternating current for decreasing said current flow through said degaussing coil after a first predetermined interval to effect degaussing of said cathode ray tube;

a capacitor chargeable from said source of direct current, and coupled in series with said relay coil and said source of direct current for causing said contacts to become nonconducting after a second predetermined interval greater than said first predetermined interval; and

means for discharging said capacitor when said video display apparatus is de-energized.

2. The arrangement defined in Claim 1, wherein said means for decreasing said current flow comprises a temperature dependent resistor.

3. A degaussing circuit for a cathode ray tube of a video display apparatus comprising:

means for providing an alternating current when said video display apparatus is energized;

a degaussing coil disposed adjacent to said cathode ray tube;

a switch operable for causing said alternating current to flow in said degaussing coil;



means coupled to said degaussing coil and to said switch and responsive to the flow of said alternating current for decreasing said current flow through said degaussing coil after a first predetermined interval to effect degaussing of said cathode ray tube;

a capacitor chargable for causing said switch to become nonconductive such that said current flow is terminated in said degaussing coil after a second predetermined interval greater than said first predetermined interval; and

a resistor coupled in parallel with said capacitor for extending the duration that said alternating current flows in said degaussing coil and for discharging said capacitor when said video display apparatus is de-energized.

4. A degaussing circuit substantially as hereinbefore described with reference to Figs.1 and 2 or Figs.3 and 4 of the accompanying drawings.
