

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) AUTOMATIC DEGAUSSING CIRCUITS

(71) We, RCA CORPORATION, formerly RADIO CORPORATION OF AMERICA, a corporation organized under the laws of the State of Delaware, United States of America, of 30 Rockefeller Plaza, City and State of New York, United States of America do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates generally to automatic degaussing circuits for television receivers employing half-wave voltage doubler type rectifier circuits for low voltage power supply and, particularly to a form of such degaussing circuit which is especially advantageous for use in color television receivers employing rectifier circuits of that type.

Undesired magnetizations of the metal shadow mask of a color kinescope, associated supporting structure and other metal structures of a color television receiver, may occur during shipment and during use, due to various extraneous fields associated with trucks, elevators, motors and other flux sources, including the earth's magnetic field. Since distortion of the color image reproduced by the kinescope may result from such undesired magnetizations, it has been recognized as desirable to incorporate degaussing apparatus in the receiver to facilitate elimination of the undesired magnetizations.

One approach to this receiver degaussing function that has found wide acceptance automatically provides a degaussing action upon each turn-on of the (cold) receiver. In accordance with this approach, a degaussing coil structure, suitably disposed about the color kinescope, is connected for energization by the alternating current input to the receiver's low voltage power supply. Initially, that is, upon turn-on of

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the receiver, there is a large surge of current charging the power supply storage capacitors; the magnitude of the alternating current rapidly diminishes as the capacitor charge builds up. Such A.C. energization — initially large, but rapidly diminishing in amplitude — is the form of energization desired for demagnetization purposes.

A degaussing circuit of the nature described above further requires apparatus for effectively switching the degaussing coil structure out of circuit during normal operation of the receiver; this is particularly necessary since charging current is continually flowing to replenish charge of the loading on the power supply. One particularly effective switching arrangement, which switches the coil out of circuit in a graduated manner (tapering down the coil current to an insignificant amplitude within a second or so after turn-on) involves the use of a thermistor and a VDR (voltage dependent resistor) with the thermistor inserted as a series element in the path of power supply capacitor charging current, and with the series combination of VDR and degaussing coil shunted across the thermistor. In operation, when the set is cold at turn-on, the value of resistance presented by the cold thermistor is sufficiently large to develop an appreciable A.C. voltage thereacross; at such a voltage level, the effective resistance value of the VDR is relatively small, and the VDR-coil series combination presents a relatively low impedance across a relatively large A.C. voltage source, whereby a significant portion of the charging current is permitted to flow in the degaussing coil structure. However, subsequently, after sufficient time to heat up the thermistor, the latter assumes its "hot" value of relatively low resistance, whereby a relatively low A.C. voltage appears thereacross; at low values of source voltage, the

resistance value of the VDR is relatively large, whereby the VDR-coil series combination appears as a high impedance across a small voltage source, resulting in insignificant coil current.

An example of use of the above-described degaussing arrangement is provided by the RCA CTC 27 color television receiver chassis, which is the subject of the RCA Service Data Pamphlet, designated 1967 No. T15. It may be noted that in the CTC 27 chassis, the low voltage power supply for the receiver is of a well-known full-wave rectifier form, with a power transformer providing a push-pull A.C. input thereto.

In receiver construction, it is often desired, in the interest of conservation of weight, volume and/or expense, to avoid the use of the conventionally bulky, heavy and relatively expensive low voltage power transformer; elimination of the transformer is particularly desirable when considering portability of the receiver. To this end a low voltage power supply circuit of cascaded voltage doubler form can be used; namely a circuit having a first stage comprising a storage capacitor portion connected in series with a half-wave rectifier portion across A.C. supply terminals and a second stage also comprising a storage capacitor portion and a reverse polarity half-wave rectifier portion connected in series with the first capacitor portion across the supply terminals, the arrangement being such that the first capacitor charges through the first rectifier on alternate half cycles of the A.C. supply and its voltage adds to the supply voltage in charging the second capacitor through the other rectifier in the intervening half cycles. Thus in such a circuit arrangement, one side of the A.C. power supply can be grounded, while the remaining, "hot" side is connected to one terminal of a storage capacitor, a first diode is connected between the opposite terminal of the first storage capacitor and ground, and a second, oppositely poled diode also connected to the opposite terminal of the first storage capacitor is returned to ground via a second storage capacitor. During given alternate half cycles of the A.C. input wave, the first diode conducts to charge the first storage capacitor; during the intervening half cycles of the A.C. input wave, the second diode conducts charging the second storage capacitor to a substantially doubled voltage value (the charge on the first storage capacitor adding to the A.C. input).

An example of color television receiver construction which avoids the use of the conventional low power transformer by employing a cascaded voltage doubler type of low voltage power supply is the RCA

CTC 22 color television receiver chassis, the subject of an RCA Service Data Pamphlet designated 1967 No. T11.

The economics of design for voltage doubler supplies of the above-described type generally dictate a larger value for the first storage capacitor relative to the second storage capacitor. A given reduction in value of the second storage capacitor, with concomitant reduction in size and cost, has less effect on doubler efficiency and resulting B+ output than a comparable reduction in the value of the first storage capacitor. This follows from the presence of the first storage capacitor in the charging circuits for both half cycles of the A.C. input wave. Accordingly, prudent design results in dissimilar values for the respective storage capacitors.

A problem arises when one attempts to employ the storage capacitor charging current of a voltage doubler power supply as just described for automatic degaussing purposes, the problem being the asymmetry of charging current magnitude for successive half cycles of the A.C. input wave. Should such an asymmetrical charging current be employed for degaussing coil energization, an undesirable beam shift effect is introduced during the degaussing coil energization because of the presence of what is effectively a D.C. component of energization.

One approach to avoidance of the undesired spot shift would be to alter the design of the voltage doubler supply to eliminate the dissimilarity of charging current magnitudes for successive half cycles, either by (a) lowering the value of the first storage capacitor, or (b) raising the value of the second storage capacitor. However, the first named design alteration would result in undesired reduction in doubler efficiency and resultant B+ level, while the second named design alteration would introduce a wasteful increase in capacitor size and cost from the point of view of power supply design economics.

The present invention is directed to degaussing circuit arrangements wherein the charging current approach to degaussing may be employed in connection with an efficiently designed voltage doubler supply, without introducing any significant asymmetry in the A.C. energization of the degaussing coil, i.e., without introducing undesired spot shifts.

In accordance with the principles of the present invention, such a combination of desirable power supply and degaussing operation is realized through the use of parallel storage capacitors as the series capacitance element (i.e., as the "first" storage capacitor) of the voltage doubler supply, and associating the degaussing coil

and its accompanying switching arrangement with the current passing through but one of the parallel capacitors. The parallel capacitance values may be chosen so that the net series capacitance provided conforms to efficient voltage doubler supply design requirements, while the charging current portion serving to energize the degaussing coil is sufficiently symmetrical for successive half-cycles as to avoid significant spot shift distortion.

In accordance with a particular embodiment of the present invention, a thermistor is connected in series with one of the above mentioned parallel capacitors, and the series combination of a VDR and the degaussing coil is shunted across the thermistor. A second thermistor (with characteristics comparable to the first) is connected in series with the remaining one of the parallel capacitors. While the first and second thermistors may be separate elements, assurance of proper matching during operation may be especially realized by incorporation of both thermistors in a single device providing a common thermal environment.

Upon turn-on of the cold receiver, the impedance of the VDR-coil path is low relative to the impedance of the cold thermistor across which it is shunted, and a major portion of the charging current passed by the associated capacitor is diverted through the coil. Moreover, the impedance of the VDR-coil path is low compared with the impedance presented (by the additional cold thermistor) in series with the capacitor of the parallel path. Thus, under these conditions the capacitor associated with the degaussing coil is primarily determinative of the series capacitance of the doubler; its value may be chosen to ensure substantially symmetrical A.C. energization of the degaussing coil. Subsequently, when the thermistors reach their hot value, and the degaussing coil is effectively switched out of circuit, equally low impedances are presented in series with the capacitors of each parallel path. Under these conditions, the series capacitance of the voltage doubler has an increased value corresponding to the sum of the individual capacitances; efficient-voltage doubler action ensures, but with its accompanying asymmetry of positive and negative current pulses introducing no disturbance to the completed degaussing action.

The primary object of the present invention is to provide novel and improved automatic circuit degaussing for a color television receiver.

An additional object of the present invention is to provide an economical and efficient combination of automatic degaussing circuitry with a low voltage power

supply of a voltage doubler type, for use in a color television receiver.

Other objects and advantages of the present invention will be readily recognized by those skilled in the art upon a reading of the following detailed description, and an inspection of the accompanying drawing in which:

FIGURE 1 illustrates, with combined schematic and block representations, a color television receiver employing automatic degaussing circuitry in accordance with an embodiment of the present invention; and

FIGURE 2 illustrates a modification of the invention embodiment of FIGURE 1.

In Figure 1, major segments of the circuitry of a color receiver are illustrated only by block representation, with the detail of the receiver's power supply and degaussing circuitry shown schematically. An A.C. power source 11, which may comprise suitable apparatus for coupling to an A.C. power line, has a pair of output terminals, one connected to chassis ground and the other connected via the receiver's on-off switch 13 to a tap TF on a filament transformer 15. Tap TF and chassis ground effectively constitute a pair of power input terminals for the receiver, across which terminals an alternating voltage is supplied when the receiver is placed in operation by the closing of switch 13.

The filament transformer 15 includes a primary winding extending between tap TF and chassis ground, and a secondary winding TS, which is utilized to derive a reduced amplitude filament voltage for the filament 21 of the receiver's color kinescope 19 (shown in dotted outline only). Coupling from the secondary winding TS to the filament 21 is effected via kinescope filament voltage input terminals KF and KF'.

An intermediate tap TD on the primary winding of transformer 15 permits derivation of a stepped-down filament voltage for use by the damper tube of the receiver's horizontal deflection circuits; for this purpose, tap TD is connected to the damper filament voltage input terminal DF of the receiver circuitry 17. The remaining tube filaments are disposed in a suitable series string, connected between a filament string voltage input terminal FS and chassis ground; voltage for the series string is supplied by a direct connection from terminal FS to the transformer tap TF. A continuation of the primary winding beyond tap TF to an terminal TH is also provided, with no external connection to the end terminal TH being made in normal operation of the receiver; however, the winding continuation permits, under conditions of high line voltage operation, the use of an augmented primary winding for the filament

transformer, whereby proper filament voltages for the kinescope and damper tube may be obtained despite the high line voltage conditions. Under such high line voltage conditions, the illustrated circuit may be altered to remove the connection from the output terminal of switch 13 to the tap TF, and to provide, in its place, a direct connection from the output terminal of switch 13 to the end terminal TH.

The output terminal of switch 13 (i.e., tap TF, for the illustrated circuit connections) serves as the input terminal for a voltage doubler type of low voltage power supply. The voltage doubler employs a pair of diodes 60 and 70 as rectifying devices. The series combination of diode 70, a circuit breaker 71 and a storage capacitor 73 is shunted across the diode 60, with the cathode of diode 60 is directly connected to the anode of diode 70; the anode of diode 60 is directly connected to chassis ground, while the cathode of diode 70 is returned to chassis ground via the circuit breaker 71 and storage capacitor 73. It will be noted that, by virtue of these connections, the diodes are oppositely poled with respect to alternating current coupled from tap TF to their junction.

The network which couples alternating current from tap TF to the junction of the diodes is of particular interest with respect to the operation of the present invention. This coupling network includes a current limiting resistor 55 in series with a pair of parallel current paths. One of these parallel current paths includes a storage capacitor 31 in series with a thermistor 33; the other of these parallel current paths includes a storage capacitor 41 in series with a parallel combination formed by a thermistor 43, shunted by a VDR 51 serially connected with a degaussing coil 53. It will be understood that the degaussing coil 53 structure is suitably disposed with respect to the color kinescope 19 so as to effect the desired demagnetization of kinescope 19 and associated elements (e.g., disposed in the physical arrangement used in the aforementioned CTC 27 receiver).

The remaining elements of the illustrated power supply include the series combination of a filter choke 81 and a filter capacitor 83, shunted across the storage capacitor 73, and the series combination of a dropping resistor 85 and an additional filter capacitor 87, shunted across the filter capacitor 83. A filtered D.C. voltage, of a level approaching twice the peak amplitude of the alternating voltage at tap TF, appears at the junction of choke 81 and filter capacitor 83 and is supplied as a unidirectional operating potential to the B++ terminal of the receiver circuitry 17. An additional filtered D.C. voltage of

suitably lessened amplitude appears at the junction of resistor 85 and filter capacitor 87, and is supplied as an additional unidirectional operating potential to the B+ terminal of receiver circuitry 17.

In operation of the voltage doubler, diode 60 conducts during those half cycles of the A.C. input wave when tap TF swings negative relative to chassis ground, while diode 70 conducts during the alternative half cycles of the A.C. input wave when tap TF swings positive relative to chassis ground. During the half cycles of diode 60 conduction, the current passes via both of the storage capacitors 31 and 41, and both are charged with the polarity indicated on the drawing (i.e., the plates remote from tap TF are charged positively). During the half cycles of diode 70 conduction, the input swing appears superimposed in aiding relationship with the charge on capacitors 31 and 41. During these periods, the stored charge on capacitors 31 and 41 is effectively transferred to capacitor 73, with the input swing further charging the capacitor 73, with the input swing further charging the capacitor 73 to a substantially doubled level.

Under normal operating conditions (i.e., after thermistor warmup), the effective series capacitance presented in the voltage doubler circuit by the coupling network interposed between tap TF and the diode junction is equivalent to the sum of the capacitances of the respective storage capacitors 31 and 41. In accordance with appropriate design principles for the voltage doubler this series capacitance value is desirably larger than the capacitance value of the shunt capacitor 73. Illustrative of a desirable ratio are values of 300 microfarads for the series capacitance and 200 microfarads for the shunt capacitance.

Under the illustrative conditions of dissimilarity between series and shunt capacitances values, the current pulses passed by diode 60 will exceed in amplitude the current pulses passed by diode 70 by a substantial amount. If current pulses so dissimilar in magnitude were passed through the degaussing coil 53, the asymmetry of A.C. energization would be such as to result in the passage of what is effectively a D.C. component, of sufficient magnitude to introduce an undesired spot shift.

However, in operation of the illustrated circuit, the current conditions that prevail after thermistor warmup are not the same as those that occur immediately after turn-on of the cold receiver, i.e., that occur during the time period when degaussing is effected. At turn-on, thermistor 43 has its higher cold value, and the VDR-coil path in shunt with it is arranged to have a significantly lower impedance value. This im-

pedance value of the VDR-coil path is also significantly lower than the impedance of the cold thermistor 33. Consequently, during the initial cycles of the input wave after turn-on, the majority of charging current is flowing through capacitor 41 in series with VDR 51 and coil 53 (i.e., with capacitor 31 substantially out of circuit due to the relatively high impedance in series with it).

Under the foregoing circumstances, the series capacitance of the voltage doubler is primarily determined by the capacitance value of capacitor 41 alone. The value of capacitor 41 may be chosen to ensure substantially symmetrical A.C. energization of the degaussing coil (illustratively, the net series capacitance referred to above may be divided equally between capacitors 31 and 41, with a resultant value of 150 microfarads for capacitor 41). Subsequently, after effective completion of the degaussing action, and upon warmup of thermistors 33 and 43, the resistance values of thermistors 33 and 43 drop substantially and the impedance of the VDR-coil path rises. Equally low impedance values (primarily determined by the hot thermistors) appear in series with both of the capacitors 31 and 41 and current divides substantially equally between them. Capacitor 31 is no longer effectively out of circuit, and the series capacitance of the voltage doubler now is a higher value corresponding to the sum of the capacitance values of capacitors 31 and 41, as desired for efficient voltage doubler action. The diode currents are now asymmetrical, but the asymmetry is not disturbing, since degaussing action is completed and the degaussing coil 53 is effectively out of circuit.

In the illustrated arrangement of Figure 1, separate thermistor devices 33 and 43 have been shown for use in association with respective capacitors 31 and 41. In such an arrangement, care should be exercised to equalize thermal conditions for the devices so as to maintain proper tracking of their value changes. Figure 2 illustrates a modification of Figure 1 which may be employed to maximize assurance of matching of thermal conditions. In the Figure 2 arrangement, a single, three-terminal thermistor device 90 is employed in place of the separate thermistors 33 and 43 of Figure 1. The general circuit arrangement remains unchanged with the thermistor element 33' of the device 90 connected between storage capacitor 31 and current limiting resistor 55, and with thermistor element 43' of device 90 connected between storage capacitor 41 and resistor 55; the series combination of VDR 51 and degaussing coil 53 is appropriately shunted across the thermistor element 43'

of device 90. The device 90 provides a common thermal environment for the thermistor elements 33' and 43'.

The table below sets forth circuit parameter values for the arrangement of Figure 70 1 which have proved satisfactory in operation; it will be appreciated that they are presented by way of example only.

Capacitor 31	—	150 microfarads	75
Capacitor 41	—	150 microfarads	
Capacitor 73	—	200 microfarads	
Capacitor 83	—	150 microfarads	
Capacitor 87	—	100 microfarads	
Resistor 55	—	2 ohms	80
Resistor 85	—	3600 ohms	
Thermistors 33, 43	—	1.8 ohms — hot 120 ohms — cold	
VDR 51	—	300 ohms at 20 volts 1200 ohms at 8 volts <75 ohms at 140 volts	85 90
Diodes 60, 70	—	1N3195	
Coil 53	—	100 Turns, No. 27 AWG 24 ohms resistance	
Coil 81	—	0.5 henry	95
B++	—	280 volts	
B+	—	140 volts	

While the invention has been described in terms of a particular preferred embodiment, modifications within the scope of the invention may be made. For example, capacitors 31 and 41 may be unequal in value.

WHAT WE CLAIM IS:—

1. An automatic degaussing network for a television receiver circuit including a degaussing coil connected in a current path between an alternating current input and a rectifier circuit, and in parallel with a device which gradually reduces its impedance spontaneously when it begins to pass current, wherein said rectifier circuit has a cascaded voltage doubler form comprising a shunt diode and a series diode before a storage capacitor, and is connected in series with the current path, which comprises a further capacitor in series with said device in parallel with the degaussing coil, and wherein a second current path, connected in parallel with the first path, comprises a third capacitor in series with a further such impedance-reducing device, for initially precluding substantial current flow through this path but subsequently permitting such current flow therethrough.

2. A television receiver circuit as claimed in claim 1 in which said impedance-reducing devices are first and second thermistors, the resistance of which have matched char-

pedance value of the VDR-coil path is also significantly lower than the impedance of the cold thermistor 33. Consequently, during the initial cycles of the input wave after turn-on, the majority of charging current is flowing through capacitor 41 in series with VDR 51 and coil 53 (i.e., with capacitor 31 substantially out of circuit due to the relatively high impedance in series with it).

Under the foregoing circumstances, the series capacitance of the voltage doubler is primarily determined by the capacitance value of capacitor 41 alone. The value of capacitor 41 may be chosen to ensure substantially symmetrical A.C. energization of the degaussing coil (illustratively, the net series capacitance referred to above may be divided equally between capacitors 31 and 41, with a resultant value of 150 microfarads for capacitor 41). Subsequently, after effective completion of the degaussing action, and upon warmup of thermistors 33 and 43, the resistance values of thermistors 33 and 43 drop substantially and the impedance of the VDR-coil path rises. Equally low impedance values (primarily determined by the hot thermistors) appear in series with both of the capacitors 31 and 41 and current divides substantially equally between them. Capacitor 31 is no longer effectively out of circuit, and the series capacitance of the voltage doubler now is a higher value corresponding to the sum of the capacitance values of capacitors 31 and 41, as desired for efficient voltage doubler action. The diode currents are now asymmetrical, but the asymmetry is not disturbing, since degaussing action is completed and the degaussing coil 53 is effectively out of circuit.

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Capacitor 73	—	200 microfarads	
Capacitor 83	—	150 microfarads	
Capacitor 87	—	100 microfarads	
Resistor 55	—	2 ohms	80
Resistor 85	—	3600 ohms	
Thermistors 33, 43	—	1.8 ohms — hot 120 ohms — cold	
VDR 51	—	300 ohms at 20 volts 1200 ohms at 8 volts <75 ohms at 140 volts	85 90
Diodes 60, 70	—	1N3195	
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2. A television receiver circuit as claimed in claim 1 in which said impedance-reducing devices are first and second thermistors, the resistance of which have matched char- 130



acteristics, and are disposed in a common thermal environment.

3. A television receiver circuit as claimed in claim 2 wherein the first and 5 second thermistors are provided by a single body three terminal device.

4. A television receiver circuit as claimed in claim 2 or 3 comprising for improved de-energization of the coil, a 10 voltage-dependent resistor, which exhibits increasing resistance to lower voltages, in a series combination with the degaussing

coil, the combination being connected in parallel with the first mentioned thermistor.

5. A television receiver circuit provided with automatic degaussing substantially as hereinbefore described with reference to FIGURE 1 or FIGURE 2 of the 15 accompanying drawing.

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