

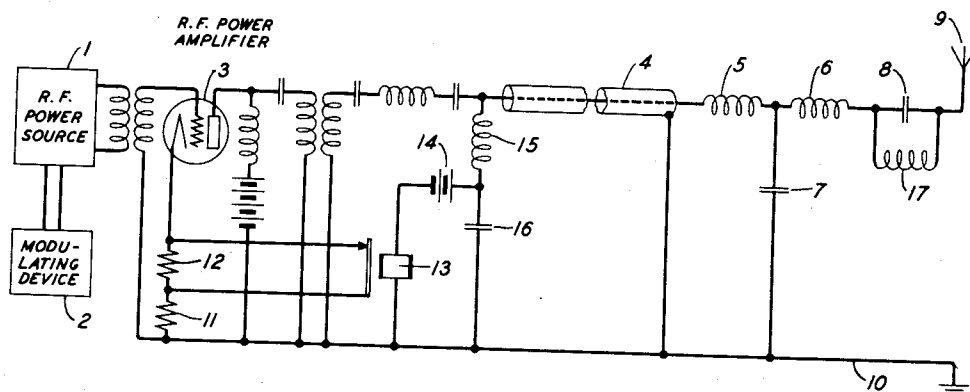
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PROTECTIVE DEVICE FOR ELECTRICAL APPARATUS

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PROTECTIVE DEVICE FOR ELECTRICAL APPARATUS

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The invention relates to systems for protecting electrical apparatus from excessive discharges and more particularly for protecting high powered radio apparatus from prolonged frequency discharges of a destructive nature.

Radio transmitting equipment, on account of the exposed position of the antenna, for example, is generally subject to disturbance by lightning with effects varying from momentary arcing to complete destruction of apparatus. Arcs or short circuits caused by lightning are usually of very brief duration and of themselves may be quite harmless in the majority of instances. It frequently happens, however, that a lightning arc occurs between conductors which are carrying high potential radio frequency waves or currents which will follow the conductive path established by the lightning discharge and prolong the short-circuit condition indefinitely after the lightning potential has disappeared. The power dissipated by the radio frequency source during the continued short-circuit condition may be comparatively large, causing injury to or destruction of the affected transmitting apparatus. The delay incident to the repair or replacement of the apparatus, even in case of slight injuries, is likely to be costly, particularly in the case of a radio transmitting station engaged in the commercial broadcasting of programs. In severe cases the damage may be very costly to repair.

Static discharges from sources other than lightning may also cause arcing. In some cases the arc may be due originally to overloading of the transmitting circuits with radio frequency power in the course of the regular operation of the station. Whatever the source of the excessive potential, the momentary breakdown may occur at any exposed point, for example, at the antenna, or in the antenna tuning circuit, or in the transmission line connecting the transmitter to the antenna system.

According to the invention, a relay circuit is so arranged that an arc or short circuit at a point to be protected serves to alter the relay circuit, causing the relay to be actuated. The power to actuate the relay may be supplied by a battery or generator, preferably either a source of direct current or a source of alternating current of relatively low frequency compared to the operating frequency of the apparatus to be protected. The operation of the relay serves to disable the radio transmitter or high frequency generator or to disconnect the same from the portion of the circuit containing the arc. The isolation of the main power source thus effected

continues for as long a time as the arc persists. Without the support of the main power source the arc usually extinguishes itself very rapidly. When the arc is extinguished the relay operating circuit is restored to its original condition, releasing the relay and automatically reconnecting the high frequency power.

The single figure of the accompanying drawing shows an embodiment of the invention in a radio transmitting system.

The conventional portions of the transmitting system include a radio frequency power source 1, a modulating device 2 whereby the power from source 1 may be modulated in accordance with any desired signals or in accordance with a program. There is also provided in conventional manner a power amplifier tube 3, a radio frequency transmission line 4 which may comprise a pair of concentric conductors, antenna tuning coils 5 and 6, a coupling condenser 7, an antenna circuit series condenser 8, and an antenna 9. A ground bus is shown at 10. The radio frequency amplifier 3 is provided with cathode circuit resistors 11 and 12, of which the former serves to furnish normal operating grid bias for the amplifier, and the latter provides a blocking bias whereby the amplifier may be disabled and the radio frequency power may be substantially prevented from reaching the output circuit of amplifier 3 or any circuit subsequent thereto in the train of circuits leading to the antenna. A relay 13 is provided with a back contact for short-circuiting resistor 12 during normal operation of the transmitting system.

Assuming that it is desired to protect the line 4, coils 5 and 6, condensers 7 and 8, and antenna 9 from destructive effects of prolonged arcing to ground, the relay 13 is placed with its operating winding connected between ground or the bus 10 and the antenna side or inner conductor of line 4. The contacts of the relay 13 are normally closed as indicated. In series with the relay winding is placed a battery 14 or other source of direct current or, if preferred, a generator of low frequency current, and a high frequency choke coil 15. A shunt condenser 16 may also be provided, if desired, to form in conjunction with the coil 15 a simple filter for segregating the high and low frequencies, or the alternating and direct currents. Means such as a high frequency choke coil 17 is employed to provide a conductive or low frequency connection between the antenna and the antenna feed circuits where such connection is otherwise interrupted by a series condenser as in the case of condenser 8.

In the operation of the system, let it be assumed that a lightning discharge or other cause produces an arc or short circuit from the antenna 9 to ground while relay 13 is unoperated and the amplifier 3 is supplying radio frequency power to the antenna through the feed circuits as shown. The arc then serves to complete the operating circuit of relay 13 from the upper terminal of the relay winding through battery 14, coil 15, inner conductor of line 4, coils 5, 6 and 17, antenna 9 to ground 13 (via the arc) and thence to the lower terminal of the relay winding. The relay operates to break its contact, thereby removing the normal short circuit from resistor 12 and causing a blocking value of negative bias to be applied to amplifier 3. By this means the high frequency power is removed from all the circuits shown to the right of the amplifier 3. The high frequency power is in this way effectively prevented from following or maintaining the arc from antenna 9 to ground. Upon cessation of the lightning discharge or other cause the arc will rapidly extinguish itself, usually without having caused any permanent injury to the apparatus. The extinction of the arc breaks the path above described whereby the relay 13 was operated. The relay in releasing short-circuits resistor 12, thereby causing high frequency power again to be transmitted to the antenna feed circuits.

It will be evident that in the system shown the relay 13 will be operated equally well by an arc or short circuit between the conductors comprising line 4, by an arc across the plates of condenser 7, by a flash-over between coil 5 and ground, or between coil 6 and ground, or by an arc in various other circuit locations either to the left or right of the point of connection of the relay 13 to the antenna feed system, provided only that the arc completes a direct current path for the battery 14 through the operating winding of the relay.

It will also be evident that if the battery 14 is replaced by a generator of alternating current the relay will be caused to operate when an arc occurs at such a point as to complete an alternating current path through the relay winding. Preferably the generator for operating the relay supplies a relatively low frequency so that condensers 16 and 7, and the capacity of the antenna to ground do not serve to complete the operating circuit.

It will be noted that the operation of the relay 13 does not depend in any way upon any wave pattern or standing waves which may be set up in the antenna feed circuits by the high frequency waves. If the high frequency wave should have a nodal point where the relay 13 is connected to the feed circuit, making the high frequency voltage null at that point, the presence of the arc, even remote from the relay, will cause reliable operation of the relay. The operation of the relay does not depend upon an over-voltage or other irregularity of the high frequency wave but only upon a conductive ground or short circuit for direct or low frequency current. The system thus affords protection from the effects of accidental short circuits from whatever cause.

Numerous variations of the system illustrated, within the scope of the appended claims, will readily occur to those skilled in the art to which the invention appertains. For example, the high frequency system need not be a radio transmitter nor need the frequency of the main power

source be especially high, provided only that the ordinary operation of the system does not affect the protective relay. It is immaterial, also, by what particular means the protective relay controls the application of the main power to the protected portion of the system.

What is claimed is:

1. In combination, a main power source, a transmission system connected to said source and having a gap subject to temporary rupture by an excessive charge, an auxiliary power source, current actuated means to reduce the transmission of power to said gap from said main power source, and impedance means for blocking currents from said main power source while passing currents from said auxiliary power source, said impedance means, said current actuated means and said auxiliary power source being serially connected in a circuit branch paralleling said gap.

2. In a high frequency transmission system, a high frequency conductor normally insulated from ground, a relay for protecting said transmission system, a source of auxiliary power, and a high frequency choke coil, said source, said choke coil and a winding of said relay being serially connected between said normally insulated conductor and ground, whereby a flash-over to ground from any point of said normally insulated conductor serves to complete a power circuit through the relay winding for the duration of the flash-over to operate the relay for the protection of the transmission system.

3. In combination with a high frequency transmission system, including a high frequency conductor insulated from ground and a relay for protecting said transmission system, a source of auxiliary power and a high frequency choke coil, said source, said choke coil and a winding of said relay being serially connected between said high frequency conductor and ground, whereby an arc from any point of said high frequency conductor to ground serves to complete a power circuit through the relay winding for the duration of the arc to operate the relay in protection of the transmission system.

4. In combination, a main power source, a transmission system connected to said source and having a gap subject to temporary rupture by an excessive charge, a source of direct current, current actuated means to reduce the transmission of power to said gap from said main power source, and a choke coil, said direct current source, said current actuated means and said choke coil being serially connected in a circuit branch paralleling said gap.

5. In combination, a main power source, a transmission system connected to said source and having a gap subject to temporary rupture by an excessive charge, a source of direct current, current actuated means to reduce the transmission of power to said gap from said main source, and a choke coil and a blocking condenser serially connected in a circuit branch paralleling said gap, said source of direct current and said current actuated means being shunted across said blocking condenser.

6. In combination, a source of high frequency power, means for radiating high frequency power, a continuous conductor connected at one end to said radiating means and capacitively coupled to said power source at the other end, a choke coil, a current responsive means to control the delivery of power from said source to said conductor, and a source of direct current,

said choke coil, said current responsive means and said source of direct current being serially connected between said conductor and ground, whereby a flash-over between said conductor and ground serves to complete a conductive circuit for the operation of said current responsive means by current from said source of direct current.

10 7. In a high frequency transmission system, a source of high frequency waves, an antenna for radiation of said waves, a concentric transmission line, the inner conductor of which is

capacitively coupled to said source and conductively connected to said antenna and the outer conductor of which is grounded, current responsive means for controlling the transmission of waves from said source, a source of direct current and a choke coil, said current responsive means, said source of direct current and said choke coil being serially connected between the inner and outer conductors of said transmission line.

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