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CONTROL CIRCUITS

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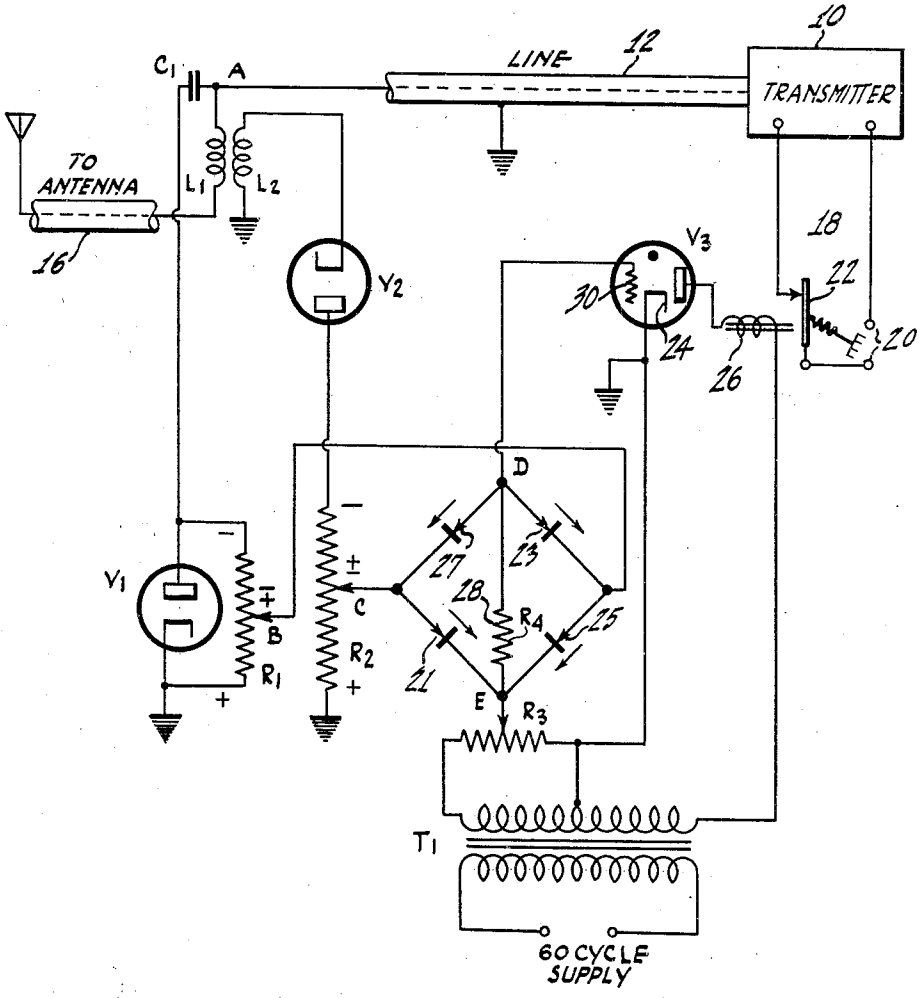

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CONTROL CIRCUITS

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This application involves control circuits for turning off or interrupting the operation of amplifiers, relays, or generators of wave energy such as transmitters of any type, whose output includes continuous substantially steady carrier energy, in the event of a decrease or interruption of said output. My invention is especially applicable to telephony transmitters of the frequency modulation, amplitude modulation, or phase modulation type.

The general broad object of my invention is improved control of wave energy generators, amplifiers, relays, or transmitters.

A more specific object of my invention is to provide an indication, or to shut down a transmitter or other source of wave energy upon any change in the character of the load at the transmitter or source output, such as would result from arc-over or other failure in the transmitter circuits.

In the prior art circuit controls operating on a change of voltage in some part of the circuit are known. Likewise, circuit controls operating on a change in the magnitude of current in some part of the circuit are known. Neither of these known types of control are entirely satisfactory because in the systems operating on voltage change there may be a circuit failure that still permits voltage of the normal operating amplitude to be developed at the monitoring point, and the control is not operated to break the circuit or perform other protective operations to prevent damage to the circuit. Likewise, in the systems operating on current change there may be circuit failures which do not result in a material current intensity change which in turn may be used to operate the control circuits.

Take for example a known arrangement wherein a transmitter feeds a load over a line and the control voltage is picked up from the line. An arc-over in the line may occur due to defective insulation. If this arc-over happens at a certain critical fraction of a wave length or a multiple of said fraction from the monitoring point, that is, the point from which the control circuit exciting voltage is derived, the voltage at that point may not change in magnitude. Then the control circuit would not be excited to function as intended. Likewise, if the failure takes place at a critical distance from the point at which the monitoring current is obtained there may not be a change in the intensity of the current and again the control would not be actuated to shut down the transmitter or otherwise condition the same so that damage will not result from the said circuit failure.

An object of our invention is to provide a radio frequency circuit control system that is free of the above and other defects.

In systems of the type mentioned above by way

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of example, practically all circuit failures cause a change in the ratio of the voltage to the current in the load or line or transmitter output. In attaining the objects of our invention as outlined above, we provide a control circuit which responds to this change that takes place in the ratio of the voltage to the current at some point in the line between the load and transmitter or other controlled circuit in the event of failure in the circuit.

In describing our invention in detail, reference will be made to the attached drawings wherein the single figure illustrates by wiring diagram and schematically the essential features of a transmitter or other radio frequency circuit control system arranged in accordance with our invention. In the drawings, 10 represents a transmitter or other source of wave energy of any type having in its output steady carrier current or energy. The transmitter supplies output by way of a line 12 to an antenna or other load circuit 16. The output circuits and load are given merely by way of example, and may take various forms to suit the needs of the installation being controlled. In the sake of simplicity and to expedite description, a simple output line and an antenna feed line have been shown. The transmitter may include a disabling circuit which itself operates to shut down the transmitter, or the disabling circuit may operate through other circuits to accomplish the control desired. The controlled circuit is shown at 18 as comprising a pair of leads connected to the transmitter for control purposes and to contacts 20 to which operating current may be applied to excite the control circuit. As an example, the points 20 may be in the alternating current supply circuit for the rectifier system supplying the plate direct current potentials for the transmitter. On the other hand, the circuit 18 may be of a relay controlling contacts in a circuit in the transmitter directly or through other relays. One of the leads includes a contact operated by an armature 22 in a relay including winding 26, which is excited when the transmitter is operating properly to complete the circuit 18 to keep the transmitter in operation.

A first diode V1 is connected by a condenser C1 between a point on the inner conductor of the line 12 and ground. The voltage supplied through C1 to the rectifier V1 is proportional to the voltage on the line. Rectified current flows through the rectifier V1 to produce across the resistance R1 a potential depending upon the magnitude of the voltage supplied by C1. The line also includes an inductance L1 coupled to an inductance L2 connected in series with the rectifier V2 and a second resistance R2 wherein is produced a potential drop proportional to the voltage induced into inductance L2. The

voltage induced in L2 is proportional to the current in the inner conductor of the transmission line 12 at point A. The rectifier V2 provides current in the resistance R2 to set up thereacross a potential drop proportional to the voltage on V2 which is in turn proportional to the current in the inner conductor of line 12. A point B on resistance R1 is connected to one corner of a rectifier bridge circuit 28, while a point C on resistance R2 is connected to the opposed corner of the bridge rectifier. In effect, one diagonal of the bridge rectifier is tapped across resistances R1 and R2. The other corners of the bridge rectifier are connected respectively one, D, to the grid 30 of an electron discharge tube V3, and the other, E, to a point on a potentiometer resistance R3 in shunt to a portion of the secondary winding of a transformer T1. Resistor R4 is also connected between points D and E so that it is in shunt to the input impedance of tube V3. A point on the transformer T1 is connected to the cathode 24 of tube V3 so that an adjustable amount of the secondary winding of the transformer T1 may be included in the grid circuit of the tube V3. The transformer T1 has a primary winding which may be supplied by alternating current power such as, for example, 60 cycle current at 110 volts. The anode circuit of the tube V3 is completed through the winding 26 and a part of the secondary winding of the transformer T1.

The tube V3 is a Thyratron of the type known as a negative grid Thyratron. In this type of Thyratron negative potential is applied to the grid to prevent it from firing but if positive potential is applied to the anode the tube fires as the negative grid potential is decreased but before the grid potential becomes zero or positive. In the embodiment illustrated we apply the 60 cycle alternating potential to the grid and anode in phase opposition. The amount of alternating potential on the grid is so adjusted relative to the alternating potential on the anode that when no negative bias potential is applied to the control grid from points D and E of rectifier 28 the tube will just draw enough current to excite relay winding 26 to hold armature 22 in the contact closed position. It will be understood that an alternating potential is used to critically bias the grid of the Thyratron in lieu of a direct current bias merely for the sake of convenience and simplicity. Since the alternating potentials applied to the grid and plate from the alternating current source are in phase opposition, the effect is substantially the same as if a direct current bias were used. The tap on potentiometer R3 is so adjusted that the grid of tube V3 is not biased to cutoff and the tube is just firing when the transmitter is operating normally. Then the points B and C on potentiometer resistances R1 and R2 are adjusted so that the voltages supplied from points B and C to the corners of the bridge are just equal, there is no potential developed across R4, and the potential on the grid 30 is unchanged. Consequently, current continues to flow in tube V3 to hold armature 22 in the position shown.

In operation, two radio frequency voltages, one proportional to the voltage in the inner conductor of the transmission line at the point A, the other proportional to the current at the same point are rectified by tubes V1 and V2. The potentiometers R1 and R2 are adjusted so that no potential exists between the points B and C under normal operating conditions in transmitter 10. The potentiometer R3 is adjusted so that the Thyratron V3 is biased near cutoff but still drawing enough current to operate the control relay 26. The rectifier bridge 28 is connected so that any potential appearing between points B and C causes point D to become negative with respect to E. This will be so since if point C becomes positive current flows through the rectifier 21 to point E through R3 to the cathode 24 and to grid 30, to point D, and through rectifier 23 to point B. If point C becomes negative with respect to point B current flows from point B through rectifier 25 to point E, through R3 to cathode 24 to grid 30 to point D, and through rectifier 27 to point C. The grid 30 then becomes more negative and cuts off the current through winding 26 to permit contact 22 to open and interrupt the circuit 18 to stop operation of the transmitter. Thus if either the reactance or resistance of the load 12, 16, etc., changes the ratio of the potentials applied to tubes V1 and V2 will change and the potentials thereby developed at points B and C will become unequal and increase the negative bias on the Thyratron grid 30, causing the relay contacts including 22 to open to operate through circuit 18 or circuits controlled thereby to shut down the transmitter. As soon as the control circuit has functioned to shut down the transmitter, the potential from B to C returns to zero, the Thyratron fires, and the relay contacts are reclosed, thereby restoring the circuit to normal. The transmitter may be arranged to then restart automatically or under the control of the operator.

What is claimed is:

1. In electrical apparatus for controlling the operativeness of a radio or equivalent circuit wherein continuous alternating current appears during operation, a rectifier for deriving a voltage the magnitude of which depends on the voltage in said circuit, a second rectifier for deriving a voltage the magnitude of which depends on the intensity of the current in said circuit, a bridge circuit connected to said recifiers for comparing said derived voltages, and a tube coupled to said bridge circuit and subjected to changes in said derived voltages for controlling the operativeness of said circuit in the same sense by changes in either direction in the magnitudes of either of the compared voltages.

2. In apparatus for controlling the operativeness of a radio or equivalent circuit in accordance with changes in magnitude of continuous alternating current, a rectifier and a resistance for deriving a voltage the magnitude of which depends on the voltage in said circuit, a second rectifier and a second resistance for deriving a voltage the magnitude of which depends on the intensity of the current in said circuit, a bridge circuit having four impedance arms, connections between opposed corners of said bridge and said resistances, a tube having a control grid and a cathode coupled to other points on said bridge, and a relay associated with said first mentioned circuit and coupled to the output electrodes of the tube.

3. In combination, a transmitter, a load coupled to said transmitter by a transmission line, a control circuit including contacts for said transmitter, a first rectifier circuit coupled by a condenser to a point on said line to be excited by the voltage therein, a resistance in said first rectifier circuit, an inductance in said line, a second inductance coupled to said first inductance and connected in a second rectifier circuit including a second resistance, a gaseous tube having an anode coupled

to a relay winding associated with said contacts, said gaseous tube having a control grid, a bridge circuit having a first diagonal connected between the control grid and cathode of said gaseous tube, said bridge circuit having a second diagonal, and connections between the second diagonal of said bridge circuit and points on said resistances.

4. In combination, a transmitter, a load coupled to said transmitter by a transmission line, a control circuit including contacts for said transmitter, a first rectifier circuit, including a load impedance, coupled to said line to produce voltage of a magnitude depending on the magnitude of the voltage in the line, a second rectifier circuit, including a load impedance, coupled to said line for developing a voltage of a magnitude depending on the intensity of the current in said line, a gaseous discharge tube having an anode coupled to a relay winding associated with said contacts, said tube having a control grid and a cathode, a bridge circuit having a first diagonal connected between the control grid and cathode of said tube, said bridge having a second diagonal, and connections between the second diagonal of said bridge and said load impedances.

5. In combination, a source of wave energy of substantially steady constant strength, a circuit excited by said energy, a first rectifier excited

by voltage at a selected point in said circuit, a second rectifier inductively coupled to said circuit at said point, an electron discharge device having a control grid and having in its output a relay with contacts in said circuit, a circuit for applying a biasing potential to said grid of a value such that said tube is conductive, a load impedance for each rectifier, and a circuit coupling said load impedances to said control grid of the device to apply to said control grid a less positive bias to reduce the conductivity of the device in the presence of material changes in the intensities of the currents in said rectifiers.

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