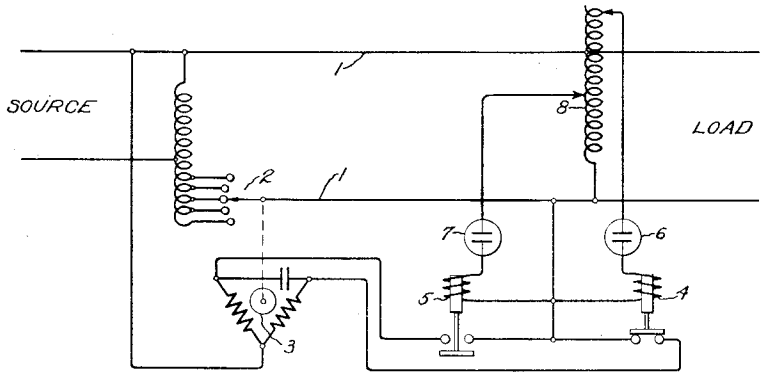
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VOLTAGE CONTROL CIRCUIT

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VOLTAGE CONTROL CIRCUIT

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5 Claims. (Cl. 171—119)

My invention relates to voltage control circuits and more particularly to improvements in automatic voltage control circuits employing glow discharge tubes.

A glow discharge tube is a device containing a pair of electrodes in a low pressure atmosphere of inert gas, such as neon. Such tubes have the property of exhibiting a very high electrical resistance up to a predetermined voltage difference applied between the electrodes whereupon the tube breaks down and an electrical discharge takes place between the electrodes thereby reducing the electrical resistance of the device to a relatively low value. The particular breakdown voltage depends upon a number of factors such as the geometry of the tube and the kind and pressure of gas employed.

In practicing my invention I utilize the fact that a given glow discharge tube breaks down at a voltage which is slightly higher than that at which the discharge will be discontinued if the voltage across the tube is lowered. It is possible to obtain tubes for which the difference in voltage between breakdown and cessation of breakdown is of the order of 1%.

An object of my invention is to provide a novel and simple voltage control circuit.

Another object of my invention is to provide a novel voltage control circuit utilizing separate glow discharge tubes for controlling, respectively, the raising and lowering operation of an automatic regulator.

My invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the single figure of the accompanying drawing I have shown by way of example an alternating current electric circuit 1 as representing electrical apparatus whose voltage is to be regulated. For regulating this voltage I may employ any well known regulating means and for this purpose I have illustrated a tap changing voltage regulating auto-transformer 2. For driving the tap changing means of the regulating transformer I provide a reversible electric motor 3 in the form of a well-known capacitor motor. For controlling the direction of operation of motor 3 so as to cause a voltage raising operation of the regulating transformer 2 I provide a raise relay 4 and likewise for controlling the direction of operation of the motor 3 for causing the regulating means to lower the voltage of circuit 1 I provide a lower relay 5.

For controlling the operation of raise relay 4 I provide a glow discharge tube 6 which, in the form of my invention illustrated in the drawing, is connected in series with the relay 4 across the circuit 1. Similarly, for controlling the operation of lower relay 5 I provide another glow discharge tube 7 connected in series with the relay 5 across the main regulating circuit 1.

In order that the control circuit may be adapted to glow discharge tubes of different types and characteristics and in order that the setting of the system may be changed for different values of regulated voltage as well as different band widths of the regulated voltage I provide means for adjustably varying the voltage applied to each glow tube with respect to the voltage of main circuit 1. This means consists of a manually adjustable auto-transformer 8 through which tubes 6 and 7 are energized.

The operation of the illustrated embodiment of my invention is as follows: As shown in the drawing the parts are in the positions they will occupy when the entire circuit is deenergized. Assume now that a suitable source of current supply is applied to the left-hand or source end of circuit 1 and that, for example, it is desired to regulate the voltage at the right-hand or load end of the circuit 1 to a constant value of 110 volts. The auto-transformer 8 will be so adjusted that when the voltage of the load end of the circuit 1 reaches 110 volts in an increasing direction the glow tube 6 will break down, while if the voltage of the load end of the circuit 1 increases to 111 volts the glow tube 7 will break down. With such a setting of the circuit the glow tube 7 will ordinarily stop its discharge at 110 volts and similarly the glow tube 6 will stop its discharge when the voltage falls to 109 volts.

If now the source voltage, or the setting of the regulating transformer 2, or the magnitude of the load are such that the load circuit voltage is only 106 volts, for example, the motor 3 will be energized from across the circuit through the contacts of the raising relay 4 and the regulating transformer will be operated so as to raise the voltage of the load circuit. When the voltage reaches 110 volts tube 6 breaks down thereby energizing relay 4 and causing it to open its contacts whereupon the motor 3 and hence the regulator are both stopped. Should the voltage continue to rise for any reason, glow tube 7 will break down at 111 volts thereby causing energization of relay 5 which completes a circuit for operating motor 3 in the reverse direction thereby causing the regulator to lower the voltage of the circuit 1. Glow tubes 6 and 7 will now both

be broken down. This lowering action will continue until 110 volts is reached when tube 7 ceases to discharge and relay 5 drops out thereby stopping the lowering action. Should, however, the voltage continue to decrease the tube 6 will stop discharging at 109 volts thereby closing the relay 4 and causing the regulating system to raise the voltage again.

From the foregoing it will be seen that there is only one stable condition of the system and that is when the voltage of the load circuit is within plus or minus one volt of 110 volts.

By suitably adjusting the auto-transformer 8 almost any desired voltage may be maintained constant on the load circuit and also tubes having similar or dissimilar characteristics may equally well be used.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from my invention and I, therefore, aim in the appended claims to cover all such changes and modifications which fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an automatic regulating system, in combination, apparatus having a voltage to be regulated, means for raising and lowering said voltage, a glow discharge tube arranged to stop said means from raising said voltage by breaking down at a predetermined value of said voltage, and another glow discharge tube arranged to start said means lowering the voltage of said circuit by breaking down at a higher voltage than the voltage at which the first glow discharge tube breaks down.

2. In an automatic voltage regulating system of the type having a relay for controlling an increase in voltage and another relay for controlling a decrease in voltage, the combination of two voltage responsive glow discharge tubes for controlling said relays respectively said glow discharge tubes being arranged to break down at different voltages.

3. In an automatic voltage regulating system, apparatus having a voltage to be regulated, means including a relay which when it is deenergized increases said voltage, a glow discharge tube connected so as to cause energization of said relay at a predetermined voltage, means including a second relay which when it is energized decreases said voltage, and a second glow discharge tube connected so as to cause energization of said second relay at a value of voltage higher than the voltage at which the first glow discharge tube causes energization of the first relay.

4. In combination, an electric circuit, voltage regulating means therefor, a relay which when it is deenergized causes said regulating means to increase the voltage of said circuit, a glow discharge tube connected in series with said relay across said circuit and arranged to break down at a predetermined voltage of said circuit thereby to cause energization of said relay, a second relay which when it is energized causes said regulating means to decrease the voltage of said circuit, a second glow discharge tube connected in series with said second relay across said circuit and arranged to break down at a particular voltage of said circuit which is higher than the predetermined voltage at which the first glow discharge tube breaks down thereby to cause energization of said second relay.

5. In combination, an alternating current circuit, a voltage regulating transformer therefor, a reversible motor for operating said regulating transformer, means including a relay which when it is deenergized causes said motor to operate said regulating transformer so as to raise the voltage of said circuit, a glow discharge tube connected in series with said relay across said circuit and arranged to break down and thereby energize said relay at a predetermined voltage of said circuit, means including a second relay which when it is energized causes said motor to operate said regulating transformer so as to lower the voltage of said circuit, a second glow discharge tube connected in series with said second relay across said circuit and arranged to break down and thereby energize said second relay at a particular voltage of said circuit, and an adjustable auto-transformer for insuring that the first glow tube breaks down at a lower voltage than the second tube does.

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