Dec. 15, 1936. C. H. BROWN 2,064,192

PROTECTIVE CIRCUIT

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Fig. 1

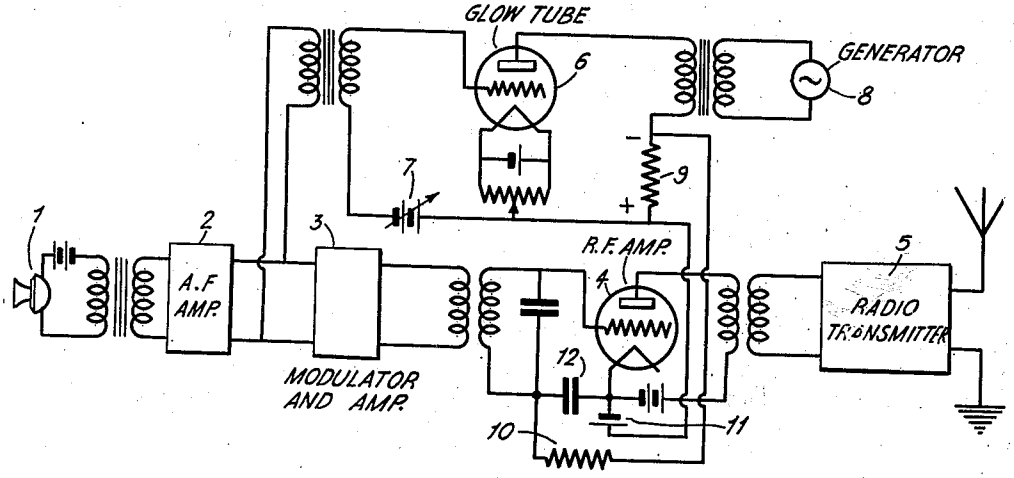
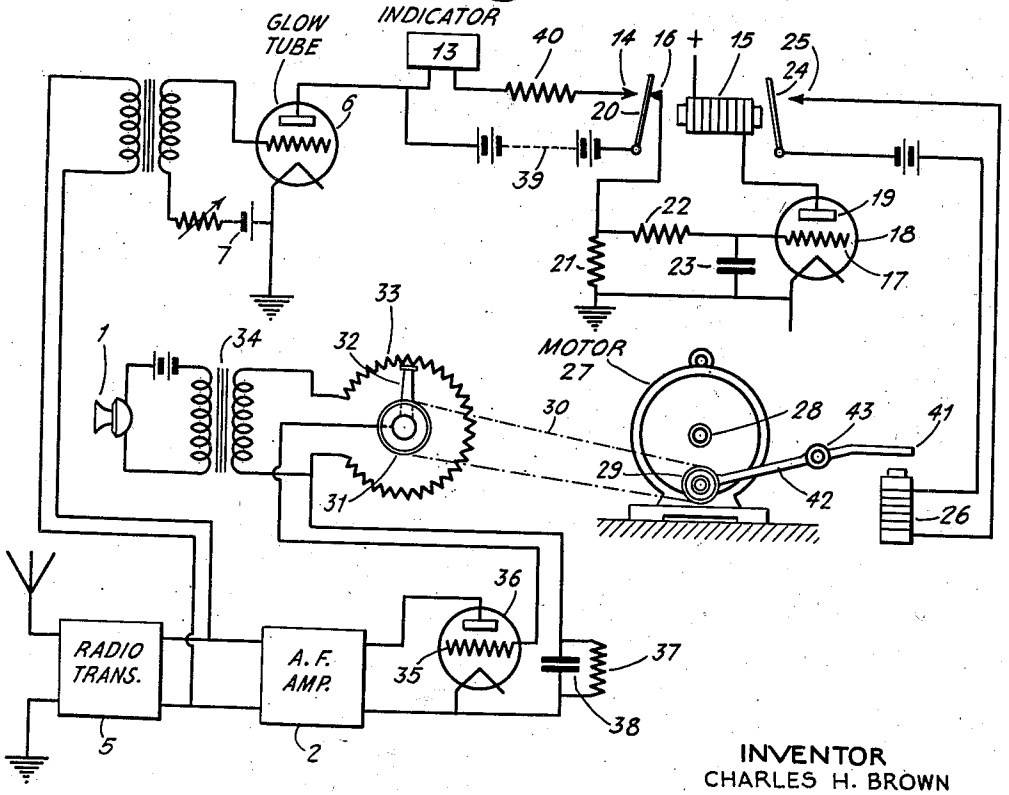


Fig. 2



INVENTOR
CHARLES H. BROWN
BY H. S. Hoover
ATTORNEY

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PROTECTIVE CIRCUIT

Charles H. Brown, Brooklyn, N. Y., assignor to Radio Corporation of America, a corporation of Delaware

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5 Claims. (Cl. 179—171)

This invention relates to a method of and apparatus for controlling, within predetermined limits, the value of transmitted energy in communication circuits.

One of the objects of the present invention is to enable the automatic control of transmitting apparatus upon the occurrence therein of voltages exceeding a predetermined peak value. A further object is to prevent overmodulation in transmitter communication apparatus.

Another object is to obtain an indication substantially simultaneously with the functioning of the over-modulation automatic control apparatus.

A feature of the invention resides in the automatic volume control apparatus employed which utilizes a grid controlled glow discharge device for varying the degree of bias of the transmitting amplifier system.

Another feature is the circuit combination of glow device and motor mechanism for mechanically controlling the amount of resistance in the grid circuit of an amplifier tube in the transmitter.

One important advantage of the invention, which is achieved by a particular embodiment thereof, lies in the inertialess control of the volume of the transmitting system and the complete absence of mechanically moving parts. Such control dispenses entirely with the use of mechanically operating relays and rotating mechanism.

Other objects, features and advantages will appear in the subsequent detailed description which is accompanied by a drawing; wherein Figure 1 illustrates, schematically, and by way of example only, a radio transmitting system provided with an over-modulation control in accordance with the preferred embodiment of the invention, and Figure 2 illustrates a modification thereof.

Referring to Figure 1 in more detail, there is shown a radio transmitting system comprising a microphone 1 arranged to impress speech currents upon an audio frequency amplifier 2, the latter, in turn, feeding into a modulator and amplifier circuit 3 which may be arranged in any well known manner to modulate a suitable carrier source, not shown. In circuit with the output of the modulator and amplifier 3 is a radio frequency amplifier circuit 4 from which the amplified message waves are passed to suitable transmitting apparatus 5 before being sent out over the antenna.

Connected with the output side of audio frequency amplifier 2 there is provided a grid controlled glow discharge device 6 of the type known in the art by the trade name "Thyratron" whose grid or control electrode is biased by a variable battery 7. The characteristics of this device are such that upon the application of a positive potential to the grid of a value sufficient to overcome the negative bias produced by the battery 7, there will be formed a glow or arc in the tube, upon the occurrence of which the grid of the glow device loses control and current flows in the anode circuit thereof. This glow will continue and the current will flow in the anode circuit until the voltage between the electrodes of the device falls below a critical value necessary to continue the glow. To effect this fall in potential so as to regain control of the glow device, there is provided in the anode circuit of the tube and coupled thereto by a transformer, a low frequency generator 8, having a frequency of about 60 cycles per second or so. This generator may, if desired, be used to supply the heating current for the cathodes of the different electron discharge devices of the circuit. It will also be understood that, if desired, variable battery 7 may be replaced by any suitable potentiometer device for providing any required bias for the grid of the glow device 6.

In the anode circuit of glow discharge device 6 is a volume control resistance 9 which, in series with another resistance 10 and a small battery 11, aids in providing desired bias potentials for the grid of radio frequency amplifier tube 4 in the transmitter. The negative side of resistance 9 is shown connected to the grid of tube 4 and the positive side of the resistance to the cathode of tube 4 through battery 11.

In the operation of the transmitter, any over-modulation or peak voltage produced by the speech waves impinging upon microphone 1 and amplified by the apparatus in box 2, which voltage is greater than a certain value determined by variable battery 7 will be impressed upon the grid of glow device 6 and will cause the potential on the grid to go positive, thus initiating the glow in the glow device with the consequent flow of current in the anode circuit through resistance 9.

The flow of current in resistance 9 will, in turn, engender an IR drop therein, and cause an increase in the negative bias placed on the grid of radio frequency amplifier 4, thus resulting in a decrease in the gain effected by the amplifier. When the potential of generator 8 is

in such direction during the negative part of a cycle to break the glow in the tube, the bias on the grid of radio frequency amplifier 4 will be reduced and the gain of the amplifier increased.

From the foregoing, it may be seen that any peak voltage impressed on glow tube 6 for a short interval of time will cause a rapid interrupted flow of current in the anode of tube 6 at the rate of the frequency of generator 8, and a rapid change in bias on the grid of radio frequency amplifier tube 4. The successive initiations and cessations of current flow in resistance 9 caused by the interruptions of the glow in tube 6 will engender a ripple in voltage across resistance 9 which will be filtered out by resistance 10 and condenser 12.

If desired, a time constant circuit, such as a resistance and condenser combination, may be provided in the grid circuit of radio frequency amplifier 4 which will charge up sufficiently to affect the bias on the grid of the amplifier only when the over-modulation effects in the transmitter continue over a short predetermined interval of time.

Although Figure 1 has been described with especial reference to a speech circuit, it will be obvious, of course, that the principles are equally applicable to a telegraph circuit whose voltages are apt to exceed a predetermined value depending upon the bias of the Thyratron glow device 6.

Figure 2 illustrates a modification of Figure 1, wherein there is provided a mechanical volume control device and an indicator, the latter of which may be either visual, audible or both. In this figure, in the output circuit of glow device 6 is any suitable indicator device 13 which is connected with a make contact 14 of a relay 15, the break contact 16 of which is in circuit with the control grid 17 of a vacuum tube 18 whose anode 19 is serially connected to the energizing winding of relay 15. Normally, vacuum tube 18 is arranged to pass current and to operate relay 15 so that armature 20 engages contact 16 in the manner shown in the drawing. Indicator device 13 may be any desired arrangement, such as a lamp, a meter, an alarm, or any combination of these.

In the grid circuit of vacuum tube 18, and associated with the break contact 16 of relay 15, is a resistance-capacity circuit comprising resistances 21, 22 and condenser 23, this circuit having a time constant of several seconds. The circuit is designed normally to bias the grid of tube 18 to permit the flow of current in the anode circuit thereof. As an example of the values which may be used, resistance 22 may be two megohms and condenser 23 two microfarads.

The advantage of this time constant arrangement is that there may be obtained an indication lasting any desired length of time even though the peak of the input voltage impressed upon the grid of glow tube 6 has a duration of but a small fraction of a second.

For controlling the transmitter circuit and in circuit with another armature 24 and make contact 25 of relay 15 through an electromagnet 26, is a motor 27 which is arranged to be continuously operated and which has a frictional cylindrical extension 28 on its shaft. A frictional drum 29 is arranged to drive a belt 30 which passes over a pulley 31 in engagement with a sliding contact 32 which rests on a resistance 33, the sliding contact being moved over the resistance when pulley 31 is rotated.

The resistance 33 is a simple form of volume control for the telephonic transmitter shown. This transmitter arrangement may comprise, as shown before, a microphone 1 supplied with a direct current through a suitable battery, the audio frequency output of the microphone passing through the primary and secondary windings of transformer 34. The volume control arrangement is adapted to control the grid 35 of a vacuum tube 36, the output of which may be supplied to a suitable audio frequency amplifier 2 from which the message waves are transmitted to a radio transmitter 5. The grid-cathode circuit of vacuum tube 36 is determined by a resistance condenser combination 37, 38.

The operation of the circuit arrangement of Figure 2 will now be described.

The receipt of any message wave in the input circuit of the grid glow device 6 from audio frequency amplifier 2 which produces a signal pulse whose voltage is of the desired polarity and whose peak overcomes the negative biasing voltage applied to the grid of Thyratron 6 by battery 7, herein shown supplied through a variable resistance, will raise the grid to a positive potential and cause the glow in the device to strike, after which the grid of glow device 6 loses control. The passage of current over a circuit including the anode of the grid glow device, battery 39, armature 20 of relay 15, break contact 16 and resistance 21, will cause a negative potential to be applied to the grid 17 of vacuum tube 18 which is sufficient to lower the voltage on the grid 17 an amount necessary to cut off the anode current flowing through the vacuum tube 18 and through the winding of relay 15. Relay 15 will, of course, release and permit armature 20 to engage the contact 14, thus closing a circuit to actuate indicator 13, this circuit being traced from the positive terminal of source 39 through the indicator 13, resistance 40, make contact 14, and armature 20 of relay 15 to the negative terminal of source 39. Indicator 13 will remain operated until relay 15 is again actuated. It will thus be seen that the contacts of relay 15 will not only break the anode supply circuit of the glow device 6 and permit the grid of the glow device circuit to regain control, but will also operate indicator 13. Condenser 23 will charge up with a negative potential which can only leak off through the slow time circuit. This negative charge on the condenser and grid 17 of vacuum tube 18 will gradually leak off after a period of perhaps two or three seconds, during which time relay 15 remains unenergized. After this period, the current through vacuum tube 18 will again flow, thus causing the re-energization of relay 15 through its winding and a return to the normal operative position of the armature 20 against the break contact 16, at which time voltage is again supplied to the anode of the glow device 6. The device will then be ready to respond to another peak of voltage.

With the release of relay 15, it will be noted that the armature 24 of this relay will also fall back to its normal position and engage make contact 25, causing a circuit which will operate electromagnet 26 over an obvious path. The energization of magnet 26 will attract its magnet 41 and cause the movement of bar 42 with armature 41 about the pivot 43, consequently raising the frictional drum 29 into contact with cylindrical extension 28 on the shaft of the motor 27, the operation of which will cause belt

30 to rotate contact 32 over resistance 33 by means of pulley 31 and thus control the volume of the transmitted message waves through the grid 35 of vacuum tube 36. In this manner the degree of amplification may be reduced until over-modulation on peaks no longer occurs.

The embodiments of the invention illustrated and described herein have merely been selected for the purpose of clearly setting forth the principles of the invention. It will be apparent, however, that the invention is susceptible of being modified to meet different conditions encountered in its use and that it is applicable to all types of transmitting arrangements, whether radio or landline; and it is, therefore, aimed to cover by the appended claims all modifications within the spirit and scope of the invention.

I claim:

1. In a transmitter provided with excessive signal voltage control, a source of message waves, an audio frequency amplifier for amplifying said message waves, a modulator and a radio frequency amplifier associated with the output of said audio frequency amplifier, a grid controlled glow discharge device, an input circuit for said glow device including means for varying the bias on the grid thereof, said input circuit being connected to the output of said audio frequency amplifier, and an output circuit for said glow discharge device connected to the input of said radio frequency amplifier for controlling the bias of said radio frequency amplifier, said glow discharge device being responsive to voltages in its input in excess of a predetermined value for biasing said radio frequency amplifier to decrease its gain.

2. In combination, a glow discharge device having an anode, a grid, and a cathode, the glow in said discharge device being arranged to strike upon the application of a positive potential of predetermined value to the grid thereof, an input circuit coupled to said grid, an output circuit including a source of potential connected to said anode, an indicator, a vacuum tube relay in circuit with said output and responsive to a current flow therein for interrupting said output circuit and for connecting said source of potential to said indicator for operating same, an amplifier tube, and means in circuit with said vacuum tube relay and responsive to its operation for controlling the gain of said amplifier tube, whereby the amount of amplification of said amplifier tube is reduced in response to the functioning of said glow discharge device, the output of said amplifier tube being coupled to said input circuit.

3. In combination, a glow discharge device having a cathode, grid and anode, the glow in said discharge device being arranged to strike upon the application of a positive potential of predetermined value to the grid thereof, an input circuit coupled to said grid, and an output circuit coupled to said anode, an amplifier tube, a vacuum tube relay in circuit with the output of said glow device and responsive to a current flow therein for interrupting said output circuit and for controlling the gain of said amplifier tube, whereby the amount of amplification of said amplifier tube is reduced in response to the functioning of said glow discharge device.

4. In combination, a glow discharge device having a cathode, grid and anode, the glow in said discharge device being arranged to strike upon the application of a positive potential of predetermined value to the grid thereof, an input circuit coupled to said grid, an output circuit including a source of potential connected to said anode, an indicator, a relay normally arranged to be operated having an energizing winding, an armature and a make and break contact, said source of potential being connected to said armature, a vacuum tube normally arranged to pass current having a control electrode and an anode, said control electrode being in circuit with the output of said glow tube and with said source of potential through the break contact and armature of said relay, the anode of said vacuum tube being in series circuit with the winding of said relay, and said indicator being connected on one side to one terminal of said source of potential and on the other side to the make contact of said relay whereby any engagement of said armature with said make contact will actuate said indicator from said source, said relay being responsive to a cessation of current flow through the anode circuit of said vacuum tube for disconnecting said source of potential from the control grid of said vacuum tube and for connecting said source to said indicator for operating same, an amplifier having an input circuit, a motor controlled potentiometer for controlling the bias of the input circuit of said amplifier, and means including an electromagnet responsive to the release of said relay for controlling the gain of said amplifier through said motor controlled potentiometer.

5. In a transmitter, a microphone, an audio frequency amplifier for amplifying the waves impinging on said microphone, a modulator connected to said audio frequency amplifier, and a radio frequency amplifier tube having anode, cathode, and control electrodes connected to said modulator, a grid controlled glow discharge device having an input circuit and an output circuit, said input circuit being connected between said audio frequency amplifier and said modulator for receiving the amplified audio frequency message waves, said output circuit comprising the secondary winding of an audio frequency transformer and a resistance in series with said winding, a generator of low frequency currents coupled to the primary winding of said audio frequency transformer, a connection including a source of potential from that terminal of said resistance remote from said secondary winding to the cathode of said radio frequency amplifier, and a conductive connection including another resistance from the other terminal of said first resistance to the control electrode of said radio frequency amplifier, said control electrode being coupled to said modulator, and said anode of said radio frequency amplifier being coupled to a utilization circuit.

CHARLES H. BROWN.