

May 4, 1937.

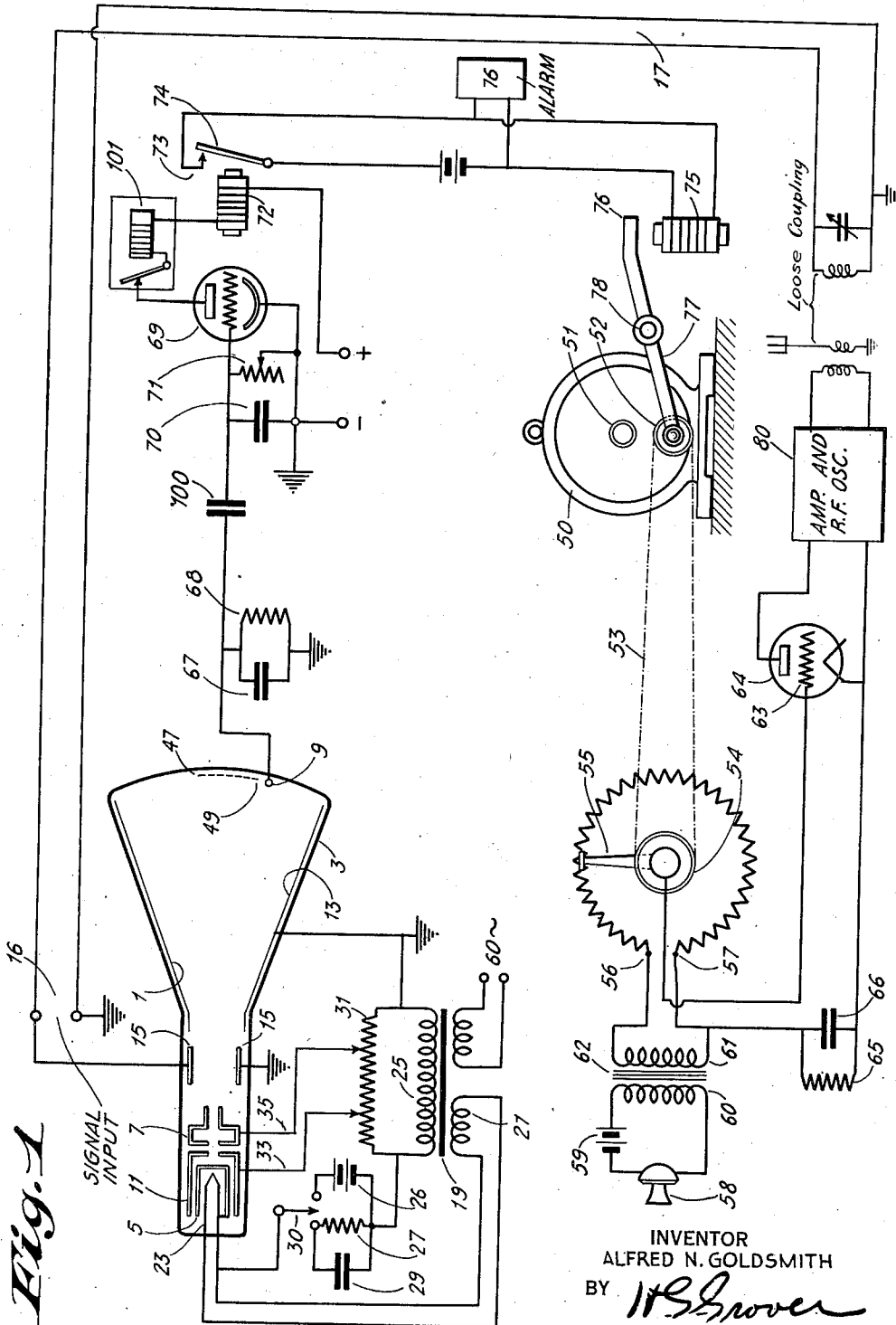
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2,079,446

OVER MODULATION PROTECTIVE DEVICE

Filed Oct. 20, 1933.

2 Sheets-Sheet 1



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Fig. 3

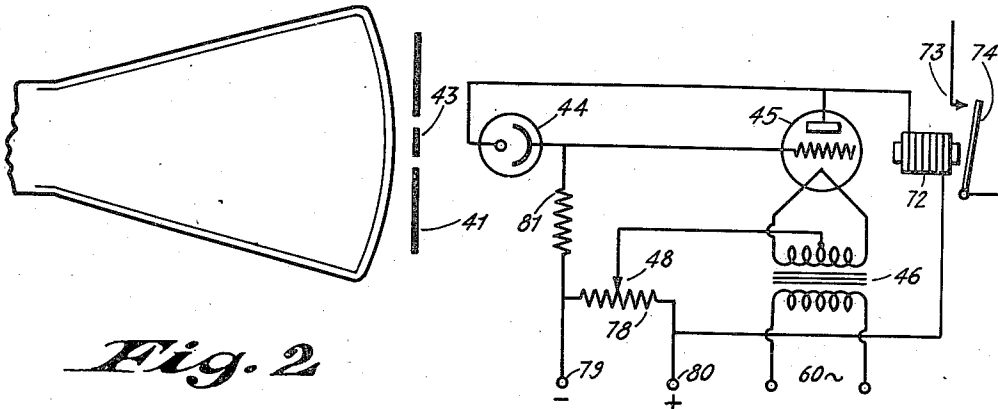


Fig. 2

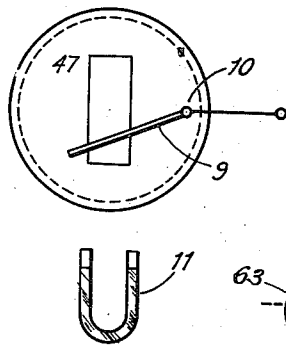


Fig. 5

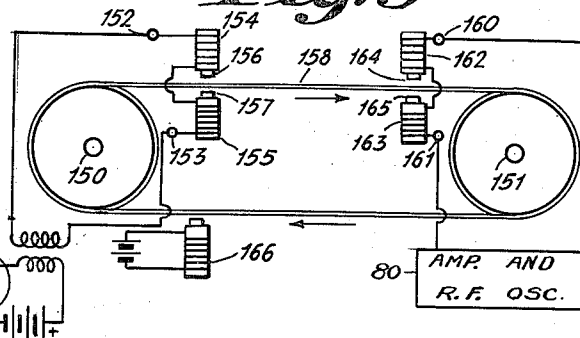
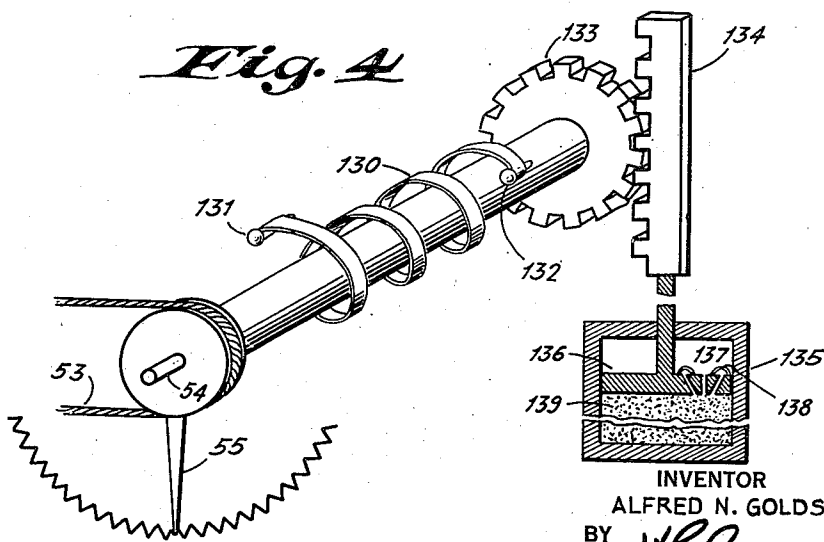


Fig. 4



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OVER-MODULATION PROTECTIVE DEVICE

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Application October 20, 1933, Serial No. 694,383

18 Claims. (Cl. 179—171)

This invention comprises a correction device for preventing the occurrence of excessive signal voltages or over-modulation in communication systems.

5 A primary object of the invention is to obtain automatic control of signal apparatus in response to over-modulation effects in a simple and highly efficient manner.

10 A further object is to provide a corrective arrangement for signal apparatus which utilizes a deflection of a beam of energy in one or more directions which is proportional or related to the signal voltages for correcting for departures of the signal apparatus from a desired condition.

15 A still further object is to provide a device for indicating peak voltages in excess of a predetermined value.

20 Although the foregoing objects are herein described as being accomplished by using a cathode ray tube, it is to be understood that any device may be employed which utilizes an electric-charge-carrying stream or a luminous beam controllably deflected or modified through the agency of a modulated current, or, for that matter, 25 any rapidly responsive galvanometric indicator of the same current.

30 A feature of the present invention lies in the utilization of a particular type of cathode ray tube which obviates the necessity of the use of steady currents, such as those provided by direct current sources for the electrodes of the devices. Essentially, this type of tube is the same as that described in a copending application of Dr. Irving Wolff, Serial No. 678,208, filed 35 June 29, 1933, which relates to peak voltage visual indicators of the cathode ray type and wherein the tube functions by the application of alternating voltages in phase to the two anodes and the control electrode of the tube. In this arrangement, the control electrode is normally 40 biased negative and the alternating voltage applied to it is given such a value that the negative bias is periodically reduced sufficiently to permit the passage of the electron beam through the tube. This will be described in more detail later in the specification.

45 The present invention involves, according to one modification, placing an auxiliary electrode within the cathode tube for effecting correction, and, in accordance with another modification, placing a photo-electric cell outside the tube at a point corresponding in the travel of the deflected cathode ray to more than 100% modulation of the peaks. Thus, when either the elec-

trode or the photo-electric cell is energized by the cathode ray as a result of over-modulation, the modulation of the broadcasting transmitting station is reduced through control of the amplification of the circuit until over-modulation on peaks no longer occurs. This is accomplished 5 either through circuits which may have a large time constant and/or by means of small motors actuating gain control apparatus.

Another feature is the delay circuit employed 10 for retarding the special currents which modulate the transmitter in order to enable the complete functioning of the over-modulation protective device before the over-modulation currents actually reach the modulation circuits of 15 the transmitter.

Other features, objects and advantages will appear in the subsequent detailed description of the invention.

20 In the drawings, Figure 1 illustrates, by way of example only, the novel portions of a complete system in accordance with the principles of the present invention for preventing over-modulation in the transmitter of a communication system; Figure 2 illustrates a view looking 25 squarely into the round end of the cathode ray device and shows the particular relation of the electrode within the tube to the path of travel of the cathode ray beam; Figure 3 shows a modification of the arrangement of Figure 1 wherein a photo-electric cell may be utilized externally 30 of the cathode ray tube instead of the internal electrode arrangement shown in Figure 1; Figure 4 illustrates a dashpot arrangement for introducing a time delay at the transmitter in the restoration of the transmitter circuit to normal 35 for avoiding over-modulation at the end of the silent periods during the transmission of message waves; and Figure 5 illustrates a particular type of delay circuit adapted to retard or store 40 the message waves in the transmitter.

Referring to Figure 1 in more detail, there is shown a cathode ray tube 1 of a well known type which is commonly used as a receiving tube in television systems and which comprises an 45 evacuated glass envelope 3 for enabling the attainment of a pure electron discharge between the indirectly heated cathode 5 and the first anode 7.

50 The cathode 5 and the anode 7 form an electron gun which causes a beam of electrons to move down the axis of the tube 1 and strike, in the ordinary case, a fluorescent screen when the proper voltages are applied. The tube, as shown, differs from the ordinary cathode ray device by 55

the absence of the fluorescent material and in the insertion of a pivoted electrode 9 which extends, in an adjustable manner, to a point corresponding to a location immediately outside the ordinary path of travel of the electron beam, if over-modulation does not occur. By referring to Figure 2 there is shown a cross-sectional view of the tube looking squarely into the round end of the tube from the narrow portion thereof, the dotted lines indicated representing the silver coating. The trace of the deflected electron beam is shown by reference characters 47, 49, the distance between 47 and 49 depending upon the percentage of modulation. A pivot 10 is provided for the search electrode 9 which enables movement of the free pivoted portion of the electrode 9 for varying its position through the means of a magnet 11 located externally of the tube, the electrode being so positioned that the electron stream will strike electrode 9 only when the modulation rises above a certain point. It will be understood, of course, that magnet 11 is removed when not actually in use for the purpose of adjustably controlling the position of the electrode 9. Alternatively, if desired, a fixed search electrode can be used, and the width of the beam trace 47, 49 controlled so that it does not reach the search electrode unless the percentage of modulation exceeds a predetermined value.

The inner surface of the large end of the envelope 3 of the cathode ray tube is coated with a metal or conducting material to form a second electrode or anode 13 for accelerating or focusing the beam of electrons.

The customary beam deflecting plates 15 are provided to which the signals or message waves, the amplitude of which is to be controlled, are connected through a suitable input circuit 16. This may be a source of the modulation signals for a transmitter which, in the present case, is shown connected through a suitable medium 17 which may be either a conductive or inductive pick-up of a portion or all of the modulated transmitter carrier wave. For energizing the electrodes of the cathode ray tube there is provided, in accordance with the preferred cathode ray tube employed, a transformer 19 which supplies alternating voltages to all of the tube electrodes from a source of 60 cycle current. A low potential secondary winding 21 supplies current to the heater 23 of cathode 5. A high potential secondary winding 25 is connected at one end to the accelerating and focusing anode 13 which is preferably connected to ground as indicated, the other end of the high potential winding being connected to the cathode 5 through either a biasing battery 26 or a resistor 27 which is shunted by a condenser 29. The resistor-condenser combination comprising units 27, 29 is the equivalent of the battery 26 and causes a negative bias potential to be established on the control electrode, this bias potential being obtained by the rectifier action of the cathode ray tube. A suitable switch 30 may be provided for connecting the cathode to either the resistor-condenser combination or to the biasing battery, as desired.

The secondary winding 25 of transformer 19 is shunted by a tapped potentiometer device 31 which supplies the proper alternating voltages to the control electrode 11 and the first anode 7 through conductors 33 and 35, respectively, and corresponding spaced taps on the device 31.

The control electrode 11 is given a negative bias

by means of the condenser-resistor combination so that it never becomes positive, this adjustment being necessary to prevent injury to the cathode. It is preferred to bias the control electrode 11 to cut-off, except during a certain period when it is the least negative, the expression "bias to cut-off" being used in the sense that the control electrode is made so negative that the electron beam is normally prevented from reaching the extreme end of the tube where search electrode 9 is located.

In this manner there is provided a cathode ray tube wherein there is supplied a comparatively low value of alternating voltage to the control electrode 11, which voltage is in phase with the alternating voltage supplied to the anodes 7 and 13, and for this reason the control electrode 11 will reach its least negative value with respect to the cathode at the same time that the anodes 7 and 13 are most positive.

For a more complete description of the operation of this particular type of cathode ray tube reference is made to the copending application of Dr. Irving Wolff, supra.

Although the particular type of cathode ray tube described above is preferred, it is to be understood that for the purposes of the present invention any type of cathode ray device may be employed.

In circuit with search electrode 9 is a time constant circuit comprising a condenser 67 and a resistance 68 which, together with a glow tube 69 normally arranged so as not to pass current controls the action of an alarm 76 and the corrective circuit of the transmitter. The resistance-condenser time constant circuit 67, 68 is arranged to build up a charge for causing the glow tube 69 to function and acts as an integrating device which enables the protective circuit to operate only upon the occurrence of over-modulation for at least a short interval of time; i. e., it permits the over-modulation protective control to operate only if a number of audio frequency cycles of high amplitude have occurred and thus prevents momentary and relatively unimportant high audio frequency modulation from operating the device.

For controlling the transmitter circuit and responsive to the operation of the glow tube there is provided a motor 50 which is arranged to be continuously operated and which has a frictional cylindrical extension 51 on its shaft. A frictional drum 52 is arranged to drive a belt 53 which passes over a pulley 54 in engagement with a sliding contact 55 which rests on a resistance 56, 57, the sliding contact being moved over the resistance when pulley 54 is rotated. The resistance combination 56, 57 is a simple form of volume control for the telephonic transmitter arrangement shown. This transmitter arrangement may comprise a microphone 58 supplied with a direct current through battery 59, the audio frequency output of the microphone passing through primary and secondary windings 60 and 61, respectively, of transformer 62. The volume control arrangement is adapted to control the voltage on grid 63 of a vacuum tube 64, the output of which may be supplied to a suitable amplifier and radio frequency oscillator circuit 80 from which the message waves are transmitted to a radio channel. The grid cathode circuit of the vacuum tube 64 is determined by resistance-condenser combination 65, 66.

The operation of the circuit arrangement of Figure 1 will now be described.

The application of message waves to the plates 15 of the cathode ray device 1 over the signal input circuit 16 will cause the electron beam to trace a path between points 47 and 49 at the outer end of tube 1 depending upon the percentage of modulation. Upon the occurrence of over-modulation, the electron stream will strike electrode 9 and thus cause the application of a voltage to a selector time constant circuit 67, 68 which is arranged to delay the functioning of the over-modulation protective device until such time as a desired voltage is built up on the grid of electron discharge device 69, a condition which will occur when the over-modulation continues for a predetermined interval of time.

The application of the electron stream to electrode 9 will make the electrode more negative and thus cause the grid of glow tube 69 to become more positive due to the presence of condenser 100. The negative bias on the grid will thus be overcome and the glow tube caused to strike and pass current. A condenser 70 and a resistance 71 are in circuit with the grid of glow tube 69 and comprise, in effect, a time delay circuit which cooperates with the resistance-condenser arrangement 67, 68 for retarding the initiation of the flow of current through glow tube 69. Upon the striking of the glow in the tube, relay 72 in the output of the glow tube is energized, thus closing contacts 73, 74 and actuating relay coil 75 over an obvious circuit. If desired, an alarm 76, which may be a bell or any other arrangement, may be caused to function, as indicated. The energization of coil 75 will attract its magnet 76 and cause the rotation of bar 77 with armature 76 around the pivot 78, consequently raising the frictional drum 52 into contact with cylindrical extension 51 on the shaft of the motor 50, the operation of which will cause belt 53 to rotate contact 55 over resistance 56, 57 by means of pulley 54 and thus control the volume of the transmitted message waves impinging upon microphone 58 through the medium of the grid 63 of vacuum tube 64. In this manner, the degree of amplification may be reduced until over-modulation on peaks no longer occurs.

In order to permit the grid of the glow tube to regain control of the circuit once the glow has started, there is provided a circuit breaker or interrupter 101 in the anode circuit, the interrupter functioning in well known buzzer fashion to open the anode voltage supply path. Due to the presence of an appreciable charge in the time-constant circuit connected to the grid, the glow will strike several times until the charge is dissipated which will occur when over-modulation ceases. Electromagnet 72 will remain operated, however, during the rapid fluctuations in the anode circuit caused by the interrupter until the tube ceases to pass current for more than a momentary lapse of time.

Figure 3 shows another modification of the invention which may be utilized instead of the time delay condenser-resistance combination 67, 68 and the glow tube circuit 69 of Figure 1. In this circuit if modulation becomes excessive, light will fall through one of the two apertures in mask 41, 43 onto the photo-electric cell 44, whereupon the relay 72 is made operative through the passage of current in a three-element vacuum tube 45. These apertures are symmetrically located relative to the central position of the cathode ray spot. The operation of relay 72 closes contacts 73, 74 for controlling the protective device in the same manner shown in

Figure 1. For energizing the vacuum tube 45 there is provided a 60 cycle alternating current source which heats the filament through the transformer 46. The potential of the filament is determined by tap 48 on resistance 78 which is bridged across a direct current supply source having terminals 79 and 80. There is provided a grid circuit resistance 81 for properly biasing the grid of tube 45.

In Figure 4 there is shown a dashpot arrangement which may be used to effect rapid control of the over-modulation protective device and slow restoration of the volume control arrangement back to normal. In this arrangement the pulley 54, belt 53 and contact 55 are the same as those disclosed in Figure 1. Attached to the pulley 54 is a shaft to which there is secured a wound up spring 130, one end of which 132 is attached to the shaft and the other end of which 131 is fixed externally in a manner not shown. At the end of the shaft opposite the pulley 54 is a gear 133 which meshes with a rack 134, the lower portion of which is attached to a dashpot, shown in cross section, comprising a cylinder 135 in which moves a piston 136. In the cylinder and attached to the piston is provided a valve 137 which is retained in place by springs 138. A viscous medium 139, such as air, oil or other suitable material, is arranged in the manner indicated to prevent too rapid and undesired movement of the piston 136 in one of its directions of travel. Rack 134 is arranged so that it can be driven downward rapidly, but will return upward under the action of spring 130 slowly and at a rate determined by the flow of the viscous material 139 through the small holes in the valve 137. Accordingly, the device will function as follows:

Assuming that over-modulation occurs, contact 55 will be suitably displaced rapidly and rack 134 will be driven downward rapidly, thus winding up spring 130. If no further over-modulation occurs the rack 134 will rise slowly, gradually carrying contact 55 towards settings corresponding to higher modulation. If the modulation then becomes excessive the process will be repeated. It is preferred that the rate at which rack 134 rises should be quite slow, for example, several tens of seconds. In order to cause a change in the position of contact 55 corresponding to a marked change in the percentage of modulation. The time delay thus introduced by the dashpot should be considerably longer than incidental silent periods in the program for avoiding over-modulation at the end of such periods.

In Figure 5 there is shown a delay circuit adapted to retard the signals in the transmitter for a time sufficient to enable the correcting circuit to adjust the sensitiveness of the transmitting modulation circuits just before the arrival of the signals in the transmitter. The circuit provides an adjustable delaying device which retards or stores the message waves without appreciably distorting the music or speech current for a time sufficient to enable contact 55 of the volume control arrangement shown in Figure 1 to be moved to lower modulation points just before the modulation currents reach the modulation circuit of the transmitter from vacuum tube 64 of Figure 1. In the arrangement shown, there is provided a telegraph wire 158 which is driven by pulleys 150 and 151 and passes between pole pieces 156 and 157 of energizing coils 154 and 155, respectively. These coils are adapt-

ed to be energized by the message waves through terminals 152 and 153 which may be connected in any suitable manner by transformer or otherwise to the circuits associated with the anode and cathode of vacuum tube 64 of Figure 1. The magnetized steel wire 158 is arranged to carry the sound record to the pole pieces 164 and 165 associated with coils 162 and 163, respectively, and to induce in these coils the speech or music currents recorded on the wire. The output terminals 160 and 161 in circuit with coils 162 and 163 are connected to the input of the remainder of the amplifiers of the modulation system which is shown in Figure 1 diagrammatically by box 80, the latter, of course, not being connected to the point of signal input 16 in this instance. The output of tube 64 will be connected to both the input coils 152 and 153 of the telegraphone and also to the point of signal input 16. Coil 166 is a powerful electromagnet and serves to magnetically clean the wire so that it may again be used after passing under coils 164 and 165. It will be understood, of course, that the separation between pole pieces 156 and 157 and 164 and 165, together with the rate of travel of the wire 158 determines the retardation of the message wave.

Alternatively, instead of the telegraphone there may be used, in the same way, well known speech or music retarding filter circuits of the non-distorting type such as are employed, for example, in certain types of trans-oceanic radio reception and transmission systems.

It will thus be seen that there are utilized in the present invention two types of "time delay" circuits; namely, a type of delay circuit such as 67, 68 which permits the over-modulation protective control to operate only if a number of audio frequency cycles of high amplitude have occurred, and also a type of delay circuit such as the telegraphone arrangement which is used to delay any modulation of the transmitter by the audio frequency wave in question until after the control for correcting over-modulation has been able to act.

To some extent, the functioning of the complete system described approaches closely in operation to what would be done by a skilled control room operator. In the operation of the device the volume control is operated and modulation considerably reduced just before over-modulation might occur. The automatic device then "cautiously" and gradually increases modulation until traces of over-modulation are imminent, whereupon the process is repeated. Over-modulation is thus avoided, but the modulation is maintained at high values by a mechanism which "foresees" possible over-modulation and prevents it.

I claim:

1. In combination with a device for producing a sharply defined electron stream in the form of a beam of energy and means for deflecting said beam in accordance with the amplitude of the signal waves applied thereto, of additional means responsive to the deflection of said beam a predetermined amount for reducing the range of amplitude of the signal waves applied to said device.

2. The combination with a cathode ray device, of a broadcasting transmitter for transmitting modulated message waves to said cathode ray device, a circuit responsive to said modulated message waves for deflecting the electron beam of said device, and means responsive to the move-

ment of the beam of said cathode ray device outside a predetermined limit resulting from over-modulation of the message waves to control the modulation of the transmitter.

3. The combination with a cathode ray device for producing a sharply defined electron stream in the form of a beam, of means to apply signal waves of varying amplitude to said device, and means in the path of the beam when deflected by a signal whose amplitude exceeds a predetermined value for controlling said first means to reduce the amplitude of said signals applied to said device.

4. In combination, an electron discharge device having a cathode, an anode, and a control electrode, said cathode being arranged to transmit an electron beam in the direction of said anode, a circuit for applying a modulated signal to the said control electrode for deflecting said electron beam, and means responsive to a predetermined deflection of said beam for controlling the degree of modulation of the signal in said circuit.

5. In combination, an electron discharge device having, within an evacuated container, a cathode for producing a beam of electrons, a control electrode for deflecting said beam in response to the application of modulated signals to said control electrode, and a search electrode within said evacuated container normally outside the path of travel of said beam, external means in circuit with said search electrode and responsive to the impinging of electrons on said electrode for controlling the degree of modulation of signals applied to the control electrode whenever the beam due to the action of said signals upon said control electrode departs a predetermined amount from its normal path of travel.

6. In combination, an electron discharge device having, within an evacuated container, a cathode for producing a beam of electrons, a control electrode for deflecting said beam in response to the application of modulated signals to said control electrode, a mask external of the evacuated container and containing apertures located normally outside the path of travel of said beam to permit the passage of energy from the electron beam whenever the beam departs a predetermined amount from its path of travel, and a photo-electric cell responsive to the passage of energy through the apertures of said mask for enabling the control of the degree of modulation of the signals applied to the control electrode.

7. The combination with a cathode ray device, of a transmitter for transmitting high frequency modulated signals to said cathode ray device, and a circuit including an electric discharge device responsive to the action of said cathode ray device whenever modulation corresponding to more than 100% modulation of the high frequency by the peaks of the signals occurs, to control the modulation of the high frequency by the signals at the transmitter.

8. In combination, an electron discharge device having, within an evacuated container, a cathode for producing a beam of electrons, a control electrode for deflecting said beam in response to the application of modulated signals to said control electrode, and a search electrode within said evacuated container normally outside the path of travel of said beam and in circuit with a condenser and a glow tube for controlling the degree of modulation of signals applied to the control electrode whenever the beam due to the action of said signals upon said control electrode

departs a predetermined amount from its normal path of travel, said condenser being arranged to receive a charge for applying the same to said glow tube when electrons of said beam impinge upon said search electrode, said glow being arranged to strike when the charge on said condenser reaches a desired value.

9. In combination, an electron discharge device having, within an evacuated container, a cathode for producing a beam of electrons, a control electrode for deflecting said beam in response to the application of modulated signals to said control electrode, and a search electrode within said evacuated container normally outside the path of travel of said beam and in circuit with a time-constant circuit and a glow tube for controlling the degree of modulation of signals applied to the control electrode whenever the beam due to the action of said signals upon said control electrode departs a predetermined amount from its normal path of travel, said time-constant circuit comprising a condenser connected in parallel with a resistance, said condenser being arranged to receive a charge for applying same to said glow tube when the electrons of said beam impinge upon said search electrode, the glow in said tube being arranged to strike when the charge on said condenser reaches a desired value.

10. In combination, an electron discharge device having, within an evacuated container, a cathode for producing a beam of electrons, a control electrode for deflecting said beam in response to the application of modulated signals to said control electrode, a mask external of the evacuated container and containing apertures located normally outside the path of travel of said beam to permit the passage of energy from the electron beam whenever the beam departs a predetermined amount from its path of travel, a photo-electric cell in line with said apertures and responsive to the passage of energy therethrough, a vacuum tube in circuit with said photo cell and arranged to pass current upon the energization of said cell, an output circuit for said tube comprising a relay whose contacts are adapted to close when said relay is operated, a transmitter for transmitting the modulated signals to said cathode ray device, and means responsive to the closure of said relay contacts for controlling the degree of modulation of the signals sent out by said transmitter.

11. A modulation correction circuit having, in combination, a cathode ray tube provided with deflecting means for deflecting the ray in said tube in circuit with a signal input, a photo-cell responsive to the ray in said tube located outside the path of travel of said ray when no signals appear in said signal input, but in the path of the ray when the latter is deflected by a modulated voltage in said signal input above a certain value, and corrective means responsive to the action of said photo-cell for controlling the character of the signal applied to said signal input.

12. A modulation protective device having, in combination, a cathode ray tube provided with deflecting means for deflecting the ray in said tube in circuit with a signal input, and means located outside the path of travel of the ray when no signals are present in said signal input but in the path of travel when the latter is deflected by modulated voltage in said signal input above a certain value, and additional means responsive to the impinging of the ray on said first means

for controlling the degree of modulation of said modulated voltage.

13. In combination, a cathode ray tube having a cathode and a search electrode arranged in spaced relation to each other, an anode electrode adjacent to the cathode, a control electrode interposed between said anode and cathode and an accelerating anode adjacent to the search electrode, means for deflecting said electron beam, a signal input circuit connected with said deflecting means, a potentiometer device, means for supplying alternating current to the terminals of said device, a circuit connection between one terminal of said device and the cathode and between the control electrode and a first tap point adjacent to said terminal on said potentiometer device, means in circuit between the control electrode and the cathode for establishing on said control electrode a predetermined negative bias potential, a circuit connection between the first anode and a second tap point on the potentiometer device, and a third circuit connection with the said potentiometer device for the accelerating anode whereby said anodes and the control electrode receive alternating potentials in phase, said search electrode being in the path of the ray when deflected by a modulated voltage above a certain value.

14. In combination, a cathode ray tube having a cathode and an output end arranged in spaced relation to each other, an anode electrode adjacent to the cathode, a control electrode interposed between said anode and cathode, an accelerating anode adjacent to the output end, and means for deflecting said electron beam, a signal input circuit connected with said deflecting means, a potentiometer device, means for supplying alternating current to the terminals of said device, a circuit connection between one terminal of said device and the cathode and between the control electrode and a first tap point adjacent to said terminal on said potentiometer device, means in circuit between the control electrode and the cathode for establishing on said control electrode a negative bias potential sufficient normally in the absence of signals to prevent the application of the electron beam to the output end, a circuit connection between the first anode and a second tap point on the potentiometer device, and a third circuit connection with the said potentiometer device for the accelerating anode, whereby said anodes and the control electrode receive alternating potentials in phase, a mask external of said tube and having an aperture therein positioned adjacent to the output end, said aperture being in the path of the beam when deflected by a modulated voltage above a certain value, a photo cell in line with said aperture responsive to the passage of energy therethrough for enabling the control of the signals applied to said input circuit.

15. In a cathode ray tube system, a transmitter of modulated signals for controlling the path of the ray of said tube, a relay adapted to be energized by the ray of said tube for closing a plurality of contacts, and means including a time delay device responsive to the closure of the contacts of said relay for controlling the degree of modulation of the signals sent out by said transmitter, said time delay device functioning to insure that the degree of modulation of the transmitted signals is controlled before the initiated signals reach the modulation circuits of the transmitter.

16. In a transmitter provided with over-modu-

lation control, a source of message waves, a vacuum tube amplifier having an input circuit coupled to said source, a device comprising an electric charge carrying stream coupled to the output circuit of said amplifier, means for deflecting said stream in accordance with the character of said message waves, a grid controlled glow discharge device having an output circuit, means for rendering said glow device responsive to the deflection of said stream when the amplitude of said waves is in excess of a predetermined value, and electromechanical means coupling the output circuit of said glow tube and the input of said amplifier and responsive to the action of said glow tube for decreasing the gain of said vacuum tube amplifier.

17. In a transmitter provided with over-modulation control, a source of message waves, a vacuum tube amplifier for said source having an input circuit, a device comprising an electric charge carrying stream coupled to said source, means for deflecting said stream in accordance with the character of said message waves, a grid controlled glow discharge device having an input and output circuit, means in the input circuit of

said glow device for biasing said glow device at a potential below the critical value necessary to cause the glow in said device to strike, and additional means in the input circuit of said glow device responsive to the deflection of said stream for raising the biasing potential of said glow device at least to said critical value for causing the glow in said glow device to strike, and electromechanical means for coupling the output circuit of said glow device to the input circuit of said vacuum tube amplifier for decreasing the gain of said amplifier whenever the glow in said grid controlled device strikes.

18. The method of preventing over-modulation in communication systems which comprises transmitting modulated message waves, receiving said waves and controlling the amount of deflection of a concentrated electron stream thereby, producing a voltage impulse whenever the degree of modulation of said waves exceeds a predetermined value, and utilizing said voltage impulse to reduce the amplitude of the transmitted message waves.

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