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AUDIO TRANSDUCING APPARATUS AND CONTROL CIRCUITS THEREFOR

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Fig. 1

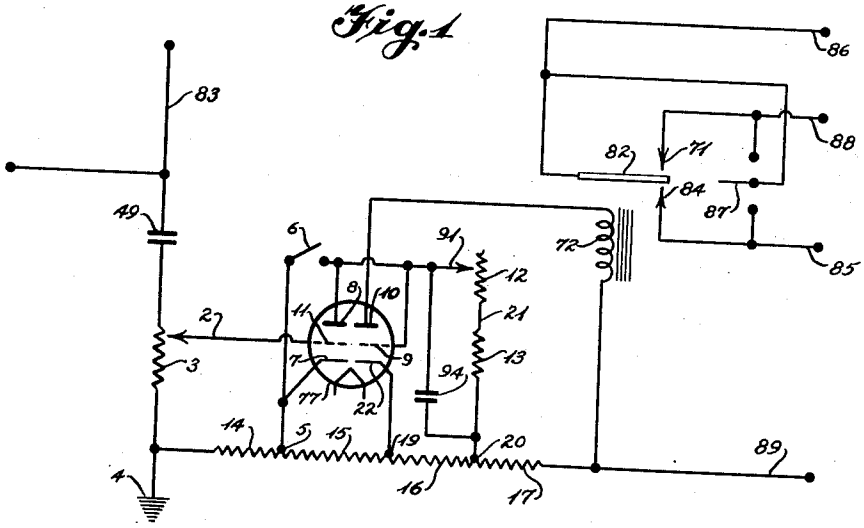
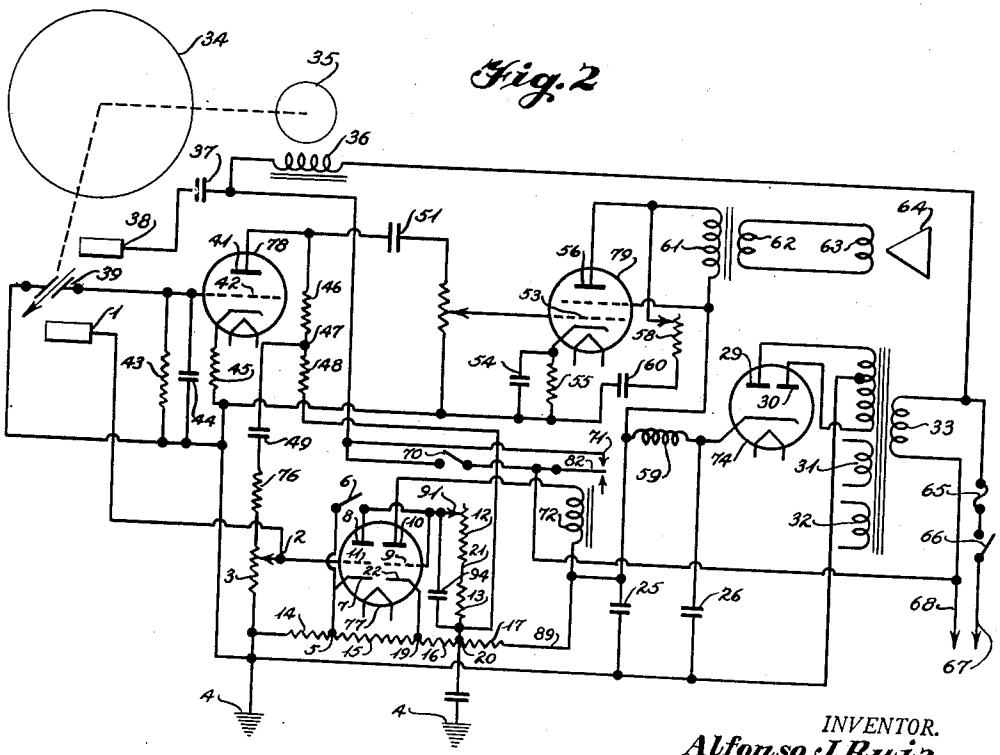


Fig. 2



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AUDIO TRANSDUCING APPARATUS AND CONTROL CIRCUITS THEREFOR

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This invention relates to audio transducing apparatus and control circuits therefor, and more particularly to audio recording apparatus having electronic time control circuits especially adapted for automatic control of moving parts such, for example, as a motor commonly used in audio recording and reproducing apparatus.

Prior art devices for accomplishing the purposes of the instant invention are characterized by a number of disadvantages and limitations. For example, the Patent No. 2,405,526 to C. M. Sinnett, for Automatic Stop for Phonographs, issued August 6, 1946, describes and claims apparatus in which movement of the tone arm functions to stop the phonograph motor or to control operation of a record changing mechanism by controlling an electric circuit.

The Patent No. 2,411,501 to C. P. Brubaker, for Sound Recording System, issued November 26, 1946, describes and claims apparatus in which a recorder motor is stopped when the voice is discontinued, but the apparatus of Brubaker lacks the versatility and sensitivity of that of the subject invention.

The Patent No. 1,810,016 to J. L. Hogg for Voice Operated Relay Circuits, issued June 16, 1931, describes and claims circuits in which a voice current operates a relay to close a circuit and the circuit is opened after a delay period when the voice current stops, but the circuit of Hogg is not suitable for accomplishing the purposes of the instant invention.

Accordingly, it is a primary object of the instant invention to provide a new and improved audio recording apparatus.

Another object is to provide a new and improved control circuit.

Another object is to provide new and improved audio electronic time control circuits and apparatus.

Another object is to provide a new and improved audio frequency electronic time control circuit suitable for opening the circuit to an aural recording drive motor a predetermined time after the expiration of the aural recording.

Still another object is to provide a new and improved audio frequency electronic timing control circuit having means for opening the aural recording drive motor circuit at the termination of each separate aural recording, when there are more than one recording and when they vary in length with respect to time.

Other objects and advantages will become apparent after a consideration of the following specification taken in connection with the accompanying drawings, in which:

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Fig. 1 is a schematic electrical circuit diagram of the control tube arrangement according to a preferred embodiment of the invention; and

Fig. 2 is a schematic electrical circuit diagram of an audio recording system embodying the circuit of Fig. 1 in slightly modified form.

Referring now to the drawings, in which like reference characters are used throughout to designate like parts, for a more complete understanding of the invention, and in particular to Fig. 1 thereof, there is shown at 77 a suitable dual triode tube, for example, one known in the trade as a type 6SN7. The grid 11 of the first triode section is connected to arm 2 of potentiometer 3 which is connected at one end thereof by way of capacitor 49 to lead 83. Lead 83 may supply an audio signal of any desired character. The other end of potentiometer 3 is connected to ground 4.

Connected to ground 4 is a voltage divider resistor network comprising resistors 14, 15, 16, and 17, lead 89 being connected to the positive terminal of a suitable source of potential, not shown, which has the other end thereof connected to ground.

The junction point 5 between aforementioned resistors 14 and 15 is connected to cathode 7 of tube 77, and is also connected to one terminal of a single-pole single-throw switch 6 which has the other terminal thereof connected to anode 8. Anode 8 is connected to grid 9 of the second triode section, and is also connected to arm 91 of rheostat 12.

The end terminal of rheostat 12 is connected by way of lead 21 and resistor 13 to the junction 20 between resistors 16 and 17. This junction 20 is also connected by way of capacitor 94 to arm 91 and anode 8. If desired, a capacitor, not shown, may be connected between junction 20 and ground.

The cathode 22 of the second triode section of tube 77 is connected to the junction 19 between aforementioned resistors 15 and 16. The anode 10 of the second triode section of tube 77 is connected to one end of the relay winding 72, which has the other end thereof connected to aforementioned lead 89.

The armature 82 of the relay is connected to lead 86, which is also connected to the movable pole of a single-pole double-throw switch 87, which has one terminal thereof connected to lead 88 and relay contact 71, and the other terminal thereof connected to lead 85 and relay contact 84. Thus, armature relay 82 has an "up" position in contact with terminal 71 and a "down" position in contact with terminal 84.

In the above described circuit, as will be readily understood by those skilled in the art, component values may be suitably chosen to provide for operation substantially as follows:

Assuming switch 6 open, and the first triode section biased at or near cut-off, when an audio frequency voltage is fed to arm 2 through blocking condenser 49 to the first grid 11, the electrons released by cathode 7 are attracted to positive anode 8 and second grid 9.

This electron flow, also through resistor 12, causes anode 8 and grid 9 to assume a negative potential with respect to the second cathode 22. Capacitor 94, which is across resistors 12 and 13, is charged in a predetermined polarity, and it continues to hold grid 9 negative with respect to the second cathode 22 and point 19 for a few seconds after the audio frequency signal has ceased on grid 11. This time constant or period is variable with variable resistor 12; resistor 13 may be fixed for the least time response desired when there is no audio frequency voltage on grid 11. After the audio signal has stopped and capacitor 94 discharged, plate or anode 8 and grid 9 thereupon assume a positive charge with respect to the second cathode and point 19.

When this latter condition prevails there is an increased amount of electron flow through plate relay 72, thus it assumes a "down" position, closing contacts 82 and 84, which are provided for controlling exterior circuits.

When an audio frequency voltage is again fed into grid 11, plate 8 and grid 9 assume a negative charge in respect to the second cathode 22 and junction point 19. Thus the electron flow through plate relay 72 is decreased, and the armature 82 assumes an "up" position and makes contact with contact 71. It is understood that biasing means, not shown, for example a spring, are provided for the relay.

The leads 86, 88, and 85 are provided for controlling exterior circuits, and switch 87 is provided for shorting selected ones of the paths through the relay contacts, when desired.

Switch 6 is provided for manual operation of the relay, when desired.

Particular reference is made now to Fig. 2, in which a recording or other audio system utilizing the circuit of Fig. 1 is shown. At 39 is designated a pick-up, for example, a crystal pick-up of the type used on aural disc recordings. This crystal pick-up feeds a minute alternating current voltage to the control grid 42 of voltage amplifier tube 78. Bias resistor 45 is provided, and resistor 43 having capacitor 44 in shunt therewith is connected between grid 42 and ground 4. A higher potential alternating voltage drop will be developed from anode 41 across resistors 46 and 48. The voltage drops developed by resistor 46 will pass through coupling capacitor 51 to feed the control grid 53 of tube 79. The cathode of tube 79 is connected by way of resistor 55 and bypass capacitor 54 to ground. The voltage drops developed by resistor 48, will feed from junction point 47 through capacitor 49 and resistor 76 to level control potentiometer 3, and the delay circuit of tube 77 will be energized as aforedescribed, with the result that the relay having winding 72 is deenergized, and the circuit is closed through contacts 82 and 71.

The anode 56 of tube 79 is connected to one terminal of the primary 61 of an output transformer, and is further connected by way of variable resistor 58 and capacitor 60 to ground 4.

The aforementioned primary 61 has the other terminal thereof connected to one terminal of filter capacitor 25, and to choke 59. Choke 59 is further connected as shown to filter capacitor 26, and the cathode of tube 74, which may be a type known in the trade as type 80. The plates 29 and 30 of tube 74 are connected to the end terminals of the high voltage secondary of a power transformer, which has the center tap thereof connected to ground. Filament windings 31 and 32 are provided as shown, and it is understood supply power to the heater or filament elements of the tubes shown.

Primary 33 for the aforementioned power transformer is energized by way of fuse 65, switch 66, and leads 68 and 67, which it is understood are connected to a suitable source of A.-C. potential, not shown, for example, 115 v., A.C., 60 cycles.

The energizing field 36 of motor 35 is also energized from the A.-C. source, by way of the contacts 82 and 71, or switch 70 in shunt therewith.

The reference numeral 34 represents a disc receiver. Member 38 is coupled by capacitor 37 to aforementioned terminal or relay contact 71 and consists of a metal plate so placed on the pick-up unit that, when the operator's hand grasps this unit for placement, the hand touches the plate. The hand also touches companion metal plate 1, placed on the pick-up unit and connected to arm 2 of potentiometer 3 and the attached grid 11 of tube 77.

The output transformer includes secondary 62, connecting to voice coil 63 of a speaker having cone 64, and which may include permanent field means, not shown, or choke 59 operatively associated therewith for generating a field.

As will now be apparent, when one's hand is applied to crystal pick-up 39 to initiate operation of the apparatus, plates 1 and 38 will be bridged by the hand and thereby a small voltage is fed from member 38 to member 1 and to the first grid 11 of timing tube 77. This voltage primes second grid 9 at a negative potential, which capacitor 94 has the capacity to hold for a few seconds. This negative potential causes the plate relay to be deenergized, thereby permitting the relay biasing means to close the aural drive motor circuit through 71 and 82. From thereon, crystal pick up 39 continues to supply the circuit with an alternating voltage, and keeps the electronic circuit relay in "up" position.

When this alternating voltage on arm 2 has come to a termination, capacitor 94 will discharge at its predetermined rate, determined by setting of plate variable resistor 12. At that time grid 9 will tend to assume a zero bias, and may tend to go positive, and permit plate relay 72 to open the motor electrical circuit through contacts 82 and 71. It will be noticed that control 3 to the first grid is preferably so adusted as to have the lowest passages in the aural recording charge the capacitor to maximum. This will eliminate any difference in time factor, at the end of each aural recording.

Whereas the invention has been shown embodied in a sound reproducing system, it will be understood that a sound recording system could be used, if desired, pick up 39 being replaced by a microphone, for example, and loudspeaker 63—64 by a cutting arm.

The term "ground" as used herein is defined as

a common junction point or point of reference potential.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

This invention may be manufactured and used by or for the government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. Control circuit apparatus comprising, in combination, first and second electron discharge tube means each having a cathode, grid, and anode, circuit connections to ground from each of said cathodes, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, a source of direct potential, resistor means directly connecting said last named anode and grid to said source of potential, capacitor means connected in shunt with said resistor means, means for applying an A.-C. signal to the grid of said first tube means, and power translating means for controlling an external circuit connecting the anode of said second tube means to said source of potential, said circuit controlling means being deenergized while said A.-C. signal is being applied and for a predetermined period after said A.-C. signal has ceased.

2. Control circuit apparatus comprising, in combination, first and second electron discharge tube means each having a cathode, grid, and anode, a source of direct potential having the negative terminal thereof connected to ground, voltage divider means having a plurality of spaced taps and connecting the positive terminal of said source to ground, the cathode of said first tube means being connected to one of said taps, circuit means for applying an A.-C. signal between the grid of said first tube means and ground, the cathode of said second tube means being connected to one of said taps, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, resistor means directly connecting said last named anode and grid to one tap on said voltage divider means, capacitor means connected in shunt with said resistor means, and relay means having contacts for controlling an external circuit and having the winding thereof connecting the anode of said second tube means to the positive terminal of said source of potential, said voltage divider means and resistor means being so proportioned that said relay means is deenergized while said A.-C. signal is applied to the grid of said first tube means, and for a predetermined period after said A.-C. signal has ceased.

3. Control circuit apparatus comprising, in combination, first and second electron discharge tube means each having a cathode, grid, and anode, first potential means for maintaining the cathode of said first tube means at a first predetermined positive potential with respect to ground, circuit means for applying an A.-C. signal between the grid of said first tube means and ground, second potential means for maintaining the cathode of said second tube means at a second predetermined positive potential with respect to ground, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, resistor means having one end thereof directly connected to said last named anode and grid, third potential means for maintaining the other end of said resistor means at a third positive potential with respect to ground, capacitor means connected in shunt with said resistor means, relay means having contacts for controlling an external circuit and having one terminal of the winding thereof connected to the anode of said second tube means, and fourth potential means for maintaining the other terminal of said relay means at a fourth positive potential with respect to ground, said resistor means and first, second, third, and fourth potential means providing an arrangement whereby said relay means is deenergized while said A.-C. signal is applied to the grid of said first tube means and for a predetermined period after said A.-C. signal has ceased.

4. Audio transducing apparatus comprising, in combination, audio transducer means, first and second electron discharge tube means each having a cathode, grid, and anode, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, a source of potential, resistor means connecting said last named anode and grid to said source of potential, capacitor means connected in shunt with said resistor means, means for applying an A.-C. signal from said transducer means to the grid of said first tube means, relay means having the winding thereof connecting the anode of said second tube means to said source of potential, and motor means operatively connected to said relay means and controlled therefrom, said relay means causing the energization of said motor means while said A.-C. signal is applied and for a predetermined period after said A.-C. signal has ceased.

5. Audio transducing apparatus comprising, in combination, audio transducer means, first and second electron discharge tube means each having a cathode, grid, and anode, a source of potential having the negative terminal thereof connected to ground, voltage divider means having a plurality of spaced taps and connecting the positive terminal of said source to ground, the cathode of said first tube means being connected to the one of said taps, circuit means for applying an A.-C. signal from said transducer means between the grid of said first tube means and ground, the cathode of said second tube means being connected to one of said taps, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, resistor means connecting said last named anode and grid to one of said taps on said voltage divider means, capacitor means connected in shunt with said resistor means, relay means having the winding thereof connecting the anode of said second tube means to the positive terminal of said source of potential, said voltage divider means and resistor means being so proportioned that said relay means is deenergized while said A.-C. signal is applied to the grid of said first tube means, and for a predetermined period after said A.-C. signal has ceased, and motor means operatively connected to said relay means and controlled therefrom.

6. Audio transducing apparatus comprising, in combination, audio transducer means, first and second electron discharge tube means each having a cathode, grid, and anode, first potential means for maintaining the cathode of said

first tube means at a first predetermined positive potential with respect to ground, circuit means for applying an A.-C. signal from said transducer means between the grid of said first tube means and ground, second potential means for maintaining the cathode of said second tube means at a second predetermined positive potential with respect to ground, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, resistor means having one end thereof connected to said last named anode and grid, third potential means for maintaining the other end of said resistor means at a third positive potential with respect to ground, capacitor means connected in shunt with said resistor means, relay means having one terminal of the winding thereof connected to the anode of said second tube means, fourth potential means for maintaining the other terminal of the winding of said relay means at a fourth positive potential with respect to ground, said resistor means and first, second, third, and fourth potential means providing an arrangement whereby said relay means is deenergized while said A.-C. signal is applied to the grid of said first tube means and for a predetermined period after said A.-C. signal has ceased, and motor means operatively connected to said relay means and controlled therefrom.

7. In audio transducing apparatus, in combination, inductive pick-up means adapted to be energized when the hand of an operator is moved adjacent thereto, first and second electron discharge tube means each having a cathode, grid, and anode, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, a source of potential, resistor means connecting said last-named anode and grid to said source of potential, capacitor means connected in shunt with said resistor means, means for applying an A.-C. signal from said pick-up means to the grid of said first tube means, relay means having the winding thereof connecting the anode of said second tube means to said source of potential, and motor means operatively connected to said relay means and controlled therefrom, said relay means causing the energization of said motor means while said A.-C. signal is applied and for a predetermined period after said A.-C. signal has ceased.

8. In audio transducing apparatus, in combination, inductive pick-up means, first and second electron discharge tube means each having a cathode, grid, and anode, a source of potential having the negative terminal thereof connected to ground, voltage divider means having a plurality of spaced taps and connecting the positive terminal of said source to ground, the cathode of said first tube means being connected to the one of said taps, a priming circuit connected to said first tube grid having a permanent gap therein adapted to be electrically bridged when the hand of an operator is applied across the gap, circuit means for applying an A.-C. signal from said pick-up means between the grid of said first tube means and ground, the cathode of said second tube means being connected to one of said taps, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, variable resistor means connecting said last-named anode and grid to one of said taps on said voltage divider means, capacitor means connected in shunt with said resistor means, relay means having the winding thereof connecting the anode of said second tube means to the positive terminal of said source of potential, said voltage divider means and resistor means being so proportioned that said relay means is deenergized while said A.-C. signal is applied to the grid of said first tube means, and for a predetermined period after said A.-C. signal has ceased, and motor means operatively connected to said relay means and controlled therefrom.

9. In audio transducing apparatus, in combination, inductive pick-up means, first and second electron discharge tube means each having a cathode, grid, and anode, first potential means for maintaining the cathode of said first tube means at a first predetermined positive potential with respect to ground, a priming circuit connected to said first tube grid having a permanent gap therein adapted to be electrically bridged when the hand of an operator is applied across the gap, circuit means for applying an A.-C. signal from said pick-up means between the grid of said first tube means and ground, second potential means for maintaining the cathode of said second tube means at a second predetermined positive potential with respect to ground, the anode of said first tube means being connected to the grid of said second tube means, resistor means having one end thereof connected by a continuous electrical conductor to said last-named anode and grid, third potential means for maintaining the other end of said resistor means at a third positive potential with respect to ground, capacitor means connected in shunt with said resistor means, relay means having one terminal of the winding thereof connected to the anode of said second tube means, fourth potential means for maintaining the other terminal of the winding of said relay means at a fourth positive potential with respect to ground, said resistor means and first, second, third, and fourth potential means providing an arrangement whereby said relay means is deenergized while said A.-C. signal is applied to the grid of said first tube means and for a predetermined period after said A.-C. signal has ceased, and motor means operatively connected to said relay means and controlled therefrom.

10. Audio transducing apparatus of the character disclosed comprising, in combination, motor driven plate means for receiving a recording disc, audio transducer means operatively associated with said plate means, inductive pick-up means on said transducer means, first and second electron discharge tube means each having a cathode, grid, and anode, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, a source of potential, resistor means connecting said last-named anode and grid to said source of potential, capacitor means connected in shunt with said resistor means, a priming circuit connected to said first tube grid having a permanent gap therein adapted to be electrically bridged when the hand of an operator is applied across the gap, means for applying an A.-C. signal from said pick-up means and transducer means to the grid of said first tube means and relay means having the winding thereof connecting the anode of said second tube means to said source of potential, said motor driven plate means being operatively connected to said relay means and controlled therefrom, said relay means causing the energization of said mot

means while said A.-C. signal is applied and for a predetermined period after said A.-C. signal has ceased.

11. Audio transducing apparatus of the character disclosed comprising, in combination, motor driven plate means for receiving a recording disc, audio transducer means operatively associated with said plate means, inductive pick-up means on said transducer means, first and second electron discharge tube means each having a cathode, grid, and anode, a source of potential having the negative terminal thereof connected to ground, voltage divider means having a plurality of spaced taps and connecting the positive terminal of said source to ground, the cathode of said first tube means being connected to one of said taps, a priming circuit connected to said first tube grid having a permanent gap therein adapted to be electrically bridged when the hand of an operator is applied across the gap, circuit means for applying an A.-C. signal from said pick-up means and transducer means between the grid of said first tube means and ground, the cathode of said second tube means being connected to one of said taps, the anode of said first tube means being connected by a continuous electrical conductor to the grid of said second tube means, resistor means connecting said last-named anode and grid to one of said taps on said voltage divider means, capacitor means connected in shunt with said resistor means, and relay means having the winding thereof connecting the anode of said second tube means to the positive terminal of said source of potential, said voltage divider means and resistor means being so proportioned that said relay means is deenergized while said A.-C. signal is applied to the grid of said first tube means and for a predetermined period after said A.-C. signal has ceased, said motor driven plate means being operatively connected to said relay means and controlled therefrom.

12. Audio transducing apparatus of the character disclosed comprising, in combination, motor driven plate means for receiving a recording disc, audio transducer means operatively associated with said plate means, inductive pick-up means on said transducer means, first and second discharge tube means each having a cathode, grid, and anode, first potential means for maintaining the cathode of said first tube means at a first predetermined positive potential with respect to ground, a primary circuit connected to said first tube grid having a permanent gap therein adapted to be electrically bridged when the hand of an operator is applied across the gap, circuit means for applying an A.-C. signal from said transducer means and pick-up means between the grid of said first tube means and ground, second potential means for maintaining the cathode of said second tube means at a second predetermined positive potential with respect to ground, the anode of first tube means being connected by a continuous electrical conductor to the grid of said second tube means, resistor means having one end thereof connected to said last-named anode and grid, third potential means for maintaining the other end of said resistor means at a third positive potential with respect to ground, capacitor means connected in shunt with said resistor means, relay means having one terminal of the winding thereof connected to the anode of said second tube means, fourth potential means for maintaining the other terminal of the winding of said relay means at a fourth positive potential with respect to ground, said resistor means and first, second, third, and fourth potential means providing an arrangement whereby said relay means is deenergized while said A.-C. signal is applied to the grid of said first tube means and for a predetermined period after said A.-C. signal has ceased, said motor driven plate means being operatively connected to said relay means and controlled therefrom.

13. Control circuit apparatus comprising, in combination, first and second electron discharge tube means each having a cathode, grid, and anode, the anode of said first tube means being connected by a continuous conductor to the grid of said second tube means, a source of potential, resistor means connecting said last named anode and grid to said source of potential, capacitor means connected in shunt with said resistor means, a priming circuit connected to said first tube grid having a permanent gap therein adapted to be electrically bridged when the hand of an operator is applied across the gap, means for applying an A.-C. signal to the grid of said first tube means, and means for controlling an external circuit connecting the anode of said second tube means to said source of potential, said circuit controlling means being deenergized while said A.-C. signal is being applied and for a predetermined period after said A.-C. signal has ceased.

14. Control circuit apparatus comprising, in combination, first and second electron discharge tube means each having a cathode, grid, and anode, the anode of said first tube means being connected by a continuous conductor to the grid of said second tube means, a source of potential, resistor means connecting said last named anode and grid to said source of potential, capacitor means connected in shunt with said resistor means, means for applying an A.-C. signal to the grid of said first tube means, and means for controlling an external circuit connecting the anode of said second tube means on said source of potential, said circuit controlling means being deenergized while said A.-C. signal is being applied and said tube means being enclosed in a single container.

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