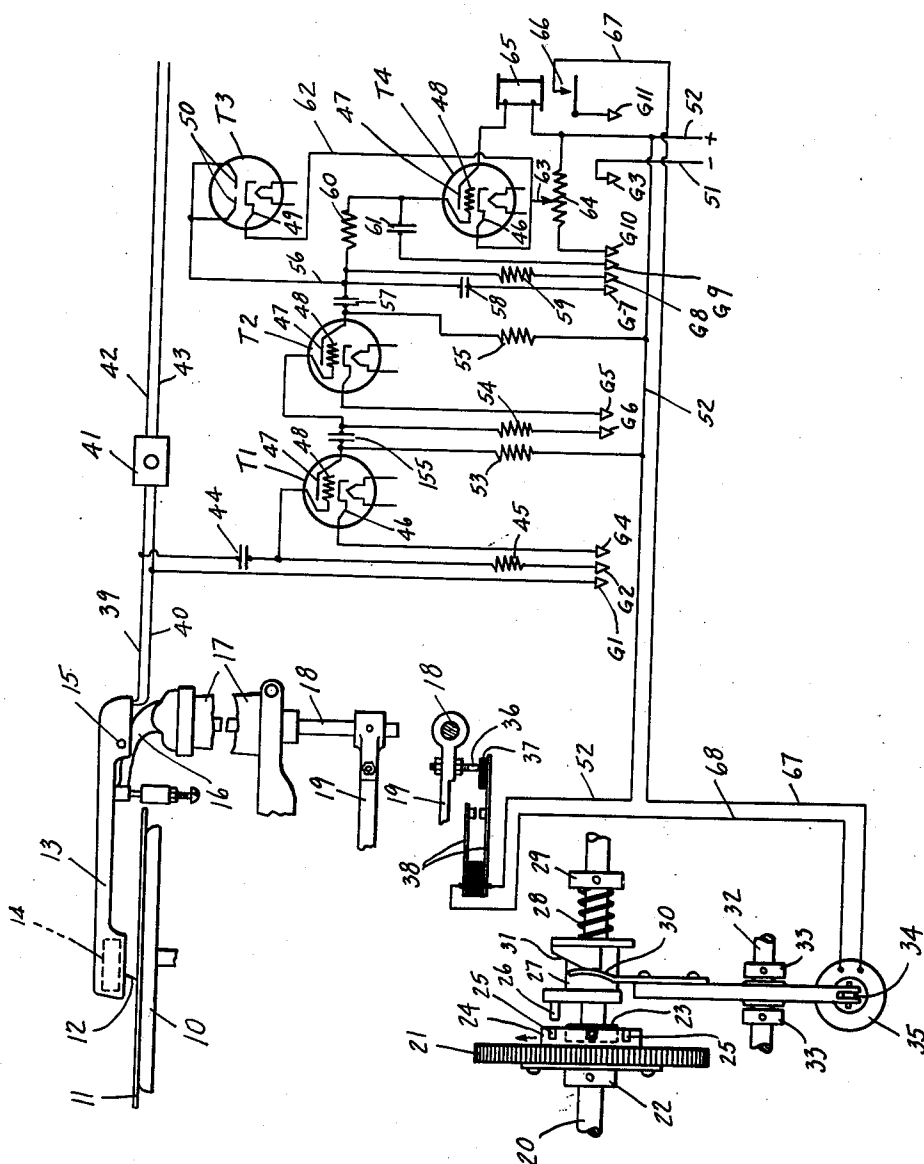


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PHONOGRAPH TRIP APPARATUS

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PHONOGRAPH TRIP APPARATUS

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This invention relates to a trip apparatus for sound reproducing devices particularly adaptable to automatic phonographs in which the playing of a record is followed by the operation of automatic record changing mechanism. The invention however is also useful in automatic sound reproducing devices of the type illustrated in copending applications of Jack Beever, filed December 24, 1937, Serial No. 181,660; Vincent R. Hokanson, filed April 18, 1938, Serial No. 202,671 and Paul U. Lannerd, filed September 26, 1938, Serial No. 231,702, in which sound is reproduced from film records which are automatically changed after the playing of a record.

Heretofore, the operation of a phonograph after the record has been played has generally been initiated by a mechanical movement of the pickup arm caused by the stylus riding in a specially formed groove at the end of the record. Two types of such grooves are in common use, one of which imparts an oscillating movement to the tone arm and the other of which simply moves the tone arm rapidly toward the center of the record. To be generally useful, a phonograph trip mechanism must be designed to operate with both types of records, but even when so designed, the usual mechanical trip cannot operate unless one or the other of these special forms of record groove is furnished.

In sound reproducing apparatus of the film type, the record changing operation has heretofore been initiated by various electrical or mechanical means requiring special construction at the end of the film.

One object of the present invention is to produce a trip mechanism which operates without the necessity of specially prepared records either of the phonograph type or the film type but which operates instead as a result of the cessation of the sound being produced. To that end the invention includes electrical apparatus operated in response to the audio frequency energy in the pickup circuit of a phonograph or the corresponding circuits of the film type of reproducing device and which provides a tripping action when the flow of such energy ceases at the end of a record. In the case of a phonograph the tripping action thus occurs as a result of the cessation of sound modulation in the record groove and is entirely independent of the path of the groove after the end of the modulated portion. In the film type of record, the tripping action occurs when the end of the modulations of the sound track are reached.

Another object of the invention is to provide a

tripping mechanism of this type which will not be actuated by a temporary cessation of sound in the body of the record. To this end there is incorporated in the electrical mechanism a time delay feature which delays the tripping action for a predetermined time after the cessation of sound. Thus a brief pause in the sound during the playing of the body of a record, as when two or more selections have been recorded on the same record with a pause between them, does not operate the trip mechanism.

A further feature of the invention particularly adapted for phonographs is the provision of means by which the trip mechanism cannot be operated while the stylus is travelling in an unmodulated groove at the start of the record.

Other objects and features of the invention will be understood from the accompanying drawing and the following description and claims:

The drawing is a diagrammatic view of an electrical circuit by means of which the invention may be practiced together with phonograph parts cooperating therewith.

In the drawing the invention is shown adapted to a phonograph which includes a rotatable turntable 10 carrying a record 11 engaged by a stylus 12 mounted on the usual pickup arm 13. The pickup arm also carries the usual pickup device 14 actuated by vibration of the stylus and which may be of any well known form used in the phonograph art. Electromagnetic pickups, electrostatic pickups or the crystal type are equally adaptable to the invention.

The pickup arm 13 is pivotally mounted at 15 on a bracket 16 which is supported on a fixed housing 17 and may be turned about a vertical axis by means of a vertical stem 18. The stem 18 carries a lever arm 19 by means of which the pickup arm may be swung by any mechanism suitable to position the stylus at the start of a record.

In automatic phonographs there is generally provided a cam shaft which controls the entire record changing cycle, including the manipulation of the pickup arm, by means of one revolution of the cam shaft. A clutch or other means for initiating the operation of the cam shaft is generally controlled by a trip mechanism operated by the pickup arm at the conclusion of playing of a record. In the film type of reproducing apparatus in which the records are automatically changed, the record changing mechanism is ordinarily controlled by a similar cam shaft, operation of which is initiated by electrical or mechan-

ical means actuated by special construction at the end of the film.

In the present instance, there is shown in the drawing by way of illustration a shaft 20 representing the cam shaft of a phonograph or film reproducer. A gear 21 is freely mounted thereon between collars 22 and 23 and may be assumed to be continuously rotated by an electric motor or other suitable power means. The gear 21 is provided with a hub 25 having a plurality of grooves 25 adapted to receive a clutch pin 26 which is mounted on a clutch collar 27 splined to the cam shaft 20. The clutch collar is normally urged to the left in the drawing by a compression spring 28 abutting against a collar 29 fixed to the shaft 20.

In the idle position of the cam shaft 20 the clutch pin 26 is held out of engagement with the grooves 25 by a latch lever 30 engaging a cam face 31 on the collar 27. The arm 30 is pivotally mounted on a pin or shaft 32 whose axis is generally parallel to the axis of the shaft 20. The arm 30 is held against longitudinal movement by a pair of collars 33 mounted on the shaft 32. The opposite end of the latch lever 30 is pivotally connected to a plunger 34 which is movable by an electromagnet 35. By means of this mechanism the actuation of the electromagnet 35 frees the latch lever 30 from the cam face 31 and permits the spring 28 to press the clutch pin 26 into engagement with the face of the hub 24. Said pin enters the first of the grooves 25 to reach the same and starts the rotation of the cam shaft 20. If the electromagnet 35 is deenergized during a revolution of the cam shaft, the latch lever 30 is returned by gravity or by a suitable spring to a position to reengage the cam face 31. The action of said cam face against the latch lever draws the clutch collar 27 to the right and disengages the pin 26 from the groove 25 at the end of a complete revolution of the cam shaft.

The arm 19 carries a pin 36 positioned to engage an insulation piece 37 carried by one of a pair of electrical contact members 38. The position of said contact members is such that this engagement takes place only when the pickup arm has been moved to the region of the outer edge of a record and said engagement serves to separate said contact members. As the pickup arm moves toward the center of the record in the playing thereof, the pin 36 moves away from the block 37 and permits contact to be reestablished between the contact members 38.

Conductors 39 and 40 constitute a pickup circuit leading to a volume control unit 41 which is in turn connected by conductors 42 and 43 to the usual amplifier and speaker. In the film type of reproducer the conductors 39 and 40 may form a part of the photo-cell circuit in which energy flow is modulated in accordance with the sound track. In phonograph operation, the conductors 39 and 40 are connected to the pickup device 14. The conductor 40 is grounded at G1 and the conductor 39 is connected to ground at G2 through a condenser 44 and a resistor 45. Thus the circuit 39-44-45-G2-G1-40 forms a path for alternating current energy from the pickup circuit and the frequencies of said current vary in accordance with the modulations of the sound groove of the record. When there is no modulation of the sound groove there is no alternating component of current in the pickup circuit and no current flows in the circuit just traced.

The electrical apparatus controlled by energy

from the pickup circuit includes four electron tubes T1, T2, T3 and T4. The tubes T1, T2 and T4 are shown herein as having the usual heated cathodes 46, anodes 47 and control grids 48. The cathodes are shown as indirectly heated but may be directly heated if direct current of suitable voltage is available. The tubes just described are used as amplifying tubes and other forms of tubes suitable for amplification may be used as well. The tube T3 is used as a rectifier and is provided with a heated cathode 49 and a pair of anodes 50. Plate potential for operating the several tubes is supplied by a pair of conductors 51 and 52 which may be connected to any suitable source of electric potential. The conductor 51 is grounded at G3.

The cathodes of the tubes T1 and T2 are grounded at G4 and G5 respectively. The grid of tube T1 is connected between the condenser 44 and the resistor 45. The anode of said tube is connected through a resistor 53 to the conductor 52. The grid of tube T2 is grounded at G6 through the usual leakoff resistance 54 and is coupled by means of a condenser 55 to the anode circuit of the tube T1. The anode of the tube T2 is connected to the conductor 52 through a resistor 55. It will be apparent that the connections just described constitute a conventional two-stage amplifier by means of which audio frequency variations in the energy in the pickup circuit are amplified and converted into corresponding greater variations in the plate voltage of the tube T2.

Both anodes of the tube T3 are connected to a conductor 56 which is coupled by means of a condenser 57 to the anode circuit of the tube T2. The conductor 56 is also connected to a condenser 58, the opposite side of which is grounded at G7 and to a resistor 59 grounded at G8. The conductor 56 is also connected through a resistor 60 to the grid of tube T4 which is shunted to ground at G9 through a condenser 61. The cathode of tube T4 is connected by a conductor 62 to the cathode of tube T3. The conductor 62 is connected to the adjustable point 63 of a rheostat 64, one terminal of which is connected to the conductor 52 and the opposite terminal of which is grounded at G10. The anode of the tube T4 is connected to one terminal of an electromagnetic relay 65, the opposite terminal of which is connected to the power conductor 52. The relay 65 is adapted when energized to close switch 66, one terminal of which is grounded at G11 and the other terminal of which is connected by a conductor 67 to the electromagnet 35. The opposite terminal of said electromagnet is connected by a conductor 68 to one of the contact leaves 38, the other of which is connected to the conductor 52.

By means of the electrical connections just described, the varying voltage of the anode of tube T2 impresses on the conductor 56 corresponding potential changes which, due to the rectifying action of the tube T3 cause a direct current to flow in the following circuit: cathode 49, conductor 62, rheostat 64, G10, G8, resistor 59, conductor 56, anodes 50. This current flows only when said anodes are positive with respect to the cathode 49 and has therefore a pulsating characteristic. The volume of current may be controlled by the setting of the rheostat 64 and the flow thereof serves to depress the potential of the grid of tube T4 and at the same time serves to change condensers 58 and 61. The direct current flows only so long as the stylus travels in a

modulated record groove and produces audio frequency energy in the pickup circuit. When the stylus reaches a non-modulated portion of the groove, the energy supplied to the amplifying tubes T1 and T2 ceases and the direct current in the circuit just described no longer flows. The condensers 58 and 61 then discharge through the resistors 59 and 60 and the potential of the grid of tube T4 is correspondingly raised at a rate dependent on the rate of discharge of said condensers. The condensers and the resistors 59 and 60 are so proportioned that the potential of the grid will not rise above a predetermined point in a predetermined time interval.

The proportions of the tube T4 are so chosen that when the grid potential is depressed by the flow of current in the rectifier circuit, little or no anode current flows through the tube. However, when the grid potential is raised by the cessation of current in the rectifier circuit, sufficient anode current flows through the tube T4 to actuate the relay 65 through the following circuit: 52, 65, anode of tube T4, cathode of tube T4, rheostat 64, ground G10, ground G3, 51. Thus, the relay 65 is energized whenever the stylus is not traveling in a modulated record groove and is deenergized when the stylus travels in a modulated groove. An exception to this statement occurs if a short unmodulated portion of the groove occurs in the body of the record. If said portion is not greater than a predetermined length, the time lag caused by the discharge of condensers 58 and 61 is sufficient to prevent energizing the relay before another modulated portion of the groove is reached.

When the stylus is travelling near the end of a record, the contact leaves 38 are engaged. Under these conditions, the energizing of relay 65 at the end of the modulated portion of the record groove completes a circuit for the electromagnet 35 (52, 38, 68, 35, 67, 66, G11, G3, 51). The energizing of the magnet 35 by this circuit operates to start the rotation of the cam shaft 20 as previously described. At some convenient point in the rotation of the cam shaft, the pickup arm is swung toward the edge of the record and contact leaves 38 are separated to break the circuit and deenergize the magnet 35. Thus, although the relay 65 continues to be energized, the clutch parts are placed in condition to stop the cam shaft at the end of one revolution thereof. Immediately upon the commencement of playing a new record, the audio frequency energy in the pickup circuit operates the electrical apparatus to deenergize the relay 65. At some time thereafter the stylus has travelled far enough to engage contact leaves 38 and the apparatus is in condition for another trip actuation at the completion of playing of the record.

The foregoing specification describes the invention in one of its preferred forms, the details of which may be varied without departing from the scope thereof as defined by the appended claims. For example, the grid of tube T4 may be connected to a portion of the rectifier circuit whose potential is raised rather than lowered by current flow in said circuit. In that case switch 66 is normally closed instead of normally open and relay 65 is deenergized to close said switch. The necessary change of wiring will be obvious to those skilled in the art.

It is not necessary that the trip apparatus be used merely to start the operation of a cam shaft. In a phonograph or film reproducer without automatic operation it may be desired simply to stop

the motor at the end of play. The relay 65 in that case is used simply to open a switch in a motor control circuit. Other changes in the application of the invention to a phonograph or film reproducer may obviously be made without departing from the basic principles thereof.

The invention claimed is:

1. In a phonograph, a stylus adapted to follow the grooves of a record, a pickup device operated by vibration of said stylus, a pickup circuit connected to said pickup device, the characteristics of energy flow in said circuit being controlled by said pickup device in accordance with the vibration of said stylus, an electrically actuated phonograph control device adapted to control one of the operations of said phonograph, electrical apparatus receiving energy from said pickup circuit and adapted to operate said control device in response to a cessation of audio frequency energy in said pickup circuit when the stylus moves from a modulated portion to a non-modulated portion of the record groove at the end of playing of a record, and other electrical control means for said device preventing operation thereof when the stylus is at or near the starting point of a record.

2. In a phonograph, a stylus adapted to follow the grooves of a record, a pickup device operated by vibration of said stylus, a pickup circuit connected to said pickup device, the characteristics of energy flow in said circuit being controlled by said pickup device in accordance with the vibration of said stylus, an electrically actuated device adapted to control one of the operations of said phonograph, and electronically operated electric circuits receiving audio frequency energy from said pickup circuit when said stylus is travelling in a modulated portion of the record groove and adapted to operate said electrically actuated device in response to a cessation of said energy as the stylus enters a non-modulated portion of said groove, said circuits including capacitances connected to delay the operation of said device to prevent operation thereof by the passage of the stylus through a relatively short unmodulated portion of the groove.

3. In a phonograph, a stylus adapted to follow the grooves of a record, a pickup device operated by vibration of said stylus, a pickup circuit connected to said pickup device, the characteristics of energy flow in said circuit being controlled by said pickup device in accordance with the vibration of said stylus, an electrically actuated device adapted to control one of the operations of said phonograph, electronically operated electric circuits receiving audio frequency energy from said pickup circuit when said stylus is travelling in a modulated portion of the record groove and adapted to operate said electrically actuated device in response to a cessation of said energy as the stylus enters a non-modulated portion of said groove, and other electrical control means for said device preventing operation thereof when the stylus is at or near the starting point of a record.

4. In a sound reproducing device having a pickup circuit in which the energy flow varies in accordance with the audio frequency vibrations of the sounds being reproduced, the combination of an electrically actuated device adapted to control one of the operations of said sound reproducing device, an electronic discharge amplifier tube having anode, cathode and control electrodes and connected to control said electrically actuated device through variations in the anode-cathode current therein, said control electrode

being distinct from said anode and said anode-cathode current being controlled by variations in the potential of said control electrode, and other electronically operated circuits receiving audio frequency from said pickup circuit and connected to impress on the control electrode of said discharge tube a different average potential when said energy is being received than when the receipt of said energy ceases.

5. In a sound reproducing device having a pickup circuit in which the energy flow varies in accordance with the audio frequency vibrations of the sounds being reproduced, the combination of an electrically actuated device adapted to control one of the operations of said reproducing device, an electronic discharge tube having anode, cathode and control electrodes and connected to control said electrically actuated device through variations in the anode-cathode current therein, and other electronically operated circuits receiving audio frequency energy from said pickup circuit and connected to impress on the control electrode of said discharge tube a different average potential when said energy is being received than when the receipt of said energy ceases, said circuits including capacitances connected to reduce the rate of change of potential of said control electrode.

6. In a sound reproducing device having a pickup circuit in which the energy flow varies in accordance with the audio frequency vibrations of the sounds being reproduced, the combination of electronic amplifying circuits, a rectifier circuit coupled thereto, said amplifying circuits receiving audio frequency energy from said pickup circuit and operating to cause current flow in said rectifier circuit only during receipt of said energy, an electron discharge tube having cathode, anode and control electrodes, said control electrode being connected to a point in said rectifier circuit whose potential is varied by current changes therein, an electric circuit including the cathode and anode of said discharge tube, current flow in said circuit being controlled by the potential of said control electrode, and means responsive to current flow in said last mentioned circuit for initiating one of the operations of said sound reproducing device.

7. In a sound reproducing device having a pickup circuit in which the energy flow varies in accordance with the audio frequency vibrations of the sounds being reproduced, the combination of electronic amplifying circuits, a rectifier circuit coupled thereto, said amplifying circuits receiving audio frequency energy from said pickup circuit and operating to cause current flow in said rectifier circuit only during receipt of said energy, an electron discharge tube having cathode, anode and control electrodes, said control electrode being connected to a point in said rectifier circuit whose potential is varied by current changes therein, an electric circuit including the cathode and anode of said discharge tube, current flow in said circuit being controlled by the potential of said control electrode, means responsive to current flow in said last mentioned circuit for initiating one of the operations of said sound reproducing device, and capacitances associated with said rectifier circuit and adapted to retard potential changes of said control electrode.

8. In a sound reproducing device having a pickup circuit in which the energy flow varies in accordance with the audio frequency vibrations of the sounds being reproduced, the combination of electronic amplifying circuits, a rectifier circuit coupled thereto, said amplifying circuits receiving audio frequency energy from said pickup circuit and operating to cause current flow in said rectifier circuit only during receipt of said energy, an electron discharge tube having cathode, anode and control electrodes, said control electrode being connected to a point in said rectifier circuit whose potential is decreased by an increase of current flow in said circuit, an electric circuit including the cathode and anode of said discharge tube, current flow in said circuit being increased by an increase in the potential of said control electrode, and means connected in the last mentioned circuit for initiating an operation of said sound reproducing device, said means being operable only when greater than a predetermined current flows in said circuit.

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