March 1, 1932. L. T. KINCANNON 1,847,400

CHANGE CONTROL MECHANISM FOR AUTOMATIC MUSICAL INSTRUMENTS

Filed Feb. 21, 1930

Fig. 1.

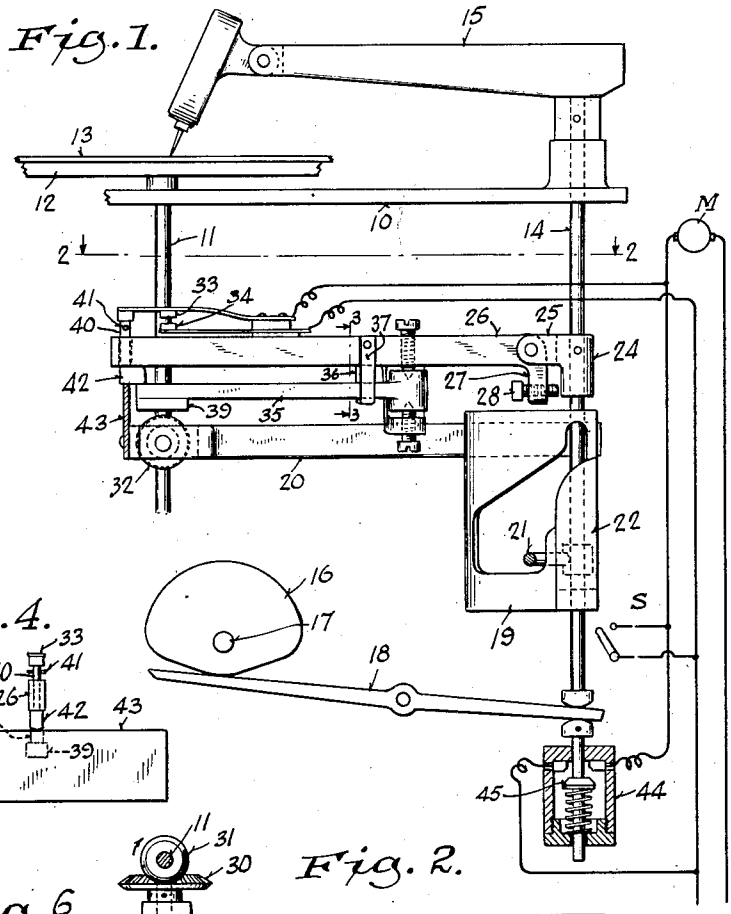



Fig. 3.

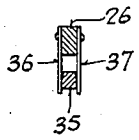



Fig. 4.

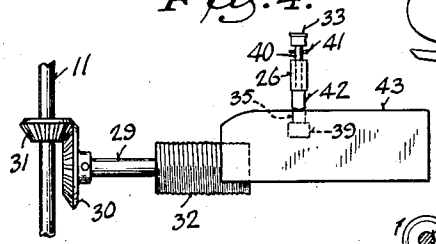



Fig. 2.

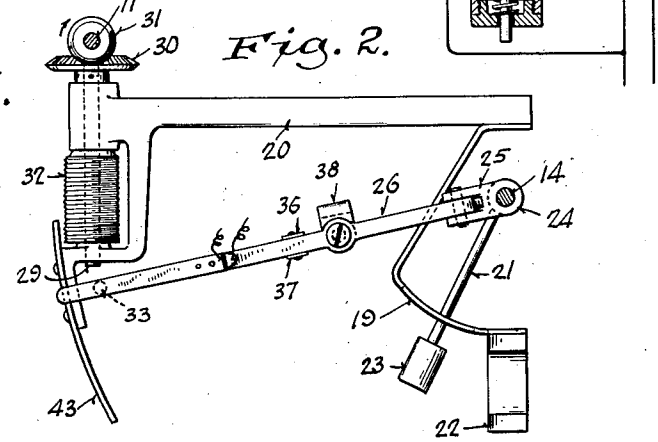



Fig. 6.

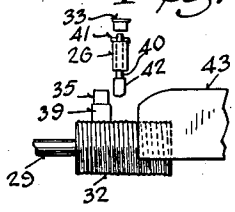
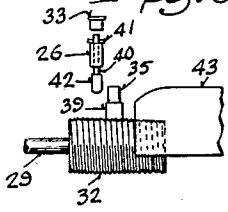



Fig. 5.




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# UNITED STATES PATENT OFFICE

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## CHANGE CONTROL MECHANISM FOR AUTOMATIC MUSICAL INSTRUMENTS

Application filed February 21, 1930. Serial No. 430,278.

The present invention relates to power driven instruments having for their purpose the reproduction of music or other matter recorded on discs.

It is applicable particularly to instruments of the type which operate automatically to effect a change in the disc at the conclusion of the reproduction of the matter recorded thereon, and to replace the said disc by another one, or to reverse the disc so that the matter recorded on its opposite side will be played.

The invention resides further in a novel means for setting into operation the devices which transfer and replace the discs. It comprises certain novel features of construction which will be hereinafter specifically described, and set out in the appended claims.

In the accompanying drawings:

Figure 1 is a view showing in elevation the general arrangement of the devices comprised in my invention.

Fig. 2 is a plan view on the line 2—2, Fig. 1, showing certain details of construction and arrangement.

Fig. 3 is a sectional view on the line 3—3, Fig. 1, showing the light spring fingers attached to the lever, which serve to maintain the vibrator in parallelism therewith.

Fig. 4 is a view in end elevation, looking from the left of Fig. 2, showing the control devices as in starting position.

Fig. 5 is a like view showing the devices as having been actuated at the termination of the reproduction of the recorded matter, whereby the transferring devices are set into operation; and

Fig. 6 is a view similar to Fig. 5, showing the operation of the same devices when actuated by a disc of the older form, in which there is no divergence of the groove at its inner end.

In the drawings, the numeral 10 indicates the top or a part of the cabinet or frame of a sound reproducing instrument. A vertically disposed constantly rotating shaft 11 passes through the top 10, and supports at its upper end a table 12, upon which is to be placed the disc 13, the latter having recorded on its surface, the music or other matter which it is desired to reproduce. A vertical shaft 14 is likewise guided in the top 10, and carries at its upper projecting end a tone arm 15, the shaft 14 being mounted so as to have both axial and rotary reciprocating motions.

An idle cam 16, mounted loosely on a continuously driven shaft 17, is adapted at the proper time to be clutched to the shaft 17, so as to partake of one rotation of the latter. The cam 16 imparts an upward longitudinal motion to the vertically disposed shaft 14, through an intermediately pivoted lever 18, one end of which is acted upon by the high part of the cam 16, and the other end of which engages the lower end of the shaft 14. The weight of the shaft 14, together with that of the tone arm 15 and some other parts, effects an opposite vertical movement of the shaft 14, and restores the tone arm in operative relation to the disc, when the end of the lever 18 rides on the low part of the cam 16. Upon completion of its cycle, the cam 16 is unclutched from the shaft 17.

The means employed for giving reciprocating or partial rotary movements to the shaft 14, during its axial reciprocations, reside in a cut out plate cam 19, curved concentrically and disposed vertically with respect to the shaft 14. The cam 19 is attached at one side to a beam 20, fixed in the frame of the machine. A radial arm 21 fixed upon the shaft 14 extends through the cut out portion of the plate cam 19. In following the contour of the cut out plate cam, the radial arm imparts the reciprocating rotary motion to the said shaft 14.

At the time the needle of the transmitter has reached the limit of its inward normal traverse over the disc 13, the radial arm 21 will have been brought into near relation to the left hand surface of the cut out plate cam 19, in Fig. 1. In such position, the accentuated overthrow of the needle and tone arm, due to the inward distortion of the pitch of the groove in the disc, will cause the clutching devices to couple the idle cam 16 to the continuously driven shaft 17. The shaft 14 will then be elevated, and the needle freed from its contact with the disc. During the continued upward movement of the shaft 14,

the radial arm 21 will be moved upwardly and outwardly along the overhanging, inclined surface of the cut out cam 19, and as the arm 21 rides along such inclined surface, a partial rotation will be imparted to the shaft 14, thus throwing the tone arm to one side and clear of the disc which has been played, to permit removal of the disc and its replacement by another. By the time that the radial arm 21 has reached the limit of its compound movement, transfer of the disc will have been effected.

The approach of the low part of the cam 16 to the lever 18 will permit the tone arm to be lowered, under the influence of gravity. In such downward movement of the tone arm, the radial arm 21 slides along the right hand surface of the cut out cam 19, Fig. 1, and at the moment that restoration of the tone arm to operative relation with respect to the disc is completed, the needle will be caused to enter the first groove of the newly positioned disc.

The proportions of the cut out cam 19 provide for some amplitude in the quick outward movement of the tone arm during the transfer and replacing operations. To check the momentum acquired in such outward movement, and avoid a slam, I apply a brake to the tone arm to prevent impact of the arm 21 with the right hand surface of the cut out cam 19. This brake is conveniently embodied in the form of a permanent magnet 22, attached to the free vertical side of the plate cam 19. The radial arm 21, carried by the shaft 14, is provided at its outer end with an armature 23, adapted in the outward movement of the tone arm, to pass into the field of the magnet. The magnetic attraction will act to restrain further movement of the tone arm, and hold it in a neutral position, until the armature has been withdrawn from the field in the further operation of the mechanism. As the tone arm descends, the radial arm 21 passes downwardly over the inclined or curved upper edge of one of the poles of the magnet, so that the armature 23 is withdrawn automatically from the field thereof. The lower part of the right hand surface of the cut out cam is so proportioned that as the armature 23 passes from the magnetic field, the needle will be entered in the starting groove of the disc.

As stated hereinbefore, the purpose of the present invention is to provide means which will become operative when the needle has traversed the disc and reproduced the music or other matter recorded thereon, and then effect automatically the removal of the disc which has just been played and its replacement by a fresh disc, either by transfer or reversal, the latter action being dependent upon the mechanism of the instrument used. To bring about the result desired, I fix upon the shaft 14 a hub 24 provided at one side with a radial ear or ears 25, to which is pivoted the inner end of a lever 26 having a downturned heel 27, through which is threaded an adjustable stop screw 28, the point of which is adapted to engage the hub 24, and thus limit the downward movement of the free end of the said lever 26, and enable the said lever to be supported at a predetermined altitude.

The bar 20 before described is formed with bearings for a shaft 29, the latter having at one end a bevel gear 30, which meshes with a like reducing pinion 31, fixed upon the shaft 11. The shaft 29 is provided with a helically grooved drum 32, the pitch of which corresponds with the grooving of the disc being played, and is so timed as to rotation that the traverse over both the disc and the drum is synchronous. That is to say, both the disc and drum rotate in the same time cycle. The length of the grooved drum 32 needs only to be such as will cover the range between the conclusions of the shortest and longest pieces recorded on the discs. It is not required that the drum be co-operating during the reproduction of the earlier or major portion of the record, inasmuch as the functions of the drum could not be exercised at such time.

The lever 26 carries at its free end the terminals 33 and 34 of an electric circuit, which latter is held open during the reproducing operation of the instrument. At its under side, the lever 26 supports a delicately mounted vibrator 35, the latter being maintained during such operation in the vertical plane of the lever 26, by light spring fingers 36 and 37, attached to opposite sides of the lever 26 and embracing the sides of the vibrator 35. This arrangement causes the lever 26 and vibrator 35 to move together in the inward travel of the tone arm, and such joint movement will continue until the needle has completed its normal traverse of the disc 13, and the matter recorded on the disc has been reproduced.

The vibrator 35 is pivoted at one end to the lever 26, at a point intermediate the ends of the latter. A bracket 38, depending from the lever 26, has a lateral finger extending under the lever. The lever and bracket finger are provided with aligned threaded perforations in which are set adjusting screws, the opposed pointed ends of which are centered in shallow stepped bearings in the opposite sides of the end of the vibrator 35, so that the latter may swing freely in a horizontal plane, whenever the vertical alignment of the lever 26 and the vibrator is disturbed, as by an interruption of the joint movement of the said parts. The light spring fingers 36 and 37 yield at such time, to permit independent movement of the vibrator with respect to the lever 26.

The free end of the vibrator 35 is provided on its under side with a plate or finger 39, the lower surface of which is grooved to cor-

respond with the drum 32. The outer end of the lever 26 is perforated for the reception of a vertically sliding pin 40, provided with a stop 41, which is adapted to engage the upper side of the lever 26, and serve to limit the downward movement of the pin 40. The lower end of the said pin is provided with a foot 42, which is adapted, in the normal operation of the instrument, to rest upon the top of the outer end of the vibrator 35.

The beam 20 supports a horizontally extending guide 43, formed as a plate standing on edge, and curved on the radius of the lever 26. One end of the said guide extends alongside the adjacent end of the grooved drum 32, so that for a short distance the guide and drum are in overlapping relation. The straight, upper face of the guide 43 terminates in the vertical plane of the adjacent end of the drum, and then sharply declines, so that the parts supported on the guide and moved thereover in the travel of the tone arm and needle inwardly of the disc, may slide downwardly to effect engagement of the grooved plate or finger 39 with the grooved drum 32.

With the parts in the starting position shown in Fig. 4, the lever 26 and vibrator 35 begin their joint sliding movement along the guide 43, being actuated by the movement of the tone arm and needle inwardly of the disc. After the lever and vibrator pass from the guide 43, and the grooved plate or finger 39 is engaged with the grooved drum 32, the further movement of the parts is synchronized with that of the tone arm, and becomes positive. The pivotal connection between the lever 26 and the shaft 14, permits the lever and its parts to drop from the surface plane of the guide 43, on to the drum. When the needle reaches the end of the spiral groove in which is recorded the music or other matter upon the disc, the sudden divergence of the groove at that point, in the modern type of disc, gives a quickened further inward movement of the tone arm toward the center of the disc. The threaded engagement of the plate or finger 39 with the grooved drum 32 acts as a drag and restrains a like movement of the vibrator 35. But the quickened movement of the tone arm, through the partial rotation of the shaft 14, to which both parts are connected, swings the lever 26 and carries the foot 42 of the pin 40 out of its engagement with the vibrator 35. Whereupon, the pin 40 moves downwardly with respect to the lever 26, and permits the contacts 33 and 34 to come together and close the circuit at that point. The light spring finger 37 on the lever 26 does not overcome the drag exerted by the drum 32, but yields sufficiently to permit independent movement of the lever 26 away from the vibrator 35; Fig. 5. The devices which actuate the clutch to couple the cam 16 to the shaft 17 are brought into action, and the ascent of the shaft 14 carrying the tone arm 15 and the radial arm 21, now begins. As before stated, the upward movement of the radial arm 21 is followed by an outward movement of the tone arm and needle to clear the disc, and permit replacement.

When the shaft 14 carrying the tone arm, the lever 26 and the vibrator 35, is lifted by the cam 16, the lever 26 and vibrator 35 partake in the outward movement of the tone arm. As the descent occurs, the foot 42 of the pin 40 will rest upon the guide 43, and the pin 40 be lifted to separate the terminals 33 and 34, and break the circuit. The spring 37, which has been flexed, will restore the vibrator 35 to its position of vertical alignment with the lever 26. Then, as the radial arm 21 rides downwardly over the right hand surface of the cut out cam 19, the lever 26 and the vibrator 35 will be moved jointly along the guide 43, until in the final downward movement of the parts, the needle will be seated in the leading end of the groove of the disc, and the audible reproduction of the recorded matter be commenced.

The idle cam 16 and the devices for changing or reversing the discs, are operated at the desired times by the motor M, which is quiescent during the normal or reproducing operation of the instrument. When contact is made at the terminals 33 and 34, in the manner hereinbefore described, the motor M is energized, and its work is performed. But inasmuch as the contact at the terminals 33 and 34 may be broken before the cycle of operations has been completed, it is desirable that means be provided for maintaining the circuit throughout the said cycle. I effect this result by providing an auxiliary circuit maker, the operation of which persists during the full cycle of rotation of the idle cam 16.

The numeral 44 indicates a switch box having a contact maker 45, in the form of a sliding rod, one end of which bears against the lower side of one end of the lever 18, in line with the shaft 14. A helical spring is shown as encircling the rod, and as acting expansively against a collar on the rod, to urge the latter toward the said lever. The gap between the terminals of the circuit within the switch box is bridged by the said collar, when the rod is moved by the spring. In the rocking movement of the lever 18, by the cam 16, the contact maker in the switch box 44, follows the lever and establishes contact with the terminals therein. The circuit is maintained until all of the devices of the instrument have performed their functions. As the end of the cycle is approached, the lowering end of the lever 18, compresses the spring and breaks the circuit in the switch box 44.

Although I have described the cam 16 as idle, and as being clutched to the shaft 17,

preparatory to the performance of its functions, it is obvious that the said cam may be fixed upon the said shaft, and suitable clutching means applied to the shaft.

In the older type of discs, there is no inward divergence of the groove at the end of the recorded matter, but such groove is usually concentric to the disc. Figure 6 illustrates the operation of my invention in connection with discs of the older type. At the end of the reproduction, the tone arm and needle have no further inward traverse, but the engagement of the grooved plate or finger 39 with the grooved drum 32, will cause a continued movement of the vibrator 35, and so carry the vibrator from under the foot 42 of the lever 26. In such circumstances, the circuit at the terminals 33 and 34, is closed as before described, and the transfer or replacing operation takes place.

In the event that it is not desired to continue the reproduction of the matter on a disc then on the table, such disc may be thrown out and replaced by closing a hand switch S, which will inaugurate the action of the transferring and replacing devices.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States, is:

1. In an instrument of the class described, a shaft mounted for both axial and rotary reciprocation, a tone arm and a lever fixed thereon, a vibrator moving with the said lever but mounted for movement independently of the lever, means for moving the shaft axially to raise the tone arm, a radial arm fixed to the said shaft, a cam surface engaged by the radial arm in the upward movement of the shaft to swing the tone arm aside, an electric motor and an open circuit therefor, and means effective in the relative movement of the said lever and vibrator to close the circuit and energize the motor, whereby the means for axially moving the shaft and the disc changing devices of the instrument are operated.

2. In an instrument of the class described, a shaft mounted for both axial and rotary reciprocation, a tone arm and a lever fixed thereon, a vibrator moving with the said lever but pivotally mounted thereon for movement independently of the lever, means for moving the shaft axially to raise the tone arm, a radial arm fixed to the said shaft, a cam surface engaged by the radial arm in the upward movement of the shaft to swing the tone arm aside, an electric motor and an open circuit therefor, and means effective in the relative movement of the said lever and vibrator to close the circuit and energize the motor, whereby the means for axially moving the shaft and the disc changing devices of the instrument are operated.

3. In an instrument of the class described, a shaft mounted for both axial and rotary reciprocation, a tone arm and a lever fixed thereon, a pivoted member moving with the said lever but mounted for movement independently of the lever, means for moving the shaft axially to raise the tone arm, a surface cam and a radial arm engaged thereby for rotating the shaft to swing the tone arm aside, an armature on the said radial arm, and a magnet into the field of which the cam swings the radial arm to arrest the rotative movement of the tone arm, an electric motor and an open circuit therefor, and means effective in the relative movement of the said lever and pivoted member to close the circuit and energize the motor, whereby the means for axially moving the shaft and the disc changing devices of the instrument are operated.

4. In an instrument of the class described an arm and a stylus carried thereby for swinging movement over a record, a lever movable with said arm, a pivoted member normally moving with said lever in fixed relation thereto but adapted to swing independently of the lever in either direction from its said fixed position, electrical means for raising the stylus and swinging the arm independently of the record, and a switch device controlling said means normally in open circuit position but arranged to be closed by said movement of the pivoted member in either direction.

5. In an instrument of the class described an arm and a stylus carried thereby for swinging movement over a record, a lever movable with said arm, a pivoted member normally moving with said lever in fixed relation thereto but adapted to swing independently of the lever in either direction from its said fixed position, electrical means for raising the stylus and swinging the arm independently of the record, and a switch device comprising cooperating contact members both carried on said lever and relatively movable toward and from contacting position in a direction transverse to that of the lever movement and arranged for actuation by the swing of said pivoted member in either direction.

In testimony whereof, I have signed my name at Milwaukee, this 13th day of February, 1930.

LEO T. KINCANNON.