July 8, 1930. W. O. JAMES 1,769,954

MEANS FOR RECORDING AND REPRODUCING SENSORIAL EFFECTS

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Fig. 1.

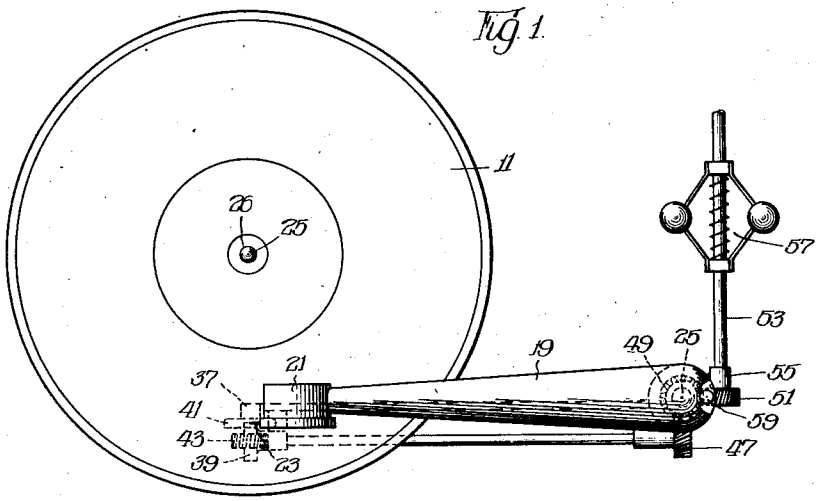


Fig. 2.

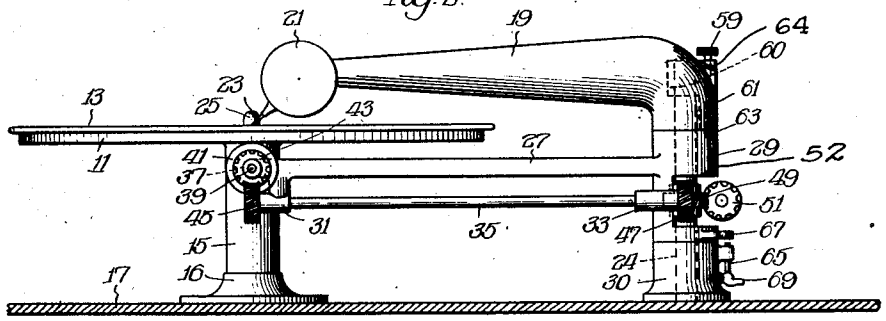
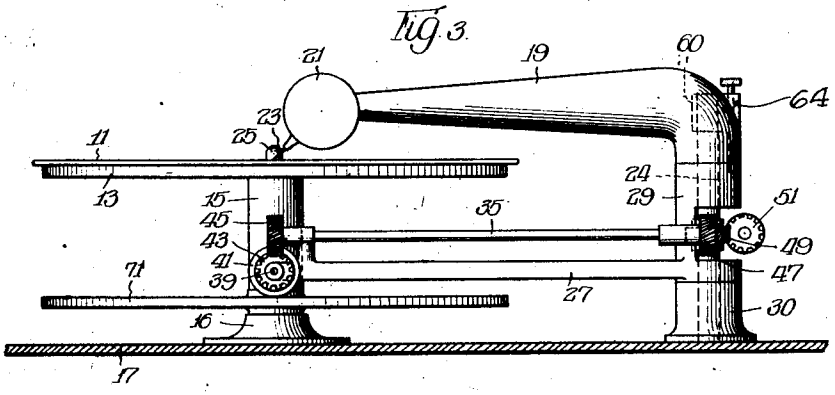


Fig. 3.



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Fig. 4.

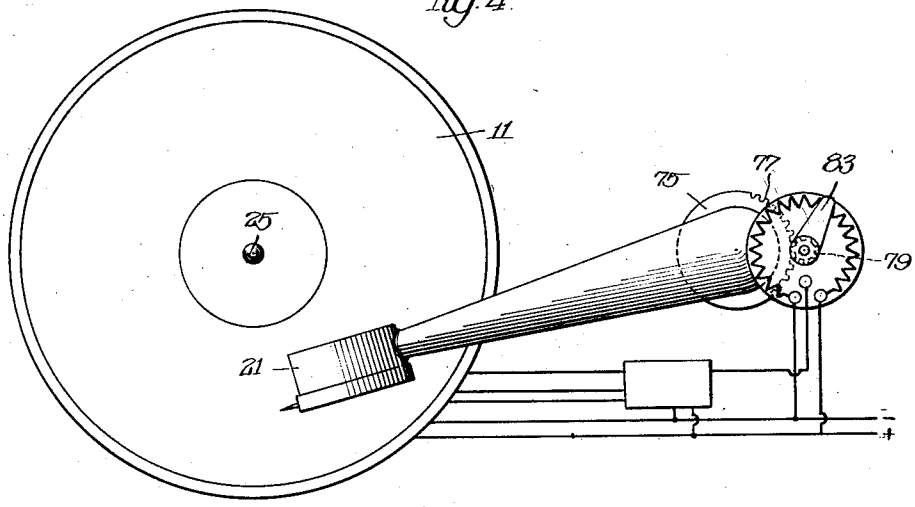


Fig. 5.

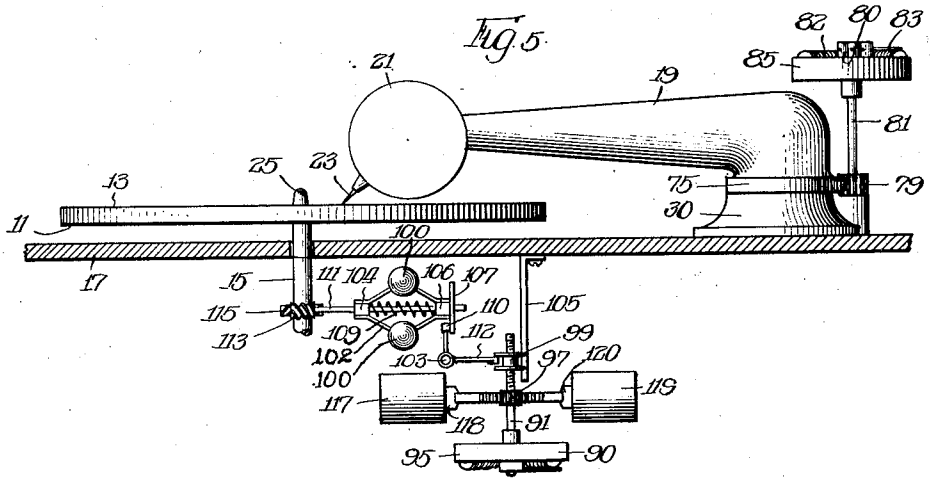
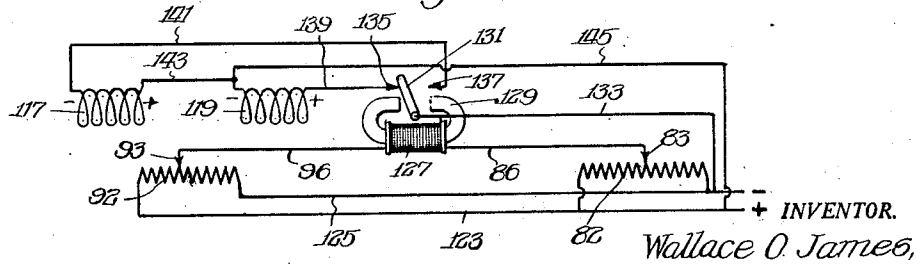


Fig. 6.



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MEANS FOR RECORDING AND REPRODUCING SENSORIAL EFFECTS

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Fig. 7.

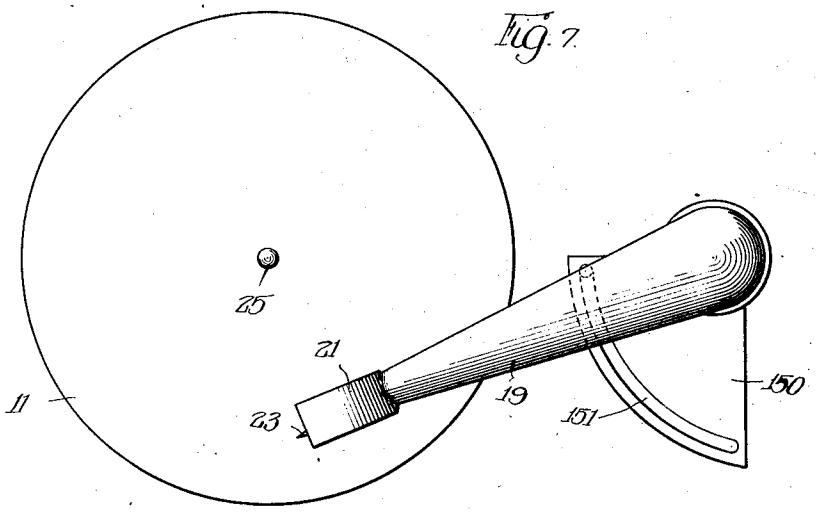
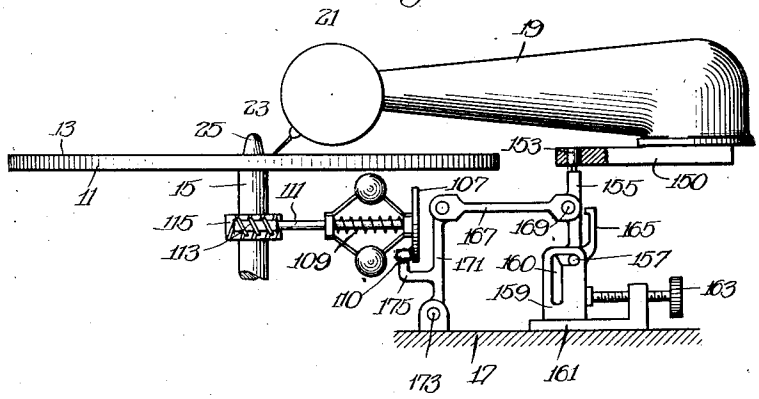


Fig. 8.



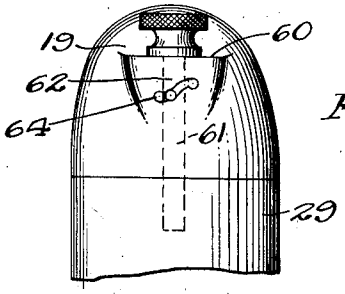


Fig. 9.

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Patented July 8, 1930 1,769,954

UNITED STATES PATENT OFFICE

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MEANS FOR RECORDING AND REPRODUCING SENSORIAL EFFECTS

Application filed October 20, 1927. Serial No. 227,403.

My invention relates to the art of reproducing sensorial effects recorded upon a rotatable disc, and although I have hereinafter described my invention as applied to phonographic reproduction of sound recorded as an undulating groove formed in a rotatable record tablet of the disc type it will be apparent that the invention has a broader application and is not limited to the grooved disc method of recording and reproduction of sounds nor is it limited to the recording and reproduction of sound effects only, but it will be apparent as the description progresses that my invention may be applied in the recording and reproduction of any sensorial effect involving vibrations.

For the purposes of illustrating my improved process and apparatus for carrying out my invention, I have selected, merely for the purposes of exemplification and not by way of limitation, a process and an apparatus for reproducing sound on phonographic records but it should be understood that, in the following specification, when I allude to the process and apparatus, and also to the disc record itself, as referring to a grooved record for recording and reproducing sounds, I am merely using this type of disc record illustratively and that the invention is of broader scope and includes the recording and reproduction of other sensorial effects on rotatable discs.

The general nature of the art of recording and reproducing sounds from a grooved record tablet of the disc type is thought to be sufficiently well understood to obviate the necessity of a detailed description of the technical aspects of the processes involved. Briefly the process comprises forming a continuous spiral groove either of constantly increasing or constantly decreasing radius of curvature in a record disc. The groove is formed in a matrix or master record by rotating the matrix against a vibrating needle or stylus in which the vibrations are induced by the sounds to be recorded. The needle may be caused to vibrate vertically, in which case the sound record comprises a groove containing elevations and depressions corresponding to the vibrations of the recorded sound, or the needle may be vibrated to engrave a laterally undulating groove in the matrix. The grooved matrix is then used as a pattern from which to make duplicate records.

The sounds so recorded are then reproduced by moving the record groove across a reproducing element or stylus at the same relative speed at which the groove was made. The stylus being vibrated by the indentations or sinuosities of the groove reproduces the recorded sounds. In reproducing apparatus heretofore provided, the record disc is rotated at constant speed and consequently as the recording or the reproducing element moves from the circumference of the disc toward the central portions thereof or vice versa during the recording or reproducing process the sound recording or reproducing element has a relatively high linear speed when at the circumference of the record disc, and a relatively low linear at the center of the record.

The principal object of my present invention is the provision of a convenient means for forming the record groove in a disc matrix at constant linear speed and for reproducing the recorded sounds at a constant linear speed of the reproducing element along the groove.

An important object of the invention is the provision of increased record space efficiency which is provided by reproducing sounds at uniform record speed, for it is apparent that by decreasing the speed of the recording and reproducing element in the groove at the circumference of the record disc to the same rate of speed which prevails at the central portions, more sounds per inch of groove may be recorded on a given record disc and the consequent saving in record disc material due to the increased space efficiency of the record will be readily appreciated.

Another important object of the invention is the reduction of the frictional noises which usually distort the reproduced sounds when the reproducing element travels at an unduly high speed along the groove.

Another important object of the invention is the provision of a more uniform tone during the reproduction of recorded sounds at

all parts of the record groove by maintaining constant the relative linear speed at which reproduction takes place.

A further important object of the invention, is the elimination of unequal wear in the record groove due to the different linear record speeds at which the sounds are ordinarily reproduced, since where the linear speed along the groove is constant the wear in the groove will be constant.

Numerous advantages of this invention will be apparent, as it is better understood from the following description which, taken with the accompanying drawings, describes preferred embodiments of my invention.

Referring to the drawings,

Fig. 1 is a plan view of a phonographic apparatus embodying my invention;

Fig. 2 is a side elevation of the apparatus illustrated in Fig. 1;

Fig. 3 is a modified arrangement of the apparatus shown in Fig. 2;

Fig. 4 is a plan view of a phonographic apparatus embodying my invention;

Fig. 5 is a side elevation of the apparatus illustrated in Fig. 4;

Fig. 6 is a diagram of electrical connections for the apparatus illustrated in Figures 4 and 5;

Fig. 7 is a plan view of a phonographic apparatus embodying my invention;

Fig. 8 is a side view of the apparatus illustrated in Fig. 7; and

Fig. 9 is an enlarged fragmentary view as viewed from right of Fig. 3.

To illustrate my invention I have shown on the drawings a phonographic apparatus comprising a rotatable turn table 11 which comprises a circular platform, arranged in a horizontal plane and mounted upon a supporting column 15. The turn table 11 is adapted to support and rotate a demountable disc record 13, an end 25 of the column 15 extending upwardly of the turn table to engage a centrally arranged aperture 26 formed in the disc for the purpose of centering it on the turn table. A pivoted tone arm 19, carrying a reproducing element comprising a diaphragm 21 and a stylus 23 is arranged to swing over the turn table 11. The pivoted tone arm 19, diaphragm 21 and stylus 23 comprise the standard pick up mechanism at present employed in ordinary phonographs, but it will be apparent that my invention is not limited to the specific form of pick up illustrated and that the hollow tone arm may be replaced by a solid pivoted arm carrying the reproducing element of an electric pick up at its free end in place of the diaphragm 21 and stylus 23, or any other preferred mechanism for transposing the sinuosities of the record groove into sensorial effects. I have illustrated the devices of my inventions as embodied in sound reproducing apparatus, but it will be apparent that the devices may, by a simple transposition, be embodied in an apparatus for recording sounds upon a matrix and since the only difference between recording and reproducing apparatus resides in the provision of a recording element in place of the reproducing element and of a mechanically driven tone arm in place of the free swinging tone arm 19, and since neither change affects my present invention, a description of the reproducing apparatus only, will be given.

The principle underlying my invention is that the speed of the reproducing stylus in the record groove shall be maintained at a constant rate. To accomplish this it is necessary to rotate the record disc at a uniformly decreasing speed as the reproducing stylus approaches the central portion of the record disc, and to accomplish this purpose accurately and positively, I have provided and here illustrate apparatus of three distinct types which I shall now describe separately and in detail.

The friction drive apparatus

In Figures 1, 2 and 3 I have shown a variable speed friction drive in which rotatable turn table 11 is supported on the shaft 15, which in turn is pivotally supported in a pedestal bearing 16 arranged in a supporting frame 17. The tone arm 19 is mounted upon a pivot pin 24, which is suitably supported in the frame 17, being mounted in a pedestal 30, secured to the frame. A bracket 27 is also pivoted on the pin 24 immediately beneath the tone arm 19, the bracket having a bearing 29, which engages the pin 24. The pedestal 30, provides a support for maintaining the bearing 29 in arranged position upon the pin. The bracket 27 is arranged to swing beneath the turn table 11, while the tone arm 19 swings thereover and the tone arm, having bearing engagement on the upper edge of the bearing 29, is supported in place thereby. A friction wheel 41, mounted on a stub shaft 39 carrying a gear 43, is supported in the free end of the bracket beneath the turn table and has driving engagement with the under side thereof, shaft 39 having bearing engagement in a journal 37 formed in the bracket. The gear 43 is driven by another gear 45 mounted on the end of a counter shaft 35 journaled in bearings 31 and 33 arranged respectively at the free and pivoted end of the bracket 27. The shaft 35 is driven by a pinion 47 mounted thereon adjacent the bearing 33. The pinion 47 engages and is driven by a gear 49 rotatably mounted upon the pivot pin 24, a portion of the bearing 29 being cut away at 52 to uncover the gear 49 and permit driving engagement between gears 49 and 47. Gear 49 is in turn driven by a gear 51 mounted on a main drive shaft 53 journaled, adjacent gear 51, in a bearing 55, and having a governor 57 arranged thereon to maintain constant driving speed. I pro-

vide suitable means for detachably locking the tone arm 19 and the bracket 27 together for rotation about their pivots. These means in the illustrated embodiment comprise an axially moveable latch pin 61, carrying a radial pin 64 adapted to engage a cam slot 62 formed in the tone arm, adapted to project downwardly into a socket 63 formed in the bearing 29. The reaction of the pin in the slot 62 provides the axial locking movement of the latch pin 61, upon rotation of the latch pin 61 a knurled head 59 being provided to facilitate manual operation of the latch pin 61. When the tone arm and bracket are so locked together, the friction drive wheel 41 engages the turn table 11 at a point vertically under the point on the record disc 13 at which the stylus 23 engages the groove. As the stylus 23 approaches the central portions of the disc, the bracket 27, being locked to the tone arm, is moved thereby so that the friction drive wheel 41 also moves towards the central portion of the turn table, having engagement with the turn table at all times immediately beneath the stylus. Since the drive wheel is driven at constant speed through the counter shaft 35, from the constant speed drive shaft 53, the relative speed between the needle 23 and the record 13 remains constant at all times.

In the preferred embodiment shown in Figure 3, a friction disc 71 is arranged on the column 15 beneath the turn table 11 and the friction wheel has driving engagement with this disc instead of directly with the turn table 11. This arrangement provides constant linear stylus speed since at all times the distance from the axis of rotation of the turn table to the drive wheel and to the stylus is constant.

In order that records made in the ordinary way may be used in the apparatus of my invention, I have provided for locking the bracket 27 against rotation on the pin 24, in order that the turn table may be driven at constant speed. This is accomplished by means of a lug 67, formed on the pivoted portion 29, of the bracket which has an aperture into which a pin 65 may be projected. The pin 65, is slidably mounted in an offset portion of the pedestal 30 and is operated by a cam device 69 adapted to project and retract the pin from engagement in the lug 67. When the bracket 27 is so locked against rotation about the pin 24, the tone arm 19 may be released by rotating the shaft 61 in order to withdraw the tip 63 thereof from engagement in the aperture 64 and so to release the tone arm 19 for free pivotal engagement on the pin 24.

The electrically controlled apparatus

In Figures 4, 5 and 6 of the drawing I have shown a combination mechanical and electrical device for maintaining constant the linear motion of the stylus in the record groove. The turn table is mounted upon a rotatable drive shaft 15, which is connected to any convenient source of motive power capable of driving the turn table and shaft at varying speeds between desired limits, the drive shaft 15 being suitably journaled in the frame 17. A tone arm 19, which comprises a hollow tube pivoted at one end and having a free end arranged to swing across the upper face of the turn table, is pivoted on a pedestal 30 supported upon the frame 17 of the phonographic apparatus, and a sound reproducing diaphragm 21 and stylus 23 is suitably secured at the swinging end of the tone arm and is carried in position to engage the groove of a record disc 13 demountably carried by the turn table. Beneath the turn table 13, a worm wheel is secured upon the shaft 15 and engages a worm 113. The worm is mounted on a shaft 111 suitably journaled or otherwise rotatably supported in the frame 17 of the phonograph apparatus. Shaft 111 carries a governor 108, comprising two separable weights 100 mounted upon leaf springs 102 the opposed ends of which are secured respectively to a collar 104 formed on the shaft 111, and to a bearing 106 embracing and slidably mounted on the shaft 111. A coil spring 109 is arranged about the shaft between the collar and the bushing in order to urge the weights of the governor together as closely as possible. A friction disc 107 is formed integral with the bushing 106. As the speed of the turn table increases under the driving action of the motor attached to the shaft 15, the governor shaft 111 is rotated by the worm and wheel drive 113 and 115, and the centrifugal action of the governor causes the weights 100 to separate. This draws the bushing 106 and the friction disc along the shaft 111 toward the collar 104 against the resilient tension of the leaf springs 102 and the coil spring 109. A brake shoe, comprising a small friction pad 110 mounted on a brake arm 101, which in turn forms a part of a bell crank pivoted at 103 and having an outwardly extending operating arm 112, is arranged to engage the friction disc 107 when it moves along the shaft 111 and to operate as a brake on the governor. It will be apparent that the governor speed at which the brake is applied to the disc 107 depends directly upon the position of the brake shoe 110 which may be adjusted by manipulating the operating arm 112 of the bell crank.

In performing my invention, it is necessary to regulate the governor in such a way as to uniformly accelerate the rotation of the turn table as the recording stylus 23 approaches the central portion of the record disc 13. I have accomplished this by means of a reversible electric motor, comprising two solenoids 117 and 119 having cores 118 and

120 respectively secured to the opposite ends of a rack gear 121 which has driving engagement with a pinion 97 which drives a threaded rod 91, the threaded portion of which engages a collar 99. Upon rotation of the rod 91, the collar 99, which is held against rotation by engaging a stop 105 secured to the frame 17 of the phonographic apparatus, moves axially along the rod 91. The collar 99 engages and moves the actuating arm 112 of the bell crank, the other arm of which engages the governor disc 107. Rotation of the shaft 91 in one direction regulates the governor allowing the turn table speed to increase, and, vice-versa, rotation of the shaft 91 in the opposite direction tightens the governor brake and allows braking to occur at a lower turn table speed thus slowing up the turn table. The shaft 91 is rotated by movement of the rack 121 which is driven by one or the other of the solenoids 117, 119 excitation of which is accomplished by completing a solenoid exciting circuit fed from a direct current supply source, indicated by the line wires 123 and 125, through a balanced relay, the armature 131 of which is connected through a wire 133 to line wire 125 and is adapted to complete the solenoid exciting circuit by making contact with one or other of the contacts 135 and 137 which are connected by wires 139 and 141 respectively to an end of the solenoid coils 119 and 117, the other ends are connected through wire 145 to the live wire 123. The balanced relay comprises an exciting coil 127, a core 129 and a movable armature 131 arranged to travel between the contacts 135 and 137 and contact with one or other according as the relay coil is excited with opposing polarities, that is to say, if the coil is excited in one direction the armature will connect with one contact and when excited in the other direction a connection will be made with the other contact and when the coil is not excited the relay will be balanced, the armature connecting with neither contact.

The excitation of the relay coil is accomplished from the direct current line wires through similar, differentially operating, potentiometers 80 and 90, the former of which is operated by movement of the tone arm 19, the latter being controlled by the rotations of the rod 91. The potentiometers 80 and 90 comprise, respectively, resistance coils 82 and 92, respectively arranged peripherally in circular support frames 85 and 95, which are respectively secured to the frame of the phonograph, and slide contacts 83 and 93 secured respectively to drive rods 91 and 81. The slide contacts are adapted to contact progressively along the resistance elements of the potentiometers and are connected by wires 86 and 96 to the opposite ends of the coil 127. The potentiometer coils are connected between the wires 123 and 125 of the direct current supply line and it will be apparent that while the slides 83 and 93 occupy the same relative positions along the resistance elements 82 and 92, there will be no difference in potential between the contacts 83 and 93 and hence the relay will be in balance. As soon as the relative positions of the contacts are not the same, a difference of potential occurs between the contacts, the coil 127 is excited and the armature 131 makes contact with one or other of the contacts 135, 137 depending on whether the position of the contact 83 on the coil 82 is leading or lagging, with respect to the position of the contact 93 on the coil 92.

The potentiometer 90, being operated by the shaft 91 the position of the slide 93, is consequently regulated by the governor adjustment, that is to say, by the speed at which the turn table is driven. The potentiometer 80, being operated by the shaft 81 which is rotated by a pinion 79 mounted thereon and driven by a gear 77, formed on a flange 75 arranged at the base of the tone arm 19, is consequently regulated by the position of the tone arm with respect to the center of the turn table.

As the turn table rotates, the stylus 23 moves toward the center portions of the record, the tone arm 19 swings about its pivot and the slide contact 83 moves across the resistance 82 of the potentiometer 80 and causes a difference of potential between the contact 83 and 93 which allows a current to flow through the coil 127 of the balanced relay. This current magnetizes the core 129 which draws the armature 131 into contact with one of the contact points 135 or 137 thus exciting one of the solenoids 117 and 119 which moves the rack 121 and drives the pinion 97 which rotates the shaft 91. Rotation of the shaft 91, operating through the collar 99 and the crank 101, releases the governor and allows the turn table speed to increase. At the same time, the rotation of the shaft 91 moves the contact 93 across the resistance coil 82 of the potentiometer 90 until the potential difference between the contacts 82 and 92 becomes zero, and the current through the coil 127 of the balanced relay ceases, at which time the relay armature swings to a neutral position, movement of the shaft 91 ceases. The turn table is thus permitted to speed up as the sound recording element moves inwardly on the disc, and the devices are so calibrated as to maintain constant the relative linear speed of the stylus 23 in the record groove. Upon returning the tone arm to the starting position, the coil of the balanced relay is excited in the reverse direction, which causes the rack 121 to return to the starting position and thus to readjust the governor setting to correspond to the position of the tone arm 19.

The mechanically controlled apparatus

In Figures 7 and 8 in the drawings, I have shown a phonographic apparatus, including a turn table and swinging tone arm 19. The turn table is supported on a shaft 15 which is driven from any motive device adapted to rotate the turn table at a variable speed, and a governor 108, having a friction disc 107 and being otherwise similar in construction and operation to the governor previously described in connection with the electrically controlled apparatus, is driven from the shaft 15 through the worm 113 and worm wheel 115.

In the present embodiment, the governor is controlled by applying the brake by means of a brake applying mechanism operated by the movement of the tone arm. The brake comprises a pad 110 mounted upon an offset arm portion of a member 171 pivoted at 173 to the frame 17 of the phonographic apparatus. The brake is adjusted by moving the member 171 about its pivot point by means of a connecting link 167 which links the member 171 to a cam following member 155 slideably secured in a bearing 160 mounted in the frame 17 of the apparatus, means, comprising a set screw 163, being provided for moving the support longitudinally in its bearing. The member 155 is provided, at its upper end, with a cam following roller 153 adapted to engage a cam slot 151 formed in an offset portion 150 of the tone arm 19. Upon rotation of the tone arm toward the center of the turn table during the reproduction of a sound record, the cam slot 151 allows the upper end of the lever 155 to move outwards and this movement is transmitted through the connection link 167 and releases the brake and allows the turn table speed to increase, the brake releasing force being the centrifugal action of the governor which causes a continual pressure to be exerted by the friction disc 107 upon the brake pad 110 as long as the motor drives the turn table. When the tone arm is returned to the circumference of the turn table, the cam slot draws the lever 155 which, operating through the link 167 and the lever 171, applies the brake member 110 and retards the turn table speed. By moving the slide support 159 bodily to change the position of the pivoted end 157 of the cam following lever, the linear speed at which the record is played may be adjusted, and I have also provided a means for adapting the apparatus to reproduce from records of the ordinary or constant turn table speed type. This is accomplished by unlocking the pivoted end 157 of the cam following lever 155 and sliding the lever downwardly, the pivot 157 engaging in an offset slot portion 160 in which position the cam roller 153 becomes disengaged from the cam slot 151 so that the movement of the tone arm will not affect the brake adjustment. A stop 165 formed on the slide 159 is adapted to limit the braking movement of the cam follower 155.

It will be obvious that as a modified construction my invention contemplates a tone arm such as is shown at 19 of Fig. 1 wherein instead of having the tone arm pivoted on a support 30, the tone arm, by means of appropriate guideways and supporting means therefor together with driving means therefor, such as the standard worm feed drive used in the present recording machines, is arranged to move bodily so that the stylus in its engagement with the groove will not drag against the walls of the groove. In this construction, since the tone arm is moved progressively and continuously by means of any appropriate driving mechanism, this will eliminate a frictional drag on the stylus itself. With regard to the means for bodily shifting the tone arm transversely across the disc, this positive feed of the tone arm across the disc, contemplates means similar to that shown in the present constructions herein illustrated for increasing the speed of motion of the disc by means of the stylus itself so that as the stylus is approaching the center of the disc, the speed of the disc will also increase, this corresponds to the operation of the other constructions hereinbefore described. It will be understood that in Figures 1 to 3 and 7 and 8 of the drawings, when the device is used for recording, the tone arm is positively fed by the usual worm feed known in the art.

It will be apparent that the invention is not limited to the phonographic recording and reproduction of sound from grooved discs, but the record may take other forms than a groove such as an undulating line formed photographically upon a sensitized disc, or a record of other sensorial effects than sound may be made, such as, for instance, a record comprising a series of pictorial views comprising a moving picture when reproduced rapidly, and I do not limit myself to the embodiment herein described which is merely employed as a convenient medium for the purpose of illustration, it being apparent that the underlying invention may be applied in various forms without departing from its spirit or scope.

Having thus described my inventon, what I claim as new and wish to secure by Letters Patent is:

1. A phonographic apparatus, comprising, a record disc support means, a tone arm mounted adjacent said support means and arranged to swing thereover, and means for rotating said support means, said means comprising a friction disc, a pivoted support member swinging across said friction disc, a friction drive wheel carried by said supporting means in position to engage said friction

disc, means for moving said friction wheel radially across said friction disc to vary the driven speed thereof, said wheel moving means being operated by said tone arm.

2. A phonographic apparatus, comprising, a horizontal record disc turn table, a tone arm pivotally mounted adjacent said turn table and arranged to swing in a horizontal plane, means for driving said turn table, comprising a friction disc, a friction wheel driving said disc, and pivoted means carrying said friction wheel in driving position, said means engaging said tone arm.

3. A phonographic apparatus including a horizontal record disc turn table, a tone arm mounted adjacent said turn table and arranged to swing in a horizontal plane, means for driving said turn table, comprising a friction disc, a friction wheel engaging said turn table, a movable support bracket for said friction wheel arranged to swing across said friction disc and pivotally mounted on a common axis of rotation with said tone arm, means securing said tone arm and said support bracket to provide driving engagement therebetween.

4. The combination, in a phonographic apparatus, of a record disc turn table, a pivoted tone arm arranged to swing thereover, a friction disc for driving the turn table, a friction wheel having driving engagement with said disc, a pivoted support bracket for said drive wheel, said bracket and said tone arm having a common access of rotation and means for locking said bracket and said tone arm against relative rotation.

5. The combination, in a phonographic sound reproducer, of a horizontal record disc turn table, a tone arm pivoted adjacent said turn table and arranged to swing in a horizontal plane over said turn table, means for driving said table, comprising a friction disc arranged to rotate with the turn table, a friction wheel arranged to engage the lower surface of said friction disc, means for supporting said drive wheel in driving position, comprising, a pivoted bracket having a common axis of rotation with said tone arm and arranged to swing beneath said turn table, means for locking said bracket and said tone arm to prevent relative motion therebetween, or to swing together.

6. The combination, in a phonographic sound reproducer, of a record disk turn table, a tone arm pivoted adjacent said turn table and arranged to swing over said turn table, means for driving said table comprising a friction disc arranged for rotation with the turn table, a friction wheel arranged to engage the lower surface of said friction disc, means for supporting said drive wheel in driving position comprising a pivoted bracket, said bracket of rotation with said tone arm and arranged to swing across the friction disc beneath said turn table, means for detachably locking said bracket and said tone arm to swing together.

7. The combination, in a phonographic sound reproducer, of a record disc turn table, a tone arm pivoted adjacent said turn table and arranged to swing over said turn table, and means for driving said turn table, comprising a friction disc and a friction wheel having driving engagement with said friction disc, means for supporting said drive wheel in driving position, comprising, a pivoted bracket, said bracket and said tone arm having a common axis of rotation, means for detachably securing said bracket and said tone arm together to prevent relative rotation therebetween, and means for detachably locking said bracket arm against rotation on its pivot.

8. The combination, in a phonographic sound reproducer. of a record disc turn table, a tone arm pivoted adjacent said turn table and arranged to swing over said turn table, a friction disc secured to said turn table, a friction drive wheel having driving engagement with said friction disc, and means controlled by said tone arm for moving said friction wheel radially with respect to said friction disc.

9. A phonographic apparatus comprising a record disc, means for supporting the record disc, a tone arm mounted to swing across said record disc, means for rotating said record disc comprising a friction disc, a friction wheel support arm pivotally mounted to swing across the friction disc, a friction wheel arranged to frictionally engage the friction disc, and guided by the support arm across the friction disc, and means for driving the friction wheel at a constant speed.

10. A phonographic apparatus comprising a record disc, means for supporting the record disc, a tone arm mounted to swing across said record disc, means for rotating said record disc comprising a friction disc, a friction wheel support arm pivotally mounted to swing across the friction disc, a friction wheel arranged to frictionally engage the friction disc, and guided by the support arm across the friction disc, and means for driving the friction wheel at a constant speed, said tone arm and said wheel support being mounted co-axially for rotation and having means whereby said tone arm and said wheel support may be caused to rotate together whereby the movement of the tone arm across the record disc may control the friction wheel with respect to the friction disc.

11. A phonographic apparatus comprising means for supporting a record disc, a tone arm mounted to swing across the record disc, means for rotating the record disc comprising a friction disc, a friction wheel making driving connection with the friction disc, a movable guide support for the wheel and means for regulating the movement of the

guide support in response to the movement of the tone arm and means for rotating the friction wheel.

12. A phonographic apparatus comprising means for supporting a record disc, a tone arm mounted to swing across the record disc, means for rotating the record disc comprising a friction disc co-axially arranged with respect to the record disc, a friction wheel making driving connection with the friction disc, a movable guide support for the wheel and means for regulating the movement of the guide support in response to the movement of the tone arm and means for rotating the friction wheel.

13. A phonographic apparatus comprising means for supporting a record disc, a tone arm mounted to swing across the record disc, means for rotating the record disc comprising a friction disc, a friction wheel making driving connection with the friction disc, a movable guide support for the wheel and means for regulating the movement of the guide support in response to the movement of the tone arm and means for rotating the friction wheel, said guide support and said tone arm having a common axis of rotation.

14. A phonographic apparatus comprising means for supporting a record disc, a tone arm mounted to swing across the record disc, means for rotating the record disc comprising a friction disc co-axially arranged with respect to the record disc, a friction wheel making driving connection with the friction disc, a movable guide support for the wheel and means for regulating the movement of the guide support in response to the movement of the tone arm and means for rotating the friction wheel, said guide support and said tone arm having a common axis of rotation.

15. A phonographic apparatus comprising means for rotatably supporting a record disc, means for supporting a pick up device in position to move along a pre-determined path substantially radially of the record disc, means for rotating the record disc comprising a friction disc mounted for co-axial rotation with the record disc support means, means causing the record disc and friction disc to rotate together, a friction drive wheel, means for supporting the drive wheel in position making driving engagements upon the friction disc, and means for causing the drive wheel to move along a pre-determined path substantially radially of the friction disc, and registering point for point with the corresponding path of the pick up device across the record disc.

16. A phonographic apparatus comprising means for rotatably supporting a record disc, a pick up device supported in position to move across the record disc along a pre-determined path, means for rotating the record disc comprising a friction disc, means causing the record disc and friction disc to rotate synchronously, a drive wheel for the friction disc, means for supporting the drive wheel in position to frictionally engage the friction disc, means for rotating the drive wheel and means for guiding the drive wheel to move across the friction disc along a pre-determined path registering point for point with the corresponding path of the pick up device across the record disc.

17. A phonographic apparatus comprising means for rotatably supporting a record disc, a pick up device and means for supporting the device in position to move across the record disc along a substantially radial pre-determined path, a friction drive device for rotating the record disc comprising a rotatable friction disc, driving connections between the friction disc and the record disc support means, a friction drive wheel, means for rotating the drive wheel and means for supporting the drive wheel in position to frictionally engage the friction disc at points in the friction disc along a substantially radial line and means for controlling the position of the drive wheel with respect to the friction disc as a function of the position of the pick up device with respect to the record disc.

In witness whereof, I have hereunto subscribed my name.

WALLACE O. JAMES.