Jan. 9, 1934. T. E. PIAZZE 1,943,038

DIFFERENTIATION OF SPEEDS

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Fig. 1.

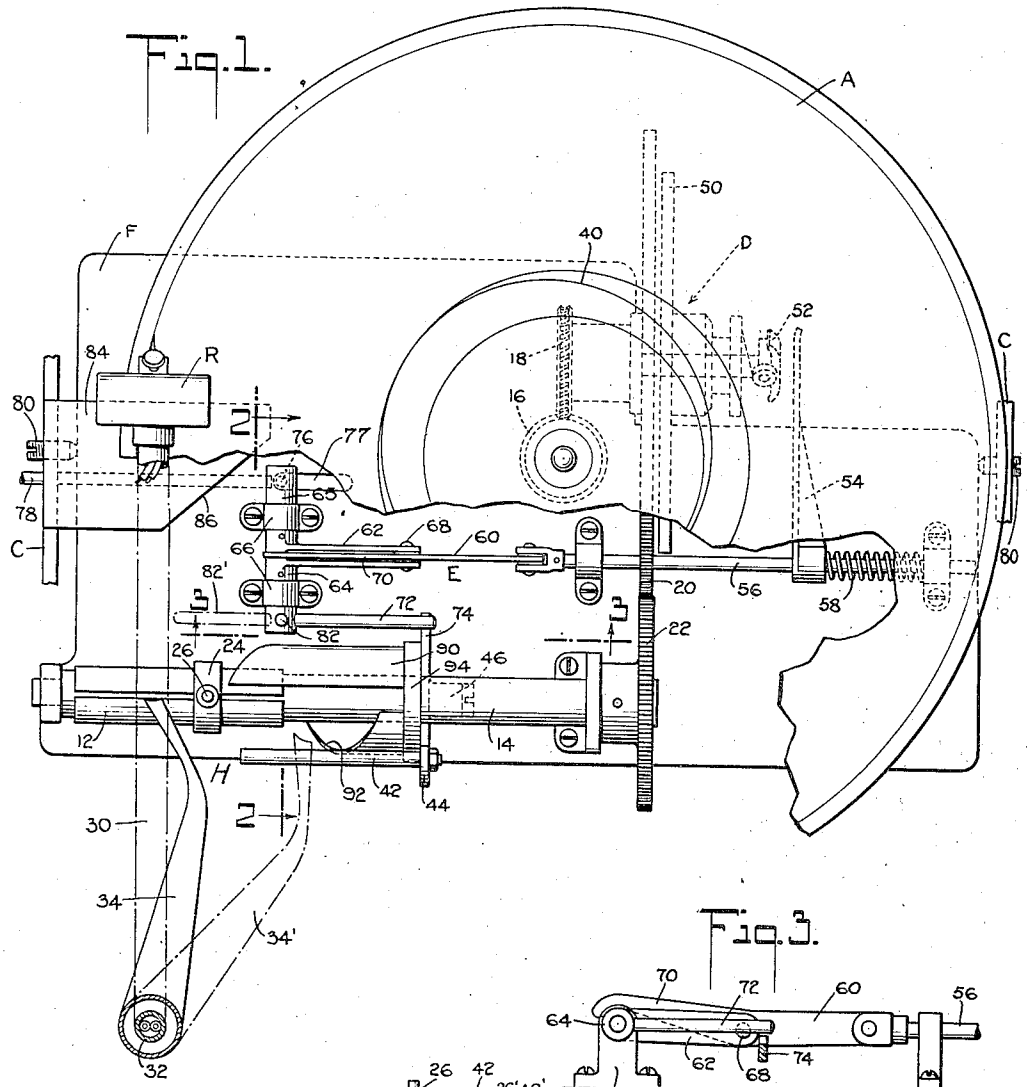
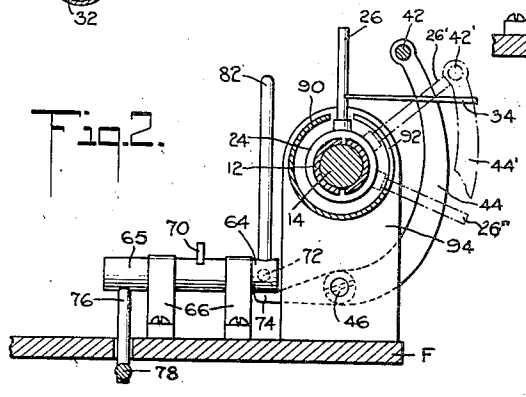


Fig. 3.

Fig. 2.



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DIFFERENTIATION OF SPEEDS

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This invention relates to the differentiation of speeds inside and outside of a range of low speeds, and more particularly to the application of such a speed differentiation to the automatic control of phonographs for stopping the same or for initiating the record changing or record repeating operations in the case of automatic record changing phonographs.

Phonograph records terminate in a variety of ways, some having a terminating groove which is eccentric, others having concentric terminating grooves interconnected with the last sound groove by a relatively high pitch spiral, while many records have no special form of terminating groove. In the case of those records having eccentric or spiral terminating grooves there is an acceleration of the reproducer at the end of the record and in the case of records without a special terminating groove there is a dwell period in which the reproducer remains stationary, so that in either case there is a change in the reproducer movement at the end of the record. In my copending application, Ser. No. 386,247, filed August 16, 1929, now Patent No. 1,881,967, dated October 11, 1932, I have disclosed automatic trip mechanism for phonographs in which advantage is taken of the change in reproducer movement, relative to an enforced movement at a constant speed equivalent to the usual speed of reproducer travel, to initiate the desired operation of the phonograph trip mechanism.

The arrangement there disclosed is very satisfactory in operation with most records, but has a slight disadvantage with some records owing to the fact that some manufacturers produce records having a different number or pitch of grooves from the usual 98 grooves per inch. For example, a closer spacing may be used where it is desired to produce a record playing for a longer period of time than usual, and on the other hand, a wider pitch may be used where it is desired to obtain loud reproduction of low frequency tones.

In general, the primary object of the present invention resides in the provision of an automatic phonograph control or trip mechanism of universal application, so that it may be used without preliminary setting and with perfect reliability and uniformity of operation on records having any form of special terminating groove or no terminating groove, and having any constant pitch or variable pitch within the range of commercially possible pitches.

Only a slight amount of energy is available from the movement of the reproducer in the record grooves, and one of the specific objects of the present invention is to make available a desired moderate amount of trip energy which is merely controlled rather than developed by the change in movement of the reproducer, and to this end I frictionally drive a movable member from the usual turn table rotating mechanism, and prevent the member from moving during the normal playing of a record, but release it for movement at the termination of the record. The resulting movement of the member may be utilized for the desired trip impulse, and the strength of this impulse may be varied to a desired value by varying the friction with which the movable member is driven by the turn table mechanism.

In the case of an automatic record changing phonograph where the trip mechanism must additionally initiate a record changing operation it may be desirable to have available a still more powerful tripping impulse, the provision of which is a further object of my invention, to which end I utilize the record changing operation to store up any desired amount of trigger energy, and thereafter employ a frictionally driven member such as I have just described to release the stored up trigger energy at the termination of a record. Additional manually operable means may be provided for releasing the stored up trigger energy at any time during the playing of a record.

A further specific object of my invention resides in the provision of means in the phonograph control mechanism for differentiating between the range of normal reproducer movement and a stopped or accelerated reproducer movement, in order to first oppose and afterward permit the movement of the frictionally driven member, as aforesaid. More broadly, one object of this invention is to differentiate between a variable speed when inside and when outside of a range of speeds. For this purpose I employ a frictionally driven member, another member moved at the variable speed, and means for causing the variable speed member to oppose the drive of the frictionally driven member, the surface of reaction therebetween being arranged in unstable equilibrium such that movement of the variable speed member at a speed outside of the range of speeds terminates the reaction and permits frictional drive of the driven member. More specifically, in the case of a phonograph the frictionally driven member is constantly actuated by the record turn table mechanism, while the variable speed member is a member moved by the reproducer. Variation in the pitch of the record grooves causes a variation in the repro-

ducer speed within a range of low speeds, and the equilibrium of the reaction opposing the drive of the frictionally driven member is sufficiently stable to accommodate this range of speed, but nevertheless is relatively unstable, so that a greater change in movement such as the dwell or acceleration of the reproducer at the end of a record terminates the reaction and permits the phonograph control to be tripped in response to the resulting movement of the frictionally driven member.

Another object of my invention is to provide the desired speed-differentiating instability in a very simple manner, and my method of doing this is radically new and is based upon the discovery that if a driven means is frictionally driven in one direction but is stopped from moving in that direction, and at the same time is sought to be moved in a transverse direction, it may readily be moved in the transverse direction over a range of low speeds, but cannot readily be moved at a speed outside of the range of low speeds.

It has already been pointed out that many records have special terminating grooves which cause an acceleration of relatively rapid movement of the reproducer at the end of the record. One object of the present invention therefore is to differentiate between relatively low and high speeds, to which end an arrangement of frictional surfaces such as has been just described may advantageously be utilized. The arrangement may most simply be embodied by the provision of a smooth rotatable cylinder which is continuously rotated and upon which a sleeve is rotatably and reciprocably mounted with considerable frictional engagement. The frictional parts may be so proportioned and the speed of rotation of the cylinder so selected that if the sleeve is prevented from rotating it may readily be moved axially along the cylinder at a low speed but will greatly resist motion along the cylinder at a higher speed.

As applied to a phonograph, the cylinder is rotated by the turn table mechanism, and the sleeve is moved axially by movement of the reproducer. The sleeve readily creeps, or follows any movement of the reproducer equivalent to normal reproducer speed, even though the speed be varied over a considerable range, but is unable to follow any sudden acceleration or rapid movement of the reproducer equivalent to the reproducer speed when it reaches a special high pitch terminating groove. The member moved by the reproducer, and which attempts to move the sleeve axially, may be arranged to simultaneously prevent rotation of the sleeve, so that when the reproducer is moved too rapidly for the sleeve to follow, the sleeve is released and permitted to rotate under the frictional drive of the cylinder, which is itself rotated by the turn table mechanism, and the resulting rotation of the sleeve may be employed as a trip impulse, in the manner previously mentioned.

While many records have special terminating grooves of varying kinds, there still remain a vast number of both old and newly manufactured records which have no special form of terminating groove. In the case of these records the reproducer comes to rest or dwells at the end of the record, and accordingly a further object of my invention is to obtain a phonograph tripping impulse in response to such a dwell condition, or more broadly, to differentiate, in general, between a variable slow speed motion and an absence of motion, or still more broadly, to differentiate between a variable speed motion and a still slower motion.

For this purpose the variable speed member which is arranged to prevent the driven means or sleeve from rotating, and which causes the same to creep with it along the cylinder, is further arranged to cause the sleeve to continue to creep along the cylinder past said member when said member is stationary or moves at a substantially slower speed, and thereby releases and permits rotation of the frictionally driven sleeve. This arrangement may be specifically embodied by the provision of a radially projecting pin on the sleeve, and a finger oscillated by the reproducer so that the tip of the finger comes into the path of the rotating pin and "picks it up", thereby preventing rotation of the sleeve, and causing the sleeve to creep along with it. The tip of the finger is biased or sloped in such a manner that when the finger is stationary the pressure of the pin against the finger tip causes the sleeve to continue to creep until the pin clears the finger and is permitted to rotate.

Further objects of my invention are to restore the sleeve to its starting position for the control of the next record to be played, to utilize the rotation of the sleeve as a trip impulse, to utilize this trip impulse for the control of amplified trigger energy for initiating a record changing operation in an automatic record changing phonograph, and more specifically to apply my invention generally to the control of an automatic record changing phonograph such as is described in the copending applications of Lester L. Jones, Ser. Nos. 341,076, 341,077, and 341,078, all filed Feb. 19, 1929.

To the accomplishment of the foregoing and such other objects as may hereinafter appear my invention consists in the speed differentiating and phonograph control method and mechanism, and the elements thereof, as hereinafter are more particularly described in the specification and sought to be defined in the claims. The specification is accompanied by drawing in which:

Fig. 1 is a broken plan view of automatic phonograph mechanism embodying a preferred form of my invention;

Fig. 2 is a vertical section taken in the plane of the line 2—2 in Fig. 1, but showing the sleeve at the other extreme of its travel; and

Fig. 3 is a vertical section taken in the plane of the line 3—3 of Fig. 1.

The phonograph arrangement schematically indicated in the drawing comprises generally a record turn table A, here illustrated as carrying a record having an eccentric terminating groove, and a reproducer R. The phonograph is an automatic record changing phonograph of the type disclosed in the copending applications of Lester L. Jones aforesaid, in which the turn table A is carried upon a tiltable frame F, pivotally mounted on a stationary chassis C. The turn table and frame are bodily tilted about a horizontal axis by mechanism generally indicated at D, the tilting movement being initiated by trigger mechanism E which, in turn, is tripped by a speed differentiating arrangement generally designated H.

Considering the arrangement more in detail, the arrangement H comprises driven means in the form of a split sleeve 12, which is rotatable and reciprocable but with considerable frictional engagement on a smooth rotatable cylinder 14. The cylinder 14 is driven from the turn table

mechanism through a worm 16 meshing with a worm gear 18 which, in turn, rotates gear 20, meshing with a gear 22 fixed to the cylinder 14. The central and preferably unsplit portion of the sleeve 12 is in the form of an annular ring 24, which carries a radially projecting pin 26.

The reproducer R is carried at the end of a reproducer arm 30, which in turn is carried upon a vertical sleeve 32 with which it oscillates during the operation of the photograph. A variable speed member, in the form of an oscillatable finger 34, is also carried upon sleeve 32 and oscillates therewith.

When the phonograph is first placed in operation the sleeve 12, together with pin 26, rotates freely. As the reproducer R is brought into playing engagement with the record, and preferably, as illustrated, only after a considerable portion of the record has been played, the tip of finger 34 cuts into the path of pin 26 and "picks it up", thereupon stopping the sleeve 12 from rotating, cylinder 14, of course, continuing its normal rotation. The surfaces of the tip of finger 34 and the pin 26 are then surfaces of opposition or reaction. Under the resulting condition of relative rotation the sleeve 12 may readily be moved axially along the cylinder 14 within a range of low speeds, and consequently, in spite of the relatively unstable reaction between the variable speed tip 34 and the pin 26, (these parts in practice being relatively tiny, and being magnified in the drawing merely for the sake of clarity), the continued movement of finger 34 along with the reproducer R during the normal travel of the reproducer causes the sleeve 12 to creep with it along cylinder 14 and thus to follow the reproducer movement. This condition obtains until the reproducer reaches the end of the record, at which time finger 34 is somewhere in the neighborhood of the dotted line position 34'. With a special terminating groove of high pitch, such as the eccentric groove 40 on the illustrated record, the reproducer R and with it the finger 34 are suddenly accelerated or moved rapidly at the end of the record, and inasmuch as the sleeve 12 strongly resists rapid axial movement it is unable to follow this movement of finger 34. The reaction between the pin 26 and the tip of finger 34 being anyway relatively unstable, due to the smallness of the parts, which are enlarged in the drawing for clarity, the tip of finger 34 is easily moved sideways past pin 26 and out of its way, whereupon sleeve 12 is permitted to rotate, and this rotation may be used as the desired trip impulse.

Should the record have no special terminating groove the reproducer R dwells or comes to rest at the end of the record. This causes finger 34 to come to rest in a position approximating the position 34'. It will be noted that the tip of finger 34 is so biassed that when in the position 34' it has a slight slope in the proper direction to tend to cause sleeve 12 to continue to creep along cylinder 14, due to the rotative pressure of pin 26 against the sloping end of finger 34. Since a slow creep requires but slight pressure, the sleeve 12 readily continues to travel until pin 26 passes finger 34, whereupon the sleeve 12 begins to rotate, and its rotation may be used to initiate the desired tripping action, just as in the case of a record having a special terminating groove.

It will be understood that in a broader aspect the rotation of sleeve 12 when pin 26 leaves either side of finger 34 may be employed as an indication of a change in speed of a variable speed member, namely, finger 34, from a speed within a range of low speeds to a speed outside of the range of low speeds. Obviously, the parts may be so proportioned that the biassed tip of finger 34 will cause a creep of sleeve 12 faster than a very slow movement of finger 34, so that the differentiation may be between speeds slower than and a range of speeds, as well as between a stationary condition and a range of speeds.

In order to utilize the rotation of sleeve 12 to obtain a trip impulse I interpose a rod 42, rigidly mounted on an arm 44, itself pivoted at 46, in the path of the end of pin 26. As is most clearly shown in Fig. 2, when sleeve 12 rotates pin 26 strikes rod 42 and causes arm 44 to move to the dotted line position 44', which movement may be used for any desired operation, as for stopping an ordinary phonograph. At the same time the movement of arm 44 to position 44' permits the end of pin 26 in the position 26' to clear the rod 42 in the position 42', and thereby allows continued rotation of pin 26 to the position 26''.

In the case of a record changing phonograph it may be desired to obtain considerable trigger energy in order to initiate the record changing operation. For example, in the illustrated arrangement frame F is tilted downwardly with turntable A to discharge the used record, and the tilting of the frame F with turn table A is accomplished by rotation of a crank 50, which is locked to gear 20 when the plunger of a single revolution clutch 52 is moved into apertures therein, and this movement should preferably be of considerable force and be continued for sufficient time to permit the plunger to come into mesh with one of the apertures in the rotating gear 20.

For this purpose a trigger member 54 is mounted on a reciprocable rod 56, and is urged into operative position by a resilient means in the form of a relatively powerful compression spring 58. The end of rod 56 carries one arm 60 of a toggle joint, the other arm 62 of which is formed integrally with trunnions 64 and 65 mounted in bearings 66. The toggle arm 60 is extended past the pivot 68 to form an extension 70 which is so shaped that it prevents movement of the toggle at a point slightly past dead center and so permits the toggle to be locked in alinement, thereby keeping spring 58 under compression. Trunnion 64 is provided with a radial arm 72 which, when the toggle is locked, is located just above the end 74 of lever 44. When the tip of finger 34 loses pin 26 and permits it to rotate it moves arm 44 so that the end 74 thereof bears upwardly against rod 72, thereby breaking the toggle and releasing the stored up trigger energy, which operates to move trigger 54 against the clutch pin 52, thereby initiating a record changing or record repeating operation, which in the case of the particular phonograph here shown, includes a bodily oscillation of the turn table A and the frame F about the bearings 80 in the stationary chassis C.

The other trunnion 65 of the toggle carries a downwardly extending arm 76, extending through a slot 77 in frame F, and the chassis C carries a manually reciprocable plunger 78, the end of which is arranged just in front of the downwardly extending rod 76. By pressing plunger 78 the rod 76 causes a rotation of trunnion 65 and thereby breaks the toggle and releases the trigger energy, so that a record may be manually discarded at any time during the playing thereof.

In order to reset the entire control mechanism for the playing of the next record it is necessary

to reset the toggle and to restore the sleeve 12 to its initial position. The toggle trunnion 64 carries an upwardly extending rod 82, which is moved to the position 82' shown in dotted lines in Fig. 1 when the toggle is broken. The chassis C carries a stationary cam plate 84 having a sloping cam surface 86 against which the rod 82 bears when the frame F is tilted about bearings 80. In this manner during the record changing operation the trigger energy for the next record is stored up, and the toggle is reset and locked in alinement.

When pin 26 on sleeve 12 is released from the tip of finger 34 and rotates it strikes rod 42, as was before explained, but moves this out of the way, in the position 26', 42', shown in Fig. 2, and then continues to rotate to the position 26'', where it is stopped by a cylindrical cam 90. This is provided with a helically cut cam surface 92, and is arranged about cylinder 14 and fixed to a pedestal 94 stationarily mounted on frame F. Pin 26 in rotating bears against the helical surface 92 and thus causes a pressure to the left, as a result of which sleeve 12 creeps back to its starting position. When pin 26 leaves the end of the helical cam surface 92 it again is free to rotate, and does so rotate until the tip of finger 34, which meanwhile was swung back with the reproducer R to its starting position during the tilting of the frame F, comes into its path during the playing of the next record. It will be observed that rod 42 is made sufficiently short in length so that pin 26 is free to rotate at its starting position.

Tests have proven the device to be exceptionally reliable, and the effects and the operation thereof to be positively reproducible under a great variety of conditions. The theory of operation is none too clear, and I advance the following explanation without wishing to be limited thereto. The friction of sleeve 12 on cylinder 14 tends, when neither or both rotate, to prevent axial movement of one relative to the other. However, when there is relative rotative movement, as by reason of one or the other being stopped from rotating, a slow creeping axial movement is very readily accomplished. The ability of finger 34 to hold pin 26 balanced at its tip for a range of slow speed, and the magnitude of that slow speed, depend upon the relation between the peripheral rotating speed of the frictional surfaces and the transverse or axial speed. By way of example, in one specific arrangement the cylinder 14 is rotated at 1/6 of the speed of the turn table, that is to say, at approximately 12 to 13 revolutions per minute, and the cylinder is smoothly finished steel approximately 3/8 of an inch in diameter. This relation seems to be best over a transverse or axial speed of approximately 1/2 inch per minute, although the relation is not critical and will accommodate speeds of say 1/5 to 1 1/2 inches per minute without causing the tip of finger 34 to lose the pin 26.

With regard to the differentiation between the range of slow speeds and the stationary condition of finger 34 it may not be amiss to point out that this action is probably aided by very minute and imperceptible oscillations of finger 34 caused by a slight eccentricity of the grooves in the record, or by a slight eccentricity in the position of the record on the turn table, the hole in the record usually being slightly larger than the diameter of the turn table pin. A very slight bias at the tip of the finger will cause the pin to ride off the tip because of the cumulative effect of these slight oscillations, each causing successive creeping movements of the sleeve on the cylinder.

In operation it will be clear that my new phonograph stop requires no preliminary setting, and is absolutely universal in responding to all types of records regardless of whether or not they have terminating grooves, and if so what kind of terminating groove is employed, and also regardless of whether or not the pitch of the record is uniform, and regardless of the magnitude of this pitch within any range met with in commercial practice. It should also be appreciated that my invention, in so far as it permits of the differentiation of speeds inside and outside of a range of speeds by means of frictional movements in relatively transverse directions, is applicable to devices other than phonographs.

It will be apparent that while I have shown and described my invention in the preferred form, many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

I claim:

1. Control mechanism for a phonograph comprising a member frictionally driven by the turn table mechanism, means to prevent the member from moving in the direction of drive during the normal playing of a record, but permitting the member to move at the termination of the record, and control means operated by the resulting movement of the frictionally driven member.

2. Control mechanism for an automatic record changing phonograph comprising means to store up trigger energy of desired strength during the record changing operation, a member frictionally driven by the turn table mechanism, means to prevent the member from moving in the direction of drive during the normal playing of a record but permitting it to move at the termination of the record, and means responsive to the resulting movement of the member for releasing the stored up trigger energy.

3. Control mechanism for an automatic record changing phonograph comprising means to store up trigger energy of desired strength during the record changing operation, a member frictionally driven by the turn table mechanism, means to prevent the member from moving in the direction of drive during the normal playing of a record but permitting it to move at the termination of the record, means responsive to the resulting movement of the member for releasing the stored up trigger energy, and additional manually operable means for releasing the stored up trigger energy at any time during the playing of a record.

4. In combination, a rotatable cylindrical surface, means to rotate the same, means frictionally engaging the rotating cylindrical surface, means to drive the said frictionally engaging means axially along the rotating cylindrical surface, and means to prevent rotation of the axially driven means with the rotating cylindrical surface, the friction between and the relative speed of rotation of the cylinder and the axially driven means being so related that the axially driven means may readily be moved axially along the cylindrical surface at a low speed but not at a high speed.

5. In combination, a rotatable smooth cylinder, means to rotate the same at a constant speed, a sleeve fitted around and frictionally engaging the cylinder, means tending to produce

relative axial movement of the sleeve and the cylinder, and means to prevent rotation of the sleeve with the cylinder, the friction between and the relative speed of rotation of the cylinder and sleeve being so related that the sleeve may readily be moved axially relative to the cylinder at a speed within a range of low speeds, but greatly resists motion relative to the cylinder at higher speeds.

6. In a phonograph control, in combination, a rotatable smooth cylindrical surface, means actuated by the record rotating means for rotating the same, means frictionally engaging the same, means responsive to movement of the phonograph reproducer for tending to drive the frictional engaging means axially along the cylinder, and means to prevent rotation of the axially driven means, the friction between and the relative speed of rotation of the cylinder and the axially driven means being so related that the axially driven means may readily be moved axially along the cylindrical surface at a speed equivalent to the normal reproducer speed, but greatly resists motion along the cylindrical surface at higher speeds, equivalent to the reproducer speed when in a record terminating groove.

7. An arrangement for differentiating between a variable speed when inside and outside of a predetermined range of speeds comprising a frictionally driven member, another member independent of the frictionally driven member, said independent member being moved at the variable speed, and means for causing the independently moving variable speed member to oppose the drive of the frictionally driven member, the surface of opposition or reaction therebetween being arranged in unstable equilibrium such that movement of the variable speed member at a speed outside of the range of speeds terminates the reaction.

8. An arrangement for differentiating between a variable speed when inside and outside of a range of low speeds comprising a frictionally driven member, another member moved transversely of the attempted direction of movement of the driven member and moved at the variable speed, and means for causing the variable speed member to oppose the drive of the frictionally driven member, the surface of opposition or reaction therebetween being arranged in unstable equilibrium such that movement of the variable speed member at a speed outside of the range of low speeds terminates the reaction.

9. An arrangement for differentiating between a variable speed when inside and outside of a range of low speeds comprising a member frictionally driven at a constant speed, another member independently moved at the variable speed, and means for causing the variable speed member to oppose the attempted drive of the frictionally driven member, the surface of opposition or reaction therebetween being arranged in unstable equilibrium such that movement of the variable speed member at a speed outside of the range of low speeds terminates the reaction and permits frictional drive of the driven member.

10. A phonograph control comprising a member frictionally driven by the record turn table mechanism, another member moved by the reproducer, means for causing the latter to oppose the drive of the frictionally driven member, the surface of opposition or reaction therebetween being arranged in unstable equilibrium such that movement of the reproducer at a speed outside of the range of normal reproducer speed terminates the reaction, and phonograph control means operated by the resulting movement of the frictionally driven member.

11. An arrangement for differentiating between a variable speed when inside and outside of a range of low speeds comprising driven means frictionally driven in one direction, a member moved at the variable speed in a transverse direction, and means causing the variable speed member to oppose the movement of the driven means in the direction of drive so long as the variable speed member is moved in the transverse direction at a speed within the range of low speeds but not when the variable speed member is moved at a speed outside of the range of low speeds.

12. An arrangement for differentiating between a variable speed when inside and outside of a range of low speeds comprising driven means frictionally driven in one direction, a member moved at the variable speed in a transverse direction, and stop means therebetween for causing the variable speed member to oppose the movement of the driven means, said stop means being effective so long as the variable speed member is moved at a speed within the range of low speeds, but ineffective when the variable speed member is moved at a speed outside of the range of low speeds, thereby permitting movement of the driven member as an indication of the change in speed of the variable speed member.

13. A phonograph control comprising driven means frictionally driven by the turn table mechanism in one direction, a member moved by the reproducer in a transverse direction, means causing the member to oppose the movement of the driven means, said means being effective so long as the member is moved at a speed equivalent to the normal reproducer speed, but ineffective at a different speed, as at the termination of a record, and phonograph control means operated by the resulting movement of the driven means.

14. An arrangement for discriminating between a variable slow speed motion and a more rapid motion comprising a rotatable cylindrical surface, means to rotate the same, rotatable driven means frictionally engaging the cylindrical surface, and a slow speed member arranged to prevent rotation of the driven means and to cause the same to creep along the cylindrical surface at the slow speed, the engagement therebetween being such that when said member is moved rapidly the driven means is unable to follow, and is freed from the member and permitted to rotate.

15. An arrangement for discriminating between a variable slow speed motion and a more rapid motion comprising a smooth rotatable cylinder, means to rotate the same, a rotatable and reciprocable sleeve frictionally engaging the cylinder, a slow speed member arranged to prevent rotation of the sleeve and to cause it to creep with it along the cylinder at the slow speed, the engagement therebetween being such that when said member is moved rapidly the sleeve is unable to follow and is freed from the member, and means responsive to the resulting rotation of the sleeve for indicating the change in motion of the member.

16. A phonograph control comprising a smooth rotatable cylinder, means driven by the turn table mechanism for rotating the same, a rotatable and reciprocable sleeve frictionally engaging the cylinder, a member moved by the reproducer and arranged to prevent rotation of the sleeve

and to cause it to creep with it along the cylinder during the normal reproducing travel of the reproducer, the engagement therebetween being such that when the reproducer moves said member rapidly, as when in the terminating groove of a record, the sleeve is unable to follow and is freed from the member, and phonograph control means operated by the resulting rotation of the sleeve.

17. An arrangement for discriminating between a variable speed motion and a slower motion comprising a rotatable cylindrical surface, means to rotate the same, driven means frictionally engaging the cylindrical surface, and a member moved at the variable speed arranged to prevent the driven means from rotating, the surface of reaction between said member and the driven means being so relatively biassed as to cause the driven means to creep along the cylindrical surface faster than the movement of the variable speed member when said variable speed member lags in speed below a predetermined range of speed, until the driven means passes the member and begins to rotate.

18. An arrangement for discriminating between a variable slow speed motion and an absence of motion comprising a smooth rotatable cylinder, means to rotate the same, a rotatable and reciprocable sleeve frictionally engaging the cylinder, a slow speed member arranged to prevent the sleeve from rotating, the surface of reaction between said member and the driven means being so relatively biased as to cause the sleeve to continue to creep along the cylinder past said member when said member is stationary, and means responsive to the resulting rotation of the sleeve for indicating the absence of motion of the member.

19. A phonograph control comprising a smooth rotatable cylinder, means driven by the turn table mechanism for rotating the same, a rotatable and reciprocable sleeve frictionally engaging the cylinder, a member moved by the reproducer and arranged to prevent the sleeve from rotating and to cause it to creep with it along the cylinder during the normal reproducing travel of the reproducer, said means being so biased as to cause the sleeve to continue to creep along the cylinder past said member when said member is stationary, as at the end of a record, and phonograph control means operated by the resulting rotation of the sleeve.

20. An arrangement for discriminating between a variable speed when inside and outside a range of speeds comprising a rotatable cylindrical surface, means to rotate the same, rotatable driven means frictionally engaging the cylindrical surface, a member arranged to prevent rotation of the driven means and to cause the same to creep along the cylindrical surface at its speed, the engagement therebetween being such that when said member is moved rapidly the driven means is unable to follow and is freed from the member and permitted to rotate, said member being so biassed as to cause the driven means to continue to creep along the cylindrical surface when said member moves at a substantially slower speed, until the driven means passes the member and begins to rotate, thereby indicating the change in motion of the member.

21. An arrangement for discriminating between a variable slow speed motion and either an absence of motion or a relatively fast motion, comprising a smooth rotatable cylinder, means to rotate the same, a rotatable and reciprocable sleeve frictionally engaging the cylinder, a variable slow speed member arranged to prevent rotation of the sleeve and to cause the same to creep with it along the cylinder at slow speed, the engagement therebetween being such that when said member is moved rapidly the sleeve is unable to follow and is freed from the member, thereby permitting the sleeve to rotate, said member being so biassed as to cause the sleeve to continue to creep along the cylinder past the member and free from the same when said member is stationary, thereby also permitting the sleeve to rotate, and means responsive to the resulting rotation of the sleeve for indicating the change in motion of the member.

22. An arrangement for discriminating between a variable slow speed motion and either an absence of motion or a relatively fast motion, comprising a smooth rotatable cylinder, means to rotate the same, a rotatable and reciprocable sleeve frictionally engaging the cylinder, a radial projection carried by said sleeve, a finger the tip of which is moved at the slow speed into the path of the projection for preventing rotation of the sleeve and for causing the same to creep along the cylinder at its speed, the size, friction, and speed of the sleeve and cylinder being so related that when the finger is moved at a relatively fast speed the sleeve is unable to follow, thereby releasing the projection from the tip and permitting the sleeve to rotate, the tip and the projection being so relatively biassed that when the finger ceases motion the projection pressure thereagainst causes the sleeve to continue to creep along the cylinder past the finger, thereby also permitting the sleeve to rotate, and means responsive to the rotation of the sleeve for indicating the change in movement of the finger.

23. A universal phonograph control comprising a smooth cylinder rotated by the turn table mechanism, a sleeve frictionally engaging said cylinder and rotatable and reciprocable thereon, a member moved by travel of the reproducer and arranged to stop rotation of the sleeve and to cause the same to creep with it along the cylinder at a speed commensurate with that of the reproducer, the surface of engagement therebetween being so biassed that either stopped or accelerated movement of the reproducer, as at the end of a record, permits the sleeve to rotate, and phonograph control means responsive to the resulting rotation of the sleeve.

24. A universal phonograph control comprising a smooth cylinder rotated by the turn table mechanism, a sleeve frictionally engaging said cylinder and rotatable and reciprocable thereon, a member moved by travel of the reproducer and arranged to stop rotation of the sleeve and to cause the same to creep with it along the cylinder at a speed commensurate with that of the reproducer, the engagement therebetween being such that the sleeve cannot follow a rapid movement of the reproducer, as when in a special terminating groove of a record, and is freed from the member, thereby permitting the sleeve to rotate, said member being so biased as to cause the sleeve to continue to creep along the cylinder past the member and free from the same when said member is stationary, as at the end of a record, thereby also permitting the sleeve to rotate, and phonograph control means responsive to the resulting rotation of the sleeve.

25. A universal phonograph control comprising a smooth cylinder rotated by the turn table

mechanism, a sleeve frictionally engaging said cylinder and rotatable and reciprocable thereon, a projection extending radially from said sleeve, a finger oscillated by travel of the reproducer, the tip of said finger cutting into the path of rotation of the projection and thereafter stopping rotation of the sleeve and causing the same to creep with it along the cylinder at a speed commensurate with that of the reproducer, the engagement of the projection and tip being unstable so that either stopped or accelerated movement of the reproducer, as at the end of a record, causes the projection to leave the tip of the finger, phonograph control means responsive to the resulting rotation of the sleeve, and a helical surface arranged about the cylinder for engagement by the projection when the sleeve rotates in order to force the sleeve back to its starting position for the control of another record.

26. A universal automatic phonograph control comprising a cylindrical surface rotated by the turn table mechanism, driven means frictionally engaging said cylindrical surface and rotatable and reciprocable thereon, a member moved by travel of the reproducer and arranged to prevent rotation of the driven means and to cause the same to creep with it along the cylinder at a speed commensurate with that of the reproducer, the surface of engagement therebetween being so biased that either stopped or accelerated movement of the reproducer, as at the end of a record, permits the sleeve to rotate, trigger mechanism comprising a trigger, resilient means for actuating the same, and means responsive to rotation of the sleeve for releasing the trigger at the termination of a record.

27. A universal phonograph control for automatic record changing phonographs comprising a cylinder rotated by the turn table mechanism, a sleeve frictionally engaging said cylinder and rotatable and reciprocable thereon, a member moved by travel of the reproducer and arranged to prevent rotation of the sleeve and to cause the same to creep with it along the cylinder at a speed commensurate with that of the reproducer, the surface of engagement therebetween being so biassed that either stopped or accelerated movement of the reproducer, as at the end of a record, permits the sleeve to rotate, trigger mechanism comprising a trigger, resilient means for actuating the same, locking means for keeping the resilient means under tension, means responsive to rotation of the sleeve for releasing the trigger at the termination of a record, and means to cause the sleeve to creep back to its starting position for the control of the next record.

28. Speed limiting mechanism comprising, in combination, a smooth rotatable shaft, means frictionally mounted thereon for axial movement therealong at a limited speed, and means to freely and unresistingly permit axial movement at said limited speed while resisting and preventing high speed movement, including means to rotate the shaft and means to prevent rotation of the sleeve.

29. In a phonograph, a smooth rotatable shaft, means frictionally mounted thereon and moved axially along the shaft in response to reproducing movement of the phonograph reproducer, and means driven by the turntable mechanism for constantly rotating the shaft in order to eliminate the friction opposing the aforesaid axial movement at slow speeds corresponding to the normal rate of reproducer travel.

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