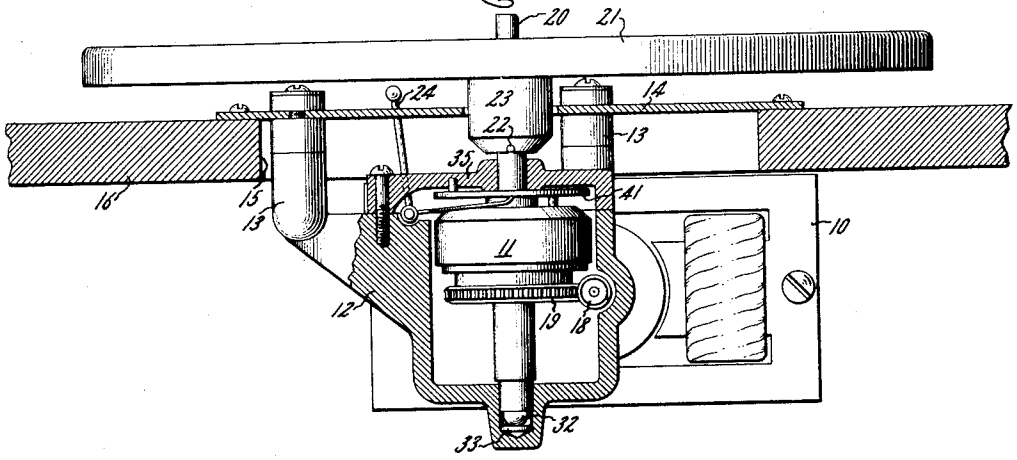
April 5, 1938. H. M. STEPHENSON 2,113,456

SPEED REDUCTION PHONOGRAPH DRIVE

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Fig. 1.



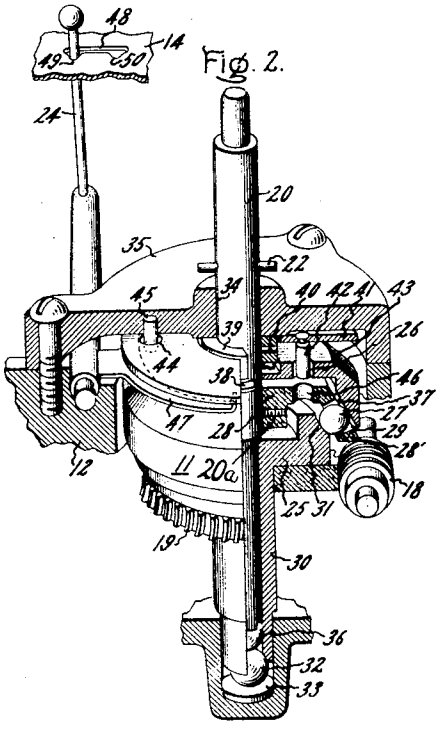


Fig. 2.

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SPEED REDUCTION PHONOGRAPH DRIVE

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Fig. 3.

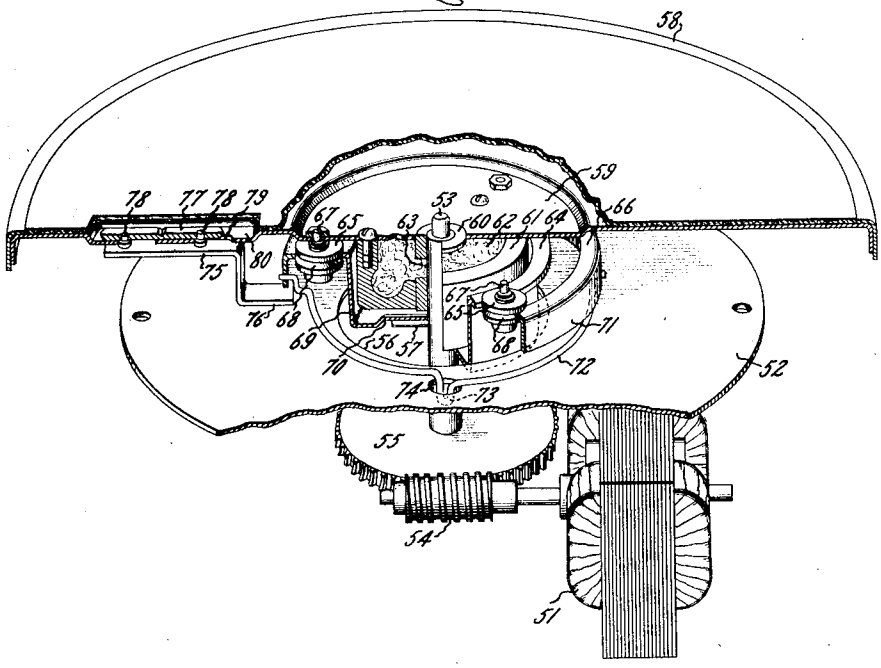
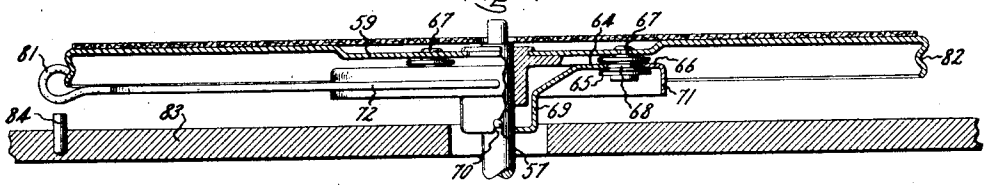


Fig. 4.



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SPEED REDUCTION PHONOGRAPH DRIVE

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Fig. 5.

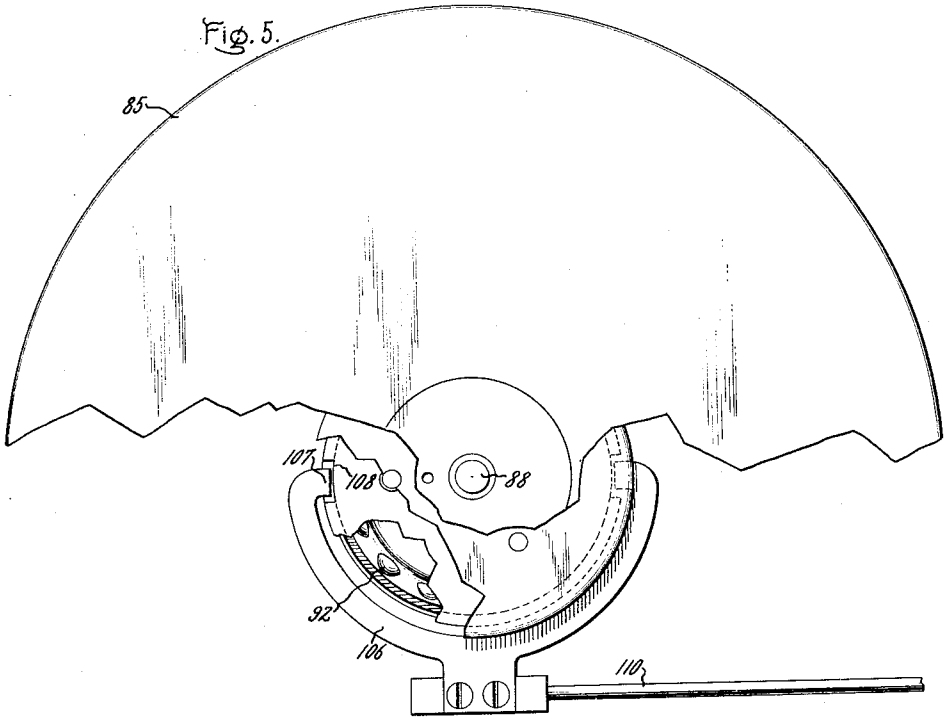
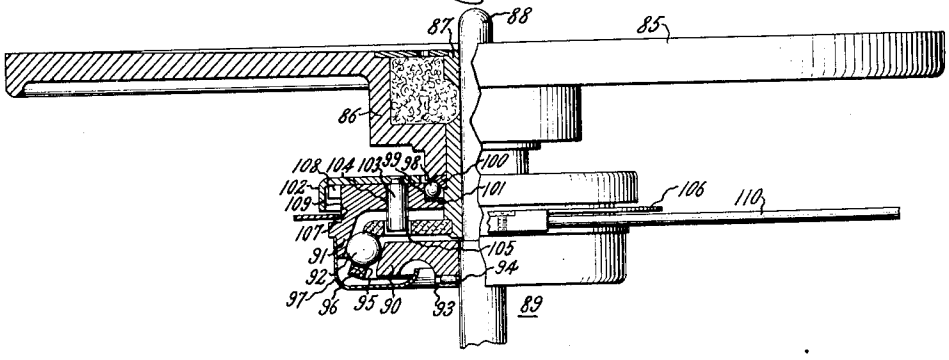


Fig. 6.



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UNITED STATES PATENT OFFICE

2,113,456

SPEED REDUCTION PHONOGRAPH DRIVE

Hugh M. Stephenson, Fort Wayne, Ind., assignor to General Electric Company, a corporation of New York

Application September 27, 1932, Serial No. 635,033

60 Claims. (Cl. 274—9)

My invention relates to variable speed mechanisms, and more particularly to phonograph drives providing for adjustable speed.

Since the development of large size, low speed, phonograph records it has become desirable to provide phonographs with a two-speed drive whereby either the large low-speed or the standard high-speed records may be played.

It is an object of my invention to provide a phonograph drive which can be conveniently operated at either full or reduced speed.

Another object of my invention is to provide an easily adjustable variable speed phonograph drive which shall be silent in operation.

A further object of my invention is to provide a phonograph turn-table having incorporated therewith a variable speed drive and which may be used in place of the turn-table on the standard machine.

Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In order that my invention may be more readily understood, reference may be had to the accompanying drawings in which Fig. 1 is a side elevation partly in section of a phonograph drive assembly embodying my invention; Fig. 2 is a sectional perspective view of the drive assembly shown in Fig. 1; Fig. 3 is a sectional perspective view of a turn-table fitted with a variable speed drive constructed in accordance with my invention for converting a standard phonograph into a two-speed phonograph; Fig. 4 is another modification of my invention similar to the construction shown in Fig. 3 for use in connection with standard phonograph equipment; Fig. 5 is a modification similar to that of Fig. 3, but employing a slightly different change-speed mechanism; and Fig. 6 is a side elevation, partly in section, of the device shown in Fig. 5.

Referring to the drawings, in Fig. 1, I have shown a phonograph drive assembly comprising a motor 10 arranged to drive a turn-table spindle through a variable speed mechanism 11 which is mounted in a frame 12. This phonograph motor assembly is suspended by legs 13 from a plate 14 which is secured over an opening 15 in the top wall or partition 16 of a phonograph cabinet and which forms a part of the wall. In the arrangement shown the motor 10 drives the worm 18 which drives the variable speed mechanism 11 through the gear 19. The variable speed mechanism 11 drives the shaft or spindle 20, and the turn-table or record support 21 is mounted on the shaft so as to rotate therewith. The turn-table is secured to the shaft 20 by a pin 22 fitting in a notch in the hub 23 of the turn-table. A lever 24 is provided for adjusting the variable speed mechanism so as to change the speed of the turn-table.

The construction of the variable speed mechanism 11 can be seen by referring to Fig. 2. This mechanism includes a frictional planetary gearing having a sun gear 25, an outer gear 26, and balls or planet gears 27 arranged to frictionally engage the inner and outer gears. The balls 27 are supported between the beveled faces of the gears 25 and 26 by a retaining member 28 secured to the shaft 20. This retaining member has a flange 28' extending between the faces of the bevel gears and openings 29 in the flange to receive the balls, the flange 28' being spaced from the gears 25 and 26 so that the retaining member can rotate freely with respect thereto. The sun gear 25 is formed as an integral part of a hollow shaft 30, which is driven by the motor through the gear 19, and has a beveled face 31 engaging the balls 27. The sun gear 25 and the hollow shaft 30 are supported on a thrust ball 32 and a plate 33 arranged in a recess in the bottom of the frame 12. The shaft 20 is journaled in the hollow shaft 30 and in a bearing 34 formed in a cover plate 35 secured to the top of the frame 12, the lower end of the shaft 20 resting on a thrust ball 36 within the hollow shaft 30 and supported on the thrust ball 32. The outer gear 26 is rotatably mounted on the shaft 20, and is provided with an internal beveled face 37 engaging the outer surfaces of the balls 27. The gears 25 and 26 are retained in frictional contact with the balls 27 by a spring 38 arranged between the gear 26 and a collar 39 which is secured to the shaft 20 by a pin 40. The collar 39 engages the cover plate 35 and retains the shaft 20 in place in the mechanism.

In the planetary gearing shown, two reproducing speeds are available when the motor drives the sun gear 25. If the outer gear 26 is held stationary, rotation of the sun gear causes the balls 27 to roll on the beveled faces of the gears and in their movement about the axis of these gears they engage the sides of the openings 29 in the retaining member 28 so as to drive the shaft 20 at reduced speed. On the other hand when the gear 26 is locked to the retaining member it prevents the balls 27 from rolling on the face of the gear 26, and the gear 25 drives the

shaft through the retaining member by frictional engagement with the balls.

In order to hold the gear 26 stationary to obtain reduced speed of the shaft 20, or to lock the gear 26 to the retaining member to obtain direct drive, I provide an adjustable lock. This adjustable lock includes a plate 41 provided with a pin 42 which engages an opening 43 in the outer gear 26 and having an opening 44 adapted to engage a pin 45 secured to the frame 12. When the plate is in its upper position, as shown in the drawings, the outer gear 26 is held stationary. When the plate 41 is in its lower position it is disengaged from the pin 45 and the pin 42 passes through both the opening 43 and an opening 46 in the retaining member 28 and locks the outer gear 26 and the retaining member 28 together.

In order to raise or lower the plate 41 to adjust the variable speed mechanism at will as desired I provide a manually operable yoke 47 pivotally mounted in the frame 12 on a shaft which is operated by the lever 24 extending through a slot 48 in the plate 14. This slot is provided with the notches 49 and 50 for holding the yoke in its upper and lower positions, respectively.

The ratio of the speeds of the hollow shaft and the turn-table shaft is determined by the relative dimensions of the gears 25 and 26, and the balls 27 and any definite ratio of transmission may be selected. If the position of the balls 27 is changed axially of the gears 25 and 26, it will be noted that there will result a slight change in the ratio of the drive; it is thus possible to obtain an accurate speed ratio by slightly varying the position of the retaining member 28 along the shaft 20. The retaining member is provided with a set screw 20a adjustably securing it on the shaft 20 in order that its position may be slightly varied to correct the gear ratio in case of wear or changes due to other causes.

In the operation of my invention, as shown in Figs. 1 and 2, when it is desired to play a large low-speed record the lever 24 is shifted into the notch 49. The yoke 47 now retains the plate 41 in its upper position and the gear 26 is held stationary by the pin 42 in engagement with the recess 43 and the pin 45 in engagement with the opening 44 in the plate. In this position of the lever 24 rotation of the gear 25 causes the balls 27 to roll between the gears 25 and 26 and, as they roll, they engage the sides of the openings 29 in the retaining member, so as to drive the turn-table 21 through the retaining member and the shaft 20 at about 33 revolutions per minute.

When it is desired to play standard high-speed records, the lever 24 is moved to the notch 50 and the plate 41 then moves to its lower position. This movement of the plate disengages the pin 45 from the recess 44 and moves the pin 42 into the opening 46 in the retaining member 28. There can now be no relative rotation between the gear 26 and the retaining member 28 which are locked together. As a result, when the shaft 30 is rotated there is a direct frictional drive between it and the shaft 20 through the balls 27 and the retaining member 28, the balls 27 being held from rotation within the openings 29 by friction.

It is often desirable to provide a two-speed drive for a standard single-speed phonograph, and in Figs. 3, 4, 5, and 6 I have shown phonograph turn-tables provided with variable speed or power transmitting mechanisms attached to the record supports and embodying my invention. These turn-tables are so constructed that they may be used interchangeably with the turn-table of the standard phonograph, and it is unnecessary to change the phonograph driving mechanism itself.

Referring now to Fig. 3, I have shown a phonograph motor 51 arranged below a supporting plate 52 and driving the shaft 53 through a worm 54 and a gear 55. The shaft 53 extends through and protrudes above an opening 56 in the plate 52 and is provided with a pin 57 for engaging a phonograph platen or turn-table. The mechanism just described constitutes a standard phonograph drive with a shaft arranged to rotate at the rate of about 78 revolutions per minute. In order to use the large low-speed records with a machine of this type it is necessary to provide some means for reducing the speed of the turn-table to about 33 revolutions per minute. I have shown a turn-table 58 incorporating a unitary differential gearing or change-speed mechanism for this purpose arranged in position on and supported solely by the central shaft or spindle 53. The turn-table comprises a metal disc 59 fitted with a bearing 60 and a lubricating well 61. The bearing 60 is fitted over and journalled on the shaft 53 and is lubricated by means of oiled packing 62 arranged in the lubricating well 61, an opening 63 being provided in the bearing to admit oil thereto. The change-speed mechanism which is permanently attached to the turn-table comprises a planetary gearing secured about the lubricating well 61 below the disc 59. This planetary reduction gearing includes a hub, driving member or sun gear 64 operable by the spindle, a plurality of planet gears or driven pinions 65 which receive power from the gear 64, and an outer member or ring gear 66 which cooperates with the sun gear to form a path for the planet gears. The planet gears 65 which provide a driving connection interengaging the hub and the turn-table are pivotally secured to the disc 59 on pins 67 which transmit to the disc movement of the gears about the spindle 53. The gears 65 are provided with grooves 68 in which the sun gear and the outer ring gear are engaged. The sun gear thus constitutes a depending hub rotatably attached to the under side of the turn-table. The sun gear 64 is formed as a flange of a cup-shaped member 69 which fits closely about the shaft 53 and is provided with an indentation 70 which engages the pin 57 and secures the cup-shaped member 69 against rotation relative to the shaft 53. In order to control the mechanism and change the relative speeds of the driving shaft and the turn-table disc, an arrangement is provided for locking the outer ring 66 to the disc for full-speed drive and to the plate 52 for reduced speed drive. The outer gear 66 is formed as a flange of an annular ring 71 surrounding the shaft and sun gear and a laterally extending yoke or bail 72 constituting a rotatable latch member is pivotally connected to the ring 71 at diametrically opposite points. This yoke is provided with a downwardly directed loop 73 which is arranged normally to engage an opening 74 in the plate 52 or other fixed part of the phonograph. This opening may be drilled in any standard machine and is the only change necessary to adapt the standard machine for use with the turn-table described. When the loop 73 is engaged in the opening 74 the ring 71 is held fixed or stationary, and the planet gears 65 are rolled between the sun gear 64 and the outer gear 66 when the sun gear is rotated. When it is desired to drive the turn-table at the full speed of the shaft 53, the ring 71 is locked with respect to the disc 59. This is accomplished by means of

a sliding bracket 75 which is shown in its outward position in Fig. 3. When the bracket 75 is moved to its inward position, a lug 76 will rotate with the turntable and slide under the yoke 72, which is inclined when it rests on the plate 52, and will lift the yoke 72 against the normal gravity bias thereof and disengage the loop 73 from the opening 74. Further sliding of the lug 76 under the yoke 72 will be prevented by the loop 73 and as a result the ring 71 will be locked with respect to the disc 59 and the turn-table, speed-changing mechanism and spindle will rotate in unison. A slide 77, which can be conveniently actuated from the top of the turn-table, is provided for adjusting the bracket 75. This bar is connected to the bracket 75 by pins 78, which are slidably mounted in openings 79 in the disc 59. The bar 77 is mounted in a depression 80 so that it will not project above the surface of the disc 59 and interfere with the record being played.

In the operation of the modification of my invention shown in Fig. 3 with the loop 73 of the yoke 72 engaged in the opening 74 to restrain movement of the member 66, the motor 51 will drive the shaft 53 at about 78 revolutions per minute, and the sun gear 64 will rotate at this rate and will roll the planet gears 65 along in frictional engagement between the gear 64 and the stationary gear 66. Under this condition the planet gears will rotate about the shaft 53 at the rate of about 33 revolutions per minute and will drive the turn-table 59 at this speed. When it is desired to drive a standard record at the full speed of the shaft, bar 77 is moved inwardly and the lug 76 is thus placed in a position to engage the bail 72. When the motor is first started, if the loop 73 is engaged in the opening 74 in the plate 52, the lug 76 will rotate with the turntable until it passes under the yoke 72 and raises it to its upper position; the lug 76 will then engage the loop 73 and lock the disc 59 and the ring 71 together. When the disc 59 and the ring 71 are thus locked the planet gears 65 cannot rotate and hence a friction driving connection is established between the sun gear 64 and the disc 59 to provide simultaneous rotation of the disc and gear, and the disc 59 is driven at the full speed of the shaft 53.

In the modification of my invention shown in Fig. 4, which is somewhat more compact than that in Fig. 3, the parts have been given the same numbers as the corresponding parts in Fig. 3. Referring to Fig. 4, the wire yoke or bail 72, instead of having the downwardly extending loop 73, has a horizontal extension terminating in a loop 81 which is arranged to engage the annular indentation 82 in the edge flange of the turntable disc 59 and to retain itself in position under spring tension. In the position shown, the loop is so engaged and the turn-table is driven directly by the motor at full speed since the outer gear 66 is held stationary with respect to the disc 59. When it is desired to run the table at reduced speed the loop 81 is snapped out of the groove 82 and the bail 72 allowed to drop down until the loop 81 rests on the motor-supporting board 83 where it will move around until the loop engages the pin 84 which is secured in the supporting board. This engagement holds the outer gear 66 stationary and the turn-table is then driven at reduced speed as has been described in connection with Fig. 3.

Referring now to Figs. 5 and 6, I have shown a unitary turn-table assembly incorporating a selectively controllable change-speed mechanism similar to that shown in Figs. 1 and 2. In this construction a horizontally disposed turn-table member 85 provided with a lubricating well 86 and a hub 87 is rotatably mounted on a phonograph spindle 88. A concentric change-speed mechanism 89 depending from the turn-table is arranged to engage the phonograph shaft or spindle 88 and to drive the turn-table either at the speed of the spindle or at a reduced speed.

The change speed mechanism 89 comprises a friction planetary gearing affixed to the record support and including a hub or bevel gear 90, an internal bevel gear 91 and balls 92 which serve as intermediate gears. The bevel gear 90 is drilled to provide a vertically disposed bore to detachably receive and fit the shaft 88 and is provided with a slot 93 which engages the pin 94 on the shaft and secures the gear thereto in non-rotative engagement. The internal bevel gear 91 which constitutes an annular ball race is journalled to rotate on the hub 87. The balls 92 are mounted in openings 95 in the down-turned flange of a retaining member 96, which is secured to the hub 87 and is arranged to coact with the balls to drive the turn-table at reduced speed. An enclosing shell 97 secured to the internal bevel gear 91 serves to enclose the gearing and also to retain the bevel gear 90 in place when the turntable assembly is removed from the spindle 88.

The weight of the turn-table is transmitted to the shaft 88 through a thrust bearing comprising a plurality of balls 98 arranged in an annular recess 99 cut in the upper side of bevel gear 91. An annular conical bearing race 100 is secured between shoulders on the hub 87 and on the bottom of the lubricating well 86. A washer 101 in the bottom of the recess 99 acts as a lower bearing race and also provides for adjustment of the position of the balls 92 between the gears 90 and 91. This adjustment is accomplished by the use of washers of different thicknesses in the position of the washer 101. For example, if a thicker washer is placed in the recess 99, the axial distance between the gear 91 and the retaining member 96 will be decreased and the balls 92 will be moved nearer the shaft by the bevel face of gear 91. As a result, the effective diameters of the bevel gears are changed and hence the speed ratio is also changed. The weight of the turntable is transmitted to the spindle through the balls 98, the internal bevel gear 91, the balls 92, the bevel gear 90 and the pin 94. This maintains sufficient pressure between the friction gears to obtain a positive drive.

Change of speed is accomplished as in the foregoing modifications of my invention by locking the retaining member and the internal bevel gear together for effecting full speed and by locking the internal bevel gear stationary for effecting reduced speed. In this construction, I provide a flanged disc 102 fitting over the internal bevel gear 91 and having a pin 103 engaging a recess 104 in the gear 91. The disc may be moved between an upper and a lower position. It is shown in Fig. 6 in its lower or normal position in which gravity constantly tends to hold it, and in this position the pin 103 engages a recess 105 in the retaining member 96 to lock the retaining member to the gear 91 and to condition the mechanism to drive the turn-table at reduced speed. I provide a yoke 106 independent of the turntable to hold the disc 102 in its upper position, and when the yoke is holding the disc in its upper position the pin 103 is disengaged from the recess 105 while the inturned ends 107 of the

yoke 106 engage recesses 108 in the upper edge of the internal bevel gear 91 to hold the gear stationary. When the yoke 106 is in its lower position the ends 107 lie in an annular groove 109 in the outer side of the gear 91 and do not, therefore, interfere with rotation of the gear. The yoke 106 is movably mounted or secured to the phonograph motor board and is therefore independent of the turn-table, and a shaft 110 is provided for shifting the yoke position by a suitable manually operable handle or lever (not shown) at the end of the shaft.

It is desirable that the noise produced by the turn-table mechanism be reduced as much as possible. In the modification shown in Fig. 3, I make the planet gears 65 of soft rubber or the like. In the construction shown in Fig. 4, I construct the planet gears 65 of a hard material such as that obtained by binding sheets of fabric together by a resinous condensation product, which is known by the trade name of "Textolite" or some similar material. When the planet gears 65 are made of soft rubber or other similar resilient material they are held slightly deformed between gears 64 and 66 to insure a good frictional drive. When the planet gears are made of "Textolite" or some similar hard material the outer and inner gears 64 and 66 are constructed of flexible metal so that they may be deformed slightly to place the planet gears under a slight pressure and insure a good frictional drive. In the modification of my invention shown in Figs. 1, 2, 5, and 6, I construct the gear 19 and the retaining members 28 and 96 of fibre, "Textolite", or other similar material and this minimizes the noise produced.

From the foregoing it is apparent that I have provided a simple and easily operated speed-reducing mechanism for driving a phonograph turn-table at either of two speeds. Where a positive non-slipping drive between the driving shaft and the driven shaft is required, toothed gears might be employed instead of friction gears. I prefer, however, to use the friction drive because of the advantage of reduced vibration and noise, and the uniform speed of the turn-table which is obtainable.

While I have shown a particular embodiment of my invention in connection with a phonograph turn-table, I do not desire my invention to be limited thereto, and intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A variable speed phonograph mechanism including a turn-table, a driving motor, means for connecting said motor to drive said turn-table at either of two predetermined speeds, said means including a friction gear driven by said motor at a predetermined speed, a second friction gear spaced from and coaxial with said first friction gear, a plurality of intermediate friction gears arranged between and engaging said coaxial friction gears, and means for locking said second gear with said turn-table to drive said turn-table at the speed of said first friction gear and for holding said second gear stationary to drive said turn-table at a reduced speed.

2. A variable speed phonograph mechanism including a turn-table, a driving motor, means for connecting said motor to drive said turn-table at either of two predetermined speeds, said means including a gear driven by said motor at a predetermined speed, a second gear spaced from and coaxial with first gear, a plurality of intermediate planet gears arranged between and engaging said coaxial gears, means for adjusting the position of said planet gears axially with respect to said coaxial gears, and means for locking said second gear with said turn-table to drive said turn-table at the speed of said first gear and for holding said second gear stationary to drive said turn-table at a reduced speed.

3. A variable speed phonograph mechanism including a motor, a plate for supporting said motor, a turn-table above said plate, means including a frictional planetary gearing arranged below said plate for connecting said motor and said turn-table in driving relation, said planetary gearing including a sun gear driven by said motor at a predetermined speed, a plurality of planet gears engaging said sun gear and connected to drive said turn-table and a ring gear engaging said planet gears, and means including a lever movable into either of two positions for locking said ring gear to said turn-table in one position of said lever to drive said turn-table at the speed of said sun gear and for holding said ring gear stationary in the other position of said lever to drive said turn-table at a reduced speed.

4. A variable speed phonograph mechanism including a motor, a turn-table, means for connecting said motor and said turn-table in driving relation including a bevel friction gear driven by said motor at a predetermined speed, an internal bevel friction gear rotatable relative to and spaced from said first gear and having a bevel face substantially parallel to a bevel face of said first gear and intermediate friction gears engaging said bevel gears and mounted in a retaining member connected to said turn-table, means for urging said internal bevel gear axially toward said first bevel gear to maintain pressure on said intermediate gears, means for locking said internal bevel gear to said turn-table to drive said turn-table at the speed of said driven bevel gear, and means for holding said internal bevel gear stationary to drive said turn-table at a speed less than that of said driven bevel gear.

5. A variable speed phonograph mechanism including a motor, a vertical hollow shaft driven at a predetermined speed by said motor, a second shaft journaled within said hollow shaft, a turn-table mounted on said second shaft, and means including a speed-changing mechanism for connecting said hollow shaft to said second shaft to drive said second shaft at either of two speeds.

6. A variable speed phonograph mechanism including a motor, a vertical hollow shaft driven at a predetermined speed by said motor, a second shaft journaled within said hollow shaft and extending vertically upward therefrom, a turn-table mounted on said second shaft, means including a planetary gearing for connecting said shafts in driving relation, said gearing including a driving gear rigidly secured to said hollow shaft, a plurality of planet gears engaging said driving gear, a retaining member engaging said planet gears and secured to said second shaft, and a ring gear rotatable with respect to said driving gear and engaging said planet gears, means for locking said ring gear with respect to said turn-table to drive said shaft at the speed of said hollow shaft, and means for holding said ring gear stationary to drive said turn-table at a speed less than the speed of said hollow shaft.

7. A variable speed phonograph mechanism including a supporting frame, a motor secured to

said frame, a vertical hollow shaft connected to be driven by said motor, a thrust bearing for said shaft comprising a ball arranged in a recess in said frame, a driven shaft journaled in said hollow shaft, a ball thrust bearing for said driven shaft within said hollow shaft, means including a speed-changing mechanism for connecting said shafts in driving relation at the speed of said hollow shaft and at a reduced speed, and means for controlling said speed-changing mechanism so as to drive said driven shaft at either of said speeds.

8. A variable speed phonograph mechanism including a record support, a spindle, means for slidably and rotatably mounting said support on said spindle, means including a planetary speed changing gearing for connecting said support to said spindle to drive said support at different speeds, said planetary gearing including a sun gear secured to said spindle, a ring gear having a hub and a plurality of planet gears engaging said sun and ring gears, a retaining member driven by said planet gears and secured to said support, means for varying the axial distance between the hub of said ring gear and said retaining member, and means for locking said ring gear to said support to drive said support at the speed of said sun gear and for holding said ring gear stationary to drive said support at a reduced speed.

9. A unitary phonograph turn-table assembly comprising a record support, a speed-changing mechanism carried by said support for operating said support at different speeds, means for mounting said assembly on a phonograph spindle, and means for controlling said change-speed mechanism so as to operate said mechanism at different speeds.

10. A unitary phonograph turn-table assembly comprising a record support, a planetary gear speed-changing mechanism for operating said support at different speeds including a plurality of planet gears pivotally secured to said support, means including a hub rigidly secured to said support for mounting said assembly on a phonograph spindle, and means for controlling the said speed-changing mechanism so as to operate said mechanism at different speeds.

11. A unitary phonograph turn-table comprising a record support, gear speed-changing mechanism for operating said support at different speeds, means for mounting said assembly on a phonograph spindle, and means slidably supported on said turn-table for controlling said speed changing mechanism so as to operate said turn-table at different speeds.

12. A unitary phonograph turn-table assembly comprising a record support, a planetary gear speed-changing mechanism for operating said support at different speeds including a plurality of planet gears rotatably secured to said support, means including a hub secured to said support for mounting said assembly on a phonograph spindle, and means including a lug slidably secured on said support for controlling the said speed-changing mechanism so as to operate said turn-table at different speeds.

13. A unitary phonograph turn-table assembly comprising a record support having a flange, a planetary gear speed-changing mechanism for operating said support at different speeds including a plurality of planet gears rotatably secured to said support, means including a hub secured to said support for mounting said assembly on a phonograph spindle, and means including a yoke detachably engaging said flange for controlling the said speed-changing mechanism so as to operate said mechanism at different speeds.

14. A unitary phonograph turn-table assembly including a record support, a planetary gear speed-changing mechanism attached to said support for driving said support at different speeds and having a plurality of planet gears rotatably mounted and arranged at different points equidistant from the center of said support, a sun gear and a ring gear cooperating with said planet gears, means for rotatably mounting said support on a phonograph spindle, means for securing said sun gear to the phonograph spindle, and means for controlling said change-speed mechanism so as to operate said mechanism at different speeds.

15. A unitary phonograph turn-table assembly including a record support, a planetary gear speed-changing mechanism attached to said support for driving said support at different speeds and having a plurality of planet gears rotatably mounted and arranged about the center of said support, a sun gear and a ring gear cooperating with said planet gears, means for rotatably mounting said support on a phonograph spindle, means for adjusting the position of said planet gears axially with respect to said sun gear, means for securing said sun gear to the phonograph spindle, and means for controlling said change-speed mechanism so as to operate said mechanism at different speeds.

16. A unitary phonograph turn-table assembly comprising a record support having a flange, a speed-changing mechanism for operating said support at different speeds, and means detachably engaging the flange of said record support for controlling said speed-changing mechanism.

17. A unitary phonograph turn-table assembly comprising a record support, a planetary friction gear speed-changing mechanism carried by said support for driving said support at different speeds and including a plurality of grooved planet gears, a sun gear engaging said planet gears and supported in the grooves thereof, a ring gear engaging said planet gears and supported in the grooves thereof, means for supporting said assembly on a phonograph spindle, means for securing said sun gear to the phonograph spindle, means for locking said ring gear with respect to said record support to drive said record support at the same speed as said sun gear, and means for holding said ring gear stationary to drive said support at a speed less than the speed of said sun gear.

18. A unitary phonograph turn-table assembly including a record support, a planetary gear speed-changing mechanism attached to said support for driving said support at different speeds and having a plurality of resilient planet gears rotatably mounted concentrically about the center of said support, a sun gear and a ring gear cooperating with said planet gears, said planet gears having diameters slightly greater than the radial distance between said sun gear and said ring gear whereby said planet gears are held slightly deformed under pressure between said sun gear and said ring gear, means for rotatably mounting said support on a phonograph spindle, means for securing said sun gear to the phonograph spindle, and means for controlling said change-speed mechanism so as to operate said mechanism at different speeds.

19. A unitary phonograph turn-table assembly including a record support, a planetary gear speed-changing mechanism attached to said sup-

port for driving said support at different speeds and having a plurality of planet gears rotatably mounted and arranged about the center of said support, a flexible sun gear and a flexible ring gear cooperating with said planet gears, said planet gears having diameters slightly greater than the radial distance between said sun gear and said ring gear whereby said planet gears are held under pressure between and slightly deform said sun gear and said ring gear, means for rotatably mounting said support on a phonograph spindle, means for securing said sun gear to the phonograph spindle, and means for controlling said change-speed mechanism so as to operate said mechanism at different speeds.

20. A unitary phonograph turn-table assembly including a record support, a planetary gear speed-changing mechanism attached to said support for driving said support at different speeds and having a plurality of planet gears rotatably mounted and arranged at different points equidistant from the center of said support, a sun gear and a ring gear cooperating with said planet gears, means for rotatably mounting said support on a phonograph spindle, means for securing said sun gear to the phonograph spindle, and means including a yoke pivotally secured to said ring gear for controlling said change-speed mechanism so as to operate said mechanism at different speeds.

21. A phonograph of the type including a motor board, a conventional motor thereunder, a driving spindle driven therefrom and protruding above the motor board, a turn-table on said spindle adapted to be driven by said spindle at the rotary speed of the latter, a friction driven speed reducing transmission of definite ratio for driving connection between the spindle and the turn-table and means for placing said transmission at will into or out of operative connection.

22. A variable speed phonograph mechanism including a turn-table, a driving motor, means for connecting said motor to drive said turn-table at either of two predetermined speeds, said means including a friction gear driven by said motor at a predetermined speed, a second friction gear spaced from and coaxial with said first friction gear, a plurality of balls arranged between and engaging said coaxial friction gears, a retaining member for said balls secured to said turn-table, and means for locking said second gear with said turn-table to drive said turn-table at the speed of said first friction gear and for holding said second gear stationary to drive said turn-table at a reduced speed.

23. A variable speed phonograph mechanism including a motor, a turn-table, means for connecting said motor and said turn-table in driving relation, means including a beveled friction gear driven by said motor at a predetermined speed for connecting said motor and said turn-table in driving relation, an internal beveled friction gear rotatable relative to and spaced from said first gear and having a beveled face substantially parallel to the beveled face of said first gear, a plurality of balls engaging said beveled gears and mounted in a retaining member connected to said turn-table, means for urging said internal beveled gear axially toward said first gear to maintain pressure on said balls, means for locking said internal beveled gear to said turn-table to drive said turn-table at the speed of said driven beveled gear, and means for holding said internal beveled gear stationary to drive said turn-table at a speed less than that of said driven beveled gear.

24. The combination with a phonograph turn-table adapted to rotate records of different reproducing speeds, of a motor for driving said turn-table, a planetary speed transmission in said driving mechanism between said motor and turn-table, and manually operated means for controlling said transmission for causing said turn-table to be driven at a predetermined speed when said means is in one position and at a different predetermined speed when in another position.

25. A change-speed mechanism for a phonograph comprising in combination a turn-table, a central shaft, a ring surrounding said central shaft and pinions between said ring and said central shaft forming therewith a unitary differential gearing, said pinions being connected to said turn-table, and means for holding said ring in fixed position to cause the driving of the turn-table at a reduced speed, or for releasing said ring to cause the driving of the turntable at the speed of said central shaft.

26. A change-speed mechanism for a phonograph comprising in combination a turn-table, a central shaft, a ring surrounding said central shaft and pinions between said ring and said central shaft forming therewith a unitary differential gearing, said pinions being connected to said turn-table, and means for holding said ring in fixed position to cause the driving of the turn-table at a reduced speed, or for releasing said ring to cause the driving of the turn-table at the speed of said central shaft, said pinions having a rolling frictional engagement with said central shaft and said ring.

27. The change-speed attachment adapted to replace the regular turn-table of a phonograph, comprising in combination a turn-table, a central shaft adapted to engage and be driven by the driving shaft of the phonograph, a ring surrounding said central shaft, pinions between said ring and said central shaft forming therewith a unitary differential gearing, said pinions being connected to said turn-table, said ring being adapted when the attachment is in position to engage a fixed part of the phonograph so as to cause the driving of the turn-table at a reduced speed.

28. The combination with a motor-board and a spindle, of a record support, and power transmitting means attached to said support, said power transmitting means comprising a member operable by said spindle, power receiving means adapted to be actuated by said member, a second member cooperating with said first-named member to form a path for said power receiving means, means associated with said second-named member and adapted to engage said motor-board to restrain movement of said second-named member, and a motion transmitting element attached to said support said element engaging said power receiving means.

29. A phonograph turntable comprising a horizontally disposed turntable member, a spindle receiving member rotatively attached to the underside thereof, said spindle receiving member having a vertically disposed bore for detachably receiving the spindle of a phonograph and supporting said turntable in position, said spindle receiving member being adapted to have non-rotative engagement with said spindle, thereby being operable in unison therewith, and means operatively associated with said spindle receiving

member and said turntable member for imparting rotative motion to said turntable member from said spindle receiving member in the same direction and at differential speed.

30. In a turntable construction for phonographs, the combination with a spindle of a phonograph driving mechanism, of a hub member detachably supported on and having non-rotative engagement with said spindle, a turntable revolubly carried by said hub member, and driving connections interengaging said hub member with said turntable for actuating the latter by said spindle at a differential speed relatively thereto.

31. The combination with a record support having a speed changing mechanism permanently attached thereto and a cabinet partition of means carried by said record support adapted to restrain one element of said mechanism against rotation relative to said record support, means carried by said mechanism normally engaging said first named means to restrain said element against rotation relative to said record support, and means carried by said partition for selectively rendering said second named means active or inactive to restrain said element.

32. In combination, a motorboard, a phonograph turntable having a change-speed mechanism permanently attached thereto, and means movably mounted on said motorboard for selectively controlling said mechanism.

33. In combination, a spindle operable at a predetermined speed, a record support rotatably mounted on said spindle, an annular ball race carried by said support, a plurality of balls associated with said ball race, means carried by said spindle for transmitting motion to said ball race, and means carried by said support and adapted to co-act with said balls whereby said support is rotated relatively to said spindle.

34. The combination with a spindle operable at a predetermined speed of a planetary speed changing mechanism including a rotatable record support rotatably mounted on said spindle as a unit and comprising a driving member connected to said spindle for rotation therewith, a stationary member surrounding said driving member but spaced therefrom, means disposed between said driving member and said stationary member and rotatable relatively to said driving means, and means depending from said support for engagement with said first-named means whereby said support is rotatable relatively to said spindle.

35. In combination, a motor board, a record support including a depending hub, a spindle therefor operable at a predetermined speed, selectively controllable means permanently journaled on said hub whereby said support is adapted to be rotated by said spindle either relatively thereto or at the same speed as that of said spindle, and means carried by said motor board for controlling said first-named means.

36. The combination with a turntable having a mechanism permanently attached thereto whereby said turntable is capable of being operated at any one of a plurality of predetermined speeds of means carried by said mechanism and turntable whereby one element of said mechanism is normally locked to said turntable for effecting one of said plurality of speeds, and manually operable means independent of said turntable for controlling said first-named means at will for effecting another of said predetermined speeds.

37. In combination, a phonograph spindle, a record-supporting platen and speed changing mechanism carried by the platen and interposed between said spindle and said platen, said mechanism being concentric with said platen.

38. In combination, a motor-board, a spindle operable at a predetermined speed, a record support journaled on said spindle, means carried by said support cooperating with said spindle whereby said support is adapted to be rotated by said spindle relatively thereto, and means carried by said first named means and adapted to engage said motor-board to restrain an element of said first named means against movement.

39. As an article of manufacture, a record support adapted to be journaled upon and solely supported by a phonograph motor spindle, said support having a planetary speed changing mechanism permanently secured thereto.

40. In combination, a motor-board, a motor spindle operable at a predetermined speed, a record support including motion transmitting means permanently secured to and depending therefrom, said motion transmitting means comprising speed changing mechanism, means carried by said spindle for supporting and driving said transmitting means, and means carried by said transmitting means and adapted to engage said motor-board for restraining an element of said transmitting means against movement whereby said support is rotated by said transmitting means relative to said spindle.

41. In combination, a rotatable spindle operable at a predetermined speed, a record support rotatably mounted on said spindle, and a speed changing device permanently attached to and depending from said support as a unit and adapted to cooperate with said spindle to transmit motion from said spindle to said support whereby said support may be rotated relatively to said spindle.

42. As an article of manufacture, a phonograph record-supporting platen provided with a concentrically depending speed-changing mechanism, the mechanism being permanently attached to and coaxial with the platen.

43. The invention set forth in claim 42 characterized in that the speed changing mechanism is of the planetary type and includes a plurality of motion transmitting members in frictional contact with one another.

44. In combination, a phonograph record-supporting platen, a spindle therefor operable at a predetermined speed, speed reducing mechanism permanently attached to and concentric with said platen and means for restraining a portion of said mechanism from rotating.

45. In combination, a phonograph spindle, a record supporting platen and selective speed changing mechanism affixed to said platen and interposed between said spindle and said platen.

46. In combination, a phonograph spindle, a record supporting platen provided with selective speed changing mechanism and means carried by said platen for either restraining a portion of said mechanism from rotation, or releasing said mechanism for rotation, at will.

47. In combination, a motor-board, a record support, a spindle therefor operable at a predetermined speed, means carried by said support whereby said support is adapted to be rotated by said spindle relatively thereto, means carried by said first named means and adapted to engage said motor-board to restrain an element of said first named means against movement, and means carried by said support whereby said last

named means may be released at will from engagement with said motor-board and locked to said record support for rotation therewith.

48. In combination, a motor-board, a record support, a spindle therefor operable at a predetermined speed, motion transmitting means associated with said support and adapted to operate said support at another predetermined speed, means carried by said spindle for driving said transmitting means, means carried by said transmitting means and adapted to engage said motor-board for restraining an element of said transmitting means against movement whereby said support is rotated by said transmitting means relative to said spindle, and manually operable means carried by said record support for controlling said restraining means.

49. As an article of manufacture, a record support having a speed changing mechanism depending therefrom, and means operable through the surface of said support for selectively controlling said mechanism.

50. A turntable for phonographs having a multi-speed mechanism permanently attached thereto, and means carried by and manually operable through the surface of said turntable for selectively shifting from one turntable speed to another.

51. In combination, a driving device, a driven device, power transmission mechanism connecting said devices and comprising a pair of inner and outer relatively movable members, a laterally extending arm pivotally mounted on said outer member, and means carried by one of said devices adapted to engage said arm for controlling the relative movement of said members.

52. In combination, a driving device, a driven device, power transmission mechanism connecting said devices and comprising a pair of inner and outer relatively movable members, a laterally extending arm pivotally mounted on said outer member, and means carried by said driven device adapted to engage said arm for locking said members to rotate as a unit.

53. The combination with a turntable having a mechanism attached thereto whereby said turntable is capable of being operated at any one of a plurality of predetermined speeds of means carried by said mechanism whereby to normally restrain one element of said mechanism against rotation for effecting one of said plurality of speeds, and means carried by said turntable for controlling said first named means at will for effecting another of said predetermined speeds.

54. In combination, a phonograph record supporting platen, means affixed to the platen for transmitting rotary motion thereto from a phonograph spindle, said means being constituted by reduction gearing, and shift means also carried by the platen for at will controlling the operation of said gearing.

55. The invention set forth in claim 54 characterized in that the shift means is constituted by a movable element and further characterized in that a portion of the reduction gearing is provided with means adapted to cooperate with said element in one position thereof to lock said gearing and platen together for simultaneous rotation.

56. The invention set forth in claim 54 characterized in that one portion of the gearing is provided with a restraining element normally biased into such position that it may engage a stationary part such as a motor board, and further characterized in that the shift means, in one position thereof, cooperates with the restraining element to move it against the bias.

57. In combination, a rotatable spindle operable at a predetermined speed, a record support, and selective speed changing mechanism permanently attached to and depending from said support as a unit, said mechanism including a member journaled on said spindle and a second member having driving connection with said spindle, and said mechanism being adapted to transmit motion from said spindle to said support at any selected one of a plurality of predetermined speeds.

58. In a phonograph, the combination of a driving spindle, a turntable, means including speed changing mechanism attached to said turntable and mounted on said spindle for transmitting power from said spindle to said turntable, means constantly tending to condition said mechanism to drive said turntable at a speed other than that of said spindle, and means for rendering said last named means ineffective to so condition said mechanism whereby said mechanism is conditioned to drive said turntable at the same speed as said spindle.

59. In a phonograph, the combination of a driving spindle, a turntable, means including speed changing mechanism attached to said turntable and mounted on said spindle for transmitting power from said spindle to said turntable, means for releasably locking said turntable, said power transmitting means and said spindle for rotation as a unit whereby said spindle may drive said turntable at its own speed, and means for releasing said members from locking engagement whereby said mechanism is free to rotate said turntable at a speed other than that of said spindle.

60. In combination, a phonograph turntable having a change-speed mechanism attached thereto, said mechanism including a rotatable latch member, and means independent of said turntable and movable into the path of movement of said latch member for controlling said mechanism.

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