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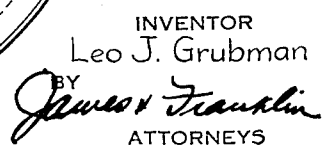
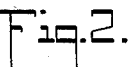
L. J. GRUBMAN

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PHONOGRAPH

Filed Dec. 19, 1932

3 Sheets-Sheet 1



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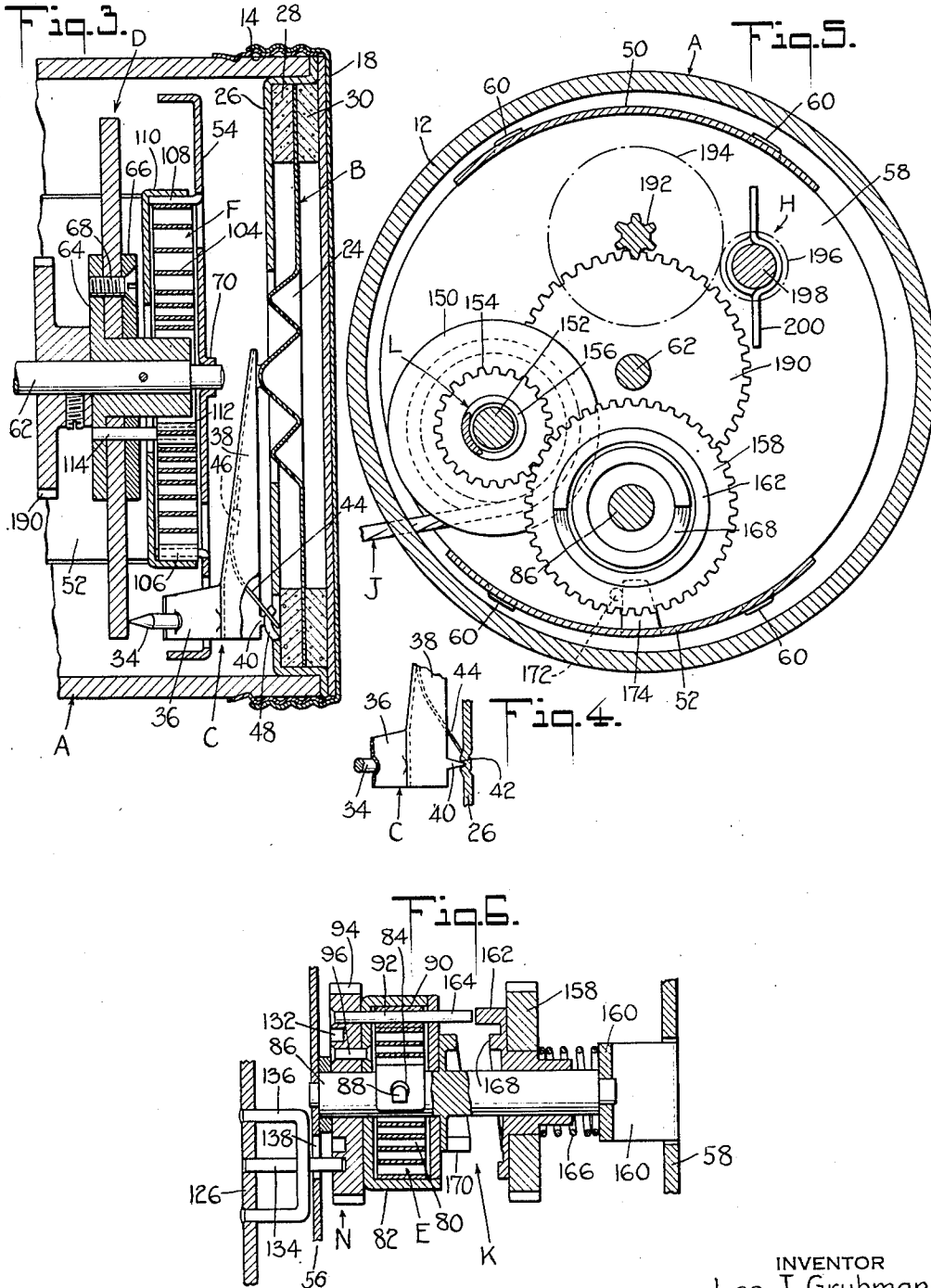
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3 Sheets-Sheet 2



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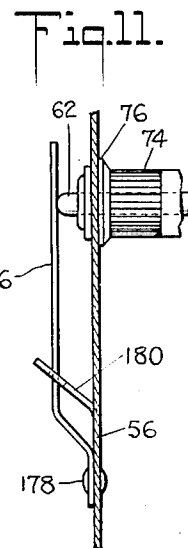
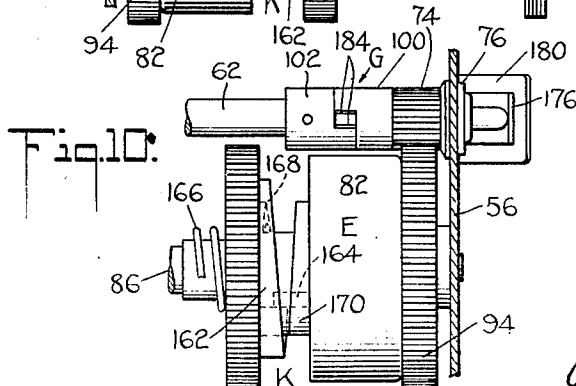
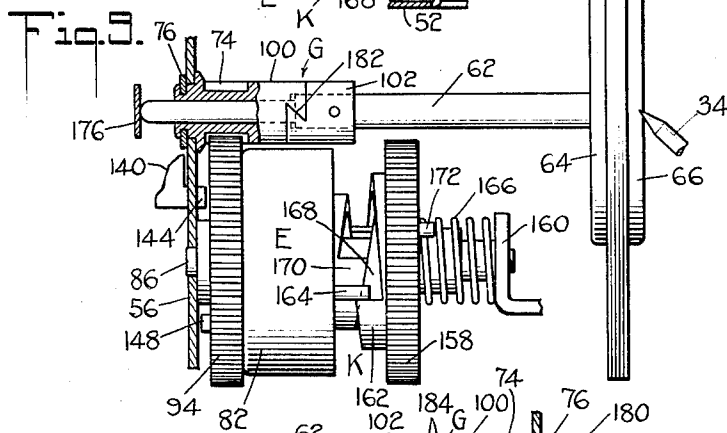
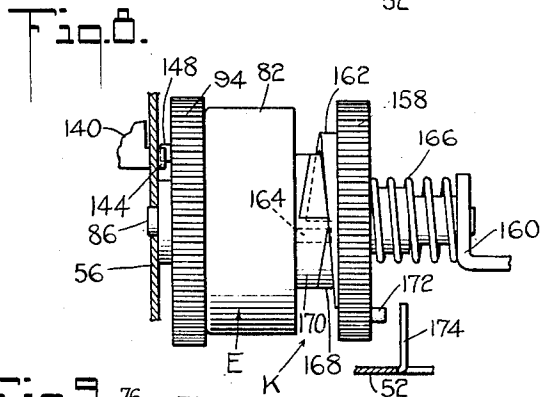
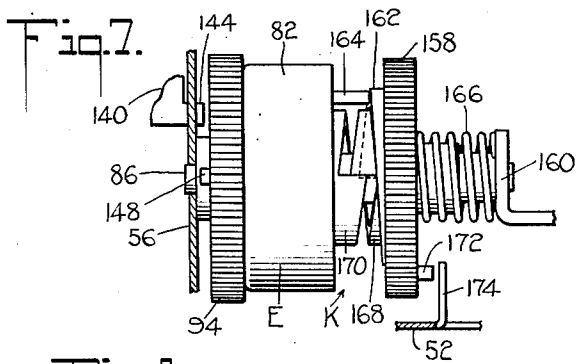
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PHONOGRAPH

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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PHONOGRAPH

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Application December 19, 1932, Serial No. 647,924

24 Claims. (Cl. 274—1)

This invention relates to phonographs, and more particularly to a miniature phonograph for use in dolls or other toys.

The primary and general object of the present invention resides in the provision of a miniature phonograph suitable to be embodied in a doll or other toy, although the phonograph may itself be employed as an attractive plaything for children. Such a phonograph, if placed in a doll, may be used, for example, to reproduce appropriate child-like words of endearment, or complaint, or the like, and, if installed in a toy animal, may reproduce sounds appropriate to that animal. The kinds of speech, music, or noise which may be recorded are without limit, making the field of use of the present toy phonograph correspondingly wide.

The primary object of the present invention resides in the provision of such a toy phonograph which will be operative in any position, so that if placed in a doll for example, it may be played regardless of the posture in which the doll is placed. Further objects of my invention reside in the provision of such a phonograph which will automatically cause engagement and disengagement of the stylus and record, and which will automatically cause relative feed movement of the stylus and the record, all without outside aid or manipulation other than mere energization of the phonograph, and all regardless of the physical position in which the phonograph may happen to be placed during the desired operations.

Still further objects of my invention reside in the provision of simplified means for energizing the phonograph: more specifically, the provision of a simple draw string for energizing the phonograph; also, the inclusion of appropriate automatically operable clutch mechanism making the phonograph operable after pulling of the draw string regardless of whether or not the draw string is thereafter released; and, finally, the addition of separate or independent take-up means for the draw string so that it will be withdrawn from sight when released, wholly independently of the playing condition of the phonograph at that time, and so that it will be effectively available for again energizing the phonograph.

Additional objects of the present invention center about the obtention of the necessary relative movements of the record and stylus, and are: to move the record relative to the stylus in order to provide engagement and disengagement of the record and stylus; to move the record

transversely of the stylus in order to provide feed movement of the record so that the stylus will follow or track in the sound groove of the record; to simplify the mechanical interconnection between the motor and record during feed movement of the record by physically moving the entire motor mechanism with the record; and, finally, to solve the problem of protectively housing the phonograph mechanism in a relatively simple and inexpensive manner by carrying the entire phonograph in a true cylindrical casing, carrying the motor mechanism in a somewhat smaller movable housing, and eccentrically pivoting the motor housing for oscillatable movement within the casing.

Further objects of my invention center about the mechanism for providing the desired rotation and feed and engagement movements of the record relative to the stylus and are: to rotate the record by spring drive; to insure a positive predetermined interrelation between the feed and rotational movements of the record, and to make this interrelation positive in both directions so that the stylus and record are brought back to initial playing position during the rewinding operation, as by the use of feed cam mechanism forming a part of the gear train interconnecting the spring and record rotating shaft; to further utilize a part of the aforesaid gearing to control the engagement or disengagement of the record and stylus, as by the interposition of a coupling having play between the driving and driven elements and so arranged as to cause axial movement of the record shaft toward or from the stylus in response to relative displacement or taking up of the play in the coupling in one direction or another; and to insure resistance to a rewinding rotation of the record so that the play in the coupling will be oppositely absorbed during the rewinding operation, as by the provision of an additional drive spring coupled more or less directly to the record shaft, or the provision of damping means connected to the record shaft, or both.

Further objects of my invention center about the sound box mechanism, and reside in the provision of simplified means for supporting a sound producing diaphragm, as by stationarily mounting the same near one end of the outer casing; the provision of sound amplifying means, as by causing sound discharge from the opposite end of the phonograph casing; the provision of appropriate means for transforming a side to side or lateral vibration of a stylus extending transversely of the diaphragm to an axial vi-

bration of the diaphragm; and, finally, the provision of an inexpensive substantially frictionless bearing means for the stylus mechanism.

To the accomplishment of the foregoing and such other objects as will hereinafter appear, my invention consists in the phonograph elements and their relation one to the other, as hereinafter are more particularly described in the specification and sought to be defined in the claims. The specification is accompanied by drawings in which:

Fig. 1 is a longitudinal section taken through a preferred form of phonograph embodying features of my invention;

Fig. 2 is a transverse section taken in the plane of the line 2—2 in Fig. 1;

Fig. 3 is fragmentary longitudinal section taken in the plane of the line 3—3 in Fig. 1 and substantially at right angles to the section of Fig. 1;

Fig. 4 is a detail of the stylus mechanism and is taken in the plane of the line 4—4 in Fig. 1;

Fig. 5 is a transverse section taken in the plane of the line 5—5 in Fig. 1;

Fig. 6 is a longitudinal section through the cam feed and rewind clutch mechanism, and is taken in the plane of the line 6—6 in Fig. 1;

Fig. 7 is an elevation of the cam feed and rewind clutch mechanism, similar to the lower left-hand portion of Fig. 1, but showing the phonograph during the playing operation with the draw string released;

Fig. 8 is a similar view showing the parts at the end of the playing operation;

Fig. 9 is a similar view during the rewinding operation and further illustrates the coupling and its control of the disengagement of record and stylus;

Fig. 10 is a rear elevation of the coupling and associated mechanism during the rewinding operation; and

Fig. 11 is a detail of the thrust spring for the record shaft.

Referring to the drawings, the particular form of phonograph here illustrated comprises an outer casing A having a sound producing diaphragm B stationarily mounted near one end thereof, and a stylus C for vibrating the diaphragm. The stylus is itself vibrated by contact with a record D driven by a spiral or clock spring E coupled indirectly to the record rotating shaft, and, if desired, an auxiliary spring F coupled directly to the record shaft. Engagement or disengagement of the record and stylus is produced by axial movement of the record and record shaft, this axial movement being under the control of a coupling G in response to relative movement of the driving and driven parts thereof, this relative movement being obtained according as the phonograph spring E is being unwound or rewound. The speed of rotation of the record may be governed by the use of a damping fan H, and either or both the damping mechanism H and the auxiliary drive spring F insure opposite displacement of the driving and driven elements of coupling G during the rewinding operation, for the rewinding operation is accomplished through the spring E. The phonograph is preferably energized by means of a flexible draw string J which may be directly connected to drive spring E but which is preferably connected thereto by a rewind clutch K which permits the draw string J to be held or released, as desired, during the playing of the phonograph, the draw string when released be-

ing immediately and independently taken up by a separate take-up spring L. The necessary transverse movement of the record and stylus, to permit the stylus to follow the sound track in the record, is obtained by moving the record sidewardly within the casing A, and this movement is in turn preferably obtained by moving the motor housing and record as an entirety within the casing A, for which purpose the motor housing is preferably eccentrically pivoted, as by the use of conical bearing pivots M, and the housing is oscillated about the bearing pivots in positive relation to the rotation of the record by feed cam mechanism N forming a part of the gearing interconnecting the drive spring E and the record rotating shaft. These various components of the phonograph are next described in greater detail.

Sound box mechanism

Referring to the drawings and more particularly to Figs. 1, 2, and 3, the outer casing A may be cylindrical in configuration and made up of a cardboard tube 12 the ends of which may be permanently provided with threaded metal sheathing or rings 14 and 16 designed to matingly receive threaded metal caps or closures 18 and 20. The sound producing diaphragm B is located near the end 18, but the sound is discharged through appropriate sound discharge openings 22 in the opposite end 126 of the casing so that the body 12 of the casing is itself made to act as an amplifying horn or sound chamber for the sound produced by diaphragm B.

Diaphragm B is preferably circular in shape and may be made from sheet metal or other appropriately light and yieldable material. It may be provided with annular corrugations 24, best shown in Fig. 3. The diaphragm is secured in place intermediate a stepped support ring 26 and closure 18, the periphery of the diaphragm being clamped between appropriate spacer rings 28 and 30 which may be made of yieldable material such as rubber.

The sound box mechanism further includes the stylus mechanism C which, for convenience and simplicity, is preferably mounted on stepped support ring 26. To hold the various parts in assembled relation even when removed from the phonograph, the sound box preferably further includes the protective disc 32 which may, if desired, be secured at its periphery to the stepped support ring 26. In such case it will be evident that the assembly including the stylus mechanism C and diaphragm B may be mounted in the phonograph by simply pushing the assembly into the end of cylinder 12 and thereafter screwing closure cap 18 in place.

The stylus mechanism C comprises a stylus 34 connected to the center of diaphragm B through appropriate mechanism for transforming a side to side or lateral vibration of the stylus into an axial vibration of the diaphragm. Specifically, the stylus and diaphragm are interconnected by a form of bell crank lever including a stylus arm 36, a diaphragm vibrating arm 38, and spaced pivot points 40 which rest in bearing seats 42 struck upwardly on the inner face of support ring 26, as is best shown in Fig. 4, to form a substantially frictionless bearing for the lever. The entire lever is preferably formed out of a single piece of sheet metal, and the stylus arm 36 is slit and oppositely offset to form straps receiving stylus

34, as will be evident from inspection of the drawings. The arm 38 is preferably channeled or made in trough shape to rigidify the same. The extreme side walls of this channel are projected to form the fulcrum points 40. Resilient means are provided to hold these fulcrum points in bearing seats 42, and in the present case a light leaf spring 44 is secured to arm 38 by slitting and offsetting a portion 46 of the arm, the free end of spring 44 being slotted and anchored in a hook 48 struck outwardly from support ring 26, as is best shown in Fig. 3. With the recited construction it will be evident that oscillation of stylus 34 about pivots 40 causes vibration of the diaphragm and develops sound corresponding to the record originally impressed on sound record D.

Record rotating mechanism

The motor mechanism is carried by a motor housing which, if desired, may be made cylindrical but somewhat smaller than the outer casing A. As here illustrated the motor housing is made of metal and comprises upper and lower sheet metal tie plates 50 and 52 which interconnect caps 54 and 56. The upper and lower tie plates 50 and 52 each form a portion of a cylinder, while the caps 54 and 56 are circular, so that the housing is generally cylindrical in configuration except that in effect the sides of the cylinder have been cut away. The tie plates are secured to the end caps by a tongue and slot construction indicated at 58. The housing is further provided intermediate the caps 54 and 56 with a generally circular partition 58, this partition being secured to the tie plates 50 and 52 by a mating tongue and slot construction 60. The arrangement is shown to advantage in Fig. 5.

The record D may be made of a conventional shellac composition or, if preferred, may be made of an appropriate synthetic resin composition. It is disc-shaped and is preferably rigidly centered and secured to a record shaft 62, as by the use of a widely flanged bushing 64, itself pressed onto the record shaft 62, and an opposed flange 66 secured to flange 64 by screws 68 passing through holes in the record D. The record shaft 62 is supported by a bearing 70 formed in end cap 54 and a bearing 72 formed within a record pinion 74 which is itself rotatably carried on the opposite end cap 56, as by means of an assembled thrust bushing 76 formed integrally with pinion 74 and freely rotatable in but not movable axially of the cap 56. Record shaft 62 is itself axially movable to a small extent to control the engagement and disengagement of stylus 34 with record D.

The record shaft and record are rotated by a spring, generally indicated at E, the action of which is in the present case aided by an auxiliary spring, generally indicated at F. The spring E is applied to record shaft 62 through gearing appropriately arranged and adapted to control the feed movement of the record and the engagement of the record with the stylus, but these functions will later be considered in detail. The fact is mentioned in passing because it affects the names of some of the parts hereinafter referred to.

For the present it may be observed by reference to Fig. 6 that spring mechanism E preferably comprises a spiral ribbon spring 80, best shown in Fig. 6, which is coiled within a cam

spring housing 82. The inner end 84 of the spring is secured to a fixed shaft 86 by a hook 88 on the shaft, while the outer end 90 of the spring is connected to the cam spring housing 82 by means of a pin 92 which passes through the cam spring housing 82 and a cam gear 94, the latter being rigidly secured to and integrally rotatable with the cam spring housing, as by means of rivets 96. The cam spring housing 82 and cam gear 94 are freely rotatable on stationary shaft 86. Referring now to Fig. 1, the cam gear 94 meshes directly with record pinion 74 and this in turn is fixedly secured to the driving element 100 of coupling G. For the present purposes the element 100 may be considered as integral with record pinion 74 although in practice it is preferably formed as a separate sleeve which is pressed with a force fit over a reduced bushing or sleeve on pinion 74. The driven element 102 of coupling G is fixedly secured to record shaft 62. It will thus be evident that unwinding of drive spring E causes rotation of cam gear 94 which in turn rotates record pinion 74, and this, through coupling G, rotates record shaft 62.

The record shaft 62 may, if desired, also be rotated by an auxiliary spring F. This spring, which is best shown in Fig. 3, consists of a spiral ribbon or clock spring 104 the outer end 106 of which is fixedly secured to one of a series of lugs 108 struck inwardly from end cap 54 to locate and support a spring housing cap 110, while the inner end 112 of the spring 104 is secured to a pin 114 which is driven through the flanges 64 and 66 supporting the record. It will thus be evident that the tendency of spring 104 to unwind is applied directly to the record. The springs E and F are preferably so wound and directed as to be additive, that is, both springs tend, in unwinding, to rotate the record in clockwise or playing direction.

Record feed mechanism

To cause the stylus to track in the conventional spiral sound groove on the record, relative movement of the record and stylus is essential. In the present case the stylus is kept stationary and the record is moved. To simplify the mechanism the driving motor as well as the record is moved. Specifically, the entire motor housing is moved, and this is facilitated by pivotally supporting the same on pivots M which are eccentrically related with respect to motor shaft 62 so that oscillation of the housing causes movement of the record relative to the stylus. The bearings are formed by pressing conical seats 116 inwardly near the edge of each of caps 54 and 56, as is best shown in Fig. 1. A fixed conical or center bearing 118 is rigidly secured to the stepped support ring 26, forming a part of the sound box mechanism previously described. An opposite conical or center bearing 120 is provided at the other end of the motor casing, and this bearing is preferably threaded into its support arm 122 and locked by a lock nut 124 so as to provide for accurate adjustment of the bearings supporting the motor housing. The arm 122 is struck inwardly from a heavy metal support plate 126 which is itself held in place at the end of cylindrical casing 12 by the screw cap 20. The latter need only be provided with a thin peripheral flange, for the plate 126 may itself constitute the closure surface at this end of the casing. The sound discharge holes 22 are formed in support plate

126 and are made ample to permit free discharge of sound from the phonograph.

The conical bearings 116 on caps 54 and 56 are brought in proper alignment by the assembly with the upper and lower tie plates 50 and 52. The conical bearing pins 118 and 120 are brought in proper alignment by the provision of mating means on the ends and cylinder of outer casing A. Thus the stepped support ring 26 is depressed to form a lug 128 which is received in a slot at one end of cylinder 12, while the support disc 126 is provided with a locating lug 130 which is received in a mating slot at the opposite end of cylinder 12. The necessary alignment of lugs 128 and 130 with the mating slots on the cylinder insures proper alignment of the bearing pins 118 and 120.

The desired movement of the motor housing is obtained by means of a feed cam N rotatable in the motor housing and cooperating with a fixed cam follower mounted on the phonograph casing. Reverting to Fig. 6, the feed cam is provided by cutting a spiral cam groove 132 directly in the outer face of cam gear 94, and the cam follower consists of a pin 134 fixedly mounted on support plate 126, the pin 134 preferably being rigidified by an arched or U-shaped support strap 136 which is also affixed to plate 126. The cam follower pin 134 passes through a slot 138 to permit necessary movement of the motor housing. The shape of the cam groove is better shown in Fig. 2 in which it will be observed that cam gear 94 is provided with a spiral cam groove 132 cooperating with a fixed follower pin 134 passing through a clearance slot 138 cut through the end cap 56 of the motor housing. The nature of the support bridge 136 will be clearly evident from an inspection of Figs. 1 and 2 of the drawings.

It will thus be seen that a single complete rotation of cam 132 causes oscillation of the motor housing from one side to the other, and that the resulting movement is definitely and predeterminedly proportioned to the rotation of the record. Thus, if the gear ratio between cam gear 94 and record pinion 74 is 5 to 1, the record may be provided with five sound grooves and will be moved to cover the spacing of these five sound grooves during five rotations of the record. The gear ratio may, of course, be altered to another value, if desired.

The rotation of the cam may be arrested or limited simply by permitting the cam follower to reach the end of the spiral cam track, but I prefer to prevent such contact and to stop the cam movement in a resilient or yieldable manner, and for this purpose I provide a relatively sturdy leaf spring 140 secured at one end to cap 56 by riveted ears 142 and having its free end provided with an inwardly projecting extension 144 passing through a slot 146 cut through cap 56 and lying in the path of a stop pin or projection 148 formed on cam gear 94. It will be evident that upon the completion of a single rotation of the cam gear, the stop pin 148 will bear against spring 140 and thus be brought to a stop in a gradual and silent manner.

Rewind mechanism

As here illustrated the phonograph is preferably rewound by the use of a draw string J. This draw string may be connected directly to spring mechanism E to rewind the spring by pulling the string, the string then being taken up and drawn into the phonograph as the spring mechanism

unwinds. However, I prefer to make the arrangement substantially fool-proof by limiting the draw string action solely to its rewinding function and by arranging for free and independent operation of the phonograph after it has been rewound, together with a free and independent take-up of the draw string regardless of when released.

For this purpose the draw string J is wound on a drum 150, best shown in Figs. 1 and 5, this drum being mounted on a shaft 152 the ends of which are journaled in cap 56 and plate 58. The shaft 152 is further provided with a rewind pinion 154 and an appropriate take-up spring 156. It will be understood that one end of the take-up spring 156 is secured to the motor housing, while the other end is secured to the rewind pinion 154, and that the direction of take-up spring 156 is opposed to the winding direction of draw string J, so that when draw string J is pulled, the take-up spring 156 is wound, and, conversely, when the draw string J is released, the take-up spring 156 immediately rewinds the draw string upon drum 150.

Rewind pinion 154 is constantly in mesh with a rewind gear 158, the latter being freely rotatable and freely reciprocable on the aforesaid fixed shaft 86. Shaft 86, it will be observed, is keyed at one end to cap 56 of the motor housing and is secured at the other end to an arm 160 struck inwardly from plate 58.

Between rewind gear 158 and spring mechanism E there is provided the rewind clutch mechanism K which further includes separating cam mechanism for automatically causing disengagement of the rewind clutch at the completion of the rewinding operation. Specifically the rewind clutch comprises a helical ring 162, fixedly secured to rewind gear 158, and a driven tooth 164, best formed by an extension of pin 92 heretofore referred to, the nature of these cooperating parts being evident from inspection of Fig. 6 and Figs. 7 to 10 of the drawings. Between rewind gear 158 and support arm 160 there is interposed a compression spring 166 which tends always to move the rewind gear toward the spring mechanism E and consequently to bring the driving ring 162 into engagement with the driven tooth 164. The direction of rise of driving ring 162 is properly selected so as to provide for positive driving engagement during the rewinding operation.

Within driving ring 162 there is provided an annular helical cam 168 which is arranged to mate with and bear against a similar but opposed helical cam 170, the latter being fixedly mounted on the stationary shaft 86. The cam surfaces 168 and 170 are so related that during the rewinding operation the cams are moved apart, thereby tending to move rewind gear 158 away from spring mechanism E against the thrust of spring 166. At the end of a single revolution of rewind gear 158, corresponding to the end of the rewinding operation, the separating cam mechanism is in the condition shown in Fig. 1 of the drawings, thus providing maximum spacing or separation of the clutch mechanism, and at this time the driven tooth 164 is freed from driving ring 162, thus permitting the phonograph to begin to unwind and play. This limiting position of the separating cam mechanism is established by cooperation of a stop pin 172 and a stop lug 174 struck inwardly from the tie plate 52 of the motor housing. If the string is held extended, the phonograph may

nevertheless continue to play. Whenever the string is released it is taken up by the take-up spring, and the resulting rotation of rewind gear 158 simply permits the separating cams to come together, and no interference results by reason of relative rotation of the driving ring 162 and driven tooth 164 because of the gradual helical nature of the driving ring. Thus, referring to Fig. 7, the draw string has been released and the cams 168 and 170 have been fully restored one relative to another as regards rotation. These cams have not, however, as yet come together because the phonograph is in the middle of its playing operation and tooth 164 bears against an intermediate portion of driving ring 162. Fig. 8 differs in showing the condition at the end of the playing operation, for at this time the driven tooth 164 has traveled to the end of driving ring 162 and has thus permitted the cams 168 and 170 to come entirely together. At the same time, driven tooth 164 is located in front of the positive abutment of driving ring 162, so that when the draw string is pulled to rewind the phonograph, the rotation of rewind gear 158 is applied directly to the spring E.

It will also be understood that spring F is re-wound at the same time as spring E, for rotation of spring housing 82 is accompanied by rotation of cam gear 94 and consequent rotation of record pinion 74. This rotates record shaft 62 through coupling G and thus rewinds the spring F. At the same time, it will be understood that rotation of the feed cam mechanism N restores the motor housing and record to their initial playing position, bringing the stylus opposite the first instead of the last sound groove of the record.

Stylus engagement control

The record and stylus must be brought into engagement during the playing operation but must be disengaged during the rewinding operation. This is preferably accomplished through the coupling G the driving and driven elements of which are provided with play therebetween, and the relative movement of these parts in taking up the play in one direction or the other, according as the phonograph is playing or being re-wound, is utilized to move the record shaft and record axially for the desired control of stylus engagement. In the present case resilient means are provided constantly urging the record into engagement with the stylus. Thus, referring to Figs. 1, 2, and 11, the end of record shaft 62 is rounded and bears against the free end of a leaf or cantilever spring 176, the fixed end being riveted to cap 56 at 178. An adjustment yoke 180 is preferably struck upwardly from cap 56, and spring 176 is passed through yoke 180. It will be evident that yoke 180 increases the spring pressure on record shaft 62, and the amount of spring pressure may be regulated by bending yoke 180 toward or away from cap 56.

The driving and driven elements 100 and 102 of coupling G are provided with inclined engagement surfaces 182 on one side of the coupling elements, as is best shown in Figs. 1 and 9, and straight engagement surfaces 184 on the opposite side of the coupling elements, as is best shown in Fig. 10. During the rewinding operation, rotation of record pinion 74 causes the inclined surfaces 182 to come into engagement, and, because of the inclination of these surfaces, the record shaft 62 is drawn axially against spring 176, thereby moving the record D away

from stylus 34, as is clearly shown in Fig. 9. It is to insure some resistance to rotation of the record in the reverse or rewinding direction, and thereby insure retraction of the record from the stylus, that it is preferable to use an auxiliary spring F, but the same result may also be obtained by any appropriate frictional resistance or even by the resistance of appropriate speed governing mechanism.

During the playing operation of the phonograph, unwinding of drive spring E causes rotation of record pinion 74 in an opposite direction, thus bringing the straight bearing surfaces 184 into engagement and providing ample slack or play or separation between the inclined bearing surfaces 182. This immediately permits spring 176 to move the record into engagement with the stylus, as is shown in Fig. 1. It may be noted that the apparent play or spacing shown in Fig. 1 is less than that actually provided because the coupling element 102 has already been moved axially toward the stylus. It will be understood that when dual spring mechanism is provided the spring mechanism E must lead the spring mechanism F in its operation so as to take up the play in coupling G in the opposite or playing direction. In other words, the proportioning of the springs and the tightness to which they are wound, and similar factors, must be adjusted to permit spring E to lead spring F. Only a slight differential is needed because of the steady tendency of thrust spring 176 to constantly urge the record toward the stylus.

Speed regulating mechanism

For the sake of simplicity the speed of the present phonograph is regulated merely by a fan or damping mechanism H. The record shaft 62 is provided with a train of step-up gearing including a gear 190, best shown in Figs. 1 and 5, meshing with a pinion 192 which in turn rotates a gear 194 meshing with a pinion 196, pinion 196 being mounted on a fan shaft 198 bearing fan 200. The step-up gearing thus described is journaled between cap 56 and plate 58. It will thus be evident that operation of the phonograph causes rotation of fan 200 at high speed, and the resistance to rotation of the vanes of the fan dampens and limits the speed of the phonograph to a desired value. No speed adjustment is provided, the operating speed being determined when designing the phonograph, by appropriate dimensioning of the fan. It should also be observed that fan shaft 198 is provided with a small fly wheel 202 shown only in Fig. 1 of the drawings. This fly wheel steadies the operation of the phonograph so that the rotative speed of the record will be uniform regardless of variations in frictional resistance such as is caused by the tracking of the stylus in the sound groove of the record.

Operation

The operation of the phonograph is as follows. Draw string J is pulled to rewind the phonograph. At the beginning of the rewinding operation the rewinding clutch mechanism K is in the condition shown in Fig. 8, and during the rewinding operation the driven tooth 164 is revolved by driving ring 162. This causes winding of spring mechanism E accompanied by rotation of cam gear 94. Cam gear 94, through record pinion 74, rotates coupling G, bringing

the sloping surfaces 182 thereof into engagement and thus retracting the record from the stylus against the thrust of spring 176, as is clearly shown in Fig. 9. At the same time, rotation of the record shaft winds up the spring F. Meanwhile the rotation of feed cam mechanism N causes the motor housing and record to be oscillated about eccentric bearings M, thus bringing the record to initial playing position so that the first sound groove of the record is opposite the stylus. At the end of the rewinding operation further movement of the draw string is positively arrested by reason of stop mechanism 172 and 174. At this limiting point the rewind clutch mechanism K is released, as is clearly shown in Fig. 1, thereby permitting the phonograph to begin to play. The initial playing rotation of spring mechanism E and cam gear 94 causes the play in coupling G to be taken up in opposite direction and thus permits the record to be moved into engagement with the stylus, as is shown in Fig. 1. The rotation of the record is aided by both the springs E and F. The speed of rotation is limited by the fan mechanism H and is steadied by the fly wheel 202. During the rotation of the record the proportional rotation of feed cam mechanism N causes a movement of the record laterally of the stylus, and the amount of this movement is made equal to the pitch or spacing of the sound grooves on the record so that the stylus accurately tracks or follows the sound grooves in the record. At the end of the record the phonograph is stopped by engagement of the stop pin 148 with cantilever spring 140. During the playing of the phonograph the string may be held in extended condition or may be released, as desired, and the time of release is of no consequence for immediately upon release of the draw string J it is taken up by the take-up spring mechanism L. The construction of the rewind clutch K is such that no interference results from release of the draw string at any time. During the playing of the phonograph record the sound track in the record causes a side to side vibration or oscillation of the stylus, and this in turn, through the substantially frictionless bell crank action of the stylus arm, causes vibration of the sound producing diaphragm B. The sound thus produced is guided toward the opposite end of the phonograph casing A and is finally discharged through the sound discharge openings 22.

It is believed that the mode of constructing and using, and the many advantages of the phonograph of my invention will be apparent from the foregoing detailed description thereof. The phonograph is compact, and, in fact, the patent drawings accompanying this application show a specific example of the phonograph to a scale twice the actual full size of the phonograph. The phonograph may therefore be placed in dolls or other toys, as well as used by itself. The phonograph will operate in any position and automatically provides for the necessary engagement and disengagement of record and stylus as well as feed movement of record and stylus, all regardless of the position in which the phonograph happens to be placed. The phonograph may be rewound in simple fashion by the use of a string which may be held or released, as desired, it being taken up independently of the phonograph operation. The record feed and the control of stylus engagement are all obtained by advantageously

utilizing portions of the record rotating gearing, so that the desired control functions are obtained without undue mechanical complication, particularly when the complexity of the phonograph operations provided are kept in mind.

It will be understood that the control of stylus engagement may, if desired, be reversed, providing resilient means for separating the record and stylus, and mechanical means for engaging the same, or, if desired, appropriately biased surfaces may be used on opposite sides of the coupling means to cause both disengagement and engagement of the record and stylus by mechanical manipulation. However, the resilient engagement is preferable as it provides yieldable contact between the stylus and the record. It will also be understood that the spring mechanism E may be used alone instead of using both the spring mechanisms E and F. It will further be understood that the draw string may be wound on a drum coupled directly and positively to the spring mechanism E, thereby dispensing with the take-up spring and the rewind clutch mechanism. It will also be appreciated that the necessary single revolution of the cam spring may be provided by an appropriate key or lever for rewinding the phonograph, instead of a draw string. It will further be appreciated that a friction governor may be used instead of a fan, and, for that matter, the governor may be eliminated entirely if the operating friction of the parts of the phonograph is accurately determined during manufacture. The mode of vibration of the stylus and the manner in which the vibration of the stylus is transferred to the diaphragm may, of course, also be altered, as desired. Still further changes will readily suggest themselves, and it will therefore be apparent that while I have shown and described my invention in 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. A phonograph comprising a diaphragm, a stylus for vibrating said diaphragm, a record, motor mechanism for rotating the record, and means for moving the motor mechanism and record bodily sidewardly in order to cause the stylus to track in the sound groove on the record.
2. A phonograph comprising a casing, a diaphragm in said casing, a stylus for vibrating said diaphragm, a disc record within said casing in generally parallel relation to the diaphragm, motor mechanism for rotating the record, and means for moving the motor mechanism and record bodily sidewardly within the casing in order to cause the stylus to track in the sound groove on the record.
3. A toy phonograph comprising a casing, a spring operated driving motor, a draw string extending out of the casing, a rewind clutch interconnecting the draw string and motor for rewinding the spring when the string is pulled outwardly, separating cam mechanism for automatically disengaging the clutch when the motor is rewound, and a take-up spring for independently taking up the draw string whenever the same is released.
4. A phonograph comprising a record, a stylus, means to relatively rotate the record and stylus including a driving spring and appropriate step-up gearing, and means for relatively moving the

stylus and record in order to cause the stylus to track in the sound groove of the record, said means including cam mechanism rotated by the aforesaid gearing.

5 5. A phonograph comprising a record, a stylus, resilient means urging the record toward the stylus, a drive spring for rotating the record, means to rewind the spring, and means responsive to rewinding of the spring by said means
10 for disengaging the record from the stylus in opposition to the aforesaid resilient means.

6. A phonograph comprising a record, a stylus, means for rotating the record including a drive spring and means interconnecting the drive
15 spring and record including a coupling having driving and driven parts, and means for causing engagement or disengagement of the record and the stylus in response to relative movement of the driving and driven parts of said coupling.

20 7. A toy phonograph comprising a record, a stylus, a record shaft, a drive spring for rotating said record shaft through an intermediate coupling having play between the driving and driven elements thereof, rewinding means operative
25 through the drive spring, and means responsive to relative movement of the coupling parts in one direction or the other for controlling the engagement and disengagement of the record and stylus.

30 8. A toy phonograph comprising a record, a stylus, a record shaft, a first drive spring for rotating said record shaft, a second drive spring for rotating said record shaft through an intermediate coupling having play between the
35 driving and driven elements thereof, rewinding means operative through the second drive spring, and means responsive to relative movement of the coupling parts in one direction or the other for controlling the engagement and disengagement
40 of the record and stylus, said first and second springs being so wound as to be additive, whereby both help to rotate the record when the phonograph is played.

9. A toy phonograph comprising a record, a
45 stylus, a record shaft, a first drive spring for rotating said record shaft, a feed cam for causing movement of the record relative to the stylus, a second drive spring for rotating said feed cam, and gearing interconnecting the feed cam
50 and the record shaft to properly relate the feed and rotation of the record.

10. A toy phonograph comprising a record, a
55 stylus, a record shaft, a first drive spring for rotating said record shaft, a second drive spring for indirectly rotating said record shaft, gearing interconnecting the second drive spring and the record shaft, a coupling in said gearing,
60 and means for controlling the engagement of the record and stylus in response to relative movement of the driving and driven parts of said coupling, said springs being so wound as to be additive, whereby both help to rotate the record when the phonograph is played.

11. A toy phonograph comprising a record, a
65 stylus, a record rotating shaft, a first drive spring for rotating said record shaft, a feed cam for causing movement of the record relative to the stylus, a second drive spring for rotating said feed cam, gearing interconnecting the feed cam
70 and the record shaft to properly relate the feed and rotation of the record, a coupling in said gearing, and means for controlling the engagement of the record and stylus in response to relative movement of the driving and
75 driven parts of said coupling, said first and

second drive springs being so wound as to be additive, whereby both help to rotate the record when the phonograph is played.

12. A toy phonograph comprising a casing, a smaller motor housing in said casing, a diaphragm near one end of the casing, a stylus connected thereto, a record near one end of the motor housing, motor mechanism in said housing connected to said record, and means pivotally mounting the motor housing eccentrically within the casing to permit feed oscillation of the record and motor housing relative to the stylus.

13. A toy phonograph comprising a record, a stylus, motor means for causing relative rotation of the record and stylus, means to cause engagement of the record and stylus and reproducing feed of the record and stylus regardless of the physical position of the phonograph, means to energize the motor, and means responsive thereto for disengaging the record and stylus and for restoring the record and stylus to their initial playing position, said means likewise being operative regardless of the physical position of the phonograph.

14. A toy phonograph comprising a cylindrical outer casing, a diaphragm near one end of said casing, a stylus for vibrating said diaphragm, a disc record within said casing in generally parallel relation to the diaphragm, motor mechanism for rotating the record, and means for moving the motor mechanism and record bodily sidewardly within the casing in order to cause the stylus to track in the sound groove on the record.

15. A toy phonograph comprising a casing, a spring operated driving motor, a draw string extending out of the casing, a rewind clutch interconnecting the draw string and motor for rewinding the spring when the string is pulled outwardly, separating cam mechanism for disengaging the clutch when the motor is rewound, stop mechanism for limiting the movement of the draw string, and a take-up spring for independently taking up the draw string whenever the same is released.

16. A toy phonograph comprising a record, a stylus, means to rotate the record including a driving spring and appropriate step-up gearing therebetween, and means for moving the record relative to the stylus in order to cause the stylus to track in the sound groove of the record including cam mechanism formed integrally with and rotated by the aforesaid gearing.

17. A toy phonograph comprising a record, a stylus, resilient means urging the record toward the stylus, means for rotating the record including a drive spring and appropriate gearing interconnecting the drive spring and record, and means for disengaging the record from the stylus when rewinding the phonograph including a coupling in the aforesaid gearing, the driving and driven parts of said coupling having mating inclined faces which engage during rewinding and are so directed as to move the record against the aforesaid resilient means.

18. A toy phonograph comprising a cylindrical outer casing, a somewhat smaller motor housing, a diaphragm near one end of the casing, sound discharge openings at the opposite end of the casing, a stylus connected thereto, a record near one end of the motor housing, motor mechanism in said housing connected to said record, and means pivotally mounting the motor housing eccentrically within the casing to permit

feed oscillation of the record and motor housing relative to the stylus.

19. A toy phonograph comprising an outer casing, a record, a stylus, a spring motor means for causing relative rotation of the record and stylus, means to cause engagement of the record and stylus and reproducing feed of the record and stylus regardless of the physical position of the phonograph casing, rewind means for rewinding the motor spring, and means responsive thereto for disengaging the record and stylus and for restoring the record and stylus to their initial playing position, said means likewise being operative regardless of the physical position of the phonograph casing.

20. A toy phonograph comprising a casing, a diaphragm and stylus mounted in the casing, a record and record shaft, resilient means urging the record axially into engagement with the stylus, a drive spring, gearing interconnecting the drive spring and the record shaft for rotating the record, mechanism forming a part of said gearing for causing relative movement of the record and the stylus both transversely for feed movement and axially for stylus disengagement, and means for rewinding the drive spring.

21. A toy phonograph comprising a casing, a diaphragm and stylus mounted in the casing, a motor housing movably mounted in the casing, a record and record shaft carried thereby, resilient means urging the record into engagement with the stylus, a drive spring, gearing interconnecting the drive spring and the record shaft for rotating the record, feed cam mechanism forming a part of said gearing for causing movement of the motor housing and record transversely of the stylus, a coupling also forming a part of said gearing and arranged during the rewinding operation to move the record away from the stylus, and means for rewinding the phonograph.

22. A toy phonograph comprising a casing, a diaphragm and stylus mounted near one end of the casing, sound discharge openings at the op-

posite end of the casing, a motor housing movably mounted in the casing, a record and record shaft carried thereby, resilient means urging the record into engagement with the stylus, a drive spring, gearing interconnecting the drive spring and the record shaft for rotating the record, feed cam mechanism forming a part of said gearing for causing movement of the motor housing and record transversely of the stylus, a coupling also forming a part of said gearing and arranged during the rewinding operation to move the record away from the stylus, and a draw string for rewinding the phonograph.

23. A toy phonograph comprising a cylindrical casing, a diaphragm and stylus stationarily mounted near one end of the casing, sound discharge openings at the opposite end of the casing, a motor housing eccentrically pivotally mounted in the casing, a record and record shaft carried thereby, resilient means urging the record axially into engagement with the stylus, a drive spring, gearing interconnecting the drive spring and the record shaft for rotating the record, feed cam mechanism forming a part of said gearing for causing movement of the motor housing and record transversely of the stylus, a coupling having play between the driving and driven elements thereof also forming a part of said gearing and arranged during the rewinding operation to move the record away from the stylus, a draw string for rewinding the phonograph, and rewinding clutch and draw string take-up mechanism to permit taking up of the string at any time during the operation of the phonograph.

24. A phonograph comprising a frame, a record, means carried by said frame for rotating said record, a stylus, and resilient means tensioned between said frame and said record rotating means to constantly urge the record rotating means and record toward the stylus in order to obtain cooperative reproducing engagement therebetween.

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