May 23, 1933. T. M. EDISON 1,910,529

SOUND REPRODUCING MACHINE

Filed Oct. 24, 1928 2 Sheets-Sheet 1

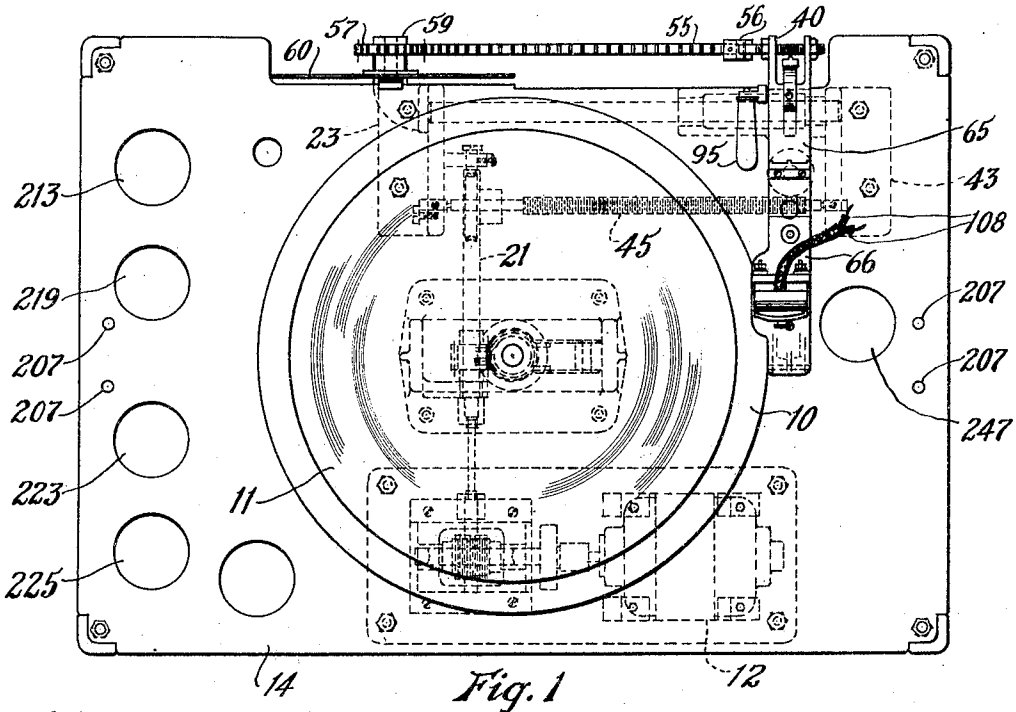



Fig. 1

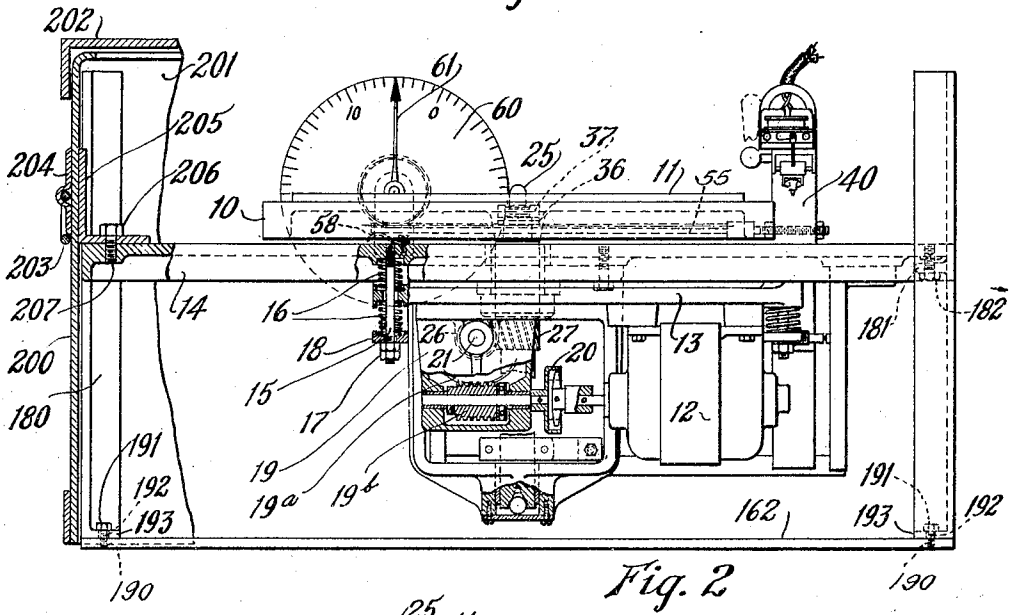



Fig. 2

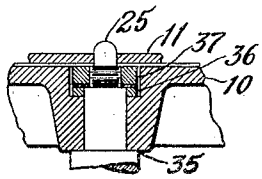



Fig. 4

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SOUND REPRODUCING MACHINE

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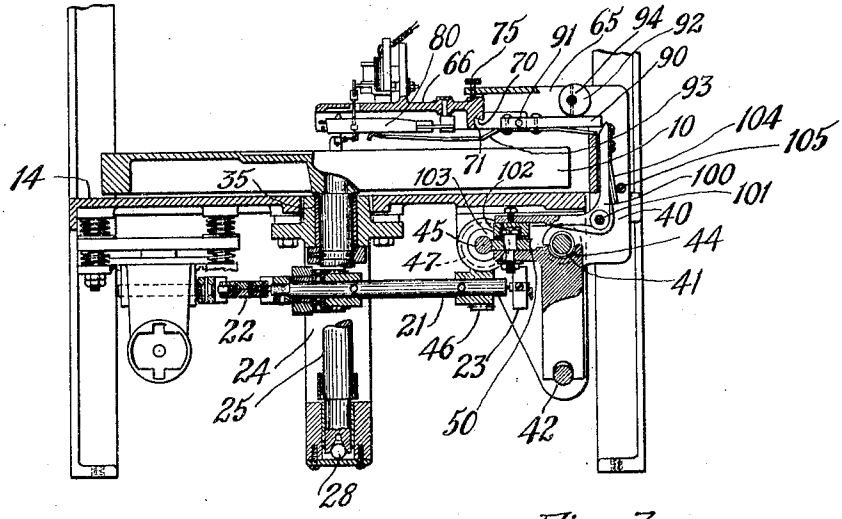



Fig. 3

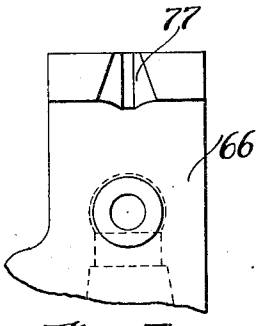



Fig. 7

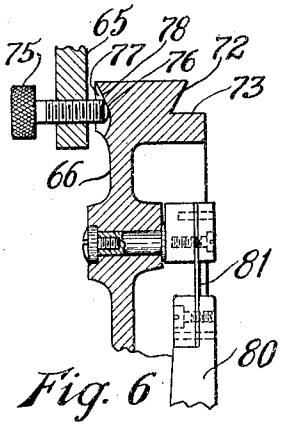



Fig. 6

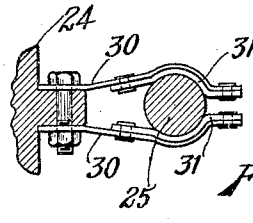



Fig. 5

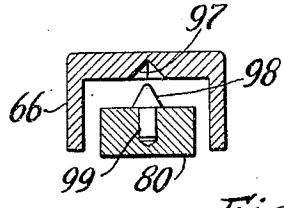



Fig. 9

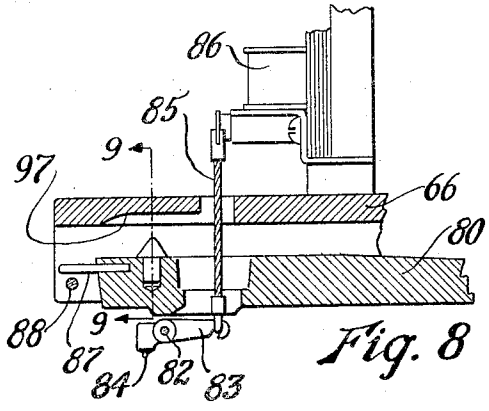



Fig. 8

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Patented May 23, 1933 1,910,529

# UNITED STATES PATENT OFFICE

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## SOUND-REPRODUCING MACHINE

Application filed October 24, 1928. Serial No. 314,577.

Upon attempting to devise and provide a machine for playing a long selection or a long succession of selections from a single sound record I was confronted with many problems and many difficulties were encountered. In solving these problems and overcoming these difficulties a number of inventions have been made. Some of these inventions were made by me and others by my associates. These various inventions have been embodied in a machine which has been operated successfully and satisfactorily. While, as stated, some of these inventions are not mine, it will facilitate disclosure of my features of invention to disclose the entire machine, and I shall therefore hereinafter do so, restricting the appended claims, however, to inventions which were made solely by me. It will be understood further that many of the features of invention may be embodied, within the scope of appended claims, in other machines of the same type, and some may be embodied in other classes of machines.

For the sake of brevity I shall not first specify the objects of my features of invention or the problems which had to be solved and were solved by them. Some but not all of the problems will be touched upon hereinafter. The various objects and advantages will be touched upon to some extent hereinafter and will be apparent to those skilled in the art after I have disclosed the now preferred machine embodying the features of invention.

Referring to the drawings which, as stated, illustrate what I now consider a preferred physical embodiment of my features of invention:

Fig. 1 is a plan view of a part of the machine, including the record support, the reproducer arm, and the mechanism for actuating and controlling them.

Fig. 2 is a front elevation, partly in section, of the apparatus shown in Fig. 1, and showing a part of the casing not shown in Fig. 1; the bottom plate 162, but not the apparatus carried thereby, being included in this view.

Fig. 3 is an end elevation of the apparatus shown in Fig. 1, certain of the parts being shown in section.

Fig. 4 is a detail enlarged sectional elevation of the central portion of the turn-table and the upper part of the turn-table spindle.

Fig. 5 is a detail enlarged plan view of the friction drag on the turn-table spindle.

Fig. 6 is a detail enlarged sectional view, turned though 90 degrees, of the connections between parts of the reproducer arm.

Fig. 7 is a detail view of the construction shown in Fig. 6, looking from the left to the right in Fig. 6.

Fig. 8 is a detail enlarged sectional elevation of the upper end of the reproducer arm and parts carried thereby.

Fig. 9 is a section on the line 9—9 of Fig. 8.

The machine illustrated is adapted to play from a single disc sound record, about one foot in diameter, without repetition for about eighty minutes. It is entirely electrically operated so that no winding is required. It gives excellent quality with great volume in reproduction. It is reliable in operation, sturdy in construction, requires little attention to maintain its satisfactory operation, but in the event that attention by a service man is required access to its various parts for inspection, removal, or replacement, may readily be had. All of these statements will be borne out by the following disclosure of the machine. Many advantages will appear. For example, it will be found that any one of a number of selections upon a sound record may be selected and played and repeated at the will of the operator.

Stated somewhat generally, the machine comprises a record support, a reproducing device, means for actuating the record support and reproducing device, amplifying means, means for supporting the various instrumentalities, and a housing enclosing the entire assemblage.

The record support (see Figs. 1 to 4) consists of a turn-table 10 which differs in construction from the turn-table commonly employed. The machine is adapted to play a twelve inch dimater record 11 having 360 threads (or grooves) per inch for about eighty minutes at a turn-table speed of

twenty-four revolutions per minute (24 R. P. M.). In these circumstances very slight change in speed of the turn-table and the record carried thereby would noticeably and disagreeably affect the reproduced music or other sounds. The turn-table 10 is therefore made of such dimensions, shape, and metal, as to be in effect a fly-wheel, i. e. to have a large radius of gyration and a large moment of inertia. Thus, as will be seen in Fig. 3, much of the mass of the steel or iron turntable 10 is concentrated at the periphery or rim. This construction prevents fluctuations in angular velocity of the turn-table that would otherwise occur and be reflected on a magnified scale as unfaithful variations in pitch of the reproduced sound. The actual size or moment of inertia of the flywheel or turntable is not very critical, as fair results may be obtained by employing, with my invention, a flywheel or turntable having approximately the moment of inertia of the ordinary turntable employed in the phonographic art. However, I have found that the best results are obtained by the use of a flywheel or turntable having a greater moment of inertia than that of the ordinary turntable used in the art, as the employment of an ordinary sized turntable is likely to produce a noticeable and false high frequency quiver in the music reproduced, and such quiver is eliminated by the use of a flywheel or turntable such as I here employ. Within certain limits the greater the moment of inertia of the flywheel the better the results, and I have found it advisable to use a flywheel or turntable having at least two or three times the moment of inertia of the turntables ordinarily used. A mere increase in the size of the flywheel has very little effect upon the running load on the synchronous motor because when the flywheel and motor have once acquired the proper running speed only a very slight torque is required to maintain the rotation. It is obvious, of course, that the flywheel I am here referring to is of the type employed in the preferred embodiment of my invention, i. e. one which is also adapted to be used as a turntable, and not a flywheel which is designed to be applied to the high speed shaft of the motor. The inertia of the latter type of flywheel could naturally be very much less. However, nothing herein contained is to be construed as limiting my invention to the exact size, form or position of the flywheel, that herein specifically described being merely a preferred form and applied in a preferred position. I shall now proceed to describe the turn-table actuating means.

The source of power is a synchronous motor 12 driven at a synchronous speed of 1800 R. P. M. from the 60 cycle alternating current supplied by the ordinary lighting mains. This motor is so connected to the turn-table 10 as to rotate the latter at its desired speed of 24 R. P. M., and in order that undesired fluctuations in turn-table speed due to vibration, chattering, hunting, or other causes, shall not occur the motor and associated mechanism are specially mounted, and special connecting means are supplied. The alternating current supplied by the various public service companies throughout the United States is usually of almost constant frequency, and any synchronous motor which is locked into step with such a power supply will maintain a very uniform average speed, although within each revolution there are likely to be appreciable speed variations due either to the impulsive character of the applied electric torque, or to what is commonly known as "hunting". If this is not corrected in some way a tremolo or quaver may be introduced into the music reproduced. It would seem most natural, perhaps, to mount a small flywheel rigidly on the relatively high speed motor shaft in order to correct this trouble. However, I have found that this is open to several objections. In the development of the present invention it was observed that when a flywheel was rigidly connected to the high speed motor shaft, the motor would drop out of synchronism, although the torque required to drive the flywheel was apparently far below the maximum synchronous output of the motor. In order to overcome this difficulty I introduce some form of resilience or slip between the motor and the flywheel. While the flywheel could, of course, be located on the high speed shaft of the motor with some suitable form of resilience or slip interposed, I discovered that there was a decided objection to so mounting the flywheel in mechanism of the construction hereinafter described, because the universal joint of such mechanism may introduce a slight speed variation if it is not perfectly in line, and furthermore, variations in load torque may cause changes in the tension of the resilient coupling of such mechanism and thus upset the constancy of the speed ratio between the flywheel and the turntable. This indicated to me that the flywheel should preferably be located as near as possible to the object which is to be kept at constant speed, to wit, the record, and led to the use of the combined turntable and flywheel in the mechanism specifically described herein. Another objection to the use of the flywheel on the high speed motor shaft is that unless great care is taken in balancing the flywheel, a large amount of vibration may result. I shall now proceed to describe in detail the driving connections which I preferably employ between the motor and the flywheel of said mechanism.

The motor 12 is bolted to the under side of a sub-base plate 13 which is resiliently suspended from the underside of the partition plate 14. It will be noted that these plates

13 and 14 are of heavy construction so as not only to be mechanically strong and rigid but also so that their susceptibility to vibration or chattering is minimized. The resilient suspension means spoken of consists of four rods or posts 15 each secured to the plate 14 and passing through clearance openings in the plate 13. A pair of compression springs 16 is provided on each rod 15, one above the plate 13 and the other below it; each rod being threaded at its lower end, and provided with a nut 17 and a washer 18, so that the degree of compression of the springs 16 between the plates 13 and 14 and between the plate 13 and washers 18 may be adjusted as desired.

Reduction gearing, 19*a*, 19*b* mounted within the housing or casing 19, is also secured to the resiliently supported plate 13, the gear housing being bolted to the said plate 13. This gearing which effects a speed reduction of 50 to 1 runs in oil in the housing which encloses it.

The connection between the shaft of the motor 12 and the high speed shaft of the reduction gearing above described is through a resilient coupling 20 the construction of which is described in United States Letters Patent No. 1,425,177, patented August 8, 1922, and which description need not be here repeated. This resilient coupling performs an important function in the present combination in preventing undesired variations in turn-table speed that would occur in the absence of such means or equivalent means.

The low speed shaft of the reduction gearing, above referred to, is connected through a universal coupling 22 to a cross or counter shaft 21 journaled in brackets 23, 24, bolted on the underside of the septum 14. The details of construction of this universal coupling 22 will be described in a separate application to be filed by the one of my associates who invented it. In other words, the coupling 22 shown was per se not my invention and, in any event, its details of construction need not be here described. Suffice it to say that it provides a highly satisfactory but comparatively inexpensive drive connection between the low speed shaft of the reduction gearing and the cross or counter shaft 21, while permitting the relative bodily movement of the reduction gearing by virtue of the resilient support of the latter.

The shaft 21 is operatively connected to the turntable spindle or shaft 25 through spiral gears 26, 27 of such ratio as to cause the spindle 25 to make one rotation when the shaft 21 rotates one and one-half times. The turn-table spindle 25 is journaled for rotation in the bracket 24, the bottom journal comprising a single ball bearing 28 which serves as a satisfactory thrust bearing for the comparatively heavy load upon it.

The turn-table spindle 25 is provided with a friction drag or brake (Figs. 1 and 5) which contributes materially and importantly in preventing undesired variations in speed of the turn-table. This drag or brake consists of resilient plates 30 bolted to the bracket 24 and having secured thereto fibre shoes 31 which press upon the spindle 25.

As a further means for preventing undesired variations in speed of the turn-table 10 the latter is driven by the spindle 25 through a friction drive means or coupling instead of the direct connection commonly employed. If the turntable or flywheel is rigidly connected to its supporting shaft or spindle the entire apparatus may begin to chatter violently at times. This action results from the fact that the flywheel cannot drive the reduction gearing 19*a* and 19*b*, whereas the reduction gearing, due to the energy stored in the resilient coupling or elsewhere, may impart to the flywheel an impulse sufficient to cause it to tend to drive such gearing. As soon as the flywheel is given this tendency it partially locks the reduction gearing and thus stores more energy in the resilient coupling for the next impulse, and in this way a very violent and objectional form of oscillation may be built up. I have found in the development of my invention that if the flywheel is not rigidly fastened to its supporting shaft, but is driven through the friction or slip connection or coupling which is about to be described, no oscillation can build up for the reason that each such impulse imparted to the turntable or flywheel causes a slight relative slipping of the said flywheel and shaft instead of storing energy in the flywheel. Though the amount of such slipping may be very minute, it is desirable for the proper operation of the mechanism. This friction coupling (Figs. 2 and 4) comprises a shoulder 35 on the turn-table spindle 25, upon which the turn-table 10 seats and presses down with its comparatively great weight. A bent resilient washer 36 surrounds the spindle 25 and is engaged by a cylindrical nut 37, which screws upon the threaded upper end of the spindle 25 into the bore or cylindrical hole of the turn-table 10

By virtue of the resilient mounting of the motor 12, the reduction gearing 19, and interconnections, i. e. the parts that rotate at comparatively high speeds; the universal coupling 22 which permits proper functioning of the resilient mounting for the high speed elements; the resilient coupling 20; the friction brake 30—31—25; the friction drive between the spindle 25 and the turn-table, last described above; and the fly-wheel construction of the turn-table; the turn-table 10 is rotated at speed of 24 R. P. M. without undesired variations in speed that would otherwise occur due to vibration, chattering, hunting, and other causes. Furthermore, by virtue of the

connections and means disclosed, the turntable 10 may be stopped and held against rotation while the motor 12 is running without any damage whatsoever to the mechanism and structure.

Recapitulating: the synchronous motor 12 is supplied with 60 cycle a. c. and runs at a speed of 1800 R. P. M.; the reduction gearing 19 reduces this speed at a ratio of 50 to 1 so that the cross or counter shaft 21 rotates at a speed of 36 R. P. M.; and the gearing 26—27 causes the spindle 25 to be rotated at a speed equal to two-thirds of the speed of the shaft 21, i. e. the spindle 25 and consequently the turntable 10 are driven at a speed of 24 R. P. M.

The machine is adapted to play disc records of the so-called hill and dale type by the provision of feeding mechanism for moving the reproducer member or arm across the record toward the center thereof at substantially the same rate as the record groove or thread feeds the stylus across the record. Having in mind that the turn-table 10 rotates at 24 R. P. M. and that the record of records played by the machine have 360 grooves or threads per inch, it will be appreciated that the rate of movement of the reproducer arm across the record is susbtantially one inch in fifteen minutes. I shall now describe the feeding mechanism (see Figs. 1, 2, and 3) for the reproducer arm and later the structure and mechanism between the reproducer arm and the stylus which it carries.

The reproducer arm 40 is mounted for sliding movement upon a pair of guide rods 41, 42, carried by the bracket 23 and a bracket 43, both of these brackets being bolted to the underside of the base plate or septum 14. The lower end of the arm 40 is forked to straddle the rod 42 and provided with a sleeve 44 which slides on the rod 41. The arm 40 is thus constrained against movement save in the direction along the rods 41, 42. The feeding mechanism comprises a feed screw 45 journaled on the brackets 23, 43, and driven from the cross or counter shaft 21 through a worm 46 secured to the latter and a worm gear 47 secured to the feed screw. At certain times in the operation it is desirable to disconnect the arm 40 from the feed screw 45. To this end the operative connections between the feed screw 45 and arm 40 are constructed as follows:

The arm 40 has journaled thereon a worm gear 50 which meshes with the feed screw 45. When this worm gear 50 is held against rotation it acts as a nut with respect to the feed screw 45 so that the arm 40 is moved along its guide rods 41, 42, by rotation of the feed screw. When rotation of the worm gear 50 is permitted, the arm 40 is not actuated by the feed screw—the worm gear 50 merely turns idly about its axis. It is impossible to cause rotation of the feed screw 45 by translatory movement of the worm gear 50. Therefore, when the worm gear 50 is held against rotation it is impossible to move the arm 40 along the rods 41, 42, except as it is actuated and moved by rotation of the feed screw 45 by the motor 12. This is an important feature as will hereinafter more clearly appear. When the worm gear 50 is free to rotate about its axis the arm 40 may be moved along its guide rods independently of the feed screw—the worm gear 50 merely rotating idly along the feed screw 45 after the fashion that a pinion rotates when moved along a stationary rack with which it meshes. After the arm 40 has been so moved to any position along its guide rods 41, 42, the operative drive connection between the feed screw 45 and the arm 40 is established by again holding the worm gear 50 against rotation.

As stated, the worm gear 50 serves, among other things, as a nut with respect to the feed screw 45. If this were the usual nut or half-nut and disengagement and re-engagement with the feed screw 45 were effected by moving the nut member bodily away from and toward the feed screw the following difficulties would arise. The new position to which the arm 40 would be moved might be such with respect to the instantaneous position of the feed screw 45 that the peaks of the thread on the nut would be in position to strike the peaks instead of the valleys of the thread on the feed screw. An appreciable and objectionable time interval might thus be required to effect proper meshing re-engagement with the feed screw 45, i. e. in the condition assumed proper meshing would not take place until the feed screw had rotated to a sufficient extent. This time interval could be reduced by employing comparatively fine threads on the feed screw and nut, but coarse threads, such as those shown on the feed screw 45, are preferable in many respects. By virtue of the worm gear 50, above described, the course thread feed screw 45 has all of the advantages of a very fine thread feed screw without the disadvantages of the latter. The nut (worm gear) 50 is always in mesh with the feed screw 45 no matter to what position the arm 40 is moved along the screw 45, and the operativeness of the connection between the feed screw 45 and arm 40 is controlled by holding the gear 50 against rotation and by permitting it to rotate as desired. The mechanism and control for locking the worm gear 50 against rotation and for releasing it for rotation will be described hereinafter.

Means, which I shall now proceed to describe, are provided whereby any one of the large number of selections recorded upon a single record may be readily selected at will and played. A rack bar 55 (Figs. 1 and 2) is pivotally connected at 56 at one end to the arm 40 so as to be movable to some degree to-

ward and away from a pinion 57 with which it meshes. The rack 55 is held in effective engagement with the pinion 57, avoiding objectionable back lash, by a spring 58 which presses the rack toward and against the pinion. The latter is mounted for rotation on the bracket arm 59, secured to the plate or septum 14, and may be rotated to any desired position by rotation of the disk or dial 60 connected to the pinion 59 so that the two rotate together. A stationary pointer 61 is provided and the dial 60 is so calibrated and the design of the parts is such that by turning the dial until it indicates, with respect to the pointer 61, the particular selection, of the many upon the record, it is desired to play, the reproducer arm 40 will be moved by the pinion 57 and rack 55 along its guide rods 41, 42 to the position in which the stylus is substantially above and in position to be engaged with the starting groove of the selected selection.

To perform the functions which the machine was created to perform, it is necessary that the stylus be very accurately positioned with respect to the record and with respect to the indicating couple 60—61. This and other problems were solved by the provision of the means and mechanism which I shall now proceed to describe.

To facilitate inspection, adjustment, repair, or replacement of the reproducer and the actuating mechanism therefor, these are not mounted directly upon the horizontally extending portion 65 of the reproducer arm but are mounted upon a detachable extension or portion 66 of the arm. When assembled, or re-assembled after removal, it is necessary that the part 66 be accurately located with respect to the part 65 of the arm 40. The machine illustrated comprises means for accomplishing this and which may be operated quickly and easily by even unskilled persons.

The inwardly extending part 65 (Figs. 1, 3, 6 and 7) of the reproducer arm 40 is provided with accurately machined plane surfaces 70, 71 which are adapted to cooperate with accurately machined plane surfaces 72, 73 on the adjacent end of the member 66 so that when the parts 65, 66 are pressed toward each other in the direction of their length and the part 66 is pressed vertically downward with respect to the part 65, the combined length of the parts 65, 66 is correct and accurate and the relative vertical position of the parts 65, 66 is correct and accurate regardless of which of various relative horizontal or lateral positions the parts 65, 66 may then happen to occupy. For moving the parts 65 and 66 into the relative position of accurate adjustment above referred to, for adjusting the said parts correctly and accurately laterally or horizontally with respect to each other, and for holding the parts 65 and 66 in the accurately adjusted position, the part 65 carries a set screw 75 which turns about a vertical axis and is provided with a rounded end 76 adapted to engage a cam slot provided in the adjacent upper portion of the part 66. This cam slot 77 is substantially V-shaped in cross-section and tapers longitudinally of the part 66, the V-shaped cross-section diminishing in size in the direction longitudinally toward the part 65 and so that the bottom 78 of the slot slopes upwardly toward right (Fig. 3). The construction and design are such that when the parts 66, 65 are placed in their approximate assembled position and the screw 75 then screwed down into the slot 77, the parts 66, 65 will be accurately located in all directions with respect to each other and held in such position of accurate relative adjustment. This is effected as follows, though not necessarily in the sequence to be stated. The lower end or tip of the set screw 75 engages one or the other of the side walls of the V-shaped cam slot 77 until the bottom 78 of the slot is reached, in which position the part 66 will have been accurately located (by the movement of the set screw) with respect to the part 65 in the lateral or horizontal direction. Further rotation of the set screw 75 causes the part 66 to be moved longitudinally toward the part 65 and downwardly with respect to the part 65 by virtue of the engagement of the lower end of the set screw with the bottom 78 of the cam slot 77. Such movements by virtue of the faces or surfaces 70, 71, 72, and 73 above described cause the parts 66, 65 to be correctly and accurately located with respect to each other. Until the set screw 75 is backed off the parts 66, 65 are held or locked in the position of accurate location. Thus, by a single operation—turning the set screw 75—the reproduced arm parts 66, 65 are accurately relatively aligned longitudinally, laterally, and vertically, and releasibly locked in the correct position.

I shall now proceed to describe the reproducer and mechanism carried by the horizontal portion 66 of the reproducer arm arm 65, 40.

A relatively floating mass or weight 80 (Figs. 3, 6 and 8) is connected to the arm member 66, so as to be capable of limited vertical and lateral movement with respect thereto, by means of a strip spring 81 secured at one end to the weight 80 and pivotally connected at its other end to the arm member 66. The weight member 80 pivotally supports, at 82, the stylus lever 83 which carries at one end the stylus 84 and to the opposite end of which is secured one end of a fibrous link 85. The vertical vibrations of the stylus 84 in the record groove are transmitted through the connection 85 to the movable element of an "electrical pick-up unit" 86,

to which the upper end of the link 85 is connected, and these mechanical vibrations are translated by the unit 86 into electrical undulations. During playing of a record, the free end of the member 80 is supported by the stylus 84. The downward movement of the member 80 with respect to the arm portion 66 is limited by the engagement of a rod 87 secured to the member 80, with a rod 88, secured to the arm portion 66. These rods 87, 88 do not interfere with the free vertical movement of the member 80 when a record is being played but prevent injury to the parts at times when playing is not taking place.

Means, which I shall now proceed to describe, (see Figs. 1, 2 and 3), are provided for raising the stylus 84 from a record after playing of a selection has been completed and for lowering the stylus into playing engagement with the same or another record to initiate or resume playing. A lever 90, pivotally mounted at 91 on the arm portion 65, engages a cam or eccentric 92 and has secured thereto a spring 93. One end of the spring 93 engages the arm 40 so as to bias the lever 90 in a contra-clockwise direction (Fig. 3) into engagement with the cam 92. The other end of the spring 93 is adapted, when elevated, to engage and raise the member 80. The cam 92 is secured to a shaft 94, rotatably mounted in the opposite sides of the arm portion 65 and provided with an operating handle 95 secured to the shaft. By moving the handle 95 in one direction or the other about its axis of rotation, the cam 92, lever 90, and spring 93 cause the member 80 to be raised or lowered as desired. In one of the two extreme positions of such movement, the stylus 84 is adapted to engage the record groove of a record upon the turn-table and in the other of the two positions, the stylus is above and clear of the record surface.

For reasons now apparent it is important that the stylus 84 be accurately located laterally with respect to the arm portion 66 when playing engagement of the stylus with the record groove is to be effected. Means are provided for effecting this.

The under side of the arm portion 66 is provided (Figs. 3, 8 and 9) with a longitudinally extending groove 97 of V-shaped cross-section adapted to be engaged by the substantially cone-shaped end 98 of a stud 99 secured to the member 80. When the handle 95 is operated to raise the member 80, thereby raising the stylus 84 from the record, the cone 98 engages the wall or walls of the groove 97 and causes the member 80 to centralize laterally with respect to the arm portion 66, assuming that the member 80 was out of such central relationship. When the handle 95 is subsequently operated to lower the member 80 and the stylus 84, the latter moves vertically downward into correct position with respect to the record.

As previously described, when the worm wheel 50 is locked against rotation, the reproducer arm 40 cannot be moved along its supporting and guide rods 41, 42 except as it is moved by the feeding action of the feed screw 45. When, however, the worm gear 50 is free to rotate about its axis, the reproducer arm 40 may be moved along its rods 41, 42 independently of the feed screw 45. Means are provided for locking the worm gear 50 against rotation and for releasing the locking means only in the event that the stylus 84 has been raised. By virtue of these means, which I shall presently describe, scraping of the stylus across the record surface by restoring movement or manual operation of the reproducer arm, is avoided.

The cam-operated lever 90 (see Fig. 3) which effects raising and lowering of the stylus, is adapted to engage and operate the inclined or bevelled upper end of a bell-crank lever 100, pivoted at 101 on the reproducer arm 40. The other end of the bell-crank is adapted, when depressed, to press downwardly upon a collar or cup 102 which engages a friction washer 103 which, in turn, engages the worm gear 50. A spring 104, secured to the upper end of the bell-crank and engaging a pin 105 provided on the reproducer arm 40, serves normally to bias the bell crank in a contra-clockwise direction (Fig. 3) and thereby to cause the worm gear 50 to be locked against rotation. When the handle 90 is operated to raise the stylus 84 from record-engaging position, the downwardly moving right hand end (Fig. 3) of the lever 90 engages the bevel of the upper arm of the bell-crank lever 100 and moves the latter in a clockwise direction (against the force of the spring 104) and releases the worm gear 50 for rotation. The stylus is now in its elevated position and the reproducer arm may be manually moved along the rods 41, 42. Thus, it is insured that the stylus shall be raised clear of the record surface before the reproducer arm is moved independently of the feed screw 45. When the handle 90 is moved to its other position, i. e. to lower the stylus into playing position, the lever 90 is moved upwardly by its spring and the bell-crank 100 is moved contra-clockwise by its spring 104, thereby locking the worm gear against rotation. It will be remembered that when the worm gear 50 cannot rotate it acts as a nut with respect to the feed screw 45 so that rotation of the latter by the motor causes feeding of the reproducer arm along the rods 41, 42.

Assuming at this point the presence of instrumentalities (not shown) for receiving the electrical undulations emanating from the unit 86 and for translating them into sound vibrations, I shall briefly summarize the operation of the structural combination which I have thus far described.

The turn-table 10 and the feed screw 45 are rotated by the motor 12 through the connections described. The handle 95 is in such position that the stylus 84 is elevated and the gear 50 is free to rotate about its axis. The disk 60 is rotated until the pointer 61 indicates thereon the desired selection of the record 11 upon the turn-table. This movement of the disk 60 causes the reproducer arm 40 to move along rods 41, 42 to a position in which the stylus 84 is vertically above the starting groove of the selected selection. The handle 95 is turned about its axis to its other position thereby lowering the stylus vertically downward to playing position and locking the worm gear 50 against rotation. The motor-driven feed screw 45 now feeds the reproducer arm 40—65—66 and the stylus 84 follows the record groove. The stylus, tracking in the sound groove, is not required to move the reproducer arm laterally but only the floating weight 80. When playing a series of selections, or a selected selection, or a desired part of a selection, has been effected, the handle 95 is operated to raise the stylus from the record. This also releases the worm gear 50 for rotation and centers the weight 80 and stylus with respect to the arm portion 66. Another selection or other selections of the same record or a different record may now be played as desired by repeating the cycle of operations outlined above.

The electrical undulations emanating from the unit 86 are amplified and supplied to a device, such as a "cone speaker" (not shown) which translates the electrical undulations into sound vibrations corresponding to the sounds recorded upon the record 11.

To facilitate safe transportation and servicing of the apparatus, the following structure is provided.

A plurality of metallic corner posts, in the present case four, are provided. Each of these posts 180 is angle-shaped in cross-section and provided with an intermediate lug 181 adapted to engage the under surface of the partition 14 at a corresponding corner thereof. The corners of the plate 14 are cut-away or cast as indicated (Fig. 1) so as to form seats for the angle or corner posts 180. Cap screws 182 extend through the lugs 181 and screw into the plate 14 so as to hold the posts 180 securely and firmly in their positions at right angles to the plane of the plate 14.

The partition or plate 14 is of such area and the corner posts 180 are of such length that the assemblage (see Figs. 1, 2 and 3) may be mounted upon a floor, platform, table, or bench, in any one of six positions without injury to the apparatus. One of the six positions is shown in Fig. 2. Another position is with the assemblage resting upon the tops of the posts 180. Fig. 2, if inverted, would show this last mentioned position. Another position is shown in Fig. 1 if it be assumed that this is an elevation instead of a top plan view. Another position would be shown in Fig. 1 by inverting this view and assuming it to be an elevation instead of a top plan view. Another position is to rest the assemblage upon the sides of the two right hand corner posts 180. Still another position is to rest the assemblage upon the sides of the two left hand corner posts 180. In short the assemblage shown in Figs. 1, 2, and 3, may be rested upon its bottom, top, either side, or either end. In each and all of these six positions none of the vital parts of the assemblage contacts with the surface upon which the assemblage rests, only the corner posts and edge of the plate 14 contact with or engage the supporting surface. Access to the various parts carried by the plate 14 may thus be readily had.

The plate 162 is adapted to support amplifying apparatus (not shown) and is of substantially the same area as the plate or partition 14. The plate 162 is provided with tapped holes 190 to receive cap screws 191 adapted to extend downwardly through holes 192 provided in the bottom flanges 193 of the posts 180, as shown in Fig. 2. The entire apparatus shown in Figs. 1 to 12 (except the device 132) is then confined within the space bounded by the corner posts 180 and the plate 162.

The entire mechanism described herein (except the "cone speaker") and its framework are enclosed in a sheet metal box or casing having end, front, and rear walls, and a top or lid which may be raised or opened, but no bottom, the plate 162 serving as the bottom. The casing or container is shown in detail in another application where it is not only disclosed but claimed. However, a part of the casing is shown in Fig. 2 of the present application. The end walls (one of which is shown at 200), the rear wall 201, the front wall (not shown but generally similar to the rear wall), and the lid or cover 202, form an enclosing casing or housing adapted to be slipped down from above and completely enclose and surround the entire assemblage (except, as stated, the "cone speaker"), the plate 162 serving as the bottom of the box or container. Each end wall 200 is provided with a swiveled handle 203 firmly secured to the end wall by a metallic strap 204. Each strap 204 is secured to its corresponding end wall 200 and to a corresponding metallic angle plate 205 by bolts, rivets, spot welding, or other suitable means. The horizontal flange of each angle plate 205 is provided with holes through which cap screws 206 are inserted and screwed into tapped openings 207 in the plate 14.

By virtue of the construction, last described above, the weight of the contents of the casing is not borne by the walls or top of

the casing. When the casing is raised by the handles 203, the weight of the plate 162 and the parts carried thereby is borne by the plate 14 through the corner posts 180, and the weight of the plate 14 and of the parts supported by it is transmitted through the angle plates 205 directly to the handles. When the assemblage is resting upon a floor or other supporting surface the weight of the casing is transmitted through the angle plates 205 to the plate 14, the weight of the latter and the parts supported thereby is borne by the corner posts 180, and the latter are in turn supported by the plate 162; i. e. the entire weight is borne by the last mentioned plate and there is no compression upon the walls of the casing.

By raising the lid 202 access may be had to all of the mechanism above the plate 14. The plate 14 is provided with holes 213, 219, 223, 225, 247, through which suitable audion tubes may be inserted from above into suitable sockets therefor (not shown) adapted to be carried by plate 162. If it be desired to remove the casing, the four cap screws 206 are unscrewed and the casing drawn vertically upward. If desired, the plate 162 and the apparatus supported thereby may be detached by unscrewing the four cap screws 191. Complete access is thus had to the mechanism and parts.

What I claim is:—

A sound-reproducing machine comprising in combination, a turn-table, a driving spindle therefor, a friction drive connection between the spindle and turn-table, a friction drag device operative upon the spindle, a synchronous electric motor, reduction gearing, the motor and reduction gearing being resiliently mounted, a resilient coupling device between the motor and the reduction gearing, and means including a universal coupling device operatively connecting the reduction gearing and the spindle.

This specification signed this 19th day of October 1928.

THEODORE M. EDISON.