

April 16, 1935.

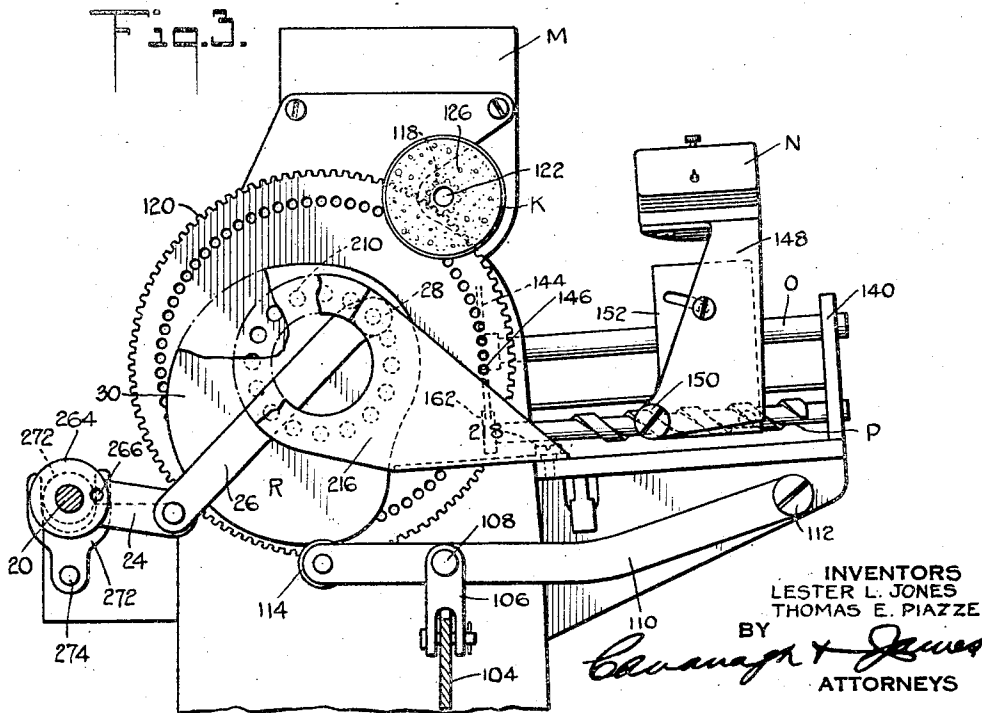
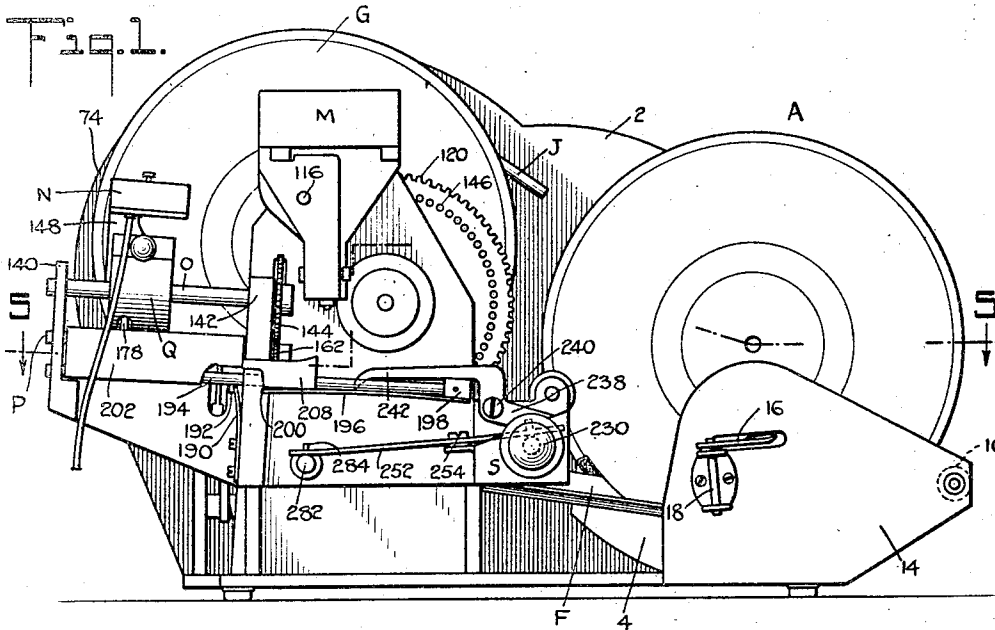
L. L. JONES ET AL

1,998,137

PHONOGRAPH

Filed Oct. 31, 1930

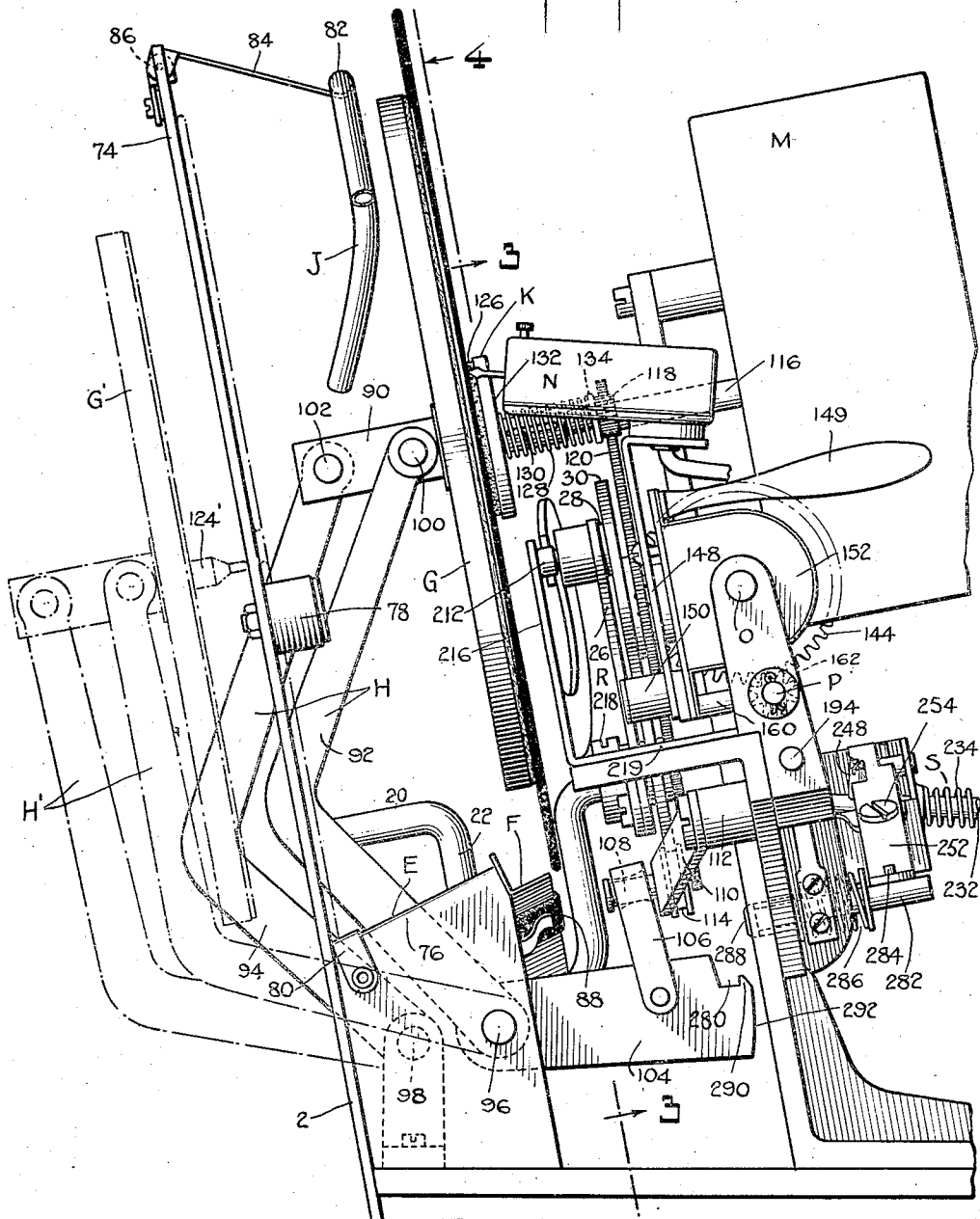
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Fig. 2.



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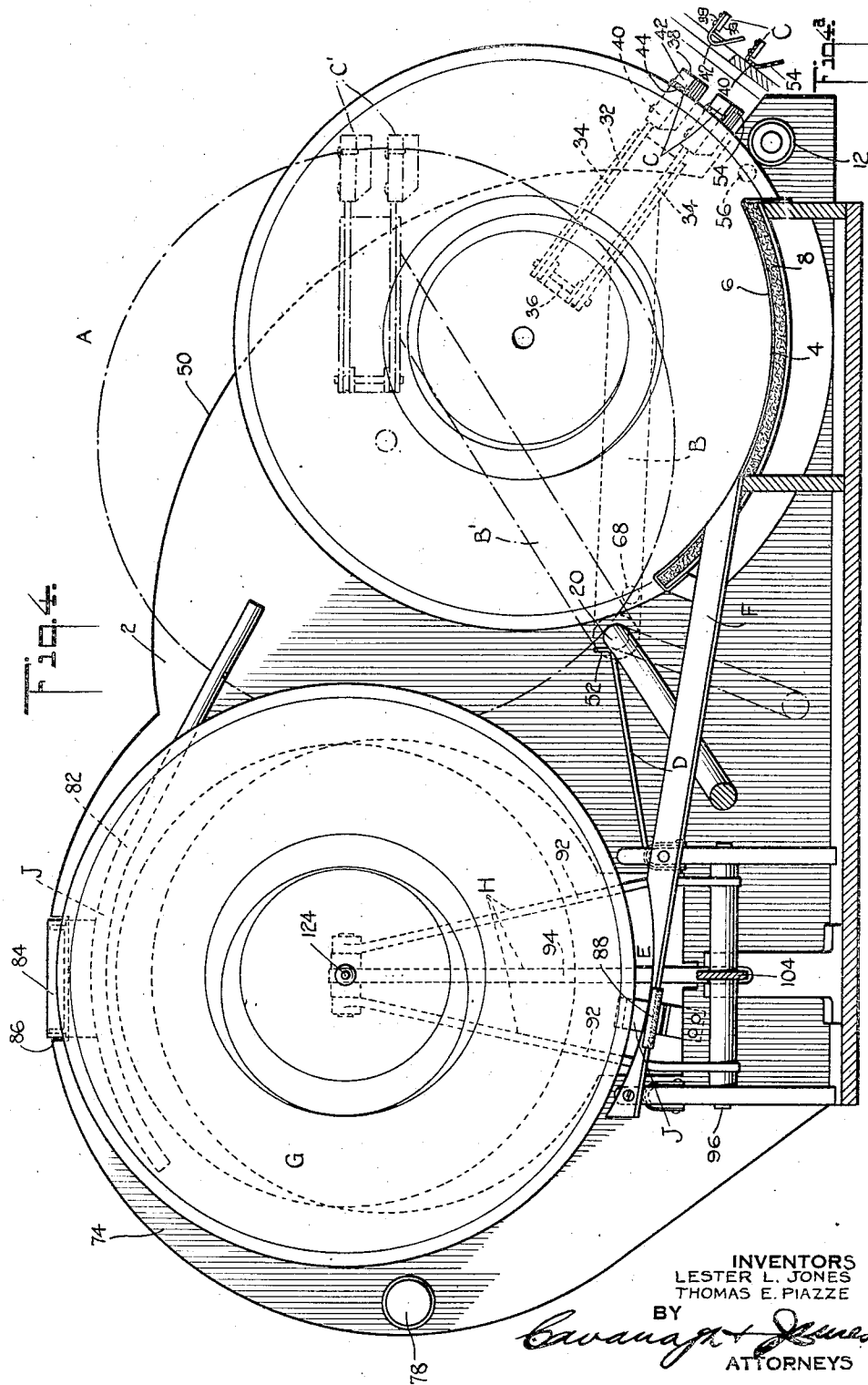
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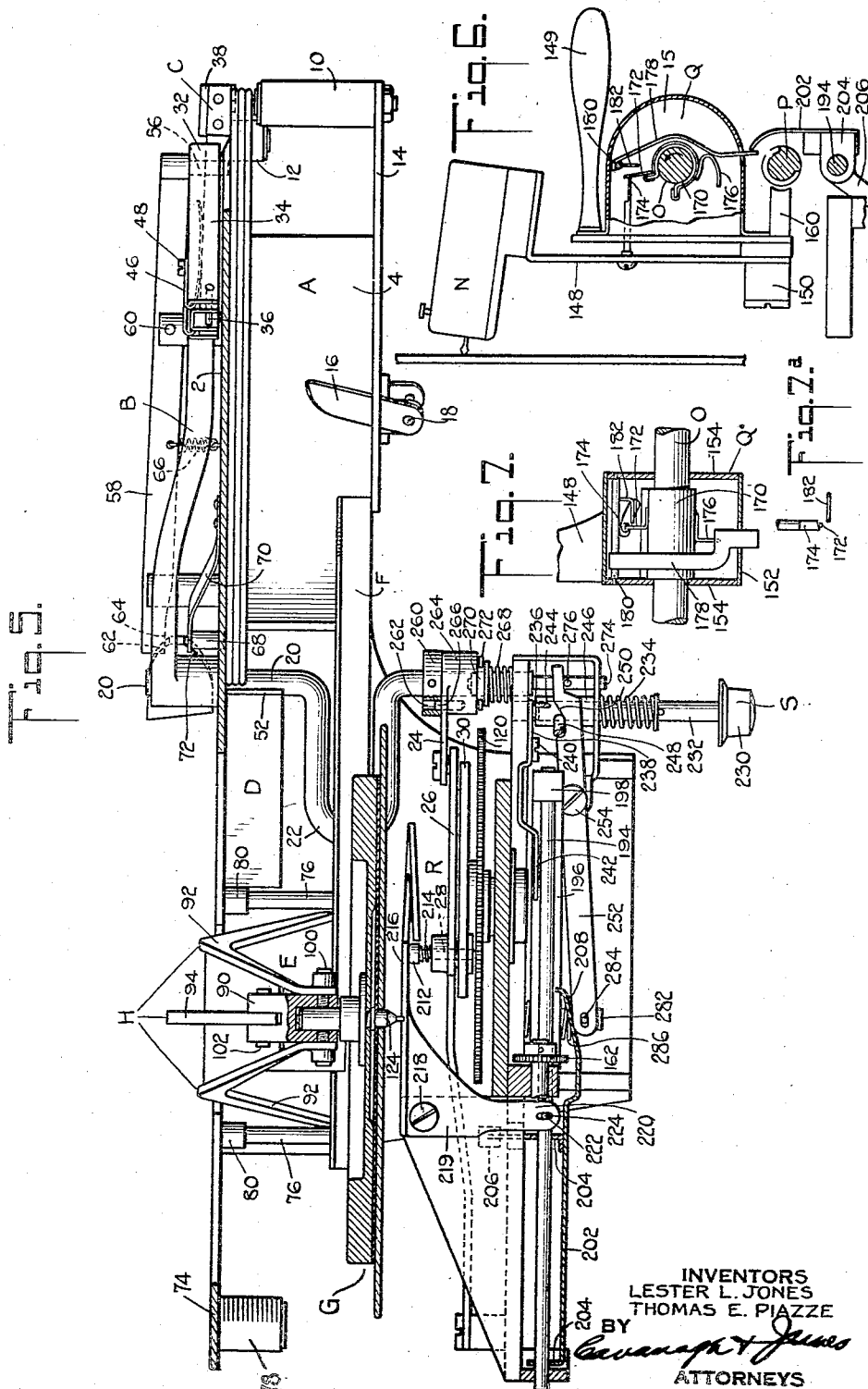
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UNITED STATES PATENT OFFICE

1,998,137

PHONOGRAPH

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Application October 31, 1930, Serial No. 492,456

52 Claims. (Cl. 274—10)

This invention relates to phonographs, and more particularly to automatic record changing phonographs.

In a copending application of Lester L. Jones, Joseph Jones, and Thomas E. Piazza, Ser. No. 458,612, filed May 31, 1930, there is disclosed an automatic record changing phonograph in which records to be played and already played are stored in a substantially upright position in supply and discharge magazines located alongside of a record turntable which is also mounted in a substantially vertical or upright position. In the said phonograph the magazine and turntable are tilted slightly backward of the true vertical in order to retain many of the advantages of playing the record in a horizontal position, while at the same time obtaining the important advantages of handling the records in an upright position, including the fact that they may be transferred to and from the record turntable by rolling the same on their periphery under the influence of gravity. In order to limit the overall height of the resulting mechanism the guide means for causing the record transfer took the form of a tiltable rail with mechanism to appropriately tilt the same for the record transfer from the supply magazine to the turntable or from the turntable to the record discharge magazine. The reproducer controlling mechanism and trip mechanism for the phonograph were not disclosed in detail, nor claimed.

Generally speaking, the objects of the present invention are, first, to improve the automatic record changing mechanism disclosed in the aforesaid copending application, and second, to provide reproducer controlling mechanism and trip mechanism, etc., which may be satisfactorily employed with either the automatic record changing mechanism disclosed in the aforesaid copending application, or with the record changing mechanism disclosed herewith.

In a copending application of Thomas E. Piazza, Ser. No. 393,359, filed September 18, 1929, now Patent No. 1,943,038, dated January 9, 1934, there is disclosed and claimed mechanism for the differentiation of speeds within and without a range of low speeds, which may be usefully employed to initiate a record changing operation at the end of a phonograph record; and a third general object of the present invention is to improve the trip mechanism disclosed in the said patent 1,943,038, and to adapt the same for use with either the phonograph disclosed in copending ap-

plication Ser. No. 458,612, or the phonograph disclosed herein.

Considered more specifically, some of the objects of the present invention are as follows. In the prior record changing mechanisms two record magazines were employed, a record supply magazine, and a record discard magazine. Records were fed from the supply magazine to the turntable and from the turntable to the discard magazine until the supply of records was exhausted. One object of the present invention is to provide for continuous playing of whatever records are placed in the machine. In other words, after the last record has been played, the first record is again begun, so that the operation of the machine is continuous unless voluntarily stopped. This improves the usefulness of the machine and makes it possible to dispense with one of the record magazines, so that a single magazine serves both as a record supply and record discard magazine.

Another object of the present invention is to dispense with the tiltable track or guide rail employed in the prior mechanism, and this makes it possible to further dispense with the mechanism for tilting said rail, and with the mechanism for ejecting a single record from the supply magazine and depositing the same upon the tiltable track. In the present arrangement two fixed tracks are employed, a discharge track which slopes downwardly from the record turntable to the magazine, and a loading track which slopes upwardly from the record turntable toward the magazine. This necessitates that the record to be played be separated from the remaining records in the magazine and elevated to the upper end of the loading track, and this desired operation is preferably obtained by the use of an oscillatable arm located in back of the magazine and provided with notched fingers or hooks for engaging the edge of the rearmost record in the magazine and rolling the same upwardly and sidewardly out of the magazine onto the loading track. Further objects of the invention are to so design the magazine that the records will be supported against a tendency to warp, and to design the previously mentioned fingers so that they will engage the edge of only a single record and yet will engage that edge regardless of whether or not the record is warped or chipped or otherwise marred.

In this machine, as in the prior machine, it is preferred to support the records and transfer the same in a position tilted slightly away from the vertical, and this tends to cause the records in the magazine to bear against the rear-

most record. In fact the bottom of the magazine is sloped so as to urge the records toward the back of the magazine, and inasmuch as the magazine is preferably designed to hold, say, 5 twenty records, the pressure upon the rearmost record may become considerable. This makes it difficult to slide the rearmost record out of the magazine when it is to be played; causes abrasion of one record against the other; and may 10 tend to cause the rearmost record to move the next adjacent record up with it either onto the loading track or to an intermediate position which may permit the previously mentioned notched fingers to catch the edge of the next 15 record in the magazine, rather than the partially elevated record. To overcome these difficulties is a still further object of the present invention, and this is accomplished by the provision of means which relieves the rearmost record in the magazine from the pressure of the remaining records as 20 the rearmost record is separated therefrom.

In the prior and present mechanisms, the record is loaded upon the turntable by advancing the turntable past the loading position where it 25 picks up the record and comes into contact with a motor driven clamp which rotates the record and turntable. In the prior mechanism the turntable shaft was mounted in a fixed bearing and was axially reciprocated therein to advance or retract the turntable. This arrangement 30 is quite successful, but introduces considerable friction in the turntable bearing, the reduction of which is a still further object of the present invention. In the arrangement which 35 we have now devised, the turntable is permanently mounted in any desired frictionless manner on a bearing which is itself movably mounted so as to permit of the desired movement of the turntable. The mounting for the bearing is preferably 40 arranged in the form of a parallelogram, so that the turntable moves in the direction of its axis, and the pivots of the parallelogram movement are so disposed that the turntable moves tangentially or at the top point of its oscillation when it 45 comes into engagement with the driving clamp. In this manner the centering pin may fit the driving clamp accurately, without a tendency to bind when it is inserted or withdrawn therefrom.

Further objects of the present invention center about the mounting and control of the reproducer or electrical pickup employed in the phonograph. Such objects include the obtention of rectilinear movement of the stylus, the obtention of radial movement of the stylus relative 55 to the record being played, and the obtention of a substantially frictionless means for guiding the reproducer in the desired rectilinear radial path. The reproducer is supported upon a smooth shaft about which it may oscillate toward or from 60 the record, and along which it may reciprocate when following the sound track in the record. In accordance with the present invention this shaft is rotated, thereby reducing the friction of rest to zero, and reducing the friction of movement to a value which is negligible at normal 65 reproducer speed.

In order to make the record changing operation rapid, the advancing movement of the turntable, which picks up the record and brings it into 70 driving engagement with the driving clamp, also brings the record into engagement with the stylus of the pickup. To insure reproduction beginning with the first sound track is a still further object of our invention, and this we accomplish by 75 bringing the stylus into engagement with the

record on the blank margin thereof, and lightly urging the reproducer toward the first sound groove. The previously mentioned smooth shaft is preferably inclined downwardly toward the center of the record so that the reproducer is 5 urged toward the first sound groove by gravity. The resulting movement, however, while permitted freely, is kept down to a slow speed which is under strict control, for, while the rotating shaft eliminates friction for slow movement, it 10 provides a retardation, with attempted increases in speed, which grows much faster than the increase in speed.

At the end of the record, the retraction of the turntable disengages the record from the reproducer, and before the next record is brought 15 into engagement therewith, the reproducer should be moved back to its starting position. To provide appropriate mechanism for accomplishing this function, is still another object of this invention, which may be fulfilled, specifically, by the provision of a threaded shaft arranged in col- 20 lateral relation to the aforesaid smooth shaft, and means on the reproducer for engaging the thread when the reproducer attempts to follow the record as the record is retracted. This threaded shaft may be used to arrest the movement of the reproducer, and may be rotated in a proper direc- 25 tion to move the reproducer back to its initial playing position.

Patent No. 1,943,038 discloses phonograph trip mechanism which possesses the remarkable advantages of functioning with any type of record, regardless of the diameter of the last sound groove, the type of special terminating groove 35 employed, or even the absence of a special terminating groove, and which, at the same time, permits the reproducer to freely follow the sound track, regardless of the changes in pitch of the sound track in different records, or even in the 40 course of a single record. This trip mechanism employs a sleeve which frictionally engages and is both rotatable and reciprocable on a smooth, constantly rotated shaft. The sleeve is provided 45 with a pin, and the reproducer is provided with a reaction surface on which the pin is received and seated in rather unstable equilibrium. This prevents rotation of the sleeve and thereby permits it to be readily moved axially at slow speed equivalent to the normal travel of the reaction 50 surface with the reproducer. When the stylus enters a special terminating groove, however, the movement of the reaction surface is accelerated, and the sleeve is unable to follow, and consequently the pin is released and the sleeve rotated, 55 which rotation is taken advantage of to initiate a record changing operation. From the foregoing brief description it will be evident that the friction of the sleeve on the shaft need not be very great during the playing of the record, but should preferably be increased when the trip mechanism is to be actuated, and, according to another object of this invention, the desired result is obtained, preferably by splitting the sleeve 65 at such a point that when the pin rests on the reaction surface of the reproducer, the sleeve tends to open, thereby relieving the friction, but when the sleeve actuates the trip mechanism, the direction of the rotation is such that the sleeve tends to close, thereby increasing the friction. 70

The seating of the pin on the reaction surface was heretofore accomplished simply by permitting the sleeve and pin to rotate at a point past which the reaction surface would travel during the movement of the pickup in the sound track 75

of the record. To obtain a sensitive trip action, the reaction surface is preferably made small, and consequently the rotating pin might seat itself on the reaction surface either at the leading or trailing edge, rather than at the middle thereof, thereby making the response of the trip too sensitive. A further object of our invention is to overcome this difficulty and to provide means for causing the pin to seat accurately in the middle of the reaction surface. This means preferably takes the form of a stop guide which prevents rotation of the pin until the pin is accurately located in front of the reaction surface. The stop guide may be moved with the reproducer, and the end thereof may be located at the middle of the reaction surface, so that the pin is kept from rotating during the initial movement of the reproducer until it finally reaches the end of the stop guide where it is released, but at this point the reaction surface is located and receives the pin. This arrangement possesses the additional advantage of tending to open the split sleeve and reduce the friction thereof during the entire operation of the phonograph except at the time the trip function takes place, at which time the increased friction of the sleeve on the shaft provides a desirably increased strength of trip impulse.

In the trip mechanism as previously constructed, the movement of the sleeve with the reproducer took place by reason of the engagement of the pin on the sleeve with the reaction surface on the reproducer. The return of the sleeve at the end of each record was accomplished by the provision of special mechanism for that purpose. Further objects of the present invention are to make the movement of the sleeve with the reproducer a positive one, without, however, defeating the trip action of the mechanism, and to provide for returning the sleeve in a simple manner, requiring practically no additional mechanism. To this end, a single smooth, rotatable shaft is employed for guiding the reproducer as described above, and for receiving the sleeve of the trip mechanism, and the sleeve and reproducer mounting means are so related that only limited relative motion can take place therebetween. The reaction surface for receiving the sleeve pin is mounted on the reproducer per se, and the reproducer is so mounted on the mounting means that it may move ahead of the same when the reproducer is accelerated in the terminating groove of the record. In the normal reproduction of the record, the mounting means moves with the reproducer by reason of the downward slope of the smooth shaft, and the limited motion permitted between the mounting means and the sleeve causes the sleeve to be moved positively with the mounting means during the playing of the record. After the reproducer has been accelerated at the end of the record, and the pin leaves the reaction surface, thereby initiating a record changing operation, the reproducer and mounting are moved back to the initial playing position by a previously described threaded shaft, and because of the limited movement permitted between the mounting means and the sleeve, the sleeve is likewise returned with the reproducer. During this return movement the pin bears against the previously described stop guide, thereby tending to open the sleeve, which facilitates the restoration thereof.

In accordance with the Patent No. 1,943,038, the trip impulse obtained is amplified in order to have available sustained trigger energy for

accomplishing the record changing operation. Resilient means may be used for storing the trigger energy and be kept in tension by release mechanism preferably taking the form of a toggle which is locked slightly beyond dead center, and which is broken by the trip impulse, thereby releasing the resilient means to obtain the stored up trigger energy. Another object of the present invention is to simplify the construction of, and to increase the sensitivity of the toggle mechanism. This, we accomplish by opposing the tensioned resilient means with a thin, flat spring arranged in compression or in column. The tendency of the thin, flat spring to buckle is opposed in one direction at a point slightly beyond dead center, and the trip impulse obtained by rotation of the sleeve of the trip mechanism is used to move the spring slightly past dead center in the opposite direction, at which time it readily bends or buckles and thereby releases the stored up trigger energy.

Further objects of the present invention center about motivating the aforesaid record changing mechanisms, such as the record transfer mechanism, the turntable reciprocating mechanism, and the reproducer restoring mechanism. For this purpose, we preferably employ the same driving motor as is used to rotate the record, and mechanically interconnect the aforesaid mechanisms with rotatable means which operate the same through a complete record changing cycle during a single revolution of the rotatable means. Clutch mechanism is provided for operatively connecting the rotatable means to the driving motor. The trigger energy is used to move a device which operates the clutch mechanism, and the said device and clutch mechanism are so related that the resulting rotation of the clutch mechanism causes a return movement of the device which again tensions the resilient means and resets the toggle, as well as permits release of the clutch mechanism at the end of the desired single revolution.

As so far described, the phonograph will play a series of records in succession, and will repeat the series of records only after all of the records in the magazine have been played. Another object of the present invention resides in the provision of manually operable means making it possible to reject any record at will, or to repeat any record any desired number of times before proceeding to play the next succeeding record.

To the accomplishment of the foregoing and numerous other objects as will hereinafter appear, our invention consists in the automatic record changing 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 claim. The specification is accompanied by drawings in which:

Fig. 1 is a front elevation of the phonograph mechanism;

Fig. 2 is a side elevation of the turntable end of the same;

Fig. 3 is a section taken in the plane of the line 3—3 in Fig. 2;

Fig. 4 is a section taken in the plane of the line 4—4 in Fig. 2;

Fig. 4a is a detailed, partially sectioned view of the notched fingers shown in Fig. 4;

Fig. 5 is a section taken in plan along the line 5—5 in Fig. 1;

Fig. 6 is a vertical section taken through the reproducer mounting and control mechanism;

Figs. 7 and 7a are explanatory of the trip mechanism.

Referring to the various figures of the drawings, the phonograph of our invention comprises a record storage magazine indicated generally at A, best shown in Figs. 1, 4, and 5; mechanism for separating a record therefrom, including an oscillatable arm B and notched fingers C, best shown in Figs. 4, 4a, and 5, a downwardly inclined loading track D for guiding the separated record to a loading station E, and an oppositely inclined discharge track F for guiding the used record back to the magazine A, best shown in Figs. 4 and 5; a turntable G which is mounted for free rotation in a bearing movably supported on a parallelogram mount H, best shown in Figs. 2 and 5, said parallelogram mount permitting the turntable G to be advanced in order to pick up a record at the loading station E and to move the same past stop means J into engagement with a driving clamp K in turn driven by any suitable driving motor M, as is best shown in Fig. 2; a reproducer or electrical pickup N, the movement of which is guided and controlled by mechanism including a smooth, rotatable shaft O, and which is restored to its initial playing position by mechanism including a threaded shaft P, best shown in Figs. 1, 2, and 3; trip mechanism, generally indicated at Q, best shown in Figs. 6 and 7; single revolution clutch and toggle restoring mechanism, generally designated R, for putting a phonograph through a record changing cycle in response to the trip mechanism; and manual control means, indicated at S, for rejecting or repeating a record any desired number of times at will.

Record storage magazine and transfer mechanism

Referring to Figs. 1, 4, and 5 of the drawings, the record storage magazine A comprises a smooth, flat plate 2 defining the rear wall of the magazine. This plate is preferably tilted backward slightly from the vertical, so that the records, while supported in a substantially or nearly upright position, tend to lean against the plate 2, and this is made fairly extensive in area in order to prevent warping of the records if they are retained in the machine over a long period of time. By supporting the records at a slight angle, best shown in Fig. 2, the primary advantage of supporting and transferring to records in an upright position is retained, for the records may be rolled by gravity on inclined tracks, and at the same time many of the advantages of playing the record in a horizontal position are retained, for the records tend to lean against and be supported by the back plate of the magazine, and later, when picked up by the turntable, tend to remain safely on the turntable as the latter is advanced or retracted. The angle of tilt selected is a compromise between the desire, on the one hand, to have the records nearly vertical so that a record may be separated from the magazine with ease, and so that it will transfer itself by gravity on a guide track without necessitating too steep a slope for the track which in turn will increase the over-all height of the machine, and, on the other hand, the desire to have the records inclined a substantial amount in order to insure against the records tilting frontward rather than backward in the magazine, and when being loaded on, or unloaded from the record turntable, particularly when it is remembered that the machine must operate successfully even when it is tilted in one direction or another, by reason of inequalities in the floor level on which the machine rests.

The machine here disclosed has been so proportioned as to allow a margin of safety of five degrees over which it may be tilted in any direction away from the true horizontal, without interfering with the successful and reliable operation of the record changing mechanism.

The record magazine further includes a bottom 4 which may, if desired, consist merely of a pair of spaced rails, or which may consist, as here illustrated, of an arcuate bottom wall, but in either case the bottom is given a relatively steep slope downwardly toward the plate 2, as here shown in Figs. 1 and 4, so that the records in the magazine tend to slide downwardly against the rear plate 2. This slope is made sufficiently steep to insure that the records will readily slide toward the back of the magazine and there remain, but is not so steep as to cause the records to wedge too tightly together to prevent the removal of the rearmost record. The movement of the records is facilitated by making the bottom of smooth, shiny metal, but in order to prevent undue noise when records are dropped into the magazine, and to prevent chipping of the edges of the records, the metal surface is preferably made of an exceedingly thin phosphor bronze strip 6 which is backed by a relatively thick layer of sponge rubber or felt 8. To prevent the records from escaping from the magazine when discharged from the turntable, a soft rubber bumper 10 may be provided, which extends from the front of the magazine and terminates short of the back of the same in order not to interfere with the notched fingers C, and this bumper 10 is therefore supplemented by an additional bumper 12 which extends from the back of the magazine to a point overlapping the end of the main bumper 10, which bumper 12 is located below the lowest point of the travel of the fingers C. Each bumper consists of soft rubber washers or tubing mounted on a supporting bolt or spindle. The bumper 10 is located beyond the periphery of the records when the latter are at rest in the magazine, and serves primarily to prevent escape of a record traveling down the discharge track F.

The radius of curvature of the bottom 4 of the magazine is preferably greater than that of the records, so that the records rest on the center of the bottom. This construction tends to insure that the records will tilt backward, rather than frontward, when discharged into the magazine, because upon tilting forward, the record meets the side edges or ends of the bottom. It will be understood that the curved bottom shown may be replaced, if desired, by a pair of rails which are inclined downwardly toward the rear, and which are preferably encased in felt or rubber surrounded by phosphor bronze in order to obtain a cushioning effect.

The back plate 2 and bottom 4 so far described, constitute practically the entire structure of the magazine. A front plate 14 is used, but this serves primarily as a support for the bumper 10 and for a flipper 16. The latter is normally swung inwardly, as shown in Fig. 5, and serves to limit the number of records which may be placed in the magazine. As here constructed, the magazine holds twenty records and is therefore capable of over an hour of entertainment without repeating the records. The flipper 16 is pivoted at 18 so that it may readily swing outwardly toward the front plate 14 when a record is discharged down the track F. This movement of the flipper 16 is desirably very free in order not to noticeably impede the discharge of a record.

into the magazine, for if the machine is tilted a considerable distance toward the rear, thereby increasing the friction of travel, or toward the left, thereby decreasing the inclination of the discharge track, the discharged record may not have sufficient momentum to move the flipper. In the present case the desired result is obtained by so pivoting the flipper on its bearing 18 that it tends to swing inwardly only by gravity.

The resulting storage magazine is almost entirely open from the side and from above. It may therefore readily be loaded and unloaded by the simple provision of a door on top of the cabinet in which the phonograph is housed, which, when swung upwardly, gives full access to the magazine, so that one, or several, or the entire collection of records may be placed in or taken from the magazine at will. If the phonograph chassis is not mounted at the top of the cabinet, as if surmounted by a radio receiving chassis or loud speaking equipment, a door may be provided at the side of the cabinet adjacent the magazine, through which records may be placed in or taken from the magazine. Furthermore, if desired, a record loading slot may be provided, through which records may be inserted in the magazine, and such a slot may be used in combination with a door, giving greater access to the magazine for removal of records therefrom. Thus, a top door and side slot may be provided, or a side door and top slot, or either a top or side door itself provided with a slot. The complete openness of the magazine makes it readily adaptable to varied cabinet conditions, it being also possible, for example, to load the magazine through a door provided in front of the chassis, but such an arrangement does not take advantage of the relative compactness of a disc record when handled edgewise.

The records gravitate to the rear of the magazine, and the rearmost record is separated from the remaining records when a new record is to be played. This separation may be accomplished by varied mechanism, a preferable form of which is here illustrated as comprising an arm B located in back of the magazine and oscillatable on a shaft 20. The shaft 20 extends from the rear to the front of the chassis, but is provided with a crank-like return bend 22 so as not to interfere with the operation of the discharge track F. The forward end of shaft 20 is fitted with an arm 24, best shown in Figs. 3 and 5, which is connected through a connecting rod 26 with a crank pin 28 mounted on a rotatable cam and crank disc 30. By means of mechanism which need not now be described in detail, including single revolution clutch mechanism generally designated R, the crank and cam disc 30 is given a single revolution at each record changing operation. It will be evident that the resulting rotation of crank pin 28 causes a downward oscillation of the arm 24, which in turn causes an upward oscillation of the arm B.

The end of arm B is provided with a finger housing 32 in which a pair of fingers C is mounted. Each finger consists of a relatively long sheet or strap 34 located within the housing 32 and pivoted therein by means of a pin 36. At the outer end of each finger there is mounted a head 38 consisting of a sheet of metal bent into an inverted U-shaped cross section and riveted to the strap 34, as is best indicated in Fig. 4a. The inner portion 40 is flattened or depressed relative to the outer portion 42, and the edge 44 of the outer portion 42 may be ground and sharpened to an edge which will effectively grip the edge of the record.

In effect, each finger is notched and is provided with a flat bearing surface 40 for locating the finger with respect to the face of the record, while the notch projects around the edge of the record. Each finger is provided with resilient means urging the finger toward the record, here illustrated by the bent spring 46 in Fig. 5, which is anchored to the outside of the housing 32 by a screw 48, and which then extends inside of the housing 32 and is appropriately bent to bear against each of the fingers.

It will be noted that the configuration of the rear plate 2 of the magazine includes an arcuate edge 50 which is so shaped as not to interfere with the operation of the fingers during the upward oscillation of the arm B. It may further be noted that the housing 32 is mounted at an angle to the arm B, such that the fingers are directed radially with respect to the record. This insures that the fingers will be placed in tension along their length when the arm is elevated, and free movement of the fingers about pin 36 is retained even when the fingers are under load, so that they readily follow the edge of a warped record during its movement out of the magazine. It should further be noted that the pin 36 on which the fingers are mounted is located as near as possible to the back plate 2 of the magazine so as to minimize any tendency for the fingers to move backward or escape from the edge of the record when under load. The projection of the end portion 42 relative to the bearing portion 40 of the fingers is made less than the thickness of the thinnest record met with in practice, so that there will be no danger of ever catching two records instead of one. One finger is sufficient to properly separate the record, and in fact only one finger is effective on any particular record, but the two fingers here shown are provided as a measure of safety in the event of the edge of a record being chipped at a slant and the said chip being located at the single finger, for in such case the other finger will grasp the record and move it in the desired manner. It should also be noted that even a badly warped record will not interfere with the successful operation of the machine, for the fingers C will merely move inwardly as far as necessary to properly engage the record, this distance being gauged by the bearing surface 40.

During the playing of a record, the arm B is at rest in its lowermost position, as is illustrated in Figs. 4 and 5. When the record changing operation takes place, the arm B oscillates upwardly and moves the rearmost record with it, this record being preferably oscillated upwardly about a fixed pivot located near the edge of the record, and in the present case this pivot is provided by the shaft 20 on which the arm is mounted. An intermediate position of the arm B and fingers C with the record moved thereby, is shown in broken lines in Fig. 4, and is designated B' and C'. During this movement of the record it should be observed that the fingers need not move relative to the periphery of the record, and in fact remain in true radial relation to the record. The record is moved partially sideward and partially upward, as the arm B continues its upward oscillation, to a nearly vertical position, at which time the lower edge of the record rides over an upward protuberance 52 at the end of the loading track D. This protuberance slopes downwardly toward the rear plate 2 in order to urge the record toward the said rear plate 2. Its height, however, is not reduced to

zero adjacent the plate 2, but remains an appreciable amount in order to permit the record to descend slightly as it leaves the fingers C. This is done because the edge of a record may, in rare cases, be chipped in a peculiar manner, so that a finger resting in the chip may prevent the record from rolling freely down the loading track. Means may be provided to move the fingers outwardly at the upper end of their stroke, but in the present case the desired result is accomplished in a very simple manner, as previously described, that is, by permitting the record to descend beyond the protuberance 52 as the fingers reach the end of their stroke, thereby insuring complete disengagement of the record from the fingers. The record then rolls down the loading track D to the loading station E, meanwhile resting on the rear plate 2 which is extended in a smooth and perfectly continuous manner from the magazine A to the loading station E. In the meantime the arm B returns to its position of rest. During this return movement, the fingers C tend to move forwardly under the influence of spring 46, but the lower faces of the U-shaped ends of the fingers are bent downwardly at a relatively long slope to form the aprons or cam surfaces 54 which cause the fingers to slide in back of the rearmost record when they reach the same during the descent of arm B, leaving them in readiness for the next record changing operation.

It has previously been explained that the pressure of the records in the magazine against the rearmost record should not be so great as to prevent the removal of the record, or, if removed, to cause it to partially or wholly remove the next adjacent record. In the present machine this factor is not critical, for additional mechanism is provided to relieve the rearmost record of the pressure of the remaining records in the magazine. By merely relieving the pressure on the rearmost record, the record is separated from the remaining records by an at least partially gravity separation, that is the remaining records are retained in the magazine by gravity, which possesses an advantage over the use of mechanical retaining means because the latter are critical to such variable factors as the thickness of the record, warping or chipping, and like defects of the record. In the present mechanism a pusher pin 56 is provided at the back of the magazine, which is mounted on an arm 58 oscillatable about a fixed pivot 60, best shown in Fig. 5. The arm 58 is rotated clockwise during the upward oscillation of the arm B by a cam 62 mounted on and oscillating with the arm B and shaft 20, the said cam 62 bearing against the end 64 of arm 58. The pin 56 is located near the edge of the records in the magazine, (see Fig. 4), and the cam 62 so shaped that the pin 56 does not begin to move inwardly until after the arm B has moved upwardly a slight amount. In consequence, the pin 56 misses the edge of the rearmost record being ejected from the magazine, but moves inwardly against the remaining records, thereby separating the same from the surface of the ejected record, which reduces abrasion and friction, and relieves the load thereon. If two records start to move out of the magazine, the second record will fall back into place when the record pressure is relieved, and the side of pin 56 is preferably covered with rubber so that no noise will result. The pin 56 is located near the edge of the records in the magazine, not only so that it may be applied against the same after only slight movement of the rear-

most record, but also in order that should two records begin to move, the second, when stopped by the pin 56, will nevertheless be so nearly in normal record position that the fingers C, in the next record changing operation, will have no difficulty in catching the same, and will not be able to move forward until they engage the next record, that is, the bearing surfaces 40 of the fingers will bear against the rearmost record even if it is considerably away from normal position.

When the arm B descends, the pusher pin 56 is retracted under the influence of a spring 56.

Another pusher pin 68 may be provided, which is located at the leading, rather than the trailing edge of the records. This pin may be mounted on a leaf spring 70, as shown, so that it also is normally retracted. A cam 72, made integral with the cam 62, urges the pusher pin 68 inwardly when the arm B is oscillated. This pin, unlike the pin 56, may be used to bear against all of the records in the magazine, including even the rearmost record, for the movement of the latter record is a pivotal one about shaft 20, and hence is very slight with reference to pin 68. The pin preferably bears against the blank margin of the record and therefore does not mar the sound grooves, and meanwhile by its operation relieves the record of its friction bearing against rear plate 2. In the latter half of the upward oscillation of arm B it acts, like pin 56, to relieve the rearmost record of the pressure of the remaining records, so that the ejected record may travel freely down the loading track D.

It will be understood that mechanism such as the arm B here described, may be used to move a record directly to its loading station. However, it is here preferred to use a partially gravity movement to the loading station, although this is made a minimum for the sake of compactness because the gravity movement is independent of defects in the record and places the record accurately at the loading station, regardless of wear or inaccuracies in the mechanism which ejected the record out of the magazine. The loading station E consists essentially of an annular extension 74 of the rear plate 2, the opening in which is large enough to permit the turntable G to reciprocate therethrough, but which, on the other hand, is small enough to provide a supporting surface for the record. The bottom edge of the record rests upon a pair of rails 76 which are inclined downwardly toward the rear plate 2, (see Fig. 2), so that the record, which rolls down the track D and rests upon and is centered by the rails 76, tends to remain against the rear plate or annular support 74. A soft rubber bumper 78 is provided to prevent escape of a record should it happen to roll down the track D at excessive speed. The tracks 76 are preferably provided with felt or rubber backed phosphor bronze cushions 80 in order to keep the record changing operation silent.

The turntable G is then advanced, and picks up the record at the loading station and moves it into engagement with the driving clamp K and with the reproducer N. During this movement, the record slides past upper and lower stops J. The upper stop consists of a light tubular rail 82 which is supported on a strap 84 pivoted on the rear plate of the chassis at 86, as is most clearly shown in Fig. 2. The normal position of stop 82 is that shown in Figs. 2 and 4, so that the rail 82 is located outside of the turntable G, but inside of the edge of the record. When the turntable and record are advanced from the loading station E, the upper edge of the

record bears against the strap 84, which is preferably arranged at a gradual slope, and lifts the strap and rail 82 clear of the record. The lower stop J is best shown in Fig. 4, and in this case is spring operated, although either, or both stops may be gravity or spring operated. The normal position of lower stop J is indicated in Fig. 4, and the end thereof lies between the periphery of turntable G, and the edge of the record. The stop is displaced downwardly during the advance of the record, and springs up behind the record after the record has passed.

When the record has been played, the turntable G is retracted. During this retraction it clears the stops J, but the record does not, and is thereby separated from the turntable. The record discharge track F is located a little beneath the record and closely adjacent the stops, as is evident from Figs. 2 and 4. When the centering pin leaves the center hole of the record, the record falls on track F which is preferably cushioned with felt or rubber backed phosphor bronze, as at 88, and then rolls down the track into the magazine A. The top of the record meanwhile rests against the rail 82 which is properly located to keep the record in a slightly backwardly tilted position which is sufficient to prevent it from falling forward, but insufficient to interfere with the movement of the record down the track. The end of rail 82 may be curved slightly, as shown in Fig. 2, so as to ease the fall of the record into the magazine. The distance that the track F is located ahead of the loading track D depends, of course, upon the number of records which the magazine is to accommodate, for this distance should be greater than the total thickness of a full supply of records.

Record loading and driving mechanism

The turntable G is mounted for free rotation in a bearing 90 which is movably mounted on a parallelogram movement H, comprising forward arms 92 and a rear arm 94 the lower ends of which are pivoted on fixed pivots 96 and 98 respectively, and the upper ends of which are pivoted at 100 and 102 respectively, on the bearing 90. The parallelogram movement is actuated through pivot 96 by means of a forwardly extending arm 104 which, as is most clearly shown in Figs. 2 and 3, is moved by a connecting link 106 pivoted at 108 to an arm 110 which rocks about a fixed pivot 112 under the influence of a roller 114 mounted at the movable end thereof and following the cam disc 30. The turntable G moves downwardly when it is retracted to a position indicated in broken lines at G', and the resulting constant tendency of the turntable to move back keeps the cam follower 114 in continuous engagement with the cam 30. The latter, as was before explained, goes through a single revolution during each record changing operation, and the configuration of the cam is such that the turntable is retracted at the beginning of the record changing operation, and after a brief dwell is advanced to pick up the next record to be played.

The driving motor M may be of any conventional type, and drives a shaft 116 at the usual reproducing speed, seventy-eight revolutions per minute. The motor may be of the low speed induction type, driving shaft 116 directly, or it may be of the high speed induction type which drives the shaft 116 through a worm and gear reduction, but in either case should be capable of driv-

ing the record changing mechanism. It should be noted that the motor remains fixed in place, and that plenty of room is available, so that any desired type of motor may be employed and may be mounted in any desired position.

Shaft 116 is provided with a pinion 118 meshing with a large gear 120, from which the drive for the record changing operation is taken. The end of shaft 116 is fitted with the driving clamp K. This is provided with a center hole 122 (see Fig. 3) for receiving and housing the centering pin 124 of the turntable G. The face of driving clamp K is preferably fitted with a sponge rubber pad 126. The bushing 128 of the driving clamp is reciprocable on the end of shaft 116, but is positively rotated therewith by reason of a slot and pin connection 130. A coil spring 132 is placed in compression between a bushing 134 on shaft 116 and the driving clamp, and urges the latter toward the record to be played. Considerable movement of the driving clamp is permitted for the following reasons. It is desirable that the driving clamp meet the approaching record in order to center the same accurately on the centering pin and hold it securely on the turntable. The driving clamp is constantly rotated, and in this manner brings the record and turntable gradually up to speed. The record meets the reproducer stylus a little before it reaches its normal playing position, and it is obviously desirable that the record be brought fully up to normal speed before the stylus enters the first sound groove of the record. Furthermore, different thicknesses of record and, in the present machine, even the thicknesses of two records, should they happen to be stuck together, are accommodated.

The lower pivots 96 and 98 of the parallelogram movement are so located that the upper pivots 100 and 102 are moving tangentially or at the top of their arcuate movement when the centering pin 124 on the turntable enters the center hole 122 in the driving clamp. The movement of the pin is therefore axial, and no binding takes place even though the pin and center hole are given a close fit. In this manner the advantage of axial movement of the table is retained, while obtaining additional advantages of the present movement such as the gravity return of the turntable and the frictionless bearing in which the turntable is mounted for rotation. The upper pivots 100 and 102 are preferably aligned, in the manner shown, with the axis of rotation of the turntable, because the center of pressure applied to the turntable against the driving clamp is thereby coincident with the center of rotation, and the turntable therefore tends naturally to keep in proper alignment with the driving clamp. The turntable is preferably made rather large in diameter to provide a good record support, and of considerable mass in order to steady the rotative speed of the record when playing a damaged or warped record. In the ordinary phonograph this expedient is of little avail, because the record is not positively driven with the turntable, but merely rests rather lightly thereon. In the present machine the record is clamped firmly by the driving clamp and rotates in fixed relation with the turntable, and the fly wheel effect of the latter may therefore be taken advantage of. The extra weight of the turntable is also useful for the reason that the cycle of operations employed in this machine results in the turntable moving downwardly when the arm B is oscillated upwardly with the next

record to be played, and the drop of the turntable aids the lift of the arm when the latter is most strongly resisted by the record.

It may also be observed that the retracted position of the turntable brings the end of the centering pin 124 appreciably back of the annular supporting plate 74, so that there will be no chance for the edge of even a warped record to strike the centering pin when sliding to the loading station E. It may further be remarked that while the turntable is here tilted at the same angle as the storage magazine and loading station, for simplicity, these angles need not be equal, but may differ from one another, if desired, in various combinations.

Pickup or reproducer control mechanism

The reproducer is indicated at N, and is arranged on the same side of the record as the driving motor. This, of course, limits the permissible diameter of the driving clamp K. It is preferred to move the reproducer in rectilinear radial relation to the turntable. Such a movement is the theoretically correct movement for accurately reproducing the recording, and results in the stylus being moved in true tangential relation to the sound grooves and vibrated in true transverse relation to the sound grooves. It also permits the stylus to wear to a chisel point, which chisel point is kept in constant relation to the groove, and this results in long wear of the stylus, which is particularly desirable in an automatic record changing phonograph of this type. The desirable long wear of the stylus is also accompanied by long wear of the record, particularly in view of the substantially upright position of the record which permits the material worn from the record by the stylus to fall out of the sound track. This powder remaining in the sound track increases the wear of the stylus and the record, when the record is played in the more customary horizontal position.

Rectilinear reproducer movement has not been widely employed, despite its advantages, because no satisfactory means has been devised for guiding the reproducer in a frictionless manner, that is, so that it will freely follow the sound track regardless of the pitch of the sound grooves. We overcome the former difficulty by mounting the reproducer N for oscillation about a smooth shaft O, and we rotate the shaft O in order to reduce the friction of rest between the reproducer and the shaft to zero. Shaft O is mounted in bearings 140 and 142, and is rotated by a gear 144, (see Figs. 1 and 2), the teeth of which mesh with a series of holes 146 in gear 120, (see Fig. 3), which in turn is constantly rotated by pinion 118 on motor shaft 116.

The reproducer is carried on an arm 148 which is pivotally mounted at 150 on mounting means 152 which in turn is carried on shaft O. The mounting means 152 consists of a hollow box, the sides 154 of which are provided with apertures which slidably fit shaft O. The entire reproducer assembly is oscillatable about shaft O toward and from the record to be played. The balance is made such that gravity tends to move the reproducer into engagement with the record. However, the reproducer may be made heavy so as to secure good response to high amplitude low frequency tones, without at the same time getting excessive needle pressure on the record.

The reproducer first engages the record at the blank margin thereof, and thereafter moves toward the first sound groove. To obtain this move-

ment the shaft O is tilted downwardly toward the center of the turntable, as is evident in Figs. 1 and 3. In consequence of this, the reproducer has a positive tendency to move toward the sound track, but can only move slowly and does not jump the first grooves because the speed of motion is accurately controlled by the relation between the rotating shaft O and the reproducer mount 152. Contrary to the normal laws of friction, the arrangement here shown makes the friction of rest zero, so that the reproducer is practically frictionless with respect to slow displacement along the shaft, but the retardation increases very rapidly with any attempted increase in speed of movement. The slope of shaft O may be made slight so as to permit movement of the reproducer at just the normal playing speed, but we prefer to employ a substantially greater inclination, so that the reproducer mount 152 tends to move slightly faster than the normal reproducer speed, first, because it is desired to move a trip sleeve, subsequently described, with the reproducer mount, and second, because it is desired to keep the reproducer in lagging relation to the reproducer mount so that it will remain at one extreme of its permissible limited oscillation about pivot 150. Both of these reasons center about the operation of the trip mechanism described later, but additional reasons for having the reproducer lightly urged toward the center of the record are, first, to keep the stylus from repeating a single groove in the record in case the groove is badly worn, and second, in order to wear the stylus on one side more than on the other. It was previously mentioned that the chisel shaped stylus tip is desirable for long wear, but, on the other hand, if this wear is obtained at the center of the stylus the length of the chisel surface may be too great to accurately reproduce high frequency vibrations. In passing, it may be remarked that tungsten pointed needles designed especially for long wear may, if desired, be employed in this machine because of the gentleness with which the stylus is moved into the first sound groove of the record.

When the record has been played, the turntable is retracted. The pickup tends to follow the record, but its movement is arrested by reason of a projection 160 bearing against shaft P, (see Figs. 2 and 6). The reproducer may then be returned to its initial playing position in a simple manner by threading shaft P, as shown in Figs. 3 and 6, and constantly rotating the same through a gear 162, meshing with gear 144, in proper direction to move the reproducer up the smooth shaft O. The continued rotation of threaded shaft P keeps the reproducer at its starting position until a new record is advanced into playing position, which oscillates the reproducer about smooth shaft O and thereby moves the projection 160, which acts as a nut when in cooperation with the thread, out of engagement with the thread, and so permits the reproducer to ride gently into the first sound groove of the record.

When it is desired to change the stylus, the reproducer may be oscillated downwardly about shaft O, and this operation may, if desired, be facilitated by a handle 149. The reproducer is then inverted and at the front of the machine, and the needle may therefore be removed and replaced in a simple manner. Even if this is done in the middle of the playing of a record, the operation of the phonograph will not be interfered with.

Trip mechanism

The trip mechanism is, generally, an improvement on that disclosed in Patent No. 1,943,038 previously mentioned. Referring to Figs. 6 and 7, a friction sleeve 170 is reciprocally mounted on smooth shaft O. This sleeve is preferably located between the walls 154 of the reproducer mount 152, but is shorter than the reproducer mount in order to permit of limited relative movement of the sleeve 170 and the reproducer mount 152. The sleeve is provided with a pin 172 adapted to bear against a reaction surface 174 which is mounted on the arm 148 of the pickup. During the playing of the record, the pin 172 rests against reaction surface 174, and prevents rotation of the sleeve. The latter may therefore be moved axially along the shaft O at a slow speed, but greatly resists acceleration. When the stylus enters a special terminating groove on the record, the pickup is moved quickly, and the reaction surface 174 therefore leaves the pin 172, whereupon sleeve 170 begins to rotate with shaft O. A cam surface on sleeve 170, consisting, in this case, merely of the bent wire 176, then bears against a lever 178 pivoted at 180 in the reproducer mount. The resulting outward movement of lever 178 may be taken advantage of as a trip impulse for initiating the record changing operation. If the record is not provided with a special terminating groove, the pickup comes to rest or dwells at the end of the record. By giving the reaction surface a slight bias, as is best shown in Fig. 7a, the pin 172 will then cause the sleeve to continue to travel along the shaft O until the pin is free of the reaction surface, whereupon the sleeve 170 will rotate and produce the desired trip impulse.

It should be noted that sleeve 170 is not continuous, but is open or split, as is most clearly shown in Fig. 6. This split is so located relative to pin 172 and cam 176 that during the normal playing of a record the reaction of the pin 172 on reaction surface 174 tends to open the sleeve, and thereby reduces the friction thereof on shaft O, which facilitates its movement along the shaft. When sleeve 170 rotates, however, as at the end of the record, the resistance of the trip mechanism to cam 176 tends to close the sleeve, and increases the friction thereof so that a strong trip impulse is made available.

When the reproducer mount 152 is returned along shaft O by threaded shaft P, the sleeve 170 is also restored, inasmuch as the permissible movement between the sleeve and the reproducer mount is limited. During this restoring action the pin 172 may be arrested by a stop guide 182 which prevents rotation of the sleeve and tends to open the same, thereby reducing the frictional drag. The stop guide 182, however, is designed to fulfil a more important function, namely, to insure that the pin 172 is seated accurately at the middle of reaction surface 174, and this is accomplished by locating the end of the stop guide just ahead of the middle of the reaction surface when the sleeve 170 lags the reproducer mount, in the manner shown in Fig. 7. This condition obtains at the beginning of the playing of a record, because the reproducer and reproducer mount are moved by gravity and by the sound track in the record, while sleeve 170 at first remains stationary, pin 172 meanwhile sliding along stop guide 182. When pin 172 reaches the end of stop guide 182, it moves with the sleeve until it meets reaction surface 174, where it remains until the end of the record.

The trip impulse obtained by rotation of split sleeve 170 is preferably employed to release trigger energy, in order to amplify and prolong the energy available to initiate the record changing operation. Referring to Fig. 1, trigger energy is obtained by tensioning resilient means here exemplified by the flat or leaf spring 190. This spring bears against a pin 192 on a reciprocable rod 194. Reciprocation of the rod 194 and therefore the spring 190 are opposed by toggle means 196 which is placed in compression and prevents reciprocation of the rod 194 until the toggle is broken. In accordance with a feature of the present invention, the toggle mechanism, instead of comprising a pair of pivoted arms and associated mechanism, consists simply of a thin flat spring 196, one end of which is affixed to a block 198 at the end of rod 194, and the other end of which rests in a slot 200 in a fixed member of the phonograph chassis. The bottom surface of the block 198 is inclined, as shown, in order to normally urge the spring 194 past dead center in the upward direction. At a point slightly past dead center, the spring 196 rests against the rod 194 and is thereby prevented from buckling upward.

A plate 202 is oscillatably mounted on rod 194 by means of ears 204, best shown in Figs. 5 and 6, and is normally held in inoperative position by means of a gravity weight 206, also best shown in Figs. 5 and 6. The upper edge of plate 202 rests closely adjacent the lower end of oscillatable strap 178, and this is true, regardless of the position of the reproducer along the guide rod O. When the trip mechanism is operated, so that sleeve 170 rotates, the cam 176 moves strap 178 outwardly, which in turn oscillates plate 202 about rod 194. The lower right hand end of plate 202 is provided with an extension 208 (see Figs. 1 and 5) and bears downwardly against toggle spring 196, readily moving the latter below dead center, whereupon the spring bends or buckles downwardly, releasing trigger spring 190 and permitting trigger rod 194 to reciprocate to the left. Spring 190 may be made sufficiently powerful to obtain trigger energy of any necessary amount, and its operation is, of course, sustained until the spring is again tensioned, which is preferably accomplished by motor driven restoring mechanism described subsequently in connection with the clutch mechanism.

It will be appreciated that the pickup control mechanism includes a smooth rotatable shaft, and that the trip mechanism includes a smooth rotatable shaft, the functions of which are mutually independent. These shafts have, for the sake of mechanical simplicity, been combined into a single shaft O, but separate shafts may, of course, be employed. The trip mechanism disclosed in Patent No. 1,943,038 has been improved, by making the friction of the sleeve variable, in an advantageous manner, by making the movement of the sleeve with the reproducer mounting positive, by restoring the sleeve with the reproducer mount, by relieving the sleeve friction during its restoration, and by insuring accurate seating of the pin on the reaction surface. It may also be observed that the relation between the trip mechanism and the plate 202 which moves the toggle past dead center is such that the reproducer may be swung bodily about shaft O in order to change the stylus, without operating the record changing mechanism. This makes it possible to play a record even if it has already been

partially played when it is decided to change the needle.

Clutch and toggle restoring mechanism

5 Referring to Figs. 2, 3, and 5, the large, constantly rotated gear 120 has coaxially arranged therewith, but rotatably free therefrom, a cam and crank disc 30. The gear 120 is provided not only with the series of holes 146 which drive the reproducer control and trip mechanisms, but also
10 with another series of holes 210. The disc 30 is in turn provided with an enlarged crank pin 28, over which the end of connecting rod 26 is fitted, and through which a clutch pin 212 is reciprocable. This pin is normally urged rearwardly or away from large gear 120 by a spring 214 housed within enlarged crank pin 28, (see Fig. 5). The radii of crank pin 28 and of the series of holes 210 coincide, and the holes 210 are dimensioned
20 to receive the forward end of clutch pin 212 when the latter is advanced to clutch the record changing mechanism to the driving motor. How the resulting rotation of cam and crank disc 30 drives the record transfer mechanism and turntable moving mechanism through a record changing cycle, has previously been explained.

To advance clutch pin 212, a bearing surface 216 is provided which is preferably in the annular form shown, in order to follow the path of the
30 clutch pin. This bearing surface forms an integral part of a bell crank lever 219 which is pivoted at 218 to the phonograph chassis, and the other arm 220 of which is provided with a slot 222 receiving a pin 224 projecting upwardly from reciprocable trigger rod 194. By reference to Fig. 5 it will be evident that when the trigger energy is released, and trigger rod 194 reciprocates to the left, the bell crank lever oscillates clockwise so that bearing surface 216 advances clutch pin 212. Gear 120 being constantly rotated, the clutch pin quickly enters one of the holes 210, whereupon the cam and crank disc 30 is rotated. During the resulting rotation, the clutch pin is kept advanced by the continued action of bearing
45 surface 216. The bearing surface is made helical in form in order to provide the same with an effective recess which permits the clutch pin 212 to be retracted by spring 214 at the end of a single revolution.

50 The bearing surface and clutch pin are properly related not only to obtain the desired release at the end of a single revolution, but also to tension trigger spring 190 and to reset toggle 196. This result is obtained by mounting the entire bearing surface 216 at a bias with respect to the path of rotation of clutch pin 212, and by limiting the permissible forward reciprocation of the clutch pin. In other words, when the trigger action takes place the clutch pin is advanced as far as it can go. Because of the bias of bearing surface
60 216 the rotation of clutch pin 212 tends to force the bearing surface back toward its initial position. This restoring movement is fully accomplished before the end of a single revolution, and the resulting counter-clockwise rotation of the bell crank about pivot 218 reciprocates trigger rod 194 to the right and tensions trigger spring 190. At the same time, toggle spring 196 is reset to the holding position because of its natural tendency to move upward by reason of its mounting on block 198. Thereafter, when the single revolution of the rotatable means for driving the record changing mechanism, that is, the cam and crank disc 30, ends, the clutch pin 212 reaches the
70 effective recess caused by the helical shape of

the bearing surface, and therefore is retracted until the next record changing operation takes place. To avoid the use of a heavy spring 214 on clutch pin 212, with attendant increased frictional and spring tensioning loads on the motor, the driving pressure of hole 210 on pin 212 (see Fig. 3) is relieved at the end of the single revolution by slightly recessing or reducing the radius of the cam 30 at its point of contact with follower 114.

Reject and repeat mechanism

As so far described, the phonograph will play a series of records in succession, each record being played entirely through one time, until the entire group of records has been played and is being repeated. In accordance with further features of our invention, manual control means, heretofore generally designated S, is provided for making it possible to reject an undesired record at any time, or to repeat a record any desired number of times. The manual control means comprises a knob 230 mounted at the end of a reciprocable rod 232 normally urged forwardly or outwardly by a spring 234. As is best shown in Fig. 5, the remote end of rod 232 is provided with a tapered portion 236 upon which rests one end of a lever 238 pivoted at 240. The other end 242 of this lever, (see Figs. 1 and 5) rests above the middle portion of toggle spring 196. It is evident that by pushing knob 230 the inclined portion 236 of rod 232 will cause lever 238, 242 to oscillate counter-clockwise about pivot 240, thereby pushing toggle spring 196 below dead center, which releases the trigger spring 190 and consequently puts the phonograph through a record changing cycle which, of course, results in the discharge of an unwanted record and the loading of a new record.

The repeat mechanism has been combined with the reject mechanism, so that a single manual control means may be employed for either purpose. More specifically, the repeat mechanism is operated by rotating control knob 230. This rotates shaft 232 which in turn rotates a pin 244 (see Fig. 5), which rotates a sleeve 246 itself provided with a pin 248. The sleeve 246 is preferably employed in order to permit reciprocation of rod 232 without causing reciprocation of pin 248, and to this end the sleeve 246 is slotted to receive the pin 244. Rotation of pin 248 moves the same against an inclined cam surface 250 on a lever 252 pivoted at 254, and causes a clockwise movement of the lever. This movement is employed to disengage the record transfer mechanism from the driving motor and to limit the retraction of the turntable to a distance sufficiently great to disengage the record and pickup to permit restoration of the latter, but insufficient to discharge the played record from the turntable.

60 Shaft 20 is provided with a collar 260, (see Fig. 5) having a hole 262. Arm 24 is fixed to a collar 264 which is rotatable and reciprocable on shaft 20 and which is provided with a pin 266 fitting hole 262. A spring 268 normally urges collar 264 against collar 260, thereby fixing arm 24 to shaft 20. Collar 264 has an annular groove or recess 270 which receives the bifurcated ends of a yoke 272, best shown in Fig. 3. The yoke 272 is rigidly mounted on a reciprocable rod 274 carrying an upstanding pin 276 (see Fig. 5) against which one end of lever 252 bears. It will be evident that when knob 230 is rotated, the fast and loose collars 260 and 264 are disengaged, thereby making the arm B inoperative.

It is necessary to permit retraction of turntable G in order to disengage the reproducer and record, and to permit restoration of the reproducer to its initial playing position. However, complete retraction of the turntable would disengage the record from the turntable and permit it to run down the discharge track F into the magazine. This may be prevented either by interposing a stop to prevent the record from rolling down the discharge track, or by permitting only a limited retraction of turntable G insufficient to disengage the record from the turntable, and the latter method is here employed.

Referring now to Fig. 2, the arm 104, which moves the parallelogram elements H, is extended forwardly to provide a cam or stop surface 280. The left hand end of lever 252 (see Fig. 5) is arranged to reciprocate a rod 282 by means of a pin and slot connection 284. The rod 282 is normally urged outwardly, and the lever 252 is normally urged counter-clockwise, by means of a spring 286. When knob 230 is rotated to make the repeat mechanism operative, the resulting clockwise movement of lever 252 causes rod 282 to move inwardly, whereupon the end 288 (see Fig. 2) comes in the path of projection 280, and thereby limits the upward movement of arm 104 and consequently the retraction or loading of turntable G. This does not interfere with the continued rotation of the cam and crank disc 30 because cam follower or roller 114 simply departs from the surface of cam 30.

It may be mentioned at this point that the location of the stops J, that is, the upper rail 82 and the lower spring stop 88, must be selected to permit sufficient clearance between the stylus and record to make the record repeat operation possible. The record must be moved away from the stylus a sufficient amount to permit the nut 160 (Fig. 6) to engage the threaded rod P, plus an additional amount to free the stylus from the record during the return movement of the pickup. This clearance must itself be sufficient to take care of some variation in needle length.

If the repeat knob is left in its turned position, the record then being played will be repeated over and over again as long as desired. When a new record is wanted, it is simply necessary to turn the knob counter-clockwise to its normal position. If a record is to be repeated only one time, it is convenient to be able to turn and immediately restore the repeat mechanism to normal position at the end of the record. For this purpose, the end of the stop surface 280 on arm 104 is provided with a hook 290 (see Fig. 2), while the inner end 288 of rod 282 is either enlarged or recessed so as to receive hook 290. If repeat knob 230 is turned at or near the end of a record, the hook 290 engages the end 288 of rod 282 during the very beginning of the record changing operation, or, more properly speaking, the reproducer restoring operation, for no record change takes place, and from that point on, the repeat mechanism will be held latched in repeat position until the reproducer restoring operation is completed. It is therefore possible for the listener to turn the knob 230 back to record change position during the reproducer restoring operation. Of course, if the knob 230 is returned from repeat position during the playing of a record, it will simply return to record change position.

It is desirable to prevent the repeat mechanism from being operated during the record changing operation in order to prevent the record trans-

fer mechanism from becoming inoperative prematurely. For this purpose, the forward end of arm 104 is provided with a cam surface 292 so disposed, that after the record changing operation has begun, it comes in front of the end 288 of rod 282. This locks the entire record repeat mechanism against movement until the record changing operation has been completed.

Summary of operation

A record being played is clamped between a large freely rotatable turntable G and a driving clamp K. The latter is constantly rotated at normal reproducing speed by a fixed motor M. This motor at the same time constantly rotates a smooth downwardly inclined guide shaft O on which the pickup N is reciprocally mounted.

During the playing of the record, the reproducer freely follows the sound track in the record, regardless of the pitch of the sound grooves, due to the rotation of shaft O. The trip sleeve 170 moves with the reproducer mount 152 and is prevented from rotating because pin 172 rests on reaction surface 174, (see Figs. 6 and 7).

If the record has a special terminating groove, the pickup is moved quickly to the right, and sleeve 170 resists this rapid movement, so that pin 172 is freed from reaction surface 174 and permits sleeve 170 to rotate. If the record has no special terminating groove, the reproducer dwells in the last regular groove, but the sleeve 170 continues to move along shaft O because of the biased tip of reaction finger 174, until pin 172 passes the reaction surface, whereupon the sleeve begins to rotate. Cam surface 176 then bears against strap 178 the lower end of which in turn presses upon the upper edge of plate 202. The lower right hand end 208 (see Figs. 1 and 5) of plate 202 moves toggle spring 196 below dead center, permitting it to buckle under the force of trigger spring 190 which moves trigger rod 194 to the left. This oscillates bell crank 219 about pivot 218 (Figs. 2, 3, and 5), causing bearing surface 216 to advance clutch pin 212 into one of the holes 210 in constantly rotated gear 120. This causes cam and crank disc 30 to be turned through a single revolution, during which turntable G is retracted, thereby disengaging the played record, first from the reproducer stylus, and second from the turntable itself. The reproducer at first tends to follow the record, but is stopped by threaded shaft P which restores the reproducer to its initial playing position and at the same time returns friction sleeve 170 along constantly rotated smooth shaft O. The sleeve at this time is prevented from rotating by reason of pin 172 resting upon stop guide 182 (see Figs. 6 and 7).

The played record rests upon stops J as the turntable is retracted, and after the centering pin leaves the center hole of the record, the record rolls downwardly on discharge track F into the magazine A, pushing the flipper 16 out of the way.

In the meantime arm B has begun to oscillate upwardly, and the resulting movement of fingers C slides the rearmost record upwardly and sideways out of the record magazine. The weight of the remaining records in the magazine, which tend constantly to move toward the rear of the magazine, is relieved by pusher pins 56 and 58. The record is moved over a protuberance 52, after which it descends out of engagement with fingers C, and rolls down the loading track D to loading station E.

Turntable G, which meanwhile has been retracted beyond the rear plate 74 at the loading

station, begins to advance until the centering pin enters the center hole of the record. The record is then moved with the turntable past the stops J when it meets record driving clamp K. The latter is constantly rotated and serves to push the record firmly against the turntable and to gradually bring the record and turntable into rotation. Continued advance of the turntable brings the blank margin of the record into contact with the pickup which is then moved backwardly and is disengaged from the threaded shaft P. The pickup then travels gradually into the first sound groove of the record which, meanwhile, has come to normal playing speed.

As the record is played, the reproducer and reproducer mount move downwardly along smooth shaft O, but sleeve 170 lags behind. Pin 172 meanwhile moves along stop guide 182 until it reaches the end thereof, at which time it begins to rotate, but is arrested by reaction surface 174 on the reproducer. At this time, however, the friction sleeve is moved with the reproducer mount, and pin 172 remains on reaction surface 174 during the playing of the remainder of the record.

The timing of the present machine is such that arm B begins to move upwardly as the played record is traveling down the discharge track F. This requires that at least two records be placed in the machine in order to obtain continuous automatic operation. Of course the timing may, if desired, be rearranged so that the record discharge will take place before the record loading begins, but this slows up the record changing operation and meanwhile presents no advantage because even with the present machine a single record may be repeatedly played by simply manipulating the repeat mechanism. Any desired number of records may be stored in the magazine within its limits, and after these records have been played, the entire group may be removed and reversed to play the opposite sides thereof, or removed and replaced by another group of records, or simply be played over.

An undesired record may be rejected at will by pushing knob 230. A desired record may be repeated by turning knob 230. The stylus may be changed when worn, by tilting the pickup backward about shaft O, and this does not trip the record changing mechanism. The entire operation of the machine may, of course, be stopped or started at will, by the provision of an electrical control switch which may at the same time control the supply of energy not only to the driving motor of the phonograph, but also to the amplifier and loud speaker equipment which serve to reproduce the energy of the electrical pickup N.

The mode of constructing and using, and the many advantages of our automatic record changing phonograph will, it is thought, be apparent from the foregoing detailed description thereof. It will further be apparent that while we have shown and described our invention in the preferred form, many changes and modifications may be made in the structure disclosed, without departing from the spirit of the invention, defined in the following claims.

We claim:

1. An automatic record changing phonograph comprising a stationary magazine for receiving and supporting a plurality of records in side by side or horizontally stacked relation with the records in a nearly upright position, means tending to cause said records to move toward one end of

the magazine, an oscillatable arm, means near the end of said arm for engaging the end record at the aforesaid end of the magazine, and means for oscillating the arm in order to slide said end record wholly away from the remaining records in the magazine, the end record being moved in an edgewise direction.

2. An automatic record changing phonograph comprising a magazine for receiving and supporting a plurality of records in a nearly upright position, an oscillatable arm located at one side of the magazine, a finger located on said arm including a hook for engaging the edge of a record and a bearing surface for locating the hook with respect to the record, means for oscillating the arm in order to move said record out of the magazine to a loading position, and a record turntable and centering pin arranged for reciprocation transversely of the loading position.

3. An automatic record changing phonograph comprising a magazine for receiving and supporting a plurality of records in a nearly upright position, an oscillatable arm located at one side of the magazine, a plurality of fingers located on said arm including hooks for engaging the edge of a record and bearing surfaces for locating the hooks with respect to the record, resilient means urging the hooks toward the record, means for oscillating the arm in order to move said record out of the magazine and onto a downwardly inclined loading track, and a record turntable and centering pin arranged for reciprocation transversely of the loading track in order to pick up the record.

4. An automatic record changing phonograph comprising a magazine for receiving and storing the records in a nearly upright position in face to face relation, the magazine being so shaped that the records tend to move to one end of the magazine, a movable finger for engaging the edge of the endmost record, means to move the finger in order to separate said record from the remaining records in the magazine, and means to relieve said record from the pressure of the remaining records in the magazine during its movement out of the magazine.

5. An automatic record changing phonograph comprising a magazine for receiving and storing records in a nearly upright position, a record loading support alongside of said magazine and arranged to support a record to be played at a level higher than that of the magazine, fulcrum means between the magazine and the support, an oscillatable arm, a finger on said arm for engaging the edge of one of the records in the magazine, and means to oscillate the arm and thereby roll the record upwardly about the aforesaid fulcrum means in order to separate the record from the remaining records in the magazine and to move the same to a loading position on the support, and means for causing the record to return back to the magazine by gravity after it has been played.

6. An automatic record changing phonograph comprising a magazine for receiving and storing the records, said magazine including a rear support disposed in a slightly rearwardly inclined position against the front of which the records are supported, an oscillatable arm located at the back of the support, a finger on said arm for engaging the edge of the rearmost record, and means to oscillate the arm and thereby move the record out of the magazine in order to separate the same from the remaining records in the magazine, the configuration of said rear support be-

ing open within the periphery of the records in the magazine so as to permit access of the finger to the edge of the record.

7. An automatic record changing phonograph comprising a turntable, a stationary magazine for receiving and storing the records in a slightly rearwardly inclined position toward the back of the magazine, an oscillatable arm located at the back of the magazine, a finger on said arm for engaging the edge of the rearmost record, and means to oscillate the arm and thereby move the record wholly out of the magazine in an edge-wise direction in order to separate the same from the remaining records in the magazine and in order to move the same to a loading position adjacent the phonograph turntable.

8. An automatic record changing phonograph comprising a turntable, a magazine for receiving and storing the records in a slightly rearwardly inclined position against the back of the magazine, an oscillatable arm located at the back of the magazine, fingers on said arm for engaging the edge of the rearmost record, a record loading support, a fulcrum between the magazine and support, means to oscillate the arm and thereby roll the record upwardly over the fulcrum in order to separate the record from the remaining records in the magazine and in order to move the same to the record loading support, and means to relieve said record from the pressure of the remaining records in the magazine during its movement out of the magazine.

9. An automatic record changing phonograph comprising a magazine for supporting a supply of records in a rearwardly inclined position, a turntable and centering pin arranged to play a record in an inclined position, a reproducer, transfer means for separating a record from the magazine and moving the same to a loading position, means to bring the record and reproducer into or out of engagement, and means to transfer the record back to the record supply magazine.

10. An automatic record changing phonograph comprising a magazine for supporting a supply of records in a slightly rearwardly inclined position, a turntable and centering pin arranged to play the record in an inclined position, a reproducer, transfer means for separating the rearmost record from the magazine and moving the same to a loading position, means to advance the turntable past the loading position toward the reproducer in order to pick up the record and move the same into contact with the reproducer, or to retract the turntable from the reproducer in order to disengage the record from the reproducer, and means to transfer the disengaged record back to the forward side of the supply magazine.

11. An automatic record changing phonograph comprising a magazine for supporting a supply of records in a slightly rearwardly inclined position, a turntable and centering pin arranged to play the record in a similarly inclined position, a reproducer, transfer means for separating the rearmost record from the magazine and moving the same to a loading position, expansible stop means, means to advance the turntable toward the reproducer in order to pick up the record and move the same past the stop means into contact with the reproducer, or to retract the turntable from the reproducer in order to disengage the record from the reproducer, and from the turntable upon reaching the stop means, and means to transfer the disengaged record back to the record supply magazine.

12. An automatic record changing phonograph comprising a substantially upright record turntable having a centering pin, a reproducer, a record driving clamp of small diameter having a central hole for receiving the centering pin, a driving motor for said clamp, means causing relative reciprocation of the turntable and the driving clamp in order to center a record on the centering pin and to thereafter bring said record into driving engagement with the driving clamp, said reproducer, driving clamp, and driving motor all being located on the side of the record opposite the turntable, and said turntable being relatively large in diameter and mounted for free rotation except when brought into driving engagement with the driving clamp.

13. An automatic record changing phonograph comprising a substantially upright record turntable having a centering pin, a reproducer, a record driving clamp of small diameter having a central hole for receiving the centering pin, a driving motor therefor, means causing reciprocation of the turntable toward and from the driving clamp and reproducer in the direction of the axis of the turntable, in order to center a record on the centering pin and to thereafter move said record thereon into driving engagement with the driving clamp, said reproducer, driving clamp, and driving motor all being located on the side of the record opposite the turntable, and said turntable being relatively large in diameter and mass and mounted for free rotation except when brought into driving engagement with the driving clamp.

14. An automatic record changing phonograph comprising a slightly rearwardly inclined record turntable, bearing means supporting the same for free rotation, a record driving clamp, a driving motor therefor, and parallelogram mounting means for said bearing means permitting reciprocation of the bearing means and turntable toward and from the driving clamp in the direction of the axis of the turntable in order to move a record gravitationally supported thereon into driving engagement with the driving clamp.

15. An automatic record changing phonograph comprising an upwardly inclined record turntable, a reproducer, a record driving clamp of small diameter, a driving motor therefor, parallelogram mounting means for permitting reciprocation of the turntable toward and from the driving clamp and reproducer in the direction of the axis of the turntable, in order to move a record gravitationally supported, thereon into driving engagement with the driving clamp, said reproducer, driving clamp, and driving motor all being located on the side of the record opposite the turntable, and said turntable being relatively large in diameter and mass and mounted for free rotation except when brought into driving engagement with the driving clamp.

16. An automatic record changing phonograph comprising a magazine for storing a plurality of records in a nearly upright position, means to separate a record from the magazine and move the same into a loading position, a record turntable, a driving clamp, means to relatively move the turntable and clamp transversely of the loading position in order to clamp the record between the turntable and clamp, means to disengage the record from the turntable, and downwardly inclined guide means for guiding the record back into the magazine.

17. An automatic record changing phonograph comprising a driving clamp, a reproducer, a mag-

azine for storing a plurality of records in a nearly upright position, means to separate a record from the magazine and slide the same sidewardly and upwardly into a loading position, 5
 a record turntable reciprocable transversely of the loading position in order to load the record upon the turntable and move the same into engagement with the driving clamp and the reproducer while the turntable is advanced, stop means 10
 for arresting the movement of the record when the turntable is retracted, and downwardly inclined guide means for guiding the record back into the magazine.

18. An automatic record changing phonograph 15
 comprising a driving clamp, a reproducer, a magazine for storing a plurality of records in a slightly rearwardly inclined position, means to separate the rearmost record from the magazine and move the same sidewardly and upwardly 20
 into a loading position, a record turntable reciprocable transversely of the loading position in order to load the record upon the turntable and move the same into engagement with the driving clamp and the reproducer when the turn- 25
 table is advanced, stop means including a guide rail for arresting the rearward movement of the record when the turntable is retracted, and a downwardly inclined discharge track cooperating with said guide rail for causing the record to 30
 roll into the forward side of the magazine.

19. A phonograph comprising means to support and rotate a disc record, a reproducer, and means to support and guide the reproducer for rectilinear movement relative to the record at 35
 any desired speed dependent upon the pitch of the sound groove in the record, said means including a reproducer support and a smooth rotatable shaft for guiding the support and reproducer in the direction of the axis of the shaft, 40
 and means for constantly rotating the shaft in order to eliminate friction between the shaft and support at normal reproducer speeds.

20. A phonograph comprising means to support and rotate a disc record, a reproducer, and means 45
 to support and guide the reproducer for rectilinear radial movement relative to the record at any desired speed dependent upon the pitch of the sound groove in the record, said means including a reproducer support and a smooth rotatable shaft about which the reproducer may oscillate toward and from the record and along which the support and reproducer may move when the record is being played, and means for rotating the shaft in order to eliminate friction between 50
 the shaft and support at normal reproducer speeds.

21. A phonograph comprising a record turntable for supporting a record to be played, a reproducer, and means permitting rectilinear movement thereof relative to the record at the natural speed of the reproducer for engagement with the sound groove of the record, including a smooth rotatable shaft supporting the reproducer, means 60
 mounting the shaft in a slightly downwardly inclined position in order to lightly urge the reproducer toward the end sound groove of the record, and means to rotate the shaft.

22. A phonograph comprising a substantially upright record turntable for supporting a record 70
 to be played, means for driving the record, a reproducer, and means for permitting rectilinear radial movement thereof relative to the record at the natural speed of the reproducer for engagement with the sound groove of the record, including a smooth rotatable shaft for supporting the 75

reproducer, means mounting the shaft in a slightly downwardly inclined position in order to lightly urge the reproducer toward the end sound groove of the record, and means to rotate the shaft in order to eliminate the friction of rest of the reproducer and at the same time to provide a friction of retardation which is negligible at normal reproducer speed, but which rapidly increases at faster reproducer speeds.

23. A phonograph comprising a record turntable, a reproducer, means for bringing a record on the turntable into engagement with the reproducer at the blank margin of the record, gravity operated means tending to move the reproducer toward the first sound groove of the record, 15
 and means to control the reproducer speed so as to obtain a gradual movement into the first sound groove including a smooth shaft, means connected to the reproducer and frictionally engaging said shaft and reciprocable thereon for movement with the reproducer, and means to rotate the shaft in order to freely permit slow movement while retarding rapid movement. 20

24. A phonograph comprising a nearly upright record turntable, a reproducer, means for moving 25
 the turntable and a record thereon into engagement with the reproducer at the blank margin of the record, a downwardly inclined shaft frictionally engaged by and supporting the reproducer and permitting gravity movement of the reproducer toward the record face and toward the first sound groove of the record, and means to control the reproducer speed so as to obtain a gradual movement into the first sound groove including means to rotate said shaft at such a speed as will freely permit slow movement but not rapid movement of the reproducer. 30
 35

25. An automatic record changing phonograph comprising a reproducer, a record turntable reciprocable toward and from the reproducer, 40
 means supporting the reproducer including a shaft on which the reproducer is frictionally mounted and relative to which the reproducer is movable toward and from the record and along which the reproducer is reciprocable for following the sound groove in the record, means to rotate the shaft in order to freely permit slow movement of the reproducer along the shaft, and means to return the reproducer to its initial playing position at the end of the record. 45
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26. An automatic record changing phonograph comprising a reproducer, a record turntable, means supporting the reproducer including a shaft on which the reproducer is frictionally mounted and about which the reproducer is oscillatable toward and from the record and along which the reproducer is reciprocable for following the sound groove in the record, means permitting relative movement of the reproducer and turntable for causing the reproducer to engage or disengage a record on the turntable, means to rotate the shaft in order to freely permit slow movement of the reproducer longitudinally of the shaft, and means to return the reproducer to its initial playing position at the end of the record including a threaded shaft arranged in collateral relation to the aforesaid smooth shaft, means on the reproducer for engaging the threaded shaft when the reproducer is disengaged from the record, and means to rotate the threaded shaft in proper direction to move the reproducer to its initial playing position. 60
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27. An automatic record changing phonograph comprising a reproducer, a record turntable reciprocable toward and from the reproducer, 75

means supporting the reproducer including a shaft on which the reproducer is frictionally mounted and about which the reproducer is oscillatable toward and from the record and along which the reproducer is reciprocable for following the sound groove in the record, means to rotate the shaft in order to obviate frictional resistance to slow movement of the reproducer along the shaft, and means to return the reproducer to its initial playing position at the end of the record including a threaded shaft arranged on collateral relation to the aforesaid smooth shaft, means on the reproducer for engaging the threaded shaft when the record and turntable are moved away from the reproducer, and means to rotate the threaded shaft in proper direction to move the reproducer to its initial playing position.

28. An automatic record changing phonograph comprising a reproducer, a record turntable reciprocable toward and from the reproducer, means supporting the reproducer including a shaft on which the reproducer is frictionally mounted and relative to which the reproducer is movable toward and from the record and along which the reproducer is reciprocable for following the sound groove in the record, said shaft being slightly downwardly inclined in order to cause the reproducer to move toward the center of the record, means to rotate the shaft in order to freely permit slow movement but to restrain rapid movement of the reproducer along the shaft, and means to return the reproducer to its initial playing position at the end of the record.

29. An automatic record changing phonograph comprising a reproducer, a record turntable reciprocable toward and from the reproducer, means supporting the reproducer including a shaft on which the reproducer is frictionally mounted and about which the reproducer is oscillatable toward and from the record and along which the reproducer is reciprocable for following the sound groove in the record, said shaft being slightly downwardly inclined in order to cause the reproducer to move toward the center of the record, means to rotate the shaft in order to permit slow movement of the reproducer along the shaft, and means to return the reproducer to its initial playing position at the end of the record including a threaded shaft arranged parallel to the aforesaid smooth shaft, means on the reproducer for engaging the threaded shaft when the record and turntable are moved away from the reproducer, and means to rotate the threaded shaft in proper direction to move the reproducer to its initial playing position.

30. A phonograph trip comprising a phonograph reproducer, a smooth rotatable shaft, a split sleeve mounted for reciprocation thereon, a pin on said sleeve, a relatively small reaction surface connected to the phonograph reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer dwells or accelerates as at the end of the record, and trip means actuated in response to the resulting rotation of the sleeve, said sleeve being so split that the friction of the sleeve on the shaft is relieved when the pin bears against the reaction surface but is increased when the rotating sleeve actuates the trip.

31. A phonograph trip comprising a phonograph reproducer, a smooth rotatable shaft, a split sleeve mounted for reciprocation thereon, a radial pin on said sleeve, a relatively small cam on said sleeve, a reaction surface connected to

the phonograph reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer dwells or accelerates as at the end of the record, and trip means actuated in response to the resulting rotation of the cam, said sleeve being so split that the sleeve tends to open when the pin bears against the reaction surface but tends to close when the cam actuates the trip.

32. A phonograph trip comprising a phonograph reproducer, a smooth rotatable shaft, a sleeve mounted for reciprocation thereon, a radial pin on said sleeve, a relatively small reaction surface connected to the phonograph reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer dwells or accelerates as at the end of the record, trip means responsive to the resulting rotation of the sleeve, and means for insuring proper seating of the pin on the reaction surface including a stop guide for preventing rotation of the pin until the pin is accurately located in front of the reaction surface.

33. A phonograph trip comprising a smooth rotatable shaft, a sleeve mounted for reciprocation thereon, a radial pin on said sleeve, a relatively small reaction surface connected to the phonograph reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer dwells or accelerates as at the end of the record, trip means responsive to the resulting rotation of the sleeve, and means for insuring proper seating of the pin on the reaction surface during the playing of the record including a stop guide moved with the reproducer for preventing rotation of the pin at a point ahead of the reaction surface, the end of said stop guide being located between the ends of the reaction surface so that the pin, when released from the stop guide, is seated on the reaction surface.

34. A phonograph comprising a smooth rotatable shaft, a phonograph reproducer mounted for reciprocation thereon, a sleeve mounted for reciprocation thereon, means limiting the permissible relative reciprocation of the sleeve and reproducer, a radial pin on said sleeve, a relatively small reaction surface on the phonograph reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer dwells or accelerates as at the end of the record, trip means responsive to the resulting rotation of the sleeve, and means for insuring proper seating of the pin on the reaction surface during the playing of the record including a stop guide moved with the reproducer for preventing rotation of the pin when the sleeve leads the reproducer, the end of said stop guide being located between the ends of the reaction surface, so that the pin, when released from the stop guide, is seated on the reaction surface.

35. Trigger mechanism for an automatic phonograph, including trip means operated at the end of the record, tensioned resilient means for supplying trigger energy, a thin flat spring arranged in compression to oppose release of the trigger energy, means supporting the flat spring at a point slightly beyond dead center in one direction, and means responsive to the trip

means for moving the spring past dead center in the opposite direction.

36. Trigger mechanism for an automatic phonograph, including trip means responsive to dwell or acceleration of the reproducer at the end of the record, motor tensioned resilient means for storing up amplified trigger energy, a thin flat spring arranged in compression to oppose release of the trigger energy, means supporting the flat spring at a point slightly beyond dead center in one direction to prevent buckling thereof, and means responsive to the trip means for moving the spring past dead center in the opposite direction in order to permit the spring to buckle and so release the trigger energy.

37. A phonograph trip comprising a phonograph reproducer, a smooth rotatable shaft, a sleeve mounted for reciprocation thereon, a radial pin on said sleeve, a relatively small reaction surface connected to the reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer dwells or accelerates as at the end of the record, resilient means for storing up amplified trigger energy, a flat spring arranged in compression to oppose release of the trigger energy, means supporting the flat spring at a point slightly beyond dead center in one direction to prevent buckling thereof, and means responsive to rotation of the sleeve for moving the spring past dead center in the opposite direction in order to release the trigger energy.

38. A phonograph trip comprising a phonograph reproducer, a smooth rotatable shaft, a sleeve mounted for reciprocation thereon, a radial pin on said sleeve, a relatively small reaction surface connected to the phonograph reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer dwells or accelerates as at the end of the record, motor tensioned resilient means for storing up amplified trigger energy, a flat spring arranged in compression to oppose release of the trigger energy, means supporting the flat spring at a point slightly beyond dead center in one direction to prevent buckling thereof, means responsive to rotation of the sleeve for moving the spring past dead center in the opposite direction in order to release the trigger energy, and manually operable means for also moving the spring past dead center in order to release the trigger energy at any desired time.

39. An automatic record changing phonograph comprising a driving motor, means driven thereby for rotating the record to be played, record changing mechanism, rotatable means operating the same over a record changing cycle during a single revolution of said rotatable means, a clutch pin, means driven by the aforesaid driving motor for rotating said rotatable means when clutched thereto by the clutch pin, trip mechanism, a bearing surface moved by the trip mechanism for advancing the clutch pin at the end of the record, and means tending to retract the clutch pin, said bearing surface being so shaped that it permits retraction of the clutch pin at the end of the single revolution.

40. An automatic record changing phonograph comprising a driving motor, means driven thereby for rotating the record to be played, record changing mechanism including intermittently rotatable means, clutch mechanism for operatively connecting said rotatable means to the aforesaid

driving motor, trip mechanism including resilient means for storing up trigger energy, toggle mechanism for opposing said resilient means, and trip means for breaking the toggle and releasing the trigger energy at the end of the record, and a device moved by the resilient means for operating the clutch mechanism, said device and clutch mechanism being so related that the resulting rotation of the clutch mechanism causes a return movement of the device which tensions the resilient means and resets the toggle.

41. An automatic record changing phonograph comprising a driving motor, record changing mechanism, rotatable means operating the same over a record changing cycle during a single revolution of said rotatable means, a clutch pin, means driven by the motor for rotating said rotatable means when clutched thereto by the clutch pin, trip mechanism including resilient means for storing up trigger energy, toggle mechanism for opposing said resilient means, and trip means for breaking the toggle and releasing the trigger energy at the end of the record, a bearing surface moved by the resilient means for advancing the clutch pin, and means tending to retract the clutch pin, said bearing surface being so shaped that the resulting rotation of the clutch pin causes a return movement of the bearing surface which tensions the resilient means and resets the toggle and at the end of the single revolution permits retraction of the clutch pin.

42. An automatic record changing phonograph comprising a driving motor, means driven thereby for rotating the record to be played, record changing mechanism, rotatable means operating the same over a record changing cycle during a single revolution of said rotatable means, a clutch pin, means driven by the aforesaid driving motor for rotating said rotatable means when clutched thereto by the clutch pin, trip mechanism including resilient means for storing up trigger energy, a flat spring for opposing said resilient means, and trip means responsive to dwell or acceleration of the reproducer at the end of the record for bending said spring and thereby releasing the trigger energy, an annular bearing surface moved by the resilient means for advancing the clutch pin, and means tending to retract the clutch pin, said bearing surface being so shaped that the resulting rotation of the clutch pin causes a return movement of the bearing surface which tensions the resilient means and resets the flat spring and then at the end of the single revolution permits retraction of the clutch pin.

43. An automatic record changing phonograph comprising a magazine for receiving and supporting a plurality of records in face to face contact in a nearly upright position, an oscillatable arm at one side of the magazine, a hook located on said arm for engaging the end one of the records in the magazine, a record turntable arranged in a nearly upright position alongside of the magazine, a downwardly inclined loading track for guiding a record to be loaded on the turntable, and means for oscillating the arm in order to move said end record out of the magazine and onto the upper end of said loading track.

44. An automatic record changing phonograph comprising a single magazine for supporting a supply of records in a nearly upright position, a turntable and centering pin arranged to play the record in a nearly upright position alongside of the magazine, a reproducer, transfer means for separating a record from one side of the magazine and moving the same to a loading position,

means to bring the record and reproducer into or out of engagement, and means to move the played record from the turntable in the direction of the magazine in order to transfer the played record directly back to the other side of the aforesaid magazine, whereby the records in the magazine are played in continuous succession.

45. An automatic record changing phonograph comprising a magazine for storing a plurality of records in a nearly upright position, a nearly upright turntable located alongside of the magazine, a downwardly inclined loading track for guiding a record to be played to a loading position adjacent the turntable, a downwardly inclined discharge track for guiding the played record from the turntable into the aforesaid magazine, and means for separating a record from the magazine and elevating the same to the upper end of the loading track, whereby the records in the magazine are played in continuous succession.

46. An automatic record changing phonograph comprising a magazine for supporting a plurality of records in a nearly upright position, a nearly upright turntable located alongside of the magazine, means to transfer a record from the magazine to the turntable, and from the turntable back to the magazine, a reproducer, means to advance or retract the turntable relative to the reproducer in order to bring a record thereon into engagement with or disengagement from the reproducer, means to restore the reproducer to its starting position between the playing of successive records, a driving motor for rotating the record and for operating the record transfer and turntable moving and reproducer restoring means, and record repeat mechanism for permitting the repeated playing of a single record, including means to make the record transfer means inoperative while permitting at least a limited operation of the turntable moving means in order to disengage the record and reproducer while restoring the reproducer between successive playings of the record.

47. A phonograph comprising a smooth rotatable shaft, means to rotate the same, a reproducer means mounting said reproducer on the shaft for reciprocation along the shaft and for permitting additional movement of the reproducer relative to the mounting means, a sleeve mounted for reciprocation on said shaft, means limiting the permissible relative reciprocation of the sleeve and reproducer mounting means whereby the sleeve is moved positively with the mounting means during the playing of the latter portion of the record, a pin on said sleeve, a relatively small reaction surface on the reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer dwells or accelerates as at the end of the record, and trip means responsive to the resulting rotation of the sleeve.

48. A phonograph comprising a nearly upright turntable, a smooth rotatable shaft arranged near said turntable and inclined downwardly, means to rotate said shaft, a reproducer, means mounting said reproducer on the shaft for reciprocation along the shaft and for permitting oscillation of said reproducer on said mounting means toward the lower end of the shaft, said reproducer and mounting means being oscillatable about the shaft toward and from the turntable, a sleeve

mounted for reciprocation on said shaft, means limiting the permissible relative reciprocation of the sleeve and reproducer mounting means whereby the sleeve is moved positively with the mounting means during the playing of the latter portion of the record, a pin on said sleeve, a relatively small reaction surface on the reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve when the reproducer oscillates relative to the mounting means as when accelerated by the terminating groove of the record, and trip means responsive to the resulting rotation of the sleeve.

49. A phonograph comprising a reproducer, a smooth rotatable shaft, a sleeve mounted for reciprocation thereon, a pin on said sleeve, a relatively small reaction surface on the phonograph reproducer for relatively unstably preventing rotation of the pin during the playing of the record but for permitting rotation of the pin and sleeve at the end of the record, trip means actuated in response to the resulting rotation of the sleeve, reproducer restoring mechanism responsive to the trip means for restoring the reproducer to initial playing position, and means on the reproducer for returning said sleeve along the shaft during the restoration of the reproducer.

50. An automatic phonograph including a stationary record storage magazine arranged to receive and store a unitary group or stack of records in a nearly upright position, said magazine being so arranged that the records are urged by gravity toward an end record of the stack, and means to separate said end record from the stack by moving the same upwardly out of the magazine in the plane of the record, whereby the remaining records in the stack are held in the magazine solely by gravity and without the aid of mechanical retaining means.

51. An automatic record changing phonograph comprising a record storage magazine, a turntable, means to transfer the records from the magazine to the turntable and back to the magazine in continuous sequence, and means to limit the number of records in the magazine to prevent overloading the same, including a stop located at one side of the magazine and means so mounting the same as to permit free movement of the stop out of the way of a played record received from the turntable, but to prevent movement of the stop means out of the way of records manually loaded into the magazine from outside of the phonograph.

52. An automatic record changing phonograph including a turntable for carrying a record, a reproducer, means for bringing the reproducer stylus into contact with the blank margin of the record on the turntable, means strongly urging the reproducer under the influence of gravity toward the first sound groove, and means retarding the resulting movement of the reproducer to a slow speed in order to obtain a gentle start in the first sound groove regardless of variations in the magnitude of the gravity force urging the reproducer toward the sound groove, whereby the starting operation of the phonograph is substantially independent of changes in floor level.

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