March 6, 1951 F. M. JOHNSON 2,544,230

AUTOMATIC PHONOGRAPH

Filed Nov. 5, 1945 8 Sheets-Sheet 1

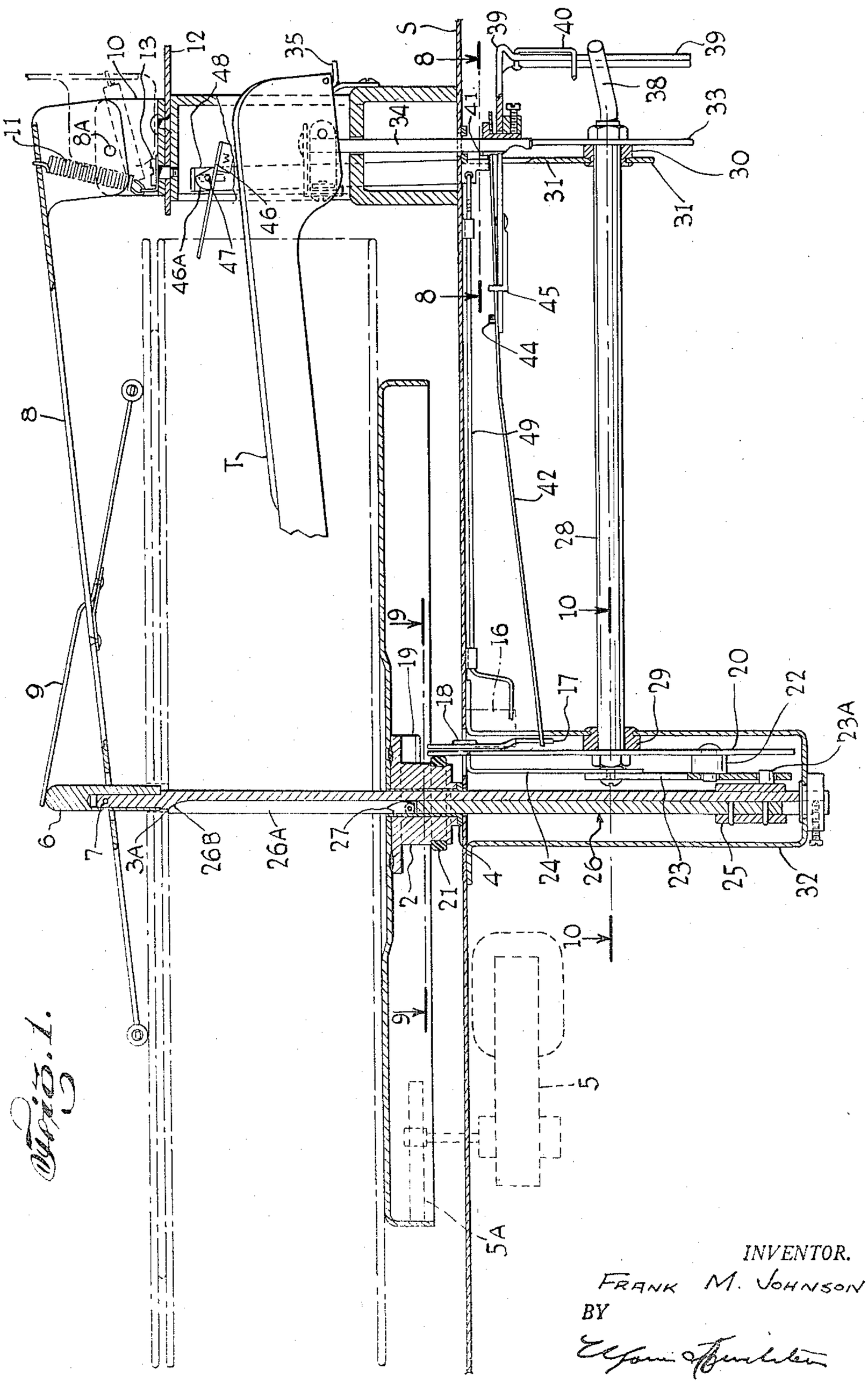

Fig. 1.

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March 6, 1951 F. M. JOHNSON 2,544,230

AUTOMATIC PHONOGRAPH

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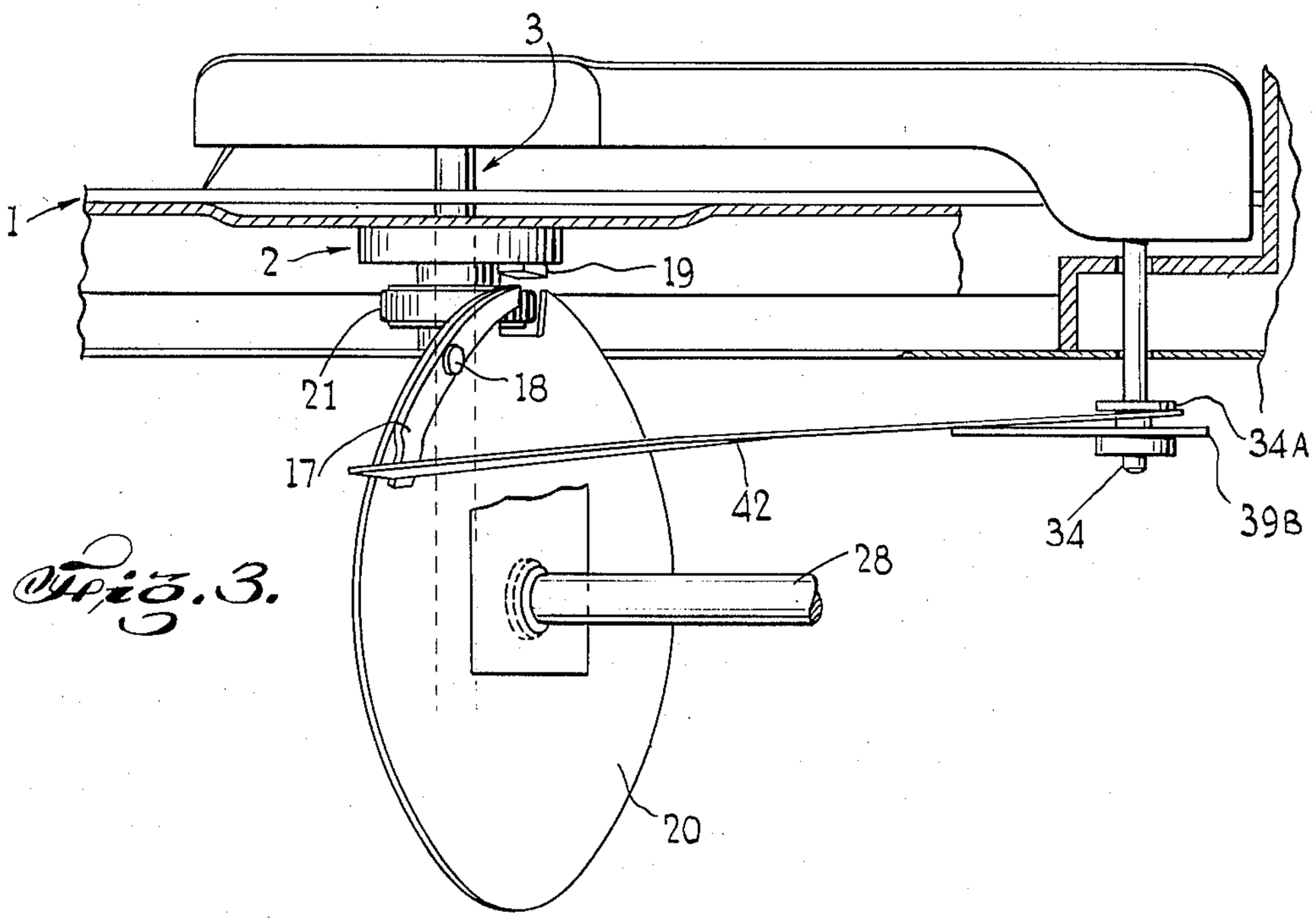


Fig. 3.

Fig. 1a.

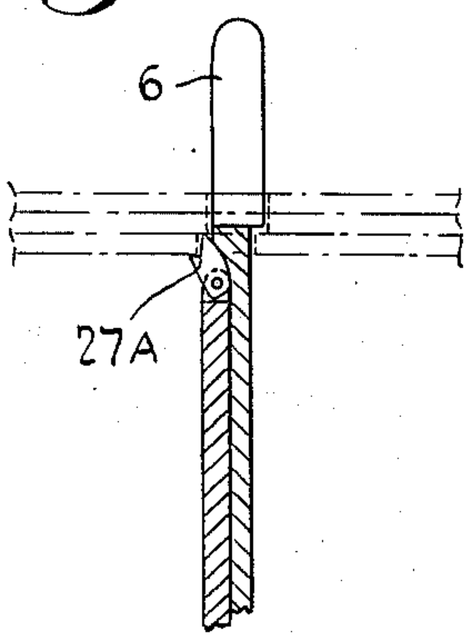
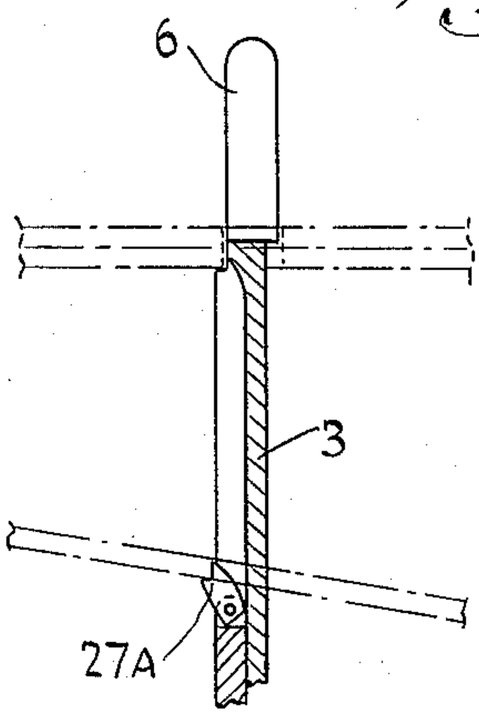


Fig. 1b.



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March 6, 1951 F. M. JOHNSON 2,544,230

AUTOMATIC PHONOGRAPH

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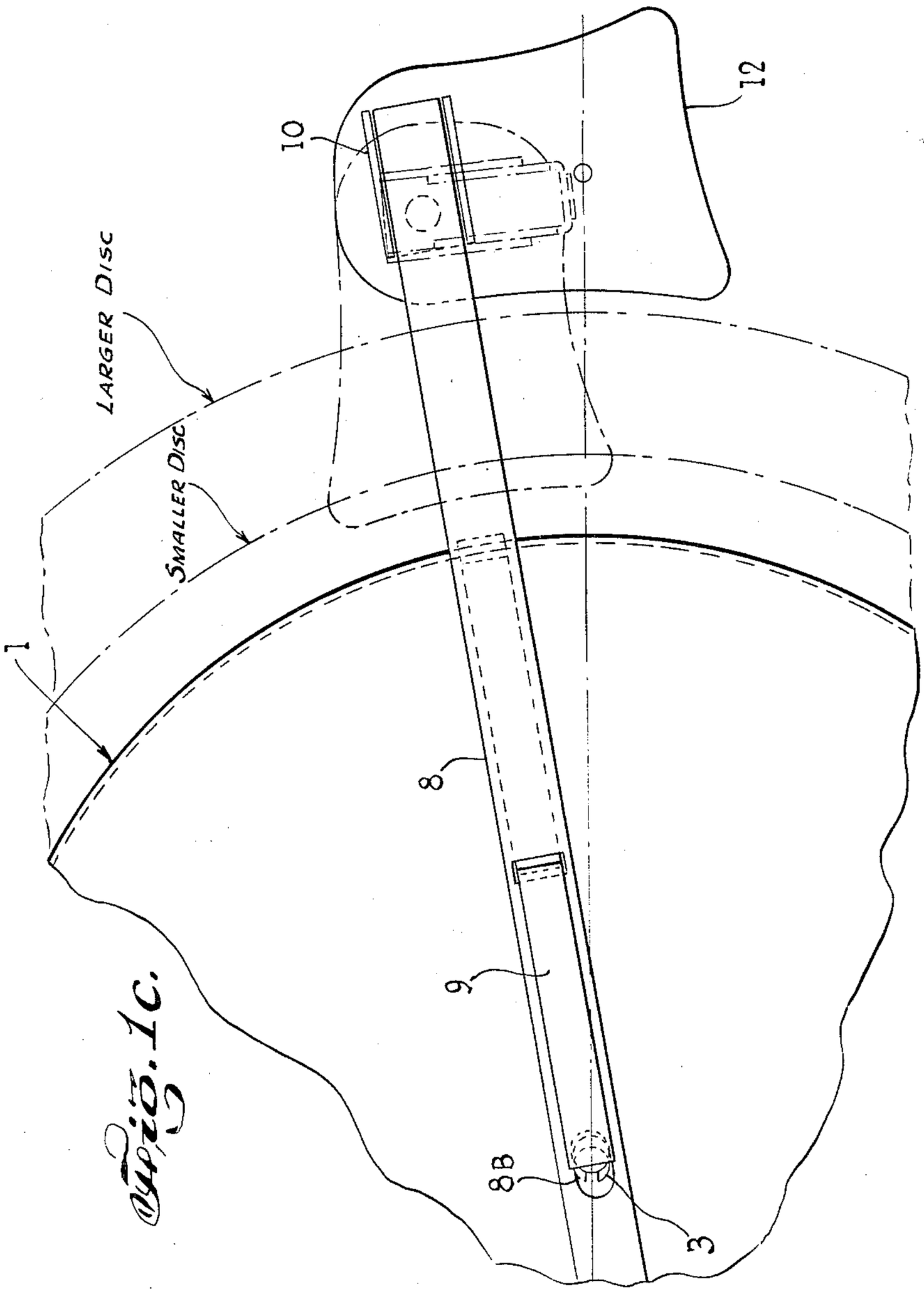

Fig. 1C.

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March 6, 1951 F. M. JOHNSON 2,544,230

AUTOMATIC PHONOGRAPH

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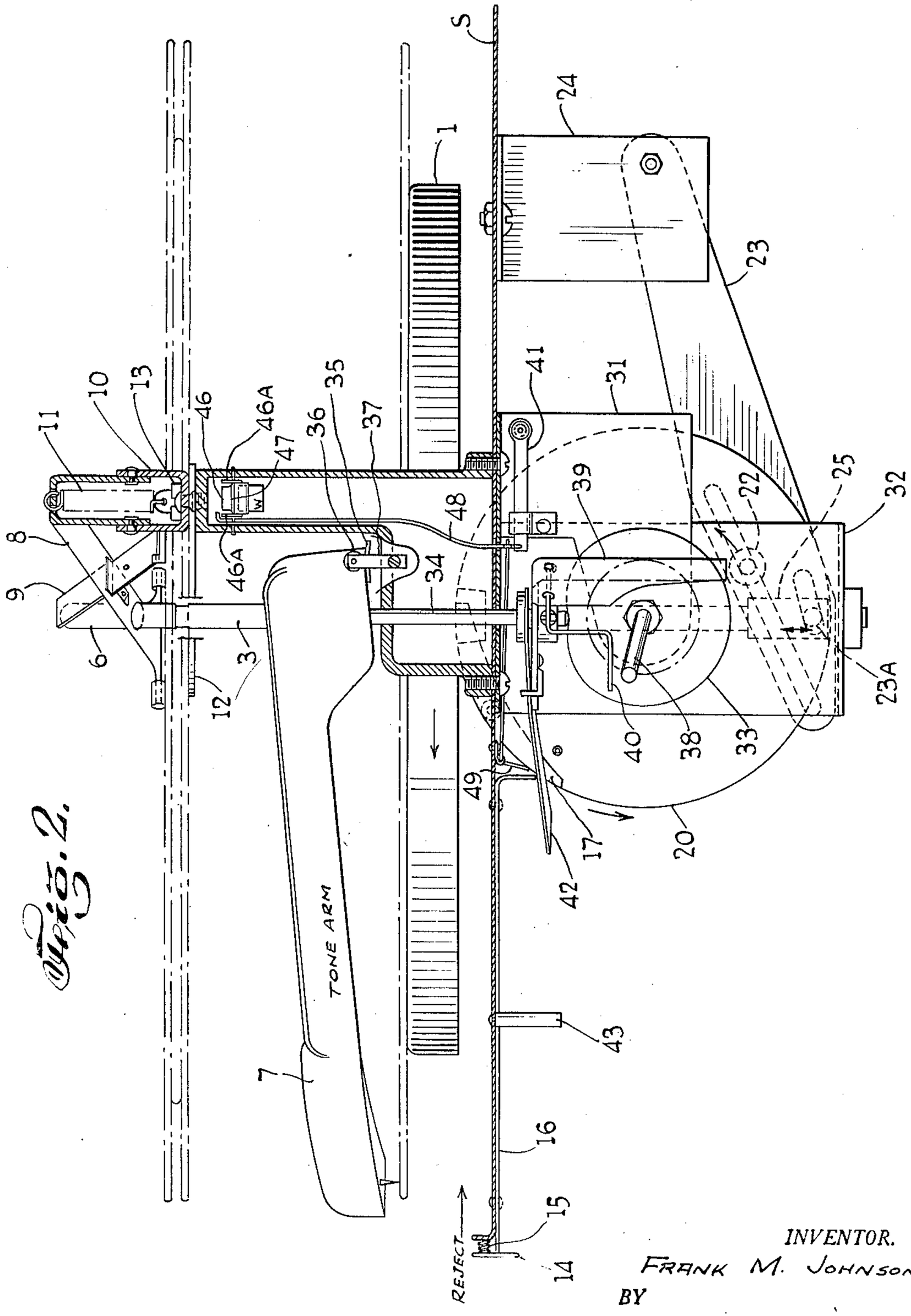

Fig. 2.

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AUTOMATIC PHONOGRAPH

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Fig. 3b.

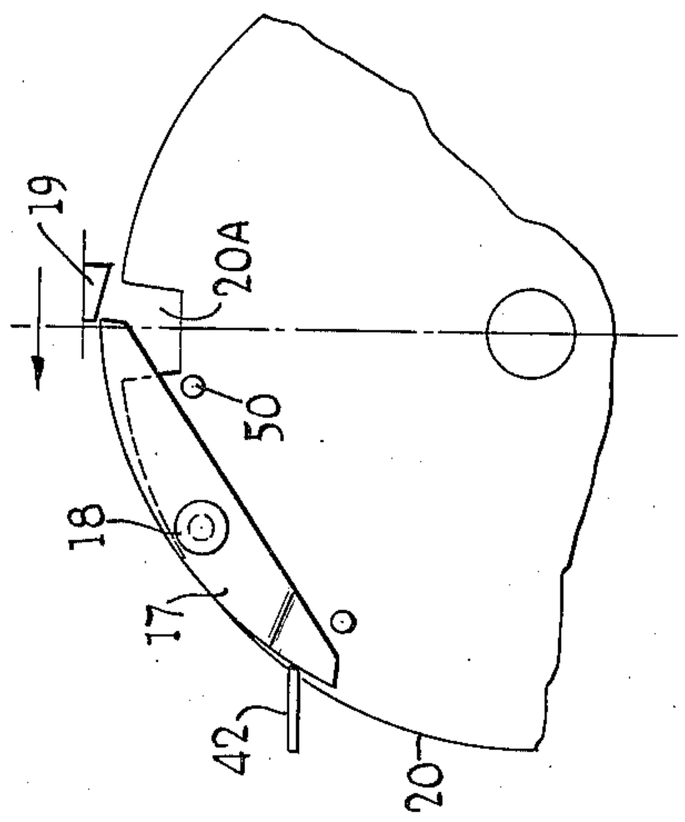


Fig. 3d.

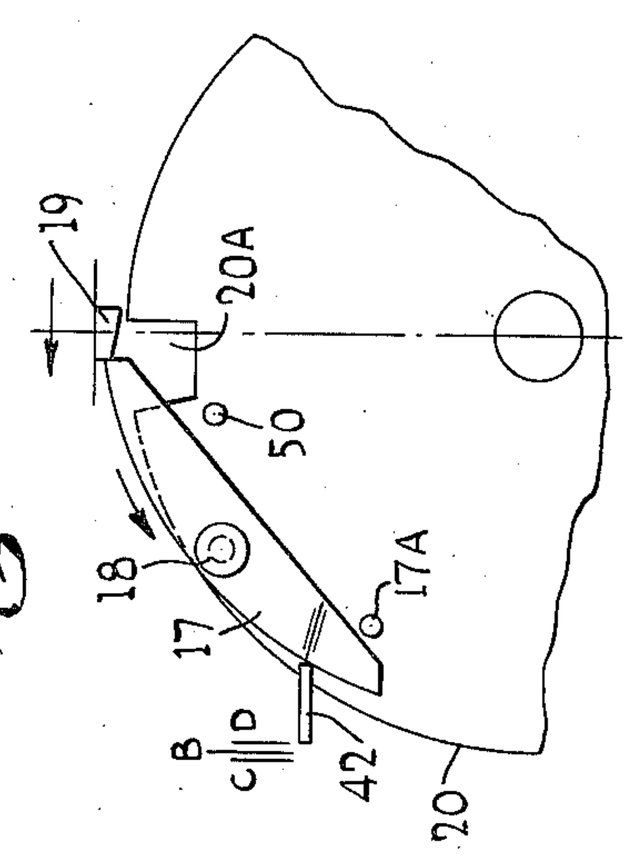


Fig. 3a.

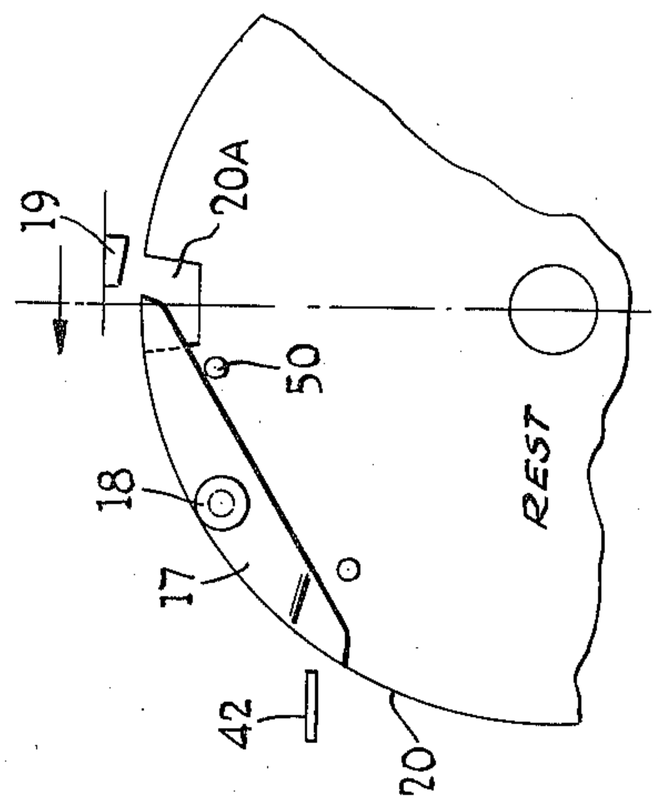
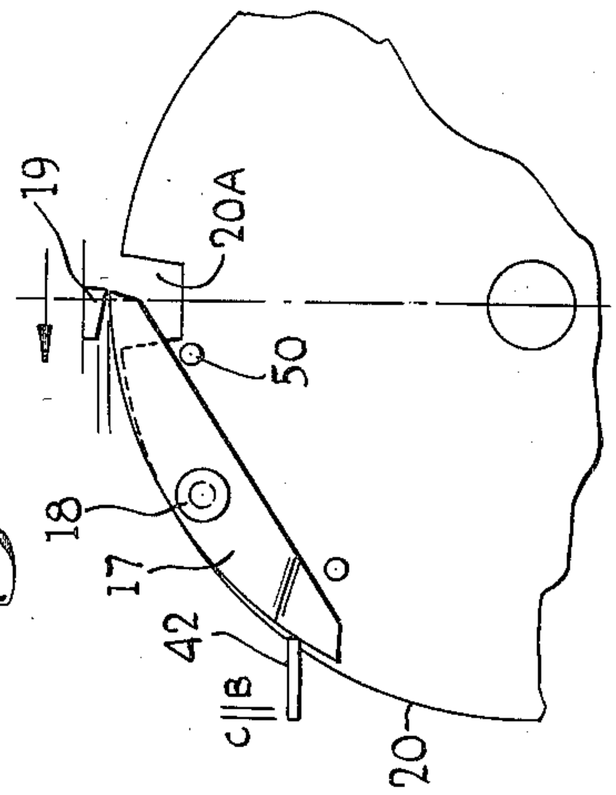


Fig. 3c.



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2,544,230

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Fig. 7.

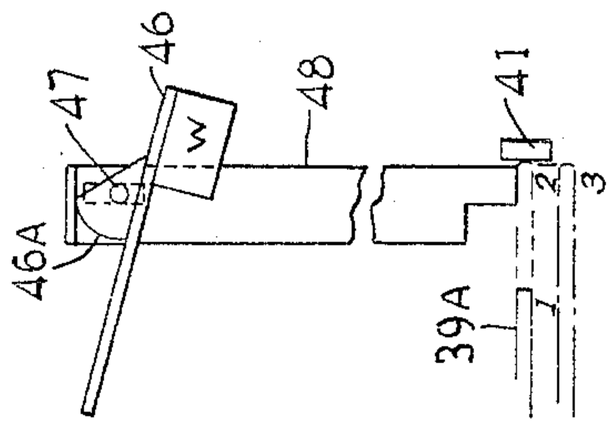


Fig. 6.

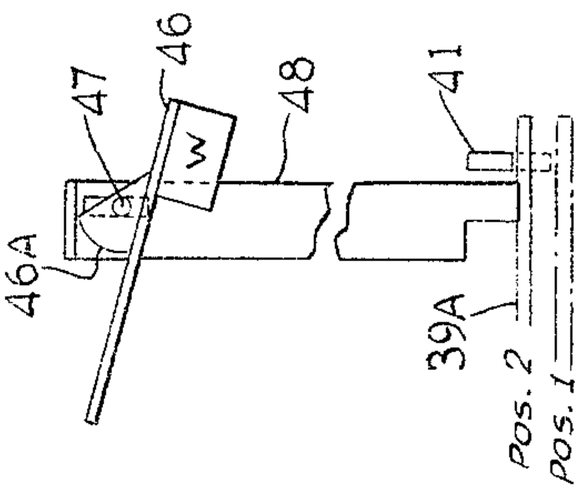


Fig. 5.

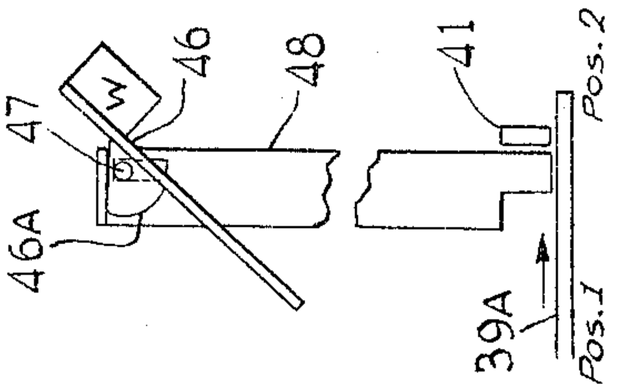
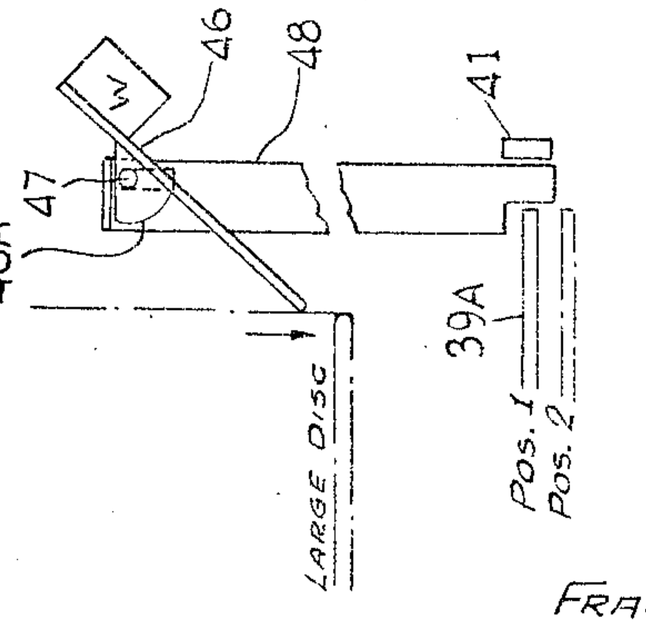


Fig. 4.



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March 6, 1951 F. M. JOHNSON 2,544,230

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Fig. 8.

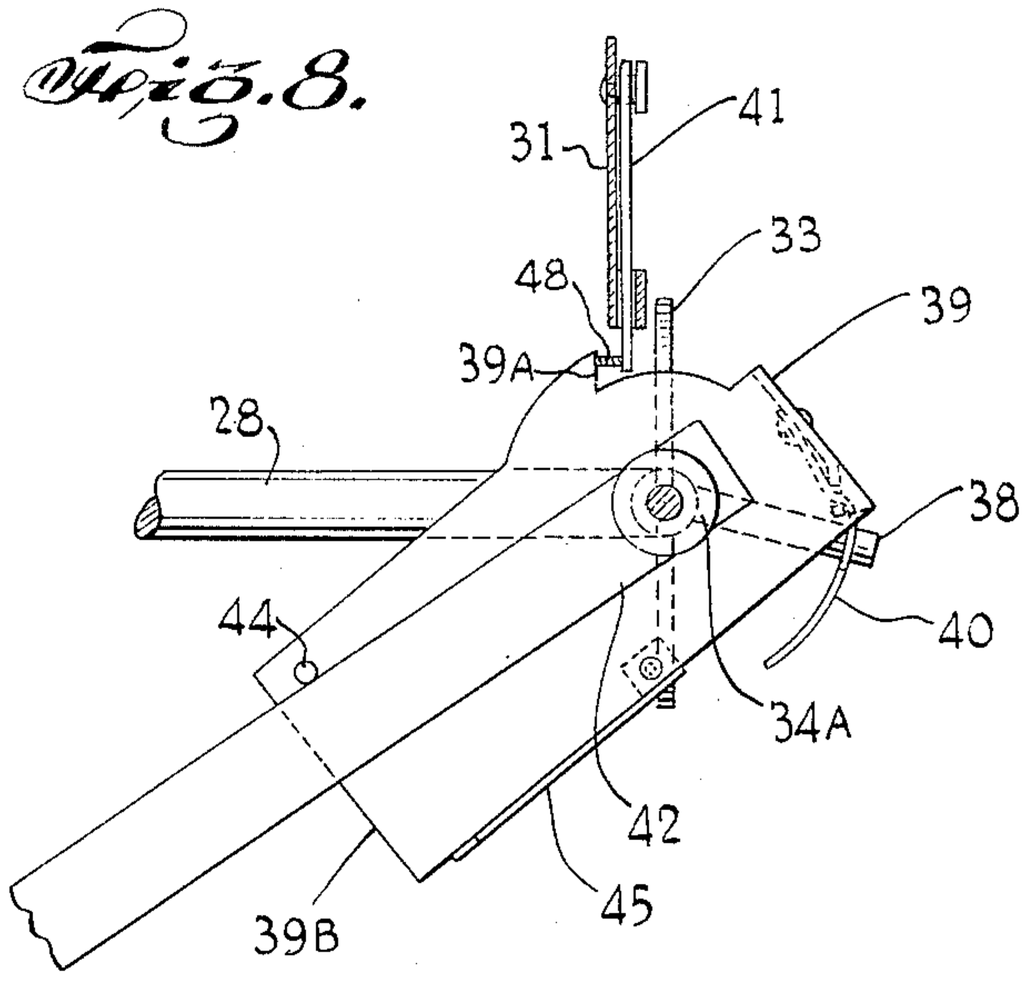
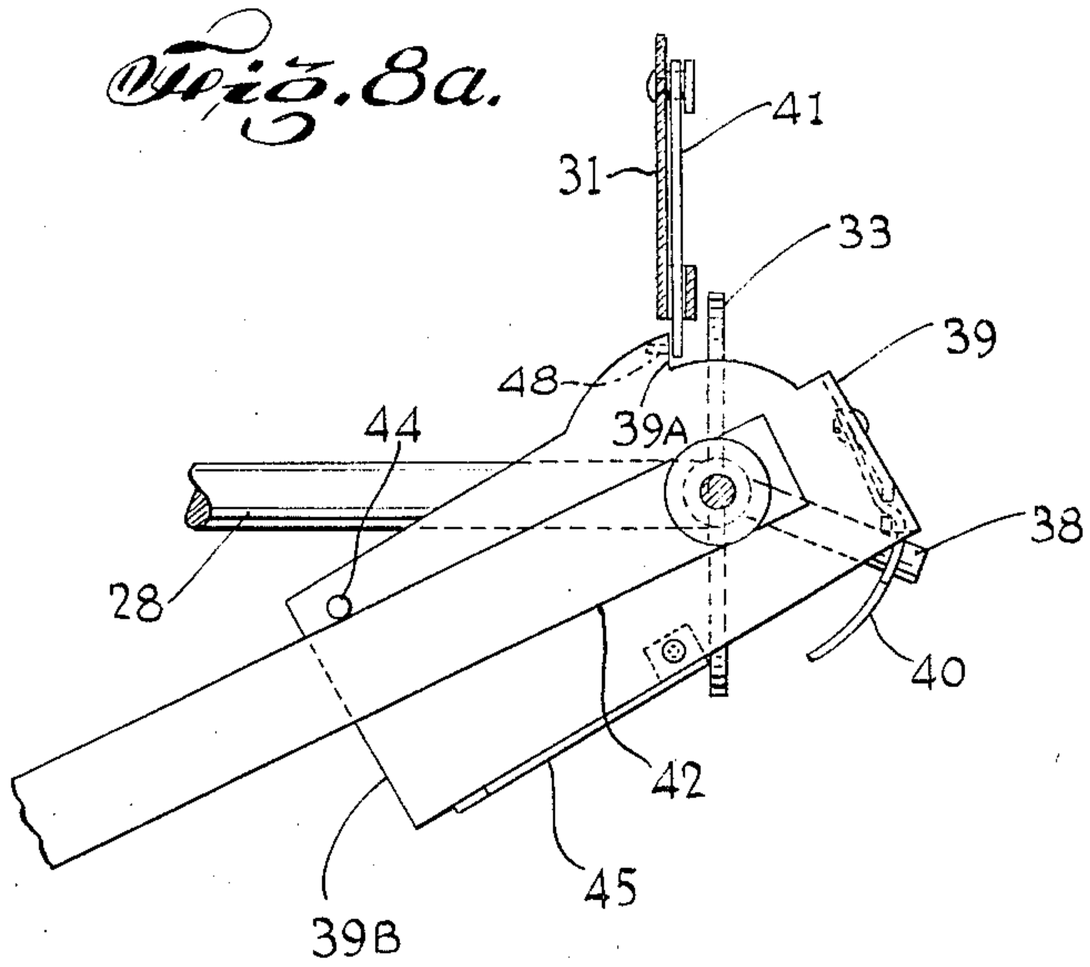


Fig. 8a.



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March 6, 1951 F. M. JOHNSON 2,544,230

AUTOMATIC PHONOGRAPH

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Fig. 10.

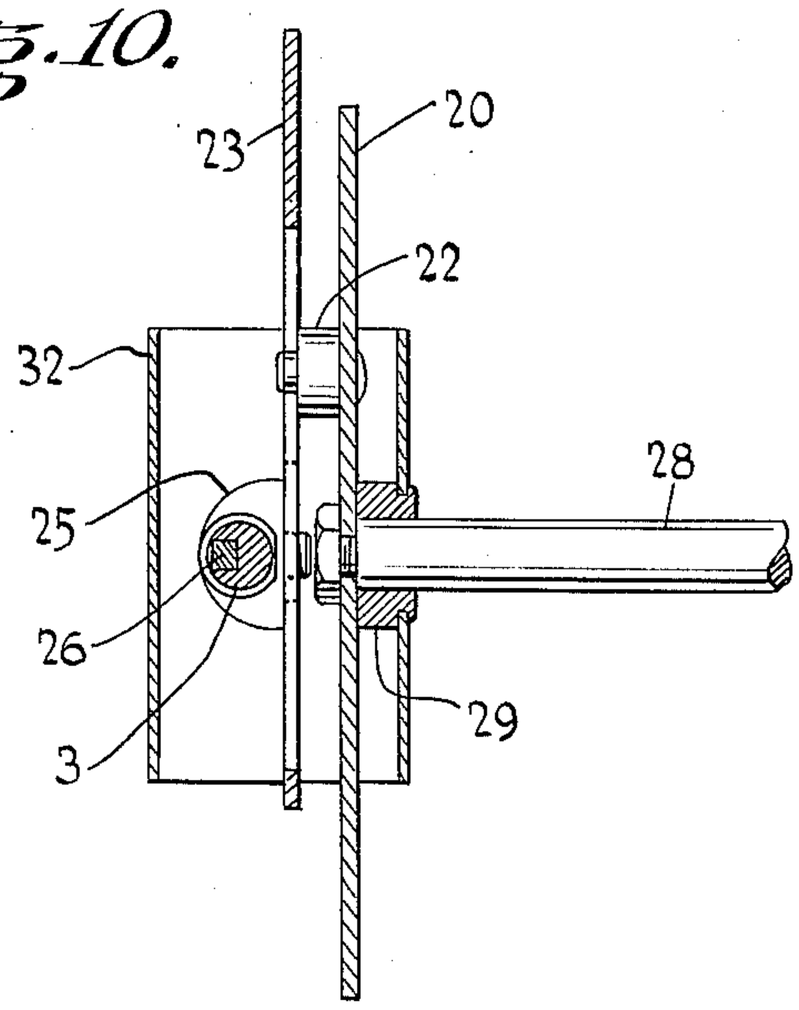
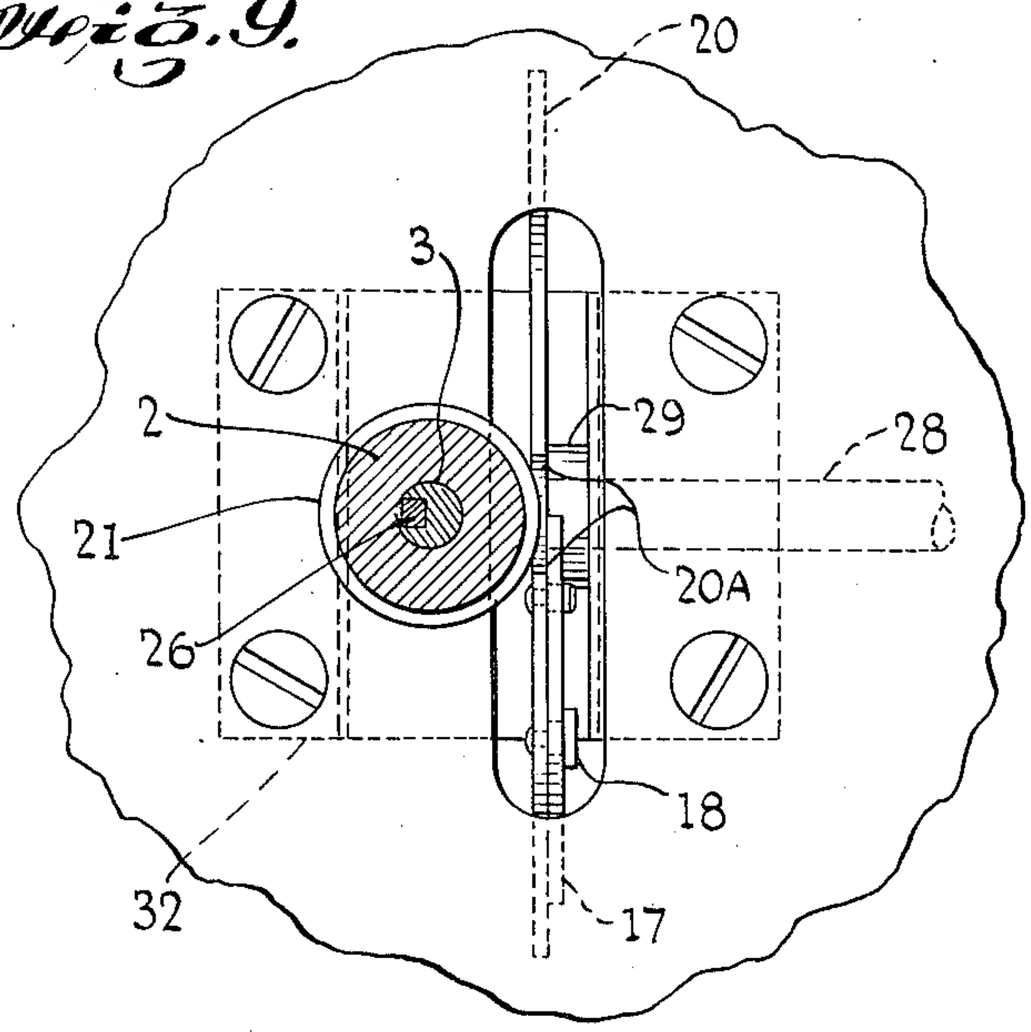


Fig. 9.



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Patented Mar. 6, 1951

2,544,230

UNITED STATES PATENT OFFICE

2,544,230

AUTOMATIC PHONOGRAPH

Frank M. Johnson, New York, N. Y., assignor to Universal Camera Corporation, New York, N. Y., a corporation of Delaware

Application November 5, 1945, Serial No. 626,732

7 Claims. (Cl. 274—10)

1

This invention relates to an automatic phonograph of the type which automatically plays a plurality of records in a predetermined sequence.

It is an object of this invention to provide an improved and simplified phonograph of the character described which will play consecutively the records in a heterogeneously mixed stack of records of different fixed diameters, and which will play the said records in such a way as to cause the least possible strain and shock to the records.

It is a further object of this invention to provide in a phonograph of the character described a mechanism which effects a quicker change from one record to the succeeding record than is attained by other mechanisms of this general type whereby to enhance the effect of continuity in the playing of records.

It is an additional object of this invention to provide in a phonograph of the character described a mechanism which will detect the end of a record positively, accurately, and with a minimum time delay.

Still another object of this invention is to eliminate the error in detecting the end of a record, which error is due to the eccentricity of the record spiral with respect to the center of rotation of the turntable.

Still a further object of this invention is to provide a phonograph of the character described, the elements of which are so constructed and arranged that the phonograph is durable and efficient in operation and comprises relatively few and simple parts which can be fabricated and assembled economically.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of application will be indicated in the appended claims.

Certain features of the invention herein shown and described, but not claimed, are shown, described and claimed in my co-pending application Serial No. 590,202, filed April 25, 1945.

In the accompanying drawings in which is shown one of the various possible embodiments of my invention,

Fig. 1 is a vertical sectional view through a phonograph embodying the invention, the same being taken substantially along a plane running through the centers of rotation of the turntable and the tone arm;

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Fig. 1*a* and 1*b* are schematic views showing various positions of the operative parts of the mechanism for transferring a record from the stack to the turntable;

Fig. 1*c* is a fragmentary top view of the phonograph showing the stack leveler in playing position;

Fig. 2 is a vertical sectional view through said phonograph taken substantially along a plane at right angles to Fig. 1 and running through the center of rotation of the tone arm;

Fig. 3 is a fragmentary auxiliary sectional view of the mechanism for determining the end of a record and starting the record changing and tone arm moving cycles;

Figs. 3*a*, 3*b*, 3*c* and 3*d* are schematic views showing various positions of the operative parts of the mechanism for determining the end of a record;

Figs. 4, 5, 6 and 7 are schematic views showing various positions of the operative parts of the discriminating mechanism for setting the tone arm in the starting grooves of records of different fixed diameters;

Figs. 8 and 8*a* are enlarged sectional views taken substantially along the line 8—8 of Fig. 1 and showing various positions of certain operative parts of the discriminating mechanism and of the mechanism for determining the end of a record;

Fig. 9 is an enlarged fragmentary top plan view taken substantially on the line 9—9 of Fig. 1 and showing the driving and timing means for the record changing and tone arm moving mechanisms; and

Fig. 10 is an enlarged sectional view taken substantially along the line 10—10 of Fig. 1 and showing the driving means for the record transferring mechanism.

Referring now to the drawings, there is illustrated a phonograph embodying the invention and comprising a turntable 1 secured to a hub 2 which is mounted for rotation about a stationary central post 3 and is seated on a thrust bearing 4. The turntable is driven by conventional means, such for example as an electric motor 5 which, through a suitable reduction train, turns a disc 5A covered with friction material, for instance rubber, which engages the inside of the downturned peripheral rim of the turntable, thus providing a frictional rim drive.

The record magazine

The central post 3 is of conventional diameter, that is, it is slightly smaller than the central hole

of a commercial record disc, so that it can be slidingly received therein. At its upper end the central post has an inset step 3A cut therein. Said upper end, further, is provided with an erect cylindrical extension 3B whose axis is offset from the axis of the post 3. The diameter of the extension is considerably less than that of the post, being sufficiently small to be rotatably received in the internal longitudinal offset bore of a cylindrical cap 6. Said cap has a diameter the same as that of the central post, so that it may be turned about the cylindrical extension 3B to a position in which the axis of the cap is coincident with the axis of the post. The eccentricity or offset of the axis of the projection 3B and that of the cap 6 is such that when the cap is turned 180° away from the position in which the axis of the cap is aligned with the axis of the post, a portion of the surface of the cap will be approximately in registration with the riser of the inset step 3A at the top of the central post. The height of said riser is slightly greater than the thickness of a commercial record at its center, but is less than the thickness of two records at their centers. Free rotation of the cap 6 is limited between these two positions by a pin 7 mounted on the reduced cylindrical extension 3B and mating with a slot in the cap.

When it is desired to load records in the magazine, the cap 6 is rotated to align a portion of its surface with the riser of the step 3A. Now records can be deposited on the cap and these records will descend no further than the tread of the step. After records have been played, the central cap 6 is rotated 180° to the position in which it is coincident with the central post. Now there is no bend, overhang, step or projection to prevent a straight lift in the removal of the played records.

The mechanism for leveling records in the stack

The stack record-leveling mechanism consists of a main arm 8 rotatably secured by a pivot 8A on a bracket 10 fixed to the phonograph support S. Said arm extends beyond the central post 3, and the free end thereof rests on the top surface of the top record in the stack. The main arm has a slot 8B in which there is freely received the central post 3 whereby said main arm is diametrically located with respect to the records in the stack. Said leveling mechanism also includes a secondary arm 9 aligned with and pivotally mounted on the main arm 8 at a point between the central post and the bracket 10. One end of the secondary arm rests upon the top of the central post cap 6, and at its pivot point the secondary arm is resiliently urged upwardly by means of a biasing leaf spring 9A. The lengths of the two arms and the positions of their pivotal mounting points are so proportioned that the bottom ends of both arms are always at substantially the same horizontal level. In this manner, the main arm 8 urges the records down on one side of the central post until the secondary arm 9 contacts the record stack to prevent further downward movement of the main arm, thus maintaining the record stack level. In the illustrated embodiment of the invention, such proportioning is attained by pivoting the secondary arm midway between the pivot point 8A and the free end of the main arm, and by having the pivoting point of the secondary arm midway between the central post 3 and the bottom end of the secondary arm.

The mounting bracket 10 has a loading blade 12 fixed to its base, and said bracket is pivoted on a screw 13 which is fixed to a pedestal secured to

the phonograph support S. The loading blade extends at an angle of about 90° to the main record leveling arm 8, so that when said arm is in position to level the records in a stack, the record loading blade 12 is clear of the largest diameter disc which the phonograph is adapted to play. Such position of said blade is shown in Fig. 1c. The loading blade is long enough to support the smallest diameter record which the phonograph is adapted to play at such time as said loading disc is in operative position.

When a set of records is to be placed into position vertically spaced above the turntable, the leveling arm is raised and rotated 90° clockwise from the position shown in Fig. 1c. This causes the loading blade 12 to project towards the central post, said blade then occupying the position indicated by the dot and dash lines in this figure. At such time when records are loaded on the cap 6 (which has been rotated to eccentric position), the lowermost record will be supported at its center on the step 3A and adjacent its periphery on the loading blade 12. After all the records to be played have been placed on the cap 6, the operator places his hand upon the top record and holds the stack of records level. Now the leveling or the main arm 8 is swung counter-clockwise a quarter of a turn to swing the loading blade 12 out of the way and place the leveling arm in proper angular position for operation. Then the leveling arm is swung downwardly about pivot 8A until the center post cap 6 is received in the slot 8B. The main and secondary arms are then allowed to fall until the two arms press down in a common horizontal plane on the top of the uppermost record in the stack. The main arm 8 is resiliently urged downwardly by means of a helical tension spring 11.

The cycling mechanism

To start the operation of the record-lowering mechanism, a reject button 14 is pressed. This button is slidably mounted on the phonograph support S and is biased outwardly by a spring 15. Pressing said button shifts a slide bar 16 whose forward end has a depending finger. In the advanced position of said lever, this finger engages the lower end of another lever 17 which is rotatably mounted by a pivot 18 on a cycle disc 20. Advance of the lever 16 turns the lever 17 about its pivot in a counter-clockwise direction, as viewed from Fig. 2, causing the upper end of the lever to project a substantial distance above the cycle disc. The position assumed by the lever 17, when moved by pressing of the reject button 14, is illustrated in Fig. 3*d*. The cycle disc 20 is secured for rotation to a cycle shaft 28 which is journaled in a pair of bearings 29, 30 mounted on brackets 31, 32 which are dependent from the support S. Said cycle disc has a peripheral notch 20A which, in normal position of the phonograph, i. e. during playing of a record, is uppermost. The axis of revolution of the cycle disc intersects the axis of revolution of the central post 3, and said notch is so disposed that in normal position of the phonograph the same is registered with the hub 2 of the turntable. Said hub has a friction element, such as a rubber tire 21, carried thereon, the tire being of a diameter sufficiently large to cause the same to project into the notch 20A of the cycle disc. Thus when the phonograph is played, said tire will rotate freely, even though a portion of the same extends within the plane of cycle disc (as is seen in Fig. 9). The hub 2 has a pin 19 (Figs. 1, 3, 3*a*, 3*b*, 3*c* and 3*d*)

on its undersurface, having a vertical side wall which, during travel of the pin with the turntable, will traverse the position occupied by the raised upper end of the lever 17 when said lever is in the position illustrated in Fig. 3*d*, this position being that which the lever is caused to assume upon operation of the reject button 14. When the vertical side wall of the pin 19 engages the raised upper end of the lever 17, there will first be a tendency to turn said lever about the pivot 18. This motion, however, cannot be obtained because the lower end of the lever rests against a stop 17A on the cycle disc. Consequently, engagement of the lever 17 by the pin 19 causes the cycle disc to rotate in a counterclockwise direction, as viewed in Figs. 3*a* and 3*d*. The upper end of the lever 17 and the vertical side wall of the pin 19 are so designed that they will remain in engagement until the cycle disc has been angularly turned at least a distance sufficient to cause the rubber tire 21 to engage the unbroken surface of the cycle disc. After such time the rubber tire will drive the cycle disc until the notch 20A is again reached. In the foregoing respect the cycle disc may be considered as a one-revolution clutch. Revolution of said cycle disc drives the various operating mechanisms, hereinafter described, in proper timed relationship. It may be mentioned at this time that the cycling mechanism comprising the cycling disc is driven from and by the turntable, and this construction in general obtains a very rapid cycle and employs an extremely small number of parts.

The record-lowering mechanism

The cycling disc has a pin 22 (Figs. 1 and 10) secured to the same for rotation therewith. This pin has a reduced portion thereof slidably received in a slot in a flat lever 23 which is pivotally mounted on a bracket 24 pendant from the support S. The lever 23 includes a second slot in which there is slidably received a second pin 23A which is fixed in a selector slide 25. As the pin 22 rotates with the cycle disc, it causes the lever 23 to oscillate about its pivotal mounting point on the bracket 24, and as this lever oscillates, it moves the selector slide 25 up and down. Said slide is constrained for vertical movement by mounting on the central post 3. The slide carries an elongated non-circular selector rod 26 which rides in a groove 26A of matching contour in the central post 3. Thus it will be seen that as the cycling disc rotates, it causes the rod 26 to vertically reciprocate. A selector dog 27 is pivoted on top of the selector rod 26 and moves up and down with said rod. Said dog is slender enough to fit entirely within the groove 26A. In addition, the right-hand side of the dog (as viewed in Fig. 1) is rounded and is adapted to engage the cammed upper end 26B of the groove 26A when said dog is in its uppermost position, for a purpose which will be explained hereinafter. Finally, the left-hand side of the dog (likewise as viewed in Fig. 1) has a step 27A formed therein. This causes the tip of the dog to be pointed. The dog operates as follows: Assume the uppermost record on the turntable has just finished playing. The cycle disc starts to turn. At this instant the selector rod 26 is in its lowermost position with the dog 27 disposed below the level of the turntable. Rotation of the cycle disc initially causes the rod and dog 27 to rise. The dog may be pivotally mounted in such manner that at this time the center of gravity of the dog is to the right of the pivotal mounting whereby the dog will naturally stay in an erect position as it is elevated. When the dog nears its uppermost position, its tip will already have been projected into the center aperture of the lowermost record in the stack. Engagement of the right-hand side of the dog with the cammed surface 26B now tips the dog over to the left, causing the riser of the step 27A to engage the inside of the hole in the record. Further upward movement of the dog presses the dog more to the left and causes the lowermost record in the stack to be shifted to the left. The dog and its step are so proportioned that the record will be shifted to the left, enough to align its central hole with the axis of the central post 3. When the record is in this position, the tip of the dog will project beyond the groove 26A, such position being illustrated in Fig. 1*a*. At this time the cycle disc is rotated approximately 180° and further rotation of the disc will cause the dog to descend. As the dog descends, the lowermost record will come down with it, said record being centrally supported on the step 27A (see Fig. 1*b*) so that said record does not experience a free fall, but rather has a controlled drop and thus prevents clatter, breakage or chipping of the record. As the dog re-enters the central hole in the hub 2, it will be straightened out and once more forced back into its idling position as shown in Fig. 1. Thus the dog is repositioned and ready to operate on the next cycle for the lowering of another record from the stack to the turntable.

The tone arm positioning mechanism

From the time that the playing of one record is finished to the time that the succeeding record is started, the tone arm must rise from the played record, be swung clear of a descending record regardless of its diameter, return to a position over the starting groove of the lowered record, and then lowered to engage the needle into the starting groove of the said record, regardless of its size. Pursuant to a feature of the invention, the automatic phonograph is capable of playing records of a plurality of predetermined but different diameters. Basically, said phonograph may be constructed to play records of any number of different fixed diameters. However, in the embodiment of the invention illustrated herein, the phonograph is shown as being adapted to play records of only two different diameters, it being understood that the phonograph may be modified in accordance with the underlying principle described herein to accommodate records of a greater number of different fixed diameters. In general, the tone arm is conditioned to be set in the starting grooves of records of different fixed diameters by means of a detector mechanism hereinafter described in detail. This detector system does not operate when records of the smaller size are played and functions only to control the position of the tone arm upon the playing of records of the large size. Accordingly, the tone arm positioning mechanism will be discussed without the detector system at the present time in order to explain its general construction and operation. Rotation of the cycle disc 20 causes rotation of the cycle shaft 28 which, as has already been mentioned, is secured at one end thereof to the cycle disc. Affixed to the opposite end of the cycle shaft is a lift cam 33 (Figs. 1 and 2) which engages a lift pin 34. This pin is mounted for free vertical movement and for free rotation about a vertical

axis. Movement of the pin is otherwise constrained. At its upper end the pin **34** is pivotally fixed to the tone arm T in such manner that said pin will rotate about its vertical axis with movement of the tone arm about the same axis, and that the pin will move vertically upward and downward with the rotation of the tone arm about a horizontal axis. At the rear of the tone arm is a shelf **35**. A roller **36** is rotatably mounted on a bracket **37** fixed to the support S. Said shelf and roller limit the rise of the rear of the tone arm. As the lift cam **33** rotates with the cycle disc, the lift pin **34** is elevated, causing the engagement of the shelf **35** with the roller **36**. Continued rise of the lift pin causes the tone arm to rotate about a horizontal axis in a clockwise direction, as viewed from Fig. 1, thus lifting the needle N clear of the played records. The amount of lift can be adjusted by varying the height of the bracket **27**. This height of the tone arm is maintained by proper shaping of the cam **33** until near the end of the cycle when the pin **34** engages the depressed surface of the cam **33** and causes lowering of the pin, and hence lowering of the needle.

Horizontal rotation of the tone arm is caused by cam **38** (Figs. 1, 2, 8 and 8*a*) which acts against a follower **39** fixed to the lift pin **34** for movement therewith. The follower **39** is so shaped that it is not contacted by cam **38** until the tone arm is fully raised. Upon contact, the cam **38** then drives the follower **39** back, causing the tone arm to rotate outwardly away from the central post **3** to a position clear of a descending record of the largest diameter. At such time the cam engages a curved portion of constant diameter in the follower **39**, so that the tone arm will remain stationary, the follower being so shaped that said tone arm will not commence to move inwardly until the record being lowered by the dog **27** has reached a position lower than the tone arm needle. The portion of the follower **39** which is engaged by the cam **38** to move the tone arm inwardly constitutes a return spring **40** (Figs. 2, 8, and 8*a*). When said cam engages the spring, the follower **39** will be rotated in a clockwise direction, as viewed in Fig. 8, moving the tone arm toward the central post **3**. In order to dispose the same in the starting groove of the record just lowered, the follower **39** rotates in such direction until a shoulder **39A** thereon abuts against a stop, hereinafter more fully described with reference to the discriminator or detector mechanism. This stop halts inward movement of the tone arm when the same is above the starting groove of the next record to be played. However, the cam **38** continues to rotate, and it is for this reason that the follower portion **40** is made resilient. The cam deflects the follower spring portion **40** until said portion disengages from the cam.

It may be mentioned that this engagement between the spring **40** and the cam **38** should be complete before lowering of the lift pin **34** moves the projection **39A** away from the stop which has halted its movement. This permits the needle to be lowered to a predetermined position in the starting groove of a record of any fixed diameter. In the idling position of the cycling mechanism, as shown in Fig. 2, the lift pin is fully depressed and the tone arm released from all control, the latter rotating freely on the lift pin which rests on the lift cam **33**. Any rotation of the tone arm about a horizontal axis during its playing position will be about the top of said pin, since in playing position, the roller **36** is clear of the shelf **35**.

The mechanism for determining the end of a record

When the cycle disc **20** has completed one revolution and the rubber tire **21** re-entered the notch **20A**, the needle will be disposed in the starting groove and the turntable will continue to rotate, causing the last lowered record to play. The needle will follow the recorded groove until the end of play whereupon it will enter the lead-off groove. A play end sensing mechanism must then cause the cycling mechanism to start its operation. The play end sensing mechanism includes a long, rigid strip **42** (Figs. 1, 2, 3, 8 and 8*a*) which is mounted at one end for pivotal rotation about the lift pin **34**. A horizontal plate **39B** movable with the follower **39** underlies the pivotally supported end of the strip **42**, and said strip extends far beyond the edge of said plate. A collar **34A** is secured to the lift pin **34** a short distance above the plate **39B**. With this construction, the weight of the strip **42** is carried by the extended edge of the plate **39B** about which said pin fulcrums, the pivotally mounted end of the strip engaging the under side of the collar **34A**, as best seen in Fig. 3. Such construction will cause a frictional engagement between the strip **42** and the system which moves with the follower **39**, said system including the collar **34A** and the plate **39B**.

Due to the foregoing frictional engagement, the strip **42** will rotate about the lift pin **34** together with the follower **39** unless the frictional engagement between said strip and the system moving with the follower **39** is overcome. In such case, of course, the strip will rotate with respect to the follower **39** in the direction of the applied force. The normal position of the strip **42** with respect to the system of the follower **39** is shown in Figs. 8 and 8*a*. In such position, said strip rests against a stop **44** carried by the plate **39B**. The strip is caused to assume such a position during an outward sweep of the tone arm by a pin **43**. Thus, the strip is reset every time that the tone arm moves outwardly subsequent to the playing of one record and prior to the playing of the following record. In this reset or normal position, the strip **42** occupies a predetermined angular position relative to the tone arm which is such that as the tone arm moves inwardly during the playing of a record, the tip of the strip **42** will contact the lower end of the lever **17** before the needle reaches the lead-off groove. The upper end of the lever **17** is heavier than the lower end thereof so that normally the lever rests against a stop **50** on the cycle disc **20**. This normal position of the lever **17** is shown in Fig. 3*a*.

In the same figure, the tip of the strip **42** is disclosed in a position preceding contact between the strip **42** and lever **17**. Eventually, however, during the play of the record, the tip of the strip **42** will engage the lower end of the lever **17** and cause the same to rotate about the pin **18** in a counter-clockwise direction, as viewed in Figs. 3*a*–3*d*. This raises the upper end of the lever **17** into the path of travel of the pin **19** which, as will be remembered, rotates with the turntable.

In addition to the vertical side surface of the pin **19** heretofore described, said pin has a sloping lower surface. The distance the tone arm moves forward during one revolution of said record in a play of the same will move the strip **42** forward

only a short distance insufficient to cause the upper end of the lever to contact the vertical side face of the pin 19. However, such movement of the tone arm will cause the upper end of the lever to be raised a distance such that the tip of said upper end will be engaged by the sloping under surface of the pin. Such engagement between the pin and lever 17 will rotate the lever 17 in a clockwise direction, thus resetting the lever 17 to the position shown in Fig. 3c. Such clockwise rotation of said lever will be transmitted to the strip 42, causing the same to rotate relative to the flat plate 39B in a direction away from the stop 44. The position of the strip 42 before it is pushed back is indicated in Fig. 3b, and the position of said strip after it has been pushed back is shown in Fig. 3c. In Fig. 3c, the notation C also indicates the position of the strip 42 after being pushed back, while the notation B indicates the corresponding position of said strip before it has been pushed back. It will be observed that the backward motion of the strip 42 is against the frictional engagement between said strip and the plate 39B. If this friction force is too high, the resetting motion of the lever 42B will be transmitted to the tone arm and will ungroove the needle, causing it to repeat grooves. Accordingly, said frictional engagement between the strip 42 and the plate 39B should be made less than the force required to ungroove the needle but large enough to cause rotation of the lever 17 into the path of the pin 19.

Such design may be accomplished by selecting the proper weight of strip 42. Also, this design can be brought about by making the lever 17 relatively light and the pivot 18 with at little friction as possible. It will now be appreciated that as the pin 19 makes one rotation, so does the record, and hence, the needle will advance one groove pitch distance at each revolution, causing the lever 17 to rotate and raise the upper end thereof a distance proportionate to the advance of the playing needle. The height of the sloping portion of the pin 19 is made greater than this rise of the upper portion of the lever 17, thereby enabling said sloping portion to reset the lever 17 once each revolution as long as the needle is in the spiral playing groove; that is, immediately before the pin 19 reaches the lever 17, the relative position of the parts will be that shown in Fig. 3b, and as the pin 19 leaves the lever 17, the relative position of the parts will be that shown in Fig. 3c. However, eventually, the needle will reach the lead-off groove. As is well known, the advance per revolution, or pitch, of a lead-off groove is many times that of a recording groove. Therefore, as the needle traverses the lead-off groove, it raises the upper end of the lever 17 a distance greater proportionately than said pin is raised during the ordinary advance of the tone arm a single pitch distance at such time as the record is playing. The distance the upper end of the lever is raised is greater than the height of the inclined portion of the pin 19. This causes said upper end to contact the vertical side surface of the pin 19, as shown in Fig. 3d. Then, instead of the pin resetting the lever 17 by pushing the upper end thereof down, the pin will force the lever 17 against the stop 17A and start the cycle disc rotating.

As already explained, the pin will maintain contact with the upper end of the lever 17, until the disc is turned far enough for the rubber tire 21 to engage the side surface of the disc. Then, the rubber tire continues to turn the disc for one

revolution until said tire once again re-enters the notch portion 20A. Rotation of the disc during one revolution completes a record change cycle, depositing a new record on the turntable, moving the tone arm out of the way of the descending record and engaging the needle in the starting groove of the new record. By way of example, the height of the sloped portion of the pin 19 may be twice the distance that the upper end of the lever 17 rises when the tone arm moves the pitch distance of a playing groove. However, it will be understood that if said height is simply greater than the distance moved by the upper end of the lever 17 for advance of the needle one pitch distance, the invention will be carried out.

It will now also be apparent that pursuant to this feature of the invention, the mechanism for sensing the end of a record play measures the advance of the tone arm once for each revolution of the turntable, and immediately upon measuring if the end of the record has not been reached, resets. It should also be noted that the stop pin 44 and resetting pin 43 conjointly act to limit the outward movement of the tone arm at such time as the same is moved away from the central post 3 because of engagement of the cam 38 and follower 39. This is necessary because no means is provided to hold said follower against the cam as the tone arm moves outward. It is thus possible that the tone arm may be moving so rapidly that it would leave the cam and swing beyond its desired rest position. However, this is prevented by abutment of the strip 42 against the resetting pin 43 and abutment of the said strip against the stop 44.

It will be appreciated that the foregoing means for sensing the end of record play functions only when the tone arm during one revolution moves further than the normal pitch distance. However, some records have a very small lead-off groove and it is desirable, therefore, to provide in addition to the above described pitch responsive record play end sensing mechanism to include a means for sensing the end of a record play, which latter means is responsive to the position of the tone arm and which will act in the event that the tone arm moves very close to the central post 3 without ever advancing more than the normal pitch distance during any given revolution. Such position sensing means includes a spring 45 (Figs. 1, 8 and 8a) which is secured to an edge of the flat plate 39B remote from the stop pin 44. Said spring has an upstanding finger which lies in the path of travel of the strip 42 as the same turns about the lift pin 34.

It will be understood that during ordinary operation of the strip 42 as the mechanism for measuring the advance of the tone arm once during each revolution of the turntable, said strip is caused to rotate in short angular steps in a counter-clockwise direction, as viewed in Fig. 8, about the lift pin 34 until such time as a marked advance of the tone arm will cause the lever 17 to be moved sufficiently to engage the pin 19. However, when the strip 42 is moved far enough to encounter the spring 45, said strip, instead of being pushed back by the resetting action of the pin 19 on the lever 17, will resume its position as soon as the pin 19 passes the upper end of said lever, the spring 45 serving to bias the strip 42 back. This causes successive advances of the tone arm during consecutive revolutions of the turntable to be added, and therefore, in two or a few

revolutions, the lever 17 will be tilted sufficiently for its upper end to engage the pin 19. In this manner, records without lead-off grooves, or of very small central diameter, are tripped off at the end of a playing cycle.

It is also desired to point out that the determination of the advance of the tone arm during one revolution of the turntable is measured over a small fraction of a revolution. This is highly desirable since it nullifies the effect of an eccentric mounting of the record. Such eccentric mounting at the present time has caused considerable difficulty in most trip mechanisms, as, for example, in velocity trip mechanisms, position trip mechanisms, and those trip mechanisms which measure motion of the tone arm during a revolution. However, the present pitch measuring trip mechanism determines the advance of the tone arm and resets itself almost instantaneously at one definite position for each revolution of the turntable, and, therefore, is not sensitive to the wobble of the tone arm due to the eccentricity of the record spiral center with respect to the turntable center, which wobble occurs in phase with the rotation of the turntable.

The discriminating mechanism

The discriminating or detecting mechanism is that which ascertains the size of a record and automatically in response thereto, positions the tone arm in the starting groove in a record of the measured size. Attention is recalled to the manner in which the tone arm is moved back toward the central post 3. This motion is caused by engagement of the cam 38 with the spring portion 40 of the follower 39. Such motion causes the tone arm to rotate in a clockwise direction, as viewed in Fig. 8, and causes the plate 39B to rotate with the tone arm inasmuch as the same is fixed to the lift pin 34. However, this plate carries the projection 39A. When a record of minimum diameter, for example, a 10-inch record, is lowered from the stack to the turntable, said record does not engage any element of the discriminating mechanism. During the inward movement of the tone arm at the time such a record is to be played, the clockwise motion of the flat plate 39B is checked by abutment of the projection 39A against a dog 41, pivoted to the bracket 31, as clearly shown in Fig. 2. The relative position of the projection and dog at such time is illustrated in Figs. 8*a* and by position 2 in Fig. 7. When a record of larger diameter is lowered to the turntable, an element of the discriminating mechanism is engaged and moved by the record. This causes another dog to be disposed in the path of travel of the projection 39A during inward movement of the tone arm. Said dog is disposed in advance of the dog 41. Thus, inward movement of the tone arm will be halted at an earlier stage, and in such manner, a larger record, for example, a 12-inch record will cause the tone arm to be initially positioned further away from the central post 3.

More specifically, said discriminating mechanism includes a lever 46 (Figs. 1, 4, 5, 6 and 7) which is pivoted on a pin 47 (Fig. 2) rotatably mounted in fixed bearings in a bracket secured to the support S. The lever 46 is unbalanced by a weight W fixed to an end thereof remote from the end facing the stack of records. This weight is of such magnitude and so located as to cause the lever to normally seek an approximately horizontal position. When in such attitude, the forward end of the lever, i. e., that remote from the weight, will project into the path of a lowering record of larger diameter, e. g., 12-inch, but not into the path of a lowering record of smaller diameter, e. g., 10-inch. Said lever has a cam element 46A provided on its upper surface. This cam element lies beneath the inturned upper end of a follower rod 48 so that said rod is supported on the cam element. At the beginning of each cycle, the lever 46 and its follower 48 are disposed in the normal position, illustrated in Fig. 7. If a large disc descends, it will strike the forward end of the lever 46, rotating the same to the position illustrated in Fig. 4. In this position, the cam element 46A presents a flat upper surface close to the pivot pin 47, whereas, as will be seen from inspection of Fig. 7, in the normal position of the lever 46, the follower is supported by a part of the cam element relatively remote from the pivot pin 47. Thus, when the lever is rotated by the passage of a large disc, the follower 48 is lowered. Due to the fact that the upper surface of the cam element in said position is flat, the follower will hold the lever 46 in this new position.

The lower end of the follower 48 is positioned adjacent the dog 41 on the side of the dog nearest the projection 39A, as will be seen in Figs. 8 and 8*a*. When the follower 48 is lowered upon passage of a large disc, the lower end thereof will be interposed in the path of travel of the projection 39A and thereby cause the tone arm to stop its inward movement at the lead-in groove of the large record.

The operation of the discriminating mechanism is as follows: Assuming said mechanism to be in normal position, as illustrated in Fig. 7, when a large disc drops, it will move the lever 46 and follower 48 to the position illustrated in Fig. 4. At such time, the plate 39B is in elevated position on the plane illustrated by position 1 in said figure. Said projection is also angularly spaced from the dog 41 and lower end of the follower 48. The follower 39 is then moved in a direction to shift the tone arm inwardly by engagement therewith of the cam 38. The projection 39A on the plate 39B will strike the lower end of the follower 48. Now, the tone arm will be vertically lowered and, at the same time, the follower 39 depressed. This causes the same to be moved to position 2 in said figure so that the tone arm is free to swing inwardly while following the playing spiral of a record.

At the end of the play, the follower 39 will reach position 2 in Fig. 5 at which time it is beneath the lower end of the follower 48 and beneath the pivoted dog 41. Now, the cycle disc has been placed in operation and, as will be remembered, the initial step is to raise the follower 39 so as to elevate the tone arm. Raising the follower 39 elevates the dog 41 and follower 48 but when the follower 48 is raised, the weight W will restore the lever 46 to its horizontal position. The movement of the follower 39 from depressed to raised position is illustrated by positions 1 and 2 of Fig. 6, the disposition of the parts in position 2 being illustrated in full lines in said figure. This resets the discriminating mechanism. Now, if a record of smaller diameter is lowered, the raised follower 39 will encounter not the follower 48 but the dog 41 during its movement from position 1 to position 2, as illustrated in Fig. 7.

Next, the follower 39 lowers, as shown in posi-

tion 3 of said figure, whereupon the tone arm is free to swing inwardly. In the event that the reject button 14 is pressed while the tone arm is in raised position, in which case the flat plate 39B is not beneath the follower 48, said follower would not be reset. To provide for such contingency, a lever 49 is included. This lever is pivotally mounted beneath the support S and is caused to rotate when the reject button is pressed. Said lever is connected to the follower 48 and rotation thereof upon pressing the reject button will lift 48, allowing 46 to be reset.

It will thus be seen that there is provided an automatic phonograph in which the several objects of this invention are achieved, and which are well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention I claim as new and desire to secure by Letters Patent:

1. In combination, in an automatic phonograph including a turntable and a stationary central post about which said turntable is adapted to rotate: means to support a stack of records on the central post offset from the axis of rotation of the turntable, said means including an element for supporting the lowermost record of the stack adjacent its central opening, means to level the records in said stack, said levelling means including at least two elements diametrically disposed on opposite sides of the central post and adapted to press down against the top surface of the uppermost record in the stack, said elements being mounted for vertical movement, and means to maintain said elements in a common plane as they move vertically, means to rotatably mount said stack record levelling means about an axis parallel to the central post at a point remote from the central post whereby said levelling means may be swung clear of the stack of records when records are loaded on or removed from the central post, and means rotatable about said axis with said record stack levelling means and moved into operative position when said levelling means is rotated out of operative position to support the under surface of the lowermost record of the stack adjacent the periphery thereof.

2. In combination, in an automatic phonograph including a turntable and a stationary central post about which said turntable is adapted to rotate: means to support a stack of records on the central post offset from the axis of rotation of the turntable, said means including an element for supporting the lowermost record of a stack adjacent its central opening, means to level the records in said stack, said leveling means including at least two elements mounted for vertical movement and coordinated for joint movement in a common plane as they move vertically, means to mount said stack-record-leveling means for rotation about an axis parallel to the post to one side of the stack whereby said leveling means may be swung clear of the stack of records when records are loaded on or removed from the central post, and means rotatable with said record-stack-leveling means and moved into operative position, when said leveling means is rotated out of operative position, to support the under surface of the lowermost record of the stack adjacent the periphery thereof.

3. In combination, in an automatic phonograph including a turntable, a tone arm, a notched cycle disc and a rotary frictional member turned by said turntable and normally freely turning in the notch of said disc: a record end play sensing means comprising an element frictionally coupled to said tone arm so as to move therewith and to be capable of movement relative thereto, a second element pivoted on said cycle disc to turn about a horizontal axis, said second element including an end having a substantially horizontal side and a substantially vertical side, the other end of said disk being positioned for engagement by said first element in such manner that advance of said tone arm will cause the first-mentioned end of said second element to move toward said turntable, a member carried by said turntable and having a sloping under surface at an acute angle to the plane of rotation of the turntable and a vertical side above said under surface, said member being disposed so that during rotation of the turntable said member will intersect the position of the mentioned end of the second element, said sloping surface being high enough to engage the horizontal side of the first-mentioned end of the second element to push down said end when the same is raised at two successive revolutions of the turntable a distance not substantially greater than that corresponding to an advance of the tone arm a pitch of the playing spiral of a record, the vertical side of said member engaging the vertical side of the first-mentioned end of the second element when said end is raised up a distance corresponding to an advance of the tone arm substantially more than the pitch of the playing spiral of a record, means to limit rotation of said second element relative to the disc when said second element is engaged by said member so that said member will initiate rotation of the cycle disc when the same engages the second element and move said disc substantially to permit frictional engagement between the circular frictional member and the cycle disc whereby said cycle disc, when the second element is engaged by the member carried by the turntable, will turn through one revolution until the circular frictional member again reaches the notch in the cycle disc.

4. In combination, in an automatic phonograph including a turntable, a tone arm, means to support a stack of records of different fixed diameters and means to successively transfer records from said stack to said turntable: means to swing the tone arm out away from the center of a played record and to then swing said arm back above the starting groove of the next record, said means including an element movable therewith, said element having a projection, means to shift said element in a direction transverse to that in which it moves upon motion of the tone arm toward and away from the center of a record, a stop disposed in the path of travel of said projection in one extreme position thereof as the tone arm moves toward the center of the record whereby to render said tone arm moving means ineffective to advance the tone arm further toward the center of a record, a second stop between said first stop and said projection when the tone arm is swung out, and means disposed in the path of travel of a large record moving from the stack to the turntable, said means being operable upon engagement by a large record to move the second

stop in a direction parallel to the direction in which said element shifts into the path of travel of the projection whereby, when a large record is to be played, the tone arm moving means will be rendered ineffective earlier in its advance toward the center of the record, said element shifting after play of a record to its other extreme position in which as the tone arm is moved away from the center of a record, the projection will clear both stops.

5. In combination, in an automatic phonograph including a turntable, a tone arm, means to support a stack of records of different fixed diameters and means to successively transfer records from said stack to said turntable: means to swing the tone arm out away from the center of a played record and to then swing said arm back above the starting groove of the next record, said means including an element movable therewith, said element having a projection, means to shift said element in a direction transverse to that in which it moves upon motion of the tone arm toward and away from the center of a record, a stop disposed in the path of travel of said projection in one extreme position thereof as the tone arm moves toward the center of the record whereby to render said tone arm moving means ineffective to advance the tone arm further toward the center of a record, a second stop between said first stop and said projection when the tone arm is swung out, and means disposed in the path of travel of a large record moving from the stack to the turntable, said means being operable upon engagement by a large record to move the second stop in a direction parallel to the direction in which said element shifts into the path of travel of the projection whereby, when a large record is to be played, the tone arm moving means will be rendered ineffective earlier in its advance toward the center of the record, said element shifting after play of a record to its other extreme position in which as the tone arm is moved away from the center of a record, the projection will clear both stops, said tone arm moving means including a lost motion mechanism whereby said means can be rendered ineffective even when continuously actuated.

6. In combination, in an automatic phonograph including a turntable and a stationary central post about which said turntable is adapted to rotate: means to support a stack of records on the central post offset from the axis of rotation of the turntable, said means including an element for supporting the lowermost record of the stack adjacent its central opening, means to press down on the uppermost record in said stack at a plurality of points in a common plane so as to level the stack, means to mount said levelling means for movement about an axis parallel to the post between two positions, in one of which said levelling means is disposed for effective operation and the other of which said levelling means is clear of the stack, and means about said axis to support the under surface of the lowermost record of the stack at a point remote from the center thereof, said last named means being rendered effective when said levelling means is clear of the stack.

7. In combination in an automatic phonograph including a turntable, a tone arm, a

notched driven cycle disc and a rotary driving member turned by said turntable, adapted to drive said disc and normally freely turning in the notch of said disc: a record end play sensing means comprising an element frictionally coupled to said tone arm so as to move therewith and to be capable of movement relative thereto, a second element pivoted on said cycle disc and engageable by said first element in such manner that advance of said tone arm will rotate the second element and cause one end of said second element to move toward said turntable, a member carried by said turntable, said member having two surfaces, one said surface being disposed to brush across the mentioned end of the second element during rotation of the turntable and push said end down when the same is raised at two successive revolutions of the turntable a distance not substantially greater than that corresponding to an advance of the tone arm a pitch of the playing spiral of a record, said second element being rotated at such time in a direction opposite to that in which it is rotated by the first element, the other said surface of said member being disposed to engage the mentioned end of the second element when said end is raised up a distance corresponding to an advance of the tone arm substantially more than the pitch of the playing spiral of a record at two successive revolutions of the turntable, said second surface causing the second element to rotate in the same direction as that in which it is rotated by the first element, and means to limit rotation of said second element relative to the disc in the direction in which it is rotated by the first element, so that when said second element is engaged by the second surface of said member, said member and second element will initiate rotation of the cycle disc and move the disc substantially to permit engagement between the rotary driving member and the disc.

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