

Feb. 17, 1953

A. E. COMSTOCK
AUTOMATIC PHONOGRAPH

2,628,843

Filed Oct. 9, 1946

5 Sheets-Sheet 1

FIG. 1

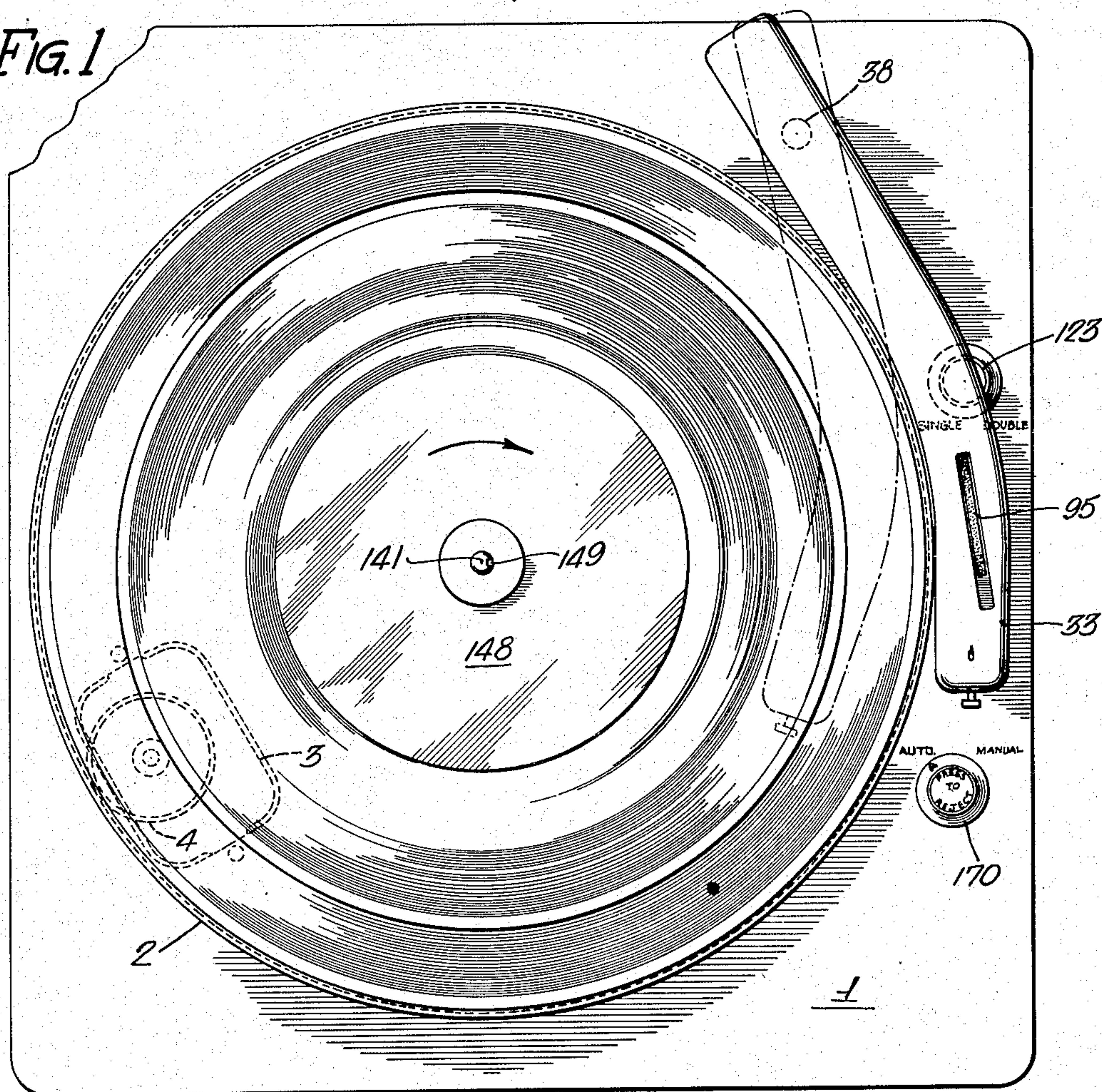
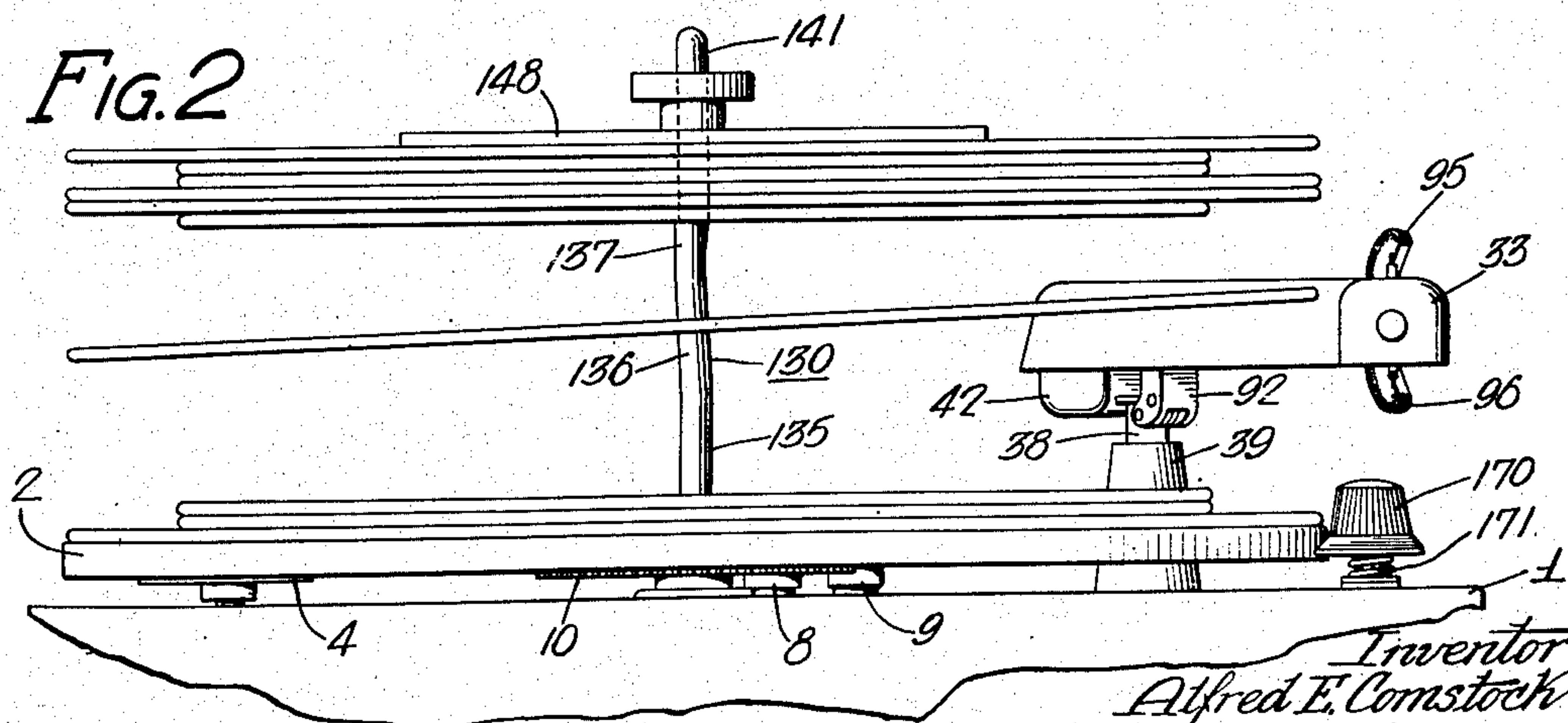


FIG. 2



Inventor:
Alfred E. Comstock
by his Attorneys
Howson & Howson

Feb. 17, 1953

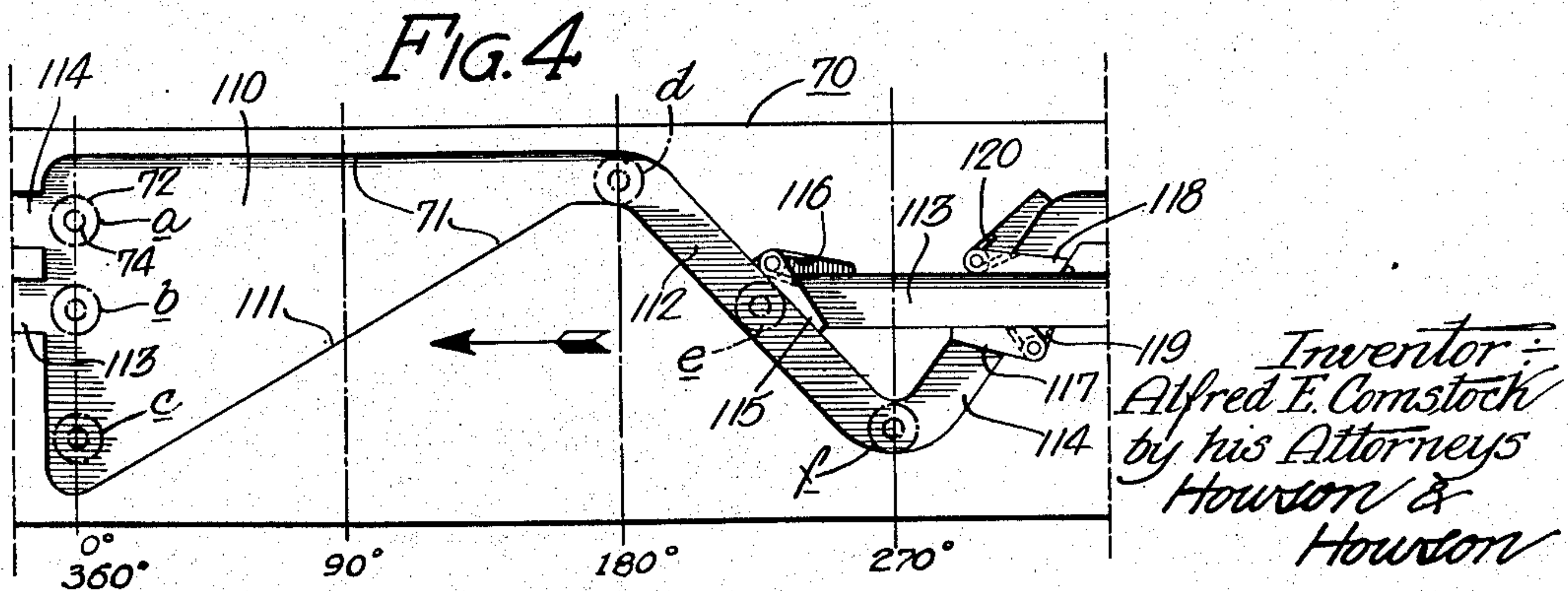
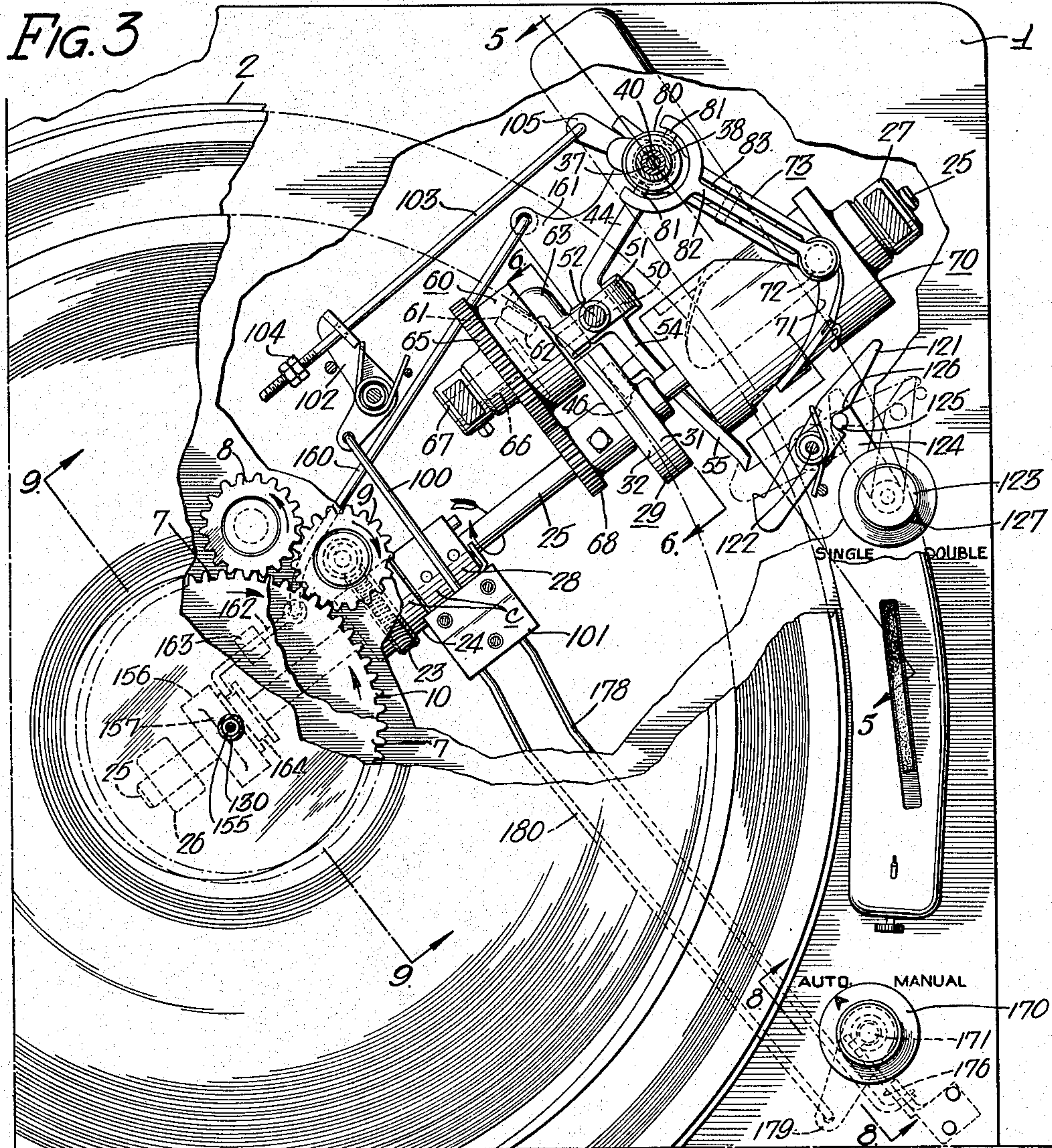
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Inventor:
Alfred E. Comstock
by his Attorneys
Houson &
Houson

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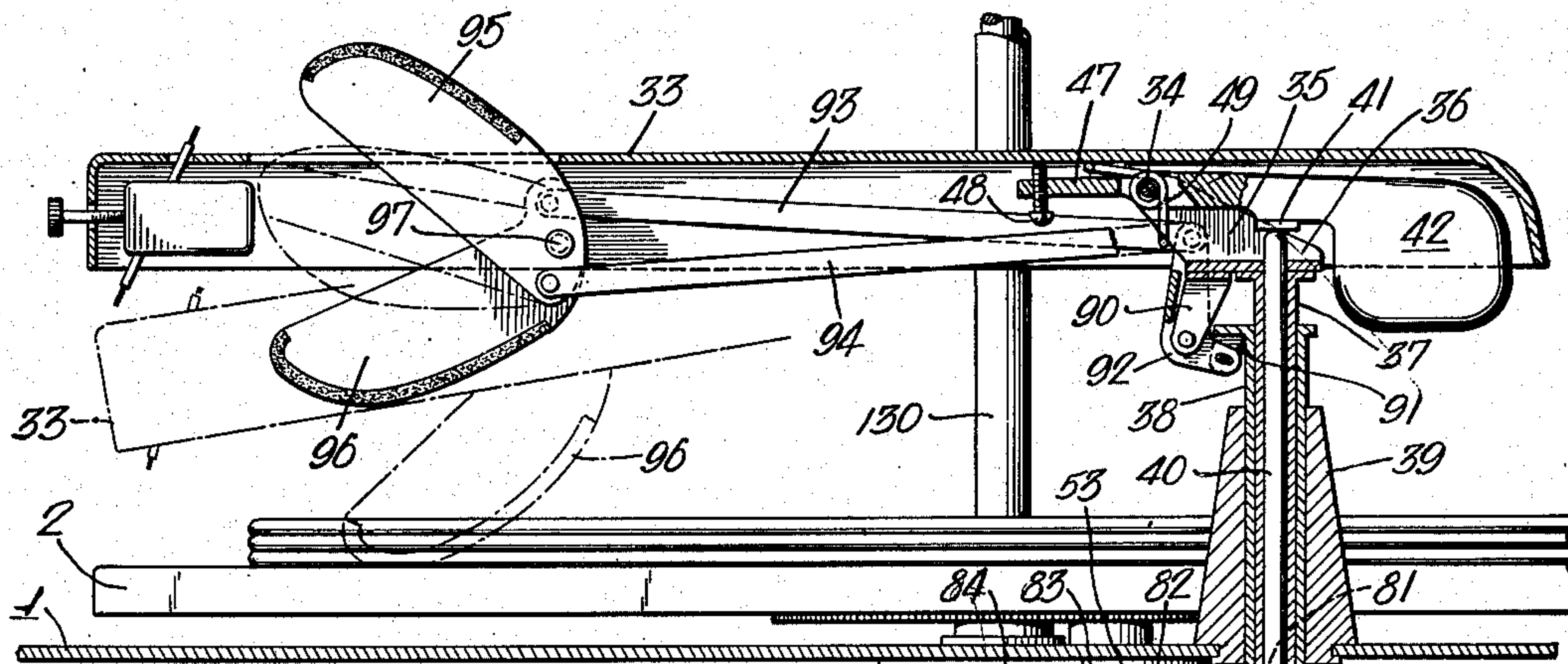


FIG. 5

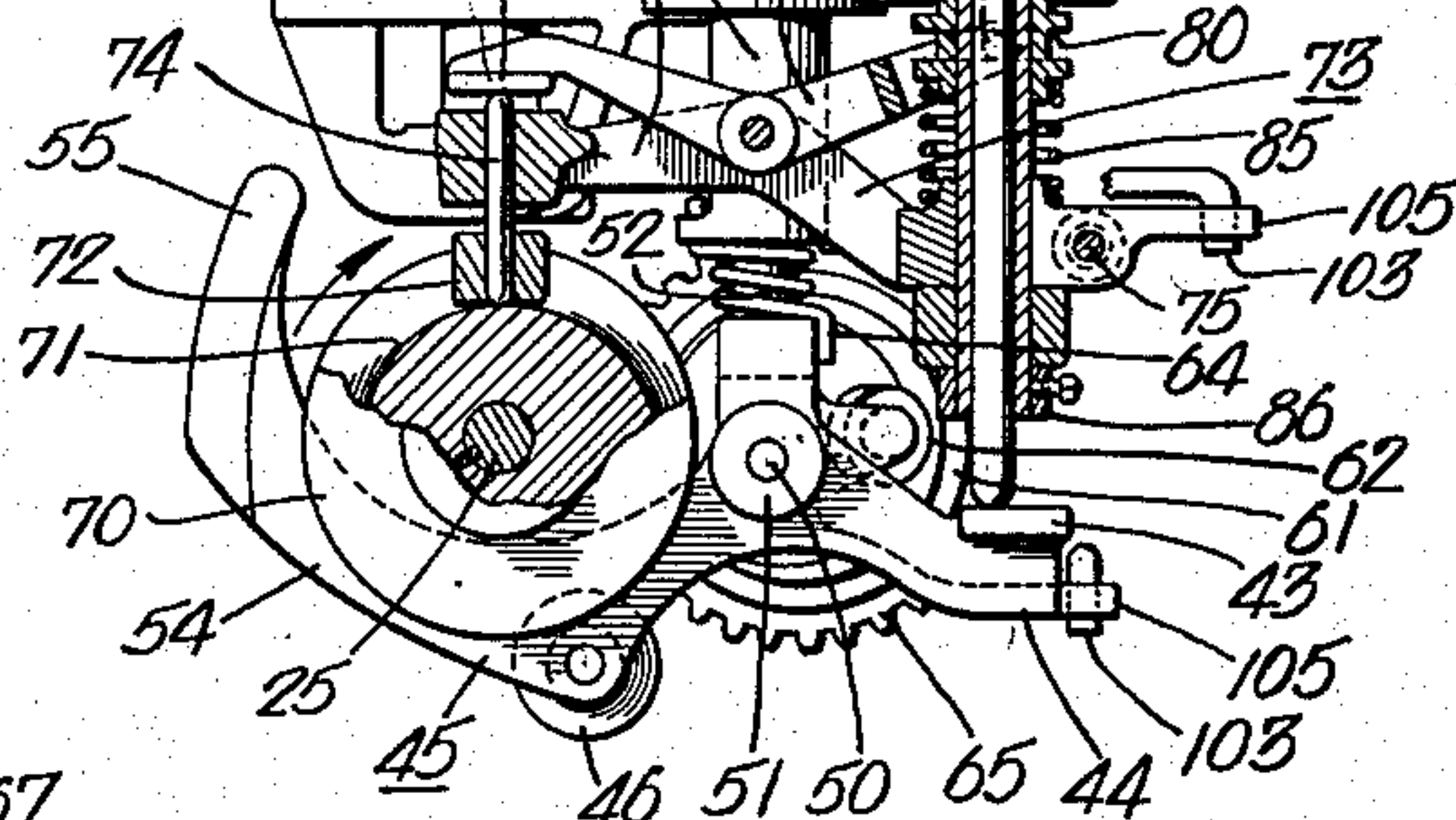


FIG. 6

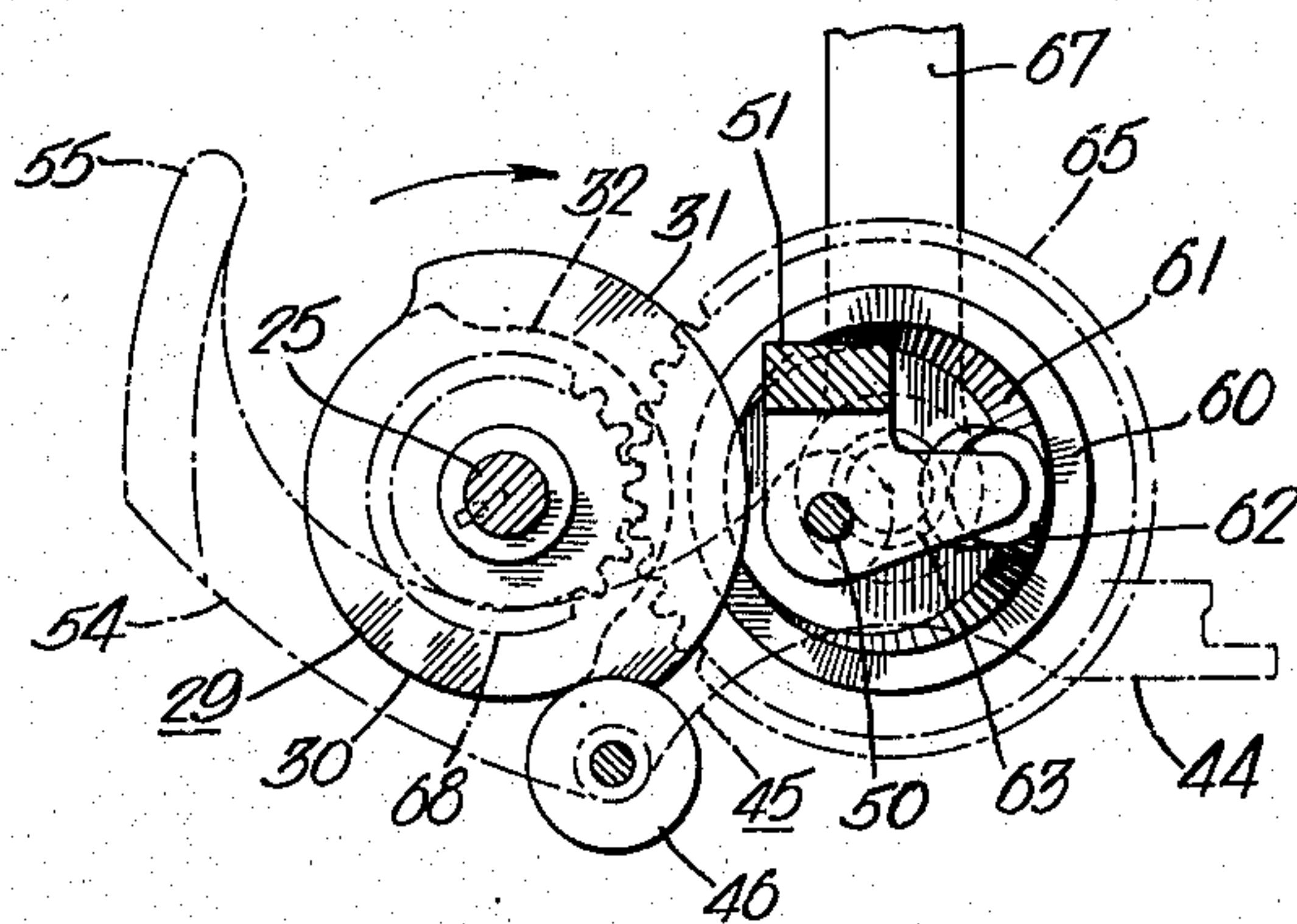


FIG. 7

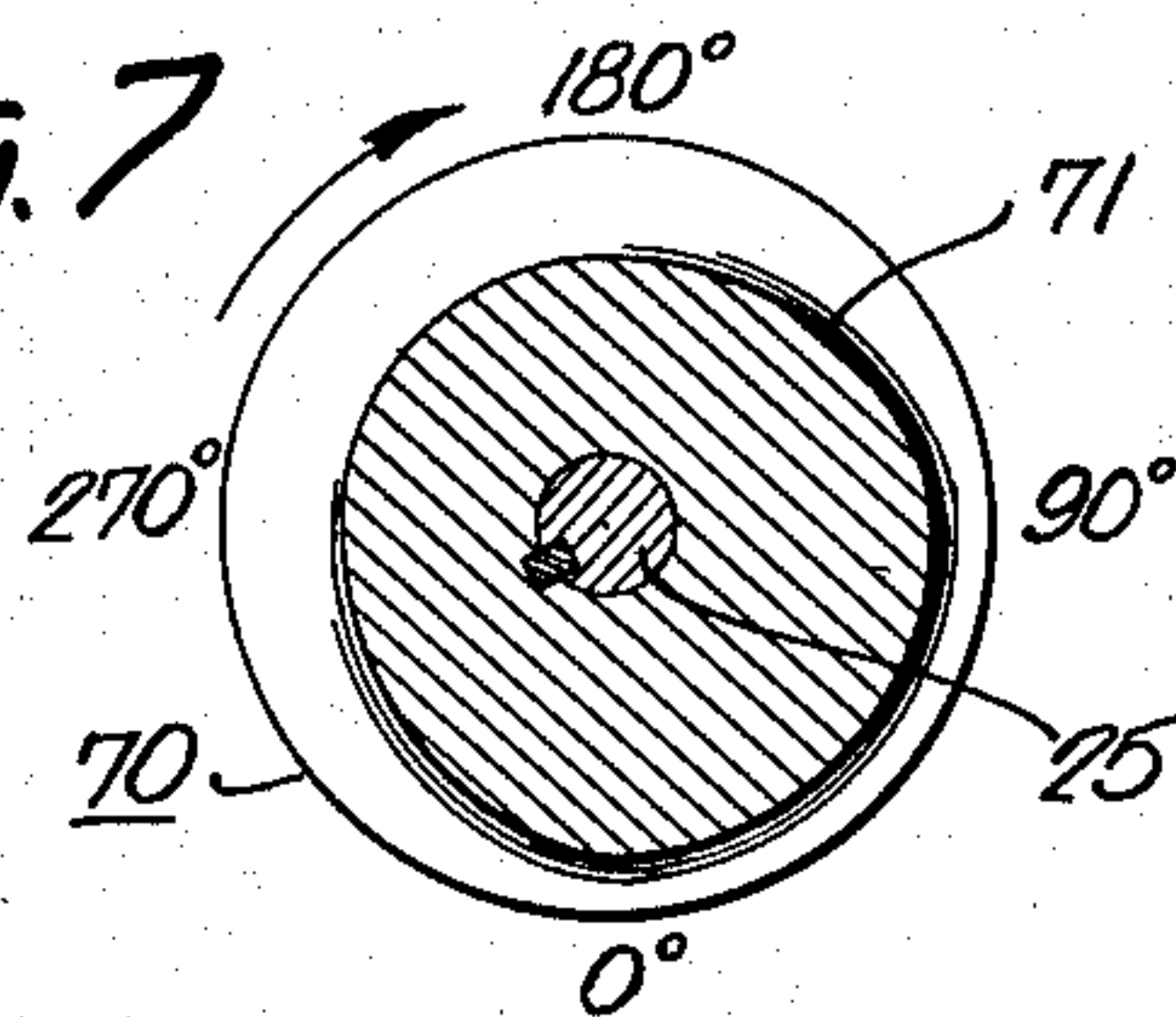
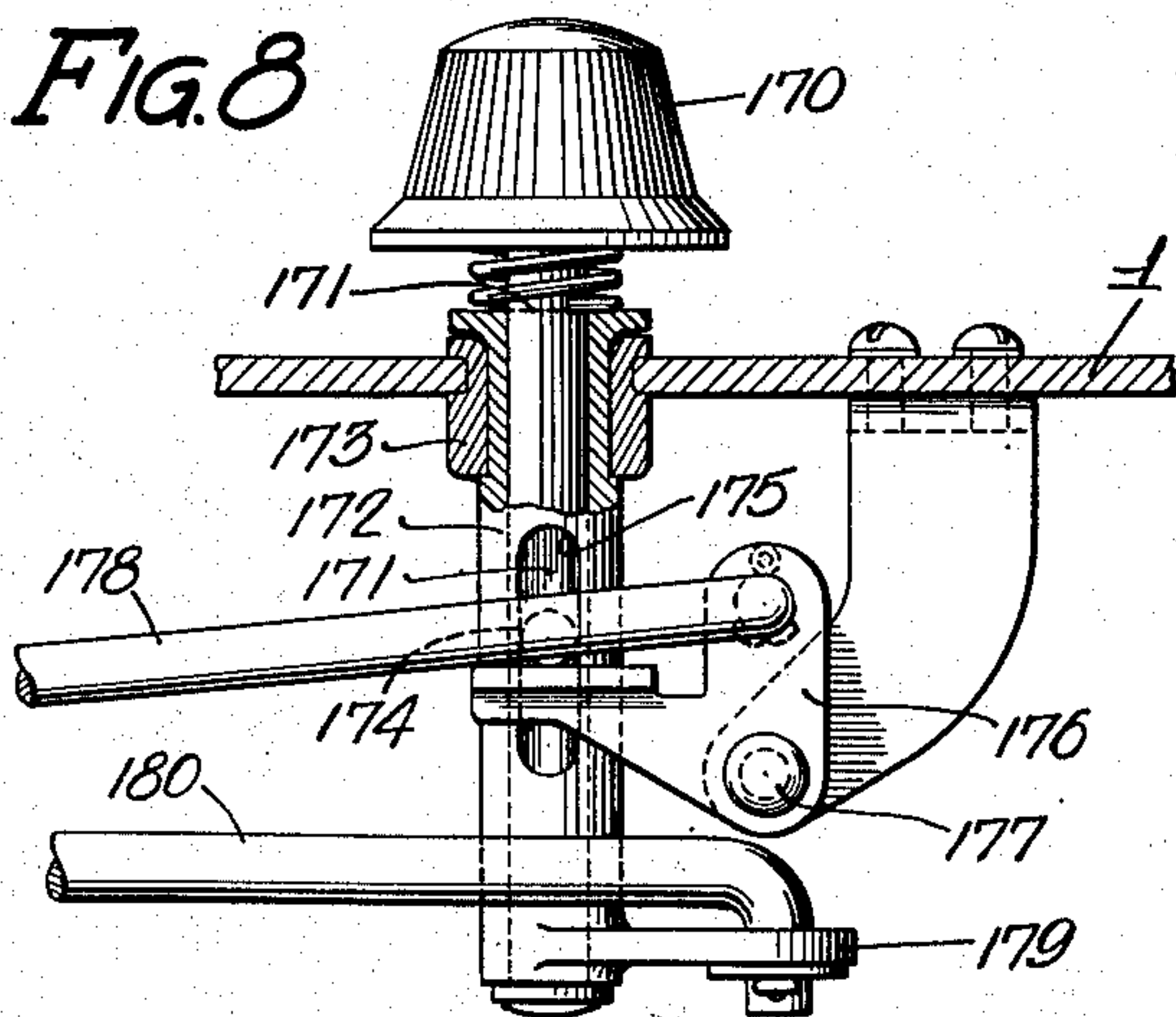


FIG. 8



Inventor:
Alfred E. Comstock
by his Attorneys
Howson &
Howson.

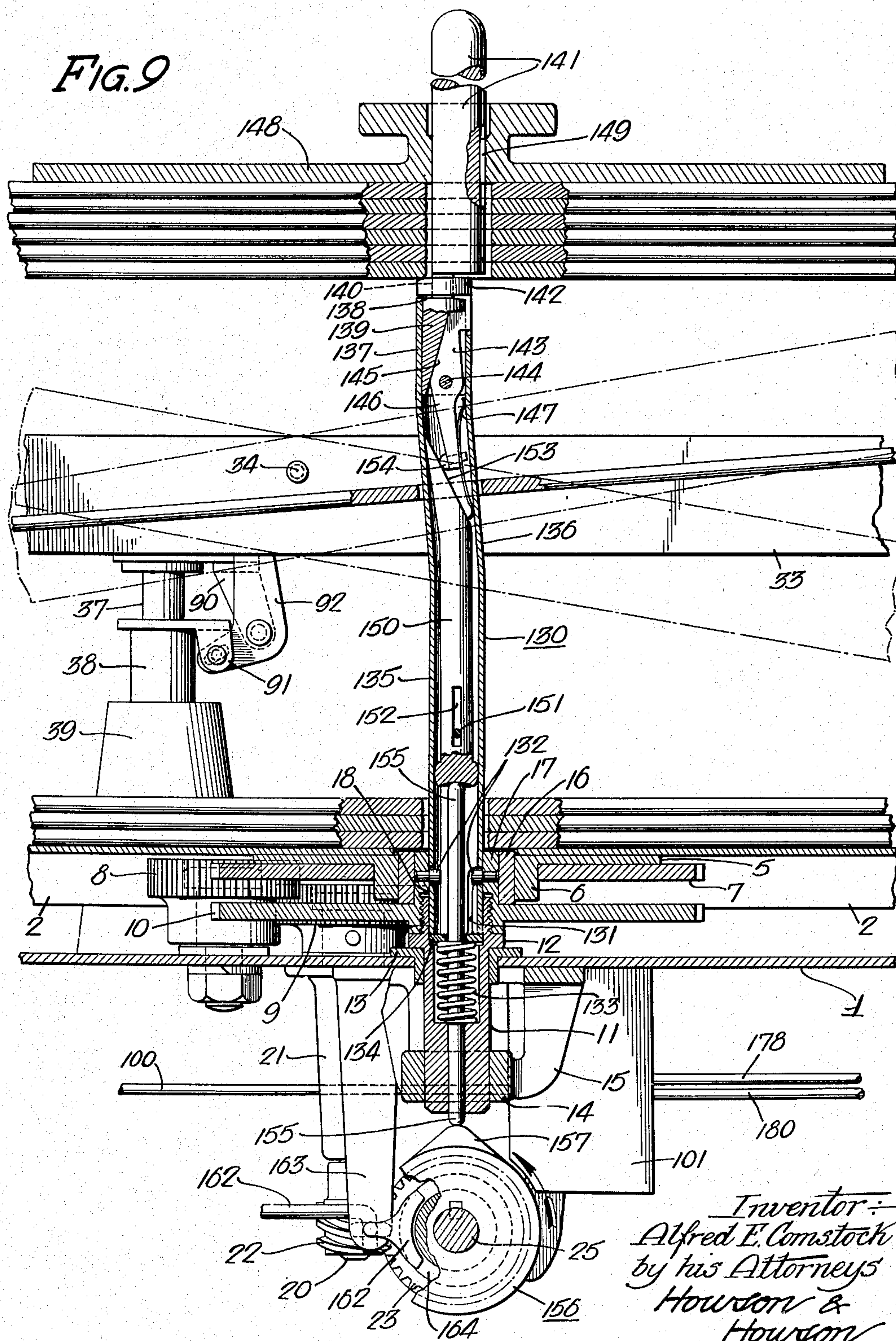
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5 Sheets-Sheet 4



Inventor:
Alfred E. Comstock
by his Attorneys
Howson &
Howson

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AUTOMATIC PHONOGRAPH

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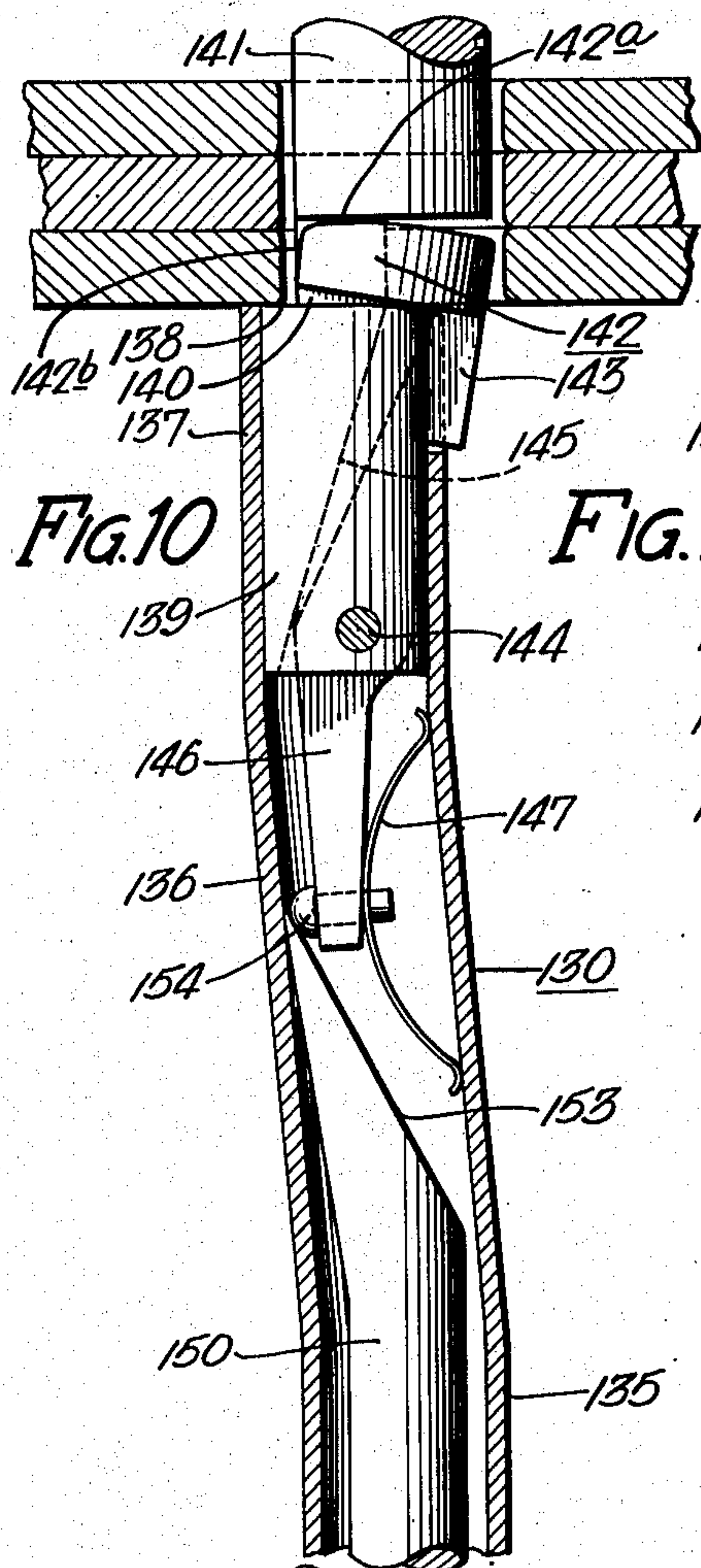


FIG. 10

FIG. 11

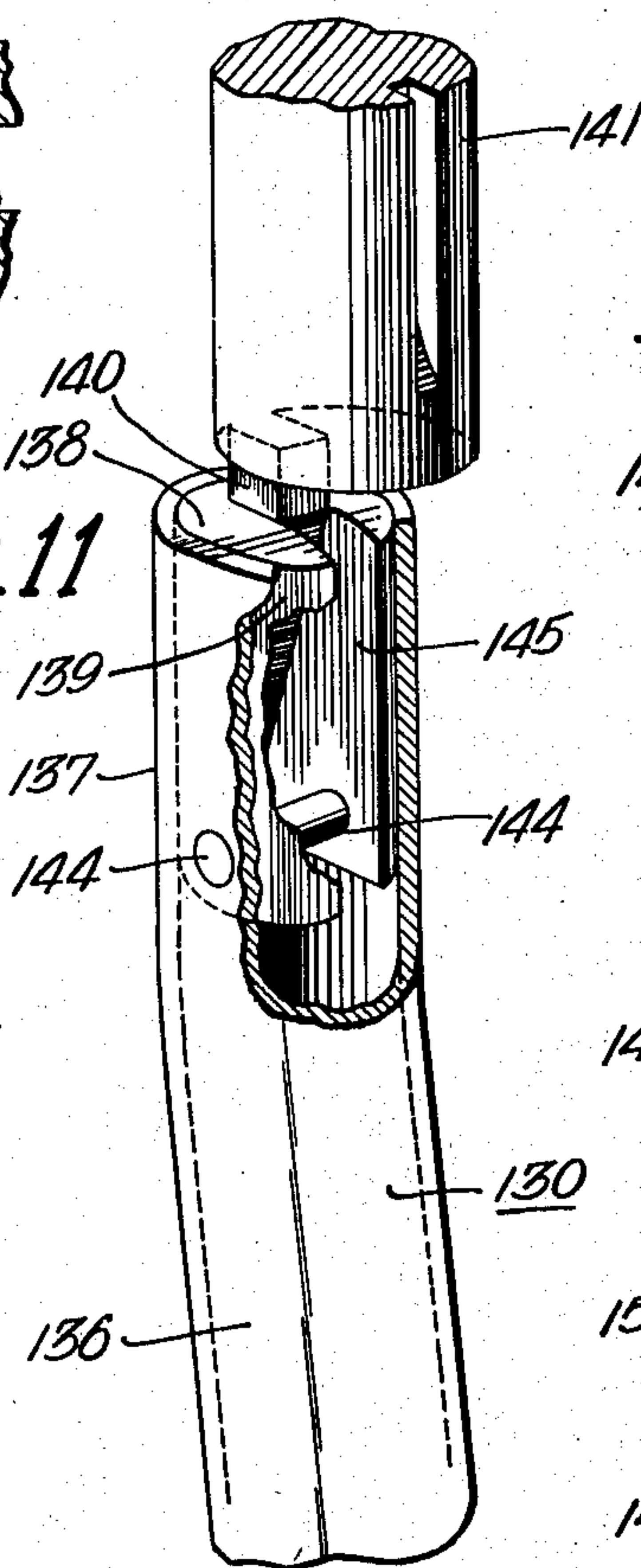


FIG. 12

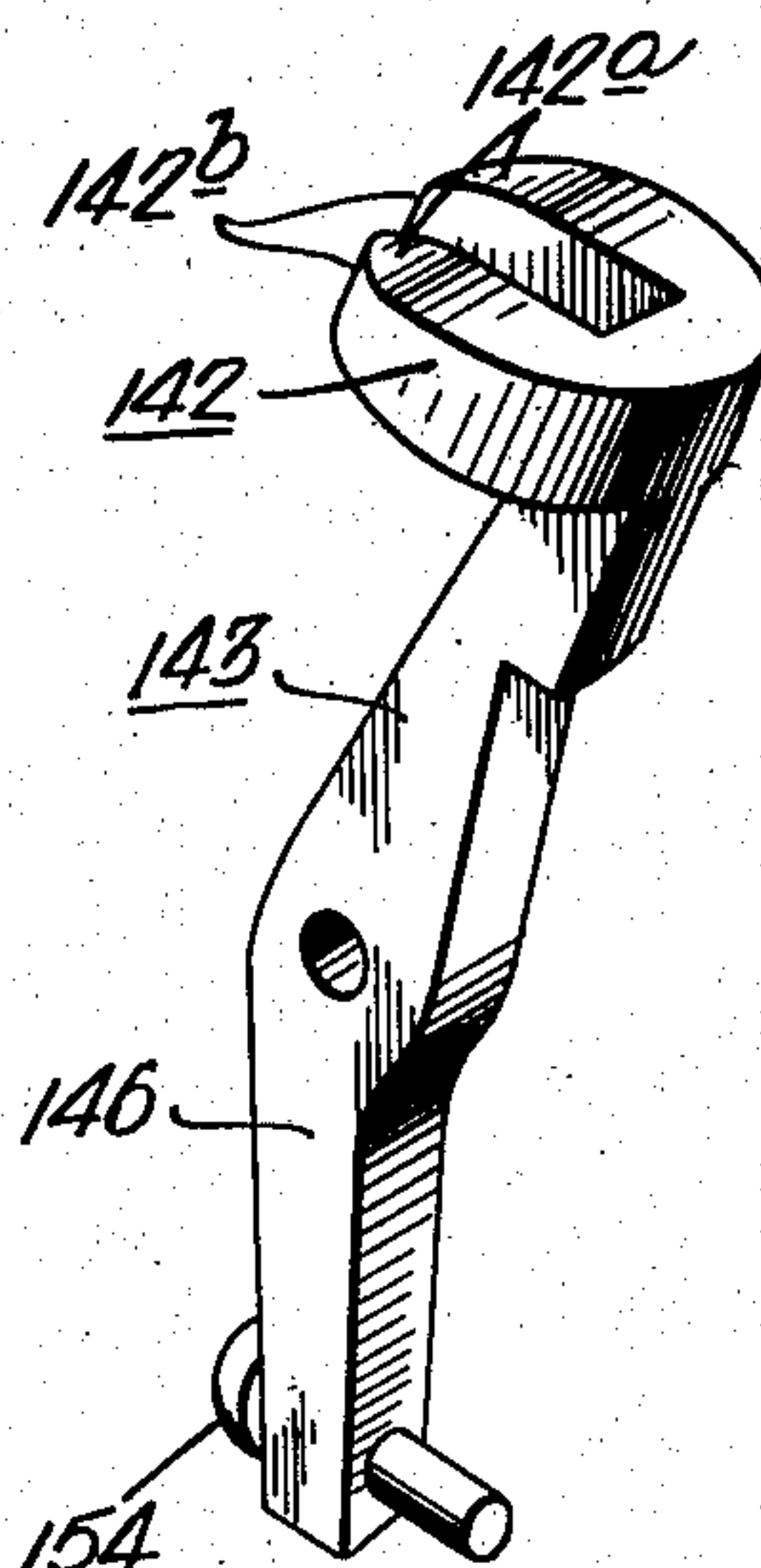


FIG. 14

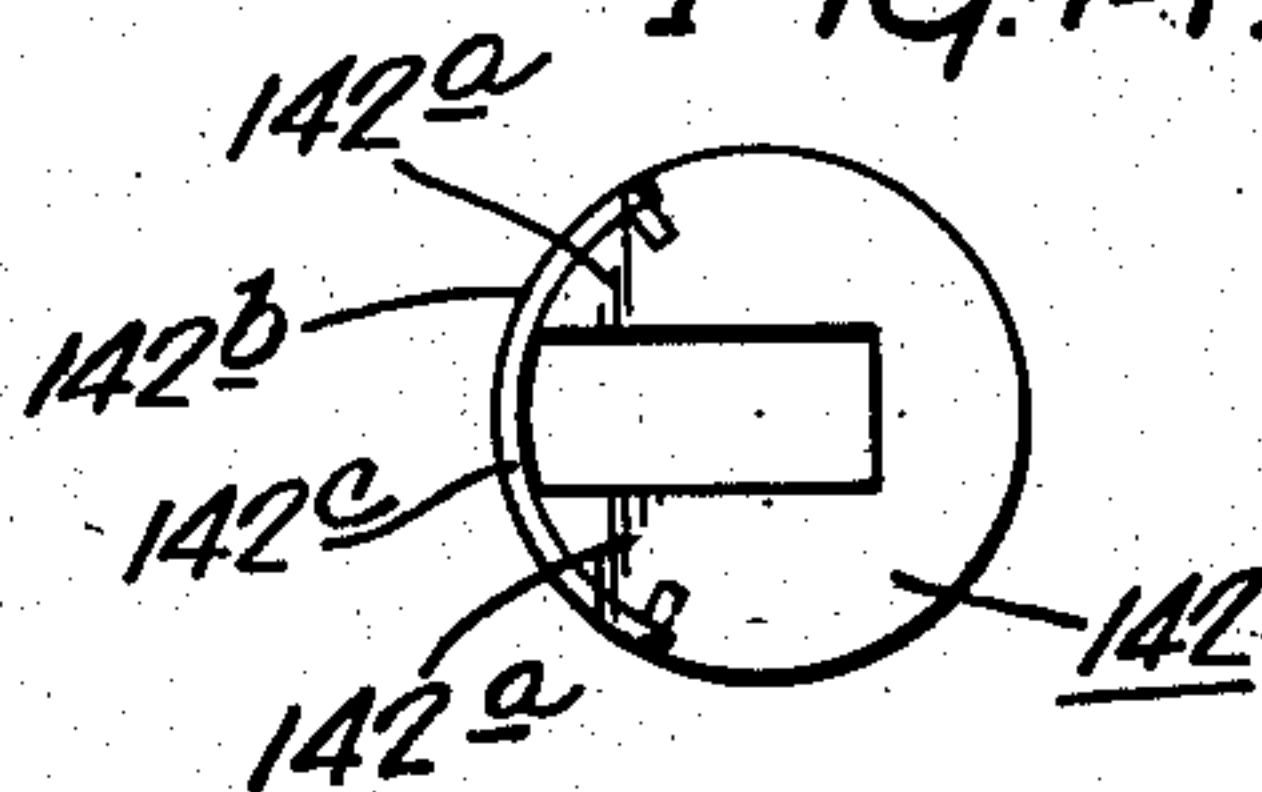
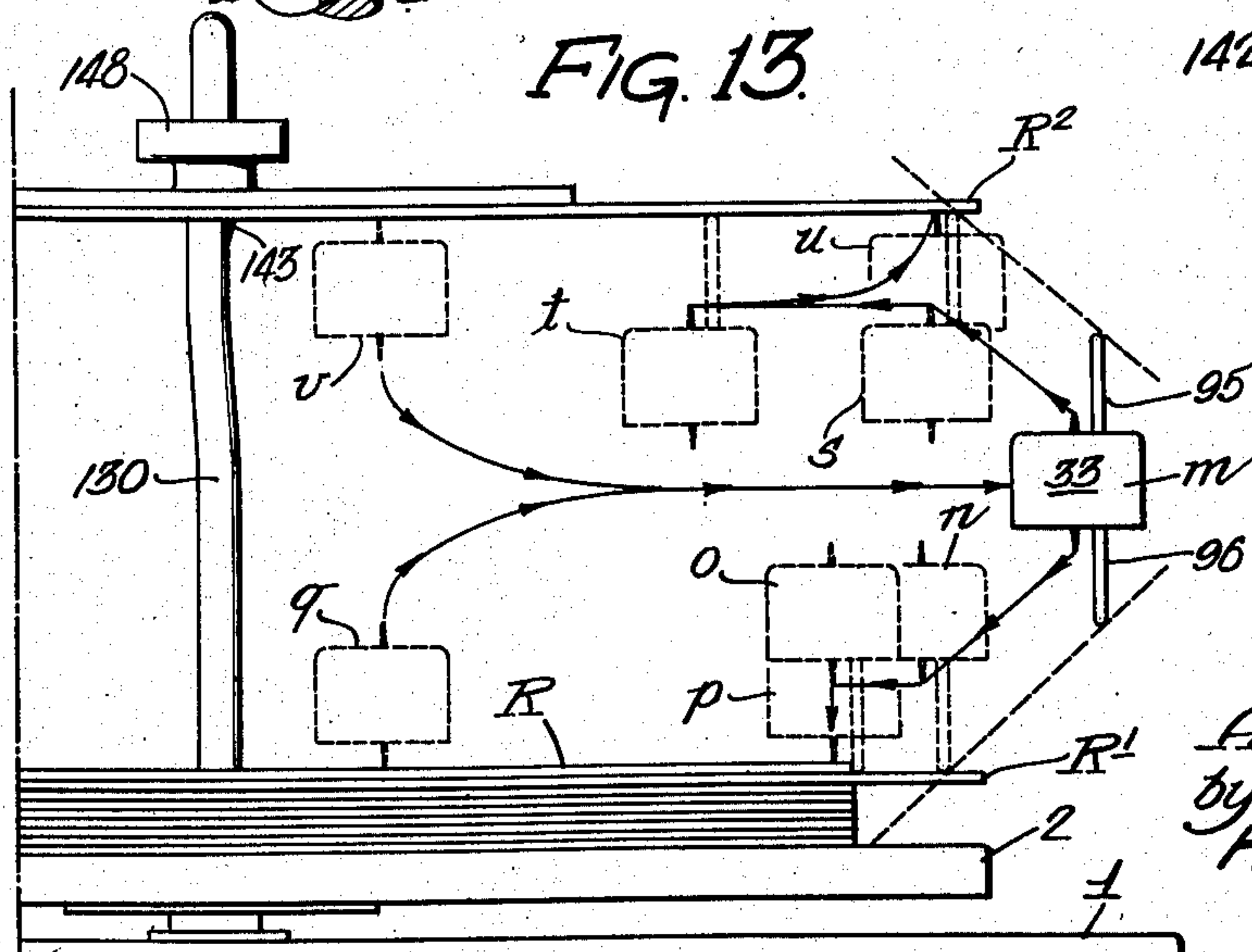


FIG. 13



Inventor:
Alfred E. Comstock
by his Attorneys
Howson &
Howson

UNITED STATES PATENT OFFICE

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AUTOMATIC PHONOGRAPH

Alfred E. Comstock, Chicago, Ill.

Application October 9, 1946, Serial No. 702,331

4 Claims. (Cl. 274—10)

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This invention relates to new and useful improvements in automatic phonographs of the type adapted to play both sides of one or a plurality of records.

More particularly, the invention relates to automatic phonographs of the stated type wherein provision is made for rotatably supporting a stack of records above the usual turntable of a phonograph in position for playing the underside of the lowermost record of the stack, after which the record is ejected from the stack and deposited by gravity upon the turntable in position for playing the upper side of the record.

The principal object of the present invention is to provide an automatic phonograph of the character set forth embodying a novel record transfer mechanism including a rotatable spindle turntable incorporating novel means for shifting a record from one playing position to another playing position.

Another and equally important object of the invention is to provide an automatic phonograph of the type described having a normally rotating turntable and an oppositely rotating coaxially extending record-supporting spindle together with improved and simplified means for rotating the turntable and spindle in respectively opposite directions.

Another and highly important object of the invention is to provide an automatic phonograph of the type described embodying novel mechanism for supporting a stack of records coaxially above the usual phonograph turntable which is characterized by novel means operable to eject from the stack the lowermost record and cause the same to be deposited by gravity upon the phonograph turntable.

Another object of the invention is to provide an automatic phonograph having record supporting mechanism as set forth wherein the means to eject the lowermost record from the supported stack thereof operates simultaneously to elevate slightly the remainder of the records in the stack and thereby remove the weight and pressure of those records from the lowermost record to permit relatively easy displacement thereof from the support mechanism for transfer to the conventional phonograph turntable.

More particularly, it is another and important object of the present invention to provide an automatic phonograph of the character set forth having the conventional record turntable and an oppositely rotatable spindle structure extending therethrough with its free end portion arranged coaxially above the turntable and adapted to receive thereon one or more records

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which are supported in an elevated position by an offset portion of the spindle and periodically ejected therefrom by means movable between a position aligned with said coaxial end portion of the spindle and a position aligned with said offset portion thereof whereby the ejected record is aligned with the offset spindle portion and caused to move down the same by gravity and be deposited in playing position upon the turntable.

Still another object of the present invention is to provide an automatic phonograph of the character set forth embodying novel mechanism for controlling movement of the tone arm which is selectively operable to position the tone arm for playing one side only of one or a plurality of records or to position the tone arm for playing both sides of such one or more records.

A further object of the present invention is to provide an automatic phonograph of the type described having a tone arm incorporating novel detecting means operable to "feel" a record in either of its playing positions and determine and effect playing engagement of the tone arm stylus with the record in accordance with the diameter thereof.

Still a further object of the invention is to provide an automatic phonograph of the type described embodying an improved tone arm construction adapted to play on adjacent sides of a pair of vertically spaced records and embodying novel counterbalance means associated therewith to effect proper upward playing pressure of the tone arm against the lower side of the uppermost of said records.

Still a further object of the present invention is to provide an automatic phonograph having a record transfer mechanism of the character set forth which is driven from the conventional drive of the phonograph turntable and which includes novel means operable to effect the necessary lateral and vertical movements of the tone arm and to control the transfer or change of records in synchronization of movements of said tone arm.

These and other objects of the invention and the various features and details of the construction, arrangement and operation thereof are hereinafter fully set forth and described with reference to the accompanying drawings, in which:

Fig. 1 is a top plan view of an automatic phonograph made according to the present invention.

Fig. 2 is a partial side elevational view of the disclosure in Fig. 1.

Fig. 3 is an enlarged fragmentary top plan

view of the disclosure in Fig. 1 wherein a portion of the turntable and underlying panel have been broken away to illustrate certain features and details of the construction and operation.

Fig. 4 is a development view of a control cam embodied in the present phonograph.

Fig. 5 is a sectional view taken on line 5—5, Fig. 3.

Fig. 6 is a sectional view taken on line 6—6, Fig. 3.

Fig. 7 is a diagrammatic sectional view illustrating the varying radial depth of the path of the control cam developed in Fig. 4.

Fig. 8 is an enlarged sectional view taken on line 8—8, Fig. 3.

Fig. 9 is an enlarged fragmentary sectional view taken on line 9—9, Fig. 3.

Fig. 10 is an enlarged fragmentary sectional view of the upper portion of the record supporting and transverse mechanism shown in Fig. 9 illustrating the other limit position of the record discharge element from that shown in Fig. 9.

Figs. 11 and 12 are perspective views showing the construction and relationship of certain of the parts of the record transfer mechanism shown in Fig. 10.

Fig. 13 is a diagrammatic view illustrating the path of travel of the tone arm for a particular record set-up; and

Fig. 14 is a plan view of the displacement foot of the record discharge element showing a modified construction thereof.

Referring now to the drawings, and more particularly to Figs. 1 and 2 thereof, reference numeral 1 designates the horizontal supporting panel or platform of the phonograph which has mounted thereabove the usual record turntable 2 that may be rotationally driven in clockwise direction with respect to Fig. 1 by means of a motor 3 driving a wheel 4 having a friction surface positioned in engagement with the inner surface of the depending peripheral skirt of the turntable 2.

As shown in Fig. 9, there is secured to the underside of the turntable 2, coaxially thereof, an annular supporting plate 5 having a hub portion 6 that is surrounded by a gear 7 which is secured to the underside of said plate 5. The gear 7 is meshed with a pinion 8 which also is meshed with a pinion 9 that in turn meshes with a gear 10. The gear 10 is threaded or otherwise secured upon the neck of a thimble 11 having a shoulder 12 which is supported with reference to the panel 1 by a thrust bearing or plate 13. The lower end of the thimble 11 is journaled in a bearing 14 provided in a depending bracket 15 at the underside of the panel 1.

A bearing 16 is interposed between the hub 6 of the plate 7 and hub 17 of the gear 10 and the construction and arrangement of said gears and pinions is such that rotational movement of the turntable 2 and its gear 7 in the clockwise direction indicated will operate through the pinions 8 and 9 to drive the gear 10 and thimble 11 in the opposite or counterclockwise direction at the same speed of rotation as the turntable 2. The hub 17 and thimble 11 form or provide a socket 18 coaxially of the turntable 2 which is adapted to receive and support an automatic record transfer mechanism which constitutes an important feature of the present invention and is described in detail hereinafter.

The pinion 9 is fixed on a vertical shaft 20 which is rotationally supported in a suitable bearing 21 at the underside of the panel 1 and has

secured on its lower end a worm 22. This worm 22 is meshed with a worm wheel 23 fixed on a sleeve 24 which is loosely mounted on a horizontal shaft 25 that extends therethrough and has its opposite ends journaled in bearings 26 and 27 as shown, for example, in Fig. 3 of the drawings. The sleeve 24 constitutes the driving member of a conventional type single revolution clutch C having a driven member 28 which is fixed on the shaft 25, and these members 24 and 28 are constructed and arranged so that upon engagement of the clutch the shaft 25 is driven in the direction indicated by the arrow through a single complete revolution (360°) and then comes to rest in accordance with the usual and well-known operation of clutches of this type.

With reference to Figs. 3 and 6 of the drawings, there is fixed on the shaft 25 a cam member generally designated 29 which is provided with a common surface portion 30 extending substantially one-half the circumference thereof and in the remainder of its circumference the cam 29 is formed to provide axially adjacent circumferentially extending cam surface portions 31 and 32, respectively, of greater and less diameter than the surface 30, which function to control vertical positioning of the pickup or tone arm 33 of the phonograph.

In the present instance, and as shown in Fig. 5 of the drawings, the tone arm 33 is mounted for vertical pivotal movement by means of a cross pin 34 which passes through the arms 35 of a bracket 36 that is fixed to the upper end of a vertically extending sleeve 37. The sleeve 37 is one of a pair of telescopic sleeve members 37 and 38 which are rotationally supported in a bearing 39 secured in upstanding relation on the panel 1. The inner sleeve 37 is of greater axial length than the outer sleeve 38 and slidably mounted within the inner sleeve 37 is a control rod 40 which has its upper end disposed in engagement with a pad 41 at the underside of a counterweight or balance device 42 and its lower end engaging upon a pad 43 on the arm portion 44 of a lever which is generally designated 45. This lever 45 carries a roller or follower 46 which is disposed in contact with the cam member 29 which operates to pivot the lever 45 vertically and thereby effect axial movement of the rod 40 to control vertical positioning of the pickup or tone arm 33 as described in detail hereinafter.

Vertical swinging or positioning of the pickup or tone arm 33 for selective engagement thereof with a record which is supported above or below the arm as the case may be is controlled by the counterweight device 42 which is pivotally mounted with respect to the tone arm 33 upon the aforesaid cross pin 34. A portion of the counterweight device extends forwardly of the cross pin 34 as indicated at 47 and is provided with an adjustable set screw 48 adapted to bear against the underside of the tone arm 33. Thus the counterweight device 42 normally urges the tone arm 33 in the clockwise direction with respect to Fig. 5 of the drawings for upward engagement with a record on a stack above the tone arm while thrust applied to the pad 41 by upward actuation of the rod 40 serves to move the tone arm 33 in the counterclockwise direction about the cross pin 34 in position for playing a record disposed upon the turntable 2. A coiled torsion spring 49 surrounds the cross pin 34 and acts between the tone arm 33 and one of the arms 35 of bracket 36 to urge the tone arm in the clockwise direction with respect to Fig. 5 thus lessening the stylus

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pressure upon a record on the turntable 2 due to the weight of the tone arm. On the other hand, the arrangement of the spring 49 and counterweight device 42 is such that the calculated forces thereof decrease progressively as clockwise movement of the tone arm 33 takes place so that the pressure of the stylus upon a record supported above the tone arm 33 will be substantially the same as the pressure of the stylus upon a record on the turntable 2.

Referring again to the lever 45 which is actuated by means of the cam member 29 to control vertical positioning of the tone arm 33 through movement of the rod 40, it is to be noted with reference to Figs. 3 and 5 of the drawings, that said lever 45 is pivotally mounted on the stud 50 of the yoke 51 which in turn has a vertically extending stud 52 that is rotatably mounted in a bearing 53 whereby pivotal movement also is afforded the lever 45 and its supporting yoke 51 in the horizontal plane. The arm portion 54 of the lever 45 which carries the aforesaid follower 46 extends oppositely of the pivot 50 from the lever arm portion 44 and has its free end terminating in an angularly arranged upwardly directed hook portion 55, the purpose of which will appear later.

With further reference to Figs. 5 and 6 of the drawings, the horizontal pivotal position of the lever 45 and its supporting yoke 51 is provided for the purpose of affording selective positioning of the follower 46 for contact with one or the other of the surfaces 31 or 32 of the cam 29. In the present instance, this horizontal positioning of the lever 45 is controlled by means of a cam member 60 having an internal surface 61 which is contacted by a roller or follower 62 that is rotatably mounted at the free end of an arm portion 63 of the aforesaid yoke 51. The roller or follower 62 is biased into contact with the cam surface 61 at all times by means of a torsional spring 64 which is interposed between the bearing 53 and yoke 51 about the spindle 52.

As shown in Fig. 3 of the drawings, the cam 60 is fixedly associated with a gear 65 that is secured on a horizontally extending shaft 66 journaled in a bearing 67. The gear 65 is meshed with a gear 68 which is fixed on the shaft 25 and this latter gear 68 has a diameter one-half the diameter of the gear 65 with the result that each time that the gear 68 is caused to be rotated through a single revolution upon engagement of the clutch C the gear 65 will be rotated one-half of a revolution or 180°. Thus two complete revolutions of the gear 68 on the shaft 25 are required in order to rotate the gear 65 and its associated cam 60 through one complete revolution. Duly related to the ratio of the gears 65 and 68 is the configuration of the surface 61 of the cam 60, and in this connection it is to be noted that said cam surface 61 is eccentrically arranged and contoured to cause the yoke 51 and lever 45 to pivot horizontally and thereby selectively present the follower 46 alternately in position to traverse the surfaces 31 and 32 of the cam 29 with resulting pivotal movement of said lever 45 in the vertical plane to control vertical positioning of the tone arm 33 through axial movement of the rod 40.

As distinguished from vertical swinging movement of the tone arm 33, horizontal swinging movement or traverse of said tone arm 33 is controlled by a cylindrical cam member 70 at all times except during inward swing of the tone arm under the control of the usual record groove as,

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for example, during the playing of a record. Like the vertical positioning control cam member 29, the horizontal control cam 70 likewise is secured upon the shaft 25 for rotation therewith. The cam 70 has a circumferentially extending track 71 which is arranged and contoured as shown in development of Fig. 4 of the drawings and has a varying radial depth as shown in the diagrammatic sectional view of Fig. 7.

Engaged within the cam track 71 is a roller type follower 72 which is operatively connected to a control arm 73 through the agency of a vertical slidable pin 74 which rides on the bottom of the cam track 71. The control arm 73 has its other end secured to the aforesaid inner sleeve 37 adjacent the lower end thereof by means of a split collar arrangement 75 and, upon rotation of the cam 70, it will be apparent that the control arm 73 will be caused to move horizontally thereby correspondingly rotating the inner sleeve 37 and tone arm 33 supported thereon.

The outer sleeve 38 of the aforesaid pair of telescopically slidable sleeves has its lower end formed to provide an annularly grooved shipper ring 80 which is engaged by radial trunnions 81 carried by forked lever 82. This lever 82 is pivoted intermediate its ends within a longitudinally extending slot 83 provided in the control arm 73 and at its free end is provided with a foot or pad 84 disposed in engagement with the upper end of the vertical slidable follower pin 74.

As previously stated the cam track 71 varies in depth circumferentially of the cam as diagrammatically shown in Fig. 7 of the drawings, and it will be apparent, therefore, that the lever 82 will be urged in clockwise direction about its pivot in accordance with the depth of the cam track 71, the pin 74 serving simultaneously to transmit horizontal movement through the arm 73 and sleeve 37 to the tone arm 33. Clockwise movement of the lever 82 is resisted by a coil-tension spring 85 which operates to maintain the pin 74 against the bottom of the cam track 71 and to elevate the sleeve 38 as the said pin descends.

The inner sleeve 37 is in a fixed position vertically and, as previously stated, has its lower end secured to the control arm 73 which in itself is vertically sustained in its horizontal swinging movement by a thrust bearing 86. Depending from the bracket 36 and secured on the upper end of the sleeve 37 is an ear 90 and the adjacent upper end of the outer vertical reciprocable sleeve 38 is provided with a generally similar depending ear 91. Pivotally connected at a medial point and at one end, respectively, to the ears 90 and 91 is a bell crank 92 which has its free end pivotally connected to a pair of elongated links 93 and 94 for actuating a pair of feeler members 95 and 96 which are pivotally mounted with respect to the tone arm 33 upon a common pivot 97 located at a point sufficiently forwardly on said arm to be engageable in operable or extended position with the edge of a 10 inch record, the uppermost record on the turntable 2, or the lowermost record of a vertically elevated stack supported above the turntable 2 by the automatic record transfer mechanism hereinafter described.

The construction and arrangement of the bell crank 92 and the elongated links 93 and 94, respectively, is such that relative axial movement of the sleeve 38 with respect to the sleeve 37 caused by vertical rocking movement of the lever 82 according to the depth of the cam track 71

results in pivotal movement of the feelers 95 and 96 between the collapsed dotted line positions thereof shown in Fig. 5 and relatively projected position exemplified by the solid line positions shown therein. In this connection, it is to be noted that the arrangement and location of the links and several pivot axes is such that as the tone arm 33 is downwardly inclined by upward actuation of rod 40, the lower feeler 96 is projected an increasing distance below the tone arm to maintain the stylus at an elevation above the turntable 2 sufficient to clear the uppermost record of a limit stack of, say a dozen, records thereon. In the case of the records supported in elevated playing position upon the spindle 130, it will be apparent that the position vertically of the lowermost record thereon will always be the same so that there is no need for increasingly projecting the upper feeler 95 as the tone arm 33 is tilted upwardly and therefore the feeler 95 is projected a substantially uniform distance above the tone arm throughout the entire arc of upward inclination thereof. The functioning of the feelers 95 and 96 will be elaborated upon in greater detail hereinafter and for the present it will be sufficient to state that in conjunction with the cam track 71 these feelers determine the position of the tone arm 33 to play either a large or a small record.

Utilization is made of the horizontal movement of the tone arm 33 to effect automatic engagement of the clutch C and this may be accomplished as shown in Fig. 3 of the drawings by means of a link 100 which is operatively connected to a clutch control box 101 that is operable to initiate operation of clutch C. The link 100 is actuated by a bell crank 102 pivoted on the panel 1 and adapted to be swung in the clockwise direction by a lost motion connector 103 having an adjustable stop 104 for engagement with the bell crank 102 at the completion of the playing of a record. The opposite end of the connector 103 is pivoted to an extension 105 on the control arm 73 with the result that when said control arm 73 has traversed a sufficient angle in the clockwise direction under the influence of the tone arm 33 during the playing of a record, the bell crank 102 will be pivoted to actuate link 100 and thereby engage the clutch C effecting rotation of the shaft 25 and cams 29 and 70 through a single complete revolution.

Referring more particularly to the cam 70 and the developed view thereof shown in Fig. 4 of the drawings, it will be observed that the track 71 thereof has an enlarged generally triangular portion 110 in which the follower 72 and pin 74 are initially disposed. At the time drive shaft 25 and cam 70 come to rest at the completion of a single revolution effected by engagement of the clutch C, the position of the follower 72 will be in one or the other of the dotted line positions a or b shown in said Fig. 4 depending upon whether the record about to be played and with respect to which the tone arm 33 is positioned is a 10 inch or 12 inch record, respectively. At this time the tone arm stylus is about to commence or has commenced the first few turns of the groove in a record and the tone arm 33 is under the control of the record groove. As inward traverse of the tone arm takes place during playing of the record the follower 72 will travel a substantially straight path with respect to the drawings to a position designated c in Fig. 4 of the drawings.

At this time the stylus has completed the final few turns of the groove of the record, the tone

arm 33 has been freed of control of the record and rod 103 has been actuated to engage its stop 104 with the bell crank 102 to engage the clutch C to cause the shaft 25 to rotate the cams 29 and 70 through one complete revolution. As this single revolution of the cams takes place, the follower 46 of lever 45 moves on to the neutral surface 30 of cam 29 thereby positioning the tone arm 33 in the neutral or intermediate position shown in Fig. 5 of the drawings and the cam 70 rotating through the first 180° operates through engagement of the angularly disposed wall 111 of the track 71 to move the follower 72 horizontally from the position indicated at c to the position d in Fig. 4, thus moving the tone arm 33 horizontally outward through the medium of the control arm 73 and sleeve 37. At this time the follower 72 enters the portion of the track 71 which operates to position the tone arm 33 for the succeeding record-playing operation, and it is during this portion of the operative movement of the cam 71 that the feelers 95 and 96 come into operation.

In this connection and with reference to Fig. 7 of the drawings, it is reiterated that the depth of track 71 of the cam 70 varies materially. Thus, in the cycle from 0° to 90° the track 71 is of uniform radial depth, increases steadily from 90° to 180° to a radial depth approximately three times that existing in the cycle from 0° to 90°, then continues uniformly at this increased depth for the cycle from 180° to 270° and then decreases steadily in depth throughout the next 90° to the starting point. Thus, it will be apparent that as the cam 70 rotates relative to the follower pin 74 the latter will rise and fall in the cam track 71. As the pin 74 falls the spring 35 elevates the outer sleeve 38 causing clockwise rotation of the bell crank 92 to thereby pivot the feelers 95 and 96 into substantially the positions shown in solid lines in Fig. 5 wherein said feelers project on either side of the tone arm 33. This actuation of feelers 95 and 96 takes place somewhat prior to commencement of inward swing of the tone arm 33 which is caused by traverse of the follower 72 along the portion 112 of the track 71 of the cam 70 and will be succeeded at a later phase by depression or elevation of the tone arm 33 as the follower 46 of the lever 45 rides onto the surface 31 or 32 of the cam 29.

The function of feelers 95 and 96 is to control positioning of the tone arm 33 with respect to a particular 10 inch or 12 inch record that is in position to be played. Thus in the distended position of the feelers shown in Fig. 5, as the tone arm 33 is moved inwardly by cam 70, the said feelers 95 and 96 will engage endwise against a 10 inch record whereupon the tone arm 33 will be held against further inward movement. At this instant the follower 72 will have traversed the portion 112 of the track 71 of the cam 70 to a position designated e in alignment with the straight line portion 113 of the track 71 whereupon continued rotation of the cam 70 causes the follower 72 to traverse said track portion 113 which holds the horizontal position of the tone arm 33 in position to commence playing a 10 inch record.

On the other hand, in the event a 12 inch record is in the playing position the feelers 95 and 96 in their distended position shown in Fig. 5 of the drawings do not engage said 12 inch record edge-wise thereof as in the case of the 10 inch record but do engage upon the face of the record. The result of this is that continued inward movement of the tone arm 33 is not interfered with and the

follower 72 instead of traversing the cam track portion 113 will continue to traverse the angular track portion 112 to the dotted line position designated *f* in Fig. 4 thus causing the tone arm 33 to continue to travel inwardly to a point slightly past the 10 inch circumference. At this point follower 72 traverses the cam track portion 114 which operates to return the tone arm 33 to the 12 inch playing position prior to actuation of the rod 40 for elevating or depressing the tone arm 33 as previously described.

In connection with the foregoing, it is to be noted that at the intersection of the cam track portions 112 and 113 of the cam 70 there is provided a hinged or pivoted gate member 115 which is urged by a spring 116 clockwise into the position shown in Fig. 4 of the drawings and operates normally to prevent entrance of the follower 72 into the 10 inch record track portion 113 except in instances where the feelers 95 and 96 horizontally position the tone arm for playing a record of that size, the strength of the spring 116 being such as to confine travel of the follower 72 to the track portion 112 for 12 inch records yet sufficiently yielding to allow follower 72 readily to enter the track portion 113 in the case of a 10 inch record. Similar gate members 117 and 118 biased by springs 119 and 120 are provided at the intersections of the cam track portions 114 and 113, and these function normally to confine travel of the follower 72 within the track portion 113 in the case of 10 inch record operation while permitting the said follower 72 readily to pass crosswise in the course of traversing the cam track portion 114 in the case of 12 inch record operation.

As the cam 70 approaches 0° (or 360°) the follower 72 passes again into the large triangular portion 110 from either the cam track portion 113 or the cam track portion 114 depending upon whether the feelers 95 and 96 have operated to position the tone arm 33 to play a 10 inch or 12 inch record, respectively. Simultaneously the pin 74 under the influence of the radial depth of the cam track 71 operates through the control arm 32 and sleeve 38 to move the feelers 95 and 96 to the contracted position shown in dotted lines in Fig. 5 and the cam follower 46 then moves onto the surface 31 or 32 of the cam 29 causing the tone arm 33 to be lowered or raised in the vertical direction to engage the stylus with a record, the shaft 25 and cams 29 and 70 then come to rest while inward traverse of the tone arm 33 takes place under the control of the groove of a record while playing the same.

It is to be noted that the position in which the cam member 29 is fixed circumferentially upon the shaft 25 for rotation therewith is such that when the said shaft 25 and cam 29 are at rest (i.e. during the playing of a record) the follower 46 carried by the lever 45 is in engagement either with the depressed cam surface 32 of said cam 29 or the raised cam surface 31 thereof, and that arrangement is such that the follower 46 leaves the depressed or raised surface 31 or 32 at the start of rotation of the shaft 25 upon engagement of the clutch C. At such time the follower 46 passes onto the common or neutral surface 30 of the cam 29 thereby operating through the lever 45 and rod 40 to return the tone arm 33 vertically to the neutral position shown in Fig. 5 of the drawings, following which the tone arm 33 is swung outwardly by rotation of the sleeve 37 effected by control arm 83 actuated by the cam 70. This positions the tone

arm 33 outwardly of the periphery of the record discs in a neutral position vertically therebetween.

The above operations occur successively when the device is set for fully automatic operation, the stylus carried at the free end of the tone arm 33 successively engaging first the lowermost side of the upper record, then the topmost side of a lower record, then the lowermost side of a second upper record, and so on. When automatic operation in this manner is not desired, means are provided to prevent horizontal oscillation of the lever 45 so that its follower 46 is retained in engagement with one or the other of the surfaces, usually the surface 31, of the cam 29. Thus, as shown in Fig. 3 of the drawing, a latch 121 is pivoted at 122 at the underside of the panel 1 and is arranged to engage the previously described end portion 55 of the lever 45. An appropriately marked manual control button 123 is provided at the upper side of the panel 1 and connected thereto is a control finger 124 which carries a pin 125 that is arranged to engage with a detent or recess 126 in the latch 121. The manually operative button 123 may operate either to maintain the latch 121 in a position disengaged from the lever 45 as shown in solid lines or in restraining engagement therewith as illustrated in dotted lines.

In this latter position horizontal movement of the lever 45 to selectively position the follower 46 with respect to the cam surfaces 31 and 32 is precluded and the follower 46 is held at all times in position for engagement with the raised cam surface portion 31 with the result that following each rotation of the cam 29 the lever 45 will be vertically pivoted in the counterclockwise direction with respect to Fig. 5 of the drawings, thereby actuating the rod 40 upwardly with resulting counterclockwise movement of tone arm 33 to engage its stylus upon the top surface of a record on the turntable 2. The peculiar shape and flared end 55 of the lever 45 permits engagement thereof by the latch member 121 notwithstanding vertical pivoting of the lever 45 about its pivot 50. Appropriate designations "single" or "double" may be fixed on the panel 1 and the button 123 provided with a suitable indicating pointer 127 to facilitate the described selective positioning of the latch 121. In addition, suitable indicating means may be provided to indicate which record surface the stylus is going to engage in the case of double-sided operation of the machine.

As previously stated, the record transfer mechanism constitutes an especially important feature of the present invention and referring to Figs. 9, 10, 11 and 12 of the drawings, a record transfer mechanism made according to the invention comprises a tubular spindle support structure 130 which is constructed and arranged to seat within the socket 18 provided coaxially of the turntable 2 by the thimble 11 and hub 17 of the gear 10. The spindle 130 is provided with diametrically arranged bayonet slots 131 that are releasably engaged by radial pins 132 secured to said hub 17, and the spindle 130 is rotationally driven thereby in the direction opposite to rotation of the turntable 2 and at the same rate of speed as said turntable as and in the manner previously described herein. Coaxially arranged within the socket 18 provided in the thimble 11 is a coil spring 133 which acts between the base of the socket 18 and a thrust disc 134 to urge the spindle 130 upwardly and thereby retain the

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pins 132 against accidental disengagement from the bayonet slots 131, the spindle 130 being readily removable merely by exerting a downward thrust thereon against spring 133, then rotating the spindle a few degrees and finally lifting it upward and out of the socket 18.

With reference particularly to Figs. 9 and 10 of the drawings, it is to be noted that the spindle 130 has approximately its lower half portion 135 disposed truly coaxial with respect to the rotational axis of the turntable 2. Above this coaxial lower portion 135, the spindle 130 has a portion 136 that is inclined outwardly at a small acute angle with respect to the vertical and then has a portion 137 thereof disposed slightly offset from the axis and extending vertically upward from said inclined portion 136 so that the upper end of the spindle portion 137 provides an offset support or shoulder 138 with respect to the base of the spindle. Fixedly secured within the spindle offset 137 is a plug 139, and supported in spaced relation above said offset as an extension of plug 139 through a connecting portion 140 of reduced cross-sectional area, is a post 141 which is disposed truly coaxial with the axis of the spindle lower portion 135.

It is to be noted that the space vertically between the offset support or shoulder 138 and the post 141 is slightly in excess of the thickness of a record disc, and operable within this space is the slotted displacing foot 142 of a record discharge element 143 that is pivotally mounted upon a pin 144 disposed crosswise of a vertical slot 145 in the aforesaid plug 139 and has an arm portion 146 extending downwardly within the spindle portion 136 a substantial distance below the said plug 139. Carried by the discharge element 143 at the lower end thereof is a bow spring 147 which is arranged to engage the interior wall of the spindle 130 and urge the element 143 in the clockwise direction with reference to Fig. 10 so as normally to maintain the displacing foot 142 thereof within the peripheral confine of the post 141. As illustrated, the post 141 is adapted to receive a stack of records which rest or are supported upon the shoulder 138 with the central opening of the lowermost record of the stack surrounding the foot 142 (see Fig. 10). An inverted turntable in the form of a lightweight disc 148 is telescoped upon the post 141 and rests upon the stack of records to maintain the same in accurate horizontal playing position for engagement by the stylus and this disc 148 is slidably keyed to the post 141 as indicated at 149 so that rotational movement of the latter is imparted to said disc and thereby to the records.

It will be apparent from the foregoing that discharge of the lowermost record of the elevated stack supported by the spindle shoulder 138 is accomplished by pivotal movement of the discharge element 143 in the counterclockwise direction against its spring 147 to cause the displacing foot 142 thereof to move in the same direction into the position shown in Fig. 9 of the drawings thereby disengaging the lowermost record from the shoulder 138 and positioning the central opening of such discharged record in alignment with the spindle offset portion 137 so that said record will travel down the spindle under the influence of gravity and be deposited in playing position upon the turntable 2. By making the foot 142 in the form of a disk substantially the diameter of the spindle it will be apparent that an extensive surface area is pro-

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vided peripherally of the foot for engagement with the central opening wall of the records thereby minimizing chipping or cracking thereof which might occur in the event the records were engaged by elements having relatively small contact area.

In connection with the discharge of records by the displacement foot 142 it is pointed out that when a full stack of records is on the spindle 130 the pressure exerted by the weight of the stack upon the bottom record is substantial and if not relieved makes discharge of the bottom record difficult and sometimes impossible. To overcome this, the foot 142 is given a height or vertical thickness sufficient to cause the upper surface 142a thereof to engage beneath the next to lowermost record with a force sufficient to lift the stack and relieve the weight and pressure thereof from the lowermost record as it is engaged by the leading peripheral edge portion 142b of the foot to discharge the same. The upper surface 142a of the foot is curved or sloped outwardly to the leading peripheral edge 142b as shown in order to enable the said edge 142b to clear beneath the next to lowermost record and to bring said upper surface 142a smoothly into engagement beneath said next to lowermost record.

Furthermore, it is to be noted that the slotted configuration of the displacement foot 142 forms spaced vertically extending edges in the peripheral contact surface 142b thereof and to eliminate the possibility of damage to the record the construction shown in Fig. 14 of the drawings may be employed if desired. In the construction of Fig. 14, the slot opening in the foot 142 is closed by means of a spring clip or similar band or strip 142c suitably secured in place, for example, by means of fingers at opposite ends thereof which resiliently engage within recesses provided in the peripheral surface of the foot as shown. In this manner the foot is provided with an uninterrupted or continuous peripheral surface of substantial extent and area for contact with the defining wall of the central spindle opening in the records thereby insuring elimination of the possibility of damage and injury to the records.

Pivotal movement of the discharge element 143 to disengage a record as described is effected in the present embodiment of the invention by means of a cam rod 150 which is mounted for vertical sliding movement within the spindle 130 upon a cross pin 151 that passes through a slot 152 in said rod. The cam rod 150 at its upper end has an angularly disposed flat face 153 which is arranged to engage a lug 154 on the discharge element 143 and activate the latter counterclockwise upon upward actuation of the cam rod 150, the spring 147 carried by said element 143 operating normally to maintain said cam rod 150 at the lower limit of its vertical traverse.

Actuation of the cam rod 150 in turn is effected by means of a push rod 155 which is slidably mounted coaxially in the spindle supporting thimble 11 and has its upper end engaged with the lower end of the said cam rod 150 and has its lower end in contact with a cam member 156. The cam 156 is slidably keyed upon the aforesaid drive shaft 25 and hence the said cam 156 will be rotated one complete revolution each time that the clutch C is engaged in the manner previously described herein.

It will be obvious, of course, that in the case of so-called "double" operation wherein the stylus of the tone arm 33 successively engages

first the lowermost side of the upper record, then the topmost side of a lower record, then the lowermost side of a second record, and so on, it will be apparent that the cam 156 should operate to cause the transfer of a record only every other cycle or, in other words, every other time that the clutch C is engaged to rotate the shaft 25 and its control mechanisms through two complete successive revolutions. On the other hand, in the case of so-called "single" operation, such as only the upper surfaces of successive records deposited on the turntable 2, it will be obvious that it is necessary a record should be deposited by the transfer mechanism onto the turntable 2 each successive cycle of operation of the device or, in other words, each time that the clutch C is engaged to rotate the shaft 25 and the control cams thereof through a single complete revolution.

To take care of this, the cam 156 is slidable upon the shaft 25 and its raised or nose portion 157 has an axial thickness or width just one-half that of the cam so that it may be moved into and out of the path of the push rod 155 as required. Thus, in Fig. 9 of the drawings, the cam 156 is axially positioned so that its raised or nose portion 157 is engaged with the push rod 155 to urge the latter upward and effect discharge of a record from the offset or shoulder 138 in the manner previously described, and with the cam in this position axially of the shaft 25 it will be apparent that upon each rotation of said shaft 25 that the cam 156 will operate to actuate the record discharge mechanism and deposit a record upon the turntable 2. On the other hand, it will be apparent that by shifting the cam 156 axially of the shaft 25 to the position shown in Fig. 3 of the drawings, the raised or nose portion 157 thereof is removed from the path of the push rod 155 so that the cam 156 may be rotated by the shaft 25 without actuating the push rod to effect discharge of a record from the spindle 130.

Therefore, to control the position of the cam 156 axially of the shaft to effect successive or alternate cycle operation of the record discharge mechanism, a link 160 is provided which is connected at one end to an extension 161 on the lever 45 and at its other end to a shifter rod 162 that is slidably guided in a bearing 163 at the underside of the panel 1. This shifter rod 162 has a laterally offset finger which is engaged with a shipper ring 164 associated with the cam 156 and arranged so that as the lever 45 is alternately swung horizontally clockwise with the yoke 51 under the actuating influence of the cam 60, as viewed with respect to Fig. 5, it will operate through the link 160 and rod 162 to axially shift the cam 156 to the position shown in said Fig. 3 so that the raised or nose portion 157 thereof is removed from the path of the spindle control push rod 155, the reverse or counterclockwise movement of said lever 45 operating through the same instrumentalities to axially reposition the cam 156 so that the raised nose 157 thereof is returned to the path of the push rod 155.

Thus with the knob 123 set for "double" operation of the phonograph and with the lever 45 free to move horizontally under the influence of the cam 60, the cam 156 will be effective only once in each two cycles of operation of the cam 29, whereas when the knob 123 is set for "single" operation in which the lever 45 is held against horizontal movement by the latch 121, the rods 160 and 162 will be ineffective to axially shift the

cam 156 with the result that it will remain in the position wherein its raised or nose portion 157 is disposed in the path of the transfer mechanism rod 155 which will be actuated thereby to cause discharge of a record at each operating cycle or every time that the clutch C is engaged to effect rotation of the shaft 25 and cam 156 through one complete revolution as described.

In addition to effecting automatic engagement of the clutch C as previously described herein, provision is made for manually engaging said clutch C as desired. To this end there is provided, as shown in Fig. 8 of the drawings, a knob or button 170 which is affixed to a vertically extending rod or shaft 171 that is slidably telescoped within a rotatable sleeve 172 supported in the panel 1 by a collar 173. The shaft 171 has a pin 174 which projects through a vertical slot 175 in sleeve 172 and when knob 170 is depressed this pin 174 is engageable with one arm of a bell crank 176 to rotate the latter counterclockwise about its pivot 177. The other arm of the bell crank 176 is connected to a link 178 which enters the clutch control box 101 to actuate the latter in the same fashion as does the link 100. By this construction it will be apparent that upon manual depression of knob 170 the clutch C will be engaged to thereby initiate the described operating cycle of the phonograph. In addition to the foregoing, the clutch C may be permanently disconnected to permit fully manual positioning, playing and changing of records. This is accomplished in the present instance by providing an arm 179 on the sleeve 172 and connecting to said arm a link 180 that also is connected with the aforesaid clutch control 101. Thus upon rotation of the knob 170 the sleeve 172 is correspondingly rotated to actuate link 180 and render the clutch C entirely inoperative.

While the operation of the present invention is believed to be entirely clear from the foregoing, a brief description with reference to a particular record set-up, such as shown diagrammatically in Fig. 13 of the drawings, is deemed to be desirable even at the expense of some reiteration. Thus, in the case of fully automatic operation of the phonograph and assuming that the clutch C is engaged thereby rotating shaft 25 through its single revolution and that the tone arm 33 is in its neutral position (designated *m* in Fig. 13) preparatory to playing the upper-side of a 10 inch record R on the turntable 2. As rotation of shaft 25 continues through its single revolution, the cams 29 and 70 thereon operate to cause the tone arm 33 to traverse an inwardly declining path until the projected feeler 96 contacts the upper surface of the next lower 12 inch record R¹ thereby limiting downward travel of the tone arm 33 to position *n* whereupon the cam 70 moves the arm 33 inwardly until the said feeler 96 engages the 10 inch record R edgewise thereof in the position *o* where it is held by the track portion 113 of cam 70 while the cam 29 operates to depress the tone arm 33 into the playing position *p* and playing of the record R commences. (If the record R¹ were a 10 inch instead of a 12 inch record, the position *n* would be eliminated and the tone arm 33 would decline inwardly from the position *m* until feeler 96, which is projected still further as continued downward movement of the arm 33 takes place, engages the surface of the turntable 2 and then is moved inwardly to engage the 10 inch records edgewise thereof, downward movement of the tone arm 33 being initially arrested

at a height above the turntable sufficient to maintain the tone arm stylus above the uppermost record of a limit stack thereon so that it is in position to be lowered into playing engagement with the surface of the record.

When playing of the record R is completed, the clutch C is again engaged and cams 29 and 70 operate to return the tone arm 33 from the inward position *q* to the neutral position *m*. Thereafter, continued rotation of the cams 29 and 70 through their single revolution causes the tone arm 33 to follow an upwardly inclined path until the feeler 95 contacts the lower face of the elevated 12 inch record R² thereby limiting upward travel of the arm to the position *s*. From this position the cam 70 through its track portions 112 and 114 causes the tone arm 33 to move inwardly to the position *t* and then return outwardly to the playing position *u*, the cam 29 cooperating in this latter movement to elevate the tone arm 33 into contact with the record R². Upon completion of the playing of the 12 inch record R² the arm 33 is returned from the position *v* to the position *m* by the cams 29 and 70 and at this time the cam 156 on shaft 25 operates to actuate the record transfer mechanism and eject the record R² thus causing it to travel down the spindle and be deposited upon the turntable 2 whereupon the described operations will be repeated to cause the tone arm 33 to be moved into playing position on the upper-side of the record R² which is then resting upon the turntable 2.

From the foregoing description it will be apparent that the present invention provides a novel and improved automatic phonograph of the character set forth having the conventional record turntable and an oppositely rotatable spindle structure extending coaxially of the turntable and adapted to receive thereon one or more records which are supported in an elevated position by an offset portion of the spindle and periodically ejected therefrom into alignment with said offset portion for travel by gravity down the spindle into playing position upon the turntable. The invention also provides an automatic phonograph of the character set forth having novel mechanism for controlling movement of the tone arm which is selectively operable to position the tone arm for playing one side only of one or a plurality of records or to position the tone arm for playing both sides of such one or more records.

The invention further provides a tone arm for automatic phonographs which incorporates novel detecting means operable to "feel" a record in either of its playing positions and determine and effect playing engagement of the tone arm stylus with the record in accordance with its diameter. The invention additionally provides a novel record transfer mechanism for automatic phonographs which is driven from the conventional drive of the phonograph turntable and includes means operable to effect the necessary lateral and vertical movements of the tone arm and to control the transfer of records in synchronization with movements of said tone arm.

While a particular embodiment of the present invention has been illustrated and described herein it is not intended to limit the invention to such disclosure and changes and modifications may be made therein and thereto within the scope of the claims.

I claim:

1. In a phonograph having a record turntable,

a transfer mechanism for supporting above said turntable a plurality of vertically superimposed records having an interface between adjacent records comprising a spindle mounted coaxially of the turntable and including relatively axially spaced apart and laterally offset intermediate and upper spindle portions providing a support for records received on said upper spindle portion, and discharge means including a displacement element operable between said intermediate and upper spindle portions and having a side surface portion arranged to engage the lowermost record in the stack to eject the same from said support and an upwardly curving top surface portion for entering the lowermost interface to engage the next to lowermost record and lift the same whereby the weight and pressure of the remainder of the stack of records is removed from said lowermost record during ejection thereof.

2. In a phonograph having a record turntable, a transfer mechanism for supporting above said turntable a plurality of vertically superimposed records having an interface between adjacent records comprising a spindle mounted coaxially of the turntable and including relatively axially spaced apart and laterally offset intermediate and upper spindle portions providing a support for records received on said upper spindle portion, and discharge means including a displacement element operable between said intermediate and upper spindle portions and having a vertical peripheral record contact surface arranged for engagement with the lowermost record in the stack to eject the same from said support and an upper surface inclining inwardly and upwardly from said vertical peripheral record contact surface, said inclined surface entering the lowermost interface to engage the next to lowermost record and move the same vertically upward during the ejecting movement whereby the weight and pressure of the remainder of the stack of records is removed from said lowermost record during ejection thereof.

3. In a phonograph having a turntable rotatable about an axis for sequentially playing a plurality of vertically superimposed records having interfaces between adjacent records, a spindle positioned coaxially with said turntable, a shoulder formed in said spindle spaced above the turntable for supporting the plurality of vertically superimposed records, displacing means movably mounted on said spindle and having a foot element, said foot element being positioned below the lowermost interface and having an inwardly and upwardly tapered portion extending above said lowermost interface, and means for moving said displacing element relative to the spindle to laterally move the lowermost record and move the tapered portion into the lowermost interface whereby the remaining plurality of records are moved vertically upward.

4. In combination with a spindle for supporting a plurality of vertically superimposed records having interfaces between adjacent records, means formed on said spindle for supporting said superimposed records, displacing means having a foot formed at one end thereof, one end of said foot being tapered inwardly and upwardly from a point on the foot, means for movably mounting said displacement means on said spindle with the point substantially in alignment with the lowermost interface, and means for moving the foot relative to the spindle to

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move the lowermost record laterally and to move the tapered portion into the lowermost interface whereby continuous movement of the foot portion moves the superimposed records vertically upward.

ALFRED E. COMSTOCK.

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