

No. 792,386.

PATENTED JUNE 13, 1905.

J. A. ARMSTRONG.
APPARATUS FOR PLAYING PIANOFORTES OR ORGANS.

APPLICATION FILED OCT. 27, 1904.

12 SHEETS—SHEET 1.

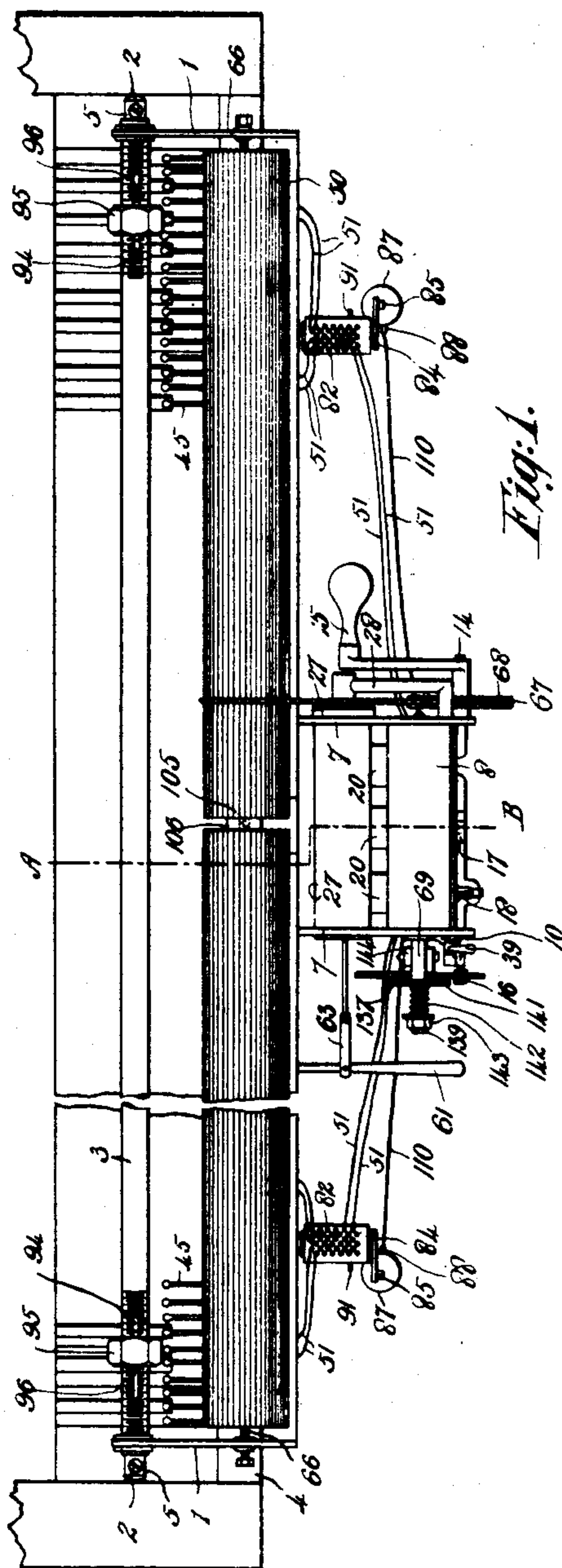


Fig. 1.

Witnesses.
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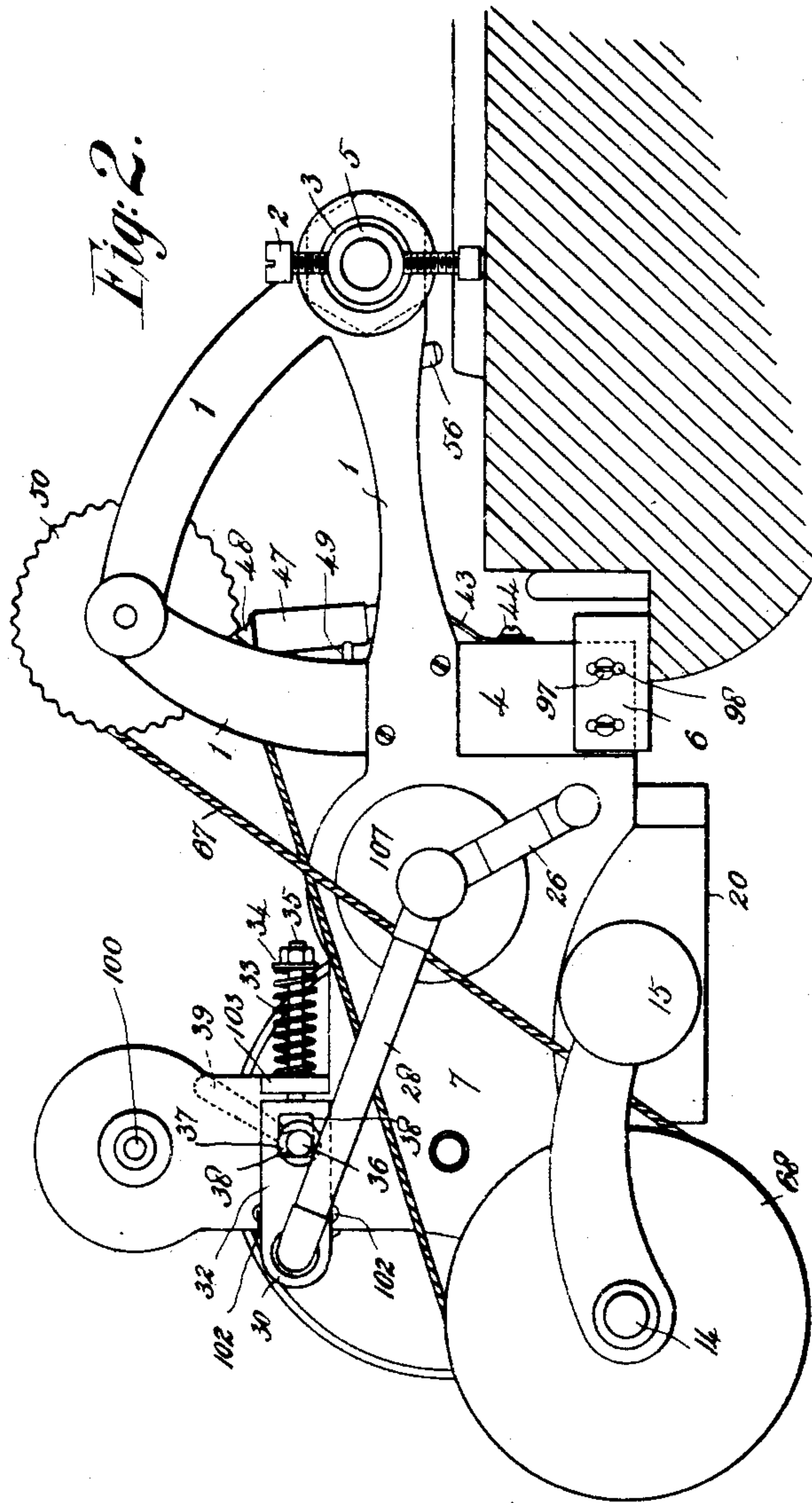
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12 SHEETS—SHEET 2.



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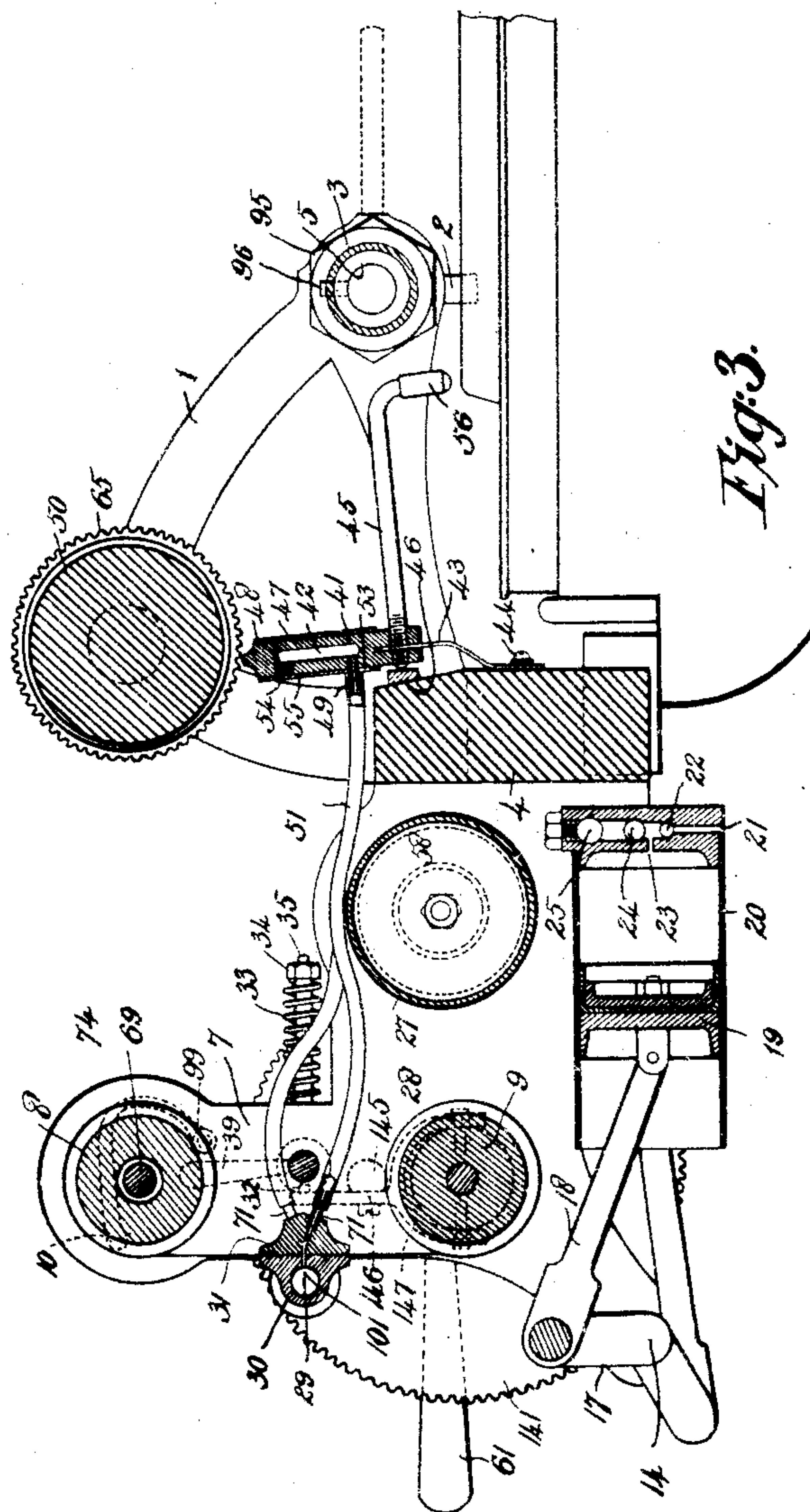
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12 SHEETS—SHEET 3.



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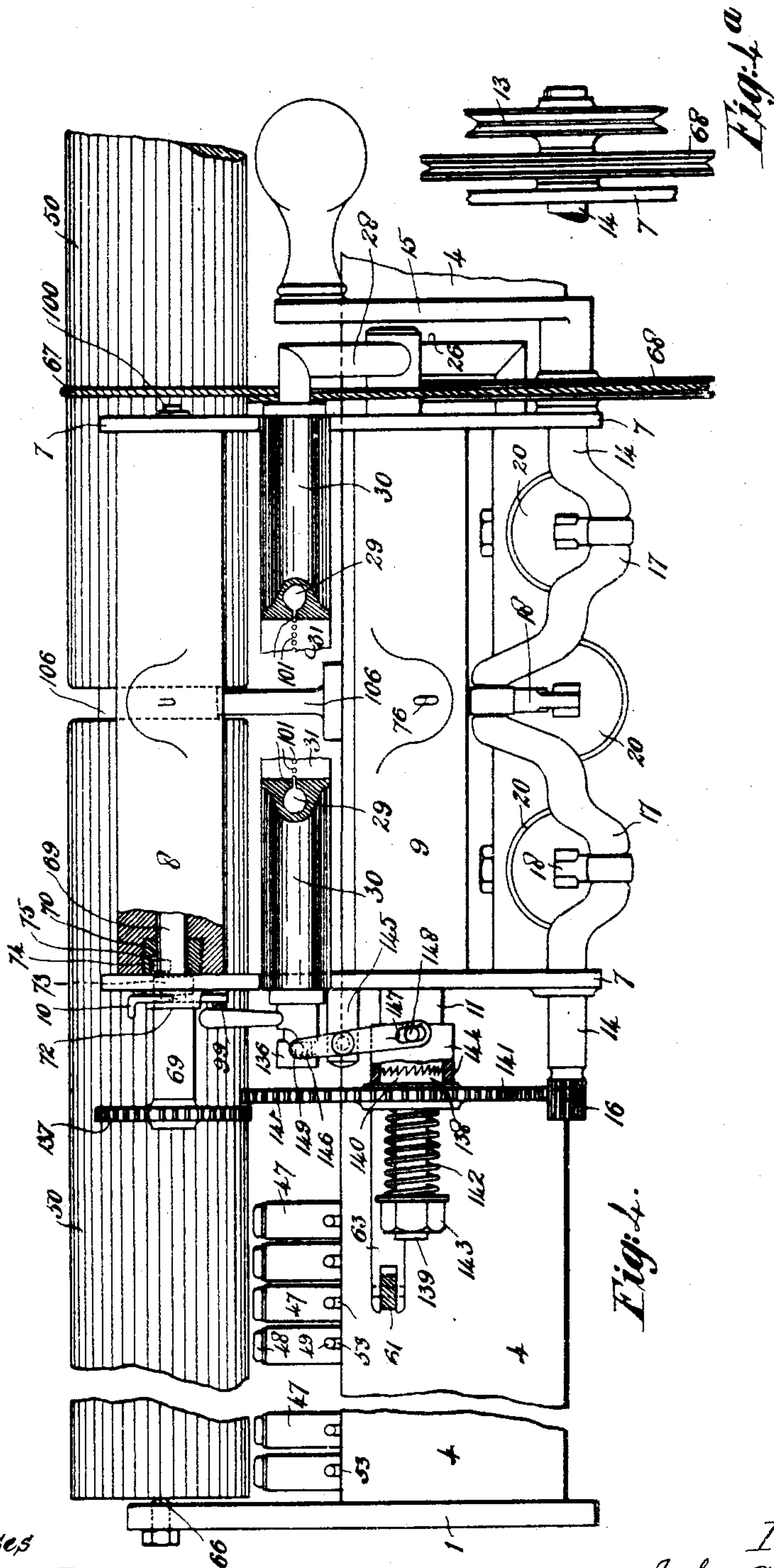
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12 SHEETS—SHEET 4.



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APPARATUS FOR PLAYING PIANOFORTES OR ORGANS.

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12 SHEETS—SHEET 5.

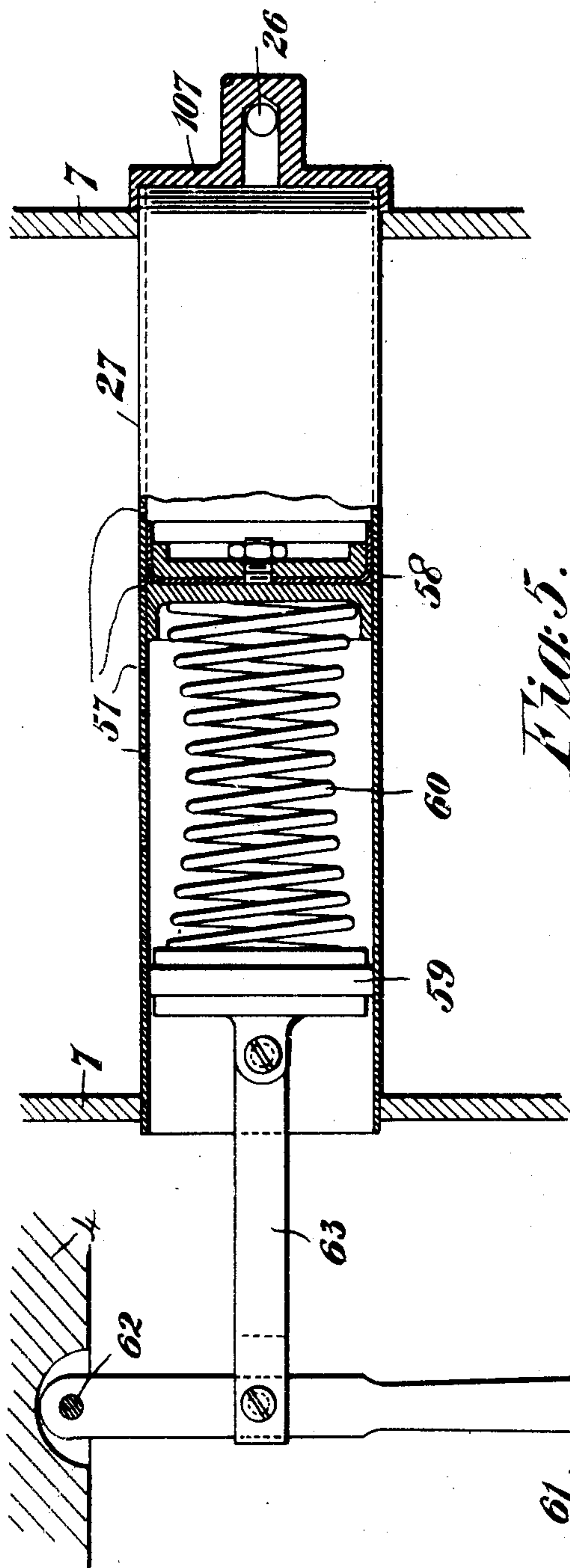


Fig. 5.

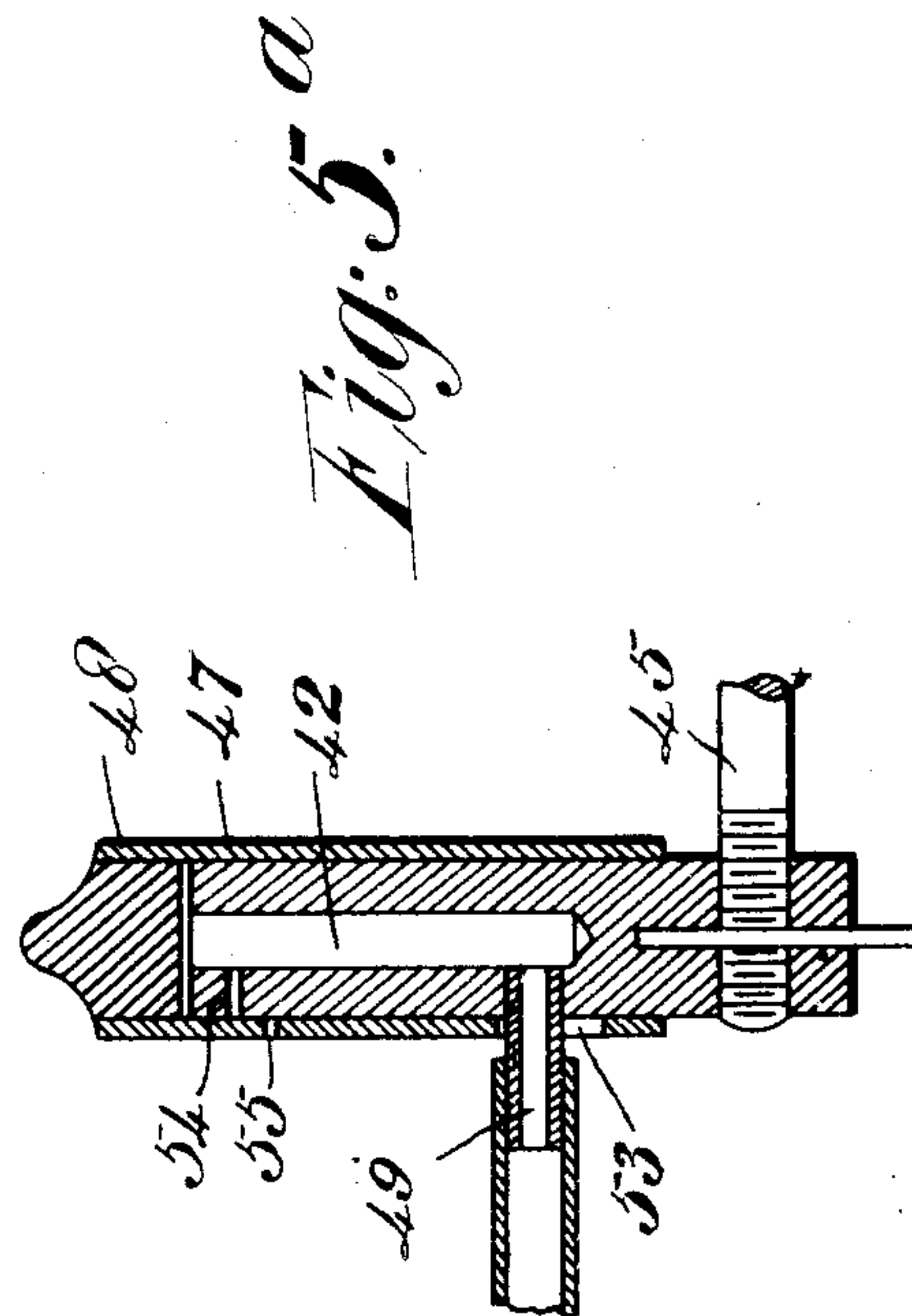


Fig. 5a

Witnesses
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12 SHEETS—SHEET 6.

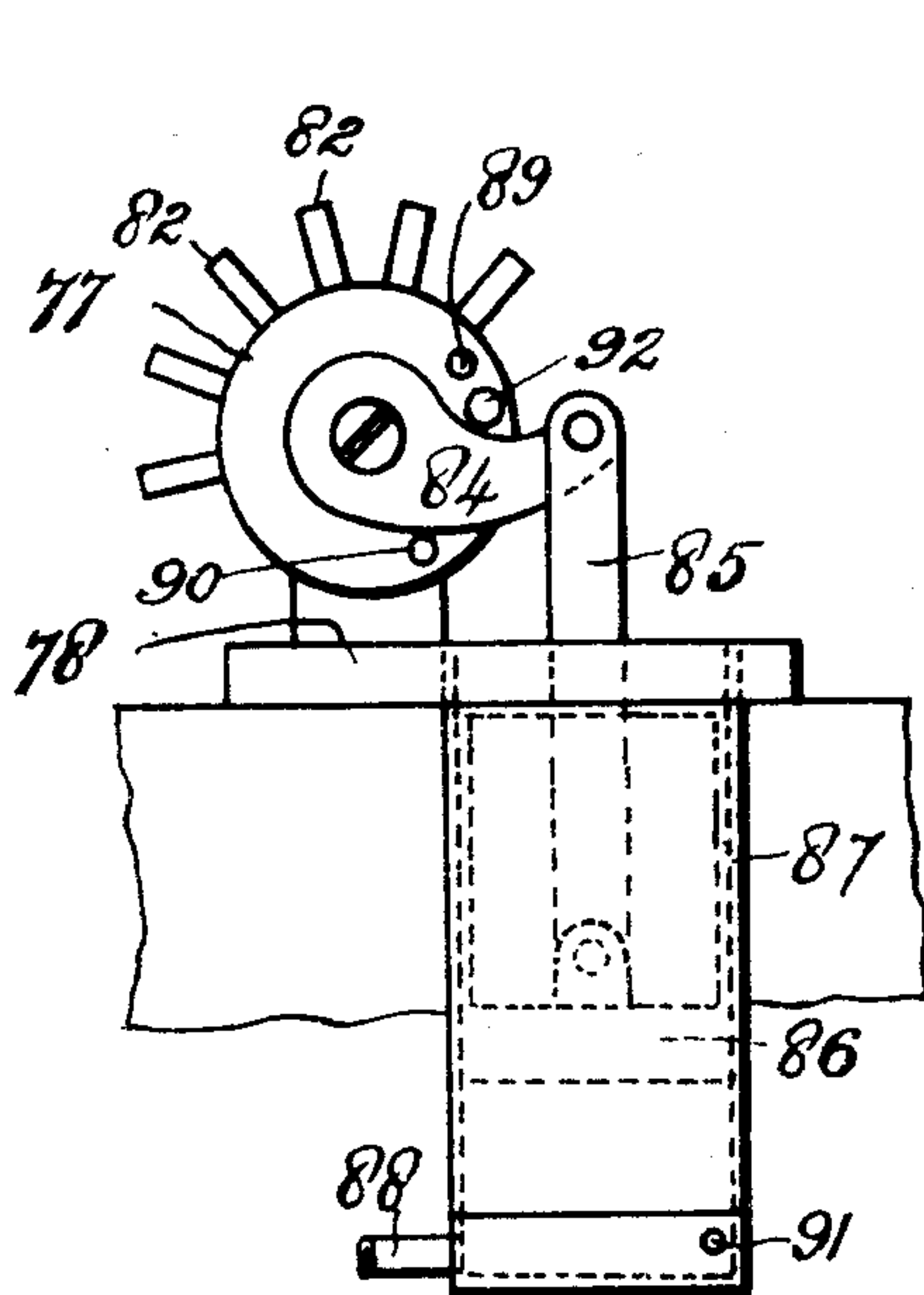


Fig: 6.

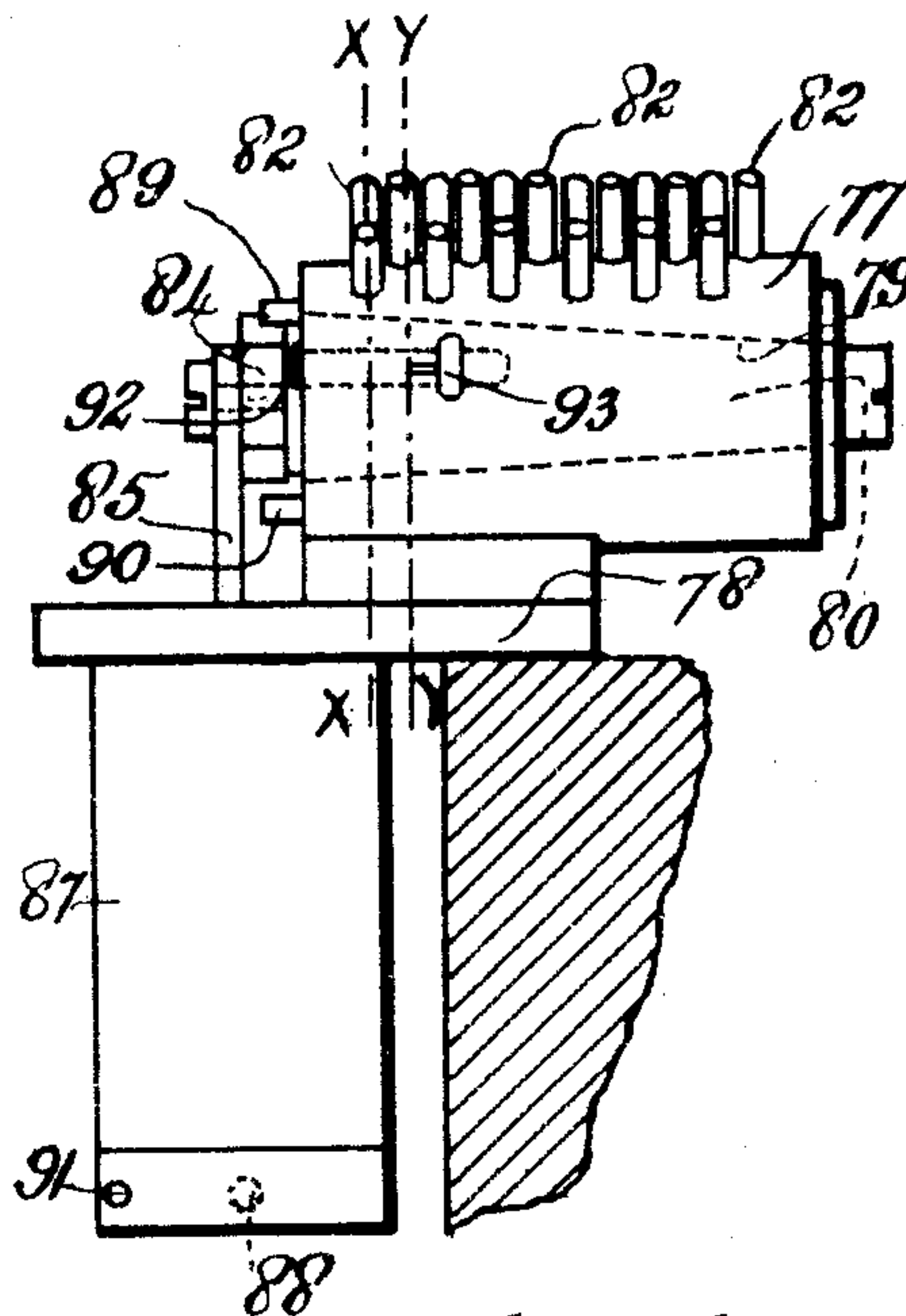


Fig: 7.

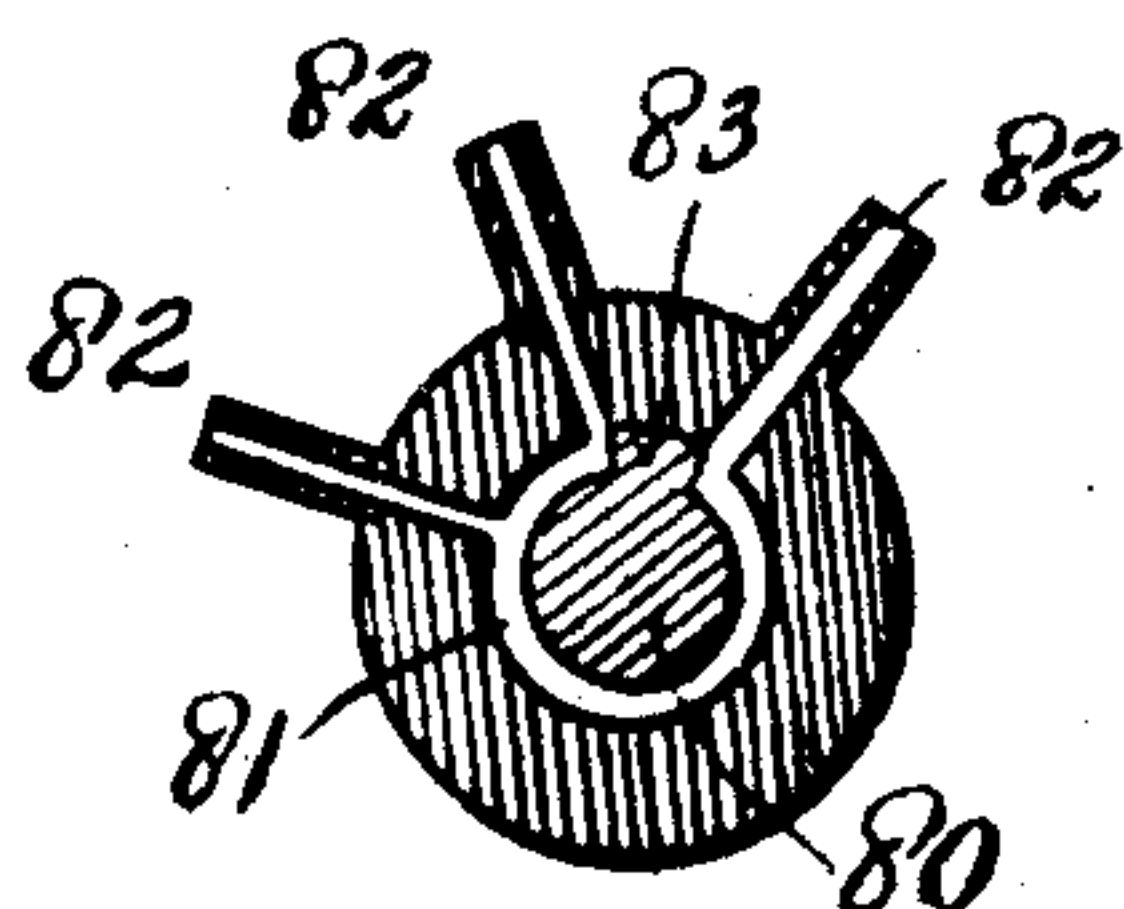


Fig: 8.

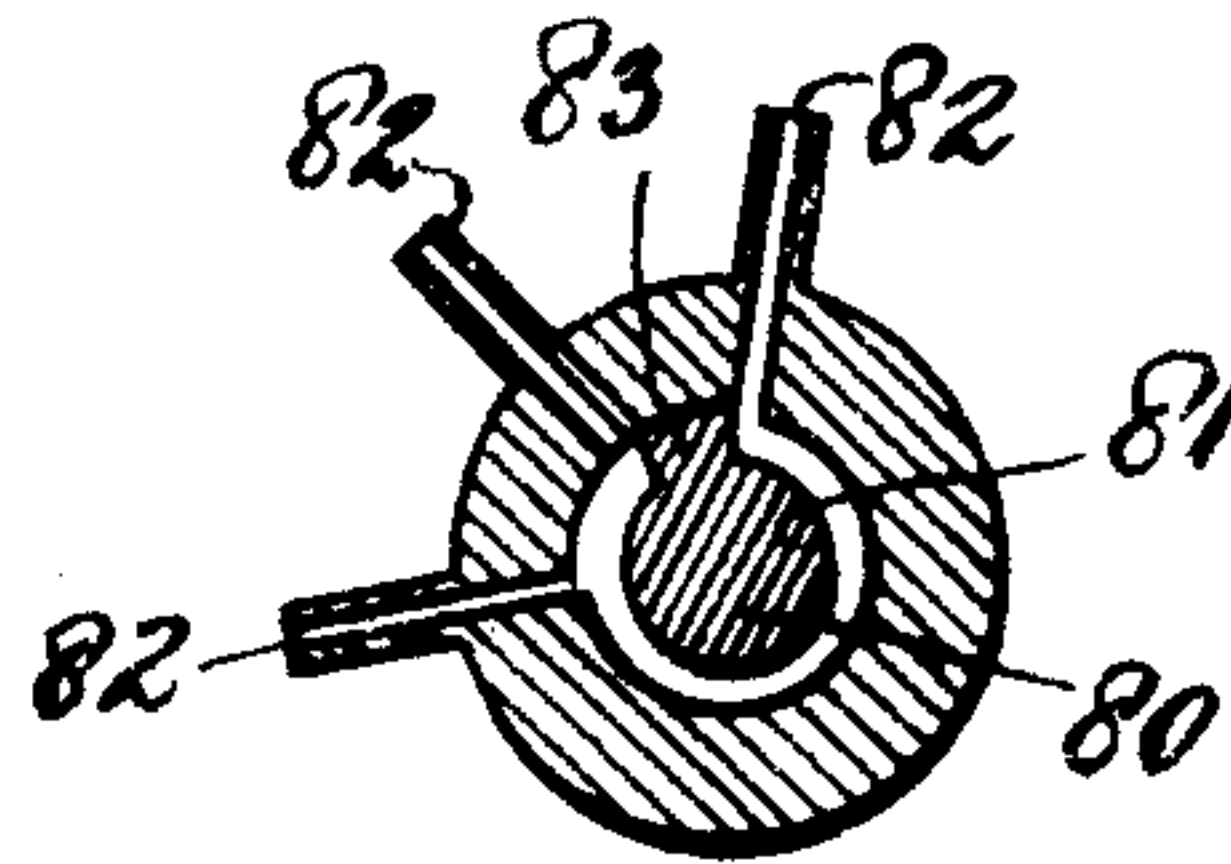


Fig: 9.

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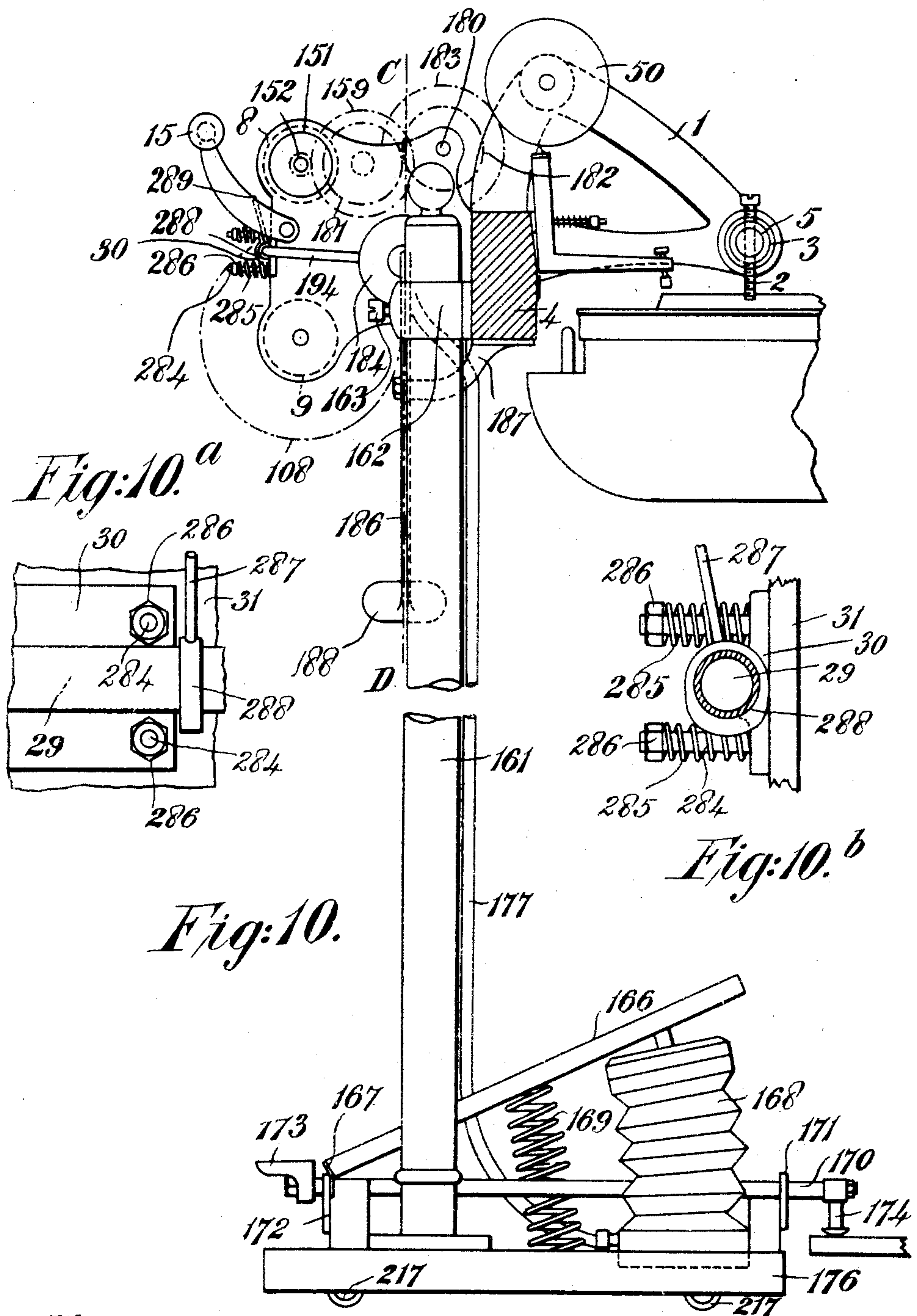
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12 SHEETS—SHEET 7.



Witnesses
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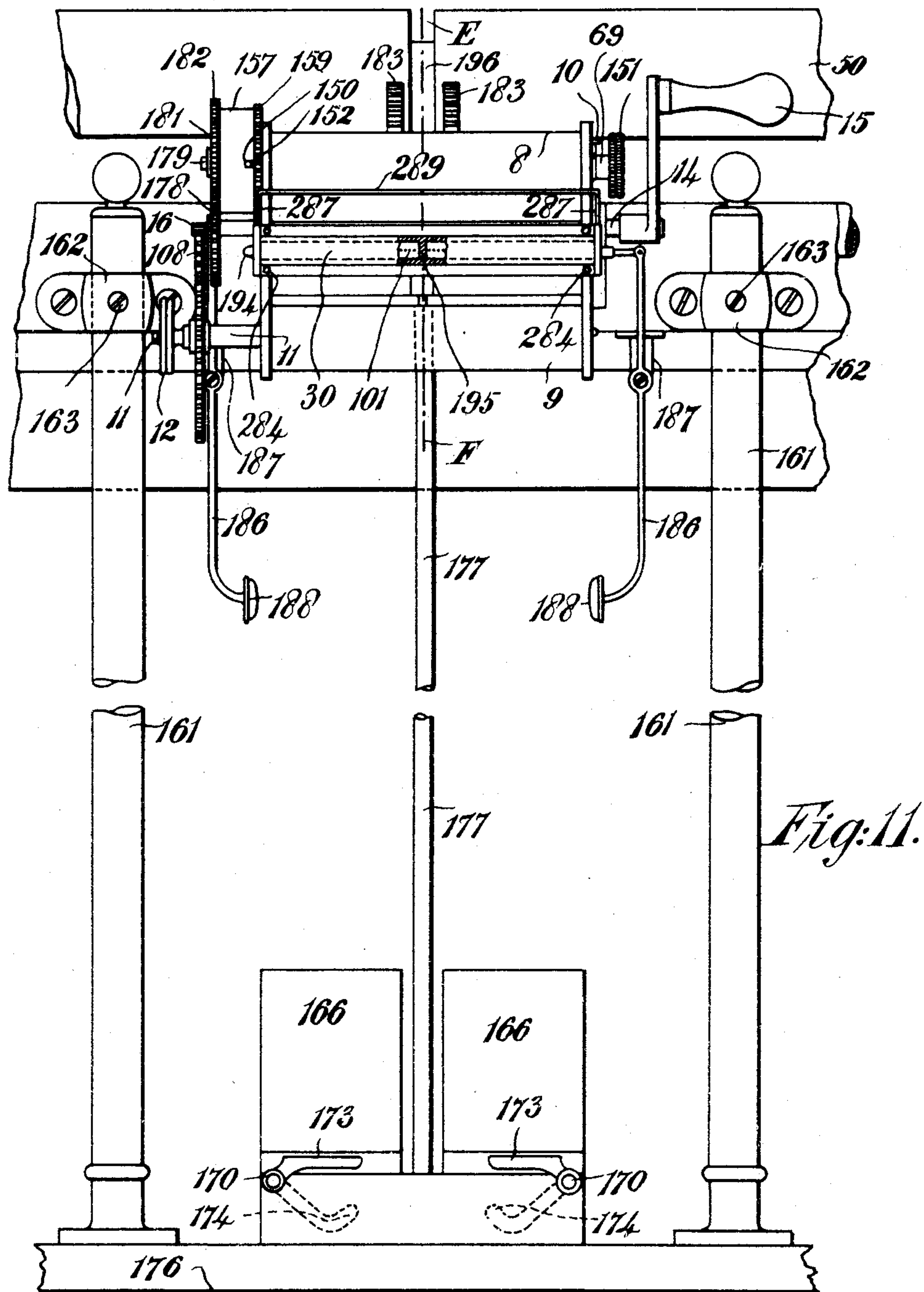
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APPARATUS FOR PLAYING PIANOFORTES OR ORGANS.

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12 SHEETS—SHEET 8.



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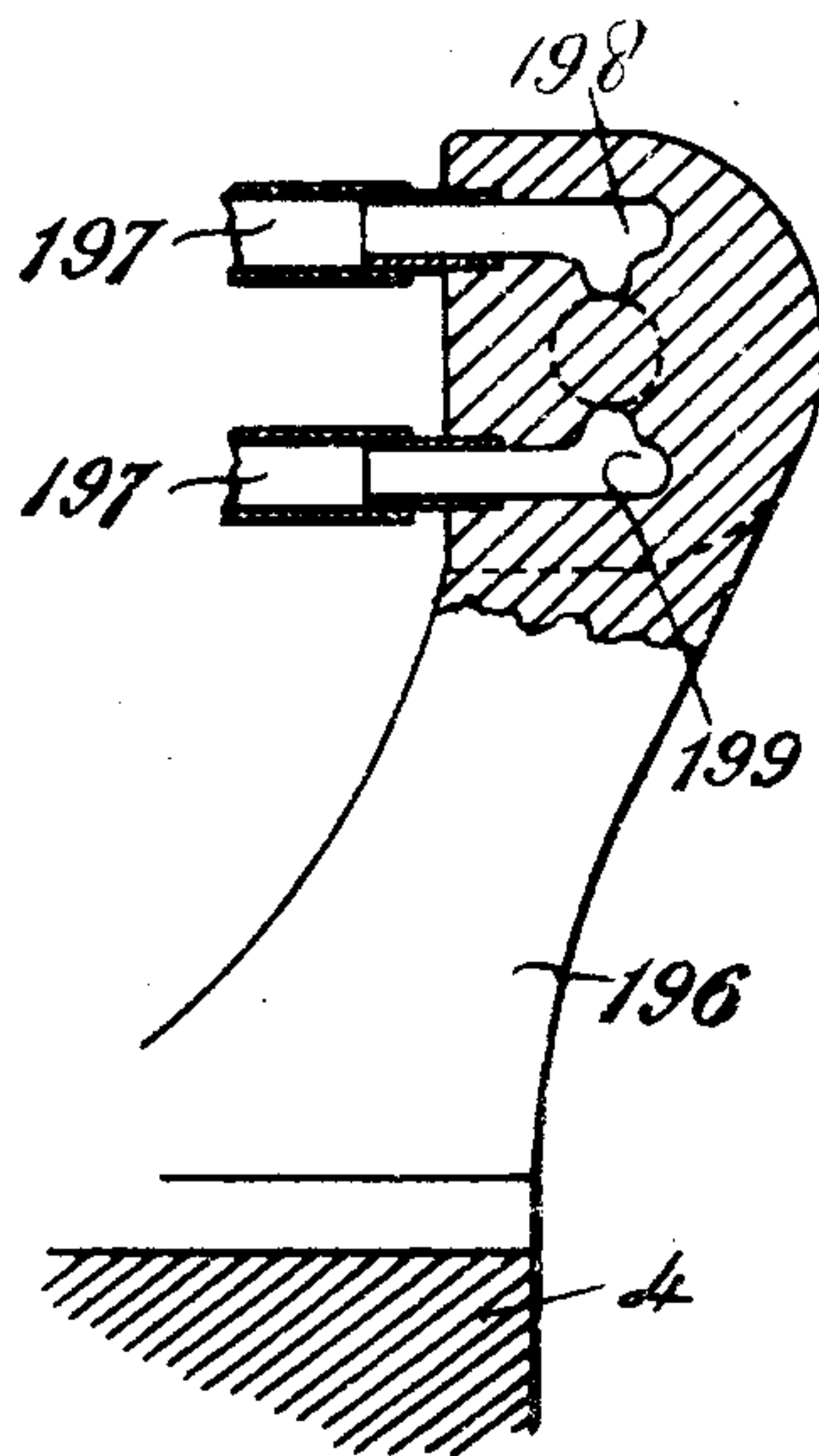
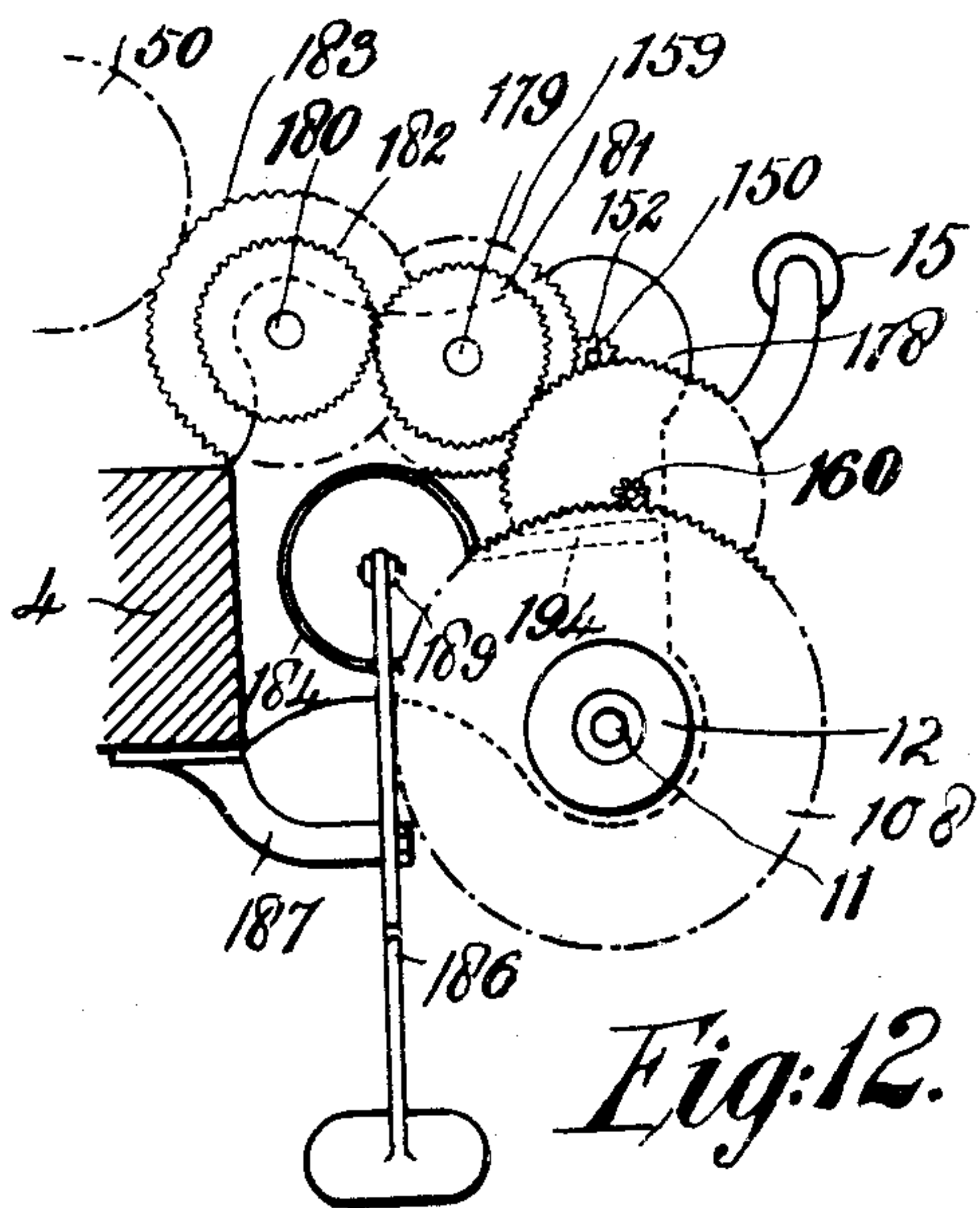
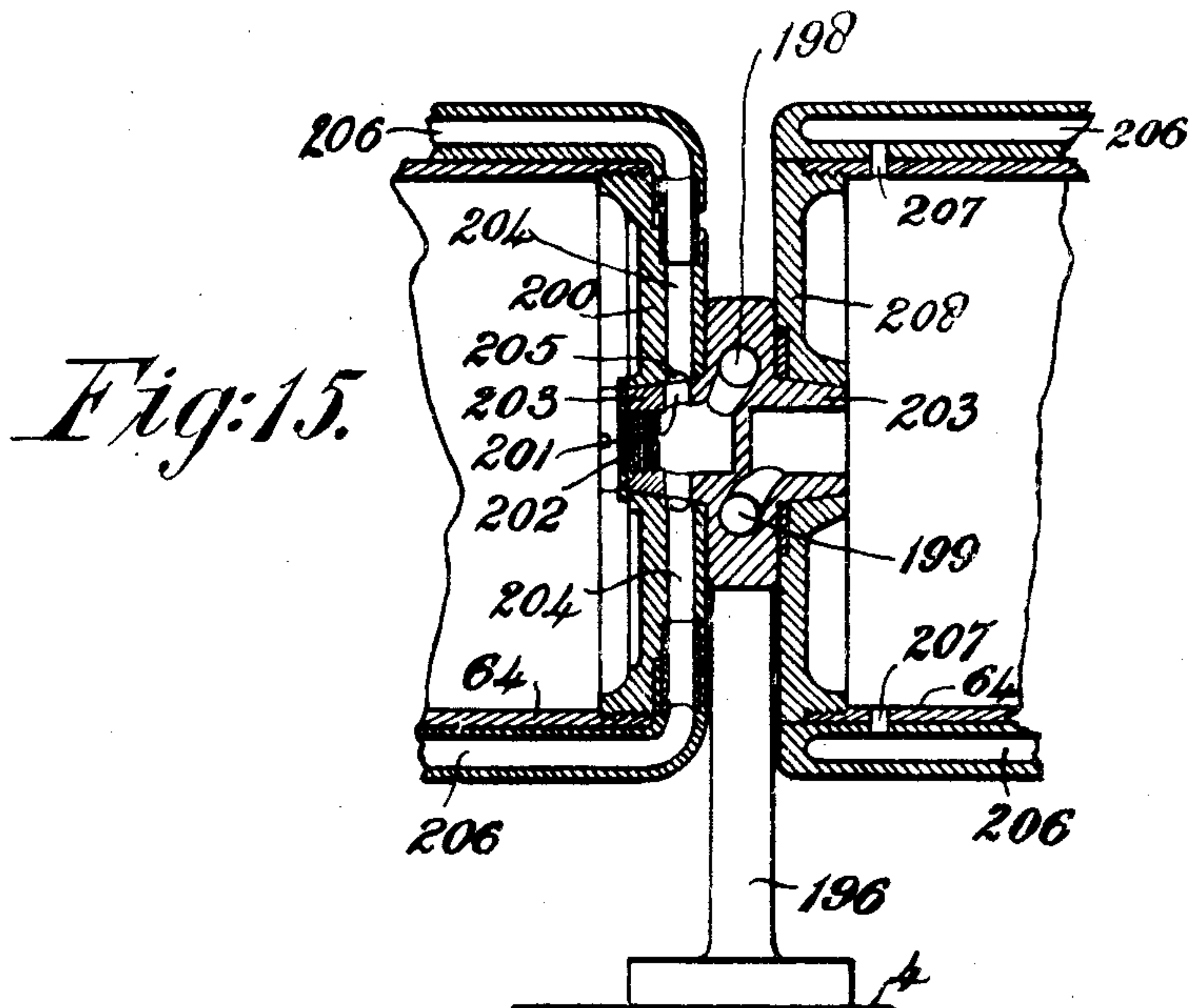
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APPARATUS FOR PLAYING PIANOFORTES OR ORGANS.

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12 SHEETS—SHEET 9.



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APPARATUS FOR PLAYING PIANOFORTES OR ORGANS.

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12 SHEETS—SHEET 10.

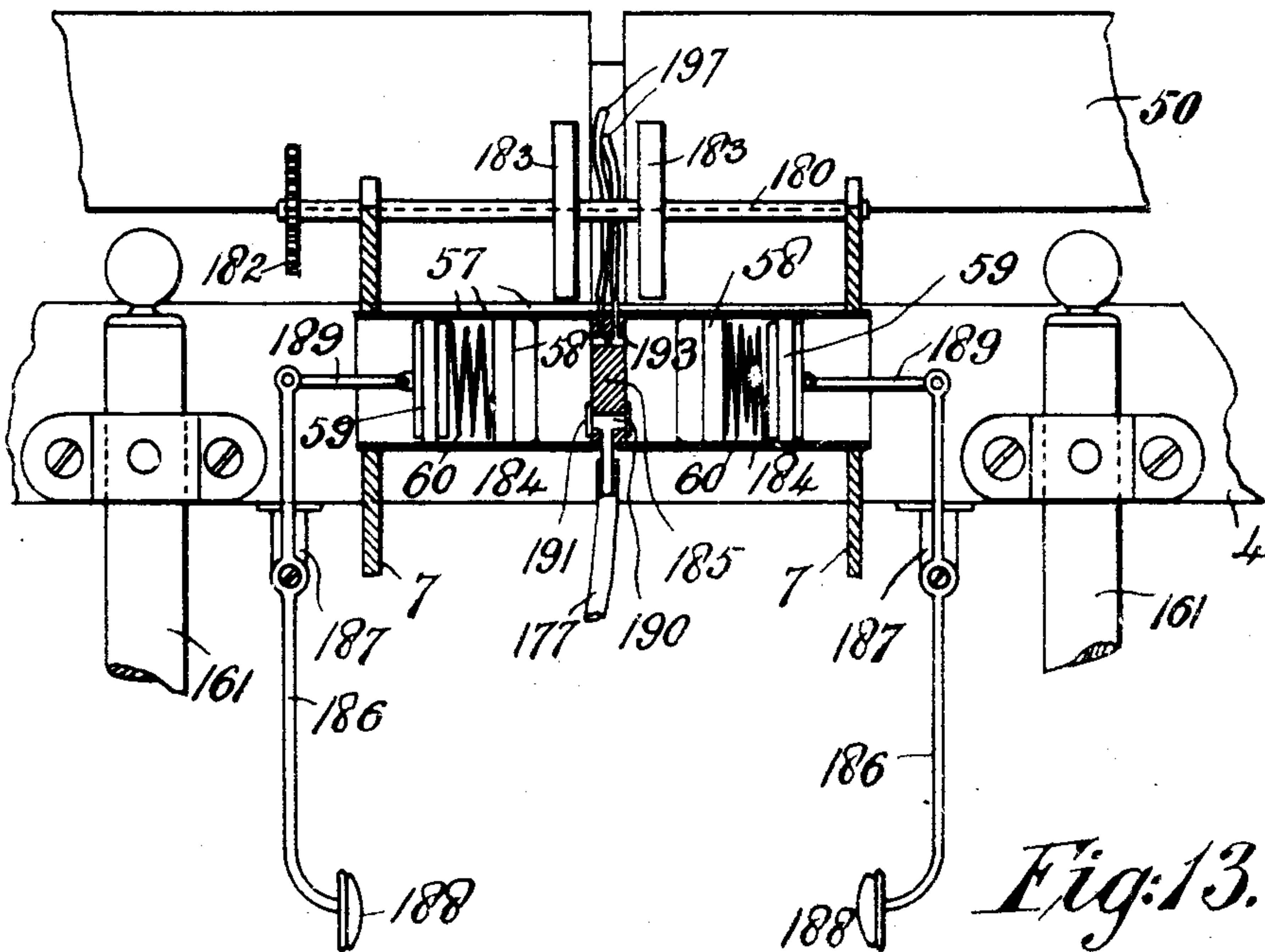


Fig:13.

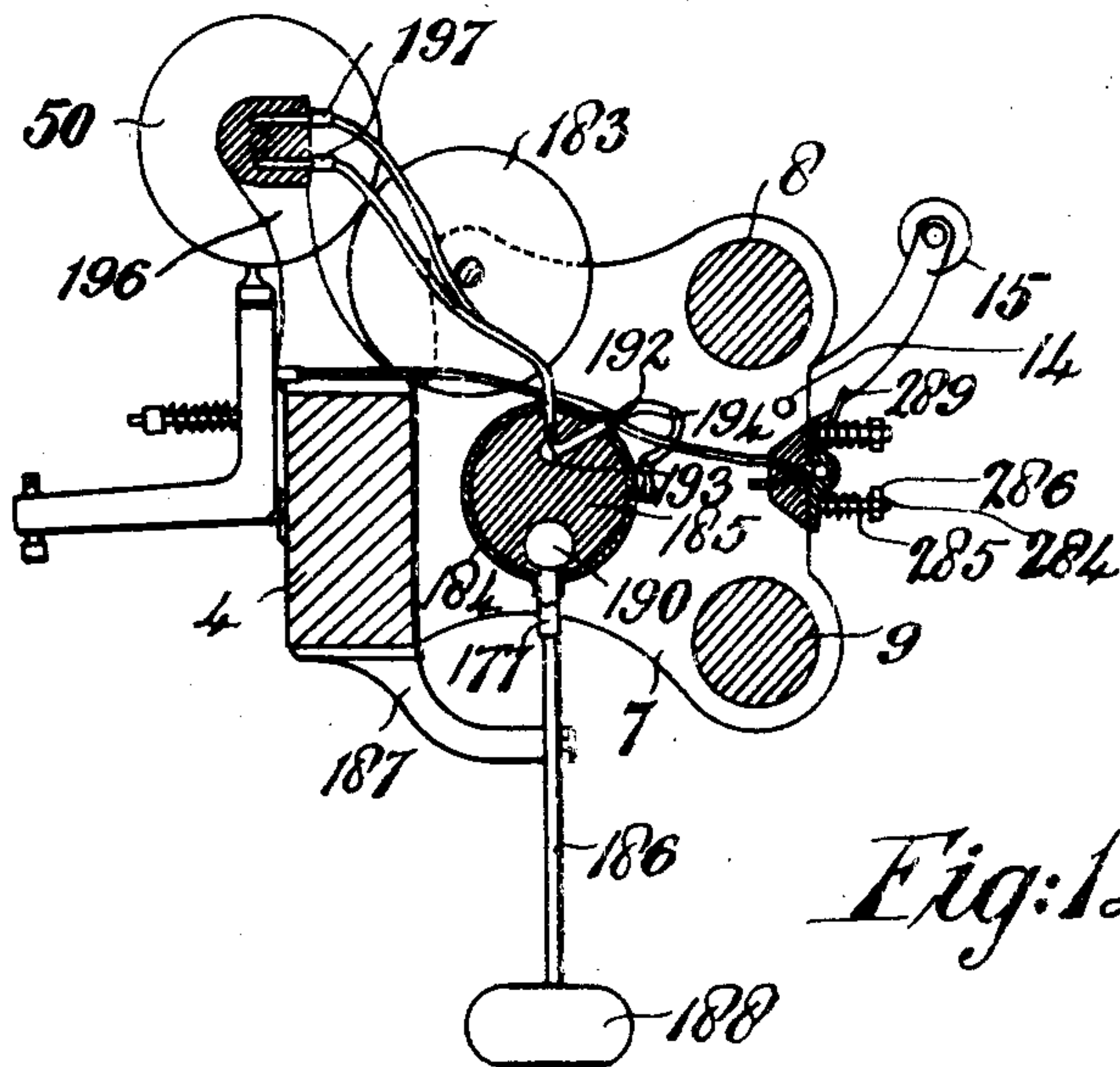


Fig:14.

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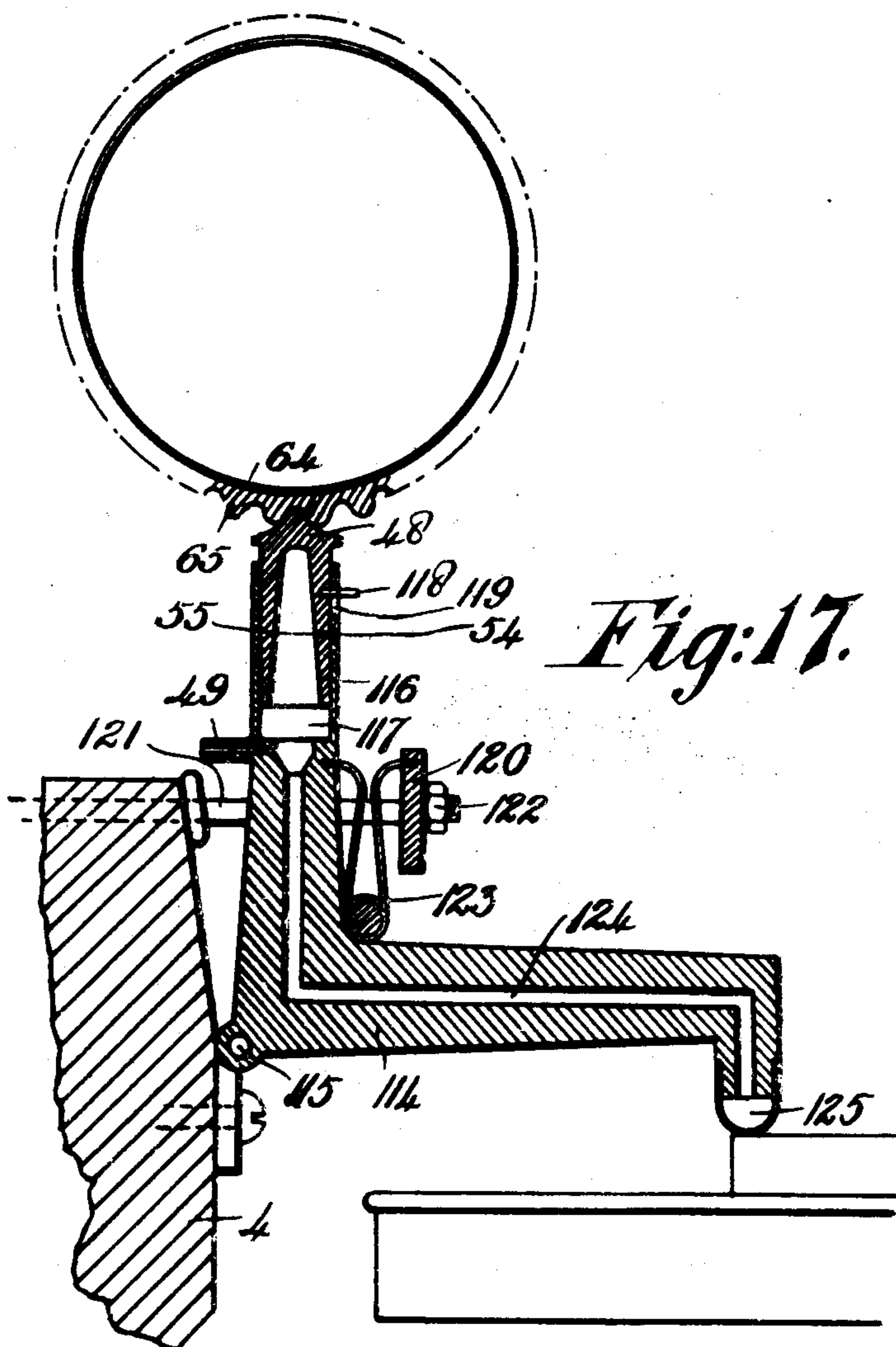
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APPLICATION FILED OCT. 27, 1904.

12 SHEETS—SHEET 11.



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APPARATUS FOR PLAYING PIANOFORTES OR ORGANS.

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12 SHEETS—SHEET 12.

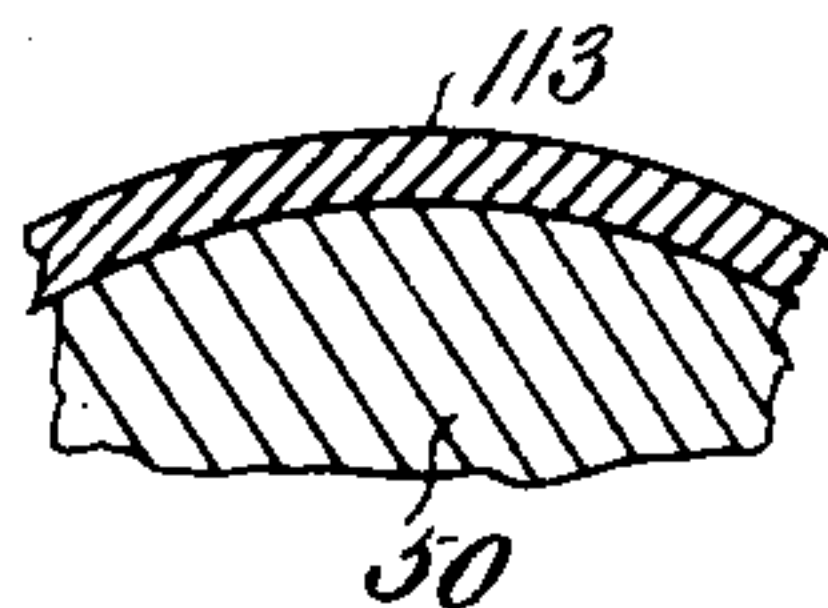


Fig:18.

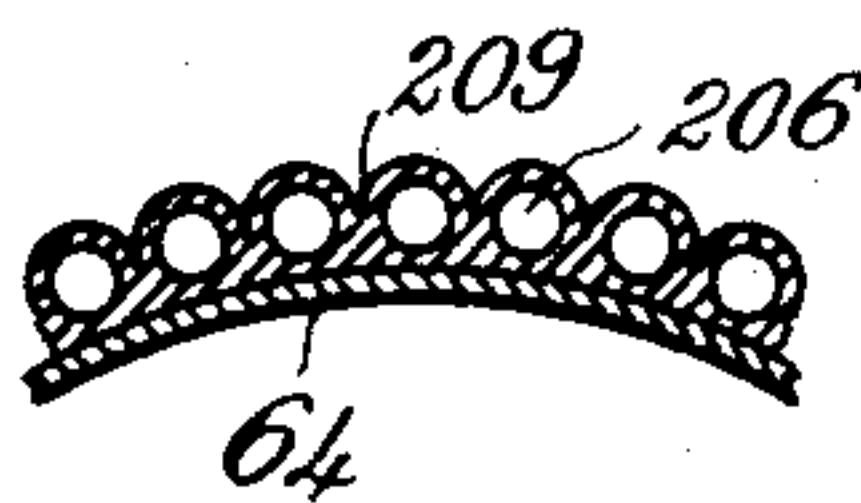


Fig:19.

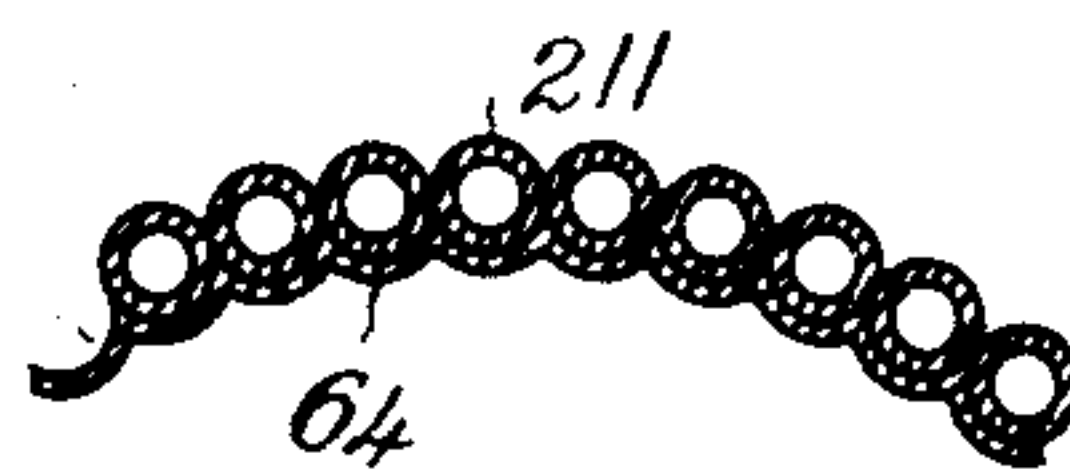


Fig:20.

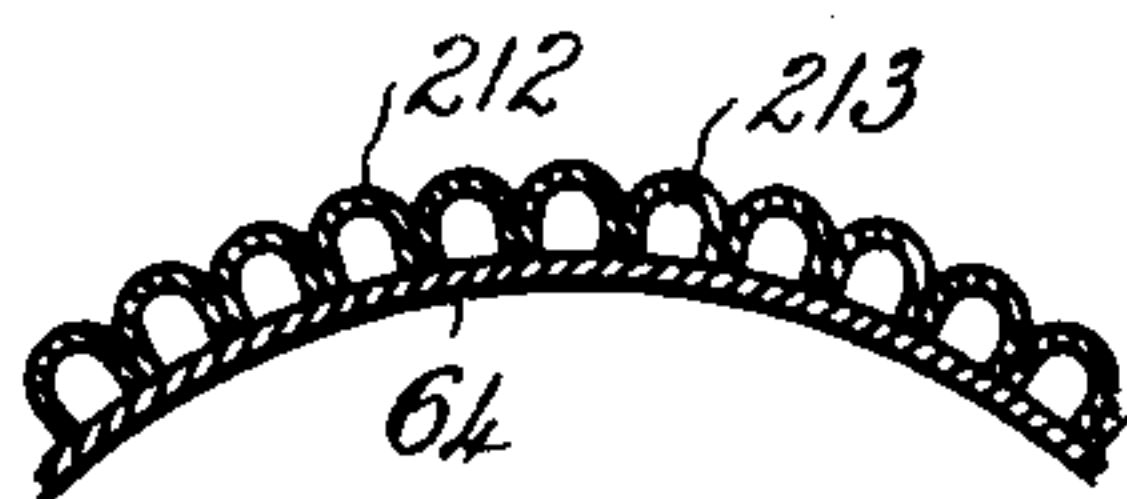


Fig:21.

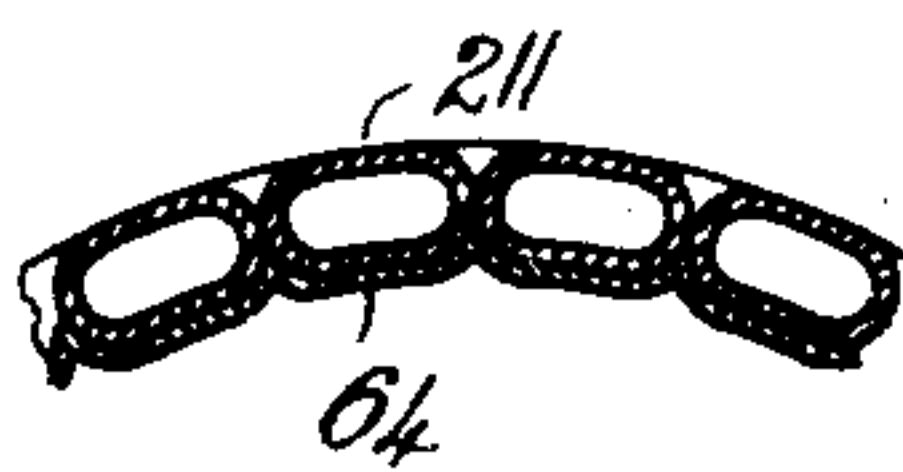


Fig:22.

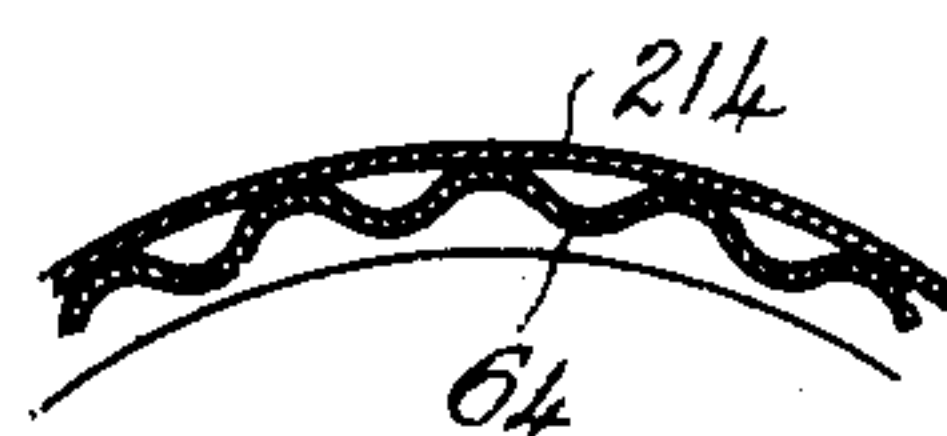


Fig:23.

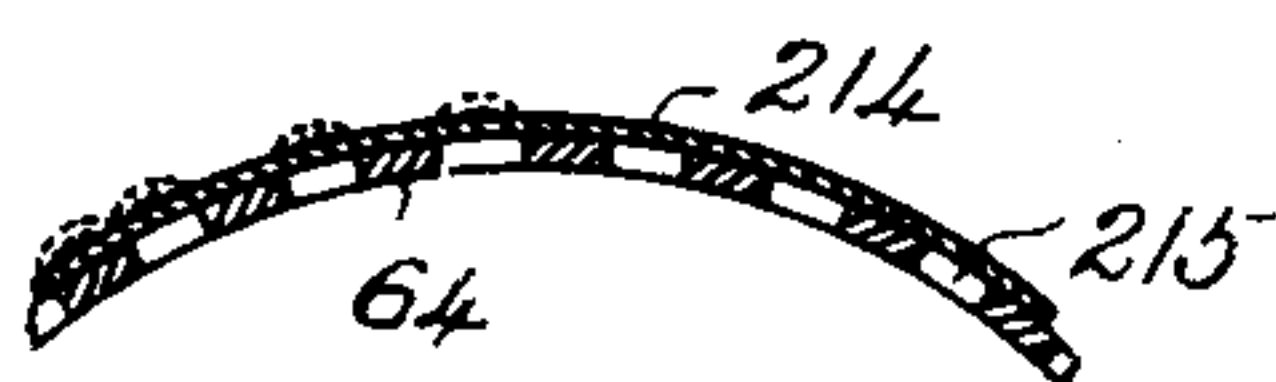


Fig:24.

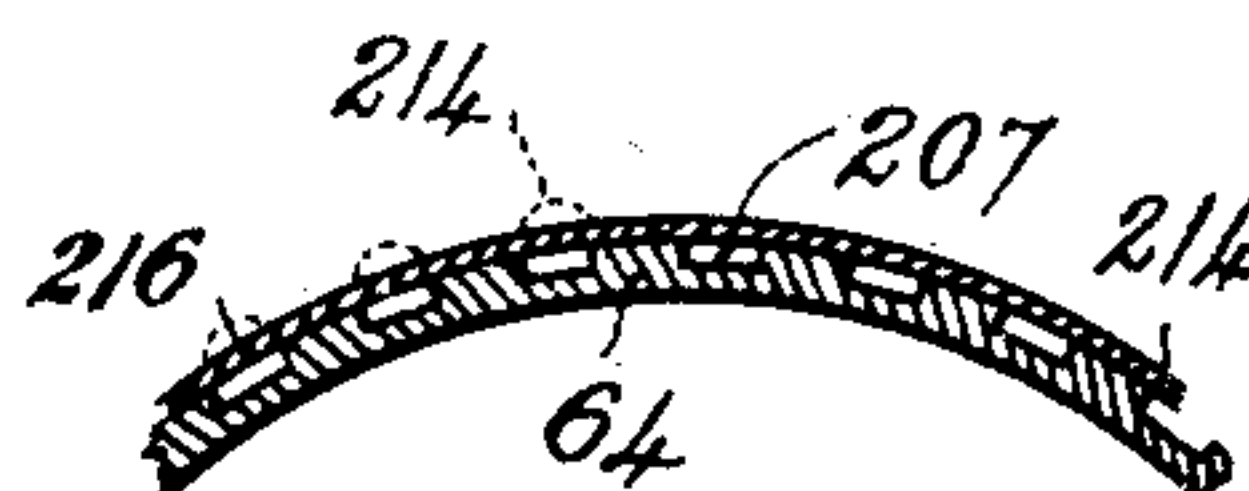


Fig:25.

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UNITED STATES PATENT OFFICE.

JOHN A. ARMSTRONG, OF GILNOCKIE, WESTCOMBE PARK, ENGLAND.

APPARATUS FOR PLAYING PIANOFORTES OR ORGANS.

SPECIFICATION forming part of Letters Patent No. 792,386, dated June 13, 1905.

Application filed October 27, 1904. Serial No. 230,284.

To all whom it may concern:

Be it known that I, JOHN ARTHUR ARMSTRONG, retired lieutenant-colonel, Royal Engineers, a subject of the King of Great Britain, residing at Gilnockie, Westcombe Park, in the county of Kent, England, have invented new and useful Improvements in Apparatus for Playing Pianofortes or Organs, of which the following is a specification.

This invention relates to automatic players for pianofortes or organs; and it has for its object a player which will not be expensive to manufacture, the construction of which is comparatively simple, but which includes means whereby the time, expression, and touch are placed fully within the control of the operator.

In this player the strikers for the instrument-keys are brought into operation by pneumatic means controlled in the well-known manner by a perforated tune-sheet; but the force with which the strikers are actually moved and the keys depressed is supplied mechanically. Thus the pneumatic means has only to establish the connection between the strikers and continuously-running mechanically-operated means for moving them. The continuously-running mechanical means is a drum with a surface adapted to engage with heads on the strikers, the said heads being raised when required by the air under pressure, which works in borings or cylinders in the strikers. The touch is varied by controlling the air-pressure raising the heads of the strikers, and for securing additional variation of touch the strikers may have pneumatic surfaces for depressing the keys, while the drum above mentioned may have an operating-surface capable of pneumatic inflation. I may also arrange the instrument to vary separately the touch of the strikers in the upper and lower registers of the keyboard, whereby additional refinement of expression can be secured. I prefer to make the instrument capable of operating directly upon about five and one-third octaves of a keyboard, and for bringing into operation the higher and lower octaves in a full compass instrument I use "octave-shunts." These and

other devices incidental to the carrying out of my invention are fully explained hereinafter.

In the accompanying drawings, Figure 1 is a plan view of one construction of the piano-player, showing the principal parts thereof. Fig. 2 is an end elevation of the same drawn to a larger scale. Fig. 3 is a vertical section on the line A B of Fig. 1, drawn to the same scale as Fig. 2. Fig. 4 is a front elevation drawn to the same scale as Figs. 2 and 3. Fig. 4^a is a detail view showing a modification. Fig. 5 is a sectional detail showing the "lung" or air-pressure-varying apparatus. Fig. 5^a is a detail view drawn to a larger scale. Fig. 6 is an end elevation, Fig. 7 a side elevation, and Figs. 8 and 9 cross-sections taken on the lines X X Y Y, respectively, of Fig. 7 and illustrating the octave-shunt. Fig. 10 is a side view illustrating, on a reduced scale, a modified form of the piano-player mounted upon a framework to stand on the ground and in which the operating-drum has a pneumatic surface, while the air-pressure is obtained by foot-actuated bellows. Figs. 10^a and 10^b are front and side detail views showing one end of the plates 30 31 to a larger scale. Fig. 11 is a front elevation of the apparatus shown in Fig. 10. Fig. 12 is an end elevation of the top portion of the piano-player as seen from the left in Fig. 11. Fig. 13 is a vertical section of the top part of the apparatus, taken on the line C D of Fig. 10. Fig. 14 is a cross-section of the top part of the apparatus, taken on the line E F of Fig. 11. Fig. 15 is a sectional front elevation showing the bearing at the center of the main operating-drum, the manner of introducing air therethrough, and two forms of pneumatic surfaces for the drum. Fig. 16 is an end elevation, partly in section, showing said central bearing. Fig. 17 is a detail view showing a form of striker different from that illustrated in Figs. 1 to 4 and also showing in section one form of operating-surface for the drum. Figs. 18 to 25 illustrate in cross-section portions of the surfaces for the operating-drum.

Referring first to Figs. 1 to 4, end pieces 1, connected by longitudinal frame-bars 3 and 4,

are mounted at the ends of the keyboard by means of suitable adjusting and fixing devices. In the example shown the bar 3 is formed as a stout tube threaded externally at its ends and provided with slots 94. Inside the said ends are placed secondary bars 5, adapted to be moved outward for locking against the side wings of the pianoforte by means of nuts 95 working on the threaded ends of the bar 3 and engaging between pins 96, projecting from the bars 5 through slots 94. Set-screws 2 in the ends of bars 5 provide for vertical adjustment of the framework and the strikers thereon relatively to the keyboard. The longitudinal bar 4 preferably rests on templets 6, as shown in Fig. 2, held, for example, by screws 97 engaging in slots 98 in said templets in order to allow of their vertical adjustment.

At the center of the instrument is a projecting framework 7, wherein are supported two rollers 8 and 9 for carrying the tune-sheets. The upper roller, to which the sheet may be permanently connected in the usual manner, is bored out longitudinally and is adapted to rest by bushes 70 on a spindle 69, extending between the two frame-pieces 7. It is adapted to be engaged by a key 74, fixed in the spindle and entering a keyway 75, formed in the bush of each roller 8. This spindle rests in a socket 100 at the right-hand side of the frame and may be withdrawn from the left-hand side to allow of the insertion or removal of music-rolls. A catch 10, of springy material, mounted at 99 on the end piece 7, is adapted to pass through the slot in a bush 72 and to engage behind a collar 73 on the spindle 69, holding the same in position. When the catch 10 is raised, the spindle may be freely withdrawn. The spindle 11 of the lower roller 9 projects at the left-hand end of the framework and carries by a clutch connection hereinafter more fully described a gear-wheel 141.

14 is the main operating-shaft also supported in the framework 7 and adapted to be driven in the example shown by a crank 15 at the right-hand end, although evidently any other convenient source of power may be connected to the apparatus by replacing the crank 15 by a pulley 13—for example, as illustrated in Fig. 4^a, when said pulley 13 will be connected by a belt to the source of power. A pinion 16, formed on the shaft at the left-hand end, gears with the toothed wheel 141. The shaft 14 is made as a crank-shaft having three cranks 17, linked by connecting-rods 18 to the piston 19 of a series of three air-pumps 20. These air-pumps may be of any known construction. In the example shown air enters at 21, passing under the ball 22 and into the cylinder through the passage 23. It escapes on the inward stroke by raising the ball 24 and passing out by the pipe 25, which is joined in common to the three cylinders. The

pipe 25 leads by a connection 26 to an air-storage chamber hereinafter called the "lung" 27, while a second pipe 28, of elastic material, leads from said lung to an air duct or passage 29 in a plate 30. The said plate, together with a second plate 31, mounted opposite to it and fixed in the framework, is perforated with a series of holes 101, arranged in a horizontal row in the manner usual in pneumatic piano-players. The outer plate 30 is movable relative to the inner one 31 and is mounted on the framework 7 at its ends by side plates 32, which are normally drawn backward by spiral springs 33, pressing, on the one hand, against lugs 103, projecting from the frame 7, and, on the other hand, against adjustable nuts 34, screwing on stems 35, extending rearwardly from the side plates 32. Guiding-pins 102 may be provided in the end plates 7 to insure proper registration between the plates 30 and 31. The shaft 36, having a cam 37 thereon near each end, passes through the slots 38 in the side plates 32 and is provided at the left-hand end with a handle 39. When pulled forward, said handle will cause the shaft 36 to turn, and the cams 37, engaging against the ends of slots 38, will move outward the end plates 32, together with the front plate 30, thereby separating this latter from the plate 31 and leaving space for the introduction or removal of the tune-sheet. When the handle is turned back, the plates 30 and 31 are drawn together by the springs 33, as before. The operation of this handle also serves to throw the gear into position for driving or for rewinding the tune-sheet, as explained below.

In the top of the frame-pieces 1 is mounted the operating-drum 50, supported at its ends by bearings 66 and which extends the whole length of the keyboard to be operated upon. In the example here shown this drum consists of a pair of rollers, which may be solid, as indicated in Fig. 3, in which case they will be made of wood or the like, or they may be hollow and formed, for instance, of a metal tube 64, as shown in Fig. 17. They are connected at the center by a solid pin 105, supported by a bracket 106 from the frame-bar 4, and each roller has a covering 65, formed of india-rubber or any like elastic material which is corrugated longitudinally for engaging with the heads of the strikers, as hereinafter explained. The main actuating-shaft 14 is connected with the drum by a crossed belt 67, passing over the drum itself and over a pulley 68 on the driving-shaft.

The shaft 36, which carries cams 37 for moving outward the front perforated plate 30, is extended beyond the handle 39 and is provided with a groove-cam 136. The spindle 69, which carries the upper drum 8, has at its end a toothed wheel 137. The spindle 11 of the lower roller 9 is formed as a ratchet-clutch member 138, with a plain projecting part 139. The second member 140 of the clutch carries

a toothed wheel 141 and is adapted to slide over the spindle 139, on which it is pressed by a spring 142, surrounding the spindle 139 and held up by means of a nut 143. A sleeve 144, sliding over the parts 138 and 140, is adapted when moved to the left to disengage the part 140 from the part 138 and by sliding the toothed wheel 141 to the left to bring it into gear with the toothed wheel 137, while it remains in gear with the long pinion 16. A lever 146, pivoted on a stud 145, has a fork 147 at one end slotted to engage over pins 148 on the sleeve 144 and at the other end has a projection 149, working in a groove of the cam 136. With this arrangement when the handle 39 is pulled forward to move outward the plate 30 the cam 136 causes the lever 146 to turn to move outward the sleeve 144, disengaging the clutch member 140 from the member 138 and bringing the wheels 141 137 into gear. As the shaft 14 now rotates in the same direction as before, the roller 8 is rotated in the direction necessary for winding back the music-sheet. The replacement of the handle 39 for closing the plate 30 upon a new music-sheet will cause the parts to return to the positions shown in Fig. 4, in which the clutch members 138 140 are in engagement and the winding-on roller 9 is driven from the shaft 14 for playing the music-piece.

On the main bar 4 of the framework are mounted a series of strikers—one for each key of the keyboard which is to be operated by the instrument. In the example shown each striker is made from a metal bar 41, having a longitudinal bore 42. The said bar is slit at the bottom to receive the upper end of the bent spring 43, fixed on the frame-bar 4 by a screw 44. The spring 43 is locked in the slit by the striker-arm 45, which is screwed through the lower end of the bar and through the spring and is made to project at the rear of the bar in order to form a stop which may rest against a padded rail 46. Over the bar 41 fits a section of tube 47, provided with a head 48, shaped to engage with the surface of the operating-drum 50 in the manner hereinafter described. A nipple 49 passes through the tube and is inserted in the bar 41 to meet the boring 42, and said nipple on each striker is connected by a flexible tube 51, of india-rubber, for example, to a corresponding nipple 71 of the plate 31, communicating with one of the perforations in said plate. The nipples 71 may be staggered alternately one above and one below in order to give more room for making connections. The nipple 49 passes through a slot 53 in the tube 47, and thus serves to guide and limit the movement of the tube over the bar 41. Fine holes 54 and 55 in the bar and tube, respectively, (see also Fig. 5^a), are adapted to register when the tube is blown outward by air-pressure to its farthest extent, and thus to form an escape-ment. The end of the arm 45 is provided

with a striking-pad 56 of any suitable construction.

The lung, whereby the air-pressure is regulated, is constructed in the manner shown in Fig. 5. It consists of the cylinder 27, mounted across the frame 7, open at the left-hand end and closed at the right-hand end by a cap 107, containing the connections for the pipes 26 28. Inside the cylinder slides a piston 58 of any suitable construction connected to a diaphragm 59 by a coiled spring 60. The ends of this spring are firmly attached by any suitable means—soldering, for instance—to the piston and diaphragm, and the spring forms the only connection between these two parts. The handle 61, pivoted at 62 in the frame-bar 4, is connected by a link 63 to the diaphragm 59, so that as said handle is moved to right and left the diaphragm is moved toward or away from the closed end of the cylinder 27, and, according to the amount of air-pressure in the cylinder, either the spring 60 is compressed or expanded or the piston 58 is moved, to a greater or less extent, with the diaphragm. By means of this device the pressure of the air passing through the perforations in the plates 30 and 31 may be varied as desired for the purpose of varying the touch, as hereinafter described. The air-pressure is reduced when the piston is drawn out and is increased when the piston is forced inward by the movement of the handle. A continuous reduction in pressure is insured by the provision of a few small holes 57 at suitable points in the cylinder 27, more of which holes are uncovered when the piston is drawn farther out. This construction of the lung and piston therefor is given by way of example. The lung and its piston might be made to serve the same purpose in many different ways.

The apparatus in so far as it has been explained operates as follows: Supposing it to be correctly adjusted over the keyboard, a roller 8, carrying a perforated tune-sheet or record, is inserted into the frame on the spindle 69. The sheet is drawn between the plates 30 and 31, and its end is engaged in the usual manner with a hook 76 on the roller 9. The outer plate 30, which is separated from the plate 31 by the means before described for the insertion of the sheet, is now allowed to fall back by the turning of handle 39, so that the plates are pressed together upon the tune-sheets by the springs 33 and the clutch 140. 138 is in engagement, so that the lower roller 9 will be turned to wind off the tune-sheet when the crank-shaft 14 is operated. The turning of said shaft also operates the pumps 20 and drives the drum 50 by the belt 67. The perforated tune-sheet is thus drawn slowly through the apparatus and air-pressure is produced in the "lung" 27 by the operation of the pumps, and as the holes in the tune-sheet register with perforations 101 in the plates 30 31 air coming from the lung to

the duct 29 in plate 30 passes through the perforations in the plates 30 31 and tune-sheet and reaches through tubes 51 the borings 42 in the strikers, which are controlled by the
 5 respectively exposed perforations. Thus each time that a perforation in the tune-sheet comes between the plates 30 31 an air-pressure is established in the boring 42 of the corresponding striker, whereby the tube 47, with
 10 its head 48, is expelled. As the said head rises it comes into engagement with the corrugated surface of the operating-drum 50, and as this latter rotates the strikers are moved forward and their hammers 56 strike the keys,
 15 giving the required note. The key is held depressed so long as the air supplied to the boring 42 is maintained, as although the relief-passages 54 55 will register with one another they are so much smaller than the feeding-tubes and nipples that as long as air is
 20 supplied it will maintain the head 48 in its expelled position. Immediately, however, that the air-supply is stopped, owing to the perforation in the tune-sheet passing away from
 25 between the holes 101 in the plates 30 31 the air readily escapes from the boring 42 and the head falls, coming out from engagement with the drum 50, whereupon the hammer rises and the key is released, owing to the elasticity of the spring 43. If the music is staccato, the perforations in the tune-sheet will be short and the strikers will thus be released almost immediately after the note is struck. The touch is varied by moving the handle 61,
 35 whereby the air-pressure operating in the borings 42 is varied, the heads 48 being forced outward more slowly and with less force when the pressure is reduced, so that the hammers
 40 strike the keys more softly. The tempo is controlled by the variable speed which the operator can impart to the driving-handle 15. After a piece of music has been played the plate 30 is moved outward by the operation
 45 of handle 39, whereby also the toothed wheel 141 is brought into engagement with the toothed wheel 137 on the shaft 69 and the clutch member 140 is disengaged. When the operating-shaft is now turned, the lower roller
 50 9 is free and the roller 8 is turned backward, so that the tune-sheet is rewound onto this latter.

For utilizing the highest and lowest octaves of an instrument having a full compass I provide devices hereinafter called "octave-shunts"—*i. e.*, devices adapted when suitably operated to divert the air from the strikers of notes in the next to the last octaves to the strikers of corresponding notes
 60 in the last octaves at the bass and treble or under some circumstances to allow the corresponding notes in both the last and next to the last octaves to be struck simultaneously. Each shunt, Figs. 6, 7, 8, and 9, consists of a
 65 cylinder of metal 77, having a base-piece 78,

by which it may be fixed, for instance, on the frame-bar 4 or on brackets connected thereto. The cylinder 77 has a longitudinal taper bore 79 for receiving the taper plug 80, which has a series of twelve partial rings cut in its surface, as shown at 81. A series of tubes 82 are inserted into the cylinder, communicating with the taper bore 79. The two first rows of tubes on the left-hand side in Fig. 6 (twelve tubes in all) serve as inlets and are connected by flexible
 75 pipes 51 with nipples 71 on the perforated plate 31. The remaining four rows of tubes, including twenty-four tubes in all, are connected by pipes 51, respectively, the first two rows to the twelve strikers of the next to the
 80 last octave and the remaining two rows to the strikers of the last octave at the bass or treble. The whole arrangement forms twelve three-way cocks alternately staggered around the cylinder relatively to one another in order to
 85 provide more room for the tubes and connections. The formation of the cocks and their arrangement are illustrated by the two sectional views Figs. 8 and 9, which are taken through two adjacent cocks on the lines X X and Y Y,
 90 for instance, of Fig. 7. It will be seen that the annular slots 81 leave projections 83, which as the plug 80 is turned can be made to lie between the two outlet-tubes 82 in each of the three-way cocks or to close one or other of the
 95 outlet-tubes 82. The plug has an arm 84 attached to its end and connected by a connecting-rod 85 with a piston 86, working in a cylinder 87, connected to the base-piece 78. A nipple 88 at the bottom of cylinder 87 is adapted to be
 100 connected by a flexible tube 110 with a nipple on the plate 31, communicating with an extra hole beyond the ordinary row of holes communicating with the note-strikers. The tune-sheet, otherwise the same as those now in use,
 105 is provided for operating the bass and treble octave-shunts with an extra column of perforations at the left and right of the normal compass-holes, adapted to register with the extra holes above mentioned in the plates 30 31. When one of said perforations comes between the plates 30 and 31, air passes by the connecting-tube 110 into the cylinder 87 of the octave-shunt, forcing upward the piston 86 until the
 110 movement of the arm 84 is stopped by a stop-pin 89. This operation causes the plug 80 to turn until the blocks 83 therein all cover the intermediate tubes 82, so that air entering by the tubes at the left-hand side is caused to pass around the slots 81 and out through the tubes
 115 at the extreme right, thus reaching the strikers for the last octaves of the keyboard. As long as the air-pressure is maintained in the cylinder 87 the plug is held in its new position despite the fact that the air can continuously escape
 120 through a small opening 91, suitably placed, or around the piston 86, if this latter is not too tightly fitted. Immediately, however, that the octave-perforations in the tune-sheet cease the supply of air to the cylinder 87
 125

will be stopped, whereupon the piston 86 will fall, owing to its weight, turning back at the same time the plug 80 until the arm 84 is stopped against a pin 90. In the position
 5 which the plug now occupies each of the blocks 83 will close the outlet-tube to the extreme right and the air entering by the tube at the left will pass out through the intermediate tube 82 to the striker of a note in the next to
 10 the last octave.

The octave-shunt may be converted into an octave-coupler by the simple operation of sliding outward a pin 92, inserted in the wall of the casing 77 and adapted to be moved by a
 15 button 93. When this pin is moved out, it will form a stop for the arm 84, so that when said arm is moved upward by air-pressure operating on the piston 86 in the cylinder 87 it will be stopped against the pin 92, thereby
 20 holding the plug in the intermediate positions shown in Figs. 8 and 9, wherein air entering through the tubes at the extreme left in each cock is distributed through both the other tubes to the strikers of notes in both the last
 25 and the next to the last octaves. The arrangement for the bass and treble octaves is exactly similar except that the parts are reversed in their relative positions from right to left, and vice versa.

30 In Fig. 1 the octave-shunts are shown mounted on the fronts of frame-bars 4 between the strikers for the last and the next to the last treble and bass octaves. The shunts may, however, be placed in any other desired positions so long as they are properly connected
 35 with the strikers by the tubes 51.

In case one or more of the extra notes which might be operated by the octave-shunt are not provided on the keyboard the tubes which
 40 would be connected with the strikers of said notes may be closed by suitable stoppers; or in case the instrument to be played upon has a compass of about five and one-third octaves only the shunts and the strikers operated
 45 thereby will be omitted altogether, while the main operating-drum, with the framework, will be correspondingly shortened. The octave-shunts can of course be operated by hand at any time quite apart from their operation
 50 by air passing through the perforations in the tune-sheets.

Fig. 17 shows a modified form of striker. This consists of a cast-metal bell-crank lever 114, pivoted to the frame-bar 4 by a hinge
 55 115. The upper arm of the bell-crank is formed as a hollow cylinder 117 and receives a piston 116, bearing the engaging head 48. Air is introduced to the space 117 by a nipple 49, as before, and the air-pressure causes
 60 the piston to rise and engage with the surface of the drum in the same way as was described for the construction shown in Fig. 3. The movement of the piston is limited by a pin 118, fixed in the piston and working in a slot
 65 119, while pairs of small perforations 54 55

are provided, adapted to register, in order to allow air to escape when the piston is fully expelled. For returning the strikers to their position of rest a bar 120 is provided, in this case held to the frame-bar 4 at suitable points
 70 by rods 121, with nuts 122, and between this bar and each striker the bent spring 123 is arranged tending to move backward the upper arm of the striker. In this construction also a passage 124 is arranged leading from
 75 the cylinder 117 to the striking-hammer, which latter in this case consists of a more or less inflatable cap 125, of rubber, for example, which will strike the key more or less
 80 firmly, according to the air-pressure therein.

Fig. 18 shows a section of a different operating-surface for the drum 50. This consists of soft india-rubber 113 or a similar composition. For engaging with this surface the projections on the heads 48 of the
 85 strikers will be rather sharp, so that they may readily indent the soft surface and be carried round therewith.

In the constructions hereinbefore explained the drum has been formed to rotate in one piece
 90 and has had a solid surface, while the whole apparatus has been actuated by hand-power. In some cases for rendering possible greater variation in the touch I may make the drum-surface pneumatic, controlling the air-pres-
 95 sure therein and in the strikers simultaneously by the lung method. I may also divide the drum into two parts and provide two lungs and lung-levers for controlling separately the air-pressures in the drums, whereby the touch
 100 in the upper and lower registers may be separately varied. The separate lungs may also in such case separately supply different parts of the perforated plates between which the
 105 tune-sheet passes, in order that the different air-pressures for the upper and lower registers may operate in the strikers also, and in place of using hand or other power to simultaneously operate the air-pumps and to drive
 110 the main operating-drum I may arrange that the air-supply shall be maintained by foot-operated bellows or the like. In Figs. 10 to 16 I have illustrated a form of apparatus embodying all these improvements. The instru-
 115 ment is mounted on a separate stand, consisting of a base 176, with pillars 161, carried, for instance, on wheels 217. The mechanism is adapted to be adjusted vertically to the keyboard of the instrument by an arrangement wherein the frame 134, carrying the central
 120 frame-plates 7, works, by means of guides 162, on the verticals 161 and may be locked in the required positions by set-screws 163. For fixing the upper part of the apparatus to the keyboard the same devices may be provided
 125 as are shown in Figs. 1 to 4. The power for driving the drum 50 is supplied by the hand-crank 15 driving a shaft 14, as before; but as there are no air-pumps in the top part of the apparatus the shaft 14 may be more con- 130

veniently arranged just above the plates 30 31. At the left-hand end shaft 14 has a pinion 16, adapted to gear with a toothed wheel 108, held by a locking-nut 12 on the spindle 11 of the lower roller 9. For driving the roller and rewinding the music-sheet a new form of gearing is shown; but it is to be understood that the type of rewinding-gear illustrated in the machine shown in Figs. 1 to 4 could be equally well applied here. The driving-shaft 14 carries beside the pinion 16 a toothed wheel 178, and on a stud 179, supported in the frame-plate 7, a toothed wheel 181 is mounted. A shaft 180 has fixed at its left-hand end a toothed wheel 182, gearing with 181. The drum is in this case made in two separate parts, as will be explained below, and each part must be driven. For this purpose the shaft 180 is carried across between the frame-plates 7 and has fixed on it two wheels 183, each adapted to bear upon the surface of the drum 50 and to drive this latter. The surfaces applied to the wheels 183 may be varied according to the surfaces applied to the drum. Said wheels may be of metal, toothed to engage in the drum-surface in some cases, while in others they may have soft, smooth, or ribbed surfaces of india-rubber or the like. The spindle 69 of the upper music-roll has a suitable head 151 at the right-hand end whereby it may be withdrawn and replaced. The catch 10 is also on the right-hand frame-plate 7. The spindle 69 is square or angular at the left-hand end, as seen at 150, in order to engage in a correspondingly-shaped recess in the boss of a pinion 152, mounted to rotate on the frame-plate 7. On the stud 179, behind the toothed wheel 181, is mounted a box 157, containing a spiral spring, which is wound up when the drum is turned in one direction. A toothed wheel 159, attached to the box 157, meshes with the pinion 152. The front perforated plate 30 is in this case guided at its ends by pins 284, projecting from the rear plate 31 and surrounded by spiral springs 285, pressing against the flanges of plate 30 and nuts 286 on said pins. At each end of the plate 30, around the projecting end of the tubular duct 29, (see Figs. 10^a and 10^b,) is pivoted an arm 287, carrying a cam 288, the two arms being connected by a bar 289. When this bar is drawn forward, the plate 30 is moved outward, owing to the cams 288 pressing against the ends of plate 31. When the bar is moved back, the plates are pressed together by the springs 285. With this arrangement, as far as it has been explained above, the mode of working is as follows: When a piece of music is being played, the lower roller 9 is driven by the shaft 14, through pinion 16 and toothed wheel 108, which latter is locked by the nut 12, and the drum 50 (made in two parts) is driven through the gearing 178, 181, 182, and wheels 183. During the winding-off of the sheet from the roller 8 the

pinion 152, gearing with the toothed wheel 159, turns the spring-casing 157, winding up the spring therein; but as soon as the piece of music has been played and the plate 30 moved out, as above explained, the nut 12 is slackened, whereupon the spring-casing turns back under the influence of the wound-up spring therein and through the toothed wheel 159 and pinion 152 carries round the roller 8, rewinding the tune-sheet thereon. The tune-sheet roller should be turned a few times before connecting the tune-sheet to the lower roller and starting to play in order to put an initial tension on the spring in casing 157 sufficient to insure that the tune-sheet will be quite rewound before the spring has run down. The supply of compressed air is, as before stated, obtained from bellows or the like operated by the feet. In the construction shown pedals 166, pivoted at 167, are adapted to operate bellows 168 of any known construction, from which the air is taken to the operating parts of the instrument by a pipe 177. 169 represents springs tending to hold the pedals in their raised positions. 170 represents shafts carried on the stand in bearing-plates at 171 and 172 and having at their forward ends heel-plates 173. At the other end of the shafts are arms 174, which may engage and depress the usual forte and pianissimo pedals 175 of the pianoforte. The heel-plates 173 may be depressed by the operator at the same time as he continues to pedal on the footboards 166, as will be well understood. The lung is made in two parts, as seen in Fig. 13. Said parts consist of cylinders 184, connected at the center in a block 185 and mounted at their outer ends in the end plates 7. Each cylinder has perforations 57, as before, and contains a piston 58, connected by spring 60 to a diaphragm 59. In place of the lung-levers 61 provided in the first-described construction knee-swells are used here. Each consists of an arm 186, pivoted on a bracket 187, projecting from the frame-bar 4. The lower end of each arm has a plate 188 for the application of knee-pressure, while the upper end is connected to the diaphragm 59 by a link 189. Air enters the cylinders from the pipe 177 through a pair of inlet-ports 190, formed in the central block 185, and in order to render possible the establishment of different pressures in the two lungs for accentuating either the upper or lower register-notes suitable non-return valves—such, for instance, as leather flaps 191—are provided at the ports. From each lung-cylinder there are two outlets 192 and 193 in the central block. The outlets 192 are connected by pipes 194 passed through the end plates 7 to the ends of the perforated plate 30, and the pipe 29 in the back of said plate is closed at the center by a narrow diaphragm 195, as seen in Fig. 11. By this means the strikers of notes in the upper register receive their air from one lung-cylinder and the strikers of notes in the lower

register receive their air from the other cylinder. The air-pressure is increased in either cylinder by pressing out the knee-swell and is allowed to fall when the knee-swell is allowed to return, while the piston is forced out by the air in the cylinder. The drum is, as before stated, made in two parts, each provided with an operating-surface which is more or less distended, according to the pressure in the lung-cylinder communicating with said surface. Each part of the drum is supported at its outer end as in the first construction, but mounted on a special air-inlet bracket 196 at the center, as shown in Figs. 15 and 16. This bracket has two inlets communicating by pipes 197 with the ports 193. The passage 198 from one inlet opens in the central bearing-surface at the left, and the corresponding passage 199 from the other inlet opens centrally to the right of the bracket. Two different constructions of the pneumatic drum are shown in Fig. 15. In the one to the left the metallic or other roller 64 screws on an end piece 200, which rests on the tapered boss 203 of the bracket 196. The end of the passage in said boss is closed by a plug 202, while a number of holes 201, radiating from the center of the boss, communicate with a groove 205 in the end piece 200. From the groove 205 radiate a number of passages 204, each communicating with a tube 206 in the pneumatic surface, (which may be of either of the types shown in Figs. 19 to 22 and explained below.) In the construction of the end of the drum shown at the right in Fig. 15 the tapered boss 203 has no holes 201, but is open at the end. The drum-roller 64 fits on an end piece 208, having no passages therein; but the tubes 206 on the drum-surface are butt-ended and communicate with the interior of the drum by holes 207. With this form of bearing also the drum may have the surfaces shown in Figs. 23, 24, and 25, herein-after explained.

Referring to Fig. 19, it will be seen that the striker-actuating surface mounted on the metallic cylinder or the like 64 consists of a thick rubber covering 209, formed with longitudinal air-passages 206, communicating in either of the ways shown in Fig. 15 with the interior of the drum. When the air-pressure is varied by means of the lung, hereinbefore explained, the pressure in the drum 64 and in the covering thereof is varied, and according as the passages 206 are more or less strongly inflated the striker is operated with more or less power, whereby an additional means is provided for varying the touch.

The drum-surface shown in Fig. 20 is a modification of that shown in Fig. 19, consisting simply in replacing the continuous cover with longitudinal perforations 206 by a series of separate air-pipes 211, which are preferably mounted on a drum of longitudinally-corrugated metal, as shown.

In the form shown in Fig. 21 the pneumatic surface is made from a rubber sheet 212, which is plaited or puckered longitudinally, preferably before vulcanization, to form a series of passages 213, the inflation of which is effected in the same manner as before.

Fig. 22 shows a modification of Fig. 20, wherein the pipes 211 are coiled spirally at any desired pitch around the drum, so that in this sectional view the pipes appear elongated.

In the construction of Fig. 23 the drum 64, which is longitudinally corrugated, simply carries a rubber sleeve 214. The variations in air-pressure in the drum cause the same to expand and contract, bending along the lines of corrugation to a certain extent.

In the constructions of Figs. 24 and 25 the drum 64 is made as a plain cylinder, either with complete perforations 215 or with longitudinal grooves 216, which communicate at suitable points 207 with the interior of the drum. The rubber or the like sleeve 214 in this case fits over the surface of the drum and is caused to pucker or swell at the points over the openings or grooves, as indicated by dotted lines, when air-pressure is applied from within. The amount of the swelling or puckering depends upon the air-pressure, which is regulated by the lungs, as before explained, and the strength of the playing depends upon the amount of distension caused by the air-pressure.

Any of the forms of strikers before explained may be used with the drums having pneumatic surfaces.

While thus describing the invention I desire that it should be understood that I do not limit myself to the exact details of construction hereinbefore explained. Many of these have been given only as examples of the modifications within the scope of my invention. Many of the mechanical devices employed may be replaced by their known equivalents. For example, pumps are usually replaceable by bellows, springs by weights, operating-cranks by hand-wheels or by means for driving the apparatus by mechanical power or human agency, such as foot-power. Further, whenever certain materials are mentioned other materials which are suitable may be employed in their places. Metal may in some cases be replaced by wood, papier-mâché, or the like. Rubber substitutes may be employed in place of india-rubber, and in some cases woven materials, such as corduroy or woven wire may be used for replacing the corrugated rubber surface above explained. It would be possible also to employ some of the parts of my invention in instruments wherein, for instance, mechanical or electrical means might be used for bringing the strikers into engagement with a drum. Owing to the clumsiness and noisiness which I believe are inherent in such contrivances, I have not employed them; but I reserve the right to use

the novel features of my invention above described and hereinafter claimed where such features are applicable in conjunction with controlling or operating devices other than those hereinbefore described.

What I claim is—

1. In an automatic player for keyboard musical instruments, the combination of a drum and means for rotating it, a plurality of strikers each comprising a striking-arm, an arm with a pneumatic chamber and a head such that it can be expelled by pneumatic action, means for supporting the strikers and pneumatic means for bringing the heads of the strikers into engagement with the drum.

2. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers each having a head capable of being expelled by pneumatic action, means for supporting said strikers, a drum, means for rotating said drum, means for supplying air under pressure, and means for controlling the supply of said air to the strikers, whereby the heads of said strikers may be caused to come into engagement with the surface of the drum.

3. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers and means for supporting same, a drum, means for rotating said drum, means for supplying air under pressure and for conveying the air to said strikers, means for varying the pressure of said air, means for controlling the supply of said air to the strikers, and means applied to said strikers adapted to be operated by air under pressure to bring them into engagement with the drum.

4. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers each having a bore, a head adapted to be expelled by pneumatic pressure and a partially-inflatable key-depressing part in communication with said bore, a drum, means for rotating said drum, means for the supply of air under pressure and for conveying the air to said strikers, means for varying the pressure of said air, means for controlling the supply of said air to the bores of the strikers, and a frame adapted to support the drum and strikers.

5. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers, a drum, means for rotating said drum, means for supplying air under pressure, two perforated plates, and means for adjusting one of said plates relatively to the other, means connecting the air-supplying means with all the perforations in one of said plates, a plurality of pipes each connecting one of the perforations in the second plate with one of the strikers, means for controlling the passage of air through the perforations from the first plate to the second, means applied to the strikers adapted to be operated

by air under pressure to bring them into engagement with the drum, and a frame adapted to support the drum, strikers and perforated plates.

6. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers, a drum, means for rotating said drum, means for supplying air under pressure, means for varying the pressure of the air supplied, two perforated plates and means for adjusting one of said plates relatively to the other, means connecting the air-supplying means with all the perforations in one of said plates, a plurality of pipes each connecting one of the perforations in the second plate with one of the strikers, means for controlling the passage of air through the perforations from the first plate to the second, means applied to the strikers adapted to be operated by air under pressure to bring them into engagement with the drum, and a frame adapted to support the drum, strikers and perforated plates.

7. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers, a drum, means for rotating said drum, means for the supply of air under pressure, two perforated plates and means for adjusting one of said plates relatively to the other, two separate air-ducts each communicating with some of the perforations in one of said plates, a plurality of pipes each connecting one of the perforations in the second plate with one of the strikers, means for controlling the passage of air through the perforations from the first plate to the second, means applied to the strikers adapted to be operated by air under pressure to bring them into engagement with the surface of the drum, separate means for varying the supply of air under pressure from the source to each of the air-ducts communicating with the perforations of the first plate, and a frame adapted to support the drum, strikers and perforated plates.

8. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers, each having a bore, a head adapted to be expelled by pneumatic pressure and a partially-inflatable key-depressing part in communication with said bore, a drum, means for rotating said drum, means for the supply of air under pressure, two perforated plates, and means for adjusting one of said plates relatively to the other, two separate air-ducts each communicating with some of the perforations in one of said plates, a plurality of pipes each connecting one of the perforations in the second plate with one of the strikers, means for controlling the passage of air through the perforations from the first plate to the second, separate means for varying the supply of air under pressure from the source to each of the air-ducts communi-

cating with the perforations of the first plate, and a frame adapted to support the drum, strikers and perforated plates.

9. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers, a drum having a surface capable of pneumatic inflation, means for rotating the drum, means for the supply of air under pressure, means for varying the pressure of said air, means for controlling the supply of said air to the strikers, means applied to said strikers adapted to be operated by air under pressure to bring them into engagement with the surface of the drum, means for conveying air from the pressure-varying means aforesaid to the inflatable surface of the drum, and a frame adapted to support the strikers and the drum.

10. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers, a drum made in two parts each having a surface capable of pneumatic inflation, means for rotating the drum, means for the supply of air under pressure, means for controlling the supply of said air to the strikers, means applied to said strikers adapted to be operated by air under pressure to bring them into engagement with the surface of the drum, means for conveying the air under pressure to each part of the drum, means for varying separately the pressure of the air supplied to each part, and a frame adapted to support the strikers and the drum.

11. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers, a drum made in two parts each having a surface capable of pneumatic inflation, means for rotating said drum, means for the supply of air under pressure, two perforated plates, and means permitting of the adjustment of one of said plates relatively to the other, two separate air-ducts each communicating with some of the perforations in one of said plates, a plurality of pipes each connecting one of the perforations in the second plate with one of the strikers, means for controlling the passage of air through the perforations from the first plate to the second, means applied to the strikers adapted to be operated by air under pressure to bring them into engagement with the surface of the drum, passages leading from the source of air under pressure to each part of the drum and to each of the ducts communicating with the perforations of the first plate aforesaid, separate means for varying the pressure of the air supplied through the passages to one part of the drum and one of the ducts for the plate, and to the other part of the drum and the other duct respectively, and a frame for supporting the drum, the perforated plates, and the strikers.

12. In an automatic player for keyboard musical instruments, the combination of a plurality of strikers each having a bore, a head

adapted to be expelled by pneumatic pressure and a partially-inflatable key-depressing part in communication with said bore, a drum made in two parts each having a surface capable of pneumatic inflation, a source of air under pressure, means for controlling the supply of said air to the bores of the strikers, means for conveying said air separately to each of said parts of the drum, and means for separately varying the pressure of the air supplied to the parts of the drum and to corresponding portions of the series of strikers.

13. In an automatic player for keyboard musical instruments, the combination of a frame, a tune-sheet roller and a winding-off roller both supported therein, a pair of correspondingly-perforated plates supported on the frame, means whereby said plates may be separated and brought together, means for supplying air under pressure to one of said plates, a drum, a plurality of strikers, means adapted to connect each striker with one of the perforations in the second plate, means applied to each striker adapted to be operated by air under pressure to bring it into engagement with the surface of the drum, means for rotating the drum and the winding-off roller, and a mechanism whereby the winding-off roller can be thrown out of gear when required for rewinding.

14. In an automatic player for keyboard musical instruments, the combination of a frame, a tune-sheet roller and a winding-off roller both supported therein, a pair of correspondingly-perforated plates supported on the frame, means whereby said plates may be separated and brought together, means for supplying air under pressure to one of said plates, means controlled by the air from the perforations in the second plate for depressing the keys of the instrument, a driving-shaft, means normally gearing said shaft to the winding-off roller, and a mechanism adapted to be operated by the plate-separating means to throw the driving-shaft out of gear with the winding-off roller and into gear with the tune-sheet roller whereby rewinding can be effected.

15. In an automatic player for keyboard musical instruments, the combination of a drum, a series of strikers, means applied to each striker adapted to be forced into engagement with the drum by pneumatic pressure, means for the supply of air under pressure and for conveying the air to said strikers, means directly controlling the supply of said air to some of said strikers, an octave-shunt comprising a plurality of three-way cocks, pipes connecting the ways of each cock respectively to the air-supply-controlling means to one striker and to another striker for a note separated from that operated by the first striker by a musical octave, and means for moving said shunt in such manner as to bring the pipes from the air-supply-controlling means into connection therein at option with the out-

let-pipes for one set of strikers, or with the outlet-pipes for the set of strikers for operating notes separated by musical octaves from those operated by the first set.

5 16. In an automatic player for keyboard musical instruments, the combination of a drum, a series of strikers, means applied to each
10 striker adapted to be forced into engagement with the drum by pneumatic pressure, means for the supply of air under pressure and for
15 conveying the air to said strikers, means directly controlling the supply of said air to some of said strikers, an octave-shunt comprising a plurality of three-way cocks, pipes
20 connecting the ways of each cock respectively to the air-supply-controlling means, to one striker and to another striker for a note separated from that operated by the first striker
25 by a musical octave, and means for moving said shunt in such manner as to bring the pipes from the air-supply-controlling means into connection therein at option with the outlet-pipes for one set of strikers, with the outlet-pipes for the set of strikers for operating
30 notes separated by musical octaves from those operated by the first set, or with the outlet-pipes for both sets of strikers simultaneously.

17. In an automatic player for keyboard musical instruments, the combination of a drum,
30 a series of strikers, means applied to each striker adapted to be forced into engagement with the drum by pneumatic pressure, means for the supply of air under pressure and for conveying the air to said strikers, means di-
35 rectly controlling the supply of said air to some of said strikers, two octave-shunts each comprising a plurality of three-way cocks, pipes connecting the ways of each cock respectively to the air-supply-controlling means
40 to one striker and to another striker for a note separated from that operated by the first striker by a musical octave, and means adapted to be operated by the air under pressure and to be controlled by the air-supply-con-
45 trolling means aforesaid for moving said shunts in such manner as to bring the pipes from the air-supply-controlling means into connection therein at option with the outlet-pipes for one set of strikers, or with the out-
50 let-pipes for the set of strikers for operating notes separated by musical octaves from those operated by the first set.

18. In an automatic player for keyboard musical instruments, the combination of a drum,
55 a series of strikers, means applied to each striker adapted to be forced into engagement with the drum by pneumatic pressure, means for the supply of air under pressure and for conveying the air to said strikers, means di-
60 rectly controlling the supply of said air to some of said strikers, two octave-shunts each comprising a plurality of three-way cocks, pipes connecting the ways of each cock respectively to the air-supply-controlling means
65 to one striker and to another striker for a

note separated from that operated by the first striker by a musical octave, and means adapted to be operated by the air under pressure and to be controlled by the air-supply-controlling means aforesaid for moving said
70 shunts in such manner as to bring the pipes from the air-supply-controlling means into connection therein at option with the outlet-pipes for one set of strikers, or with these
75 pipes and also with the outlet-pipes for the set of strikers for operating notes separated by musical octaves from those operated by the first set.

19. In an automatic player for keyboard musical instruments the combination of a plu-
80 rality of strikers each having a bore and a head adapted to be expelled by pneumatic pressure, means for supplying air under pressure and for conveying the air to said strikers, means
85 for controlling the supply of air to said strikers, and mechanical means adapted to be engaged by the heads of said strikers when they are expelled and to depress said strikers against the keys of the instrument to be played.

20. In an automatic player for keyboard musical instruments, the combination of a plural-
90 ity of strikers each having a bore and a head adapted to be expelled by pneumatic pressure, means for supplying air under pressure and for conveying the air to said strikers, means
95 for controlling the supply of air to said strikers, means for varying the pressure of the air supplied, and mechanical means adapted to be engaged by the heads of said strikers when they are expelled and to depress said
100 strikers against the keys of the instrument to be played.

21. In an automatic player for keyboard musical instruments, the combination of a plural-
105 ity of strikers each having a bore, a partially-inflatable key-depressing part in communication with said bore, and a head adapted to be expelled by pneumatic pressure, means for supplying air under pressure and for convey-
110 ing the air to said strikers, means for controlling the supply of air to said strikers, means for varying the pressure of the air supplied, and mechanical means adapted to be engaged by the heads of said strikers when they are
115 expelled and to depress said strikers against the keys of the instrument to be played.

22. In an automatic player for keyboard musical instruments, the combination of a plural-
120 ity of strikers, an engaging device in proximity to said strikers and mechanical means whereby said device may be made to move continuously but at varying speeds, means for the supply of air under pressure, two perforated plates, and means permitting of
125 the adjustment of one of said plates relatively to the other, two separate air-ducts each communicating with some of the perforations in one of said plates, a plurality of pipes each connecting one of the perforations in the sec-
130 ond plate with one of the strikers, means for

controlling the passage of air through the perforations from the first plate to the second, means applied to the strikers adapted to be operated by air under pressure to bring
5 them into engagement with the surface of the engaging device aforesaid, separate means for varying the supply of air under pressure from the source to each of the air-ducts communicating with the perforations of the first
10 plate, and a frame adapted to support the

engaging device, strikers and perforated plates.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

J. A. ARMSTRONG.

Witnesses:

L. E. HAYNES,

HUBERT A. GILL.