No. 855,073.

PATENTED MAY 28, 1907.

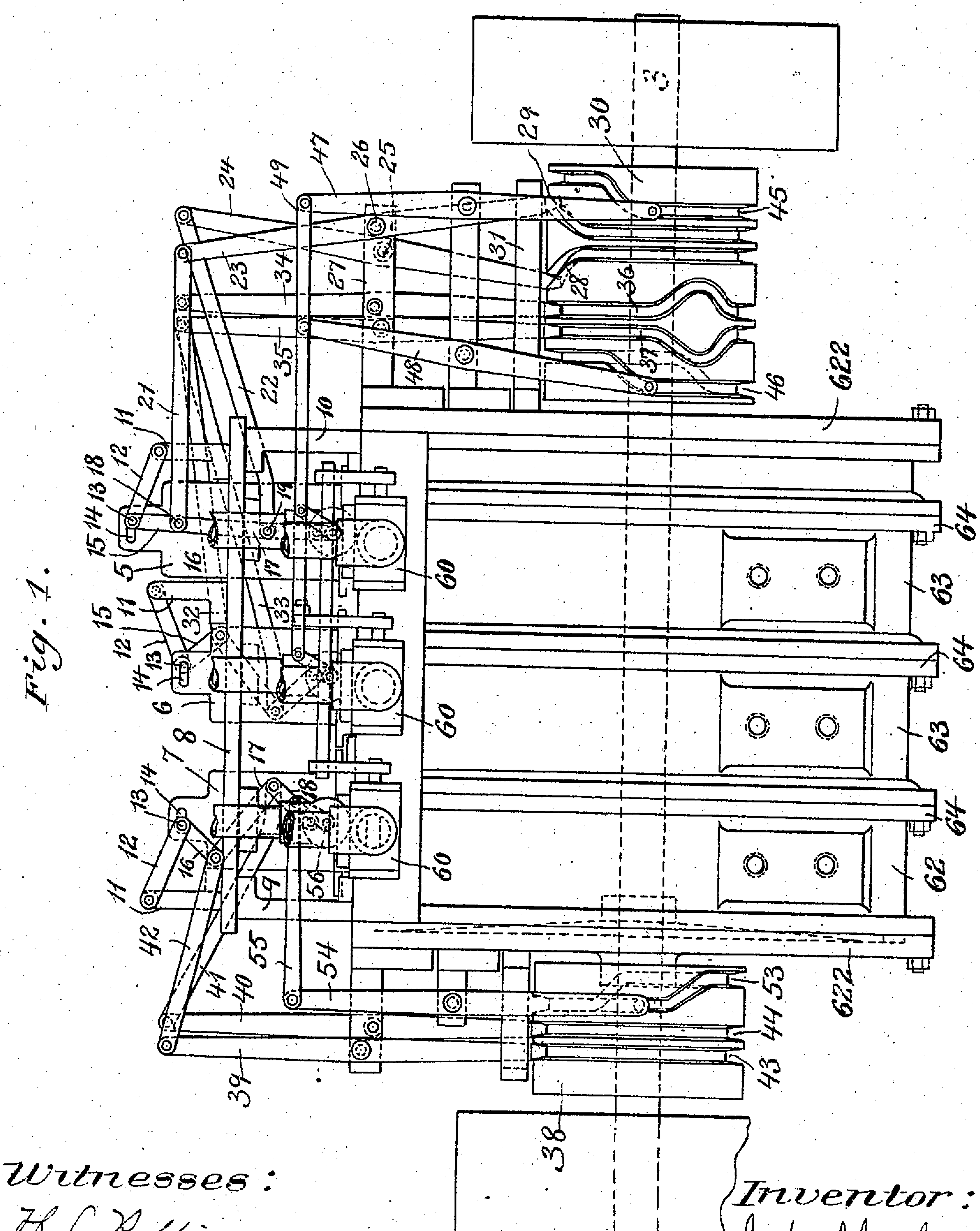
J. M. SPARKES.

ROTARY ENGINE.

APPLICATION FILED AUG. 15, 1906.

8 SHEETS—SHEET 1.

Fig. 1.



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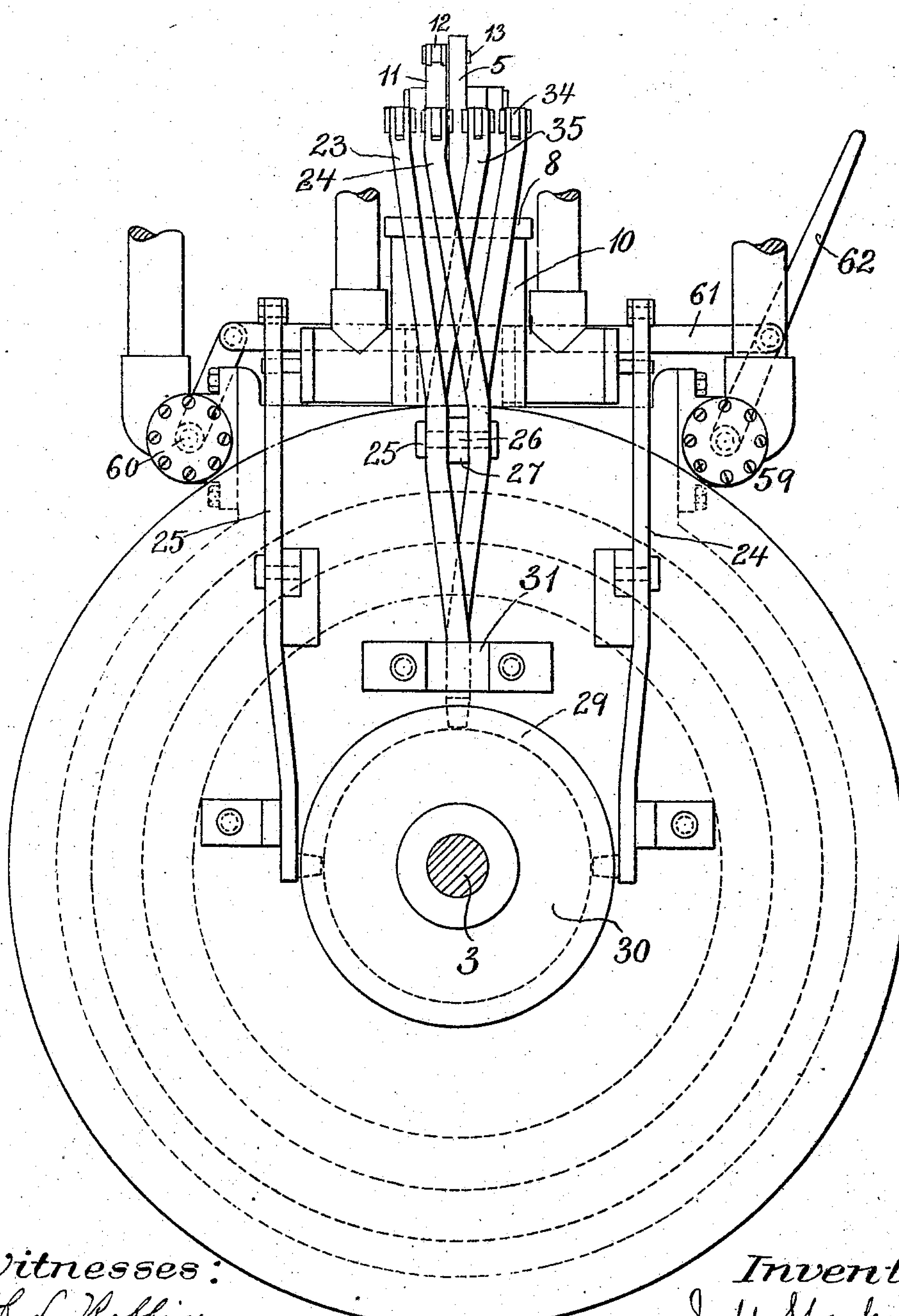
8 SHEETS—SHEET 2.

Fig. 2.



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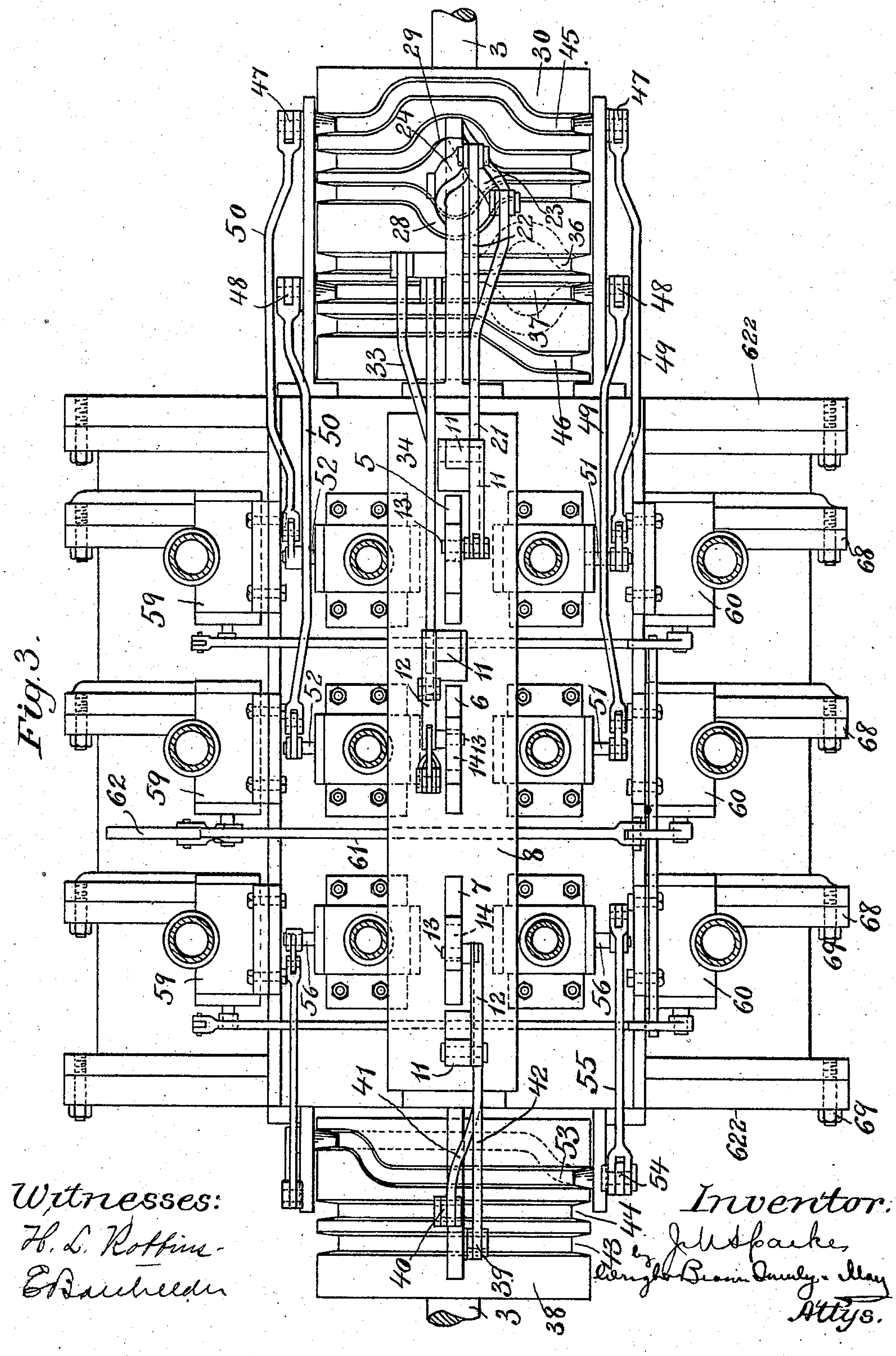
8 SHEETS—SHEET 3.



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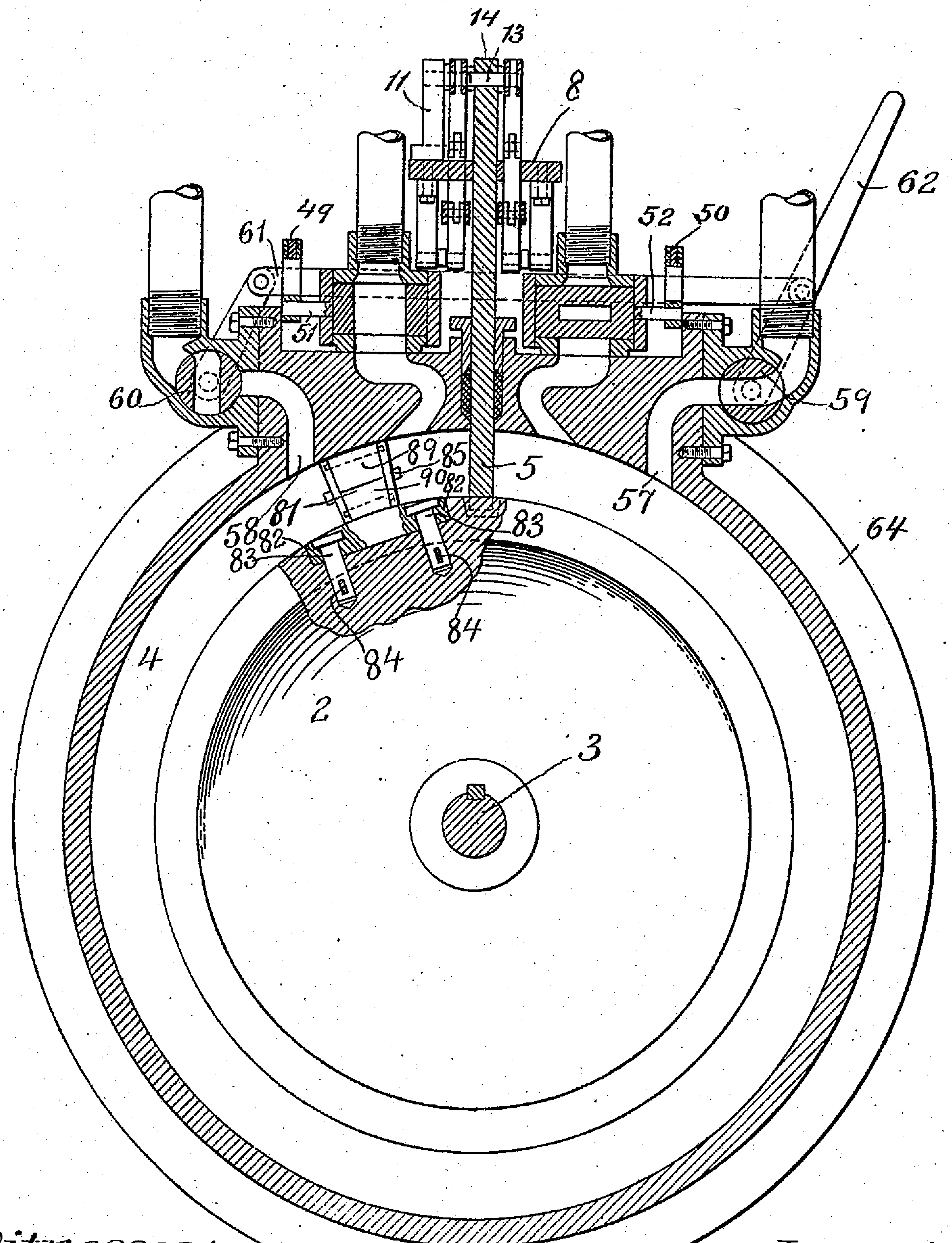
8 SHEETS—SHEET 4.

Fig. 4.



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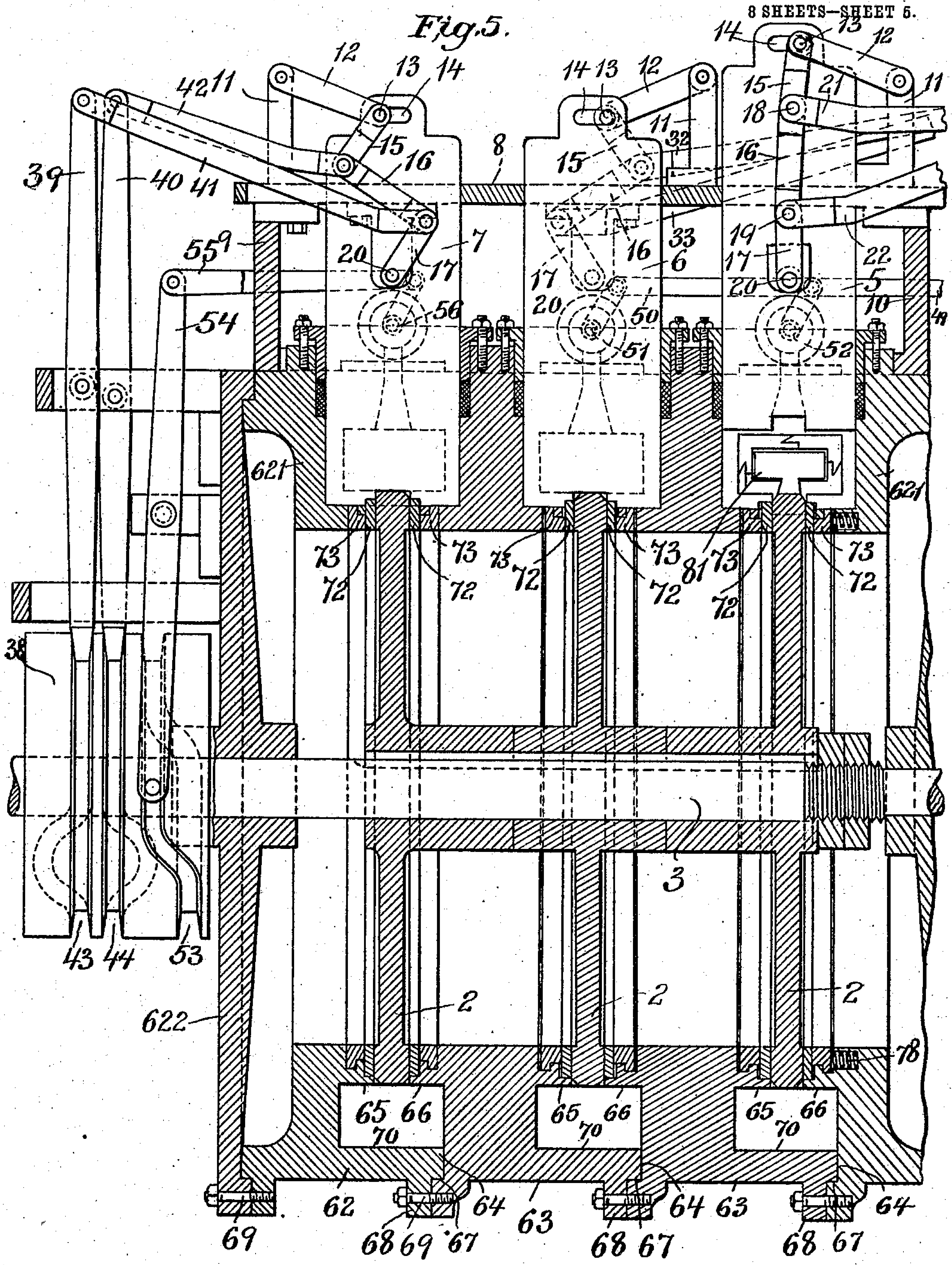
8 SHEETS—SHEET 5.

Fig. 5.



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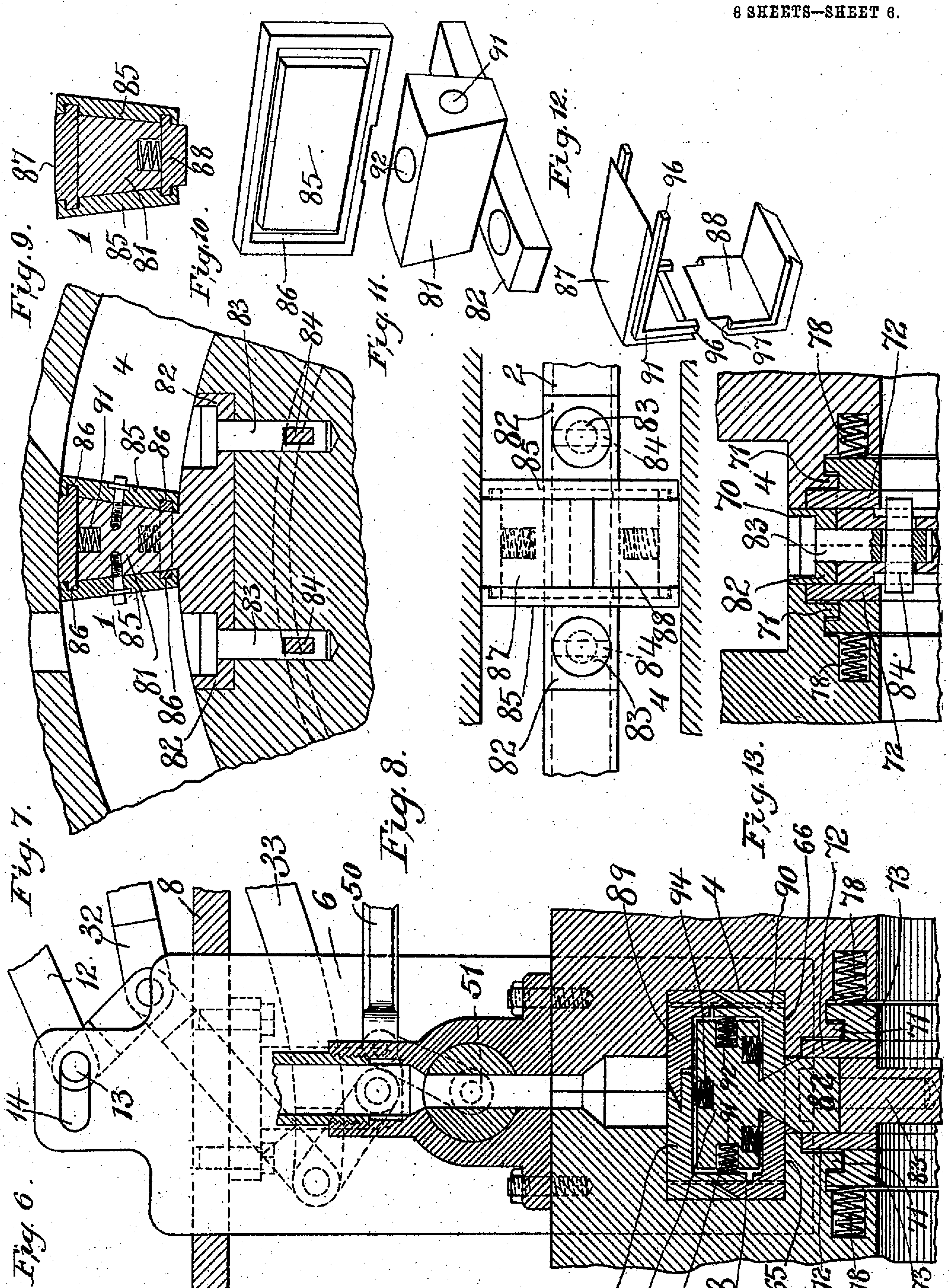
8 SHEETS—SHEET 6.



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No. 855,073. PATENTED MAY 28, 1907.

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ROTARY ENGINE.

APPLICATION FILED AUG. 15, 1906.

8 SHEETS—SHEET 7.

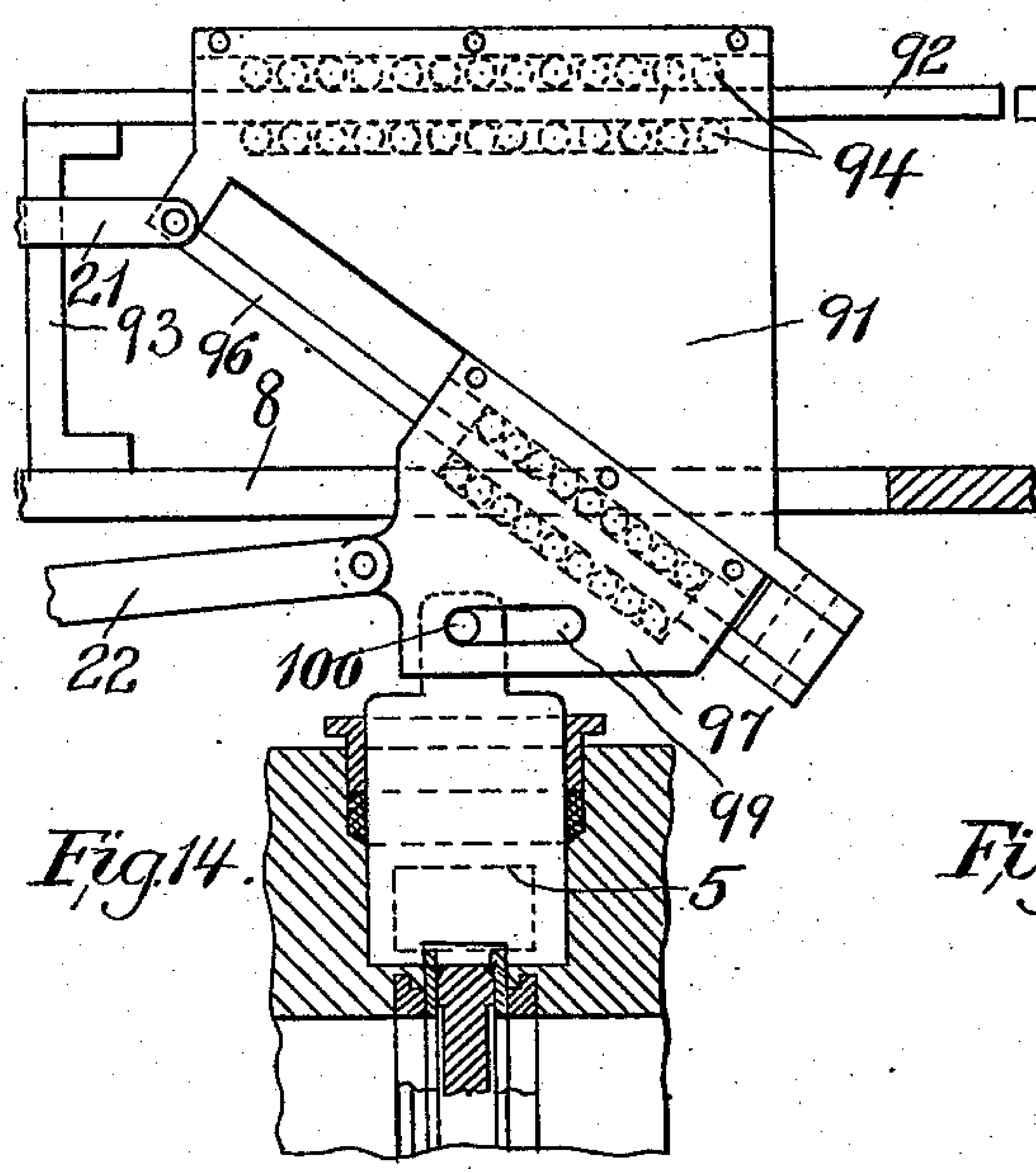

Fig. 14.

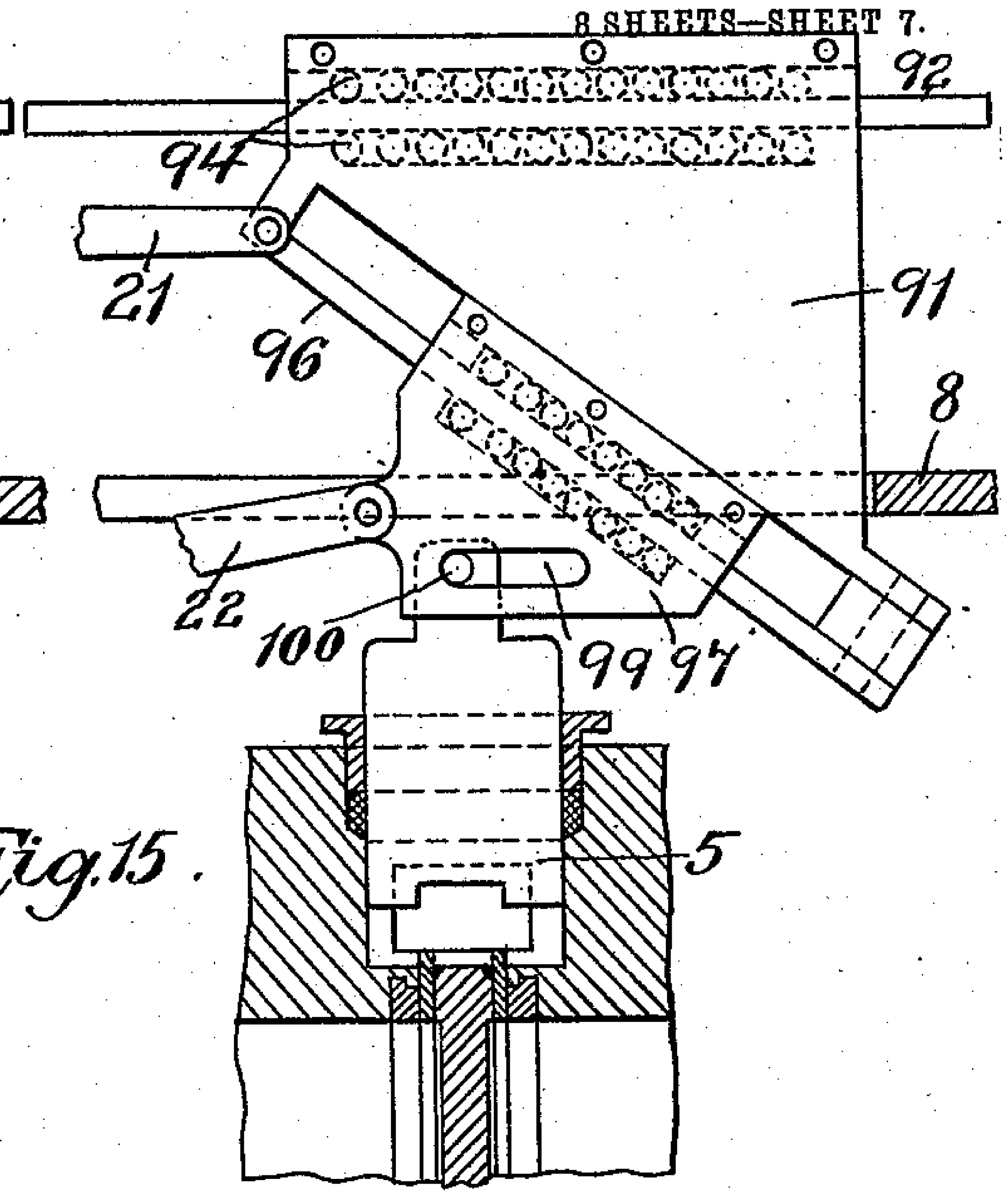

Fig. 15.

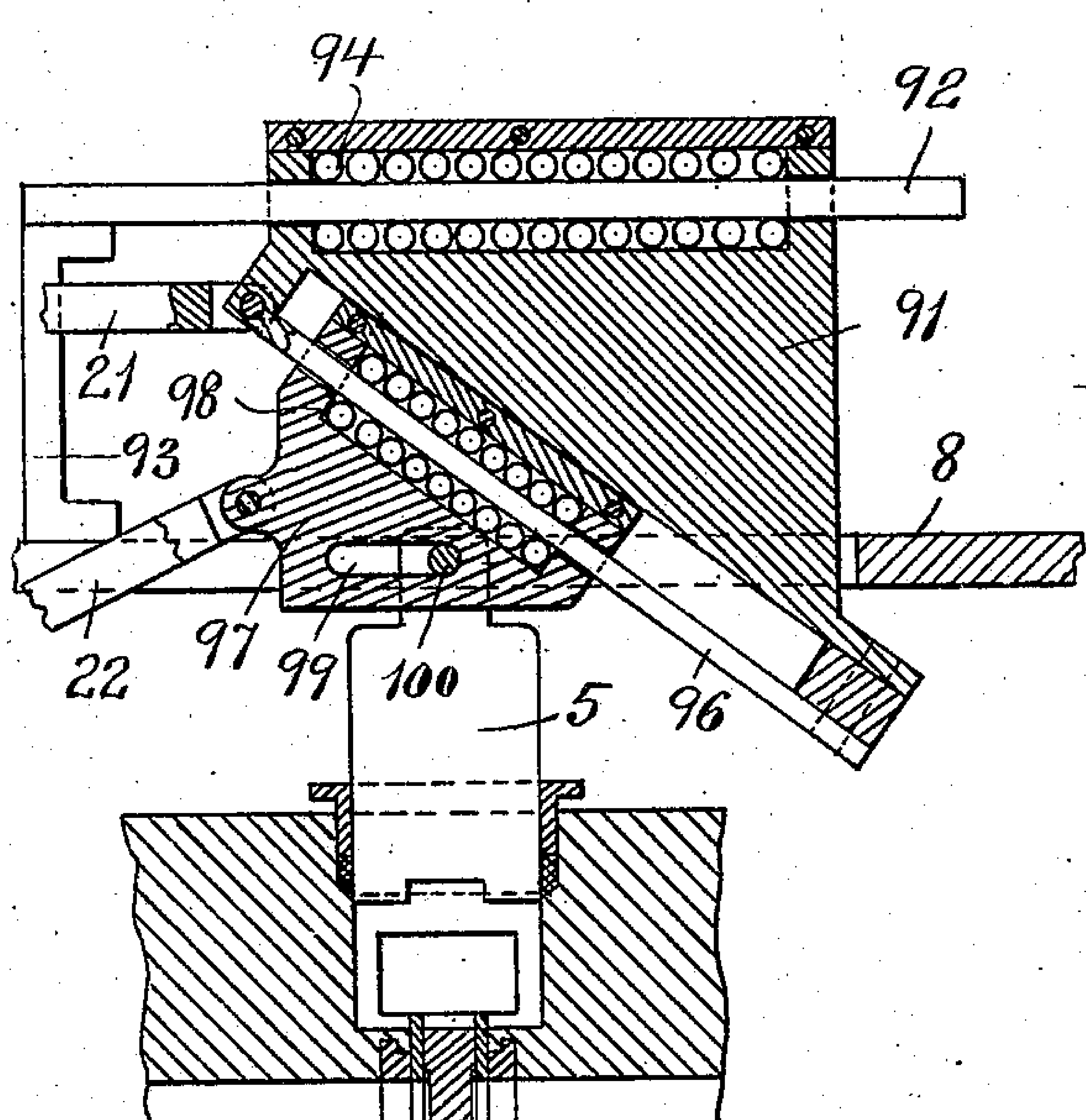

Fig. 16.

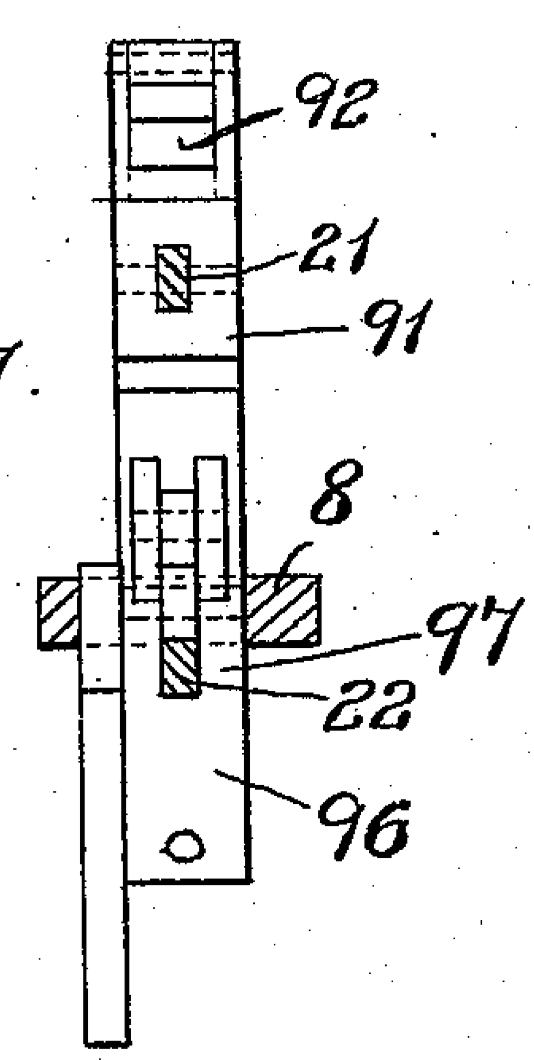

Fig. 17.

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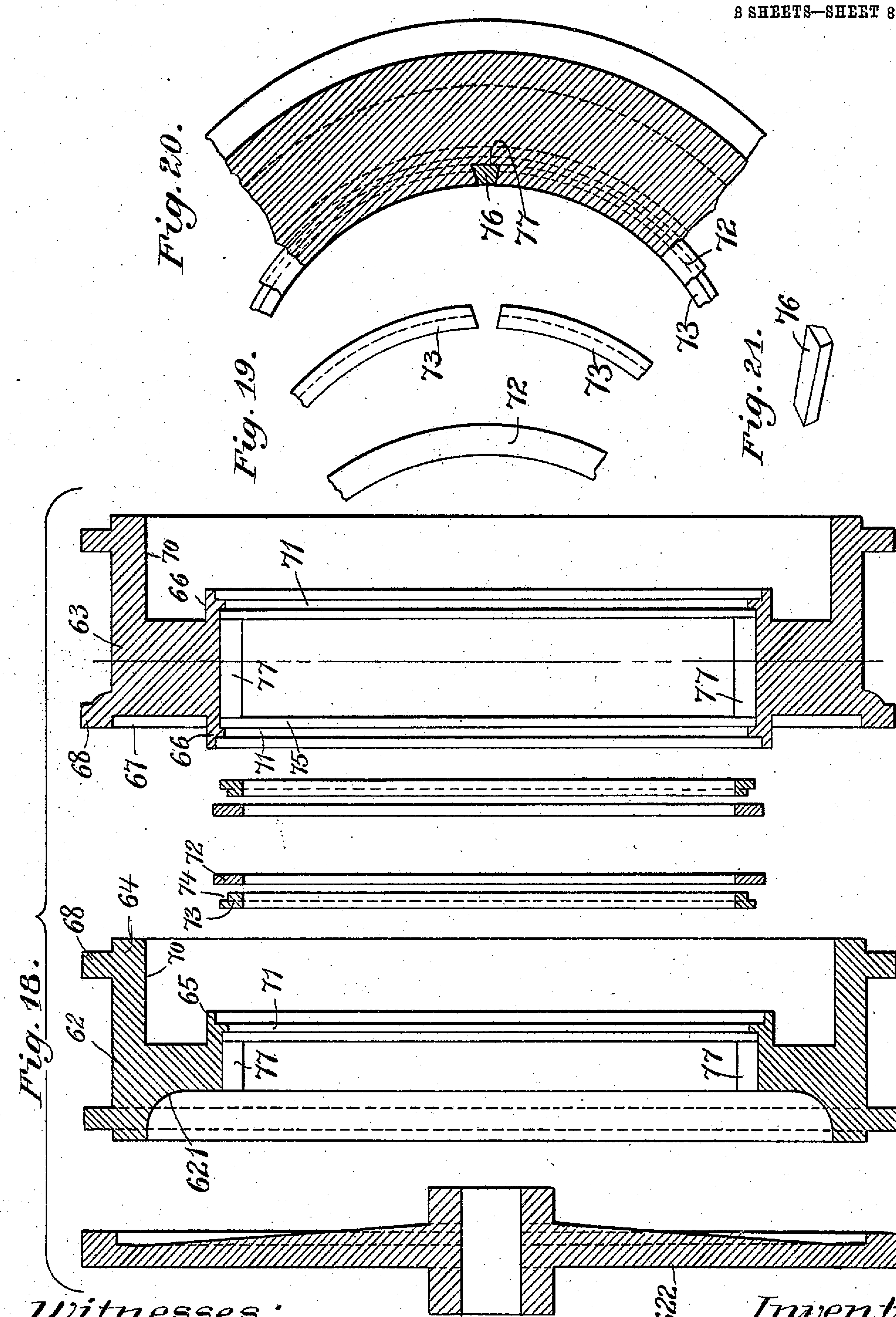
APPLICATION FILED AUG. 15. 1906.

8 SHEETS—SHEET 8.



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UNITED STATES PATENT OFFICE.

JAMES M. SPARKES, OF LYNN, MASSACHUSETTS, ASSIGNOR OF NINE-TWENTIETHS TO FRED H. SEAVEY, OF BOSTON, MASSACHUSETTS, AND ONE-TWENTIETH TO CHARLES W. BLACKETT, OF LYNN, MASSACHUSETTS.

ROTARY ENGINE.

No. 855,073. Specification of Letters Patent. Patented May 28, 1907.

Application filed August 15, 1906. Serial No. 330,710.

To all whom it may concern:

Be it known that I, James M. Sparkes, of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to rotary engines in which one or more pistons are supported from a shaft and are caused to travel in a fixed circular path in annular chambers, and in which the abutment for the reaction of the steam consists of a plate or plates which normally extend across the chambers and are displaceable for a short period in each revolution to permit the pistons to pass by them.

The object of the invention is to provide a new and improved means for operating the abutments to cause them to retract and be again projected with the least possible expenditure of time, to provide a new and improved construction of self-adjusting and self-fitting piston; and to provide self-adjusting packing between the rotating disks which carry the pistons and the walls of the pressure chambers.

The accompanying drawings illustrate the manner in which my invention is practiced.

In the drawings,—Figure 1 represents an elevation of a rotary engine embodying the principles of my invention. Fig. 2 represents an end elevation of the same as seen from the right of Fig. 1. Fig. 3 represents a plan view. Fig. 4 represents a transverse section taken through one of the pressure chambers. Fig. 5 represents a longitudinal central section of the engine. Fig. 6 represents a section similar to Fig. 5, on an enlarged scale, showing one of the chambers and pistons with the abutment therefor, and means for operating it in elevation. Figs. 7, 8, 9, 10, 11 and 12 represent detail views, showing the construction of the novel piston. Fig. 13 represents a detail section showing the construction of packing between the division rings and piston-carrying disks. Figs. 14 to 17 represent detail views representing a modified construction of abutment-operating mechanism. Fig. 18 represents details of the division rings in which the working chambers are formed, and the packing therefor. Fig. 19 represents detail elevations of the chamber packing rings and holding rings. Fig. 20 represents a fragmentary cross section of a portion of a division ring with the packing in place. Fig. 21 represents a perspective view, showing the key for retaining the packing in place.

The same reference characters indicate the same parts in all the figures.

Referring to the drawings,—the engine may be constructed with any number of working chambers and pistons, of which each piston 1 is supported upon a disk 2 keyed to a main shaft 3 and working in an annular chamber 4. In the present embodiment of the invention three such annular chambers are shown, although as before stated, there may be more, and I provide abutments represented by 5, 6 and 7, respectively, which are arranged so as to reciprocate radially of the engine, and to be alternately projected across and removed from each respective chamber.

The abutments are guided through slots in a yoke or cross bar 8 extending longitudinally of the engine and supported by brackets 9 10. Adjacent each abutment is a bracket 11 to which is pivoted a link 12 having in its swinging end a pin 13 projecting through a slot 14 in its respective abutment. By raising and lowering the pin 13, the abutments may be reciprocated. The slots 14 are provided to permit swinging of the pins on arcs of circles.

The means for raising and lowering the abutment-operating pins consists of a double toggle linkage composed of the links 15 16 and 17 connected together by pivot pins 18 and 19, respectively. The uppermost link 15 is pivoted on the pin 13, while the lowermost link is pivoted on a pin 20 at a fixed point on the engine. When the links are all in line, the abutment is retracted in the position occupied by the abutment 5, while when the links are out of line, and the toggle is broken, the abutment is more or less projected across the chamber.

For extending and breaking the toggle of abutment 5, I provide links 21 and 22, which are pivotally connected to the ends of levers 23 and 24, the latter being mounted upon fulcrum pins 25 and 26 held in a bar 27. The lower ends of the levers extend into cam grooves 28 29 on a cam 30 which is secured to the main shaft 3. Anti-friction rollers are mounted on the ends of the levers and are prevented from being deflected transversely by means of a guide 31 having the shape of an elongated U extending parallel to the shaft 3 and embracing the lower ends of the levers. The cam grooves 28 29 are symmetrical, being parallel through the greater part of their extent but diverging apart, and again converging in one portion. The inclined parts of the cam grooves are made of as short an extent as possible so as to secure quick operation of the abutments. It will be evident that when the divergent portions of the cam grooves reach the levers, the latter are swung in opposite directions, thereby moving the pivot pins 18 19 in opposite directions and straightening the toggle, while the converging portions move the levers into parallelism and break the toggle, causing the abutment to project across its respective chamber. As shown in the drawings, the abutment 5 is retracted and abutments 6 and 7 projected. The abutment 6 is operated by connecting rods 32 33 and levers 34 35 which are operated by grooves 36 37 in a cam 30 in a similar manner. The abutment 7 is operated from a cam 38 on the shaft 3 at the other end of the engine through similar levers 39 40, connecting rods 41 42, and cam grooves 43 44.

The links 12 are necessary to guide the pivots 13 by which the toggle links are engaged with the abutments, and to take the horizontal thrust of the links or connecting rods 21 22, 32 33, and 41 42, this thrust being longitudinal with respect to the rods and lateral as to the abutments, and prevent the abutments cramping in their guideways. If the links 15 were directly attached to the abutments by the pivots 13, the thrust of the connecting rods would press the abutments with great force against the frame of the engine, producing a powerful frictional resistance to the reciprocation thereof. By providing swinging links to take this thrust, however, the only force applied to the abutments acts in the direction of their motion and they are thus enabled to slide freely in and out.

The abutment-operating levers are arranged to travel in a plane passing through the axis of the shaft 3, and so are directly above and radial to the cams. The pivots of the levers which operate the lower of the connecting rods of each pair are slightly lower than the pivot of the other levers, so as to make the arms of slightly greater length to compensate for the greater angularity of the respective connecting rods.

It will be seen that the compound mechanism including the levers which are operated simultaneously in opposite directions, enables the movement of the abutment to be produced with half the displacement of the cam which would be necessary if only one lever were used, for each gives half the necessary travel to the abutment and adds its actuation to that of the other. Therefore a cam of smaller diameter and one in which the offset portion is of less length than would be the case in a single cam giving the whole travel to the abutment may be employed, thereby diminishing weight and increasing the rapidity with which the abutment is moved. Furthermore, the oppositely moving parts balance each other and prevent vibration. The cam 30 also has grooves 45 and 46, the former of which operates a lever 47 and the second a lever 48 for controlling the steam-admission valve of the engine. These levers are on opposite sides of the cam and have rollers on their ends engaging the cam at points in a horizontal diametrical plane. These levers are connected by links 49 50 respectively, with arms on the valve shafts 51 52, and each is oscillated once in every revolution of the cam to open and close the valve, thereby admitting steam to each chamber for a fraction of each revolution. Cam 38 has a similar groove 53 acting upon a lever 54 and link 55 to oscillate valve 56. The pistons are preferably spaced at different angular points about the shafts, and the cams are so arranged that each abutment and admission valve is operated in turn, so that steam is admitted during a fraction of the revolution of each chamber, and there is full pressure upon one of the pistons all the time. The exhaust steam passes out through one or the other of two ports 57 58 which are governed by valves 59 60 connected by a link 61 and operated by an arm 62 so that only one port is opened at a time. By shifting the valves, the engine may be reversed.

The chambers in which the pistons run are formed in division rings 62 63 as most clearly shown in Fig. 18. Each ring has on the right-hand side a wide laterally-extending peripheral flange 64, and a shorter inner flange 65, while the intermediate rings have on their left-hand sides a flange 66 surrounded by a shallow groove 67 of sufficient depth to receive the end of flange 64. Outer rings 68 are provided through which bolts 69 extend for drawing and securing the division rings together. It will be noticed that the groove in the right-hand face of the ring is by far the deeper, and constitutes practically the entire steam chamber, and that the annular surface 70 extends throughout the whole width of the chamber. Thus the outer side of the chamber is entirely formed in one ring, and there is no necessity of machining two abutting rings to the exact size, and thereby the work required to attain an exact alinement, and danger of imperfect alinement are avoided. The flanges 65 and 66 do not abut, since they are separated by the width of the disk 2, and therefore no great care is necessary to have them of exactly the same diameter.

The division rings are bored wholly from one side to the other, and are faced off inside of the flanges 65 and 66 to provide short circular ribs 71 to hold the packing. The packing consists of rings 72 fitting between the ends of flanges 65 and the disks 2, as shown in Fig. 5. They are secured detachably to holding rings 73 which are grooved at 74 to receive the ribs 71. The holding rings are made in two parts, and are slipped into the grooves 75 between the ribs 71 and bodies of the division rings, and are held expanded in such grooves by means of dove-tailed keys 76 which pass through slots 77 in the inner walls of the division rings, and in the ribs 71. The grooves 74 of the holding rings accommodate the ribs 71, and the packing rings are screwed onto the projecting parts of the holding rings 73 so that in effect the holding and packing rings form a single ring embracing a rib 71 by which it is held in place. There is sufficient clearance between the rings to allow the packing to adjust itself, and provide for expansions of the parts, and the latter is held up against the disks by springs 78, as shown in Fig. 13. The endmost division rings 621 are of somewhat different construction, and are shaped to receive separable heads 622, but the intermediate rings are all alike, and the size of the engine may be indefinitely increased or diminished by adding or taking out rings.

The principal feature of my invention consists of the new construction of piston which is self-adjustable so as to fit accurately in the chamber. It is shown in detail in Figs. 6 to 12 inclusive, and consists of a center-piece 81 having projecting arms 82 which are placed in slots in the disk 2 and secured therein by sunken bolts 83 through which and the disk project keys 84. On each of the opposite sides of the center-piece are fastened rigidly plates 85 having grooves 86 parallel with their sides. The plates extend slightly beyond the center-piece 81 and the grooves are also beyond the sides and ends of the center-piece and act to hold the expansible self-adjusting parts of the piston. These parts consist of four pieces 87 88 89 and 90, each of which has ribs 91 on its sides projecting into the grooves 86 of the opposed side pieces 85. The members 87 and 89 have a beveled joint between them and fit together over the outer face of the piston so as to bear against the outer wall and outer portions of the side wall of the steam chamber. The members 88 and 90 are beveled to fit against correspondingly beveled ends of the members 87 and 89, respectively, and fit against the inner walls and covers of the chambers.

In sockets 91 92 of the center-piece are placed springs 93 94 95 which press against the adjustable members and push them outward in all directions. The springs 93 and 94 are arranged at the beveled joints between the expansible members, and act upon two of them at once, outward bulging of the beveled joints being prevented by the interlocking rib ends 96 and sockets 97 of corresponding expansible members. The ribs 91 are of slightly less width than the grooves 86 so that some play of the expansible members is permitted, whereby the piston may automatically fit the chamber whether the engine is expanded or contracted with variations of temperature, but the outer sides of the ribs and grooves abut when the chamber is in its most expanded position, and hold the members in exact alinement with each other and with the chamber walls. The outer sides of the expansible members and the chamber walls are at first made a slight amount smaller than the fully-expanded piston, so that the piston will not be expanded to its fullest amount when the engine is first assembled, but after the engine has been run, the piston wears its bearing until it is an exact fit in the chamber. When the bearing has been formed, the ribs 91 press against the outer limits of the grooves 86, and accordingly exert no frictional resistance upon the chamber walls, while they are close enough to the walls to prevent leakage of steam, and the overlapped beveled joints are closed by the pressure of the springs. Thus a piston is provided which accurately fits the chamber and absolutely prevents leakage of steam, while it also accommodates itself to variations in shape of the chamber, and will not stick when the latter becomes cold.

Instead of the toggle linkage for operating the abutments, I may use the modified construction illustrated in Figs. 14 to 17. This construction consists of a cam plate 91 which is adapted to slide on a horizontal rod 92 mounted on brackets 93 above the guide plate 8 through a slot in which it projects and is guided. This cam plate is provided with a ball bearing 94 and is connected with the connecting rod 21 adapted to be joined with a lever similar to lever 23 of the other construction. This cam plate carries a guide rod 96 upon which is mounted a second cam plate 97 linked to the other connecting rod 92. It has a ball bearing 98 to diminish its friction on the guide 96 and is provided with a slot 99 through which projects a pin 100 on the abutment 5. The connecting rods 21 22 being reciprocated in the previously described manner, move the two cams in opposite directions simultaneously, and cause the cam 97 to ride up and down on the inclined rod 96, each of the cams supplementing the movement given by the other, and by their combined movements raising and lowering the abutment.

Figs. 14, 15 and 16 show the successive steps by which the two cams together act to raise and lower the abutment. In Fig. 14, the abutment is projected across the chamber, the cam 91 being in its extreme left-hand, and the cam 97 in its extreme right-hand position. If the cam 91 could be moved independently to the right through the full throw of its actuating connecting rod 21, and cam 97 held stationary, the parts would occupy the position shown in Fig. 15, cam 97 having been caused to ride part way up the rod 96, leaving the abutment 5 approximately half way out of the chamber. Movement of cam 97 to the left through the full throw of its connecting rod 92 brings it to the position shown in Fig. 16, where it has ridden to the upper end of rod 96 and wholly retracted the abutment from the chamber. In actual operation these movements take place simultaneously so that while cam 91 moves to the right, cam 97 moves to the left in an equal period of time, and the motion given to the abutment is the resultant of these two movements.

I claim:—

1. A rotary engine comprising a shaft; pistons secured thereto; and a plurality of division rings separate from each other and each having an annular chamber formed in one side thereof, in which one of the pistons travels; each chamber being closed by the side of the adjacent ring, whereby the number of chambers and the size of the engine may be indefinitely increased or reduced.

2. In a rotary engine, co-operating rings, one having an annular recess in one side to form a piston-chamber, and the other having on the adjacent side a plane surface adapted to extend over the recess of the first ring to inclose the chamber, and heads having bearings for the engine shaft engaging and extending across the rings on the outer sides thereof, forming the ends of the engine.

3. In a rotary engine, a ring having on one side an annular groove, a flange forming the outer wall of said groove, and a second flange of less width than the first-named flange forming the inner wall of the groove, the ring having on its other side a narrow flange of the same diameter as the second said flange, whereby to co-operate with a second, similarly-formed ring to constitute a piston-chamber.

4. In a rotary engine, a plurality of rings, one of which has outer and inner flanges of different heights, and the other of which has a flange adapted to project over the edge of the first ring and has also a lateral flange of the same diameter as the inner flange of the first ring, said rings when placed together inclosing an annular chamber for the reception of a piston.

5. In a rotary engine, separably connected rings containing between them a groove forming an annular piston chamber, co-axial flanges on said rings forming the inner wall of said chamber and separated from each other, a piston-carrying disk located between said flanges, packing rings bearing against opposite sides of said disk, and means retaining packing rings in place adjacent the flanges.

6. In a rotary engine, separable members having between them a groove forming an annular chamber, alining flanges forming the inner walls of said chamber and separated from each other by a space, a piston-carrying disk located between the said flanges, ribs on the inner sides of the flanges, packing rings located between said ribs and the sides of the disk, and holding rings connected to the packing rings and having portions in locked engagement with said ribs.

7. In a rotary engine, separable members having between them a groove forming an annular chamber, alining flanges forming the inner walls of said chamber and separated from each other by a space, a piston-carrying disk located between the said flanges, ribs on the inner sides of the flanges, packing rings located between said ribs and the sides of the disk, and holding rings connected to the packing rings and having peripheral extensions projecting in rear of said ribs co-operating with the latter to retain the packing and holding rings in place.

8. In a rotary engine, separable members having between them a groove forming an annular chamber, alining flanges forming the inner walls of said chamber and separated from each other by a space, a piston-carrying disk located between the said flanges, ribs on the inner sides of the flanges, packing rings located between said ribs and the sides of the disk, holding rings connected to the packing rings and having portions in locked engagement with said ribs, and springs mounted in said separable members bearing on said holding rings to force the packing rings into tight engagement with the disk.

9. In a rotary engine, a member having a flange forming one wall of a steam chamber, an annular rib formed on the inner wall of said flange and having a transverse slot, a holding ring made in a plurality of parts adapted to be separately inserted behind the annular rib and having a groove to receive such rib, a key fitting in said slot and retaining the members of the packing ring separated and in locking engagement with the rib, and a packing ring detachably secured to the holding ring.

10. A rotary engine comprising a revoluble piston, an annular chamber in which said piston is adapted to travel, an abutment, and a plurality of devices for reciprocating said abutment, each having a range of movement insufficient to advance and retract the abutment fully, but arranged so as by their combined movement to give the required amount of travel to the abutment.

11. A rotary engine, comprising a revoluble piston, an annular chamber in which said piston is adapted to travel, an abutment, and

a plurality of actuating members for advancing and retracting the abutment; each of said members being adapted to give part of the necessary movement to the abutment and to supplement the movement given thereto by the other member.

12. A rotary engine comprising a revoluble piston, an annular chamber in which said piston is adapted to travel, an abutment, levers arranged to be simultaneously oscillated by the motion of the engine in opposite directions, and connecting rods attached to said levers and to a plurality of members which by their combined movements in opposite directions actuate the abutment.

13. A rotary engine comprising a revoluble piston, an annular chamber in which said piston is adapted to travel, an abutment, a plurality of oppositely moving members connected to each other and to the abutment, adapted by their combined movements to reciprocate the abutment, connecting rods attached to said members, and levers attached to said connecting rods and oscillated by the engine in opposite directions.

14. A rotary engine comprising a revoluble piston, an annular chamber in which said piston is adapted to travel, an abutment, links connected respectively to the abutment and a fixed pivot, an intermediate link pivoted thereto by joints movable in opposite directions, and oppositely traveling members connected to the joints for straightening and breaking the linkage to reciprocate the abutment.

15. A rotary engine comprising a revoluble piston, an annular chamber in which said piston is adapted to travel, an abutment, a linkage forming a compound toggle pivotally connected at its ends to the abutment and a fixed portion of the engine and having a plurality of joints intermediate its ends, and a plurality of members movable simultaneously in opposite directions, each engaged with one of said joints for straightening and breaking said toggle, whereby the several movements of the several actuating members supplement each other and reciprocate the abutment through the required distance.

16. A piston for rotary engines comprising a prismatic center-block, wide angular bearing members adapted to embrace the edges at each end of said block and bearing on their outer surfaces against the walls of the pressure chamber, means tending to move the bearing members outwardly from the center-block, and stops fastened to the block for preventing excessive outward movement of said bearing members.

17. A piston for a rotary engine comprising a body, front and rear plates thereon having peripheral lips, and bearing members located between said plates surrounding the block, and having projections adapted to engage and be retained by said lips.

18. A piston for rotary engines comprising a rigid center block; bearing members arranged between the block and the outer, inner and lateral bounding walls of the annular chamber in which the piston is adapted to travel, having wide surfaces to bear on said chamber walls, whereby to prevent leakage of steam; means pressing said members outward to cause them to wear to an exact fit in the chamber; and retaining means for the bearing members fixed to the center block permitting such outward movement, but confining the same within narrow limits, whereby to hold the bearing members and prevent friction with the chamber walls after they have worn to a true fit.

19. A piston for rotary engines comprising a rigid center block; angular bearing members arranged between the block and the outer, inner and lateral bounding walls of the annular chamber in which the piston is adapted to travel, and springs set in recesses in the center block pressing against the several bearing members to force their angular edges outward into the angles of the chamber.

20. A piston for rotary engines comprising a rigid center block; angular bearing members arranged between the block and the outer, inner and lateral bounding walls of the annular chamber in which the piston is adapted to travel, and springs set in recesses in the center block pressing against the several bearing members to force their angular edges outward into the angles of the chamber; the meeting ends of the several members being beveled to overlap, and pressed into tight engagement by said springs.

21. A piston for rotary engines comprising a rigid center block; bearing members arranged between the block and the outer, inner and lateral bounding walls of the annular chamber in which the piston is adapted to travel; plates secured to the front and rear of said center block, having grooves bounded by peripheral lips; flanges on the bearing members entering said grooves; and springs tending to force the bearing members outwardly, such outward movement being limited by engagement of the flanges with the lips.

22. In a rotary engine having a steam chamber, an abutment movable into and out of the chamber, toggle links, connecting rods joined to the joints of said links for straightening and breaking the toggle, and a swinging link pivoted to one end of the toggle linkage for taking the thrust of the connecting rods; the pivotal connection between such link and the toggle being engaged with the abutment to reciprocate the latter.

23. In a rotary engine having a steam chamber, an abutment movable into and out of the chamber, toggle links, connecting rods joined to the joints of said links for straightening and breaking the toggle, and a link

lying approximately parallel to said rods and pivotally connected to a fixed point and to the toggle linkage, for resisting the thrust of the latter, said link being adapted to swing about its fixed pivot and engaged with the abutment for causing reciprocation of the latter.

24. In a rotary engine, a piston-carrying disk, a piston having flanges set into and flush with the periphery thereof, pins or bolts extending through said flanges and into the body of the disk, and keys passing transversely through the disk and bolts to secure the latter.

In testimony whereof I have affixed my signature, in presence of two witnesses.

JAMES M. SPARKES.

Witnesses:

MARCUS B. MAY,

JAMES E. SPARKES.