

(No Model.)

3 Sheets—Sheet 1.

L. K. & C. S. CARNAHAN.
ROTARY STEAM ENGINE.

No. 605,852.

Patented June 21, 1898.

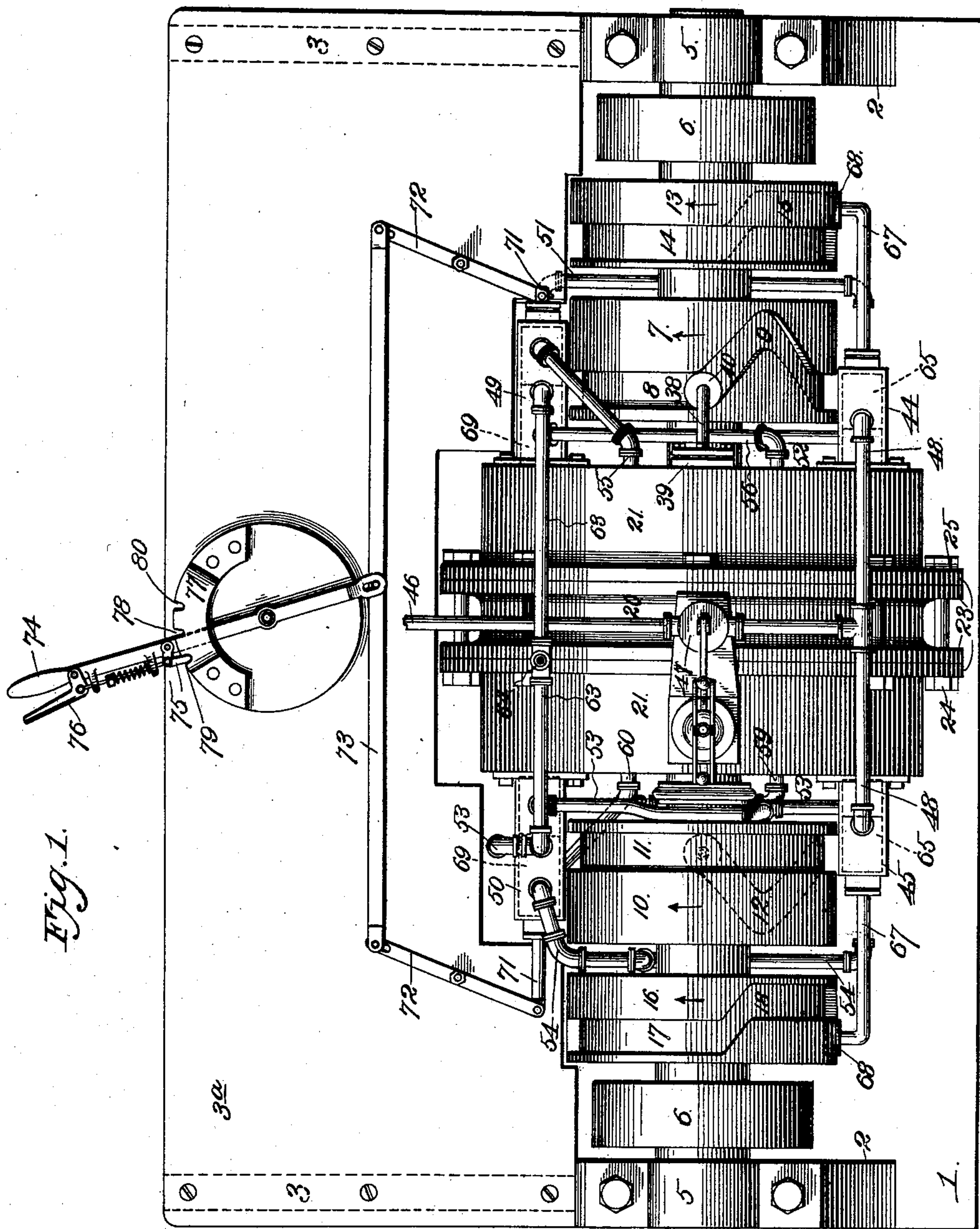


Fig. 1.

Witnesses:

G. P. Thorpe.
M. R. Remley.

Inventors
L. K. & C. S. Carnahan

By *Higdon & Higdon.*
attys.

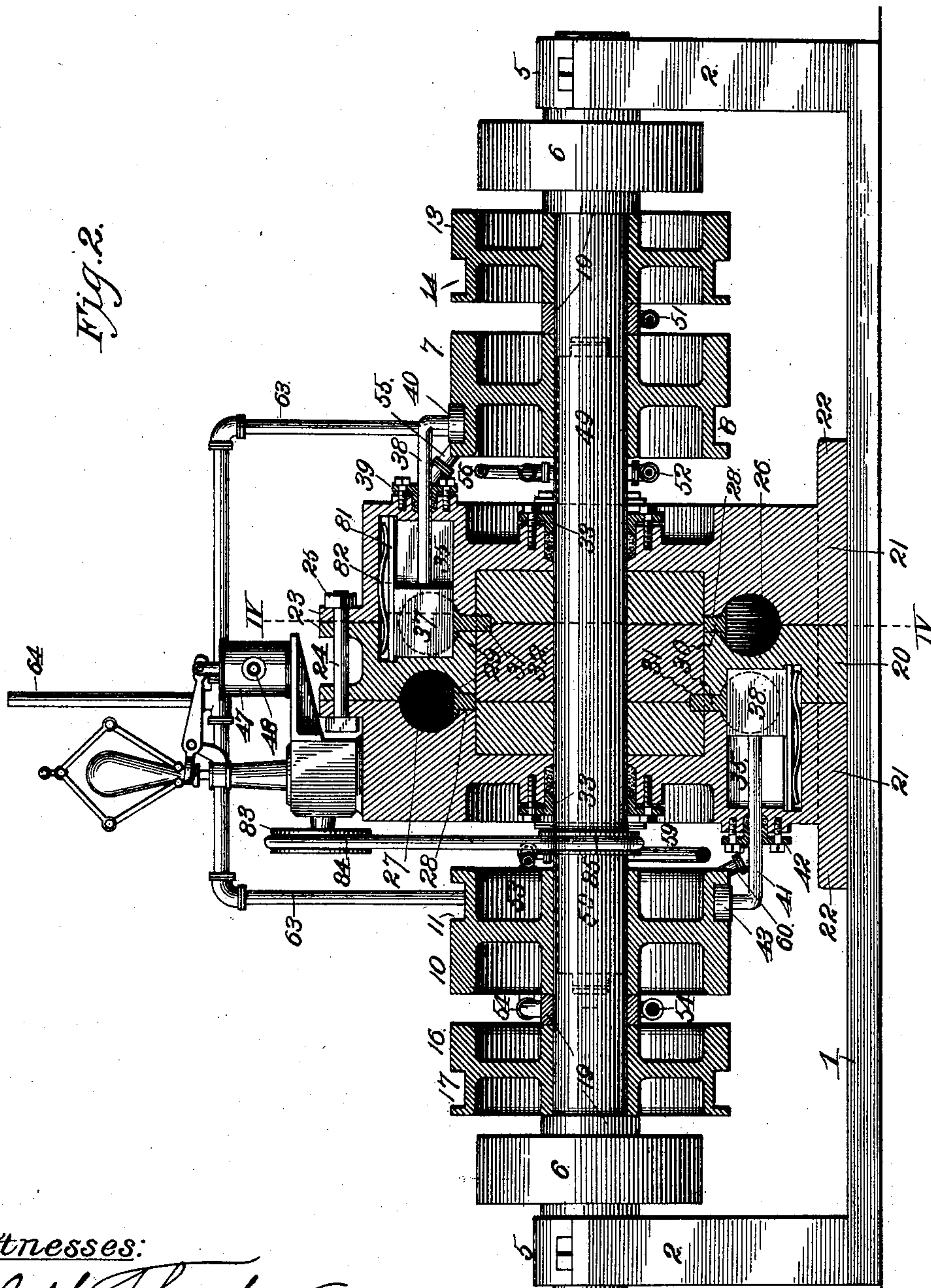
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3 Sheets—Sheet 2.

L. K. & C. S. CARNAHAN.
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(No Model.)

3 Sheets—Sheet 3.

L. K. & C. S. CARNAHAN.
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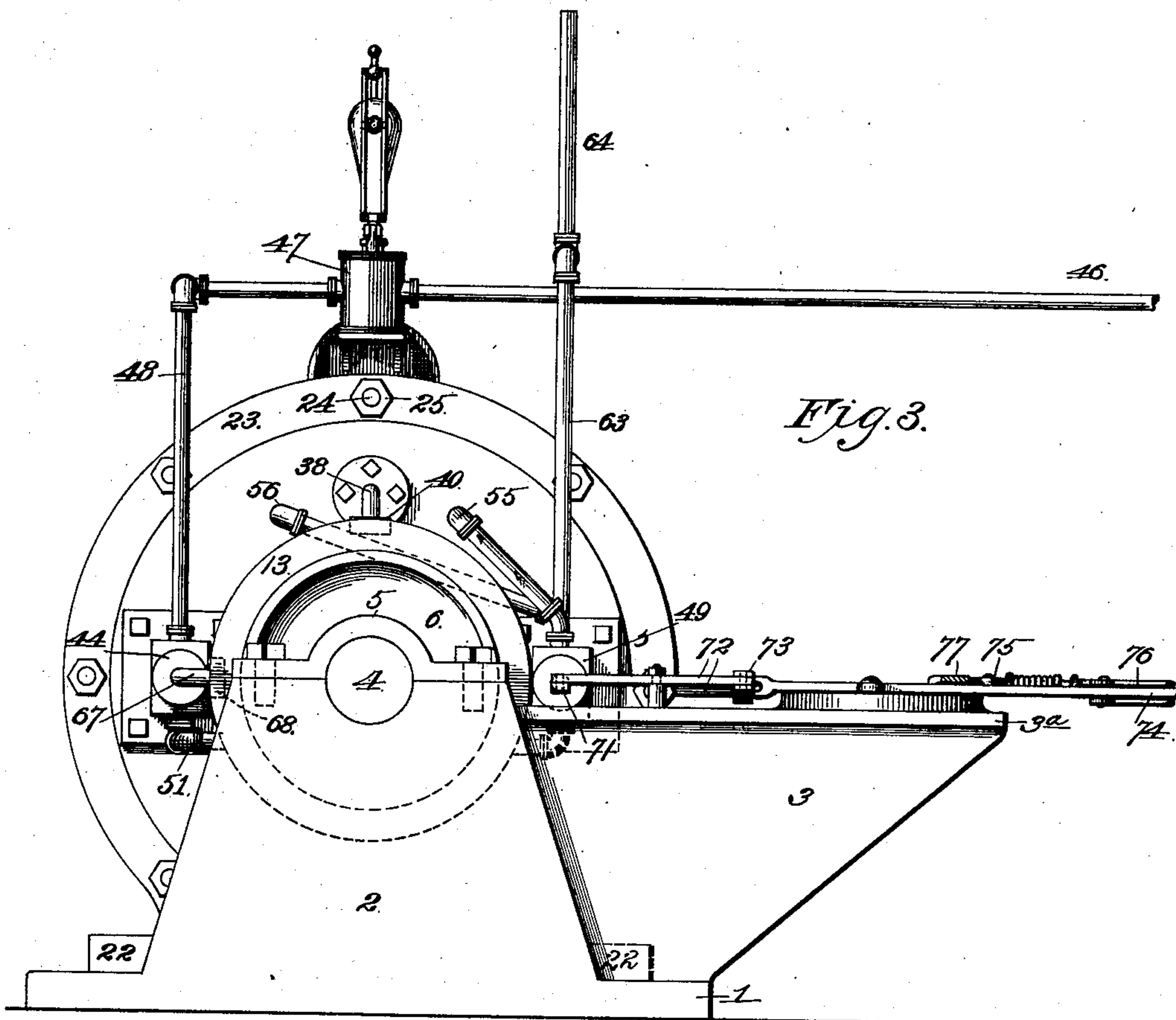


Fig. 3.

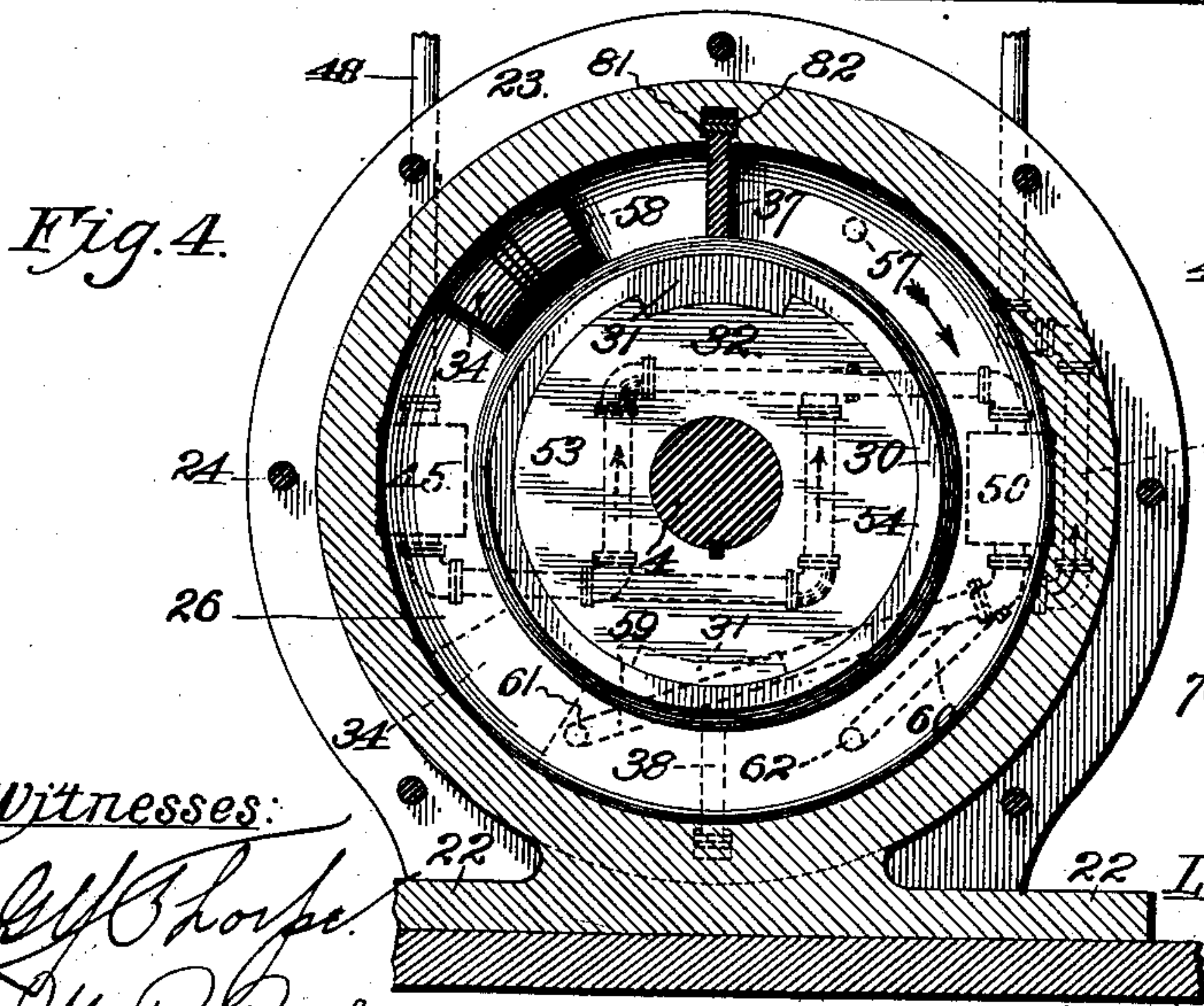


Fig. 4.

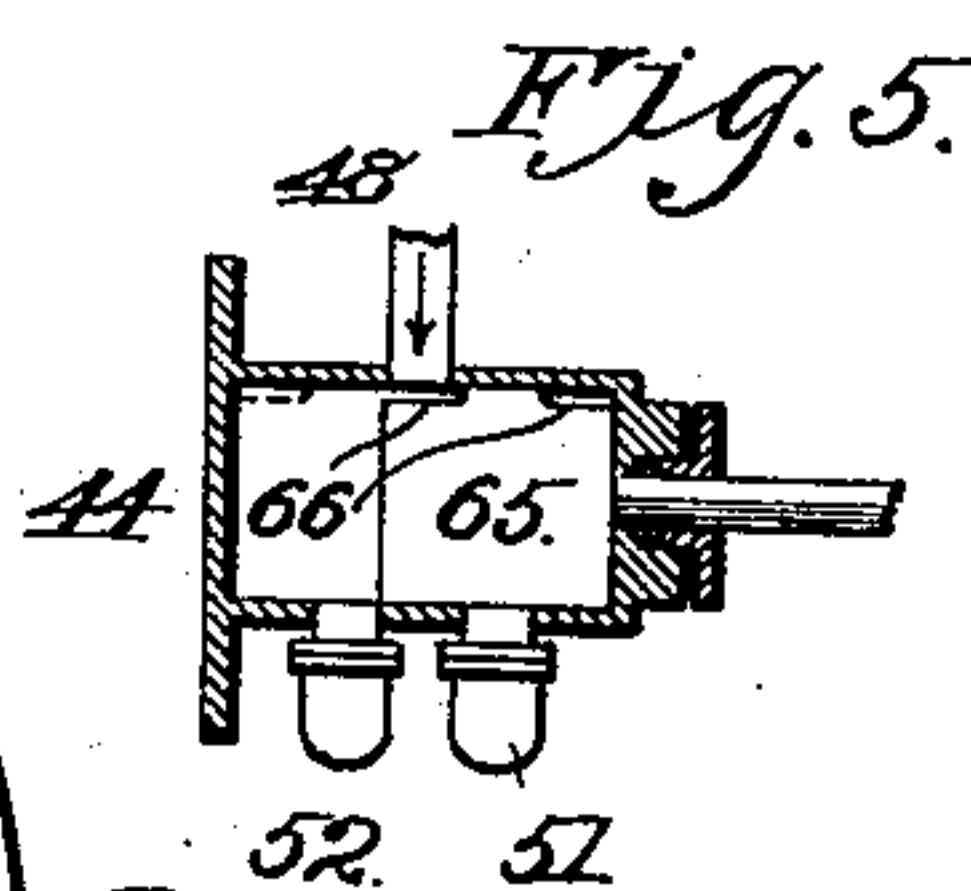


Fig. 5.

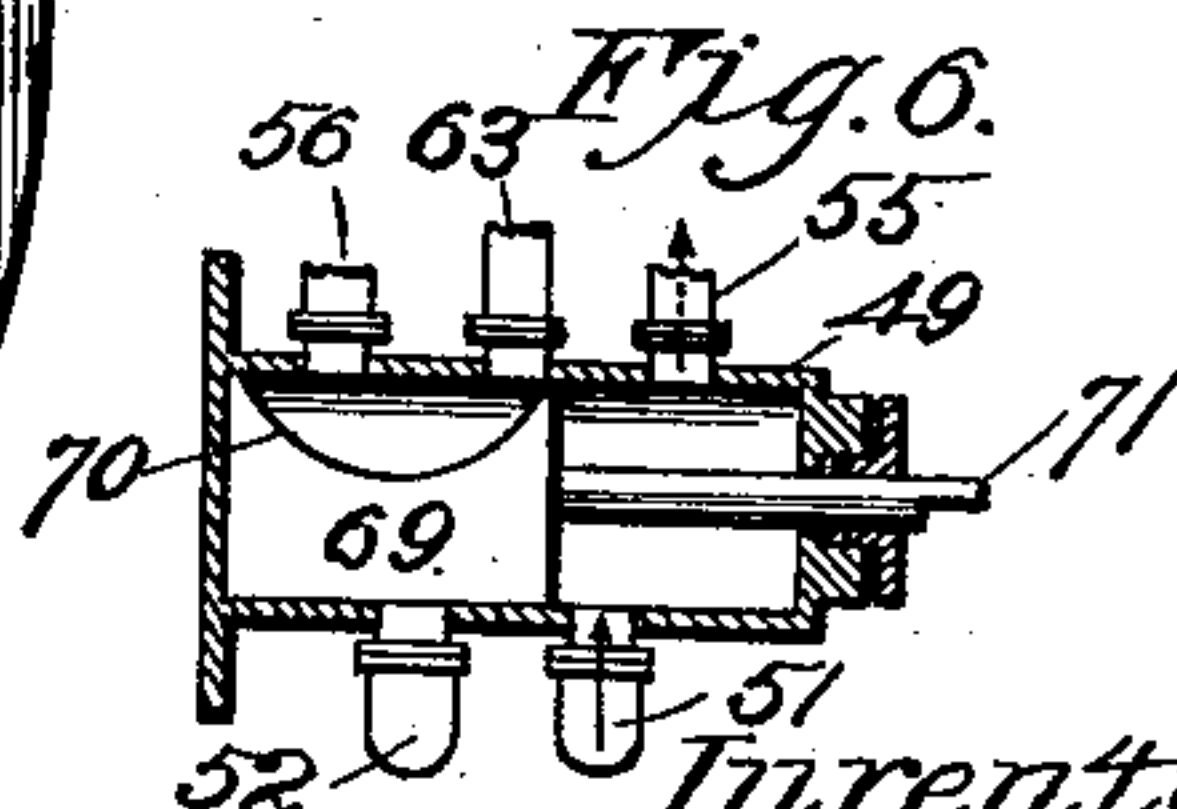


Fig. 6.

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UNITED STATES PATENT OFFICE.

LOUIS K. CARNAHAN AND CHARLES S. CARNAHAN, OF McLOUTH, KANSAS.

ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 605,852, dated June 21, 1898.

Application filed April 29, 1897. Serial No. 634,421. (No model.)

To all whom it may concern:

Be it known that we, LOUIS K. CARNAHAN and CHARLES S. CARNAHAN, of McLouth, Jefferson county, Kansas, have invented certain new and useful Improvements in Rotary Steam-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part thereof.

Our invention relates to rotary engines, and more particularly is designed as an improvement on the engine embodied in our application which was filed April 5, 1897, and is serially numbered 630,743.

The object of our present invention is to produce an engine of this character of fewer parts and of more compact construction than the other and which shall operate with much less friction.

With this object in view the invention consists in certain novel and peculiar features of construction and organization, as hereinafter described and claimed.

In order that the invention may be fully understood, reference is to be had to the accompanying drawings, in which—

Figure 1 represents a top plan view of a rotary engine embodying our invention. Fig. 2 represents a vertical longitudinal section of the same. Fig. 3 represents an end view of the engine. Fig. 4 represents a cross-section taken on the line IV IV of Fig. 2. Fig. 5 represents a longitudinal section of one of the steam-chests and in elevation its valve, which regulates the flow of steam to the engine. Fig. 6 is a longitudinal section of one of the reverse-valve steam-chests, the function of its valve being to determine the port through which the steam shall enter the engine.

In said drawings, where like numerals designate corresponding parts, 1 designates the base of the engine, provided, by preference, with two bearing-standards 2, and projecting laterally and in the same direction from one side of said standards are braces 3, upon which are secured, by screw-bolts preferably, the horizontal table or plate 3^a, or said table may be cast integral with said braces.

4 designates the engine-shaft, which is journaled at its opposite ends in standards 2 and is held from displacement by bearing-caps 5 in the customary manner.

6 designates one or a pair of belt-wheels, which is or are mounted rigidly upon the shaft near its end or ends. Mounted rigidly, yet adjustably, upon the shaft at a suitable point is a wheel 7, provided peripherally with an annular groove 8, which is formed with a V-shaped portion 9; the apex of said V portion being disposed toward the adjacent end of the shaft. At an equal distance, preferably, from the other end of the shaft a similar wheel 10 is mounted rigidly, but adjustably, upon it, its annular groove 11 having its V-shaped portion 12 disposed in the opposite direction or toward the adjacent end of the shaft, as shown in Fig. 1.

Interposed between the cam-wheel 7 and the adjacent belt-wheel 6, and also mounted rigidly, yet adjustably, upon the shaft, is a cam-wheel 13, which is companion to said wheel 7 and is also provided with an annular groove 14 in its periphery, provided with an offset 15, the offset of said groove being parallel to the body portion of the groove for a distance approximately equal to that between the junction-points of the V-shaped groove with its body portion and having its ends communicating with diverging or inclined portions of the groove, which in turn communicate directly with the body portion of the groove.

Interposed between the cam-wheel 10 and the adjacent belt-wheel 6 is a cam-wheel 16, mounted, like the wheel 13, on the shaft, said wheel being provided with an annular groove 17, having an offset 18, similar to the offset 15 of the groove 14 and disposed, by preference, in the same direction.

The various belt and cam wheels are separated by collars 19 and are independently mounted, of course, upon the shaft 4 in order that they may be independently adjusted upon the same. This independent adjustment is essential, owing to the fact that through wear or other cause it may be found necessary or desirable to vary the relations of the grooves of each companion pair of wheels to each other.

The casing of the engine is constructed, by preference, in three sections—20 the middle section and 21 the end sections—said sections being turned out so as to form a cylindrical chamber, through which extends axi-

ally the shaft 4. Said casing is interposed between the cam-wheels 7 and 10 and is mounted upon the base 1. It is provided with a base flange or flanges 22, whereby each section is secured rigidly by bolts (not shown) or in any other suitable manner to the base 1. Said sections are also provided with external flanges 23, through which extend the tie-bolts 24, engaged by clamping-nuts 25 at their ends in order to secure said sections firmly and reliably to each other. The middle section is provided in its opposite faces with annular grooves of equal diameter, said grooves being semicircular in cross-section and arranged concentrically of the shaft. The end sections 21 are provided in their inner faces with grooves of equal diameter, form, and location to the grooves of the inner section and form conjointly therewith two circular cylinders or piston-chambers 26 and 27.

The sections composing the casing are so constructed that they form conjointly two annular grooves 28, which afford communication between the cylinders 26 and 27 and the hollow cylindrical chamber, through which the shaft axially extends, as explained.

In order to prevent the passage of steam from the cylinders through said grooves into said chamber, however, we employ the similar expansive packing-rings 29, which are segmental in cross-section, so as to conform at their contacting sides to the curvature of said cylinders to prevent the passage of steam between them, and they are provided centrally at their inner sides with annular ribs 30, which completely fill the grooves 28, as shown clearly in Fig. 2, said ribs being provided with one or more teeth 31.

32 designates a cylindrical enlargement of the shaft 4, which fills, preferably, the cylindrical chamber of the casing. Said enlargement by preference is keyed upon the shaft and is composed of three sections, provided at their junction-points with recesses, into which the dogs 31 snugly fit, so as to provide a positive gear or connection between the rings 29 and the shaft 4.

In order to absolutely prevent any possible chance of the steam, which may in limited volume enter the chamber occupied by the enlargement 32 of the shaft, escaping, the casing at opposite sides is provided with stuffing-boxes 33 of the customary construction and arrangement, and thereby the only possible outlets for steam are closed.

34 designates the pistons, which are flattened at their inner sides, where they fit squarely upon and are secured in any suitable manner to the flattened peripheries of the rings 29. Said pistons in cross-section are of form and diameter to fit snugly in and form a complete partition for the cylinders or piston-chambers 26 and 27, as shown clearly in Fig. 4.

Vertically above and below its axis the casing is formed with the chambers 35, one of which intersects the cylinder 26 and the other

the cylinder 27, as shown clearly in Fig. 2, and mounted to reciprocate therein are abutments 37 and 38, respectively, said abutments being designed as a fulcrum for the steam in its expansive action upon the pistons. The abutment 37 is secured upon the inner end of the rod 38, which rod, at the point where it emerges from the casing, extends through a stuffing-box 39 and carries upon its outer end the antifriction-roller 40, which engages the annular groove of the cam-wheel 7 and is held therein in any suitable or preferred manner. The abutment 38 is mounted upon the inner end of a rod 41, which also extends through a stuffing-box 42 of the casing and carries at its outer end an antifriction-roller 43, permanently located and held in any suitable manner in the annular groove of the cam-wheel 10. From this construction it is obvious that with each revolution of said cam-wheels, said abutments will make one complete reciprocation—that is to say, will move outward and uncover their respective cylinders or piston-chambers—and then will return to their original positions and completely partition or intersect said chambers.

44 and 45 are steam-chests which are bolted or otherwise secured to the opposite sides of the casing, and by preference in the plane of its axis, as illustrated in Figs. 1 and 3 most clearly. The steam-supply pipe 46 from the source of supply (not shown) leads to and from the valve-cylinder 47 of the governor, of the type shown or of any other suitable or preferred type, and communicates with the branch pipes 48, communicating centrally with the steam-chests 44 and 45 at their upper sides. Arranged at opposite sides of the shaft and preferably in the same horizontal plane are the reverse-valve steam-chests 49 and 50, the steam-chest 49 being companion to the steam-chest 44 and the steam-chest 50 to the steam-chest 45. The pipes 51 and 52 connect the under side of the steam-chest 44 with the under side of the steam-chest 49 at opposite sides of its center, as shown in Figs. 5 and 6 most clearly, and the corresponding steam-pipes 53 and 54 connect the steam-chest 45 at its under side with the steam-chest 50 at its upper side, as shown clearly in Fig. 1 and by dotted lines in Fig. 4.

55 and 56 designate pipes leading from the upper side of the reverse-valve steam-chest 49 to the casing, the former communicating with the steam-port 57 and the latter with the steam-port 58, which ports in turn communicate with the cylinder or piston-chamber 26 at opposite sides of the abutment 37. 59 and 60 designate similar pipes leading from reverse-valve steam-chest 50 to the casing, the former communicating with the port 61 and the latter with the port 62, which ports communicate with the cylinder or piston-chamber 27 at opposite sides of its abutment 38.

63 designates the exhaust-pipes for the reverse-valve steam-chests 49 and 50, and they are united or coupled to the upwardly-ex-

tending exhaust-pipe 64, as shown clearly in the drawings.

65 designates reciprocating valves for the steam-chests 44 and 45, and said valves, at the sides where the supply-pipes 48 communicate, are formed with the recesses or notches 66, so as to permit the steam to enter and reach the pipes 51 or 52 and 53 or 54, accordingly as they are opened or closed by the positions of said valves. 67 designates the stems of said valves, said stems extending through stuffing-boxes in the ends of the steam-chests in customary manner, and mounted upon their outer ends are anti-friction-rollers 58, which permanently engage the cam-grooves of the wheels 13 and 16 and are held therein in any suitable or preferred manner, in order that the valves may reciprocate as said wheels turn.

69 designates the reverse-valves, mounted in the steam-chests 49 and 50. They are recessed, as shown at 70, in the edge which is opposite to or opposes the pipes through which the steam passes to or returns from the cylinder, as shown clearly in Fig. 6. Owing to the fact, therefore, that said pipes communicate with the upper side of the steam-chest 49 and with the lower side of the steam-chest 50 it is obvious that in the former case the recess 70 will be in the upper edge of the valve, while in the latter case it will be in the lower valve. The effect is the same, however. Said reverse-valves are provided with the short stems 71, which project through the outer ends of the steam-chests and the stuffing-boxes secured thereto and are pivotally connected to the parallel and similar rock-levers 72, mounted upon the table or plate 4^a in any suitable manner. Said rock-levers are connected by the link 73, which in turn is pivotally connected to the controlling-lever 74, mounted also upon the base-plate. Said lever carries the customary spring-actuated dog 75 and the bell-crank lever 76 for retracting the same from engagement with the sector 77, which sector is provided with the middle or neutral notch 78 and with the end notches 79 and 80.

When the dog engages notch 78, the engine is at rest, because the reverse-valves occupy the position shown in dotted lines, Fig. 6, and prevent the entrance of steam to the steam-chests 49 and 50.

When the dog engages the notch 79, the reverse-valves occupy the positions shown in dotted lines, Fig. 6, and in dotted lines, Fig. 1, and consequently permit steam to pass from the steam-chest 44, through pipe 51 to steam-chest 49, and thence through pipe 55 and port 57 into the cylinder or piston-chamber 56, and at the same time will pass from the steam-chest 45, through pipe 53 to steam-chest 50, and thence through pipe 59 and port 61 into the cylinder or piston-chamber 27, the steam entering in both cases in rear of the pistons, so as to propel them both in the direction indicated by the arrow in Fig. 4.

When the lever 74 is thrown to such position that the dog 75 engages the notch 80, the positions of the reverse-valves are reversed, and as a consequence the steam enters the cylinders or piston-chambers 26 and 27 by way of the ports 58 and 62 and therefore propels the pistons in the opposite direction and causes the engine to operate accordingly.

In the former case the ports 57 and 61 are the inlets, as explained, and the ports 58 and 62 the outlets for the steam, the latter passing by way of the pipes 56 and 60 back into the recessed portions of the reverse-valves and escapes therefrom through the exhaust-pipes 63, which at this time are in communication with said pipes 56 and 60. When the engine is rotating in the opposite direction, the ports 58 and 62 are the inlets and the ports 57 and 61 the outlets for the steam, the steam in this case passing back into the reverse-valve steam-chest by way of the pipes 55 and 59 and escaping by way of the exhaust-pipes 63, as before.

The pistons are arranged about quartering to each other, and the same arrangement is carried out substantially with reference to the grooved cam-wheels for operating the abutments and the pistons of steam-chests 44 and 45 in order that the steam may always be acting upon one piston or the other and for the greater part of each revolution of the engine upon both.

Referring particularly to Fig. 4, it will be noticed that at the moment the piston of the chamber 26 has reached the position shown the steam has ceased to act upon it by reason of the fact that the cam-wheel 13 has disposed the valve of the steam-chest 44 in the position shown in Fig. 5, and consequently has cut off the passage of steam through the pipe 51 to the reverse-valve steam-chest. It is cut off to said chest by way of the pipe 52 because the reverse-valve closes said pipe, as shown in Fig. 6. At the same instant it will be noticed that the companion piston of the cylinder or piston-chamber 27, as shown by dotted lines, same figure, is getting the full force of the steam entering said chamber 27 by way of the port 61, and this pressure of course continues until said piston reaches its opposite port and has therefore traveled the greater part of its revolution. While this travel is taking place the piston of the cylinder 26 is passing from the position shown in Fig. 4 to the opposite side of the at this time inlet-port 57, being carried such distance by its own momentum and by the pressure of the steam upon the other piston, as explained. Immediately after the steam is cut off by reason of the fact that the valve in the steam-chest 44 has been moved by the cam-wheel 13 to the position shown in Fig. 5 the rotating cam-wheel 7 commences to move the abutment 37 out of the way of the piston in the chamber 26. This movement is accomplished by reason of the fact that the roller 40 travels up one side of the V-shaped portion of the

groove of said wheel, and as it reaches and rounds the apex of the same the piston passes the point of intersection of the abutment with the cylinder or piston-chamber and then the abutment as the roller descends the opposite side of said V-shaped portion of the groove begins to close, and this closure is completely effected at the instant said piston passes the inlet-port 57. At this instant the roller 68 of the valve 65 of steam-chest 44, which has been traveling in that portion of the groove of the cam-wheel 13 parallel to the body portion, is moved back into the body portion of the groove, and consequently forces the valve 65 to the position shown in dotted lines, Fig. 5, and permits the steam from the supply-pipe 48 to enter the reverse-valve by way of the pipe 51 and pass thence through the port 57 into the cylinder or piston-chamber 26 and, expanding between the piston and the abutment 37, now closed, apply direct and expansive pressure upon the piston in the customary manner. By the time this piston has made about a half-revolution from the inlet-port 57 the steam is cut off in the same manner from the piston in the cylinder or piston-chamber 27 by the cam-wheel 16 and the abutment 38 is moved out of the path of said piston by the cam-wheel 10 and is then returned to its original position as the cam-wheel 16 again permits steam to enter said cylinder or piston-chamber, the operations of the abutment and valve in connection with this chamber being precisely the same as described with reference to the cylinder or chamber 26.

The customary pulley 83 of the governor is connected by the belt 84, engaging the pulley 85 above the shaft, whereby movement is transmitted to the governor through the operation of said shaft. The governor acts in the customary manner—that is to say, when the load of the engine is lightened the supply of steam is correspondingly diminished and when the load increases the steam-supply is increased in a proportionate degree.

Owing to the fact that it is essential that the cylinders be perfectly steam-tight, we form recesses outward of said cylinders and fit snugly therein plates 81, which are held firmly against the outer edges of the abutments by means of the springs 82, so as to compensate for any wear upon the abutments, in order that they may always fit squarely against the flat or outer sides of the packing-rings 29 and thus prevent steam leaking past the abutment when its entire action should be upon the piston.

The pistons are provided with or girded by the customary packing-rings, as shown, or they may be otherwise suitably packed.

In case the engine be used to propel a train or car it will be preferable to secure the casing pendently to the framework of the car thus equipped and to mount the drive or traction wheels directly upon the shaft 4, which

will then in fact form one axle of the car-trucks.

Having thus described the invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A rotary engine, comprising a stationary casing provided with a cylinder extending concentrically of the axis of the casing, and of circular form in cross-section, an annular groove at and communicating with the inner side of said cylinder, a shaft extending axially through the casing, an annular packing-ring within the cylinder geared to said shaft, and of segmental form in cross-section, its curved surface corresponding to and fitting snugly against the inner surface of the cylinder, and provided with an annular rib projecting inwardly from the center of its curved surface, and fitting snugly in the groove communicating with said cylinder, and a piston having a flat surface secured against the flat surface of the said packing-ring; said piston and packing-ring conjointly forming a complete circle and a steam-tight partition for the cylinder, substantially as described.

2. A rotary engine, comprising a stationary casing provided with a circular cylinder having steam-ports, a shaft journaled in the casing axially of the cylinder, a piston in the cylinder and geared to said shaft, a reciprocating abutment partitioning said cylinder at times between the steam-ports, a steam-chest connected to the steam-supply, a second steam-chest, a pair of pipes connecting them, a pair of pipes connecting the last-named steam-chest with the ports of the engine, an exhaust-pipe also communicating with the last-named steam-chest, a slide-valve in said last-named steam-chest, and connecting the exhaust-pipe with one of the pipes connected to the ports of the engine, and closing one of the pipes leading from the first-named to the last-named steam-chest, and a reciprocatory valve in said first-named steam-chest, which once in each revolution of the piston cuts off the supply of steam to the cylinder, substantially as described.

3. A rotary engine, comprising a stationary casing provided with a circular cylinder having steam-ports, a shaft journaled in the casing axially of the cylinder, a piston in the cylinder and geared to said shaft, a reciprocating abutment partitioning said cylinder at times between the steam-ports, a steam-chest connected to the steam-supply, a second steam-chest, a pair of pipes connecting them, a pair of pipes connecting the last-named steam-chests with the ports of the engine, an exhaust-pipe also communicating with the last-named steam-chest, a slide-valve in said last-named steam-chest, and connecting the exhaust-pipe with one of the pipes connected to the ports of the engine, and closing one of the pipes leading from the first-named to the last-named steam-chest, a reciprocatory valve in the first-named steam-

chest, which once in each revolution of the piston cuts off the supply of steam to the cylinder, and means to shift the position of the valve in the last-named steam-chest, and consequently reverse the movement of the engine, substantially as described.

4. A rotary engine, comprising a casing provided with a plural number of circular cylinders provided with steam-ports, a shaft journaled in the casing axially of said cylinders, pistons set at an angle to each other in the cylinders and geared to said shaft, reciprocating abutments arranged opposite each other, and between the ports of and partitioning their respective cylinders, a pair of reverse-valve steam-chests, pipes connecting the same with said ports, exhaust-pipes leading from said steam-chests, a second pair of steam-chests connected to a steam-supply pipe, a pair of pipes connecting each of said steam-chests with the reverse-valve steam-chests, slide-valves in the reverse-valve steam-chests cutting off the passage of steam through one of the pipes leading from each

of the other steam-chests, and connecting one of the pipes leading to each cylinder with their respective exhaust-pipes, reciprocating valves in the other steam-chests, and means to alternately and automatically operate said valves so that the supply of steam to each cylinder will be cut off once in each revolution of the piston, but never from both pistons at the same instant, and to shift the abutment out of the path of their respective pistons during the time the supply of steam is cut off, and a lever connected to the reverse-valves, whereby their positions may be reversed and the engine caused to operate in the opposite direction, substantially as described.

In testimony whereof we affix our signatures in the presence of two witnesses.

LOUIS K. CARNAHAN.

CHARLES S. CARNAHAN.

Witnesses:

R. B. JANES,

C. M. RANKIN.