(No Model.) 5 Sheets—Sheet 1.

M. E. CLARK.

ROTARY ENGINE.

No. 572,961. Patented Dec. 15, 1896.

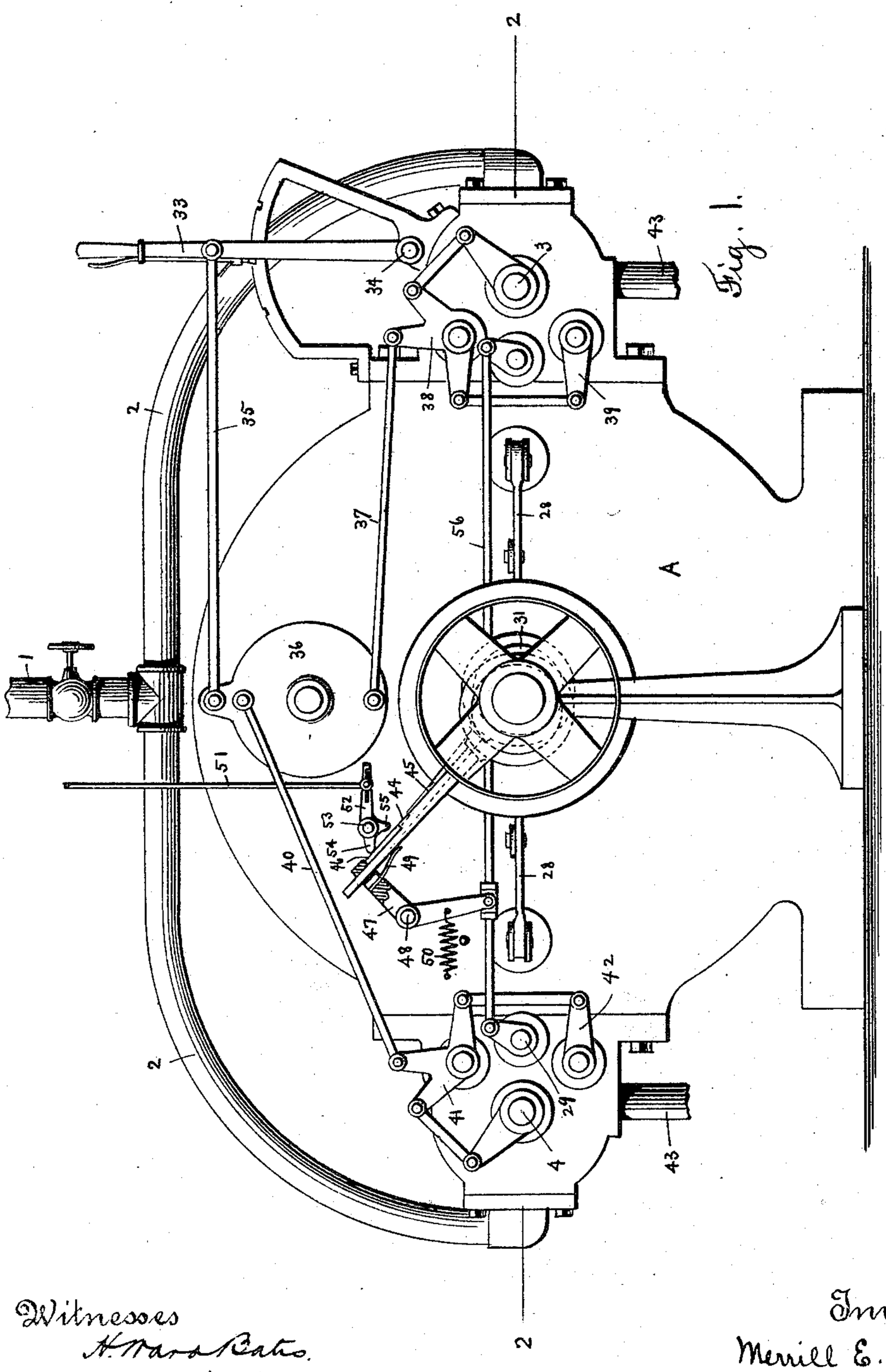

Fig. 1.

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ROTARY ENGINE.

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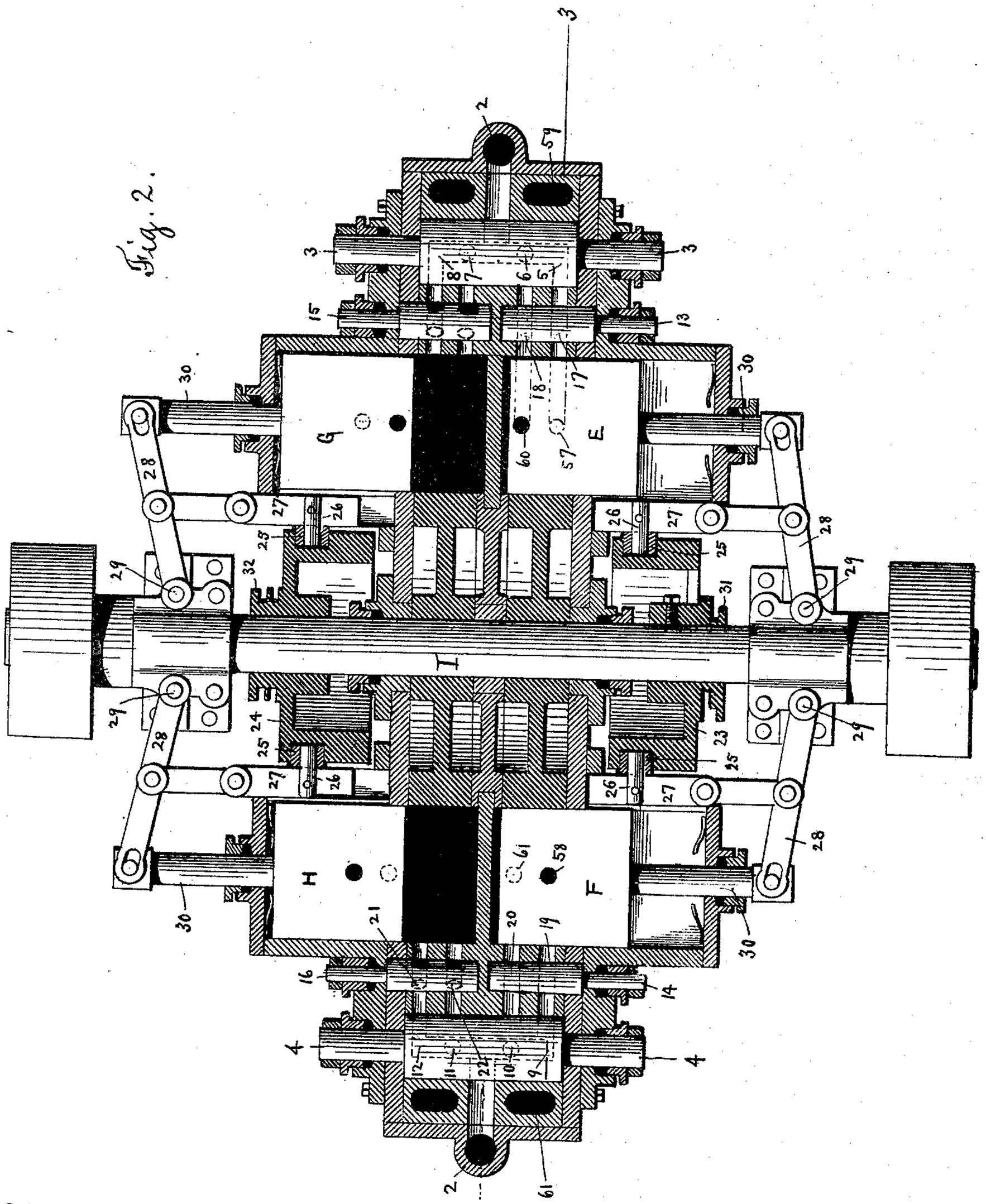
Fig. 2.



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M. E. CLARK.

ROTARY ENGINE.

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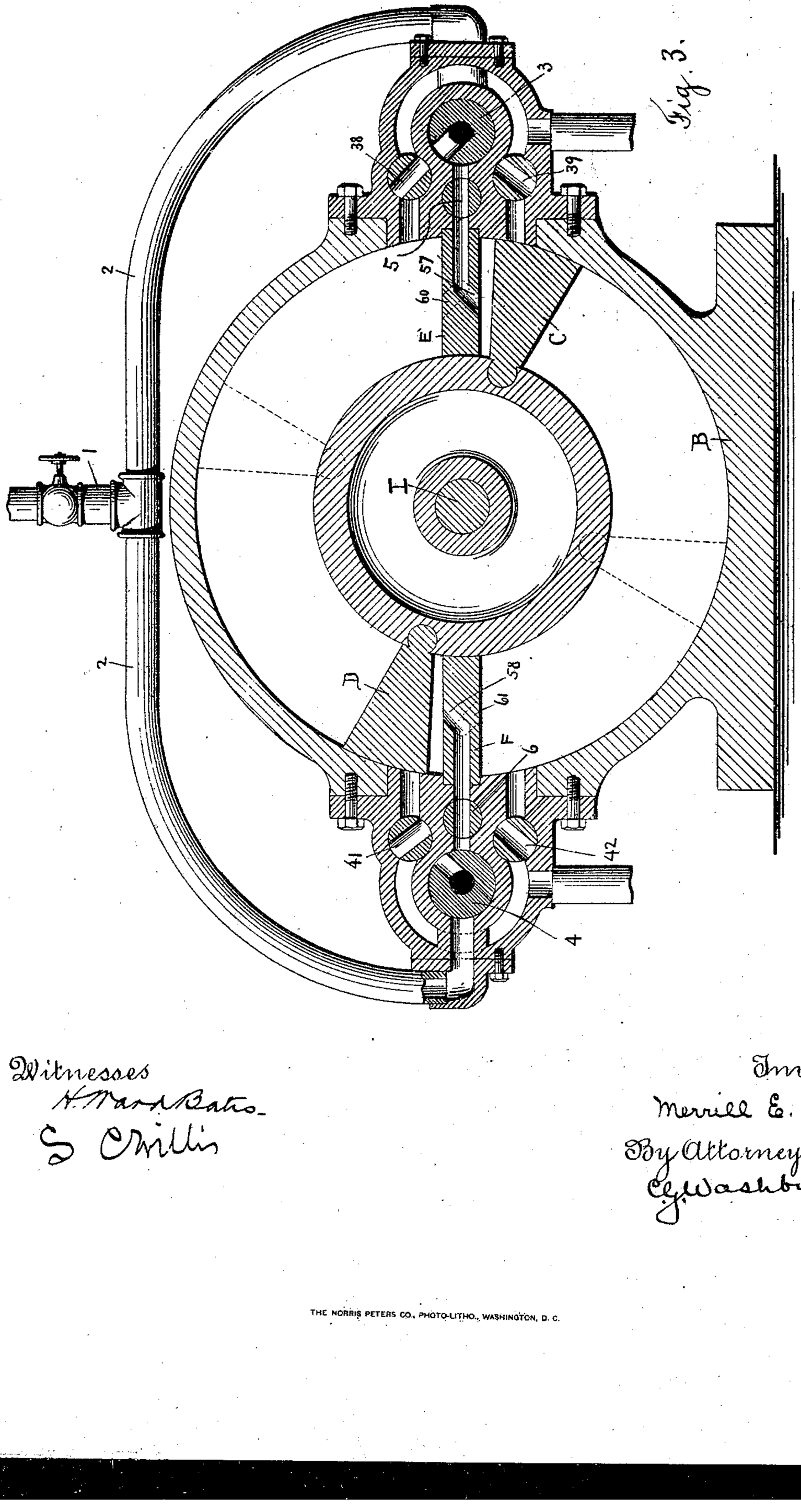

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Fig. 4.

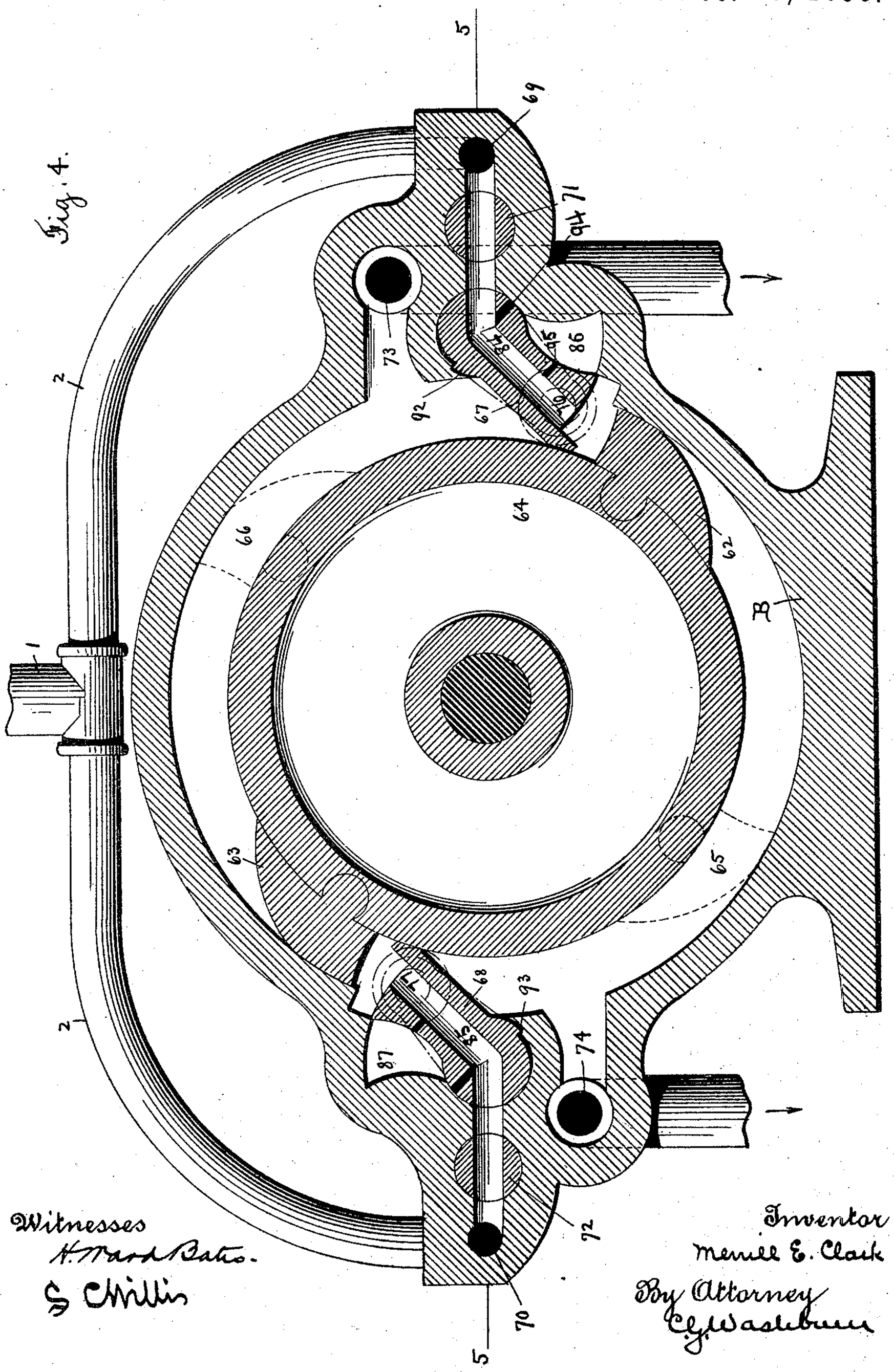

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Fig. 5.

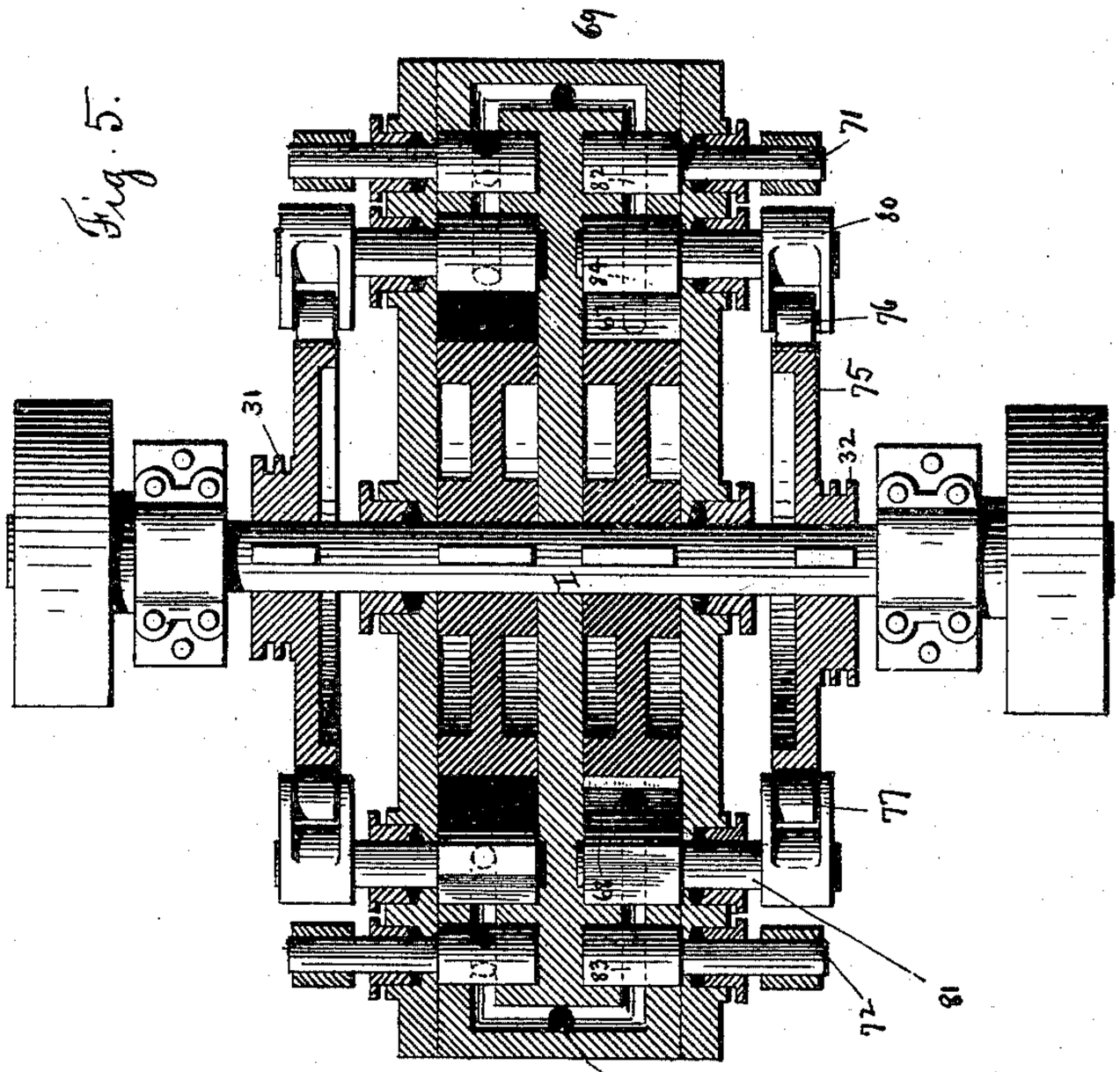
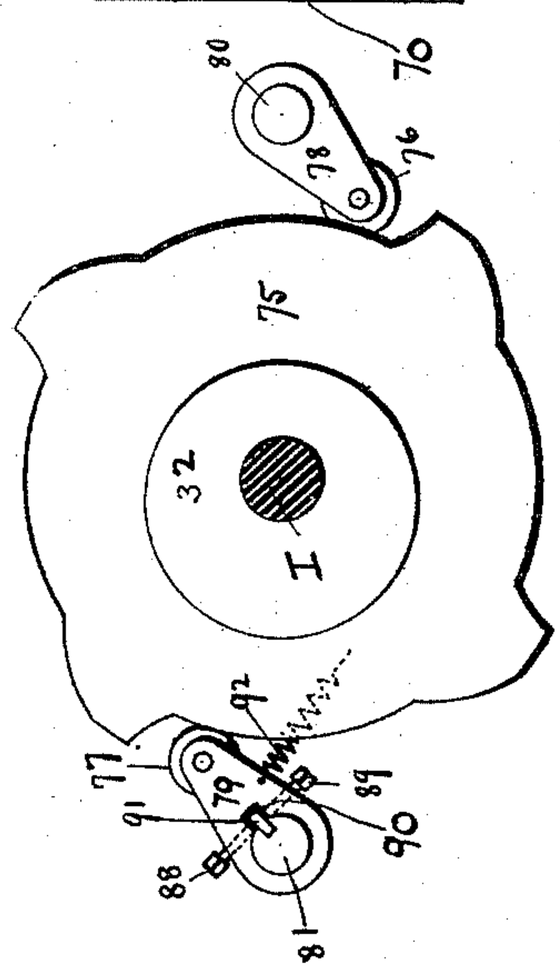


Fig. 6.



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UNITED STATES PATENT OFFICE.

MERRILL E. CLARK, OF WORCESTER, MASSACHUSETTS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 572,961, dated December 15, 1896.

Application filed October 14, 1895. Serial No. 565,580. (No model.)

To all whom it may concern:

Be it known that I, MERRILL E. CLARK, a citizen of the United States, residing in the city and county of Worcester and Commonwealth of Massachusetts, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

The object of my invention is to construct a rotary engine in which the working parts shall be evenly balanced and the arrangement and adjustment of the abutments such as to utilize a maximum amount of the force used, which shall be evenly applied to the pistons through each revolution, thus developing a large amount of power in an engine of small size. This object I attain by the construction of a double engine, the details of which are shown in the accompanying drawings, and in which—

Figure 1 is a side view of the outline of the frame of the engine and shows the fluid-supply pipe, the starting-lever and connections with the valve mechanism, the cut-off mechanism, main driving-pulley and cam, and connecting-levers for communicating a reciprocating motion to the abutments. Fig. 2 is a plan view in the main through the line 2 2, Fig. 1, but not cutting the main shaft, valves, and mechanism for actuating the abutments. In Fig. 2 the exhaust-valves are not shown, but the exhaust-ports are shown, 59 being the exhaust-port for exhaust-valve 38, and 61 being the exhaust-port for exhaust-valve 41. Fig. 3 is a vertical section on line 3 3, Fig. 2, and shows in detail the valve mechanism and ports through the abutments and the positions of the pistons. Fig. 4 is a modification showing a vertical section of the cylinder, pistons, and abutments, inlet and exhaust valves, and cut-off valves, the novel features of which are the pistons and abutments, so constructed and arranged that the pistons, as they revolve, push the abutments out of their path or the abutments may be provided with rolls adapted to travel in cam-paths which are so located as to carry the abutments out of the path of the pistons at the proper time. Fig. 5 is a plan view of that modification shown in Fig. 4, in which the abutments are moved out of the path of the pistons by means of cams placed upon the main shaft of the engine. Fig. 6 shows the construction of the cams and the connections with the abutments.

The position of the valves in Fig. 3 harmonizes with the position of the starting-lever shown in Fig. 1; but in order to place the valves in the position shown in Fig. 2 the starting-lever must be thrown to the right.

The general plan of the motor consists in the arrangement of two engines within a common casing, the pistons in each engine being secured to a hub attached to a common main shaft.

In the drawings, A is the outline of the casing.

B is the cylinder, which may be secured in any suitable manner to a proper foundation.

C is a piston within the cylinder, secured to a hub mounted upon the main shaft I.

D is a second piston opposite C and similarly secured in position.

E and F are abutments in one engine, and G and H are the corresponding abutments in the other engine.

1 is the fluid-supply pipe, with the branch pipes 2 2, which convey the fluid to both sides of the engine.

3 is the inlet-valve for both engines on one side.

4 is the inlet-valve for both engines on the other side. The valve 3 is provided with four ports 5 6 7 8. The valve 4 is provided with four ports 9 10 11 12.

13 14 15 16 are the cut-off valves. The cut-off valve 13 is provided with the ports 17 and 18. The cut-off valve 14 is provided with the ports 19 20. The cut-off valve 16 is provided with the ports 21 22.

23 24 are disks secured to the main shaft and provided on their outer faces with cam-paths in which run the rolls 25, connected by the pin 26 with the jointed arm 27, which imparts a reciprocating motion to the arm 28, which is loosely pivoted at one end 29, and at the opposite end is connected through the rods 30 with the abutments, to which a reciprocating motion is thus communicated.

In Fig. 2 the abutments E F are shown in the inward position and the abutments G H in the outward position.

31 32 are double eccentrics for actuating the cut-off mechanism and are rigidly connected with the disks 23 24.

33 is the valve-lever, pivoted at 34 and connected by the rod 35 with the wrist-plate 36. It is represented in the drawings in the central position. When it is desired to run the engine from left to right, the lever is moved to the right, and when it is desired to run the engine in the opposite direction the lever is moved to the left.

The wrist-plate 36 is connected by the rod 37 and its connections with the main inlet-valve 3 and exhaust-valves 38 and 39, and similarly the wrist-plate 36 is connected by the rod 40 and its connections with the main inlet-valve 4 and exhaust-valves 41 and 42 on the opposite side of the engine.

43 is the exhaust-pipe on either side of the engine.

44 45 are two levers connected by straps to the double eccentric 31, and near their opposite ends are provided with shoulders 46, which can have bearings upon the lower side of the angle-piece 47, pivoted at 48, through which the ends of the levers project. The levers are held in their seats by the spring 49, and the angle-piece 47 is held in its initial position by the spring 50.

51 is a rod which may be connected with any well-known form of ball-governor, (not shown in the drawings,) and has an adjustable connection with the arm 52, pivoted at 53 to the casing of the motor and provided with the projections 54 55. When the speed of the motor is increased, the governor-rod is elevated, the end 54 of lever 52 is depressed, the levers 44 45 are tripped from their seats on the angle-arm 47, the result being that the rod 56 is drawn to the left by the action of the spring 50, the cut-off valves closed, and the speed of the engines diminishes. The governor-rod is now depressed, the shoulders 46 of levers 44 45 regain their seats upon the arm 47 and are not tripped as quickly at the succeeding revolution of the eccentric, the result being that the rod 56 is thrown to the right, the cut-off valves are opened, and the speed of the engine increases. At each revolution of the eccentric the levers 44 45 are tripped from their seats on arm 47, the action of the governor determining when the trip shall occur. If, for any reason, the governor-belt should break or slip out of position, the arm 51 would be sufficiently depressed to force the lug 55 against the levers 44 45, holding the latter permanently out of contact with the arm 47, and the engine would stop.

The starting-lever 33 is shown in Fig. 1 in the central position, and the valves are then in the positions shown in Fig. 3. If the lever 33 is moved to the right, the valves take the positions shown in Fig. 2, and fluid is admitted through the port 5 in the inlet-valve 3, through port 17 in the cut-off valve, through the passage 57 in the abutment E, and upon the upper face of the piston C. Similarly fluid is admitted through the port 9 in the inlet-valve 4, through port 19 in the cut-off valve, through the passage 58 in the abutment F, and upon the lower face of the opposing piston D, as shown in Fig. 3, causing the pistons to revolve in the cylinder from left to right. The fluid behind the piston C exhausts through the exhaust-valve 42 and the fluid behind the piston D exhausts through the exhaust-valve 38. As the pistons approach the abutments the latter are quickly withdrawn from the path of the pistons until the pistons have passed, and are then instantly returned to their inward positions. The abutments G and H are represented in the extreme outward positions. It is understood that fluid is on all four pistons throughout the revolution, excepting when the abutments are withdrawn, and during the time when the abutments are withdrawn in one cylinder the pistons are receiving fluid in the other cylinder.

If it is desired to reverse the engine and run it from right to left, the lever 33 is thrown to the left. This closes port 5 in valve 3 and places port 6 in line with port 18 in the cut-off valve, through which and through the passage 60 in the abutment E fluid is admitted upon the piston, which is then in position to receive it. Similarly the port 9 in valve 4 is closed, and port 10 is placed in line with port 20 in the cut-off valve 14, through which and through the passage 61 in the abutment F fluid is admitted upon the piston, which is then in position to receive it. When the engine is running in this direction, the fluid exhausts through the ports 41 and 39. The operation of the companion engine is the same and need not be described.

In the initial position of the engine (shown in Fig. 1) the cut-off is closed, but the lever 47 may be moved sufficiently by hand or by any convenient connecting mechanism to start the engine.

In the modification illustrated in Figs. 4, 5, and 6 two different methods for actuating the abutments are shown by means of an oscillatory instead of a reciprocating motion, as in the form of abutment I have already described. These modified forms, unlike the one described, do not admit of reversing the engine, but are useful and economical.

62 63 are the pistons, which are secured to the piston-hub 64, and which are wedge-shaped, for a purpose hereinafter explained.

65 66 are the corresponding pistons in the companion engine.

67 68 are the abutments, mounted upon a shaft, through which they may receive rotary motion in a manner to be described.

69 70 are the inlet-ports for the fluid.

71 72 are the cut-off valves.

73 is one exhaust-port, and 74 is the other.

The cut-off valve 71 is provided with a port 82, and the cut-off valve 72 is provided with the port 83.

75 is a cam eccentrically secured to the

main shaft, on whose face the rolls 76 77 are adapted to travel and are held in contact with the face of the cam by springs 92. These rolls are mounted in the arms 78 79, rigidly connected at their opposite ends with the shafts 80 81, to which the abutments 67 68 are secured and through which the abutments may be moved through the arc of a circle when the main shaft revolves.

In Fig. 5 the abutments 67 68 are shown in the inward position illustrated in Fig. 4, the abutments in the companion engine being in the outward position, which they must take to allow the pistons to pass. Now if the starting-lever 33, Fig. 1, is moved to the right the valves take the positions shown in Fig. 5. Fluid is admitted through the port 69, through the port 82 in the cut-off valve 71, through the passage 84 in the abutment 67, and upon the base of piston 62. Similarly fluid is admitted through the port 70, through the port 83 in the cut-off valve 72, through the passage 85 in the abutment 68, and upon the base of piston 63, causing the pistons to revolve in the cylinder from left to right. The fluid behind the piston 62 exhausts through the exhaust-port 74, and the fluid behind the piston 63 exhausts through the exhaust-port 73. As the pistons approach the abutments the connecting parts are so arranged and timed that the action of the cam 75 on the rolls 76 77, through the arms 78 79 and shafts 80 and 81, rotates the abutments out of the path of the pistons and into the pockets 86 87, made in the frame of the engine. When the pistons have passed the abutments, the latter are returned to their initial positions by the action of the springs, Fig. 6, upon the arms 79 and 80, or they may be returned in a manner to be described in connection with the other modification referred to later. The cam and rolls are so adjusted that the abutments have no greater friction upon the piston-hub than is sufficient to effect a tight joint, and hence exercise no appreciable retarding effect upon the engine.

I provide for any wear of the parts by means of the screws 88 89, Fig. 6, slot 90, and key 91, by means of which any wear in the cam or rolls may be compensated for by moving the central line of the arms 78 79 toward or away from the axis of the eccentric 75, as may be desired.

Coming now to my second modification, I may dispense with the cam 75 and intermediate parts connecting it with the abutments and rely upon the action of the pistons to remove the abutments from their path as they revolve in the cylinder. This modification will be understood upon reference to Fig. 4, where it will be seen that as the wedge-shaped pistons revolve in the cylinder from left to right they will push the pivotally-hung abutments aside and into the pockets 86 87, and as soon as the pistons have passed the abutments will be returned to their outward positions and in the following manner: Each abutment, like 67, is provided with two ports 94 95. When in the outward position, as shown in Fig. 4, the port 94 is closed; but when in the inward position, in pocket 86, the port 94 receives fluid, which, having no other egress, passes through the port 95 and presses against the sides of the pocket 86, so that when the piston has passed and the abutment is free to do so it will be returned to its outward position, where it will be held by the pressure of the incoming fluid. This construction, as stated above, may be used with the modification last explained.

In order that the abutments may not come in any closer contact with the piston-disks than necessary to make a perfect steam-joint, I make on the abutments the shoulders 92 93, adapted to engage with recesses in the frame of the engine so formed that the abutments are held permanently out of excessive frictional contact with the piston-disk, and the same effect may be produced in a variety of ways.

The most efficient form in which my invention may be embodied is the double engine shown in the drawings, the individual engines being so related and timed that fluid is continually acting upon the pistons in one engine, and with the exception of the brief time during which the abutments are withdrawn the fluid is continually acting in both engines.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a rotary engine, the combination of a cylinder and piston and disk and eccentric attached to the main shaft, said disk being provided with a cam-path and said eccentric being operatively connected with suitable cut-off mechanism and an abutment provided with a port through which the fluid may be conveyed to the piston, and connecting and operating mechanism intermediate said disk and said abutment, and suitable valve mechanism and means for operating the same, whereby the abutment may be withdrawn from the path of the piston and returned to its initial position substantially as described.

2. In a rotary engine, the combination of a cylinder and two pistons, secured on opposite sides to the piston-hub, and disk and eccentric attached to the main shaft, said disk being provided with a cam-path, and said eccentric being operatively connected with suitable cut-off mechanism, and two abutments provided with ports, with outlets on opposite faces of said abutments through which the fluid may be conveyed to the pistons, and connecting and operating mechanism intermediate said disk and said abutment, and suitable valve mechanism, and means for operating the same, whereby the abutments may be withdrawn from the path of the revolving pistons, and returned to their initial positions,

and the fluid cut off at any desired part of the stroke, and the engine reversed, substantially as described.

3. A rotary engine, comprising the following elements, in combination: a cylinder, two rotary inlet-valves supplied with suitable ports, intermediate rotary cut-off valves and suitable exhaust-ports, two pistons, secured on opposite sides to the piston-hub, two abutments provided with ports, having outlets upon opposite faces of said abutments, a disk attached to the main shaft, provided with a cam-path and mechanism for operatively connecting said disk with said abutments, an eccentric attached to said main shaft, operatively connected with the governor, suitable valve mechanism and means for operating the same, substantially as described.

4. In a rotary engine, the combination of a cylinder, provided with a suitable pocket, within which the abutment may be withdrawn, a piston, a cam upon the main shaft, an abutment adapted to receive oscillatory motion and provided with a main port, which is closed when the abutment is within the pocket, and an opening connecting its outer face and the main port through which a supply of fluid may be admitted, when the abutment is within the pocket, and a second opening between said main port and said pocket, and connecting and operating mechanism intermediate said cam and said abutment, whereby the abutment may be withdrawn from the path of the piston and returned to its initial position, substantially as described.

5. In a rotary engine, the combination of a cylinder provided with a suitable pocket, within which the abutment may be withdrawn, a wedge-shaped piston, an abutment pivotally secured at one end and adapted to receive oscillatory motion, and provided with a main port which is closed when the abutment is within the pocket, and an opening connecting its outer face and the main port, through which a supply of fluid may be admitted when the abutment is within the pocket, and a second opening between said main port and said pocket, whereby the piston, as it revolves, may push the abutment out of the piston-path, and the abutment may be returned to its initial position, substantially as described.

6. In a rotary engine, the combination of a cylinder provided with a suitable pocket within which the abutment may be withdrawn, a wedge-shaped piston, an abutment pivotally secured at one end and adapted to receive oscillatory motion and provided with a main port, which is closed when the abutment is within the pocket, and an opening connecting its outer face and the main port, through which a supply of fluid may be admitted when the abutment is within the pocket, and a second opening between said main port and said recess, and means for holding the abutment out of frictional contact with the piston-hub, whereby the piston, as it revolves, may push the abutment out of the piston-path, and the abutment may be returned to its initial position, without retarding the motion of the piston-hub, substantially as described.

7. In a rotary engine the combination of a cylinder provided with a suitable pocket within which the abutment may be withdrawn, a wedge-shaped piston, an abutment, pivotally secured at one end, and adapted to receive oscillatory motion, and provided with a main port which is closed when the abutment is within the pocket, and an opening connecting its outer face and the main port, through which a supply of fluid may be admitted, when the abutment is within the pocket, and a second opening between said main port and said pocket, the said abutment being also provided with a shoulder adapted to find a bearing on a recess in the side of the cylinder, whereby the piston, as it revolves, may push the abutment out of the piston-path, and the abutment may be returned to its initial position, without retarding the motion of the piston-hub, substantially as described.

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