No. 692,212. Patented Jan. 28, 1902.

G. F. SAGE, Dec'd.

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ROTARY ENGINE.

Application filed Sept. 4, 1900.

(No Model.)

Fig. 6.

Fig. 4.

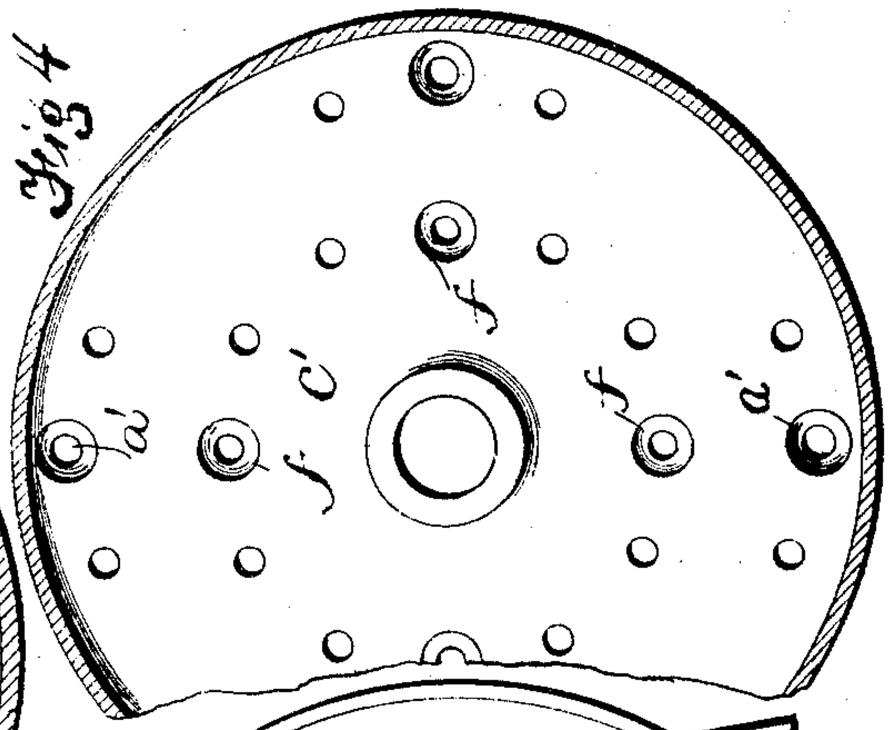


Fig. 2.

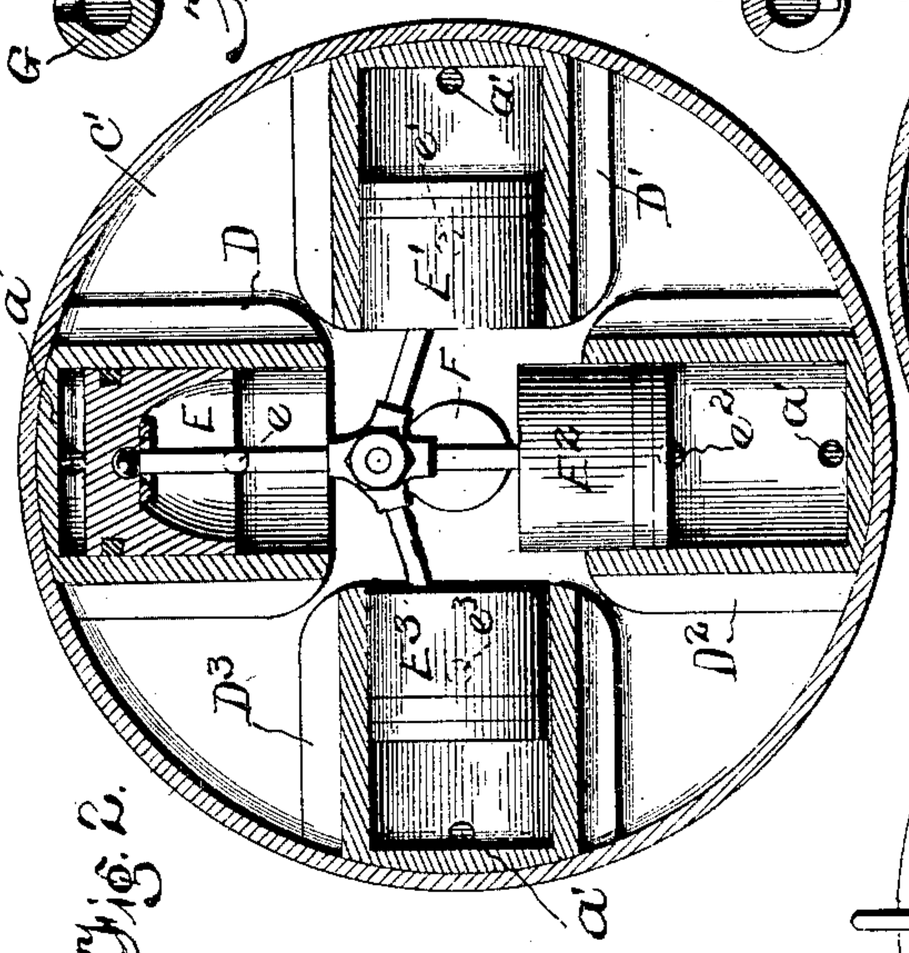


Fig. 3.

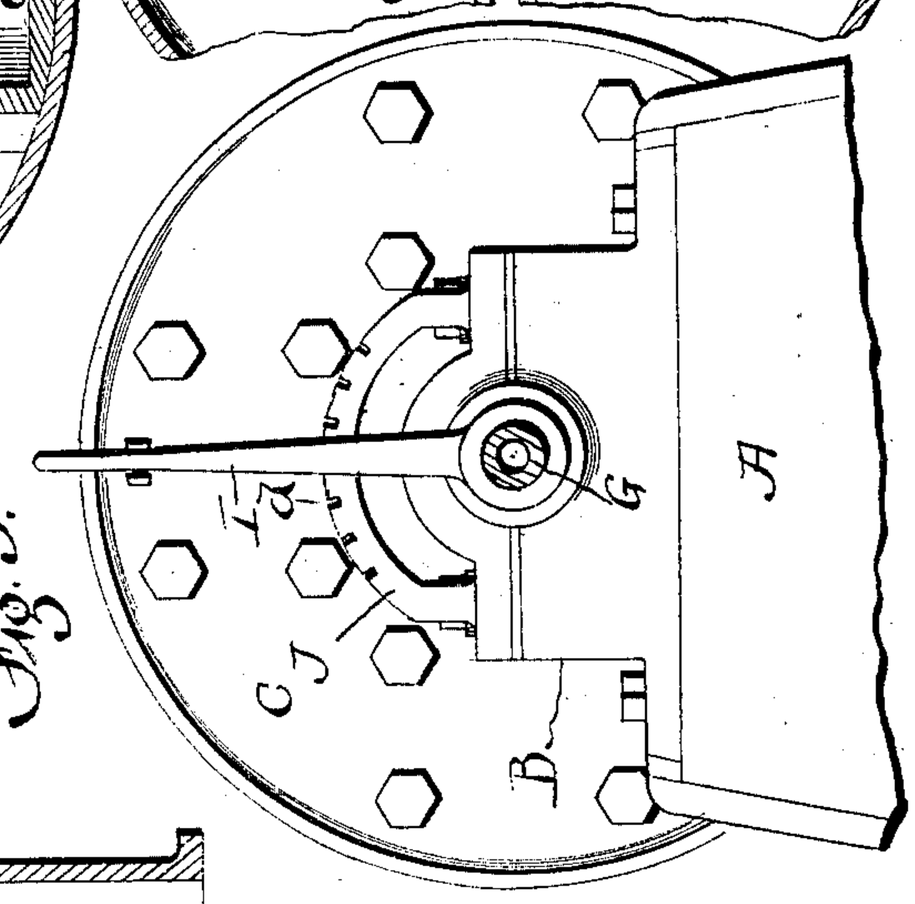


Fig. 1.

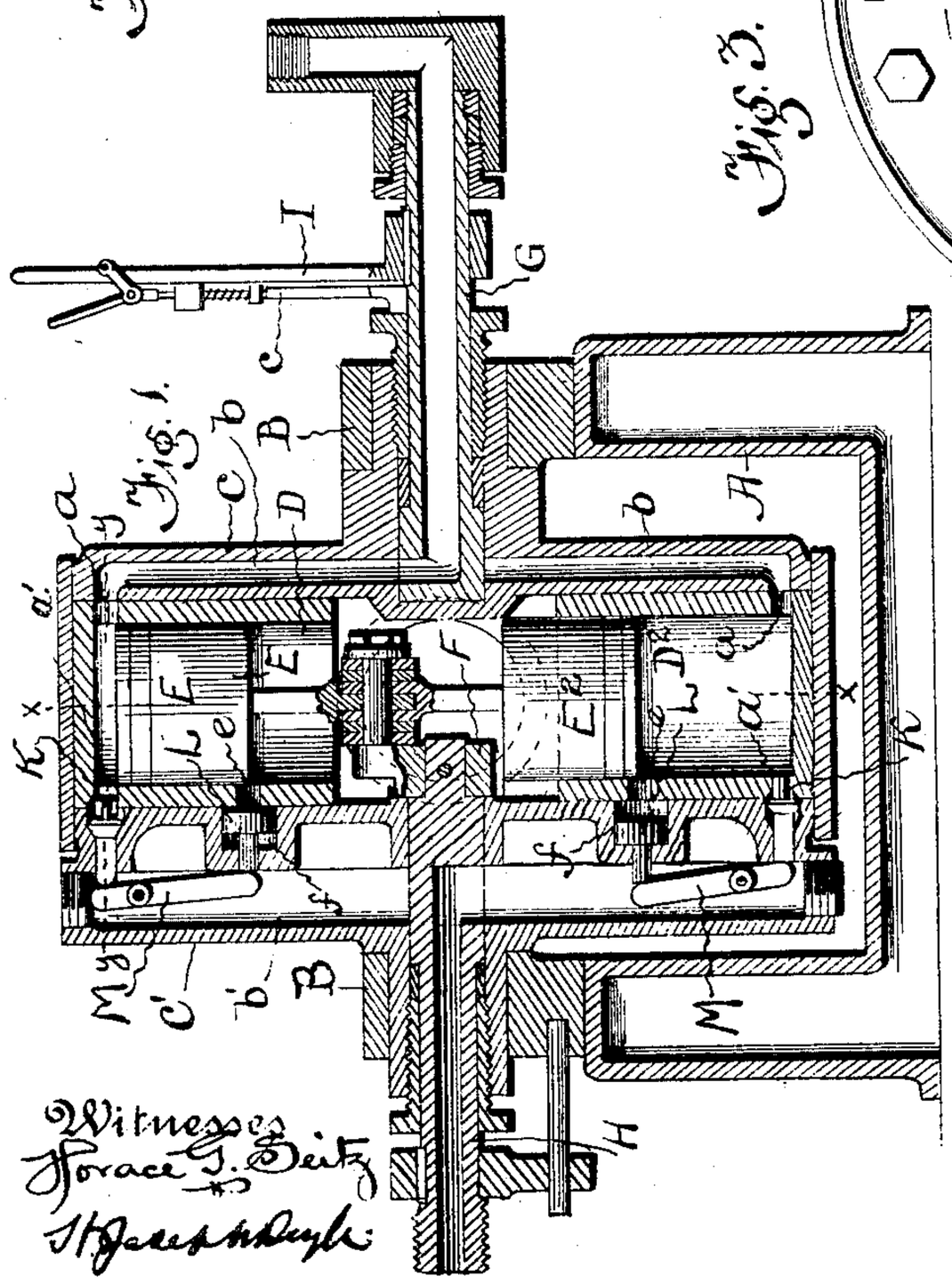
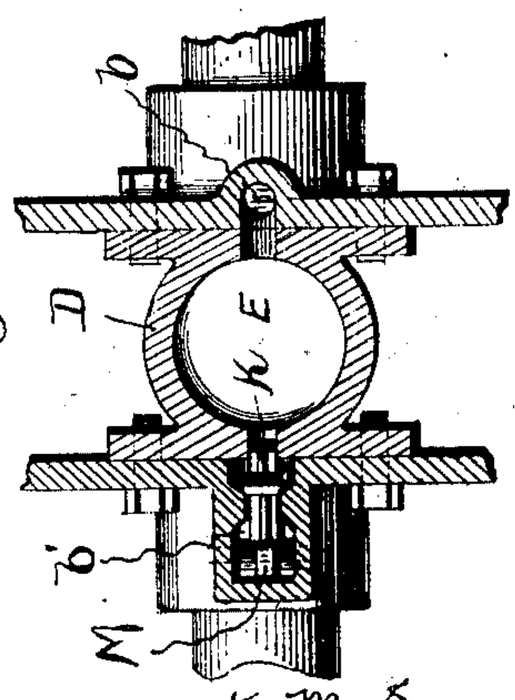


Fig. 5.



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UNITED STATES PATENT OFFICE.

GEORGE F. SAGE, OF CLEVELAND, OHIO; AUGUSTA M. SAGE ADMINISTRATRIX OF SAID GEORGE F. SAGE, DECEASED.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 692,212, dated January 28, 1902.

Application filed September 4, 1900. Serial No. 28,872. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. SAGE, a citizen of the United States of America, and a resident of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention relates to that class of rotary engines in which a plurality of cylinders are pivotally mounted and provided with reciprocating pistons, of which the rods connect with an eccentrically-fixed crank-pin; and the object of my invention is to provide for such engines an efficient positively-operating valve mechanism. I attain this object in an engine constructed and equipped substantially in the manner as shown in the accompanying drawings, in which—

Figure 1 represents a longitudinal vertical sectional view of said engine complete. Fig. 2 represents a transverse sectional view of the same on line $x\,x$. Fig. 3 is an end view of said engine. Fig. 4 represents a partial face view of one of the disks thereof. Fig. 5 is a detached partial horizontal sectional view on line $y\,y$, (see Fig. 1;) and Figs. 6 and 7 represent transverse sectional views of the induction and eduction mediums hereinafter referred to.

Like letters of reference denote like parts in the drawings and specification.

The engine in connection with which my improvement is illustrated substantially comprises a base A, with suitable bearings B B, in and between which are journaled the disks C C′, which carry the cylinders D, D′, D^2, and D^3 between them. Each of the cylinders is provided with a trunk-piston E E′ E^2 E^3, of which the rods are pivotally connected with the fixed eccentric-pin F. In opposite position near the outer extremity of each cylinder are the inlet and outlet ports, respectively, as at a and a'. Said ports communicate with the radial ports b and b' in the disks, as shown in Figs. 1 and 5, and the radial ports in turn establish communication with stationary tubes G and H. Within the tube G the live agent (gas or liquid) is conveyed to the cylinders, while the exhausted gases or liquid are discharged through tube H. Normally the tubes G and H remain in fixed position, one (the inlet-tube) having its channel terminating in upward direction, the other (the outlet-tube) having its channel extending downwardly. Each cylinder receives its charge when it is approximately in the highest position, and exhausting of the spent charges begins as each cylinder is approaching its lowest position.

Attached to the tube G is a lever I, of which the latch c engages the notches d of the segment J, and according to how this lever is set the engine may be made to run either to the right or left, as conditions may require. If the tube is set as shown in Fig. 6, then the breadth of its channel is depending to the "right," and consequently the motor will turn to the right. Ordinarily the outlet from the tube G is so set as to admit the propelling medium to the receiving-cylinder as the latter is about reaching its highest position. Thence charging of the respective cylinder can continue until it reaches about the horizontal position. From about the horizontal position in downward direction the expansive force of the charge is utilized, and when either cylinder has reached its lowest position then the discharge-ports must be opened and held open until the cylinder or cylinders are finishing the remaining half-revolution in upward direction and are in suitable position for the next charge to maintain the motor in rotation.

To provide suitable means to effect a timely opening of the discharge-valves K constitutes the essential feature of my invention. I prefer to open said valves by internally-arranged means.

As shown, there is a lateral port e in the lower portion of each of the cylinders and in that side of the cylinder-wall which adjoins the disk C′, containing the exhaust-ports b'. In alinement with each of the exhaust-valves K, exhaust-ports b', and lateral ports e there is a cavity or depression f in the face side of the disk C′, arranged in open relation with the lateral ports e. Within each of the cavities is placed and snugly fitted a piston L, which has or makes operative contact with the lever M, the latter being pivotally arranged within said exhaust-ports in such

manner that the long arm of such lever is reached by the piston and the short arm by the valve K in and of each exhaust-port. As shown in the drawings, the outward movement of the pistons is limited, so that there will at all times remain a space between the outer end of the piston and the head of the cylinder, which space is practically sufficient to permit the inlet and exhaust ports to remain unclosed by the piston during its movement, and the axial length of the piston is such that when at its extremes of movement the port or passage *e* will be opened, as shown in Figs. 1 and 2, the opening being on opposite ends of the piston, according to the position of the latter. During the greater portion of the movement of the piston, however, said port or passage is closed by the piston.

The operation of the exhaust mechanism is substantially as follows: Referring particularly to Figs. 1 and 2 and following the course of the piston E, the valve K is, in the position shown, closed by the pressure of the inflowing operating agent, the pressure of this agent being greater than the atmospheric pressure on the face of the auxiliary piston L. There being no escape, the pressure causes the cylinder to begin its rotary movement, the piston E having a relative inward movement, during which the piston passes over and covers the opening *e*, thereby forming a means for preventing movement of the auxiliary piston L. This movement is continued, the inflow of the agent being cut off, as hereinbefore set forth, passing the position in which the piston E′ is shown until it nears the position shown by the piston E^2. At this point (as the outer face of the piston passes the periphery of the opening *e*) the pressure within the cylinder has access to the face of the auxiliary valve L, and as the area of said face is greater than that of the face of the valve K the excess of pressure will cause said piston to be forced outward, thus moving the lever M and moving the valve K inward to open the exhaust-port. The further movement of the piston carries it to and past the position shown by the piston E^2, and as soon as it begins its outward movement the opening *e* is closed, thus forming a cushion (fluid) in the inner side of the auxiliary piston L, which prevents any movement of said piston L to permit the valve K to resume its position to close the exhaust-port. When, however, the piston has moved to a point where the inner face of the piston D clears the opening *e*, the pressure on the face of the valve K being greater than the atmospheric pressure on the piston L causes said valve to close. By this construction it will be seen that the valve K and the piston L, in connection with the lever M, form a differential valve or mechanism which is operated solely by the pressure within the cylinder. In addition there is no requirement of a slide-valve or equivalent means operated by the piston for permitting the exhaust to take place, and there is no requirement of the use of springs and other auxiliary means for holding the valve in either its open or closed position, this being accomplished by the formation of the cushion (fluid) for the piston L, which prevents the valve K closing, the pressure within the cylinder normally holding said valve closed. Furthermore, there is no requirement of by-passes, &c., the inlet and exhaust having independent and fixed ports. As the port *b′* moves with the cylinder and the tube H is so arranged to communicate therewith during the greater part of the revolution of the cylinder, as shown in Fig. 7, the exhaust is permitted to pass freely through the tube H to some suitable point, either to the atmosphere or to a suitable condensing apparatus.

From the foregoing it can readily be seen and understood that the centrifugal force of the rotating parts can have no detrimental effect upon the elements which are provided for the purpose of holding the exhaust-valves open during the required intervals.

Motors equipped and operating in the manner as above stated possess the necessary qualifications for high efficiency and smooth running, and thus combine the good features of reciprocating and rotary engines in one compact structure.

What I claim, and desire to secure by Letters Patent, is—

1. In a rotary motor, the combination with a plurality of cylinders; pistons movable therein, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; of an exhaust-port for each of said cylinders, independent of the inlet-port; and means for opening and closing the exhaust-port, said means being operated solely by the pressure within the cylinder.

2. In a rotary motor, the combination with a plurality of cylinders; and pistons movable therein, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; of an exhaust-port for each of said cylinders independent of the inlet-ports; a valve for each of said exhaust-ports, said valves being normally subjected to pressure from within the cylinder to hold said exhaust-ports closed; and means for opening said valve when each piston is about to finish its instroke; and independent means for controlling the inlet of the operating medium.

3. In a rotary motor, the combination with a plurality of cylinders; and pistons movable therein, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; of an exhaust-port for each of said cylinders independent of the inlet-ports; a valve for each of said exhaust-ports, said valves being normally subjected to pressure from within the cylinder to hold said exhaust-ports

closed; and means operated solely by the pressure within the cylinder for opening said valve when each piston is about to finish its relative instroke.

4. In a rotary motor, the combination with a plurality of cylinders; and pistons movable therein, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; of an exhaust-port for each of said cylinders independent of the inlet-ports; and a valve for each of said exhaust-ports, said valve forming a portion of a differential mechanism for opening and closing said exhaust-port, said differential mechanism being operated solely by pressure from within the cylinder.

5. In a rotary motor, the combination with a plurality of cylinders; and pistons movable therein, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; of an exhaust-port for each of said cylinders independent of the inlet-ports; a valve for each of said exhaust-ports, said valve being normally held closed by pressure from within the cylinder; and an auxiliary piston movable in a chamber having a direct communication with the cylinder when said piston has about completed its relative instroke, for moving said valve to an open position.

6. In a rotary motor, the combination with a plurality of cylinders; and pistons movable therein, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; of an exhaust-port for each of said cylinders independent of the inlet-ports; a valve for each of said exhaust-ports, said valve being normally held closed by pressure from within the cylinder; an auxiliary piston movable within a chamber having a direct communication with the cylinder when said piston has about completed its relative instroke, for moving said valve to an open position; and means, provided by said piston, for retaining said valve in open position until said piston has about completed its relative outward movement.

7. In a rotary motor, the combination with a plurality of cylinders; and pistons movable therein, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; of an exhaust-port for each of said cylinders independent of the inlet-ports; a valve for each of said exhaust-ports, said valve being normally held closed by pressure from within said cylinder; an auxiliary piston for moving said valve to an open position; and a port communicating with said cylinder and normally closed by the piston, said port being open at substantially the extremes of movement of said piston, whereby said auxiliary piston will be acted upon by the pressure within the cylinder when said piston is at one extreme of movement, and free to be moved when the piston is at the opposite extreme of movement.

8. In a rotary motor, the combination of a plurality of cylinders; a piston movable in each of said cylinders, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; an exhaust-port for each of said cylinders; and differential mechanism for controlling the opening and closing of the exhaust-port, said mechanism being subject to the pressure within the cylinder.

9. In a rotary motor, the combination of a plurality of cylinders; a piston movable in each of said cylinders, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; an exhaust-port for each of said cylinders; and differential mechanism for controlling the opening and closing of the exhaust-port, said mechanism being subject to the pressure within the cylinder and operative to change the position of the exhaust-port-controlling means only at points approximate the completion of the in and out strokes of the piston.

10. In a rotary motor, the combination of a plurality of cylinders; a piston movable in each of said cylinders, said pistons having a connection with a fixed eccentric common to each of said pistons, each of said cylinders having an inlet-port; an exhaust-port for each of said cylinders; and differential mechanism for controlling the opening and closing of the exhaust-port, said mechanism being subject to the pressure within the cylinder, the portion of said mechanism operating to open said port having communication with said cylinder only at approximately the completion of the instroke of the piston.

Signed at Cleveland this 29th day of August, 1900.

GEORGE F. SAGE.

Witnesses:
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