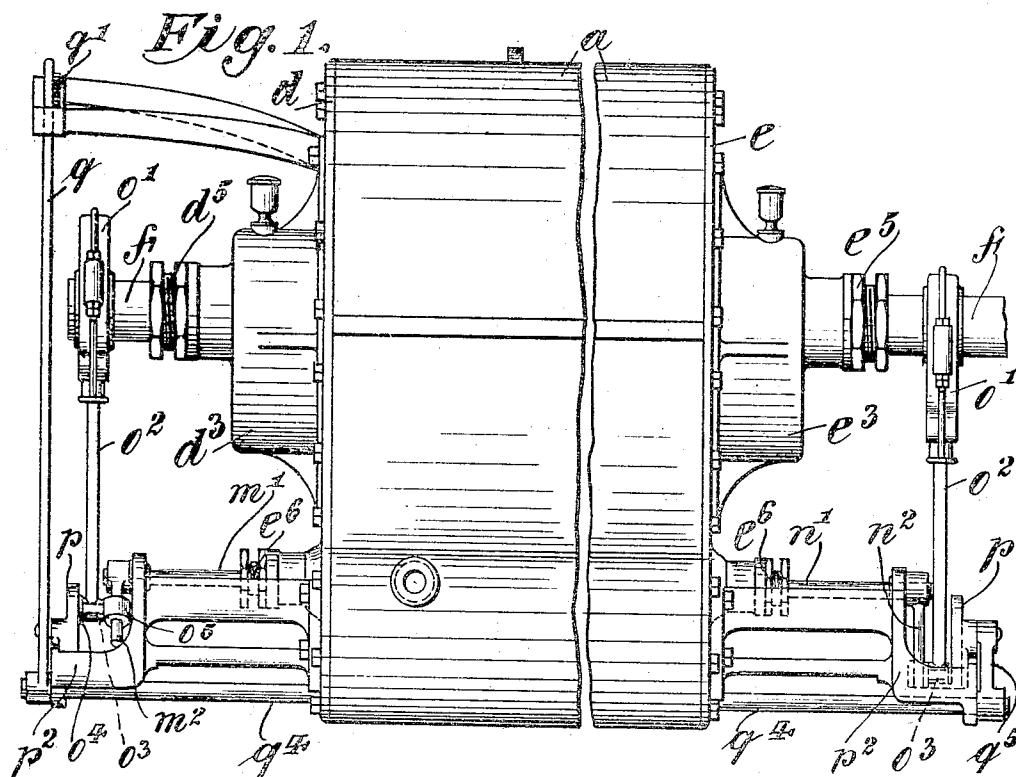
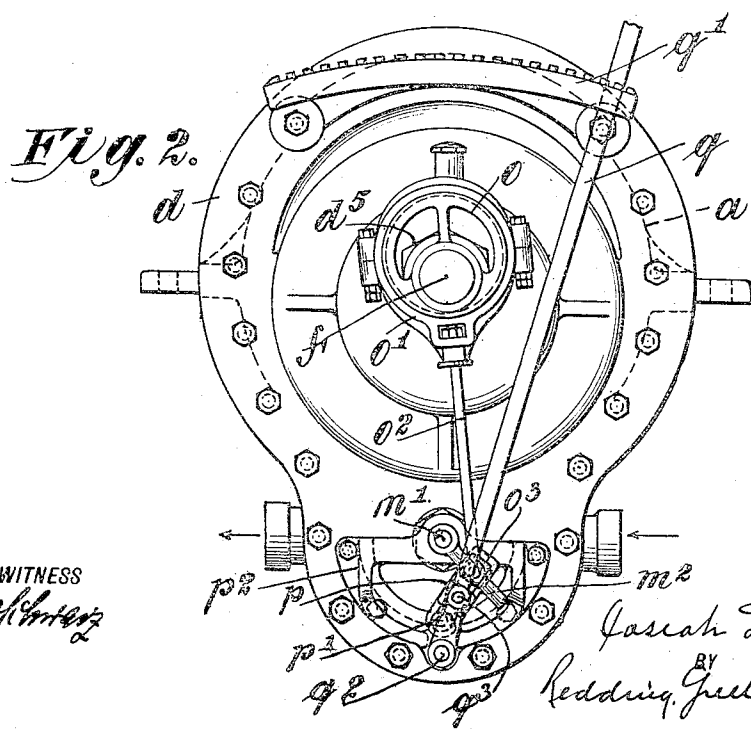


1,246,248.

J. DOW.
ROTARY MOTOR.
APPLICATION FILED MAR. 30, 1916.

Patented Nov. 13, 1917.
3 SHEETS—SHEET 1.



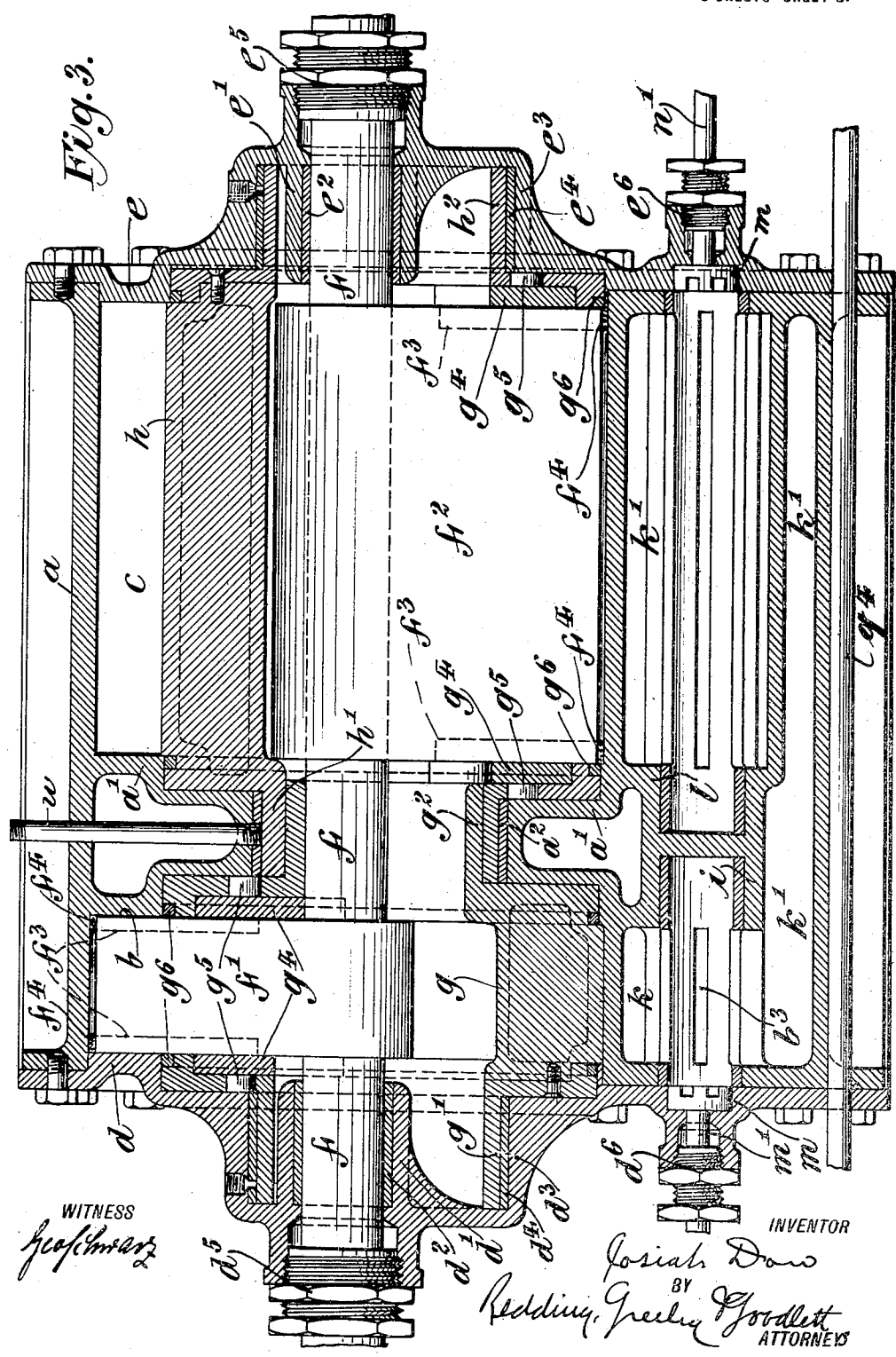
WITNESS
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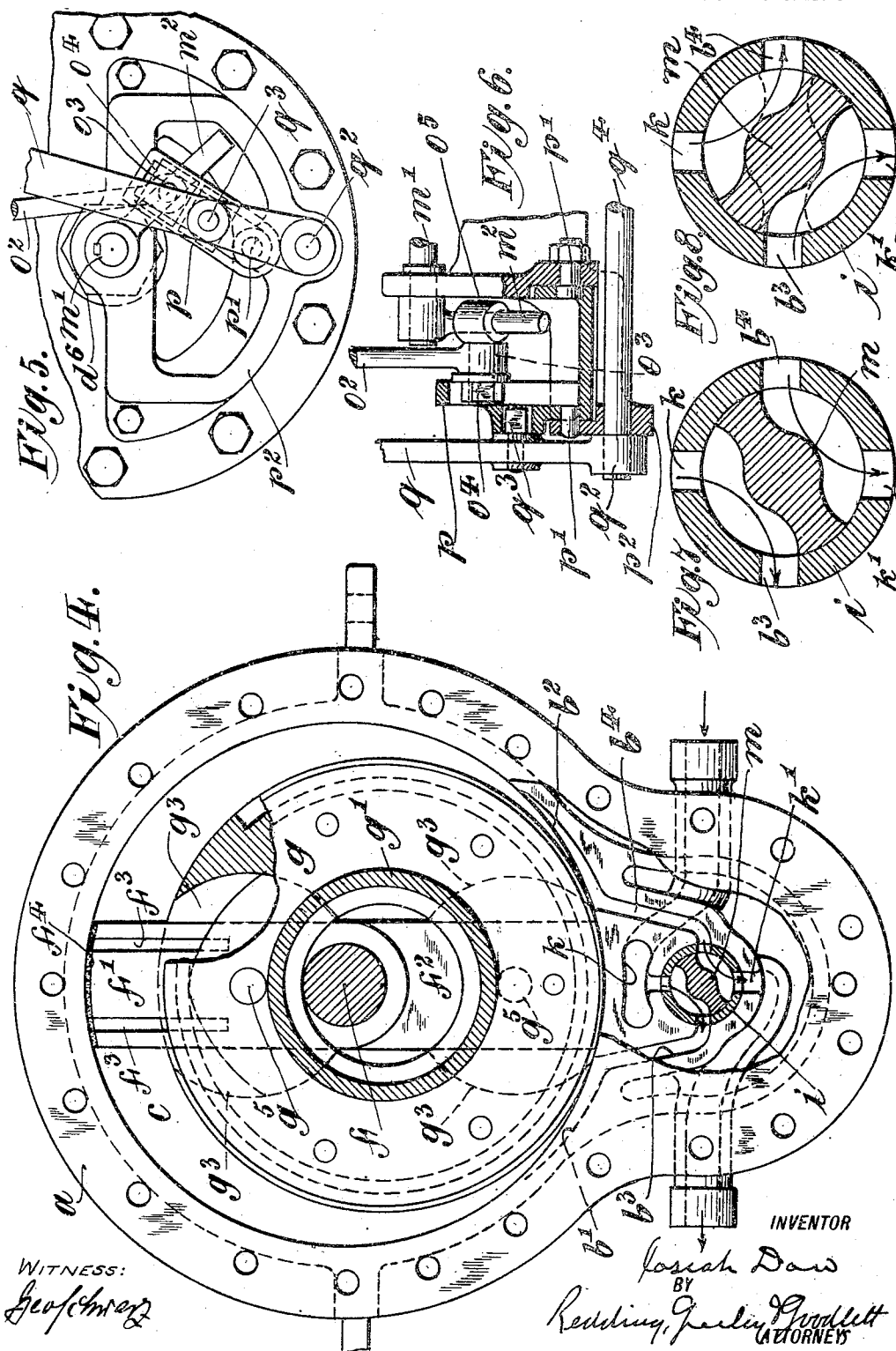
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 3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

JOSIAH DOW, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY MOTOR.

1,246,248.

Specification of Letters Patent.

Patented Nov. 13, 1917.

Application filed March 30, 1916. Serial No. 87,676.

To all whom it may concern:

Be it known that I, JOSIAH DOW, a citizen of the United States, and residing in the city of Philadelphia, county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Rotary Motors, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to that type of rotary motors in which are combined a cylinder, a driving shaft coaxial therewith, a piston rotating concentrically with said shaft and in contact with the circumferential wall of the cylinder, and a cylindrical reaction member mounted eccentrically within the cylinder and in contact with the circumferential wall thereof between the inlet and exhaust ports, said eccentrically mounted reaction member being slotted to receive the piston and to rotate therewith.

The objects of my invention are to perfect the bearings between the piston and reaction member and between said reaction member or members and the casing of the motor, to properly govern the flow of motive fluid from cylinder to cylinder in multiple cylinder or compound motors of the type referred to, to simplify the valve mechanism, and to provide an accurate and easily controlled valve operating gear for such motors.

The invention will be more fully explained hereinafter with reference to the accompanying drawings in which it is illustrated and in which,—

Figure 1 is a view in side elevation of a motor which embodies the invention, partly broken out to save space.

Fig. 2 is a view of the same in end elevation, as seen from the left hand in Fig. 1.

Fig. 3 is a view of the same in central longitudinal section, on a larger scale, the valve-gear being omitted.

Fig. 4 is a view in end elevation, as seen from the left hand in Fig. 3, with the end plate removed and some of the parts broken away and in section to show details of construction.

Figs. 5 and 6 are detail views of the valve-gear for one of the cylinders.

Figs. 7 and 8 are detail views in section through the valve of one of the cylinders respectively showing the valve in position for going ahead and in position for reversing.

The invention is illustrated in the drawings as embodied in a compound motor, the exhaust motive fluid from the high pressure cylinder being admitted directly to the low pressure cylinder for further expansion therein, but it will be evident as this description proceeds that the invention is applicable also to a single-acting, direct-expansion motor.

In the embodiment of the invention illustrated the cylinder casting *a* has formed therein a high pressure cylinder *b* and a low pressure cylinder *c* of the same diameter but of greater length, the two cylinders being separated by an annular wall or partition *a'*. The same casting may also have formed therein the valve seats and passages for the inlet and exhaust of the motive fluid, as hereinafter described. The partition or wall *a'* in part forms one end wall of each of the cylinders. Cylinder heads *d* and *e*, bolted to the cylinder casting, form the other end walls of the two cylinders. The annular wall or partition *a'*, provided with a suitable bushing *a²*, forms a bearing for the annular hub *h'* at the inner end of one of the reaction members, as hereinafter explained. The cylinder head *d* forms a bearing *d'*, suitably bushed as at *d²*, for the driving-shaft *f*, and a bearing *d³*, suitably bushed as at *d⁴*, for the annular hub *g'* of one of the reaction members, as hereinafter explained, such bearing *d³* being of larger diameter than the bearing *d²* so as to surround the same and being eccentric with respect thereto. The cylinder head *e* is similarly formed with a bearing *e'*, bushed as at *e²*, for the driving-shaft *f*, and with a bearing *e³*, bushed as at *e⁴*, for the annular hub *h'* of the corresponding reaction member. Suitable stuffing-boxes *d⁵* and *e⁵* may also be provided.

The driving-shaft *f*, mounted on the bearings *d'* and *e'*, has secured thereto the pistons *f¹* and *f²*, each of which has a broad face for smooth, sliding contact with the circumferential wall of the corresponding cylinder, each face being provided at its ends with suitable packing, as at *f⁴*. Each piston also has a smooth, sliding contact at its sides with the walls which form the end walls of the cylinder and may be provided with packing strips, as indicated at *f³*. In a two-cylinder engine, whether single-acting or compound, the two pistons are diametrically opposite and of equal weight, equality

in weight in a compound engine being secured by making the low pressure piston hollow.

In every fluid pressure motor in which the motive fluid acts expansively and not by impact, there must be a reaction surface against which the motive fluid may react while acting upon the piston to propel the same. Moreover, in a motor in which the piston rotates continuously in the same direction, the reaction member must not stand permanently in the path of the piston. It is impracticable, in such a motor, to cause the reaction member to move radially into and out of the path of the rotating piston. In accordance with this invention the necessary reaction surface is provided by reaction members g and h for the corresponding pistons f' and f'' . Each such reaction member consists of a cylindrical body which is supported eccentrically within the corresponding cylinder and is slotted to receive the corresponding piston so as to permit relative movement between the piston and the reaction member in a radial direction. The reaction member g has at one end a projecting annular hub g' turning in the bearing d^3 of the cylinder head d , and at the other end a projecting annular hub g^2 fitting within the projecting annular hub h' of the reaction member in the bushing a^2 of the annular partition wall a' of the cylinder casting. At its other end the reaction member h has a projecting annular hub h^2 turning in the bushed bearing e^3 of the cylinder head e . The relative movement between the overlapping hubs of the two reaction members is slight and the friction is therefore small. The bearing of the hub h' in the partition wall a' and the bearing of the hollow hubs of both reaction members in the corresponding heads of the cylinder may be suitably lubricated; a pipe for the conveyance of lubricant to the journal h' being shown, at w in Fig. 3. Bearing blocks g^3 , having concentrically curved seats in the opposite faces of the slotted portion of the reaction member g bear with smooth, plane faces against the corresponding sides of the piston f' , permitting the necessary freedom of movement between the piston and the reaction member and preventing the passage of the motive fluid, into the interior of the reaction members, which are necessarily hollow, in order to permit the eccentric movement about the shaft f . The two bearing blocks g^3 are connected, at opposite sides of the piston, by cheek pieces g^4 ; each of which has a stud g^5 in the plane of the center line of the piston and forming the axis on which the blocks g^3 may swing. Packing strips g^6 may also be let into the sides of the reaction member for contact with the sides of the piston. It will be understood that the piston f'' is similarly provided with bearing

blocks g^3 , cheek pieces g^4 , studs g^5 and packing strips g^6 . It will be observed that the bearing blocks g^3 have their curved outer faces generated from a point in the central plane of the piston and oscillate about a corresponding axis, providing for the differential changes in position of the piston in relation to a radius of the reaction member as the two rotate.

At its lowest point the reaction member f' or f'' , as the case may be, has a close working fit against the corresponding cylinder and in order that leakage may be prevented it is desirable that there should be a broad contact face between the two rather than a line contact only. Accordingly, at the lower portion of its circumference, the cylinder is dished or concaved slightly on the center of rotation of the reaction member, so that there shall be a wide contact face, as shown in Fig. 4. The operation of the piston is not affected in any manner by such dishing of the cylinder because, at this point in the rotation of each piston and reaction member, the piston is relatively withdrawn within the circumference of the reaction member. At one side of this broad bearing of the reaction member against the circumferential wall of the cylinder is formed the inlet port b' ; and at the other side is formed the outlet port b^2 , for the cylinder b , the inlet and outlet ports for the cylinder c being similarly placed. In order that the available area of each port may not be restricted by the proximity of the reaction member, each port is extended in a circumferential direction, as shown clearly in Fig. 4, and communicates with the valve seat, the one by the channel b^3 and the other by the channel b^4 .

For each cylinder there is a valve to control the admission and exhaust of the motive fluid with suitable passages. As shown in the drawings there is formed in the lower part of the cylinder casting a bushed cylindrical valve seat i which has four ports equally distributed circumferentially, one communicating with the inlet passage k , a second with the passage b^3 , which communicates with the inlet port b' of the cylinder, a third with the exhaust passage k' which, in a single-acting motor, would be the external exhaust, but in a compound motor forms the receiver or channel by which the exhaust of the high pressure cylinder is conducted to the inlet of the low pressure cylinder, and a fourth with a channel b^4 , which communicates with the outlet port b^2 of the cylinder. In a similar manner there is formed below the cylinder c a bushed valve seat l which has four ports circumferentially distributed, one communicating with the receiver or inlet k' , a second with the cylinder inlet port, a third with the external exhaust, and a fourth with the cylinder outlet channel.

The arrangement of these ports and passages is the same as already described with respect to the cylinder b and need not be further explained herein.

- 5 In the valve seat i is an oscillating valve m which extends from end to end of the valve seat, also extends diametrically across the valve seat, and has its edges or working faces broad enough to cover the ports b^3 and b^4 when the valve is in a horizontal position. The valve is engaged with and arranged to be actuated by a valve stem or spindle m' which passes through a suitable stuffing-box d^e on the cylinder head d . The valve for the low pressure cylinder c is similarly engaged with and operated through a valve-stem or spindle n' which has a bearing in a suitable stuffing-box e^e on the cylinder head e .
- 20 Each of the two valves is actuated to control the admission and exhaust of the motive fluid by a corresponding eccentric on the driving-shaft f . Since the pistons are placed diametrically opposite each other on the shaft the eccentrics also are placed diametrically opposite. Since the same valves serve not only to control the cut-off but as throttle valves and must act in harmony, the regulation of the effect of the eccentric throw upon the two valves may be accomplished by a single controlling means. The several devices involved in the operation just referred to will now be described, it being understood that the valve-gear for the low pressure cylinder is identical with the valve-gear for the high-pressure cylinder but timed differently.

- On the shaft f , adjacent to each cylinder is fixed an eccentric o , the two eccentrics being set 180° apart. The eccentric strap o' carries an eccentric rod o^2 which has at its end a cross-pin o^3 . Swiveled on one end of the cross-pin is a bushed socket o^3 which slides freely on an arm m^2 secured to the valve stem or spindle m' . On the other end of the cross-pin is swiveled a block o^4 which travels freely in a slotted arm p which is pivoted at p' on the frame or supporting bracket p^2 . A controlling hand-lever q , coöperating with an ordinary detent rack q' and pivoted at q^2 , carries a pin q^3 which engages the arm p with freedom for longitudinal movement therein. If the throttle-lever is in its middle position the arm p will be moved also, by the pin q^3 , to its middle or vertical position, thus causing the arm m^2 , through the sliding block o^4 , to be moved also to its middle or vertical position. In this position of the arm m^2 the valve m will occupy its horizontal position, covering both the cylinder inlet port b^3 and the cylinder exhaust port b^4 , cutting off entirely the admission of the motive fluid to the cylinder. The cross-pin o^3 will move up and down in a vertical line, the block o^4

sliding in the slotted arm p and the block o^5 sliding on the arm m^2 without causing any oscillatory movement thereof. If the control-lever q is thrown to the right hand position, as shown in Fig. 2, the arm p will also be swung to the right, thus carrying the cross-pin o^3 to the right, so that the valve will be moved to its wide open position, as shown in Fig. 4, and the throw of the eccentric o will have the maximum effect in oscillating the valve. For any intermediate position of the throttle-lever q the position of the valve and the effect of the throw of the eccentric will be modified correspondingly. For all positions of the throttle-lever to the right of its central position, the motive fluid will be admitted to the cylinder through the channel b^3 and the port b' , causing the piston and therefore the shaft to move in a clockwise direction. According to the position of the cut-off, the motive fluid under direct pressure will follow the piston to a given point and thereafter will expand behind the piston until the piston passes the exhaust port b^2 . Thereafter, the admission of the motive fluid being cut off until the piston has passed the low point of its rotation, the motive fluid in advance of the piston will be completely displaced through the port b^2 and channel b^4 . As soon as the piston has passed beyond the low point of its movement, uncovering the inlet port b' , the motive fluid will be admitted behind it, continuing to drive it in a clockwise direction as before.

For any position of the control-lever to the left of its central position, the position of the valve m will be changed so that the motive fluid will be admitted to the cylinder through the channel b^4 and the cylinder port b^2 and the exhaust will escape through the port b' and channel b^3 , thus reversing the motor. It will be evident that such reversal of the motor can be effected even when the motor is in operation and that the motor may therefore be used as a brake for the driving shaft f .

The control-lever q is fixed upon a shaft q^4 and has fixed thereto, at its opposite end, a short arm q^5 which engages a swinging arm p through which the path of movement of the cross-pin o^3 , of the eccentric rod o^2 , and the position of the arm n^2 of the valve-stem or spindle n' are controlled in the same manner as before.

It will be observed that since the flow of the motive fluid is completely controlled by the coöperation of the valve m with the horizontal ports b^3 and b^4 , it is not necessary that the valve should at any time cover the vertical ports k and k' , and that the necessary movement of the valve m is therefore small; it is just sufficient to open the ports b^3 and b^4 simultaneously with a little lap

in the position for the most widely open cut-off and then completely closing them again according to the position of complete cut-off, which, as explained, may take place at the initial position of the piston so that there will be no movement whatever. The motor is therefore very easily and quickly controlled.

It has already been explained that in a compound motor the exhaust from the high pressure cylinder is delivered directly into a receiver or channel $\mathcal{L}'$ by which it is conducted to the valve chamber of the low pressure cylinder. Description and explanation of the valve-gear for the low pressure cylinder are not necessary because of the identity of such valve-gear in construction and operation with the high pressure valve-gear.

It will be understood that the invention might be embodied in a motor having one or any number of direct acting pistons, as well as in a compound motor. It will also be understood that various changes in details of construction and arrangement may be made to suit different conditions of use and the convenience of the manufacturer.

I claim as my invention:

1. A rotating piston motor comprising a cylinder having inlet and exhaust ports, a driving shaft concentric with the cylinder, a piston rotating concentrically with said shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member mounted eccentrically in the cylinder with its circumference concentric with its axis of rotation and in contact with the circumferential wall of the cylinder between the inlet and exhaust ports thereof, said reaction member being slotted to permit the piston to pass through it but rotating therewith, front and rear bearing blocks each having a straight face bearing upon the corresponding face of the piston, and an outer curved face bearing against a correspondingly curved seat in the reaction member, and cheek pieces connecting said bearing blocks so as to cause them to move in unison.

2. A rotating piston motor comprising a cylinder having inlet and exhaust ports, a driving shaft concentric with the cylinder, a piston rotating concentrically with said shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member mounted eccentrically in the cylinder with its circumference concentric with its axis of rotation and in contact with the circumferential wall of the cylinder between the inlet and exhaust ports thereof, said reaction member being slotted to permit the piston to pass through it but rotating therewith, front and rear bearing blocks each having a straight face bearing upon the corresponding face of the piston, and an outer curved face bearing

against a correspondingly curved seat in the reaction member, and cheek pieces connecting said bearing blocks so as to cause them to move in unison, said cheek pieces having pivot studs concentric with the outer curved faces of the bearing blocks and adapted to bearings in the reaction member.

3. A rotating piston motor comprising a structure with partition member therein dividing said structure into cylinder members on opposite sides of said partition, heads closing the outer ends of said cylinder members, a driving shaft concentric with the cylinders, pistons rotating concentrically with said shaft with their outer ends in contact with the circumferential walls of the respective cylinders, cylindrical reaction members mounted eccentrically in the cylinders in contact with the circumferential walls thereof between the inlet and exhaust ports, said reaction members being slotted to permit the pistons to pass therethrough but rotating therewith, annular hubs at the outer ends of said reaction members adapted to bearings in the outer heads of the cylinders, and annular hubs at the inner ends of said reaction members, one of said hubs being adapted to a bearing in the partition member of the cylinder structure and the other being adapted to a bearing within the first.

4. A rotating piston motor comprising a cylinder having inlet and exhaust ports, a driving shaft concentric with the cylinder, a piston rotating concentrically with said driving shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member mounted eccentrically in the cylinder in contact with the circumferential wall thereof between the inlet and exhaust ports, said reaction member being slotted to permit the piston to pass therethrough, but rotating therewith, a valve seat having inlet, discharge and controlling ports, the latter communicating, respectively, with the inlet and exhaust ports of the cylinder, a valve oscillating upon its axis and coacting with said controlling ports to govern the flow of motive fluid into and from the cylinder, and a valve operating gear comprising a controlling lever, a slotted and swingable arm engaged thereby, a radial arm on the valve stem, a reciprocated rod and blocks carried by the latter, one of said blocks engaging and slidable on said radial arm on the valve stem and the other engaging the slotted and swingable arm which is moved by the controlling lever.

5. A rotating piston motor comprising a cylinder having inlet and exhaust ports, a driving shaft concentric with the cylinder, a piston rotating concentrically with said driving shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member mounted

ed eccentrically in the cylinder in contact with the circumferential wall thereof between the inlet and exhaust ports, said reaction member being slotted to permit the
 5 piston to pass therethrough but rotating therewith, a valve seat having inlet, discharge and controlling ports, the latter communicating, respectively, with the inlet and exhaust ports of the cylinder, an oscillating
 10 valve coacting with said controlling ports to govern the flow of motive fluid into and from the cylinder, and a valve operating gear comprising a controlling lever, a swingable arm having two radial slots therein, a
 15 radial arm on the valve stem, a reciprocated rod, blocks carried by the latter, one of said blocks engaging with and slidable upon said radial arm on the valve stem, and the other engaging with and slidable in one of the
 20 slots in the swingable arm, and means carried by the controlling lever and engaging the other slot in said arm.

6. A rotating piston motor comprising a cylinder having inlet and exhaust ports, a
 25 driving shaft concentric with the cylinder, a piston rotating concentrically with said driving shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member mounted
 30 ed eccentrically in the cylinder in contact with the circumferential wall thereof between the inlet and exhaust ports, said reaction member being slotted to permit the piston to pass therethrough but rotating
 35 therewith, a valve seat having inlet, discharge and controlling ports, the latter communicating, respectively, with the inlet and exhaust ports of the cylinder, a valve oscillating upon its axis and coacting with said
 40 controlling ports to govern the flow of motive fluid into and from the cylinder, and a valve operating gear comprising a radial arm on the valve stem, a slotted and swingable arm having its axis so disposed that
 45 said arm can swing across the axis of the valve stem, a reciprocated rod, and blocks carried by the latter, one of said blocks engaging said radial arm on the valve stem and the other engaging the slot in the swingable
 50 arm.

7. A rotating piston motor comprising a cylinder having inlet and exhaust ports, a driving shaft concentric with the cylinder, a piston rotating concentrically with said
 55 driving shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member mounted eccentrically in the cylinder in contact with the circumferential wall thereof
 60 between the inlet and exhaust ports, said reaction member being slotted to permit the piston to pass therethrough but rotating therewith, a valve seat having inlet, discharge and controlling ports, the latter communicating, respectively, with the inlet and
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exhaust ports of the cylinder, a valve oscillating upon its axis and coacting with said controlling ports to govern the flow of motive fluid into and from the cylinder, and a valve operating gear comprising a radial arm on
 70 the valve stem, a slotted and swingable arm, a reciprocated rod, and blocks carried by the latter, one of said blocks engaging said radial arm on the valve stem and the other engaging the slot in the swingable arm, and
 75 both of said blocks being carried by one and the same pin which is adapted to a transverse bearing in the reciprocated rod.

8. A rotating piston motor comprising a cylinder with inlet and exhaust ports, a
 80 driving shaft concentric with the cylinder, a piston rotating concentrically with said driving shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member
 85 mounted eccentrically in the cylinder in contact with the circumferential wall thereof between the inlet and exhaust ports, said reaction member being slotted to permit the piston to pass therethrough, but rotating
 90 therewith, a valve seat having inlet, discharge and controlling ports, the latter communicating, respectively, with the inlet and exhaust ports of the cylinder, a valve coacting with said controlling ports, to govern
 95 the flow of motive fluid into and from the cylinder, and a valve operating gear comprising a controlling lever, a slotted and swingable arm engaged thereby, a radial arm on the valve stem, a reciprocated rod,
 100 blocks carried by the latter, one of said blocks engaging and slidable on said radial arm on the valve stem and the other engaging and slidable in the slot of the swingable arm, and means for retaining said controlling lever in different positions of adjustment and thereby fixing the limits of swing of the valve.

9. A rotating piston motor comprising a cylinder with inlet and exhaust ports, a driving
 110 shaft concentric with the cylinder, a piston rotating concentrically with said driving shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member mounted
 115 eccentrically in the cylinder in contact with the circumferential wall thereof between the inlet and exhaust ports, said reaction member being slotted to permit the piston to pass therethrough but rotating therewith, a valve
 120 seat having inlet, discharge and controlling ports, the latter communicating, respectively, with the inlet and exhaust ports of the cylinder, a valve coacting with said controlling ports to govern the flow of motive fluid into
 125 and from the cylinder, and a valve operating gear comprising a pivoted controlling lever, a slotted and swingable arm engaged thereby, a radial arm on the valve stem, a reciprocated rod, and blocks carried by the lat-
 130

- ter, one of said blocks engaging and slidable on said radial arm on the valve stem, and the other engaging and slidable in the slot of the swingable arm, the pivotal axes of said swingable arm and controlling lever being so disposed in respect to the valve stem that both the slotted arm and controlling lever can be swung from one side to the other of the axis of said valve stem.
- 10 10. A rotating piston motor comprising a cylinder with inlet, and exhaust ports, a driving shaft concentric with the cylinder, a piston rotating concentrically with said driving shaft and with its outer end in contact with the circumferential wall of the cylinder, a cylindrical reaction member mounted eccentrically in the cylinder in contact with the circumferential wall thereof between the inlet and exhaust ports, said reaction member being slotted to permit the piston to pass therethrough but rotating therewith,
- a valve seat having inlet, discharge and controlling ports, the latter communicating, respectively, with the inlet and exhaust ports of the cylinder, a valve coacting with said controlling ports to govern the flow of motive fluid into and from the cylinder, and a valve operating gear comprising a controlling lever, a slotted and swingable arm engaged thereby, a radial arm on the valve stem, a reciprocated rod, and a transverse pin adapted to a bearing in said rod, said pin having at one end a fixed block and at the other end a block mounted so as to turn thereon, said fixed block engaging and slidable on the radial arm on the valve stem and the pivotally mounted block being slidable in the slot of the swingable arm.
- This specification signed this 28th day of March, A. D. 1916.
- JOSIAH DOW.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."