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C. F. BALL

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FLUID OPERATED MOTORS

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Fig. 1.

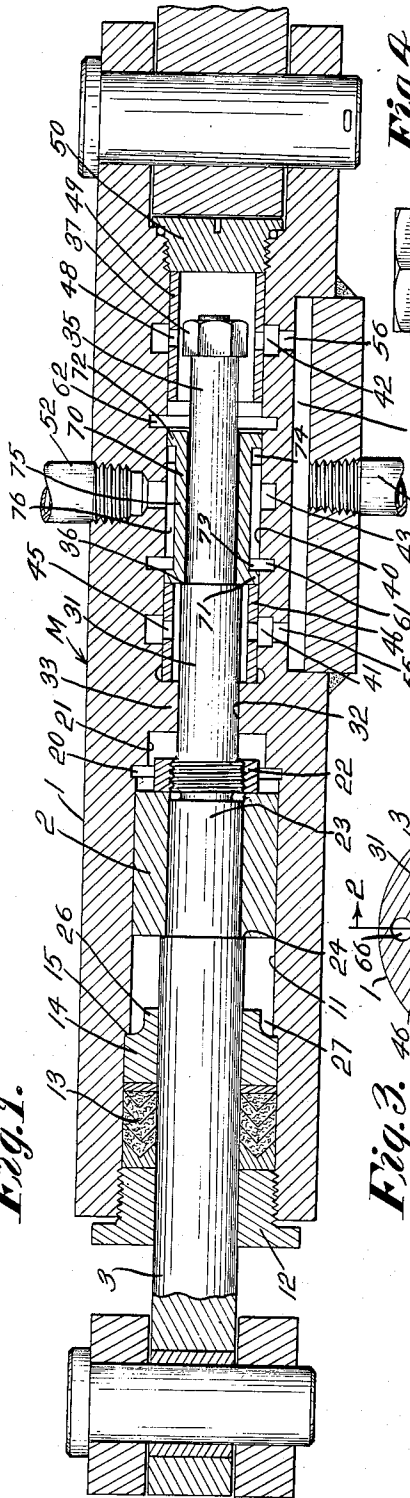


Fig. 4.

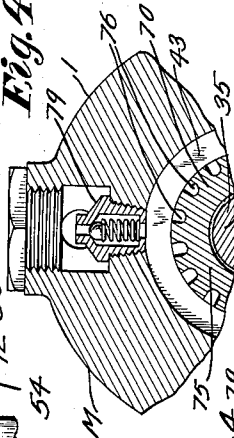


Fig. 3.

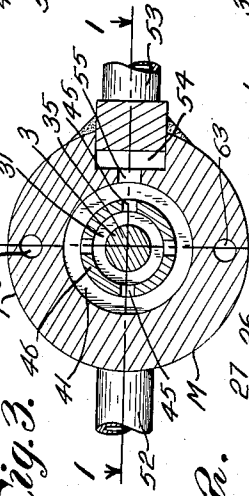
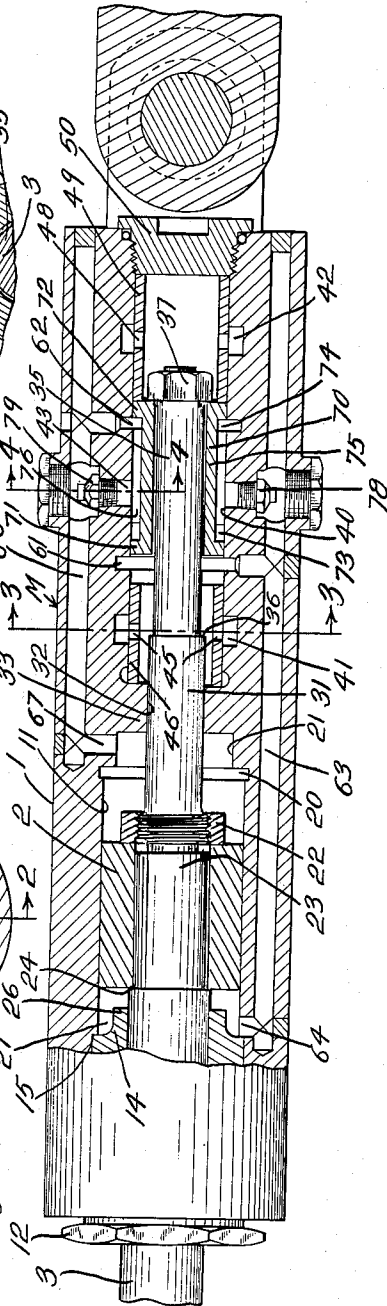


Fig. 2.



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2,742,880

FLUID OPERATED MOTORS

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Original application October 19, 1950, Serial No. 191,004.
Divided and this application September 15, 1952, Serial No. 309,665

12 Claims. (Cl. 121-164)

My invention relates to fluid motors, and more particularly to hydraulically operated fluid motors.

Jigging conveyors require for the movement of material along them that their opposite movements shall be made in such a manner that the material shall move with the conveyor during the movements of the latter in a discharge direction and that the conveyor shall slide beneath the material when moving in the opposite direction. It is an object of this invention to provide an improved fluid motor especially adapted for actuating a shaker conveyor, but in no sense limited to such use, and which shall provide strokes of its power transmitting element in the desired manner, which shall control the lengths of the passes of the conveyor and insure reversals at the proper times and in the requisite manner, and which incorporates an improved valve mechanism whose reversals may be insured under all working conditions. Generally speaking, the invention has for its objects, from different aspects, the provision of an improved hydraulic motor, and the provision of an improved distributing valve mechanism for such a motor. Other objects of the invention will subsequently appear.

A shaker conveyor appropriate for operation by the motor of this application is shown in my copending application, Serial No. 191,004, filed October 19, 1950, for Vein Disintegrating and Material Handling Apparatus, of which this present application is a division.

In the accompanying drawings, in which one illustrative embodiment of the invention is shown,

Fig. 1 is a central longitudinal section through a hydraulic motor in which the invention is embodied, the section being on the plane of the line 1-1 of Fig. 3, and the view showing the motor just about to complete one of its strokes.

Fig. 2 is another central longitudinal section, this time on a plane at right angles to the plane of the section line 1-1 and on the plane of the section line 2-2 of Fig. 3.

Figs. 3 and 4 are transverse sections on the planes of the section lines 3-3 and 4-4 of Fig. 2, and show details of construction, Fig. 4 being on an enlarged scale.

Referring now to the drawings, it will be noted that a motor M—herein a hydraulic motor—of the double-acting type includes a cylinder 1 and a piston 2 reciprocable in the bore of the cylinder and having a piston rod 3, the piston rod 3 and the end of the motor M opposite that from which the piston rod extends, each being pivotally connected to devices or structures between which relative reciprocatory movement is desired.

The cylinder 1 of the motor M has a bore 11 in which the piston 2 is reciprocable, and this bore is closed, except for the opening traversed by the piston rod 3, at one end by a threaded head or gland follower 12, a suitable packing as, for example, a chevron packing 13, and an inner head 14, the latter held in engagement with a shoulder 15 in the bore 11. The piston rod 3 passes through the two heads and the intervening packing 13. The end of the bore 11 opposite the head 14 is provided with a counter-bore 20, and beyond the latter a reduced

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bore 21 adapted to receive a nut 22 which holds the piston 2 upon a reduced portion 23 of the piston rod 3, the piston being clamped between the nut and a shoulder 24 on the piston rod. At this point, it may be noted that the head 14 has a portion of reduced diameter 26, whereby an annular relief 27 is provided, and it will be noted later that a distribution passage communicates constantly with this relief. To the right of the piston rod portion 23 and the nut 22 in Figs. 1 and 2, there is a further reduced portion 31 of the piston rod 3, this passing through a bore 32 formed in a partition portion 33 in the cylinder member 1. The portion 31 carries a still further reduced portion 35, a shoulder 36 being provided at the junction of the portion 35 with the portion 31, and a nut 37 being carried by the end of the reduced portion 35 in spaced relation to the shoulder 36. Cylinder member 1 is provided with an elongated bore 40 coaxial with the piston rod portions 35 and 31. This bore has three circumferentially extending, mutually longitudinally spaced grooves 41, 42 and 43. Groove 41 communicates with a series of openings 45 formed in a sleeve 46 pressed into the end of the bore 40 nearer the cylinder bore 11. Groove 42 communicates with a series of passages 48 opening through a sleeve 49 which is also pressed into the bore 40, and which engages a threaded head 50, threaded into the right-hand end of the cylinder 1, see Figs. 1 and 2. A supply conduit, 52, for operating fluid communicates with the groove 43, which is midway between the sleeves 46 and 49. An exhaust connection 53 communicates with an elongated passage 54 which, in turn, communicates near its opposite ends through passages 55 and 56 with the annular grooves 41 and 42 respectively. Between the adjacent ends of the sleeves 46 and 49, but relatively near the latter, the bore 40 has annular grooves 61 and 62 in communication with it. The groove 61 is connected by a distribution passage 63 with a port 64 opening into the forward end of the bore 11 and communicating with the relief space 27. The annular groove 62 is connected by a passage 66 with a distribution port 67 opening into the rearward reduced bore 21. A sleeve valve 70 is reciprocally received in the bore 40 between the sleeve portions 46 and 49, and can occupy positions in which it connects the fluid supply groove 43 respectively with the grooves 61 and 62. The hollow sleeve valve 70 fairly closely fits the periphery of the reduced piston rod extension portion 35, but there is a slight annular clearance between them. The hollow sleeve valve 70 is so formed as to avoid catching on the edges of the grooves 61 and 62, while yet alternately connecting these grooves with the central supply groove 43. It will be observed that it has narrow cylindrical end heads 71, 72, spaced by annular grooves, 73 and 74 respectively, from a longitudinally grooved but otherwise cylindrical central section 75, the grooves in the section 75 being numbered 76 and connecting the grooves 73 and 74 in communication with each other and with the supply groove 43. The heads 71 and 72, and the intermediate section 75 where there are no grooves in the latter, are all close sliding fits in the valve chamber. The distribution passages 63 and 66 may be connected with the supply groove 43 through spring pressed relief valves 78 and 79 respectively if the pressures in the ends of the cylinder bore 11 become great enough, at the ends of the passes of the piston 2, due to the momentum of the reciprocating system. The motor is so connected with its load, in a set-up such as is shown in the parent application above mentioned, that when fluid pressure is not being supplied through the conduit 52 the piston 2 will normally occupy the extreme right-hand end of its cylinder (the bore 11), and the valve 70 will occupy a position corresponding to that shown in Fig. 2, that is,

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a position connecting supply groove 43 with the distributing groove 62, with the result that upon the admission of fluid to the conduit 52, the piston 2 will be moved to the left. As the piston rod 3 is moved outwardly from the cylinder it raises, in a set-up such as said parent application discloses, the structure which it actuates with it and the weight of this structure will aid the opposite movements of the piston rod. The effective area of the piston 2 at its right-hand or rearward end is larger than that at its lefthand or forward end, and the work it must do is therefore adequately handled. In practice the piston actuates a pan or hopper (not shown herein), but disclosed in said parent application, raising the hopper and simultaneously moving it toward the left.

Assuming now that the motor is in operation, and that the parts are in the relative positions shown in Fig. 2, it will be understood that fluid is passing from the groove 43 through the peripheral grooving in the sleeve valve and through the groove 62 into the distributing passage 66 and then through the port 67 to the right-hand end of the piston 2. The piston is therefore moving toward the left and causing the pan or hopper which it actuates to be raised and simultaneously moved to the left. The parts are shown with the nut 37 just engaging the right-hand end of the valve 70, and, accordingly, the valve will immediately commence to be moved towards the position shown in Fig. 1. Continued movement of the piston 2 will cause the valve 70 to close off the communication of the groove 62 with the groove 43 and will establish communication between the groove 61 and the groove 43. It will also interrupt communication between the port 64 and the exhaust which has been subsisting through the passage 63, groove 61, the space to the left of the valve 70, the radial openings 45, the groove 41, the passages 55 and 54, and the exhaust conduit 53.

The stroke to the right of the piston 2 will be readily understood as, during it, fluid will be passed by the valve 70 from the supply conduit 52 to the groove 61 and thence via the passage 63 to the port 64 and into the lefthand end of the cylinder bore 11. This movement will be more rapid than the movement in the opposite direction, because the volume increases as the piston 2 moves to the right is less, per unit of distance moved, than is the case during leftward piston movement. When the piston gets to the position shown in Fig. 1, as it moves toward the right, the rod will commence to move the distributing valve 70 to the right, and the distributing valve will ultimately assume the position shown in Fig. 2. It should be noted that the distributing valve will be held in its opposite extreme positions by the unbalanced force of the fluid discharging on its way to exhaust from the grooves 62 or 61, as the case may be, and, there being an unbalanced pressure due to the fact that there will be both a larger area of the valve exposed to the flowing pressure fluid, and due to the fact that the porting between the spaces surrounded by the sleeves 46 and 49 is such as to maintain a higher pressure at the ends of the valve subjected to exhausting fluid than at the opposite ends. This may readily be understood if it be realized that the discharge from longitudinal passage 54 is so free that there is no tendency for fluid to pass around and act on both ends of the valve at once.

In use, my improved motor, with the type of load described in my parent application, will ordinarily have an accumulator connected in communication with the supply conduit 52 to take care of the interruption in fluid flow during reversals of the motor.

It will be understood from the foregoing description that there is provided an improved expansible chamber motor having an improved arrangement of parts and highly suited to the actuation of a shaker conveyor mechanism, the movements of which in the direction material is to be moved involve a higher force exertion than its opposite movements, and which assured valve throwing and holding is provided in an improved manner.

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While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim is:

1. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber, a valve in said valve chamber having thereon transverse surfaces spaced apart longitudinally of said valve, a valve operating rod operatively connected with said piston for reciprocation by the latter and extending into said valve chamber and providing valve engaging abutments engaging in alternation said transverse surfaces on said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections communicating with the valve chamber outwardly of the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance and which provides restricted communication along said rod between the opposite ends of said valve chamber, and abutment sleeves with whose interiors said exhaust connections communicate and which have mutually adjacent ends presenting surfaces facing towards each other and which are alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation.

2. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber having thereon transverse surfaces facing away from each other and spaced apart longitudinally of said valve, a valve operating rod operatively connected with said piston for reciprocation by the latter and extending into said valve chamber and providing valve engaging abutments spaced apart more widely, longitudinally of said rod, than the distance between said transverse surfaces, to engage in alternation said transverse surfaces on said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections communicating with the valve chamber outwardly of the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance and which provides restricted communication along said rod between the opposite ends of said valve chamber, and abutment sleeves with whose interiors said exhaust connections communicate and which have mutually adjacent ends presenting surfaces facing towards each other and which are alternatively engaged by said valve when the latter is in its fully thrown positions said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation.

3. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber having in stationary relation thereto longitudinally spaced transverse surfaces, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage different ones of said longitudinally spaced transverse surfaces as said piston approaches

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the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections communicating with the valve chamber outwardly of the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance and through which the opposite ends of said valve are communicable, and abutment sleeves with whose interiors said exhaust connections communicate and which have mutually adjacent ends presenting surfaces facing towards each other and which are alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation.

4. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections communicating with the valve chamber outwardly of the communications of said distribution passages with said chamber, said valve having a bore extending longitudinally therethrough connecting the opposite ends thereof and through which bore said operating rod extends with restricted clearance, and abutment sleeves with whose interiors said exhaust connections communicate and which have mutually adjacent ends presenting surfaces facing towards each other and which are alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery means for connecting the fluid supply passages with the distribution passages in alternation.

5. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber, adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections for said cylinder communicating with the valve chamber outwardly of the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance, and stationary abutment sleeves with whose interiors said exhaust connections communicate and which have mutually adjacent ends presenting surfaces facing towards each other and which are alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its outer periphery means for connecting the fluid supply passage with the distribution passages in alternation.

6. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply

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ply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections communicating with the valve chamber outwardly of the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance, and abutment sleeves with whose interiors said exhaust connections communicate and which have mutually adjacent ends presenting surfaces facing towards each other and which are alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery a groove for connecting each of the distribution passages alternately with the fluid supply passage and having its opposite ends controlling the connections of said distribution passages with said exhaust connections.

7. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a single, unitary, peripherally imperforate, sleeve valve reciprocable in said valve chamber, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections communicating with the valve chamber at points between the ends of the latter and the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance, and abutment sleeves traversed by said exhaust connections and providing at their mutually adjacent ends annular shoulders extending inwardly of said valve chamber and alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation.

8. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections communicating with the valve chamber at points between the ends of the latter and the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance to provide restricted communication between the opposite ends of said valve, and stop means presenting stationary abutments alternatively engaged by the then leading ends of said valve when the latter is arriving in its fully thrown positions to halt the movements of said valve, said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation.

9. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a piston rod connected to said piston, a valve chamber coaxial with said bore but partitioned from and spaced longitudinally from said bore, a sleeve valve in said valve chamber, a valve operating rod of smaller diameter than said piston rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage

the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections communicating with the valve chamber at points between the ends of the latter and the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance and which provides restricted communication between spaces at the opposite ends of said valve in said valve chamber, abutments alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation, and relief valve controlled connections opening from said distribution passages to said fluid supply passage.

10. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage, and exhaust connections also opening through the wall of said valve chamber into communication with the valve chamber at points between the ends of the latter and the communications of said distribution passages with said chamber, said valve having a bore therethrough through which there is communication between the opposite ends of said valve chamber and through which said operating rod extends with restricted clearance, abutments alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation, connections between said distribution passages and said fluid supply passage, and relief valves controlling said last mentioned connections and opening towards said supply passage and set to open only when the pressure in a distribution passage exceeds supply pressure.

11. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber

at opposite sides of said fluid supply passage at points each adjacent one end of the valve when the latter is fully thrown, and exhaust connections communicating with the valve chamber at points between the ends of the latter and the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance, and abutment sleeves traversed by said exhaust connections and alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation and the exhaust connections for said valve so constricting the escape of exhausting fluid from the exhausting ends of the cylinder bore that the pressures on the ends of the valve past which exhausting fluid flows upon its exit from the vented distribution passages holds the valve against the abutments.

12. In a motor, a cylinder having a bore, a piston reciprocable in said bore, a valve chamber coaxial with said bore but spaced longitudinally from said bore, a valve in said valve chamber, a valve operating rod connected with said piston and extending into said valve chamber and providing valve engaging abutments spaced to engage the opposite ends of said valve as said piston approaches the opposite ends of its strokes, a fluid supply passage opening into said valve chamber adjacent the midpoint of the travel of the valve therein, distribution passages opening through the wall of said valve chamber at opposite sides of said fluid supply passage at points each adjacent one end of the valve when the latter is fully thrown, and exhaust connections communicating with the valve chamber at points between the ends of the latter and the communications of said distribution passages with said chamber, said valve having a bore therethrough through which said operating rod extends with restricted clearance, and abutment devices alternatively engaged by said valve when the latter is in its fully thrown positions, said valve having in its periphery means for connecting the fluid supply passage with the distribution passages in alternation and the exhaust connections for said valve so constricting the escape of exhausting fluid from the exhausting ends of the cylinder bore that the pressures on the ends of the valve past which exhausting fluid flows upon its exit from the vented distribution passages moves and holds the valve against the abutment devices.

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