

Oct. 15, 1946.

V. V. BLASUTTA

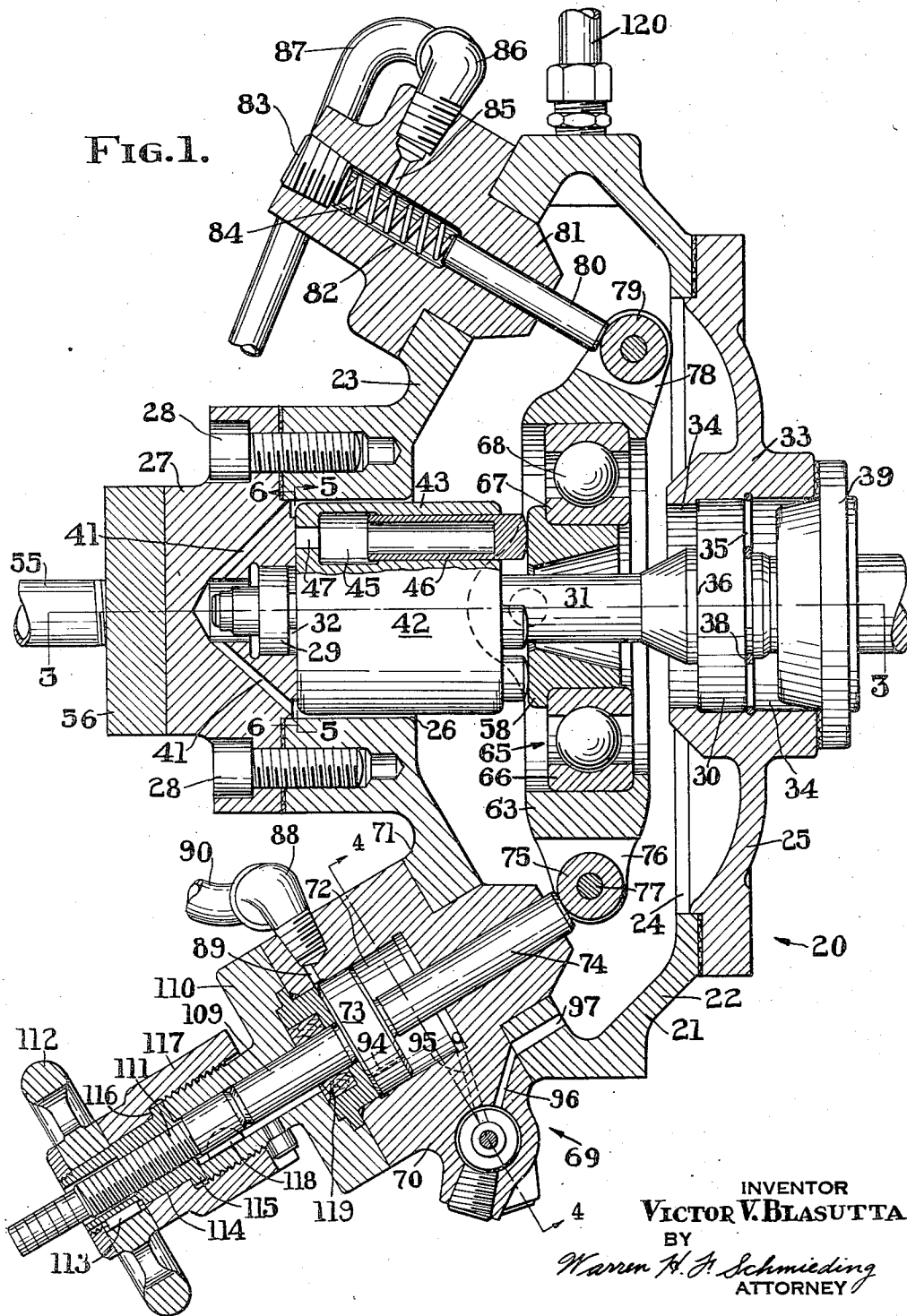
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HYDRAULIC APPARATUS

Filed June 19, 1943

4 Sheets-Sheet 1

FIG. 1.



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V. V. BLASUTTA

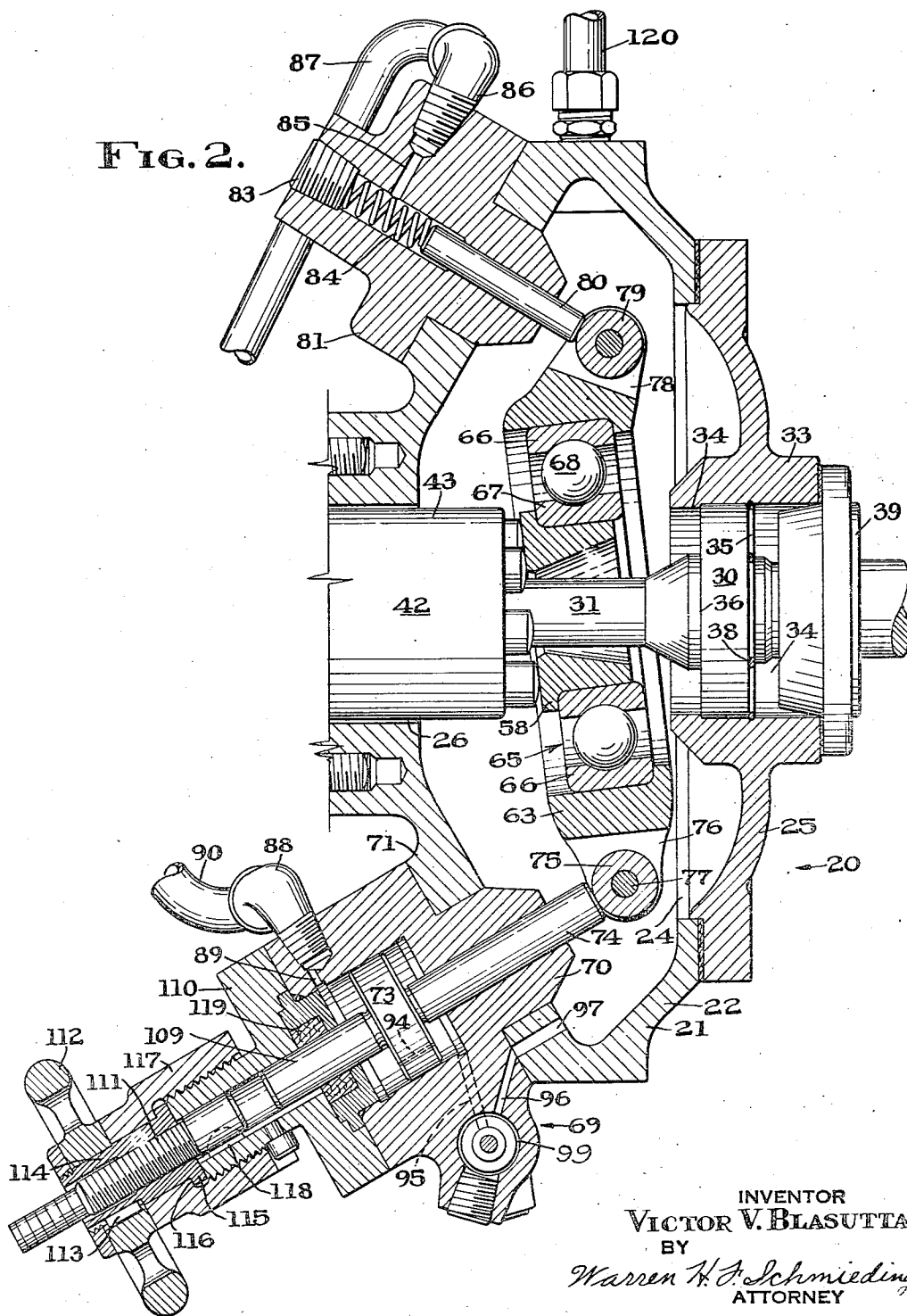
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4 Sheets-Sheet 2

FIG. 2.



INVENTOR
VICTOR V. BLASUTTA
BY

Warren H. Schmieding
ATTORNEY

Oct. 15, 1946.

V. V. BLASUTTA
HYDRAULIC APPARATUS

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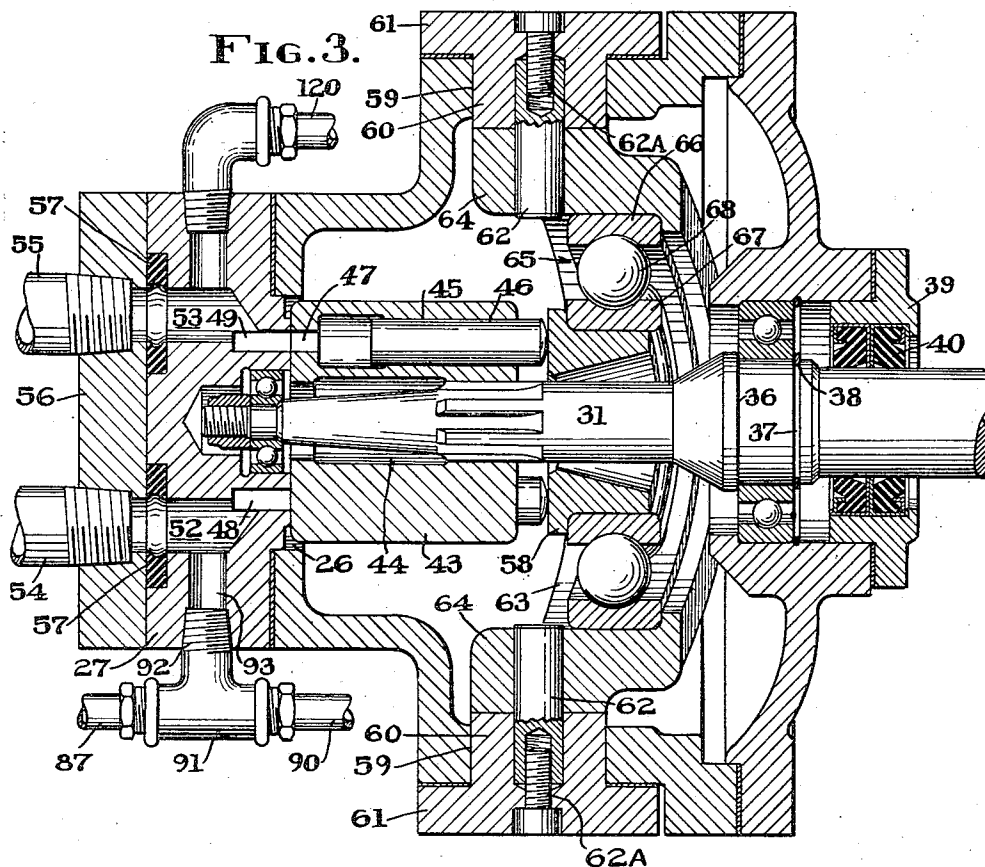
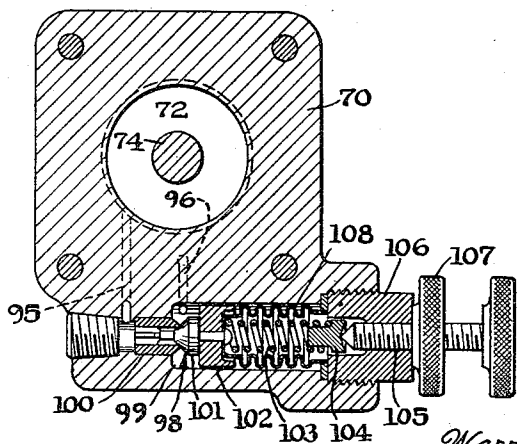


FIG. 4.



INVENTOR
VICTOR V. BLASUTTA
BY
Warren H. J. Schmieding
ATTORNEY

Oct. 15, 1946.

V. V. BLASUTTA

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FIG. 5.

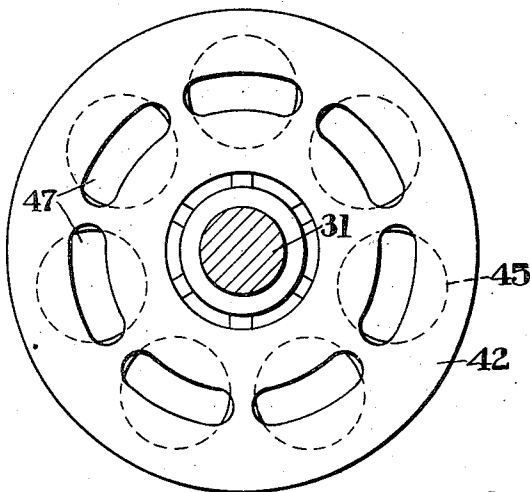
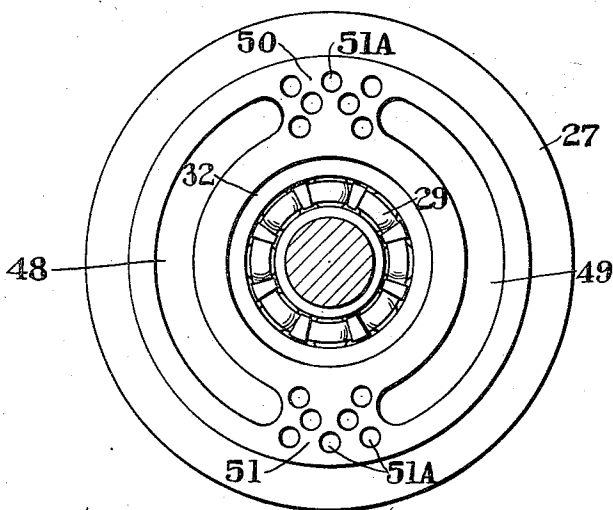


FIG. 6.



INVENTOR
VICTOR V. BLASUTTA
BY
Warren H. F. Schmieding
ATTORNEY

UNITED STATES PATENT OFFICE

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HYDRAULIC APPARATUS

Victor V. Blasutta, Columbus, Ohio, assignor to
The Denison Engineering Company, Columbus,
Ohio, a corporation of Ohio

Application June 19, 1943, Serial No. 491,474

11 Claims. (Cl. 121—62)

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This invention relates generally to hydraulic equipment and is particularly directed to fluid pressure energy translating devices of the type having rotatable cylinder barrels with movable pistons and thrust means for imparting movement to the pistons or cylinder barrels in the operation of the devices.

An object of this invention resides in the provision of a fluid operated motor which will produce a substantially constant power but due to certain adjustable elements therein will be capable of developing a variable torque in response to changes in fluid pressure caused by the application to or removal of loads from the motor.

Another object of this invention rests in providing a fluid motor of the type mentioned with fluid pressure operated mechanism which is connected with the thrust means and is subjected to the pressure of the fluid in the supply line to the motor whereby an increase in pressure on the fluid in the supply line, due to the imposition of a load on the motor, will be transmitted to the pressure operated mechanism and will cause it to change the position of the thrust means so that the torque of the motor will be increased and maintained until the load is relieved.

A further object of the invention resides in the provision of a fluid motor having a rotatable cylinder barrel with a plurality of pistons and thrust means disposed at an angle to the longitudinal axes of the pistons so that when the latter are forced by fluid pressure toward the thrust member the reaction produced by the angularity of the thrust member will cause the cylinder barrel to revolve, the motor having means for supporting the thrust member for pivotal movement and means actuated by fluid pressure to move the thrust member whereby the angular relation thereof to the pistons will be changed to increase or decrease the reaction according to variations in loads placed upon the motor.

Another object is to provide the fluid motor mentioned above with piston means for changing the angularity of the thrust member, means also being provided to balance the fluid pressure on opposite sides of the piston, under normal conditions of operation, but when abnormal conditions obtain a differential in pressure on opposite sides of the piston will be created which will cause the piston to move and change the angularity of the thrust means thereby increasing the torque of the motor.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accom-

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panying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawings:

Fig. 1 is a vertical longitudinal sectional view taken through a hydraulic motor formed in accordance with the present invention showing the thrust means thereof in condition to prevent operation of the motor;

Fig. 2 is a similar view showing the thrust means in condition to cause the motor to operate when fluid under pressure is supplied thereto;

Fig. 3 is a horizontal sectional view taken on the plane indicated by the line 3—3 of Fig. 1 showing the thrust means in condition to cause operation of the motor;

Fig. 4 is a detail sectional view taken through the means for automatically adjusting the thrust member of the motor on the plane indicated by the line 4—4 of Fig. 1;

Fig. 5 is a vertical transverse sectional view taken on the plane indicated by the line 5—5 of Fig. 1; and

Fig. 6 is a similar view on the plane indicated by the line 6—6 of Fig. 1.

Referring more particularly to the drawings, the numeral 20 designates the motor in its entirety. In the embodiment of the invention illustrated, the motor 20 includes a casing 21 which may be formed from cast metal and is generally circular when viewed from the front. This casing has angularly related front and rear walls 22 and 23, the former of which is provided with an enlarged circular opening 24. This opening is normally closed by a removable cover 25 which is suitably secured to the casing to permit ready removal, when necessary, to service the motor. In axial registration with the opening 24, the rear wall of the casing is provided with an opening 26 which is smaller in diameter than the former opening and is closed by a port plate 27 secured to the rear wall of the casing by headed screws 28. Both the port plate 27 and the cover 25 are provided with ball bearings 29 and 30, respectively, to rotatably receive the drive shaft 31 of the motor. The bearing 29 is received in a central recess 32 formed in the port plate 27 and this bearing is relatively small when compared to the bearing 30 in the cover 25. To hold the latter bearing, the cover 25 is provided with a central boss 33 in which an opening 34 is formed, the bearing being inserted in the opening and held against removal by a snap ring 35. The shaft is prevented from being withdrawn through the bearing 30 through the provision of a shoulder

36 on the shaft which shoulder engages the inner race of the bearing 30 at the outer side of the bearing 30. The shaft 31 is provided with a groove 37 to receive a second snap ring 38 which assists in maintaining the relative positions of the shaft and the bearing. The opening 34 is closed at the outer end by a packing gland 39 which is provided with sealing rings 40 for engagement with the shaft 31 to permit rotation of the shaft without the escape of fluid therearound when the casing is filled with hydraulic fluid.

The bearing 30 will be constantly lubricated by the fluid in the casing and the bearing 29 at the inner end of the shaft will be lubricated by the flow of fluid through angularly related passages 41 which extend from the inner face of the port plate to the inner end of the recess 32. This method of providing for lubrication of the bearing 29 is essential because of the sealing engagement of a cylinder barrel 42 with a circular raised pad on the inner face of the port plate.

The cylinder barrel consists of a cylindrical block 43 having a central opening 44 extending therethrough for the reception of a shaft 31. At its outer end, the cylinder barrel has a splined connection with the shaft 31 in order that when the cylinder barrel revolves, similar movement will be imparted to the shaft, the splines serving to key these two elements to one another.

Around the central opening 44, barrel 42 is provided with a circularly arranged row of cylinders 45 provided for the reception of elongated pistons 46, the latter being closely fitted to the cylinders to reduce the escape of fluid between the walls thereof to a minimum but still permit sliding movement of the pistons in the cylinders. At its rear end, the barrel 43 has arcuate openings 47 which establish communication between the cylinders 45 and inlet and outlet ports 48 and 49, respectively, formed in the port plate 27. The latter ports are also arcuate in shape and extend slightly less than one-half the distance around the port plate, the ends of the inlet and outlet ports being spaced to provide sealing surfaces 50 and 51. These sealing surfaces have a plurality of shallow recesses 51A formed therein to entrap foreign material contained in the hydraulic fluid and prevent the same from injuring the sealing surfaces or other parts of the motor due to abrading action.

The inlet and outlet ports 48 and 49 are connected at their inner ends with chambers 52 and 53 formed in the port plate 27 with which conduits 54 and 55 communicate. These conduits are threaded into a connector plate 56 which is attached to the outer end of the port plate and sealing rings 57 are disposed around the chambers 52 and 53 at the points where the openings in the connector plate meet the chambers. These sealing rings prevent the escape of fluid at the joint between the connector and port plates. When fluid under pressure from any suitable source is introduced into the chamber 52 through the pipe 54, the fluid will flow through the inlet port 48 and into the particular cylinders 45 which are connected to the inlet port by the openings 47. This fluid will force the pistons 46 outwardly of the cylinders causing the outer ends of the pistons to exert pressure on a thrust ring 58 which is supported around the shaft 31 at the outer end of the cylinder barrel.

To support the ring 58, the casing 21 is provided at its sides with registering openings 59 for the reception of bosses 60 provided on plates 61. These bosses are formed with openings to

receive pivot pins 62 which project toward the interior of the casing. The pivot pins are provided with tapped holes at their outer ends to receive screws 62A which extend into the boss 60 from the outer side of the plates 61 and serve to retain the pins in connection with the plates 61 to provide for the pivotal support of a cradle 63. The latter member consists of a ring-like body provided at opposite sides with apertured ears 64 for the reception of the pins 62. When the cradle is disposed in the casing with the pins 62 properly positioned in the openings in the ears 64, the cradle will be free to rock about the axes of the aligned pins. In the present instance, the casing and the plates 61 with the boss 60 are so formed and positioned that the axis formed by the pins 62 will extend at right angles to the shaft 31 and precisely through the longitudinal axis thereof. The cradle is provided with an enlarged ball bearing 65, the outer race 66 of which is carried directly by the cradle 63 and the inner race 67 is supported for rotation by a plurality of balls 68, the inner race in turn supporting the thrust ring 58. Through the provision of the pivoted cradle, the thrust ring may be adjusted relative to the axis of rotation of the cylinder barrel from a position substantially at right angles thereto, as shown in Fig. 1, to inclined positions, as illustrated in Fig. 2. The degree of adjustment of the cradle will depend upon the clearance provided between the cradle and the adjacent parts of the motor. When the cradle is so positioned that the thrust ring is inclined relative to the cylinder barrel and fluid is introduced into the cylinders communicating with the inlet port, the pistons in these cylinders will be urged toward the thrust ring and due to the inclination thereof, a reaction will be set up which will cause the cylinder barrel to rotate in a direction which will permit the pistons to move outwardly of the cylinders as far as possible. In so moving the cylinders will consequently reach the sealing surface 51 which will prevent communication between the inlet port and the respective cylinder, and after each cylinder has passed the surface 51, the cylinder will communicate with the outlet port 49 whereby the fluid will be permitted to escape and relieve the pressure in the cylinder. As one cylinder moves beyond the end of the inlet port 48, another cylinder will be moved into communication therewith and the cycle of operation will be repeated. During the time the cylinders are in communication with the port 49 while the cylinder barrel is revolving, the fluid previously introduced to the cylinders will be expelled because the pistons are moved inwardly of the cylinders by the thrust ring. When the piston in any particular cylinder has been forced into the cylinder as far as possible by the thrust ring, the respective cylinder will have reached the sealing surface 50 which separates the rear end of the outlet port from the forward end of the inlet port and fluid flow from the cylinder will be discontinued. After the surface 50 is passed fluid under pressure will again flow into the cylinder as before described. Continued rotation of the cylinder barrel causes repeated operations of the pistons and the cylinder barrel will be caused to rotate as long as fluid under pressure is supplied to the inlet port and the thrust ring is maintained in an inclined position.

It is proposed to utilize this motor for effecting the operation of any suitable machine such as a lathe, and in some instances, loads applied

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to the machine will increase the resistance to turning movement of the motor shaft. When these conditions obtain, it has been found desirable to increase the inclination of the thrust ring and thereby increase the torque of the motor or if the load on the motor is decreased, the torque should be correspondingly decreased. The thrust ring has been supported within the casing in the manner previously described to permit these adjustments. To effect them automatically, however, additional mechanism has been provided as indicated generally at 69 in Figs. 1 and 2. This mechanism includes a body 70 which is secured to an inclined pad 71 on the rear wall of the casing 21. The body is provided with an internal chamber 72 for the slidable reception of a piston 73. This piston has a stem 74 projecting therefrom through an opening in the body into the interior of the casing 21. At its inner end, this stem engages a roller 75 carried between bifurcated ears 76 on the cradle 63, the roller 75 being rotatably mounted on a pin 77 supported by the ears 76, to eliminate friction between the stem 74 and the cradle during relative movement of these elements. The ears 76 are disposed on the cradle at approximately 90° from the axis formed by the pins 62 and a second set of ears 78 are arranged on the cradle diametrically opposite the ears 76. Ears 78 are spaced to receive a second roller 79 which is engaged by the inner end of a plunger 80 disposed for sliding movement in an opening formed in a body 81. This body is secured to the upper portion of the rear wall of the casing 21 and is provided with a chamber 82 in open communication with the opening in which the plunger 80 slides. The outer end of the chamber 82 is closed by a plug 83 which also serves as an abutment for one end of spring 84, the opposite end of this member engaging the outer end of the plunger 80. Due to the resiliency of the spring 84, the plunger 80 will be urged into yieldable engagement with the roller 79 and will tend to maintain the cradle 63 in a position at right angles to the axis of rotation of the shaft 31. To assist the spring 84 in moving the plunger 80 and the cradle 63, the body 81 is provided with an opening 85 through which fluid under pressure is supplied to the chamber 82. This fluid enters the chamber through an elbow 86 threaded into the opening 85 and connected to one end of a tube 87 which receives hydraulic fluid under pressure from the inlet of the motor.

To move the cradle against the force of the spring 84 and the fluid supplied to the chamber 82, means are provided to supply fluid under pressure to one end of the chamber 72. This means comprises an elbow 89 which is threaded into the body 70 and communicates with a drilled opening 89 extending from the opening for the elbow to the outer end of the chamber 72. A section of tubing 90 is connected at one end to the elbow 88 and at the other end to a fitting 91 threaded into the port plate as at 92. A short passage 93 leads from the inner end of the fitting 91 to the chamber 52 which is connected with the inlet port 48 and the source of fluid under pressure. Thus, when fluid is initially supplied to the pump, some thereof will flow through the passage 93 and tubing 90 to the elbow 88 and through the opening 89 to the chamber 72. This fluid will exert pressure on the outer side of the piston 73 and tend to move the same toward the motor casing. Some of the fluid will flow through a restricted orifice 94 provided in the

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piston 73, to the opposite end of the chamber 72. This end of the chamber is connected by a series of passages 95, 96 and 97 with the interior of the casing 21. Under normal conditions, fluid flow through this series of passages is precluded by a relief valve 98 disposed in a chamber 99 formed in the body 70 between the passages 95 and 96. Since fluid is contained by the chamber 72 on both sides of the piston 73 and the valve 98 is closed, pressure on opposite sides of the piston will be equalized and piston 73 will remain stationary. The valve 98 includes a seat 100 and a conical valve 101, the latter being carried by a head 102 disposed for sliding movement in the chamber 99. Valve seat 100 is arranged in the chamber 99 between the points where passages 95 and 96 communicate therewith and the valve 101 is held in engagement with the seat 100 to normally prevent communication between the passages 95 and 96, by a coil spring 103 which engages the head 102 at one end and an adapter 104 at the other end. The degree of force exerted by the spring on the head and valve may be varied through the adjustment of screw 105 carried by a plug 106 which closes the outer end of the chamber 99. The inner end of the screw 105 has a conical point for engagement in a similarly shaped recess in the adapter. When the screw 105 is adjusted inwardly, the force exerted by the spring on the valve will be increased and, conversely, if the screw is adjusted outwardly, the spring will exert less force on the valve. The screw is maintained in its positions of adjustment by a jam nut 107. To prevent the escape of fluid around the screw, a flexible seal 108 is positioned between the inner end of the plug 106 and the movable head 102. When the pressure on the fluid in the chamber 72 increases sufficiently to overcome the force exerted by the spring 103, the fluid will flow past the valve 101 and through ports 96 and 97 to the interior of the casing 21. This flow will permit fluid to escape from the inner end of the chamber 72 and if the rate of flow is greater than the rate at which fluid can flow through the orifice 94 the piston will be moved inwardly or toward the casing by the fluid pressure on the outer side of the piston. This movement will be transmitted to the cradle by the stem 74 and the cradle will be rocked about the pins 62 to an inclined position, as shown in Fig. 2, and the torque of the motor will be increased. The movement of the cradle will be discontinued when the piston 73 reaches the limit of its travel or the fluid pressures on opposite sides of the piston became balanced due to the restriction of fluid flow through the passages 95, 96 and 97 by the valve 101. When the latter condition occurs, the force exerted by spring 84 and the fluid in chamber 82 will tend to move the cradle towards its inactive position, shown in Fig. 1, and this movement will cause the piston 73 to move toward the outer end of chamber 72. The rate of movement of the piston in this direction will be controlled by the speed at which fluid can flow through the orifice 94.

In some instances, it may be desirable to limit the degree of movement of the cradle toward the position wherein the thrust ring will be at right angles to the axis of the shaft 31. To accomplish this object, a stem 109 is provided on the outer side of the piston 73. This stem extends into an opening formed in the cap 110 for the body 70 and engages the inner end of a threaded stop screw 111, the head of which is also

disposed in the opening. The longitudinal position of the stop screw in the opening may be changed by adjusting a hand wheel 112 which is rotatably supported at the outer end of the body 70. This hand wheel is keyed at 113 to a sleeve 114 which is interiorly threaded for the reception of stop screw 111. One end of the sleeve is provided with a flange 115 to form a shoulder 116 with which a complemental shoulder provided in a retaining nut 117 is engaged. The nut 117 is interiorly threaded so that it may be applied to the threaded reduced outer end of the cap 110. When the nut 117 is so positioned, the end of the sleeve 114 will be held in abutting relation with the end of the cap through the engagement of the shoulders on the sleeve and in the nut. As illustrated in Figs. 1 and 2, the opening for the stem 109 has a keyway for the reception of a key 118 carried by the head of the screw 111. This key prevents the screw from rotating and when the hand wheel 112 is revolved, the reaction between the threads in the sleeve 114 and on the screw 111 will cause the latter to move into or out of the opening of the cap 110. The degree of movement may be determined by comparing the relative position of the annular marks on the outer end of the screw with the outer end of the sleeve. When it is desired to make this adjustment, the nut 117 is turned sufficiently to free the flange 115 and permit the hand wheel and sleeve to rotate. After the screw has been placed in the desired position, the nut 117 is tightened to clamp the flange 115 and maintain the adjustment. Packing 119 is provided around the stem 109 to prevent the escape of fluid from the chamber 72.

The operation of the device is as follows: Assuming that the system in which the motor is connected is charged with hydraulic fluid; upon the introduction of fluid under pressure to the motor through the line 54, the fluid will flow through the inlet port 48 into the cylinders communicating therewith. The pressure of the fluid on the pistons will force the same outwardly against the thrust ring. If the thrust ring is at right angles to the axis of the shaft 31, the cylinder barrel will not revolve and the motor shaft will stand idle. The pressure will therefore increase in the line 54 and chamber 52 as well as in tubing 90 and the outer end of chamber 72. The pressure on the fluid will also be exerted by the piston 73 on the fluid in the inner end of chamber 72, and will be transmitted through the passage 95 to the inlet side of relief valve 98. When this pressure is of sufficient intensity to overcome the force of spring 103, the valve will open to permit fluid to escape from the inner end of the chamber and a differential in pressure will exist on opposite sides of piston 73, the higher pressure being on the outer side thereof. Due to this difference in pressure, the piston will move toward the motor casing 21 causing the stem 74 to impart movement to the cradle and the thrust ring will then be inclined with respect to the cylinder barrel. When this condition obtains the force of the pistons against the thrust ring reacts to cause the cylinder barrel to revolve. After the cylinder barrel gains some momentum and the resistance to rotation has decreased, the pressure on the fluid in the chamber 72 will be relieved and valve 98 will close to such an extent that the flow of fluid through the restricted orifice 94 will be sufficient to balance the pressure on opposite sides of the piston 73. At this time, the force of the spring 84 and

the fluid supplied to chamber 82 will move the plunger 80 into the casing and transmit force to the cradle causing it to move in the opposite direction. This movement will be transmitted to the stem 74 and piston 73 whereby the latter will move toward the outer end of the chamber 72. As the thrust ring approaches a position at right angles to the shaft 31, the resistance to the flow of fluid through the motor will again increase and the cycle of operation will be repeated. The apparatus will finally reach a balanced condition wherein the thrust ring is maintained at the properly inclined position to cause the motor to develop the required power but in the event an undue load is placed on the motor, the pressure of the incoming fluid will again be increased causing the automatic control mechanism to operate to again increase the angularity of the thrust ring. Thus the torque of the motor will be increased as occasion demands. When the relief valve 98 operates to permit fluid to flow from the passage 95 to passage 96, this fluid will flow through passage 97 into the motor casing. It will escape from this casing through a conduit 120 at the top of the motor to the outlet chamber 53 with which the conduit 120 is connected.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

I claim:

1. A fluid motor actuated by fluid pressure comprising a casing having inlet and outlet ports; shaft means journaled in said casing; a barrel having a plurality of cylinders for imparting rotation to said shaft means, said cylinders communicating alternately with said inlet and outlet ports upon rotation of said cylinder barrel; piston means disposed for movement in said cylinders; thrust means mounted in said casing in engagement with said piston means, said thrust means being disposed at an angle with respect to axis of said shaft; and means for varying the angle of said thrust means including a body having a chamber, a piston disposed for movement in said chamber, means for transmitting movement from said piston to said thrust means, fluid conducting means establishing communication between said inlet port and one end of said chamber and the opposite end of the chamber and said outlet port, said piston having a restricted orifice establishing communication between opposite ends of said chamber, and a pressure operated valve located between said chamber and said outlet port, said valve being operative under predetermined fluid pressure to establish fluid flow from said chamber.

2. A fluid motor actuated by fluid pressure comprising a casing having inlet and outlet ports; shaft means journaled in said casing; a barrel having a plurality of cylinders for imparting rotation to said shaft means; said cylinders communicating alternately with said inlet and outlet ports upon rotation of said cylinder barrel; piston means disposed for movement in said cylinders, a cradle mounted in said casing for pivotal movement about an axis extending at right angles to and through the axis of rotation of said shaft means, thrust means carried by said cradle in engagement with said pistons; and means for moving said cradle about the axis therefor, said cradle moving means having a body with a chamber, a piston mounted for movement in said

chamber, means for transmitting movement from said piston to said cradle, fluid conducting means establishing communication between the inlet to said casing and one end of the chamber in said body, means for conducting fluid from the opposite end of the chamber, said piston having an orifice to establish restricted communication between opposite ends of the chamber in said body and a spring-pressed valve in said latter fluid conducting means, said spring pressed valve being responsive to pressures in the chamber in said body to provide for fluid flow from said chamber whereby pressure differentials will exist on opposite sides of said piston and the latter will move in response to the higher pressure.

3. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports; piston means disposed for movement in said cylinders; thrust means engaging said pistons; means in said casing supporting said thrust means for movement to vary the angular relation thereof to said pistons; and means for automatically controlling the angularity of said thrust means in response to pressure variations in said inlet port, said control means having a body with a cylinder therein; control piston means dividing said cylinder into a pair of chambers having limited communication with one another; means transmitting movement from said piston means to said thrust means; means connecting one of said chambers with the port having the variable pressures; passage means connecting the other chamber with a low pressure line; and means responsive to the pressures in said inlet port to control fluid flow through said last mentioned passage means.

4. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports, piston means disposed for movement in said cylinders; thrust means engaging said pistons; means in said casing supporting said thrust means for movement to vary the angular relation thereof to said pistons, and means for automatically controlling the angularity of said thrust means in response to pressure variations in said inlet port, said control means having a body with a cylinder therein; control piston means dividing said cylinder into a pair of chambers having limited communication with one another; means transmitting movement from said piston means to said thrust means; a fluid passage connecting one of said chambers with the port having the variable pressures whereby increasing pressure will cause said piston to move said thrust means to vary the angularity thereof relative to the pistons in said cylinder barrel; a second fluid passage connecting the other of said chambers with a low pressure line; and valve means for controlling fluid flow through the second fluid passage, said valve being responsive to variations in pressure in the chamber connected with said passage.

5. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports, piston means disposed for movement in said cylinders; thrust means engaging said pistons;

means in said casing supporting said thrust means for movement to vary the angular relation thereof to said pistons, and means for automatically controlling the angularity of said thrust means in response to pressure variations in said inlet port, said control means having a body with a cylinder therein; control piston means dividing said cylinder into a pair of chambers, said control piston being provided with a reduced orifice to establish limited communication between said chambers; means for supplying fluid at the pressure in said inlet port to one of said chambers; and pressure responsive means to control fluid flow from the other of said chambers whereby pressure differentials will occur on opposite sides of said control piston to cause movement thereof.

6. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports, piston means disposed for movement in said cylinders; thrust means engaging said pistons; means in said casing supporting said thrust means for movement to vary the angular relation thereof to said pistons, and means for automatically controlling the angularity of said thrust means in response to pressure variations in said inlet port, said control means having a body with a cylinder therein; control piston means dividing said cylinder into a pair of chambers, said control piston being provided with a reduced orifice to establish limited communication between said chambers; means for supplying fluid at the pressure in said inlet port to one of said chambers; pressure responsive means to control fluid flow from the other of said chambers whereby pressure differentials will occur on opposite sides of said control piston to cause movement thereof; and means for varying the sensitivity of said pressure responsive means.

7. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports, piston means disposed for movement in said cylinders; thrust means engaging said pistons; means in said casing supporting said thrust means for movement to vary the angular relation thereof to said pistons, and means for automatically controlling the angularity of said thrust means in response to pressure variations in said inlet port, said control means having a body with a cylinder therein; control piston means dividing said cylinder into a pair of chambers, said control piston being provided with a reduced orifice to establish limited communication between said chambers; means for supplying fluid at the pressure in said inlet port to one of said chambers; pressure responsive means to control fluid flow from the other of said chambers whereby pressure differentials will occur on opposite sides of said control piston to cause movement thereof; and means for limiting the range of operation of said control piston.

8. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports, piston means disposed for movement in said cylinders; thrust means engaging said pistons; means in said casing supporting said thrust means for movement to vary the angular relation thereof

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to said pistons, and means for automatically controlling the angularity of said thrust means in response to pressure variations in said inlet port, said control means having a body with a cylinder therein; control piston means dividing said cylinder into a pair of chambers, said control piston being provided with a reduced orifice to establish limited communication between said chambers; means for supplying fluid at the pressure in said inlet port to one of said chambers; pressure responsive means to control fluid flow from the other of said chambers whereby pressure differentials will occur on opposite sides of said control piston to cause movement thereof; and means for varying the minimum torque developed by said motor at a particular fluid pressure.

9. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports, piston means disposed for movement in said cylinders; thrust means engaging said pistons; means in said casing supporting said thrust means for movement to vary the angular relation thereof to said pistons; and means for automatically controlling the angularity of said thrust means in response to pressure variations in said inlet port, said control means having a passage extending from said inlet port to an outlet; a cylinder in said passage; control piston means dividing said cylinder into chambers, a passage establishing limited communication between said chambers; said control piston being movable in response to pressure differentials in said chambers; means for transmitting movement of said piston to said thrust means; and pressure responsive means in said passage between said cylinder and said outlet to control fluid flow from said cylinder, an increase in pressure in said cylinder beyond a predetermined degree serving to increase the flow of fluid from said cylinder to create a differential in pressure in said chambers.

10. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports, piston means disposed for movement in said cylinders; thrust means engaging said pistons; means in said casing supporting said thrust means for movement to vary the angular relation thereof

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to said pistons; and means for automatically controlling the angularity of said thrust means in response to pressure variations in said inlet port, said control means having a passage extending from the inlet port to an outlet; a cylinder in said passage; control piston means dividing said cylinder into chambers, a passage of predetermined size establishing limited communication between said chambers; said control piston being movable in response to pressure differentials in said chambers; means for transmitting movement of said piston to said thrust means; valve means in said passage between said cylinder and said outlet, said valve being responsive to pressures above a predetermined degree to increase fluid flow from said cylinder; and means for varying the degree of pressure at which said valve becomes operative.

11. A motor actuated by fluid pressure comprising a casing having inlet and outlet ports; a cylinder barrel supported for rotation in said casing with the cylinders thereof alternately communicating with said inlet and outlet ports, piston means disposed for movement in said cylinders; thrust means engaging said pistons; means in said casing supporting said thrust means for movement to vary the angular relation thereof to said pistons; resilient means tending to urge said thrust means toward an inactive position; means for urging said thrust means toward active position in opposition to said resilient means, said second urging means having a cylinder; a piston disposed for movement in said cylinder in response to pressure differentials obtaining in opposite ends of said cylinder, said piston being returned to normal position by said resilient means when pressures are equalized in opposite ends of said cylinder; means for transmitting motion from said piston to said thrust means; and means for creating pressure differentials in opposite ends of said cylinder having a fluid passage connecting one end of said cylinder and the inlet port of said motor; a second fluid passage extending from the opposite end of said cylinder to the outlet port, the ends of said cylinder being in limited communication; and pressure responsive valve means in said second fluid passage, said valve means regulating fluid flow through said second passage in proportion to the pressures existing in the end of said cylinder connected with said second passage.

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