Feb. 16, 1932. W. FERRIS 1,845,257

HYDRAULIC MOTOR

Filed March 24, 1924 2 Sheets-Sheet 1

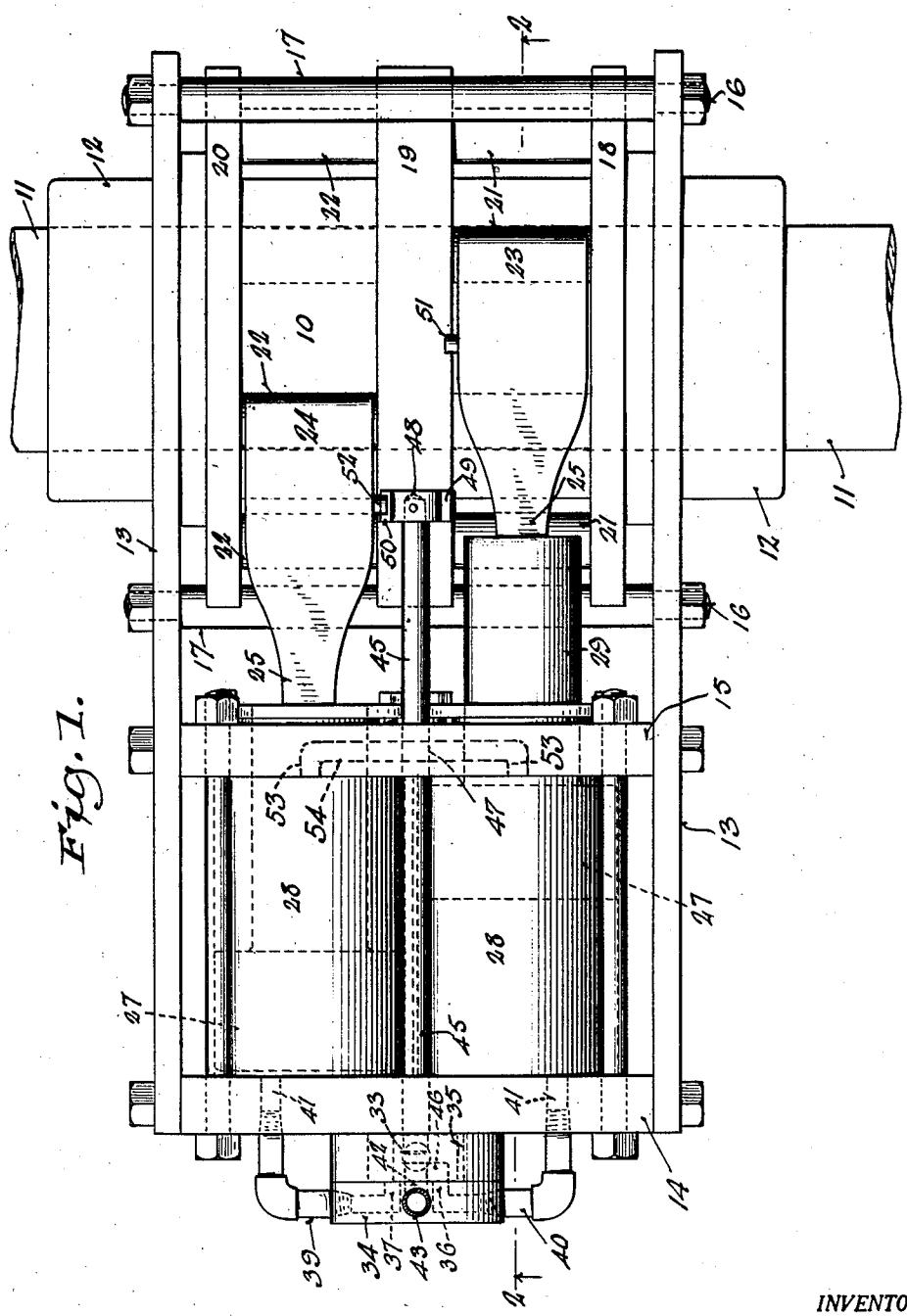


Fig. 1.

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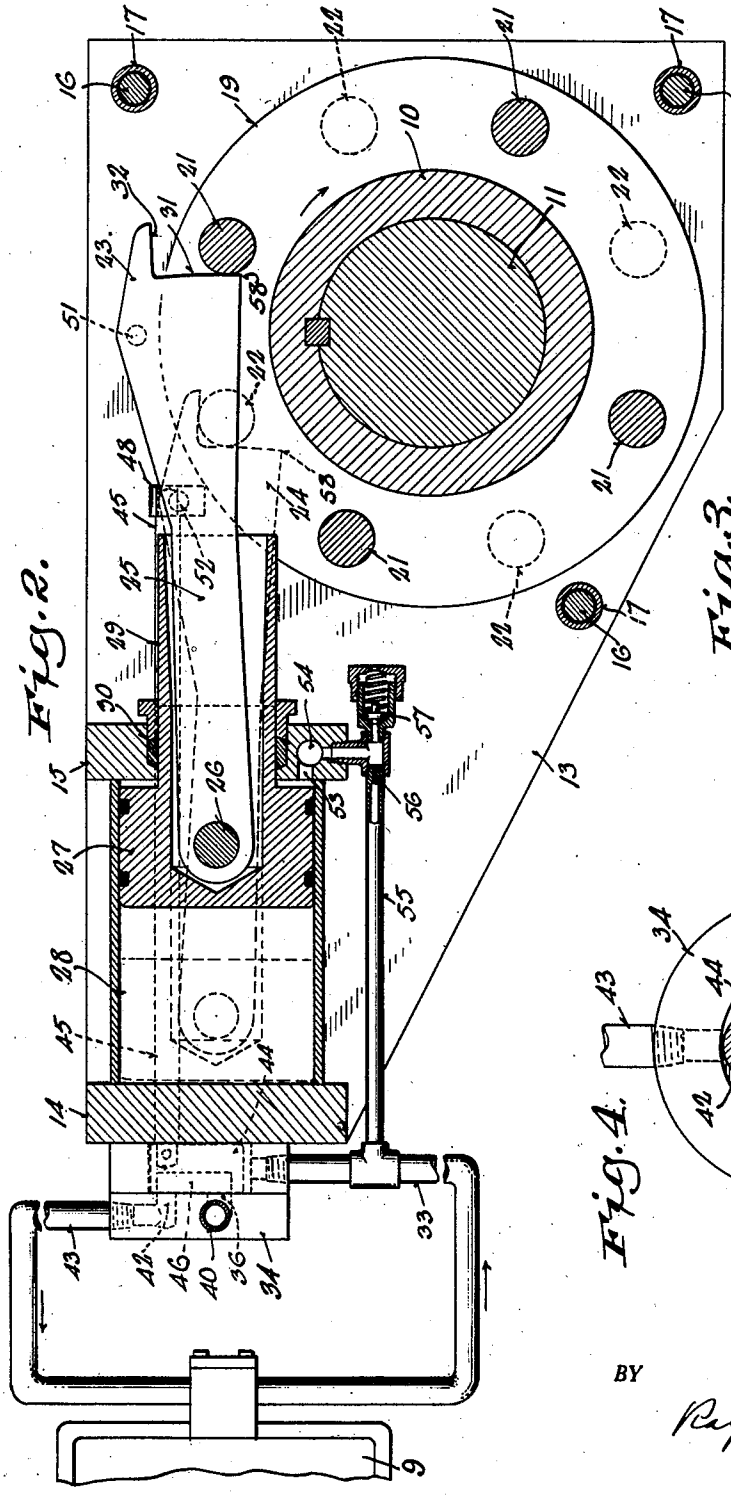


Fig. 2.

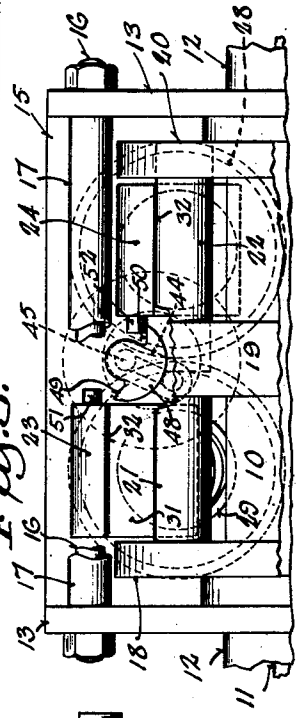


Fig. 3.

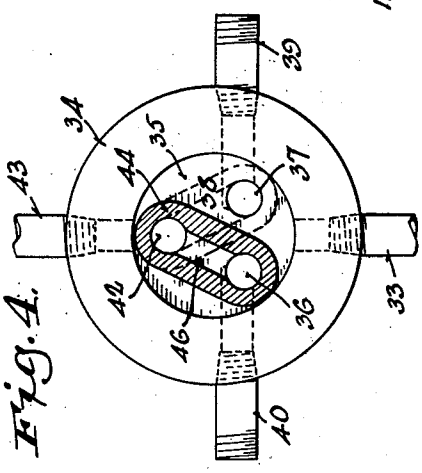


Fig. 4.

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UNITED STATES PATENT OFFICE

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HYDRAULIC MOTOR

Application filed March 24, 1924. Serial No. 701,355.

This invention relates to hydraulic motors.

The motors commonly employed in hydraulic transmissions are essentially high speed motors, their practical application in some instances being rendered possible only by the use of appropriate speed reduction gearing between the motor and driven part. Such motors are not, therefore, well suited for driving endless conveyors, hoists and the like, wherein the driven part is ordinarily a slow speed rotary element.

One object of the present invention is the provision of a slow speed motor well adapted for the purposes above mentioned.

Another object is the provision of a ratchet motor for converting hydraulic power into slow rotary motion.

Other objects and advantages will appear from the following description of an illustrative embodiment of the present invention.

In the drawings:

Figure 1 is a plan view of a ratchet motor constructed in accordance with the present invention.

Figure 2 is a sectional view taken substantially on the line 2—2 of Figure 1.

Figure 3 is an end elevation of the driving dogs and operating mechanism therefor.

Figure 4 is a sectional view of a valve mechanism employed.

The motor shown comprises a drum 10 keyed to a driven shaft 11 journaled in fixed bearings 12, integrally formed upon the side plates 13 of the main frame. The side plates 13 are rigidly connected by flat transverse bars 14 and 15 and by rods 16 extending through spacer tubes 17 between the plates. The drum carries three disks 18, 19 and 20 secured thereto. A circular series of round ratchet bars 21 are secured to and extend between the disks 18 and 19 in a direction parallel to the axis of rotation of the drum and a corresponding series of similar bars 22 are secured to and extend between the disks 19 and 20. The bars of each series are equally spaced and disposed intermediate the bars of the other series. The drum is actuated by a pair of dogs 23 and 24, each cooperating with one of said series of ratchet bars and operating alternately to effect a substantially continuous rotation of the drum.

The dogs shown are substantially identical. Each comprises a shank 25 mounted at one end upon a horizontal pivot 26 fixed in a piston 27. Each piston reciprocates in a horizontal cylinder 28 so disposed that the axis of reciprocation is substantially tangential to the circular series of bars 21 or 22. In the motor shown, the transverse bars 14 and 15 of the main frame constitute end heads for the cylinders 28. The pistons 27 are each provided with a hollow extension 29 reciprocable through an appropriate packing 30 in the transverse bar 15 and constituting a housing for the shank 25 of the associated dog. Each dog is further provided with a pressure transmitting face 31 curved substantially concentrically with respect to the axis of the pivot 26 and adapted for engagement successively with the ratchet bars 21 or 22 of one series. A lip 32 on each dog cooperates with successive bars of the series to limit the downward movement of the dog.

The motor shown is driven by fluid received through a supply pipe 33, preferably from a variable displacement pump 9 of any well known or approved design. The pump shown is fully described in my prior Patent No. 1,578,233 issued March 23, 1926. An appropriate control valve is interposed between the supply pipe and motor to effect the admission of fluid to the cylinders 28 alternately. In this instance, this valve for this purpose comprises a casing 34 having a chamber 35 therein in constant communication with the supply pipe 33. Two ports 36 and 37 in one wall 38 of the casing communicate through pipes 40 and 39, respectively, with ports 41 in the adjacent ends of the cylinders 28. A third port 42 in the wall 38 communicates with a discharge pipe 43. Port 42 is covered at all times by the upper end of a valve 44 fixed upon one end of a rock shaft 45, so as to oscillate over the face of wall 38 in such manner that the lower end of the valve may be made to cover either of the ports 36 or 37. A passage 46 in the valve communicates at all times with the port 42 and, by oscillating the valve, may be made

to communicate with either of the ports 36 or 37. The rock shaft 45 extends forwardly through a fixed bearing 47 and at its forward end carries a rocker element 48 fixed thereto and provided with shoulders 49 and 50 adapted for engagement with the pins 51 or 52, respectively, carried by the dogs 23 and 24, in a manner which will be hereinafter described.

The forward ends of the cylinder are provided with ports 53 in constant communication through a passage 54 in bar 15, through which fluid discharged from the forward end of one cylinder is delivered into the forward end of the other. To insure that the forward ends of the two cylinders are maintained flooded against leakage losses, the passage 54 is preferably connected with the supply pipe 33 through a pipe 55 and restricted passage 56, a pressure relief valve 57 of any well known type being provided in connection with the passage 54 to maintain the pressure therein and in the forward ends of the cylinders below a predetermined maximum.

For purposes of describing the operation, let it be assumed that the drum 10 is being rotated in a clockwise direction, as indicated by the arrow in Figure 2, and that the dog 23 has just arrived at the end of its working stroke. The other dog 24, at the end of its return stroke, has dropped down behind the bar 22, and in so doing the pin 52 carried thereby, by its engagement with the shoulder 50 on the rocker element 48, has rocked the shaft 45 and valve 44 to the full line position of Figure 4 so as to uncover the port 37 and effect communication between the port 36 and discharge port 42. Fluid pressure is thus transmitted from the supply pipe 33, through the port 37 and pipe 39, to the cylinder 28, and applied to the piston to force the dog 24 against the bar 22. As the dog 24 advances on its working stroke, the drum is rotated correspondingly and the consequent rolling action between the face 31 of the dog and the bar 22 causes the dog to rise until at the end of its working stroke it assumes the same position as that assumed by dog 23 in Figure 2.

In the meantime, the fluid displaced from the forward end of one cylinder as the dog 24 and its piston advances, is forced through passage 54 into the forward end of the other cylinder, thereby causing the dog 23 and its piston to travel rearwardly on a return stroke at a rate substantially equal to the rate of advance of the other dog. During the return stroke of the dog 23 it is engaged and lifted by the next upwardly advancing bar 21 and retained thereby in elevated position until this bar has passed beyond the shoulder 58 on the dog 23. When this position is attained, by the retraction of the dog and by the continued rotation of the drum, this dog then drops into the position corresponding to that assumed by dog 24 in Figure 2 with the face 31 thereof in driving contact with the advancing bar 21. As the dog 23 drops into this position the pin 51 thereon strikes the shoulder 49 on the rocker element 48 and the valve 44 is instantly shifted from the full line position to the dotted line position shown in Figure 4.

This action of the valve opens communication between the supply pipe 33 and the port 36 so that fluid under pressure is delivered through pipe 40 to the rear end of that cylinder 28 which actuates the dog 23. The dog 23 thus begins its working stroke driving the bar 21 so as to effect continued rotation of the drum. This action of the valve also opens communication between the pipe 39 of the other cylinder 28 and the discharge pipe 43 through the ports 42 and 37 and the passage 46 in the valve, permitting the dog 24 to begin its return stroke under the pressure of fluid delivered to the forward end of its actuating cylinder 28 from the forward end of the other cylinder through the passage 54. Dog 24 continues its return stroke, during the advance of dog 23, withdrawing from driving engagement with one of the bars 22 and being retained in elevated position by the next upwardly advancing bar 22 until this bar has passed the shoulder 58 on the dog 24 permitting this dog to drop into the position of Figure 2. As the dog drops into driving engagement with the bar 22, the pin 52 on the dog actuates the rocker element 48 so as to return the valve to the full line position of Figure 2 in the manner above described.

It will thus be noted that the dogs 23 and 24 are individually driven by hydraulic motors of the piston and cylinder type whose forward ends are hydraulically connected through the passage 54. To insure coordination between these motors provision is preferably made for returning each piston to a definite position before the other piston has reached the end of its forward stroke. In this instance each piston is returned the full limit of its stroke, or in other words, until it strikes the bar 14, constituting the end head of the cylinders. This is accomplished by making the restricted passage 56 of such capacity that the liquid supplied from pipe 55 to passage 54 is always somewhat in excess of that required to compensate for leakage losses. This excess of fluid supplied to passage 54 will always insure the return of each dog into its fully retracted position where it may drop into driving engagement with the next advancing bar, the instant that the drum has been rotated sufficiently by the other dog. The relief valve 57 permits the escape of liquid that may be necessary to permit the other dog to continue its advance after the first dog has reached its fully retracted position.

Various changes may be made in the em-

bodiment of the invention, without departing from or sacrificing any of the advantages of the invention as defined by the appended claims.

I claim:

1. A reciprocating drive mechanism comprising a pair of cylinders, a piston in each cylinder, means for delivering a driving fluid into one end of each of said cylinders alternately to drive said pistons in one direction, means for driving said pistons in the opposite direction including a communication between the other ends of said cylinders, and means for maintaining said communication flooded against leakage losses.

2. A reciprocating drive mechanism comprising a pair of cylinders, a piston in each cylinder, fluid supply means, means for effecting communication between said supply means and one end of each of said cylinders alternately, a fluid passage between the other ends of said cylinders, a restricted communication between said fluid supply means and said passage, and a pressure relief valve associated with said passage.

3. In a motor the combination of a drum having a circular series of curved pressure receiving faces, a pair of driving dogs each having a driving face for rolling contact with said pressure receiving faces, successively, a pivotal support for each dog, and means for reciprocating said supports along an axis substantially tangential to said circular series of faces.

4. In a motor the combination of a drum having a circular series of curved pressure receiving faces, a pair of fluid actuated means reciprocating along an axis substantially tangential to said circular series of faces, and a pair of dogs each rockably connected with one of said reciprocating means and having a driving face for rolling contact with said pressure receiving faces, successively.

5. In a motor the combination of a drum having a circular series of curved pressure receiving faces, a pair of dogs each having a driving face for rolling contact with said pressure receiving faces, successively, a piston and cylinder for driving each dog in a direction substantially tangential to said circular series of faces, and means for delivering a driving liquid to said cylinders alternately.

6. In a power transmitting device the combination of a driven rotary member having two circular series of driving elements thereon, a pair of dogs reciprocable substantially tangentially of said circular series of elements and each engageable successively with the elements of one series to drive said member, a pair of motor cylinders each for driving one of said dogs, a hydraulic pump, means for directing the liquid discharged from said pump alternately to each of said cylinders to the exclusion of the other to thereby drive said dogs alternately at a predetermined rate in one direction, and means for driving each dog in the opposite direction during movement of the other dog in the direction first named.

7. In a power transmitting device the combination of a driven rotary member having two circular series of driving elements thereon, a pair of dogs reciprocable substantially tangentially of said circular series of elements and each engageable successively with the elements of one series to drive said member, a pair of motor cylinders each for driving one of said dogs, a hydraulic pump, means for directing the liquid discharged from said pump alternately to one end of each of said cylinders to the exclusion of the other to thereby drive said dogs alternately at a predetermined rate in one direction, and a communication between the other ends of said cylinders through which said cylinders are alternately energized to drive each dog in the opposite direction during movement of the other dog in the direction first named.

8. In a power transmitting device the combination of a driven rotary member having two circular series of driving elements thereon, a pair of dogs reciprocable tangentially of said series of elements and each coacting with the elements of one series to drive said member, a separate motor cylinder for reciprocating each dog to effect a working stroke and a return stroke, each dog being rockable into driving engagement with successive elements of said series at the end of each return stroke thereof, a hydraulic pump, means responsive to the rocking action of each dog at the end of each return stroke thereof for directing the liquid discharged from said pump to one end of its driving motor cylinder to thereby effect a working stroke thereof, and a communication between the other ends of said motor cylinders through which each is energized to effect a return stroke of each dog during the working stroke of the other dog.

9. In a power transmitting device the combination of a driven rotary member having two circular series of driving elements thereon, a pair of dogs reciprocable substantially tangentially of said circular series of elements and each coacting with the elements of one series to drive said member, a motor cylinder for reciprocating each dog to effect a working stroke and a return stroke thereof, each dog being rockable into driving engagement with successive elements of said series at the end of each return stroke thereof, a hydraulic pump, a valve operable to direct liquid from said pump to said motor cylinders alternately to thereby cause said dogs to execute a working stroke alternately, means for causing each dog to effect a re-

turn stroke during the working stroke of the other dog, and means responsive to the rocking action of each dog at the end of the return stroke thereof for operating said valve.

In witness whereof, I hereunto subscribe my name this 1st day of February, 1924.

WALTER FERRIS.