

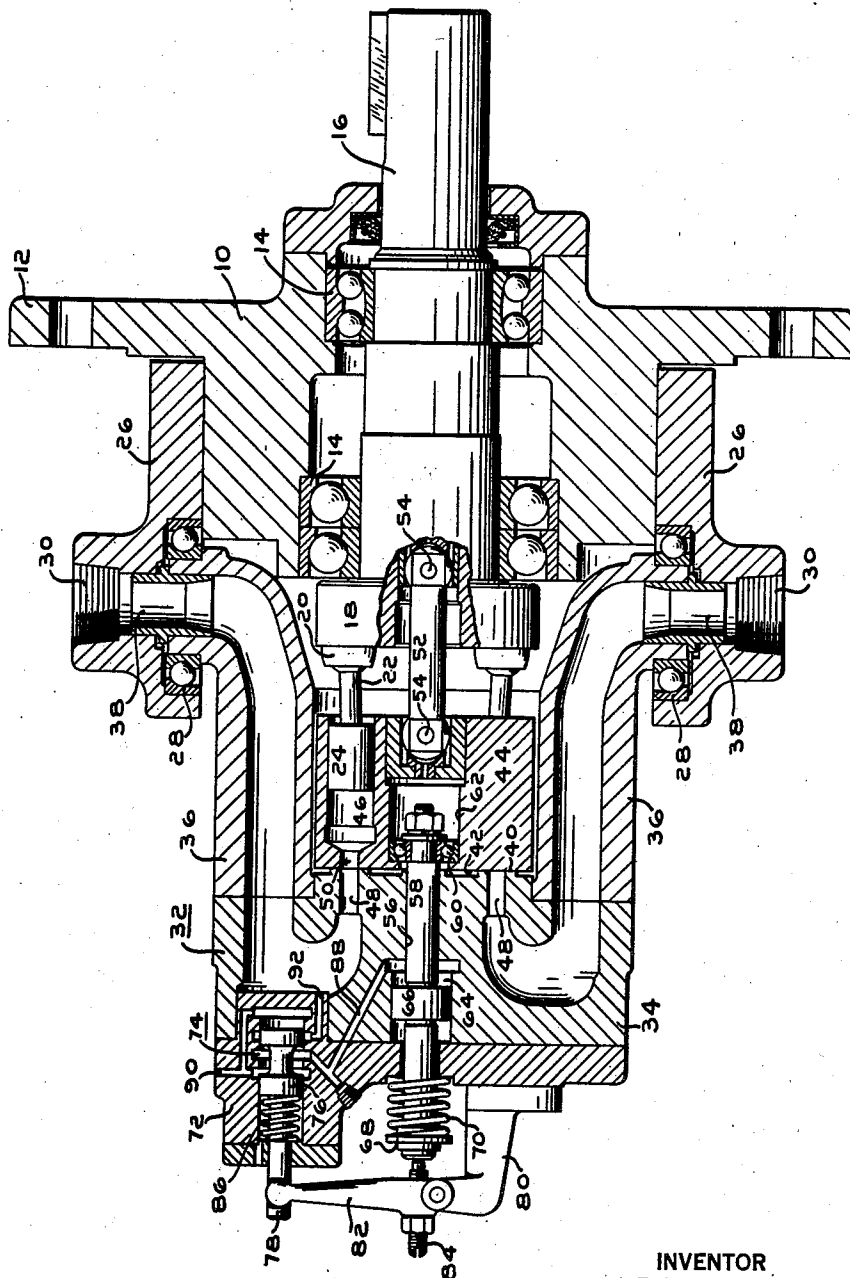
May 26, 1942.

K. R. HERMAN

2,284,146

HYDRAULIC PUMP OR MOTOR

Filed June 28, 1939



INVENTOR
KENNETH R. HERMAN

BY *Carl L. Tweedale*
ATTORNEY

UNITED STATES PATENT OFFICE

2,284,146

HYDRAULIC PUMP OR MOTOR

Kenneth R. Herman, Detroit, Mich., assignor to
Vickers Incorporated, Detroit, Mich., a corporation of Michigan

Application June 28, 1939, Serial No. 281,583

2 Claims. (Cl. 103-162)

This invention relates to power transmissions and more particularly to those of the type comprising two or more fluid pressure energy translating devices, one of which may function as a pump and another as a fluid motor. In such devices of the type which comprise a revolving cylinder barrel having a plurality of parallel cylinder bores therein within which pistons are reciprocated by a swash plate device, it is customary to provide a rotary valving mechanism which is operated by the rotation of the cylinder barrel itself for the purpose of alternately connecting each cylinder bore with the inlet and outlet passages of the device. Many machines of this character utilize a plate type valve formed by a flat surface of the cylinder barrel which runs in abutting and in fluid sealing relationship on a stationary flat valve plate. The plate type valve may be so constructed that the cylinder barrel is constantly pressed into engagement with the valve plate so that the clearance at the valve is automatically adjusted to take care of variations in oil viscosity and to compensate for wear. This is a distinct advantage and contributes much to the reliability and long life of machines employing a valve of this character.

It is customary with machines of this character to so proportion the size of the distributing ports in the end face of the cylinder barrel relative to the piston area and to the area of the annular surface of contact with the valve plate as to provide approximate hydraulic balance between the fluid pressure forces exerted by piston reaction on the end faces of the cylinder bores and the fluid pressure separating forces exerted in the oil film between the cylinder barrel and valve plate. It is, of course, impossible in practice to provide an exact balance between these forces, and since it is necessary to provide some means for holding the barrel in contact with the valve plate while the machine is idle, a spring or other resilient means is usually provided for urging the barrel into contact with the valve plate with a relatively light force at all times.

It is extremely difficult to predetermine with precision the exact amount of hydraulic unbalance which will exist in a given machine since small variations in dimensions which are entirely within normal manufacturing tolerances produce large changes in the hydraulic balance when the operating pressures are high. If the net unbalance is in a direction holding the barrel in contact and is very large, then the unit bearing pressures at the valve plate are apt to be excessive. On the other hand, if the machine is

designed for a very small net unbalance it occasionally happens, due to manufacturing variations, that the net unbalance of the hydraulic forces on the barrel is in a direction tending to lift the barrel off from the valve plate, and in such cases the spring is sufficient to maintain the barrel in contact with the valve plate at all operating pressures below a certain maximum. When this maximum is exceeded, however, the barrel lifts away from the valve plate, and since the valve is thereby rendered ineffective, the power drive through the transmission is completely and suddenly interrupted. This difficulty can be extremely troublesome at times, particularly where the transmission is used to operate a device, such as a hoist, which has to overcome a gravity load and in which complete dependence upon the transmission is placed for sustaining that load. In such cases it occasionally happens that the critical pressure at which the barrel will blow off is slightly above the normal operating pressure required for lifting the usual loads and that on rare occasions, due to snagging of hoisting lines or some other momentary small overload during hoisting, the critical pressure is exceeded causing the barrel to lift and resulting in dropping of the load with consequent damage thereto.

It is an object of the present invention to provide a valve plate construction for a fluid pressure energy translating device of the class described in which the above problems are avoided by the provision of means for exerting an increased force on the cylinder barrel tending to hold the barrel on the valve plate which is brought into action automatically as required whenever the sum of the hydraulic balancing force and the spring force is insufficient to hold the barrel in position.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of the present invention is clearly shown.

In the drawing the single figure is longitudinal cross section of a fluid pressure energy translating device incorporating a preferred form of the present invention.

The embodiment of the invention selected for illustration comprises a pump of the same general class as that illustrated in the patent to Hans Thoma, No. 1,931,969, and comprises generally a main ring-like frame member 10 having a mounting flange 12 thereon and provided with bearings 14 on which a main shaft 16 is jour-

nalled. The shaft 16 is provided with a socket flange 18 carrying a plurality of ball sockets 20 in which are mounted ball-ended, connecting rods 22 carrying reciprocating pistons 24.

Rigidly secured to the frame member 10 by suitable bolts not shown are a pair of plates 26 provided with bearings 28 and with fluid connections 30. Journalled on the bearings 28 is a swinging yoke generally designated as 32 comprising a valve plate 34 with rigidly attached hollow arms 36 providing trunnions for the yoke and connected to the fluid connection 30 by sealing sleeves 38.

The valve plate 34 is provided with an arcuate raised sealing surface 40 against which runs the flat end face 42 of a cylinder barrel 44 provided with a plurality of cylinder bores 46 therein. Formed in the valve plate 34 are two arcuate fluid distributing ports 48 each of which extends through an arc somewhat less than 180 degrees and communicates with the passages in the hollow arms 36. Formed at the left-hand end of the cylinder bores 46 are a plurality of fluid distributing ports 50 opening into the flat face 42 and adapted to alternately register with each of the distributing ports 48. A shaft 52 provided with universal joints 54 at its opposite ends connects the barrel 44 to rotate with the shaft 16 in any position of the yoke 32. The parts thus far described are in a broad aspect well known in the art and per se form no part of the present invention.

The hydraulic balance of the cylinder barrel 44 is, of course, determined by suitable proportioning of the radial width of the flat pressure surface 40 relative to the total area of all of the ports 50 and the total area of all of the pistons 24. With the present invention these areas are so proportioned as to produce a net fluid pressure force on the cylinder barrel 44 tending to lift the barrel out of contact with the surface 40. This unbalance is made as small as possible, however, and is, of course, proportional to the operating pressure.

According to the present invention there is provided a means for exerting an additional force tending to hold the barrel on the valve plate and means for bringing it into action depending upon the tendency of the barrel to lift off of the valve plate. Mounted in a bore 56 in the valve plate 34 is a longitudinally slidable shaft 58 carrying a thrust bearing 60 at its left-hand end and which abuts against a shoulder formed at the left-hand end of a central recess 62 in the barrel 44.

Also formed in the valve plate 34 is a cylindrical chamber 64 in which is slidably mounted a piston 66 integrally formed on the rod 58. The left-hand end of the rod 58 carries an adjustable spring abutment 68 for receiving a spring 70. Thus the spring 70 acts as the normally present cylinder barrel spring and constantly urges the barrel 44 into contact with the valve plate surface 40 so long as the operating pressure of the device is below the value at which the net hydraulic unbalance at the cylinder barrel is sufficient to overcome the spring.

Mounted on the left-hand face of the valve plate 34 is a plate member 72 having formed therein a three-way spool valve 74, the spool 76 of which has a projecting stem 78. Pivoted in a bracket 80 secured to the plate 72 is a lever 82 having an adjustable screw 84 adapted to abut the left-hand end of rod 58. A spring 86 normally urges the valve spool 76 to the right

whenever the barrel 44 tends to move to the right a small amount. The valve spool 76 in its normal position illustrated serves to connect a passage 88 communicating with chamber 64 to a drain passage 90. When the spool is shifted to the right, this connection is cut off and the passage 88 is connected with a passage 92 in communication with the upper distributing port 48.

The single passage 92 may be provided where the pump or motor has its high operating pressure always at one port of the machine and never at the other. For devices where the high pressure side may be at one or the other of the ports 48 depending upon operating conditions, the passage 92 may lead to both ports 48 with the provision of a shuttle valve operating in the well-known manner to connect the valve 74 with whichever port happens to be the high pressure port at any instant.

In operation, assuming that the conduits 30 are connected into a power transmission circuit in the usual manner so that the upper conduit 30 is the pressure supply connection while the lower one is the suction connection and that the shaft 16 is connected to a suitable prime mover and rotated thereby at a constant speed, with the top moving away from the observer the pistons 24 are reciprocated in the cylinder bores 46 in the well-known manner with a stroke depending upon the angular displacement of the yoke 32.

With the left-hand end of the yoke moved away from the observer each piston 24 will travel to the left during its top-half revolution and will be withdrawn to the right during its bottom-half revolution, thus withdrawing fluid from the lower port 48 into the cylinders 46 and discharging it out of them into the upper port 48.

During operation at pressures below the critical pressure at which the spring 70 is no longer able to hold the barrel on the valve plate, the chamber 64 is connected to the tank through passage 88, valve 74, and passage 90. Under these conditions the device operates in the conventional manner. As soon as this critical pressure is exceeded, however, and regardless of how high or low that pressure may be for a given machine, there is a tendency for the barrel 44 to lift off from the valve plate thus drawing the rod 58 slightly to the right. Due to the large amplification of this movement which appears at the stem 78, the valve spool 76 is rapidly shifted to the right thus cutting off chamber 64 from the tank and opening it to the upper valve port 48 through passage 88, valve 74 and passage 92. The high pressure thus admitted to chamber 64 reacts against the piston 66, thus preventing any further lifting of the cylinder barrel away from the valve plate.

While the form of embodiment of the 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.

What is claimed is as follows:

1. In a fluid pressure energy translating device having a plurality of cylinders and pistons reciprocable therein, a rotary valve structure comprising two relatively rotatable members provided with flat, annular, sealing surfaces in running engagement and containing fluid distributing ports communicating with said cylinders, said members being subject to a separating force increasing with increase in operating pressure of the device, valve means mechanically connected to one of the members and controlled by rela-

tive movement thereof, and a fluid motor controlled by the valve and connected to force the members together, said valve being located in a passage between and communicating with a source of pressure fluid and the motor.

2. In a fluid pressure energy translating device having a plurality of cylinders and pistons reciprocable therein, a rotary valve structure comprising two relatively rotatable members provided with flat, annular sealing surfaces in running engagement and containing fluid distribut-

ing ports communicating with said cylinders, said members being approximately balanced with respect to hydraulic pressure forces tending to seat and unseat the same, hydraulic means for imposing additional seating force, a valve located in a passage connecting between a source of pressure fluid and said hydraulic means, and means responsive to separation of the members to operate the valve only upon substantial unbalancing of said members.

KENNETH R. HERMAN.