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ADJUSTABLE STROKE HYDRAULIC MOTOR
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This invention relates to hydraulic motor cylinder assemblies for producing linear mechanical movement by hydraulic power, such assemblies being hereinafter referred to as hydraulic jacks.

More specifically, the invention relates to jacks the working stroke of which is normally constant but is capable of adjustment. Such devices are particularly useful in, although not limited to, agricultural implements in which the depth of a working tool or ground working tool is to be controlled.

An object of the invention is to provide a practicable hydraulic jack, the stroke of which can be varied between wide limits.

Another object is to provide a hydraulic jack having a piston structure, the effective length of which can be varied to thereby determine the stroke of the piston structure as a unit.

A more specific object is to provide a jack having a piston structure comprising two separate pistons with provision for trapping variable quantities of fluid between the sections to thereby vary the overall length of the piston structure.

Other more specific objects and features of the invention will be apparent from the detailed description to follow of a specific embodiment thereof:

Briefly, the invention comprises a jack having a working piston connected to the usual piston rod, a second, floating piston, and a valve mechanism whereby variable volume of fluid can be trapped between the two pistons to vary the distance therebetween and in that way vary the distance the composite piston can travel from one end of the cylinder before abutting against the other end.

In the drawing:

Fig. 1 is a side elevational view, with parts shown in section, of a jack in accordance with the invention; and

Fig. 2 is a similar view in less detail showing the pistons in a different position than in Fig. 1.

Referring to Fig. 1, there is shown a hydraulic jack comprising a cylinder 10 having end closure members 11 and 12 respectively which may be held together by external stay bolts 13. The cylinder head 14 is shown extending a short distance into the cylinder 10 and sealed therewith by an annular sealing ring 14. The cylinder head 12 may be sealed to the cylinder in a similar manner. The head 14 may have an eye 15 for attachment to a suitable support and have a liquid port 16. The head 12 has a central opening for passage of a piston rod 17 therethrough, and has a port 18 for the entry or discharge of fluid.

Mounted within the cylinder 10 are a working piston 19 and a free or floating piston 20. The working piston 19 is of conventional construction having annular sealing rings 21, and being secured to the piston rod 17 for reciprocating the latter.

The floating piston 20 is sealed with the cylinder 10 by a sealing ring 22, but it is not connected to the working piston 19 nor the piston rod 17. It is free to move in either direction in the cylinder 10 in response to any difference in fluid pressure thereacross except when it is in the extreme left end of the cylinder, as shown in Fig. 1, in which position it is yieldably locked by a spring detent mechanism.

Thus the floating piston 20 has extended from its left end a central tubular projection 23 having an external flange 23a on its outer end which alidably fits in a cylindrical recess 24 in the cylinder head 14 and is yieldably retained therein by a detent consisting of an annular helical spring 25 positioned in an internal annular groove in the recess 24, when the floating piston 20 is in extreme left position. The annular detent spring 25 is capable of yielding in response to appreciable force applied to the floating piston to permit the flange 23a to move therepast.

The floating piston 20 is provided with a valved passage for permitting the flow of fluid therethrough from one side to the other. Thus there extends from the right face of the floating piston a longitudinal passage 26 which communicates with a valve chamber 27 containing a ball check valve 28 which is urged against a seat 29 by a spring 30 which is compressed between the ball 28 and a plug 31, the latter sealing with a sealing ring 32 and being retained in position by a split washer 33 which is expanded into a groove in the wall of the chamber 27. The valve seat 29 communicates with a radial passage 35 which contains a reciprocable valve lifter 36, the latter being fluidly permitted to flow of fluid therepast. The inner end of the passage 35 communicates with a central cylindrical passage 39 in the piston 20 which communicates with another radial passage 33 similar to and diametrically opposite to the passage 35, and containing a valve lifter 40 which cooperates with a ball check valve 41 which is urged against a seat 42 by a spring 43. The ball valve 41 controls communication between the passage 39 and the chamber 45 which is communicated by a longitudinal passage 45 with the left face of the floating piston 20.

The check valves 28 and 41 are normally held against their seats by their associated springs, and since they face in opposite directions they normally prevent flow in either direction between the passages 45 and 26. However, by moving the lifters 36 and 40 radially outwardly in their passages, the ball valves 28 and 41 can be lifted off their seats to permit fluid flow through the floating piston from one side to the other.

The valve lifters 36 can be selectively actuated by a cam plug 46 which is reciprocable in the central passage 39 in the piston 20, and has an annular recess therein defining a conical face 46a juxtaposed to the valve lifters 36 and 40 so that movement of the plug 46 to the right forces the valve lifters 36 and 40 outwardly to lift their
3 associated valves off their seats. The plug 48 is normally maintained in a leftmost position, as shown in Fig. 1, by a helical compression spring 49 which is partially positioned in a passage 50 within the plug 46. This passage 50, together with a smaller continuing passage 51 interconnects the opposite ends of the plug 46 so that fluid is not compressed or expanded between the right end of the passage 38 and the plug. The communication between the passage 35 and the passage 39 is effected through the annular recess in the plug 46 which defines the contact surface 46a and this space is segregated from communication with the left end of the floating piston by sealing rings 52a and 53b respectively.

The cam plug 48 can be actuated to the right, to lift the valve balls 29 and 41, by rotation of a cross shaft 57 in the cylinder head 51, on which cross shaft is shown as having an actuating arm 58 on its outer end. Suitable sealing means is provided to prevent leakage of fluid around the shaft 57 to the exterior. The shaft is provided with a flat surface 57a juxtaposed to the left end of the cam plug 46, so that rocking of the shaft 57 in either direction from its normal position shifts the actuator plug 48 to the right.

The operation of the device is as follows: As shown in Fig. 1, the floating piston 20 and working piston 19 are in contact with each other, and the floating piston is in the extreme left end of the cylinder 10. If pressure fluid is admitted to the port 18 and exhausted from the port 16, both pistons will be moved as a unit from the left end of the cylinder to the right, through the maximum stroke of which the apparatus is capable. Initial movement overcomes the resistance of the detent spring 28 to permit disengagement thereby of the flange 23a.

When it is desired to limit the effective stroke of the jack to a lesser value, the pistons 19 and 20 are separated from each other, and fluid trapped between, so that the effect is to produce an elongated piston structure which obviously will have a shorter stroke in a cylinder of given length than would the shorter piston structure that results when the two pistons 19 and 20 are in contact with each other, as shown in Fig. 1. The separation of the two pistons is achieved by rotating the arm 58 and the shaft 57 to move the actuating plug 48 to the right sufficiently to lift the ball valves 28 and 41 off their seats, thereby establishing free communication between the opposite faces of the floating piston 20. While these valves are held open in the manner described, fluid is admitted slowly through the port 16 and exhausted through the port 18. This fluid flows freely through the floating piston 20 and does not exert sufficient force thereon to overcome the force of the detent spring 28, so that the floating piston remains stationary, and the fluid flow moves the working piston 19 away from the floating piston. When the working piston has been separated from the floating piston the desired distance, the arm 58 is released, permitting closure of the ball valves 28 and 41 to thereby block escape of the fluid trapped between the two pistons and preserving the spacing therebetween until subsequent readjustment is effected by again actuating the arm 58.

Fig. 2 shows the two pistons in separated positions and in mid-stroke position within the cylinder.

To bring the pistons together and thereby lengthen the stroke, the arm 58 is actuated to open the valves in the floating piston while the latter is in the left end of the cylinder and fluid is admitted to port 18 and exhausted from port 16 to move the working piston into its desired left stroke limit position, after which the arm 58 is released to close the valves in the floating piston.

It will be apparent that separation of the two pistons limits the leftward movement of the working piston 19 and the piston rod 17 without affecting the limit of movement to the right.

Each time the floating piston 20 moves into its extreme left end position, as shown in Fig. 1, the detent spring 28 engages the floating piston flange 23a, which offers some resistance to movement of the floating piston into and out of extreme end position. However, this resistance is usually relatively small as compared to the resistance offered by the mechanism controlled by the cylinder, and is of no significance.

Although for the purpose of explaining the invention, a particular embodiment thereof has been shown and described, obvious modifications will occur to a person skilled in the art, and I do not desire to be limited to the exact details shown and described.

I claim:

1. A hydraulic motor comprising: a cylinder having liquid ports at opposite ends for ingress and egress of operating liquid; a working piston within said cylinder and means connecting it to an exterior device to be actuated; a floating piston in said cylinder; means defining a passage interconnecting the space between said two pistons with one end of said cylinder; valve means in said passage, said valve means being normally closed irrespective of pressures applied thereto to trap liquid between said pistons and maintain them in spaced-apart relation to thereby limit the stroke of said two pistons as a unit in said cylinder; and means for selectively opening said valve means to admittance liquid to and from said space between said pistons and thereby vary the spacing between said pistons.

2. A hydraulic motor according to claim 1 in which said valve means is located within said float piston for intercommunicating opposite faces thereof.

3. A hydraulic motor according to claim 2 in which said valve opening means comprises longitudinally reciprocable valve operating means in said floating piston and projecting from one end thereof, and a cooperating actuating member in said cylinder adapted to be juxtaposed in operating relation to said valve actuating member when said floating piston is in one end position of said cylinder.

4. Apparatus according to claim 3 including means for yieldably retaining said floating piston in said one end position in said cylinder.

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