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 APPARATUS FOR CAUSING INTERMITTENT OPERATION
 OF A HYDRAULIC MOTOR
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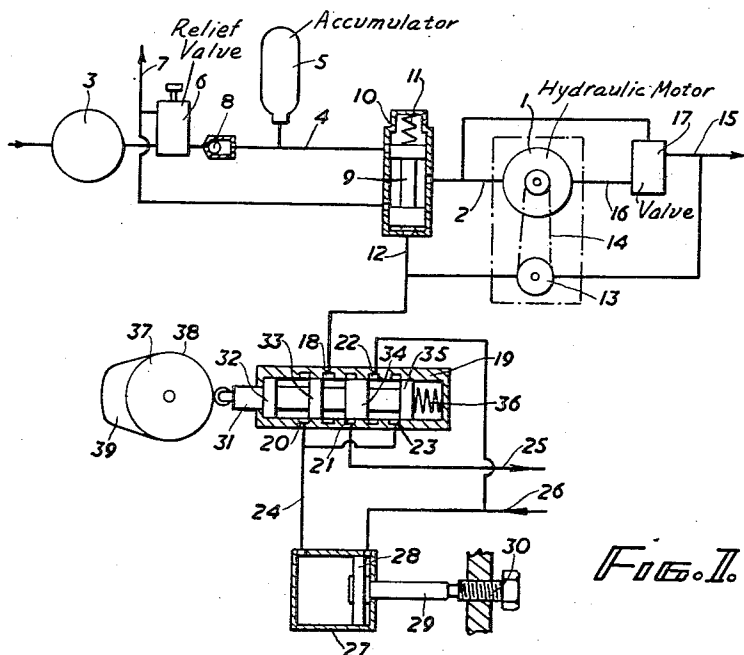


FIG. 1.

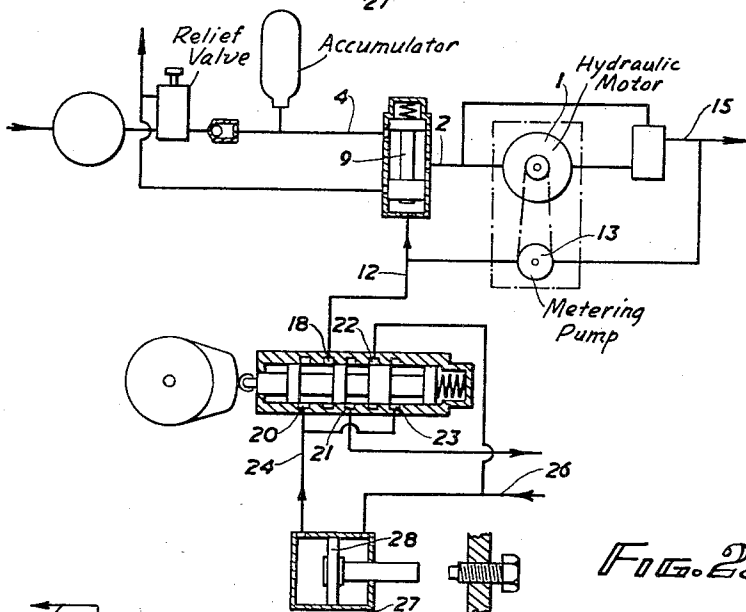


FIG. 2.

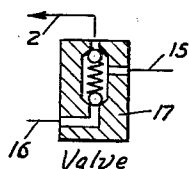


FIG. 3.

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1

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APPARATUS FOR CAUSING INTERMITTENT OPERATION OF A HYDRAULIC MOTOR

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3 Claims. (Cl. 60—51)

This invention relates to apparatus for causing intermittent operation of a hydraulic motor, which term is to be understood as including rotary hydraulic motors of the rotary piston, reciprocating piston or other type as well as motors of the ram, or like type, and has for its object to provide a form of apparatus by which a hydraulic motor may be caused to operate in a series of steps, which can be exactly determined and consistent and may take place in rapid succession and yet have to be separated by a relatively long period of rest so that rapid accurate operation is necessary, as for example when the hydraulic motor is used to effect the feed in a tube reducing machine of the kind in which reducing rollers are moved rapidly back and forth over the tube and have gaps therein which relieve the pressure on the tube momentarily at one end of each stroke of the rollers to permit the tube to be advanced by feed mechanism.

Apparatus for causing intermittent operation of a hydraulic motor in predetermined steps according to the present invention comprises a hydraulic system (hereinafter for convenience called the accumulator system), and including an accumulator device having a movable piston or the equivalent (hereinafter called the accumulator piston) which has one position (hereinafter called for convenience the discharged position) in which the fluid capacity of the accumulator system is at its minimum and a second position (hereinafter for convenience called the charged position), determined by a stop which limits its movement, so that there is a predetermined difference in the volume of the accumulator system respectively when the accumulator piston occupies its charged and discharged position, means by which fluid is delivered to the accumulator system to cause movement of the accumulator piston from its discharged position to its charged position, and this supply is then cut off, means by which, after the accumulator piston has reached its charged position, the hydraulic motor can be started, a metering pump arranged to be driven from the hydraulic motor and through which discharge of fluid from the accumulator system then takes place so as to cause the return of the accumulator piston to its discharged position and means by which when the accumulator piston reaches its discharged position, the hydraulic motor is stopped.

One form of the apparatus according to the invention is shown diagrammatically in the accompanying drawings in which:

Figure 1 shows the apparatus with the various parts thereof in the positions which they occupy in readiness for the time when the hydraulic motor is to perform one step;

Figure 2 shows the apparatus with the various parts in the positions which they occupy during the performance of such a step; and

Figure 3 is a sectional view illustrating a conventional relief valve employed in the apparatus of Figures 1 and 2.

In the drawings 1 is the hydraulic motor which is to be intermittently operated. The hydraulic motor 1 is ar-

2

anged to be fed with operating fluid through an inlet passage 2 from a source of supply comprising a pump 3 arranged to deliver operating fluid under pressure to an inlet passage 4 communicating with an accumulator 5 and containing a pressure relief valve 6 by which surplus fluid can escape to a relief passage 7 and a non return valve 8.

The admission of working fluid from the passage 4 to the passage 2 to cause operation of the hydraulic motor 1 is controlled by a valve 9 of the piston type arranged within a casing 10 and acted upon at one end by a spring 11 and at its other end by the pressure in a passage 12. The relief passage 7 also communicates with the casing 10 and the construction of the valve is such that it can either occupy an inoperative position as shown in Figure 1 in which the passage 2 communicates with the relief passage 7 or an operative position as shown in Figure 2 in which the inlet passage 4 communicates with the passage 2.

The hydraulic motor 1 is arranged to drive a metering pump 13 through a chain 14, the metering pump 13 being arranged to accept fluid from the passage 12 and deliver it to a discharge passage 15.

Associated with the inlet passage 2, the outlet passage 16 of the hydraulic motor 1 and the discharge passage 15 is a valve device 17 of known type, shown more particularly in Figure 3, which will open to permit flow of fluid from the passage 2 or the passage 16 into the discharge passage 15 if at any time an excessive pressure occurs in the passage 2 or the passage 16.

The passage 12 communicates with one port 18 in the casing 19 of a piston type changeover valve having further ports 20, 21, 22 and 23 of which the ports 20 and 23 communicate with a passage 24, the port 21 communicates with a relief passage 25 while the port 22 communicates with a passage 26 connected to a source of hydraulic pressure.

The passages 24 and 26 communicate with opposite ends of a cylinder 27 constituting the cylinder of an accumulator device, containing a piston 28 having a piston rod 29 passing in a fluid tight manner through one end of the cylinder and having its travel to the right in the drawings limited by an adjustable stop 30. The movable piston member 31 of the valve 19 has four lands 32, 33, 34, 35 as shown, and is acted upon at one end by a compression spring 36 and at its other end by a cam 37 including at least one cylindrical surface 38 of constant radius and at least one lobe 39.

The operation of the apparatus is as follows:

When the valve member 31 bears against the cylindrical part 38 of the cam 37 as shown in Figure 1 it will be seen that the passage 26 which communicates at all times with the right hand end of the cylinder 27, is brought into communication by way of the ports 22 and 23 and the passage 24 also with the left hand end of the cylinder 27 with the result that the pressure from the passage 26 acting differentially on the two faces of the piston 28 move it to the right until its piston rod 29 engages the adjustable stop 30 as shown. At this time it will be apparent that the ports 20 and 18 communicate with closed chambers within the valve 19 while the passage 25 is closed by the land 34. At this time also for reasons hereinafter explained, the valve 9 will occupy the position shown in which the passage 2 communicates with the passage 7 and the motor 1 is therefore stationary.

When the rotation of the cam 37 brings the lobe 39 around into position so as to move the valve member 31 into the position shown in Figure 2, it will be seen that the passage 24 is now connected through the ports 20 and 18 and the passage 12 to the lower end of the casing 10 of the valve 9, the port 23 communicates with the

3

closed chamber, the port 22 is closed by the land 34 and the port 21 communicates with the closed chamber. The pressure acting through the passage 26 now therefore moves the piston 28 to the left so that the pressure thus created in the passages 24 and 12 moves the valve 9 into the position shown in Figure 2 in which the passage 4 is brought into communication with the passage 2. The hydraulic motor 1 is therefore caused to rotate and to cause simultaneous rotation of the metering pump 13 which therefore begins to accept fluid from the passage 12 and discharge it into the passage 15. The piston 28 therefore moves to the left under the pressure acting on its right hand face to maintain the pressure in the passages 24 and 12 substantially unchanged until the piston 28 reaches the left hand end of the cylinder 27 and its further movement is therefore prevented. When this occurs the continued rotation of the hydraulic motor 1 and metering pump 13 by accepting further fluid from the passage 12 allows the valve 9 to move downwards under the influence of its spring into the position shown in Figure 1 and thus stop further rotation of the hydraulic motor 1.

When the cam 37 continues its rotation to bring the part 38 thereof again into engagement with the end of the valve member 31 so that this valve member again occupies the position shown in Figure 1, the piston 28 will again be forced to the right as shown in Figure 1, and the cycle of operation repeated.

It will be apparent that the degree of rotation of the hydraulic motor 1 following each step will be determined by the volume of fluid in the left hand end of the cylinder 27 when this rotation begins and hence by the setting of the adjustable stop 30. The metering pump 13 may be of fixed capacity or variable capacity type and in the latter case it will be apparent that the degree of rotation of the hydraulic motor 1 during each step it is in opera-

4

tion can be adjusted by adjustment of the capacity of the metering pump as well as by adjustment of the stop 30.

It will be apparent that although in the example shown the valve 31 is arranged to be operated by a rotating cam 37, the movement of this valve from one of its positions to the other will be effected by any convenient means in response to any convenient signal.

What we claim as our invention and desire to secure by Letters Patent is:

1. Apparatus for causing intermittent operation of a hydraulic motor in predetermined steps by opening and closing of a control valve, said apparatus comprising an accumulator system including a source of fluid under pressure, a metering pump, an accumulator device chargeable from said source and dischargeable by said metering pump, said pump being connected to be directly driven by the hydraulic motor, and hydraulic pressure responsive means operatively connected to the control valve and responsive to the pressure in the accumulator system to start the motor when the accumulator device is charged and to stop the motor when the accumulator has been discharged.

2. Apparatus as claimed in claim 1 including means for varying the capacity of the accumulator device.

3. Apparatus as claimed in claim 1 in which the metering pump is of the variable capacity type.

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