June 9, 1942. D. V. SMYTH 2,286,020

POWER TRANSMISSION

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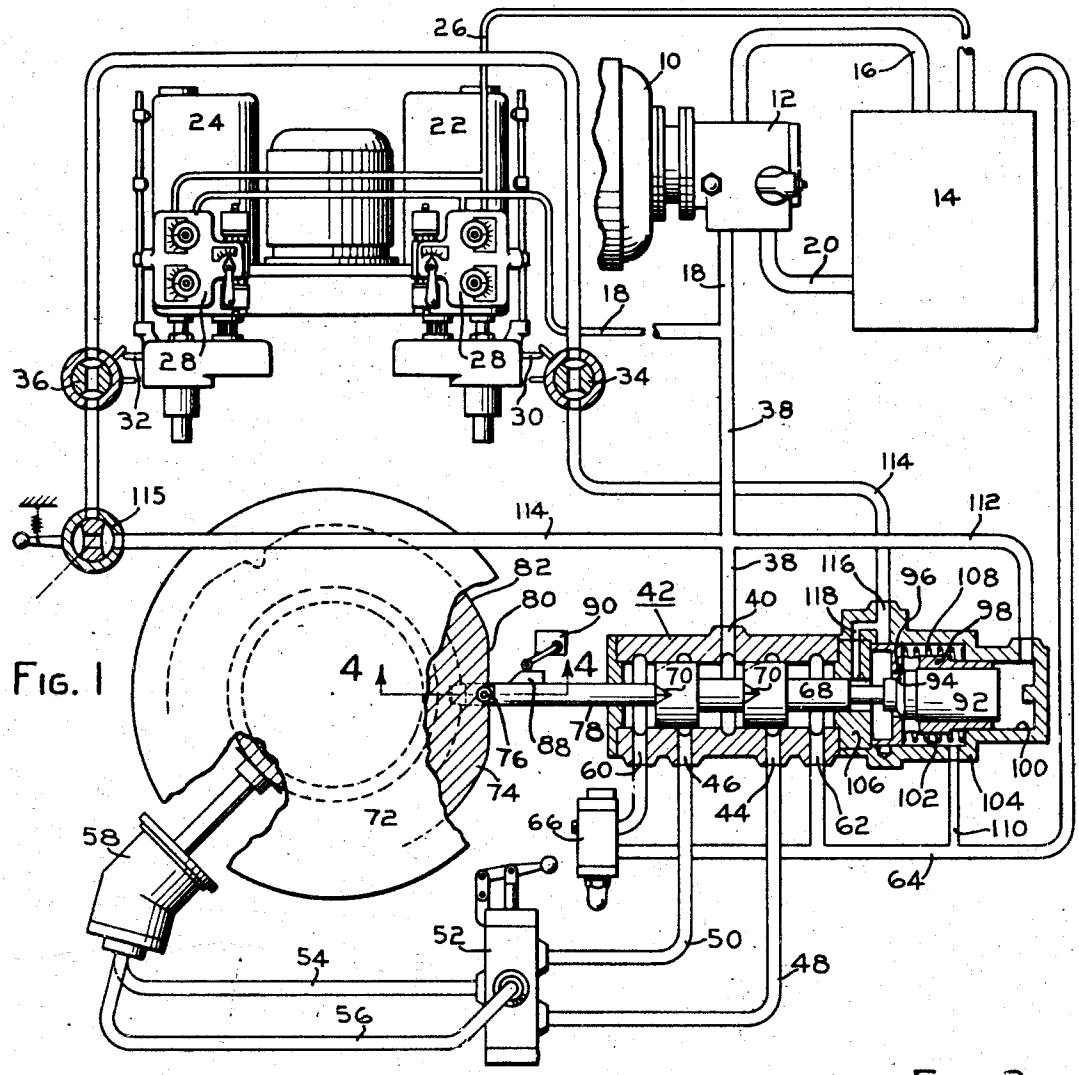


FIG. 1

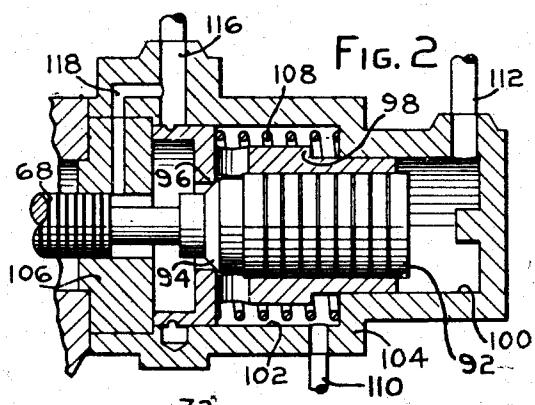


FIG. 2

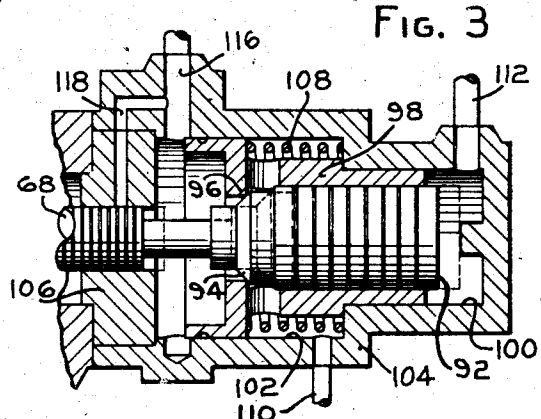


FIG. 3

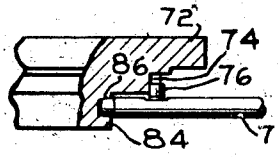


FIG. 4

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POWER TRANSMISSION

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3 Claims. (Cl. 121—38)

This invention relates to power transmissions, 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.

The invention is more particularly concerned with a hydraulically-operated, single-cycle, control mechanism of the type which may be initiated into operation by an impulse of pressure fluid and will thereafter cause a predetermined cycle of operation to occur during which the control mechanism is unaffected by any subsequent accidental or intentional pressure impulses.

Control mechanisms of this general character have been heretofore constructed and used with complete success. They have, however, required that the source of pressure fluid from which initiating pressure impulses are derived be such as to admit of the pressure source being bypassed through the control device whenever an impulse is attempted to be applied while a cycle of operation is taking place. This has heretofore required a separate pump for supplying fluid to the initiating circuit which could not be utilized for other purposes.

It is an object of the present invention to provide an improved single-cycle control mechanism of this character and in which means is provided for preventing bypassing of the pressure supply while a cycle is taking place in the event of an attempted restarting of the mechanism.

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:

Figure 1 is a diagrammatic view of a power transmission system incorporating a preferred form of the present invention.

Figures 2 and 3 are enlarged views showing the single-cycle control mechanism in cross section in different positions of the parts.

Figure 4 is a fragmentary sectional view on line 4—4 of Figure 1.

Referring now to the drawing, the invention is there illustrated as applied to the control of a rotary table indexing mechanism used with a machine tool such as a multiple-head drilling machine. It will be understood that the invention may be readily utilized for other purposes where a predetermined cycle of operation is to be accomplished of which the machine tool indexing mechanism is merely an example.

A suitable prime mover, such as an electric motor 10, is provided for driving a pump 12 forming a source of fluid under pressure. The pump 12 may be of any suitable type, the one illustrated being a duplex combination pump which is arranged to provide large and small volumes for rapid traverse and feed depending upon the pressure encountered in the delivery line. Such pumps are a standard article of commerce, for example, the Vickers VC type of pump which incorporates the necessary control valves for shifting between large and small volume output in accordance with delivery line pressure. The basic circuit for such a pump is illustrated, for example, in the Vickers Patent 1,982,711.

The pump is adapted to draw liquid from a sump tank 14 through a suction conduit 16 and deliver the same through a delivery conduit 18. A bypass conduit 20 returns to the tank any oil delivered by either pump which is bypassed by the internal control valves at any time. The delivery conduit 18 supplies pressure to a pair of hydraulically-actuated drilling heads 22 and 24 from which exhausting fluid is returned to tank through a conduit 26.

The drilling heads and their actuating and control mechanism per se form no part of the present invention, and they are intended as merely examples of one type of mechanism which may be used to control by an interlock circuit teh single-cycle control mechanism hereafter to be described.

Briefly, the heads 22 and 24 are hydraulically actuated under the control of well-known rapid traverse and feed panels 28 which may be manually initiated by means of a push button starting switch, not shown, and thereafter controlled by means of dogs traveling with the drill heads to perform an automatic cycle of rapid advance, feed, and rapid return to a stop in the position illustrated. The heads 22 and 24 carry trip dogs 30 and 32 which are adapted, when the heads lie in the position shown, to open a pair of interlock circuit valves 34 and 36 and to close the same as the heads start downwardly on a working cycle.

The fluid delivered by pump 12 is also utilized to operate an indexing table drive and control mechanism which receives fluid through a branch delivery conduit 38. Conduit 38 extends to a pressure port 40 of a four-way stop-and-go valve 42. The latter has motor supply and return ports 44 and 46 which are connected by conduits 48 and 50, four-way reverse valve 52 and conduits 54 and 56 with a rotary fluid motor 58. Valve 42 also has a tank return port 60 and a drain

port 62 which are connected to tank by a conduit 64. The port 60 communicates with the conduit 64 through a foot valve or back-pressure valve 66 of well-known construction and arranged to remain closed until a predetermined pressure builds up at the port 60.

The valve 42 has a spool 68 which, when in the position shown in Figure 1, blocks the ports 44 and 46 as well as the port 40. When the valve is moved to the right, port 40 is gradually opened to port 44, and port 46 is gradually opened to port 60, the graduation being determined by V-shaped notches 70 formed in the spool. The spool 68 is thus the member which controls operation of the rotary motor 58. The latter drives by means of bevel gearing a rotary work table 72 on which work may be positioned for operation upon by the heads 22 and 24. Thus, the table 72 may be driven to carry the work between three indexed positions, one of which is a loading and unloading position and the other two of which bring the work beneath the heads 22 and 24. Depending upon the tooling in use on the respective heads, it may be desirable to rotate the table 72 in one direction for one type of tooling and in the opposite direction for another type of tooling. For this purpose the valve 52 may be shifted to reverse rotation of the table whenever the tooling is changed.

Beneath the table 72 there is formed a cam 74 (see Figure 4) adapted to cooperate with a roller 76 carried by a stem 78 of the valve spool 68. The cam 74 is provided with three depressions, such as the one in which the roller 76 lies, and on either side of each depression has a rise portion 80 terminating in a circular portion 82. Beneath the cam 74 there is formed a shoulder 84 in which three tapered recesses 86 are provided for the reception of the tapered end of the stem 78 which thus forms a locking pin to lock the table in the indexed position.

The stem 78 may carry a cam 88 arranged to close a normally-open limit switch 90 which may be connected in series with the starting push button for the heads 22 and 24, thus preventing initiation of head movement whenever the stem 78 is retracted from the recess 86.

For the purpose of shifting the spool 68 to the right and starting a cycle of table indexing movement, the spool 68 carries at its right hand end an enlarged piston 92 having a tapered portion 94 adapted to rest on a seat 96 formed in a hollow piston 98. The piston 98 is slidable in stepped bores 100 and 102 formed in an end cap 104 secured to the righthand end of the valve 42. The cap 104 also includes an end plate 106 positioned adjacent the right end of valve 42 and having a central bore within which the spool 68 is slidable. The piston 98 is biased to the left by a spring 108 and is slidable relative to the enlarged piston portion 92 in the direction separating seat 96 from tapered portion 94. The chamber formed by the piston 98 and bore 102 communicates with the tank conduit 64 through a branch 110.

Branching from the delivery conduit 38 is a conduit 112 which admits pressure fluid continuously to the righthand end of bore 100, thus creating a constant bias on the piston 92 toward the left as well as on the piston 98.

Also branching from the delivery conduit 38 is an interlock circuit 114 which extends in series through a spring-closed, manually-operated, starting valve 115 and through the valves 34 and 36. The interlock circuit terminates at the end cap 104 in two branches. Branch 116 leads directly to the bore 102 in a position where it is closed by the piston 98 whenever the latter lies in the position shown in Figures 1 and 2. Branch 118 leads to the central bore of member 106 at a point therein where the valve spool 68 will close the passage whenever it is moved slightly to the right.

In operation, with the pump 12 running and with the parts in the position illustrated in Figure 1, the delivery of pump 12 being blocked at panels 28, valve 42 and valve 115, it will be completely bypassed through the internal valve mechanism of the pump maintaining a predetermined pressure in the conduit 38.

When it is desired to start a cycle of operation, the valve 115 may be manually opened momentarily to admit pressure fluid through interlock circuit 114, valves 34 and 36 being open at this time, and through branch 118 to the lefthand end of cylinder 102. Piston 98 accordingly moves to the right, and, since seat 96 is in engagement with the tapered portion 94, it carries with it the piston 92 and spool 68, thus retracting the stem 78 from recess 86 as well as retracting roller 76 from its recess in cam 74.

This movement continues until the piston 98 abuts the shoulder at the end of bore 102 as shown in Figure 3. Since the area at the right end of piston 92 is larger than the area of the seat 96, the pressure in the left end of bore 102 cannot lift the piston 92 off the seat, and the spool 68 remains in this position leaving the roller 76 spaced from the cam 74 at a point where the final part of the rise portion 80 will contact the roller after some movement of the table 72. This position of valve spool 68 opens port 44 to port 40, and port 46 to port 60, thus admitting pressure fluid through conduits 48 and 54 to the motor 58 from which it returns through conduits 56 and 50 to the tank conduit 64. The valve 66 maintains a predetermined back pressure on the motor 58 which causes the delivery line pressure to be maintained at a value where the small volume alone of the combination pump 12 is utilized.

As the cam 74 rotates to the point where rise portion 80 contacts roller 76, the valve spool 68 is moved further to the right to the dotted line position illustrated in Figure 3. This lifts the piston portion 94 off from the seat 96 permitting the oil in the left end of bore 102 to pass through the seat 96 and out conduit 110 to the tank. The fluid pressure acting on the annular area at the right end of piston 98 and also the spring 108 causes the piston 98 to quickly shift to the left, thus again closing the branch conduit 116. Branch conduit 118 was closed as spool 68 moved to the right and remains closed at this time.

It will be noted that, before cam 74 pushed the spool 68 farther to the right, any accidental or intentional reopening of valve 115 would be harmless because the admission of pressure fluid to the left end of bore 102 can shift pistons 92 and 98 no farther. Likewise, after the piston 98 has been reset by the action of cam 74 opening the passage through the piston and seat 96, the interlock conduit 114 is blocked at both branches 116 and 118.

As the table 72 continues to rotate, the roller 76 rides down the incline of the next rise portion 80 permitting spool 68 to gradually shift to the left under the pressure bias on piston 92 thus decelerating the motor 58 by means of the throttling grooves 70. As the roller 76 rides down into

the next notch and the stem 78 drops into the recess 86, the table is again locked both mechanically and hydraulically, and piston portion 94 again seals the seat 96. Not until this happens does the spool 68 open the branch passage 118 to admit of restarting a cycle by actuation of valve 116. With the table thus locked, the working heads 22 and 24 may be actuated in the usual way by manually starting a cycle of operation. The limit switch 98 prevents starting a cycle at any time while the table 72 is in motion. During the working cycle of the heads 22 and 24, the interlock circuit is blocked by the valves 34 and 36, thus preventing another indexing cycle until both heads have returned to their stopped position.

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. A hydraulically-operated, single-cycle, control mechanism comprising a member shiftable between a stop position and a run position, a piston movable relative to said member and arranged to shift the member from stop to run position, a control conduit for directing fluid to operate said piston and shift said member toward run position, means constantly urging said member toward stop position, additional means for moving said member further in the same direction that the piston moves it, a valve controlled by said further movement of said member for relieving pressure from the piston to thereby reset the piston for another cycle, and means controlled jointly by the piston and the member for blocking said conduit after the piston is reset and until the member is returned to stop position.

2. A hydraulically-operated, single-cycle, control mechanism comprising a member shiftable between a stop position and a run position, a piston movable relative to said member and arranged to shift the member from stop to run position, a control conduit for directing fluid to operate said piston and shift said member toward run position, means constantly urging said member toward stop position, additional means for moving said member further in the same direction that the piston moves it, a valve controlled by said further movement of said member for relieving pressure from the piston to thereby reset the piston for another cycle, and means including a branch conduit controlled by the piston and a second branch conduit controlled by the member for blocking admission of fluid pressure to the piston after it is reset and until the member is returned to stop position.

3. A hydraulically-operated, single-cycle, control mechanism comprising a member shiftable between a stop position and a run position, a piston movable relative to said member and arranged to shift the member from stop to run position, a control conduit for directing fluid to operate said piston and shift said member toward run position, means constantly urging said member toward stop position, additional means for moving said member further in the same direction that the piston moves it, a valve controlled by said further movement of said member for relieving pressure from the piston to thereby reset the piston for another cycle, means controlled by the piston for blocking said conduit when the piston is reset, and means including a valve controlled by the member for reopening said conduit when the member is returned to stop position.

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