June 9, 1942. F. T. HARRINGTON ET AL 2,285,968

POWER TRANSMISSION

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FIG. 4

FUNCTION	SOL. 60	SOL. 62	PATH
RAPID ADVANCE	ON	ON	1
FEED	ON	OFF	2
RAPID RETURN	OFF	ON	3
STOP	OFF	OFF	4

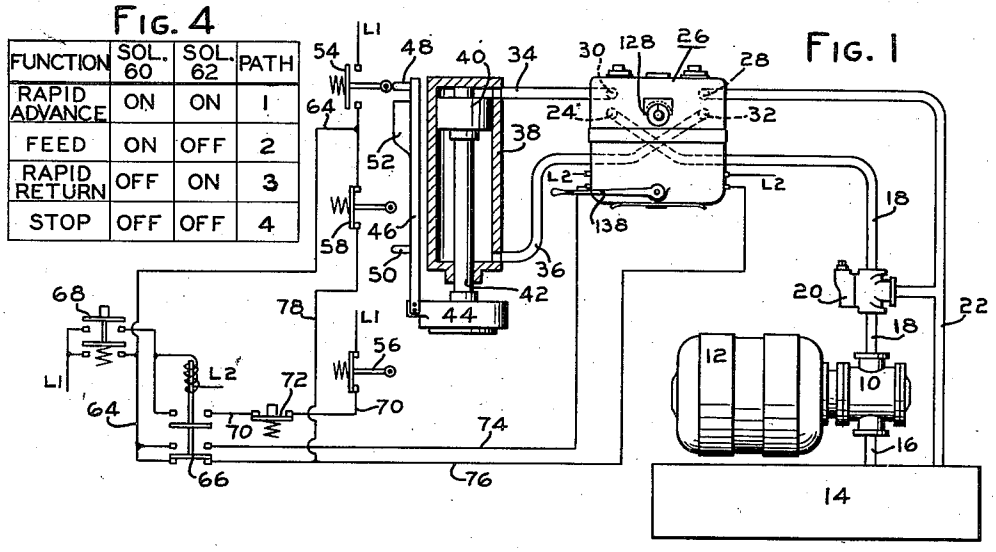


FIG. 1

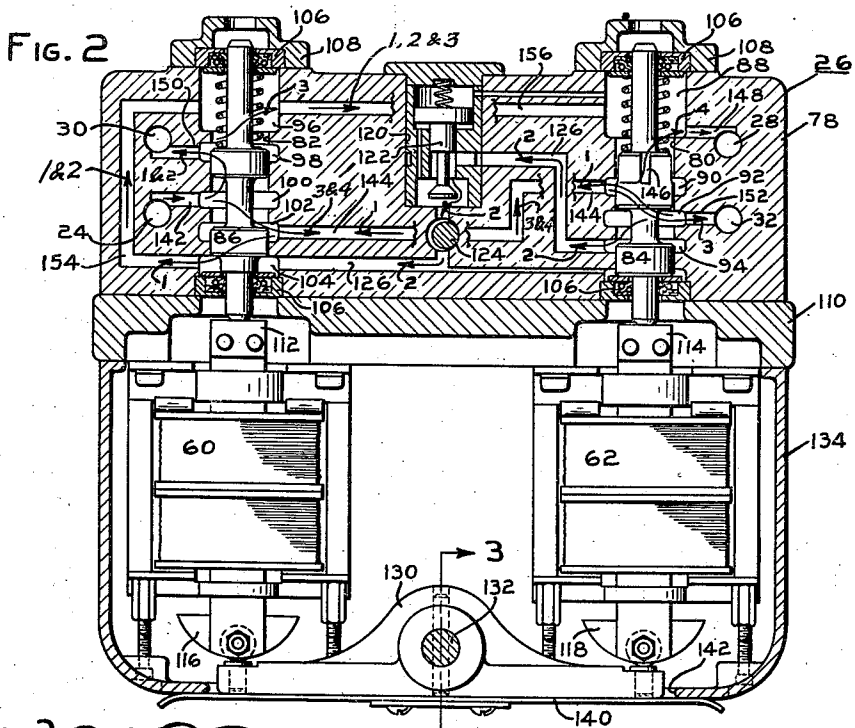


FIG. 2

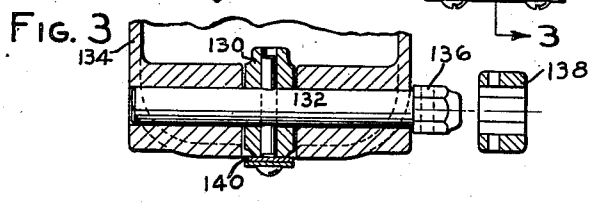


FIG. 3

INVENTORS
FERRIS T. HARRINGTON
& RALPH L. TWEEDALE

BY Ralph L. Tweedale
ATTORNEY

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POWER TRANSMISSION

Ferris T. Harrington and Ralph L. Tweedale, Detroit, Mich., assignors to Vickers Incorporated, Detroit, Mich., a corporation of Michigan

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2 Claims. (Cl. 60—52)

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 control panel of the class commonly used for actuating machine tool slides for providing the customary cycle of rapid advance, feed advance, rapid return and stop of the machine tool slide. In the patent to Harrington, No. 2,210,665, granted August 6, 1940, there is disclosed a control panel suitable for hydraulically operated machine tools. The panel there disclosed presents certain advantages in the way of adaptability by reason of the fact that it is adaptable to remote control by selectively energizing either, both, or neither of the two valve shifting solenoids, thus permitting mounting of the control panel in any location upon the machine in distinction from certain control panels of the prior art which must be located adjacent to the slides which they control so that the panel valve or valves may be shifted directly by means of dogs carried by the slide.

Panels of this class are frequently utilized in constructing complex multiple head machines having a large number of independently movable machine slides, the actions of which are correlated by means of a complex electrical circuit interconnecting the various control panels to provide a completely automatic cycle of operation during normal use. In constructing such an automatic machine it is necessary, however, to provide for manual operation of the machine slides individually during setting-up operation, and it has been found that, due to the complex nature of the electrical circuit used during automatic operation, the addition of manual control entails considerable additional expense because of the necessity of providing extra relays and contactors to permit manual operation with complete safety.

It is an object of the present invention to provide a power transmission system incorporating a control panel of the general class described above having improved manual means for controlling the system independently of the automatic electric control circuit.

A further object is to provide in a panel of the character described a manual control suitable for setting-up operation and which precludes the possibility of accidental shifting of the control panel into any position dangerous to the setting-up operation.

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.

Figure 2 is a sectional view of the control panel shown in Figure 1.

Figure 3 is a cross section on line 3—3 of Figure 2.

Figure 4 is a table of cycle functions and flow paths for use in conjunction with Figure 2.

Referring now to Figure 1, there is shown a pump 10 driven by an electric motor 12 to withdraw fluid from a tank 14 through a suction conduit 16. Fluid is delivered through a delivery conduit 18, a relief valve 20 of conventional construction being provided for bypassing fluid to the tank through a return conduit 22 whenever a predetermined pressure is exceeded in the delivery conduit 18.

The conduit 18 leads to a port 24 of a control panel 26. A port 28 of the latter connects with the return conduit 22. The panel 26 is also provided with cylinder ports 30 and 32 which connect by conduits 34 and 36 with the upper and lower ends of a motor cylinder 38. The latter carries a slidable piston 40 having a rod 42 connected to a suitable machine tool slide indicated diagrammatically at 44. Secured to an upwardly extending arm 46 are two tripping dogs 48 and 50 and a cam 52 adapted to actuate limit switches 54, 56 and 58, respectively, when the slide 44 is at the top, bottom and middle positions, respectively.

The panel 26 is controlled by two solenoids 60 and 62, respectively (see Figure 2), these solenoids in turn being under the control of an electric circuit including the previously mentioned limit switches. From one side of a suitable power source designated L^1 the normally-closed limit switch 54 is adapted to supply current to a conductor 64 which connects with both the normally-open and the normally-closed contacts of a holding relay 66. A normally-open, two-circuit, starting push button switch 68 is adapted to establish a connection from line L^1 to the coil of relay 66 and also to the conductor 64, these circuits being independent when the switch 68 is open. The opposite side of the coil of relay 66 is connected to the opposite side of the supply line L^2.

The holding contacts of the relay 66 are con-

trolled by a conductor 70 which has in series therewith both the limit switch 56 and a normally-closed emergency reverse switch 72. The normally-open contacts of relay 66 connect between conductor 64 and a conductor 74 extending to one side of the solenoid 60, the other side of which is connected to the other side of the line designated L^2. Likewise, the normally-closed contacts of relay 66 connect between conductor 64 and a conductor 76 extending to one side of solenoid 62, the other side of which is connected to line L^2. The normally-closed limit switch 58 connects between conductor 64 and conductor 76 by a conductor 78.

It will be seen that, when the starting button 68 is depressed, the holding relay 66 is energized to connect conductor 64 with conductor 74. Simultaneously the lower contacts of push button 68 connect conductor 64 temporarily with line L^1, thus establishing a circuit for solenoid 60. A circuit is also established for solenoid 62 from conductor 64 through limit switch 58, conductor 78 and conductor 76. As will be later described, energization of both solenoids causes the piston 40 to descend so that trip dog 48 rides off limit switch 54 thus shunting the lower contacts of push button 68 and permitting the latter to be opened without deenergizing solenoid 60.

As the piston 40 descends, a point is reached where the cam 52 opens limit switch 58, thus deenergizing solenoid 62. The piston 40 will continue to descend, at a lower rate, however, until trip dog 50 opens limit switch 56 which in turn releases relay 66 thereby breaking the circuit 74 of solenoid 60.

Dropping of relay 66 also established a circuit for solenoid 62 from conductor 64 to conductor 76. As will be described later, this causes the piston 40 to return until trip dog 48 opens limit switch 54, thus breaking the connection between line L^1 and conductor 64. It will be noted that during the latter portion of the upward movement of piston 40, limit switch 58 again rides off cam 52. This has no effect, however, on the energization of solenoid 62, since it is already energized by relay 66, and the closure of limit switch 58 merely establishes a second or shunt circuit between conductors 64 and 76.

The electric circuit thus far described is disclosed merely by way of example of a suitable circuit for controlling the energization of solenoids 60 and 62, it being understood that in multiple unit machines more complex circuits are ordinarily required to provide various interlocking functions between the several machine units as is well known to those skilled in the art.

Referring now to Figure 2, the internal construction of the panel 26 is there illustrated. Thus the panel comprises a main valve block 78 having two vertical bores 80 and 82 in which are positioned two two-position valve spools 84 and 86. Suitable annular ports 88, 90, 92 and 94 are formed in the bore 80, and corresponding ports 96, 98, 100, 102 and 104 are formed in the bore 82. Communication between the various ports is controlled by the piston heads formed on the valve members 84 and 86 in the well-known manner. The opposite ends of the bores are closed by providing oil seals 106 which are held in position by end caps 108 at the upper end of the bores and by an intermediate plate 110 at the lower end of the bores.

The valve spools 86 and 84 have stems projecting through the oil seals, the lower stems being adapted to be engaged by the pushing end of the armatures 112 and 114 of the solenoids 60 and 62, respectively. These armatures are provided with T-shaped heads 116 and 118 in the well-known manner at their lower ends. The operating coils of the solenoids are secured to the intermediate plate 110 by suitable bolts or other fastening means.

The block 78 is also provided with a central bore 120 in which is positioned a hydrostatic flow controlling valve 122 which serves in conjunction with a manually adjustable throttle 124 to maintain a predetermined volumetric rate of flow through a conduit 126 which extends between port 94 and port 104. The throttle 124 may be adjusted by means of a knob and dial 128 which appears in Figure 1. The hydrostatic flow controlling valve and throttle operate in the well-known manner to maintain a constant pressure drop across the throttle 124 thereby insuring a fixed rate of flow therethrough irrespective of the total pressure drop through the conduit 126.

The annular ports of the bores 80 and 82 are connected with each other and with the connection ports 24, 26, 30 and 32 by various internal passages which will be described later in connection with the operation of the apparatus as a whole.

For the purpose of shifting the valve spools 84 and 86 selectively under manual control and independently of electrical energization of solenoids 60 and 62, there is provided a manually operable lever 130 secured to a cross shaft 132 in turn pivoted in a housing 134 which surrounds the two solenoids. The shaft 132 is provided with a hexagonal end 136 projecting from the front of the housing and on which a lever 138 may be positioned for manual oscillation of the lever 130. The two arms of the lever 130 extend beneath the heads 116 and 118 so that whenever the arm is moved clockwise the head 116 will be raised and when it is moved counterclockwise the head 118 will be raised. For the purpose of normally biasing the lever 130 to its neutral position illustrated, a leaf spring 140 is secured to the bottom face of the lever 130 and overlaps the end of a slot 142 formed in the housing 134. The slot 142 is provided to permit downward movement of one arm of the lever 130 while the other arm is raised.

In operation, with the parts in the position as shown in the drawing and with the motor 12 and pump 10 running, the piston 40 will remain at rest and the pump 10 will be bypassed. The flow path through the panel under these conditions is indicated by the arrows carrying the numeral 4 at their head from which it will be seen that oil delivered through conduit 18 to port 24 flows through an internal passage 142 to the port 100 and from there to the port 102 where it flows through a passage 144 to the port 90 of the valve bore 80. This oil returns to tank through longitudinal slots 146 formed on the valve spool 84 and through port 88, a passage 148, port 28 and conduit 22 to the tank.

When both solenoids 60 and 62 are energized by depressing starting switch 68, the flow indicated by arrows numbered 1 is made to take place. Thus pressure oil entering at port 24 passes to port 100 and from there to port 98 where it passes to port 30 through a pasage 150. This oil flows through conduit 34 to the head end of cylinder 38 causing piston 40 to move downwardly and to discharge oil from the lower

end of cylinder 38 through conduit 36 to the port 32. This port is connected with port 92 by a passage 152, and from port 92 the oil flows to port 90 and through passage 144 to the port 102 of valve bore 82. Port 102 is at this time connected with port 104 from which the oil flows through a passage 154 to port 96 and through a passage 156 to port 88. From there the oil returns to tank through pasage 148 and port 28. It will be seen that all of the passages above described are free and unrestricted, permitting the piston 40 to travel at a rapid speed which is determined by the rate of discharge of pump 10 in relation to the volumetric displacement of the piston 40.

When the piston has descended to a point where the tools are ready to engage the work, cam 52 opens limit switch 58, thus deenergizing solenoid 62. Under these conditions the flow to the head end of cylinder 38 is the same as before, being indicated by arrows marked No. 2. The return flow, however, entering the panel at port 32, flows through passage 152, ports 92 and 94, passage 126, hydrostatic valve 122, and throttle 124, into port 104 where it returns to tank as previously described. Under these conditions of flow the hydrostatic valve and throttle limit the rate of discharge from the lower end of cylinder 38, thus causing the piston 40 to move at a feeding rate. The excess delivery of the pump under these conditions is bypassed to tank through the relief valve 20.

When the piston 40 has descended to the point where dog 50 opens limit switch 56, solenoid 60 is deenergized while solenoid 62 is energized. The flow under these conditions is indicated by the arrows marked 3 from which it will be seen that pressure oil is directed from port 24 through passage 142, ports 100 and 102, passage 144, ports 90 and 92, passage 152, port 32, and conduit 36 to the lower end of cylinder 38. The piston 40 accordingly moves upwardly discharging oil through conduit 34, port 30, passage 150, ports 98 and 96, passage 156, port 88, passage 148, port 28 and conduit 22 to the tank.

When the piston has moved fully upwardly, dog 48 opens limit switch 54, thus deenergizing solenoid 62 causing the piston 40 to stop and bypassing the discharge of pump 10 as previously described.

It will be seen that this cycle of operation can be made to take place automatically by the use of an electric control circuit which controls the energization of the solenoids in response to movement of the machine slide after the cycle has been initiated by the manual starting switch 68. When it is necessary to actuate the slide 44 under manual control, the electric circuit may be disabled by opening the usual main line switch, not shown, and the slide may be actuated forwardly, at a feeding rate only, by lifting the lever 138 which in turn lifts valve spool 86. Thus the slide 44 may be advanced slowly toward the work, and precise set-up of the tripping dogs with respect to the tool and work positions may be easily made.

It will be noted that it is impossible by actuation of the handle 138 to cause the slide 44 to advance rapidly. This arises from the fact that it is necessary to lift both valve spools 84 and 86 in order to cause the rapid advance function. This is impossible to do by the single lever 130 and insures positive safety in the setting up operation making it impossible for the operator to accidentally lift both valves and thus cause the machine slide to advance rapidly and cause damage to the tools before it could be stopped. By shifting the lever 138 downwardly the valve spool 84 is, of course, lifted causing the rapid return function to take place. During setting up operation a return movement at high speed is not objectionable since there is no possibili y of wrecking an expensive set of tools by accidentally backing the slide away too far.

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 hydraulic power transmission system for actuating a shiftable member at rapid traverse and feed rates in opposite directions, a control panel of the type having a pair of two-position valves separately and jointly shiftable out of the normal position to provide four different operating functions including a rapid advance with both valves shifted, a feed advance with one valve shifted, a return with the other valve shifted and a stop of said member with neither valve shifted, individual electric actuators for said valves, a control circuit including circuit controllers actuated by the shftable member for providing said functions in sequence automatically, and manual means for shifting said valves to selectively provide either feed advance or rapid return of said member, said means including a single lever normally biased to a neutral position in which both valves are freely shiftable by said actuators, said lever being shiftable to one side of neutral position to shift said one valve only and being shiftable to the other side of neutral position to shift the other valve only, whereby under manual control it is impossible to obtain a rapid advance of said member.

2. In a hydraulic power transmission system for actuating a shiftable member at rapid traverse and feed rates in opposite directions, a control panel of the type having a pair of two-position valves shiftable to provide four different operating functions, a pair of solenoids for actuating said valves, means responsive to shifting of the member for controlling energization of said solenoids, a removable housing surrounding said solenoids and having an elongated slot in one end, a straight lever pivoted in the housing adjacent the slot and adapted when manually oscillated to engage and shift either of the solenoids respectively, and a leaf spring secured to the lever adjacent its pivot and overlapping the edges of the slot, said spring biasing the lever to a neutral position parallel to the end of the housing.

FERRIS T. HARRINGTON.
RALPH L. TWEEDALE.