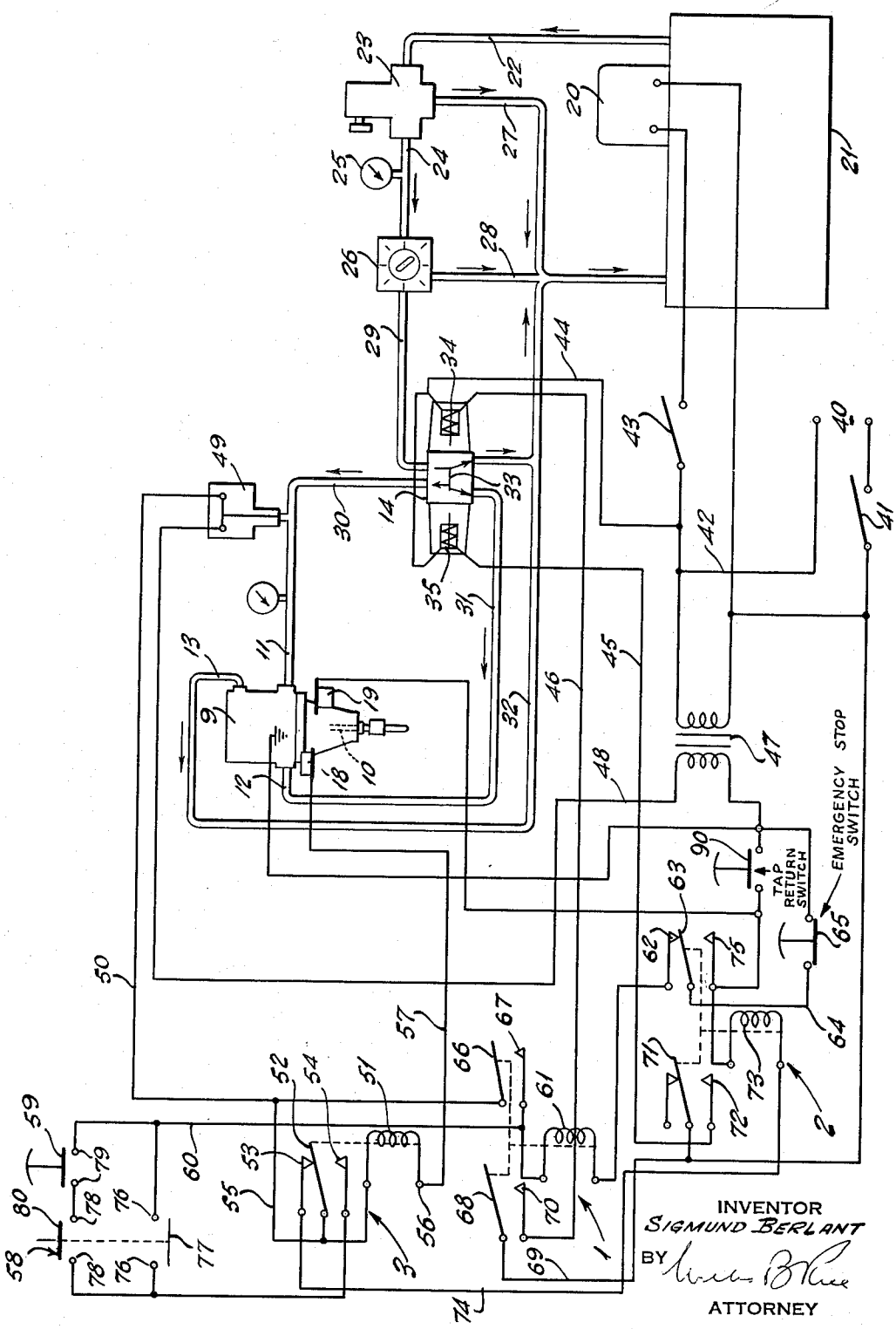
June 16, 1964 S. BERLANT 3,137,016

ELECTRICALLY CONTROLLED REVERSIBLE HYDRAULIC CIRCUIT MEANS FOR ROTARY AND AXIALLY MOVABLE TOOL SPINDLE

Original Filed Sept. 16, 1958



United States Patent Office 3,137,016 Patented June 16, 1964

3,137,016

ELECTRICALLY CONTROLLED REVERSIBLE HYDRAULIC CIRCUIT MEANS FOR ROTARY AND AXIALLY MOVABLE TOOL SPINDLE

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Continuation of application Ser. No. 761,371, Sept. 16, 1958. This application Jan. 8, 1963, Ser. No. 250,462
5 Claims. (Cl. 10—136)

This is a continuation of applicant's previously filed application Serial No. 761,371, filed September 16, 1958, now abandoned.

This invention relates to an automatic tapping device.

A main object of the invention is to provide an automatic tapping device which when desired can be operated repeatedly at high speed.

A further object of the invention is to provide an automatic tapping device which, if the tap thereof encounters undue resistance for any reason, will automatically shut down the machine.

A still further object of the invention is to provide an improved automatic tapping device which can be made to operate either with a single stroke, or to operate successively at high speed at will.

A still further object of the invention is to provide an improved automatic tapping device of the character described in which the speed of the tapping operation can be controlled, and in which the pressure exerted on the tap can be adjusted in accordance with the size of the tap.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawing, wherein the single figure diagrammatically illustrates an automatic tapping device constructed in accordance with the present invention.

In the drawing, the reference numeral 9 designates a hydraulic motor for driving the lead screw 10, having a hydraulic intake 11 for downward movement of a tap, and a hydraulic intake 12 for return movement of the tap, and a drain 13, which serves both the upward and downward motion mechanisms. Fluid to the motor is controlled by a fluid control valve 14, adapted to direct a hydraulic fluid from a supply 21 to either intake, as will be described presently.

The control of the tapping motor 9 is by means of relays which in turn are actuated to control the tapping operation by a microswitch 18 at the top of the stroke of the hydraulic motor and by a microswitch 19 at an adjustable lower point. These microswitches perform the function of switching the relays of the control system from a down-operating position to an up-operating position and back, when required.

The fluid pressure system comprises the motor-pump 20 for establishing the pressure upon the supply tank 21, and the fluid under pressure is led by a pipe 22 through a relief valve 23 by a conduit 24 past a gauge 25 to a pressure-compensated valve 26, for the purpose of controlling the rate of flow of the liquid to the motor, and hence to control the speed of the motor. The relief valve 23 has a drain 27, and the pressure valve 26 has a drain 28 leading back to the supply tank 21. A pressure conduit 29 leads the liquid under pressure from the valve 26 to the control valve 14, and this control valve has a conduit 30 leading to the intake 11, and a conduit 31 leading to the intake 12.

The drain 13 of the motor 9 leads back to the supply tank 21 by a conduit 32.

The control valve 14 has a slide valve 33 which in one position connects the pressure conduit 29 to the conduit 30, and in another position connects it to the conduit 31.

Within the valve 14 there are provided two operating solenoids 34 and 35, the solenoid 34 being designed to move the slide valve to cause the admission of fluid through the conduit 30, and the solenoid 35 being designed to move said slide valve to admit fluid to the conduit 31.

As shown in the drawing, the electric power line 40 is controlled by a main switch 41, which when closed, energizes the motor 20 by a wire 42 directly through a switch 43. A branch wire 44 leads to the power side of each of the solenoids 34 and 35. The other side of these solenoids is controlled by wires 45 and 46 and respective control relays 2 and 1 in a manner presently to be described.

A transformer 47 is connected directly across the power line 40 beyond the switch 41. A wire 48 leads from one terminal of the secondary of this transformer through an excess pressure switch 49 to a line 50. Transformer 47 steps down to 10 volts.

The control system, as here shown, in the preferred embodiment, includes three relays, here numbered 1, 2 and 3. Of these, relay 3 is for the purpose of opening the relay circuits to stop the operation at the close of a tapping operation, when the selector switch 58 of the apparatus is set for single tapping.

Relay 1 controls solenoid 34 at its contacts 68, 70 to cause the downward movement of the tapping head and relay 2 controls the solenoid 35 at its contacts 71, 72 to cause the return movement.

Relay 3 includes a coil 51 positioned to actuate a blade 52 movable between an upper contact 53 and a lower contact 54. The blade is connected by a wire 55 to line 50, and it is also connected to the top of coil 51.

The bottom terminal 56 of coil 51 is connected by a wire 57 through microswitch 18 to ground. Thus relay 3 is deenergized as soon as the tapping head moves down far enough to open microswitch 18.

While relay 3 is energized, it connects line 50 through selector switch 58 and manual switch 59 to a wire 60, which connects to the top of the coil 61 of relay 1, the circuit continuing through the back contact 62 and blade 63 of relay 2 to the other side of the ten volt line through a wire 64 and an emergency stop switch 65.

The operation of relay 1 through this circuit closes a circuit through a blade 66 connected to wire 50 and relay contact 67 connected to wire 60, to hold the relay 1 closed while relay 2 is deenergized.

Relay 1 is also provided with the blade 68 connected to the 110 volt line through a wire 69. The relay is also provided with a contact point 70 adapted to be engaged by blade 68, which contact point is connected to the wire 46, for the control of the solenoid 34, so that when relay 1 is energized, the solenoid acts to move the valve 14 to cause downward movement of the tap.

Correspondingly, the relay 2 is provided with the blade 71, connected to the wire 69 and adapted to be brought into contact with a contact point 72 which is connected to the line 45, to operate the solenoid 35 responsive to the energization of relay 2, to return the tap to its upper position.

Relay 2 has one terminal of its coil 73 connected by a wire 74 with the top contact 53 of relay 3, the other terminal of the coil 73 being connected to its own back contact 75, which is in a position to be engaged by blade 63 when the coil 73 is energized, said other terminal of coil 73 being connected to ground through the microswitch 19. The selector switch 58 is a double-pole, double-throw switch having the respective poles 80 and 77 and the respective sets of points 78, 78, engageable by the pole 80, and 76, 76 engageable by the pole 77. One of the contact points 76 is connected to the relay contact point 54 and the other contact point 76 is connected to the wire 60, so that when the contact points 76, 76 are

bridged by the pole 77, the machine is caused to operate repeatedly. The other set of contact points 78, 78 are connected in series with the contact points 79, 79 of a manually controlled switch 59. When the contact points 78, 78 are bridged by the pole 80, the machine is placed under the control of the manually operated switch 59, and will operate only while the manually operated switch 59 is held closed.

A tap return switch 90, which is manually controlled, and which is normally open, is connected between the contact point 75 of relay 2 and ground, in other words, in shunt with the microswitch 19.

The operation of the device is as follows:

Starting with the tap in its uppermost position, which will hold the microswitch 18 closed, and with the power off and the switches 58, 59 in the condition illustrated diagrammatically in the drawing, namely, in open position, let us assume that first the power switch 41 is closed, which will energize the secondary of the transformer 47, which will cause energization of the relay 3 through the wire 48, switch 49, wire 50, wire 55, coil 51, terminal 56, wire 57, and microswitch 18, which is closed, and which is thus connected to ground. The switch 43 is likewise closed, energizing the pump motor 20.

The energization of relay 3 causes blade 52 to engage contact point 54. Now, if switch 58 is operated to cause pole 80 to bridge contact points 78, 78 and switch 59 is closed, to bridge the contact points 79, 79, or alternatively, if switch 58 is operated to cause pole 77 to bridge the contact points 76, 76, the coil 61 of relay 1 will be energized by a circuit including the secondary winding of transformer 47, wire 48, switch 49, wire 50, wire 55, the contacts 52 and 54, either the series-connected pole 80 and its associated switch contacts and manual switch 59, or pole 77 and its associated contacts, the wire 60, the coil 61, the contacts 62, 63 of relay 2, the closed emergency switch 65 and the grounded terminal of the secondary winding of transformer 47. The energization of the relay 1 will close its contacts 68, 70 and 66, 67. The closure of the contacts 66, 67 establishes a holding circuit for the coil 61. Solenoid 34 is energized by the closure of the contacts 68, 70, since this connects the wire 46 to the wire 69. Energization of the solenoid 34 starts the movement of the tap downwardly.

As soon as the downward movement of the tap starts, the microswitch 18 will open, releasing the relay 3. The coil 61 of relay 1 is held energized through the holding contacts 66 and 67. The downward movement of the tap continues as long as contacts 68 and 70 of relay 1 are closed.

However, as soon as the tap reaches its lowermost position and closes the microswitch 19, thereby energizing the relay 2, the closure of the contacts 71 and 72 of relay 2 connects wire 45 to the wire 69, energizing the solenoid 35, which starts the upward movement of the tap. The closing of microswitch 19, which thereby energizes the relay 2, causes relay 1 to become deenergized by the opening of contacts 62, 63, thereby opening the energizing circuit of solenoid 34 at the contacts 68, 70. When the tap moves upwardly, the microswitch 19 opens, but the upward movement still continues, because the coil 73 of relay 2 is held energized by the closure of the contacts 63 and 75, the relay 2 being maintained energized until the tap moves upwardly sufficiently to close the microswitch 18. The closure of microswitch 18 causes the coil 51 of relay 3 to become energized through a circuit comprising the secondary of transformer 47, the wire 48, the switch 49, the wire 50, the wire 55, coil 51, terminal 56 and the wire 57, which is connected to ground through the microswitch 18. The energization of relay 3 causes relay 2 to become deenergized by the opening of the contacts 52, 53 of relay 3.

The manually operated switch 59 is in series with the upper pole 80 of selector switch 58, but is not in series with the lower pole 77 of the selector switch, so that when the switch 58 is moved downwardly, the tapping mechanism is under the control of the manual switch 59, and will continue its tapping operation successively so long as the switch 59 is closed. With the switch 59 open and the selector switch 58 in its upper position, the mechanism will continue its tapping operation indefinitely.

With the construction above described, it will be apparent that whereas the mechanically operated mechanism of the tapping machine is operated by the full line voltage available across the wires 42 and 69, the sensitive control mechanisms, including the relays 1, 2 and 3, are operated by a relatively low voltage, thereby reducing the danger to the operator and minimizing the risk of damage to the machine and the relay contacts.

The machine above described is designed to be operated with a self-feeding mechanism, not shown, or to be set by hand at the highest speed that the operator can work.

Because the parts are controlled hydraulically, a very accurate control of the tapping operation is possible, even at high speed.

The tap return switch 90, described above, is provided to energize the relay 2 at any time, as desired, to return the tap to its raised position. As above mentioned, the switch 90 is connected in shunt with the microswitch 19. The closure of either switch 90 or microswitch 19 will cause the coil 73 to become energized (with relay 3 deenergized), causing energization of the "up" solenoid 35. The movement of the tap to its upper position closes the microswitch 18 and causes the coil 51 of relay 3 to become energized, resetting the apparatus for further operation.

While a specific embodiment of an improved automatic tapping device has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A control device for a hydraulic tapping machine having first electrically operated valve means for admitting fluid to said machine for driving said machine in a down-tap direction and having second electrically operated valve means for admitting fluid to said machine for driving said machine in an up-tap direction, said device including a first relay having contacts for operating said first valve means and a second relay having contacts for operating said second valve means, said machine having a vertically traveling head and having a bottom microswitch operated by said head at the bottom limit of its travel and a top microswitch operated by said head at the top limit of its travel, a third relay, means to energize said first relay responsive to the energization of said third relay, means including said top microswitch to energize said third relay when the head is at said top limit to drive the machine in said down-tap direction, means including said bottom microswitch to energize said second relay when the head is at said bottom limit to drive the machine in said up-tap direction, and means preventing energization of the first relay when the second relay is energized.

2. A control device for a hydraulic tapping machine having first electrically operated valve means for admitting fluid to said machine for driving said machine in a down-tap direction and having second electrically operated valve means for admitting fluid to said machine for driving said machine in an up-tap direction, said device including a first relay having contacts for operating said first valve means and a second relay having contacts for operating said second valve means, said machine having a vertically traveling head and having a bottom microswitch operated by said head at the bottom limit of its travel and a top microswitch operated by said head at the top limit of its travel, a third relay,

means preventing energization of said second relay when said third relay is energized, means including said top microswitch to energize said third relay when the head is at said top limit, means to energize said first relay responsive to the energization of said third relay to drive the machine in said down-tap direction, means including said bottom microswitch to energize said second relay when the head is at said bottom limit to drive the machine in said up-tap direction, and means preventing energization of the first relay when the second relay is energized.

3. In combination, a hydraulic motor adapted to be reversibly driven and having a rotor provided with a chuck for a tap and rotating in one direction to drive the tap downwardly and in an opposite direction to move the tap upwardly, a fluid pressure source, first conduit means connected to the motor for admitting pressure fluid to the motor to drive the tap downwardly, second conduit means connected to the motor for admitting pressure fluid to the motor for driving the tap upwardly, a two-position slide valve connected between the source and said first and second conduit means, said slide valve in a first position connecting the source to said first conduit means and in a second position connecting the source to said second conduit means, a first solenoid on the slide valve moving the slide valve to said first position when energized, a second solenoid on the slide valve moving the slide valve to said second position when energized, a lower microswitch closed by the arrival of the tap at a predetermined down position, an upper microswitch closed by the arrival of the tap at a predetermined upper position, a first relay, means to energize said first solenoid when the first relay is energized, a second relay, means to energize the second solenoid when the second relay is energized, a third relay, means to energize said first relay when said third relay is energized, means to energize said second relay when the lower microswitch is closed, means responsive to the closure of said upper microswitch for energizing said third relay, whereby to move the slide valve to said first position and to drive the tap downwardly, means responsive to the energization of said second relay to deenergize the first relay, and means to energize said second solenoid responsive to the energization of said second relay, whereby to drive the tap upwardly.

4. In combination, a hydraulic motor adapted to be reversibly driven and having a rotor provided with a chuck for a tap and rotating in one direction to drive the tap downwardly and in an opposite direction to move the tap upwardly, a fluid pressure source, first conduit means connected to the motor for admitting pressure fluid to the motor to drive the tap downwardly, second conduit means connected to the motor for admitting pressure fluid to the motor for driving the tap upwardly, a two-position slide valve connected between the source and said first and second conduit means, said slide valve in a first position connecting the source to said first conduit means and in a second position connecting the source to said second conduit means, a first solenoid on the slide valve moving the slide valve to said first position when energized, a second solenoid on the slide valve moving the slide valve to said second position when energized, a lower microswitch closed by the arrival of the tap at a predetermined down position, an upper microswitch closed by the arrival of the tap at a predetermined upper position, a first relay, a second relay, means to energize said second relay when the lower microswitch is closed, means to energize said first solenoid responsive to the energization of said first relay, a third relay, means to energize said first relay responsive to the energization of said third relay, means to energize said third relay when the upper microswitch is closed, means to hold said first relay energized while the tap moves downwardly, means to deenergize said first relay responsive to the energization of the second relay, and means to energize said second solenoid responsive to the energization of the second relay, whereby to drive the tap upwardly.

5. In combination, a hydraulic motor adapted to be reversibly driven and having a rotor provided with a chuck for a tap and rotating in one direction to drive the tap downwardly and in an opposite direction to move the tap upwardly, a fluid pressure source, first conduit means connected to the motor for admitting pressure fluid to the motor to drive the tap downwardly, second conduit means connected to the motor for admitting pressure fluid to the motor for driving the tap upwardly, a two-position slide valve connected between the source and said first and second conduit means, said slide valve in a first position connecting the source to said first conduit means and in a second position connecting the source to said second conduit means, a first solenoid on the slide valve moving the slide valve to said first position when energized, a second solenoid on the slide valve moving the slide valve to said second position when energized, a lower microswitch closed by the arrival of the tap at a predetermined down position, an upper microswitch closed by the arrival of the tap at a predetermined upper position, a first relay, means to energize said first relay when the upper microswitch is closed, a second relay, means to energize said first solenoid responsive to energization of said second relay, means to energize said second relay responsive to energization of said first relay, whereby to drive the tap downwardly, means to hold the second relay energized during downward movement of the tap, means including a third relay to deenergize the second relay responsive to closure of the lower microswitch, means to energize said second solenoid responsive to energization of said third relay, means to energize said third relay responsive to the closure of the lower microswitch, whereby to drive the tap upwardly, and means to hold the third relay energized until the first relay again becomes energized.

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