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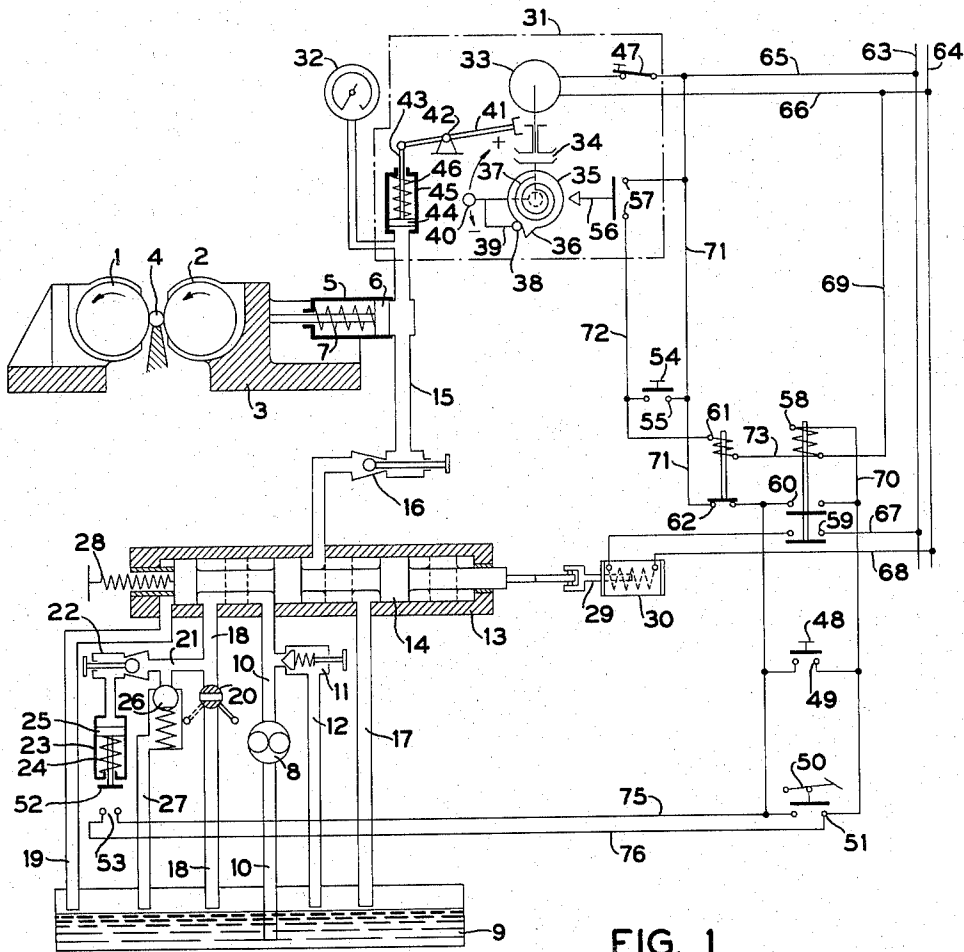
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ROLLING MACHINES AND CONTROL MEANS THEREFOR

Filed June 30, 1953

2 Sheets-Sheet 1



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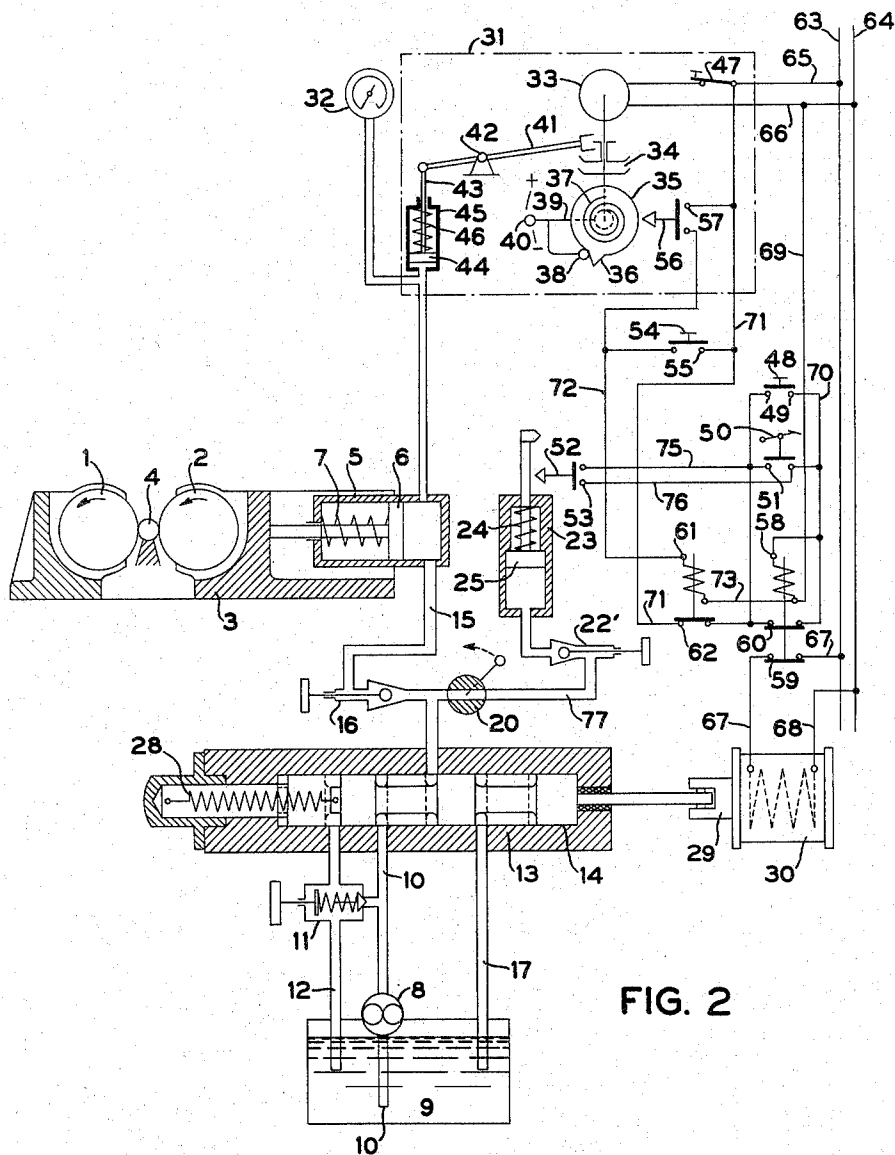
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1

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ROLLING MACHINES AND CONTROL MEANS THEREFOR

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5 Claims. (Cl. 80—6)

This invention relates to control means for hydraulically driven thread rolling machines. Thread rolling machines for the production of external threads by means of two thread rolls driven in the same direction of rotation, are known, in which the work piece is placed between the rolls and the rolls are caused to approach each other during the rolling operation, in a direction transversely of their axes. In these machines, one of the threading rolls is mounted axially stationary to absorb the operating pressures, while the other threading roll is mounted, together with its shaft bearings and worm gearing, on a slide which is moved hydraulically in a direction transverse to the roll axis. During the rolling process the threading rolls are moved together under high pressure until the work piece is completely rolled and are separated at the conclusion of the rolling process.

For controlling this known hydraulically operated thread rolling machine, there was employed a valve spool, positioned in the pressure line to the roll-operating cylinder and provided with a resetting spring. This valve spool effected the connection and disconnection of the hydraulic medium and was pushed manually, against the force of its resetting spring, to the position in which the hydraulic fluid was conducted to the operating piston. The valve spool was held locked in this position. The termination of the rolling process was determined by a timer mechanism, that is, a rotating timer with an angularly adjustable electrical contact, so that, upon the expiration of a predetermined time from the beginning of the rolling process, the electrical contacts in the timer mechanism were actuated. The circuit of an electromagnet was thereby closed which unlocked the valve spool so that it returned to its other position by means of spring pressure. In this position of the valve spool the flow of hydraulic fluid to the operating cylinder was cut off and the oil was discharged from the operating cylinder, so that the operating piston returned under spring pressure and the rolls were separated.

The hydraulic fluid was reconnected to the operating cylinder by renewed manual pressure on the valve spool. This semi-automatic thread rolling machine, in which only the disconnection of the hydraulic fluid and the relative approach of the rolls were effected automatically, has proved to be effective in all cases where the work piece was laid between the rolls by hand and where the work pieces were rolled in small lots.

An object of the invention is to increase the production of the thread rolling machine substantially by causing it to operate fully automatically. To accomplish this purpose, the re-connection of the hydraulic fluid, after it is disconnected by the timer mechanism, is effected by an adjustable timer piston which actuates, after an adjustable period of time, a starter for the electrical operation of the valve spool, so that the rolls are relatively reciprocated automatically, at adjustable intervals.

In this operation the valve spool is positioned to connect the hydraulic fluid by an electromagnet with a plurality of parallel starting contacts, actuated manually or

2

by the timer piston and a holding circuit is established for a starting relay. A plurality of parallel circuit-breaking contacts, actuated manually or by the timer mechanism, are provided for a circuit-breaking relay whose contacts are installed in the holding circuit of the starting relay.

The electromagnet employed as a power means for the valve spool therefore effects the connection and disconnection of the hydraulic medium by corresponding operation of the valve spool.

Other electrical power means, for example a motor with reversing control, can be used instead of the electromagnet.

The adjustable timer piston is under the influence of a resetting spring and cooperates with a metering valve, which, according to the arrangement of the timer piston, meters either the hydraulic fluid passing to the timer piston or the oil discharged from the cylinder of the timer piston. In both cases the amount of metering determines the period of time, reckoned from the start of the movement which effects the closing of the starting switch of the timer piston, after which period the electrical contacts are closed which reconnect the electrical power for the valve spool.

In the first case a stop valve is installed in the discharge line for the pump, which line is connected to the valve body, and a branch line is installed between the valve body and the stop valve, said branch line leading to the spring loaded timer piston which is provided with a metering valve. A discharge line with a relief valve is connected to the branch line and said relief valve opens to a pressure which is less than the minimum rolling pressure set by a pressure control valve.

In the second case a branch line, provided with a stop valve and a metering valve, leads from the pressure line for the operating cylinder, which line is connected to the valve spool, to the spring-loaded timer piston. The metering valve permits free flow of the oil under pressure while metering the discharge oil.

In both cases, the stop valve, which is associated with the timer piston, serves to change the control system of the hydraulically operated thread rolling machine either to hand initiation, corresponding to semi-automatic operation, or to fully automatic operation in which the rolls are again brought together for a new rolling operation after a predetermined stationary period. At the end of the rolling operation the rolls are automatically separated and both of the intervals are adjustable. The subject matter of the invention is shown in the drawing in two exemplary embodiments.

In the drawings:

Figure 1 shows a fully automatic control with the timer piston arranged in a branch of the discharge line and Figure 2 shows the same control but with the timer piston arranged in a branch of the pressure line.

According to Figure 1 the thread rolling machine has the threading roll 1, mounted axially stationary, and the threading roll 2, which is journaled on the slide 3. Between the threading rolls is the work piece 4. Both rolls are driven in the same direction of rotation by a driving means which is not shown.

The feeding movement of the slide 3 is effected hydraulically by the operating piston 6 in the operating cylinder 5. The compression spring 7 is disposed in the cylinder to withdraw the slide when the oil is discharged from the cylinder 5.

The oil is pumped from the reservoir 9 by the pump 8 through the line 10 and is forced to the operating cylinder 5. The adjustable pressure regulating valve 11 with the discharge line 12 is installed in the line 10 behind the pump 8. The relief valve 11 can be adjusted

3

and, according to its adjustment determines the pressure of the hydraulic fluid.

The line 10 is connected to the valve body 13 in which is disposed the valve spool 14, which is formed as a three-landed piston. The pressure line 15, leading from the valve body 13 to the operating cylinder 5 contains the adjustable metering valve 16 for regulating the feed.

The discharge lines 17, 18 and 19 are also connected to the valve body 13. The discharge line 18 contains the stop valve 20. The branch line 21 is connected to the discharge line 18 between the stop valve and the valve body. Line 21 contains the adjustable metering valve 22 for controlling the duration of the period during which the slide 3 is stationary and this line 21 leads to the cylinder 23 of the timer piston 25 which is under the pressure of the spring 24. The branch line 21 contains the relief valve 26 with the discharge line 27.

The resetting spring 28 is attached to one end of the valve spool 14 and the armature 29 of the electromagnet 30 is attached to the other end.

The timer mechanism 31 serves to disconnect the rolling pressure which is indicated by the pressure gage 32 connected to the pressure line 15.

An exemplary embodiment of the timer mechanism is shown in the drawing. The synchronous electric motor 33 drives the cam disk 35 through the shiftable clutch 34. The cam disk 35 is provided with the cam 36 and the resetting spring 37 which brings the cam 36 to rest against the stationary stop 38 when the clutch 34 is uncoupled. The stop 38 is secured on the rocking lever 39 and can be set in its rotational position on the circumference of the cam disk 35 by the handle 40. The two-armed lever 41, whose fulcrum is designated by 42, engages the sleeve of the clutch 34. The piston 44, disposed in the cylinder 45 against the force of the resetting spring 46, is linked to the lever 41. The cylinder 45 is connected to the pressure line 15. The synchronous motor 33 is started by the switch 47.

Connection and disconnection of the electromagnet 30 is effected by relay contacts. The electromagnet is energized either by the manual switch 48 with the contacts 49, the foot switch 50 with contacts 51 or the switch 52 with contacts 53 actuated by the timer piston 25. The electromagnet is de-energized either by the manual switch 54 with contacts 55 or by the switch 56 with contacts 57, actuated by the cam 36 of the cam disk 35 of the timer mechanism 31.

The energizing contacts 49, 51 or 53 energize the relay 58 having operating contacts 59 and holding contacts 60.

The de-energizing contacts 55 or 57 energize the relay 61 with the normally closed contacts 62.

The power lines 63 and 64 are connected to the synchronous motor 33 by lines 65 and 66, the switch 47 being installed in the line 65.

The power lines 63 and 64 are also connected to the electromagnet 30 by lines 67 and 68. The operating contacts 59 of the energizing relay 58 are installed in line 67.

The holding circuit of the energizing relay 58 leads from the line 66 through the line 69 of the coil of the energizing relay and thence through the line 70, holding contacts 60, contacts 62 and line 71 to line 65.

The de-energizing contacts 55 and 57 are installed between lines 71 and 72; line 72 leads to the coil of the de-energizing relay 61 and through the line 73 to line 69. The energizing contacts 49, 51 and 53 lie parallel to each other and are connected to the lines 75 and 76 which are connected to the holding contacts 60.

The manner of operation of the control system is as follows:

For fully automatic operation the stop valve 20 remains in the position shown. The hand switch 48 is operated, closing the contacts 49, to start the feeding movement of the threading roll 2. The coil of starting relay 58 is energized. The power flows from line 64

4

through line 66 and line 69 to the coil of the starting relay and thence through line 70, line 76, energizing contacts 49, line 75, normally closed contacts 62, line 71 and line 65 to the power line 63. The starting relay 58 closes the operating contacts 59 and holding contacts 60. Thereupon the electromagnet 30 is energized through the line 67, operating contacts 59 and line 68. The holding circuit maintains the starting relay in energized condition.

The armature 29 of the electromagnet pulls the valve spool into the dotted-line position. The hydraulic fluid coming from the pump flows from line 10 through the pressure line 15 into the operating cylinder 5 and exerts pressure against the operating piston 6. The speed of advance of the slide 3 is set at the metering valve 16.

At the same time, the hydraulic fluid exerts pressure against the piston 44 in the timer mechanism and engages the clutch 34. The synchronous motor 33 is connected to the cam disk 35. The cam disk rotates in the direction of the arrow until the cam 36 encounters the stop switch 56 and closes the contacts 57. Thus the relay 61 is energized through line 71, contacts 57, line 72 and lines 73 and 69. Energization of the relay opens the circuit breaking contacts 62, whereby the holding circuit of the starting relay is broken and the operating contacts 59 are opened. As a result, the circuit of the electromagnet 30 is interrupted and the armature 29 is released.

At this instant, the valve spool 14 is pulled back to the full line position by the resetting spring 28. The hydraulic fluid flows from cylinders 5 and 45 through lines 15 and 17. The threading roll 2 is pulled rearwardly by the compression spring 7, as shown in the drawing. At the same time, the clutch 34 is disengaged and the cam disk 35 rotates into its initial position in which the cam 36 lies against the stop 38. Simultaneously, oil from the pump under pressure strikes the timer piston 25 since, in the position of the valve spool 14 shown, the line 10 is connected to line 18. The piston 25 operates the starting switch 52 in accordance with a time set by adjusting the metering valve 22. The switch 52 closes the contacts 53 so that the starting relay 58 is again energized and the cycle begins once more. The surplus hydraulic fluid flows out through the relief valve 26 and discharge line 27 when the timer piston 25 is operated. As soon as the valve spool 14 is again disposed in the dotted-line position, the timer piston 25 returns by operation of its spring 24 and the displaced oil flows out of line 18 through the discharge line 19.

The thread rolling machine can also be started by the foot switch 50 and, in case of necessity, can be stopped by the manual stop switch 54.

If the thread rolling machine is not to be operated fully automatically, the stop valve 20 is opened, so that after stopping by the timer mechanism 31, the hydraulic fluid flows freely out of line 10 through discharge line 18 without exerting pressure on the timer piston 25. In this case the machine must be restarted by hand and the control operates semi-automatically.

In case of necessity the timer mechanism 31 can also be disconnected by opening the switch 47 for the synchronous motor 33. In this case starting and stopping of the feed of the threading roll 2 is effected by hand.

In Figure 2 the control system of Figure 1 is shown in altered form. The change mainly concerns the arrangement of the timer piston. The same reference characters are used as in Figure 1.

The timer piston 25 is actuated by the hydraulic fluid simultaneously with the operating piston 6. The pressure line 15 is provided with a branch line 77 for this purpose. Branch line 77 is connected to the cylinder 23 of the timer piston 25 and contains the stop valve 20. Also the metering valve 22' is disposed in the branch line 77.

The manner of operation is as follows:

When the manual starting switch 48 is actuated, the starting relay 58 is energized along with the electromagnet 30 and the valve spool 14 is disposed in the position shown in full lines in Figure 2. In this position of the valve spool, the hydraulic fluid is advanced from the line 10 to the pressure line 15. The stop valve 20 is open and pressure is exerted simultaneously on the timer piston 25 and the operating piston 6. The metering valve 22' allows the fluid to pass freely so that the timer piston 25 immediately takes the position shown.

When the operation is stopped by the timer mechanism 31, the circuit of the electromagnet 30 is broken in the same way as in the circuit of Figure 1 and the valve spool 14 is moved into the dotted-line position by the resetting spring 28. In this position the pressure line 15 is connected to the discharge line 17. The oil displaced by the returning timer piston 25 is metered through the metering valve 22'. As soon as the timer piston strikes the switch 52 in its return movement and closes the starting contacts 53, the circuit of the starting relay 58 is again closed, the electromagnet 30 is again energized and moves the valve spool again into the position shown. The remainder of the operation is the same as in Figure 1.

I claim:

1. A machine tool comprising a working member movable through an advance stroke under the influence of fluid pressure and a retract stroke when said pressure is relieved; a valve movable between first and second positions to selectively connect said working member to a source of fluid pressure and to exhaust; an electrical control circuit including a solenoid for actuating said valve adapted to be connected to a source of electrical energy, and, when energized, to energize said solenoid to shift said valve to said first position to advance said working member; first switch means in said electrical control circuit; a pressure responsive timer operable a predetermined time after said valve is shifted to said first position to actuate said switch to deenergize said solenoid whereby said valve is shifted to said second position to connect said working member to exhaust; second switch means in said electrical control circuit; and fluid pressure switch control means operable a predetermined time after said valve is shifted to said second position to close said second switch to reenergize said solenoid to shift said valve to said first position to again apply fluid to advance said working member, said valve including means to connect said switch control means to said source of fluid pressure when said valve is in said second position.

2. A machine tool comprising a working member movable through an advance stroke under the influence of fluid pressure and a retract stroke when said pressure is relieved, a valve movable between first and second positions to selectively apply and relieve said fluid pressure; an electrical control circuit including a solenoid for actuating said valve adapted to be connected to a source of electrical energy, and, when energized, to energize said solenoid to shift said valve to said first position to apply fluid pressure to advance said working member; a holding circuit to maintain said solenoid energized; switch means in said holding circuit; pressure responsive means connected in parallel with said working member and operable a predetermined time after said valve is shifted to said first position to actuate said switch to open said holding circuit and thereby deenergize said solenoid whereby said valve is shifted to said second position to relieve said fluid pressure; second pressure responsive switch means in said electrical control circuit; and means operable a predetermined time after said valve is shifted to said second position to reenergize said solenoid and said holding circuit to shift said valve to said first position to again apply fluid to advance said working member.

3. An electrical control circuit including a solenoid valve operator comprising, a normally open starting switch adapted to be selectively closed to energize the control circuit and said solenoid valve operator; a holding circuit to maintain said control circuit energized after the starting switch is open; a switch in said holding circuit; timing means operable a predetermined time after said holding circuit is closed to actuate said switch in said holding circuit to open said holding circuit to deenergize said solenoid valve operator; a second switch in parallel with said starting switch; and timing means effective a predetermined time interval after said holding circuit is opened to close said second switch and said holding circuit thereby placing said control circuit in its initial condition for a repeat operation.

4. In a thread rolling machine having a first threading roll mounted for movement toward and away from a second threading roll; a power cylinder containing a piston connected to said first roll and adapted to move said first roll toward said second roll upon the application fluid pressure to said cylinder and spring biased to move said first roll away from said second roll when said fluid pressure is relieved; a valve movable between first and second positions to selectively connect said cylinder to a source of fluid under pressure and exhaust, said valve being spring biased to said second position; an electrical control circuit including a solenoid adapted to move said valve to said first position; first switch means in said control circuit adapted, when actuated, to deenergize said solenoid; actuating means for said first switch means including a pressure responsive element connected to said cylinder and effective a predetermined time after the application of pressure thereto to actuate said first switch means to deenergize said solenoid whereby said valve is moved to said second position; additional switch means in said circuit adapted, when actuated, to reenergize said solenoid; and operating means for said second switch means including a pressure responsive element and effective a predetermined time after connection of said cylinder to exhaust to reenergize said solenoid to move said valve to said first position.

5. A machine tool comprising a working member movable through an advance stroke under the influence of fluid pressure and through a retract stroke when said pressure is relieved, valve means movable between a first position to connect said member to a source of fluid under pressure and to a second position for connecting said member to exhaust to thereby advance and retract said tool, resilient means urging said valve means toward said second position, a solenoid adapted, when energized, to move said valve means to said first position, a timer actuated by movement of said valve means toward said second position to actuate said solenoid to move said valve means to said first position after a first predetermined time, and an additional timer actuated by movement of said valve means to said first position to deenergize said solenoid to thereby permit said valve means to move to said second position after a second predetermined time whereby said tool is moved through a succession of advance and retract strokes, said strokes being initiated said first and second predetermined times after the initiation of the previous stroke.

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