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CONTROL MECHANISM FOR HYDRAULIC DRIVES

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Fig. 1.

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3 Sheets-Sheet 2

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To whom it may concern:

Be it known that I, WALTER FERRIS, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Control Mechanism for Hydraulic Drives, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to hydraulic drives for presses and the like and, more particularly, to controls therefor.

One object of the present invention is the provision of an automatic control for reciprocating machines so constructed and arranged as to operate independently of the movement of the driven reciprocating part, but under the control thereof.

Another object is the provision of an automatic control mechanism for reciprocating machines in which energy transmitted from the driven reciprocating part to the control mechanism may be stored therein to later effect the operation thereof as determined by the position of the driven part.

These and other objects and advantages will appear from the following description of an illustrative embodiment of the present invention.

In the accompanying drawings:

Figure 1 is a side elevation of a hydraulic press embodying the novel features of the present invention.

Figure 2 is a front elevation thereof.

Figures 3, 4 and 5 are fragmentary views illustrating more or less diagrammatically the several positions of the parts during an operating cycle.

Although the invention is illustrated and will be described as embodied in a press for broaching, assembling or the like, the novel features thereof may be employed to advantage in effecting and controlling the feed of the tool or work table in other types of machines, such, for instance, as boring mills, lathes and grinders.

The press shown comprises a base frame 10 of appropriate form supporting the usual bed 11 and C-frame 12. A power cylinder 13 is fixed in vertical position in the top of the frame 11. A piston 14 reciprocable in the cylinder 13 is connected in driving relation with a plunger 15 so as to drive the plunger toward and from the work on the bed. Conduits 16 and 17, communicating with the upper and lower ends, respectively, of the cylinder 13, are connected to the opposite sides of a reversible, variable displacement pump 18 of any standard or approved type.

The pump shown is fully described in my copending application, Serial No. 682,056, filed December 21, 1923, and since the particular construction thereof is not essential to a complete understanding of the present invention a detailed description thereof will not be given herein. Suffice it to state that the pump shown is driven at substantially constant speed through the belt and pulley 19 from any appropriate power source. A control stem 20 regulates the fluid displacement of the pump so as to vary and control the direction and rate of flow of the fluid in the conduits 16 and 17. When the stem 20 is in the intermediate position shown in Figure 1 pump displacement is zero so that the fluid in the conduits 16 and 17 is at rest and the plunger 15 remains stationary. When the stem 20 is withdrawn outwardly from the position shown the pump delivers fluid into and through the conduit 16 to force the piston and plunger downwardly, the fluid in the base of the cylinder 13 returning to the pump through the conduit 17. When the stem 20 is shifted inwardly from the intermediate neutral position shown the pump delivers fluid to and through conduit 17 to force the piston and plunger upwardly, the fluid in the top of the cylinder 13 returning to the pump through the conduit 16. The direction and rate of movement of the plunger 15 is thus dependent upon the direction and extent of shifting of the stem 20 from its intermediate neutral position.

In the present instance, the stem 20 is placed under the control of the plunger 15 so as to automatically vary the rate and direction of movement of the plunger at predetermined points in an operating cycle. In the press shown, mechanism for this purpose includes a tappet rod 21 mounted for vertical reciprocation in appropriate brackets 22 and 23 fixed to the machine frame. A coiled compression spring 24 surrounding the rod 21 tends normally to force the rod downwardly. This spring bears at one end
against the upper fixed bracket 22 and at its other end against an arm 25 adjustably fixed to the rod 21. The plunger 15 carries a rigid arm 26 suitably perforated to slidably receive the rod 21 and so disposed that, as the plunger approaches the end of its upward travel, the arm 26 forces the arm 25 and consequently the rod 21 upwardly against the pressure of the spring 24. The arm 25 is limited in its downward movement by any appropriate means, such as a stop collar 27 adjustably fixed to a vertical rod 28 anchored at its lower end in the lower bracket 23 and projecting loosely through the end 29 of the arm 25.

Two spaced detent lugs 30 and 31 are adjustably fixed to the upper end of the tappet rod 21. A dog 32 rockably mounted upon a horizontal pivot pin 33, fixed in the bracket 22, is yieldably retained by a tension spring 34 with its nose 35 in the path of movement of the lug 30. A second dog 36, similarly mounted, is yieldably retained by a tension spring 37 with its nose 38 in the path of movement of the lug 31. A trip rod 39 anchored in vertical position in the arm 26 carries a pair of spaced trip cams 40 and 41. Cam 40 is so disposed as to engage the tail 42 of dog 32 to trip this dog as the rod 39 travels downwardly with the arm 26 and plunger 15. Cam 41 is similarly disposed with respect to the tail 43 of dog 36.

Two collars 44 and 45 are adjustably fixed in spaced relation upon the lower end of the tappet, rod 21. A bell-crank lever 46, supported upon a horizontal pivot pin 47, fixed to the bed of the machine, is provided with a horizontal arm 48 having a bifurcated head 49 loosely embracing that portion of the rod 21 between the collars 44 and 45. Lever 46 is also provided with a depending arm 50 which is operatively connected through a link 51 with one end 52 of a lever mounted upon a fixed vertical pivot 53 and connected at its other end 54 to the pump control stem 20. The connections between the arm 50 and stem 20 are such that the stem is actuated by and responds at all times to the position of the lever 46.

The lever 46, and consequently the stem 20, may be controlled by the operator by means of the handle 55, integrally connected with the lever, or by a foot lever 56 connected through a link 57 therewith. The foot lever 56 is pivoted as at 59 upon the base frame of the press and is yieldably supported by a spring 60 of such tension as to merely counterbalance the weight thereof.

 Provision is preferably made for yieldably retaining the lever 46 in any position to which it may be set. In this instance, mechanism for this purpose comprises a link 61 pivotally connected at one end 62 with the link 57 and provided with a longitudinal slot 63. The pin 64 connecting the arm 50 with the link 51 extends through the slot 63 and carries a compression spring 64 which maintains a clamping pressure between the link 61 and arm 50 to thereby offer frictional resistance to movement of the arm 50 along the link 61. This frictional resistance is sufficient to maintain the lever 46 in any set position against accidental displacement.

Before an operating cycle the several parts are normally in the respective positions shown in Figures 1 and 2. The plunger 15 is at rest at the upper end of its stroke with the tappet rod 21 supported in its upper extreme position by the engagement of the arm 26 beneath the arm 25 fixed to the tappet rod. The spring 24 is under maximum compression. The lever 46, and consequently the pump control stem 20, are in intermediate neutral position, so that the pump is operating at zero stroke. The lower collar 44 on the rod 21 is in contact with the head 48 of the lever 46 while the upper collar 45 is spaced well above the head 48. To begin an operating cycle, the operator, by depressing either the handle 55 or the foot lever 56, rocks the lever 46 in a clockwise direction until the head 49 thereof strikes the upper collar 45 on the rod 21. This movement of the lever shifts the pump control stem 20 outwardly (toward the right) to an extreme position to thereby cause the pump to deliver fluid at a maximum rate to and through the conduit 16 to the cylinder 13, and the plunger 15 moves downwardly at a maximum rate in the manner hereinabove described. The instant the arm 25 is relieved of the supporting pressure of the arm 26 by the downward movement of the plunger, the tappet rod moves downwardly slightly until arrested by the engagement of the detent lug 30 with the dog 32. The tappet rod through the collar 45 sets the lever 46 into the position shown in Figure 3 so that the plunger 15 continues to travel downwardly at a high rate of speed. High speed of the plunger during this first stage of the cycle is advantageous because the plunger is at that time merely performing the necessary idle stroke to bring it into operative relation with the work.

The plunger continues the downward movement at this predetermined rate until it or the tool carried thereby is about to engage the work. Trip cam 40 is so positioned on the downwardly moving rod 39 as to engage the tail 42 and release the dog 32 from engagement with the detent lug 30 at the end of the first stage of the cycle. When so released the tappet rod 21 is forced downwardly under the action of spring 24 until arrested by engagement of detent lug 31 with the second dog 36. This action of the rod 21 is transmitted through the collar 45 to the head 49 of the lever 46 to shift the
lever into the position of Figure 4. This action of the lever 46 effects a corresponding movement of the pump control stem 20 so that pump displacement is reduced, and the rate of downward travel of the plunger is correspondingly reduced. This constitutes the second stage of the cycle in which the plunger or tool carried thereby is engaged with the work. By adjusting the detent lug 31 upon the tappet rod 21 the rate of advance of the plunger during this stage may be nicely determined to best suit the character of the work to be performed.

The downward advance of the plunger continues at this rate until the trip cam 41 strikes the tail 43 and releases the dog 36 from engagement with lug 31. When so released the tappet rod 21 is again forced downwardly by the spring 24 until arrested by engagement of the arm 25 with the stop collar 27 on the rod 28. This movement of rod 21 is transmitted through collar 45 to the lever 46 to force the lever through the neutral intermediate position into the position of Figure 5. This movement of lever 46 is transmitted to the pump control stem 20 so as to shift it into its extreme inward position to thereby reverse the pump and cause the same to deliver fluid into and through conduit 17 to the base of the cylinder 13. The plunger 15 then begins its upward or return stroke in the manner hereinabove described. This upward travel of the plunger 15 continues until the arm 26 carried thereby has reengaged and lifted the arm 25 on the tappet rod 21 into the position shown in Figures 1 and 2. The arm 25, of course, carries the rod 21 upwardly with it and by the engagement of the collar 44 thereon with the head 49 of lever 46 returns the lever and consequently the pump control stem 20 into neutral position. The pump is thus readjusted to zero displacement condition and the plunger comes to rest in its upper extreme position. It will be noted that during the return or upward stroke of the plunger sufficient energy is stored in the spring 24 by the action of the plunger to supply the power necessary to effect the automatic adjustment of the pump during the succeeding operating cycle.

It will thus be noted that the machine described embodies an automatic control mechanism, including the rod 21 which is operated in one direction by the upward travel of the arm 26 carried by the driven plunger 15, and that this mechanism operates automatically in the other direction under the action of the spring 24, and under the control of the latch mechanism and rod 39 the position of which always corresponds to the position of the driven plunger 15.

At any stage in the cycle the operator may arrest or reverse the movement of the plunger 15 by manipulation of the handle 55.

Various changes may be made in the embodiment of the invention hereinabove described, without departing from or sacrificing any of the advantages of the invention as defined in the appended claims.

1 claim:

1. In a machine of the character described the combination of a reciprocating member, driving means therefor, means automatically operable in one direction to vary the rate of movement of said member, means controlled by said member for controlling said rate varying means, and means actuated by said member for operating said rate varying means in the opposite direction.

2. In a machine of the character described the combination of a reciprocating member, driving means therefor, means for varying the rate of movement of said member, means controlled by said member for controlling said rate varying means, resilient means for operating said rate varying means in one direction and means actuated by said member for operating said rate varying means in the opposite direction.

3. In a machine of the character described the combination of a reciprocating member, means including a variable displacement pump for driving said member, means automatically operable in one direction to vary pump displacement to thereby vary the rate of movement of said member, means controlled by said member for controlling said displacement varying means, and means actuated by said member for operating said displacement varying means in the opposite direction.

4. In a machine of the character described the combination of a reciprocating member, means including a variable displacement pump for driving said member, means for varying pump displacement to vary the rate of travel of said member, means controlled by said member for controlling said displacement varying means, resilient means for operating said rate varying means in one direction, and means actuated by said member for operating said displacement varying means in the opposite direction.

5. In a machine of the character described the combination of a reciprocating member, hydraulic means for driving said member, means automatically operable in one direction to reverse the operation of said hydraulic means at the end of a predetermined movement of said member, and means actuated by said member for operating said reversing means in the opposite direction.

6. In a machine of the character described the combination of a reciprocating member, hydraulic means for driving said member, means for reversing the operation of said hydraulic means at the end of a predetermined movement of said member, resilient means for operating said reversing means
in one direction, and means actuated by said member for operating said reversing means in the opposite direction.

7. In a machine of the character described the combination of a reciprocating member, hydraulic means for driving said member through a complete cycle, means controlled by said member for varying the rate of movement of said member at one point in the cycle and for reversing the movement thereof at another point in the cycle, and means actuated by said member for returning said movement varying means to a predetermined position at the end of a cycle.

8. In a machine of the character described the combination of a reciprocating member, means including a variable displacement pump for driving said member through a complete cycle, means controlled by said member for varying and controlling pump displacement to vary and control the rate and direction of movement of said member throughout the cycle, and means actuated by said member for returning said displacement varying means to a predetermined position at the end of a cycle.

9. In a machine of the character described the combination of a reciprocating member, means including a variable displacement pump for driving said member, means actuated by said member for varying pump displacement, and detent mechanism controlled by said member for controlling said displacement varying means.

10. In a machine of the character described the combination of a reciprocating member, means including a variable displacement pump for driving said member, means actuated in one direction by said member for varying pump displacement, and detent mechanism controlled by said member for controlling the operation of said displacement varying means in the opposite direction.

11. In a machine of the character described the combination of a reciprocating member, means including a variable, displacement pump for driving said member, means including a reciprocable element for varying pump displacement, latch mechanism for releasably restraining said element against movement, and trip mechanism movable with said member for releasing said latch mechanism.

12. In a machine of the character described the combination of a variable displacement pump, a member driven thereby, means for varying pump displacement, a rod for actuating said means, latch mechanism for yieldably maintaining said rod in a predetermined position, and trip mechanism controlled by said member for releasing said latch mechanism to permit said rod to actuate said displacement varying means.

13. In a machine of the character described, the combination of a reciprocating member, means for driving said member, a rod movable to vary the rate of movement of said member, a plurality of latch mechanisms normally operable to retain said rod in any of several predetermined positions, and trip mechanism movable with said member for releasing said latch mechanisms successively.

14. In a machine of the character described the combination of a variable displacement pump, a member driven thereby, pump displacement varying means, a rod operable to shift said means, latch mechanism for releasably retaining said rod in a predetermined position, trip mechanism controlled by said member for releasing said latch mechanism, and means under the control of the operator for operating said displacement varying means.

In witness whereof, I hereunto subscribe my name this 7th day of May, 1924.

WALTER FERRIS.