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FLUID OPERABLE STROKE CONTROLLING DEVICE FOR FLUID PUMPS

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2 Sheets-Sheet 1

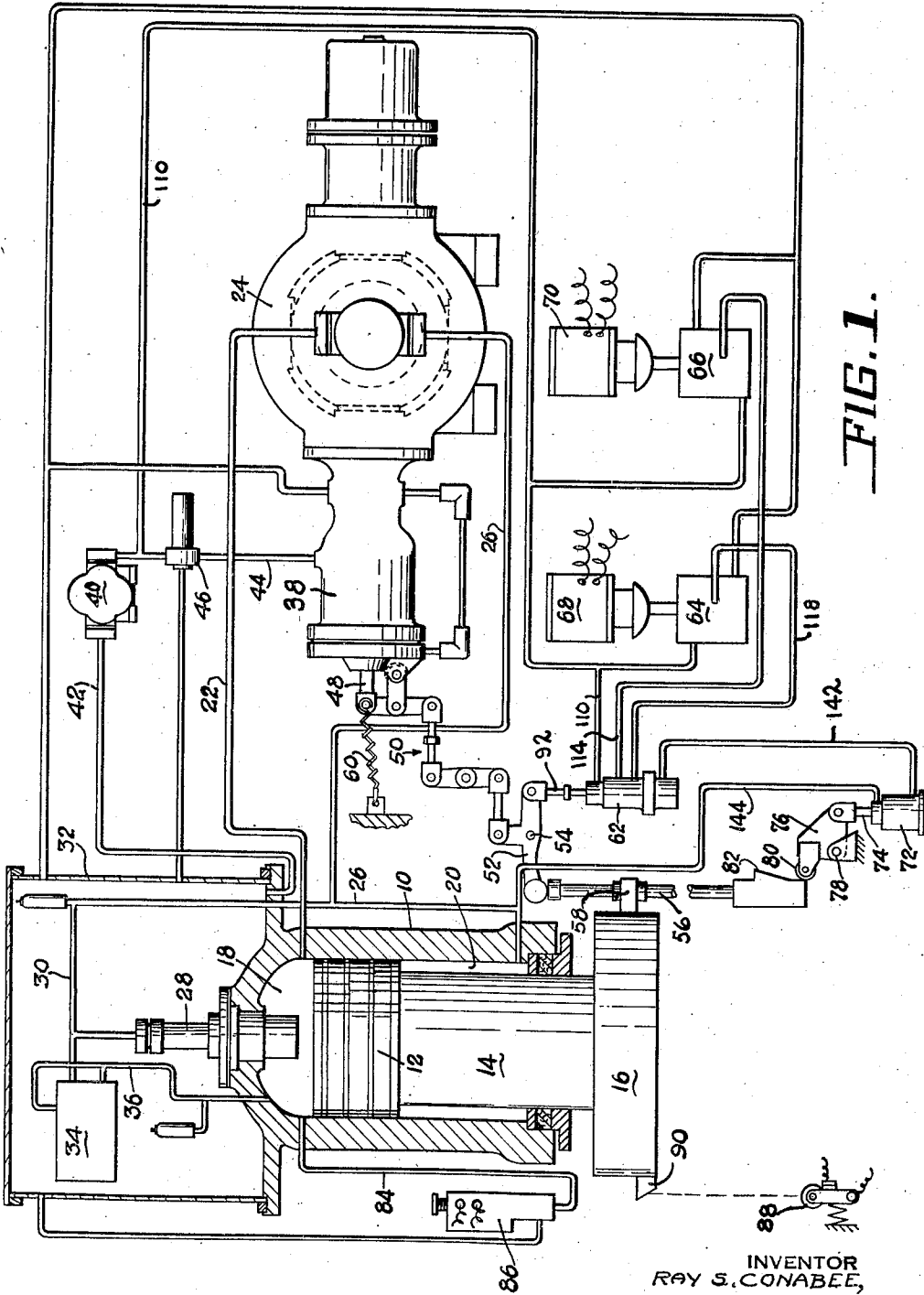


FIG. 1.

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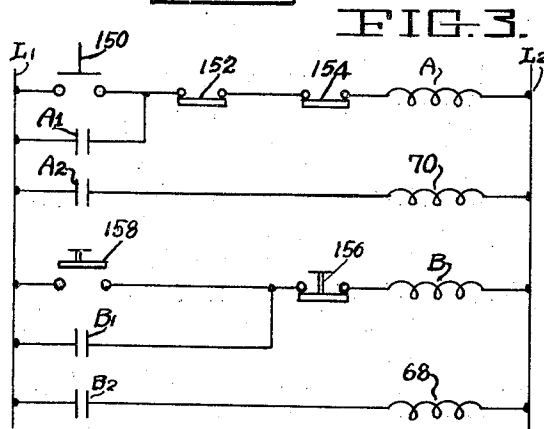
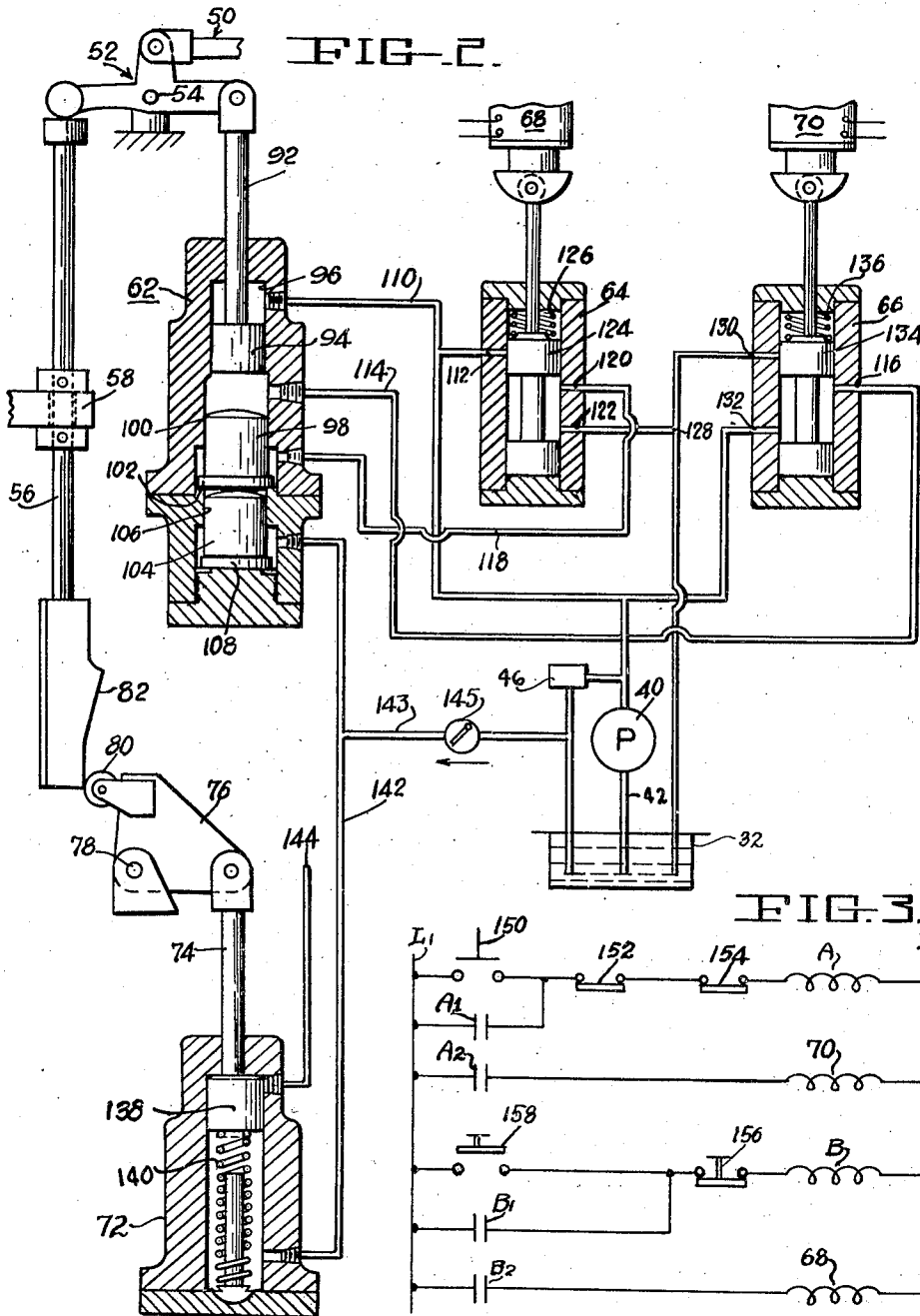
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FLUID OPERABLE STROKE CONTROLLING
DEVICE FOR FLUID PUMPS

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9 Claims. (Cl. 60—52)

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This invention relates to fluid operable systems and, particularly, to hydraulic press control systems.

In a hydraulic press it is often desirable or necessary to vary the speed of the ram during the working stroke thereof. In a press actuating system this can best be accomplished by varying the supply of fluid to or from the press ram. It is further advantageous to be able to control the speed variations of the ram according to the position thereof.

It is a primary object of this invention to provide a mechanism operated by a press platen for controlling the speed thereof.

It is another object to provide a fluid displacing mechanism to be operated by a press ram for displacing a metered quantity of fluid for controlling the supply of actuating fluid to the ram.

In very large hydraulic presses the auxiliaries such as the pump and valves are often large and heavy and difficult to manipulate. In this event it is advantageous to employ hydraulic actuators for the said auxiliaries and to control the hydraulic actuator by a pilot circuit including small solenoid operated valves.

Accordingly, it is still another object to provide a control system including fluid displacing means for a press circuit employing pilot operated actuators.

These and other objects and advantages will become more apparent upon reference to the accompanying drawings in which:

Figure 1 is a diagrammatic view of a hydraulic press having an operating system and a control circuit according to this invention;

Figure 2 is a diagrammatic view showing my improved control circuit somewhat enlarged and in section; and

Figure 3 is a diagrammatic view of an electrical diagram adapted for use in connection with control circuits of Figures 1 and 2.

Referring to the drawings, there is shown in Figure 1 a press cylinder at 10 having reciprocally mounted therein the piston 12 to which is secured the ram 15 which carries the platen 16. The piston 12 and cylinder 10 define the advancing means 18 and the retracting means 20 for reciprocating the said piston, ram and platen.

Fluid is supplied to the advancing means 18 by conduit 22 which is connected with one of the ports of the reversible variable delivery pump 24, the other port of which is connected by a conduit 26 with the retracting means 20.

The cylinder 10 mounts a surge valve 28 in the upper end thereof which is adapted in response to

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a predetermined pressure conducted thereto from the retracting means 20 by a conduit 30 to interconnect the advancing means 18 with the reservoir 32.

A valve 34 is provided which is connected with the retracting means by the conduit 30 and with the advancing means by the conduit 36 and which is operable, at the end of an advancing stroke of the press plunger, to bypass the delivery from the pump 24 while relieving the pressure of the advancing means 18 thereby to effect a shockless and smooth reversal of the press ram and platen.

The pump 24 is fitted with the usual servomotor controls such as those illustrated in the Patent No. 2,280,190 issued to Walter Ernst.

The supply of pressure fluid for actuating the servomotor indicated at 38 is had from the pilot pump at 40. The pilot pump draws fluid from the reservoir 32 by the conduit 42 and delivers it to the said servomotor by the conduit 44. A relief valve at 46 provides a means for discharging the excess delivery of the pump 40 to the reservoir.

The servomotor is controlled by the plunger 48 which is connected by a linkage generally indicated at 50 with the lever 52 which is pivoted at 54. One arm of the lever 52 is adapted for being engaged by the rod 56 which passes through the platen arm 58. A pair of adjustable collars on either side of the said platen arm are adapted for adjustably securing the said rod to the platen arm. When the press ram and platen are in their retracted position, the rod 56 engages the lever 52 and actuates the plunger 48 to position the pump in neutral. A spring 60 is connected with the plunger 48 for continuously urging the same into position to bring about the delivery of the pump 24 to the retracting means 20.

The third arm of the lever 52 is connected with a hydraulic actuator generally indicated at 62 which is controlled by a pair of valves at 64 and 66. The valves 64 and 66 are controlled respectively by the solenoids 68 and 70.

The hydraulic actuator 62 is further controlled by a cylinder 72, the plunger 74 of which is pivotally secured to a lever 76 which is rotatably mounted on the stationary pivot 78. The lever 76 also comprises a roller 80 which is adapted for being engaged by the cam 82 carried by the rod 56. As will become more apparent hereinafter, the actuation of the lever 76 by the cam 82 is effective through the cylinder 72 and the hydraulic actuator at 62 to move the pump 24 into reduced delivery position thereby to retard the speed of the press platen during its downward travel.

The advancing means 18 is connected by a conduit 84 with an adjustable pressure switch 85 which is adapted in response to a predetermined pressure to open a circuit to bring about the reversal of the press platen. A limit switch at 88 and a cam 90 on the press platen are also arranged to bring about the reversal of the press platen and may be selectively made effective rather than the switch 86 if desired.

Referring to Figure 2, the hydraulic connections of the control circuit are more particularly shown. Referring to Figure 2, it will be seen that the lever 52 is connected by the rod 92 with the piston 94 in the bore 96 of the hydraulic actuator 62. A second piston 98 is reciprocable in the bore 100 of the actuator 62 and is adapted for abutting the lower end of the piston 94. The piston 98 comprises a shoulder 102 adapted for stopping the movement of the said piston at a predetermined point in its travel. A third piston 104 reciprocates in the bore 106 and abuts the lower surface of the piston 98 for actuating there-through the piston 94. The piston 104 also comprises a shoulder portion 108 adapted for limiting its movement. In the position shown, the pump is in neutral. When the piston 94 is moved downwardly to abut the piston 98, the linkage 50 shifts the pump to deliver full volume to the advancing means 18. If the piston 98 is then actuated to move upwardly against its stop, the piston 94 is also moved upwardly to bring the pump, through the linkage 50, into neutral position. The piston 98 thereby provides for an emergency stop.

If the piston 104 is actuated through a predetermined distance, the pistons 98 and 94 are moved upwardly thereby, through the linkage 50, to vary the pump stroke, thereby to reduce the speed of travel of the press ram.

The upper end of the cylinder 96 is connected by conduit 110 with the port 112 of the valve 64 and also with the discharge port of the pilot pump 40. The lower end of the cylinder 96 is connected by a conduit 114 with the port 116 of the valve 66.

A conduit 118 is connected with the port 120 on the valve 64 and is adapted for exhausting or supplying pressure to the piston 98. The exhaust of the piston 98 is accomplished by the port 122 in the valve 64 when the valve member 124 is urged into its downward position by the spring 126. The conduit 128 connects with the exhaust and also with the port 122 and with the port 130 of the valve 66. The valve 66 likewise comprises a port 132 which is connected with the conduit 110 for receiving pressure from the pump 40. The valve member 134 of the valve 66 is urged downwardly by the spring 136 to interconnect the port 116 and 132.

Referring to the cylinder 72, this will be seen to comprise the piston 138 which is connected with the plunger 74. A spring 140 urges the piston and plunger upwardly thereby to position the roller 80 in the path of the cam 82. The lower end of the cylinder 72 is connected by conduit 142 with the piston 104 so that fluid displaced from the said cylinder will actuate the said piston. The upper end of the cylinder 72 is connected by conduit 144 with the retracting means 20 so that the pressure conducted from the retracting means to the cylinder will move the piston 138 downwardly during the retraction stroke of the press and position the roller 80 away from the path of the cam 82. A conduit 143 comprising the check valve 145 connected from the conduit 142 to the reservoir 32 to make

up for leakage in the actuating system for the plunger 104.

In Figure 3 is shown the electrical circuit for controlling the solenoids 68 and 70 thereby to control the control circuit of Figure 2. There is connected between the power lines L1 and L2 a contactor A which is in series with the start button 150, the normally closed contacts 152 of the switch 86 and the normally closed contacts 154 of the switch 88.

A set of contactor blades A1 bypass the start button 150 for maintaining the coil A energized until the blades 152 or 154 are opened. A second pair of blades A2 are connected by the lines L1 and L2 in series with the solenoid 70. Thus, energization of A brings about the energization of 70 and actuates the valve 66.

Also connected between lines L1 and L2 is the contactor coil B which is in series with the normally closed switch 156 and the normally open switch 158. The aforementioned normally open switch is bypassed by a set of contactor blades B1. Another set of contactor blades B2 are connected in series with the solenoid 68 between the lines L1 and L2.

Operation

In operation, a working stroke is commenced by energizing the solenoid 70 thereby to shift the valve member 134 upwardly thereby to interconnect the ports 116 and 130 to bring about the exhaust of the lower end of the bore 96. This permits the pilot pressure standing on the upper end of the piston 94 to move the latter downwardly thus to shift the linkage 50 and to place the pump in position to deliver to the conduit 22.

The press platen moves downwardly as the pump withdraws fluid from the retracting means 20 until the platen 16 reaches work engaging position. Thereafter, the platen moves downwardly as the pump supplies fluid to the advancing means 18. If, however, during the advancing movement, it is desired to retard the speed of the platen 16, this may be accomplished by the supply of fluid to the piston 104 from the cylinder 72 when the cam 82 engages the roller 80. The amount of fluid displaced from the cylinder 72 is regulated by the configuration of the cam 82 and the upward movement of the piston 104 is regulated by the amount of fluid delivered thereto from the cylinder 72. Thus, by selecting the proper cam the amount and duration of slow-down may be controlled.

After the work stroke has been completed, either the switch 86 or the switch 88 operates to de-energize the contactor A, and also the coil 70. Deenergization of the solenoid 70 again directs pressure fluid to the under side of the piston 94 raising the same, and through the linkage 50, shifts the pump 24 to supply fluid to the retracting means 20. The pressure developed in the retracting means 20 is transmitted to the pump 24 to the upper end of the piston 138 and moves the latter downwardly to move the roller 80 out of the path of the cam 82. At the end of the retraction stroke the lever 52 is engaged by the rod 56 and the pump is moved to neutral.

If, at any time during the advancing stroke, it is desired to halt the press ram, the stop button 158 may be depressed to energize the coils B and 68. Energization of coil 68 shifts the valve member 124 to bring about the supply of pressure fluid to the piston 98. The upward movement of the piston 98 moves the piston 94 into

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position to center the pump. The press ram will remain halted until the restart button 156 is depressed to de-energize B and 68.

It will be apparent that this stop feature is not effective during the retracting stroke of the press ram. However, inasmuch as an emergency stop has its principal value during the working stroke of the press, it is not usually necessary to provide for a stop during the retraction stroke.

While the apparatus disclosed and described herein constitutes a preferred form of my invention, it will be understood that the apparatus is capable of alteration without departing from the spirit of the invention, and that all modifications that fall within the scope of the appended claims are intended to be included herein.

I claim:

1. In a control system for a press having a ram and a fluid source connected to supply said ram, a flow controlling means movable to vary said supply, a fluid operable actuator for said flow controlling means, a fluid displacing device hydraulically connected with said fluid operable actuator, cooperating cam means connected with said ram and device responsive to relative movement thereof for actuating said device to displace fluid to said actuator, and fluid pressure responsive means associated with said cam means and connected with one side of said ram for moving said cam means out of effective position during the supply of pressure fluid to the said one side of said ram.

2. In a control system for a press having a ram and a pump connected to supply said ram, a servomotor movable to vary the discharge of said pump, fluid operable means for actuating said servomotor, means operated by the travel of the ram in one direction comprising a fluid displacing device hydraulically connected with said fluid operable means for varying the discharge of said pump and, therefore, the speed of said ram, means to prevent the operation of said device during the movement of said ram in the other direction, and means of conditioning said device for again being actuated when said ram moves again in said one direction.

3. In a control system for a press having a ram and a pump connected to supply said ram, a servomotor for moving said pump to full stroke position in either direction to reciprocate said ram, a fluid operable actuator for moving said pump to reduced stroke position, means for metering fluid to said actuator comprising a fluid displacing device connected therewith, cam and roller means carried by said ram and device engageable during the advancing movement of said ram for actuating said device, and fluid pressure responsive means responsive to the pressure acting to retract said ram for moving at least one of said cam and roller out of position to be engaged by the other.

4. In a control system for a press having a ram and a pump connected to supply said ram in both directions of movement, a servomotor movable to reduce the rate of fluid supply to said ram in at least the advancing direction thereof, a fluid operable actuator adapted to actuate said servomotor, a metering device connected to displace fluid to said actuator, cam and roller means for operating said metering device during the advancing movement of the ram, and means responsive to the pressure acting on said ram during its retracting movement for moving said cam and roller means out of operative alignment.

5. In a hydraulic system; a fluid motor; a fluid

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source connected with said motor; a member movable for bringing about the delivery of said source to said motor; a fluid operable piston movable into position for providing an abutment for said member in reduced stroke position; means comprising a fluid displacing mechanism hydraulically connected with said piston; cooperating cam means carried by the movable part of said motor and said fluid displacing mechanism for actuating the latter to displace fluid to said piston during one direction of movement of said motor; and means responsive to the pressure acting on said motor during its movement in the opposite direction for making said cam means inoperative.

6. In a hydraulic system; a fluid motor; a fluid source connected with said motor; a member movable between a first and a second position for bringing about the delivery of said source in either direction; a fluid operable piston movable into position for providing an abutment for said member between said positions; a piston-cylinder arrangement hydraulically connected with said piston for displacing actuating fluid thereto to move it into said abutment providing position; mechanism operable by the motor during one direction of movement thereof for causing said piston-cylinder to displace fluid to said piston, and means responsive to the pressure of the actuating fluid supplied to said motor in its movement in the other direction for preventing actuation of said piston-cylinder by said motor.

7. In a hydraulic system; a reciprocable ram having advancing and retracting means; a fluid source connected with said means; a member associated with said source and movable into a first end position to bring about the full delivery thereof to said advancing means, and into a second end position to bring about the delivery thereof to said retracting means; piston means movable to provide an abutment for said member short of said first end position; piston cylinder means hydraulically connected with said piston means for displacing fluid thereto to move the same into said abutment providing position; cooperating cam means carried by said ram and said piston-cylinder means operable during the advancing stroke of said ram to actuate said piston-cylinder means to displace actuating fluid to said piston means to reduce the delivery of said source and therefore, to slow down said ram, and means operable during the retraction stroke of said ram for moving said cooperating cam means out of operative alignment.

8. In a hydraulic system; a ram having advancing and retracting means; a reversible variable delivery pump connected with said means; a plunger associated with said pump movable from a first end position where it positions said pump to deliver to said advancing means to a second end position where it positions said pump to deliver to said retracting means; a fluid operable piston movable to abut said plunger short of said first end position; a double acting piston hydraulically connected on one side with said fluid operable piston; cooperating cam means carried by said ram and said double acting piston adapted during the advancing stroke of said ram to actuate said double acting piston to displace fluid to said fluid operable piston to move it into said abutting position thereby to move said pump into reduced delivery position to slow down said ram; channel means connecting the other side of said double acting piston with said retracting means

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for moving the former together with its cam means out of position to be engaged by the cam means on said ram during the retraction stroke thereof; and yielding means continuously urging said double acting piston into cam engaging position.

9. The combination with a ram having advancing and retracting areas and a reversible pump connected therewith; of a control means associated with said pump comprising a first member movable into opposite full stroke end positions a second member movable to abut said first member in zero stroke position; a fluid operable piston movable to abut said second member and therethrough to move said first member into reduced stroke position during the advancing movement of said ram; means selectively operable to actuate said members; and means for supplying fluid to said piston comprising a double acting plunger having one side hydraulically connected with said piston; cooperating cam means carried by said ram and said plunger operable to move said plunger at any predetermined point during the advancing movement of said ram

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thereby to displace fluid to said piston to slow down said ram; channel means hydraulically connecting the other side of said plunger with said retracting area whereby said cam means are moved out of operative alignment during the retracting movement of said ram; and yielding means continuously urging said cam means into operative position.

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