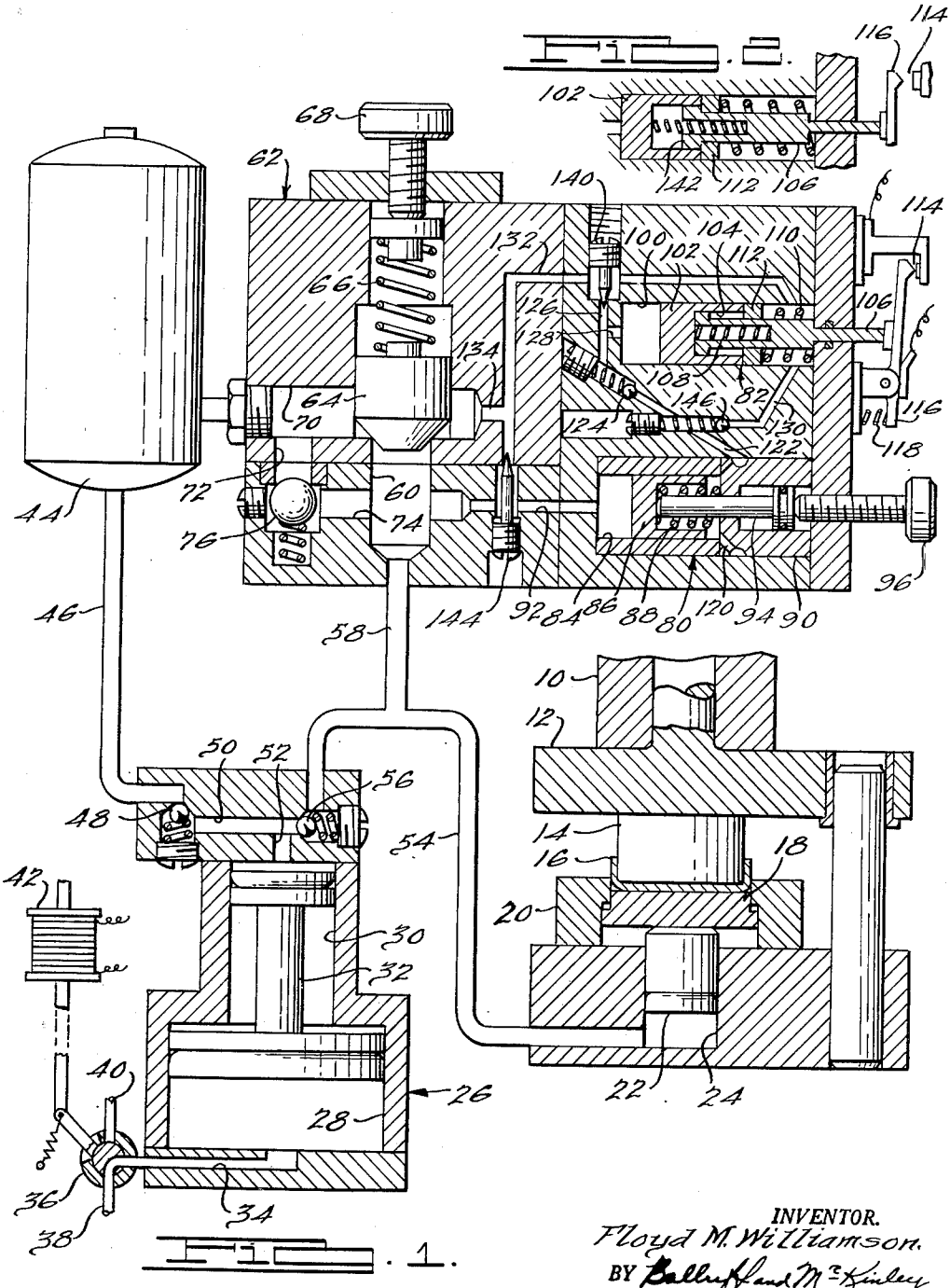
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HYDRAULIC CONTROL SYSTEM FOR DIE PADS IN PRESSES

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HYDRAULIC CONTROL SYSTEM FOR DIE PADS IN PRESSES

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This invention relates to presses of the type employing a movable die pad and a hydraulic cushion for resisting movement of the die pad upon closing of the press and for returning the die pad to its extended position upon opening of the press. The invention is particularly directed to an improved hydraulic control system for controlling the movement of the die pad.

In presses of the type described it is frequently desirable to provide a control system which will automatically increase the pressure on the piston which is relied upon to move the die pad to its extended position when the press is opened, thereby insuring that the work will be stripped from the die by the return movement of the die pad. This increased pressure should also be made available for a long enough time to insure that the work will be stripped from the die, and the present invention is directed to a hydraulic system of this type in which closing of an electrical circuit is effected by the downward stroke of the ram, the closing of the circuit actuating a booster cylinder which increases the pressure in the hydraulic cushion to return the die pad to its extended position, and to an improved hydraulic system to maintain the electrical circuit closed for a suitable time interval so as to insure stripping of the work from the die by the pressure pad.

It is an object of the present invention to provide an improved control system for hydraulic pads in a press.

Another object of the invention is to provide a control system of the type described incorporating therein a time-delay mechanism for insuring that the die pad will efficiently strip the work from the die upon opening of the press.

Other and further objects of the invention will be apparent from the following description and claims and may be understood by reference to the accompanying drawing, which by way of illustration shows a preferred embodiment of the invention and what I now consider to be the best mode of applying the principles thereof. Other embodiments of the invention may be used without departing from the scope of the present invention as set forth in the appended claims.

In the drawing:

FIG. 1 is a schematic sectional view of a hydraulically actuated die pad and the controll system for the die pad; and

FIG. 2 is a fragmentary sectional view of a part of the control system shown in FIG. 1 and illustrating a different position thereof.

A press of the type with which this invention may be used includes a ram 10 and an upper die 12 carrying a forming tool, punch or the like 14 engageable with the work 16 upon the downward stroke of the ram. The work is supported on a movable die pad 18 which is vertically reciprocable within a fixed bolster 20. The hydraulic cushion for the die pad 18 consists of a piston 22 reciprocable with a cylinder 24.

A booster cylinder 26 is provided with a large diameter portion 28 and a smaller diameter portion 30. A double ended piston 32 is arranged within the booster cylinder 26. The larger diameter end 28 of the cylinder is provided with a passage 34 leading to a valve 36 by means of which the end 28 of the cylinder may alternately be connected to a source of air under pressure through line 38 or to the exhaust line 40. The control valve 36 is

operated by a solenoid 42. The pressure fluid such as oil is supplied to the upper end of the cylinder 30 from a supply tank 44 through a line 46 and past check valve 48 to passages 50 and 52 which communicate with the cylinder 30.

A passage 54 connects the hydraulic cushion cylinder 24 with the booster cylinder 30. A check valve 56 normally closes the communication between passages 52 and 54. A passage 58 is connected into passage 54 and leads to a bore 60 in a valve block 62. The upper end of the bore 60 is closed by a pressure relief valve 64 which is backed up by a spring 66 and an adjustable threaded screw 68 so that the pressure at which the valve 64 will open may be adjusted. The bore 60 intersects a transverse bore 70 in the valve block which communicates with the supply tank 44. A by-pass consisting of passages 72 and 74 provides a communication between the passages 60 and 70 and the by-pass is normally closed by a check valve 76.

The control system further includes a pump indicated generally at 80 and a time-delay mechanism indicated at 82. The pump includes a cylinder 84 containing a piston 86 which is urged to the left, as viewed in FIG. 1, by a spring 88 which is disposed within a recess in the piston 86 and reacts against a block 90 which closes the other end of the cylinder 84. A passage 92 is provided between the left-hand end of the cylinder 84 and the passage 60. The stroke of the pump piston 86 is regulated by its engagement with a plunger 94, the position of which may be adjusted by an adjusting screw 96.

The time-delay device 82 includes a cylinder 100 containing a piston 102 provided with a recess 104 within which a plunger 106 is reciprocable. A spring 108 located within a recess in the plunger 106 reacts between the piston 102 and the plunger 106 tending to urge the plunger outwardly. A stronger spring 110 reacts against a collar 112 secured to the piston 102 and urges the piston and the plunger carried thereby to the left to the position shown in FIG. 2.

An electric switch 114 includes a movable contact carried by a pivoted arm 116 which is urged by a spring 118 in a direction to open the switch 114. The switch 114 is wired into the electric circuit for the solenoid 42 and, when the switch 114 is closed by movement of the plunger 106, the solenoid will be energized to move the valve 36 to the position shown in which the booster cylinder 28 is connected to a source of fluid pressure.

When the press closes, the die pad 18 moves downwardly against piston 22 and such downward movement is resisted by the hydraulic cushion provided by the oil trapped in the system. The oil discharged from the cylinder 24 is forced through lines 54 and 58 into chamber 60 and through passage 92 into cylinder 84 where it reacts against the piston 86 to move the same to the right against its stop 94.

The oil in the right-hand end of the cylinder 84 is forced out of such cylinder through passages 120 into a passage 122, past check valve 124 and through passages 126 and 128 into the left-hand end of the cylinder 100 to move the piston 102 and the plunger 106 carried thereby to the right to close the switch 114 and energize solenoid 42. The oil in the right-hand end of the cylinder 100 is forced out through a passage 130, past a check valve therein and back to the passage 122 or through a passage 132 which is connected by a passage 134 with the bore 70 so as to be returned to the supply tank 44.

When the solenoid 42 is energized the booster piston 32 will be actuated and oil under high pressure will be forced from the booster cylinder 30, past check valve 56 through passage 54 into the cylinder 24 to force the piston 22 and the pad 18 upwardly to strip the work from the die. Oil will also be forced through passages

58, 60 and 92 into the cylinder 84 to maintain the piston 86 against the stop 94.

The solenoid will remain energized until the plunger 106 is returned to its left-hand position shown in FIG. 2, and return of the plunger 106 and the piston 102 is delayed due to the oil trapped in the cylinder 100. The oil in the cylinder 100 escapes slowly through passages 128 and 126, past a bleeder valve 140 and then through passages 132 and 134 and bore 70 back to the supply tank 44. The bleeder valve 140 is in the form of an adjustable screw which may be adjusted to regulate the rate at which oil escapes from the cylinder 100. The extent of the time delay is also determined by the amount of oil forced into the cylinder 100 and this is in turn regulated by the extent of movement of the pump piston 86. As the oil escapes from the cylinder 100, the piston 102 moves to the left under the force of spring 110, but the plunger 106 will remain in its extended position under the influence of spring 108 until the piston 102 reaches the end of its stroke at which time the collar 112 on the piston engages a shoulder 142 on the plunger 106 to retract the plunger against spring 108 to open the switch 114. When the switch 114 is opened the solenoid 42 is de-energized to connect the passage 34 to the exhaust line 40, whereupon the booster cylinder 30 will be filled with oil from the tank 44 through passage 46, past check valve 48 and through passages 50 and 52, thereby returning the booster piston 32 to its lowered position. During the time the solenoid is energized the high pressure will be maintained within the cylinder 24. When the pressure is released, as described, the piston 86 is returned to its left-hand position, forcing oil from the left-hand end of cylinder 84 through passage 92, past bleeder valve 144 to passage 134 and bore 70 back to the supply tank 44. The right-hand end of the cylinder 84 will be filled with oil from the tank 44 through passages 134, 132 and 130, past check valve 146 and through passages 122 and 120.

The pressure relief valve 64 is normally closed and will open only when a predetermined pressure is exceeded either upon closing of the press or upon actuation of the booster piston to return the die pad 18 to its extended position.

This application is a continuation-in-part of my prior copending application Serial No. 768,889, filed October 22, 1958, for Hydraulic Press Ram Cushion.

While I have illustrated and described a preferred embodiment of my invention, it is understood that this is capable of modification, and I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a press having a movable pressure pad engaged by the work so as to be moved in one direction upon closing of the press and including a hydraulic cushion to resist such movement of said pad and to effect return movement of the pad upon opening of the press, said hydraulic cushion including a cylinder and a piston in said cylinder, a supply of hydraulic fluid under pressure connected to said cylinder for biasing said piston therein to react against said pad, a control system for controlling the return movement of said pad, comprising a booster cylinder having a hydraulic fluid connection with said hydraulic cushion cylinder, a piston in said booster cylinder, a valve connected between said booster cylinder and a source of pressure fluid for controlling actuation of said booster piston and adapted when open to supply pressure fluid to said booster cylinder so as to move said booster piston in a direction to increase the pressure in said hydraulic cushion cylinder to effect return movement of said pad, a solenoid connected to said valve and adapted when energized to open said booster control valve, a normally open switch in the solenoid circuit and including a movable contact, a cylinder having a plunger

therein, said movable contact being movable with said plunger, a spring reacting on said plunger in a direction to open said switch, a pump cylinder having a piston therein, means communicating said hydraulic cushion cylinder with said pump cylinder on one side of said pump piston to move the latter in one direction by hydraulic fluid discharged from said hydraulic cushion cylinder upon closing of the press, a passage connecting the cylinder containing said plunger with said pump cylinder on the other side of said pump piston, a one-way valve in said passage through which hydraulic fluid is pumped from said pump cylinder into said plunger cylinder to effect movement of said plunger against its spring to close said switch and effect actuation of said booster piston, a supply tank for said hydraulic fluid, passage means communicating said plunger cylinder with said tank, and a bleeder valve in said passage means for restricting the flow of hydraulic fluid from said plunger cylinder to delay return movement of said plunger and thereby opening of said switch.

2. In a press having a movable pressure pad engaged by the work so as to be moved in one direction upon closing of the press and including a hydraulic cushion to resist such movement of said pad and to effect return movement of the pad upon opening of the press, said hydraulic cushion including a cylinder and a piston in said cylinder, a supply of hydraulic fluid under pressure connected to said cylinder for biasing said piston therein to react against said pad, a control system for controlling movement of said pad, comprising a booster cylinder having a hydraulic fluid connection with said hydraulic cushion cylinder, a piston in said booster cylinder, a valve connected between said booster cylinder and a source of pressure fluid for controlling actuation of said booster piston, said booster piston when actuated being adapted to increase the pressure in said hydraulic custion cylinder to effect return movement of said pad, a cylinder having a plunger therein, a spring reacting on said plunger in one direction, means operable in response to movement of said plunger in the other direction for operating said valve to actuate said booster piston, a pump cylinder having a piston therein, means communicating said hydraulic cushion cylinder with said pump cylinder on one side of said pump piston to move the latter in one direction by hydraulic fluid discharged from said hydraulic cushion cylinder upon closing of the press, a passage connecting the cylinder containing said plunger with said pump cylinder on the other side of said pump piston, a one-way valve in said passage through which hydraulic fluid is pumped from said pump cylinder to effect movement of said plunger in said other direction against its spring to operate said valve and thereby effect actuation of said booster piston, a supply tank for said hydraulic fluid, passage means communicating said plunger cylinder with said tank, and a bleeder valve in said passage means for restricting the flow of hydraulic fluid from said plunger cylinder to delay return movement of said plunger.

3. In a press having a movable pressure pad engaged by the work so as to be moved in one direction upon closing of the press and including a hydraulic cushion to resist such movement of said pad and to effect return movement of the pad upon opening of the press, said hydraulic cushion including a cylinder and a piston in said cylinder, a supply of hydraulic fluid under pressure connected to said cylinder for biasing said piston therein to react against said pad, a control system for controlling movement of said pad, comprising a booster cylinder having a hydraulic fluid connection with said hydraulic cushion cylinder, a booster piston in said booster cylinder, a valve connected between said booster cylinder and a source of pressure fluid for controlling actuation of said booster piston and adapted when open to supply pressure fluid so as to move said booster piston

in a direction to increase the pressure in said hydraulic cushion cylinder to effect return movement of said pad, a cylinder having a plunger therein, means operably connecting said valve and plunger for opening said valve upon movement of said plunger in one direction and for closing said valve upon movement of said plunger in the opposite direction, means responsive to hydraulic fluid discharged from said hydraulic cushion cylinder upon closing of the press to move said plunger in said one direction, spring means biasing said plunger in said opposite direction, a supply tank for said hydraulic fluid, passage means communicating said plunger cylinder with said tank, and a bleeder valve in said passage means for restricting the flow of hydraulic fluid from the said plunger cylinder to delay movement of said plunger in said opposite direction thereby to delay closing of said booster piston controlling valve.

4. In a press having a movable pressure pad engaged by the work so as to be moved in one direction upon closing of the press and including a hydraulic cushion to resist such movement of said pad and to effect return movement of the pad upon opening of the press, said hydraulic cushion including a cylinder and a piston in said cylinder, a supply of hydraulic fluid under pressure connected to said cylinder for biasing said piston therein to react against said pad, a control system for controlling movement of said pad, comprising a booster cylinder having a hydraulic fluid connection with said hydraulic cushion cylinder, a booster piston in said booster cylinder, a valve connected between said booster cylinder and a source of pressure fluid for supplying fluid under pressure to said booster cylinder to move said booster piston in one direction thereby to increase the pressure in said hydraulic cushion cylinder, a valve actuating means operable in response to hydraulic fluid discharged from said hydraulic cushion cylinder upon movement of said pad in said one direction to open said valve and effect said movement of said booster piston, said valve actuating means including a cylinder having a plunger therein, means operably connecting said valve and plunger for opening said valve upon movement of said plunger in one direction and for closing said valve upon movement of said plunger in the opposite direction, an inlet passage for said plunger cylinder through which pressure fluid is supplied to said plunger cylinder to effect movement of said plunger in said one direction to open said valve, spring means urging said plunger in said opposite direction, a supply tank for said hydraulic fluid, passage means communicating said plunger cylinder with said tank, and a bleeder valve in said passage means for restricting the flow of pressure fluid from said plunger cylinder thereby to delay movement of said plunger in said opposite direction.

5. In a press having a movable pressure pad engaged by the work so as to be moved in one direction upon closing of the press and including a hydraulic cushion to resist such movement of said pad and to effect return movement of the pad upon opening of the press, said hydraulic cushion including a cylinder and a piston in said cylinder, a supply of hydraulic fluid under pressure connected to said cylinder for biasing said piston therein to react against said pad, a control system for controlling movement of said pad, comprising a booster cylinder having a fluid pressure connection with said hydraulic cushion cylinder, a booster piston in said booster cylinder, a booster control valve connected between said booster cylinder and a source of pressure fluid for controlling actuation of said booster piston and adapted when open to supply pressure fluid for moving said booster piston in a direction to increase the pressure in said hydraulic cushion cylinder to effect return movement of said pad, a solenoid connected to said control valve and adapted when energized to open said booster control valve, a normally open switch in the solenoid circuit and including a movable contact, a time-delay device including a control cylinder having a plunger therein, said movable contact being movable with said plunger, means responsive to hydraulic fluid discharged from said hydraulic cushion cylinder upon closing of the press to effect movement of said splunger in one direction to close said switch and effect actuation of said booster piston, spring means urging said plunger in the opposite direction to open said switch and thereby close said valve and deenergize said booster, a supply tank for said hydraulic fluid, passage means communicating said control cylinder with said tank, and a bleeder valve in said passage means for restricting the flow of pressure fluid from said control cylinder to delay movement of said plunger in said opposite direction thereby to delay opening of said switch.

6. In a press according to claim 5, said time-delay device including a piston reciprocable in said control cylinder, said plunger being reciprocable within said piston, a first spring reacting between said last-named piston and plunger and urging said plunger in said one direction, a second spring reacting in said opposite direction between said control cylinder and said piston therein, said second spring being stronger than said first spring, said piston in said control cylinder being movable in said opposite direction without corresponding movement of said plunger, and cooperating means on said last-named piston and plunger operable for moving said plunger with said piston only as the latter reaches the limit of its movement in said opposite direction whereby said switch remains closed until the pressure fluid escapes past said bleeder valve.

7. In combination with a press having a movable pressure pad engaged by the work so as to be moved in one direction upon closing of the press ram and a hydraulic system including a hydraulic cushion to resist such movement of said pad and to effect return movement of the pad upon opening of the press ram, said hydraulic cushion including a cylinder and a piston therein, a tank of hydraulic fluid under relatively low pressure having a hydraulic fluid connection to said cylinder for supplying hydraulic fluid to said cylinder for biasing said piston therein to react against said pad, a pressure relief valve in said connection which resists the displacement of hydraulic fluid from said cylinder upon closing of the press ram, a fluid pressure actuated booster having a hydraulic fluid connection with said tank and with said hydraulic cushion cylinder and operable when actuated to increase the pressure of the hydraulic fluid in said hydraulic cushion cylinder substantially above the pressure in said supply tank, to effect return movement of said pad, and means operable upon closing of the press ram to control the supply of fluid pressure to said booster so as to actuate said booster upon closing of the press ram and to maintain the supply of fluid pressure to said booster for a predetermined time during the opening of said press ram.

8. In combination with a press having a movable pressure pad engaged by the work so as to be moved in one direction upon closing of the press ram and a hydraulic system including a hydraulic cushion to resist such movement of said pad and to effect return movement of the pad upon opening of the press ram, said hydraulic cushion including a cylinder and a piston therein, a tank of hydraulic fluid under relatively low pressure having a hydraulic fluid connection to said cylinder for supplying hydraulic fluid to said cylinder for biasing said piston therein to react against said pad, a pressure relief valve in said connection which resists the displacement of hydraulic fluid from said cylinder upon closing of the press ram, a booster having a hydraulic fluid connection with said hydraulic cushion cylinder and operable upon closing of the press ram to increase the pressure of the hydraulic fluid in said hydraulic cushion cylinder substantially above the pressure in said supply tank to effect return movement of said pad upon opening of the press ram, and means operable upon closing of the press ram in response to closing of the press ram to actuate said

booser and to maintain said booster operable for a predetermined time during the opening of said press ram.

9. In a press having a movable pressure pad engaged by the work so as to be moved in one direction upon closing of the press ram, a hydraulic cushion reacting against said pad to resist such movement of said pad and to effect return movement of the pad upon opening of the press ram, said hydraulic cushion including a cylinder and a piston therein, a tank containing hydraulic fluid under pressure, a booster cylinder, a fluid connection between said tank and booster cylinder, a check valve in said connection past which hydraulic fluid flows from said tank to said booser cylinder, a passage connecting said booster cylinder and said hydraulic cushion cylinder, a piston in said booster cylinder, a control valve connecting said booster cylinder to a source of pressure fluid and adapted when open to supply pressure fluid to actuate said booster piston in a direction to force the hydraulic fluid in said booster cylinder through said passage to said hydraulic cushion cylinder to increase the pressure in the latter cylinder to effect return movement of said pad, control means connected to said control valve and actuated by the press for opening said control valve to actuate said booster piston at a predetermined time during each cycle of the press, a normally closed valve in said passage, including a reciprocable valve member and a spring biasing said valve member to a position closing said passage, the opposite sides of said valve member being exposed to the pressure in said tank so that both sides of said valve member are normally subjected to the pressure of the hydraulic fluid in said tank, said valve member being movable against said spring to open said passage upon actuation of said booster piston, a return line through which hydraulic fluid flows from said hydraulic cushion cylinder to said tank upon closing of the press, and a pressure relief valve in said return line providing resistance to movement of said die pad and adapted to open when the pressure in said hydraulic cushion cylinder exceeds a predetermined pressure.

References Cited in the file of this patent

UNITED STATES PATENTS

1,433,116	Beyer	Oct. 24, 1922
2,890,669	Williamson	June 16, 1959
2,933,307	Williamson	Apr 19, 1960