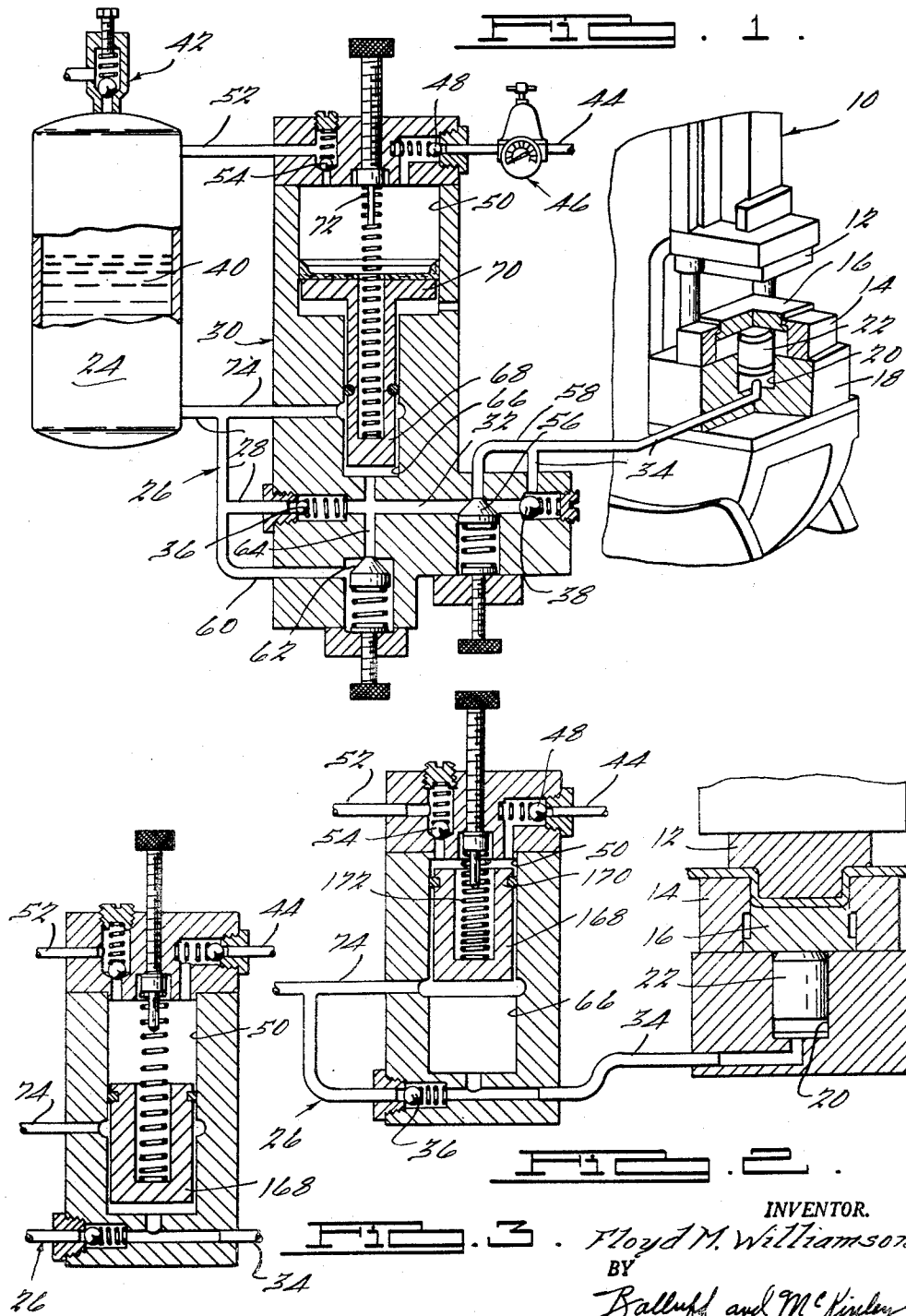


April 19, 1960

F. M. WILLIAMSON
AIR PRESSURE INTENSIFIER FOR HYDRAULICALLY
OPERATED PRESSURE PADS
Filed Feb. 16, 1959

2,933,307



INVENTOR.

Floyd M. Williamson

BY

Balluff and McKinley
ATTORNEYS.

1

2,933,307

AIR PRESSURE INTENSIFIER FOR HYDRAULICALLY OPERATED PRESSURE PADS

Floyd M. Williamson, Detroit, Mich.

Application February 16, 1959, Serial No. 793,499

12 Claims. (Cl. 267—1)

This invention relates to presses employing a hydraulic cushion for the die pads and has particular reference to a hydraulic system actuated by a relatively low pressure air supply and incorporating means actuated by the operation of the press for increasing the air pressure substantially above that at which it is supplied to the system.

In presses employing hydraulic cushions for the die pad the hydraulic system associated with the cushion is usually air pressure operated. The usual low air pressure source employed for actuating such hydraulic systems does not develop sufficient pressure for many applications. The present invention contemplates a system in which an air pump actuated by operation of the press is employed for increasing the air pressure above the pressure at which it is normally supplied.

In accordance with my invention the hydraulic supply tank of the hydraulic system is partially filled with oil and pressurized from a normal shop air line developing 75 to 100 pounds per square inch pressure. Such air pressure forces the oil in the system through a valve unit in the die, the force exerted by such hydraulic cushion being proportional to the pressure in the supply tank. The pressured pad is used to hold a workpiece in the die and is moved down with the press ram as the press closes, the cushion being operable for returning the pad to its upper position as the press ram moves upwardly on the opening of the press. The pad in returning to its upper position strips the part from the die or punch after being formed. The forming or punching operation is performed by the pressure of the press ram forcing the workpiece held in place by the pressure pad into the die and forcing the pad down with the part. When the press ram retracts upon the opening of the press, the pressure pad under the influence of the hydraulic cushion is forced back to its original position lifting the workpiece from the die. The lifting pressure exerted on the die pad when the hydraulic system is energized by the usual shop air line is not sufficient in many cases. The invention contemplates a means for utilizing the force developed by the closing of the press to increase the pressure of the air in the supply tank and thus provides sufficient pressure in the hydraulic cushion for stripping the work from the lower die.

A principal object of the invention, therefore, is to provide an air pressure intensifier for hydraulically operated pressure pads.

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 preferred embodiments 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.

2

In the drawing:

Figure 1 is a schematic view of a hydraulically operated pressure pad system incorporating my invention;

Figure 2 is a schematic view illustrating a modified form of the invention; and

Figure 3 is a view of the air pressure booster of Figure 2, shown in another position.

As illustrated in Figure 1, a ram type press 10 includes a reciprocable upper die 12 and a lower die comprising a fixed section 14 and a reciprocable pad 16. The section 14 is fixed to be bolster 18 while the pad 16 is biased upwardly to the position as shown by a hydraulic cushion which includes a cylinder 20 and a piston 22, the piston 22 being arranged to react on the pad 16 so as to resist downward movement thereof by the upper die section 12 during closing of the press and to move the pad upwardly to the position illustrated upon opening of the press.

Hydraulic fluid under pressure is supplied to the cylinder 20 from a tank 24 through a line indicated generally at 26 which includes conduit 28 between the tank 24 and the valve unit 30, passage 32 through the valve unit 30, and conduit 34 between the valve unit 30 and the cylinder 20. A spring pressed check valve 36 is arranged at the inlet of the passage 32 so as to prevent return flow of hydraulic fluid from the passage 32 into the conduit 28. A spring pressed check valve 38 is arranged at the discharge end of the conduit 32 so as to prevent return flow of hydraulic fluid from the conduit 34 into the passage 32 through the discharge end thereof. The tank 24 contains a supply of hydraulic fluid, such as oil 40. An adjustable pressure relief valve 42 connected with the upper end of the tank 24 provides a means for limiting the maximum pressure inside the tank 24. Air under low pressure, say for example 100 pounds per square inch, is supplied through an air pressure line 44 past an adjustable pressure regulating valve 46 and a check valve 48 to the air cylinder 50, and from the cylinder 50 air under pressure may flow through the air pressure line 52 to the upper end of the tank 24. Check valve 54 in the air line 52 prevents back flow of air under pressure from the tank 24 to the cylinder 50. Thus air under the pressure regulated by the valve 46 will be supplied to the upper end of the tank 24 and will pressurize the oil 40 in the tank 24, the conduit 26, and the cylinder 20.

Upon closing of the press, the upper die 12 will react on the pad 16 and the piston 22, moving the same downwardly, thereby displacing oil from the cylinder 20 into conduit 34. The check valve 38 prevents return flow of oil from the conduit 34 into the conduit 32. However, an adjustable pressure relief valve 56 arranged in a bypass 58 around the check valve 38 permits return flow of oil from the conduit 34 into the passage 32 when the pressure for which the valve 56 is set is exceeded, which occurs during closing of the press. The valve 56 is set so as to develop sufficient resistance to displacement of oil from the cylinder 20 so that the piston 22 will provide a hydraulic cushion for the pad 16. A bypass 60 having an adjustable safety relief valve 62 therein is adapted to permit flow of oil from the passage 32 into the passage 28 around the check valve 36 when the pressure in the passage 32 exceeds that for which the valve 62 is set.

A passage 64 in the valve 30 intersects the passage 32 and at one end communicates with the valve 62 and at its other end with the discharge end of a hydraulic cylinder 66 having a piston 68 therein. The piston 68 is connected to a piston 70 which is operatively disposed in the air cylinder 50, and a spring 72 biases the pistons 68 and 70 to their advanced positions. The effective

area of the piston 70 is many times (say, for example, ten times) that of the piston 68. A by-pass conduit 74 extends between the tank 24 and the cylinder 66 at a point remote from the discharge end thereof, and the piston 68 will function as a valve to close the by-pass conduit 74.

Assume that the hydraulic system, including the tank 24, is charged with oil, that the pistons 68 and 70 are in their advanced positions, and that the pressure relief valve 62 is set at a substantially higher pressure than that of the valve 56. Upon closing of the press the hydraulic cushion formed by the piston 22 and cylinder 20 will react on the pad 16 to resist downward movement thereof by the die 12. However, when the pressure in the line 34 exceeds that for which the valve 56 is set, the valve 56 will open and permit the flow of oil under pressure from the line 34 into the line 32 and into the cylinder 66, causing the piston 68 to retract against the air pressure in the cylinder 50, and permitting return of oil through by-pass 74 to tank 24 so long as the by-pass 74 is open. Depending upon the resistance to flow through by-pass 74, the piston 68 may move upwardly past the by-pass 74 due to the surge of fluid under pressure in passage 32 during closing of the press. When the air piston 70 is forced up, air in the cylinder 50 is forced through the line 52 past the check valve 54 into the tank 24, thus increasing the air volume and pressure in the tank by a small amount.

Upon opening of the press, the upward movement of the die 12 away from the pad 16 will release the pressure in the line 34 and cylinder 20, whereupon oil under pressure from the tank 24 will flow through the line 26, thereby upwardly displacing the piston 22 in the cylinder 20 and moving the pad 16 upwardly. Since the piston 68 is under the pressure of the air in the air cylinder 50, some oil will also flow from the cylinder 66 into the passage 32 at such time. Thus upon each closing of the press the pistons 68 and 70 move upwardly, thereby displacing a small amount of air from the cylinder 50 through the line 52 to the upper part of the tank 24, thereby increasing the pressure of the air in the upper end of the tank 24. It will thus be evident that as the press continues to operate, the air pressure in the tank 24 will increase to a value substantially in excess of that at which air under pressure is supplied through the line 44. As previously noted, valve 42 will limit the pressure developed in the tank 24.

In the modification of Figures 2 and 3, the hydraulic fluid line 26 from the tank 24 to the cylinder 20 is the same as in Figure 1, except that the check valve 38 and the pressure relief valves 56 and 62 are omitted. Thus upon the closing of the press as shown in Figure 2, the surge of pressure fluid in the conduit 34 is transmitted to the cylinder 66 in which the piston 168 is reciprocable. In this case the cylinder 66 and the air cylinder 50 are the same size, as are the air piston 170 and the hydraulic piston 168. Thus the air under pressure in the air cylinder 50 plus the force of the spring 172 reacting on the piston 168 resist the downward movement of the piston 22. However, the downward movement of the piston 22 upon the closing of the press will force fluid into the cylinder 66, thereby upwardly moving the piston 168 and displacing air under pressure from the cylinder 50 past the check valve 54 and through the line 52 to the pressure tank 24. When the piston 168 moves above the end of the by-pass 74, the excess fluid displaced by the downward movement of the piston 22 will be returned to the tank 24 through the by-pass 74. The construction and operation of the modification of Figures 2 and 3 are otherwise the same as in Figure 1.

While I have illustrated and described preferred embodiments of my invention, it is understood that these are 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 ram press having a movable pressure pad arranged to be moved in one direction by the press ram upon the closing of the press and a hydraulic cushion reacting on said pad to resist such movement and to move such pad in the other direction upon the opening of the press; a tank of hydraulic fluid, an air pressure line connected to said tank for subjecting fluid therein to pressure, a hydraulic line extending from said tank to said cushion for supplying hydraulic fluid under the pressure in said tank to said cushion, an air pressure booster including an air cylinder having a piston therein and a hydraulic cylinder having a piston therein, said pistons being interconnected for movement together and said air piston having an effective area much greater than the hydraulic piston connected thereto, the discharge end of said hydraulic cylinder being connected to said hydraulic line, a check valve in said hydraulic line between said tank and said hydraulic cylinder, a check valve in said hydraulic line between said hydraulic cylinder and said cushion, and a pressure relief valve controlled by-pass around said last-mentioned check valve, a hydraulic line extending from said tank to said hydraulic cylinder and communicating with said hydraulic cylinder at a point intermediate the ends thereof, said air pressure line connected to said tank being connected to said air cylinder of said booster and having a check valve therein which permits flow of air from said air cylinder to said tank and a check valve therein to prevent return flow of air under pressure from said air cylinder through such line.

2. In a ram press having a movable pressure pad arranged to be moved in one direction by the press ram upon the closing of the press and a hydraulic cushion reacting on said pad to resist such movement and to move such pad in the other direction upon the opening of the press; said hydraulic cushion including a cylinder and a piston therein, a tank of hydraulic fluid, an air pressure line connected to said tank for subjecting the fluid therein to pressure, a hydraulic line extending from said tank to said cylinder for supplying hydraulic fluid under the pressure in said tank to said cylinder whereby the piston therein reacts on said pad, an air pressure booster including an air cylinder having a piston therein and a hydraulic cylinder having a piston therein, said last-named pistons being interconnected for movement together, the discharge end of said booster hydraulic cylinder being connected to said hydraulic line, a check valve in said hydraulic line between said tank and said booster hydraulic cylinder, a hydraulic line extending from said tank to said booster hydraulic cylinder and communicating with said hydraulic cylinder at a point intermediate the ends thereof, said air pressure line connected to said tank being connected to said air cylinder of said booster and having a check valve therein which permits flow of air from said booster cylinder to said tank and a check valve therein to prevent return flow of air under pressure from said air cylinder through such line.

3. In a ram press having a movable pressure pad arranged to be moved in one direction by the press ram upon the closing of the press and a hydraulic cushion reacting on said pad to resist such movement and to move such pad in the other direction upon the opening of the press; a tank of hydraulic fluid, an air pressure line connected to said tank for subjecting the fluid therein to pressure, a hydraulic line extending from said tank to said cylinder for supplying hydraulic fluid under the pressure in said tank to said cylinder whereby the piston therein reacts on said pad, an air pressure booster including an air cylinder having a piston therein and a hydraulic cylinder having a piston therein, said last-named pistons being interconnected for movement together and said air piston having an effective area much greater than the hydraulic piston connected thereto, the discharge end of

5

said booster hydraulic cylinder being connected to said hydraulic line, a check valve in said hydraulic line between said tank and said booster hydraulic cylinder, a hydraulic line extending from said tank to said booster hydraulic cylinder and communicating with said hydraulic cylinder at a point intermediate the ends thereof, said air pressure line connected to said tank being connected to said air cylinder of said booster and having a check valve therein which permits flow of air from said booster cylinder to said tank and a check valve therein to prevent return flow of air under pressure from said air cylinder through such line.

4. In a ram press having a movable pressure pad arranged to be moved in one direction by the press ram upon the closing of the press and a hydraulic cushion reacting on said pad to resist such movement and to move such pad in the other direction upon the opening of the press; said hydraulic cushion including a cylinder and a piston therein, a tank of hydraulic fluid, an air pressure line connected to said tank for subjecting the fluid therein to pressure, a hydraulic line extending from said tank to said cylinder for supplying hydraulic fluid under the pressure in said tank to said cylinder whereby the piston therein reacts on said pad, an air pressure booster including an air cylinder having a piston therein and a hydraulic cylinder having a piston therein, said last-named pistons being interconnected for movement together and said air piston having an effective area much greater than the hydraulic piston connected thereto, the discharge end of said booster hydraulic cylinder being connected to said hydraulic line, a check valve in said hydraulic line between said tank and said booster hydraulic cylinder, a check valve between said booster hydraulic cylinder and said cushion cylinder and a pressure relief valve controlled by-pass around said last-mentioned check valve, a hydraulic line extending from said tank to said booster hydraulic cylinder and communicating with said hydraulic cylinder at a point intermediate the ends thereof, said air pressure line connected to said tank being connected to said air cylinder of said booster and having a check valve therein which permits flow of air from said booster cylinder to said tank and a check valve therein to prevent return flow of air from said booster cylinder under pressure through such line.

5. In a ram press having a movable pressure pad arranged to move in one direction by the press ram upon the closing of the press and a hydraulic cushion reacting on said pad to resist such movement to move such pad in the other direction upon the opening of the press, a tank of hydraulic fluid, an air pressure line connected to said tank for subjecting the fluid therein to pressure, a hydraulic line from said tank to said hydraulic cushion for supplying hydraulic fluid under the pressure in said tank to said cushion whereby the cushion reacts on said pad, a check valve in said hydraulic line arranged so that the hydraulic fluid in said cushion is always subject to the pressure in said tank, a pressure relief by-pass around said valve, an air pump, a one-way communication between said air pump and said tank whereby the air discharged by said pump is supplied to said tank, and means responsive to the displacement of hydraulic fluid from said cushion into said hydraulic line for actuating said air pump whereby the air discharged therefrom is effective for increasing the pressure in said tank above the pressure in said air pressure line.

6. In a ram press having a movable pressure pad arranged to be moved in one direction by the press ram upon the closing of the press and a hydraulic cushion reacting on said pad to resist such movement and to move such pad in the other direction upon the opening of the press; a tank of hydraulic fluid under pressure, a hydraulic line extending from said tank to said cushion for supplying hydraulic fluid under the pressure in said tank to said cushion, an air pressure booster including an air

6

cylinder having a piston therein and a hydraulic cylinder having a piston therein, said last-named pistons being interconnected for movement together, the discharge end of said hydraulic cylinder being connected to said hydraulic line, a check valve in said hydraulic line between said tank and said hydraulic cylinder, a second hydraulic line extending from said tank to said hydraulic cylinder and communicating with said hydraulic cylinder at a point intermediate the ends thereof, an air pressure line interconnecting said tank and said air cylinder and having a check valve therein which permits flow of air from said air cylinder to said tank, and an air pressure line connected to said air cylinder and having a check valve therein which prevents return flow of air under pressure from said air cylinder through such line.

7. Apparatus according to claim 6 including a pressure relief by-pass around said check valve in said hydraulic line.

8. Apparatus according to claim 6 wherein the effective area of said pistons is the same.

9. Apparatus according to claim 6 wherein a check valve is arranged in said first mentioned hydraulic line between said hydraulic cylinder and said cushion and a pressure relief by-pass is disposed around said check valve.

10. Apparatus according to claim 6 including a spring reacting on said piston in said hydraulic cylinder for biasing said piston to obstruct the communication of said second hydraulic line with said hydraulic cylinder and wherein said hydraulic cylinder and the piston therein form a pressure relief by-pass around said check valve in said hydraulic line.

11. In a ram press having a movable pressure pad arranged to move in one direction by the press ram upon the closing of the press and a hydraulic cushion reacting on said pad to resist such movement and to move such pad in the other direction upon the opening of the press, a tank of hydraulic fluid under air pressure, a hydraulic line from said tank to said hydraulic cushion for continuously supplying hydraulic fluid under the pressure in said tank to said cushion whereby the cushion reacts on said pad and the hydraulic fluid therein is always subject to the pressure in said tank, a check valve in said line, an air pump actuated by operation of said press, a one way communication between said air pump and said tank whereby the air discharged by said pump is supplied to said tank for increasing the pressure therein, said air pump having a piston which reacts on the hydraulic fluid in said hydraulic line between said check valve and said cushion and forms a part of a pressure relief by-pass around said check valve.

12. In a ram press having a movable pressure pad arranged to move in one direction by the press ram upon the closing of the press and a hydraulic cushion reacting on said pad to resist such movement and to move such pad in the other direction upon the opening of the press, a tank of hydraulic fluid, an air pressure line connected to said tank for subjecting the fluid therein to pressure, a hydraulic line from said tank to said hydraulic cushion for supplying hydraulic fluid under the pressure in said tank to said cushion whereby the cushion reacts on said pad, a check valve in said hydraulic line arranged so that the hydraulic fluid in said cushion is always subject to the pressure in said tank, a pressure relief by-pass around said valve, and an air pump actuated by the hydraulic fluid displaced from said cushion by operation of said press and connected to said air pressure line and tank for increasing the pressure in said tank above the pressure in said air pressure line, said air pump forming part of a hydraulically actuated booster which includes a hydraulic cylinder having a piston therein connected to said air pump for operating the same, said booster hydraulic cylinder having its discharge end connected to said hydraulic line between said check valve and cushion

2,933,307.

7

whereby the piston in said booster hydraulic cylinder is actuated by the hydraulic fluid in said line upon the closing of the press.

1,848,383
2,122,871

References Cited in the file of this patent

5

769,308

UNITED STATES PATENTS

1,354,785 Strand ----- Oct. 5, 1920

8

Rode ----- Mar. 8, 1932
Saxe ----- July 5, 1938

FOREIGN PATENTS

Great Britain ----- Mar. 6, 1937