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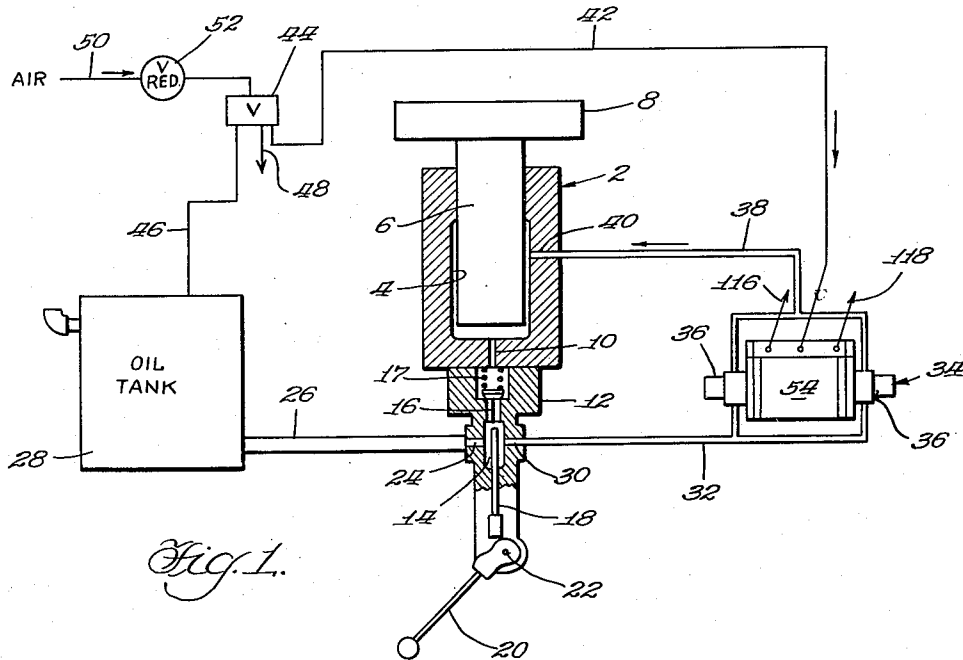
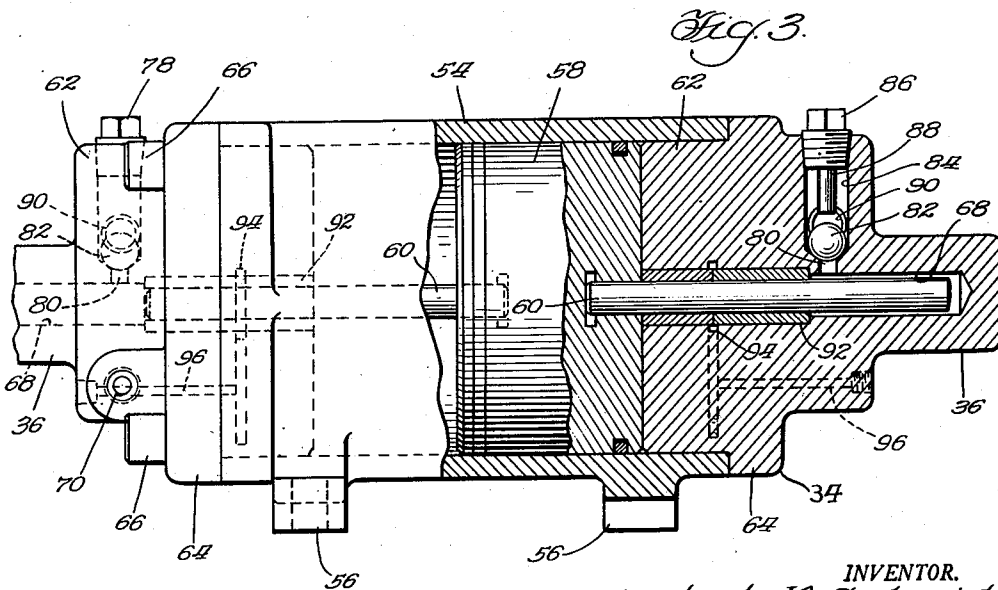
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2,573,993

HYDRAULIC PNEUMATIC SYSTEM FOR ACTUATING PRESSURE

Filed July 10, 1948

2 SHEETS—SHEET 1



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2 SHEETS--SHEET 2

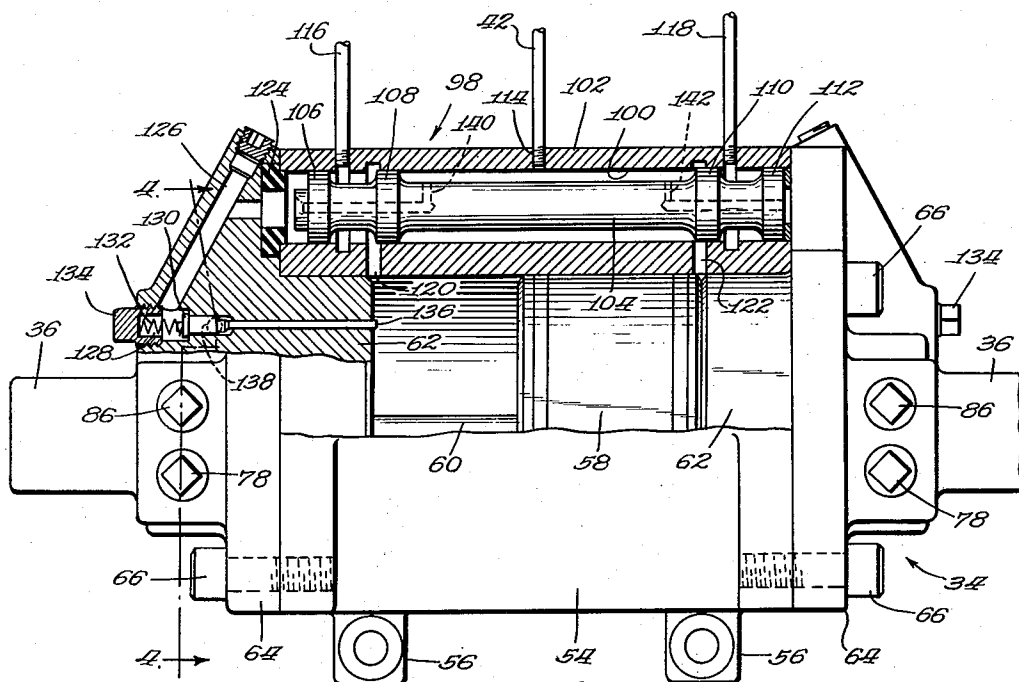


Fig. 2.

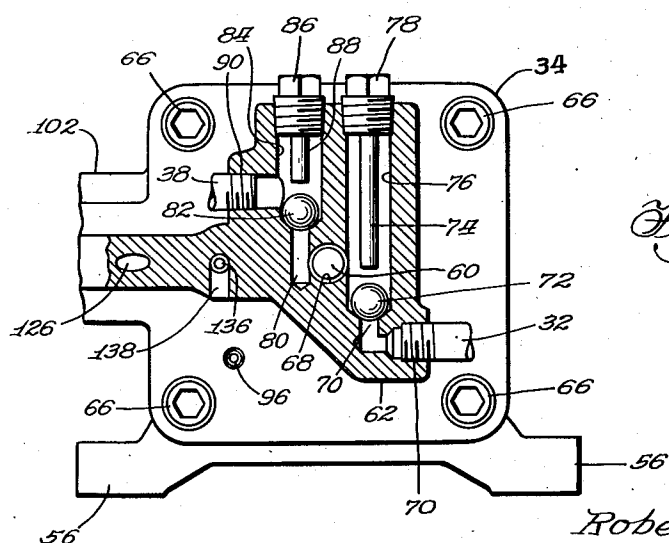


Fig. 4.

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This invention relates to hydraulic presses and more particularly to a novel actuating circuit adapted for operation of small inexpensive hydraulic presses.

Throughout the hydraulic press industry, and particularly in the plastic molding field, there has been a demand for a small, relatively inexpensive hydraulic press for the production of small pieces involving simple pressing techniques and comparatively low tonnage. To meet this demand there have been designed many small presses of the "laboratory type" and a number of small presses constructed according to conventional designs for standard large size presses. Both of these types of presses have proved inadequate inasmuch as the laboratory type press is inconvenient to handle and is generally not powered, and the small presses of conventional design are necessarily expensive per unit of capacity because of the hydraulic pumps and motors required.

Thus this particular size range of hydraulic presses has been reluctantly neglected by press manufacturers in favor of designs and sizes which have warranted a considerable investment on the part of the purchaser. The present invention relates to a small size inexpensive hydraulic press which is power actuated and is suitable to meet the requirements of the industry.

A general object of the invention is to provide a practical and inexpensive powered hydraulic press for the above-mentioned purposes.

Another object of the invention is to devise an hydraulic press comprising a novel actuating system including a pneumatic intensifier or power device for developing hydraulic pressure on the pressure or working stroke of the press.

Still another object of the invention is to devise a novel actuating circuit such as above described whereby the rapid advance stroke of the press ram to the work is effected by pneumatic displacement of the hydraulic fluid in the associated reservoir and the pressure or working stroke of the ram against the work is effected by a pneumatic intensifier or pressure device.

A further object of the invention is to devise a circuit such as above described comprising an automatically operable, continuous intensifier for continuously advancing the ram against the work until a predetermined load is developed there-against.

Still another object of the invention is to devise an intensifier of novel form particularly adapted for the above type of circuit, said intensifier comprising an air cylinder containing a double acting

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piston, each end of the cylinder being sealed by a head containing an hydraulic unit including a plunger operatively connected to the piston. The cylinder is provided with means for automatically directing compressed air alternately to opposite ends of the cylinder thereby effecting continuous operation of the hydraulic intensifier units, until a predetermined pressure is developed against the work.

The foregoing and other objects and advantages of the invention will become apparent from a consideration of the following specification and the accompanying drawings, wherein:

Figure 1 is a flow diagram illustrating the novel circuit;

Figure 2 is a plan view of the novel intensifier, portions thereof being broken away in vertical section to clarify the construction;

Figure 3 is a view taken from the side of Figure 2 with portions of the structure broken away; and

Figure 4 is an end view taken from the left of Figure 2, partly in section, on the line 4—4 thereof.

Describing the invention in detail and referring first to the flow diagram of Figure 1 wherein the hydraulic piping is shown in double lines and the pneumatic piping in single lines, the system comprises an hydraulic press motor 2 including a cylinder 4 with a ram 6 reciprocal therein and adapted to actuate a platen 8 against associated work (not shown). The cylinder 4 comprises a passage 10 connected to a prefill and exhaust valve 12 having a chamber 14 adapted for connection to the passage 10 and containing a valve stem 16 spring-pressed to closed position, as by a coil spring 17. The valve stem is actuated to open position, as hereinafter described, by a plunger 18 operated by a lever 20 pivoted at 22 to the valve 12. The chamber 14 is connected by an inlet port 24 to an hydraulic inlet line 26 connected to a tank or reservoir 28 adapted to contain a supply of hydraulic fluid, such as oil. The chamber 14 is also connected by an outlet port 30 to a line 32 connected to an intensifier 34, hereinafter described in detail. The intensifier comprises a pair of hydraulic units 36 having their suction sides connected to the line 32 and their discharge sides connected to a high pressure line 38 communicating by a port 40 with the cylinder 4.

The intensifier is operated, as hereinafter discussed, by compressed pneumatic fluid, such as air, conveyed thereto by a line 42 connected to an air valve 44 which is also connected by a

line 46 to the top of the tank 28 and is connected to a discharge line 48. Compressed air is conveyed to the valve 44 by a shop air line 50 containing a conventional reducing valve 52.

In operation of the above-described system, the valve 44 is first actuated to rapid advance or prefill position at which compressed air is directed through the line 46 to the tank 28; and the valve stem 16 is actuated to open position by the lever 20 accommodating flow of hydraulic fluid under pneumatic pressure from the tank 28 into the passage 10 urging the ram 6 on its rapid advance stroke to the work. After the ram has engaged the work under the comparatively light pressure of the hydraulic fluid in the tank 28, the stem 16 is closed, as shown in Figure 1, the line 26 being connected to the line 32; and the valve 44 is actuated to its full pressure position whereat compressed air is directed to the line 42 and thence to an air cylinder 54 of the intensifier 34 operating the units 36, as hereinafter discussed, to urge high pressure fluid through the main pressure line 38 into the passage 40 thereby actuating the ram 6 under full pressure against the work until a predetermined pressure has been developed thereagainst.

The ram 6 is released by actuation of the valve 44 to neutral position whereat the lines 42 and 46 are connected to the exhaust line 48 thereby terminating operation of the intensifier 34 and releasing pneumatic pressure on the hydraulic fluid in the tank 28. Thereafter the operator actuates the stem 16 to open position accommodating discharge of the pressure fluid within the cylinder 4 to the tank 28 whereupon the pressure on the ram 6 is relieved and, in the vertical position illustrated in Figure 1, the ram is returned by operation of gravity to position shown in the drawings.

Referring now to Figures 2 to 4 inclusive, the intensifier 34 is shown in detail and comprises the above-mentioned air cylinder 54 which is provided with brackets 56 adapted for convenient mounting on a press frame (not shown).

The cylinder 54 contains a double acting air piston 58 connected at opposite sides thereof to a pair of identical hydraulic plungers 60 which, as best seen in Figure 3, are press fitted into complementary openings in the piston 58.

Each end of the cylinder 54 is sealed by a head 62 having a flange 64 secured as by screws 66 to the cylinder. The head 62 contains an hydraulic unit including the associated plunger 60 which reciprocates within an hydraulic chamber 68 having an inlet or suction port 70 provided with a ball check valve 72 adapted to open on the suction stroke of the plunger and adapted to close on the discharge stroke of the plunger. The ball valve 72 is limited in its movement to open position by a stem 74 within a chamber 76 containing a plug 78 carrying the stem 74. The chamber 68 is also connected to an outlet or discharge port 80 equipped with a ball check valve 82 operable within a chamber 84 closed by a plug 86 which carries a stem 88 adapted to limit movement of the ball 82 to open position. The chamber 84 is connected to a discharge port 90 whereby on the pressure stroke of the plunger 60, the ball 82 is forced to open position accommodating discharge of hydraulic fluid from the chamber 68 to the discharge port 90.

Each head 62 is preferably provided with a plunger bushing 92 having a machined fluid-tight fit with the plunger 60, and the head is provided with an annular groove 94 surrounding the outer

diameter of the bushing to collect leakage oil which is drained from the groove 94 by a drain port 96.

The air piston 58 during actuation of the intensifier 34 is automatically reciprocated by a valve mechanism, generally designated 98 (Figure 2). This mechanism comprises a cylindrical valve chamber or bore 100 in a boss 102 formed on the side of the cylinder 54. The bore 100 contains a valve stem 104 having four spaced lands or spools 106, 108, 110, and 112 slidably fitted within the bore 100 in substantially fluid-tight engagement therewith. Compressed air is admitted to the bore 100 through a port 114 connected to the before-mentioned air line 42, and air is exhausted from the bore by exhaust or discharge lines 116 and 118. The bore 100 is connected to one end of the cylinder 54 by a port 120 and to the opposite end by a port 122, and each end of the bore is sealed by a rubber annular gasket or bumper 124. Each end of the bore is connected to a passage 126 in the associated head 62, said passage terminating in a chamber 128 containing a valve 130 urged to closed position by a spring 132 adjustably compressed by a cap 134 threaded into the head. The valve 132 is engaged by an actuator rod 136 extending through a complementary opening in the head and projecting into the cylinder 54 whereby upon engagement of the piston 58 with the rod 136, the valve 130 is urged to open position against the resistance of spring 132 exhausting the air within the passage 126 to an exhaust or discharge port 138.

With the stem 104 in the position shown in Figure 2, compressed air is delivered to each end of the bore 100 by passages 140 and 142 through the stem and compressed air is delivered to the port 122 urging the piston 58 to the left, as seen in Figure 1, forcing air from the cylinder 54 through the port 120 into the discharge line 116. When the piston 58 engages the rod 136 at the left of Figure 2, the rod actuates the valve 130 to open position exhausting the left end of the bore 100 whereupon the pressure at the opposite end thereof is effective to urge the valve stem 104 against the bumper 124 at the left end of the bore. Under these conditions compressed air is delivered from the bore 100 to the port 120 and the piston 58 is urged to the right forcing air from the cylinder 54 through the port 122 and the discharge line 118 until the piston 58 engages the rod 136 (not shown) at the right end of the cylinder whereupon the action is reversed and the piston 58 is urged again to the left. Thus it will be understood that upon delivery of compressed air to the line 42, the piston 58 is automatically and continuously reciprocated within the cylinder 54 to operate the units 36 which alternately suction hydraulic fluid from the line 32 and discharge the fluid under pressure to the line 38 until the ram 6 has developed the predetermined pressure against the work.

As above noted, after completion of the cycle, the line 42 is exhausted and thereafter the exhaust valve stem 16 of the exhaust chamber 12 is opened to accommodate discharge of the pressure fluid within the cylinder 4 to the tank 28.

I claim:

1. In an actuating circuit for a hydraulic motor having a cylinder and a ram therein; the combination of a closed reservoir of hydraulic fluid, a hydraulic intensifier having a discharge side connected to said cylinder and having a suction side connected to said reservoir, said intensifier being adapted upon actuation thereof to continu-

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ously deliver hydraulic pressure fluid to said cylinder, pneumatic motor means for continuously operating said intensifier as long as pneumatic pressure fluid is delivered to said motor means, an hydraulic valve comprising a casing having a chamber connected at all times to the intensifier and to the reservoir, said casing comprising a port connecting the chamber to the cylinder, and said valve comprising a stem and spring means for urging the stem to closed position whereat said port is closed, means for moving said stem to open position against the resistance of said spring means, and pneumatic valve means operable in one position thereof to deliver pneumatic pressure fluid only to said reservoir where-
 by, upon opening of said stem, hydraulic fluid is forced from said reservoir to said cylinder, said pneumatic valve means being adapted in another position thereof to deliver pneumatic pressure fluid to said motor means, and being adapted in neutral position to exhaust both said reservoir and said motor means.

2. In an actuating circuit for a hydraulic motor having a cylinder and a ram; the combination of a closed reservoir of hydraulic fluid, a reciprocating hydraulic intensifier having a discharge side connected to said cylinder and having a suction side connected to said reservoir, said intensifier being adapted on one stroke thereof to draw fluid from the reservoir and on another stroke to force fluid to said cylinder, pneumatic motor means for continuously reciprocating said intensifier as long as pneumatic pressure fluid is

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delivered to said motor means, an hydraulic valve comprising a casing with a chamber connected at all times to the intensifier and to the reservoir, said valve casing comprising a port connecting the valve chamber to the cylinder, and said valve comprising a stem for closing said port and spring means for urging the stem to closed position, means for moving said stem to open position against the resistance of said spring means, said stem having an opening area acted upon by pressure of hydraulic fluid in said valve chamber and having a closing area greater than said opening area, said closing area being acted on by pressure of hydraulic fluid in said cylinder, and pneumatic valve means operable in one position thereof to deliver pneumatic pressure fluid only to said reservoir, said pneumatic valve means being adapted in another position thereof to deliver pneumatic pressure fluid to said motor means, said pneumatic valve means being adapted in a third position thereof to exhaust said intensifier and said motor means.

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