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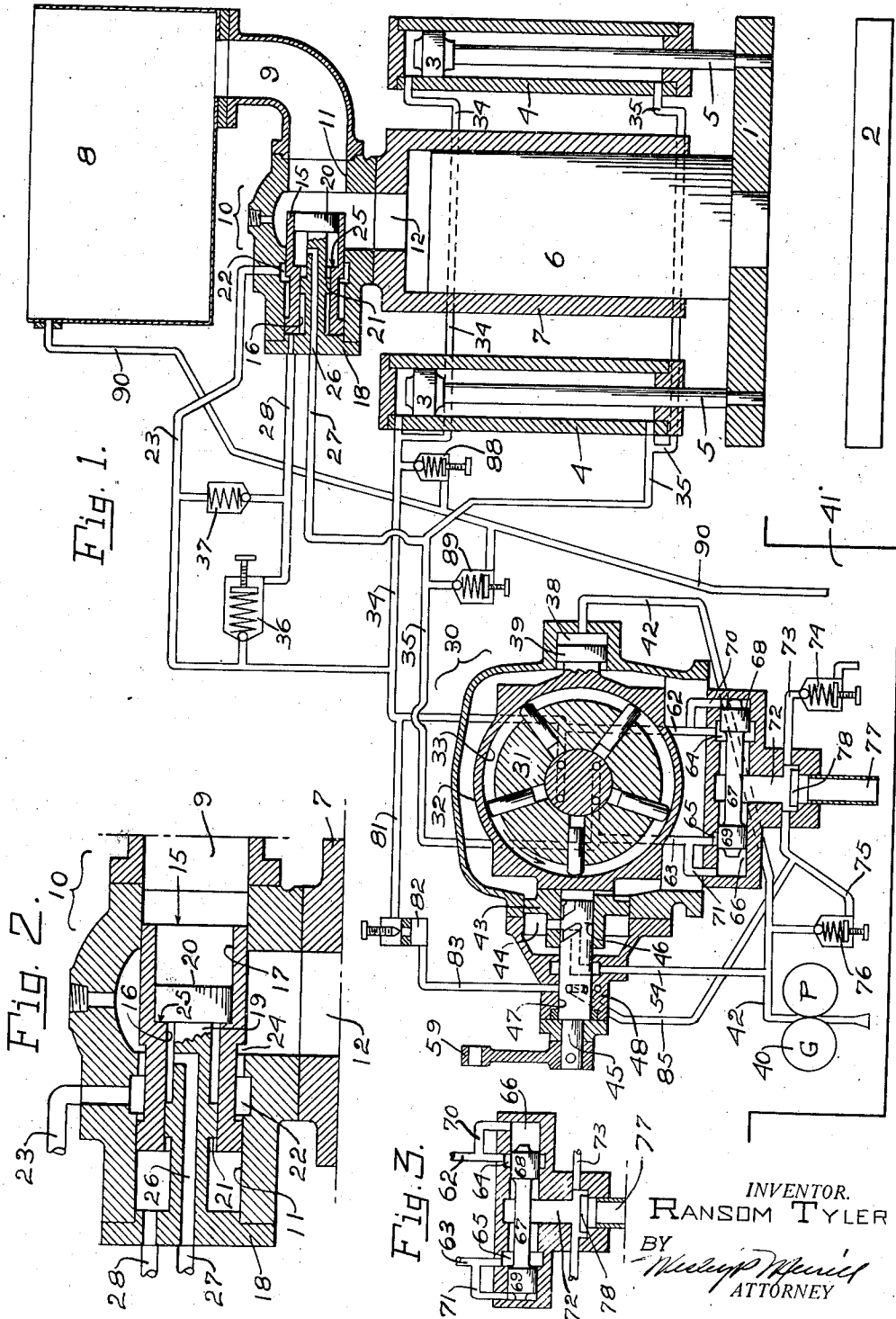
R. TYLER

2,114,005

HYDRAULIC SPEED PRESS

Filed May 3, 1937

2 Sheets-Sheet 1



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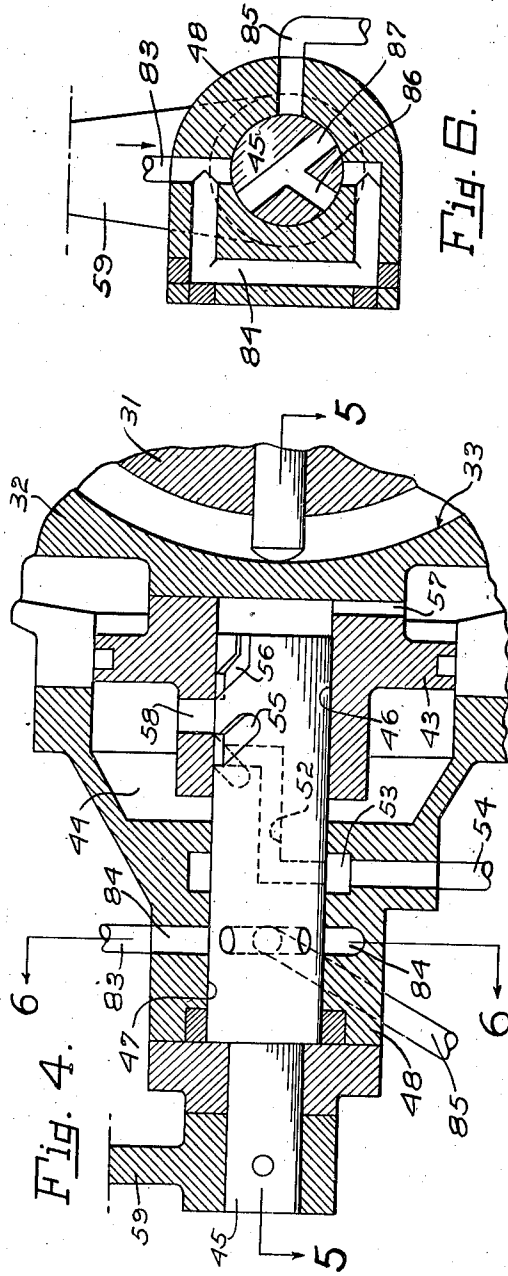
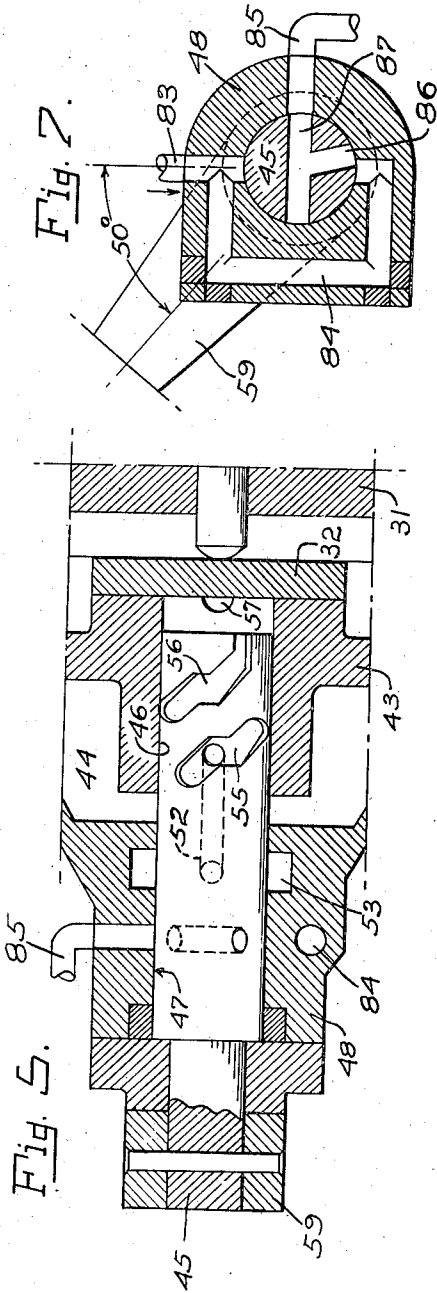
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HYDRAULIC SPEED PRESS

Filed May 3, 1937

2 Sheets-Sheet 2



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2,114,005

HYDRAULIC SPEED PRESS

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Application May 3, 1937, Serial No. 140,473

9 Claims. (Cl. 60—52)

This invention relates to hydraulic presses of the type having a ram arranged in a stationary cylinder, a reciprocating hydraulic motor for advancing and retracting the ram toward and from the work at high speed, a reversible pump for supplying liquid to the motor to operate the same, a surge tank for supplying liquid to the ram cylinder when the ram is being advanced by the motor and for receiving liquid ejected from the ram cylinder when the ram is being retracted by the motor, and a surge valve for controlling communication between the ram cylinder and the surge tank and adapted when the motor stalls at the end of the advance movement of the ram to close the ram cylinder to the surge tank and open it to the pump to enable the pump to supply liquid to the ram cylinder and thereby cause the ram to exert a high pressing force upon the work. The surge valve is shifted in response to variation in the pressure differential between the two sides of the hydraulic circuit which connects the pump to the press cylinders.

The liquid delivered by the pump to the ram cylinder compresses the liquid therein, and the pressure in the ram cylinder acts upon the surge valve and holds it in a position to block communication between the ram cylinder and the surge tank with the result that, when the pump is reversed, the ram cannot be retracted until the pump has pumped sufficient liquid from the ram cylinder to reduce the pressure therein enough to permit the surge valve to shift, thereby causing a delay equal to a large percentage of the time required for a complete cycle of operation.

The present invention has as an object to provide means for relieving the pressure in the ram cylinder in response to reversal of the pump.

In the presses of the downward pressure type, the combined weight of the ram, the piston and piston rod of the motor, the platen and the die carried by the platen is often so great that the ram will fall as soon as the pump is adjusted to start a down stroke, thereby causing a heavy impact against the work and creating a partial vacuum in the upper end of the motor cylinder.

Another object of the present invention is to provide a hydraulic speed press in which the outflow from the motor is metered by the pump to thereby prevent the ram from descending at a rate greater than the rate determined by the adjustment of the pump.

Other objects and advantages will appear from the following description of the hydraulic press shown in the accompanying drawings in which the views are as follows:

Fig. 1 is a diagrammatic view illustrating the hydraulic circuit of the press and showing the several parts in the positions occupied when the press is idle and the ram is at the top of its stroke.

Fig. 2 is a detail view of the surge valve and shows it in the position occupied when the press is acting upon the work.

Fig. 3 is a detail view showing an automatic valve in a position different from that shown in Fig. 1.

Fig. 4 is a detail view showing the pump control valve on a scale larger than that shown in Fig. 1 and with the valve in the position occupied when the pump is at zero stroke.

Fig. 5 is a sectional plan view taken on the line 5—5 of Fig. 4 showing the valve in elevation.

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 4.

Fig. 7 is a view similar to Fig. 6 but showing the control valve shifted to a position to cause the pump to deliver liquid at its full volumetric rate in a direction to raise the ram of the press.

The press chosen for illustration includes a movable press head or platen 1 which is adapted to be moved toward and from a stationary press head 2 by two reciprocating hydraulic motors each of which includes a piston 3 fitted in a stationary cylinder 4 and connected to platen 1 by a piston rod 5. In order that platen 1 may exert a pressing force against head 2 or upon any work or other object placed therebetween, it is connected to a large diameter ram 6 which is fitted in a stationary ram cylinder 7.

When motive liquid is supplied to the upper ends of cylinders 4, pistons 3 will move ram 6 downward and cause it to draw liquid into the upper end of cylinder 7 from a surge tank 8 and, when motive liquid is supplied to the lower ends of cylinders 4, pistons 3 will move ram 6 upward and cause it to eject liquid from cylinder 7 into surge tank 8.

Cylinder 7 is connected to the lower part of surge tank 8 through a channel 9 and a surge valve 10 which has an axial bore 11 formed in its casing and communicating at its right end with channel 9 and communicating intermediate its ends with a channel 12 which extends through the side wall of the surge valve casing and through the upper end of the ram cylinder.

Communication between channel 9 and channel 12 is controlled by a valve member 15 which is closely fitted in bore 11 and provided with an axial bore 16 and a counterbore 17. The left end of bore 11 is closed by a cap 18 having fixed to the inner face thereof a valve core 19 which is

provided at its inner end with a large stationary piston 20 and provided intermediate its ends with a small stationary piston 21. Piston 20 is closely fitted in counterbore 17 and piston 21 is closely

5 fitted in bore 16.
When valve member 15 is moved to the position shown in Fig. 1, it opens communication between channel 9 and channel 12 and closes communication between channel 12 and a port 22
10 which is formed in the wall of bore 11 and communicates with an external channel 23 through which pressure liquid may be supplied to ram cylinder 7. When valve member 15 is moved to the position shown in Fig. 2, it closes communication between channel 9 and channel 12 and
15 opens communication between channel 12 and port 22, communication being established by means of an annular groove 24 which is formed in the outer peripheral surface of valve member
20 15 and of sufficient width to remain in communication with port 22 when valve member 15 is shifted from one to the other of its positions.

Valve member 15 is adapted to be moved to the position shown in Fig. 1 by the pressure of liquid
25 in counterbore 17 acting upon a shoulder 25 which is formed at the junction of bore 16 and counterbore 17. Liquid is supplied to counterbore 17 through a duct 26 which is formed in valve core 19 and extends through cap 18 into communication with an external channel 27. Valve member
30 15 is adapted to be moved to the position shown in Fig. 2 by liquid supplied through a channel 28 to the left end of bore 11 and acting upon the left end of valve member 15.

35 Liquid for operating the press is supplied by a power driven pump 30 which has been shown as being of the rolling piston type fully illustrated and described in Patent No. 2,074,068. It is deemed sufficient to state herein that the pump
40 has its pistons and cylinders arranged in a rotatable cylinder barrel 31 which is arranged inside a thrust member or slide block 32 having an inner annular reaction surface 33 to engage the outer ends of the pump pistons.

45 When slide block 32 is in its central or neutral position so that the axis of reaction surface 33 coincides with the axis of cylinder barrel 31 as shown in Fig. 1, the pump is at zero stroke and no liquid will be delivered thereby. When slide
50 block 32 is shifted in one direction or the other from its neutral position and cylinder barrel 31 is rotated, the pump will deliver liquid in a direction and at a rate dependent upon the direction and distance slide block 32 is shifted from its
55 neutral position.

As shown, cylinder barrel 31 is adapted to be rotated in the direction of the arrow so that, when slide block 32 is shifted toward the right from its neutral position, the pump will deliver liquid
60 through a channel 34 to the upper ends of both cylinders 4 and have liquid returned to it from the lower ends of both cylinders 4 through a channel 35 and, when slide block 32 is shifted toward the left from its neutral position, the pump
65 will deliver liquid through channel 35 to the lower ends of both cylinders 4 and have liquid returned to it from the upper ends of both cylinders 4 through channel 34.

In order that pump 30 may also deliver liquid
70 to ram cylinder 7, and in order that surge valve 10 may be operated automatically, channel 23 is connected to channel 34 intermediate the ends thereof, channel 27 is connected to channel 35
75 intermediate the ends thereof, channel 23 is connected at a point intermediate its ends to chan-

nel 28 through a resistance valve 36 which is adjusted to open at a predetermined high pressure, and channel 28 is connected to channel 23 through a check valve 37 which permits liquid to flow freely from channel 28 into channel 23 but
5 prevents it from flowing in the opposite direction.

Slide block 32 is continuously urged toward the left by liquid pressure in a stationary cylinder
38 acting upon a piston 39 which is fitted in cylinder 38 and connected to slide block 32. Liquid for operating piston 39 is supplied by a gear pump
10 40 which is ordinarily arranged in the same casing as pump 30 and driven in unison therewith as shown in the patent, referred to above. Gear pump 40 draws liquid from a reservoir 41 and discharges it into a low pressure supply channel 42
15 which is connected to cylinder 38. Liquid discharged by gear pump 40 in excess of requirements is exhausted through relief valves which will be presently described and which enable gear
20 pump 40 to maintain a constant low pressure in channel 42 and in cylinder 38.

Slide block 32 is adapted to be moved toward the right by gear pump pressure acting upon a piston 43 which is fitted in a stationary cylinder
25 44 and engages slide block 32. The delivery of liquid to cylinder 44 is controlled by a rotary follow-up valve 45 which is journaled in coaxial bores 46 and 47 formed, respectively, in piston 43 and in the end wall or head 48 of cylinder 44 as
30 best shown in Figs. 4 and 5.

Valve 45 has a duct 52 formed therein with its outer end in constant communication with an annular port 53 which is formed in the wall of bore 47 and connected by a channel 54 to channel
35 42. The inner end of duct 52 opens into a spiral groove 55 which is formed in the peripheral surface of valve 45 and normally closed by the wall of bore 46. The arrangement is such that gear pump pressure prevails in groove 55 at all times.
40 A second spiral groove 56 is formed in the peripheral surface of valve 45 a short distance from groove 55 and opens into the right end of bore 46 from which a drain channel 57 extends through the hub of piston 43.

Grooves 55 and 56 are normally arranged upon opposite sides of a port 58 which extends through the hub of piston 43 into communication with the interior of cylinder 44 and is of a width equal to the distance between grooves 55 and 56 so that
50 rotation of valve 45 in one direction or the other will open one or the other of grooves 55 and 56 to port 58. Valve 45 is adapted to be rotated by means of a lever 59 which is fixed upon the outer end thereof and has rotary movement through a
55 given angular distance, for instance, 50 degrees, from the central or neutral position shown in Fig. 6, the movement of lever 59 in each direction being ordinarily limited by stops not shown.

When lever 59 is moved toward the right or in a clockwise direction in respect to Fig. 6, groove 55
60 will open to port 58 and permit liquid from gear pump 40 to flow through channels 42 and 54, port 53, duct 52, groove 55 and port 58 into cylinder 44. The liquid entering cylinder 44 will move piston
65 43 and slide block 32 toward the right for the reason that piston 43 has a considerably greater pressure area than piston 39 which is also subjected to gear pump pressure.

Piston 43 will start to move as soon as groove 55
70 opens to port 58 and it will continue to move as long as valve 45 is rotated. As soon as rotation of valve 45 ceases, port 58 will move out of communication with groove 55 and movement of piston 43 and slide block 32 will cease.

When lever 59 is moved toward the left or in a counterclockwise direction in respect to Fig. 6, groove 56 will open to port 58 and permit liquid to escape from cylinder 44 through port 58 and groove 56 into the right end of bore 46 which is open to drain through channel 57, thereby permitting the gear pump liquid acting upon piston 39 to move it and slide block 32 toward the left.

Piston 39 will start to move slide block 32 and piston 43 toward the left as soon as groove 56 opens to port 58 and it will continue to move as long as valve 45 is rotated. As soon as rotation of valve 45 ceases, port 58 will move out of communication with groove 56 and trap the remaining liquid in cylinder 44, thereby stopping further movement of slide block 32 and holding it in adjusted position. Slide block 32 may thus be moved in one direction or the other by swinging lever 59 in one direction or the other, and the distance through which slide block 32 is moved is dependent upon the angular distance through which lever 59 is moved.

In order to supply pump 30 with the volume of liquid required by it in excess of the volume returned to it during operation of motors 3-4 in one direction, and in order to permit exhaust of the volume of liquid discharged by motors 3-4 in excess of the volume required by pump 30 during operation of motors 3-4 in the opposite direction, channels 34 and 35 are connected, respectively, by channels 62 and 63 to two ports 64 and 65 which are formed in the wall of a valve chamber 66 intermediate the ends and center thereof.

Chamber 66 has arranged therein an automatic valve 67 having pistons 68 and 69 arranged upon its ends and closely fitted in chamber 66 to control ports 64 and 65 respectively. Chamber 66 communicates at its extreme right end with channel 62 through a channel 70, at its extreme left end with channel 63 through a channel 71, and at a point intermediate the ports 64 and 65 with a supply chamber 72.

The arrangement is such that, when the pressure in channel 62 is higher than the pressure in channel 63, liquid will flow from channel 62 through channel 70 to the right end of chamber 66 and move valve 67 toward the left to the position shown in Fig. 3 and, when the pressure in channel 63 is higher than the pressure in channel 62, liquid will flow from channel 63 through channel 71 to the left end of chamber 66 and move valve 67 toward the right to the position shown in Fig. 1.

The liquid returned from the circuit to pump 30 in excess of its requirements is exhausted from supply chamber 72 through a channel 73 and a low pressure resistance valve 74 which discharges into reservoir 71 and is adjusted to open at a low pressure, for instance, at 60# per square inch.

The liquid required by pump 30 in excess of the volume returned to it from the circuit is ordinarily supplied by gear pump 40. To this end, chamber 72 is connected to supply channel 42 through a channel 75 and a low pressure resistance valve 76 which is adjusted to open at a low pressure, for instance, at 85# per sq. in. Gear pump 40 ordinarily delivers liquid at a rate in excess of requirements and discharges continuously through resistance valve 76, channel 75, chamber 72, channel 73 and resistance valve 74 into reservoir 41, thereby maintaining a pressure in chamber 72 equal to the resistance of valve 74 and maintaining in channel 42 a pressure equal to the sum of the resistances of valves 74 and 76.

Liquid may also be supplied to chamber 72 from reservoir 41 through a suction channel 77 and a

check valve 78 in order that pump 30 may be employed in circuits in which the volumetric capacity of gear pump 40 would be insufficient to make up the difference between the volume required by pump 30 and the volume returned to it from the circuit. Check valve 78 permits liquid to be drawn into chamber 72 through channel 77 but prevents liquid from escaping from chamber 72 into channel 77.

In order that the press may be promptly reversed at the end of a pressing operation, means are provided for relieving the pressure in ram cylinder 7 in response to reversal of pump 30. To this end, channel 34 is connected through a channel 81, a throttle valve 82 and a channel 83 to a channel 84 (Fig. 6) which is formed in end head 48 and adapted to be connected through valve 45 to a channel 85 (Fig. 1) which has one of its ends in communication with bore 47 and its other end connected to channel 75 intermediate the ends thereof.

Channel 84 communicates with bore 47 at diametrically opposite points so that the pressure prevailing in channel 84 may act upon opposite sides of valve 45 to hydrostatically balance the same. Valve 45 has formed therein two intersecting radial passages 86 and 87 which are adapted to register, respectively, with channels 84 and 85 when valve 45 is rotated through a predetermined angular distance in a counterclockwise direction from its neutral position shown in Fig. 6 to thereby cause slide block 32 to be moved toward the left so that pump 30 will deliver liquid through channel 35 to the lower ends of cylinders 4 to raise ram 7 as previously explained.

The reason that channels 86 and 87 are not opened to channels 84 and 85 until after valve 45 has been rotated through a predetermined angular distance, for instance through 15°, in a counterclockwise direction from its neutral position is to enable pump 30 to deliver sufficient liquid to the lower ends of cylinders 4 to support platen 1 and the parts movable therewith should they tend to descend due to leakage when the press is idle.

Operation

The press is provided with a suitable control so that pump 30 may be reversed manually, or in response to the creation of a predetermined high pressure, or in response to platen 1 reaching a predetermined point in its travel, depending upon the operation to be performed by the press. Since such controls are well known and form no part of the present invention, the same have not been illustrated. It is to be understood however that the press should be provided with suitable means for moving lever 59 to its neutral position in response to platen 1 approaching the upper limit of its movement and for causing lever 59 to move in a counterclockwise direction in response to platen 1 moving downward from its upper position so that, if platen 1 should descend due to leakage when the press is idle, pump 30 would be caused to deliver liquid to the lower ends of cylinders 4 to hold platen 1 in its upper position, as is customary in presses of this type.

Assuming that the several parts are in the positions shown in Fig. 1 and that pumps 30 and 40 are being driven, the press will operate as follows:

Pump 30 will be at zero stroke and no liquid will be delivered thereby unless platen 1 tends to descend. Pump 40 will be discharging through channel 42, resistance valve 76, channel 75,

chamber 72, channel 73 and resistance valve 74 so that it will be maintaining in chamber 72 a pressure equal to the resistance of valve 74 and maintaining in cylinder 38 a pressure equal

5 to the combined resistances of valves 74 and 76. The weight of platen 1 and the parts movable therewith will create pressure in the lower ends of cylinders 4, and this pressure will extend through channels 35, 63 and 71 to the left end of

10 valve chamber 66 and hold valve 67 in the position shown in Fig. 1 in which position piston 69 blocks port 65, thereby trapping liquid in the lower ends of cylinders 4 and preventing platen 1 from descending.

15 When lever 59 is swung in a clockwise direction in respect to Fig. 6, groove 55 will open to port 58 and permit liquid from gear pump 40 to enter cylinder 44 and move slide block 32 toward the right, thereby causing pump 30 to draw

20 liquid from channel 35 and deliver it into channel 34.

When pump 30 first starts to deliver liquid, channel 63 is blocked by piston 69 and channel 34 is open to supply chamber 72 through channel 62 and valve chamber 66 so that, for an instant, pump 30 cannot increase the pressure in channel 34 above the pressure required to open resistance valve 74. However, the liquid drawn by pump 30 from channel 35 almost instantly

30 lowers the pressure therein and consequently lowers the pressure in channels 63 and 71 and in the left end of valve chamber 66 and thereby permits the pressure prevailing in the right end of valve chamber 66 to shift valve 67 from the position shown in Fig. 1 to the position shown in Fig. 3.

Then the liquid discharged by pump 30 will flow through channel 34 to the upper ends of cylinders 4 and cause pistons 3 to move downward and expel liquid from cylinders 4 through channel 35 to the intake of pump 30. Due to the displacement of piston rods 5, the volume of liquid discharged from the rod ends of cylinders 4 is less than the volume supplied by pump 30

40 to the head ends of cylinders 4, and this deficiency is made up by gear pump 40 which delivers liquid through channel 42, resistance valve 76, channel 75, supply chamber 72, valve chamber 66 and channels 63 and 35 to the intake of pump 30.

50 Pistons 3 will move platen 1 and ram 6 downward, and liquid will flow from surge tank 8 through channel 9, bore 11 and channel 12 to ram cylinder 7 and keep it filled.

55 If the weight of platen 1 and the parts movable therewith is great enough to cause the same to fall, that is to descend by gravity at a rate greater than the rate determined by the displacement of pump 30, pistons 3 will tend to draw liquid into the upper ends of cylinders 4 faster than liquid would be supplied thereto by pump 30, thereby causing the pressure in channels 34 and 62 to drop substantially to zero.

60 This drop in pressure in channels 34 and 62 would permit the pressure in the left end of valve chamber 66 to shift valve 67 to the position shown in Fig. 1 in which position piston 69 blocks port 65 so that all the liquid expelled from cylinders 4 by pistons 3 must pass through

70 pump 30 which would meter the outflow from cylinders 4 and prevent platen 1 from descending at a rate greater than the rate determined by the displacement of pump 30. As soon as valve 67 is shifted, gear pump 40 would deliver

75 liquid through channel 42, resistance valve 76,

channel 75, chambers 72 and 66 and channels 62 and 34 to the upper ends of cylinders 4 to make up the deficiency of liquid therein.

When platen 1 is descending by gravity and further downward movement thereof is arrested as by platen 1 or a die carried thereby engaging a piece of work, the pressure in channels 35 and 63 and in the left end of valve chamber 66 will drop to zero as soon as downward movement of platen 1 ceases. Then the pressure prevailing in the right end of valve chamber 66 will shift valve 67 to the position shown in Fig. 3 and thereby enable pump 30 to increase the pressure in channel 34. When platen 1 is being moved downward by liquid supplied by pump 30 to the upper ends of cylinders 4, valve 67 is in the position shown in Fig. 3 so that the pressure in channel 34 increases in response to further downward movement of platen 1 being resisted by a piece of work or other object placed between

2 platen 1 and stationary head 2. The resistance to further downward movement of platen 1 causes the liquid delivered by pump 30 into channel 34 to increase the pressure therein until it is high enough to open resistance valve 36 and then liquid will flow therethrough and through channel 28 into the left end of bore 11 and shift valve member 15 from the position shown in Fig. 1 to the position shown in Fig. 2, thereby closing ram cylinder 7 to tank 8 and opening it to channel 23 so that liquid from pump 30 may flow through channels 34 and 23, surge valve 10 and channel 12 into cylinder 7 and act upon ram 8. Platen 1 is then urged downward by pump pressure acting upon the combined areas of ram 6 and pistons 3.

The pressure created by pump 30 in each direction of delivery is limited by two resistance valves 88 and 89 which are ordinarily built into the pump casing but which, for the purpose of illustration, have been shown as having the inlets thereof connected, respectively, to channels 34 and 35 and the outlets thereof connected to an overflow pipe 90 which limits the level of the liquid in surge tank 8 and discharges into reservoir 41.

When the pressing operation has been completed, control lever 59 is swung to the position shown in Fig. 7, thereby opening groove 56 to port 58 so that gear pump liquid acting upon piston 39 can move slide block 32 toward the left as previously explained.

Pump 30 will then deliver liquid to the lower ends of cylinders 4 to raise pistons 3 and ram 6 but, if it were not for the bypass through valve 45, the pressure prevailing in the upper ends of cylinders 4 and 7 would hold surge valve 10 closed so that the liquid in the upper end of cylinder 7 would prevent ram 6 from being raised. Also, this high pressure would extend through channels 34, 62 and 70 to the right end of valve chamber 66 and hold valve 67 in the position shown in Fig. 3. Ram 6 would thus be prevented from being raised until pump 30 had pumped enough liquid out of cylinder 7 to reduce the pressure therein sufficiently to permit surge valve 10 to shift.

Since the oil ordinarily used as the motive liquid is somewhat elastic, the liquid in cylinder 7 would be compressed so much that an appreciable volume would have to be pumped out of cylinder 7 before the pressure therein would be reduced sufficiently to permit surge valve 10 to be shifted. Consequently, a considerable delay would ensue before ram 6 started to move upward, and this

delay has been found to be equal to as much as 25% of the time required for a complete pressing operation.

However, by providing a bypass through valve 45, a delay in reversing ram 7 is avoided for the reason that, when lever 59 is swung toward the left, passage 86 registers with channel 84 and passage 87 registers with channel 85, as shown in Fig. 7, so that liquid may escape from cylinder 7 through channel 12, surge valve 10, channels 23, 34 and 81, throttle valve 82, channels 83 and 84, passages 86 and 87, channels 85 and 75, chamber 72, channel 73 and resistance valve 74 into reservoir 41 at a rate determined by throttle valve 82 which is so adjusted that ram 6 may be reversed quickly but not instantaneously as instantaneous reversal would cause a shock due to the sudden expansion of the liquid.

When pump 30 is reversed, it delivers liquid into channel 35 and raises the pressure therein. This pressure extends through channels 63 and 71 to the left end of valve chamber 66 and shifts valve 67 to the position shown in Fig. 1. Pressure also extends through channels 27 and 26 to counterbore 17 and shifts valve member 15 to the position shown in Fig. 1, liquid being expelled by valve member 15 from the left end of bore 11 through channel 28, check valve 37 and channel 23 into channel 34.

With valve member 15 in the position shown in Fig. 1, the liquid discharged by pump 30 flows through channel 35 to the lower ends of cylinders 4 and raises pistons 3 which raise ram 6 and cause it to expel liquid from cylinder 7 through channel 12, bore 11 and channel 9 into surge tank 8.

Pistons 3 in moving upward expel liquid from cylinders 4 through channel 34 to the intake of pump 30. Since, due to the displacement of piston rods 5, pistons 3 will expel liquid from the upper ends of cylinders 4 at a rate greater than the rate at which pump 30 delivers liquid to the lower ends thereof, the excess liquid will be exhausted through channel 62, chambers 66 and 72, channel 73 and resistance valve 74 into reservoir 41.

When platen 1 approaches the upper limit of its movement, lever 59 is operated to cause the displacement of pump 30 to be reduced to zero to thereby bring the press to rest.

The hydraulic press herein described is susceptible of various modifications without departing from the scope of the invention as hereafter claimed.

The invention is hereby claimed as follows:

1. A hydraulic speed press, comprising a movable member for exerting a force upon a stationary object, a reciprocating hydraulic motor for advancing said member into engagement with said object and for retracting it therefrom, a ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven reversible pump for supplying liquid to said motor to cause it to reciprocate said member and said ram and for supplying liquid to said ram cylinder to create pressure therein, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supplying liquid to said cylinder during advance of said ram and for receiving liquid from said cylinder during retraction of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and

close it to said pump in response to the pressure in one side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to advance or retract said member, said control means including an element movable in one direction to effect an advance of said member and movable in the opposite direction to effect a retraction of said member, and means responsive to the movement of said element a given distance in said opposite direction for relieving the pressure in said ram cylinder.

2. A hydraulic speed press, comprising a movable member for exerting a force upon a stationary object, a reciprocating hydraulic motor for advancing said member into engagement with said object and for retracting it therefrom, a ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven reversible pump for supplying liquid to said motor to cause it to reciprocate said member and said ram and for supplying liquid to said ram cylinder to create pressure therein, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supplying liquid to said cylinder during advance of said ram and for receiving liquid from said cylinder during retraction of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and close it to said pump in response to the pressure in one side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to advance or retract said member, said control means including an element movable in one direction to effect an advance of said member and movable in the opposite direction to effect a retraction of said member, means responsive to the movement of said element a given distance in said opposite direction for relieving the pressure in said ram cylinder, and means for limiting the rate at which the pressure in said ram cylinder is relieved.

3. A hydraulic speed press, comprising a movable member for exerting a force upon a stationary object, a reciprocating hydraulic motor for advancing said member into engagement with said object and for retracting it therefrom, a ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven reversible pump for supplying liquid to said motor to cause it to reciprocate said member and said ram and for supplying liquid to said ram cylinder to create pressure therein, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supplying liquid to said cylinder during advance of said ram and for receiving liquid from said cylinder during retraction of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and close it to said pump in response to the pressure in one

side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to advance or retract said member, said control means including a control valve movable in one direction to effect an advance of said member and movable in the opposite direction to effect a retraction of said member, and means including a relief channel for connecting said control valve to said ram cylinder, said control valve having a bypass passage formed therein and so arranged as to connect said relief channel to an exhaust upon said control valve being moved in said opposite direction to a predetermined position to thereby relieve the pressure in said ram cylinder.

4. A hydraulic speed press, comprising a movable member for exerting a force upon a stationary object, a reciprocating hydraulic motor for advancing said member into engagement with said object and for retracting it therefrom, a ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven reversible pump for supplying liquid to said motor to cause it to reciprocate said member and said ram and for supplying liquid to said ram cylinder to create pressure therein, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supplying liquid to said cylinder during advance of said ram and for receiving liquid from said cylinder during retraction of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and close it to said pump in response to the pressure in one side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to advance or retract said member, said control means including a control valve movable in one direction to effect an advance of said member and movable in the opposite direction to effect a retraction of said member, means including a relief channel for connecting said control valve to said ram cylinder, said control valve having a bypass passage formed therein and so arranged as to connect said relief channel to an exhaust upon said control valve being moved in said opposite direction to a predetermined position to thereby relieve the pressure in said ram cylinder, and a throttle valve for controlling the rate of flow through said relief channel to thereby control the rate at which the pressure in said ram cylinder is relieved.

5. A hydraulic press of the downward pressure type, comprising a movable member for exerting a force upon a stationary object, a differential hydraulic motor for advancing said member downward into contact with said object and for retracting it out of contact therewith, a vertical ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven pump for supplying liquid to said cylinder to create pressure therein and for delivering liquid in one direction or the other to

said motor to cause it to move said member in one direction or the other, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supplying liquid to said cylinder during downward movement of said ram and for receiving liquid from said cylinder during upward movement of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and close it to said pump in response to the pressure in one side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to move said ram vertically in one direction or the other, a source of liquid, a valve chamber connected to said source, fluid channels connecting said source to opposite sides of said circuit, and an automatic valve arranged in said chamber and operable by the difference in pressure prevailing in opposite sides of said circuit to connect said source to the low pressure side of said circuit and close it to the high pressure side of said circuit in each direction of pump delivery to thereby compensate for the difference between the volume of liquid discharged by said pump and the volume returned thereto from said circuit, and also to close said return side to said source in response to said member descending by gravity to thereby cause the outflow from said motor to be metered by said pump and said member permitted to descend only at the rate determined by the adjustment of said pump.

6. A hydraulic press of the downward pressure type, comprising a movable member for exerting a force upon a stationary object, a differential hydraulic motor for advancing said member downward into contact with said object and for retracting it out of contact therewith, a vertical ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven pump for supplying liquid to said cylinder to create pressure therein and for delivering liquid in one direction or the other to said motor to cause it to move said member in one direction or the other, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supplying liquid to said cylinder during downward movement of said ram and for receiving liquid from said cylinder during upward movement of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and close it to said pump in response to the pressure in one side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to move said ram vertically in one direction or the other, a source of liquid, a valve chamber connected to said source, fluid channels connecting said source to opposite sides of said circuit, an automatic valve arranged in said chamber and operable by the difference in pressure prevailing in opposite sides of said circuit to connect said

source to the low pressure side of said circuit and close it to the high pressure side of said circuit in each direction of pump delivery to thereby compensate for difference between the volume of liquid discharged by said pump and the volume returned thereto from said circuit, and also to close said return side to said source in response to said member descending by gravity to thereby cause the outflow from said motor to be metered by said pump and said member permitted to descend only at the rate determined by the adjustment of said pump, a control element included in said control means and movable in one direction to effect a downward movement of said member and movable in the opposite direction to effect an upward movement of said member, means responsive to the movement of said element in said opposite direction to a given position for relieving the pressure in said cylinder and in the channels communicating therewith to thereby permit said surge valve and said automatic valve to shift promptly upon said element being moved to said position, and means for limiting the rate at which the pressure in said ram cylinder is relieved.

7. A hydraulic press of the downward pressure type, comprising a movable member for exerting a force upon a stationary object, a differential hydraulic motor for advancing said member downward into contact with said object and for retracting it out of contact therewith, a vertical ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven pump for supplying liquid to said cylinder to create pressure therein and for delivering liquid in one direction or the other to said motor to cause it to move said member in one direction or to the other, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supplying liquid to said cylinder during downward movement of said ram and for receiving liquid from said cylinder during upward movement of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and close it to said pump in response to the pressure in one side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to move said ram vertically in one direction or the other, a source of liquid, a valve chamber connected to said source, fluid channels connecting said source to opposite sides of said circuit, an automatic valve arranged in said chamber and operable by the difference in pressure prevailing in opposite sides of said circuit to connect said source to the low pressure side of said circuit and close it to the high pressure side of said circuit in each direction of pump delivery to thereby compensate for the difference between the volume of liquid discharged by said pump and the volume returned thereto from said circuit, and also to close said return side to said source in response to said member descending by gravity to thereby cause the outflow from said motor to be metered by said pump and said member permitted to descend only at the rate determined by the adjustment of said pump, a control element included in said control means and movable in one direction to

effect a downward movement of said member and movable in the opposite direction to effect an upward movement of said member, and means responsive to the movement of said element in said opposite direction to a given position for relieving the pressure in said cylinder and in the channels communicating therewith to thereby permit said surge valve and said automatic valve to shift promptly upon said element being moved to said position.

8. A hydraulic press of the downward pressure type, comprising a movable member for exerting a force upon a stationary object, a differential hydraulic motor for advancing said member downward into contact with said object and for retracting it out of contact therewith, a vertical ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven pump for supplying liquid to said cylinder to create pressure therein and for delivering liquid in one direction or the other to said motor to cause it to move said member in one direction or the other, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supplying liquid to said cylinder during downward movement of said ram and for receiving liquid from said cylinder during upward movement of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and close it to said pump in response to the pressure in one side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to move said ram vertically in one direction or the other, a source of liquid, a valve chamber connected to said source, fluid channels connecting said source to opposite sides of said circuit, an automatic valve arranged in said chamber and operable by the difference in pressure prevailing in opposite sides of said circuit to connect said source to the low pressure side of said circuit and close it to the high pressure side of said circuit in each direction of pump delivery to thereby compensate for the difference between the volume of liquid discharged by said pump and the volume returned thereto from said circuit, and also to close said return side to said source in response to said member descending by gravity to thereby cause the outflow from said motor to be metered by said pump and said member permitted to descend only at the rate determined by the adjustment of said pump, a control valve included in said control means and movable in one direction to effect a downward movement of said member and movable in the opposite direction to effect an upward movement of said member, means including a relief channel for connecting said control valve to said ram cylinder, said control valve having a bypass passage formed therein and so arranged as to connect said relief channel to an exhaust upon said control valve being moved in said opposite direction to a predetermined position to thereby relieve the pressure in said ram cylinder and permit said surge valve and said automatic valve to shift promptly upon said valve being moved to said position.

9. A hydraulic press of the downward pressure

type, comprising a movable member for exerting a force upon a stationary object, a differential hydraulic motor for advancing said member downward into contact with said object and for retracting it out of contact therewith, a vertical ram cylinder, a ram fitted in said cylinder and connected to said member to move therewith, a power driven pump for supplying liquid to said cylinder to create pressure therein and for delivering liquid in one direction or the other to said motor to cause it to move said member in one direction or the other, fluid channels connecting said pump and said motor and forming therewith a hydraulic circuit having pressure and return sides, a surge tank for supply liquid to said cylinder during downward movement of said ram and for receiving liquid from said cylinder during upward movement of said ram, a surge valve for controlling the flow of liquid to and from said ram cylinder, said valve being adapted to open said cylinder to said tank and close it to said pump in response to the pressure in one side of said circuit exceeding the pressure in the other side thereof and to close said cylinder to said tank and open it to said pump in response to the pressure in said other side exceeding a predetermined value, pump control means for causing said pump to deliver liquid in one direction or the other and thereby cause said motor to move said ram vertically in one direction or the other, a source of liquid, a valve chamber connected to said source, fluid channels connecting said source to opposite sides of said circuit, an automatic valve arranged

in said chamber and operable by the difference in pressure prevailing in opposite sides of said circuit to connect said source to the low pressure side of said circuit and close it to the high pressure side of said circuit in each direction of pump delivery to thereby compensate for the difference between the volume of liquid discharged by said pump and the volume returned thereto from said circuit, and also to close said return side to said source in response to said member descending by gravity to thereby cause the outflow from said motor to be metered by said pump and said member permitted to descend only at the rate determined by the adjustment of said pump, a control valve included in said control means and movable in one direction to effect a downward movement of said member and movable in the opposite direction to effect an upward movement of said member, means including a relief channel for connecting said control valve to said ram cylinder, said control valve having a bypass passage formed therein and so arranged as to connect said relief channel to an exhaust upon said control valve being moved in said opposite direction to a predetermined position to thereby relieve the pressure in said ram cylinder and permit said surge valve and said automatic valve to shift promptly upon said valve being moved to said position, and a throttle valve for controlling the rate of flow through said relief channel to thereby control the rate at which the pressure in said ram cylinder is relieved.

RANSOM TYLER.