

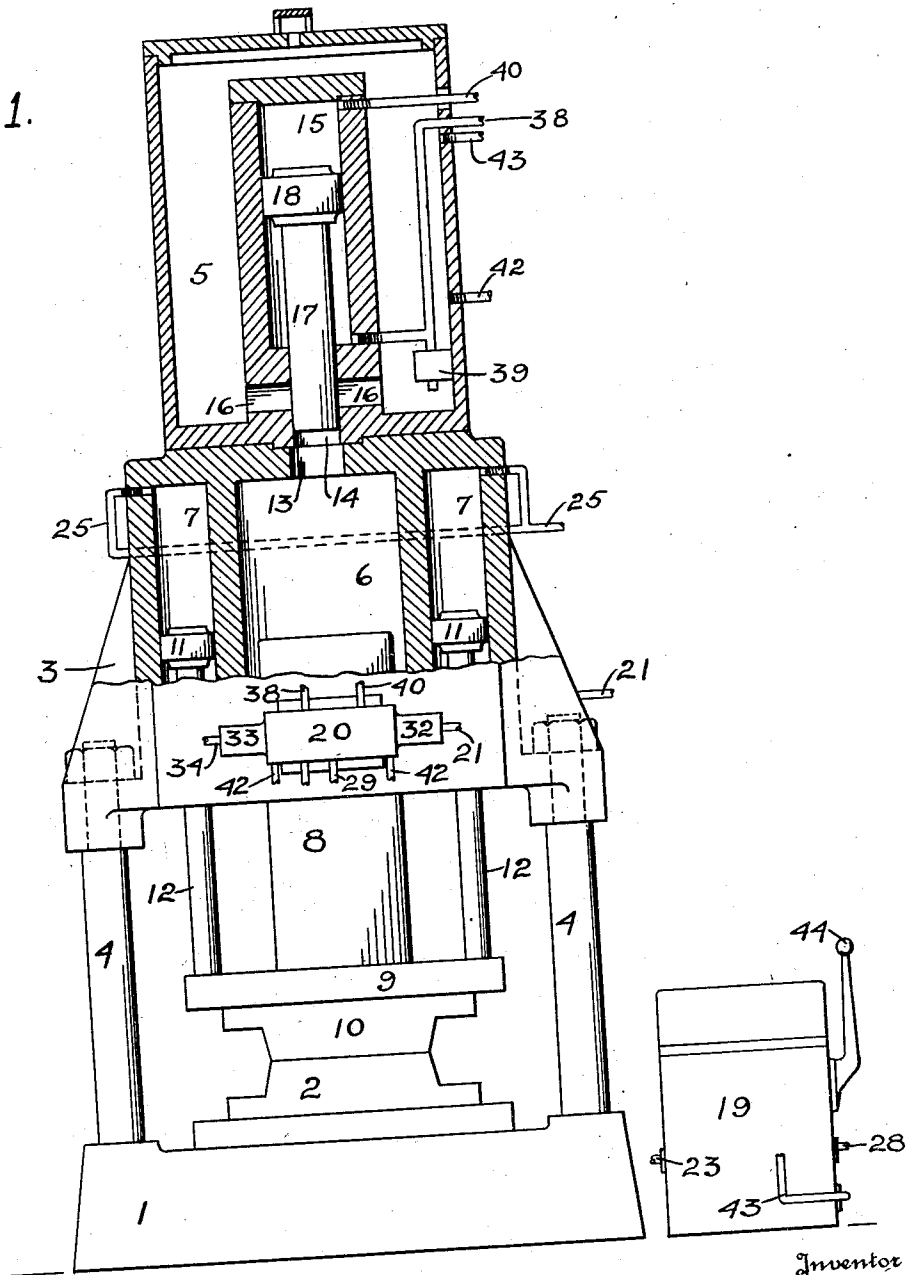
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2 Sheets-Sheet 1

Fig. 1.



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Fig. 3.

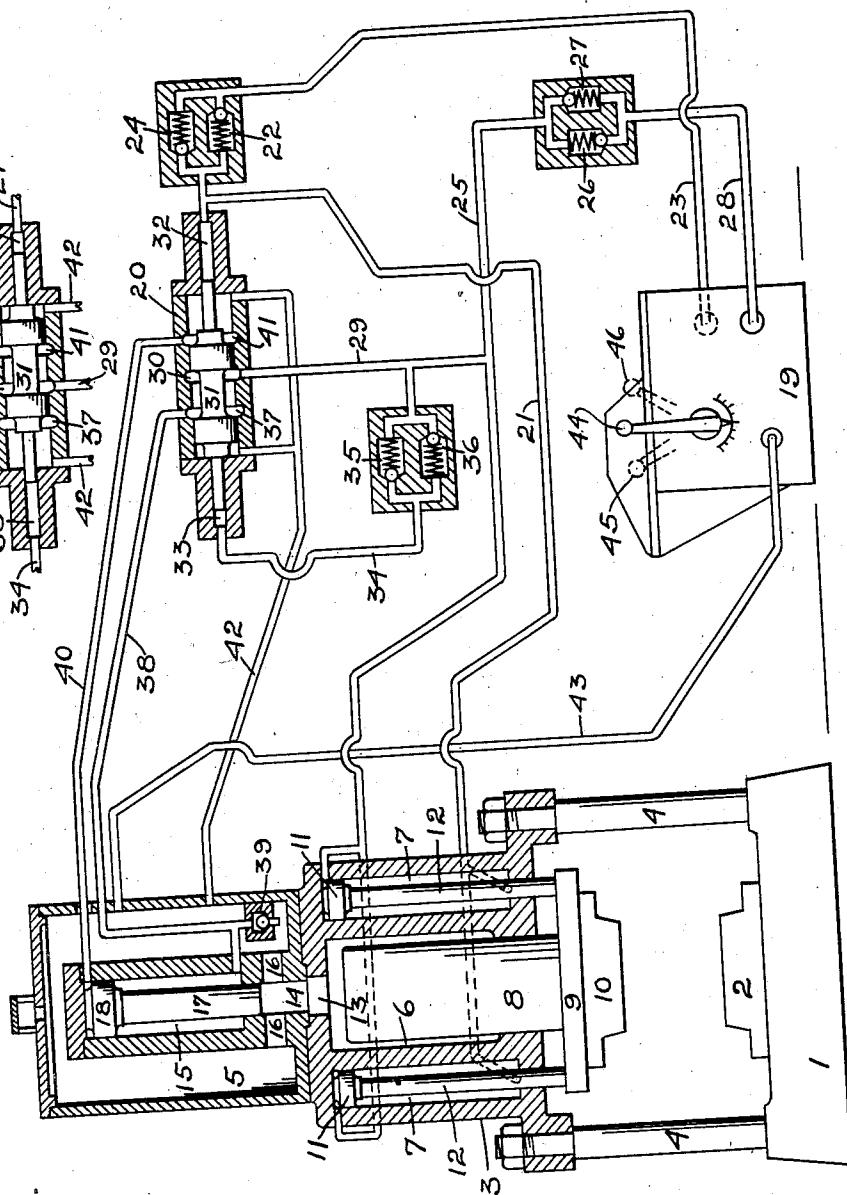


Fig. 2.

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HYDRAULIC PRESS

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16 Claims. (Cl. 138—17)

This invention relates to hydraulic presses.

The press to which the invention applies in particular has a ram and a ram cylinder, a hydraulic motor for moving the ram at high speed, a reservoir for supplying liquid to the ram cylinder and for receiving liquid therefrom during the high speed movement of the ram, a valve controlling the flow of liquid to and from the ram cylinder, and an intensifying ram for exerting pressure upon the liquid in the ram cylinder after the ram has engaged the work.

The invention has as an object to provide a high speed heavy duty press which may be operated by a pump of relatively small capacity.

Another object is to provide a press of this character which is highly efficient.

According to the invention in one of its aspects, the press is provided with a main ram which is arranged in a main cylinder, a separate hydraulic motor for reciprocating the main ram into and out of engagement with the work, a reservoir for supplying liquid freely to the main cylinder and receiving liquid therefrom during reciprocation of the main ram by the motor, an intensifying ram for advancing into the main cylinder to exert pressure upon the liquid therein and to close communication between the main cylinder and the reservoir, and means for causing the intensifying ram to advance into the main cylinder after the main ram has stalled against the work.

According to the invention in another aspect, the liquid expelled from the high speed motor is employed for retracting the intensifying ram.

The invention is exemplified by the press shown in the accompanying drawings in which the views are as follows:

Fig. 1 is a front elevation, partly in central section, of a high speed press in which the invention is embodied.

Fig. 2 is a schematic drawing of the hydraulic circuit.

Fig. 3 is a longitudinal section through a control valve.

This press has a base 1 for supporting a lower die 2, a cylinder block 3 connected to the base 1 and held in spaced relation thereto by four shouldered bolts 4, and a reservoir 5 arranged upon the top of the cylinder block 3.

The cylinder block 3 has a ram cylinder 6 formed therein upon the vertical centerline of the press and an auxiliary cylinder 7 formed therein upon each side of the ram cylinder 6 and parallel thereto.

The ram cylinder 6 has a ram 8 fitted therein and provided upon its lower end with a die block 9 for supporting an upper die 10.

Each of the auxiliary cylinders 7 has a piston 11 fitted therein and connected by its rod 12 to the die block 9 for raising and lowering the ram 8 at high speed.

The ram cylinder 6 has a bore 13 formed in its upper head in alinement with a bore 14 which extends through the bottom of the reservoir 5 and through the lower head of an intensifying ram cylinder 15 which is arranged within the reservoir 5 and shown as being formed integral therewith.

The bore 14 is intersected intermediate its ends by one or more transverse passageways 16 which provide communication between the reservoir 5 and the ram cylinder 6.

The bore 14 has an intensifying ram 17 fitted therein and provided at its upper end with a piston 18 which is fitted in the cylinder 15.

When the intensifying ram 17 is lowered, it first interrupts communication between the reservoir 5 and the ram cylinder 6 by closing the inner ends of the passageways 16 and then it exerts pressure upon the liquid in the cylinder 6 to thereby cause the ram 8 to exert a high pressure upon a piece of work arranged between the dies 2 and 10.

The ram 17 thus functions as a valve to control the flow of liquid to and from the ram cylinder 6.

The downward movement of the ram 17 is initiated by operating a control valve 20 which is shown arranged upon the front of the cylinder block 3.

The press is operated by liquid supplied by a pump 19 which is shown in the drawings as being of the reversible flow type, such as the pump shown in Patent No. 1,798,198 issued March 31, 1931 to John P. Ferris.

As this pump is well known and in extensive commercial use, it has not been illustrated in detail nor described herein.

The ram 8 and the pistons 11 are raised at high speed by liquid delivered to the lower ends of the cylinders 7 through a pipe 21, a check valve 22, and a pipe 23 which is connected to one side of the pump 19.

The check valve 22 has a low pressure resistance valve 24 connected in parallel therewith which resists the flow of liquid from the cylinders 7 to the pump 19 and has sufficient resistance to hold the ram 8 against downward movement when the press is idle.

The ram 8 and the pistons 11 are lowered at high speed by liquid delivered to the upper ends of the cylinders 7 through a pipe 25, a check valve 26 which has a low pressure resistance valve 27 connected in parallel therewith, and a pipe 28 which is connected to the other side of the pump 19.

The pipe 25 is connected intermediate its ends by a pipe 29 to a port 30 in the control valve 20 which has a hydraulically operated plunger 31 to control the flow of liquid therethrough.

One stem of the plunger 31 is fitted in a cylinder 32, which is arranged at one end of the valve

20 and connected to the pipe 21, and the other stem of the plunger 31 is fitted in a cylinder 33 which is arranged at the other end of the valve 20 and connected to the pipe 29 by a pipe 34 having a check valve 35 and a high pressure resistance valve 36 connected in parallel therein.

The port 30 is normally open to a port 37 which is connected by a pipe 38 to the lower end of the cylinder 15 for delivering liquid thereto to raise the intensifying ram 17.

The lower end of the cylinder 15 is also preferably open to the reservoir 5 through a check valve 39 which allows liquid to flow freely from the reservoir 5 into the cylinder 15 when the ram 17 is being raised but prevents the escape of liquid from the cylinder 15 into the reservoir 5. The check valve 39 may be connected to the pipe 38, as shown.

When the ram 17 rises, liquid is discharged from the upper part of the cylinder 15 into the reservoir 5 through a pipe 40, which connects the upper end of the cylinder 15 to a port 41 formed in the valve 20, and through a pipe 42 which connects the reservoir 5 to the valve 20 at both ends of its valve chamber.

The level of the liquid in the reservoir 5 is limited by an overflow pipe 43 which has one end connected thereto near the upper end thereof and its other end connected to the sump of the pump 19.

When the press is idle, the control lever 44 of the pump 19 is in its neutral position as shown in Fig. 2, the ram 8 is supported by the liquid held in the lower ends of the cylinders 7 by the low pressure resistance valve 24, and the ram 17 is supported by liquid held in the lower end of the cylinder 15 by the low pressure resistance valve 27.

To start the press, the operator moves the control lever 44 to or toward the full speed downward position 45 indicated in dotted lines, and the pump 19 delivers liquid through the pipe 28, the check valve 26 and the pipe 25 to the upper ends of the cylinders 7 and moves the pistons 11 and the ram 8 downward at high speed, and pressure extends from the pipe 25 through the pipe 29, the valve 20 and the pipe 38 to the lower end of the cylinder 15 and holds the ram 17 in its upper position.

As the ram 8 and pistons 11 move downwardly, liquid flows from the reservoir 5 through the passageways 16 and bores 13 and 14 into the upper end of the cylinder 6, and liquid is exhausted from the lower ends of the cylinders 7 through the pipe 21, the resistance valve 24 and the pipe 23 to the intake of the pump 19.

When the ram 8 stalls, the pressure in the pipes 25 and 29 rises and liquid breaks through the high pressure resistance valve 36, enters the cylinder 33, and moves the plunger 31 to the right into the position shown in Fig. 3.

Moving the plunger 31 to the right closes the port 37 to the port 30 and opens the port 41 to the port 30 to allow pressure liquid to flow through the pipe 40 to the top of the cylinder 15 and force the ram 17 downward and to allow the liquid in the lower part of the cylinder 15 to exhaust through the pipe 38, the valve 20 and the pipe 42 into the reservoir 5, the excess liquid delivered to the reservoir 5 escaping through the overflow pipe 43 to the sump of the pump 19.

When the ram 17 moves downward, it first closes the passageway 16, thereby preventing the liquid in the cylinder 6 from escaping, and then it exerts pressure upon the liquid in the cylinder 6 and causes the ram 8 to exert a high pressure

upon a piece of work arranged between the dies 2 and 10.

The operator then moves the lever 44 to or toward the full speed upward position 46 indicated in dotted lines and liquid is delivered by the pump 19 through the pipe 23, the check valve 22 and the pipe 21 to the lower ends of the cylinders 7 and raises the pistons 11 and the ram 8, and liquid enters the cylinder 32 on the valve 20 and moves the plunger 31 to its initial position.

As the pistons 11 rise, liquid is expelled from the upper ends of the cylinders 7 into the pipe 25 but the return of this liquid to the pump 19 is resisted by the valve 27, and the liquid flows through the pipes 25 and 29, the valve 20 and the pipe 38 to the lower end of the cylinder 15 and raises the ram 17.

However, a greater amount of liquid must be expelled from the upper end of the cylinder 6 than from the upper ends of the cylinders 7 and this liquid raises the ram 17 until the passageways 16 are partly open.

During this part of the movement of the ram 17, it moves at a higher speed than would be produced by the liquid expelled from the cylinders 7, and liquid is drawn into the cylinder 15 through the check valve 39.

The ram 8 then expels liquid from the cylinder 6 through the bores 13 and 14 and the passageways 16 into the reservoir 5 and the liquid expelled from the cylinders 7 raises the ram 17 until it stalls at the top of its stroke and then liquid breaks through the low pressure resistance valve 27 and flows through the pipe 28 to the intake of the pump 19.

The liquid expelled from the upper end of the cylinder 15 flows through the pipe 40, the valve 20 and the pipe 42 to the reservoir 5.

When the ram 8 has been raised the desired distance or reaches the top of its stroke, the operator returns the lever 44 to its initial or neutral position and the output of the pump 19 falls to zero.

The invention herein set forth is susceptible of various modifications without departing from the scope thereof as hereafter claimed.

The invention is hereby claimed as follows:

1. A hydraulic press, comprising a stationary die block, a main cylinder spaced from said die block, a main ram arranged in said cylinder, a separate double-acting hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir containing liquid and having a passageway communicating with said main cylinder for allowing liquid to flow therebetween, an auxiliary cylinder having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, means for delivering pressure liquid to said motor to operate the same and cause reciprocation of said main ram, and means for delivering pressure liquid to said auxiliary cylinder to operate said intensifying ram.

2. A hydraulic press, comprising a stationary die block, a main cylinder spaced from said die block, a main ram arranged in said cylinder, a hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir containing liquid and having a passageway communicating with said main cylinder for allowing liquid to flow therebetween, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder-

der, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, means for delivering pressure liquid to said motor to operate the same and cause reciprocation of said main ram, and means for delivering pressure liquid to said auxiliary cylinder to operate said intensifying ram.

3. A hydraulic press, comprising a stationary die block, a main cylinder arranged above said die block, a main ram arranged in said cylinder, a separate double-acting hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir for containing liquid carried by said main cylinder upon the upper end thereof and having a passageway communicating therewith for allowing liquid to flow therebetween, an auxiliary cylinder having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, means for delivering pressure liquid to said motor to operate the same and cause reciprocation of said main ram, and means for delivering pressure liquid to said auxiliary cylinder to operate said intensifying ram.

4. A hydraulic press, comprising a stationary die block, a main cylinder arranged above said die block, a main ram arranged in said cylinder, a hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir for containing liquid carried by said main cylinder upon the upper end thereof and having a passageway communicating therewith for allowing liquid to flow therebetween, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, means for delivering pressure liquid to said motor to operate the same and cause reciprocation of said main ram, and means for delivering pressure liquid to said auxiliary cylinder to operate said intensifying ram.

5. A hydraulic press, comprising a stationary die block, a main cylinder spaced from said die block, a main ram arranged in said cylinder, a hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir containing liquid and having a passageway communicating with said main cylinder for allowing liquid to flow therebetween, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, and means for delivering pressure liquid to said press to operate the same including a valve for first directing said liquid to said motor to advance said main ram at high speed and automatically operable to divert the delivery of said liquid to said auxiliary cylinder to advance said intensifying ram.

6. A hydraulic press, comprising a stationary die block, a main cylinder arranged above said die block, a main ram arranged in said cylinder, a separate double-acting hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir for containing liquid carried by said main cylinder upon the

upper end thereof and having a passageway communicating therewith for allowing liquid to flow therebetween, an auxiliary cylinder having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, and means for delivering pressure liquid to said press to operate the same including a valve for first directing said liquid to said motor to advance said main ram at high speed and automatically operable to divert the delivery of said liquid to said auxiliary cylinder to advance said intensifying ram.

7. A hydraulic press, comprising a stationary die block, a main cylinder arranged above said die block, a main ram arranged in said cylinder, a hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir for containing liquid carried by said main cylinder upon the upper end thereof and having a passageway communicating therewith for allowing liquid to flow therebetween, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, and means for delivering pressure liquid to said press to operate the same including a valve for first directing said liquid to said motor to advance said main ram at high speed and automatically operable to divert the delivery of said liquid to said auxiliary cylinder to advance said intensifying ram.

8. A hydraulic press, comprising a stationary die block, a main cylinder spaced from said die block, a main ram arranged in said cylinder, a separate double-acting hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir containing liquid and having a passageway communicating with said main cylinder for allowing liquid to flow therebetween, an auxiliary cylinder having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, and means for delivering pressure liquid to said press to operate the same including a valve hydraulically operable in response to the pressure of said liquid reaching a predetermined maximum for directing said liquid first to said motor to advance said main ram at high speed and then to said auxiliary cylinder to advance said intensifying ram.

9. A hydraulic press, comprising a stationary die block, a main cylinder spaced from said die block, a main ram arranged in said cylinder, a hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir for containing liquid arranged above said main cylinder and having a passageway communicating therewith for allowing liquid to flow therebetween, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, and means for delivering pressure liquid to said press to operate the same including a valve for first directing said liquid to said motor to advance said main ram at high speed and hydraulically operable to di-

vert the delivery of said liquid to said auxiliary cylinder to advance said intensifying ram upon the pressure of said liquid reaching a predetermined maximum.

- 5 10. A hydraulic press, comprising a stationary die block, a main cylinder arranged above said die block, a main ram arranged in said cylinder, a separate double-acting hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir for containing liquid carried by said main cylinder upon the upper end thereof and having a passageway communicating therewith for allowing liquid to flow therebetween, an auxiliary cylinder having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, and means for delivering pressure liquid to said press to operate the same including a valve hydraulically operable in response to the pressure of said liquid reaching a predetermined maximum for directing said liquid first to said motor to advance said main ram at high speed and then to said auxiliary cylinder to advance said intensifying ram.
- 15 11. A hydraulic press, comprising a stationary die block, a main cylinder arranged above said die block, a main ram arranged in said cylinder, a hydraulic motor connected to said ram for reciprocating it toward and from said die block, a reservoir for containing liquid carried by said main cylinder upon the upper end thereof and having a passageway communicating therewith for allowing liquid to flow therebetween, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder, an intensifying ram arranged in said auxiliary cylinder and said bore and extendable into said main cylinder and controlling the flow of liquid through said passageway, and means for delivering pressure liquid to said press to operate the same including a valve for first directing said liquid to said motor to advance said main ram at high speed and hydraulically operable to divert the delivery of said liquid to said auxiliary cylinder to advance said intensifying ram upon the pressure of said liquid reaching a predetermined maximum.
- 20 12. In a hydraulic press, the combination of a main cylinder, a main ram arranged in said cylinder, a hydraulic motor mechanically connected to said ram for reciprocating it, means for delivering pressure liquid to said motor to operate the same, a reservoir arranged above said main cylinder for supplying liquid thereto and receiving liquid therefrom during reciprocation of said ram, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder and a passageway for connecting said bore to said reservoir, an intensifying ram arranged in said auxiliary cylinder and extendable through said bore to close said passageway and to exert pressure upon liquid within said main cylinder, and means for delivering liquid to each end of said auxiliary cylinder to reciprocate said intensifying ram.
- 25 13. In a hydraulic press, the combination of a main vertical cylinder, a main ram arranged in said cylinder, a hydraulic motor mechanically

connected to said ram for reciprocating it, means for delivering pressure liquid to said motor to operate the same, a reservoir supported upon said main cylinder for supplying liquid thereto and receiving liquid therefrom during reciprocation of said ram, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder and a passageway for connecting said bore to said reservoir, an intensifying ram arranged in said auxiliary cylinder and extendable through said bore to close said passageway and to exert pressure upon liquid within said main cylinder, and means for delivering liquid to each end of said auxiliary cylinder to reciprocate said intensifying ram.

14. In a hydraulic press, the combination of a main cylinder, a main ram arranged in said cylinder, a hydraulic motor mechanically connected to said ram for reciprocating it, means for delivering pressure liquid to said motor to operate the same, a reservoir arranged above said main cylinder for supplying liquid thereto and receiving liquid therefrom during reciprocation of said ram, an auxiliary cylinder arranged within said reservoir and having a bore communicating with said main cylinder and a passageway for connecting said bore to said reservoir, an intensifying ram arranged in said cylinder and extendable through said bore to close said passageway and to exert pressure upon liquid within said main cylinder, means for delivering liquid to each end of said auxiliary cylinder to reciprocate said intensifying ram, and means including a check valve for allowing liquid to flow from said reservoir into said auxiliary cylinder but preventing said liquid from flowing in the opposite direction.

15. In a hydraulic press, the combination of a ram cylinder, a ram arranged in said cylinder, a hydraulic motor connected to said ram for advancing and retracting the same, an auxiliary cylinder, a plunger arranged in said auxiliary cylinder and extendable into said ram cylinder, means for delivering liquid to said motor to advance and retract said ram, means for delivering liquid to one end of said auxiliary cylinder to advance said plunger into said ram cylinder, and means for directing exhaust liquid from said motor to the other end of said auxiliary cylinder to retract said plunger.

16. In a hydraulic press, the combination of a ram cylinder, a ram arranged in said cylinder, a hydraulic motor connected to said ram for advancing and retracting the same, an auxiliary cylinder, a plunger arranged in said auxiliary cylinder and extendable into said ram cylinder, means for delivering liquid to one end of said motor to advance said ram until it meets a predetermined resistance and thereby causes an increase in the pressure of said liquid, means responsive to said increase in pressure to divert said delivery of liquid to one end of said auxiliary cylinder to advance said plunger into said ram cylinder to thereby increase the force exerted by said ram, means for then delivering liquid to the other end of said motor to retract said ram, and means for directing exhaust liquid from said motor to the other end of said auxiliary cylinder to retract said plunger.

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