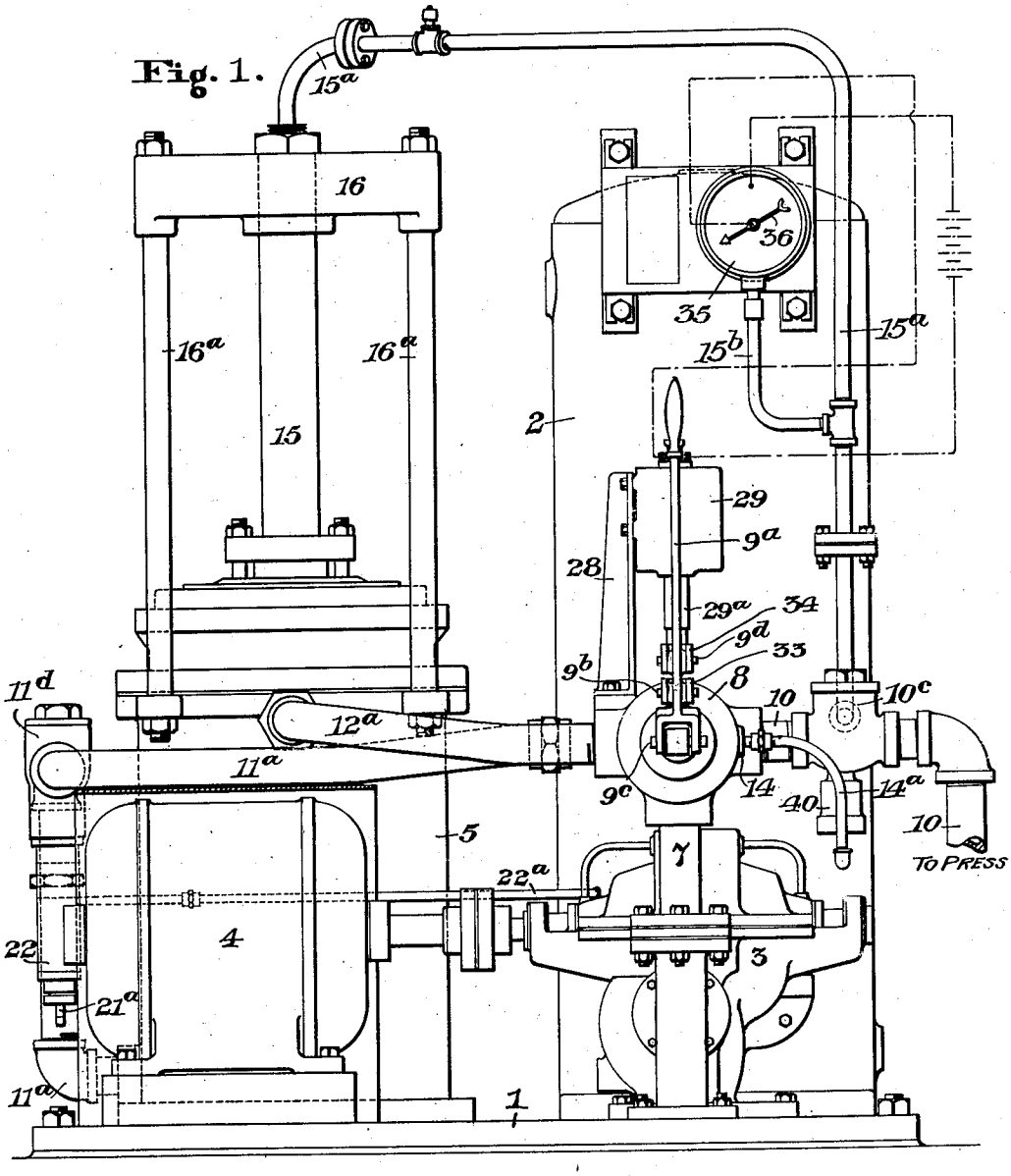
Sept. 19, 1933. R. W. DINZL 1,927,085

HYDRAULIC APPARATUS

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Fig. 1.



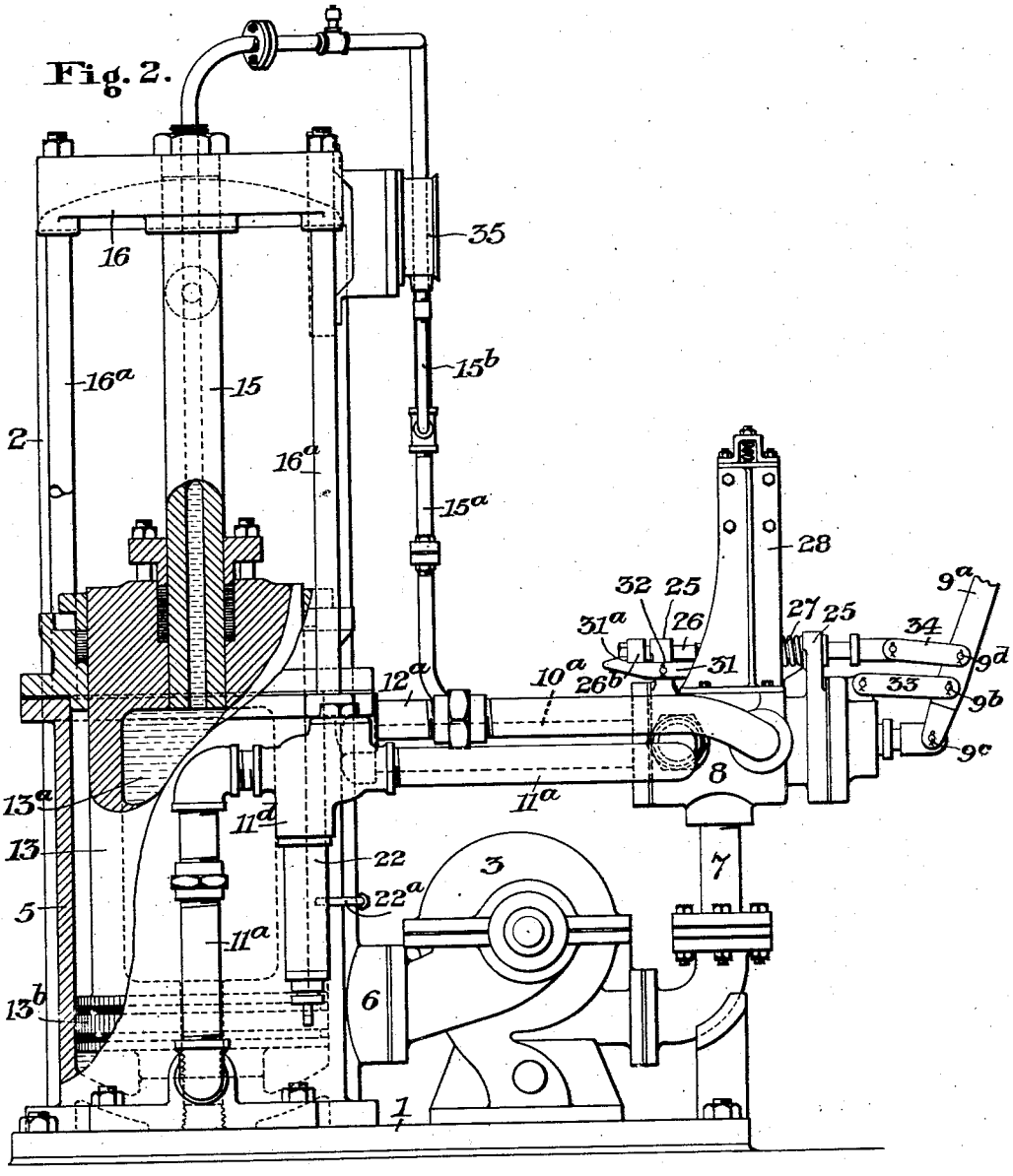
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HYDRAULIC APPARATUS

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Fig. 2.



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HYDRAULIC APPARATUS

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Fig. 3.

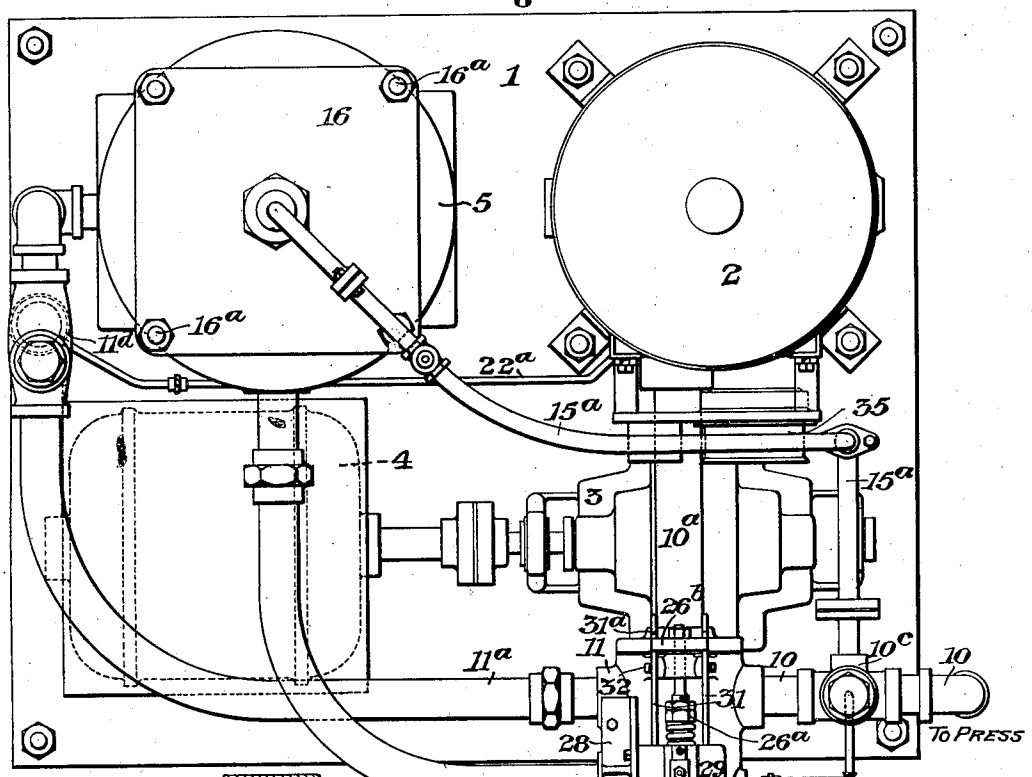


Fig. 4.

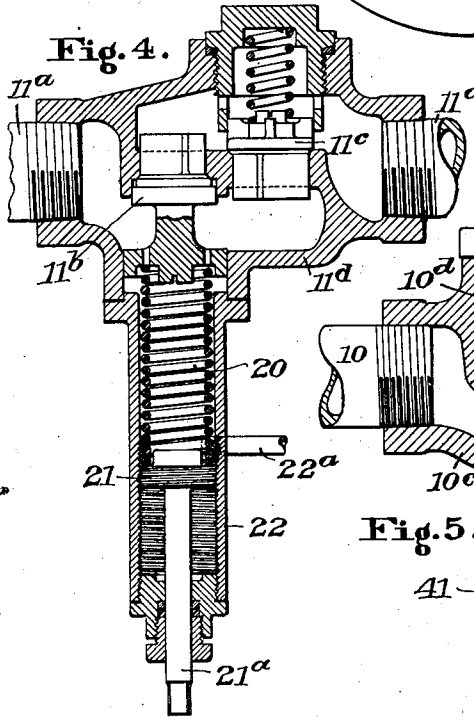
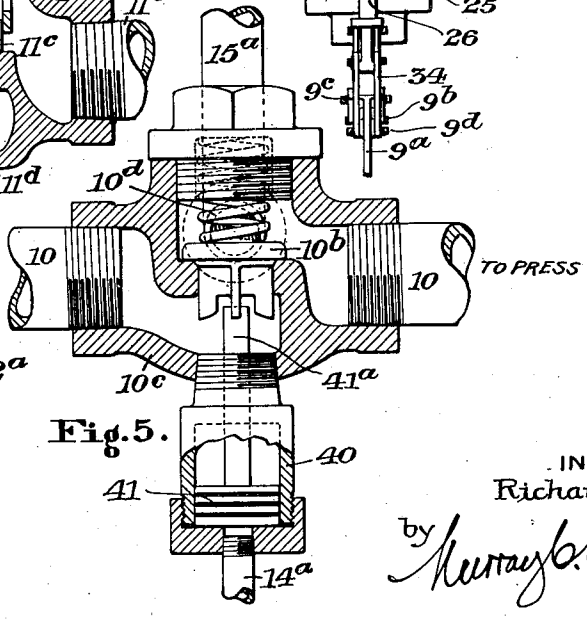


Fig. 5.



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HYDRAULIC APPARATUS

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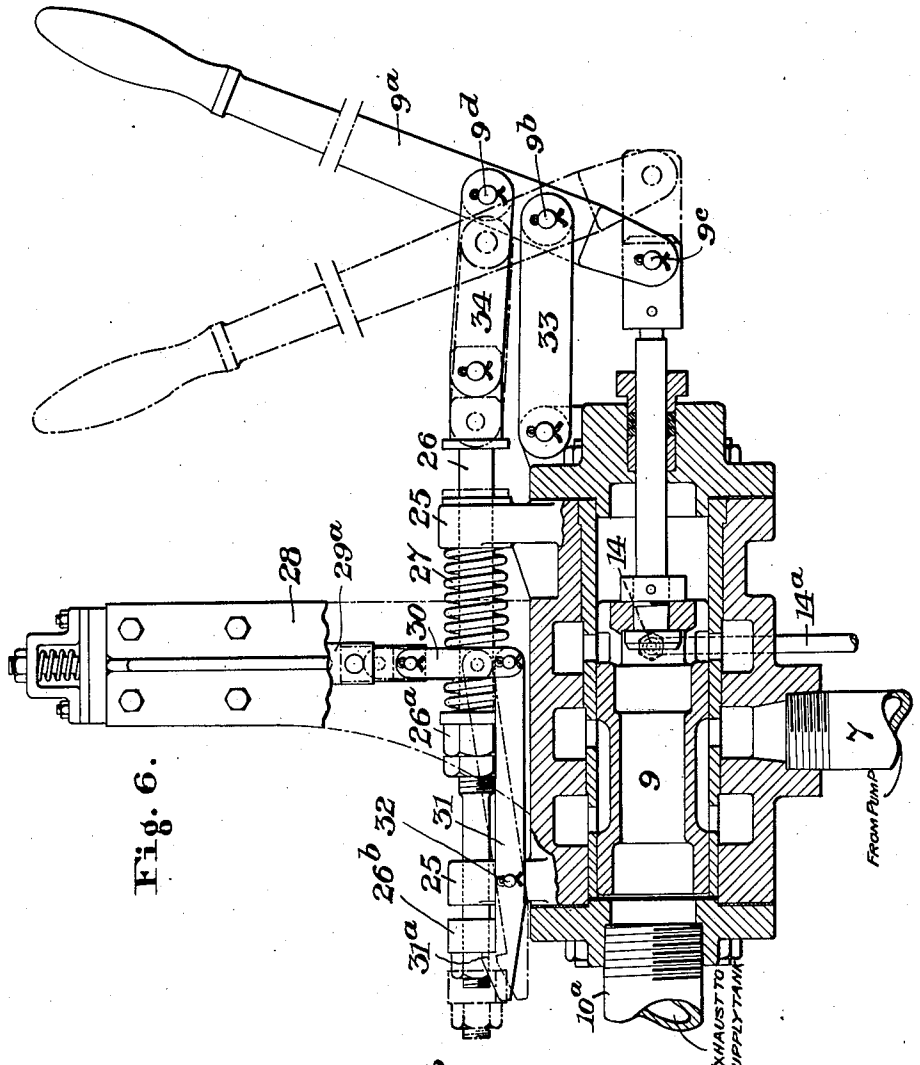


Fig. 6.

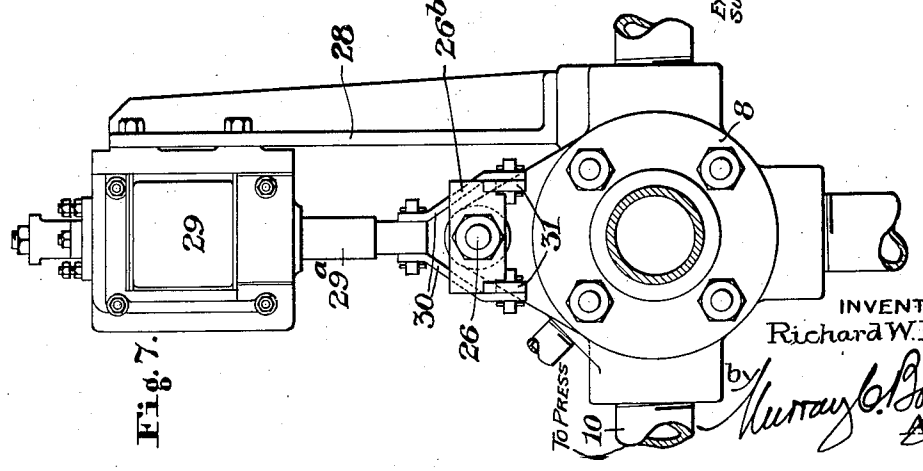


Fig. 7.

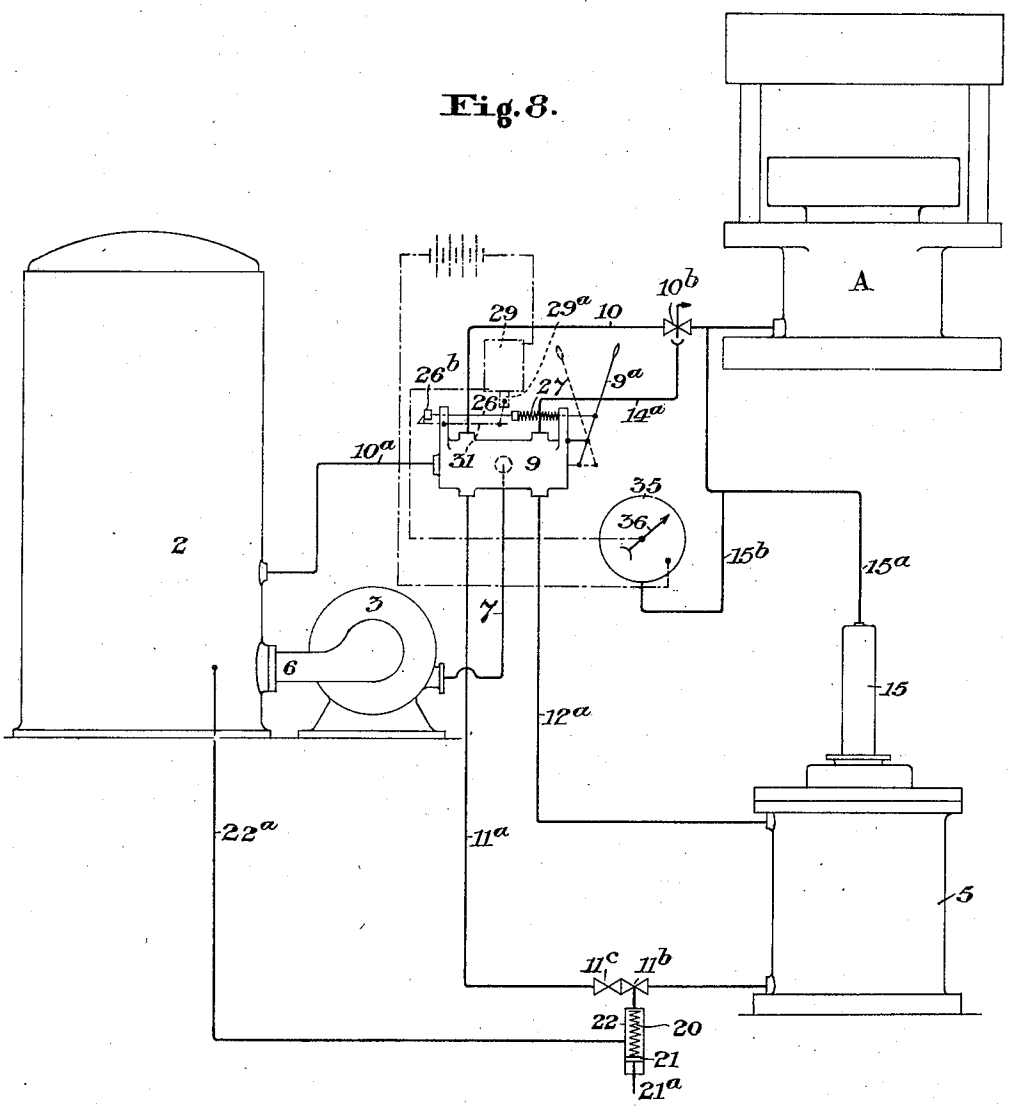
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HYDRAULIC APPARATUS

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Fig. 8.



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UNITED STATES PATENT OFFICE

1,927,085

HYDRAULIC APPARATUS

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Application August 5, 1929. Serial No. 383,681

9 Claims. (Cl. 138—17)

My invention relates to mechanism for controlling the operation of hydraulic apparatus, hydraulic presses for instance, and comprises a centrifugal pumping unit with high pressure automatic control.

One object of my invention is to utilize the effort of a constantly operated pump, preferably of the centrifugal type.

A further object of my invention is to provide an improved controlling valve which may be moved manually to open position and held in such position during the operation of the pumping unit; such valve being released when the high pressure reaches a predetermined point. If desired the valve may be locked in operative position and released automatically.

A further object of my invention is to provide mechanism whereby fluid under pressure may be delivered to the ram of an hydraulic press or similar mechanism, for actuating a movable platen during a working stroke; such platen serving to close a mold, and to subsequently deliver pressure to an intensifier whereby suitable high pressure may be built up for delivery to such press ram to effect movement of the platen to complete the compressive work. The extent of development of the high pressure is controlled and when it reaches its limit which may be indicated to the operator, such high pressure may actuate means to close an electrical circuit whereby a solenoid may be energized which in turn releases a catch normally holding the controlling valve in the operative position so that such valve may change its position automatically and permit the pressure admitted to the press ram and the low pressure cylinder of the intensifier to open to exhaust and at the same time apply pressure to pull back the intensifier ram.

A further object of my invention is to provide a check valve between the source of fluid pressure and the low pressure ram of the intensifier ram, which check valve may be loaded as may be desired whereby the high pressure may be prevented from building up until the press ram or other mechanism has reached the limit of its movement under low pressure; such low pressure being then automatically delivered to the intensifier to build up high pressure to a substantially predetermined point and simultaneously delivered to the press ram to complete the compressive action.

A further object of my invention is to provide a pressure actuated check valve which may be located at the point where low and high pressures are directed to the press or other operating structure; such check valve opening automatically to pass fluid pressure to the press ram and to the high pressure line leading to the cylinder of the intensifier; closing under high pressure when the latter passes over the same to the press ram, and being opened by pressure to exhaust position when the controlling valve is open to exhaust.

And a still further object of my invention is to provide cooperative and associated means whereby the entire operation is carried on automatically once the controlling valve is opened.

These and other features of my invention are more fully described hereinafter; reference being had to the accompanying drawings, in which:

Figure 1 is a front elevation of my improved pumping unit and associated mechanism.

Fig. 2 is a side elevation of the same, partly in section; the motor being omitted and the intensifier structure being shown partly broken away.

Fig. 3 is a plan view of the mechanism shown in Figs. 1 and 2.

Fig. 4 is a sectional elevation illustrating a pair of check valves located in the line between the main valve casing and the low pressure cylinder of the intensifier; one of such valves being loaded to control the building up and delivery of the high pressure.

Fig. 5 is a sectional elevation illustrating a check valve arranged between the main valve casing and the line leading to the press ram, through which the low pressure and over which the high pressure passes to the press ram.

Fig. 6 is a sectional elevation of the main controlling valve and operating means which may be employed therewith.

Fig. 7 is an end elevation of the controlling valve, and

Fig. 8 is a diagrammatic representation of the piping leading to the several parts of the mechanism.

In the operation of hydraulic presses which have a comparatively long working stroke and which require a high pressure only near the end of such stroke, at which time the moving die is acting upon the material to be compressed, it is desirable to employ fluid under high and low pressure. The low pressure fluid is used for the greater part of the working stroke and then the high pressure is employed to complete the stroke. In carrying my invention into effect, I propose to use the effort of a constantly operated pump, preferably of a centrifugal type, which serves to supply the low pressure needed and subsequently delivers pressure to actuate an intensifier wherein high pres-

sure may be built up which is automatically delivered to the press ram when the low pressure has moved the ram of the press nearly to the end of the working stroke and is about to commence the actual compressing work.

The several associated and cooperative elements which constitute my improved mechanism may be mounted on a base 1 which may be bolted to a suitable foundation. Upon this base is mounted a supply tank 2, a centrifugal pump 3, a direct-connected motor 4 for driving such pump, and an intensifier 5.

The suction connection of the pump with the supply tank is indicated at 6, and its delivery line, indicated at 7, is connected directly to the casing 8 of a controlling valve 9. The valve 9, which may be operated in one direction by a lever 9^a, is of the sleeve type and is clearly shown in Fig. 6 in the operative position, that is, in the position whereby fluid pressure may be directed to a line 10 leading to the press or other hydraulic apparatus A, (Fig. 8) whose operation is effected by the delivery of fluid under pressure. When moved to the opposite end of the valve chamber, which action may be effected manually or automatically, as hereinafter described, the valve will be placed in position for the fluid pressure to exhaust through the line 10^a to the storage or supply tank 2.

The valve casing 8 is provided with ports 11 and 12 communicating by combined inlet and exhaust lines 11^a and 12^a, respectively, with the bottom and top of the low pressure cylinder of the intensifier 5 containing a hollow ram 13. In addition, the casing 8 is provided with a port 14 communicating with a pipe 14^a leading to a plunger for operating a pilot check valve 10^b located in the low pressure line 10 leading to the press ram, when the latter is open to exhaust, more particularly referred to hereinafter. In addition to the check valve 10^b located in the low pressure line 10 leading to the press or other hydraulic mechanism, the line 11^a, affording communication between said valve casing 8 and the bottom of the low pressure cylinder of the intensifier, is provided with a pair of check valves 11^b and 11^c, for a purpose to be described.

I employ an intensifier of the pull-back type, shown partly in section in Fig. 2, in which 5 indicates the cylinder mounted upon the base 1 and containing within the same the low pressure ram 13 which, in the present instance, is vertically movable with respect to the high pressure ram 15 which occupies a fixed position and may be hung from a head 16 supported on the cylinder 5 by means of rods 16^a connected to the head of such cylinder. The low pressure ram is hollow and provides the cylinder 13^a for the high pressure ram, and it is externally provided with a flange 13^b forming a pull-back piston whereby it may be lowered by pressure directed via line 12^a to the space above said piston. As soon as the working pressure delivered to the press ram or other mechanism to be operated builds up, low pressure passes via line 11^a, past check valve 11^b, to the lower part of the cylinder 5 and raises the low pressure ram 13, compressing the fluid within the latter and forcing the same into the high pressure ram 15 from which it passes through the line 15^a, over the check valve 10^b to the press ram.

The delivery of pressure to raise the low pressure ram and develop the necessary high pressure is regulated by the spring-controlled check valve 11^b, contained within a casing 11^d carried by the line 11^a, which check-valve may be loaded as may be desired to control the fluid pressure delivered and prevent the intensifier ram rising until the low pressure has built up in the press, by means of a spring 20 whose tension is controlled by a movable head 21 threaded into a cylinder 22 depending from the casing 11^d receiving such spring; such head having an operating stem 21^a outside such casing, as clearly indicated in Fig. 4. In addition, this check valve controls the amount of high pressure delivered by the intensifier; the low pressure having to build up in the casing 11^d before the check valve 11^b can be unseated. This casing also contains the check valve 11^c, which may also be spring-controlled, through which the pressure exhausts from the lower part of the cylinder 5 containing the low pressure ram when the latter is lowered by pressure delivered above its piston 13^b from the line 12^a.

The line 10 through which fluid pressure is delivered to the press or other mechanism is provided with a pilot check valve 10^b, contained within a casing 10^c, and shown more particularly in the sectional view, Fig. 5. This valve may be lightly loaded by a spring 10^d and is arranged to open automatically upon the delivery of pressure to the press ram. The high pressure line 15^a is connected to the casing of this valve so that simultaneously with the delivery of fluid pressure to the press ram, such fluid pressure will be open to the high pressure cylinder 13^a within the ram 13. When the low pressure admitted to the press ram has built up, the high pressure starts to build up and overcomes the low pressure tending to open check valve 10^b, whereupon said high pressure closes said check valve and passes to the press ram to complete the compressive work of the press or other mechanism.

The valve 9 which controls the operation of my improved mechanism may be operated by a lever 9^a; normally occupying the position indicated by broken lines, Fig. 6. While it may be held by the operator in the position shown until the desired high pressure has built up in the cylinder of the press, I have illustrated mechanism which may be employed for holding it in the operative position and then automatically releasing it when the high pressure reaches a predetermined point.

Suitably guided in bosses 25 carried by the valve casing 8, in the present instance at the top of the same, is a rod 26, normally held in the position indicated by broken lines by a spring 27 interposed between one of said bosses 25 and an adjustable nut 26^a carried by said rod. Also carried by the casing of the valve is a support 28 for a solenoid magnet 29 whose core is indicated at 29^a and is connected by links 30 to one end of a pair of lever latches 31 pivoted at 32 to one of the bosses 25; said latches having shoulders 31^a at their ends opposite the link connections with the core of the solenoid, which shoulders are adapted to engage a cross piece 26^b at the end of the rod 26 when the latter is moved upon operating the lever 9^a, to the position indicated by full lines, Fig. 6. The latches are held in the position indicated by the weight of the inactive solenoid core.

The lever 9^a is pivotally connected at 9^b to links 33 which may be pivotally attached to the head of the valve casing, and such lever is also connected at 9^c and 9^d, respectively, to the stem of the valve 9 and to links 34 pivotally connected to the rod 26. It will be seen therefore that when the valve is in the position indicated by full lines, Fig. 6, the lever may be locked to hold

the same in such position by the pivotally mounted latches 31 held in engaging position by the weight of the inactive solenoid core. When the solenoid is energized upon the high pressure reaching its predetermined limit, by means hereinafter described, the latches are shifted by the movement of the solenoid core and the spring 27, compressed when the valve is moved to operative position, restores the lever to the inactive position indicated by broken lines, and moves said valve 9 to exhaust position.

When the pump is put in operation by starting the motor, the line 12^a is open for delivery of pressure to the pull back piston 13^a of the low pressure ram and the line 14^a is open for delivery of pressure to open the check valve 10^b; the valve 9 remaining in the inoperative position. The pump is churning without delivering pressure to any other line. When the valve 9 is moved to the operative position represented by full lines in Fig. 6, however, pressure is delivered by the constantly operating centrifugal pump 3 via line 10 to the press ram, see Fig. 8. When this pressure has built up to its limit pressure is directed to the line 11^a leading to the lower part of the low pressure cylinder of the intensifier, and is open to the line 15^a leading to the high pressure cylinder of the intensifier. The ram of the press is operated to bring the platen with the work in engagement with a fixed portion of the press, depending upon the manner of operating the same, and at this point fluid pressure from line 11^a will overcome the force of the spring 20 holding the check valve 11^b in the closed position, permitting the low pressure to build up in the low pressure cylinder of the intensifier, raising the ram 13 and creating the necessary high pressure in the cylinder 13^a which passes via the line 15^a over the check valve 10^b to the press ram.

The high pressure for any particular work may be predetermined and when it has built up to the desired extent which fact may be observed from the indicator 35 the operator, in the case of hand control, releases the lever 9^a and the spring 27 restores the valve 9 to inoperative position.

In this particular arrangement, I have indicated means whereby the high pressure may be automatically controlled. The indicator gauge 35 may be connected by means of a by-pass 15^b to the high pressure line 15^a leading from the high pressure cylinder of the intensifier and when such high pressure reaches the predetermined limit, a moving part of such gauge, the indicating arrow 36, for instance, closes an electric circuit which energizes the solenoid 29 and the latter in turn raises its core 29^a which actuates the latches 31 holding the valve-controlling lever in the open position; releasing said latches and permitting the valve to return to the exhaust position automatically by the action of the spring 27 which has been compressed when the valve 9 is opened.

When the valve 9 has been moved to the inoperative position, (either manually or automatically) pressure will be directed via line 12^a to the space in the cylinder between the head of the same and the low pressure ram 13, and acting upon the piston formed by the flange 13^b of said ram, will lower the same ready for further action; the fluid beneath the ram exhausting through the check valve 11^c and line 11^a into the casing of the main valve and thence passing to the supply tank. The pump continues to deliver such pressure after the ram 13 is lowered. When the low pressure ram is in the lowered position, and the pump is in motion, it simply churns, holding pressure on the pull back piston of the low pressure ram. At the same time pressure is passing from the valve casing 8 through port 14 and by-pass 14^a to the cylinder 40 depending from the casing 10^c containing the check valve 10^b; such pressure acting upon a piston 41 within the cylinder whose rod 41^a underlies said check valve 10^b. The delivery of such pressure via the by-pass 14^a raises the piston and rod, thereby lifting the check valve 10^b from its seat so that the line leading to the press ram may exhaust through the operating valve to the supply tank.

Any liquid that may accumulate in the cylinder 22 depending from the casing 11^d containing the check valve 11^b, may drain via line 22^a to the storage or supply tank 2.

The operation of my improved apparatus is as follows:

Upon starting the motor, the centrifugal pump will deliver fluid pressure to the pull back piston of the ram with the controlling valve 9 in the position opposite that indicated by full lines, Fig. 6. When it is desired to admit the fluid pressure to the press ram or other mechanism, the valve is moved to the position indicated in Fig. 6, and the lever operating the same is held in this position manually or by means of the latches 31. Low pressure fluid now passes from the pump via the valve 9 and line 10 to the press ram until such pressure builds up to its limit. When such low pressure builds up in the press, it passes to the ram 13 of the intensifier and to the high pressure cylinder of the intensifier; in the first instance past the loaded check valve 11^b which controls the building up of high pressure, and in the latter instance past the check valve 10^b which automatically lifts. When the low pressure admitted to the press ram has built up, such pressure in line 11^a overcomes the check valve 11^b and passes to the intensifier whereby high pressure may be developed which passes via line 15^a over the check valve 10^b thence to the ram of the press; the low pressure ram of the intensifier continuing to move and effect the desired high pressure. When this high pressure reaches a predetermined point, which may be indicated by the arrow of the gauge, the operator releases the lever and the controlling valve 9 moves to the inoperative position. If such action is to be automatic, such arrow makes contact with a circuit closing device, and the closing of the circuit energizes the solenoid switch, which in turn raises the latches 31 holding the main valve in the operative position and the latter is then free to be moved by the spring 17 acting upon the valve operating lever. The press ram is now open to exhaust through the valve 9 and the low pressure ram of the intensifier is open to exhaust via the line 11^a. At the same time, full pump pressure is being supplied via line 12^a to the pull back piston of the low pressure ram of the intensifier; such pressure holding the same down until the next operation. After the mechanism is once in operation the several lines are filled with liquor which builds up therein or is exhausted therefrom upon operation of the controlling valve 9.

I claim:

1. The combination of a rotary pump, means for continuously operating the same for creating a constant circulation of fluid pressure, a valve for controlling the distribution of such fluid pressure; said valve being manually movable to admit

fluid pressure and automatically movable to exhaust such fluid pressure at the end of a press operation, a press to which such fluid pressure is directed, an intensifier including a low pressure ram and a high pressure ram, means for delivering fluid pressure to the low pressure ram of the intensifier to create high pressure when the fluid pressure directed to the press has built up, an adjustably loaded valve controlling such delivery to the low pressure ram, a casing for said valve, means for directing said high pressure to the press, and a valve in said casing, independent of the adjustably loaded valve, for controlling exhaust from the low pressure ram.

2. The combination of a rotary pump, means for continuously operating the same for creating a constant circulation of fluid pressure, a valve for controlling the distribution of such fluid pressure; said valve being manually movable to admit fluid pressure and automatically movable to exhaust such fluid pressure at the end of a press operation, a press to which such fluid pressure is directed, an intensifier including a low pressure ram of the pull back type and a high pressure ram, means for delivering fluid pressure to the low pressure ram of the intensifier to create high pressure when the pressure directed to the press has built up, means for controlling the time interval preceding the building up of high pressure including an adjustably loaded valve controlling delivery to the low pressure ram, a casing for said valve, means for directing said high pressure to the press, and a valve in said casing for controlling exhaust from the low pressure ram.

3. The combination of a rotary pump, means for continuously operating the same for creating a constant circulation of fluid pressure, a valve for controlling the distribution of such fluid pressure; said valve being manually movable to admit fluid pressure and automatically movable to exhaust such fluid pressure at the end of a press operation, a press to which such fluid pressure is directed, an intensifier including a low pressure ram and a high pressure ram, means for delivering fluid pressure to the low pressure ram of the intensifier, adjustable valve means for restraining delivery of pressure to said low pressure ram, until the pressure directed to the press has built up, a casing for said adjustable valve means, means for directing high pressure created by the intensifier to the press, and a valve in said casing for controlling exhaust from the low pressure ram.

4. The combination of a continuously operating pump for creating fluid pressure, a valve for controlling distribution of such pressure, an intensifier having a low pressure ram and a high pressure ram, said valve having ports communicating with one side of said low pressure ram and with a press when in one position, and with the latter, another side of said low pressure ram and a source of fluid supply when in another position, manually controlled means for operating said valve in one direction, means including a latch for holding it in fixed position after such movement, and electrically controlled means for automatically releasing such holding means.

5. The combination of a rotary pump, means for continuously operating the same for creating a constant circulation of fluid pressure, a valve for controlling distribution of such pressure, means for moving said valve to operative position, a press to which such fluid pressure is directed, a line leading to said press, an intensifier having a low pressure ram and a high pressure ram, means affording communication between said valve and both sides of the cylinder containing the low pressure ram, a high pressure line between the intensifier and the line leading to the press, a pilot check valve in said latter line; said check valve opening automatically for the passage of working pressure to the press, means for directing fluid pressure to open said pilot value when the press line is open to exhaust, and electrically controlled means for automatically releasing the valve controlling distribution of pressure.

6. The combination, in fluid pressure operated mechanism, of a constantly operating rotary pump, means for continuously driving the same, a valve for controlling delivery of fluid pressure from said pump to a press ram, said valve being manually movable to admit fluid pressure and automatically movable to exhaust such fluid pressure at the end of a press operation, an intensifier, means for delivering fluid pressure to the intensifier for building up high pressure after the low pressure delivered to the press ram has built up, means for delivering such high pressure to the press ram, a loaded check valve controlling the passage of fluid to the intensifier cylinder when building high pressure, a casing for said loaded valve having a tubular extension, a spring in engagement with said valve mounted in said tubular extension; the latter being internally threaded, and a threaded plunger movable in said tubular extension for adjustably loading said check valve.

7. The combination of a rotary pump, means for continuously operating the same for creating a constant circulation of fluid pressure, a valve for controlling the distribution of such fluid pressure, a press to which such fluid pressure is directed, an intensifier including a low pressure ram and a high pressure ram, means for delivering fluid pressure to said low pressure ram to build the desired high pressure, means for delivering said high pressure to the press to complete the compressive action, a valve casing in the line leading to the low pressure ram, an adjustably loaded valve for restraining delivery of pressure to said low pressure ram until the low pressure delivered to the press has built up mounted in said casing, and a spring-pressed check valve also mounted in said casing independently of the adjustably loaded valve through which fluid pressure exhausts from said low pressure ram when it moves to inactive position.

8. The combination of a rotary pump, means for continuously operating the same for creating a constant circulation of fluid pressure, a main valve for controlling distribution of such pressure, manually actuated means for moving said valve to operative position, a press to which such fluid pressure is directed, a line leading to said press, an intensifier having low and high pressure rams, means affording communication with both ends of the cylinder containing the low pressure ram, a high pressure line between the high pressure ram and the pressure line leading to the press, a pilot check valve in said latter line; said check valve opening automatically for the passage of pressure to the press, electrically actuated means for automatically releasing the main valve to permit it to shift to reverse position, and means for delivering pressure to open said pilot check valve when the press is open to exhaust after the main valve has been shifted to the reverse position.

9. The combination, in fluid pressure operated mechanism, of a constantly operating rotary pump, means for driving the same, a press ram, an intensifier, means for delivering fluid pressure from said pump to the press ram, independent means for delivering fluid pressure to the intensifier for building up high pressure therein after the low pressure delivered to the press ram has built up, means for subsequently delivering high pressure to the press ram, a check valve controlling the passage of fluid pressure to the low pressure cylinder of the intensifier when building high pressure, a casing for said check valve, means for adjustably loading said check valve so as to control the time interval and speed at which said high pressure builds up, an independent check valve in said casing controlling exhaust from the low pressure cylinder of the intensifier, a pilot check valve in the line leading to the press ram, a main operating valve, manual means for operating the same, means including a latch for holding said valve in the operative position until the high pressure builds up to a predetermined point, electrically actuated means for automatically releasing the main operating valve and permitting it to move in the opposite direction, and pressure actuated means for opening said pilot check valve when the press ram is open to exhaust through the main operating valve.

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