May 10, 1927. 1,628,094

C. WIGTEL

HYDRAULIC PRESSING APPARATUS

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Fig.1.

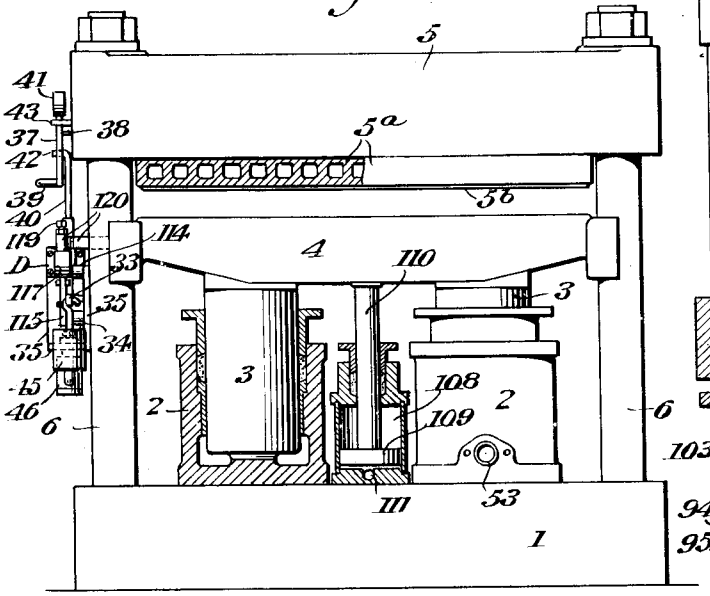


Fig.2.

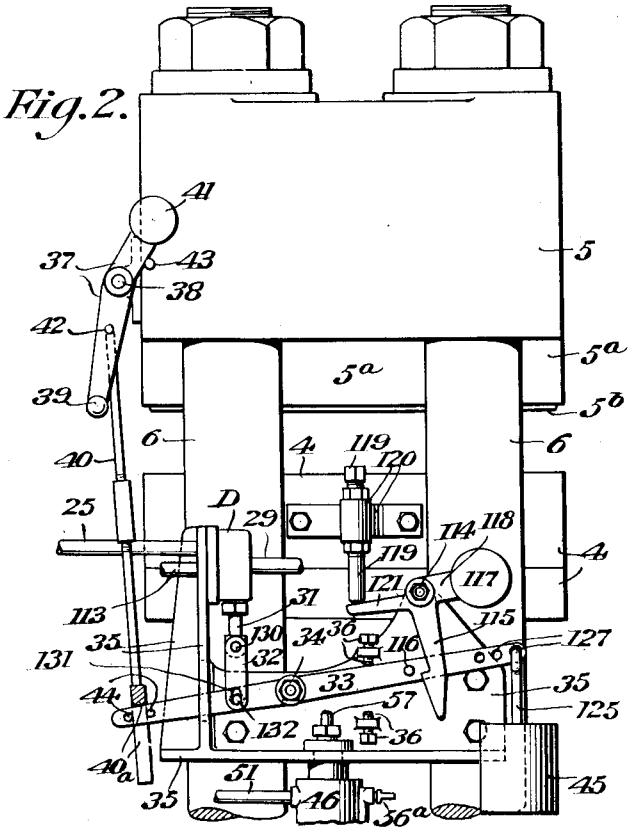
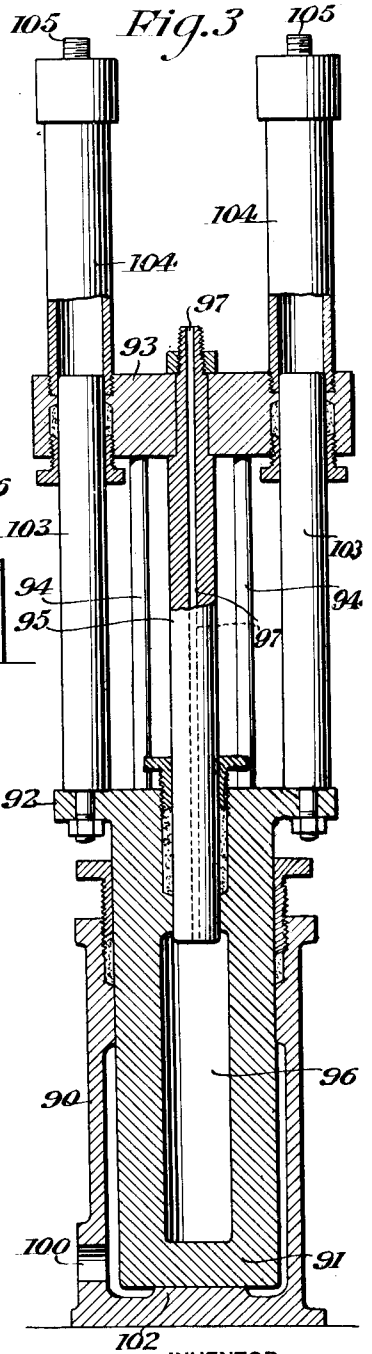


Fig.3



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Fig.4.

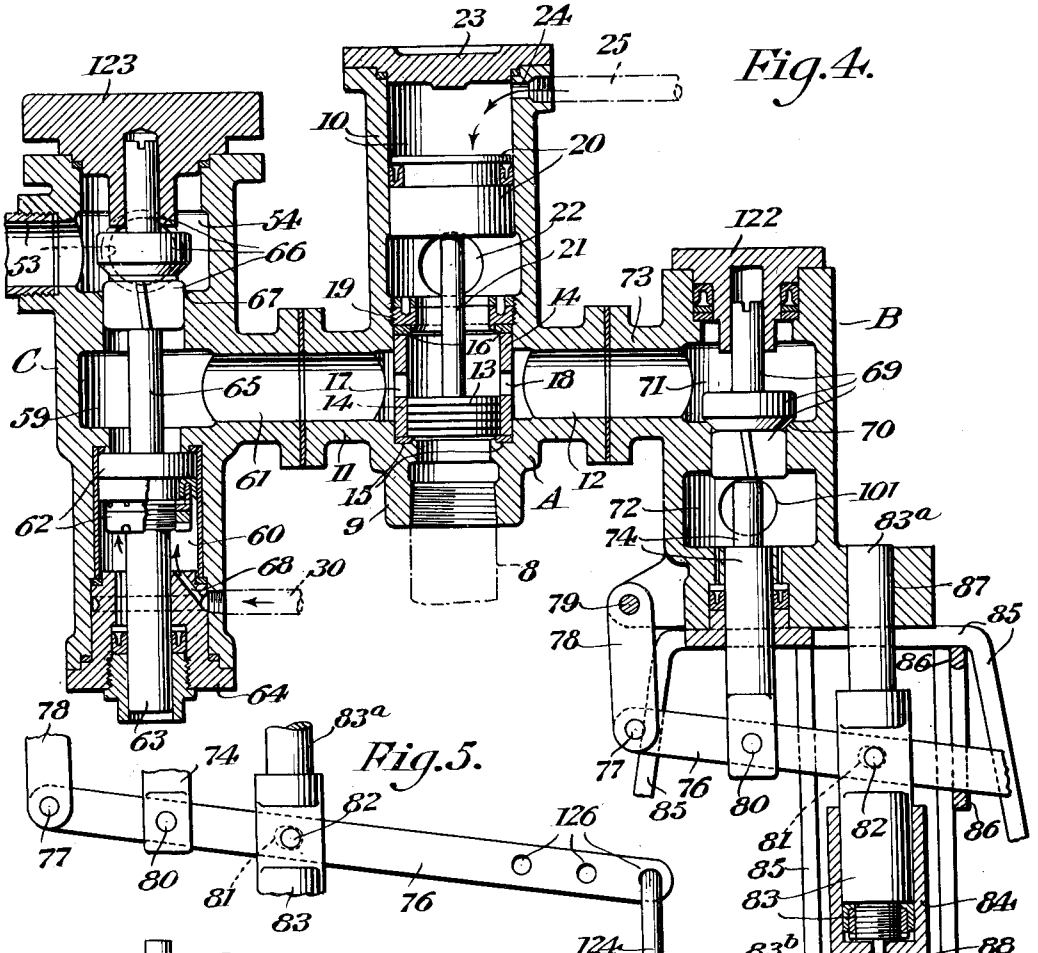
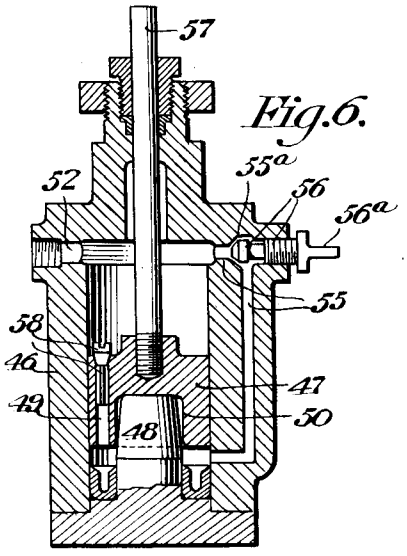


Fig.5.

Fig.6.



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Fig. 8.

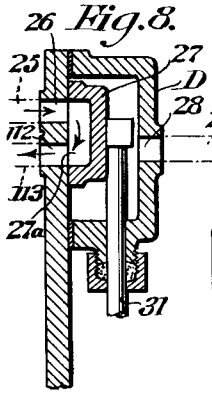


Fig. 7.

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Fig. 9.

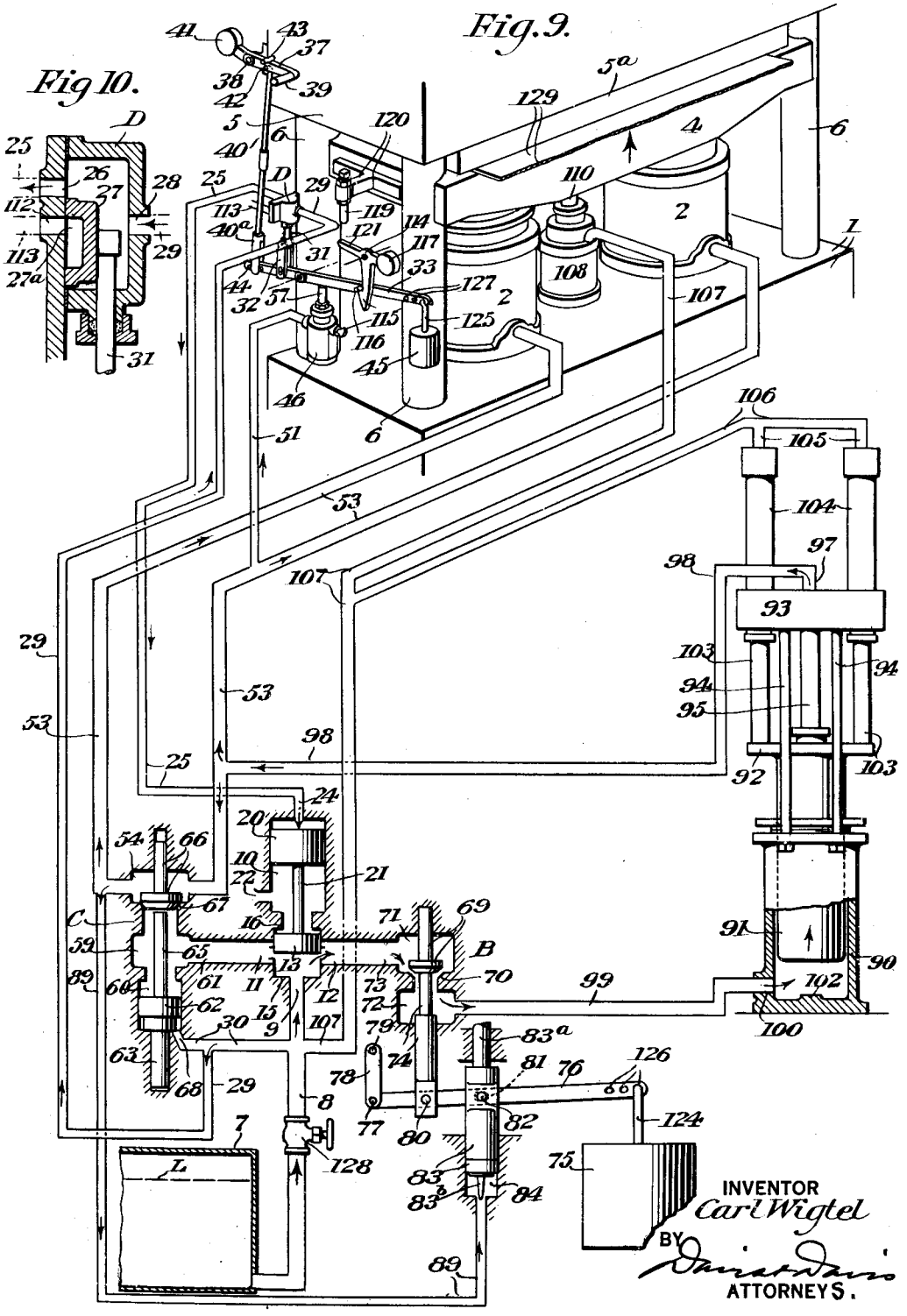


Fig 10.

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Patented May 10, 1927. 1,628,094

UNITED STATES PATENT OFFICE.

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HYDRAULIC PRESSING APPARATUS.

Application filed June 2, 1926. Serial No. 113,197.

This invention relates to improvements in hydraulic pressing apparatus, and has for its principal objects to provide simple and efficient means for utilizing liquid under pressure in an economical manner for developing high pressures in hydraulic pressing apparatus, such as embossing, molding, die, baling, and other presses, and analogous apparatus for subjecting articles and materials to pressure; to provide means for automatically subjecting a movable press member to low and high fluid pressure successively, and then automatically relieving the pressure on said member; to provide means for actuating a movable pressing member by fluid under pressure, operating to first move said member by fluid at low pressure from a low-pressure source; and then to automatically segregate a body of fluid from said source, intensify the pressure on the segregated body of fluid by means operable by fluid at low pressure from said source, and supply fluid at high pressure from the segregated body of fluid to move the pressing member; to provide a pressing apparatus comprising a source of fluid at low pressure, an intensifier, relatively movable pressing members, and means whereby pressure fluid is automatically supplied to effect relative movement between said pressing members first from said source and then from the intensifier, and finally automatically released upon the developing of a predetermined pressure on the pressing members; to provide in combination with a hydraulic press and a source of liquid under constant pressure, an intensifier connected with said source, and automatic valve means for effecting repeated cycles of operation of the press each comprising, first, opening communication between the source of liquid under pressure and the press cylinder, then actuation of the intensifier by liquid under pressure supplied from said source to disconnect said source of liquid from the press cylinder and supply liquid at high pressure to the press cylinder, and finally exhausting the liquid from the press cylinder upon developing a predetermined pressure in the cylinder; to provide in a hydraulic press, valve means controlled by a constant pressure and press cylinder pressure for first effecting the supply of fluid at relatively low pressure and then at a higher pressure to a press cylinder, and finally exhausting fluid from the press cylinder upon developing of a predetermined pressure in the cylinder, and means controlled by movement of a part of the press upon exhaustion of the fluid from the press cylinder for causing said valve means to repeat the operating cycle; to provide fluid pressure operated controlling means for hydraulic pressing apparatus, adjustable to automatically effect release of pressure in the press cylinder or cylinders upon the developing of a desired pressure in the cylinder; and to provide a hydraulic pressing apparatus capable of automatically performing repeated pressing operations in rapid succession and developing high pressures from a low-pressure source, and in which the pressure exerted on the article or material acted on may be varied at will and accurately regulated.

Other objects and advantages will appear from the description in detail of the embodiment of the invention illustrated in the annexed drawings.

The invention has been illustrated in its preferred embodiment, and in connection with a press for embossing leather; but it will be understood that the invention is not limited in its application to embossing presses, and that the construction shown may be varied.

In the drawings:

Figure 1 is a front elevation of a leather-embossing press, partly in section, showing part of the control means and liquid connections;

Fig. 2 a side elevation of the press;

Fig. 3 a vertical sectional view of the intensifier;

Fig. 4 a detail sectional view of the valve mechanism controlling communication from the accumulator to the press cylinders and intensifier, and for releasing pressure from the apparatus;

Fig. 5 a detail view of the means for opening communication between the accumulator and intensifier for operating the intensifier;

Fig. 6 a vertical sectional view of a part of the automatic pilot valve device for in-

itiating the pressure-supplying and releasing operations;

Fig. 7 a partly diagrammatic view of the apparatus, showing the piping arrangement and the positions of the parts just prior to development of maximum low pressure in the press cylinders;

Fig. 8 a sectional view of the pilot valve with its slide in the position occupied thereby when the parts are in the position shown in Fig. 7;

Fig. 9 a view similar to Fig. 7, showing the position of the parts at the instant the release-initiating valve is actuated by the developing of the desired maximum high pressure in the press cylinders; and

Fig. 10 a view similar to Fig. 8, showing the pilot valve slide in the position occupied thereby when its operating lever is rocked to the position shown in Figs. 2 and 9.

In Figs. 1 to 6 inclusive, and Fig. 10, the several parts and devices are shown in normal idle position, the relatively movable pressing members or platens being separated and the apparatus being locked against operation. The embossing press proper is of ordinary construction, comprising a base 1, a pair of cylinders 2 on the base, a pair of pistons 3 in the cylinders, a vertically reciprocable platen 4 mounted on the upper ends of the pistons, and a fixed platen 5 overlying the platen 4 and rigidly supported on posts 6 rising from the base 1. The platen 5 is provided with the usual lower or hot plate section 5^a having the usual passages therein for circulation of heating fluid, and the usual embossing die plate 5^b is held against the lower face of the heated section 5^a of platen 5. It will be understood that various other forms of hydraulic pressing devices embodying relatively shiftable, opposed, pressure-exerting members for acting on work may be used in connection with my improvements which will be now described.

The source of operating liquid and pressure comprises an accumulator 7 in which liquid is maintained at a constant level, as at L, under a constant and relatively low pressure of air thereabove within the accumulator tank, the supply of liquid and air under pressure being maintained in the usual or any suitable manner, as by means of automatically controlled liquid and air pumps operated by a suitable low-horsepower motor.

A pipe 8 leads from the lower part of tank 7 to the branch 9 of a T-fitting A which is formed with a cylinder 10 in line with said branch 9 and has two lateral branches 11 and 12 between branch 9 and the adjacent open end of cylinder 10. A combined supply and exhaust valve 13 in the form of a small pitson is adapted to reciprocate in a small cylinder or sleeve 14 extending from the upper end of branch 9 to the lower end of the larger cylinder 10, and to seat against either a lower seat 15 or an upper seat 16. The cylinder 14 is open at both ends and provided with lateral openings 17 and 18 communicating with branches 11 and 12 of the T-fitting A. The valve seat rings 15 and 16 and cylinder 14 are held in place by an externally threaded ring 19 screwed into the lower end of cylinder 10. A relatively large operating piston 20, working in cylinder 10, is rigidly connected by a rod 21 with piston valve 13. Valve 13 is normally seated on seat ring 15 to prevent flow of liquid from pipe 8 to branches 11 and 12 and open communication between said branches and the liquid exhaust outlet 22 formed in cylinder 10 below the lower limit of movement of piston 20. A suitable waste pipe may be connected to the outlet 22. The upper end of cylinder 10 is closed, as by a suitable cap 23, and said cylinder is formed with a liquid inlet and outlet port 24 at its upper end.

Cylinder 10, above the large piston 20, is normally filled with liquid under accumulated tank pressure to hold small piston valve 13 closed against pressure of liquid in the accumulator tank and pipe 8, the communication being open via port 24, a pipe 25 connecting said port with a port 26 in the seat of a pilot slide valve 27 in the pilot valve casing D, a constantly open port 28 in valve casing D, and a pipe 29 connecting port 28 with a pipe 30 which in turn is connected with pipe 8 between the accumulator and valve 13. The stem 31 of pilot valve 27 is connected by a link 32 with one arm of a lever 33 fulcrumed at 34 on a bracket 35 held to the press frame. Up and down swinging of lever 33 is limited by adjustable stops 36 carried by the bracket 35.

Lever 33 is normally locked in the position shown in Figs. 1 and 2 to hold the pilot valve in the position just described, and shown in Figs. 1, 2 and 10, by means of a manually shiftable starting and stopping control device. This device comprises a two-armed lever 37 fulcrumed at 38 on a suitable bracket held to fixed platen 5, one arm of said lever being provided with a handle 39 and having pivotally connected therewith at 42 the upper end of a link 40 whose forked lower end 40^a loosely straddles that arm of lever 33 with which the stem of the pilot valve is connected. The other arm of lever 37 carries a weight 41 and normally engages a stop pin 43 on platen 5. Fork 40^a is loosely confined between a pair of pins 44 on lever 33 to form a pivoted and vertical lost-motion connection between link 40 and lever 33. The parts are so arranged that when lever 37 is manually shifted to the position shown in Fig. 2, said lever and link 40 will positively hold lever 33 in the position shown in Fig. 2 against the pull of a weight 45 attached to the lever 33 at the opposite side of its fulcrum, so that slide valve 27 will

remain in the position shown in Fig. 10 until such time as lever 37 is manually rocked to its press-starting position shown in Figs. 7 and 9, in which the handle-carrying end of said lever 37 engages under pin 43.

When lever 37 is held in the position shown in Figs. 7 and 9 by weight 41, lever 33 may be moved to the opposite limit of its throw by weight 45, as shown in Fig. 7, to shift pilot valve 27 to the position shown in Fig. 8, and may be also moved back to its original position by an automatic device, as shown in Fig. 9, without any movement of the hand-operated lever and link. This automatic device comprises a vertical cylinder 46 rigidly held to bracket 35 and closed at both ends, and an inverted cup-shaped piston 47 normally seated on a conical projection 48 rising from the bottom of the cylinder. A relief passage or port 49 extends vertically through the piston 47 outside of the cylindrical recess 50 in the bottom of said piston into which projection 48 extends. Port 49 is normally closed by a downwardly seating check valve 58 having the usual fluted stem extending loosely into the upper portion of the port or passage. Open communication is maintained between the upper end of cylinder 46 and the press cylinders, as by means of a pipe 51 leading from port 52 in cylinder 46 to one of the pipes 53 which lead from the lower ends of the press cylinders to a chamber 54 in the casing C of an automatic check valve device. Liquid is adapted to pass around the piston 47 through a passage or by-pass 55 in the cylinder wall, said passage being enlarged to form a conoidal chamber 55ª into which extends the conical head of a restriction valve 56 having a threaded shank tapped through the adjacent portion of the cylinder wall and provided with a finger piece 56ª for adjusting the valve. A rod 57, rigidly held to piston 47, extends upwardly through a suitable stuffing box in the upper end of the cylinder 46 and is adapted to engage under lever 33, when piston 47 is forced upward, and rock lever 33 from the position shown in Fig. 7 to the position shown in Fig. 9.

The casing C is formed with a central chamber 59 communicating with the lower end of chamber 54 and the upper end of a cylinder 60 in the lower end of the casing, and said casing is formed with a lateral branch 61 leading from chamber 59 and suitably coupled with the outer end of branch 11 of the casing A. A piston 62 in cylinder 60 has a depending stem 63 reciprocable in a bore in a cap 64 closing the lower end of the cylinder. This piston carries a rigid tappet rod 65 at its upper end, adapted to loosely engage under and hold a check valve 66 in chamber 54 off its seat 67 to open and maintain communication between chambers 54 and 59 when the piston is in its elevated position shown in Fig. 4. Piston 62 is constantly subject on its under face to liquid at accumulator tank pressure, the lower end of cylinder 60 being connected with the accumulator 7 via a port 68 and the pipes 30 and 8 hereinbefore referred to.

A check valve 69 normally rests on its seat 70 to close communication between the superposed connected chambers 71 and 72 formed in a valve casing B. Casing B is formed with a lateral branch 73 leading from chamber 71 containing valve 69, said branch being suitably coupled with the outer end of branch 12 of casing A. Valve 69 is adapted to be engaged and unseated by a tappet rod 74 passing through the bottom wall of chamber 72 and normally held in retracted or lowered position (as shown in Fig. 4) by a weight 75 on the free end of a lever 76. Lever 76 is fulcrumed at its other end at 77 on the lower end of a short link 78 which is pivoted at its upper end at 79 on the valve casing B. Tappet 74 is pivoted at its lower end to lever 76 at 80. Lever 76 is provided with a short longitudinal slot 81 between the weight and tappet, through which extends a horizontal pin 82 rigidly held to a vertical piston or plunger 83. The lower end of piston 83 is reciprocable in a vertical cylinder 84 rigidly mounted on a suitable framework 85 upon which the valve casing B is secured. The throw of lever 76 is preferably limited by suitable stops 86 on the framework 85, and the piston or plunger 83 is preferably formed with a reduced stem portion 83ª slidably guided in an opening 87 in an extension of casing B. At its lower end piston 83 is preferably formed with a conical central extension 83ᵇ which passes down into a vertical cylindrical passage 88 extending through the bottom of cylinder 84. A section of a pipe 89 is connected with passage 88, said pipe 89 being arranged to maintain in cylinder 84 liquid at press cylinder pressure, as by connecting said pipe with one of the press cylinder supply pipes 53 adjacent chamber 54 in casing C, as shown in Figs. 7 and 9.

A pressure intensifier is provided which is operable by liquid under pressure from the accumulator 7 to force into the press cylinders, under pressure greater than accumulator pressure, liquid which has previously passed from the accumulator. This intensifier comprises a large, upright, fixed cylinder 90 rigidly mounted on a floor or other suitable base adjacent the press device proper; a large and relatively long piston 91 reciprocable in and projecting through the open upper end of cylinder 90 and formed with a cross-head 92 at its upper end; a fixed cross-head 93 above cross-head

92 rigidly supported by columns 94 connecting said cross-head 93 with cylinder 90; and a stationary or fixed piston 95 having its upper end extending through and rigidly held to cross-head 93 and its lower end extending into a small traveling cylinder moving with large piston 91 and formed by casting piston 91 with a long cylindrical chamber 96 of relatively small diameter extending axially of said piston 91, the small fixed piston 95 having an axial bore or passage 97 therethrough for discharge of liquid at intensified pressure from cylinder 96. Discharge passage 97 is connected at its upper end with a pipe 98 arranged to deliver the high-pressure liquid to the press cylinders. For this purpose pipe 98 may be connected to the press cylinder liquid supply at any point beyond check valve 66, as by connecting said pipe with one of the pipes 53 adjacent chamber 54 as shown in the drawings. Liquid for actuating the intensifier is conducted to the lower end of cylinder 90 by a pipe 99 connecting the port 100 of the cylinder with a port or outlet 101 in the wall of chamber 72 in casing B.

When valve 13 in casing A is in normal or release position (Fig. 4), the combined piston and traveling cylinder 91—96 is adapted to move by gravity to the position shown in Figs. 3 and 7 in which its lower end rests on a small boss 102 on the bottom wall of cylinder 90. To facilitate downward movement of piston 91, I prefer to provide a pair of small upstanding return plungers 103 secured at their lower ends to cross-head 92 and having their upper ends working in a pair of small upright cylinders 104 held to cross-head 93, said cylinders 104 having pipe connections 105 at their upper ends connected by a pipe 106 with a pipe 107 which leads from pipe 8 to the upper end of a small return cylinder 108 fixed on base 1 of the embossing press under the movable platen 4. Platen 4 and pistons or rams 3 are adapted to move by gravity to the position shown in Fig. 1 when valve 13 is in release position, but I prefer to facilitate the return movement of the platen by providing the small return cylinder 108 having the small return piston 109 therein, which piston is connected with platen 4 by a piston rod 110. Cylinder 108 is open to the atmosphere at its lower end through a port 111. It will be seen that return pistons 103 and the return piston 109 are constantly subjected to liquid at accumulator tank pressure on their upper ends or faces, so that whenever pressure is relieved below rams or pistons 3 and 91 the downward movement thereof will be hastened by the pressure on the return pistons.

The slide valve 27 in casing D is provided with a vertical groove or passage 27^a in its face, adapted, when the valve is moved upward, to connect port 26 with a discharge port 112 in the valve seat, a suitable waste pipe 113 being connected with port 112.

Lever 33 is adapted to be temporarily locked in the position thereof shown in Figs. 2 and 9 by an automatic latching device comprising a three-arm latch pivoted at 114 on bracket 35 and having a depending hook arm 115 adapted to engage under a pin 116 on the weight-carrying arm of lever 33. The hook arm of the latch is moved to latching position (Fig. 9) by a weight 117 on a lateral arm 118 of the latch, and said hook arm is moved to release position (Fig. 2) at the final part of the return or downward movement of platen 4 by means of an adjustable tappet screw 119 tapped through a bracket 120 fixed on one end of platen 4. The lower end of tappet 119 is adapted to engage a laterally extending arm 121 of the latch at the opposite side of the latch pivot from weighted arm 118 as the platen 4 approaches its downward limit of movement, and rock the latch to release position and hold it there until the platen is again moved upward.

The upper ends of casings B and C are closed by suitable caps 122 and 123, respectively, and the check valves 69 and 66 are preferably guided in said caps and in the passages between the chambers in these casings, as shown in Fig. 4. The weights 75 and 45 are carried by detachable suspension hooks 124 and 125 of ordinary form, and the loads on these levers may be adjusted by adding additional weights or by engaging the hooks in different ones of a series of apertures 126 and 127 in the respective levers. A cut-off valve 128 may be provided in pipe 8 for isolating the accumulator from the rest of the apparatus when making repairs.

Operation.

The work to be acted upon, which in the particular apparatus shown is a sheet of leather 129, is fed or placed in position over the movable platen 4, whereupon the apparatus is put into action by swinging the hand lever 37 from the position shown in Figs. 1 and 2 to that shown in Figs. 7 and 9 where it is held by weight 41 until it is again desired to put the apparatus out of action, which may be after a single pressing operation or any greater number of pressing operations. The movement of lever 37 draws up link 40 sufficiently to allow weight 45 to rock lever 33 to the position shown in Fig. 7 and thereby shift pilot valve 27 from the position shown in Figs. 2 and 10 to the position shown in Figs. 7 and 8, cutting off communication between accumulator 7 and the space in cylinder 10 above piston 20 of the main combined liquid supply and release valve device and connecting said space with

the liquid exhaust or waste port and pipe 112, 113. Pressure of the liquid in tank 7 and pipe 8 on the lower face of piston valve 13 then forces the combined supply and release valve from released position (Fig. 4) to supply position (Fig. 7) in which said valve engages its seat 16 to shut off communication between the T-fitting A and the exhaust or waste outlet 22 in the lower part of cylinder 10. Liquid then flows from the accumulator through pipe 8 and passages 18, 12 and 73 into chamber 71 but is prevented from flowing to the cylinder 90 of the intensifier by means of the check valve 69 of the automatic intensifier operating valve device which is engaged at this time with its seat 70. Liquid also flows through 17, 11 and 61 into chamber 59 of casing C (where it lifts check valve 66) and thence into chamber 54 from which it flows into the press cylinders 2 via pipes 53, to cylinder 46 of the automatic high-pressure control and release-initiating device via pipe 51 and port 52 where it equalizes around piston 47 via passage 55, and also to cylinder 84 of the automatic intensifier-operating valve device via pipe 89. The load imposed on lever 76 of the intensifier-operating valve device by the adjustable weight 75 is so regulated that piston 83 cannot be lifted by liquid flowing to the lower end of cylinder 84 until the pistons or rams 3 in press cylinders 2 are first moved up to carry the work sheet 129 against the die plate 5^b fixed on the bottom face of the fixed platen $5—5^a$. After this engagement takes place the increased resistance to movement of the platen 4 and pistons 3 results in substantial arrest thereof so that pressure rises in the cylinders 2 and 84 until there is sufficient back pressure in pipe 89 and cylinder 84 from cylinders 2 to force up plunger 83 and the connected tappet rod 74 to unseat and hold up check valve 69, as shown in Fig. 9.

I prefer to maintain a relatively low pressure in the accumulator sufficient only to lift the platen 4 and the work and effect firm engagement of the work between the platens and to regulate the load on lever 76 so that valve 69 will be unseated upon development or equalization of substantially the maximum low-pressure in the accumulator into the various pipes and cylinders then connected therewith as described above and shown in Fig. 7 It will be obvious, however, that I may employ sufficiently high accumulator tank pressure to perform more or less of the actual pressing action on the work, and also that weight 75 may be regulated so that valve 69 will be unseated by less than the maximum accumulator pressure where it is not desired to fully equalize the accumulator with the press cylinders after initial clamping of the work between the platens.

The pressure areas at opposite sides of piston 62 in casing C are so proportioned that the piston and its connected tappet rod 65 will be forced down from its valve unseating position (Fig. 4) to the position shown in Fig. 7 where it will be held until valve 13 is moved back to release position.

The load imposed on lever 33 by the adjustable weight 45 is regulated or varied to prevent forcing up of the piston 47 prior to unseating of valve 69 in casing B, and permit forcing up of said piston upon development of a desired higher pressure in the press cylinders due to an operation of the intensifier effected by the unseating of valve 69.

Upon unseating of valve 69 (see Fig. 9) liquid flows from the accumulator via 8, 18, 12, 73, 71, 72, 101, 99 and 100 into the low pressure cylinder 90 of the intensifier and drives the combined traveling piston and cylinder 91, 96 upward relatively to the small fixed piston 95 to develop in the high-pressure cylinder 96 a pressure greater than the maximum pressure in the low pressure accumulator 8, in accordance with well known principles of hydrostatics, and liquid under high-pressure in cylinder 96 will then be forced back through passage 97 and pipe 98 into the press cylinders and chamber 54 via pipes 53. As its unseating device 62, 65 is at this time forced down by pressure in chamber 59 and upper end of cylinder 60, check valve 66 will be seated by the increased back pressure in chamber 54.

High-pressure liquid will also be forced into the upper end of cylinder 46 via pipe 51 and port 52 and will pass around piston 47 via passage 55. Check valve 58 in piston 47 will be held to its seat by the pressure on its larger upper end. The high-pressure liquid forces rams or pistons 3 in the press cylinders upward slightly with a slow movement of great force to perform or complete the embossing operation of the die 5^b on the leather sheet 129. As soon as the increasing resistance to movement of the platen 4 by liquid under high pressure from the active intensifier results in development of sufficient pressure in the press cylinders 2, and consequently in cylinder 46 at both sides of piston 47, to cause the piston to move upward against the resistance of load 45 thereon, the piston rod or tappet 57 carried by the piston will press upward against the weighted arm of lever 33 and rock the lever from the position shown in Fig. 7 to the position shown in Fig. 9 (which is the same as that shown in Fig. 4) thus shifting the pilot valve back from its pressure supply initiating position (Figs. 7 and 8) to its pressure release initiating position (Figs. 9 and 10). Piston 47 is movable upward upon building up of the desired maximum high-pressure thereunder owing to the fact that

the effective pressure area is greater at the under face than at the upper face of the piston.

When the weighted arm of lever 33 is forced up by tappet 57 it is automatically locked by latch hook 115 against downward movement to maintain the pilot valve in the position shown in Figs. 9 and 10 until platen 4 returns to normal lowered position. In Fig. 9 the parts are shown in the positions thereof immediately after shifting of the pilot valve by the tappet 57 and latching of lever 33, and it will be seen that this movement of pilot valve 27 has closed waste port 112 and again connected the upper end of cylinder 10 of the main release and supply valve device with the accumulator 7 via 24, 25, 26, valve casing D, 28, 29, 30 and 8 so that the main supply and release valve 13 has started down from seat 16 by pressure on piston 20 and will be instantly forced against seat 15 (as shown in Fig. 4) thereby venting T-fitting A and connected chambers 59 and 71 in casings C and B to the liquid exhaust or waste outlet 22 in cylinder 10 below piston 20. Piston valve 13 will be held on seat 15 by pressure on top of the larger piston 20 until pilot valve 27 is again shifted. Venting of chamber 59 permits the constant pressure on the under side of piston 62 to force the piston up and cause tappet 65 to unseat check valve 66 against the pressure in chamber 54, the effective pressure areas of the piston and check valve being properly proportioned for this purpose, whereupon liquid may flow back from press cylinders 2 and cylinder 46 and out through the exhaust 22 to permit pistons 3 and 47 to descend to the lower limit of their travel. Piston 83 in cylinder 84 will also descend to the lower limit of its travel since pipe 89 is connected with one of the pipies 53. Descent of piston 83 is cushioned by partial throttling of outlet 88 by conical plug 83b. Liquid will also flow out of the low pressure cylinder 90 of the intensifier via 100, 99, 101, 72 past check valve 69, and then via 71, 73, 12 and 18 to the outlet 22 until piston 91 returns to the position shown in Fig. 7, whereupon valve 69 will move down to its seat 70 as shown in Fig. 4, the back pressure from cylinder 90 having been relieved and tappet 74 having been lowered by the descent of piston 83. When there is no longer any pressure on the liquid in those parts of the hydraulic system open to the exhaust 22 the flow through the exhaust will cease.

During the exhaust of liquid through outlet 22, as just described, the movable platen 4 descends with the pistons or rams 3 and, just as said platen reaches its lowest position, the trip or tappet 119 carried by said platen engages and depresses arm 121 of the weighted latch and rocks the latch hook arm 115 to release position (see Fig. 2) and holds it there until the platen is again moved upward. If the manually operable lever 37 has been left in the position to which it was moved to put the apparatus into action (Fig. 7), it will be obvious that, upon release of the latch, weight 45 will again rock the lever 33 to the position shown in Fig. 7 and the apparatus will automatically repeat its operating cycle above described, and will continue to so repeat its operating cycle to perform successive pressing operations until lever 37 is manually shifted back to the position shown in Figs. 1 and 2 to lock the automatic pilot valve mechanism against movement with the pilot valve 27 in release position. While lever 37 may be rocked at any time to lock the press against further operation, it should preferably be so rocked during descent of platen 4 before release of latch 115 so that the press will stop after completing a perfect cycle of operation.

It has heretofore been stated that the load on lever 33 may be varied as by increasing the weight 45 or adjusting the weight along the lever to thereby vary the pressure which may be developed in cylinders 2 before piston 47 and tappet 57 are actuated by the press-cylinder pressure to move the pilot valve to pressure-release initiating position. This construction provides means whereby the platen 4 is retracted automatically as soon as a desired high pressure is exerted on the work being acted upon, and this pressure will be the same at each operation of the press until the further adjustment is made. By changing the adjustment the pressure limit may be increased or diminished at will within the capacity of the apparatus.

In certain pressing operations, such as embossing operations, it is desirable to very nicely regulate the degree of pressure. For greater convenience and greater accuracy of adjustment than may be readily obtained merely by changing or adjusting weight 45, I have provided additional regulating means which may be employed in connection with a rough or approximate regulation by weight or load variations on lever 33 to readily effect accurate pressure regulation. This auxiliary means comprises the manually adjustable cone valve 56 in the conical chamber 55a in by-pass 55 in the wall of cylinder 46, and hereinbefore described. By screwing this valve 56 in or out by the thumb-piece 56a on its stem the time required for the high pressure fluid charged in through 51 and 52 to build up the weight lifting pressure under the larger pressure area on the lower face of the piston 47 may be increased or diminished, so that the intensifier may continue to operate to force high pressure liquid into the ram cylinders for a greater or less time after development of a pressure in said cylinders 2 and the top of cylinder 46 sufficient to over-

come the load on lever 33 if the liquid were free to immediately equalize around the piston through an unrestricted by-pass. By delaying more or less the period of time required for the building up under piston 47 of sufficient pressure to overcome the load on lever 33 more or less pressure, in excess of that determined by the load alone, will be developed in the press cylinders by continued operation of the intensifier before the piston 47 and its tappet 57 will operate to shift the lever.

The check valve 58 is adapted to unseat during release action to facilitate release of liquid from beneath piston 47. The conical plug 48 co-operates with the cylindrical recess 50 in piston 47 to cushion the final part of the down movement of the piston by progressively restricting outflow of liquid partially trapped in said recess by the plug.

It will be obvious that by returning the hand lever to locking position after the parts first assume the position shown in Fig. 9, following a movement of said lever to the position shown in Fig. 7, the operator may cause the apparatus to start, perform a single pressing operation, and then stop. Any suitable feed mechanism may be employed for intermittently feeding work to the press between pressing actions of the relatively shiftable pressing members or platens 4 and 5.

The descent of the ramp pistons 3 and piston 91 of the intensifier, as heretofore described, is facilitated by the constant pressure of liquid from accumulator 7 in the return cylinders 108 and 104, respectively, and it will be understood that these cylinders are relatively small in diameter so that the back pressure therein during upward movement of pistons 3 and 91 does not materially affect the action of the apparatus.

I prefer to provide a slight vertical lost-motion connection between link 32 and lever 33. This link is pivoted at 130 to the stem 31 of pilot valve 27 and has a short closed vertical slot 131 in its lower end in which is engaged a pin 132 on lever 33, the parts being so arranged that the pilot valve will receive its full upward throw during the last part of the movement of lever 33 into the position shown in Fig. 7 and its full downward throw during the last part of the movement of lever 33 into the position shown in Fig. 9. The pilot valve will be held stationary by friction and pressure until positively shifted. The lower end of latch arm 115 cooperates with latch pin 116 to limit swinging of the latch arm by weight 117 when the lever 33 is in the position shown in Fig. 7.

The supply of liquid in cylinder 96 of the intensifier is automatically maintained through pipe 98 and passage 97, the source of liquid supply being the accumulator 7, and it will be observed that this low-pressure accumulator is the source from which liquid and power is derived for effecting the operation of the parts to perform the multi-stage pressure movement of the platen 4 and the automatic cycling of the apparatus.

Pressing apparatus constructed in accordance with my invention is capable of rapid and quiet operation, of developing very high pressures at minimum cost of operation, and of developing uniform pressure in successive pressing operations, which pressure may be varied to suit the work to be performed.

It will be obvious that any other suitable means than that hereinbefore described may be provided for maintaining in pipe 8 a supply of fluid under a substantially constant pressure.

What I claim is:

1. In an apparatus of the class set forth, the combination of opposed relatively shiftable pressing members, means operable by liquid under pressure for automatically imparting a relative approaching movement between said members first under the influence of liquid under one stage of pressure and then under the influence of liquid under higher pressure, and finally automatically effecting a relative separating movement between said members.

2. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, and means for automatically subjecting one of said members to action of liquid under successive stages of pressure to move said member toward the other member first by liquid under relatively low pressure and finally by liquid under higher pressure, and subsequently automatically freeing said liquid-actuated member from liquid pressure.

3. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, means for automatically subjecting one of said members to action of liquid under successive stages of pressure to move said member toward the other member first by liquid under relatively low-pressure and finally by liquid under higher pressure, and means operable by pressure exerted on said actuating member for releasing the pressure of liquid acting on the member.

4. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, means for automatically subjecting one of said members to action of liquid under successive stages of pressure to move said member toward the other member first by liquid under relatively low pressure and finally by liquid under higher pressure, and means operable by pressure of liquid acting on said movable member to relieve said liquid of pressure.

5. In a hydraulic pressing apparatus, the

combination of opposed relatively shiftable pressing members, means for automatically subjecting one of said members to action of liquid under successive stages of pressure to move said member toward the other member first by liquid under relatively low pressure and finally by liquid under higher pressure, and automatically operable means for relieving liquid acting on said movable member of pressure upon development of a predetermined pressure by the liquid on said member.

6. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, means for automatically subjecting one of said members to action of liquid under successive stages of pressure to move said member toward the other member first by liquid under relatively low pressure and finally by liquid under higher pressure, automatically operable means for relieving liquid acting on said movable member of pressure upon development of a predetermined pressure by the liquid on said member, and means whereby said last-mentioned means may be caused to act at different predetermined degrees of pressure.

7. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, a ram cylinder, a ram in said cylinder connected with one of said members to move the same toward the other member, a source of liquid under constant pressure, and means connected with said source of liquid and operable by liquid under pressure therefrom for first connecting said ram cylinder with said source of liquid to move the ram and then disconnecting said cylinder from said source of liquid and supplying liquid at a higher pressure to said cylinder.

8. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, a ram cylinder, a ram in said cylinder connected with one of said members to move the same toward the other member, a source of liquid under constant pressure, means connected with said source of liquid and operable by liquid under pressure therefrom for first connecting said ram cylinder with said source of liquid to move the ram and then disconnecting said cylinder from said source of liquid and supplying liquid at a higher pressure to said cylinder, and means operating upon a predetermined rise in pressure in said cylinder following the supplying of high-pressure liquid to the cylinder to prevent further supply of said high pressure liquid.

9. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, a ram cylinder, a ram in said cylinder connected with one of said members to move the same toward the other member, a source of liquid under constant pressure, means connected with said source of liquid and operable by liquid under pressure therefrom for first connecting said ram cylinder with said source of liquid to move the ram and then disconnecting said cylinder from said source of liquid and supplying liquid at a higher pressure to said cylinder, and means operable by ram cylinder pressure for causing said first-mentioned means to act to stop the supply of liquid to the ram cylinder and exhaust liquid from said cylinder to permit return movement of the ram.

10. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, a ram cylinder, a ram in said cylinder connected with one of said members to move the same toward the other member, a source of liquid under constant pressure, means connected with said source of liquid and operable by liquid under pressure therefrom for first connecting said ram cylinder with said source of liquid to move the ram and then disconnecting said cylinder from said source of liquid and supplying liquid at a higher pressure to said cylinder, means operable by ram cylinder pressure for causing said first-mentioned means to act to stop the supply of liquid to the ram cylinder and exhaust liquid from said cylinder to permit return movement of the ram, and means controlled by return movement of the ram for automatically initiating the multi-pressure stage liquid supply operation of said first-mentioned means.

11. In a hydraulic pressing apparatus, the combination of opposed relatively shiftable pressing members, a ram cylinder, a ram in said cylinder connected with one of said members to move the same toward the other member, a source of liquid under constant pressure, means connected with said source of liquid and operable by liquid under pressure therefrom for first connecting said ram cylinder with said source of liquid to move the ram and then disconnecting said cylinder from said source of liquid and supplying liquid at a higher pressure to said cylinder, means operable by ram cylinder pressure for causing said first-mentioned means to act to stop the supply of liquid to the ram cylinder and exhaust liquid from said cylinder to permit return movement of the ram, means controlled by return movement of the ram for automatically initiating the multi-pressure stage liquid supply operation of said first-mentioned means, and manually operable means for rendering said ram controlled means ineffective to so initiate a liquid supply operation.

12. In a fluid pressure operated pressing apparatus, the combination of a fixed pressing member, a reciprocable pressing member, a ram connected with said reciprocable

member, fluid-pressure controlled means for first supplying fluid under one stage of pressure to said ram and then supplying fluid at a higher stage of pressure to said ram and finally effecting withdrawal of fluid pressure from said ram upon development of a predetermined pressure thereon, said means normally acting upon each withdrawal of fluid pressure from the ram to automatically repeat the recited cycle of operation thereof, and manually operable means cooperating with a part of said fluid-pressure-controlled means when shifted to one position to cause said fluid-pressure-controlled means to assume and then remain in its fluid-pressure withdrawing position and adapted when moved to another position to permit automatic cycling of said fluid-pressure-controlled means.

13. In a fluid-pressure-operated pressing apparatus, the combination of a fixed platen, a movable platen, a ram cylinder, a ram in said cylinder connected with the movable platen, an accumulator, a fluid-pressure-operated intensifier, a combined pressure supply and release valve, a valve casing having a fluid inlet connected with the accumulator and a fluid exhaust outlet, fluid conduits leading respectively to the ram cylinder and the low pressure side of the intensifier from said valve casing, a combined supply and exhaust valve in said casing movable to a supply position closing said exhaust and connecting said inlet with said conduits and movable to an exhaust position closing said inlet and connecting said conduits with said exhaust outlet, a check valve in the ram cylinder conduit seating toward said valve casing, a second check valve in the conduit leading to the low pressure side of the intensifier seating away from said valve casing, a conduit connecting the high pressure side of the intensifier with the ram cylinder, means for effecting movement of the combined supply and release valve between supply and release position, means operable by ram cylinder pressure to unseat the second-mentioned check valve following a movement of the combined supply and release valve to supply position, and fluid-pressure-operated means acting to permit seating of the first-mentioned check valve upon unseating of the second check valve and to unseat said first-mentioned check valve upon movement of the combined supply and release valve to release position.

14. A fluid-pressure-operated pressing apparatus as claimed in claim 13, in which the means for effecting movements of the combined supply and release valve operates automatically to move said valve to supply position upon exhaustion of pressure from the ram cylinder and to move said valve to release position upon development of a predetermined pressure in the ram cylinder.

15. A fluid-pressure-operated pressing apparatus comprising relatively movable pressing members, cylinder and piston means for effecting relative movement between said members, means for supplying operating fluid under pressure to said cylinder and piston means to effect a pressing action, and means for automatically releasing operating fluid from said cylinder and piston means upon development of a predetermined pressing force.

16. A fluid-pressure-operated pressing apparatus comprising relatively movable pressing members, cylinder and piston means for effecting relative movement between said members, means for supplying operating fluid under pressure to said cylinder and piston means to effect a pressing action, and fluid-pressure-operated means subject to the cylinder pressure and operable automatically upon development of a predetermined cylinder pressure for exhausting operating fluid from said cylinder and piston means.

17. In a pressing apparatus, the combination of a fixed platen, a vertically movable platen cooperating with the fixed platen, a ram connected with the movable platen to move up and down, a cylinder for said ram, means for supplying fluid under pressure to said ram cylinder to force the movable platen toward the fixed platen and for exhausting fluid from said ram cylinder to permit withdrawal of the movable platen from the fixed platen, and fluid-pressure actuated means operable by a predetermined maximum ram cylinder pressure for automatically causing said supply and exhaust means to cease the supply of fluid under pressure to said ram cylinder and exhaust the pressure fluid therefrom.

18. In a pressing apparatus, the combination of a fixed platen, a vertically movable platen cooperating with the fixed platen, a ram connected with the movable platen to move up and down, a cylinder for said ram, means for supplying fluid under pressure to said ram cylinder to force the movable platen toward the fixed platen and for exhausting fluid from said ram cylinder to permit withdrawal of the movable platen from the fixed platen, fluid-pressure actuated means operable by a predetermined maximum ram cylinder pressure for automatically causing said supply and exhaust means to cease the supply of fluid under pressure to said ram cylinder and exhaust the pressure fluid therefrom, means controlled by return movement of the movable platen whereby said pressure supply and exhausting means is caused to supply fluid under pressure to said cylinder and prevent exhaust thereof until said ram-cylinder pressure actuated means is again operated, and manually operable means for preventing at will a pressure supplying operation of

said pressure supplying and exhausting means.

19. In a fluid pressure actuated press, the combination of a vertically movable platen, a ram supporting said platen, a vertical cylinder for the ram, a fixed platen above the movable platen, a source of fluid pressure, a fluid conduit means connecting said pressure source with the lower end of said ram cylinder and having an intermediate exhaust outlet, a differential piston valve device interposed in said conduit means and movable between a supply position closing said exhaust and opening communication between the pressure source and ram cylinder and a release position opening communication between the ram cylinder and exhaust and closing communication between the ram cylinder and pressure source, said piston valve device having one pressure face constantly subject to pressure from the fluid pressure source and an opposed pressure face of greater area, and pilot-valve controlled means for alternately supplying fluid from said source to said opposed pressure face of said piston valve device and exhausting pressure fluid acting on said face.

20. A fluid pressure actuated press as claimed in claim 19, in which said pilot valve is shiftable by a weight to exhaust pressure from the large pressure face of the piston valve device to effect movement thereof to supply position and is movable by ram cylinder pressure to admit pressure to said large pressure face for effecting movement of the piston valve device to exhaust position.

21. A fluid pressure actuated press as claimed in claim 19, in which the pilot valve is shiftable between its two operating positions by an abutment subject to ram cylinder pressure and a load means opposing movement of said abutment by ram cylinder pressure, said load means normally tending to shift the pilot valve to its pressure exhausting position.

22. A fluid pressure actuated press as claimed in claim 19, in which the pilot valve is movable to its pressure exhausting position by a load connected therewith and is moved to its pressure supplying position by a device subject to ram cylinder pressure, means being provided for automatically latching the pilot valve in its pressure supplying position upon actuation thereof by said device and for automatically unlatching the pilot valve upon return of the movable platen to its lowered position.

23. In a fluid pressure actuated press, a fixed platen, a movable platen, a ram for moving the movable platen toward the fixed platen, a ram cylinder, an accumulator, an intensifier connected at its high pressure side with the ram cylinder, means operating automatically when put into action for first opening communication between the accumulator and ram cylinder and subsequently closing said communication and opening communication between the accumulator and the low pressure side of the intensifier and then, upon development of a predetermined pressure in the ram cylinder, venting fluid from the ram cylinder and low pressure side of the intensifier and preventing flow of pressure fluid from the accumulator to both the ram cylinder and low pressure side of the intensifier, and means for putting said automatically operating means into action.

24. In a fluid pressure actuated press, a fixed platen, a movable platen, a ram for moving the movable platen toward the fixed platen, a ram cylinder, an accumulator, an intensifier connected at its high pressure side with the ram cylinder, means operating automatically when put into action for first opening communication between the accumulator and ram cylinder and subsequently closing said communication and opening communication between the accumulator and the low pressure side of the intensifier and then, upon development of a predetermined pressure in the ram cylinder, venting fluid from the ram cylinder and low pressure side of the intensifier and preventing flow of pressure fluid from the accumulator to both the ram cylinder and low pressure side of the intensifier, means for putting said automatically operating means into action, means constantly subject to accumulator pressure tending to force the movable platen away from the fixed platen, and means constantly subject to accumulator pressure tending to restore the intensifier to idle position.

25. In a fluid pressure actuated press, a fixed platen, a movable platen, a ram cylinder, a ram in said cylinder connected with the movable platen, a source of constant fluid pressure, a pressure intensifier connected at its high pressure side with the ram cylinder, valve means for supplying fluid from the source of pressure to the ram cylinder, a second valve means subject to the opposing actions of a weight and an abutment subject to ram cylinder pressure for automatically supplying fluid from the source of pressure to the low-pressure side of the accumulator upon building up of a predetermined ram cylinder pressure, and a check valve for closing communication between the source of pressure and the ram cylinder upon actuation of said second valve means by said abutment.

26. In a fluid-pressure-operated press, the combination of a fixed platen, a movable platen, a ram cylinder, a ram in said cylinder connected with the movable platen, a valve operable to control supply of pressure fluid to said ram cylinder and exhaust of pressure fluid from said cylinder, a loaded member connected with said valve and nor-

mally urging it toward its position for effecting supply of pressure fluid to the ram cylinder, a pressure control cylinder, a piston in said pressure control cylinder, means movable by said piston for shifting said loaded member in opposition to the load thereon to move said valve to its position for effecting exhaust of pressure fluid from the ram cylinder, means forming an open path for fluid between the two cylinders, and manually adjustable means for restricting the flow of fluid through said path.

27. In a fluid-pressure-operated press, the combination of a fixed platen, a movable platen, a ram cylinder, a ram in said cylinder connected with the movable platen, a valve operable to control supply of pressure fluid to said ram cylinder and exhaust of pressure fluid from said cylinder, a loaded member connected with said valve and normally urging it toward its position for effecting supply of pressure fluid to the ram cylinder, a pressure control cylinder, a piston in said pressure control cylinder, means movable by said piston for shifting said loaded member in opposition to the load thereon to move said valve to its position for effecting exhaust of pressure fluid from the ram cylinder, means forming an open path for fluid between the two cylinders, manually adjustable means for restricting the flow of fluid through said path, means for automatically locking said loaded member in the position to which it is movable by said piston, means operable by recession of the movable platen from the fixed platen for releasing the loaded member, and manually operable means for locking the loaded member in the position to which it is movable by said piston and releasing said member at will.

28. A press as claimed in claim 27, in which said manually operable locking means is effective on a locking movement thereof to positively move said loaded member to shift the valve to its position for effecting exhaust of fluid from the ram cylinder if said manually operable means is actuated when said valve and member are in the position for effecting supply of pressure fluid to the ram cylinder.

In testimony whereof I hereunto affix my signature.

CARL WIGTEL.