Oct. 19, 1943. T. F. STACY 2,332,023

MULTIPLE PRESS UNIT

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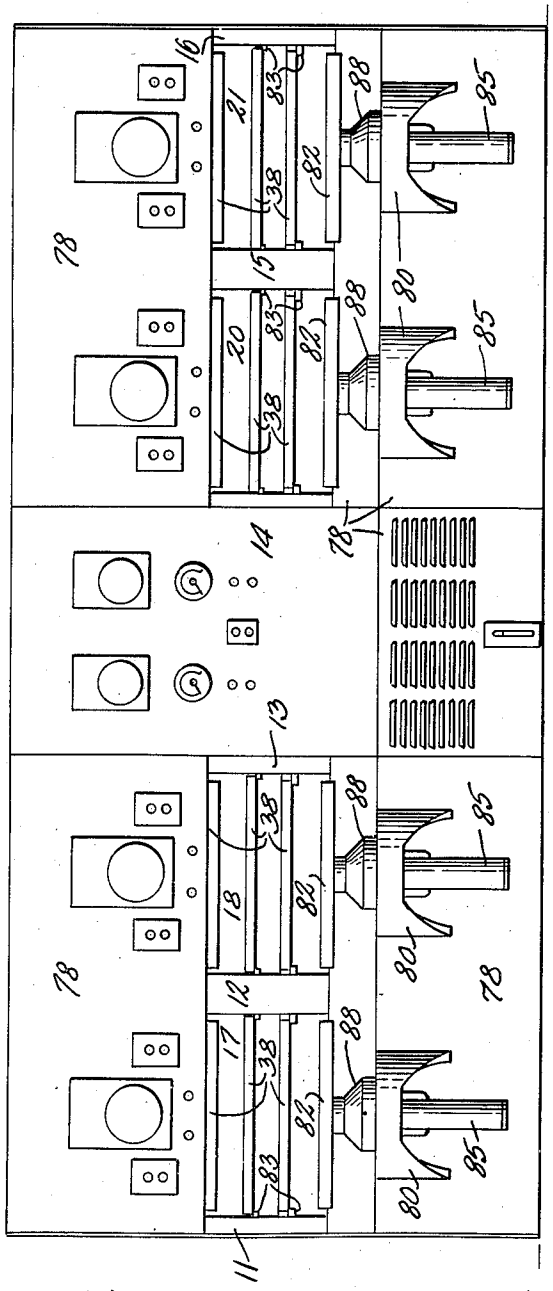


Fig. 1.

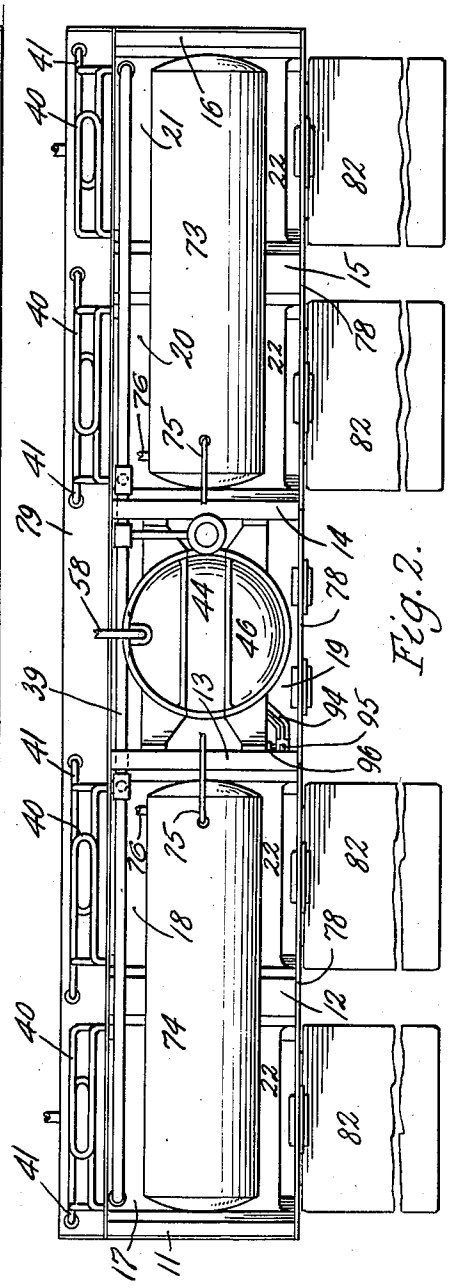


Fig. 2.

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Oct. 19, 1943. T. F. STACY 2,332,023

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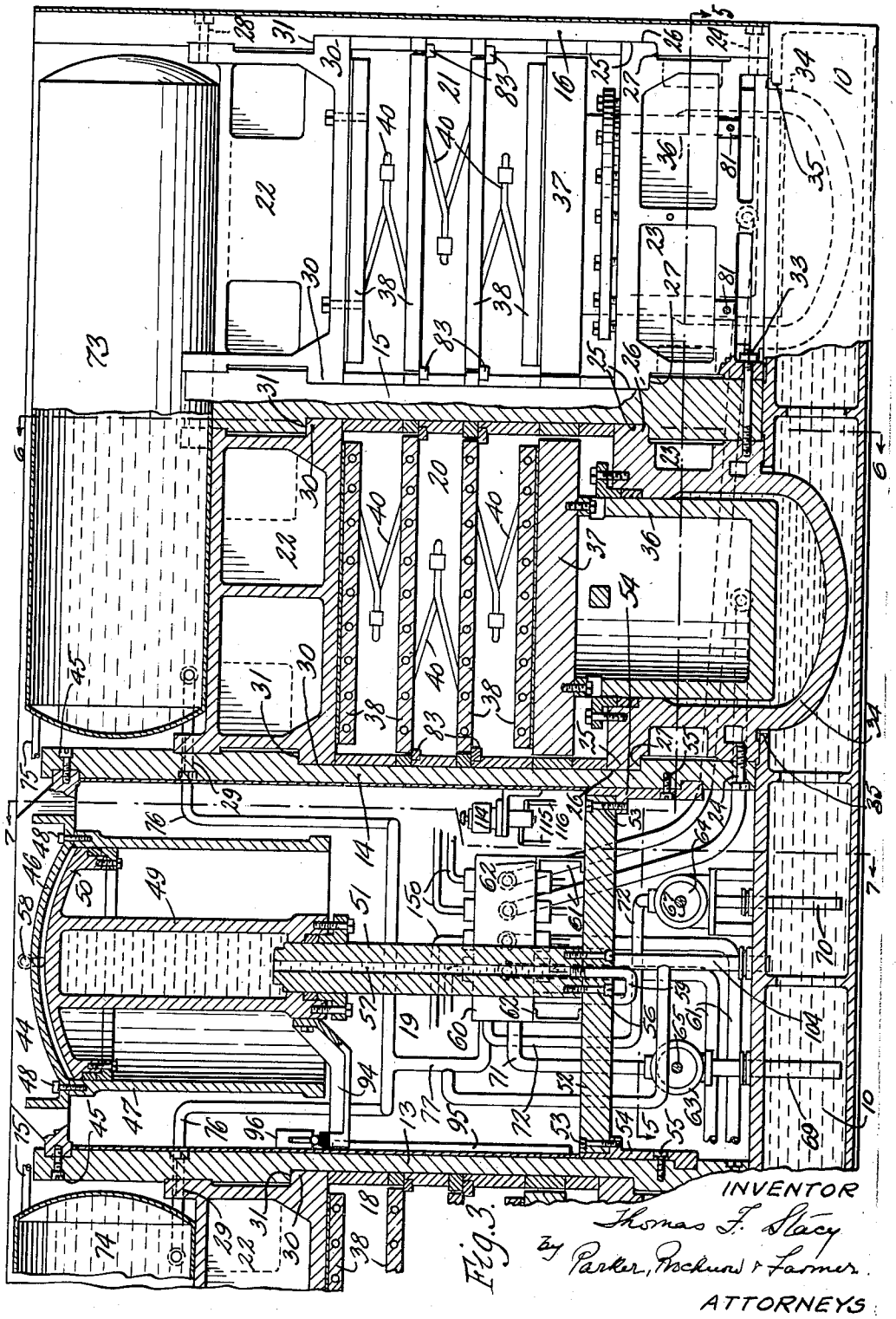


Fig. 3.

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MULTIPLE PRESS UNIT

Filed April 5, 1940 6 Sheets-Sheet 3

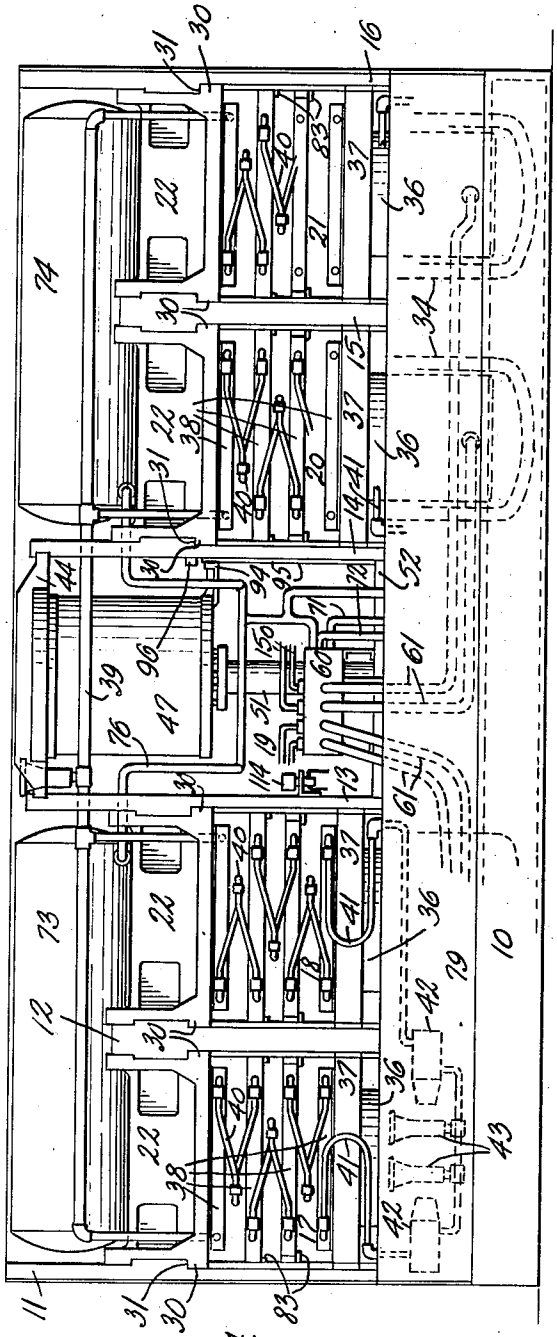


Fig. 4.

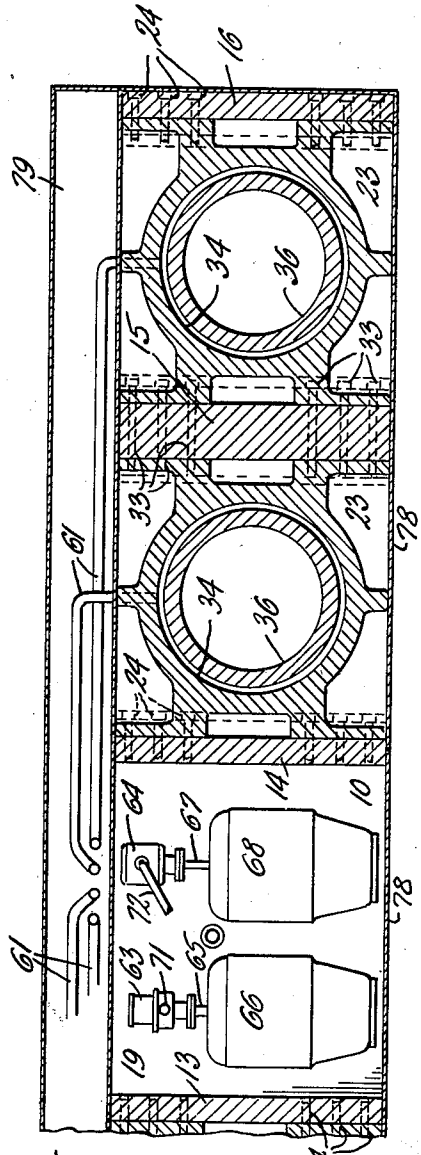


Fig. 5.

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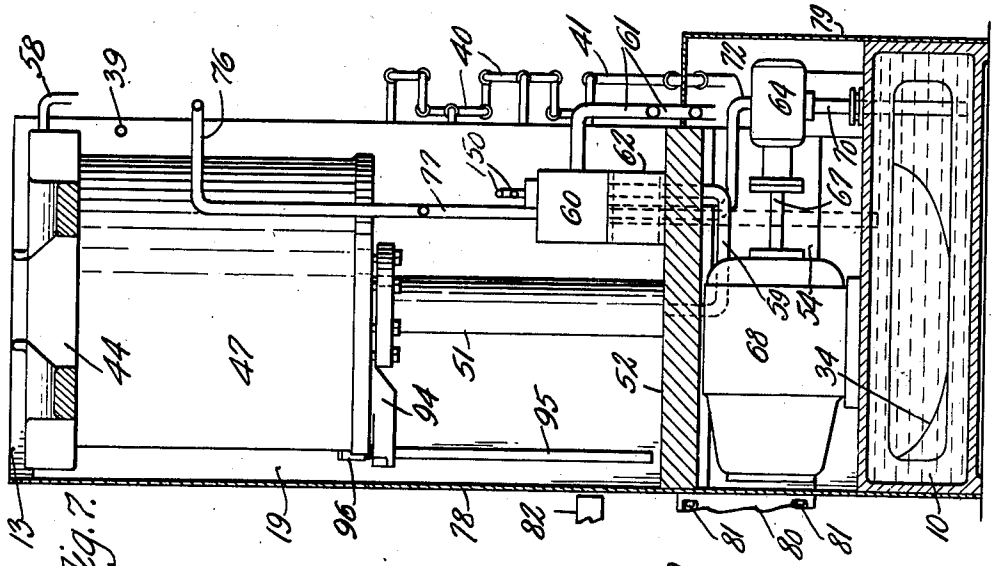


Fig. 7.

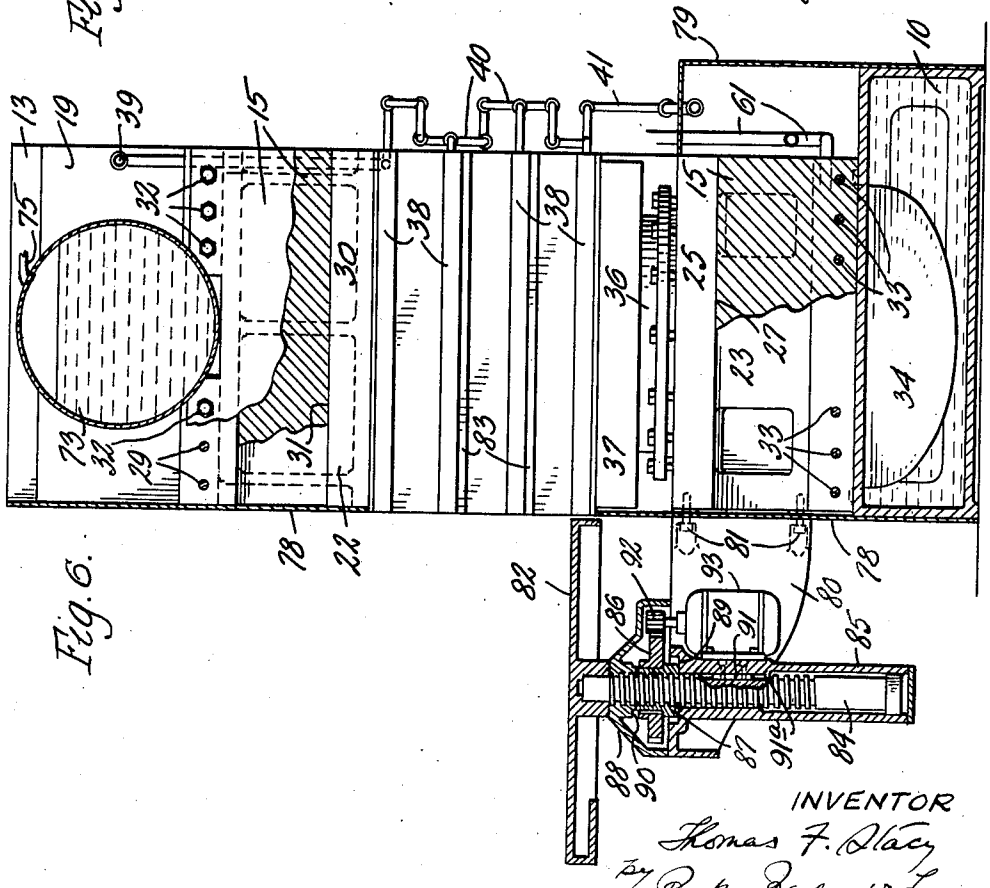


Fig. 6.

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MULTIPLE PRESS UNIT

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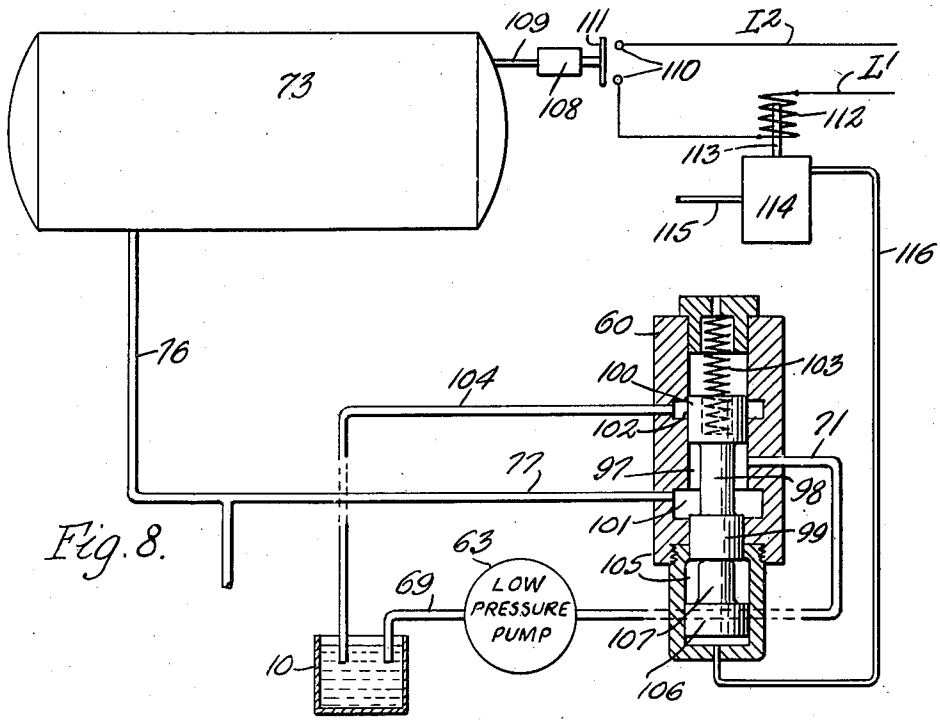


Fig. 8.

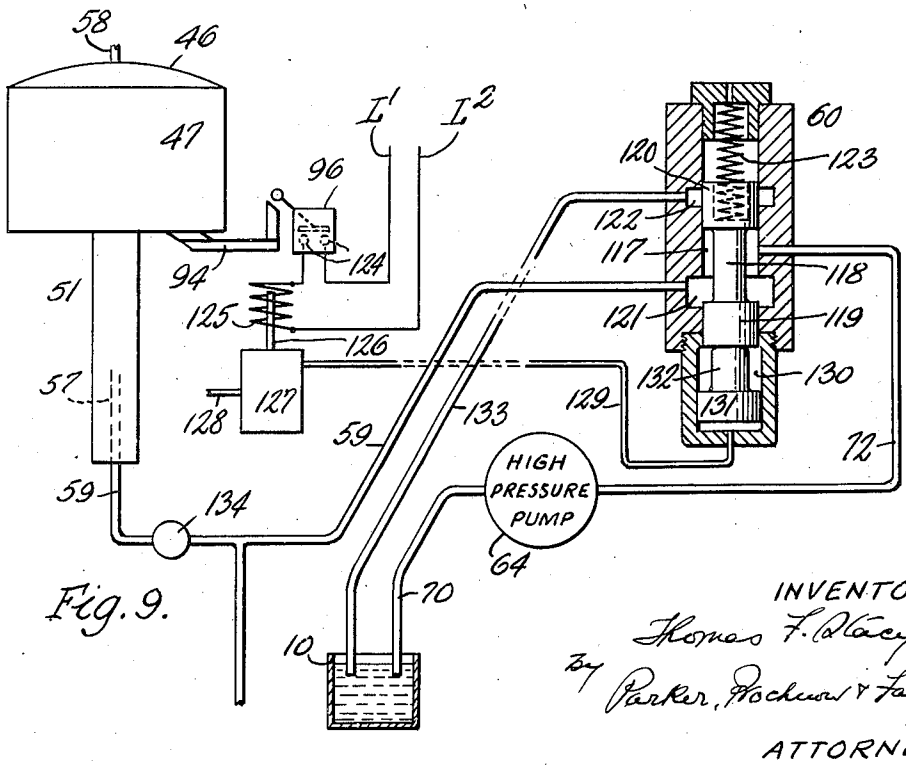


Fig. 9.

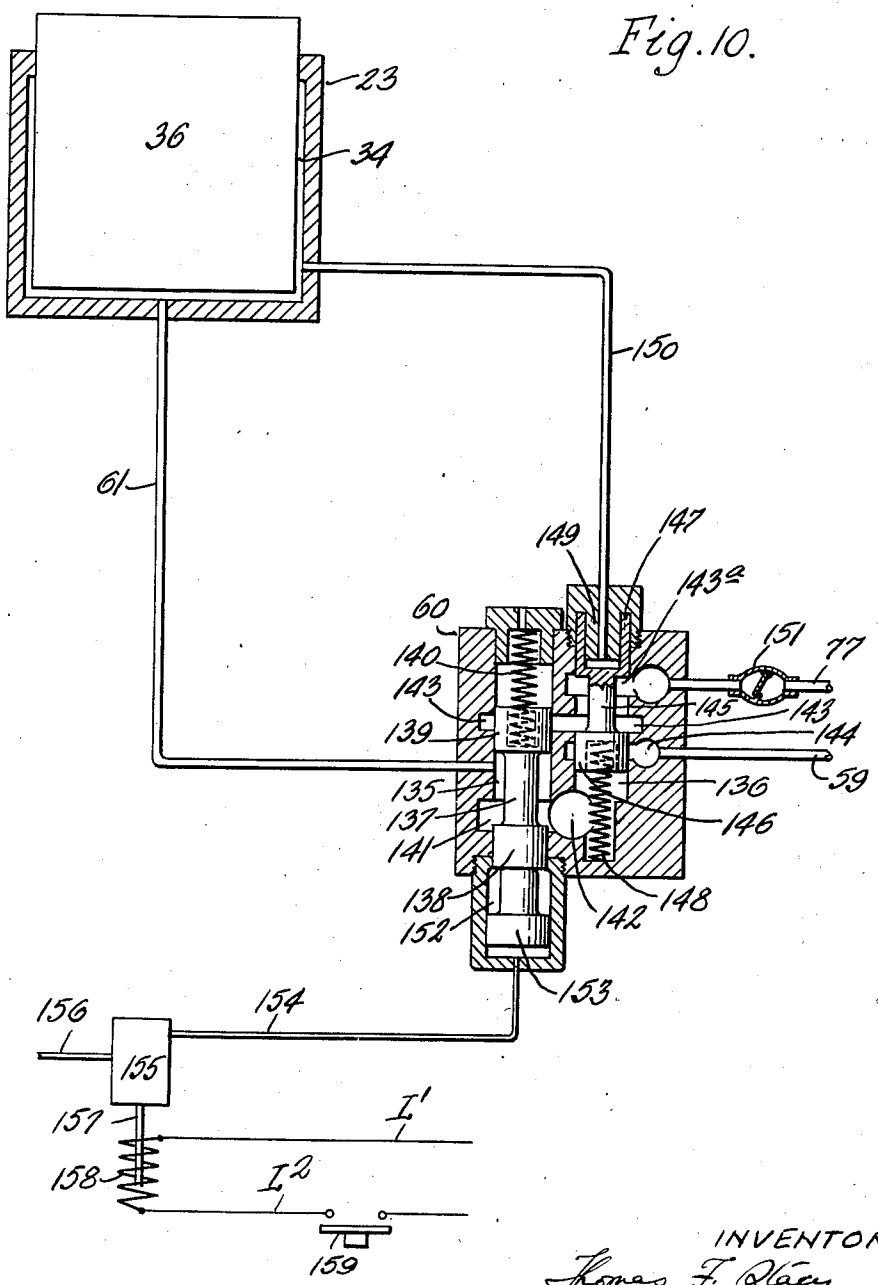
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MULTIPLE PRESS UNIT

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Fig. 10.



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UNITED STATES PATENT OFFICE

2,332,023

MULTIPLE PRESS UNIT

Thomas F. Stacy, Piqua, Ohio, assignor to The French Oil Mill Machinery Company, Piqua, Ohio

Application April 5, 1940, Serial No. 328,059

11 Claims. (Cl. 100—71)

This invention relates to multiple press units and particularly to a unit battery of a plurality of hot plate presses of the side plate type of construction.

An object of the invention is to provide an improved multiple press unit which is largely self-contained within its overall limits, with which there will be a minimum of piping, a maximum capacity within minimum overall dimensions, with which various parts will be easily accessible, and which will be relatively simple, compact, durable and inexpensive.

Another object of the invention is to provide an improved unit construction for a plurality of side plate presses, which will provide for maximum capacity in a minimum of space, which will have all of the advantages of accumulator operated presses, with which large pumps and accumulators are unnecessary, which is largely self-contained as to operating power, and with which all the presses making up the unit are easily accessible for operation and servicing.

Another object of the invention is to provide improved means for maintaining a supply of both low pressure and high pressure operating fluids with relatively small pumps and motors and relatively simple controls.

Various other objects and advantages will be apparent from the following description of one embodiment of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a front elevation of a multiple press unit constructed in accordance with this invention;

Fig. 2 is a plan of the same;

Fig. 3 is a front elevation, on a larger scale, of a portion of the same, and with portions thereof in vertical section to illustrate interior details of construction;

Fig. 4 is a rear elevation of the unit of Fig. 1;

Fig. 5 is a sectional plan of a portion of the same, with the section taken approximately along the line 5—5 of Fig. 3;

Fig. 6 is a transverse sectional elevation through the same, the section being taken approximately along the line 6—6 of Fig. 3;

Fig. 7 is another transverse, sectional elevation through the same, but with the section taken approximately along the line 7—7 of Fig. 3;

Fig. 8 is a diagram illustrating the manner in which low pressure operating fluid is automatically stored for future use during periods of inactivity of the different presses of the unit;

Fig. 9 is a diagram illustrating the manner in which high pressure operating fluid is automatically stored for future use of the various presses individually, during periods of inactivity of the presses; and

Fig. 10 is a diagram illustrating the manner in which the different presses are controlled from the sources of low and high pressure.

In the illustrated embodiment of the invention, the improved unit comprises a flat, hollow base 10 which serves as a reservoir for the actuating fluid. Upon the upper face of this base the various presses are arranged in a row. For this purpose a plurality of heavy, upstanding plates 11, 12, 13, 14, 15 and 16 (Fig. 4) are disposed on end upon the upper face of the hollow base 10, and in parallel, spaced relation to one another, the plates being arranged in a row along the base with the planes of their faces disposed crosswise of the length of the row. The adjacent plates form between them a plurality of chambers or spaces 17, 18, 19, 20 and 21. Press heads 22 are disposed across the upper parts of certain of these spaces, such as the spaces 17, 18, 20 and 21, and cylinder heads 23 are similarly disposed in the same spaces across the lower portions thereof. The cylinder heads are connected to the adjacent plates in any suitable manner such as by screws 24 (Fig. 3) which pass through the end plates 11 and 16 and the intermediate plates 13 and 14 into the adjacent cylinder heads.

The cylinder heads adjacent their upper ends or faces are provided with ribs 25 along the sides which are notched into recesses 26 in the adjacent faces of the side plates so as to engage against shoulders 27 on the side plates. Similarly the press heads 22 are secured to the adjacent plates by screws 28 (Fig. 3) which pass through the end walls 11 and 16 into the press heads 22 in the end spaces 17 and 21, and by screws 29 which pass through the intermediate plates 13 and 14, defining the space or chamber 19, into the adjacent press heads 22. The press heads adjacent their undersfaces are provided with ribs 30 which run horizontally along the sides of the heads from front to rear, and these ribs are also notched into the adjacent faces of the side plates defining that space or chamber so as to engage against shoulders 31 on the side plates. The engagement of the ribs 25 and 30 with the shoulders 27 and 31 respectively thus resists separation of the press heads and cylinder heads during pressing operations, the operating stresses being taken up by the heavy side plates into which the heads are notched. Similarly the remaining intermediate

plates 12 and 15 are connected to the adjacent press heads 22 by screws or bolts 32 (Fig. 6) which pass through upstanding flanges on the upper ends of the press heads 22 and through the upper ends of the plates 12 and 15 respectively. The flanges on the press heads which extend along the common walls 12 and 15 lie flat against opposite faces of these plates 12 and 15, and are coupled thereagainst by these screws 32.

Similarly the cylinder heads are coupled to these intermediate walls 12 and 15 by screws or bolts 33 (Figs. 5 and 6). It will be noted that all of the screws or bolts which secure the press heads and cylinder heads to the side plates of each press are spaced substantially from the ribs 25 and 30 for reasons disclosed in my prior U. S. Patent No. 2,013,587. Each cylinder head is provided with a depending cylinder portion 34 (Fig. 3) and the upper flat face of the reservoir is provided with correspondingly located openings 35 to receive these depending portions 34. This serves to reduce the overall height of the complete unit. In each cylinder head I mount a ram or piston 36 which reciprocates vertically toward and from the press head 22 in that chamber or space.

A platen 37 is mounted on the outer or upper end of each ram, and the usual heated plates 38 may be disposed on the platen, the underface of the head 22 and also, if desired, at intermediate points between them when the ram is in open position, as usual in the hot plate type of press. These plates 38 are supplied with a heating medium in any suitable manner, but in the particular example shown, steam is supplied through a common supply pipe 39 with a branch leading to each plate 38 that abuts the underface of each press head 22, as shown in Fig. 4. All of these plates 38 in each unit are connected to one another vertically in succession by flexible, or hingedly connected, pipes 40 arranged at the rear of each press, and the lowermost plate 38 for each press which rests on the platen 37 is connected by a flexible pipe 41 to a condensation trap 42, there being a condensation trap for each press space. These condensation or steam traps 42 are connected to discharge to any suitable source through temperature control valves 43 (Fig. 4).

The plates 13 and 14 which define the central chamber 19, and the end walls 11 and 16 extend to a greater height than the other intermediate walls 12 and 15, and the upper ends of the intermediate plates 13 and 14 are connected by a rigid frame member 44 (Figs. 3 and 4), this frame member being notched into the upper ends of the plates 13 and 14 and secured therein in any suitable manner such as by the screws 45. The frame member 44 includes as an interior part thereof a dome shaped section 46 with a downwardly concave face, and a cylinder 47 is secured to the underface of this dome shaped portion 46 in any suitable manner such as by screws 48. The dome 46 and the cylinder 47 together constitute a major cylinder of a hydro-pneumatic accumulator. The lower end of the cylinder 47 is open and a smaller cylinder 49, having an enlarged head 50 which acts as a piston, reciprocates in the cylinder 47. The smaller cylinder 49 reciprocates over the free upper end of a tubular stem 51 which is secured to and is upstanding from a frame member 52 that extends across between the plates 13 and 14 adjacent their lower ends.

The member 52 is secured, as by screws 53, to bracket members 54, which are in turn clamped to the adjacent faces of the plates 13 and 14, as by screws 55. The stem 51 is conveniently secured to the frame member 52 by screws 56. The stem 51 is provided with a passage 57 from end to end thereof and opening downwardly through the frame member 52 and upwardly into the chamber within the cylinder 49. A pipe 58 opens downwardly through the dome 46 into the interior of the cylinder 47 above the head 50, and this pipe 58 is connected to any source of suitable continuous pressure, such being floated into a shop air line of any suitable pressure (such as one hundred pounds or more) so that such pressure will be continuously supplied to the interior of the cylinder 47 above the head 50. This pressure tends to force the piston head 50 downwardly, and such downward movement will in turn force the actuating fluid contained in the interior of the cylinder 49 outwardly through the passage 57. A pipe 59 connects the lower end of the passage 57 with a valve 60 which distributes the displaced actuating fluid selectively and individually to the cylinder heads through pipes 61, there being an individual pipe 61 leading from the valve 60 to each cylinder head. The valve 60 is suitably mounted on the frame member 52 such as on beams 62 (Fig. 3).

The valve 60 has a plurality of individual valve mechanisms incorporated in a common valve housing, and also provides for the delivery of actuating fluid under pressure into the cylinder 49 through the passage 57 at intervals in a manner which will be explained later herein. Also disposed in the chamber 19 between the plates 13 and 14 but preferably below the frame member 52 are a low pressure pump 63 and a high pressure pump 64. The pumps 63 and 64 may be of any suitable type such as are commonly used in hydraulic press systems. The moving element of the pump 63 is coupled to the shaft 65 of an electric motor 66, so as to be directly and continuously driven thereby, and similarly the high pressure pump 64 is directly coupled to the shaft 67 of an electric motor 68 so that the pump 64 will be directly and continuously driven by the motor 68. The motors 66 and 68 are arranged side by side as shown in Fig. 5 in the chamber 19. The low pressure pump 63 is connected at its intake side by a pipe 69 to the chamber of the base 10 forming the reservoir for the hydraulic system, and similarly the intake side of the high pressure pipe 64 is connected by a pipe 70 to the reservoir in the base. The output side of the low pressure pump 63 is connected by a pipe 71 to the valve 60, and similarly the output side of the high pressure pump 64 is connected by a pipe 72 to the valve 60.

A low pressure tank or accumulator 73 is disposed above the press heads 22 of the press spaces 20 and 21 (Fig. 3) and across the relatively lower common plate 15 between those spaces, the tank being supported upon the press heads and the upper edge of the plate 15. Inasmuch as the plates 14 and 16 extend to a greater height than the plate 15 a space is provided above the press heads 22 between the plates 14 and 16 to receive this tank 73. A tank 74 is similarly mounted above the press heads 22 for the spaces or chambers 17 and 18 (Figs. 3 and 4). These tanks are of the hydro-pneumatic type in that they have a gas chamber in the upper part thereof which is compressed by the injection of liquid under pressure. Inasmuch as the tanks 73 and 74 act together as a common, low pressure accumulator their upper parts are con-

livery through the pipe 59 to the accumulator is prevented. The high pressure pump then circulates the actuating fluid idly back to the reservoir in the base 10, but as soon as the accumulator operates to deliver a high pressure fluid to one of the press cylinders the cylinder 49 (Fig. 3) will fall and carry the arm 94 downwardly, and this will release switch 96 and cause an opening of the circuit to the solenoid 125.

The valve 127 then automatically operates to cut off communication between the pipes 128 and 129 and to vent the pipe 129, which releases the pressure on the pilot piston 131. The spring 103 then shifts the valve element 118 back into the full line position of Fig. 9, where it closes the port 122 to the by-pass and reconnects the pipe 72 from the high pressure pump to the pipe 59 leading to the high pressure accumulator, so that the pump will then immediately start restoring to the accumulator a high pressure operating fluid. If desired, a choker check valve 134 may be included in the pipe 59 leading to the stem 51, so that when the accumulator is delivering fluid under pressure, the maximum rate at which it can be delivered will be restricted by the degree to which the valve 134 chokes the flow in that direction. When the flow, however, is from pipe 59 into the high pressure accumulator the choker valve automatically swings to open position so as to pass the fluid into the accumulator without material restriction on the rate of flow.

Referring now to Fig. 10 of the drawings, the valve control for one of the press cylinders is illustrated, and it will be understood that there is a similar valve arrangement in the main valve 60 for each one of the press cylinders, connected by a pipe 61 to the particular, related press cylinder. For each such valve assembly, the valve 60 has a valve chamber 135 and beside it another valve chamber 136. In the chamber 135 is a valve element 137 having spaced lands 138 and 139. A compression spring 140 acting between one end of the chamber 135 and the valve element 137 urges the latter into the full line position shown in Fig. 10. The chamber 135 has a port 141 leading to an exhaust passage 142, and another port 143 leading to a correspondingly designated port in the chamber 136. When the valve element 137 is in the full line position shown in Fig. 10, the land 139 covers and closes the port 143 and the land 138 uncovers the exhaust port 141. When the valve element 137 is shifted (upwardly in Fig. 10) against the action of spring 140, the land 139 uncovers port 143 that leads to the other chamber 136, and the land 138 covers and closes the exhaust port 141. The chamber 136 also has a port 144 connected to the high pressure line 59 from the bypass valve, and another port 143a connected to the pipe 77.

In the chamber 136 is a valve element 145 which has a land 146 operable, when the valve element is in the full line position in Fig. 10, to close the high pressure inlet port 144. The valve element 145 also has another land 147 which, when in the full line position of Fig. 10, uncovers the low pressure inlet port 143a. A spring 148 acts between the wall of the chamber 136 and the land 146 so as to urge the valve element 145 into the full line position of Fig. 10. The upper land is tubular and reciprocates over a stem 149, into the interior of which opens a pipe 150 leading from that press cylinder 23 to which the pipe 61 from the related chamber 135 is connected, so that when a predetermined pressure is built up in the cylinder head 23 to which this valve assembly is connected, the pressure from that cylinder will be transmitted to the interior of the stem 149 so as to force the valve element 145 downwardly and carry the land 147 into closing engagement with the port 143a and move the land 146 into a position to uncover the high pressure inlet port 144, leaving port 143 in chamber 136 open.

In order to prevent a short circuit between the high and low pressure ports when the valve element 145 is moved in this manner, I also preferably insert in the low pressure line 77 a free check valve 151 which opens to pass low pressure to the port 143a and closes automatically to prevent reverse flow. A pilot valve chamber 152 is provided at the lower end of each valve chamber 135, and a pilot piston 153 is mounted in this pilot cylinder or chamber 152 for movement by fluid pressure on the full end of piston 153 in a direction to move the valve element 137 against the action of the spring 140 and into a position in which the land 138 closes the exhaust port 141 and the land 139 uncovers the port 143. The actuating fluid is supplied to the closed end of pilot cylinder or chamber 152 by a pipe 154 leading to a solenoid operated hydraulic valve 155. A pipe 156 leads from the valve 155 to a suitable source of actuating fluid under pressure, such as to the air line of the shop, and when the valve 155 is operated, it connects the pipe 156 to the pipe 154, and the fluid passing therethrough operates the pilot piston 153 to shift the valve element 137 into a position in which land 138 closes the exhaust valve and the land 139 uncovers the pipe 61 leading to the press cylinder and connects it to the port 143, and thence to the low pressure inlet pipe 77.

When this happens, fluid under low pressure flows from pipe 77 to the pipe 61, and the operation of that particular press is initiated. When the pressure in the related cylinder head 23, as transmitted through the pipe 150 to the stem 149, is sufficient to overcome the action of spring 148, the valve element 145 is moved out of the full line position shown in Fig. 10 (which would be downwardly in Fig. 10) so that the land 146 uncovers the high pressure inlet port 144, and the land 147 covers the port 143a. This cuts off the flow of low pressure at the port 143a a moment after the land 146 uncovers the high pressure inlet port 144, so that the high pressure fluid entering from the hydro-pneumatic accumulator through the pipe 59 will pass into the chamber 136, thence through port 143 into the chamber 135, thence through the chamber 135 and the pipe 61 that opens into the chamber 135 between the ports 143 and 141. The high pressure fluid is then supplied to the press cylinder, and the closing of the low pressure port 143a prevents the passage of the high pressure fluid back through the low pressure inlet pipe 77, this reverse flow being also prevented by the check valve 151. The travel of the press under high pressure then continues until the valve 155 is reversed.

When the valve 155 is reversed so as to relieve the pressure from the pipe 154 and vent the latter, the pilot piston 153 releases the valve element 137 and the spring 140 then returns the valve element 137 to the full line position in Fig. 10 in which the land 139 closes the inlet port 143 and the land 138 uncovers the exhaust port 141. This releases the pressure in the related press cylinder 23 and the ram in that cylinder starts to descend. The valve 155 may be operated in any

suitable manner, one form of control being disclosed and claimed in my copending application Serial No. 297,335 filed September 30, 1939, which provides for a "bumping" operation of each press, and inasmuch as the details of one control of the valve 155 are covered in said copending application, no reference thereto is made at this time. Instead, a simple circuit is disclosed in which the valve 155 is operated by a core 157 of a solenoid 158 which is connected across line wires L^1 and L^2, with a controlling switch 159. By closing or opening the switch 159, the valve 155 may be operated. The control of switch 159 may be automatic or manual as desired.

It will be observed that a plurality of side plate presses have been brought together in a compact, self-contained unit with all of the advantages of an accumulator operated press, and with maximum capacity for the relatively small space occupied by the unit. All of the operating parts are readily available for servicing, and the several presses of the unit are served by one low pressure pump and one high pressure pump, both relatively small and motor driven. By using the small pumps operating continuously, and storing the energy so developed, all of the advantages of the accumulator system are available in a small compact unit, and relatively small motors and pumps may be employed. Assembling the side plate presses together in this manner makes possible a considerable saving in parts, because many parts are common to several or all of the presses. It will also be observed that the connections for the supply of heat to the various hot plates, and the piping are disposed in the rear, so that the press unit is not only compact but attractive in appearance. The gauges and control members for each press are also arranged on the front, so as to be in convenient positions for anyone operating any particular press of the unit.

It will be obvious that various changes in the details and arrangement of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention, as expressed in the appended claims.

I claim as my invention:

1. A hydraulic press unit, comprising a base, a plurality of relatively heavy flat plates disposed in upright positions on said base, spaced apart in parallel positions across the surface of said base, a press head disposed between and secured to adjacent plates in each of a plurality of the spaces between the spaced plates, a cylinder head also disposed between and secured to adjacent plates in each of the same spaces between plates in which said press heads are disposed but with the cylinder heads spaced from the press heads, a ram mounted in each cylinder head for movement toward and from the press head in each of said same spaces between adjacent plates, a high pressure accumulator in another one of said spaces which is free of a press ram, motor driven pumping means and controlling valve means also disposed in said another space, a low pressure tank disposed above said press heads between certain of said plates, and connections between said pumping means, valve means, tank and accumulator to form a hydraulic circuit for selective, independent and individual operations of each of said rams at any time.

2. A hydraulic press unit comprising a base, a plurality of parallel, upstanding, heavy plates spaced apart along said base, a plurality of press heads disposed each in a space between adjacent plates, a plurality of cylinders each disposed in one of said spaces in which a press head is disposed but spaced from the press head in that space, a ram in each cylinder operable toward and from the press head in that same space between plates, means for anchoring said press heads and cylinders to the adjacent plates with those plates serving as the stress members connecting the heads and cylinders in each of said spaces in which the press heads are disposed, a high pressure accumulator disposed in another of said spaces which is free of said press rams and tied to and rigidly connecting the plates defining said another space at vertically spaced points in that space, pumping means and valve means disposed in said another space, and means connecting said cylinders, valve means and pumping means in a hydraulic circuit by which individual and independent operation of each of said rams may be selectively initiated at any time.

3. A hydraulic press unit comprising a base, a plurality of parallel, upstanding, heavy plates spaced apart along said base, a plurality of press heads disposed each in a space between adjacent plates, a plurality of cylinders each disposed in one of said spaces in which a press head is disposed but spaced from the press head in that space, a ram in each cylinder operable toward and from the press head in that same space between plates, means for anchoring said press heads and cylinders to the adjacent plates with those plates serving as the stress members connecting the heads and cylinders in each of said spaces in which the press heads are disposed, a high pressure accumulator disposed in another of said spaces and tied to and rigidly connecting the plates defining said another space at vertically spaced points in that space, pumping means and valve means disposed in said another space, and means connecting said cylinders, valve means and pumping means in a hydraulic circuit by which individual operation of said rams may be independently and selectively initiated, said base being hollow and connected in said hydraulic circuit to serve as a reservoir therefor.

4. A hydraulic press unit comprising a hollow base having a reservoir for the storage of operating fluid, a plurality of parallel, upstanding heavy plates spaced apart along the top of said base, a plurality of press heads, each disposed in the upper part of a space between adjacent plates, a plurality of cylinder heads, each disposed in the lower part of a space between adjacent plates in which a press head is disposed, the cylinder heads having depending cylinders and said base having openings in its top to receive said depending cylinders, fastening means connecting said heads to the adjacent plates, with said plates connecting press and cylinder heads to one another in any of said spaces and preventing their separation, a ram in each cylinder operable toward and from the press head in that same space between adjacent plates, means for providing a fluid under pressure disposed in another space between adjacent plates, and an operating hydraulic circuit including said base, said cylinder heads, and also said last means, for supplying operating fluid under pressure, selectively and individually to each of said cylinder heads.

5. A hydraulic press unit comprising a base, a plurality of parallel upstanding heavy plates spaced apart upon and along said base and providing a plurality of press spaces, two adjacent intermediate plates and said end plates having

nected together by a pipe 75 (Fig. 3) and their lower parts are connected together by the pipe 76, enabling the tanks 73 and 74 to act together as a common low pressure accumulator. The pipe 76 is connected by a pipe 77 to the valve 60, and through the valve 60 it may be connected with the pipe 71 from the low pressure pump 63.

Similarly the pipe 59 leading to the valve 60 from the passage 57 of the high pressure accumulator may be connected through the valve 60 to the pipe 72 leading from the output side of the high pressure pump 64. The low pressure pump 63 thus serves to withdraw operating liquid from the reservoir in the base 10 of the unit and deliver it, when permitted by the valve 60, to the low pressure tanks 73 and 74 where it is held under pressure by the gas or air in the upper parts of the tanks 73 and 74. Similarly the high pressure pump 64 withdraws operating liquid from the reservoir in the base 10 and delivers it continuously, when permitted by the valve 60, to the cylinder 49 so as to force the latter upwardly and through the head 50 displace the air from the cylinder 47 into the shop air line through pipe 58. This insures a continuous storing of both high and low pressure actuating liquids for delivery in proper sequence to the various cylinder heads individually and selectively in a manner which will be explained more fully hereinafter.

The forward edges of the upstanding plates 11, 12, 13, 14, 15 and 16 are approximately in the plane of the forward vertical face or edge of the base 10, and the entire front of the base and the spaces between the upstanding plates 11 to 16 inclusive are covered by removable plate sections 78 (Figs. 1, 5, 6, 7) except that the plate sections 78 do not cover those portions of the openings in the press spaces between the press heads and platens, as shown in Fig. 1, so that except for the openings to the pressing spaces between the platens and press heads, the front of the structure is substantially covered by the plate sections 78. The base 10 extends rearwardly from the front plates 78 to an extent greater than the upstanding plates 11 to 16 inclusive, as shown clearly in Figs. 2, 5 and 6, and a box-like housing 79 (Fig. 6) is disposed against the rear vertical edge face of the base 10 so as to extend upwardly for a suitable distance such as approximately to the level of the upper ends of the cylinder heads 23 and then forwardly approximately to the rear edges of the upright plates 11 to 16 inclusive. This housing 79 is removable and it provides between it and the cylinder heads and the rear edges of the upstanding plates 11 to 16 inclusive, a chamber in which the piping from the central chamber or space 19 to the different cylinder heads may be enclosed. Within the same housing the pipes 42 from the lowermost of the plates 38, the condensation traps 42 and the temperature control valves 43 may also be disposed as well as other auxiliary equipment.

Where elevators are desired for each press, such an elevator may be mounted on a bracket 80 (Fig. 6) in any suitable manner such as by screws 81 which pass through the sides of the bracket and the front plates 78 into the adjacent cylinder head 23. Each elevator includes a platform 82 which may be elevated and lowered into positions at different levels in front of the related opening between the platen and the press head as usual in hot plate presses, it being understood of course that the hot plates 38, except those secured to the platens and the press heads, are supported in intermediate positions on ledges or lugs 83 (Figs. 1 and 3) as usual in this type of press, so that when the platen 37 moves upwardly with objects between the plates 38, the plates 38 will be picked up in succession and the entire group pressed against one another and the related press head 22. When the platen again is lowered, the intermediate plates 38 in that press will be lowered until they engage in succession with their respective lugs 83, and will be supported against further descent at their proper, predetermined positions while the other plates 38 and the platen descend.

The elevating mechanism may be of any suitable type, but in the illustrated example each platform 82 is mounted upon the upper end of a vertically extending screw 84 which is received in a tubular housing 85 depending from the underface of the bracket 80. A gear 86 is fixed on a nut 87 which is disposed above bracket 80 and is threaded upon the screw or rod 84 adjacent its upper end, beneath the platform 82 and a cover 88. The nut 87 abuts at one end face against a shoulder 89 on the upper end of the housing or tube 85 and at its other end face against a shoulder 90 on the underface of the cover 88. Since the nut 87 is thus limited against movement vertically, whenever it is rotated it will shift the threaded rod 84 endwise in one direction or the other, depending upon the direction of rotation of the nut 87. The threaded rod 84 is held against rotation but guided for vertical reciprocation by a key 91 carried on the inner face of the tube 85 and received in a keyway or slot 91a extending endwise along the threaded portion of the rod 84. The gear 86 meshes with and is driven by a pinion 92 carried on the rotor shaft of an electric motor 93 which is secured in the space between the side flanges of the bracket 80 in any suitable manner such as by bolting or screwing its base to the depending tube 85. The motor 93 is of the reversible type, so that by its operation in one direction or the other it will turn the nut 87 in one direction or the other and thus shift the threaded rod 84 vertically in one direction or the other to elevate or lower the platform 82.

The cylinder 49 of the hydro-pneumatic accumulator carries an arm 94 (Fig. 3) which extends laterally therefrom and below the lower end of the cylinder 47 even when the cylinder 49 is in its uppermost position in cylinder 47, as shown in Fig. 3. The free end of this arm 94 is forked to embrace and be slidingly guided vertically by a guide strip 95 which is secured in vertical position against the plate 13 on the face thereof within the space or chamber 19. The guide 95 thus prevents the arm 94 and the cylinder 49 from rotating about the axis of the stem 51 on which the cylinder 49 reciprocates, so that the arm 94 will always pursue a definite path in its ascent and descent. A limit switch 96 of any suitable type is disposed in a position to be operated by the arm 94 when the latter reaches its uppermost, desired position, and this limit switch 96 is employed to control the admission of high pressure actuating fluid to the interior of the cylinder 49 in a manner which will be explained hereinafter.

Referring now particularly to Fig. 8, the manner in which the low pressure tanks 73 and 74 are supplied continuously with actuating fluid under desired pressure will be explained. A portion of the valve 60 connecting pipe 76 and tank 73 has a chamber 97, and a valve element 98 is mounted

for reciprocation endwise in that chamber. The valve element 98 is provided with spaced lands 99 and 100 which cover and uncover alternately the ports 101 and 102 respectively when the valve element 98 is shifted endwise. A spring 103, provided in one end of the chamber 97, is under compression and extends into a recess in the adjacent end of the valve element 98, so as to resiliently urge the valve element 98 in one direction (which is downwardly in Fig. 8) to carry the land 100 into the position in which it closes the port 102 and the land 99 into a position in which it uncovers the port 101. The port 102 is connected by a by-pass pipe 104 back to the reservoir, and the port 101 is connected to the pipe 77 which leads to the pipe 76 that connects the tanks 73 and 74. At the bottom of the valve element 60 there is an auxiliary or pilot chamber 105 which opens upwardly into the chamber 97, and in this pilot chamber 105 I provide a pilot piston 106 which has a stem 107 that abuts against the end of the valve element 98 and limits movement of the valve element 98 under the action of the spring 103 beyond that shown in Fig. 8 in which the port 102 is covered and the port 101 is uncovered. The pipe 71 from the low pressure pump 63 opens into the chamber 97 at a point between the ports 101 and 102, so as to be always in communication with the chamber 97 between the lands 99 and 100.

A pressure responsive switch 108 is connected by pipe 109 to one of the tanks such as tank 73, and when the pressure on the switch 108 exceeds a predetermined pressure for which it is set, it will operate to close a circuit between contacts 110 that are included in series in a line wire L^2, such as by carrying a conducting bridge 111 into engagement with the spaced contacts 110. The line wire L^2 after passing the switch contacts 110 is connected to one end of the solenoid 112, the other end of which is connected to the line wire L^1. The solenoid 112 has a core 113 which extends into a valve 114 that controls the flow of actuating fluid from any suitable source of fluid under pressure, such as an air line connected to the pipe 115, selectively to a pipe 116 which leads to the outer end of the pilot chamber 105. When the pressure responsive switch 108 closes the circuit between contacts 110 and through the solenoid 112, the resulting actuation of the core 113 will operate the valve 114 to connect the source of fluid under pressure at the pipe 115 to the pipe 116, and thus admit fluid under pressure to the pilot chamber 105. The pressure in that chamber then forces the piston 106 endwise and shifts the valve element 98 away from its position shown in full lines in Fig. 8 (which will be upwardly in that figure) against the action of spring 103 until the land 100 abuts against the opposite end of the chamber 97, in which position the land 100 uncovers the port 102 and the land 99 covers the port 101.

When the valve member 98 is in this last mentioned position the pipe 71 from the pump 63 will be connected directly to the by-pass 104 and cut off from the pipe 77. Then the delivery from the pump 63 will be back to the reservoir idly, with minimum load on the pump 63 and its motor, so long as the pressure in the tank 73 remains up to that predetermined pressure for which the switch 108 is set. When the pressure in tank 73 falls to a desired extent, the switch 108 will open the circuit through the solenoid 112, whereupon the valve 114 will be operated in a manner to cut off the flow of compressed fluid from the pipe 115 to the pipe 116, and will vent the pipe 116 so that the pressure on the pilot piston 106 will be released, whereupon the spring 103 will then move the valve element 98 back to the position shown in full lines in Fig. 8 where the delivery from the pump is again to the tank 63 until the pressure is again brought up to the desired extent. Thus a very simple arrangement is provided for maintaining a desired pressure in the tanks 73 and 74 with continuous operation of the low pressure pump 63.

Referring now to Fig. 9, the manner in which the high pressure operating fluid is stored in the hydro-pneumatic accumulator will now be explained. The valve 60 is provided with another valve chamber 117 which is separate from the chamber 97, and a valve element 118 is mounted for reciprocation endwise of the chamber 117. The valve element 118 also has spaced lands 119 and 120 which alternately cover and uncover the ports 121 and 122 respectively. The pipe 72 opens into the chamber 117 between the ports 121 and 122 so as always to be placed alternately in communication with the ports 121 and 122 as the valve element 118 is shifted endwise. A spring 123 acts between one end of the chamber 117 and the valve element 118 so as to resiliently urge the valve element 118 into the position shown in full lines in Fig. 9, in which position the land 120 covers the port 122 and the land 119 uncovers the port 121.

In this position of the valve element 118, the pipe 72 from the high pressure pump is connected to the pipe 59 leading to the stem 51 of the high pressure accumulator, and then through passage 57 thereof (Fig. 3) to the interior of the cylinder 49. The delivery of this fluid forces the cylinder 49 upwardly, and the enlarged head 50 on that cylinder 49 also moves upwardly in the cylinder 47 and displaces air or operating fluid from the cylinder 47 above the head 50 into the pipe 58 such as the shop air line. When the cylinder 49 reaches approximately its upper limit of movement, its arm 94 operates the limit switch 96 to complete a circuit by bridging contacts 124 provided in series in the line wire L^1 from any suitable source of current leading to a solenoid 125, the other side of which solenoid is connected to the line wire L^2. The solenoid 125 has a core 126 which is connected to the movable valve element of a valve 127 which is similar to the valve 114 of Fig. 8, and which serves to connect a pipe 128 from a suitable source of fluid under pressure, such as the shop air line, selectively to a pipe 129 leading to a pilot cylinder 130 provided at the lower end of the chamber 117.

A pilot piston 131 fits the pilot cylinder 130 and has a stem 132 which abuts against the lower end of the valve element 118 to shift the latter against the action of spring 123, which would be upwardly in Fig. 9. Thus when the limit switch 96 is operated into closed position by the arm 94, the solenoid 125 will operate the valve 127 to connect the pipe 128 from the source of fluid under pressure to the pipe 129, and thus deliver this fluid to the pilot chamber 130 where it operates the piston 131 in a manner to shift the valve element 118 against the action of spring 123 into a position in which the land 119 closes port 121 and the land 120 uncovers the port 122. The valve element 118 then connects the pipe 72 from the pump to the by-pass pipe 133 leading back to the reservoir in the base 10, and further de-

greater height than the other intermediate plates, means rigidly connecting together said pair of high intermediate plates adjacent their top and at a substantial distance below the top in the one space between said high intermediate plates, a hydro-pneumatic accumulator supported by said connecting means in said one space, press heads disposed between adjacent plates in the others of said spaces, cylinder heads also disposed in the same other spaces, a ram in each cylinder head operable toward and from the press head in that space, said press heads being each disposed adjacent the tops of the intermediate plates of lesser height, means anchoring said heads to the adjacent plates, a tank disposed above adjacent press heads between said high intermediate plates and the end plates at each side of said one space, pipes connecting the upper and lower parts of said tanks, valve means disposed in said one space, a pair of motor driven pumps disposed also in said one space and storing high and low pressure actuating fluids in said accumulator and tanks respectively, and a multiple branch hydraulic circuit having connections including said tanks, said accumulator, said valve means and said pumps, whereby low pressure from said tanks may be admitted to said rams selectively to cause initial movements thereof, and high pressure from said accumulator admitted to said rams to complete the pressing movements.

6. A hydraulic press unit comprising a hollow base having a reservoir for the storage of operating fluid, a plurality of parallel, upstanding, heavy plates spaced apart along said base on the top thereof, a spaced press head and a cylinder head with a ram disposed between and coupling two adjacent plates in each of certain of said spaces to provide a plurality of pressing units having common walls between certain of said units, with the ram of each unit operable towards and from the press head in that same space, said cylinder heads having cylinder portions depending into said base reservoir and said hollow base having in its upper wall apertures formed to receive said depending cylinder projections, means disposed in another of said spaces for supplying a source of fluid under high pressure, and a hydraulic circuit including a plurality of branches leading from said one space to said cylinder heads for causing movements of said rams selectively and individually.

7. A hydraulic press unit comprising a hollow base, a plurality of parallel, upstanding, heavy plates spaced apart along said base on the top thereof, a spaced press head and a cylinder head with a ram disposed between and coupling two adjacent plates in each of certain of said spaces to provide a plurality of pressing units having common walls between certain of said units, with the ram of each unit operable towards and from the press head in that same space, said cylinder heads having depending cylinder portions and said hollow base comprising a reservoir for operating fluid and having in its upper wall apertures formed to receive said depending cylinder projections, low pressure accumulator tanks disposed above said press heads and connected to one another at their tops and bottoms, a hydropneumatic accumulator disposed in another of said spaces, a motor driven, low pressure pump disposed in said another space and connected at its intake side to the reservoir formed in said hollow base and at its output side to said tanks, a motor driven high pressure pump also disposed in said another space and connected at its intake side to the reservoir formed in said hollow base and at its output side to said hydro-pneumatic accumulator, valve means in said another space and controlling the delivery of said pumps to said accumulator and to said tanks, and also operable to cause delivery of fluid from said tanks and accumulator selectively and individually to said cylinder heads at any time.

8. A multiple hydraulic press unit comprising a base, a plurality of upstanding heavy tension plates spaced apart upon and along said base and providing between them a plurality of unit spaces, a press head and a cylinder head disposed in spaced relation to one another in each of a number of said spaces, a ram in each cylinder head operable toward and from the press head in that space, said heads being secured to the adjacent plates between which they are disposed to form a plurality of side plate presses, means disposed in another of said spaces for supplying actuating fluid to said cylinder heads individually and selectively, and wall means covering the major portion of the front of said spaces but being apertured at the portions of the press spaces between the cylinder and press heads of that space, whereby a compact multiple unit assembly is obtained.

9. A hydraulic press unit comprising a plurality of upstanding, heavy plates disposed parallel to one another and spaced apart in a row, with the planes of the faces of said plates extending transversely of the length of the row, a press head and a cylinder head disposed in each of a plurality of spaces defined between adjacent plates, a ram in each cylinder head operable toward and from the press head in that space, said heads being connected to adjacent plates to unite them into a unit structure, a source of fluid under pressure disposed in another of said spaces, pipes leading from said another space to each of said cylinder heads and extending along the rear of said unit, plate means covering the front of said unit, said plate means being apertured between each of said press and cylinder heads of each press, and means in said another space for controlling the flow of fluid under pressure from said another space selectively and individually to said cylinder heads through said pipes.

10. A multiple unit hydraulic press of a type which occupies a minimum of floor and room space and has a relatively large capacity, which comprises a hollow base having a reservoir for the storage of press operating fluid, a plurality of parallel, upstanding, heavy plates spaced apart along said base, a plurality of press heads disposed each in a space between a pair of said plates, a plurality of cylinders each disposed in one of said spaces in which a press head is disposed but spaced therefrom, a ram in each of said cylinders mounted for movement toward and from a press head, each of said cylinders and press heads being secured to the adjacent heavy plates whereby pressing strains will be carried by said plates under tension, each of said cylinders depending into said reservoir, a high pressure accumulator tank disposed in another of said spaces free of said rams, cylinders and press heads, a low pressure accumulator tank disposed above a plurality of said spaces and adjacent the press heads therein, and hydraulic circuit means for operating said press rams individually and selectively with fluid under pressure from said accumulators.

11. In a hydraulic multiple press unit, a closed

hollow base comprising a reservoir for the hydraulic operating fluid and having spaced openings in its top wall along said base, a plurality of relatively heavy, parallel, upstanding plates spaced apart along said base between said openings and on opposite sides thereof, with an opening between each pair of adjacent plates, said plates resting at their lower edges on said base, a cylinder head disposed between each pair of adjacent plates of a plurality of said plates, in adjacent spaces between plates, and coupled to the lower ends of adjacent plates, each head having a closed cylinder end depending into said reservoir through the opening in that space between the adjacent plates and locating said plates against material displacement on said base, a press head above and spaced from each cylinder head and also coupled to the plates between which it extends, a ram in each cylinder head operable by pressure in that head toward the press head above it, and means, including a source of power and controlling mechanism disposed in another space between two of said adjacent plates, forming with said cylinders and reservoir hydraulic circuits by which said rams may be caused to advance and retract selectively and individually by power from said source under the control of said mechanism.

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