July 30, 1935. W. ERNST ET AL 2,009,487

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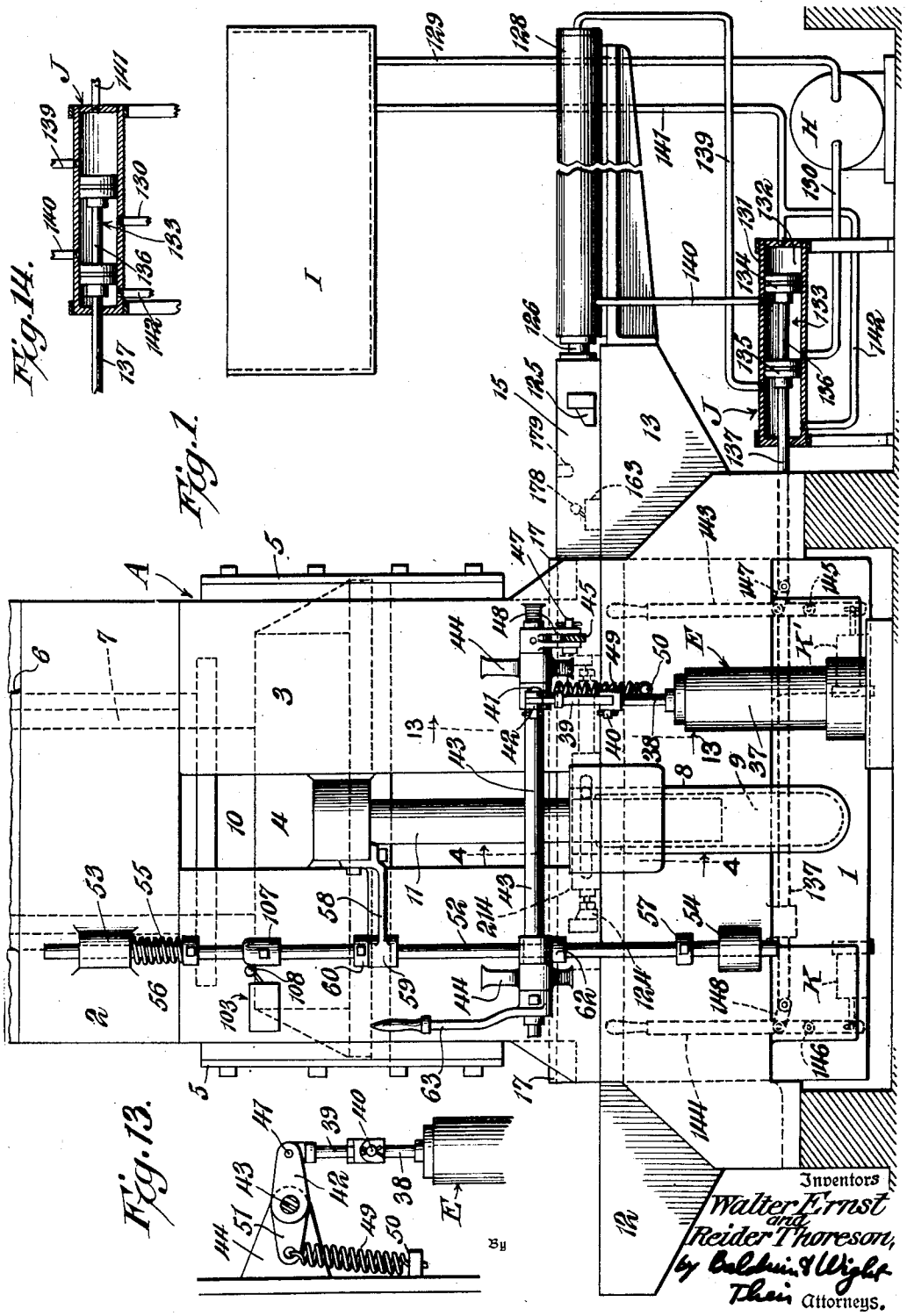

Fig. 1.

Fig. 14.

Fig. 13.

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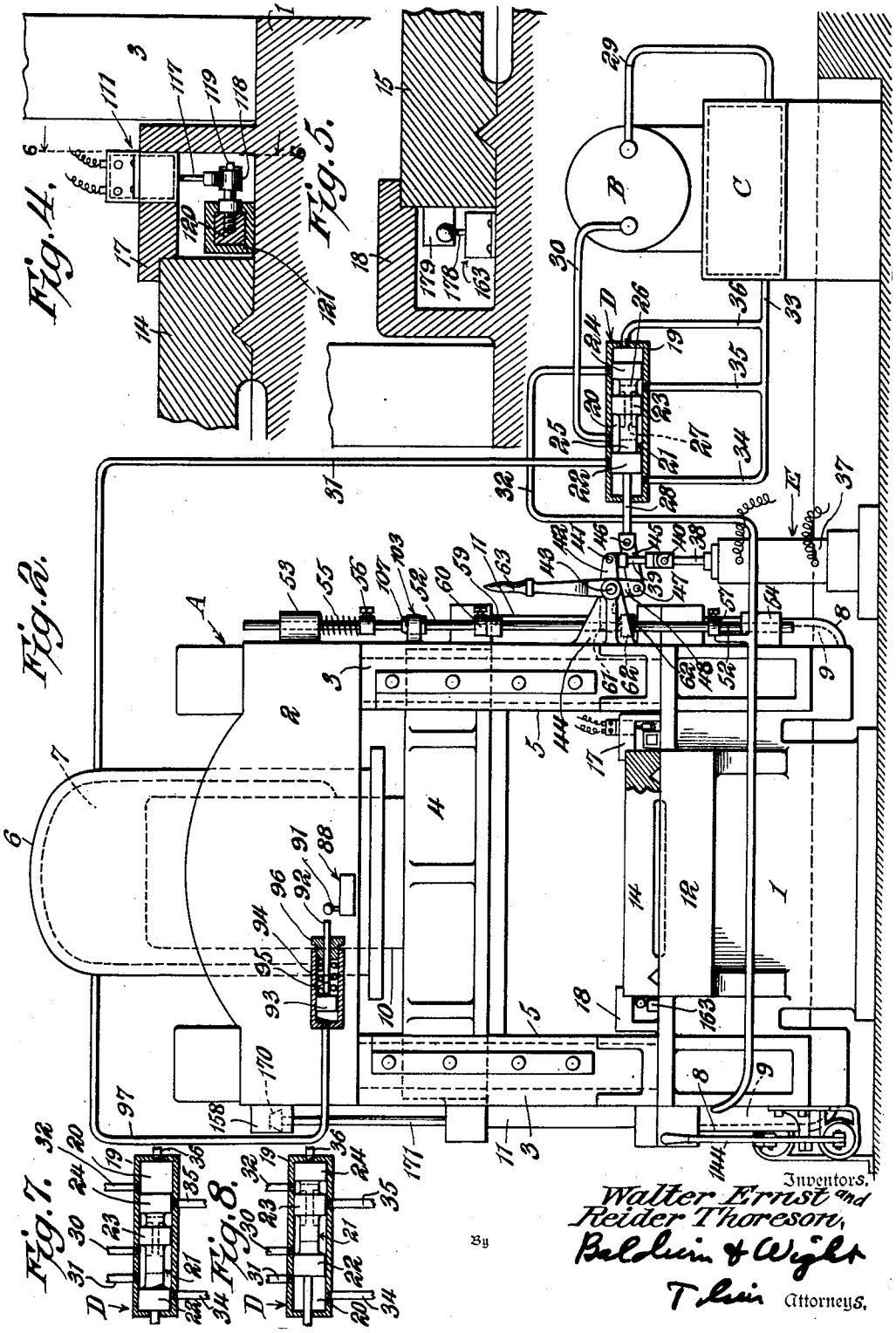

Fig. 1. Fig. 8.

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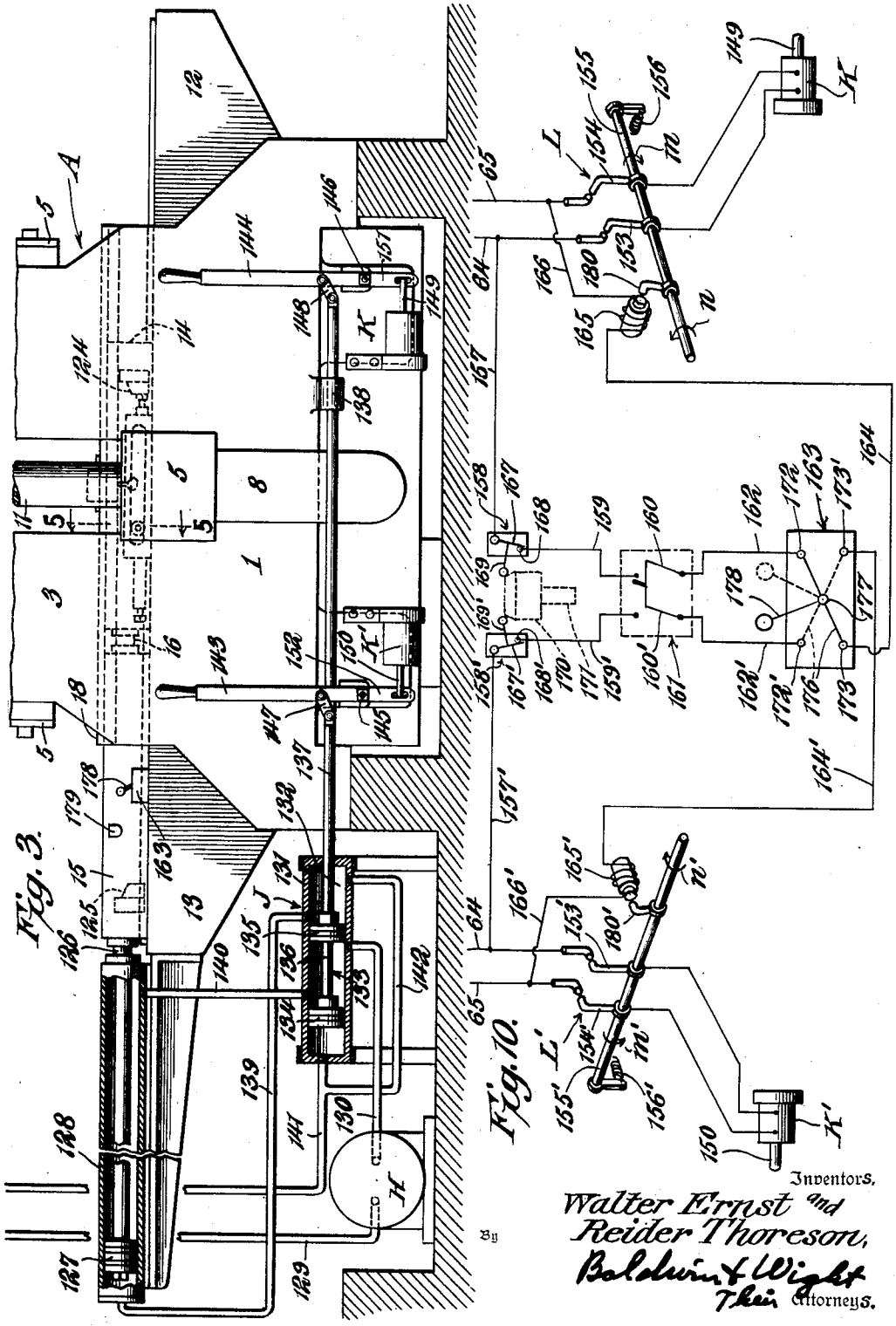

Fig. 3.

Fig. 10.

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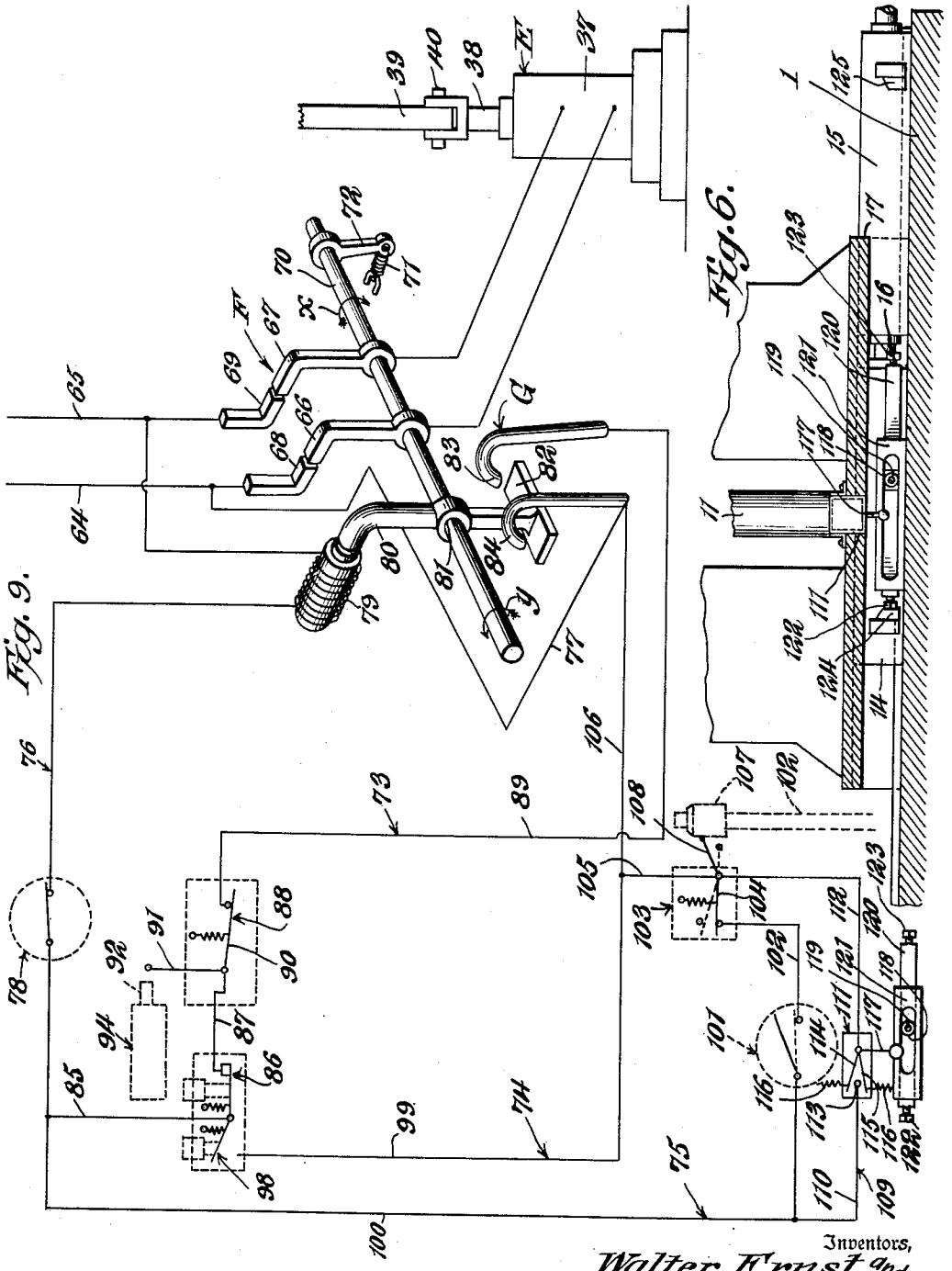

Fig. 6.

Fig. 9.

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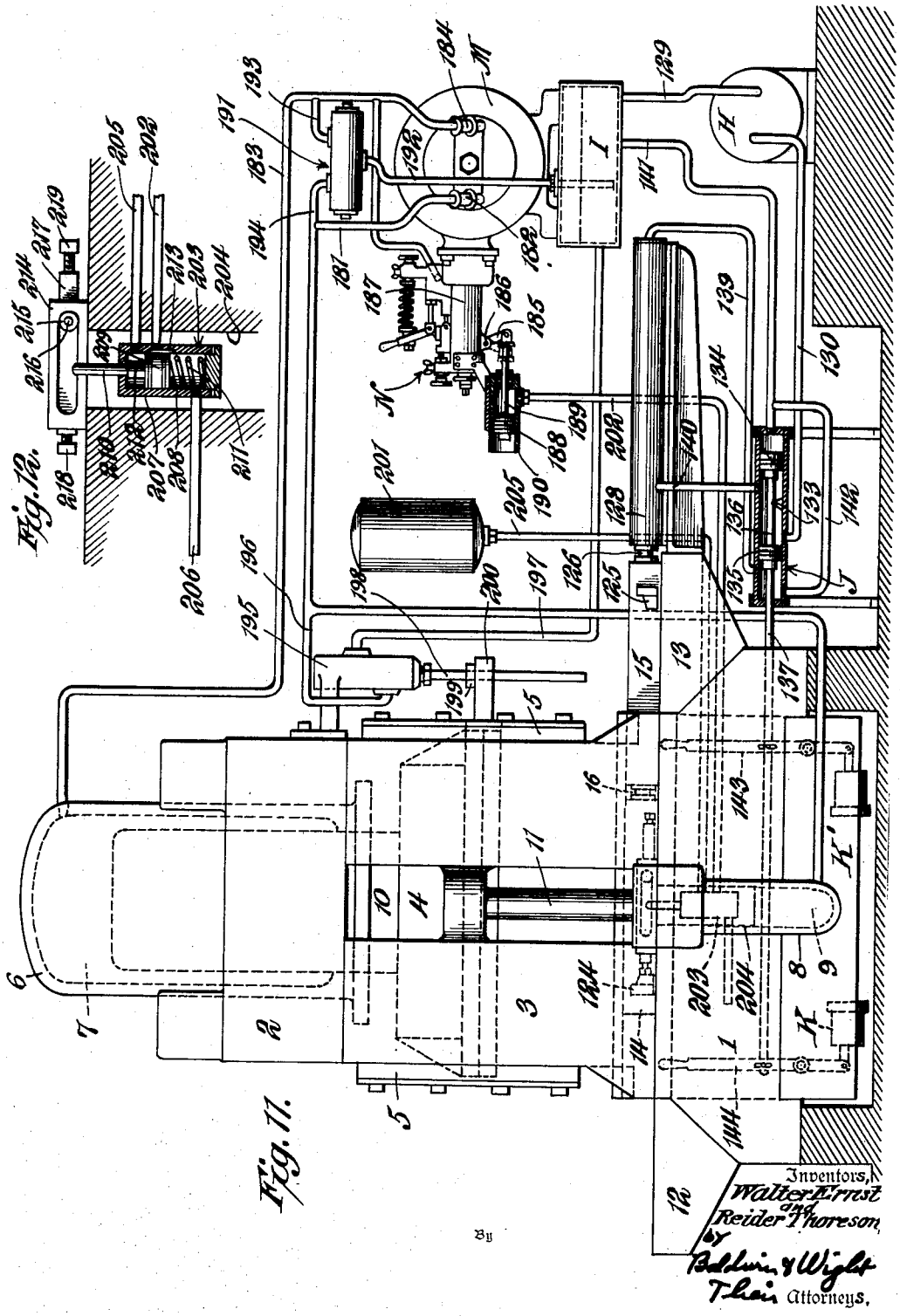

Fig. 12.

Fig. 11.

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UNITED STATES PATENT OFFICE

2,009,487

HYDRAULIC PRESS

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Application July 13, 1931, Serial No. 550,558

14 Claims. (Cl. 100—71)

This invention relates to presses or the like, and more particularly to presses of the kind provided with a reciprocatory ram equipped with a platen, die, punch, or other tool and with a table or other means for positioning material or articles to be worked upon in the path of the platen or other equipage and for subsequently withdrawing the table and positioning it accessibly for removal of the completed work and for reception of another charge of material or article to be worked upon.

Presses of this general description are well known in the art, and for an example thereof reference may be had to United States Patent 1,778,803, granted to Leslie S. Hubbert, October 21, 1930. In the press shown in the patent referred to, a platen is fixed to a hydraulic ram arranged to move the platen towards a press head for performing pressing operations. Mounted on the platen is a slidable table arranged to be moved into or out of the path of the platen by means of a hydraulic piston connected to the table. In the press shown in the patent, as well as in other presses of this general character heretofore known in the art, separate means are provided for controlling the movements of the platen, and of the slidable table. In operation, with the platen in its retracted position, a table-controlling valve is opened in order to effect application of pressure to the hydraulic piston to move the table with the work thereon into the path of the platen and subsequently a ram-controlling valve is opened to effect application of pressure to the ram to produce a pressing stroke of the platen. After the pressing stroke has been completed, the ram-controlling valve is moved to a position effecting a return of the platen to its retracted position, and then the table-controlling valve is moved to a position effecting movement of the table out of the path of the platen to permit removal of the completed work. It will be noted that to effect a complete operating cycle of a press of this kind it is necessary for the operator to make four separate settings or adjustments of the valves. The overall operating time for each cycle therefore varies in accordance with the skill of each individual operator, and, in most cases, the maximum production of which a given press is capable is not obtained.

The main object of the present invention is to provide, in a press of the general character set forth above, means controlling the movements of the work positioning table, and automatically controlling the movements of the press ram to effect a pressing stroke thereof when the table is moved into the path of the ram.

Among the several other objects of the invention are to provide means for automatically effecting a movement of the work positioning table into the path of the platen when the latter reaches the end of a return stroke; to provide means for causing the platen either to perform an indeterminate number of working strokes while the table remains in a given position or to perform only one such stroke and then to come to rest in its retracted position, as may be desired; and to provide means for readily adapting the press for operation in accordance with the varying requirements of the particular operation to be performed. Other objects will become apparent from a reading of the following description, the appended claims, and the accompanying drawings, in which:

Figure 1 is a view in side elevation of a press embodying the invention with the top of the press broken away and with certain control mechanism being shown in section;

Figure 2 is a view in front elevation of the press shown in Figure 1, certain control mechanism being shown in section;

Figure 3 is a fragmentary view in side elevation of the press shown in Figure 1, and showing the opposite side of the press from that shown in Figure 1, certain control mechanism being shown in section;

Figure 4 is a fragmentary vertical sectional view taken on the line 4—4 of Figure 1 and drawn on an enlarged scale;

Figure 5 is a fragmentary vertical sectional view taken on the line 5—5 of Figure 3 and drawn on an enlarged scale;

Figure 6 is a fragmentary vertical sectional view taken on the line 6—6 of Figure 4;

Figures 7 and 8 are vertical sectional views of a ram control valve and showing a piston valve element thereof in different positions;

Figure 9 is a diagrammatic showing of an electrical control circuit for the press ram;

Figure 10 is a diagrammatic showing of an electrical control circuit for the work positioning tables;

Figure 11 is a view in side elevation of a press embodying the invention in modified form, certain control mechanism being shown in section;

Figure 12 is a detail view in vertical section of an automatically operable air valve.

Figure 13 is a detail vertical sectional view taken on the line 13—13 of Figure 1; and

Figure 14 is a view in vertical section of a table-

controlling valve, with the piston valve thereof in a different position from that shown in Figure 1.

The invention may be embodied in various kinds of hydraulic motors, but for the purposes of illustration is shown as embodied in a hydraulic press A of the downward pressure type having a base 1, a head 2 connected to the base by means of side frame elements 3, and a platen 4 mounted in guides 5 for reciprocatory movements with respect to the base and the head. For reciprocating the platen there are provided cylinder means including a pressing cylinder 6 having a work chamber 7 and push-back cylinders 8 having return chambers 9, and ram means connected to the platen and including a pressing ram 10 mounted for reciprocation in the pressing cylinder, and return rams 11 mounted for reciprocation in the push-back cylinders 8.

The base 1 is provided with extensions 12 and 13 which project forwardly and rearwardly from the base respectively and which, together with the central or intervening part of the base, form a support for two slidable tables 14 and 15 connected together as at 16 and constrained for sliding movements into and out of the path of the platen by means of guides 17 and 18.

In operation, assuming the parts to be in the positions shown in Figures 1, 2, and 3, wherein the platen is at dwell in its uppermost position and the table 15 is positioned at the rear of the press, the operator will position the material or article to be pressed upon the table 15 and will then, in a manner to be described, cause the tables to be moved together to the left as viewed in Figure 1 and to the right as viewed in Figure 3, thereby positioning the table 15 in the path of the platen. After this the ram will be caused to descend to perform the pressing operation and to then return to its upper position. During the movement of the ram, the operator may load or change the table 14 which, it will be observed, will at this time be positioned at the front of the press over the extension 12 and accessible to the operator. To perform a pressing operation on the material thus placed on the table 14, the tables will be moved to their starting positions and the ram will be caused to operate as before. Control mechanism for effecting the desired operation of the tables and ram in accordance with various requirements will be hereinafter described.

The hydraulic circuit for operating the press ram and the means for controlling fluid flow in this circuit is similar to those shown in the patent to Walter Ernst, No. 1,927,583, granted Sept. 15, 1933. For supplying fluid under pressure to the work chamber and to the return chamber to reciprocate the platen we provide a pump B, a tank or reservoir C, a reversing ram-controlling valve D, and suitable piping forming, with the work and return chambers, the pump, the tank and the valve, a reversible flow hydraulic circuit.

The valve D includes a casing 19 formed with a valve chamber 20, and a piston valve 21 mounted for sliding movements within the casing. The piston valve comprises spaced heads 22, 23, and 24, a valve stem 25 interposed between and connecting the heads 22 and 23, and a stem 26 interposed between and connecting the heads 23 and 24. A passage 27 formed within the piston valve provides constant communication between the space defined by the valve casing and the heads 22 and 23 and the space defined by the valve casing and the heads 23 and 24. A valve rod 28 extends from the head 22 through the adjacent end of the casing 19 for connection to valve actuating means to be later described.

The piping connecting the reversing valve, the tank, and the pump to complete the reversible flow circuit includes a pump intake or suction pipe 29 respectively communicating at its opposite ends with the pump and the tank, a discharge pipe 30 communicating at one end with the pump and at its other end with the valve chamber 20, adjacent to the center thereof, a pipe 31 which connects the work chamber 7 of the main cylinder with the valve chamber at a point between the pipe 30 and the left hand end of the valve as viewed in Figures 2, 7, and 8, a pipe 32 which connects the return chambers 9 of the push-back cylinders with the valve chamber adjacent the right hand end thereof, an exhaust pipe 33 connected to the tank C and exhaust branches 34, 35, and 36 respectively, communicating with the valve chamber, as shown in Figures 2, 7, and 8.

Thus far only the press and associated hydraulic circuit have been described and no means have been described for actuating the valve D to control the movements of the platen. In order to assist in the understanding of the detailed description of the control means which is to follow, the operation of the press will be briefly set forth without reference to any particular means for shifting the valve.

Assuming that the parts are in the relative positions shown in Figures 1, 2, and 3, the pump will receive fluid through the suction pipe 29 and will discharge fluid under pressure through the pipe line 30 into that part of the valve chamber 20 then included between the valve heads 22 and 23. This fluid will then pass through the passage 27 in the piston valve to the space between the valve heads 23 and 24 and thence to tank C by means of the branch exhaust pipe 35 and the exhaust pipe 33, the pump discharge being thus by-passed so as to produce no movement of the press platen. When the piston valve 21 is moved to its extreme left hand position (the position shown in Figure 7), discharge from the pump will flow through the discharge pipe 30 into that part of the valve chamber then included between the heads 22 and 23 and thence through the pipe 31 to the work chamber 7. At this time the return chambers of the push-back cylinders will communicate with the tank C by means of the pipe 32, that part of the valve chamber then included between the head 34 and the right hand end of the valve casing, the exhaust branch 36, and the exhaust pipe 33. Fluid under pressure entering the work chamber will then move the platen downwardly to perform a pressing operation, this downward movement of the platen and consequently of the push-back rams 11 forcing from the return chambers 9 the fluid which remained therein after the termination of the preceding return stroke. When the working stroke has been completed, the valve 21 will be moved to its extreme right hand position (the position shown in Figure 8), at which time the pump will deliver fluid under pressure to the push-back cylinders by means of the discharge line 30, that part of the valve chamber then included between the heads 22 and 23, the passage 27 in the piston valve 21, that part of the valve chamber then included between the heads 23 and 24, and the pipe 32. Fluid under pressure thus delivered to the push-back cylinders will cause the platen to move upwardly which

will result in expelling from the work chamber the fluid remaining therein at the completion of the preceding working stroke, this fluid passing back to the tank through the pipe **31**, that part of the valve chamber included between the head **22** and left hand end of the valve casing, the exhaust branch **34**, and the exhaust pipe **33**. When the platen has been thus returned to its uppermost position, the valve **21** may be moved either to its Figure 7 position to start another working stroke, or to its Figure 2 position to bring the platen to rest.

From the foregoing it will be observed that the valve **21** is movable to three positions respectively to direct fluid under pressure to the work chamber **7** to effect a working stroke, or to the return chambers **9** to effect a return stroke, or to cut off fluid flow to both the work and return chambers simultaneously.

For moving the valve **21** from either its Figure 2 or its Figure 8 position to its Figure 7 position to effect a pressing stroke of the platen, we have provided electrical valve-actuating means generally designated E and comprising a solenoid **37** having a plunger **38** connected to the valve rod **28** through the medium of a link **39** pivoted at its lower end to the plunger **38** as at **40** and pivoted at its upper end as at **41** to a forked crank arm **42** secured to a rock shaft **43** journalled in brackets **44** on the side frame of the press, and a link **45** pivoted at one of its ends as at **46** to the valve rod **28** and pivoted at its other end as at **47** to a forked crank arm **48** also secured to the shaft **43**. When the solenoid is energized in a manner to be hereinafter described, the plunger **38** will be drawn downwardly which, through the link **39** and the crank arm **42**, will rock the shaft **43** in a clockwise direction. This rocking of the shaft will swing the arm **48** in a clockwise direction and will move the valve rod **28** and the valve **21** to the left to their Figure 7 positions, thus initiating a pressing stroke. It will be observed that the solenoid **37** and valve D together constitute electrically actuated flow-controlling means. Any other suitable form of electrical device having a movable element connected to the valve rod **28** may be used instead of the solenoid **37**.

For constantly urging the valve **20** to its extreme right hand or Figure 8 position, there is provided a spring **49** interposed between a lug **50** on the press frame and an arm **51** secured to the shaft **43**, this spring tending to rotate the shaft **43** in a counter-clockwise direction, and to move the valve **21** to its Figure 8 position.

In accordance with the invention, control means is provided for either automatically energizing the solenoid when the platen approaches the end of a return stroke, for automatically energizing the solenoid when one or the other of the tables **14**—**15** is moved into the path of the platen, or for manually effecting energizing of the solenoid when the platen is at rest in its upper position; and for automatically effecting deenergizing of the solenoid when a predetermined degree of pressure is built up in the work chamber **7** during a pressing stroke, the deenergizing of the solenoid permitting the spring **49** to return the valve to its Figure 8 position to start a return stroke. This control means includes a rod **52** mounted for vertical sliding movements in lugs **53** and **54** on the press head and base respectively, the rod **52** being urged downwardly by means of a spring **55** interposed between the lug **53** and a collar **56** secured to the rod, and being limited in its downward movement by a collar **57** secured to the rod and adapted to engage the lug **54**. Mounted on the platen is an arm **58** having at its outer end a boss **59** through which the rod **52** extends and with respect to which the rod is freely slidable. During upward movement of the platen, the boss **59** is adapted to engage a collar **60** secured to the rod in adjusted position. After this engagement of the boss **59** with the collar **60**, further movement of the platen will raise the rod, and will move the valve **21** toward its Figure 2 position through medium of a forked arm **61** secured to the shaft **43** and engageable by a collar **62** secured to the rod **52**. When the rod is lifted the collar **62** will engage the arm **61** and will rock the latter in a clockwise direction, thus moving the valve **21** from its Figure 7 position to the right. As the platen approaches its uppermost position the valve **21** will, by means of the mechanism just described, be caused to gradually approach its Figure 2 position. During this movement of the valve, the head **23** will gradually uncover the exhaust branch pipe **35** so that the by-pass to the tank will be gradually opened. At the same time the head **24** will gradually cover the end of the pipe **32**. The return motion of the platen will cease as soon as the throttled exhaust opening between the valve chamber and the exhaust branch **35** is enlarged to such a degree that the pump pressure has dropped to a value required to balance the weight of the movable press elements. At this time a state of balance will exist in the circuit and the pump will supply fluid at a pressure just sufficient to hold the movable press parts in their upper position against the attraction of gravity. Although, when the platen is automatically brought to rest in its upper position, the valve **21** will not be moved all the way from the Figure 8 to the Figure 2 position, it is obvious that in the position to which the valve will be moved in actual practice flow of fluid under pressure is effectively cut off from both the work and return chambers. A manually operable lever **63** secured to the shaft **43** provides for manual control of the press whenever desired.

In some cases, where the reversing valve is necessarily heavy because of the high pressures handled, the force required to move the valve may be greater than that available from the solenoid **37** and the spring **49**. In such cases the reversing valve may be actuated by means of an auxiliary hydraulic pilot circuit including a "Servo Motor" for effecting the application of pressure to suitable pistons or plungers for moving the main valve to each of its three positions. Devices of this kind are well known in the art and need not be here further referred to.

The solenoid **37** is adapted to be connected to a suitable source of electrical power by means of power lines **64** and **65**, and a two-pole normally open main switch F which includes switch arms **66** and **67** adapted to be closed upon switch points **68** and **69** to close the circuit through and to energize the solenoid. The arms **66** and **67** of the main switch are fixed to a rotatable shaft **70** urged in the direction of the arrow *x* in Figure 9 by means of a spring **71** connected to an arm **72** on the shaft, the switch arms **66** and **67** being thereby normally maintained out of contact with the points **68** and **69**. The shaft **70** is adapted to be rotated in the direction of the arrow *y* and the main switch consequently adapted to be closed by electric means comprising a pilot electric circuit connected across the line

64 and 65 and including three parallel circuit branches 73, 74, and 75, a circuit portion 76 common to all of the branches and connecting one end of each to the line 65, and a conductor 77 also common to all of the branches and being adapted to connect one end of each to the line 64.

Interposed in series in the circuit portion 76, which, it will be noted, is exterior of all of said branches, is a manually operable cut-out switch 78 or selector device and a holding coil 79, the latter when energized being adapted to attract an arm 80 fixed to the shaft 70 as at 81 and to thus rotate the shaft to close the main switch and to energize the solenoid. When the holding coil 79 is energized the arm 80 will be swung in the direction of the arrow *y* (see Figure 9), at which time a normally open contactor switch G will be closed, the switch G comprising a contactor bridge piece 82 on the lower end of the arm 80 adapted to bridge two contact points 83 and 84, thus connecting the circuit branch 73 with the conductor 77 and completing the pilot circuit through the branch 73. The shaft 70 and the arm 80 are urged to their Figure 9 positions by the spring 71.

The circuit branch 73 includes a conductor 85 connected to the circuit portion 76, a normally closed emergency reverse push button switch 86, a conductor 87, a normally closed pressure responsive switch 88, and a conductor 89. The switch 88 includes a switch arm 90, spring urged to its closed position, and an operating arm 91 mounted in fixed relation to the switch arm 90. This switch is adapted to be opened by means of a rod 92 mounted on a piston 93 arranged for sliding movements in a cylinder 94 mounted on the press head. The piston 93 and the rod 92 are urged to the left as viewed in Figures 2 and 9 by means of a spring 95 interposed between the piston and a nut 96 by means of which the compression of spring 95 may be adjusted. The chamber within the cylinder 94 is in constant communication with the work chamber 7 through the medium of a pipe 97 so that the pressure within the cylinder 94 will always be equal to that in the work chamber. The compression of the spring 95 is so adjusted that the piston 93 will remain in its extreme left hand position as shown in Figure 2 until a desired predetermined pressure has built up in the work chamber and in the cylinder 94 during a working stroke, at which time the piston 93 and the rod 92 will be moved to the right against the action of the spring 95, the rod 92 at this time engaging the operating arm 91 of the switch 88 and moving it to rock the switch arm 90 in a clockwise direction. This opening of the switch 88 serves to break the pilot circuit through the circuit branch 73, thereby deenergizing the coil 79 and effecting opening of the main switch to deenergize the solenoid also. This permits the spring 49 to move the valve 21 to its Figure 8 position and to start a return stroke of the platen.

It will be observed that when the holding coil 79 has been once energized and the bridge piece 82 closed upon the contact points 83 and 84 in the manner already described the pilot circuit will be closed through the conductor 77, the circuit branch 73, and the common circuit portion 76, thus maintaining the coil 79 energized and maintaining the bridge piece 82 closed upon the points 83 and 84 until either the switch 86 or the switch 88 is opened.

The circuit branch 74 includes the conductor 85, a normally open manually operable starter switch 98 preferably of the push-button variety, and a conductor 99 connected to the common conductor 77. Assuming that all of the circuit branches are open as shown in Figure 9 and that it is desired to momentarily manually energize the holding coil 79 to close the main switch and to close the bridge piece 82 upon the points 83 and 84, the push-button switch 98 is pressed, thus closing the pilot circuit through the common circuit portion 76, the conductor 85, the switch 98, the conductor 99, and the conductor 77. As soon as the holding coil is thus energized the pilot circuit will be closed through the circuit branch 73 in the manner described above and subsequent opening of the push-button switch 98 will not act to deenergize the holding coil 79 or to open the main switch.

It is sometimes desirable that the platen perform an indeterminate number of pressing operations or impart a number of blows upon a single charge, that is to say, perform a number of successive operations while the work positioning tables remain in one position. In order to render such operation available means are provided for automatically effecting a closing of the main switch F to energize the solenoid when the platen approaches the end of a return stroke. To this end the circuit branch 75 includes a conductor 100 connected to the common circuit portion 76, a manually operable selector switch 101, a conductor 102, a normally open switch 103 having a switch arm 104 spring urged to open position, a conductor 105, and a conductor 106. A collar 107 secured to the platen operated rod 52 is adapted when the rod is lifted in the manner already described to engage an operating arm 108 mounted in fixed relation to the switch arm 104 to move the latter to its closed position, thus completing the pilot circuit through the circuit branch 75 and energizing the holding coil 79 which, as stated above, effects closing of the main switch and energizing of the solenoid. When the platen begins another pressing stroke with the resultant lowering of the rod 52 and opening of the switch 103, the holding coil will maintain the bridge piece 82 closed upon the contact points 83 and 84, thus maintaining the main switch F closed and the solenoid energized until the pressing stroke has been completed and the switch 88 opened in the manner already described.

An important feature of the invention consists in the provision of means for automatically initiating a pressing stroke of the platen when one or the other of the tables 14—15 is moved under the platen. To this end the pilot circuit shown in Figure 9 is provided with a shunt circuit portion 109 including a conductor 110, a normally open table-operated switch 111, and a conductor 112 which is connected to the conductor 105 previously referred to.

The switch 111 is mounted in an opening in the table guide 17 as shown in Figure 4, and includes a fixed contact point 113 and a movable element comprising upper and lower arms 114—115 respectively which are normally maintained out of contact with the point 113 by means of balanced springs 116—116. An operating arm 117 is fixed to the movable element 114—115 and is adapted to be engaged by a roller 118 on a pin 119 carried by a slide 120 mounted in a box-like guide 121 secured to the base 1 of the press alongside of the table slide-way as shown in Figures 1, 2, 4, and 6.

The slide 120 extends through both ends of the guide 121, and is provided at its opposite ends

with bolts 122—123 which serve to vary the effective overall length of the slide. The bolt 122 is disposed in the path of and is adapted to be engaged by a lug 124 on the table 14 when the tables are moved to the right as viewed in Figure 6 to thereby cause the slide 120 to be moved to the right. Similarly, the bolt 123 is disposed in the path of and is adapted to be engaged by a lug 125 on the table 15 when the tables are moved to the left as viewed in Figure 6 to thereby move the slide to the left.

Assuming the parts to be in the positions shown in Figures 1, 4, 6, and 9, with the tables at the right, if it is desired that movement of one or the other of the tables under the platen automatically effect a single pressing and return stroke of the platen, the selector switch 101 will be opened, and the tables 14 and 15 will then be moved to the left in a manner to be described to bring the table 15 under the platen, resulting in engagement of the lug 125 with the bolt 123 on the slide 120, and movement of the slide to the left. As the roller 118 on the slide passes the switch 111, the roller will contact with the operating arm 117 of the switch, momentarily moving the latter to the left to cause the lower arm 115 of the switch to close upon the fixed contact point 113, thereby completing the pilot circuit through the circuit branch 75 and the shunt circuit branch 109. This will effect closing of the main switch F and energizing of the solenoid E, shifting of the piston valve 21 of the valve D to its Figure 7 position, and a downward movement of the ram and platen in the manner already described. The platen will then perform a complete pressing stroke and will be returned to its upper position in the manner heretofore described, after which it will be brought to rest. When the tables 14 and 15 are returned to their right hand position, the lug 124 on the table 14 will engage the bolt 122, moving the slide 120 to the right. As the roller 118 passes the operating arm 117, the latter will be deflected to the right as viewed in Figure 9, thereby closing the upper arm 114 of the switch upon the fixed contact 113, thus closing the pilot circuit through the circuit branch 75 and shunt circuit branch 109, and energizing the solenoid in the same manner as before. The platen will then perform another complete pressing and return stroke, after which it will come to rest in its upper position.

If it is desired that the platen perform a number of pressing strokes upon a given piece of work and without any intervening movement of the tables, the switch 101 will be closed. This will immediately close the pilot circuit through the circuit branch 75, closing the main switch F and energizing the solenoid E. The platen will then perform a complete pressing and a return stroke. As the platen approaches the end of the return stroke, the boss 59 will engage the collar 60 on the rod 52 and will lift the latter, causing the collar 107 to engage the operating arm 108 of the switch 103 to close the latter. This will automatically close the pilot circuit and close the main switch F, resulting in energizing of the solenoid E and performance of another working stroke. The platen will continue to perform working and return strokes automatically until the switch 101 is opened, rendering closing of the switch 103 ineffective.

It will be noted that the table-operated switch 111 constitutes means associated with the work positioning tables and automatically operable upon movement thereof for operation of the ram-controlled valve D to effect application of force to the ram to cause the latter to perform a working stroke.

Through the closing or opening of the manually operable selector switch 101, the closing and opening of the switch 103 in the circuit branch 75 will be rendered effective or ineffective as desired, that is to say, when the switch 101 is closed the closing of the switch 103 will automatically effect energizing of the solenoid when the platen approaches the end of a return stroke, whereas, when the switch 101 is open, the closing of the switch 103 will be ineffective and pressing strokes of the platen will be initiated only upon one or the other of the tables 14—15 being moved into position under the platen, upon manual closing of the push button starter switch or manual operation of the lever 63.

Referring now to the means for moving the tables 14 and 15 into and out of the path of the platen, and to the control means therefor, a piston rod 126 connected to the table 15 extends rearwardly therefrom and is provided at its outer end with a double acting piston 127 mounted to slide in a cylinder 128. A pump H is provided for supplying the opposite ends of the cylinder 128 with fluid under pressure for moving the piston 127 and the tables 14 and 15 in both directions. The pump is connected to a tank I by means of a suction pipe 129, and is adapted to discharge fluid under pressure through a delivery pipe 130 connected to a control device or table-controlling valve J.

The valve J includes a casing 131 defining a valve chamber 132 and a piston valve 133 mounted for sliding movements in the valve chamber. The piston valve comprises spaced heads 134 and 135 connected by a reduced portion 136, and a long stem 137 extending through one end of the valve casing and being guided in a lug 138 on the press base. A pipe 139 provides communication between the valve chamber and the rear or outer end of the cylinder 128, and a pipe 140 provides communication between the valve chamber and the inner end of the cylinder. An exhaust pipe 141 provides communication between one end of the valve chamber and the tank I, and a branch exhaust pipe 142 connected to the exhaust pipe 141 provides communication between the opposite end of the valve chamber and the tank I.

In order to provide for manual operation of the valve J, levers 143 and 144 are pivoted to the press base at 145 and 146 respectively, and are pivotally connected to the stem 137 of the piston valve by means of links 147 and 148.

In operation, assuming the parts to be in the positions shown in Figures 1 and 3, and assuming that it is desired to move the table 15 under the platen, one or the other of the levers 143—144 will be manually moved in a clockwise direction as viewed in Figure 3, thereby shifting the piston valve 133 to its Figure 14 position. The pump H will then deliver fluid under pressure through the pipe 130 into that part of the valve chamber bounded by the heads 134 and 135, thence through the pipe 139 to the outer end of the cylinder 128, thereby moving the piston 127 and the tables to the left as viewed in Figure 1 and to the right as viewed in Figure 3 to position the table 15 under the platen. While the piston 137 is being thus moved toward the inner end of the cylinder 128, fluid contained in the inner end of the cylinder will be returned to the tank I

by means of the pipe 140, the outer end of the valve chamber, and the exhaust pipe 141. In order then to move the tables to bring the table 14 under the platen, one or the other of the levers 143—144 is moved in a counterclockwise direction as viewed in Figure 3 to return the piston valve 133 to its Figure 1 and Figure 3 position. Fluid discharged by the pump H will then pass through the pipe 130, the valve chamber between the heads 134 and 135, the pipe 140 and into the inner end of the cylinder 128, thereby forcing the piston 127 and the tables 14 and 15 to the right as viewed in Figure 1 and to the left as viewed in Figure 3, thus returning the table 14 to its position under the platen. While the piston 127 is being thus driven to its outer position, fluid contained in the outer end of the cylinder 128 will be returned to the tank I through the medium of the pipe 139, the inner end of the valve chamber, the branch exhaust pipe 142, and the exhaust pipe 141. It will be observed that the valve J and the associated levers 143 and 144 constitute a manually operable control device for effecting single movements of the tables 14 and 15.

In accordance with a further feature of the invention, means are provided for automatically operating the valve J to institute a movement of the tables when the platen approaches a predetermined point during its upward travel. To this end two automatically operable control devices or solenoids K and K' are mounted on the press base and are provided with movable plungers 149 and 150 respectively having pin and slot connection with depending arms 151 and 152 of the levers 143 and 144. When the solenoid K is energized, the plunger 149 thereof is moved to the left as viewed in Figure 3, thereby rocking the lever 144 in a clockwise direction and moving the valve stem 137 and the piston valve 133 to the right to its Figure 4 position. Similarly, when the solenoid K' is energized, the lever 143 will be rocked in a counter-clockwise direction as viewed in Figure 3, thereby moving the valve stem 137 and the piston valve 133 to the left to its Figure 3 and Figure 1 position.

The solenoid K is adapted to be connected across the power line 64—65 by means of a double pole switch L which controls the energizing of the solenoid. The switch L comprises switch arms 153 and 154 mounted upon a shaft 155 urged in the direction of the arrow *m* by a spring 156. The switch L is adapted to be automatically closed when the tables have moved to the position shown in Figures 1 and 3. For accomplishing this purpose there is provided a pilot electric circuit connected across the power line 64—65 and comprising a conductor 157; a table control means comprising a normally open platen operated switch 158; a conductor 159; a cut out switch 160, being one arm of a manually operable double pole switch 161; a conductor 162; a table-operated switch 163; a conductor 164; a holding coil 165; and a conductor 166 connected to the conductor 65 of the power line, all of the foregoing elements being connected in series across the line 64—65.

The platen operated switch 158 comprises a pivoted switch arm 167, a fixed contact point 168, and an operating arm 169 carried by the switch arm 167. The operating arm 169 is disposed in the path of a cam block 170 mounted on the upper end of a rod 171 fixed to the press platen.

The table operated switch 163 includes four fixed contact points 172, 173, 172', 173', and a rockable contact-making arm 176 pivoted centrally as at 177 and provided with an operating arm 178. The switch 163 is mounted on the base 1 alongside of the table slide-way as most clearly shown in Figure 5, the operating arm 178 of the switch extending upwardly and being disposed in the path of a lug 179 on the table 15.

Assuming that the parts are in the positions shown in Figures 3, 5, and 10, with the exception that the switch 160 (Figure 10) is closed, and further assuming that the platen is moving upwardly, the tables will be automatically moved to bring the table 15 under the platen in the following manner. When the platen reaches a predetermined point during its upward travel, the cam block 170 will engage the operating arm 169 of the switch 158, thereby closing the switch arm 167 upon the contact 168. The pilot circuit will then be closed through the conductor 157, the switch 158, the conductor 159, the switch 160, the conductor 162, the switch arm 176, the conductor 164, the holding coil 165, and the conductor 166. The holding coil being thus energized will attract an arm 180 on the shaft 155, thereby rocking the latter in the direction of the arrow N and closing the arms 153 and 154 of the switch L upon the associated fixed contacts. This will complete the circuit through the solenoid K, energizing the latter and rocking the lever 144 in a clockwise direction as viewed in Figure 3, shifting the piston valve 133 to its Figure 14 position, and thereby moving the table 15 under the platen in the manner described above.

After the table 15 has been moved under the platen in this manner, the platen will perform a pressing stroke and a return stroke in the manner already described. It is desirable that as the platen approaches the end of this return stroke the solenoid K' be energized in order to move the valve stem 137 and the piston valve 133 to their outer positions, that is, the positions shown in Figures 1 and 3. To this end a separate pilot circuit is provided for automatically effecting connection of the solenoid K' to the power line 64—65. This circuit is identical with that described for effecting the energizing of the solenoid K, and a detailed description thereof is not deemed necessary. The reference characters applied to the corresponding parts of the two pilot circuits are the same, with the exception that those applied to the circuit effecting energizing of the solenoid K' are primed, i. e., the switch L' corresponds to and operates in exactly the same manner as the switch L, the switch 158' corresponds to and operates in exactly the same manner as the switch 158, et cetera.

Assuming that the table 15 is under the platen and that the platen is approaching the end of its return stroke, the operating arm 178 and the switch arm 176 of the switch 163 will be in the positions indicated in dotted lines in Figure 10. As the platen approaches the end of the return stroke, the cam block 170 will engage the operating arm 169' of the switch 158', thereby closing the pilot circuit through the conductor 157', the switch 158', the conductor 159', the switch arm 160', the conductor 162', the switch arm 176, the conductor 164', the holding coil 165', and the conductor 166', thereby energizing the holding coil 165' and attracting the arm 180' to rock the shaft 155' in the direction of the arrow N'. This will effect closing of the switch L' and energizing of the solenoid K', whereby the lever 143 will be rocked in a counterclockwise direction as viewed in Figure 3 and the piston valve 133 moved to its

outer position so as to direct fluid to the inner end of the cylinder 128 to thereby return the tables to the positions shown in Figures 1 and 3, wherein the table 14 is disposed under the platen. By opening the switch 161 the closing of the switches 158—158' is rendered ineffective, it being noted that the switch 161 constitutes means whereby said table may be selectively adapted for either automatic or manually controlled operation.

It will be observed that the main ram 10 and the push-back rams 11—11 together constitute in effect a double acting ram for reciprocating the platen.

Operation

In order that the invention may be better understood, typical operating cycles of the press will be briefly reviewed.

If the character of the work is such as to make it desirable that both the ram and the tables be operated independently under separate manual control, the switch 78 in the circuit shown in Figure 9 and the switch 161 in the circuit shown in Figure 10 will be opened. Assuming the parts to be otherwise in the positions shown in Figures 1, 2, and 3, in order to start a pressing stroke of the platen, the control lever 63 will be moved in a clockwise direction as viewed in Figure 2, thereby shifting the piston valve 21 of the valve D to its Figure 7 position. Fluid will then be directed through the pipe 31 to the main cylinder 6, and the platen will be moved downwardly. When the desired pressure has been exerted the lever 63 will be rocked in a counterclockwise direction as viewed in Figure 2 to move the piston valve 21 to its Figure 8 position, thereby causing fluid to be directed through the pipe 32 to the push-back cylinders 8 and causing the platen to move on a return stroke. When a predetermined position has been reached during the return stroke, the boss 59 on the arm 58 will engage the collar 60 on the rod 52, lifting the latter until the collar 62 on the rod 52 engages the lever 42, rocking the latter in a clockwise direction as viewed in Figure 2 and returning the valve 21 to its Figure 2 position, whereupon the platen will be brought to rest. The lever 144 will then be rocked in a clockwise direction as viewed in Figure 3 to move the piston valve 133 of the table control valve J to its Figure 14 position, causing fluid to be delivered by the pump H through the pipe 139 to the outer end of the cylinder 128, and causing the piston 127 and the tables to be moved to the right as viewed in Figure 3 to position the table 15 under the platen. The completed work may then be readily removed from the table 14 and a new charge of material placed thereon. The platen and tables may then be caused to perform the same cycles of operation through repeated manipulation of the lever 63 and of the lever 144 respectively.

If it is desired that the tables be operated under manual control, and that the platen be automatically operated so as to perform an indeterminate number of pressing operations without intervening movement of the tables, the switch 161 shown in Figure 10 will be left open and the switches 78 and 101 shown in Figure 9 will be closed. In order to initiate the first pressing stroke of the platen, the manually operable push-button switch 98 will be closed. This will effect energizing of the holding coil 79, closing of the main switch F, and energizing of the solenoid E in the manner already described. The plunger 38 of the solenoid will then be drawn downwardly, moving the piston valve 21 of the ram control valve D to its Figure 7 position, whereupon fluid will be directed to the main cylinder 6 and a pressing stroke will be performed. When a predetermined pressure has built up in the work chamber 7, the piston 93 will be moved to the right to open the switch 88 to deenergize the holding coil 79, and to permit the main switch F to be opened, thereby deenergizing the solenoid E and permitting the spring 51 to move the piston valve 21 to its Figure 8 position so as to direct fluid under pressure to the push-back cylinders 8, and to produce a return stroke of the platen. When the platen approaches the end of its return stroke, the boss 59 will engage the collar 60, lifting the rod 52 until the collar 107 closes the switch 103. This will complete the pilot circuit through the circuit branch 75 and will effect energizing of the solenoid E and movement of the piston valve 21 of the valve D to its Figure 7 position in the manner described above, and another pressing stroke will be performed. Repeated pressing and return strokes will take place automatically until the switch 101 is opened, after which closing of the switch 103 by upward movement of the platen will be rendered ineffective and the upward movement of the platen will move the piston valve 21 to its Figure 2 position, bringing the platen to rest. The tables may then be shifted to bring the table 15 under the platen by manual operation of the lever 144 to move the piston valve 133 of the table-controlling valve J to its Figure 14 position.

If it is desired that the tables be operated under manual control, and that the platen automatically perform a pressing and return stroke upon a single movement of the tables, the switch 161 in Figure 10 will be left open, the switch 78 in Figure 9 will be closed, and the switch 101 in Figure 9 will be opened. The lever 144 will then be rocked in a clockwise direction as viewed in Figure 3 to move the piston valve 133 of the valve J to its Figure 14 position to thereby move the table 15 under the platen. During this movement of the table, the lug 125 thereon will engage the bolt 123 and move the slide 120 to the left as viewed in Figure 6, thereby closing the switch 111 and completing the pilot circuit of Figure 9 through the circuit branch 75 and the shunt circuit branch 109. This will energize the holding coil 79 and will close the main switch F to energize the solenoid E and to move the piston valve 21 of the valve D to its Figure 7 position, thus starting a pressing stroke of the platen. The pressing and return strokes will then be performed in the manner previously described, and the platen will be brought to rest in its upper position. To effect another cycle of operation, the lever 144 will be rocked in a counterclockwise direction as viewed in Figure 3, thereby moving the tables 14 and 15 so as to position the table 14 under the platen. The lug 124 will then move the slide 120 so as to close the switch 111 again to effect energizing of the solenoid E and thereby to start another pressing stroke. It will be observed that the ram-controlled valve J constitutes common control means for the work positioning tables and for the ram means, since actuation of the valve automatically produces shifting of the tables and operation of the ram.

When it is desired that the movement of the tables automatically effect beginning of a pressing stroke of the platen and that return movement of the platen automatically effect a shifting

of the tables so as to provide for completely automatic and continuous operation of both the platen and the tables, the switch 78 shown in Figure 9 will be closed, and the switch 101 shown in Figure 9 will be opened. To start operation of the tables and platen the switch 161 will be closed. Assuming the parts to be in the positions shown in Figures 1 to 10 inclusive, closing of the switch 161 will complete the pilot circuit through the holding coil 165, thereby closing the switch L and energizing the solenoid K. The plunger 149 of the solenoid K will be drawn to the left as viewed in Figure 3, thereby rocking the lever 144 in a clockwise direction and shifting the piston valve 133 to its Figure 14 position. Fluid under pressure from the pump H will then be directed through the pipe 139 to move the tables to the right as viewed in Figure 3 and to position the table 15 under the platen. During this movement of the tables, the slide 120 will be moved to the right as viewed in Figure 3 and to the left as viewed in Figure 6 to close the switch 111, to energize the solenoid E, and to start a pressing stroke in a manner already described. Also during this movement of the tables, the lug 179 will engage the operating arm 178 of the switch 163, rocking the latter in a clockwise direction as viewed in Figures 3 and 10 and moving the switch arm 176 to its dotted line position to bridge the fixed contact points 172' and 173'. After the pressing stroke has been completed and the platen is moving upwardly on a return stroke, the cam block 170 on the rod 171 will close the switches 158 and 158', thereby closing the pilot circuit through the holding coil 165', effecting closing of the switch L' and energizing of the solenoid K'. The plunger 150 of the solenoid will then be moved to the right as viewed in Figure 3, thereby rocking the lever 143 in a counterclockwise direction and returning the piston valve 133 to its Figure 3 position. Fluid discharged by the pump H will then be delivered through the pipe 140 to move the piston 127 and the tables to the left, positioning the table 14 under the platen. During this movement of the tables, the lug 179 on the table 15 will engage the operating arm 178 of the switch 162 to return the switch arm 176 to the full line position shown in Figure 10, and the slide 120 will again be operated to close the switch 11 to start another pressing stroke. After the completion of the pressing stroke and of the succeeding return stroke, the cam block 170 will close the switch 158 to effect closing of the switch L and energizing of the solenoid K, whereupon the tables will again be moved to the right as viewed in Figure 3 to bring the table 15 under the platen, and the platen will start to perform a pressing stroke as already described. The ram and tables will continue to operate in the foregoing sequence until either the switch 76, the emergency push-button switch 88, or the switch 161 is opened.

Figures 11 and 12 show a modified form of the invention in which a reversible flow hydraulic circuit is employed for reciprocating the platen and in which pressure actuated means is used for automatically reversing the direction of fluid travel in the circuit upon movement of the tables instead of the electrical means described above. The press, shown in Figure 11, is the same as that already described, so that a description thereof is not considered necessary.

The fluid delivered to the chambers in the cylinders 6 and 7 is furnished by a reversible radial pump M, for example, of the kind known in Patent No. 1,250,170 to Hele-Shaw, et al. Generally speaking, in such pumps the direction of travel of the fluid discharged may be reversed by reciprocating the cross-head or similar device from one position to another. This cross-head is connected to a floating ring which, by movement of the cross-head, may be shifted off center with relation to other elements of the pump. When this floating ring is off center in one direction, fluid will be discharged under pressure in one direction and will be discharged in the opposite direction when the floating ring is moved off center to the opposite side.

It is unnecessary to set forth the specific construction of the pump in further detail, and such construction is, therefore, not illustrated in detail herein, since the present invention relates to novel control mechanism interposed between the pump and the press whereby the operation of the pump will be controlled through the shifting of the tables from one position to the other and vice versa.

Means forming a reversible flow hydraulic circuit with the pump and press includes a pipe line 181 connected between a pipe connection 182 on the pump and the ram return chamber 9 of the cylinders 8, and a pipe line 183 connected between a pipe connection 184 of the pump and the work chamber 7 in the cylinder 6. When the pump is set to discharge through the pipe 183, fluid will be delivered to the work chamber 7 of the cylinder 6, thereby driving the ram and platen downwardly. At this time fluid contained in the return chambers 9 of the cylinders 8 will be expelled therefrom and drawn into the pump through the pipe 181. When the pump is reversed so as to discharge through the pipe 181, fluid will be delivered through this pipe to the return chambers 9, thereby moving the platen upwardly and fluid contained in the work chamber 7 of the cylinder 6 will be expelled therefrom, being drawn in by the pump through the pipe 183.

The pump shown is provided with mechanism generally designated N for moving the pump cross-head in both directions to reverse the direction of fluid flow through the pump and circuit, the mechanism end being of the kind shown, described and claimed in the patent to Walter Ernst and Howard F. MacMillin, No. 1,937,192 granted November 28, 1933. This mechanism is described in detail in that patent, and for the purposes of the present disclosure, it will be necessary only to describe certain elements thereof. The mechanism includes a reversing control lever 185 pivoted as at 186 to a housing 187 secured to the pump casing. This control lever is adapted to occupy two positions, being normally urged to the full line position indicated in Figure 11 and being adapted to be moved to the dotted line position through the medium of a power-operated device comprising a pressure operated piston 188 connected to the control lever by means of a piston rod 189 and mounted in a cylinder 190 carried by the housing 187.

As stated above, the lever 185 is normally urged to its full line position. In this position of the lever, the pump will discharge through the pipe 181 into the return chambers 9 to effect a return stroke of the platen. When the lever is moved to its dotted line position, in a manner to be described later, it will be latched and retained in this position as further described in the above named patent, the pump then delivering fluid through the pipe 183 to the work chamber 7 and effecting a pressing stroke of the platen.

It will be observed that due to the differential areas of the main ram 10 and the push back rams 11 the change in volume in the ram returning chambers for a given amount of ram movement will be considerably less than the change in volume in the work chamber for the same movement of the ram. In order to compensate for this a "make-up" or differential valve 191 is provided. This valve may be of the kind shown in the patent referred to and is provided with a pipe 192 communicating with the tank I, a pipe 193 providing communication between the valve and the pipe 183, and a pipe 194 providing communication between the valve and the pipe 181. Assuming that the pump is discharging through the pipe 183 during a working stroke, fluid will be drawn from the return chamber 9 through the pipe 194 This fluid, however, will not be sufficient alone to fill the more rapidly increasing volume of the work chamber, and the amount of fluid necessary to be added to the fluid removed from the returning chambers will be supplied from the tank I through the pipe 192 and the pipe 194. During a return stroke of the ram excess fluid from the work chamber will be returned to the tank I by means of the pipe 193, the compensating valve and the pipe 192.

When the platen reaches the end of a return stroke, the pump will continue to discharge fluid under pressure through the pipe 181, and it is necessary that this pressure be relieved. To accomplish this purpose, a platen operated by-pass valve 195 of appropriate form such, for example, as that shown in the copending application, is connected between the pipe 181 and the tank I by means of a pipe 196 and a pipe 197. The by-pass valve is provided with a long stem 198 which extends downwardly parallel to the direction of movement of the platen. Secured to the stem is a collar 199 adapted to be engaged by a lug 200 on the platen when the latter approaches the end of a return stroke, the valve stem 198 being thereby lifted to open communication between the pipe 196 and the pipe 197 thereby effecting a by-passing of the fluid from the pipe 181 to the tank I. The platen will then be maintained in its upper position during continued discharge of the pump through the pipe 181 until the control lever 185 is moved to the left to the position shown in dotted lines in Figure 11.

For admitting fluid under pressure to the cylinder 190 for moving the piston 188 to the left, a tank 201 of compressed air or other fluid under pressure is adapted to be placed in communication with the cylinder by means of a pipe 202 connected to the cylinder, a table operated valve 203 located in a recess 204 in the press base, and a pipe 205 connecting the tank and valve. An exhaust pipe 206 provides for the exhausting of pressure fluid from the cylinder 190 when desired.

The valve 203 includes a valve casing 207 defining a valve chamber 208 and a piston valve 209 mounted to slide in the casing and being provided with a stem 210 extending vertically upward and provided with a rounded upper end. A spring 211 interposed between the piston valve 209 and the lower end of the valve casing constantly urges the piston upwardly, and an enlarged portion on the stem 210 is arranged to abut the upper end of the valve casing and to limit the upper movement of the piston. The inner wall of the valve casing is formed with a recess 213 which extends longitudinally of the casing and which is not quite covered by the piston 209 in the normal position of the piston as shown in Figure 12, it being noted that the lower end of the recess projects slightly below the piston when the latter is in the position shown. The pipe 202 leading from the cylinder 190 communicates with the recess 213, so that when the piston valve 209 is in its normal position, the cylinder 190 is in communication with the exhaust pipe 206. When, however, the piston valve 209 is moved downwardly, the piston will cut off communication between the pipe 202 and the exhaust pipe and will open communication between the pipe 202 and the pipe 205, thereby placing the cylinder 190 in communication with the tank 201, and effecting movement of the piston 188 to the left to move the control lever 185 to the position shown in dotted lines in Figure 11.

In order that the piston valve 209 be automatically operated when the tables 14 and 15 are shifted, the stem 210 of the valve is arranged to project upwardly through a guide 214 which is similar in construction to the guide 121 shown in Figure 6 and described above. The rounded upper end of the stem 210 is disposed for engagement with a roller 215 mounted on a pin 216 carried by a slide 217 which is provided at its opposite ends with bolts 218 and 219, the slide, roller and other associated parts being similar to those shown in Figure 6. When the slide 217 is moved to the left as viewed in Figure 12, the roller 215 will engage the upper end of the stem 210, thereby moving the latter and the piston valve 209 downwardly to momentarily provide communication between the pipes 205 and 202. After the roller passes the stem 210, the valve will be returned to its Figure 12 position by means of the spring 211. The same operation of the valve will take place when the slide 217 is returned to its Figure 12 position.

The means for moving the tables 14 and 15 into and out of the path of the platen is the same as the means shown and described in connection with the embodiment of the invention illustrated in Figures 1 to 10, inclusive, and it will be understood that these means may be controlled either manually or automatically as previously set forth.

Operation of modified form

Assuming that the parts are in the positions shown in Figures 11 and 12, in order to effect a complete operating cycle of the press, the piston valve 133 of the table control J will be moved to the left in the manner previously described, thereby causing the tables 14 and 15 to be moved to the left and the table 15 to be positioned under the platen 4. During this movement of the tables, the lug 125 on the table 15 will engage the bolt 219 on the slide 217 moving the latter to the left and causing the roller 215 to engage and depress the valve stem 210 of the piston valve 209. This will cause the piston valve to move downwardly, to close communication between the pipe 202 and the exhaust pipe 206 and to open communication between the pipe 202 and the pipe 205. Fluid under pressure in the tank 201 will then flow through the pipe 205, the valve chamber 208, and the pipe 202 into the cylinder 190, thereby moving the piston 188 to the left where it will be latched in its dotted line position. After the roller 215 has passed the stem 210, the valve 209 will be returned to its upper position placing the cylinder 190 in communication with the exhaust pipe 206. Because of the control lever 185 being latched in position, it will remain in its dotted line position even after fluid has been exhausted from the cylinder 190.

The pump M will then deliver fluid through

the pipe 183 to the main cylinder and will effect a pressing stroke of the platen. When pressure builds up in the main cylinder and in the pipe 183, the control lever 185 will be released, i. e., unlatched and returned to its full line position, thereby reversing the direction of discharge of the pump and causing fluid to be delivered to the push-back cylinders 8 to effect a return stroke of the platen. When the platen approaches the end of the return stroke, the lug 200 will engage the collar 199 thereby lifting the valve stem 198 of the by-pass valve 195 and placing the pipe 181 in communication with the tank I after which fluid will be by-passed to the tank and the platen will be maintained in its upper position.

In order to cause the press to perform another complete cycle of operation, the piston valve 133 of the valve J will be returned to its Figure 11 position either manually or automatically, thereby causing the tables to be moved to the right to bring the table 14 under the platen. During this movement of the tables, the lug 124 on the table 14 will engage the bolt 218 on the slide 217 moving the roller 215 toward the right into engagement with the stem 210 of the piston valve 209. This will effect movement of the control lever 185 to its dotted line position in the manner described above, and the platen will perform another pressing and returning stroke.

Although the two forms of control means illustrated and described herein are considered practical embodiments of the invention, it will be understood that various changes may be made in the arrangement of parts without departing from the scope of the invention as defined in the appended claims.

We claim:

1. The combination with a press including a reciprocable ram, and a work positioning table mounted for movements into and out of the path of the ram; of means controlling movement of the ram and being automatically operable by the table when the latter is moved into the path of the ram for initiating a working stroke of the latter; means for automatically effecting reversals of ram travel at the end of working strokes; and means responsive to movements of said ram for automatically effecting an indeterminate number of work positioning movements of said table.

2. The combination with a press including a reciprocable ram, and a work positioning table mounted for movements into and out of the path of the ram; of means controlling movement of the ram and being automatically operable by the table when the latter is moved into the path of the ram for initiating a working stroke of the later; means for moving said table into and out of the path of said ram; a manually operable control device for said means and being operable to effect single movements of said table independently of movement of the ram; an automatically operable control device for said means responsive to movement of said ram and being automatically operable to effect an indeterminate number of movements of said table; and means for rendering said automatically operable control means inactive whereby said table may be selectively adapted for either automatic or manually controlled operation.

3. The combination with a press including a reciprocable ram, and a work positioning table mounted for movements into and out of the path of the ram; of means controlling movement of the ram and being automatically operable by the table when the latter is moved into the path of the ram for initiating a working stroke of the latter; means for moving said table into and out of the path of said ram; a manually operable control device for said means and being operable to effect single movements of said table independently of movements of the ram; an electrically actuated control device for said means; an electric switch in circuit with said electrically actuated device; means responsive to movement of said ram for automatically operating said switch to effect actuation of said device; and a manually operable electric switch in circuit with said automatically operable switch and adapted, when open, to render operation of the latter ineffective, whereby said table may be selectively adapted for automatic or semi-automatic operation.

4. The combination with a press including a reciprocable ram, and a work positioning table mounted for movements into and out of the path of the ram; of means responsive to movement of the table for controlling movement of the ram and being automatically operable by the table when the latter is moved into the path of the ram for initiating a working stroke of the latter; means for moving said table into and out of the path of said ram; an electrically actuated control device for said table-moving means; an electric switch in circuit with said device; and means responsive to movement of said ram for automatically operating said switch to effect actuation of said device.

5. The combination with a press including a reciprocable hydraulic ram, and a work positioning table mounted for movements into and out of the path of the ram; of hydraulic means for reciprocating the ram; hydraulic means for moving the table; an electrically actuated control valve device for said table-moving means; and an electric switch in circuit with said control valve device and being automatically operable by said ram when the latter approaches the end of a return stroke, to thereby effect actuation of said control device and movement of said table.

6. The combination with a press including a reciprocable ram, and a work-positioning table mounted for movements into and out of the path of the ram; of means for applying force to the ram for moving it to perform working strokes; electrically actuated means for controlling said force-applying means; an electric switch automatically operable by said table during movement of the latter for closing a circuit through said controlling means; and a selector switch in circuit with the table-operated switch and adapted when open to render operation of the latter ineffective.

7. The combination with a press including a reciprocable ram, and a work-positioning table mounted for movements into and out of the path of the ram; of means for applying force to the ram for moving it to perform working strokes; means for controlling said force-applying means; means automatically operable by said table during movement of said table for actuating said controlling means; and a selector device cooperatively connected to said table-operated means and being adapted to render operation of the table-operated means ineffective.

8. The combination with a hydraulic press including a reciprocable double-acting ram, a work-positioning table mounted for movements into and out of the path of the ram, and a double-acting hydraulic piston connected to said table

for moving the latter in both directions; of means for supplying hydraulic pressure to said ram and piston; a ram-control valve for selectively directing fluid under pressure from said pressure supplying means to the respective sides of the ram; a table-controlled valve for selectively directing fluid under pressure from said pressure supplying means to the respective sides of the piston for moving the latter and the table; means operatively connected to said ram-control valve and associated with said table and being operable upon movement of said table for automatically moving said ram-control valve in one direction to direct pressure fluid to one side of the ram to effect a working stroke thereof; and means connected to said reversing valve and being responsive to the pressure acting on said ram for automatically moving said reversing valve in the opposite direction to direct pressure fluid to the other side of the ram to effect a return stroke thereof.

9. The combination with a hydraulic press including a reciprocable double-acting ram, a work-positioning table mounted for movements into and out of the path of the ram, and a double-acting hydraulic piston connected to said table for moving the latter in both directions; of means for applying hydraulic pressure to said ram and piston; a ram-control valve for directing fluid under pressure to the respective sides of the ram; a table-control valve for directing fluid under pressure to the respective sides of the piston; means associated with said table and being operable upon movement thereof for automatically moving said ram-control valve in one direction to direct pressure fluid to one side of the ram to effect a working stroke thereof; and means operated by the ram when the latter reaches a predetermined position during a return stroke for automatically moving said table control valve to effect a movement of said table.

10. The combination with a hydraulic press including a reciprocable double-acting ram, a work-positioning table mounted for movements into and out of the path of the ram, and a double-acting hydraulic piston connected to said table for moving the latter in both directions; of means for supplying hydraulic pressure to said ram and piston; a ram-control valve for selectively directing fluid under pressure from said pressure supplying means to the respective sides of the ram; a table-control valve for selectively directing fluid under pressure from said pressure supplying means to the respective sides of the piston for moving the latter and the table; an electrically actuated device operatively connected to said ram-control valve for moving the latter in a direction to direct pressure fluid to one side of said ram to effect the stroke thereby; and an electric switch in circuit with said device and being movable to closed position by said table when the latter is moved into the path of the ram for operating said electrically actuated device to move the ram-control valve in said direction to effect a stroke of said ram.

11. The combination with a hydraulic press including a reciprocable double-acting ram, a work-positioning table mounted for movements into and out of the path of the ram, and a double-acting hydraulic piston connected to said table for moving the latter in both directions; of means for supplying hydraulic pressure to said ram and piston; a ram-control valve for selectively directing fluid under pressure from said pressure supplying means to the respective sides of the ram; a table-control valve for selectively directing fluid under pressure from said pressure supplying means to the respective sides of the piston for moving the latter and the table; electrically actuated means connected to said table-control valve for moving the latter in one direction; and an electric switch in circuit with said means and being automatically operable to closed position when the ram reaches a predetermined position during one of its strokes for operating said electrically actuated means and moving said table-control valve in said direction to effect movement of said table.

12. The combination with a hydraulic press including a reciprocable double-acting ram, a work-positioning table mounted for movements into and out of the path of the ram, and a double-acting hydraulic piston connected to said table for moving the latter in both directions; of means for applying hydraulic pressure to said ram and piston; a ram-control valve for directing fluid under pressure to the respective sides of the ram; a table-control valve for directing fluid under pressure to the respective sides of the piston; means associated with said table and being operable upon movement thereof in either direction for automatically moving said ram-control valve in one direction to direct pressure fluid to one side of the ram to effect a working stroke thereof; and means associated with said table-control valve and being automatically operable by said ram when the latter approaches the end of a return stroke for moving said valve to effect a movement of said table.

13. Control mechanism for a press of the type including a reciprocable ram and a work-positioning table mounted for movements into and out of the path of the ram, comprising means for controlling movement of the ram and being automatically operable by the table when the latter is moved into the path of the ram for initiating a working stroke of the latter; means for automatically effecting reversals of ram travel at the end of working strokes; and means responsive to movements of said ram for automatically effecting an indeterminate number of working and return strokes of the ram without intervening movement of the table.

14. Control mechanism for a press of the type including a reciprocable ram and a work-positioning table mounted for movements into and out of the path of the ram, comprising means for controlling movement of the ram and being automatically operable by the table when the latter is moved into the path of the ram for initiating a working stroke of the latter; means for automatically effecting reversals of ram travel at the end of working strokes; means responsive to movements of said ram for automatically effecting an indeterminate number of working and return strokes of the ram without intervening movement of the table or for automatically effecting sequential ram and table movements; and selector means for adapting said control mechanism for either kind of operation.

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