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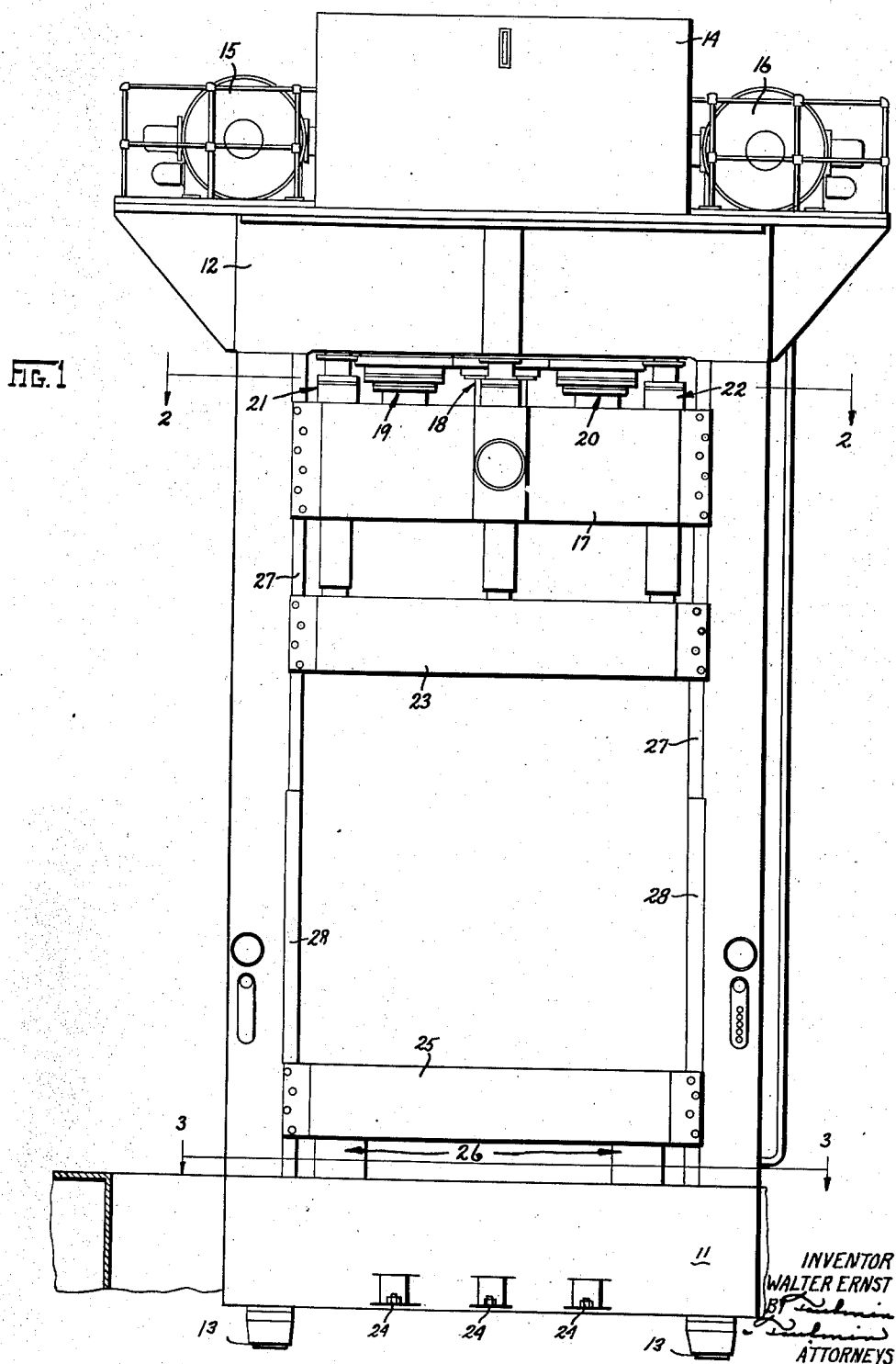
W. ERNST

2,390,359

TRIPLE ACTION AUTOMOBILE BODY PRESS

Filed June 24, 1940

4 Sheets-Sheet 1



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2,390,359

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FIG. 2

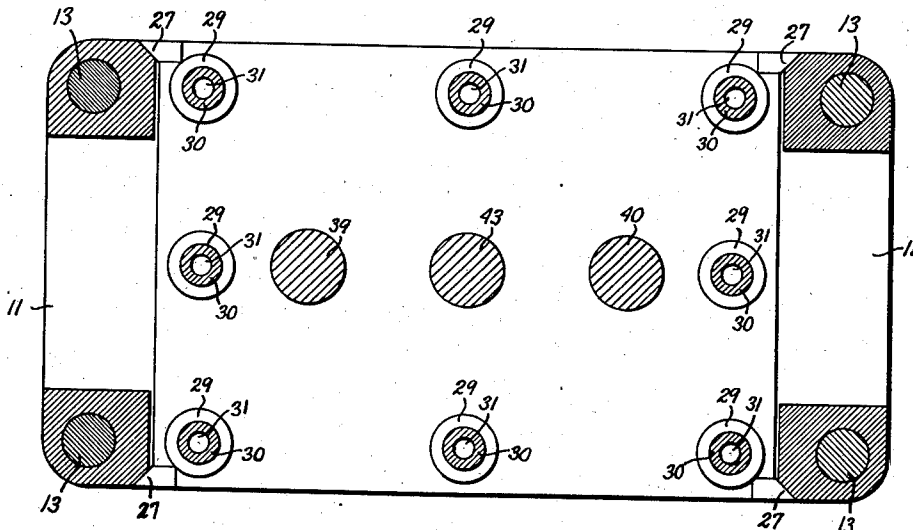
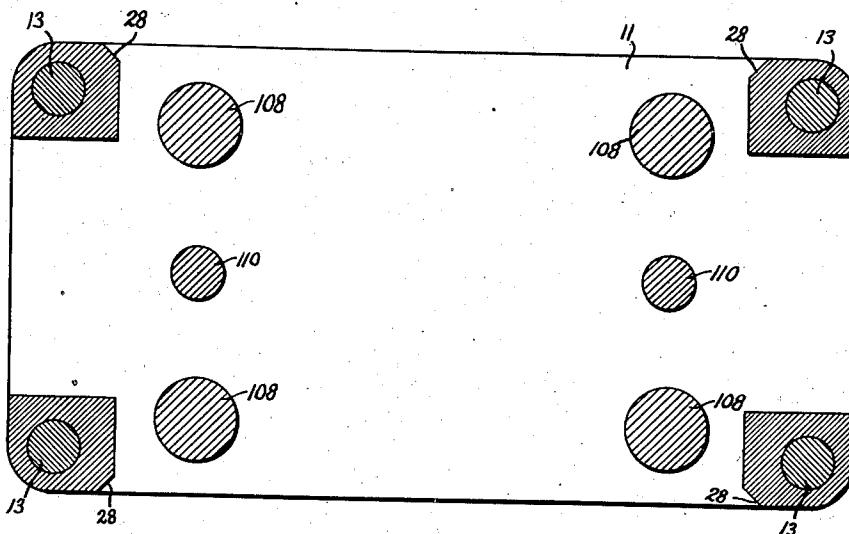


FIG. 3



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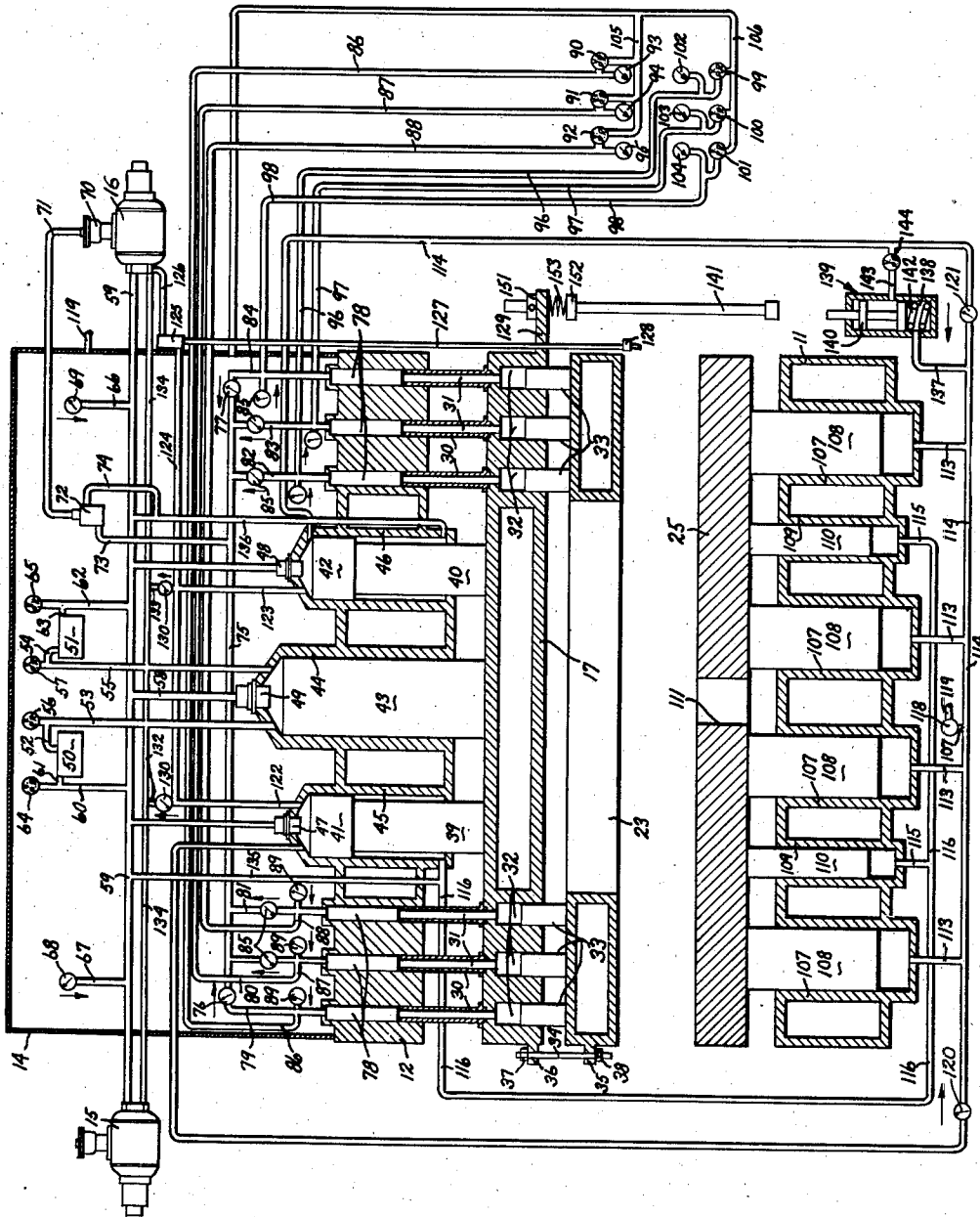


FIG 4

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FIG. 5

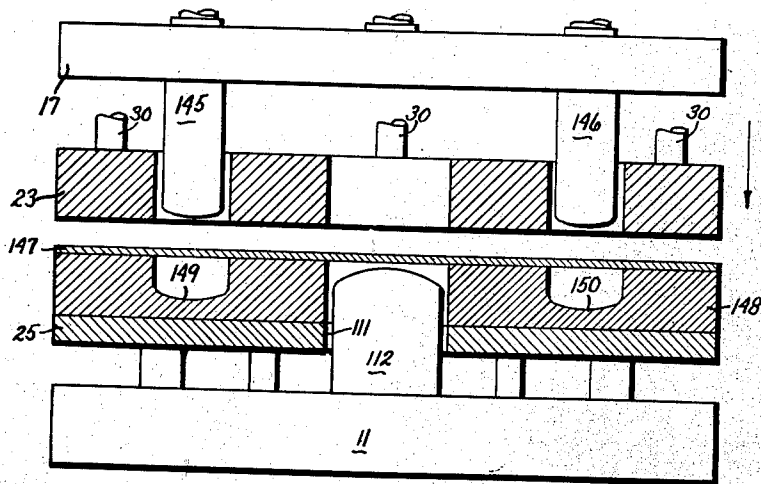


FIG. 6

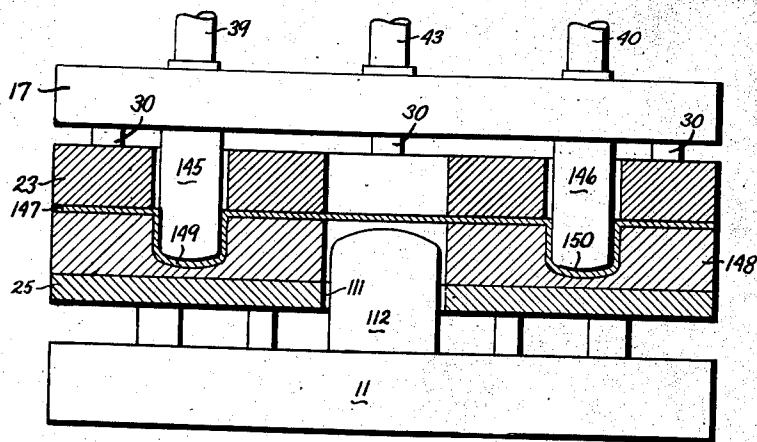
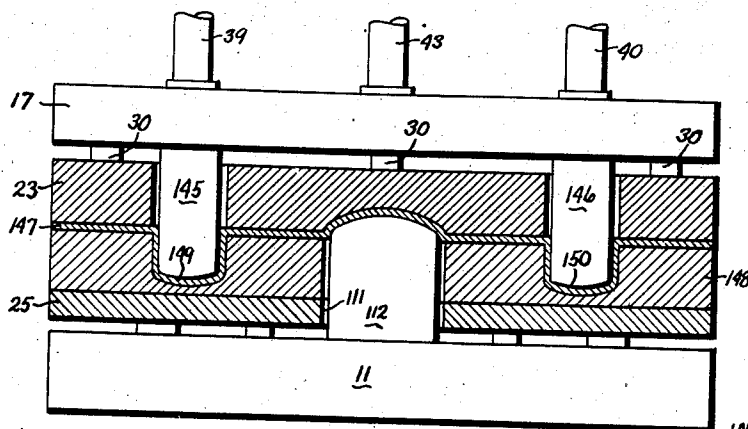


FIG. 7



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2,390,359

TRIPLE ACTION AUTOMOBILE BODY PRESS

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Application June 24, 1940, Serial No. 341,994

9 Claims. (Cl. 113—45)

This invention relates to presses and, in particular, to multiple action presses.

Multiple action presses, as heretofore known, comprise a plurality of metal shaping punches which are to be moved in opposite directions to perform the work piece shaping operation. Presses of this type are relatively complicated in construction and expensive in operation.

It is, therefore, an object of the invention to provide a multiple action press, in which the operation of the work piece shaping punches is materially simplified so as to reduce the cost of construction and operation.

A further object of the invention consists in the provision of a multiple action press in which one and the same die carrier moves during subsequent shaping operations.

Another object of the invention consists in the provision of a hydraulic multiple action press, in which, for shaping the work piece in a plurality of steps, only one power unit is required, acting all the while through the same main ram.

It is still another object of the invention to provide a hydraulic multiple action press, in which the press bed is associated with hydraulically adjustable die supporting means for holding the die associated therewith stationary during subsequent shaping operations, while the press platen moves in one and the same direction.

A still further object of the invention consists in the provision of a hydraulic multiple action press having a press bed and a pressing platen in which the press bed is associated with hydraulically adjustable die supporting means which is automatically adjusted responsive to a predetermined position of said pressing platen but held stationary during subsequent shaping operations of said platen.

It is a further object of the invention to provide a hydraulic multiple action press of the type set forth in the preceding paragraph, in which hydraulically adjustable die supporting means associated with the press bed works as die cushioning means between two subsequent actual shaping operations.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

Figure 1 illustrates a front view of the press according to the invention.

Figure 2 is a section along the line 2—2 of Figure 1.

Figure 3 illustrates a section along the line 3—3 of Figure 1.

Figure 4 is a diagrammatic illustration of the hydraulic system according to the invention.

Figures 5, 6 and 7 illustrate sequential steps during the work piece shaping operation.

General arrangement

The present invention comprises a press having a pressing platen associated with a first die member and a hydraulically adjustable bed plate for supporting a second die member. The bed plate is associated with a press bed, which comprises a stationary punch, and is held stationary during the shaping operation of the pressing platen so as to prevent operation of the stationary punch during the first shaping step, while bringing said stationary punch into action during the second working step.

Structural arrangement

Referring to the drawings in detail, the press illustrated in the drawings comprises a press bed 11 and a press head 12 connected with each other by strain rods 13. Supported by the press head 12 are a fluid tank 14 and two variable delivery pumps 15 and 16. The press head has, furthermore, associated therewith a pressing platen 17 operable by a main cylinder-piston-assembly, generally designated 18 and auxiliary cylinder-piston-assemblies, generally designated 19 and 20. The press head also supports clamping cylinder-piston assemblies 21 and 22 cooperating with the clamping platen 23. Supported by the press bed 11, which may be connected to the floor by screws 24, is a bed plate 25 which is hydraulically adjustable by means of cylinder-piston-assemblies, generally designated 26. While the pressing platen and clamping platen 17 and 23 respectively are guided in guides 27, the bed plate is guided by means of guides 28.

As will be seen from Figure 2, the press illustrated in Figure 1 comprises eight clamping cylinders 29, associated with hollow clamping pistons 30, which are connected with the pressing platen 17. Communicating with the bore 31 of each clamping piston 30 is a cylinder 32, provided in the pressing platen 17. The clamping platen 23 is movable relative to the pressing platen 17 and is supported thereby by means of a plurality of rods 34 which pass through lugs 35 and 36 connected with the clamping platen 23 and the pressing platen 17 respectively and carry at their ends nuts or collars 37 and 38. The pressing platen 17 is furthermore connected with two auxiliary plungers 39 and 40 carrying double-acting pistons 41 and 42. Arranged be-

tween the auxiliary double-acting pistons 41 and 42 is a single-acting main pressing plunger 43 reciprocable in the main cylinder 44. The main cylinder 44 forms a unit with the auxiliary cylinders 45 and 46 in which the auxiliary pistons 41 and 42 are reciprocably mounted.

The hydraulic system illustrated in Figure 4 comprises surge valves 47 and 48, arranged in the auxiliary cylinders 41 and 42, and the surge valve 49 associated with the main cylinder 44. The hydraulic system furthermore comprises cylinder relief and pump by-pass valves 50 and 51. The surge valves 47, 48 and 49 and the valves 50 and 51 do not form a part of the present invention and for a more detailed description thereof reference may be had to U. S. Patent 2,193,248 to Ernst, issued March 12, 1940, and the Ernst patent application No. 286,063, filed July 24, 1939. The purpose of the surge valves 47, 48 and 49 is to prefill the adjacent cylinder portions of the cylinders 45, 46 and 44 at the beginning of the working stroke of the main pressing plunger 43, and in cooperation with the valves 50 and 51 to relieve the pressure in the upper portion of the cylinders 45, 46 and 44 for facilitating initiation of the retraction stroke of the platen 17.

The valve 50 is connected with the main cylinder 44 by means of conduits 52 and 53, while the valve 51 is likewise connected with the main cylinder 44 by means of the conduits 54 and 55. Each of the conduits 53 and 55 has respectively associated therewith a safety valve 56 and 57. The surge valve 49 communicates, by means of a conduit 58 and a conduit 59, with the pumps 15 and 16. Also communicating with the conduit 59 are conduits 60 and 61 leading to the valve 50 and conduits 62 and 63 leading to the valve 51. The conduits 60 and 62 comprise respectively a safety valve 64 and 65. Furthermore, branching off from the conduit 59 are conduits 66 and 67 provided with check valves 68 and 69 respectively.

A servomotor 70 pertaining to the variable delivery pump 16 communicates through a conduit 71 with a two-way valve 72 adapted to effect communication between a conduit 73 and the tank 14 through an exhaust opening (not shown) in valve 72. Such servomotors in connection with variable delivery pumps are well known in the art and for a more detailed description thereof reference may be had to U. S. Patent No. 2,184,665 to Ernst. The conduit 73 leads to the conduit 75 comprising check valves 76 and 77 opening in opposite directions, and communicates with each of the clamping cylinder bores 78 by conduits 79, 80, 81, 82, 83 and 84. Each of the conduits 80, 81, 82 and 83 comprises a check valve 85 opening toward the conduit 75.

Branching off from the conduits 79, 80 and 81 are conduits 86, 87 and 88, each comprising a check valve 89 and leading respectively to relief valves 90, 91 and 92 associated with gauges 93, 94 and 95. The conduits 96, 97 and 98, branching off from the conduits 82, 83 and 84 lead respectively to safety valves 99, 100 and 101 associated with gauges 102, 103 and 104. The relief valves 90, 91 and 92 and 99, 100 and 101 are individually adjustable so as to open at a predetermined pressure through conduits 105, 106 to the fluid tank 14. In this way different clamping pressure may be obtained with the individual clamping cylinders 78.

The press bed 11 comprises a plurality of holding cylinders 107 having reciprocably mounted

therein plungers 108 connected with the bed plate 25. The press bed 11 furthermore comprises a plurality of push back cylinders 109 in which plungers 110 are reciprocably mounted, which plungers are likewise connected with the bed plate 25. The bed plate 25 comprises a bore 111 adapted to receive a stationary punch 112 (see Figure 5).

Each of the holding cylinders 107 is connected by a conduit 113 with a conduit 114, while each of the push back cylinders 109 is connected by means of a conduit 115 with a conduit 116. Branching off from the conduit 114 is a conduit 117 comprising a safety valve 118 and communicating by means of a conduit 119 with the fluid tank 14. The conduit 114 comprises two oppositely opening check valves 120 and 121 and communicates on one hand with the upper portion of the auxiliary cylinder 45 and on the other hand with the upper portion of the auxiliary cylinder 46. The upper portion of the auxiliary cylinders 45 and 46 communicates through conduits 122 and 123 with a conduit 124 leading to a two-way valve 125 which, in its turn, is adapted to communicate through conduit 126 with the pump 16. The valve 125 is controllable by means of a control rod 127 which has adjustably connected therewith a collar 128 adapted to be engaged by the arm 129 connected with the pressing platen 17.

The conduits 122 and 123 are adapted respectively to communicate through the check valves 130 and 131 and conduits 132 and 133 with a conduit 134 communicating with one side of the pumps 15 and 16. The other side of the pumps 15 and 16 is connected with the conduit 59 which, in its turn, communicates through conduits 135, 136 and 136 with the lower portion of the auxiliary cylinders 45 and 46 respectively.

Branching off from the conduit 114 is a conduit 137 leading to a chamber 138 of a control valve generally designated 139. Arranged in the chamber 138 of the control valve 139 is a valve member 140 adapted to be actuated by a control rod 141 adjustably connected with the arm 129 of the platen 17 by means of collars 151 and 152 which latter is continuously urged downwardly by a spring 153 engaging on one hand the platen arm 129 and on the other hand the collar 152. The valve member 140 is continuously urged upwardly by a spring 142 located in the valve chamber 138 so as to interrupt communication between the conduit 137 and the conduit 143 comprising a relief valve 144 and communicating with the conduit 114. Downward movement of the valve member 140 by means of the control rod 141 causes the conduits 137 and 143 to communicate with each other so that fluid below the plungers 108 may escape into the upper portion of the auxiliary cylinders 45 and 46.

Operation

Assuming that the pressing platen 17 is provided with punches 145 and 146, as indicated in Figure 5, and that a work piece 147 supported by the lower die 148 is to be shaped by means of the punches 145 and 146 and the stationary punch 112, the shaping operation will be effected in two steps, indicated in Figures 6 and 7.

Provided that all parts of the press occupy the position shown in Figure 4, which position corresponds to the end of the retraction stroke, the pressing operation is carried out as follows:

The pumps 15 and 16 are started in any convenient manner by shifting the flow-control mem-

ber (not shown) associated therewith into full stroke forward position. The shifting of the said flow-control member also causes fluid pressure to pass through the conduit 71 so as to cause the valve 72 to interrupt communication between the conduit 73 and the tank 14. While the pressing platen 17 together with the auxiliary pistons 41 and 42 will slide downwardly by gravity, the upper portions of the auxiliary cylinders 45 and 46 and of the main cylinder 44 will be supplied by fluid flowing from the tank 14 through the surge valves 47, 48 and 49. In addition thereto, the pumps 15 and 16 will supply the main cylinder 44 with fluid through the conduits 134, 53 and 55. Downward movement of the platen 17 also causes downward movement of the hollow clamping pistons 30, and the clamping cylinder bores 78 will be supplied with fluid flowing from the tank 14 through the check valves 89 and the conduits 75 and 80 to 84. The clamping platen 23 supported by the pressing platen 17 will of course likewise move downwardly together with the platen 17. As soon as the clamping platen 23 engages the work piece 147, the clamping platen 23 comes to a standstill so that further downward movement of the pressing platen 17 causes a relative movement of the plungers 33 with respect to the cylinders 32. This relative movement results in a building up of pressure in the cylinders 32 which pressure is conveyed into the cylinder bores 78 where it acts upon the hollow pistons 30 thereby supporting the relative movement of the platen 17 and cylinders 32 with regard to the plungers 33 and increasing the clamping pressure exerted upon the clamping platen 23. If any excessive pressure should occur in the cylinders 32 and 78, this excessive pressure will be conveyed through the conduits 86, 87 and 88 and the conduits 96, 97 and 98 to the relief valves 90, 91 and 92, and valves 99, 100 and 101, which will then open to exhaust.

When the clamping platen 23 is thus firmly pressed against the work piece 147 the punches 145 and 146 begin to act upon the work piece 147. Pressure now builds up in the upper portion of the main cylinder 44 and the auxiliary cylinders 45 and 46 with the result that the surge valves 47, 48 and 49 and the check valves 130 and 131 close. At this time the platen arm 129 has engaged the collar 128 on the control rod 127 so as to effect communication between the conduit 126 and the conduit 124. Pressure fluid will therefore also be supplied by the pumps 15 and 16 through the conduit 126, the valve 125, the conduit 124 and the conduits 122 and 123 to the auxiliary cylinders 45 and 46 respectively. The fluid expelled by the auxiliary pistons 41 and 42 is conveyed through the conduits 135 and 136 and the conduit 59 to the suction side of the pumps 15 and 16. Since the fluid conveyed by the pistons 41 and 42 to the suction side of the pumps 15 and 16 is less than that required by the pressure side of said pumps, additional fluid is taken in from the tank 14 through the check valves 68 and 69 associated with the conduits 67 and 66 respectively. Since the pressure acting upon the pistons 41 and 42 also prevails in the conduit 114 and since, furthermore, the valve member 140 is in its uppermost position, no fluid can escape from the holding cylinders 107 so that the bed plate 25 is held in its upper position. The pressing platen 17 now performs the first working step, as indicated in Figure 6, from which it will be noted that the work piece 147 has been shaped

in accordance with the shaping of the punches 145 and 146 and the corresponding recesses 149 and 150 in the lower die 148.

At the end of the first working step the control rod 141 engages the valve member 140 and, due to the further downward movement of the platen 17, moves the valve member 140 against the thrust of the spring 142 downwardly thereby establishing communication between the conduit 137 and the conduit 143. This position of the valve member 140 enables the fluid in the holding cylinders 107 to escape through the conduits 113 and 114 into the auxiliary cylinders 46 and from there through the conduits 123 and 124 into the auxiliary cylinders 45, thereby supporting the fluid pressure acting upon the pistons 41 and 42 and the plunger 43, while the plungers 108 in cooperation with the cylinders 107 act as cushioning means and the bed plate 25 gradually recedes until it arrives at its lowermost position. As soon as this position has been reached, the stationary punch 112 has bulged out the work piece 147, as indicated in Figure 7, and the second shaping operation is finished.

As will be seen from the drawings, the clamping platen or blank holder 23 does not firmly clamp the work piece against the lower die since, during the second working step, there is no relative movement between the blank holder pistons 33 and the blank holder cylinders 32, whereas relative movement occurs between the hollow pistons 30 and the clamping cylinder bores 78. However, the work piece is nevertheless firmly held in its position by the punches 145 and 146 pressing against the lower die and moves together with the pressing platen 17 and the bed plate 25.

If, for any reason, the valve member 140 should get stuck or undue pressure in that portion of the conduit 114, which is located between the check valves 120 and 121, should develop for any other reason, the excess pressure will be released through the emergency valve 118 and the conduit 119 leading to the fluid tank 14.

In order to start the retraction stroke of the pressing platen 17 to remove the work piece, the flow-control members of the pumps 15 and 16 are shifted to full delivery retraction stroke position by any convenient means so that the conduit 59 becomes the pressure side and the conduit 134 becomes the suction side. As soon as this shifting movement is carried out, the cylinder relief and pump by-pass valves 50 and 51 release the pressure in the upper portion of the cylinders 44, 45 and 46, while the valves 130 and 131 open, thereby facilitating initiation of the retraction stroke. Pressure fluid from the pumps 15 and 16 now flows through the conduit 59 and the conduits 135 and 136 into the lower portion of the auxiliary cylinders 45 and 46, thereby moving the pistons 41 and 42 upwardly and lifting the pressing platen 17. At the same time pressure fluid flows from the conduit 135 through the conduits 116 and 115 into the lower portion of the push back cylinders 109, thereby lifting the bed plate 25. The dimensions of the retraction side of the auxiliary pistons 41 and 42, with regard to the diameter of the push back plungers 110 are preferably such that the platen 17 is lifted faster than the bed plate 25. The fluid expelled by the pistons 41 and 42 is passed through the now open surge valves 47 and 48 and also through the conduits 114 and 113 to the holding cylinders 107 thereby filling the space between the plungers 108 and the lower portion of the cylinders 107, while the bed plate 25 is

lifted by means of the push back plungers 110. The fluid expelled by the main pressing plunger 43 is exhausted through the now open surge valves 49 into the tank 14 and through conduits 53 and 134 to the suction side of the pumps 15 and 16.

During the first portion of the retraction stroke, the pressing platen 17 recedes, while the blank holder 23 still rests upon the work piece 147. As a result of this relative movement of the pressing platen 17 and the blank holder 23, the space of the cylinders 32 above the upper surface of the plungers 33 gradually increases, while the space of the cylinders 78 above the upper surface of the hollow clamping pistons 30 decreases. Consequently, the pressure tending to develop in the cylinders 78 is conveyed through the hollow clamping pistons 30 into the cylinders 32 where it makes up to a certain extent the decrease in pressure occurring in the cylinders 32. In this way the space between the pressing platen 17 and the blank holder 23 gradually increases until the lugs 35 connected with the blank holder 23 engage the collars 38. From this point on the blank holder 23 will be lifted in unison with the pressing platen 17.

The fluid pressure in the push back line 136 is conveyed through the conduit 74 to the valve 72 so as to effect communication between the conduit 73 and the tank 14 with the result that the fluid from the clamping cylinders 78 may freely exhaust through the conduits 75, 73 and valve 72 into the tank 14.

Retraction of the pressing platen 17 will cause the control rod 141 to disengage the shifting member 140 so that the latter will again be lifted to its uppermost position by the spring 142, in which position communication between the conduits 137 and 143 is again interrupted.

After the auxiliary pistons 41 and 42 and the main pressing plunger 43 have performed the full retraction stroke, the pumps 15 and 16 are shifted to neutral or substantially no delivery position by any convenient means, well known to those skilled in the art, whereupon the press comes to a standstill. All parts now again occupy the position shown in Figure 4 and the press is ready for another cycle.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a multiple action press, a first die member, fluid operable means for advancing and retracting said die member, a second die member for cooperating with said first die member to effect a first drawing operation, a movable support for said second die member, a fluid operable cylinder-piston-assembly for actuating said support, valve means operable to entrap the fluid in said cylinder-piston-assembly for holding said support stationary during said first drawing operation, a third die member arranged stationary for cooperation with said second die member, conduit means controlled by said valve means for establishing fluid connection between said cylinder-piston-assembly and said fluid operable means, and means responsive to a predetermined travel of said first die member for actuating said valve means to establish said fluid connection, thereby allowing movement of said movable support toward said third die member to enable a second drawing operation in response to a continued advance of said first die member while causing fluid expelled from said cylinder-piston-

assembly to pass to said fluid operable means and to assist the latter.

2. In combination in a multiple action press, fluid operable supporting means for movably supporting a first die member, a reciprocable press plunger adapted to support a second die member for cooperation with said first die member, a third die member stationarily mounted for exerting a shaping action on a work piece being shaped by said first and second die members, control means for hydraulically locking and temporarily maintaining said supporting means stationary in a predetermined position to hold said work piece spaced from said stationary die member, thereby making said stationary die member ineffective, and means responsive to a predetermined movement of said second die member for actuating said control means to hydraulically unlock said supporting means, thereby allowing said press plunger to advance said work piece toward said stationary die member to make the latter effective.

3. In combination in a multiple action press, a press platen, die means supported by said platen, hydraulic motor means for advancing and retracting said platen, hydraulically movable supporting means for supporting a work piece, said supporting means having a passageway therethrough, means for locking and maintaining said supporting means in a predetermined position for cooperation with said die means to effect a drawing step, and means responsive to a predetermined advancement of said platen during said drawing step to unlock said supporting means for causing said platen, during its further advancing movement, to move said supporting means toward a stationary die member, thereby causing the latter to act upon said work piece through said passageway for exerting a further shaping operation on said work piece.

4. In a multiple action press, a press head, a press platen associated with said press head and adapted to receive a first die member, a press bed, cushion means associated with said press bed and adapted to cooperate with said press platen, said cushion means being adapted to support a second die member and a work piece, hydraulically operable clamping means for clamping the work piece with respect to said cushion means, a third die member stationary with respect to said bed and adapted to extend through said second die member, hydraulic motor means common to said press platen, said cushion means and said clamping means for operating the same, means for making said cushion means ineffective during a first shaping action of said platen, and means operable in response to a predetermined travel of said platen during said first shaping action to make said cushion means effective while the platen continues its advancing movement for causing said third die member to extend through said second die member and to exert a shaping action upon said work piece.

5. In a multiple action press, a press plunger, hydraulic motor means operatively connected with said press plunger for reciprocating the same, a stationary die member, work piece supporting means movable with respect to said die member to selectively space a work piece on said supporting means from said die member to allow said press plunger to exert a first shaping action on said work piece, or to bring said work piece into engagement with said die member, to cause the latter to exert a second shaping action on said work piece, a hydraulic cylinder-piston-

assembly for movably supporting said supporting means, valve means normally entrapping the fluid in said hydraulic cylinder-piston-assembly to hold said supporting means stationary in spaced position from said die member, and means responsive to a predetermined advancing movement of said press plunger to shift said valve means into position for effecting fluid connection between said cylinder-piston-assembly and said hydraulic motor means, thereby aiding the advancing movement of said press plunger and causing said die member to effect said second shaping action.

6. In a multiple action press, a press platen, clamping means for clamping a work piece, hydraulic means for operating said clamping means and advancing and retracting said press platen, said press platen being adapted to receive a first die member, a press bed, a stationary die supported by said press bed, work piece supporting means movable with respect to said press bed, fluid operable means for actuating said supporting means, valve means operable to entrap fluid in said fluid operable means to hold said work piece spaced from said stationary die and to allow said first die member to exert a first shaping action upon said work piece, and means responsive to a predetermined travel of said press platen for actuating said valve means to release fluid from said fluid operable means in response to the advancing movement of said supporting means together with said work piece toward said bed for bringing said work piece into engagement with said stationary die and causing the latter to exert a second shaping action upon said work piece.

7. In a multiple action press, a reciprocable press platen adapted to receive a first die member, hydraulic motor means including a main cylinder and an auxiliary cylinder for advancing and retracting said platen, a press bed, movable supporting means associated with said press bed for supporting a work piece to be shaped, said supporting means being adapted to receive a second die member to exert a first shaping action upon said work piece, a third die member stationary with respect to said press bed, a fluid operable cylinder-piston-assembly associated with said supporting means for movably supporting the latter, valve means normally entrapping the fluid in said cylinder-piston-assembly to allow of said supporting means being held stationary in a predetermined spaced position with respect to said bed during said first shaping action, means responsive to a predetermined travel of said platen for causing said valve means to establish fluid connection between said cylinder-

der-piston-assembly and said auxiliary cylinder to cause said supporting means to recede in response to the advancing movement of said platen so as to bring said work piece into engagement with said third die member, and means for conveying fluid expelled from said cylinder-piston-assembly to said auxiliary cylinder for assisting the advancing movement of said platen.

8. In combination in a multiple action press, a press plunger adapted to support a first die, fluid operable advancing and retracting means for reciprocating said plunger, movable supporting means adapted to support a work piece and to cooperate with said first die for exerting a first shaping action upon said work piece, a fluid operable cylinder-piston-assembly for selectively effecting movement of said supporting means into advanced or retracted position, controlling means for controlling the release of fluid from said cylinder-piston-assembly, a fluid source for supplying actuating fluid to said press plunger and said cylinder-piston-assembly, means independent of said controlling means and responsive to the supply of fluid to said retracting means for conveying fluid to said cylinder-piston-assembly to move the same into advanced position, means continuously urging said controlling means into position for entrapping the fluid in said assembly, a second die stationarily mounted and adapted to exert a shaping action upon said work piece in response to a movement of said supporting means from its advanced position into its retracted position, and means responsive to a predetermined travel of said press plunger during said first shaping action for shifting said controlling means into releasing position to allow movement of said supporting means to its retracted position to make said second die effective.

9. In a multiple action press, a press platen, a shaping die carried by said platen, movable supporting means adapted to support a work piece and to cooperate with said platen, a single hydraulic power unit for advancing and retracting said platen and adjusting and holding said supporting means stationary during a predetermined advancement of said platen to allow said die on the platen to effect a first shaping operation, oppositely extending stationary die means, and means responsive to a predetermined advancement during one and the same advancing stroke of said platen for causing said supporting means to move concomitantly with said platen to bring said work piece into engagement with said stationary die means for effecting a second shaping operation on said work piece.

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