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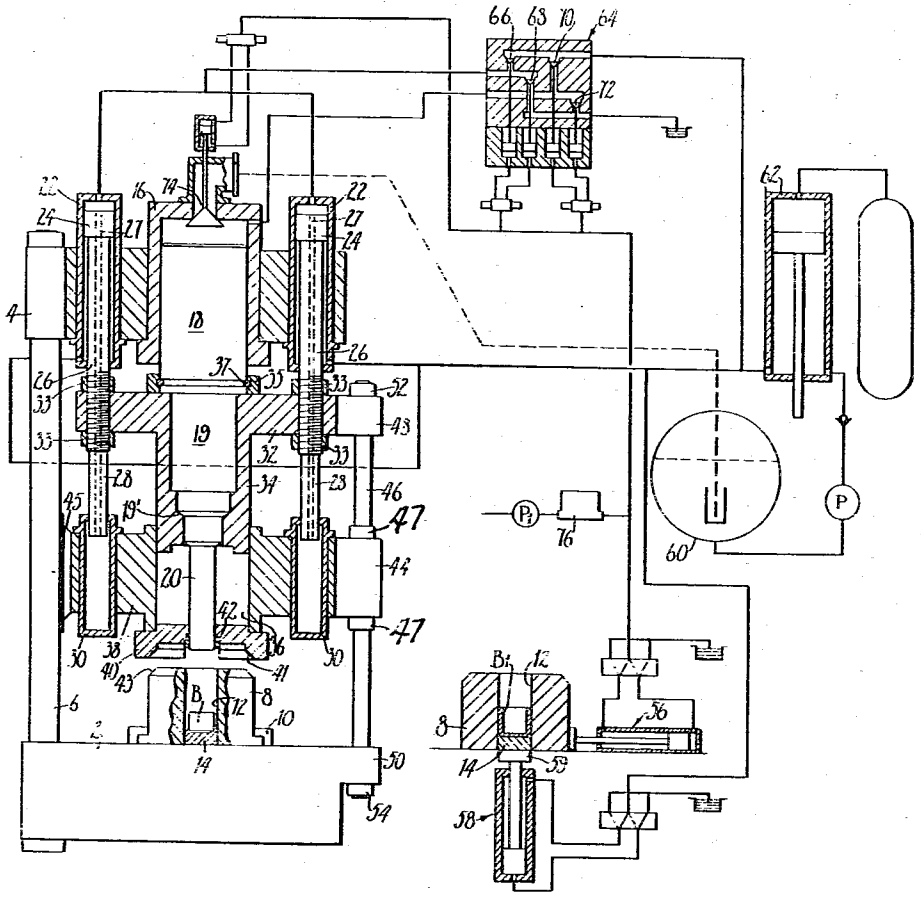

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ABSTRACT OF THE DISCLOSURE

Describes a hydraulic press having a first and second movable hydraulic system, a main tool in the first system and an auxiliary tool in the second system, with means to stop the movement of the secondary system when the auxiliary tool has reached its working position, means to speed up the movement of the main tool when the auxiliary tool has come to rest and double acting cylinders in said second system to return both systems to their starting position when the main tool has finished its work.

The invention relates to hydraulic presses, and, in particular, to hydraulic presses having more than one movable system, each having its own pressure unit or units for its movement.

It is an object of the present invention to provide a hydraulic press of the above-mentioned type in which the main tool is capable of rapid movement while economising in pressure fluid.

In a press having two movable systems, one system may include a main ram and a main pressing or forming tool, such as a punch, attached to said main ram, and the second system may include centering or blank-holding means which, at the beginning of the approach stroke of the tool, have to be moved at a relatively slow speed until they come to rest, whereupon the tool makes the remainder of its approach stroke at a faster speed.

It is a special object of the present invention to provide a press of the type described in the preceding paragraph, in which the two systems are operated in such a manner that high pressure fluid is saved, and the transmission from slow to fast movement during the approach stroke of the tool takes place without the necessity for operating any valves or switches.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawing whose single Figure shows a vertical press according to the invention, partly in elevation and partly in section, with the hydraulic circuits of the press added in diagram form.

The press illustrated in the drawing is intended for the production of hollow bodies with closed ends by piercing and backward extrusion, and has a lower platen **2**, and upper platen **4** and columns **6** connecting the two together, so as to provide a rigid stationary frame. The lower platen carriers a container **8** for billets B which is slidable along guides **10** on platen **2**. The container can thus be placed either in a working position in the main vertical axis of the press frame, as shown in the left of the figure, or in a position outside the frame for loading and unloading, as shown in the centre of the figure. The

container **8** has a central opening **12** which can receive a billet B and which at its lower end is closed by a die **14**. For the sake of simplicity, the die is shown as being placed directly on top of platen **2**, although in actual practice one or more bolsters may be interposed between die and platen.

The upper platen **4** carries a main cylinder **16** in which a main ram **18** is displaceable. This ram has a downward extension or shaft **19** to which a mandrel or punch **20** is detachably secured. Two cylinders **22** are further mounted on the platen **4**, one at each side of cylinder **16** and equidistant from its axis. Pistons **24** are displaceable in cylinders **22**. Each piston has a downward extension **26** to which a further downward extension **28** of somewhat smaller diameter is joined. The latter extensions are displaceable in cylinders **30**. Both pistons **24** and their respective extensions **26/28** have through longitudinal bores **27**, so that the spaces in the cylinders **22** above the pistons **24** are in direct communication with the spaces in the cylinders **30** below the extensions **28**.

The extensions **26** are threaded over that part of their length which is always outside the cylinders **22** whatever the position of the pistons **24** in those cylinders. A first movable crosshead **32** is secured by these threaded portions to the extensions **26** and locked in position by nuts **33**. Secured to the top of crosshead **32** is a retaining ring **35** with a split ring **37** mounted inside it which enters an annular groove in main ram **18**. Thus, this ram is fixedly attached to crosshead **32**.

Downwardly depending from crosshead **32** is a barrel **34** adapted to be received in a bore **36** of a second movable crosshead **38**. The shaft **19** is centred in extension **34** by a conical seat 19_1. This latter crosshead carries the above-mentioned cylinders **30**.

The bore **36** of crosshead **38** is partly closed at its lower end by a ring **40** attached to crosshead **38** and having a central hole for the passage therethrough of punch **20**. Located in the opening of ring **40** is a stripper ring **42**. The ring **40** has on its underside a conical face **41**, adapted to engage a matching conical seat **43** on the top of the container **8**. In this way, the ring **40** and thereby also the punch **20** are centred relative to container **8** and its bore **12** when, on descent of ring **40**, face **41** engages seat **43**.

Crosshead **38** is guided on columns **6** by shoes **45** and has also lugs **44** at its ends to which rods **46** are fastened by nuts **47**. These rods extend upwardly and downwardly as far as the crosshead **32** and the bottom platen **2** respectively. The rods pass through lugs **48** on the crosshead **38** and lugs **50** on the platen **2**, and carry at their ends nuts **52** and **54** respectively as stops.

A piston-and-cylinder unit **56** is provided for the transverse movement of the container **8** along guides **10** from the working to the loading/unloading position. Another piston-and-cylinder unit **58** installed below that last-mentioned position operates an ejector **59** for removing a punched billet B from the container **8**.

The hydraulic system for operating the aforedescribed press contains a low-pressure tank **60**, an accumulator **62** which is shown here as being of the piston type, but may be of any other suitable type, and a control block **64**. A pump P takes water from tank **60** to accumulator **62** which is directly connected to the return sides of the cylinders **22**, whereas the advance sides of these cylinders and the main cylinder **18** are connected to the accumu-

lator through valves in the control block 64. These valves include an inlet valve 66 and an outlet valve 68 for the advance side of the cylinders 22, and an inlet valve 70 and an outlet valve 72 for the main cylinder 16. A pre-fill valve 74 admits low-pressure fluid from tank 60 to cylinder 16.

A servo-pump P_1 and a servo-accumulator 76 feed pressure fluid to the controls of the above-mentioned valves and also direct to piston-and-cylinder unit 56.

Operation of the press starts with a billet B being loaded into the bore 12 of container 8 outside the press. In many cases, a fresh die 14 is required for each operation. This is then placed into the container bore 12 in advance of the billet. The container is then moved back into the press by the piston-and-cylinder unit 56.

Valve 66 is now opened to allow high-pressure fluid to enter the space in the cylinders 22 above their pistons 24. The space in these cylinders below the pistons 24 is always kept filled with hydraulic fluid taken direct from accumulator 62 and hence at constant pressure. Assuming that:

p is the specific pressure of the hydraulic fluid from accumulator 62

A_1 the cross-sectional area of the space inside a cylinder 22

A_2 the cross-sectional area of an extension 26

A_3 the cross-sectional area of an extension 28.

then

$P_1=2\times p\times A_1$ is the pressure acting on both pistons 24 from above

$P_2=2\times p\times (A_1-A_2)$ the pressure acting on both pistons 24 from below

$P_3=P_1-P_2=2\times p\times A_2$ the resultant pressure acting on the pistons 24 from above

After opening of the valve 66, the pistons descend under the pressure P_3, together with the crosshead 32, being followed by crosshead 38 with cylinders 30, and also the main run 18 with punch 20, the main cylinder 16 being filled at the same time with low-pressure fluid from tank 60 through pre-fill valve 74. This movement takes place at the relatively slow rate at which pressure fluid enters the cylinders 22. There is no relative displacement between cylinders 30 and extensions 28 at this stage.

Downward movement of ring 40 continues until its face 41 engages seat 43 on container 8, whereby the ring 40 and consequently also crosshead 38, bore 36, barrel 34 and punch 20 are centered relative to that container. The crosshead 38 and the cylinders 30 are then at a standstill, and further downward movement of the pistons 24 and extensions 26/28 has to resist the pressure in these cylinders. Hence, the resulting pressure on pistons 24 is now reduced to:

$$P_4=2\times p\times (A_2-A_3)$$

The ensuing displacement of extensions 28 in cylinders 30 causes pressure fluid from these cylinders to flow through bores 27 into the space of the cylinders 22 above pistons 24, thus augmenting considerably the rate at which pressure fluid is fed into this space and correspondingly increasing the speed of the downward movement of crosshead 32 and punch 20. As the crosshead 32 continues its descent after engagement of ring 40 with container 8, the lugs 48 of crosshead 32 move out of contact with nuts 50. During this stage, the main ram 18 descends together with the crosshead 32.

When, during this descent, the punch 20 reaches a point just above billet B, contact of a part moving with the punch with an electric limit switch, not shown, causes valve 70 to open, so that high-pressure fluid is supplied to main cylinder 16, and pre-fill valve 74 caused to close. Punch 20 now descends under full power to pierce a billet B, extruding it backwards at the same time, so

that billet B is transformed into a cup-shaped body B_1. The pistons 24 remain under pressure and relieve, therefore, the main ram, at least to some extent, from the necessity to supply power to the crosshead 32. At the end of the stroke, the lower end of barrel 34 engages ring 40 from above, the power of the stroke being absorbed through container 8 and lower platen 2.

After the end of the working stroke of punch 20, valves 68 and 72 are opened and valves 66 and 70 closed. The spaces above main ram 18 and pistons 24 are thereby connected to the low-pressure tank 60. The constant pressure acting on the cylinders 30 from below on the extensions 28 causes the pistons 24, and thereby also crosshead 32, to rise. The latter takes main ram 18 and punch 20 with it, whereas crosshead 38 with ring 40 remains stationary. Stripper ring 42 can thus free punch 20 from cup B_1 should the latter adhere to the former. As soon as the lugs 48 reach the nuts 52, crosshead 38 and ring 40 are returned to their starting positions. It will be seen from the foregoing that the return of the various parts of the press is effected without the aid of any special return cylinders.

After the ring 40 has been lifted from the container 8, the latter can be shifted by means of piston-and-cylinder unit 56 to the unloading station outside the press where the cup B_1 and die 14 can be ejected from container 8 through ejector 59. A fresh die and another billet are then placed into the container bore 12, and the container moved back into the press. A new cycle of operation can then begin.

The following is an example of the pressure capacities acting in the hydraulic system of the press:

	Tons
Main ram 18	1450
Top of each piston 24	280
Underside of each piston 24	100
Cylinders 30	150

It is to be understood that these figures are only by way of example, and that the pressure capacities in the cylinders may vary over a wide range.

We claim:

1. A hydraulic press comprising first and second movable systems, said first movable system including a main hydraulic unit and a main pressing tool attached to the ram of said unit, and said second system including an auxiliary tool co-axial with said main tool, auxiliary hydraulic units having cylinders and pistons attached to said first movable system, secondary cylinders attached to said second movable system, extensions from said pistons depending into said secondary cylinders and having a diameter smaller than the diameter of said pistons, the space in said secondary cylinders being connected by ducts to the space in the cylinders of said auxiliary units above their pistons, the cylinders of said auxiliary unit being double acting, with that part of their pistons passing through the cylinders of said auxiliary unit having a larger diameter than that part of the extensions of said pistons which depend into said secondary cylinders, and means for arresting the movement of said second movable system before the first movable system has finished its stroke.

2. A hydraulic press according to claim 1, in which each of said movable systems has a crosshead, the crossheads being coupled to each other in such a manner that the crosshead of the second system is carried along by the crosshead of the first system during the return stroke of the latter.

3. A hydraulic press according to claim 2, in which the crosshead of the first movable system has a barrel-shaped extension in which the holder for the main tool is centred, and which itself is centred again in a bore in the crosshead of the second movable system.

4. A hydraulic press according to claim 1, in which the main tool is a punch and the auxiliary tool a ring for stripping a workpiece from said punch after the workpiece has been pierced.

5. A hydraulic press according to claim 1, in which the movement of the second movable system is stopped by a stripping ring meeting a container for the workpieces undergoing a forming operation in the press.

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