Nov. 17, 1964 G. L. ANDERSEN 3,157,111

WORK EJECTOR FOR PRESSES

Filed May 15, 1961

FIG.1.

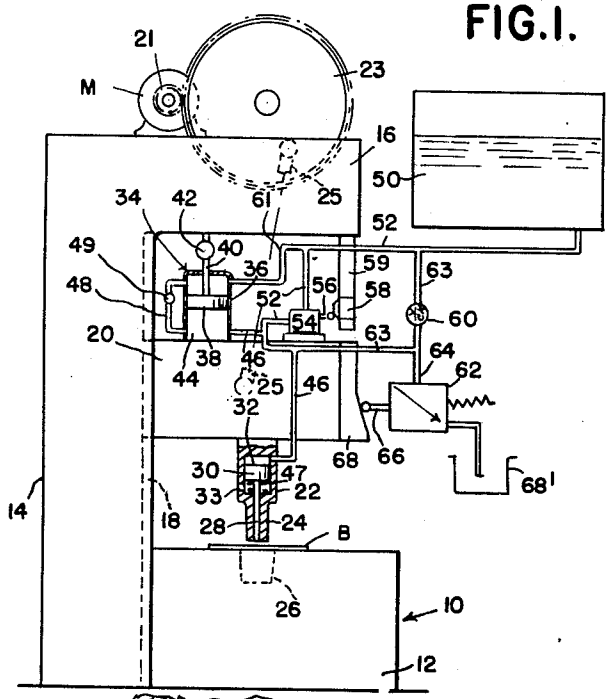


FIG.2.

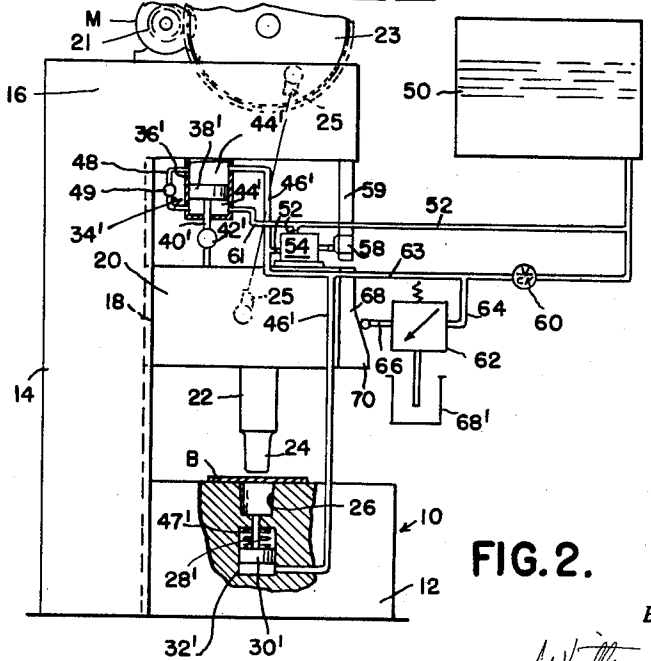


FIG.3.

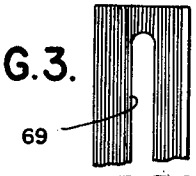


FIG.5.

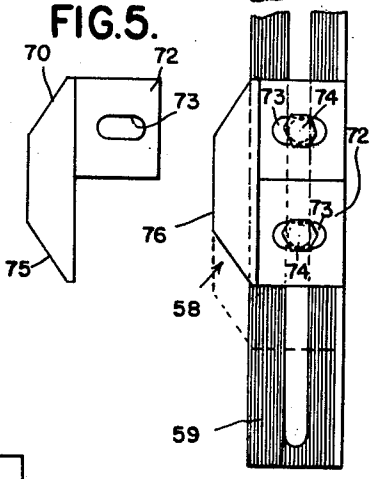


FIG.4.

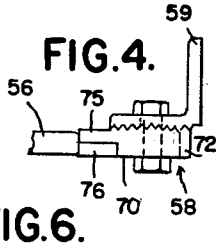
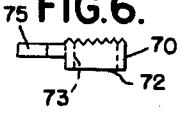


FIG.6.



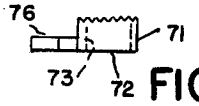


FIG.7.

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3,157,111
WORK EJECTOR FOR PRESSES

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This invention relates generally to a work ejector for presses and refers more particularly to a work ejector for use on a mechanically driven cold extrusion press which is operated by the moving parts of the press itself and especially by the inertia of the press flywheel. This application is a continuation-in-part of my co-pending application Serial No. 13,068 filed March 7, 1960, now abandoned.

The tonnage used in cold extrusion is very high. Accordingly any ejection device must be kept small since in any form it represents a hole in the die support which must be bridged by the die. Purely hydraulic systems now available have certain drawbacks. First of all, an expensive high pressure system (on the order of 5,000 p.s.i.) would be required to keep the knock-out cylinders small. While an accumulator could be employed to reduce the horsepower required to operate the pump, accumulators are undesirable because of the loss in control of the rate of knock-out speed. Even in hydraulically operated presses of a size large enough to do cold forming work, a separate high pressure hydraulic knock-out system would be required since such presses are operated by relatively low pressure pumps, that is less than 3,000 p.s.i.

Mechanically driven presses inherently have the reserve power to operate a work ejector, and accordingly one object of this invention is to provide a work ejector for a mechanically driven press which is essentially mechanical in operation but which operates through a column of hydraulic fluid, the ejector being operated by the moving parts thereof and in particular by the inertia of the flywheel. Pressures of up to 9,000 p.s.i. are available for the ejector, and the cost of the system is a small fraction of any standard purely hydraulic unit. Such energy as is required is taken from the flywheel and any resultant slowdown does not result in a loss of timing because the ram is directly geared to the flywheel.

Another object is to provide a power device having a piston and cylinder, one of which is mounted on the ram of the press and the other is mounted on the stationary press frame, and a hydraulic fluid conduit communicating with a chamber defined by the piston and cylinder and connected to the work ejector to operate the same by pressure developed in the chamber. Accordingly the pressure developed in the chamber results from the movement of the ram which is geared to the flywheel.

Another object is to provide a system wherein the pressure transmitting conduit is not subjected to any flexing and hence may be in the form of a rigid tube.

Another object is to provide a work ejector and operating means therefor as described above having control means for defining the period of time during which pressure fluid is delivered to the work ejector as well as for regulating the pressure delivered.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, illustrating preferred embodiments of the invention, wherein:

FIGURE 1 is a side elevational view, partly in section, diagrammatically illustrating a press embodying my invention.

FIGURE 2 is similar to FIGURE 1 but illustrates a modification.

FIGURE 3 illustrates a cam and track carried by the crown of the press.

FIGURE 4 is a plan view of the cam and cam track shown in FIGURE 3.

FIGURES 5, 6 and 7 are detail views of parts making up the cam.

Referring now more particularly to the drawing and especially to FIGURE 1 thereof, the cold extrusion press there illustrated comprises a frame generally indicated at 10 having a bed plate 12, an upright column or columns 14 and a crown 16. The portions 12, 14 and 16 are all parts of the rigid press frame. The upright column has a vertical guideway 18 receiving the ram 20 for reciprocation. A motor M which may be an electric motor is mounted on the crown 16 of the frame and a pinion 21 either on the output shaft of the motor or on the output shaft of a gear box driven by the motor meshes with a flywheel 23 mounted for rotation on the crown 16. A connecting rod or crank 25 has one end pivoted to the flywheel and the other end pivotally connected to the ram so that rotation of the flywheel by the motor produces a required up and down reciprocation of the ram. The ram carries a depending plunger-like member 22 having at the lower end a generally cylindrical work forming projection 24 adapted to cooperate with the recess or die 26 in the bed plate 12 to form a workpiece from a blank B initially laid over the die, or from a slug placed in the cavity 26.

The plunger 22 carries a knock-out pin 28 which slides in a vertical passage of the plunger and is connected at its upper end to a piston 30 reciprocable within a cylinder 32 also inside the plunger. Below the piston, the cylinder is vented at 33. The knock-out pin is shown retracted and in its extended position projects beneath the work forming projection 24 to disengage or strip a formed part. The knock-out pin is operated or projected downwardly by pressurizing the cylinder 32 above the piston. This is accomplished by structure including a power device indicated generally at 34 and including a cylinder 36 secured to the ram and a piston 38 reciprocable within the cylinder. The cylinder is disposed vertically and the piston is connected to the crown 16 of the frame by a rod 40. It will be noted that the rod 40 incorporates therein a self-aligning coupler 42 to compensate for any misalignment between the cylinder and the piston. The cylinder 36 and piston 38 cooperate to define a pressure chamber 44 which communicates with the space in cylinder 32 above piston 30 by way of a conduit 46. The upper end of the conduit is secured to the cylinder 36 and its lower end is secured to plunger 22. Thus both ends of the conduit are movable as a unit with the ram. A light spring 47 may, if desired, be utilized to retract piston 30. A conduit 48 connects the space in cylinder 36 above the piston to the chamber 44 below, and a check valve 49 in the conduit permits flow toward chamber 44 only.

A reservoir 50 is provided as a reserve for hydraulic fluid and is connected to conduit 46 by means of a conduit 52. Preferably a pressure of about 40 p.s.i. is maintained in the reservoir. The conduit 52 has therein a normally open valve 54 which has a valve element 56 in position to be engaged by a cam 58 and cam track 59 depending from the crown of the press. The housing of valve 54 is fixed on the ram. A by-pass conduit 63 is provided which bypasses valve 54 and has a check valve 60 therein which permits flow of hydraulic fluid in a direction away from the reservoir but prevents reverse flow. A conduit 61 also extends from the space in cylinder 36 above the piston to conduit 52.

A pressure regulating valve 62 is provided which is connected in the system by a conduit 64. This valve regulates the pressure in the conduit 46 when the valve 54 is in closed position. The pressure regulating valve 62 is controlled by a valve element 66 engaged by a cam 68 on the ram or may be set by spring pressure for constant oil pressure. A line from valve 62 returns to the reservoir as

diagrammatically shown by tank 68', to relieve the excess pressure.

Cam 58 and track 59 are shown in detail in FIGURES 3–7. Track 59 is secured at its upper end to the crown 16 of the press and is angle-shaped in cross section. One side of the track has a longitudinal slot 69 and the outer surface thereof has longitudinal V-shaped serrations. The cam 58 includes two cam elements 70 and 71. Each cam element has a mounting plate 72 formed with slot 73 elongated transversely of the track. Nut and bolt assemblies 74 extend through the slots 69 and 73 to clamp the cam elements to the track in adjusted position, longitudinally and transversely thereof. The mounting plates 72 are provided with serrations matching those on the track, so that by loosening the nut and bolt assemblies 74, the cam elements may be slid longitudinally. By loosening the assemblies 74 still more to permit disengagement of the serrations, the cam elements may also be shifted transversely of the track.

The cam element 70 has a cam part 75 and cam element 71 has a cam part 76 which are shaped alike but joined to their respective mounting plates in a manner such that they lie in different planes. The cam elements are shown in the drawing in solid lines in FIGURE 3 with their cam parts 75 and 76 precisely overlying one another, and in this position the follower 56 is operated, and hence valve 54 is closed, for a very short interval during the movement of the ram. The cam elements may be separated so that the element 71 assumes the dotted line position of FIGURE 3, for example, thereby extending the time interval that the follower 56 engages the cam contour and closes its valve. The cam elements are transversely adjustable to line up the follower 56 with both cam parts 75 and 76.

The operation of the structure will now be described. On downward movement of the ram during a forming operation, the volume of the pressure chamber 44 increases and draws fluid from the reservoir past the check valve 60; assisted by 40 p.s.i. tank pressure. Fluid may also enter chamber 44 via conduit 48. Hence, the hydraulic system is full of hydraulic fluid at all times. On the up or retraction stroke of the ram, and after the forming part 24 of the ram has withdrawn from the die as shown in the drawings, the valve element 56 engages cam 58 to close valve 54 and thereby block communication of pressure chamber 44 with the reservoir. Continued upward movement of the ram reduces the chamber 44 and thereby increases the pressure in the chamber as well as in conduit 46 and the knock-out pin cylinder 32. Pressure thus delivered to the knock-out cylinder 32, as controlled by the regulating valve 62, is effective to project the knock-out pin and strip the formed part from the plunger projection 24. During the upward movement of the ram and while valve 54 is closed, the valve element 66 engages the rise in cam 68 to provide a regulation of the pressure delivered to the knock-out pin cylinder. Disengagement of follower 56 on further upward movement of the ram immediately dissipates the pressure to 40 p.s.i. (reservoir pressure), thus drawing only such power as is required to operate the ram. In other words, the pressure is maintained in conduit 46 only long enough to perform the knock-out function.

FIGURE 2 illustrates a modification in which corresponding parts are identified by the same reference numerals. The structure of FIGURE 2 differs from that of FIGURE 1 in that the power device 34' has its cylinder 36' secured to the crown 16 of the frame, and its piston 38' is connected to the ram by rod 40' having a self-aligning coupler 42'. A further difference resides in the fact that the knock-out pin 28' is carried in the base plate or fixed portion of the press rather than by the ram. The knock-out pin is shown in its retracted position. It is operated by pressure fluid delivered to the lower end of cylinder 32' through conduit 46' to operate piston 30' to which the knock-out pin is connected. The conduit 46' is connected to the cylinder 36' and to the bed of the press, both fixed members, and hence conduit 46' may be a rigid tube if desired. Cylinder 32' is vented above the piston and a light return spring 49' may be provided.

As the ram moves up in its stroke to the position indicated in FIGURE 2, the valve 54 is operated to seal the hydraulic system from the reservoir so that further reduction of the pressure chamber 44' transmits pressure fluid to the knock-out cylinder 32' to project the knock-out pin 28'. This construction is employed where the part formed sticks to the die rather than to the plunger. The follower 56 of the valve disengages the cam 58 on the completion of the up movement of the ram, to again open valve 54 and relieve the pressure in the conduit 46 through conduit 53. Here again on continued upward movement of the ram after valve 54 closes the pressure regulating valve 62 controls the pressure in the hydraulic system. On the next down cycle of the ram, the volume of the pressure cylinder 44' increases and the hydraulic system draws fluid from the reservoir through the check valve 60.

It will be noted that in both forms of the invention, the tubing 46 or 46' connecting the pressure chamber and the knock-out cylinder is not required to flex in any degree. In the FIGURE 1 construction both ends of the conduit 46 move with the ram. Hence the conduit may if desired be in the form of a rigid length of tubing. In the FIGURE 2 construction all portions of the conduit 46' are stationary since both ends are connected to elements of the fixed frame. Here again the conduit may take the form of a rigid tube.

In both forms of the invention illustrated, the knock-out pin is operated by the inherent reserve power of the press. This reserve power is in the form of kinetic energy developed in the moving parts including the ram and flywheel. The flywheel, because of its mass, has a great deal of inertia and hence is a primary source of this energy. Such energy as is required for the knock-out or ejection of the workpiece is taken from the flywheel and any resultant slowdown in the ram movement will not affect the timing because the ram is directly geared to the flywheel.

As noted above, pressures on the order of 5,000 p.s.i. are required to be developed in order to operate the knock-out cylinders. It has been found that with ordinary mechanically driven cold extrusion presses as much as 9,000 p.s.i. is available in the inertia of the ram and flywheel in the system described herein. This system is essentially a mechanical knock-out which uses a column of oil to transmit the operating pressure, and hydraulic valves for timing and pressure control. A relief valve is used for safety. The pressure limitations of this system are less restricting than in a purely hydraulic system using pumps.

It will also be noted that pressure in the system is built up only for a limited part of the ram stroke, since the follower 56 engages and then rides over cam 58 to only momentarily close the line 46 or 46' from the reservoir return line 52. The cam 58 is also adjustable to vary its length. Hence the duration of time that follower 56 engages the cam parts 75 and 76 can be varied as required and of course is preferably kept at brief as possible to save power. Also, the position of the cam may be adjusted along track 59 to precisely locate the point at which the valve 54 is operated.

The drawing and the foregoing specification constitute a description of the improved hydraulic system for presses in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. A press for shaping workpieces comprising a frame, a first work forming member on said frame, a ram mounted on said frame for reciprocation toward and away from said first forming member, a second work forming member on said ram cooperable with said first work form-

ing member upon movement of said ram toward the latter to shape a workpiece, power means including a flywheel for reciprocating said ram, a work ejector adjacent one of said work forming members and operative to remove the workpiece from said one of said work forming members after shaping, and a hydraulic power device for operating said ejector, said power device being operatively connected to said flywheel to be operated by the inertia thereof during the return stroke of the ram.

2. A press for shaping work pieces comprising a frame having members supported for relative movement toward and away from each other, said members having means adapted to shape a work piece upon relative movement of said members toward each other, means for relatively moving said members, a movable device for acting upon a workpiece and positioned adjacent the shaping means of one of said members, and means for operating said movable device including a hydraulic power device having parts cooperable to define a hydraulic chamber, said parts being respectively operatively connected to said member so as to be relatively movable by the relative movement of said members to vary the volume of said chamber, a conduit connected to said power device and communicating with said chamber, said conduit leading to said movable device to deliver operating pressure thereto upon a relative movement of the parts of said power device in a direction to reduce said chamber, a variable pressure regulating valve for said conduit, and means for varying said valve in response to relative movement of said members.

3. A press for shaping work pieces comprising a frame having members supported for relative movement toward and away from each other, said members having means adapted to shape a work piece upon relative movement of said members toward each, means for relatively moving said members, a movable device for acting upon a workpiece and positioned adjacent the shaping means of one of said members, and means for operating said movable device including a hydraulic power device having parts cooperable to define a hydraulic chamber, said parts being respectively operatively connected to said members so as to be relatively movable by the relative movement of said members to vary the volume of said chamber, a conduit connected to said power device and communicating with said chamber, said conduit leading to said movable device to deliver operating pressure thereto upon a relative movement of the parts of said power device in one direction to reduce said chamber, and pressure regulating means for preventing the pressure in said conduit from exceeding a predetermined maximum limit during the relative movement of said members in said one direction.

4. A press for shaping work pieces comprising a frame having members supported for relative movement toward and away from each other, said members having means adapted to shape a work piece upon relative movement of said members toward each other, means for relatively moving said members, a movable device for acting upon a workpiece and positioned adjacent the shaping means of one of said members, and means for operating said movable device including a hydraulic power device having parts cooperable to define a hydraulic chamber, said parts being respectively operatively connected to said members so as to be relatively movable by the relative movement of said members to vary the volume of said chamber, a conduit connected to said power device and communicating with said chamber, said conduit leading to said movable device to deliver operating pressure thereto upon a relative movement of the parts of said power device in a direction to reduce said chamber, a reservoir for hydraulic fluid normally communicating with said chamber and means for closing the communication between said reservoir and chamber in response to such movement of said members as to relatively move said parts in a direction to reduce said chamber.

5. The press defined in claim 4 wherein the last-mentioned means is adjustable.

6. A press for shaping workpieces comprising a frame, a first work forming member on said frame, a ram mounted on said frame for reciprocation toward and away from said first forming member, a second work forming member on said ram cooperable with said first work forming member upon movement of said ram toward the latter to shape a workpiece, power means for reciprocating said ram including a motor, a flywheel driven by said motor and having a driving connection with said ram, a work ejector adjacent one of said work forming members and operative to remove the workpiece from said one of said work forming members after shaping, and a hydraulic power device for operating said ejector, said power device including piston and cylinder parts cooperable to define a hydraulic chamber and relatively movable to vary the volume of said chamber, one of said parts being carried by said ram and the other by said frame for relative movement of said parts upon movement of said ram, and a condut leading from said chamber to said work ejector to deliver operating pressure thereto upon such movement of said ram as to relatively move said piston and cylinder parts in a direction to reduce said chamber, said piston and cylinder parts being relatively moved to reduce said chamber and thereby deliver operating pressure to said work ejector upon movement of said ram away from said first work forming member, said power device receiving energy from the inertia of said flywheel by reason of its operative connection thereto through said ram.

7. The structure defined in claim 6 including a reservoir for hydraulic fluid normally communicating with said chamber, and means for closing the communication between said reservoir and chamber in response to movement of said ram away from said first work forming member.

8. The structure defined in claim 6 wherein said ejector is mounted on said frame to eject a workpiece from the first work forming member and said conduit is connected to said ejector and to the part of said power device carried by said frame.

9. The structure defined in claim 6 wherein said ejector is mounted on said ram to eject a workpiece from the second work forming member and said conduit is connected to said ejector and to the part of said power device carried by said ram.

10. The structure defined in claim 6 having a pressure regulating valve for said conduit.

11. The structure defined in claim 10 wherein said pressure regulating valve is variable and means are provided to vary the same in response to movement of said ram.

12. A press for shaping workpieces comprising a frame having members supported for relative movement toward and away from each other, said members having means adapted to shape a workpiece upon relative movement of said members toward each other, means for relatively moving said members, a movable device for acting upon a workpiece and positioned adjacent the shaping means of one of said members, and means for operating said movable device including a hydraulic power device having parts cooperable to define a hydraulic chamber, said parts being respectively operatively connected to said members so as to be relatively movable by the relative movement of said members to vary the volume of said chamber, a conduit connected to said power device and communicating with said chamber, said conduit leading to said movable device to deliver operating pressure thereto upon a relative movement of the parts of said power device in a direction to reduce said chamber, a reservoir for hydraulic fluid, a second conduit between said reservoir and chamber, a normally open valve in said second conduit, and a cam for closing said valve in response to such movement of said members as to relatively move said parts in a direction to reduce said chamber.

13. The press defined in claim 12 including a third conduit between said reservoir and chamber and a check

valve therein preventing flow from said chamber to said reservoir.

14. The press defined in claim 12 wherein said cam is adjustably mounted to control the point in the movement of said members when the valve is closed and wherein the length of said cam is adjustable to control the length of time the valve is closed.

15. The press defined in claim 14 including a third conduit between said reservoir and chamber and a check valve therein preventing flow from said chamber to said reservoir.

16. The press defined in claim 15 having a pressure regulating valve in the first-mentioned conduit.

17. The press defined in claim 16 wherein one of said members is a movable ram and the other is a fixed portion of the frame, said movable device and one of the parts of said power device are carried by said ram, and said first-mentioned conduit is connected to said one part of said power device.

18. The press defined in claim 16 wherein one of said members is a movable ram and the other is a fixed portion of said frame, said movable device and one of the parts of said power device are carried by said fixed portion of the frame, and said first-mentioned conduit is connected to said one part of said power device.

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