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MATERIAL WORKING APPARATUS

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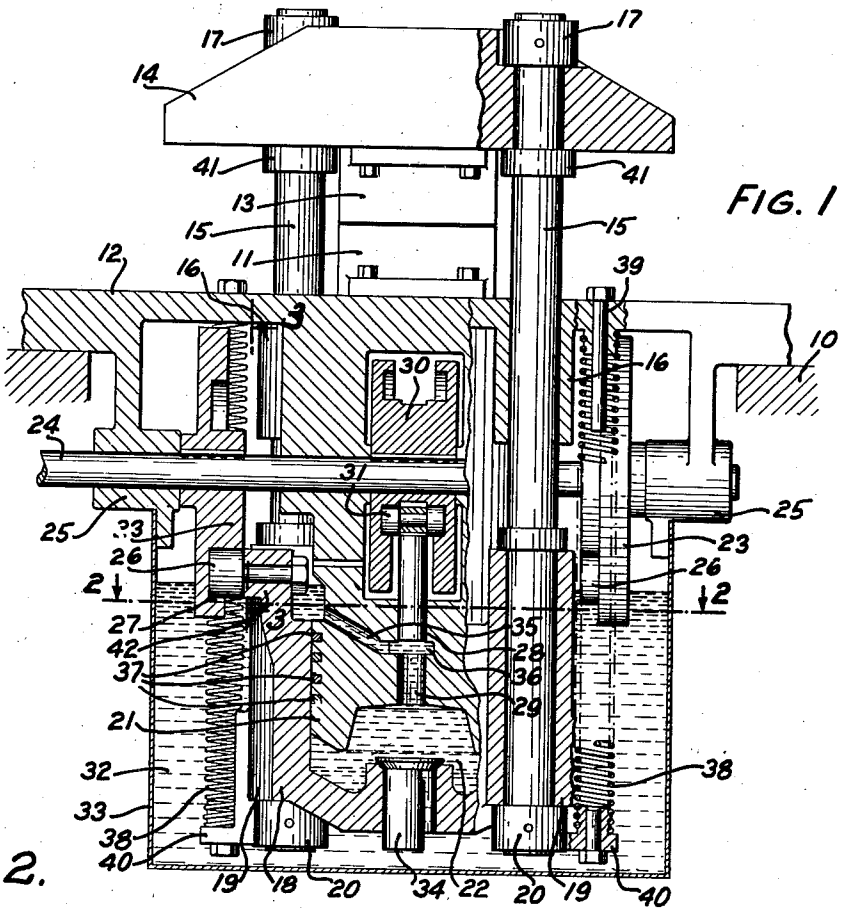


FIG. 1

FIG. 2.

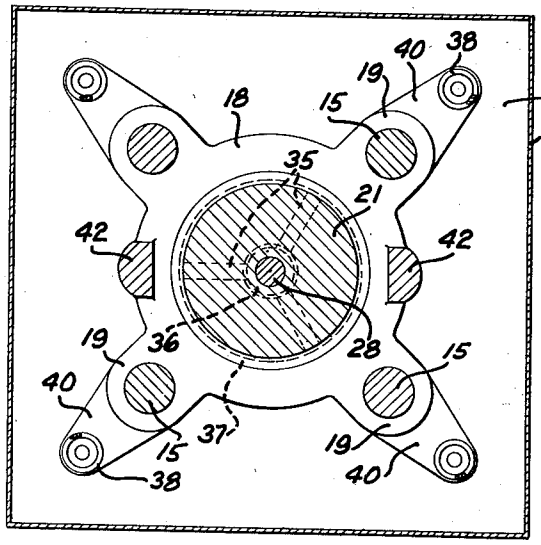
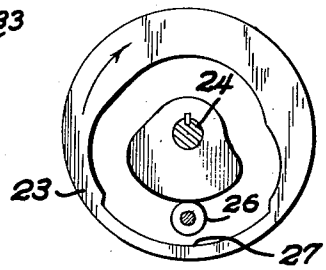


FIG. 3.



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MATERIAL WORKING APPARATUS

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2 Claims. (Cl. 100—70)

This invention relates to material working apparatus and more particularly to a pressure fluid actuated apparatus for forming material.

An object of the invention is to provide an improved apparatus of compact construction for forming material efficiently and accurately at high pressures.

In accordance with one embodiment of the invention, there is provided a combination mechanical and hydraulic press wherein a reciprocating platen is supported on a hydraulic cylinder connected to a rotating cam which causes the cylinder to descend until the platen approaches its working position, at which time a second cam operates a hydraulic system for introducing fluid into the cylinder under substantial pressure to actuate the platen during its working stroke, after which the cylinder is restored to its normal position by the first cam to complete the cycle.

A more complete understanding of the invention may be had by reference to the following detailed description taken in conjunction with the appended drawing, in which—

Fig. 1 is an elevation in section of a forming press embodying the invention,

Fig. 2 is a sectional view of the apparatus shown in Fig. 1, taken on the line 2—2, and

Fig. 3 is another sectional view of the apparatus shown in Fig. 1, taken on the line 3—3.

The forming press shown in the attached drawing is compactly constructed and is adapted for convenient association with a standard shop bench 10. The apparatus is arranged to locate the working tools to which the material is fed at the approximate level of the bench top and the actuating mechanism is located below the bench surface level to provide a neat appearance and avoid interference with the feeding operations.

In performing one type of conventional forming or blanking operation on this equipment, a lower die 11 is bolted to the top of a stationary machine base or bed 12 and a cooperating upper die 13 is secured to a reciprocating platen or tool head 14. The platen is supported over the bed on the upper ends of four spaced vertical rods 15 which are slidably supported in bearings 16 in the press bed and secured to the platen by means of nuts or pinned collars 17.

The lower end portions of the rods are fixed to a hollow cylinder 18. The cylinder is suspended between the four rods and the rods are fastened to longitudinal bosses 19 on the outside of the cylinder with pinned collars or nuts 20. The inner surface of the cylinder closely engages a fixed ram 21 which is secured to the press bed. The ram is cylindrical in shape and the cylinder is vertically movable thereon. The bottom of the cylinder is enclosed to provide a chamber 22 between the cylinder and the ram.

The cylinder, and the connected rods and platen, are actuated both mechanically and hydraulically. Mechanical force is applied to the cylinder by a pair of grooved cams 23 keyed to a horizontal drive shaft 24 which is rotatably supported in bearings 25 in the machine bed and driven from a suitable power source (not shown). The cams are positioned on opposite sides of the cylinder and the grooves engage rollers 26 mounted on brackets 42 extending from the top of the cylinder wall.

The cams are constructed to lower the cylinder a predetermined distance until the dies reach their working position, provide a dwell period during which the work is performed by the dies, and subsequently raise the cylinder and platen to their elevated or normal positions. During the dwell period of the cams, hydraulic pressure is applied to the inside of the cylinder to further depress the cylinder and actuate the dies during their working cycle. To permit this additional downward movement of the cylinder when the hydraulic pressure is applied, suitable clearance 27 is provided in the dwell portion of the cam grooves.

The hydraulic pressure is applied by a piston or plunger 28 which is slidably mounted in a bore 29 running through the central portion of the ram to the cylinder chamber. The plunger fits tightly in the bore and is moved vertically by means of a grooved plunger cam 30 keyed to the drive shaft. The plunger cam groove engages a roller 31 at the top end of the plunger and operates in timed relation with the mechanical cams on the same shaft to apply the hydraulic pressure at the proper interval.

A supply of oil 32 or other suitable fluid for the hydraulic system is contained in a housing 33 enclosing the cylinder. A seated valve 34 in the bottom of the cylinder is adapted for restricted movement to admit oil to the chamber when the cylinder is lowered by its cams. To insure consistent operation of the hydraulic system, a series of ports 35 are provided to connect the bore and the oil supply which is maintained at a level above the port entries. The ports terminate in an enlarged ring shaped aperture 36 in the bore corresponding with the bottom of the plunger in its elevated or normal position. As the bore is filled with oil through the ports before the beginning of each plunger stroke; the resultant pressure in the chamber and consequently the force applied to the dies, will be consistent. The ports also serve to release the oil from the chamber at the end of the hydraulic cycle. A series of oil rings 37 mounted on the periphery of the ram provide an oil tight seal between the ram and the cylinder.

In order to prevent the cylinder from locking

or binding on the ram, four compression springs 38 are mounted between the cylinder and the machine bed. These springs are made of heavy wire and are anchored on elongated bolts 39 fixed in the top of the bed and to brackets 40 extending outwardly from the bottom of the cylinder. The springs are spaced at uniform intervals around the periphery of the cylinder and are preferably aligned with the bosses supporting the rods to balance the cylinder in its movement on the ram and also the rods in their bearings and thus prevent binding in any part of the system.

In a complete cycle of operation the press functions as follows: In their normal position the working tools are spaced apart to permit material to be fed between them. As power is applied to the drive shaft, which is controlled by a clutch or other suitable means, the two mechanical cams on the shaft initially lower the cylinder until the dies are lightly compressed against the material. As the cylinder is lowered into the oil, the seated foot valve in the base of the cylinder is released by pressure of the oil and the chamber and bore are filled through the valve and the ports. In this position, shown in Fig. 1, the cam rollers on the cylinder ride against the upper part of the cam grooves and the clearance spaces in the lower part of the grooves allow for additional downward movement of the cylinder.

As the next step in the cycle the plunger is advanced into the ram bore by its cam. The resultant pressure in the chamber initially closes the foot valve and then builds up to move the cylinder and the platen downwardly and compress the dies together to form the material. The clearances in the cylinder cams permit these members to move under the hydraulic pressure until limited by the contour of the dies which insures complete forming of the material.

After the forming operation is completed, the plunger is raised by its cam to release the hydraulic pressure and enable the mechanical cams to return the cylinder and the platen to their normal positions. Before the cams begin to raise the cylinder the plunger has been returned to its normal position above the enlarged ring chamber and the oil is readily expelled through the ports as the cylinder is raised without material resistance to the action of the cylinder cams. The four springs mounted around the cylinder keep the cylinder and the rods properly balanced on their supports and insure smooth motion throughout the movements of these members.

The above described apparatus is particularly suitable for use in forming and punching operations requiring high pressures. The hydraulic system is constructed to deliver a certain maximum pressure depending on the desired capacity of the press. The maximum pressure is determined primarily by the size and travel of the plunger and the size of the chamber in the cylinder. The actual pressure applied to the dies in each individual case is controlled by the relative positions and contour of the dies and close adjustment of the forming pressure can be accomplished readily by changing the elevation of the dies on the bed or platen. It is also convenient to regulate the applied pressure by adjusting the position of the platen on its supporting rods. The platen can be made conveniently adjustable by the use of a sizing collar 41 or a threaded collar on each rod underneath the platen.

The use of hydraulic and mechanical actuating mechanisms in the described combination, facilitates economy in equipment and in operation. The high forming pressure is applied to only part of the machine and for a relatively short stroke and period. Consequently, lighter and more compact members can be employed satisfactorily with resultant economies over conventional types of construction. The use of relatively light members for the mechanical system permits higher speeds and the initial approaching and retracting movements of the platen are conducted more rapidly with an economy in operating time and expense.

Various modifications of the above described apparatus are feasible and it is to be understood that the invention is limited only by the scope of the appended claims.

What is claimed is:

1. A material working apparatus, comprising a bed, a plurality of vertical rods slidably supported in the bed, a platen secured to the top portion of the rods, a hollow cylinder secured to the bottom portions of the rods, a cylindrical portion of the bed forming a ram within the cylinder, an enclosed bottom on the cylinder forming a chamber between the cylinder and ram, a rotating shaft, a cam on the shaft engaging the cylinder for lowering the cylinder a predetermined distance, releasing the cylinder for additional movement in the same direction and subsequently raising the cylinder to its normal position, a housing surrounding the cylinder, a supply of oil in the housing, a valve in the cylinder bottom for admitting oil to the chamber when the cylinder is lowered by the cam, a plunger mounted for vertical movement in the ram, a second cam on the shaft engaging the plunger for advancing the plunger against the oil in the chamber during the period that the cylinder is released by the first cam, and a port in the ram for conducting oil from the chamber at the termination of the hydraulic cycle.

2. In a material working apparatus, a stationary platen for supporting the material, a reciprocating platen above the stationary platen, a fixed ram of cylindrical section below the platens, a hydraulic plunger in the ram, a cylinder encircling and slidably mounted on the ram, said cylinder having an enclosed bottom forming a chamber between the cylinder and the ram and being rigidly connected to the reciprocating platen, a drive shaft, a cam on the shaft for engaging the cylinder and moving the cylinder mechanically, said cam being adapted to move the cylinder downwardly until the reciprocating platen engages the material, release the cylinder for further downward movement and then elevate the cylinder from its lowest to its normal position, means for supplying fluid to said chamber, and a second cam on the shaft operating in timed relation with the first cam for advancing the plunger when the cylinder is released by the first cam to compress the fluid in the chamber and cause further downward movement of the cylinder and reciprocating platen.

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