MULTIPLE STATION FORMING PRESS

Inventor: Charles R. Bradlee, Cheshire, Conn.
Assignee: Textron, Inc., Providence, R.I.
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ABSTRACT

This disclosure relates to a press adapted to receive strip material and form primary workpieces in two sets of work stations while attaching a secondary workpiece to the primary workpiece. Also disclosed are cam driven, fluid pressure returned forming members which permit higher speeds of operation.

22 Claims, 10 Drawing Figures
MULTIPLE STATION FORMING PRESS

This invention relates to presses and more particularly relates to a press of the type with a plurality of forming stations where workpieces are successively formed by forming tools carried on a row of reciprocating plungers which act with complementary dies or other plungers.

This invention provides a press of the type described particularly adapted to high speed production with very precise control of die operations. Such characteristics are required in a press adapted to form and score workpieces such as the tops of cans, including pull tabs. In such operations, only a small stroke is required which may be similar to a coining operation. To accommodate the high speed of operation which is necessary to make such workpieces economically feasible and suitable for high volume production, the invention provides a new and improved return for the forming mechanism to provide maximum loading during the forming stroke but only requiring a small restoring force to the forming tool.

The invention further provides a press of the type described adapted to make articles such as can tops and pull tabs therefor where both the top of the can may be scored, the tab formed, and the tab attached to the scored portion on the same machine.

A press embodying the invention is further arranged to accept variable sized workpieces at the infeeding station and further to simultaneously accept two workpieces.

Briefly stated, the invention, in one form thereof, comprises a press of the type described wherein strip material is fed in between two rows of forming plungers. Two workpieces are blanked by a blanking tool and placed in transfer levers which move the workpieces in opposite directions to the two rows of forming plungers. Auxiliary presses are provided on the frame which form a secondary part in strip form which are fed to a predetermined forming station and then attached to the primary workpiece. The invention further provides new and improved cam driven, fluid pressure return, forming plungers to provide maximum loading during a forming stroke while requiring only a small restoring force.

An object of this invention is to provide a new and improved forming press.

Another object of this invention is to provide a forming press having new and improved means for forming two parts at different locations and then joining said parts.

Another object of this invention is to provide a new and improved workpiece blanking and initial transfer mechanism.

Another object of this invention is to provide a new and improved forming plunger operating mechanism.

Other objects and advantages of the invention will be pointed out or become apparent hereinafter.

The features of the invention which are believed to be novel are particularly pointed out and distinctly claimed in the concluding portion of this specification.

The invention, however, both as to its operation and organization, together with further objects and advantages thereof may best be appreciated by reference to the following detailed description taken in conjunction with the drawings, wherein:

FIG. 1 is a front elevation of a press embodying the invention;
FIG. 2 is a view of the press of FIG. 1 seen from the right hand side thereof with respect to FIG. 1;
FIG. 3 is a sectional view seen in the plane of lines 3—3 of FIG. 1;
FIG. 4 is an enlarged reversed view of a portion of FIG. 3;
FIG. 5 is a view partly in section seen in the plane of lines 5—5 of FIG. 4;
FIG. 6 is an elevation partly in section showing the lower cam shaft and plungers;
FIG. 7 is a view seen looking down on the bed of the press of the workpiece feed and transfer mechanism;
FIG. 8 is an elevation of the feed mechanism of FIG. 7 seen in the plane of lines 8—8 of FIG. 7;
FIG. 9 is a plan view of the feed mechanism of FIG. 7;
and
FIG. 10 is a block diagram of a fluid pressure system used in conjunction with the press.

A press embodying the invention is generally indicated by the reference numeral 10 and comprises upright supporting members 11, 12 and 13 and an upper cross member or crown 14. A die bed 15 extends between support members 11 and 12 and carries thereon a bolster 16. A cam shaft 17 is rotatably carried in support members 18—24 depending from and supported by crown 14. A plurality of cam assemblies 26 adapted to act upon a forming plunger are mounted to shaft 17. Cam shaft 17 is driven by a pulley 27 through a belt 28 about the pulley 29 of a motor 30 (FIG. 2) carried on a platform 31 attached to the frame of machine 10. Pulleys 33 and 34 mounted adjacent the ends of cam shaft 17 drive timing belts 35 and 36, respectively, which in turn drive pulleys 37 and 38, respectively, on shafts 39 and 40. As shown in FIG. 2, each of the belts 35 and 36 (only one shown) are passed over a take-up or adjusting pulley 41. The shafts 39 and 40 drive transfer mechanisms as will hereinafter be exemplified.

A sprocket 42 mounted to cam shaft 17 drives a chain 43 about sprockets 44 and 45 on shafts 46 and 47, respectively. The chain 43 further engages idler sprockets 48 and 49 and a take-up idler 50 rotatably mounted to the frame. The idler sprocket 50 is slidable in guides 51 to provide the desired take-up in chain 43.

Shaft 46 has mounted thereon a plurality of cam assemblies adapted to operate lower plungers as hereinafter exemplified. Shaft 47 is a power take-off shaft adapted to drive stock feeders and a cam switch for electrical timing.

The shafts 39 and 40 drive transfer assemblies in housings 52 and 53, respectively, which through cam arrangements lock the arms, actuate the shafts 54 and 55 extending from the housings to rock levers 56 and 57 and actuate the transfer bars 58 and 59 in timed relation with the rotation of cam shaft 17. The transfer bars 59 and 59 are slidably mounted through the side frames 11 and 12 as shown in copending application, Ser. No. 787,493 filed Dec. 27, 1968 now U.S. Pat. No. 3,596,498.

Two rows of plungers 60a and 60b, as shown in FIGS. 1, 3 and 4, are slidably carried in a cross bridging member 61 which extends between vertical support members 11 and 12. Plungers 60a and 60b are each
adapted to receive a forming tool or die (not shown) at the lower end thereof as viewed in FIG. 4. Member 61 is further provided with upper and lower guide bushings 62 which receive the plungers.

Each plunger is tubular in form and has a slot 63 defined therein. Received in each of plungers 60 is an insert 64 having a fluid pressure passage 65 defined therein from the top thereof to a transverse slot 66. A fitting 67 having a fluid passage 68 therein extends into slot 66 and carries sealing means 69 at one end thereof. The passage 68 of fitting 67 is in fluid communication with a fluid pressure manifold 70 adapted to receive fluid pressure from an exterior source. A check valve 70a prohibits passage of air from chamber 72 to manifold 70, but allows make-up air to enter the plunger from manifold 70.

There is a fluid pressure circuit from manifold 70 through passage 68 to the upper portion of plunger 60. Plunger 60 at the upper portion thereof carries a fluid tight seal 71 to define a chamber 72 between the upper end of member 64 and the seal 71. The plungers at the upper end thereof carry a shaft 74 which rotatably mounts a cam follower 75 thereon and which further carries a guide member 76. Guide member 76 is received between guide bushings 77 carried on a bracket 78. During a forming stroke as cam shaft 17 rotates, a cam 26 thereon engages cam follower 75 in a driving stroke and moves it to the position shown in full line in FIG. 4. When the plunger 60 has reached the position shown in full line in FIG. 4, and upon continued rotation of cam shaft 17, the radius from the center of cam shaft 17 to the point of contact on cam follower 75 commences to decrease. During the downward forming stroke, the fluid (air) in chamber 72 was substantially compressed. Now, as the cam continues its rotation, the pressure acting against sealing member 71 forces plunger 60 carrying cam followers 75 upwardly at a rate determined by the return contour of cam 26. It will be apparent that cam 26 will control the return stroke of plunger 60 to the extent that plunger 60 can move upwardly only as the radius R1 between the center of cam shaft 17 and the point of contact of cam 26 and follower 75 decreases.

In practice, the pressure in manifold 70 will be maintained at a regulated value. A plurality of members 80 disposed along the upper surface of member 61 retain the upper bushings 62 in place.

With the driving and plunger return structure shown, it will be seen that the disclosed press eliminates mechanical linkages and lifters, and the plungers will be raised or returned from a forming position by the energy stored in the air or other fluid compressed in chamber 72. This allows higher speed operation and substantially reduces the inertia of the drive system during the return stroke.

The lower knockout pins or forming plungers 82 (FIG. 6) depending upon the machine's functional purpose, each reciprocate in a liner 83 extending through die bed 15. The pins or plungers 82 are provided with a slot 84 to which are rotatably mounted followers 85 and 86 which receive therebetween a bearing member 87 having upper and lower surfaces defined on the perimeter of a cylinder. The upper and lower surfaces of bearing member 87 act against upper and lower followers 86 and 85, respectively, and through the definition of the cylindrical surfaces are always in engagement with the follower 85 and 86. Bearing member 87 is carried on an arm 88 of a bell crank-like member 89 which is rockably mounted about a shaft 90 carried by the frame of the press. A cam follower 91 is rotatably mounted to arm 92 of crank 89 and a bushing 93 is rotatably mounted to an arm 94 of crank 89. Shaft 46 has mounted thereon a plurality of cams 96 which act upon cam followers 91. During a portion of the cycle of operation, cam 96 will rock crank 89 in a clockwise direction as viewed in FIG. 6 and bearing member 87 will slide pin or plunger 82 upwardly. During this stroke, roller 93 acts against a tubular plunger or piston 97 having an end closure 98 which moves backwardly to compress the air in a chamber 99 defined in end closure 98 and also walls 100 and a manifold 101. A check valve 99a is employed to prevent flow of fluid from chamber 99 to manifold 101.

In this manner, during the working stroke of the plunger or pin 82, energy is stored in chamber 99 for the return stroke. Manifold 101 may be maintained at a predetermined pressure to replace any leakage from chamber 99. If desired, the reverse operation may also be achieved by reversing the bell crank 89 and placing plunger 97 in a lower bore 101a which communicates with a manifold 101b, through a check as described above. This reverse arrangement is exemplified in FIG. 3.

The disclosed press, as more clearly exemplified in FIG. 1, is adapted to have workpieces fed intermediate the two rows of plungers 60a and 60b at the space indicated by the reference numeral 102. A strand of material as exemplified at S (FIG. 7) has the workpieces W blanked therefrom in the feed area 102. The feed mechanism generally indicated by the reference numeral 104 is arranged to feed the workpieces along each set of plungers 60a and 60b in timed relation with actuation of the transfer means 58 and 59. Each of the transfer mechanisms 58 and 59 may comprise a pair of spaced apart rods 105 and 106 which are reciprocated a distance D to transfer a workpiece from one forming station to the next forming station and then to return to the previous position for the next transfer step. Such transfer mechanism is shown in the aforementioned copending application and also in U.S. Pat. No. 3,369,387. Pivotingally mounted to the end of rod 105 of each of transfer mechanisms 58 and 59 is a link 107 which is pivotally mounted intermediate the ends of a feed lever 108 at 109. The feed levers 108 are pivotally mounted to supports 110 carried on bolster 16.

Each of workpiece feed pick-up levers 108 includes a stationary work grasping finger 111 and a finger 111a biased toward a workpiece grasping position by a spring 112 acting thereon and reacting against a pin 112a. A workpiece is shown between fingers 110 and 111 in broken line in FIG. 9. A blanking tool is shown in FIG. 8 and comprises a ram or gate 113 carrying blanking tools 114 and 115 thereon adapted to extend through openings 116 and 117 in guides 118 and 119 which define a guide path for the strips of blanking material.

As the workpieces are blanked by tools 114 and 115, they are carried up into and between fingers 110 and 111 on levers 108 and grasped therebetween. On the
next movement of the transfer mechanism they are positioned at the first forming station. Then as the upper and lower forming tools come together they grasp the workpiece and retain it while performing a forming operation. The transfer mechanism then reciprocates levers 108 to receive a new workpiece and the previous workpiece having been acted on by the tools is engaged by fingers 120 for movement to the next forming station.

Gate 113 is formed in two parts 122 and 123 to lock the flanges 124 of blanking tools 114 and 115 therebetween and includes a key 125 which locks it to one of the lower plungers. The plunger 126, as shown in FIG. 8, is operated in the same manner and is similar in construction to those shown in FIG. 6, differing only in strength of construction for blanking purposes.

Referring to FIGS. 2 and 3, and also FIG. 1, there is shown an auxiliary press adapted to provide a second workpiece to the primary workpieces at forming stations F, as exemplified in FIG. 7, along the path P through guides G. The primary and secondary workpieces may be secured in a forming operation by the forming tools at station F. As, for example, at this station there may be attached a pull tab on a cap of a beverage container. As shown more clearly in FIG. 3, an eccentric 130 is mounted to cam shaft 17 toward opposite ends thereof. Each of the eccentrics 130 rotates with cam shaft 17 within the guide 131 of a pitman 132. Carried at the end of pitman 132 is a pin 133 to which is attached a bridging member 134. Member 134 is generally rectangular in plan view and each extremity thereof carries one of four rods 135. Attatched to rods 135 at the upper end thereof is a tool carrying member 136 adapted to carry a tool 137 arranged to coact with a tool 138 which is carried on an anvil member 139. Member 136 reciprocates vertically with rods 135 which are affixed to bridging member 134. With reference to FIG. 1, one of the secondary presses is shown in a forming position while the other press 129 is shown in a non-forming position. Anvil member 139 is carried on crown member 14 and is secured thereto as by a plurality of bolts 140.

In operation, stock S is fed into the feed zone blanked and moved under each row of plungers 60a and 60b. Additional stock which is formed in the secondary presses 128 and 129 is fed to the fourth station in strand form and attached to the workpiece thereat. Such strand is advanced in step-by-step fashion by a feed mechanism 140 which may be of any conventional construction well known to those skilled in the art. Guide means as shown in U.S. Pat. No. 3,369,387 of Charles R. Bradlee may be provided for guiding the strip of workpieces to the fourth station.

The strip may be advanced in step-by-step fashion by a feed mechanism as shown in U.S. Pat. No. 3,369,387, particularly FIG. 3 thereof.

A press as exemplified may be arranged to operate on various size workpieces by merely changing the forming tools and ties carried by the plungers.

The feed or pick-up levers 108 may be arranged for various size workpieces by varying the location of pivot point providing member 110 on bolster 16 to compensate for the change in the center point of the workpiece.

The pick-up levers 108 may be provided with various means to receive and hold a workpiece. As exemplified, the workpiece is held by spring compression. However, an arcuate pocket may be formed in the under side of levers 108 and placed in communication with a vacuum or low pressure source inasmuch as a fluid pressure system is already present on the machine.

Fluid pressure may be derived from a compressor 141 (FIG. 10) driven by shaft 47. A pressure regulator 142 then applies regulated pressure to manifold 70 or to a plenum in communication with manifold 70.

It may thus be seen that the objects of the invention set forth as well as those made apparent from the foregoing description are efficiently attained. While preferred embodiments of the invention have been set forth for purposes of disclosure, modification to the disclosed embodiments of the invention as well as other embodiments thereof may occur to those skilled in the art. Accordingly, the appended claims are intended to cover all embodiments of the invention and modifications to the disclosed embodiments which do not depart from the spirit and scope of the invention.

What is claimed is:

1. In a press having a forming plunger arranged to reciprocate and means defining a guide for said plunger, a cam shaft having a cam thereon, and a cam follower arranged to be acted thereon by the cam and drive the plunger in a forming stroke, the improvement comprising; the plunger is a hollow member, a stationary insert is received in said plunger, said insert and said plunger defining a fluid chamber between the upper portion of said plunger and the upper portion of said insert so that when said plunger is driven in a forming stroke by said cam shaft it moves relative to said insert, the fluid in said chamber is compressed and stores energy therein effective to move said plunger upwardly as the driving force of said cam is removed.

2. A press according to claim 1 including a plurality of plungers of the type specified, a fluid pressure manifold, each of said inserts having a passage defined therein extending longitudinally thereof to said fluid tight chamber, and a plurality of conduit defining means providing fluid communication between the passages in said inserts and said manifold.

3. A press according to claim 2 wherein a longitudinal slot is defined in each of said plungers and said conduit defining means extend therethrough to the passages in said inserts.

4. A press according to claim 2 further including means for regulating the fluid pressure in said manifold.

5. In a press of the type described, a frame, a shaft rotatably mounted in said frame, a plunger, means defining a guideway for said plunger, a cam mounted to said shaft, first and second levers in fixed angular relation to each other and pivotally mounted at one end thereof about a common axis, one of said levers carrying a cam follower thereon arranged to be contacted by said cam, a fluid pressure cylinder having a piston in contact with the other of said levers, the other of said levers adapted to move said piston and compress the fluid in said cylinder as said cam contacts and drives said first lever, and store energy in the compressed fluid which is effective to move said piston against said other lever as the driving force of said cam on said cam follower is removed, an arm in fixed relation to and actu-
ated by movement of said levers and means interconnecting said arm and said plunger.

6. The press of claim 5 in which said first and second levers and said arm are in the form of a bell crank.

7. The press of claim 5 wherein said cam drives said first lever to cause said plunger to move in a forming stroke.

8. The press of claim 5 wherein said piston drives said other lever to cause said plunger to move in a return stroke.

9. In a press having a forming plunger arranged to reciprocate, means defining a guide for said plunger, a cam shaft having a cam thereon and a follower arranged to be acted thereon by said cam and drive the plunger, the improvement comprising a bell crank having a cam follower thereon adapted to be acted upon by said cam, said bell crank having a driving connection to said plunger, a fluid cylinder having a piston therein, an arm on said bell crank acting on said piston to compress the fluid in said cylinder during a driving stroke on said plunger whereby energy is stored in the compressed fluid and acts to rotate said bell crank in the opposite direction when the driving force on said cam is removed.

10. In a forming press comprising a frame, a plurality of forming plungers carried by said frame, means for driving said plungers, a transfer mechanism linearly reciprocated in timed relation to operation of said driving means for sequentially transferring workpieces along said plungers, a workpiece blanking station, a blanking tool adapted to blank a workpiece; the improvement comprising said transfer mechanism including a workpiece pick-up lever having means adapted to receive a workpiece from said blanking tool, said lever arranged to pivot upon movement of said transfer means in one direction to deliver a workpiece in alignment with a first of said plungers and upon movement of said transfer mechanism in the other direction to return to a workpiece receiving position.

11. The invention of claim 10 wherein said lever is pivoted about a point in fixed relation to the frame at one end thereof and defines a workpiece receiving means on the other end thereof, a link pivotally mounted to said lever intermediate the ends thereof and to said transfer mechanism.

12. The invention of claim 10 wherein the fixed pivotal point of said lever may be varied to accommodate workpieces of different size.

13. A forming press comprising a frame, first and second rows of aligned forming members carried in said frame, a cam shaft rotatably mounted in said frame and adapted to operate said forming members, a blanking station intermediate said rows of forming members including strip material guide means and a blanking tool adapted to simultaneously blank two workpieces from the strip material, transfer means including a pair of arms adapted to accept the blanked workpieces and move the blanked workpieces in opposite directions to said two rows of forming members.

14. The press of claim 13 wherein said transfer means are linearly reciprocated in timed relation to operation of said forming members to sequentially move blanked workpieces along said rows, said arms comprising levers pivoted at one end thereof about a point fixed with respect to the frame and defining a workpiece receiving means at the other end thereof, a link pivotally mounted to each lever intermediate the ends thereof and to each of said transfer means.

15. The press of claim 14 wherein said levers pivot between a position to receive workpieces from said blanking tool and a position aligned with the first forming member of each row upon reciprocation of said transfer means.

16. The press of claim 15 wherein said fixed pivot point of said lever may be varied to accommodate workpieces of different size.

17. A forming press comprising a frame, first and second rows of upper forming plungers carried in said frame, first and second rows of lower forming plungers carried in said frame and defining with said upper forming plungers two rows of forming stations, first and second transfer mechanisms arranged to sequentially advance workpieces along the forming stations of each row of forming stations, means for feeding strip stock to said press between said rows of forming stations, a blanking tool arranged to simultaneously blank two workpieces disposed between said rows of forming stations, a feed lever operatively arranged with each transfer mechanism to receive blanked workpieces from said blanking tool and transfer said received workpieces to the first forming station of each row of forming stations.

18. The press of claim 17 further including means provided to said frame providing a pivotal connection for said feed lever at one end thereof and a link pivotally interconnected said lever and said transfer mechanism.

19. A forming press comprising a frame, first and second rows of aligned forming members carried in said frame, a cam shaft rotatably mounted in said frame and adapted to operate said forming members, a blanking station intermediate said rows of forming members including strip material guide means and a blanking tool adapted to simultaneously blank two workpieces from the strip material, reciprocal transfer means including a pair of arms adapted to accept the blanked workpieces and move the blanked workpieces in opposite directions to said two rows of forming members, means mounted to said frame and pivotally mounting said arms at one end thereof, said arms defining workpiece receiving means in the other end thereof, a link pivotally interconnecting each of said arms and one of said transfer means whereby when said transfer means are reciprocated said arms are pivotally moved between a workpiece accepting position and a position to present the workpiece to said rows of forming members.

20. A forming press comprising a frame, a plurality of aligned forming members carried in said frame and defining forming stations, drive means for operating said forming members, a blanking tool, means for feeding a first strip of material to said blanking tool, transfer means for transferring first workpieces to said forming stations from said blanking tool, a second forming press carried on said frame and operated by said drive means and arranged to form second workpieces in strip, and means for feeding said second workpieces in strip to one of said forming stations so that first and second workpieces may be simultaneously acted upon by the forming member thereat.
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21. The press of claim 20 wherein said drive means is a shaft rotatably mounted in said frame above said forming members, a plurality of cams on said shaft adapted to drive said forming members, said second forming press being mounted to said frame above said shaft, and means interconnecting said shaft and said second press to operate said second press in timed relation to operation of said transfer means.

22. The press of claim 21 wherein said second press comprises an anvil member, a movable member supported on rods above said frame, a member slideable on said rods, an eccentric cam on said shaft and a pitman receiving said cam therein at one end thereof and pivotally connected to said movable member at the other end thereof.

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