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Degenhardt et al.

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[54] **HIGH SPEED EJECTOR MECHANISM**

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[52] **U.S. Cl.** ..... **72/345**; 72/349; 72/427; 113/7 A; 113/120 H

[51] **Int. Cl.**[2] **B21D 45/00**; B21D 45/02; B21D 45/04

[58] **Field of Search** ..... 72/344, 345, 349, 427; 113/7 R, 7 A, 120 H

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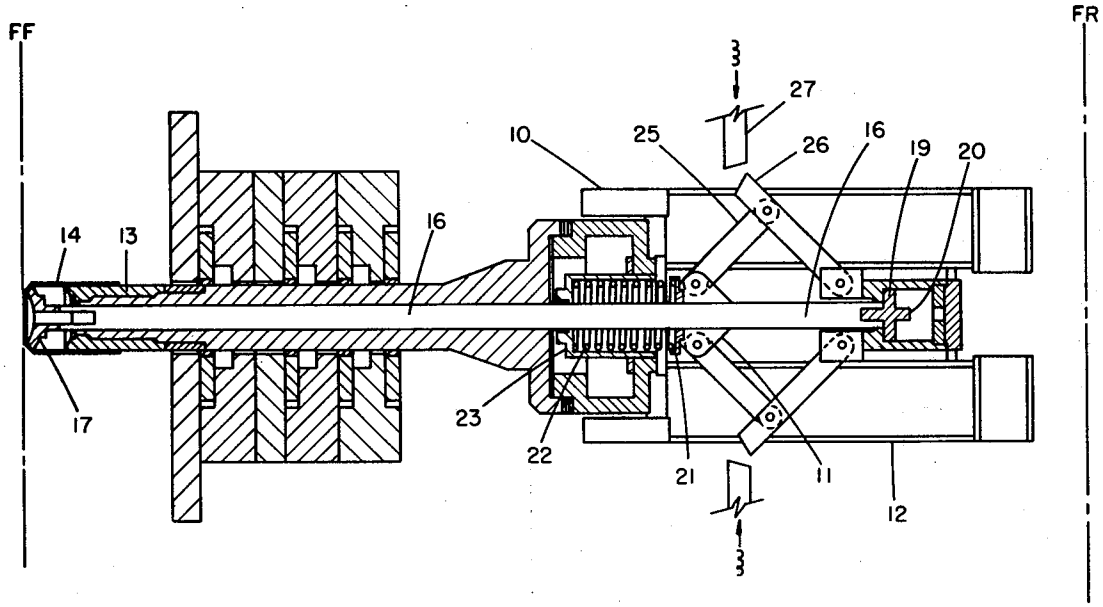
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[57] **ABSTRACT**

An ejector mechanism for ejecting a thin-walled seamless cylindrical metal can having a bottom from around the punch of a drawing and ironing press having one or more hollow cylindrical dies and a punch which is movable into said dies to draw and iron a ductile metal blank or cup into a can. The front end of said ejector mechanism forms the nosepiece of the punch and said nosepiece moves reciprocally with respect to said punch after the punch begins its rearward stroke out of the dies.

10 Claims, 3 Drawing Figures



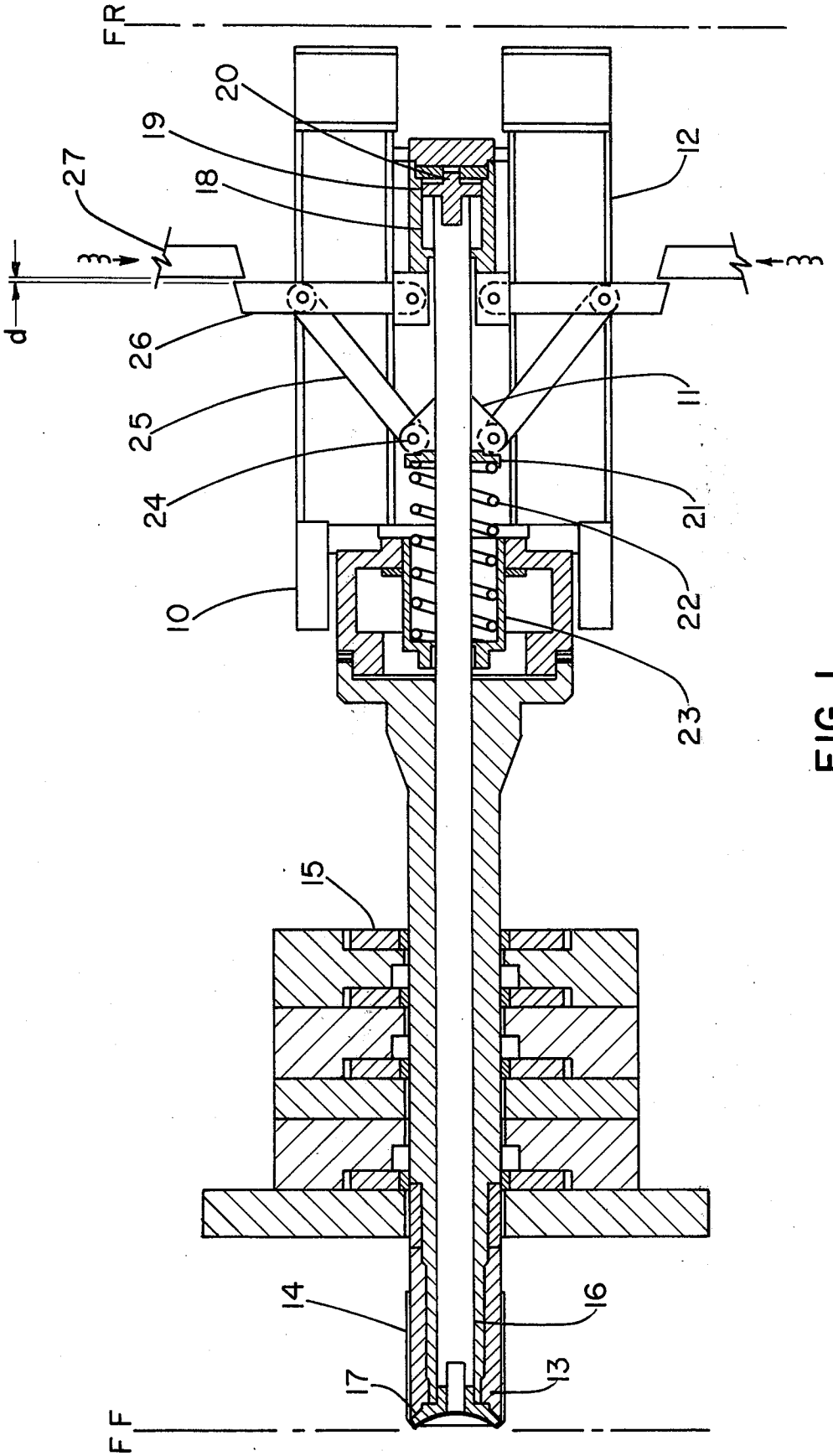


FIG. 1

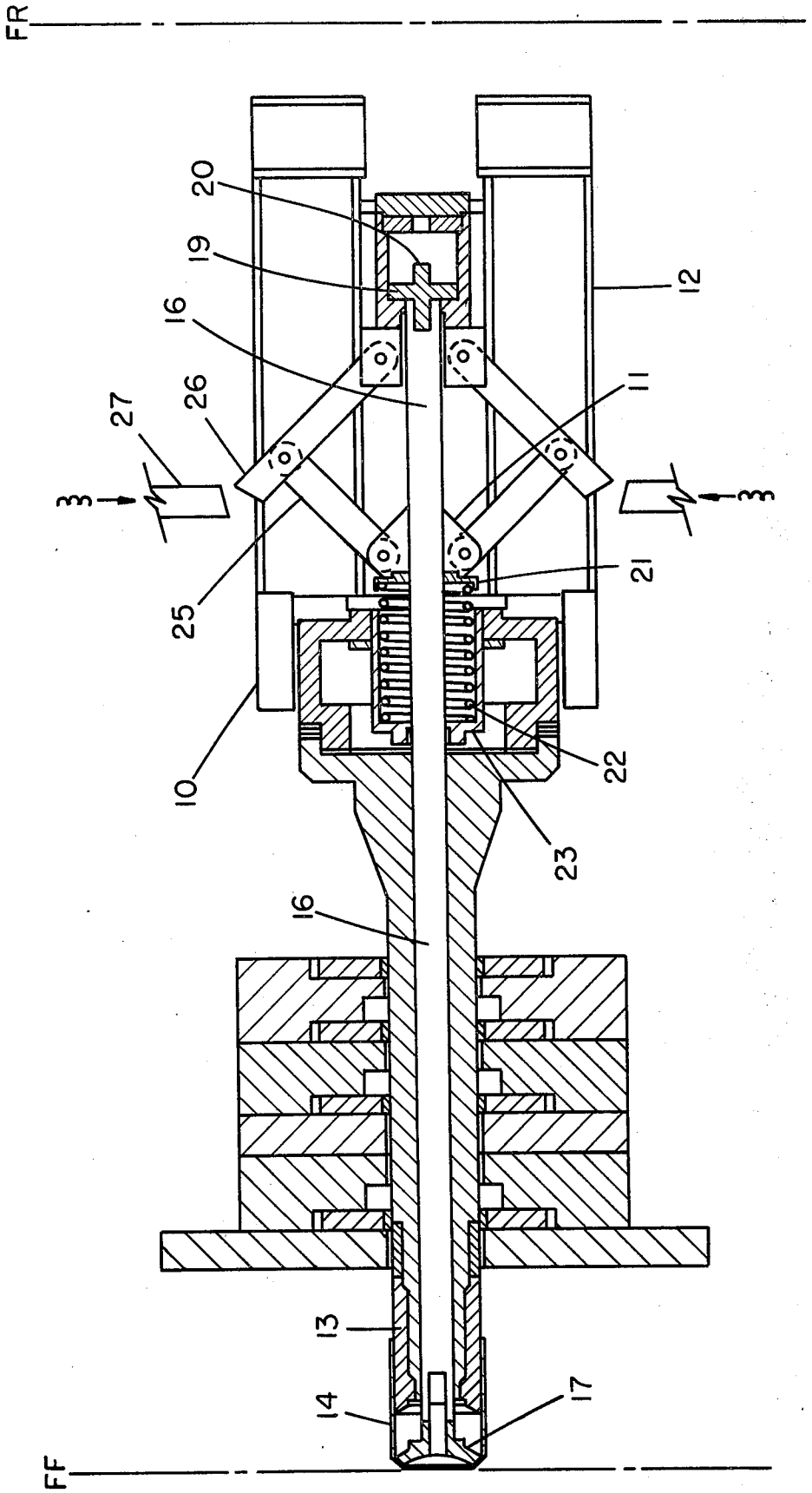


FIG. 2

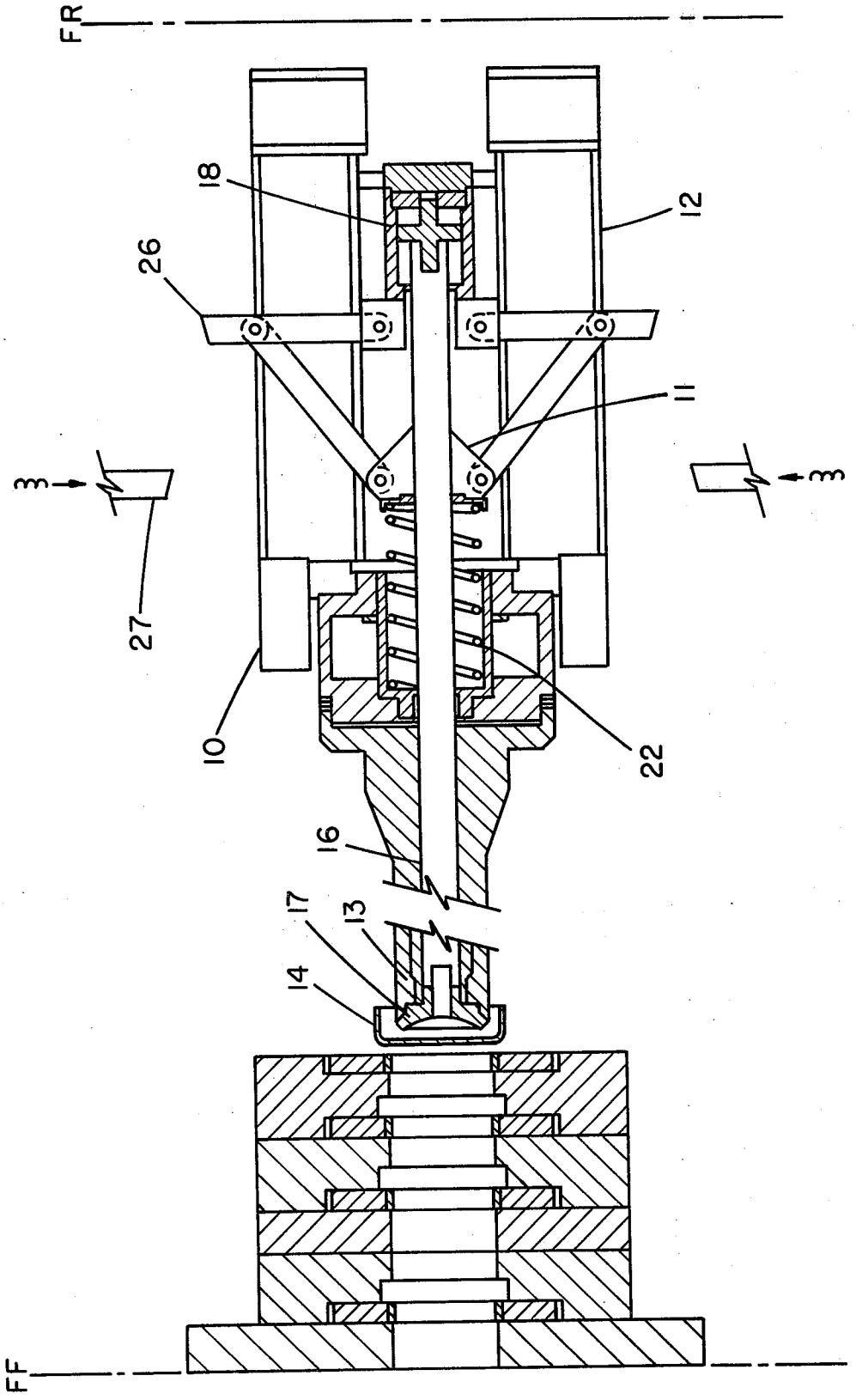


FIG. 3

HIGH SPEED EJECTOR MECHANISM

BACKGROUND OF THE INVENTION

This invention relates to ejector mechanisms for drawing and ironing presses which conventionally comprise one or more dies and a punch which is movable coaxially with respect to the dies with both the dies and the punch each comprising an axially central bore so adapted and arranged that the ductile material of a blank or cup flows back in a space between the walls of the punch and the dies to form a container. More particularly, this invention relates to ejector mechanisms for drawing and ironing presses for drawing and ironing ductile metal blanks or cups to form thin-walled seamless metal cans suitable for storage of liquids or semi-liquid substances such as beverages, food stuffs, aerosols and paints.

In order to function effectively, ejector mechanisms for thin-walled cans must quickly overcome forces from a number of sources. For example, since the axial walls and edge portions of the bottoms of the cans are formed by drawing and ironing the blank's ductile metal back along the punch between the walls of the punch and dies, frictional forces are formed all along the walls of the can. Furthermore, in many drawing and ironing presses, the punch often has a slightly irregular or tapered shank, wherein the front of the punch often has a slightly larger diameter than the rear portion. This taper produces cans of slightly increased thickness near the top so that the top of the can will be able to withstand subsequent machining operation associated with the addition of a top to the can. Such a taper produces a "hump", which in turn creates mechanical forces between the punch and can near the tapered top portion of the can which the ejector mechanism must also overcome.

Hitherto known ejector mechanisms for thin-walled cans have utilized such means as ejector pins operating from either the die side or the punch side to deliver a sharp tap to the bottom of the can, pneumatic means to deliver a blast of air to the bottom of the can, strippers or grippers to apply pressure to the top edges of the can from the punch side as the punch starts its return stroke, or combinations of these means such as those taught in U.S. Pat. No. 3,165,203 and 3,719,069. Owing to the high mechanical and frictional forces and the thinness of the walls of the can, the cans are often deformed by these types of ejector actions. Furthermore, the relatively thin ejector pins are, themselves, sometimes deformed or broken by the high buckling stresses caused by their impact with the cans. These buckling stresses are particularly prevalent in ejection systems wherein the pins are activated by means of electrical or pneumatic contacts which in turn activate the ejection pin driving means. This is because pneumatic or electrical make and break devices take slightly varying time spans to activate the ejector pins particularly as these devices wear in use. This results in improperly timed ejection actions and hence higher buckling stresses. Thus, "timing" of the ejection is of the utmost importance, particularly when rejections are carried out at rates in excess of **100** cans per minute.

SUMMARY OF THE INVENTION

A specific object of this invention is to provide an ejector mechanism which operates through completely mechanical means, that is, through mechanical linkages without the need for electrical or pneumatic operations. It being understood, however, that the ejector mechanism of this invention is designed to initially loosen the workpiece from the mechanical and frictional forces caused by the drawing and ironing process. After the workpiece is free of these forces, then known devices for holding and conveying the finished workpiece away from the die and punch work area may be used. Such devices form no part of this invention. It should also be understood that known pneumatic means could be used in synchronization with the ejector mechanism of this invention to prevent the collapse of the can due to vacuum forces created by the withdrawal of the punch in the can; again, however, such known devices form no part of this invention. It is a particular object of this invention to eject thin-walled cans from the work area of drawing and ironing presses at rates which may exceed **100** cans per minute without harmful deformations to said cans. It is still another object of this invention to reduce tool wear in the ejection mechanism in ways which will be hereinafter described.

Ejector mechanisms constructed in accordance with this invention comprise a nosepiece located at the working end of a punch. Said punch forms a fixed part of a punch carriage. The nosepiece is capable of reciprocal motion with respect to the punch with the reciprocal motion being independent of the motion of the punch. The nosepiece is connected to a push rod which transmits independent reciprocal motions to the nosepiece as the punch makes its rearward stroke out of the die. The push rod has connecting points for pivotally receiving actuator arms which are in turn pivotally connected to actuators. The actuators are pivotally mounted at one end to a known type of punch carriage which forms no part of this invention. The actuators are so adapted and arranged that the actuator initially jams against a biased trip dog during the return stroke of the punch carriage. This causes the actuator to pivot forward about its punch carriage pivot mounting. Thus, the actuator arm, the push rod, and hence the nosepiece is forced forward to eject the workpiece. As the punch carriage continues its rearward stroke, the actuator slips past the biased trip dog. When this happens, a push rod biasing means forces the push rod back to its original position before the punch carriage completes its rearward stroke. The return of the push rod is inhibited by a damping means connected to said push rod to prevent harmful impacts between the nosepiece and punch as the push rod is forced back by the push rod biasing means. The punch carriage then completes its rearward stroke. The actuator is also adapted to slide past the biased trip dogs as the punch carriage makes its forward or work stroke.

Other and further objects of the present invention will be apparent from the following description and claims. The accompanying drawings shown only the preferred embodiments of the present invention and the principles thereof, and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention utilizing the same or equivalent principles may be made as desired by those skilled in the art without departing from the scope of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Throughout this specification and in the appended

claims the terms "cylindrical can" and "can" are employed in the general sense as referring to a configuration generated by movement of a straight line in a closed path about a parallel straight line axis; thus, these terms include cylinders of generally rectangular, square, elliptical and other cross-sectional configurations, as well as the usual cylinders of circular cross-section. In the apparatus embodiments of this invention illustrated in the drawings, the drawing and ironing press is shown as having a generally circular configuration, and this is also true with respect to the workpieces, such as the lower portions of beer cans, produced by said drawing and ironing press. It being understood that modification to other cross-sectional configurations can be readily accomplished by changing the die and punch to the appropriate configuration. Furthermore, it will be understood by those skilled in the art that although the can is envisioned as having a full bottom in the approximate conformation of the nosepiece, the mechanism would operate on cans without full bottoms.

Likewise, even though the term "drawing and ironing" is generally used throughout this application, those skilled in the art will recognize that "cold ironing" or "extruding" presses could also utilize the ejection mechanisms taught by this invention and hence these terms should be considered as equivalents insofar as they apply to this invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a known drawing and ironing press with the ejector mechanism of this invention associated therewith. The punch carriage, and hence the punch which is fixedly attached to said punch carriage, is shown in its full forward position.

FIG. 2 is a sectional view of the drawing and ironing press and ejector mechanism showing the action of the ejector mechanism at a point just after the actuators have slid past the trip dogs during the rearward stroke of the punch carriage,

FIG. 3 is a sectional view of the drawing and ironing press and ejector mechanism showing the push rod returned to a full rearward position in the damping means after the actuators have slid past the trip dogs, but before the punch carriage has reached its full rearward stroke position. The figure shows a new workpiece in position ready to be extruded as the punch comes forward.

FIG. 1 is a sectional view of a drawing and ironing press **10**, in which an ejection mechanism **11** constructed in accordance with one embodiment of the present invention is incorporated. The press **10** comprises a punch carriage **12** having a known power means not shown for driving said punch carriage **12** between a full forward position FF and a full rearward position FR. The punch carriage **12** has a punch **13** fixedly attached so that said punch carriage **12** and punch **13** move in unison. A work piece **14** is "ironed" or "extruded" between the punch **13** and a die or series of dies **15** as the punch **13** moves into the die(s) **15**. The punch **13** is substantially hollow throughout its center to allow reciprocal passage of push rod **16**. A nosepiece **17** which substantially forms the forward or working end of the punch **13** is reciprocally mounted to move forward and rearward with respect to said forward end of the punch **13** as the punch carriage **12**, and hence the punch **13** makes its rearward stroke. The rear end of the nosepiece **17** is fixedly mounted to the front end of the push rod **16**. Another point on said push rod **16**, shown as the rear end in FIG. **1**, is fixedly mounted for reciprocation therewith to a damping means **18**. The damping means **18** shown in FIG. **1** is a known two-stage hydraulic damper having a first-stage piston **19** and a second-stage piston **20**. The push rod **16** is provided with an abutting means such as a back up ring **21** for contacting a biasing means depicted as a spring **22** in FIG. **1**. The purpose of said spring **22** is to force the push rod **16** far enough to the rear that the nosepiece **17** returns to the front of the punch **13** when the spring **22** is allowed to decompress. When the punch carriage **12** is in the full forward position FF shown in FIG. **1**, the other end of the spring **22** rests in a substantially decompressed state against a spring housing **23** which forms a fixed part of the punch carriage **12**. The push rod **16** is also fixedly provided with at least one connector **24** for pivotal connection with an actuator arm **25**. Said actuator arm **25** is pivotally connected at one end to the push rod connector **24** and pivotally connected at the other end to an actuator **26**. The actuator **26** is pivotally mounted to the punch carriage **12** at one end and pivotally mounted to the actuator arm **25** at some point adjacent to the actuator's punch carriage pivot mounting point. The actuator **26** is forced to pivot forward about the actuator's punch carriage pivot mounting point by a lever action delivered to the actuator **26** by a trip dog **27** after the punch carriage **12** begins its rearward stroke with said actuator **26** being so adapted and arranged that it initially jams against the trip dog **27** to create the levered pivot action of the actuator **26** about its punch carriage pivot mounting point, and then slides past the trip dog **27** after the actuator **26** has pivoted far enough forward to allow the actuator **26** to slide past the trip dog **27** as the punch carriage continues on its rearward stroke. The actuator **26** is also so adapted and arranged that it slips past the trip dog **27** without creating any forward movement of the actuator arm **25** during the forward stroke of the punch carriage **12**.

FIG. **1** shows the trip dog **27**, located a distance d from the rear edge of the actuator **26** when the punch carriage **12** is in the full forward FF position. The trip dog **27** has a biasing means for returning said trip dog to an actuating position when the trip dog is not in contact with the actuator **26**. The actuating end of the trip dog **27** is so adapted and arranged that the actuating end of the trip dog **27** initially jams against the actuator **26** after the punch carriage **12** begins its rearward stroke. The trip dog actuating end arrangement then allows the actuator **26** to slide past the actuating end of the trip dog as the punch carriage **12** continues on its rearward stroke. The actuating end of the trip dog **27** is so adapted and arranged that it allows the actuator **26** to slide past the biased trip dog **27** without a forward lever action of the actuator **26** as the punch carriage **12** makes its forward stroke.

FIG. **2** is a sectional view of the drawing and ironing press **10**, in which the ejection mechanism **11** constructed in accordance with one embodiment of this invention is shown at a position where the actuator **26** is just sliding past the trip dog **27** during the rearward stroke of the punch carriage **12**. The actuator **26** has forced the actuator arm **25** completely forward and the actuator arm **25** has forced the push rod **16** completely forward and the push rod **16** has in turn pushed the

nosepiece 17 forward to free the workpiece 14 from the forces holding the workpiece 14 to the pucnh 13. At this point in the ejection process other known devices for holding and conveying the finished workpiece 14 away from the die and punch work area may be utilized. Such devices are not shown and form no part of this invention. In the position shown in FIG. 2 the spring 22 has been put in compression between the back up ring 21 and the spring housing 23. The first stage piston 19 and the second-stage piston 20 have been pulled forward by the push rod 16 where they are now ready to dampen the return of push rod 16, and hence the return of the nosepiece 17 to the punch 13.

FIG. 3 is a sectional view of the drawing and ironing press 10, in which the ejection mechanism 11, constructed in accordance with one embodiment of this invention, is shown at a position in the return stroke of the punch carriage 12 where the actuator 26 is no longer in contact with the trip dog 27 and hence the spring 22 has decompressed. This decompression has preferably taken place before the punch carriage 12 has gone to the full rearward strike position FR. The forces supplied by the decompressing spring 22 have driven the push rod 16 rearward and hence pulled the nosepiece 17 back into contact with the front end of the punch 13. The impact of the return of the nosepiece 17 to the punch 13 has been softened by the damping means 18. A new workpiece 14 in the form of a blank or cup has been placed in position for drawing and ironing when the punch 13 makes its forward stroke.

Although a preferred embodiment of this invention is illustrated, it will be realized by those skilled in the art that modifications of the structual details may be made without departing from the mode of operation and the essence of this invention. For example, in all the figures shown above, the ejector mechanism is shown as being bilaterally symmetrical, i.e., actuator arms, actuators, and trip dogs are shown on each side of the push rod axis. This is the preferred arrangement, although it should be understood that the ejector mechanism would work with just one of each of the above elements in the arrangement shown in the drawings.

Furthermore, the push rod biasing means could be a device other than the spring shown in the above figures. Likewise, a damping means other than the hydraulic means shown in the figures above could be utilized. The two-stage hydraulic means shown above is preferred, however, since the first stage can be adapted to allow a damped, but nonetheless high speed return of the nosepiece to the ram under the influence of the biasing means and then further dampen the impact of the nosepiece to the ram at the end of this return to prevent harmful impacts between the nosepiece 17 and the punch 13. This combination is particularly well suited for the high speed operations contemplated by this invention.

Similarly, applicants have discovered that harmful mechanical impacts between the actuator and trip dog can be minimized if the distance between the rear edge of the actuator and the foward edge of the trip dog shown in FIG. 1 is less than about 2 inches and most preferably less than about ¼ of an inch. With this arrangement, the actuator has not had time to achieve a high rearward velocity before the rear edge of the actuator 26 and the front edge of the trip dog 27 impact. It should also be noted with respect to the actuator and trip dog that other geometric forms such as, for example, rounded edges would have the capability of sliding past each other in the rearward direction to lever the actuator and not lever the actuator during the forward stroke of the punch carriage. The trip dog can be biased toward the actuating position by any suitable biasing means such as springs, air pressure, etc.

Finally, it will be understood by those skilled in the art that the relationship between the punch and the die could be reversed since it is not absolutely essential that the punch be the movable element of the die and punch combination.

Therefore, except insofar as they are claimed in the appended claims, structural details may be varied widely without modifying the mode of operation. Accordingly, the appended claims and not the aforesaid descriptions are determinative of the scope of this invention.

What is claimed is:

1. An ejector mechanism for ejecting a workpiece from a drawing and ironing press having at least one die, a means adapted for receiving said workpiece, and a punch mounted to a powered punch carriage so adapted and arranged that the punch moves in the die(s) during a forward stroke to draw and iron the workpiece and moves out of the die(s) during a rearward stroke to permit ejection of the workpiece from the press, said ejector mechanism comprising:

a. A nosepiece reciprocally mounted with respect to the working end of the punch, said nosepiece having a forward working end for drawing and ironing the workpiece and for ejecting said workpiece by moving forward with respect to the punch just after the punch begins its rearward stroke, and having a rear end rigidly attached to a push rod for transmitting reciprocal motions from the push rod to said nosepiece;

b. A push rod for transmitting reciprocal motions to the nosepiece by having one end of said push rod rigidly attached to the nosepiece and another point fixedly mounted for reciprocation therewith, to a damping means and by having another point on said push rod fitted with at least one connector for pivotal connection with at least one actuator arm and by having another point fitted with a means for fitting a biasing means which returns the push rod to a position far enough to the rear that the nosepiece returns to the working end of the punch after a forward force delivered by the actuator arm is removed and before the punch carriage completes its rearward stroke;

c. At least one actuator arm for transmitting forward forces to the push rod from an actuator arm and for transmitting rearward forces from the push rod biasing means to the actuator arm by having one end of the actuator arm pivotally connected to the push rod and the other end pivotally connected to an actuator;

d. At least one actuator pivotally mounted to the ram carriage at one end and pivotally mounted to the actuator arm at some point adjacent to the actuator's punch carriage pivot mounting so that the actuator pushes the actuator arm forward when the actuator is forced to pivot forward about the actuator's punch carriage pivot mounting by a levered pivot action delivered to the actuator by a trip dog after the punch carriage begins its rearward stroke

with said actuator being so adapted and arranged that it initially jams against the trip dog to create the levered pivot action of the actuator about its punch carriage pivot mounting and then slides past the trip dog when the actuator has pivoted far enough forward to allow the actuator to slide past the trip dog as the punch carriage continues on its rearward stroke and then allows the actuator to slide past the trip dog without creating any levered pivot action during the forward stroke of the punch carriage;

e. At least one trip dog, having a biasing means to return the trip dog to an actuating position when the trip dog is not in contact with the actuator, and having an actuating end so adapted and arranged that the actuating end initially jams against the actuator after the punch carriage begins its rearward stroke and then allows the actuator to slide past the actuating end of the trip dog as the punch carriage continues on its rearward stroke and then allows the actuator arm to slide past the biased trip dog without pivoting of the actuator forward as the punch carriage makes its forward stroke;

f. A biasing means for returning the push rod to its rearward position with respect to a damping means after the actuator slides past the trip dog, but before the punch carriage completes its return stroke:

g. A damping means mounted to the punch carriage and reciprocally mounted to the push rod for damping the return of the nosepiece to the punch during the period the push rod is under the influence of the biasing means after the actuator slides past the trip dog during the rearward stroke of the punch carriage.

2. The mechanism of claim **1** wherein the workpiece receiving means is adapted to receive a blank of material capable of undergoing drawing and ironing.

3. The mechanism of claim **2** wherein the workpiece receiving means is adapted to receive a blank of ductile metal.

4. The mechanism of claim **3** wherein the workpiece receiving means is adapted to receive a blank of aluminum.

5. The mechanism of claim **3** wherein the workpiece receiving means is adapted to receive a blank of mild steel.

6. An ejector mechanism for ejecting a thin-walled cylindrical metal can having a bottom from around a ram of a drawing and ironing press having a means adapted for receiving a ductile metal blank, a hollow cylindrical die or dies and a punch mounted to a powered punch carriage so adapted and arranged that a working end of said punch moves into the die(s) during a forward stroke to draw and iron the ductile metal blank into a can and moves out of the die during a rearward stroke to permit ejection of the can, said ejector mechanism comprising:

a. A nosepiece reciprocally mounted with respect to the working end of the punch, said nosepiece having a forward working end for drawing and ironing the can and for ejecting the can from around the punch by a forward movement with respect to the punch just after the punch starts the rearward stroke, and having a back end rigidly attached to a push rod for transmitting reciprocal motions from the push rod to the nosepiece;

b. A push rod for transmitting reciprocating motions to the nosepiece by having one end rigidly attached to said nosepiece and the other end fixedly mounted for reciprocation therewith, to a damping means with said push rod being fitted with a plurality of connectors for pivotal connection with a plurality of actuator arms and being fitted with a biasing means to return said push rod to a rearward position after forward forces delivered by the actuator arms are removed and before the punch carriage completes its rearward stroke;

c. A plurality of actuator arms for tramsmitting forward forces to the push rod from a plurality of actuators and for transmitting rearward forces from the push rod biasing means to the actuators by having each actuator arm pivotally connected to the push rod at one end and the other end pivotally connected to an actuator which pushes the actuator arm forward after the punch begins its rearward stroke;

d. A plurality of actuators, each pivotally mounted to the punch carriage at one end and each pivotally mounted to an actuator arm at some point adjacent to the actuator's punch carriage pivot mounting so that the actuator pushes the actuator arm forward when the actuator is forced to pivot forward about the actuator's punch carriage pivot mounting by a lever action delivered to the actuator by a biased trip dog after the punch carriage begins its rearward stroke with said actuator being so adapted and arranged that it initially jams against the trip dog to create the pivot action of the actuator about its punch carriage pivot mounting then slides past the trip dog when the actuator has pivoted far enough forward to allow the actuator to slide past the trip dog as the punch carriage continues on its rearward stroke and allows the actuator to slide past the trip dog without creating any lever actions during the forward stroke of the punch carriage;

e. A plurality of trip dogs, each having a biasing means to return the trip dog to an actuating position when the trip dog is not in contact with the actuator, and each having an actuating end so adapted and arranged that the actuating end initially jams against the actuator after the punch carriage begins its rearward stroke, and then allows the actuator to slide past the actuating end of the trip dog as the actuator pivots forward as the punch carriage continues its rearward stroke and subsequently allows the actuator arm to slide past the biased trip dog without forward actuation of the actuator as the punch carriage makes its forward stroke;

f. A spring resting between the push rod and a spring housing which forms a fixed part of the punch carriage, for returning the push rod to a rearward position with respect to the damping means after the spring has been put in compression by the forward force of the actuator arm as the actuator jams against the trip dog, with said spring being allowed to decompress and hence push the push rod rearward after the actuator slides past the trip dog during the punch carriage's return stroke, with said spring having sufficient force to return the push rod to the rearward position before the punch carriage completes its rearward stroke;

g. A hydraulic damping means fixedly mounted to the ram carriage and having means for fixedly mounting for reciprocation therewith, the push rod, for damping the closing of the nosepiece to the punch during the period when the push rod is under the influence of the decompressing spring after the actuator has slid past the trip dog during the rearward stroke of the punch carriage;

7. The ejector mechanism of claim **6** wherein two actuator arms, two actuators, and two trip dogs are mounted in bilateral symmetry about the push rod.

8. The ejector mechanism of claim **7** wherein the trip dogs are mounted so that contact with the actuators is made near the end of the actuator which is opposite the actuator's punch carriage pivot mounting and at a time before the actuator has traveled rearward a distance of less than two inches.

9. The ejector mechanism of claim **8** wherein the means to bias the trip dogs into the actuating position is air pressure.

10. The ejector mechanism of claim **6** wherein the hydraulic damping means operates in two stages to allow a first stage for a rapid initial closing of the distance between the nosepiece and the punch when the spring is moving the push rod rearward and a slower closing during a second stage before the nosepiece and the punch come into actual contact so as to prevent harmful impacts between said nosepiece and punch.

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