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Suzuki et al.

[11] **3,861,192**

[45] **Jan. 21, 1975**

[54] **PRESS FOR COLD EXTRUSION OF DEEP-HOLED OR BOTTOMED CYLINDRICAL ARTICLES**

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[30] **Foreign Application Priority Data**

Feb. 6, 1973 Japan 48-14246

[52] **U.S. Cl.** **72/267,** 72/273, 72/352, 72/456

[51] **Int. Cl.** **B21c 3/18**

[58] **Field of Search** 72/267, 352, 273, 456, 72/257

[56] **References Cited**

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Primary Examiner—C. W. Lanham
Assistant Examiner—Robert M. Rogers
Attorney, Agent, or Firm—Toren, McGeady and Stanger

[57] **ABSTRACT**

In a press including an upper die movable vertically relative to a lower die for the cold extrusion of deep-holed or bottomed cylindrical articles, the lower die contains a die ring for accommodating a solid cylindrical blank or workpiece, and the upper die supports a punch movably displaceable into the die ring. The press includes a guide arrangement to ensure the concentricity of the die ring and punch, and to maintain the central axes of the die ring and punch in axial alignment. The guide arrangement also is movable displaceable so that the product being formed can move upwardly about the punch without interference.

7 Claims, 6 Drawing Figures

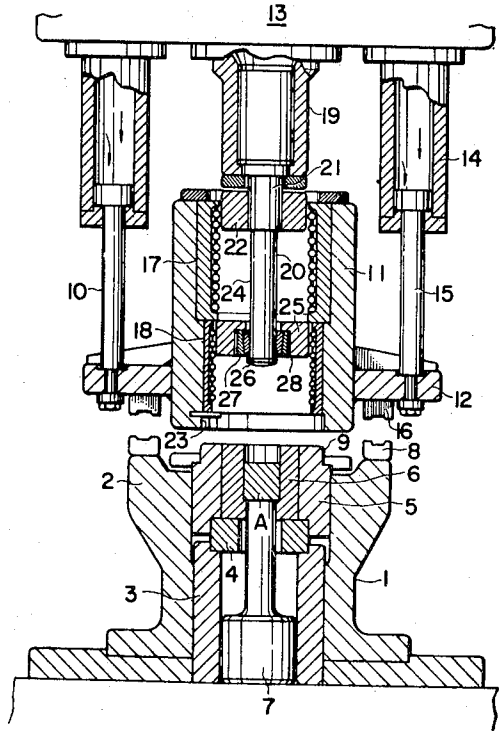


FIG. 1

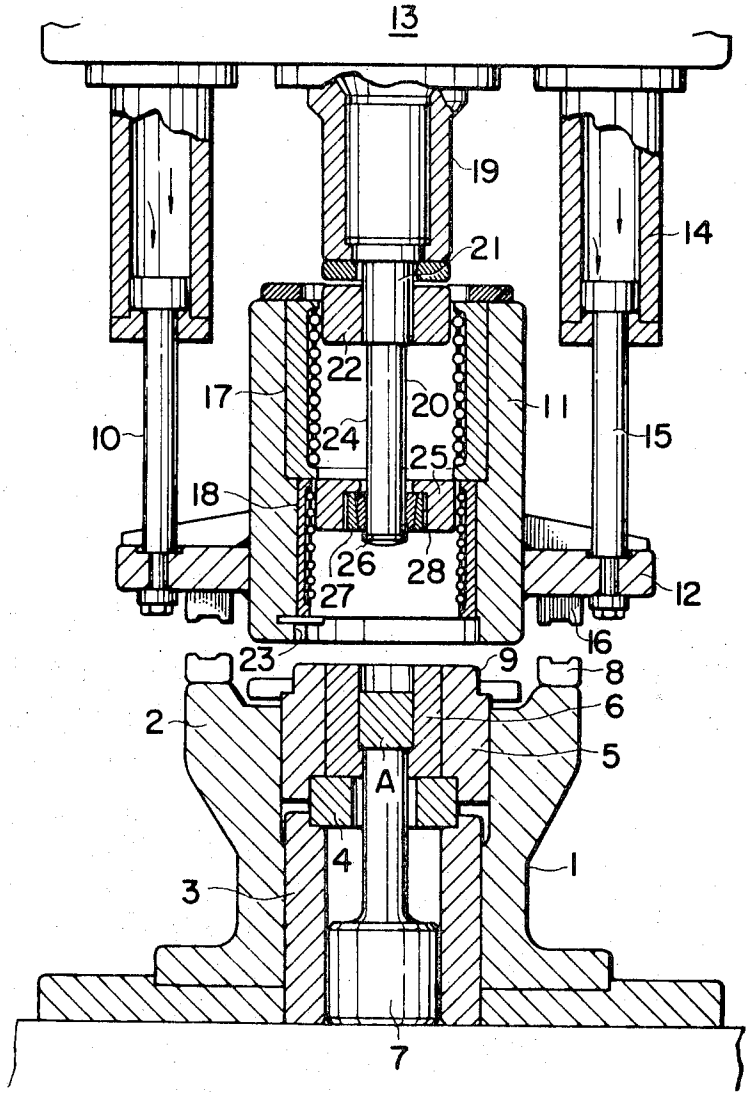


FIG. 2

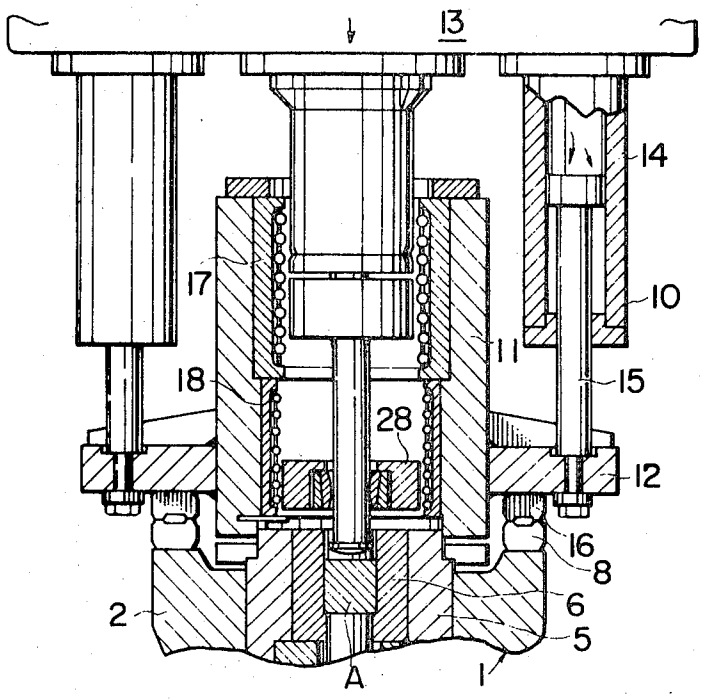


FIG. 3

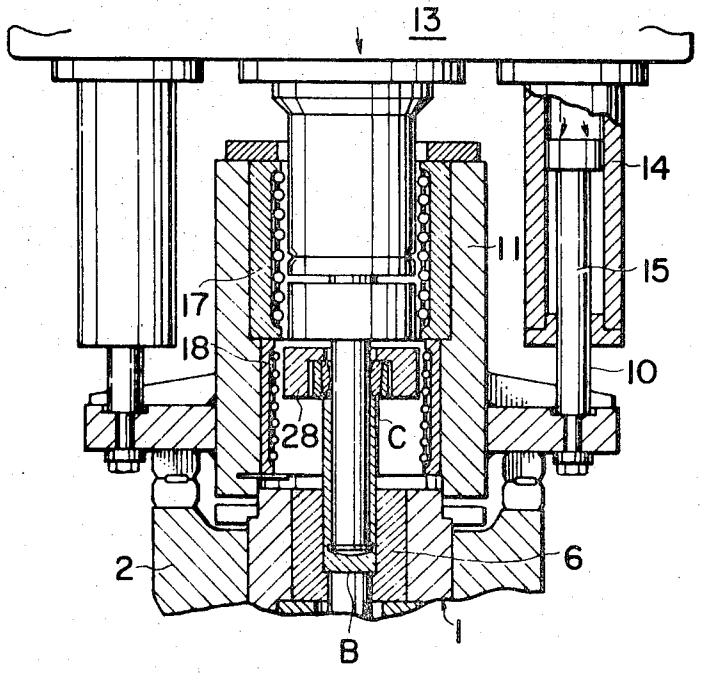


FIG. 4

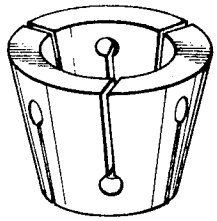


FIG. 5

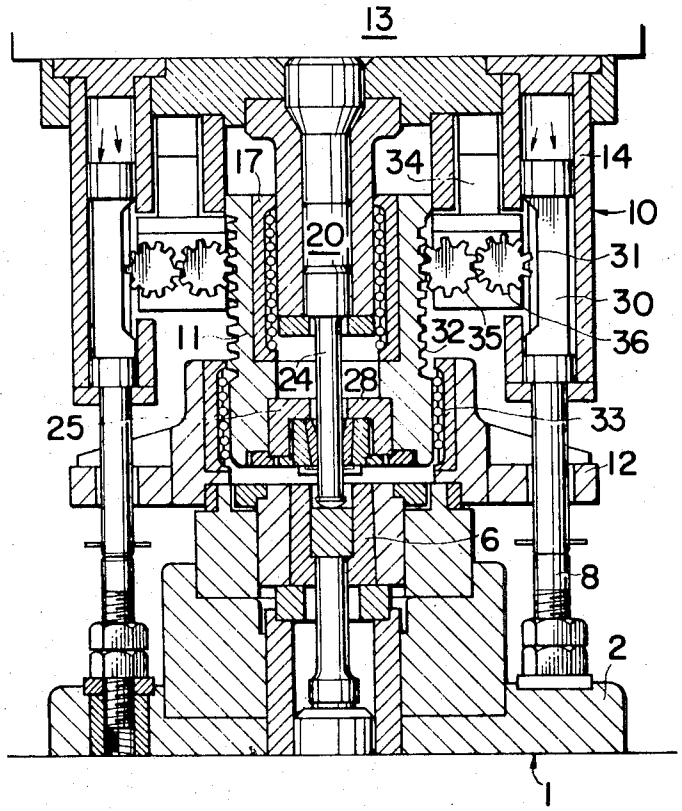
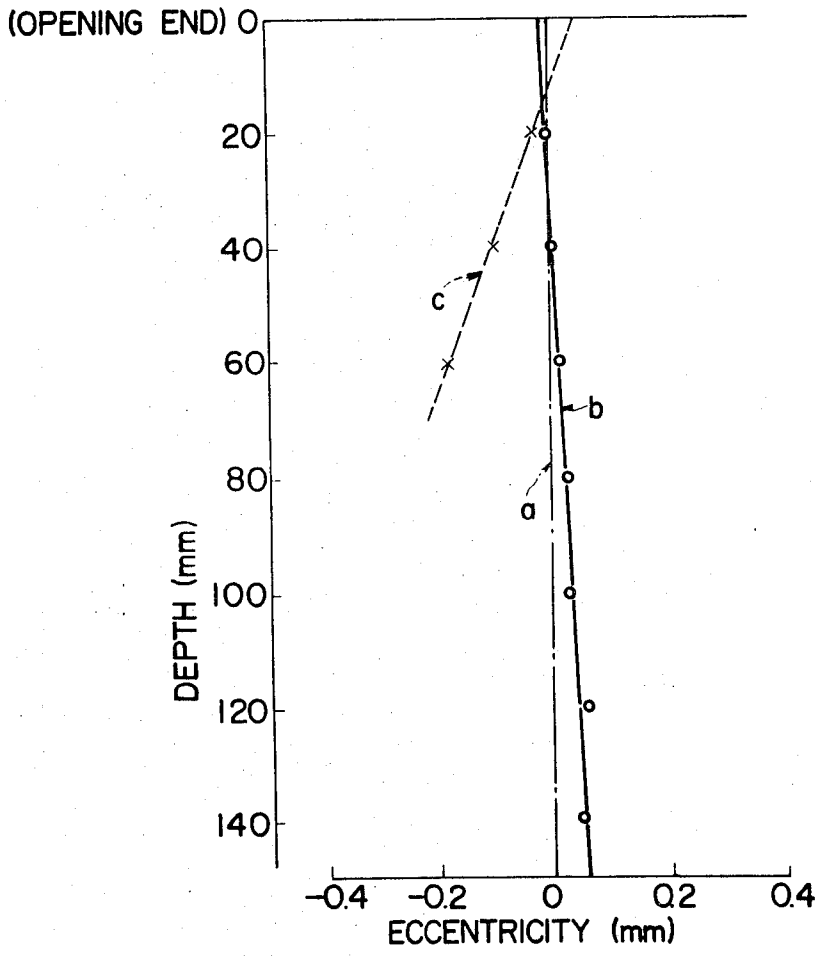


FIG. 6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80
100
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b
a
-0.4
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0.2
0.4
ECCENTRICITY (mm)

PRESS FOR COLD EXTRUSION OF DEEP-HOLED OR BOTTOMED CYLINDRICAL ARTICLES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a press for cold extruding deep-holed or bottomed cylindrical articles having a length-to-diameter ratio of four or more, from solid cylindrical blanks.

2. Description of the Prior Art

Generally it has been very difficult with conventional presses of this character to form deep-holed or bottomed cylindrical articles with a high degree of precision, since the punches tend to buckle because of their free length during punching operation and the punches are also easily distorted under eccentric load due to endwise tilting of the workpieces.

SUMMARY OF THE INVENTION

Therefore, the present invention has for its object to eliminate the defects experienced in the past by ensuring the concentricity of parts effecting the pressing action, as well as maintaining the center axis of the punch and die in parallel and by reducing the free length of the punch.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. **1** is a vertical sectional view of one embodiment of the invention;

FIGS. **2** and **3** are fragmentary sectional views of the press of FIG. **1** in different positions of an operational cycle;

FIG. **4** is a perspective view showing the detail of a punch guide;

FIG. **5** is a vertical sectional view of another embodiment of the invention; and

FIG. **6** is a graph showing the dimensional accuracy of an article formed in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

In the drawings, and particularly in FIGS. **1** to **3**, a press is illustrated embodying the present invention and consisting of a lower die **1** and an upper die **10** movable vertically toward and away from the lower die. The lower die **1** includes a die holder **2** laterally enclosing a support base **3.** A die spacer **4** rests on the upper end of the support base **3** and supports a die case **5** laterally enclosing a die ring **6.** As shown in FIG. **1,** a solid cylindrical blank A is positioned within the die ring **6.** Within the support base **3,** the die spacer **4,** and the die ring **6,** a knockout **7** is arranged for movement in the upward direction by a hydraulic pressure device or other lifting member for removing the formed article from the die ring. On top of the die holder **2,** stopper blocks **8** are mounted, each having an upper surface oriented at right angles to the vertical center axis of the lower die. The die case **5** has a reduced outside diameter at its upper end forming a neck **9** concentric with the center axis and projecting upwardly above the die holder **2.**

The upper die **10** has a cylindrical guide member **11** located above and concentric to the die ring **6.** Adjacent its lower end, a flange **12** is secured to and laterally encircles the lower portion of the guide member **11.** The flange **12** is attached to the lower ends of vertically movable pistons **15** of cylinders **14,** and the cylinders in turn are fixed to a press ram **13** which is adapted to move up and down. Stopper blocks **16** are fixed to the underside of the flange **12** opposite the stopper blocks **8** on the lower die **1.** The underside of each stopper block **16** is in a plane normal to the vertical center axis of the upper die **10.** The cylinders **14** are supplied with a fluid and normally force the pistons **15** downward. Thus, when the press ram **13** ascends or descends, the mutual relation between the pistons **15** and cylinders **14** causes the guide member **11** to rise or fall. When the press ram **13** descends, the stopper blocks **16** are brought into contact with the stopper blocks **8** and closer contact is ensured by increasing the hydraulic pressure in the cylinders **14.** Lining the interior of the guide member **11** are two thrust ball bearings **17, 18,** one positioned above the other.

Within the guide member **11** and extending along the center axis of the upper die **10** is a stepped punch **20,** which is dependently supported from the press ram **13** by a mounting member **19.** The lower end of the punch **20** has a smaller diameter portion **24** as compared to its larger diameter upper portion **21.** A ring **22** is secured about the larger diameter upper portion **21** of the punch **20** in such a manner that its outer lateral surface can slide along the bearing **17** to ensure the concentricity of the punch **20** with respect to the guide member **11.** The inside diameter of the guide member **11** is increased at its lower end **23** to an extent sufficient to receive snugly the neck **9** of the die case **5.** The lower, smaller diameter portion **24** of the punch **20** extends through a punch guide assembly **28,** which consists of a punch guide case **25** arranged to slide up and down along the bearing **18,** a punch guide **26** surrounding and in sliding contact with the punch **20,** and an adjust screw **27** for coupling the guide and guide case together.

As shown in FIG. **4,** the punch guide **26** has the form of an inverted truncated cone and contains a plurality of longitudinal slits **29** which extend alternately from the opposite ends to permit adjustment of the inside diameter. The slits extend in the axial direction of the punch but do not extend for the full length of the punch guide. The interior of the adjust screw **27** is also cone-shaped for a collet-type engagement with the punch guide **26.** By means of the adjust screw **27** the clearance between the punch **20** and the punch guide **26** is made equal to the diametral expansion of the punch that is caused by the elasticity of the punch itself during the forming operation.

Thus, when the press ram **13** is in the up position, as shown in FIG. **1,** the guide member **11** and punch guide assembly **28** are also raised by means of the cylinders **14** and pistons **15.** Further, the knockout **7** is in the down position. A solid cylindrical blank A is placed in the die ring **6.** As the forming operation is initiated, the press is started, and the ram **13** descends. As the lower end of the punch moves downwardly with the ram to a position short of contact with the workpiece A, as in

FIG. 2, the enlarged bore portion 23 of the guide member 11 fits around the neck 9 of the die case 5 to ensure the axial alignment of the punch 20 and die ring 6. Next, the stopper blocks 8, 16 come into contact, and from then the hydraulic pressure by the cylinders 14 is increased as the press ram 13 descends to assure the axial alignment of the upper die 10 and the lower die 1. At this time the assembly 28 is positioned at the lower end of the bearing 18 and slightly above the lower end of the punch. As the press ram 13 continues its downward movement, the relative sliding of the ring 22 and the bearing 17 enables the punch 20 to contact the workpiece A and start its cold extrusion. Practically the entire free length of the lower, smaller diameter portion 24 of the punch 20 is guided by the assembly 28 without any axial distortion midway of the punch and accordingly, the workpiece A is forced to assure a bottomed cylindrical form B having a bore corresponding to the diameter of the punch and also a tubular formed lateral part C in close contact with the punch surface. As the forming operation progresses, the tubular formed part C increases in length. Consequently, the assembly 28 is gradually pushed upwardly by the upper end of the part C sliding along the bearing 18, preventing distortion of the punch 20 while not interfering with the extruding operation. Finally, as shown in FIG. 3, the assembly 28 reaches the upper end of the bearing 18 as the punch 20 reaches the lower limit of its stroke, and the forming operation is completed. In the return to the starting position, the press ram 13 moves upwardly and the punch 20 and cylinders 14 move with it, however, the assembly 28 remains in the same position guiding the punch as it is withdrawn from the cylindrical article B. Next, the guide member 11 is raised by the engagement between the lower parts of the cylinders and the larger diameter portions of their pistons. When the ram 13 has returned to its initial position, the knockout 7 is moved upwardly and pushes the formed article B out of the die ring. Accordingly, one complete operating cycle is concluded.

FIG. 5 shows another embodiment of the present invention in which the punch guide assembly 28 is allowed to move upwardly as the press ram 13 descends. Unlike the embodiment illustrated in FIGS. 1 to 3, this one is provided with pistons 30 which are accommodated in cylinders 14 but are capable of contacting, at their lower ends, stopper blocks 8 of a die holder 2. Each piston 30 has a rack 31 formed on one side. Guide member 11 is also formed with racks 32 on each of its exterior sides. The case 25 of the assembly 28 is fitted within the guide member, and the combination of the guide member 11 and assembly 28 is slidable relative to a flange 12 via a slide ball bearing 33 in the flange. Each pair of adjacent racks 31, 32 are engaged with one pair of pinions 35, 36 supported from the press ram 13 by a member 34.

This second embodiment operates in the following way. At the commencement of a forming cycle, the press ram 13 descends, bringing the pistons 30 into contact with the stopper blocks 8 immediately before the start of extrusion. Then, the pinions 35, 36 roll downwardly in mesh with the racks 31 of the pistons 30, and through the racks 32 and their engagement with the pinions the assembly 28 and bearing 17 are raised together with the guide member 11 along the bearing 33 of the flange 12. This positively keeps the assembly 28 from interfering with the skirting up of the workpiece around the punch during the extruding operation. The dimensions of the racks 31, 32 and pinions 35, 36 are so chosen that they can raise the assembly 28 as slowly as possible within the rate at which the assembly is kept away from the article being formed from the workpiece.

The dimensional accuracy of a cylindrical article formed by extrusion through such embodiments is graphically represented in FIG. 6. The cylindrical article with a center axis *a* has a hollow or hole whose axis *b* is off center by less than 0.05 mm per 140 mm of the depth of the hole. Thus, it will be appreciated that a very good concentricity is attained with practically negligible eccentricity. As compared with the central axis *c* of the hole of a conventionally fabricated article represented by a broken line, that of the article according to this invention has an eccentricity of only about one-fourth that of the former despite the fact that the latter has a hole more than twice as deep.

As will be obvious from the foregoing description, it is possible with the cold extrusion press of the present invention to achieve concentricity of the die ring 6 about the punch 20 through the engagement of the neck 9 of the die case 5 and the enlarged bore portion 23 of the guide member 11; the co-axial relationship of the punch 20 and die ring 6 is attained through contact of the stopper blocks 8 of the die holder 2 and the stopper blocks 16 of the flange 12 or the pistons 30; and the alignment of the punch 20 with the workpiece A is obtained through the use of the assembly 28 which is vertically movable with respect to the punch 20 during the forming operation. These features enable the press to perform the extrusion without distortion or buckling of the punch 20 and, therefore, to produce cylindrical articles with such a high degree of precision that the products can be advantageously used in their various applications.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A press for cold extrusion of deep-holed or bottomed cylindrical articles including a lower die, an upper die movably displaceable in the vertical direction toward and away from said lower die, said lower die comprises a die holder, a die case located within said die holder and a die ring positioned within said die case and secured within said holder by said case, said die ring arranged to receive and hold a solid cylindrical blank, said upper die includes a press ram, a punch mounted on said press ram and arranged to be forced into the blank so that the blank can skirt up around said punch and adopt a bottomed cylindrical form, wherein the improvement comprises a guide member for said punch, means for supporting said guide member from said press ram for movement with said press ram, said guide member arranged to engage said die case for maintaining the alignment of said punch and said die ring, means associated with said press ram and arranged to apply pressure downwardly against said die holder, and means laterally encircling said punch for vertical, slidable movement within said guide member for preventing distortion and buckling as said punch is forced into the blank in said die ring.

2. A press, as set forth in claim 1, wherein said means laterally encircling said punch comprises a punch guide assembly which includes a punch guide case positioned within said guide member and spaced laterally outwardly from said punch, a punch guide slidably fitted about said punch and spaced laterally inwardly from said guide case, and an adjust screw laterally enclosing said punch guide and located in said guide case for coupling said punch case to said punch guide, and means for permitting said punch guide assembly to be moved gradually upwardly by the upper rim of the article being formed by said punch from the blank.

3. A press, as set forth in claim 1, wherein said means laterally encircling said punch comprises a punch guide assembly which includes a punch guide case positioned within said guide member and spaced laterally outwardly from said punch, a punch guide slidably fitted about said punch and spaced laterally inwardly from said guide case, and an adjust screw laterally enclosing said punch guide and located within said guide case for coupling said punch case to said punch guide, means for permitting said punch guide assembly to be moved gradually upwardly by the upper rim of the article being formed by said punch from the blank, said means arranged to apply pressure downwardly against said die holder comprising at least one pair of vertically arranged hydraulic cylinders and pistons each located on an opposite side of and spaced outwardly from said guide member, a rack formed on each of the opposite sides of said guide member on which one of said hydraulic cylinders and pistons is located, a rack formed on each of said pistons opposite said rack formed on said guide member, a pair of pinions in meshed engagement with one another and located between each pair of racks formed by one of said racks on said guide member and one of said racks on said adjacent said piston, one of said pinions disposed in meshed engagement with said rack on said guide member and the other said pinion disposed in meshed engagement with said rack on said piston so that as said press ram and said piston move downwardly said guide member and its associated said punch guide assembly can move upwardly by virtue of said means for permitting said punch guide assembly to be moved gradually upwardly for preventing any interference with the upward movement of the article formed by said punch from the blank.

4. A press, as set forth in claim 2, wherein said means for permitting said punch guide assembly to be moved gradually upwardly comprises a first ball bearing fitted into and extending vertically within the upper portion of said guide member and a second ball bearing fitted into and extending vertically within the lower portion of said guide member, the radially outer surface of said punch guide case is disposed in sliding contact with said second ball bearing.

5. A press, as set forth in claim 4, wherein said punch has a stepped configuration with its lower end having a smaller diameter and positioned within and in sliding contact with said punch guide, an increased diameter portion of said punch as compared to the smaller diameter lower portion is located above the lower end of said punch, and a ring secured to said increased diameter portion of said punch and disposed in sliding contact with said first ball bearing.

6. A press, as set forth in claim 1, wherein the inside diameter at the lower end of said guide member has a dimension sufficient so that it closely laterally encloses the upper end of said die case.

7. A press, as set forth in claim 2, wherein said punch guide has a frusto-conical configuration and contains a plurality of longitudinal slits extending through its wall in the axial direction of said punch, adjacent ones of said slits extend from opposite ends of said punch guide to a point close to but short of the opposite end of said punch guide, and said adjust screw has a frusto-conically shaped inner surface to engage said punch guide and provide a collet-type engagement.

* * * * *