Feb. 12, 1957 F. W. LIVERMONT 2,781,016

DIE CONSTRUCTION

Filed Dec. 10, 1952

FIG. 1.

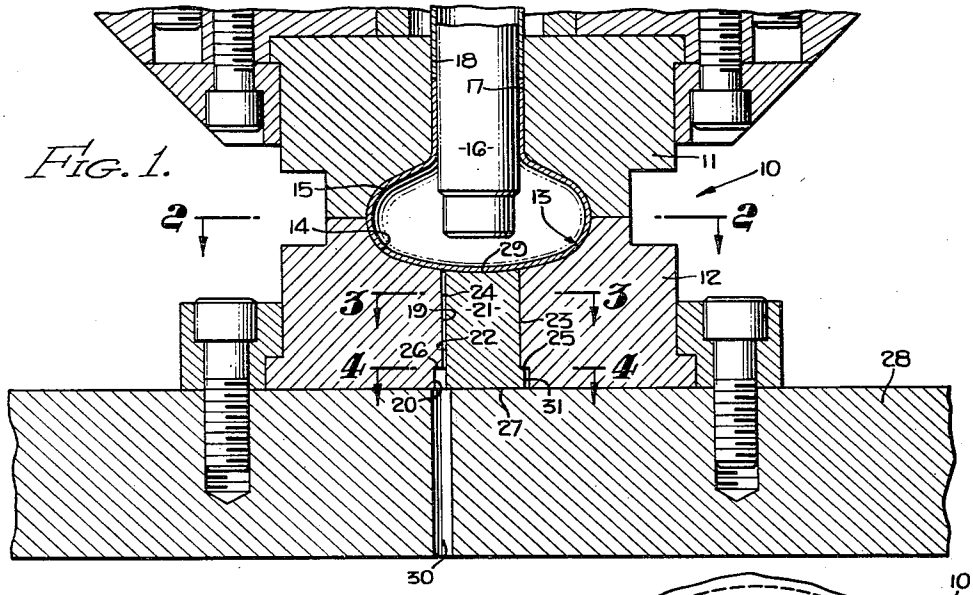
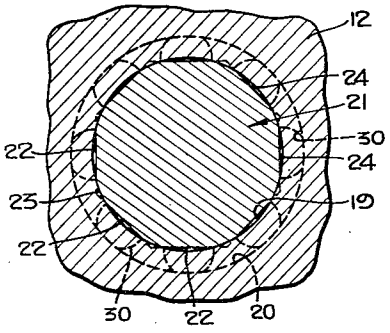


FIG. 3.



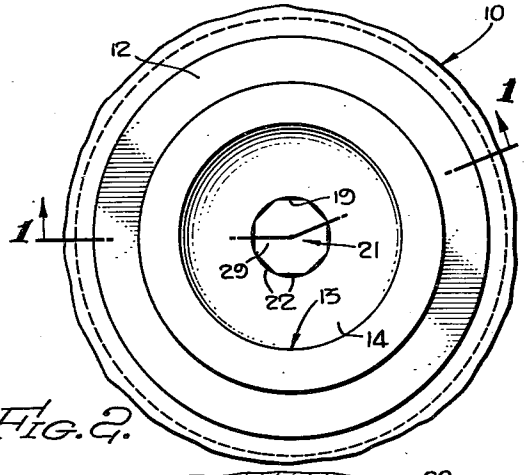


FIG. 2.

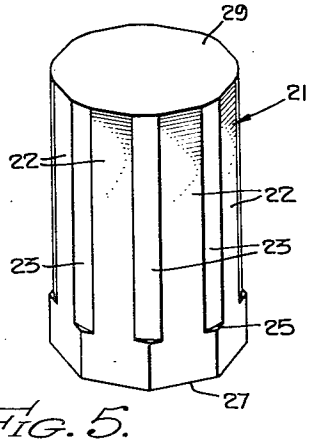


FIG. 5.

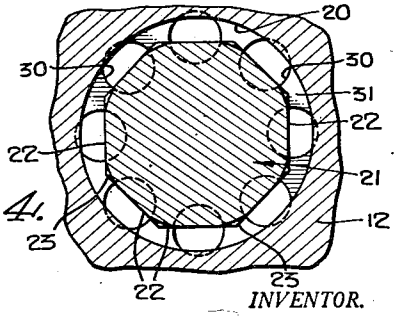


FIG. 4.

INVENTOR.
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2,781,016

DIE CONSTRUCTION

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Application December 10, 1952, Serial No. 325,168

2 Claims. (Cl. 113—49)

This invention relates generally to the metal stamping art and is particularly directed to improvements in die construction for hydraulically expanding and hollow bulbous parts within a die set.

In the copending application of Livermont et al., Serial No. 93,524, filed May 16, 1949, now Patent No. 2,688,297, there is disclosed a method and apparatus for producing hollow door knobs from flat sheet stock. One of the steps in this process is to hydraulically expand a necked cup by means of a plunger which fits very closely within the cylindrical neck of the cup. Upper and lower dies cooperate to define a cavity into which the large part of the necked cup is expanded. It has been found that a certain amount of liquid is spilled into the die cavity during the loading and unloading of the workpieces from the die set and that not all hydraulic liquid is always expelled from the die cavity prior to completion of the hydraulic expansion step. The result is that small amounts of liquid are trapped within the lower part of the cavity and serve to cause objectionable indentations on the finished workpiece. I have found that the indentations can be eliminated by providing a plurality of very small holes in the lower die part through which the hydraulic liquid can escape.

It is therefore the principal object of my invention to provide escape means for hydraulic liquid trapped within the lower part of a die cavity.

Another object is to provide a novel form of apparatus which forms a plurality of escape ports having very small entrance openings.

Another and more detailed object is to provide a cavity in a lower die and provide escape means for liquid from said cavity through small ports formed as clearances between a relatively large opening in the die and a plug received within said opening.

Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

Figure 1 shows a sectional elevation, partly broken away, illustrating a preferred embodiment of my invention and taken substantially on line 1—1 as shown in Figure 2.

Figure 2 is a sectional plan view taken substantially on the line 2—2 as shown in Figure 1.

Figure 3 is a view similar to Figure 2, on an enlarged scale, taken substantially on the line 3—3 as shown in Figure 1.

Figure 4 is a view similar to Figure 3 taken substantially on the line 4—4 as shown in Figure 1.

Figure 5 is a perspective view of the plug which is received within the lower die.

Referring to the drawings, the die set generally designated 10 includes an upper die 11 and a lower die 12 cooperating to define a die cavity 13. A portion 14 of this cavity is formed in the lower die 12. A workpiece 15 in the form of a necked cup filled with hydraulic liquid is placed in this cavity 14. A plunger 16 moves

downward into the neck portion 17 at the same time that the upper die 11 moves downward over the neck portion 17. The liquid within the workpiece 15 is pressurized by the plunger 16 and acts to expand the lower portion of the workpiece into tight engagement with the surface of the cavity 13. After this hydraulic expansion step has occurred, the plunger 16 and upper die 11 move upwardly away from the die 12 and an ejector sleeve 18 is actuated to strip the part 15 from the plunger 16.

Hydraulic liquid is spilled into the cavity portion 14 during loading and unloading of the workpiece 15 and also when the plunger 16 expels excess liquid from the neck 17 as it enters therein. Since the necked cup blank is flatter on the bottom than the bottom of the cavity portion 14 a circular metal to metal seal may develop which entraps some of the liquid. Moreover, the necked cup is subjected to an expanding operation so that the metal to metal contact becomes increasingly wide as the die parts move together. If no provision is made to permit escape of this liquid from the lower portion of the cavity 13, I have found that occasionally a dimple or indentation will be formed on the lower surface of the workpiece 15. These dimples or indentations do not appear on every part but do occur occasionally.

In accordance with my invention, I eliminate the indentations on all parts by providing liquid escape means in the lower die 12 so that liquid can escape from the lower part of the cavity 13. As shown in the drawings, I provide a cylindrical bore 19 in the die 12 which communicates with the cavity portion 14. This cylindrical bore 19 is enlarged at its lower end to form a counterbore 20. A plug 21, which is formed from octagonal stock, is turned in a lathe for the major portion of its length, as shown in Figure 5. The flat octagonal sides 22 are then joined by the arcuate portions 23. These arcuate portions 23 from a press fit within the cylindrical bore 19 and the clearances between the flat sides 22 and the bore 19 from escape passages 24. These escape passages 24 may have a maximum width of from 0.002 inch to 0.020 inch, for example. This narrow width has been found sufficient to permit escape of hydraulic liquid without forming bulges in a pattern on the workpiece 15 corresponding to the location of the outlet passages 24.

The shoulders 25 at the ends of each of the arcuate portions 23 of the plug 21 engage the end wall 26 of the counterbore 20 so that the plug 21 cannot move upward within the bore 19. The lower end 27 of the plug 21 rests on the upper surface of the stationary plate 28 which carries the lower die 12. The upper surface 29 of the plug is shaped to conform to the desired contour of the lower cavity portion 14.

The plate 28 is provided with a series of drilled openings 30 arranged in a circle and having their upper ends in communication with the space 31 between the counterbore 20 and the plug 21. From this description, it will be understood that hydraulic liquid passing through the escape passages 19 enters the space 31 and passes out through the openings 30.

While I have shown and described an eight-sided plug 21, it is to be understood that the number of sides may be varied as desired in order to produce the necessary escape passages 19.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth but my invention is of the full scope of the appended claims.

I claim:

1. Apparatus for use in hydraulically expanding a hollow workpiece, comprising: a die having at least a portion of a cavity formed therein, the die having a bore communicating with said cavity, a plug having portions fitting within said bore, the upper end of the plug being shaped

to conform to the contour of the cavity, the plug having a plurality of surfaces spaced radially inwardly from the wall of the bore and cooperating with said bore to define liquid escape passages leading from said cavity, the lower die having a counterbore communicating with said bore and defining a downwardly facing shoulder therebetween, and an upwardly facing abutment near the lower end of the plug engaging said shoulder.

2. Apparatus for use in hydraulically expanding a hollow workpiece, comprising in combination: an upper die and a lower die cooperating to define a cavity therebetween, a plate supporting the lower die, the lower die having a bore communicating with said cavity, a plug resting on said plate and having portions fitting within said bore, the upper end of the plug being shaped to conform to the contour of the cavity, the plug having a plurality of surfaces spaced radially inwardly from the wall of the bore and cooperating with said bore to define liquid escape passages leading from said cavity, the lower die having a counterbore communicating with said bore

and defining a downwardly facing shoulder therebetween, an upwardly facing abutment near the lower end of the plug engaging said shoulder, and a plurality of openings in the plate communicating with said counterbore.

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