May 14, 1968 H. S. ACHLER ET AL 3,382,690

DRAW DIE

Filed Sept. 17, 1965

FIG. 1.

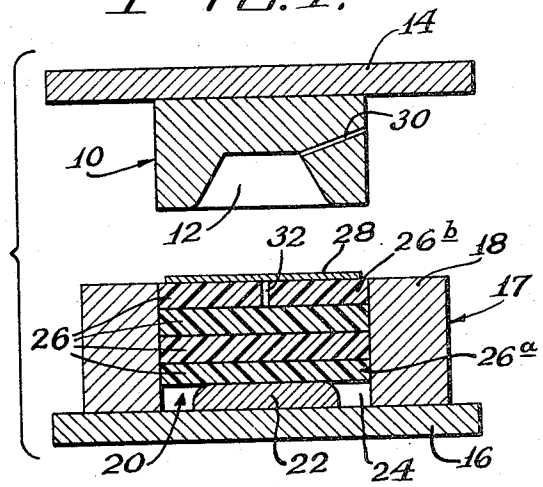


FIG. 2.

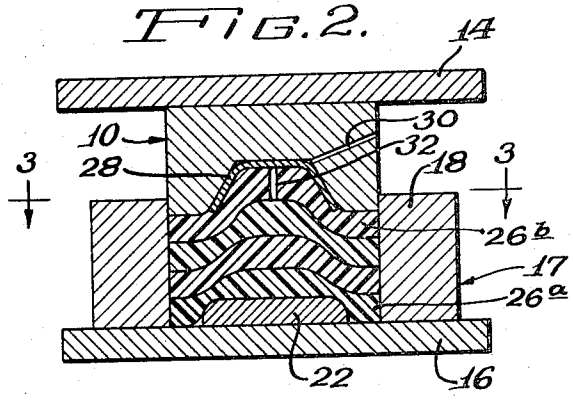


FIG. 3.

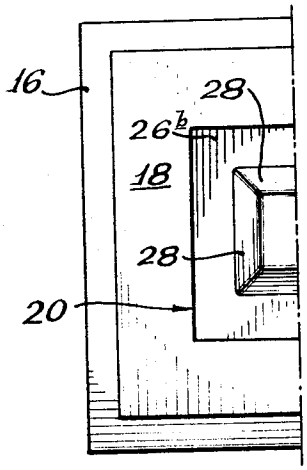


FIG. 4.

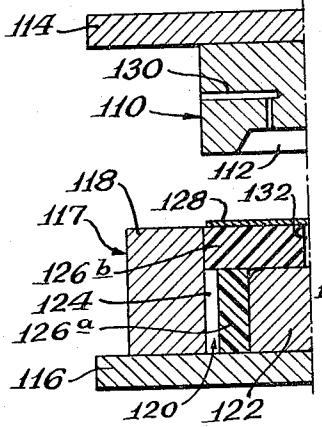
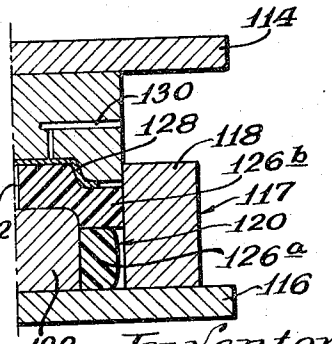


FIG. 5.



Inventors:
Howard S. Achler
Harold Kaufmann
By Bair, Freeman & Molinare
Attys.

United States Patent Office 3,382,690
Patented May 14, 1968

3,382,690

DRAW DIE

Howard S. Achler and Harold Kaufmann, Chicago, Ill., assignors to Kaufmann Tool & Engineering Corp., Chicago, Ill., a corporation of Illinois

Filed Sept. 17, 1965, Ser. No. 488,048
4 Claims. (Cl. 72—57)

ABSTRACT OF THE DISCLOSURE

An improved mechanism for drawing sheet steel and the like is provided by use of a female die defining the shape to which the sheet is to be drawn, and a retainer for cooperation with the female die, wherein the retainer uses a rigid insert spaced from the walls of the retainer to define a well, and at least two die pads of urethane rubber are used in the retainer with at least the uppermost pad overlying the rigid insert and arranged to enter the recess of the female die and at least the lowermost pad providing portions that flow in the well during a drawing operation. A preferred size of urethane rubber pad is disclosed to have a thickness in the range of ½ to 1 inch. In one form of device one of the pads is provided in annular shape for entry into said well.

This invention relates to a drawing mechanism and more particularly relates to a drawing mechanism that utilizes, as a working portion thereof, a flexible solid element that performs, when deflected, in much the manner of a "liquid" by providing substantially uniform pressure therefrom in all directions.

The process of "drawing" sheet material is well known and, for purposes of precision herein, must be carefully distinguished from the process of "embossing." "Die Design Handbook," McGraw-Hill Book Company, Second Edition, © 1965, at pp. 10–1 states: "Drawing is a process of cold forming a flat precut metal blank into a hollow vessel without excessive wrinkling, thinning or fracturing." In "embossing," the material of the blank surrounding the bead portion being embossed or distorted is gripped or held by relative large pressures, or because of the proportion of the bead to the blank being very small, so that as a result the material of the blank generally resists movement and the small portion of the blank being acted upon actually stretches, thus causing relative severe thinning of the portion of the material being embossed. In "drawing," the portions of the material being acted upon are desired to deform to the ultimate shape without undue thinning down of the material. Consequently, the material surrounding the portion thereof being deformed is not to be held by relatively large pressures, and the dies are normally designed to permit the material being drawn to flow to the desired condition and position. Hence the reduction in overall area size of the blank dimension is very much greater in drawing work.

Now, in drawing mechanisms for producing cupped or hollow-vessel products, it is normal practice to provide cooperating and carefully matched male and female dies to achieve the desired deformation. The amount of draw necessary to achieve the desired end product may dictate drawing of the blank of material in a series of progressive steps which requires the provision of multiple matched sets of dies. Such tooling is expensive, and, unless used in very high production runs, adds materially to the per unit cost of production of the end product.

Thus, one object of this invention is to provide a drawing mechanism which avoids the necessity of a carefully matched die set and which is characterized by its simplicity and inexpensiveness of construction.

Another object of this invention is to provide a drawing mechanism which requires in a drawing die only a female die to define the exterior of the shape desired and the provision of multiple pads of urethane rubber for cooperation with the female die.

Further objects and advantages of this invention will become apparent as the following description proceeds and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

A preferred embodiment of the invention is shown in the accompanying drawings, in which:

FIG. 1 is a vertical cross-sectional view through the die mechanism of this invention showing the arrangement of parts prior to the deformation of the blank;

FIG. 2 is a view similar to FIG. 1 but showing the arrangement of parts at the end of the deformation process;

FIG. 3 is a top plan view of the retainer or lower portion of the die mechanism shown in FIG. 1;

FIG. 4 is a vertical cross-sectional view similar to FIG. 1 but showing a modified form of draw die; and

FIG. 5 is another view, similar to that in FIG. 2 of the modified form of draw die of FIG. 4.

Referring now to the drawings, there is shown in FIG. 1 a female die **10** formed of steel and which defines side walls and the bottom for an open female-die recess **12** that is shaped to provide the outer contour of the hollow vessel that is to be formed from a plat precut metal blank that is to be drawn. The female die is mounted, as shown, on an appropriate base, or backing plate **14**.

The other portion of the drawing mechanism is a retainer means, and it includes a base, or backing plate **16** having mounted thereon an upright hollow retainer **17** that provides a peripheral wall means **18** surrounding a cavity **20** into which a portion of the die **10** enters during the drawing process. In the bottom of the cavity **20**, mounted on the backing plate **16**, is a rigid steel insert **22** that is shaped to be generally protruding or convex and is spaced centrally in the cavity **20** so as to define a well **24** between the insert **22** and the spaced retainer walls **18**.

Also positioned in the retainer cavity **20** are a plurality of die pads **26** of urethane rubber. The plurality of die pads **26** of urethane rubber are laid one upon each other as shown in FIGS. 1 and 2, with a lowermost pad **26*a*** overlying the rigid insert **22** and being of an areal dimension that is at least as large as the areal size of the cavity **20**, so that the edges of pad **26*a*** engage the walls **18** of the retainer. At least one additional pad **26*b*** is provided positioned in cavity **20**. Preferably the pads **26*b*** are of the same areal size as the lowermost pad **26*a***, as shown in FIG. 1, but it will be understood that such is not required. In FIG. 1 a precut blank of metal that is to be shaped to define a hollow vessel is shown at **28** and is positioned on the upper surface of the uppermost die **26*b***. The areal size of the cavity **20** is selected to be at least slightly greater than the size of the blank **28**. The female die **10** is preferably provided with at least one air vent **30** communicating with the die recess **12** adjacent the innermost portion thereof.

While the steel insert **22** shown appears in the form of a plate with rounded edges, it will be understood that the shape and height of the insert may be varied as desired to provide a very general approximation to the shape of the recess in the female die and forming a well **24**, between it and the retainer walls **18**, into which a portion of the urethane rubber may flow, as seen in FIG. 2, during a drawing operation. The thickness of the urethane pads **26** should be in the range of ⅛ inch to 2 inches, and preferably is in the range of substantially ½

to 1 inch. Although the insert 22 is preferably of steel, it will be appreciated that it can be made of other hard materials, such as other metals or wood, and may even be made of urethane of a greater durometer reading, or hardness index, as compared with that of at least 50 Shore A. Excellent results have been obtained using pads having a hardness index 80–90 Shore A, and using an insert 22 of 95 Shore A or harder.

In use, in the form of device of FIGS. 1–3, at least two urethane pads 26*a* and 26*b* are selected for overlying each other and the steel insert 22, and a precut blank of material 28 is positioned on the uppermost pad 26*b* centrally relatively to the recess 12 in the female die 10. Upon bringing the drawing mechanism together in the manner shown in FIG. 2 the female die 10 operates against the pads of urethane rubber to effect a drawing of the blank to the finished condition of the hollow vessel as shown in FIG. 2.

The applying of pressure to the urethane rubber pads 26 causes the urethane rubber to flow into the recess 12 and to exert substantially uniform pressure in all directions against the blank 28 causing same to deform to assume the contour of the female-die recess 12 and thereby forming the part by drawing. Sufficient numbers of pads 26 are used to cause the blank 28 to be formed in a single pass. If wrinkling occurs in the finished product, one may assume that insufficient pressure is being developed and that an additional pad 26 of urethane rubber should be added in the retainer cavity 20. If tearing, or fracture, or thinning of the blank occurs, one may assume too many die pads are being used, and the number reduced accordingly, but at least two die pads are to be used in the drawing process of this invention, as only a single die pad does not provide for the necessary relative movement between the die pads 26 to achieve an acceptable draw. Because of the uniform and high pressures developed in the urethane rubber by the die 10 moving against the pads 26 and the rapidity with which the drawing is accomplished, it is desirable to vent the female recess 14, and at least one vent means 30 is provided in the die 10 communicating with the recess 12. The vent means 30 also permits of release of the shaped vessel 32 from the cavity 14. The use of multiple pads 26 of the same areal shape permits of interchange thereof whenever the outermost pads begin to wear or abrade. Because of the tendency to express air from the retainer 17 during a drawing operation, if necessary a bent bore 32 may be provided centrally in each pad 26, and at least in the uppermost pad 26*b*.

In the form of device of FIGS. 4 and 5 elements corresponding generally with earlier described elements are given the same reference numeral in the 100 series. Thus, the female die 110 provides an open female-die recess 112 that is vented by a plurality of vent passageway means 130. The retainer means includes a base 116 having an upright hollow retainer 117 that provides peripheral wall means 118 surrounding a cavity 120 in which is positioned an insert 122 spaced from walls 118 to define a well or air space 124 therebetween.

Positioned in cavity 120 is a lowermost urethane rubber die pad 126*a* that is annular in shape to enter and be positioned in well 124 and an uppermost urethane rubber die pad 126*b* which is sheet-like in appearance and has an areal dimension that is substantially the same as the areal dimension of cavity 120. The precut metal blank is at 128 positioned on pad 126*b*. An air vent 132 is preferably provided centrally in pad 126*b*. Additional pads corresponding in size and shape with pad 126*b* may be provided as necessary. The pad 126*a* operates to provide for greater blank-holding pressure in the annular region surrounding insert 122 and during the blank-drawing operation. In use, the pads 126*a* and 126*b* deform substantially to the shape shown in FIG. 5, the size of the well 124 being selected to accommodate the bulging of pad 126*a*.

While the shape of the die recess 12 is shown as a simple geometrical shape or as the surface of a body of revolution, it will be understood that more complex die recesses may be provided depending upon the shape to be produced. Again, while the peripheral shape of cavity 20 is shown square in FIG. 3, it will be understood that the cavity 20 may also have a circular or rectangular periphery or other shape as desired.

The passageways 130 in female die 110 may also be provided with compressed air therethrough after a drawing operation, in order to eject the formed part from the die. While the die is described herein for use with precut blanks, it will also be understood that the mating dies 10 and 18 of FIGS. 1–3, or 110 and 118 of FIGS. 4 and 5 may be used to produce a shear action which converts the dies to one which perform both a blanking action from a sheet of material and a drawing function.

While there has been shown and described a particular embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and therefore, it is intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What we claim as new, and desire to secure by Letters Patent of the United States is:

1. A drawing mechanism for steel and the like comprising, in combination: die wall means defining sidewalls and the bottom of an open female die recess; retainer means including a base, peripheral wall means on the base and cooperating with the base to define a cavity into which a portion of the die wall means of the female die may enter during the drawing process; a rigid insert in the cavity of the retainer means, the insert being spaced from said wall means to define a well between the insert and the walls of the retainer; and at least two separate die pads of urethane rubber lying one on top of the other in said cavity, and with at least the uppermost one of said die pads overlying the rigid insert and arranged to have portions thereof enter the recess of the female die and with at least the lowermost one of the die pads providing portions thereof positioned to flow in said well during a drawing operation.

2. A drawing mechanism for sheet steel and the like comprising, in combination: a female die with a forming recess therein, a retainer defining a walled cavity of greater area dimension than the size of the blank to be drawn; a rigid insert in said cavity extending in the direction toward the recess in the female die; a plurality of die pads of urethane rubber in said cavity with at least one of said pads laid upon another pad and over the rigid insert; and the insert being spaced centrally of the cavity to define a well between the insert and the walls of the retainer into which portions of the urethane rubber may flow during a drawing operation.

3. A device as set forth in claim 2 wherein one of said pads of urethane rubber has an annular shape for entry into said well, and another of said pads of urethane rubber overlying said one pad and said insert.

4. A device as set forth in claim 2 wherein at least one of the pads of urethane rubber is of areal dimensions approximating at least the areal size of the walled cavity and is of a thickness in the range of substantially ½ inch to 1 inch.

References Cited

UNITED STATES PATENTS

840,921	1/1907	Dickey	72—60
1,267,591	5/1918	Rehbein	72—57
2,239,339	4/1941	Oeckl	72—60
2,280,359	4/1942	Trudell	72—60
3,121,944	2/1964	Karau	72—57

FOREIGN PATENTS

584,365	9/1933	Germany.

RICHARD J. HERBST, *Primary Examiner.*