United States Patent [19]

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[54] **FOLDING APPARATUS**

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[52] **U.S. Cl.** **156/479**, 69/1, 72/57, 156/493, 156/204, 161/226

[51] **Int. Cl.** **B32b 3/04**

[58] **Field of Search** 156/204, 217, 443, 156/479, 480, 493, 580, 212, 213, 214, 216, 227, 475, 477; 69/1; 161/226, 42; 72/57; 425/383, 389; 264/295, 313, 339

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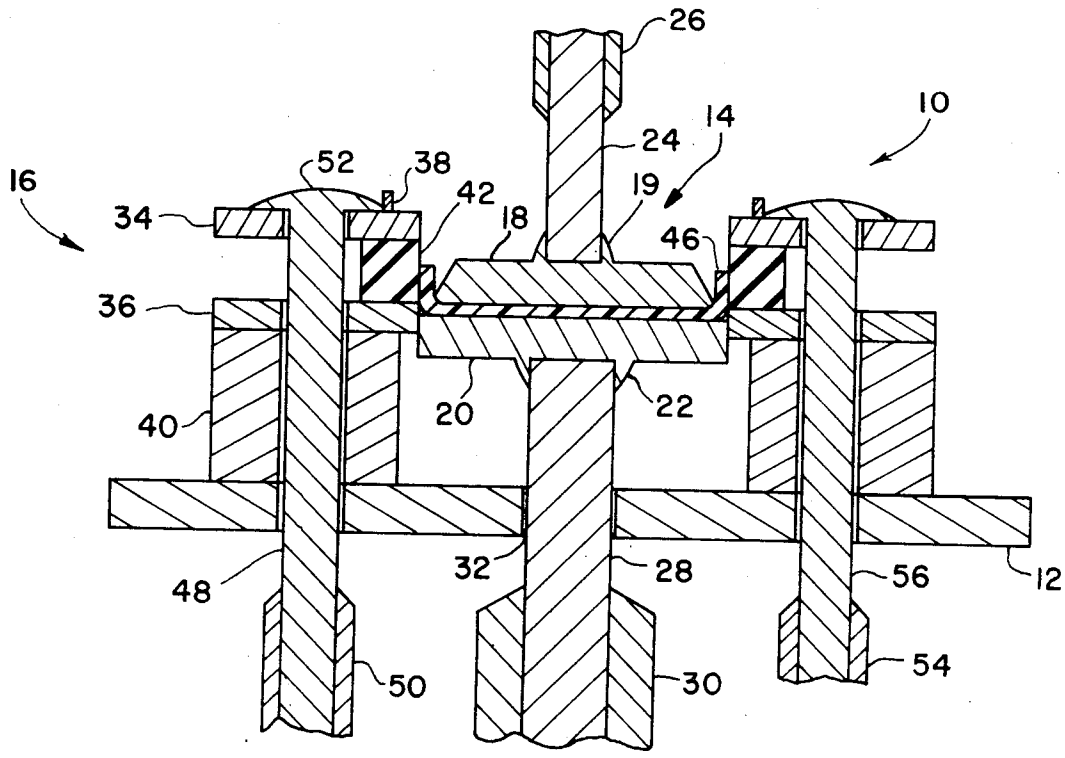
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[57] **ABSTRACT**

The invention is directed to an apparatus and method for simultaneously folding the entire peripheral portion of a workpiece or part thereof. The apparatus comprises a shaping die having upper and lower elements, an elastomer sandwiched between the upper and lower elements, a press having upper and lower die members, and means for actuating the shaping die and press. The die elements and elastomer are formed with an internal hole which is adapted for reception of the upper and lower die members. The profiles of the die members conform substantially to the aperture profile of the internal hole and are in registration therewith. When the upper and lower elements are urged toward each other, the elastomer is compressed and bulges into the internal hole and engages the peripheral portion of the workpiece, whereby the entire margin of the workpiece or any portion thereof as desired is folded simultaneously.

4 Claims, 4 Drawing Figures



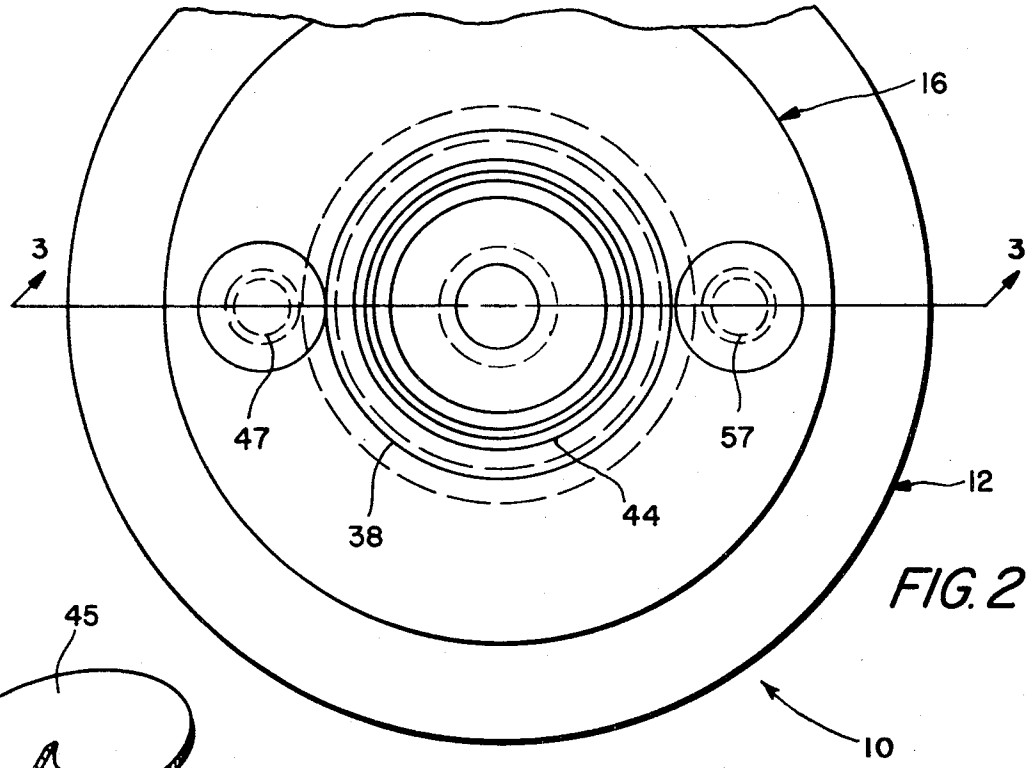


FIG. 2

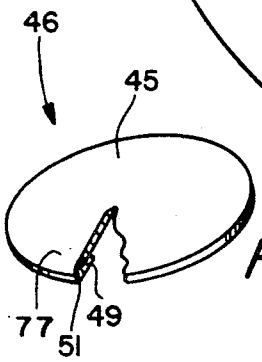


FIG. 1

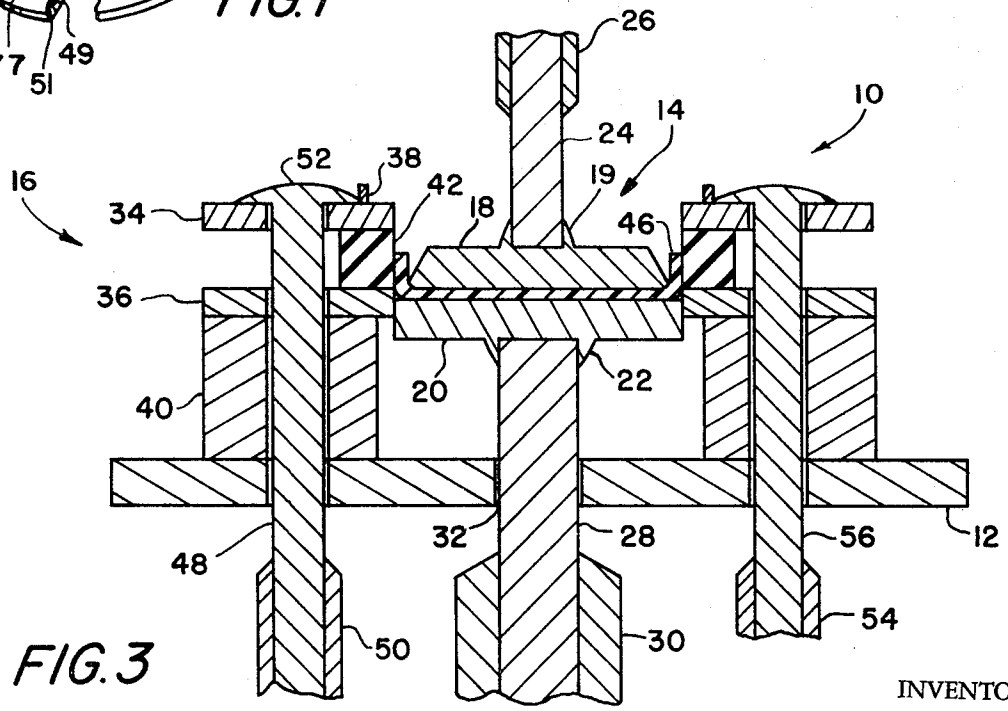


FIG. 3

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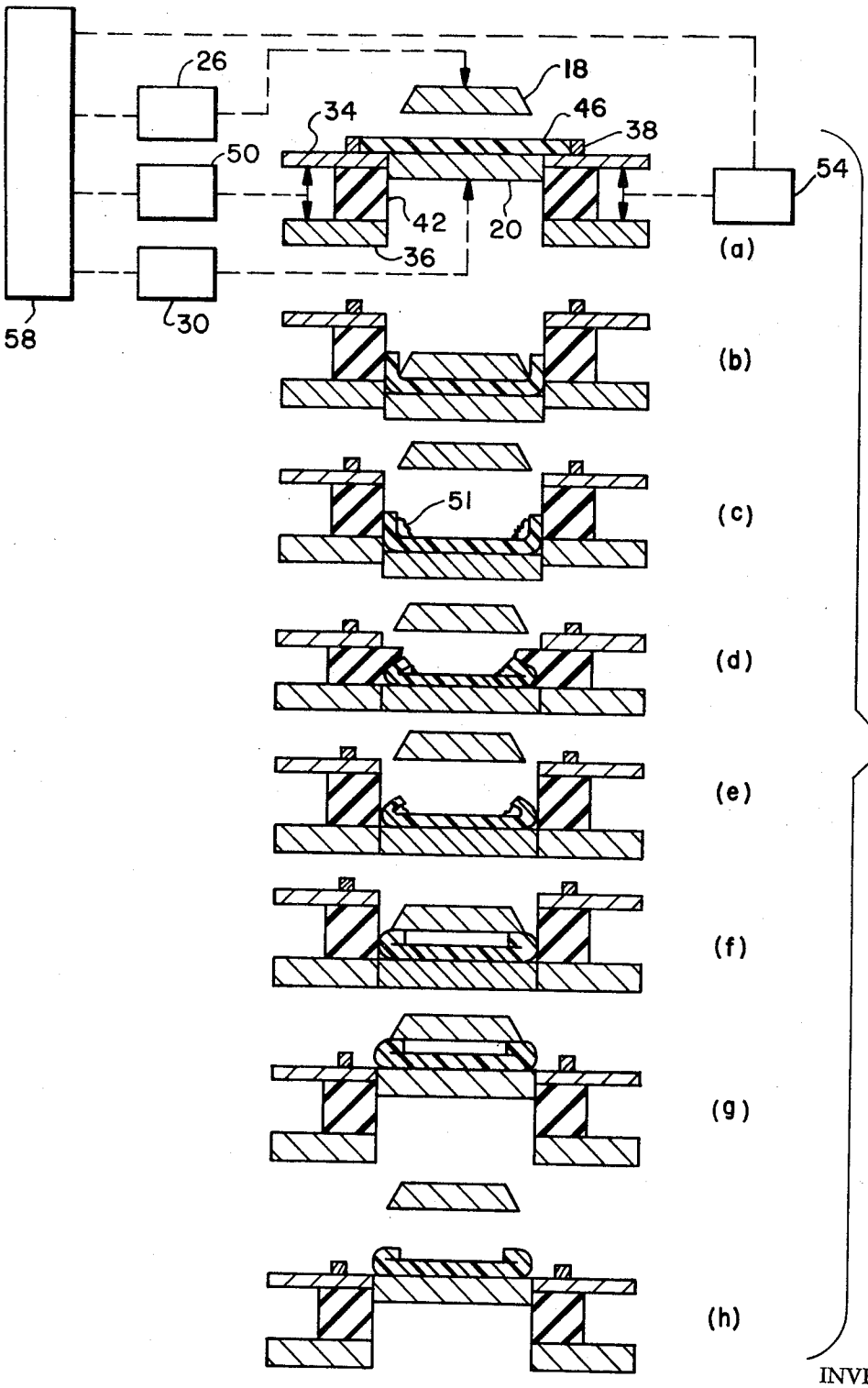


FIG. 4

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FOLDING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of Invention

The invention relates to folding and more particularly to an apparatus and method for simultaneously folding the margin of a workpiece throughout its entire 360° periphery of any portion thereof. Examples of such workpieces are variously spaced ornaments for shoes, edges of books, or purses and pocketbooks or portions of shoe uppers.

2. Description of the Prior Art

Various types of apparatus have been proposed for folding the peripheral portion of workpieces. One type employs a sequential folding technique in which the peripheral portion of the workpiece is folded in discrete segments. Such folding apparatus have suffered from inefficiency due to the time required to complete a fold throughout the entire periphery. Another type utilizes pivoted folding dies by which the entire peripheral portion of the workpiece is folded simultaneously. Such pivoted folding dies are complex in production and costly in operation. Other folding devices, such as described in U.S. Pat. No. 3,073,141 are complex and require the services of a skilled die sink craftsman.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a simple and efficient simultaneous folding apparatus which is characterized by a shaping die having upper and lower elements, an elastomer sandwiched therebetween, a press having upper and lower die members, and means for actuating the shaping die and press. The purpose of this apparatus is to simultaneously fold the entire or segments of the peripheral portion of a workpiece in the form of a sheet material that is composed, for example, material such as leather, vinyl polymer, etc. The shaping die and elastomer are formed with an internal opening and the upper and lower die members are adapted for reciprocable movement within the aperture profiles of the elements of the shaping die and of the elastomer and the profile of each die member of the press being in registration. A slight clearance, typically ranging between 0.01 and 0.10 inch between the aperture profiles and the profile of the upper die member is provided in order to enable reception therebetween of the peripheral portion of the workpiece. The upper and lower die members are adapted for independent reciprocating movement within the opening. The upper and lower elements are adapted for compressing the elastomer sandwiched therebetween, the elastomer bulging into the internal opening when compressed to fold the peripheral portion of the workpiece reversely. Appropriate operation of the shaping die, elastomer, press and actuator means is such as to develop a fold in the peripheral portion of the workpiece and to press the superimposed peripheral portion in order to provide a permanent 360° fold.

The invention accordingly comprises the method and apparatus possessing the construction, combination of elements, and arrangement of parts that are exemplified in the following detailed description, the scope of which will be indicated in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and objects of the present invention, reference should be had to the following detailed description taken in connection with the accompanying drawings wherein:

FIG. 1 is a perspective, partly in section, of a folded workpiece;

FIG. 2 is a top plan of a folding apparatus made according to the drawing;

FIG. 3 is a section taken along the lines 3—3 of FIG. 1; and

FIG. 4(*a*) through (*h*) are diagramatic schematics illustrating consecutive operational steps of the folding apparatus of FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in FIG. 1, the purpose of the invention is to produce from a workpiece **46**, using a simultaneous folding technique, a shaped ornament **45** having a margin portion **77** and a reversely bent portion **49**.

A folding apparatus **10** of the type embodying the invention is shown in FIGS. 2 and 3 as being supported on a platform **12**. Generally, the folding apparatus comprises an elastomer **42** formed with an internal opening **44**, a press **14**, and a shaping die **16**. Press **14** includes an upper die member **18** having an axial socket **19** and a lower die member **20** having an axial socket **22**. One end of a shaft **24** of an actuator **26** is secured in socket **19** and one end of a shaft **28** of an actuator **30** is secured in socket **22**. In the illustrated embodiment, upper die member **18** is driven upwards and downwards in response to the movement of shaft **24** and lower die member **20** is moved upwards and downwards in response to movement of shaft **28**. Platform **12** is formed with a aperture **32** which is adapted for slidable engagement with shaft **28**.

Shaping die **16** includes an upper element **34** and a lower element **36**. The topside of upper element **34** is provided with a guide **38** which is adapted for positioning workpiece **46** in spaced relation to upper and lower die members **18** and **20**, respectively. Shaping die **16** is held in spaced relation to platform **12** by a spacer **40**. Upper element **34**, lower element **36**, spacer **40**, and platform **12** is formed with an opening **47** which is adapted for slidable reception of a shaft **48** of an actuator **50**. One end of shaft **48** is provided with a head **52**, the profile of head **52** being slightly larger than the opening in upper element **34**. When actuator **50** is energized, upper element **34** is pulled toward lower element **36**. In the illustrated embodiment, the compressive movement of upper element **34** against lower element **36** is accomplished by means of actuator **50** and an actuator **54**. Actuator **54** is similar to actuator **50** and includes a shaft **56** which corresponds to shaft **48**, shaft **56** being slidably received in an opening **57**. In the preferred embodiment, actuators **26, 30, 50,** and **54** are air driven. It is to be understood that, in alternative embodiments, the actuators are other than air driven, for example hydraulic actuators.

Elastomer **42**, for example cast silicone rubber, is sandwiched between upper element **34** and lower element **36**. Shaping die **16** and elastomer **42** are formed with an internal opening defining a concentric hole **44** which is adapted for reception of upper and lower die members **18** and **20**, hole **44** and the die members being in registration. As best shown in FIG. 2, the profile of lower die member **20** and the aperture profile of hole **44** are slightly smaller than and corresponds substantially to the profile of workpiece **46**. Upper die

member 18 conforms substantially to the profile of lower die member 20 but is slightly smaller by an amount which approximates the thickness of workpiece 46. In consequence, the peripheral portion of workpiece 46 is turned upwardly about 90° as the workpiece is drawn downwardly into hole 44 by the upper and lower die members. When upper element 34 is pulled toward lower element 36, elastomer 42 is compressed, whereby the elastomer bulges into hole 44 and engages the upturned peripheral portion of the workpiece. In consequence, the upturned peripheral portion is folded greater than 90° down to the prepared surface.

For a fuller understanding of the operation of the invention, reference is now made to FIGS. 4(*a*) through (*h*). As shown in FIG. 4(*a*), a control 58 is operatively connected to actuators 26, 30, 50, and 54 for selectively energizing the actuators in a specified sequence. Initially upper die member 18 is withdrawn from hole 44 and lower die member 20 is positioned in planar relation to upper element 34. Workpiece 46 is placed on the lower die member and the upper element within the area defined by guide 38.

As shown in FIG. 4(*b*), upper die member 18 is brought to bear against workpiece 46 and the lower and upper die members, working cooperatively, draw workpiece 46 into hole 44, the sidewalls of hole 44 being defined by the elastomer sandwiched between the upper and lower elements. As workpiece 46 is pulled downwardly into the hole, its peripheral portion is turned upwardly approximately 90°. The downward movement of the die members continues until the upper surface of workpiece 46 is in planar relation to the upper surface of lower element 36. Thereafter, upper die member 18 is withdrawn from hole 44 and an adhesive 51 is applied at the edge of the interior face of the upturned periphery of workpiece 46. It will be readily appreciated that adhesive 51 is not required if workpiece 46 is composed of a material that is pliant, but yet stiff enough to retain a fold or the adhesive may be applied previously.

In the next step, as shown in FIG. 4(*d*), upper element 34 is pulled toward lower element 36 by actuators 50 and 54 in such a way that elastomer 42 is compressed. In consequence, the elastomer bulges into hole 44 and engages the upturned peripheral portion, whereby the peripheral portion of workpiece 46 is folded reversely to 180°. As illustrated in FIG. 4 (*e*), the upper element is pulled away from the lower element, elastomer 42 returns to its original configuration and the peripheral portion of the workpiece 46 remains folded. Thereafter, the upper die member is brought downwardly and presses the folded peripheral portion of workpiece 46 into the shaped ornament illustrated in FIG. 1. As shown in FIGS. 4(*g*) and (*h*), lower die member 20 is raised to the starting position shown in FIG. 4(*a*) and upper die member 18 is retracted away from workpiece 46. The shaped ornament is removed and the apparatus is available for folding another workpiece.

By way of an exemplary illustration, the apparatus shown in FIG. 1 simultaneously folds the entire 360° peripheral portion of a workpiece having a circular profile. It is to be understood that, in alternative embodiments, the workpiece to be folded has other than a circular profile, for example a pear or a heart shaped profile and the fold may not extend for the entire periphery. It will be readily appreciated that, in such alternative embodiments, the aperture profile of elastomer 42, upper element 34, and lower element 36 and the profile of upper die member 18 and lower die member 20 conform substantially to the profile of the workpiece to be folded and have the same relation thereto as described in connection with the circular profile of workpiece shown in FIG. 1.

Since certain changes may be made in the foregoing disclosure without departing from the scope of the invention involved, it is intended that all matter contained in the above description and depicted in the accompanying drawings be construed in an illustrative and not in a limiting sense.

What is claimed:

1. An apparatus for making a reverse fold in a workpiece, said apparatus comprising:
   a. an elastomer formed with an internal opening adapted for reception of said workpiece, the aperture profile of said opening being slightly smaller than and substantially conforming to the peripheral profile of said workpiece;
   b. means for positioning said workpiece within said opening, said means for positioning including upper and lower members, the profile of said upper member being smaller than the aperture profile of said opening, said upper member having operative and inoperative positions, said upper member engaging said workpiece when in its operative position and disengaging said workpiece when in its inoperative position, said lower member having operative and inoperative positions, said lower member engaging said workpiece when in its operative position, said upper and lower members cooperating to position said workpiece in planar relationship to said elastomer, the peripheral portion of said workpiece being upturned when in planar relationship to said elastomer; and
   c. means operatively connected to said elastomer for compression thereof, said compression means including lower and upper elements, each said upper and lower element formed with a hole having a profile corresponding to said opening, said upper and lower elements having operative and inoperative positions, said elastomer being compressed when said upper and lower elements are in their operative positions, said compressed elastomer bulging into said opening and engaging the periphery of said workpiece and reversely folding the periphery of said workpiece, said upper and lower elements are in their operative positions when said upper member is in its inoperative position and said lower member is in its operative position.

2. The apparatus as claimed in claim 1 wherein said elastomer is silicone rubber.

3. The apparatus as claimed in claim 1 including means operatively connected to said compression means and positioning means for selective control thereof.

4. An apparatus for making a reverse fold in a workpiece, said apparatus comprising:
   a. an elastomer formed with an internal opening adapted for reception of said workpiece, the aperture profile of said opening being slightly smaller than and substantially conforming to the peripheral profile of said workpiece;

b. means for positioning said workpiece within said opening, said means for positioning including upper and lower members, the profile of said upper member being smaller than the aperture profile of said opening, said upper member having operative and inoperative positions, said upper member engaging said workpiece when in its operative position and disengaging said workpiece when in its inoperative position, said lower member defining a support for the workpiece, said upper and lower members cooperating to position said workpiece in planar relationship to said elastomer, the peripheral portion of said workpiece being upturned when in planar relationship to said elastomer; and

c. means operatively connected to said elastomer for compression thereof, said compression means including lower and upper elements, each said upper and lower element formed with a hole having a profile corresponding to said opening, said upper and lower elements having operative and inoperative positions, said elastomer being compressed when said upper and lower elements are in their operative positions, said compressed elastomer bulging into said opening and engaging the periphery of said workpiece and reversely folding the periphery of said workpiece, said upper and lower elements are in their operative positions when said upper member is in its inoperative position.

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