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(54) **Expandable forming tool**

Expandierbares Formwerkzeug

Outil de formage expansible

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to tools for forming and cutting sheet metal workpieces and the like.

[0002] Machine tools are widely utilized to form sheet metal workpieces into a desired configuration by cooperating upper and lower dies which are configured to provide the contours in the workpiece. The configured forming tool is located in the head of the machine and is moved downwardly against the workpiece which is disposed upon a die that cooperates with the forming tool. Many of such dies have a resiliently deformable portion which facilitates the forming of the metal about the contours of the forming tool. Such tooling may simply deform the workpiece to provide the desired contours and the cooperating surfaces of the components will generally have radiused edges. Other tooling may cut through the workpiece and their components will have sharp cooperating edges to shear the workpiece. Some tooling may provide both forming and cutting action by the providing forming edges about a portion of the periphery and cutting edges about the remainder of the periphery.

[0003] The terms "forming" and "forming tools" as used herein encompass tools which merely form the workpiece into a desired configuration, tools which cut through the workpiece, and tools which combine both forming and cutting actions.

[0004] Generally, machine tools have a limitation as to the diameter of the forming tool which can be employed. If that diameter of the conventional forming tool is less than the length of the contour to be formed, multiple operations may be required to effect the formation of the full length of the desired contour. This is costly in terms of time required, and it can require use of multiple tools to obtain the desired formation.

[0005] It is an object of the present invention to provide a novel forming tool which can be expanded beyond the normal maximum diameter for the forming tool to enable the forming of a workpiece over a wider length.

[0006] It is also an object to provide such a forming tool which can be readily and relatively economically fabricated to provide a relatively long lived assembly.

SUMMARY OF THE INVENTION

[0007] It has now been found that the foregoing and related objects may be readily attained in an expandable forming tool having a body with a mounting stem on its upper surface and a transversely extending channel in its lower surface. A wedge-shaped actuator has its smaller, upper end slidably seated in the channel for movement vertically therein and has its larger, lower end normally depending from the body. The actuator has inwardly sloping side surfaces which bear against cooperatively sloping side surface of a pair of slide members slidably seated in the channel on opposite sides of the wedge-shaped actuator.

[0008] Slide member biasing means biases the slide members against the sloping surfaces of the actuator, and actuator biasing means biases the actuator outwardly of the body. The actuator is driven vertically inwardly of the channel by movement of the larger lower end against an opposing surface usually provided by a cooperating die, and the inward movement of the actuator pushes the slide members outwardly in the channel so as to project beyond the periphery of the body.

[0009] Generally, the actuator and the slide member may have their lower surfaces cooperatively configured to form a contour in a workpiece against which they are driven, or the edges of the lower surfaces may be sharp to cut through the workpiece, or both sharp and radiused edges in different portions may be provided to both form and cut different portions of a workpiece. To do, so the bottom surfaces cooperate with similar edges on the top surface of a die underlying the workpiece. Moreover, the slide member and the larger end of the actuator have their lower surfaces lying in a common plane when the actuator is fully moved inwardly of the body.

[0010] The body has depending portions at the upper and outer ends of the channel and the slides have cooperating upstanding portions at their inner ends. The slide member biasing means comprises compression springs seated between these depending and upstanding portions.

[0011] The stem and the body have aligned axial passages therein opening into the channel, and an actuator retainer is slidably seated in the axial passages. The actuator biasing means includes a compression spring acting between the upper end portion of the actuator retainer and a shoulder in the passage in the stem. Preferably, the axial passage in the body has a shoulder formed thereabout adjacent its upper end and the actuator retainer has a collar which abuts the upper surface of the shoulder to retain the actuator in the body.

[0012] As will be readily appreciated, the punch or forming tool cooperates with a die having an upper surface which is generally complimentary to the lower surface of the forming tool or punch. Sharp edges are provided in portions where the workpiece is to be cut and arcuate edges are provided where the workpiece is to be contoured.

BRIEF DESCRIPTION OF ATTACHED DRAWINGS

[0013]

Figure 1 is a perspective view of an expandable forming tool embodying the present invention;
Figure 2 is a cross sectional view thereof;
Figure 3 is an exploded view thereof;
Figure 4 is a cross sectional view of the actuator drawn to an enlarged scale;
Figure 5 is an end elevational view of a slide;
Figure 6 is a bottom view of the forming tool with the

slides extended;

Figures 7a-7e are cross sectional views drawn to a reduced scale of the expandable forming tool and a cooperating die at various states of relative movement;

Figure 8 is a bottom view of another embodiment of a forming tool embodying the present invention for both cutting and forming a contour in the workpiece, and with the slides extended;

Figure 9 is a cross sectional view of a slide in the tool of Figure 8;

Figure 10 is a cross sectional view of the actuator in the tool of Figure 8;

Figure 11 is an elevational view of the tool of Figure 8 in partial cross section showing the tool in the process of forming a second louver in the workpiece;

Figure 12 is a fragmentary sectional view of the die cooperating with the forming tool of Figure 8;

Figure 13 is a fragmentary cross sectional view of a workpiece which has been cut and contoured by the forming tool of Figure 8; and

Figure 14 is a fragmentary cross sectional view along the line 14-14 or Figure 13.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] An expandable forming tool embodying the present invention is shown in the attached drawings and is generally comprised of a body generally designated by the numeral 10, an actuator generally designated by the numeral 12, and a pair of slides generally designated by the numeral 14.

[0015] The body 10 comprises a generally circular housing 16 with a transversely extending channel 18 in its lower surface terminating in depending end walls 20. A concentric, generally cylindrical stem 22 on the upper surface has a bore or passage 24 extending therethrough. The upper end portion of the bore 24 is threaded and receives a threaded cap 26 and the lower portion seats a compression spring 28 which bears upon the cap 26. A concentric passage 27 extends through the body 10 from the bore 24 to the channel 18.

[0016] Slidably seated in the channel 18 are the slides 14 which have their bottom surface 29 configured to form the desired contour in a workpiece and an upstanding portion 30 on their inner ends which cooperate with the depending end walls 20 of the body to define recesses 31 in which are seated compression springs 32 which bias the slides 14 inwardly. The lower portions 34 of the inner end surface of the slides 14 are angled outwardly downwardly.

[0017] The actuator 12 is generally wedge shaped with outer end surfaces 36 which angled outwardly downwardly to cooperate with the lower portions 34 of the slides 14. The bottom surface 38 of the actuator is contoured cooperatively with the bottom surfaces 29 of the slides 14 to produce the desired contour in the workpiece.

[0018] The upper end of the actuator 12 has a threaded bore 40 which threadably seats the shank 42 of the bolt generally designated by the numeral 44 and which extends through the passage 27 in the body 10. The spring 28 bears upon the head 46 of the bolt 44 to bias the actuator 12 outwardly of the channel 18 in the body 10 as seen in Figure 1 in which position the slides 12 are disposed within the periphery of the body 10.

[0019] In accordance with conventional practice, the expandable forming tool of Figures 1-6 cooperates with a die shown in Figures 7a-7e and generally designated by the numeral 48 to deform a sheet metal workpiece schematically illustrated and designated by the numeral 50.

[0020] As will be readily appreciated, the actuator 12 is retained in the body 10 by the retainer bolt 44. Since the actuator 12 is positively held in place, this also effects the retention of the slides 14 within the body 10.

[0021] In assembling the forming tool of the present invention, the slides 14 and the compression springs 32 are initially assembled in the body 10. The actuator 12 is then moved into place between them and the bolt 44 is threadably engaged therein. The compression spring 28 is then placed within the passage 24 in the stem 22, and the cap 26 is threaded inwardly of the stem to trap the spring 28 in position and to hold all of the elements in assembly.

[0022] Turning now to Figures 7a-7e, the operation of the expandable tool is diagrammatically illustrated. In Figure 7a, the forming tool has been clamped in position in the machine tool (not shown) and the actuator 12 is in its at rest position extending substantially outwardly of the body 10. The springs 32 are biasing the slides 14 against its side surfaces of the actuator 12 so that they are fully disposed within the periphery of the body 10. The sheet material workpiece 50 is disposed on the die 48 located in the bed of the machine tool (not shown).

[0023] In Figure 7b, the forming tool has been moved against the surface of the workpiece 50. In Figure 7c, the continuing movement of the forming tool against the workpiece 50 has caused the actuator 12 to move vertically upwardly and this, in turn, has caused the slides 14 to move outwardly into the projecting positions which are illustrated. The bottom surfaces of the slides 14 and actuator 12 with the contours thereon are all aligned in a common plane. The continuing motion of the forming tool now causes the underlying deflectable portion of the die 48 to compress and deform about the workpiece to effect its bending until it assumes the shape shown in Figure 7d across the full width of the expanded tool, i.e., the actuator and the projecting slides.

[0024] In Figure 7e, the machine tool has now moved the forming tool upwardly so that the workpiece 50 can be removed.

[0025] Turning next to Figures 8-10, therein illustrated is a forming tool which will both cut and contour the workpiece in a single stroke. The basic structure of the tool is the same as that illustrated in Figures 1-7 except for the

bottom or working surface of the tool, and the parts have the same reference numerals with the letter "a" appended thereto.

[0026] Figures 11 and 12 illustrate a part produced thereby with a louver opening 100 formed therein. An arcuate wall 102 extends away from the plane of the workpiece 104 along the length thereof to provide an opening 106 for air to pass therethrough and thence through the louver 100. The ends of the louver 100 are formed with a similar arcuate configuration.

[0027] In the tool of Figures 8-10, the louver surfaces of the slides 14a and actuator 12a are machined to provide cooperating and aligned recesses 108 which have an arcuate portion 110 corresponding to the arcuate wall 102 and a sharp edge portion 118 to cut through the workpiece 104 and provide the opening 106. The ends 112 of the recesses 108 in the slides 14a are arcuate to produce the arcuate ends of the louver formation.

[0028] The forming tool illustrated in Figures 8-10 cooperates with the die illustrated in Figure 12 and generally designated by the numeral 110. The die 110 is comprised of a body 120 having a stepped channel 112 formed in its upper surface in which is seated the ejector 124 and the resiliently compressible member 126. A rib 128 borders the channel and has a sharp edge 120 at the upper end of the vertical face which is aligned with the channel 112 and an arcuate surface 122. In another embodiment, the rib 118 may be provided by a readily replaceable insert seated in a channel adjacent the channel 112. The sharp edge 130 of the forming tool 100 cooperates with the sharp edge 120 of the die 110 to cut the metal and allow the adjacent portion of the workpiece 104 to form about the adjacent arcuate surface 122 of the die.

[0029] As can be seen from the foregoing detailed drawings and description, the expandable forming tool of the present invention may be fabricated readily easily and economically and provides an expanded forming surface. This enables the fabrication of workpieces more quickly and enables far less complex forming dies than might otherwise be required.

Claims

1. Ain expandable forming tool having:

(a) a body (10) with a mounting stem (22) on its upper surface and a transversely extending channel (18) in its lower surface;
(b) a wedge-shaped actuator (12) having its smaller end slidably seated in said channel for movement vertically therein and having its larger end normally depending from said body, said actuator (12) having upwardly inwardly sloping side surfaces;
(c) a pair of slide members (14) slidably seated in said channel on opposite sides of said wedge-shaped actuator (12) and having cooperating angular surfaces slidably bearing on said sloping side surfaces of said actuator;
(d) slide member biasing means biasing said slide members (14) against said sloping side surfaces of said actuator (12); and
(e) actuator biasing means biasing said actuator outwardly of said body, said actuator being driven vertically inwardly of said channel by movement of said larger end against an opposing surface, said inward movement of said actuator pushing said slide members outwardly in said channel so as to project beyond the periphery of said body (10).

2. The expandable forming tool in accordance with Claim 1 wherein said actuator (12) and said slide members (14) have their lower surfaces cooperatively configured to form a contour in a workpiece against which they are driven.

3. The expandable forming tool in accordance with Claim 1 wherein said actuator (12) and slide members (14) have their lower surfaces cooperatively configured to cut through a workpiece against which they are driven.

4. The expandable forming tool in accordance with Claim 1 wherein said actuator (12) and slide members (14) have their lower surfaces cooperatively configured to provide edge surfaces in a portion thereof to cut through the workpiece and edge surfaces in portions thereof to form the workpiece thereabout.

5. The expandable forming tool in accordance with Claim 1 wherein said slide member (14) and said larger end of said actuator (12) have their lower surfaces lying in a common plane when said actuator is fully moved inwardly of said body (10).

6. The expandable forming tool in accordance with Claim 1 wherein said body (10) has depending portions (20) at the upper and outer ends of said channel (18) and said slides (14) have cooperating upstanding portions (30) at their inner ends.

7. The expandable forming tool in accordance with Claim 6 wherein said slide member biasing means comprises compression springs (32) seated between said depending (20) and upstanding portions (30).

8. The expandable forming tool in accordance with Claim 1 wherein said stem and said body have aligned axial passages therein opening into said channel, and wherein an actuator retainer (44) is slidably seated in said axial passages.

9. The expandable forming tool in accordance with Claim 8 wherein said actuator biasing means includes a compression spring (28) acting between said actuator retainer (44) and a shoulder in said passage

10. The expandable forming tool in accordance with Claim 9 wherein said axial passage in said body has a shoulder formed thereabout adjacent its upper end and said actuator retainer (44) has a collar about its lower end, said collar abutting the upper surface of said shoulder to retain said actuator (12) in said body.

11. A punch and die assembly for forming a contour in a workpiece comprising:

(a) an expandable forming tool according to claim 1, said slide members (14) and actuator (12) having their lower surfaces cooperatively configured to form a contour in a workpiece (50) gainst which they are driven; and
(b) a die (48) having an upper surface configured cooperatively with respect to the lower surfaces of said slide members and actuator to form the workpiece into a desired contour.

12. The punch and die assembly in accordance with Claim 11 wherein said slide member (14) and said larger end of said actuator (12) have their lower surfaces lying in a common plane when said actuator is fully moved inwardly of said body.

13. The punch and die assembly in accordance with Claim 11 wherein said body has depending portions (20) at the upper and outer ends of said channel and said slides (14) have cooperating upstanding portions (30) at their inner ends.

14. The punch and die assembly in accordance with Claim 13 wherein said slide member biasing means comprises compression springs (32) seated between said depending (20) and upstanding portions (30).

15. The punch and die assembly in accordance with Claim 11 wherein said stem and said body have aligned axial passages therein opening into said channel, and wherein an actuator retainer is slidably seated in said axial passages.

16. The punch and die assembly in accordance with Claim 11 wherein said actuator biasing means includes a compression spring (28) acting between said actuator retainer (44) and a shoulder in said passage.

17. A punch and die assembly for forming a contour in a workpiece comprising:

(a) an expandable forming tool according to claim 1, said actuator (12) and slide members (14) having their lower surfaces cooperatively configured to cut through a workpiece (50) against which they are driven; and
(b) a die (48) having an upper surface configured cooperatively with respect to the lower surfaces of said slide members and actuator to cut the workpiece.

18. The punch and die assembly in accordance with Claim 17 wherein said slide member (14) and said larger end of said actuator (12) have their lower surfaces lying in a common plane when said actuator is fully moved inwardly of said body.

19. The punch and die assembly in accordance with Claim 17 wherein said body has depending portions (20) at the upper and outer ends of said channel and said slides (14) have cooperating upstanding portions (30) at their inner ends.

20. The punch and die assembly in accordance with Claim 17 wherein said slide member biasing means comprises compression springs (32) seated between said depending (20) and upstanding portions (30).

21. The punch and die assembly in accordance with Claim 17 wherein said actuator (12) and slide members (14) have their lower surfaces cooperatively configured to provide edge surfaces in a portion thereof to cut through the workpiece (50) and edge surfaces in portions thereof to form the workpiece thereabout.

Patentansprüche

1. Expandierbares Umformwerkzeug mit:

(a) einem Körper (10), dessen obere Fläche mit einem Befestigungsschaft (22) und dessen untere Fläche mit einem quer verlaufenden Kanal (18) versehen ist;
(b) einem keilförmigen Betätigungselement (12), dessen schmaleres Ende gleitend in dem Kanal sitzt, um sich vertikal darin zu bewegen und dessen breiteres Ende üblicherweise an dem Körper nach unten weist, wobei das Betätigungselement (12) nach innen oben geneigte Seitenflächen aufweist;
(c) einem Paar von Gleitelementen (14), die in dem Kanal auf einander gegenüberliegenden Seiten des keilförmigen Betätigungselementes (12) gleitend sitzen und damit zusammenwirkende Schrägflächen aufweisen, die auf den geneigten Seitenflächen des Betätigungselemen-

tes gleitend lagern;
(d) einer Vorspanneinrichtung für die Gleitelemente, welche die Gleitelemente (14) gegen die geneigten Seitenflächen des Betätigungselementes (12) vorspannt; und
(e) einer Vorspanneinrichtung für das Betätigungselement, welche das Betätigungselement zu der Außenseite des Körpers hin vorspannt, wobei das Betätigungselement durch die Bewegung des breiteren Endes gegen eine gegenüberliegende Fläche vertikal in das Innere des Kanals angetrieben wird, wobei die Gleitelemente in dem Kanal durch die Einwärtsbewegung des Betätigungselementes derart nach auswärts geschoben werden, dass sie über den Umfang des Körpers (10) vorstehen.

2. Expandierbares Umformwerkzeug nach Anspruch 1, wobei die unteren Flächen des Betätigungselementes (12) und der Gleitelemente (14) derart miteinander zusammenwirkend ausgebildet sind, dass sie in einem Werkstück, gegen das sie angetrieben werden, eine Kontur formen.

3. Expandierbares Umformwerkzeug nach Anspruch 1, wobei die unteren Flächen des Betätigungselementes (12) und der Gleitelemente (14) derart miteinander zusammenwirkend ausgebildet sind, dass sie ein Werkstück, gegen das sie angetrieben werden, durchtrennen.

4. Expandierbares Umformwerkzeug nach Anspruch 1, wobei die unteren Flächen des Betätigungselementes (12) und der Gleitelemente (14) derart miteinander zusammenwirkend ausgebildet sind, dass sie an einem Abschnitt Randflächen zum Durchtrennen des Werkstücks und an einem Abschnitt Randflächen zum Umformen des Werkstücks bereitstellen.

5. Expandierbares Umformwerkzeug nach Anspruch 1, wobei die unteren Flächen des Gleitelements (14) und des breiteren Endes des Betätigungselementes (12) in einer gemeinsamen Ebene liegen, wenn das Betätigungselement vollständig in das Innere des Körpers (10) bewegt ist.

6. Expandierbares Umformwerkzeug nach Anspruch 1, wobei der Körper (10) nach unten weisende Abschnitte (20) an den oberen und äußeren Enden des Kanals (18) aufweist und die Gleiter (14) an ihren inneren Enden damit zusammenwirkende aufrechte Abschnitte (30) aufweisen.

7. Expandierbares Umformwerkzeug nach Anspruch 6, wobei die Vorspanneinrichtung für die Gleitelemente Druckfedern (32) umfasst, die zwischen den nach unten weisenden (20) und den aufrechten Abschnitten (30) sitzen.

8. Expandierbares Umformwerkzeug nach Anspruch 1, wobei der Schaft und der Körper miteinander fluchtende Axialdurchgänge aufweisen, die in den Kanal münden und wobei ein Halter (44) für das Betätigungselement gleitend in den Axialdurchgängen sitzt.

9. Expandierbares Umformwerkzeug nach Anspruch 8, wobei die Vorspanneinrichtung für das Betätigungselement eine Druckfeder (28) umfasst, die eine Wirkung zwischen dem Halter (44) für das Betätigungselement und einer Schulter in dem Durchgang hervorruft.

10. Expandierbares Umformwerkzeug nach Anspruch 9, wobei der Axialdurchgang in dem Körper nahe seinem oberen Ende eine um den Durchgang herum angeformte Schulter aufweist und der Halter (44) für das Betätigungselement einen Außenbund um sein unteres Ende aufweist, wobei der Außenbund an der oberen Fläche der Schulter anliegt, um das Betätigungselement (12) in dem Körper zu halten.

11. Matrizen- und Stempelanordnung zum Formen einer Kontur an einem Werkstück, umfassend:

(a) ein expandierbares Umformwerkzeug nach Anspruch 1, wobei die unteren Flächen der Gleitelemente (14) und des Betätigungselementes derart miteinander zusammenwirkend ausgebildet sind, dass sie an einem Werkstück (50), gegen das sie angetrieben werden, eine Kontur formen; und
(b) eine Matrize (48) mit einer oberen Fläche, die derart mit den unteren Flächen der Gleitelemente und des Betätigungselementes zusammenwirkend ausgebildet ist, dass die Flächen das Werkstück in eine gewünschte Kontur umformen.

12. Matrizen- und Stempelanordnung nach Anspruch 11, wobei die unteren Flächen des Gleitelements (14) und des breiteren Endes des Betätigungselementes (12) in einer gemeinsamen Ebene liegen, wenn das Betätigungselement vollständig in das Innere des Körpers bewegt ist.

13. Matrizen- und Stempelanordnung nach Anspruch 11, wobei der Körper nach unten weisende Abschnitte (20) an den oberen und äußeren Enden des Kanals aufweist und die Gleiter (14) an ihren inneren Enden damit zusammenwirkende aufrechte Abschnitte (30) aufweisen.

14. Matrizen- und Stempelanordnung nach Anspruch 13, wobei die Vorspanneinrichtung für die Gleitele-

mente Druckfedern (32) umfasst, die zwischen den nach unten weisenden (20) und den aufrechten Abschnitten (30) sitzen.

15. Matrizen- und Stempelanordnung nach Anspruch 11, wobei der Schaft und der Körper miteinander fluchtende Axialdurchgänge aufweisen, die in den Kanal münden und wobei ein Halter für das Betätigungselement gleitend in den Axialdurchgängen sitzt.

16. Matrizen- und Stempelanordnung nach Anspruch 11, wobei die Vorspanneinrichtung für das Betätigungselement eine Druckfeder (28) umfasst, die eine Wirkung zwischen dem Halter (44) für das Betätigungselement und einer Schulter in dem Durchgang hervorruft.

17. Matrizen- und Stempelanordnung zum Formen einer Kontur an einem Werkstück, umfassend:

(a) ein expandierbares Umformwerkzeug nach Anspruch 1, wobei die unteren Flächen des Betätigungselementes (12) und der Gleitelemente (14) derart miteinander zusammenwirkend ausgebildet sind, dass sie ein Werkstück (50), gegen das sie angetrieben werden, durchtrennen; und
(b) eine Matrize (48) mit einer oberen Flächen, die derart mit den unteren Flächen der Gleitelemente und des Betätigungselementes zusammenwirkend ausgebildet ist, dass das Werkstück geschnitten wird.

18. Matrizen- und Stempelanordnung nach Anspruch 17, wobei die unteren Flächen des Gleitelements (14) und des breiteren Endes des Betätigungselementes (12) in einer gemeinsamen Ebene liegen, wenn das Betätigungselement vollständig in das Innere des Körpers bewegt ist.

19. Matrizen- und Stempelanordnung nach Anspruch 17, wobei der Körper nach unten weisende Abschnitte (20) an den oberen und äußeren Enden des Kanals aufweist und die Gleiter (14) an ihren inneren Enden damit zusammenwirkende aufrechte Abschnitte (30) aufweisen.

20. Matrizen- und Stempelanordnung nach Anspruch 17, wobei die Vorspanneinrichtung der Gleitelemente zwischen den nach unten weisenden (20) und den aufrechten Abschnitten (30) sitzende Druckfedern (32) umfasst.

21. Matrizen- und Stempelanordnung nach Anspruch 17, wobei die unteren Flächen des Betätigungselementes (12) und der Gleitelemente (14) derart miteinander zusammenwirkend ausgebildet sind, dass sie an einem Abschnitt Randflächen zum Durchtrennen des Werkstücks (50) und an einem Abschnitt Randflächen zum Umformen des Werkstücks bereitstellen.

Revendications

1. Outil de formage expansible comprenant

(a) un corps (10) avec une tige de montage (22) sur sa surface supérieure et une rainure (18) s'étendant transversalement dans sa surface inférieure ;
(b) un actionneur cunéiforme (12), dont la petite extrémité est montée à coulissement dans la rainure afin de se déplacer verticalement dans cette rainure, et dont la grande extrémité est normalement dépendante du corps, l'actionneur (12) possédant des surfaces latérales en pente vers l'intérieur et vers le haut ;
(c) une paire d'éléments coulissants (14), montés à coulissement dans la rainure sur des côtés opposés de l'actionneur cunéiforme (12) et possédant des surfaces angulaires coopérantes reposant à coulissement sur les surfaces latérales en pente de l'actionneur ;
(d) des moyens de sollicitation d'éléments coulissants sollicitant les éléments coulissants (14) contre les surfaces latérales en pente de l'actionneur (12) ; et
(e) un moyen de sollicitation d'actionneur sollicitant l'actionneur à l'extérieur du corps, l'actionneur étant entraîné verticalement à l'intérieur de la rainure par le déplacement de la grande extrémité contre une surface opposée, ce déplacement de l'actionneur vers l'intérieur poussant les éléments coulissants vers l'extérieur dans la rainure, de manière à faire saillie au-delà de la périphérie du corps (10).

2. Outil de formage expansible selon la revendication 1, **caractérisé en ce que** l'actionneur (12) et les éléments coulissants (14) possèdent des surfaces inférieures conçues pour coopérer de manière à former un contour dans une pièce usinée contre laquelle ils sont entraînés.

3. Outil de formage expansible selon la revendication 1, **caractérisé en ce que** l'actionneur (12) et les éléments coulissants (14) possèdent des surfaces inférieures conçues pour coopérer de manière à réaliser une coupe à travers une pièce usinée contre laquelle ils sont entraînés.

4. Outil de formage expansible selon la revendication 1, **caractérisé en ce que** l'actionneur (12) et les éléments coulissants (14) possèdent des surfaces

inférieures conçues pour coopérer de manière à fournir, dans une partie, des surfaces de chant pour réaliser une coupe à travers la pièce usinée et, dans des parties, des surfaces de chant pour former la pièce usinée autour de celles-ci.

5. Outil de formage expansible selon la revendication 1, **caractérisé en ce que** les éléments coulissants (14) et la grande extrémité de l'actionneur (12) possèdent des surfaces inférieures situées dans un plan commun lorsque l'actionneur est déplacé totalement à l'intérieur du corps (10).

6. Outil de formage expansible selon la revendication 1, **caractérisé en ce que** le corps (10) possède des parties dépendantes (20) aux extrémités supérieure et extérieure de la rainure (18), et les éléments coulissants (14) possèdent des parties dressées coopérantes (30) à leurs extrémités intérieures.

7. Outil de formage expansible selon la revendication 6, **caractérisé en ce que** les moyens de sollicitation d'éléments coulissants comprennent des ressorts de compression (32) montés entre les parties dépendantes (20) et les parties dressées (30).

8. Outil de formage expansible selon la revendication 1, **caractérisé en ce que** la tige et le corps possèdent à l'intérieur des passages axiaux alignés s'ouvrant dans la rainure, et **en ce qu'**un moyen de retenue d'actionneur (44) est monté à coulissement dans ces passages axiaux.

9. Outil de formage expansible selon la revendication 8, **caractérisé en ce que** le moyen de sollicitation d'actionneur comprend un ressort de compression (28) agissant entre le moyen de retenue d'actionneur (44) et un épaulement dans le passage.

10. Outil de formage expansible selon la revendication 9, **caractérisé en ce que** le passage axial dans le corps possède un épaulement formé sur le pourtour au voisinage de son extrémité supérieure, et le moyen de retenue d'actionneur (44) possède un collier autour de son extrémité inférieure, ce collier butant contre la surface supérieure de l'épaulement afin de retenir l'actionneur (12) dans le corps.

11. Ensemble poinçon et matrice pour former un contour dans une pièce usinée, comprenant :

(a) un outil de formage expansible selon la revendication 1, les éléments coulissants (14) et l'actionneur (12) possédant des surfaces inférieures conçues pour coopérer de manière à former un contour dans une pièce usinée (50) contre laquelle ils sont entraînés ; et
(b) une matrice (48) possédant une surface supérieure conçue pour coopérer avec les surfaces inférieures des éléments coulissants et de l'actionneur afin de former la pièce usinée avec un contour souhaité.

12. Ensemble poinçon et matrice selon la revendication 11, **caractérisé en ce que** les éléments coulissants (14) et la grande extrémité de l'actionneur (12) possèdent des surfaces inférieures situées dans un plan commun lorsque l'actionneur est déplacé totalement à l'intérieur du corps.

13. Ensemble poinçon et matrice selon la revendication 11, **caractérisé en ce que** le corps possède des parties dépendantes (20) aux extrémités supérieure et extérieure de la rainure, et les éléments coulissants (14) possèdent des parties dressées coopérantes (30) à leurs extrémités intérieures.

14. Ensemble poinçon et matrice selon la revendication 13, **caractérisé en ce que** les moyens de sollicitation d'éléments coulissants comprennent des ressorts de compression (32) montés entre les parties dépendantes (20) et les parties dressées (30).

15. Ensemble poinçon et matrice selon la revendication 11, **caractérisé en ce que** la tige et le corps possèdent à l'intérieur des passages axiaux alignés s'ouvrant dans la rainure, et **en ce qu'**un moyen de retenue d'actionneur est monté à coulissement dans ces passages axiaux.

16. Ensemble poinçon et matrice selon la revendication 11, **caractérisé en ce que** le moyen de sollicitation d'actionneur comprend un ressort de compression (28) agissant entre le moyen de retenue d'actionneur (44) et un épaulement dans le passage.

17. Ensemble poinçon et matrice pour former un contour dans une pièce usinée, comprenant :

(a) un outil de formage expansible selon la revendication 1, l'actionneur (12) et les éléments coulissants (14) possédant des surfaces inférieures conçues pour coopérer de manière à réaliser une coupe à travers une pièce (50) contre laquelle ils sont entraînés ; et
(b) une matrice (48) possédant une surface supérieure conçue pour coopérer avec les surfaces inférieures des éléments coulissants et de l'actionneur afin de couper la pièce.

18. Ensemble poinçon et matrice selon la revendication 17, **caractérisé en ce que** les éléments coulissants (14) et la grande extrémité de l'actionneur (12) possèdent des surfaces inférieures situées dans un plan commun lorsque l'actionneur est déplacé totalement à l'intérieur du corps.

19. Ensemble poinçon et matrice selon la revendication 17, **caractérisé en ce que** le corps possède des parties dépendantes (20) aux extrémités supérieure et extérieure de la rainure, et les éléments coulissants (14) possèdent des parties dressées coopérantes (30) à leurs extrémités intérieures.

20. Ensemble poinçon et matrice selon la revendication 17, **caractérisé en ce que** les moyens de sollicitation d'éléments coulissants comprennent des ressorts de compression (32) montés entre les parties dépendantes (20) et les parties dressées (30).

21. Ensemble poinçon et matrice selon la revendication 17, **caractérisé en ce que** l'actionneur (12) et les éléments coulissants (14) possèdent des surfaces inférieures conçues pour coopérer de manière à fournir, dans une partie, des surfaces de chant pour réaliser une coupe à travers la pièce usinée (50) et, dans des parties, des surfaces de chant pour former la pièce usinée autour de celles-ci.

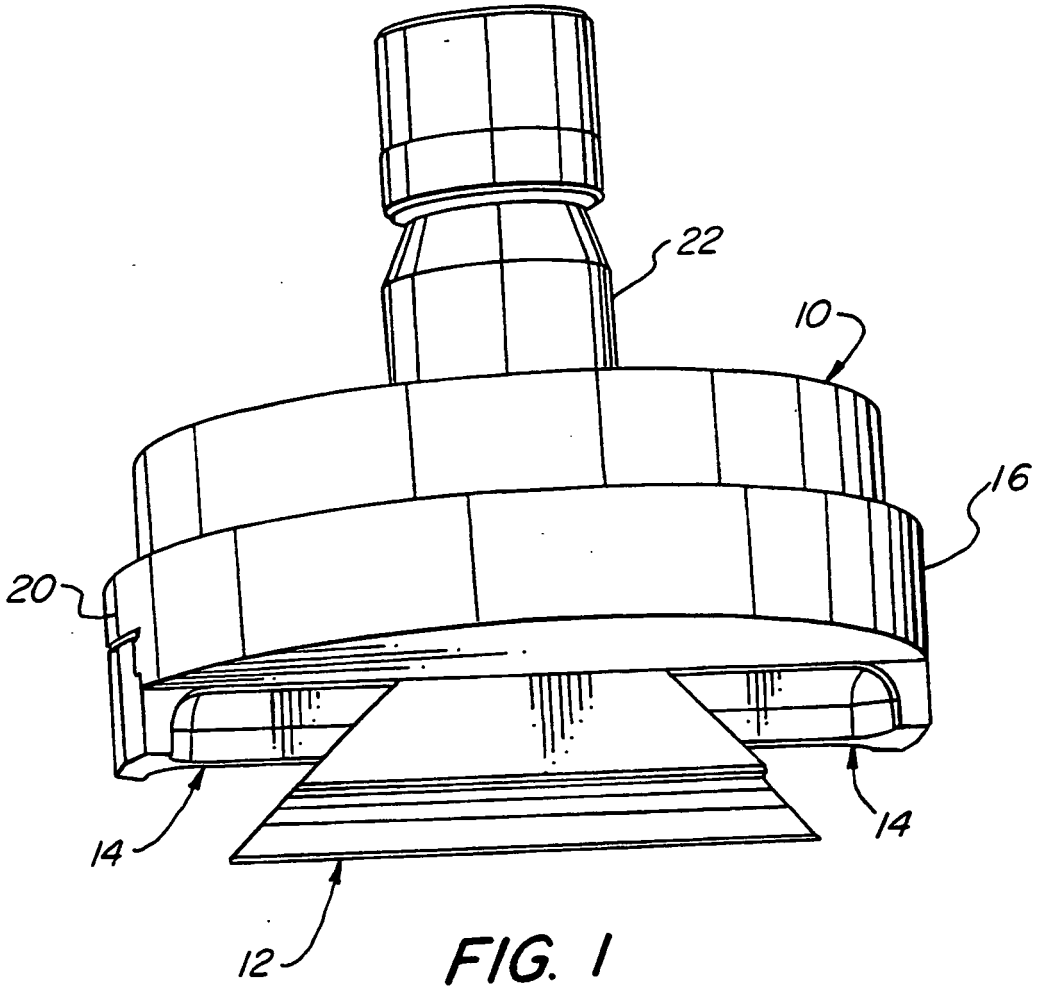


FIG. 1

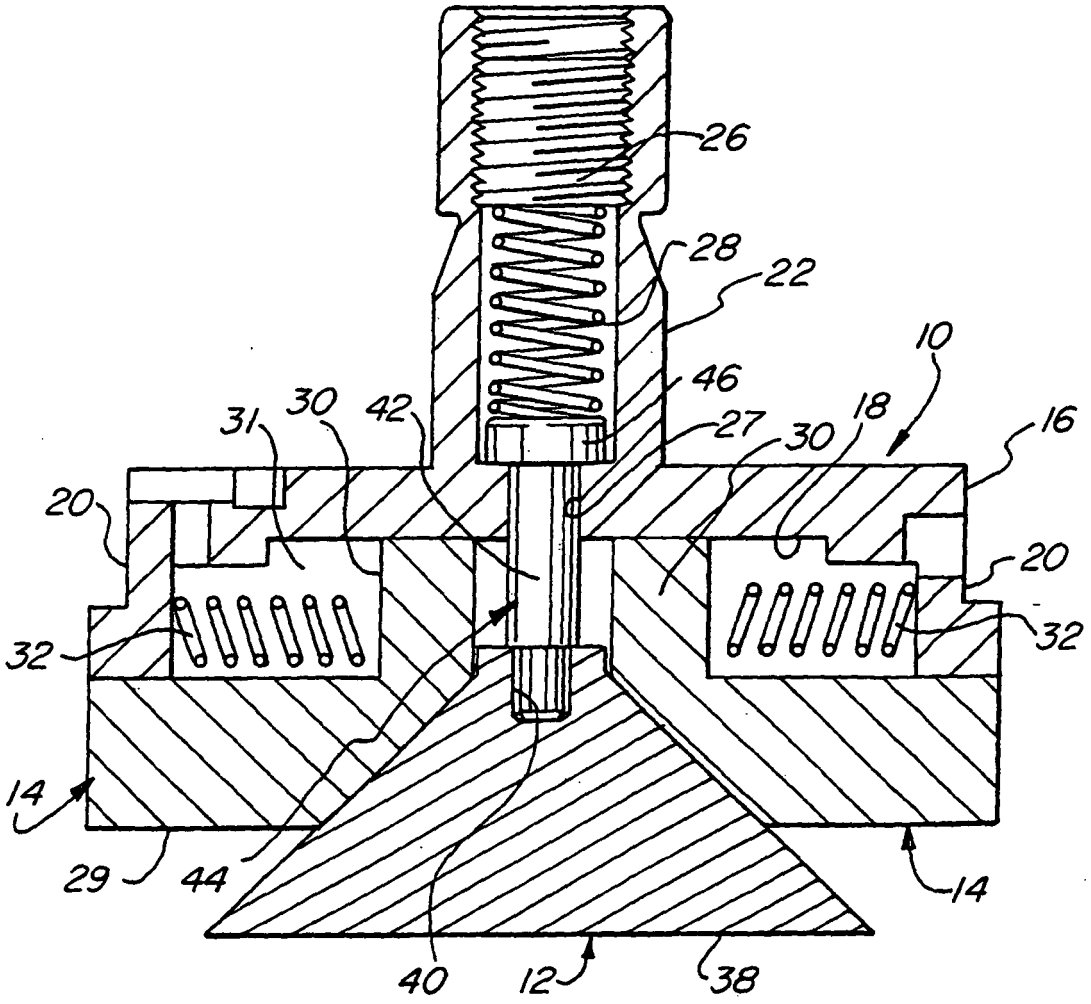


FIG. 2

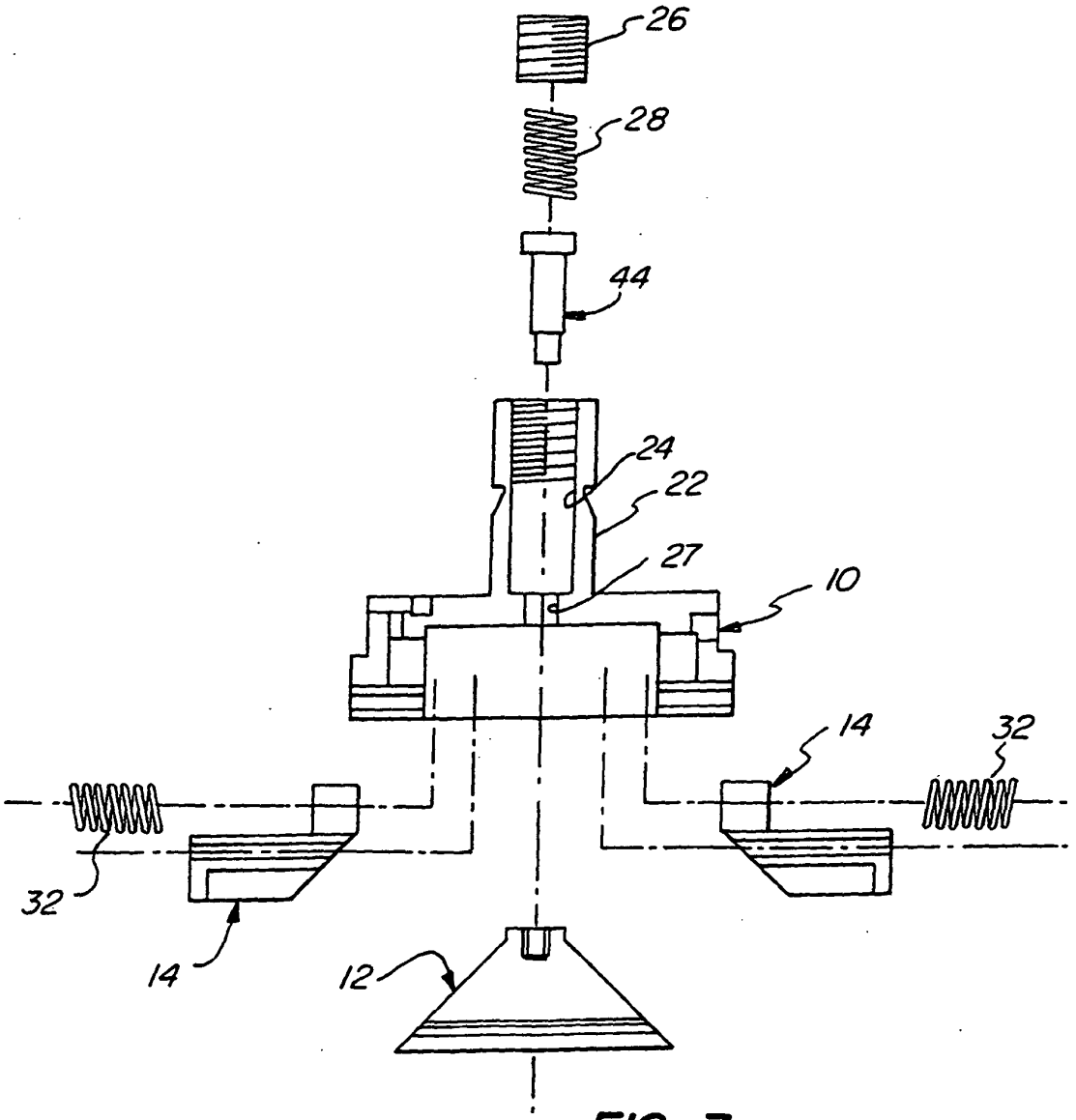


FIG. 3

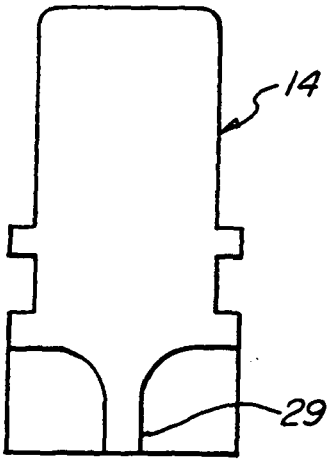


FIG. 5

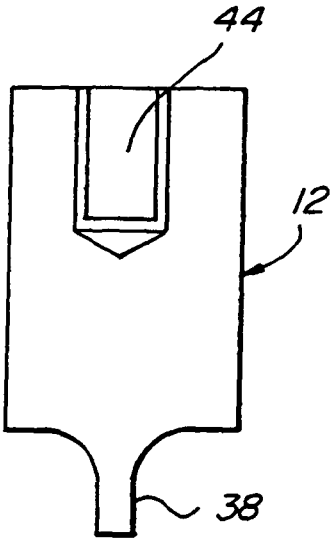


FIG. 4

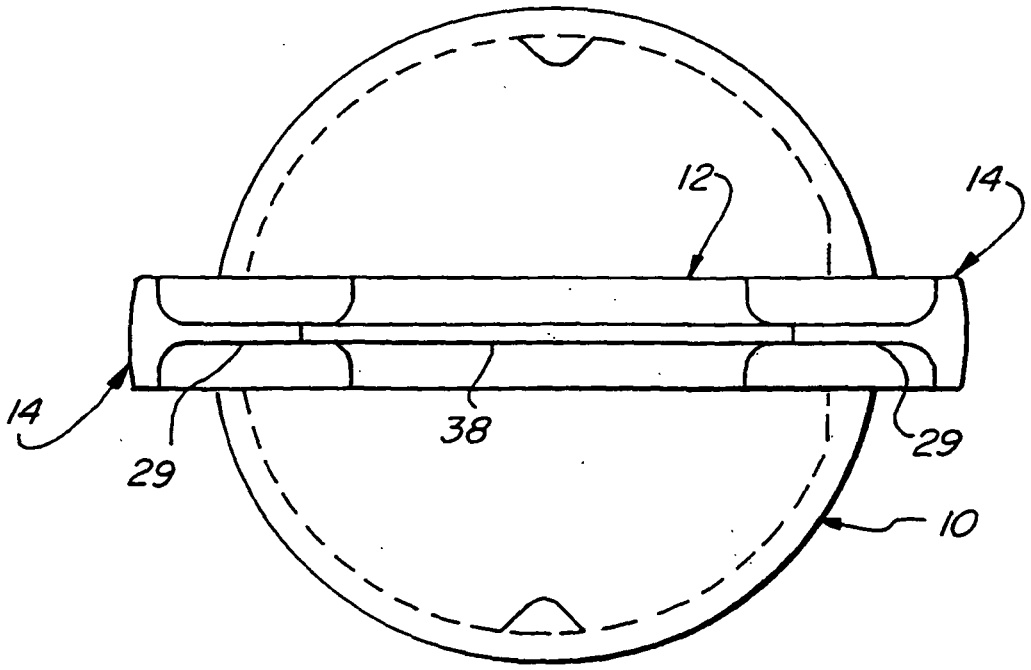


FIG. 6

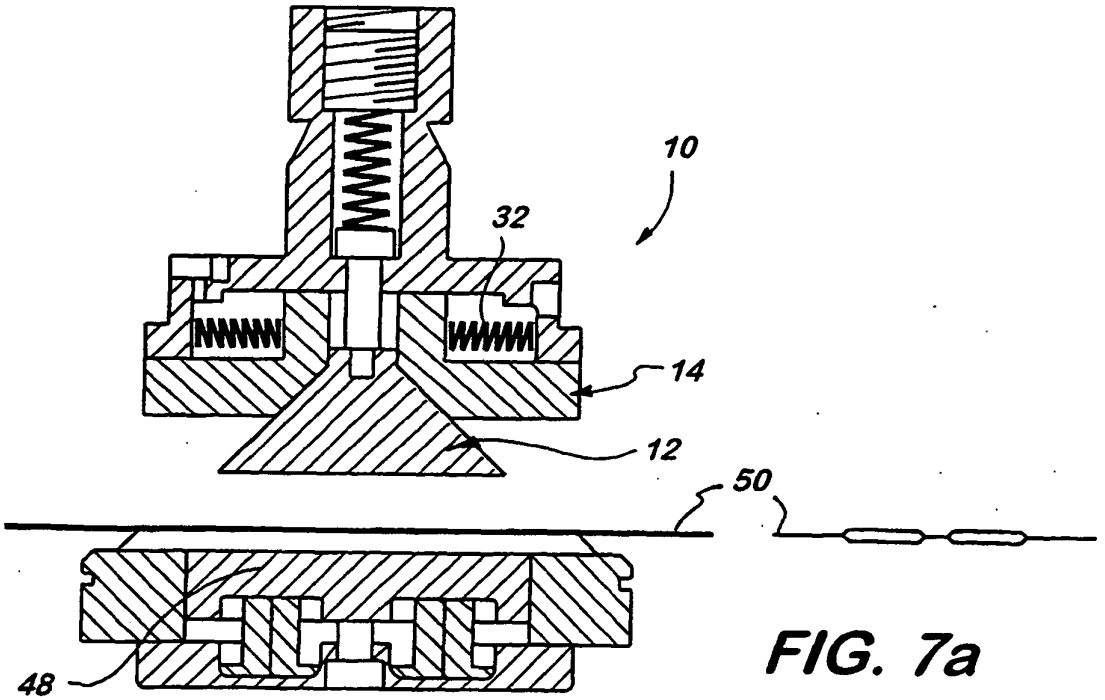


FIG. 7a

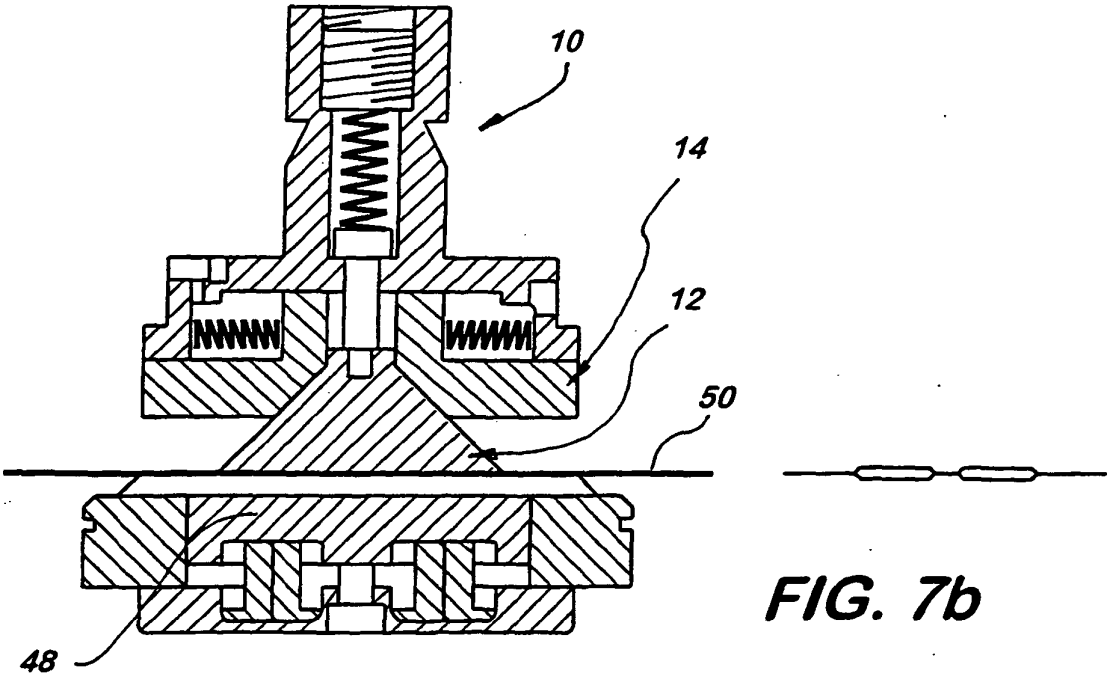


FIG. 7b

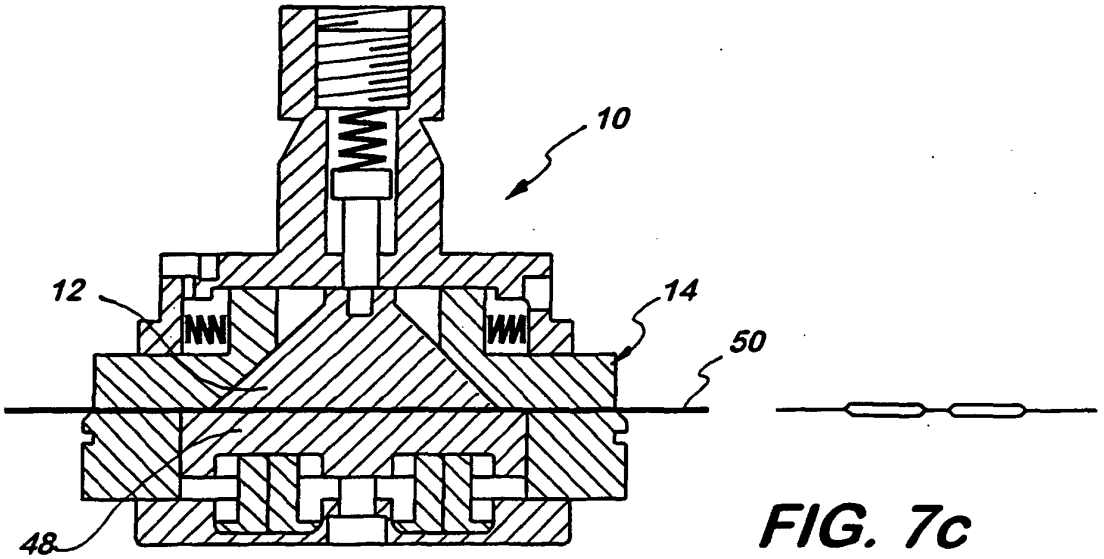


FIG. 7c

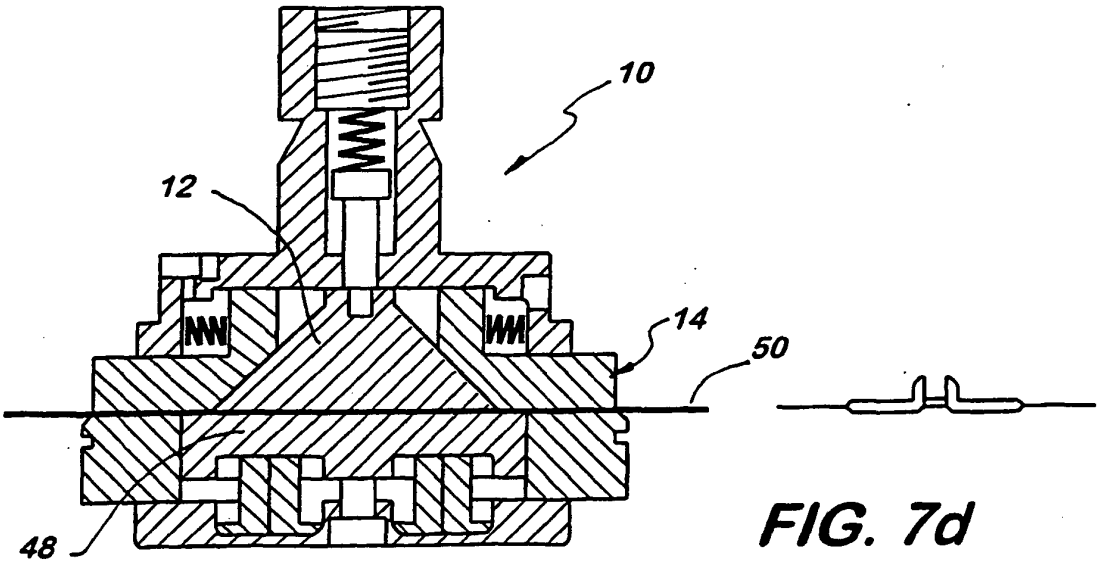


FIG. 7d

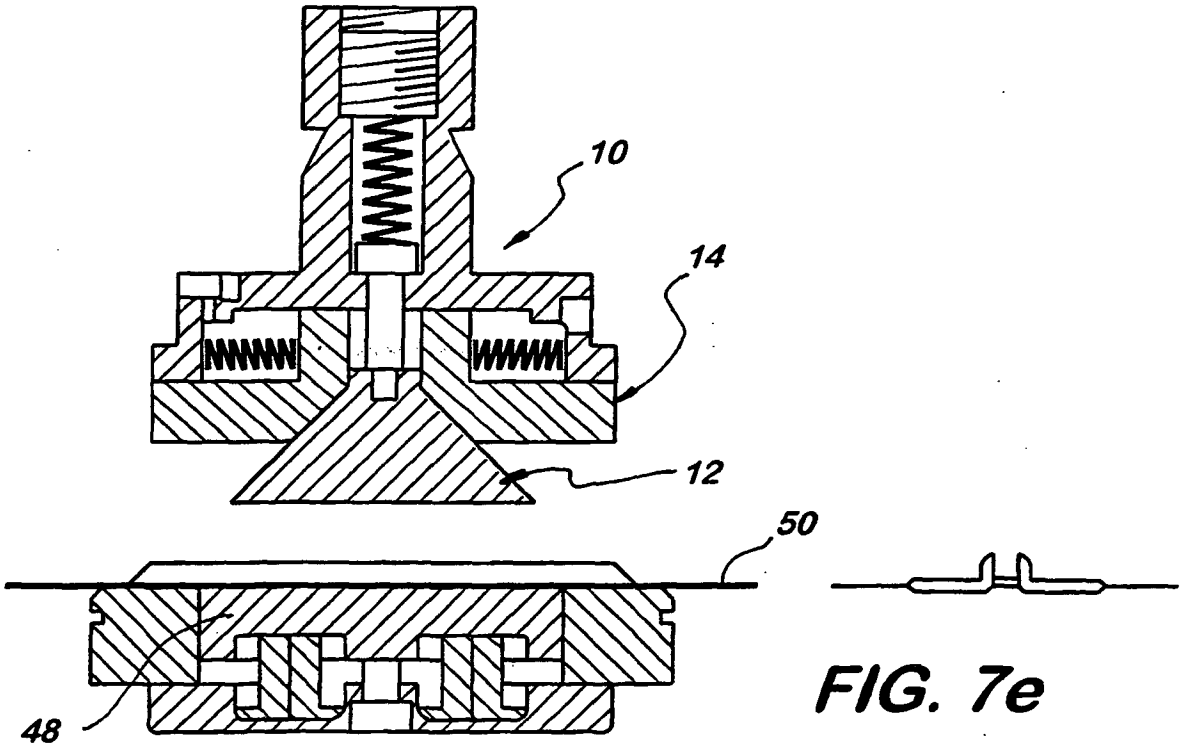


FIG. 7e

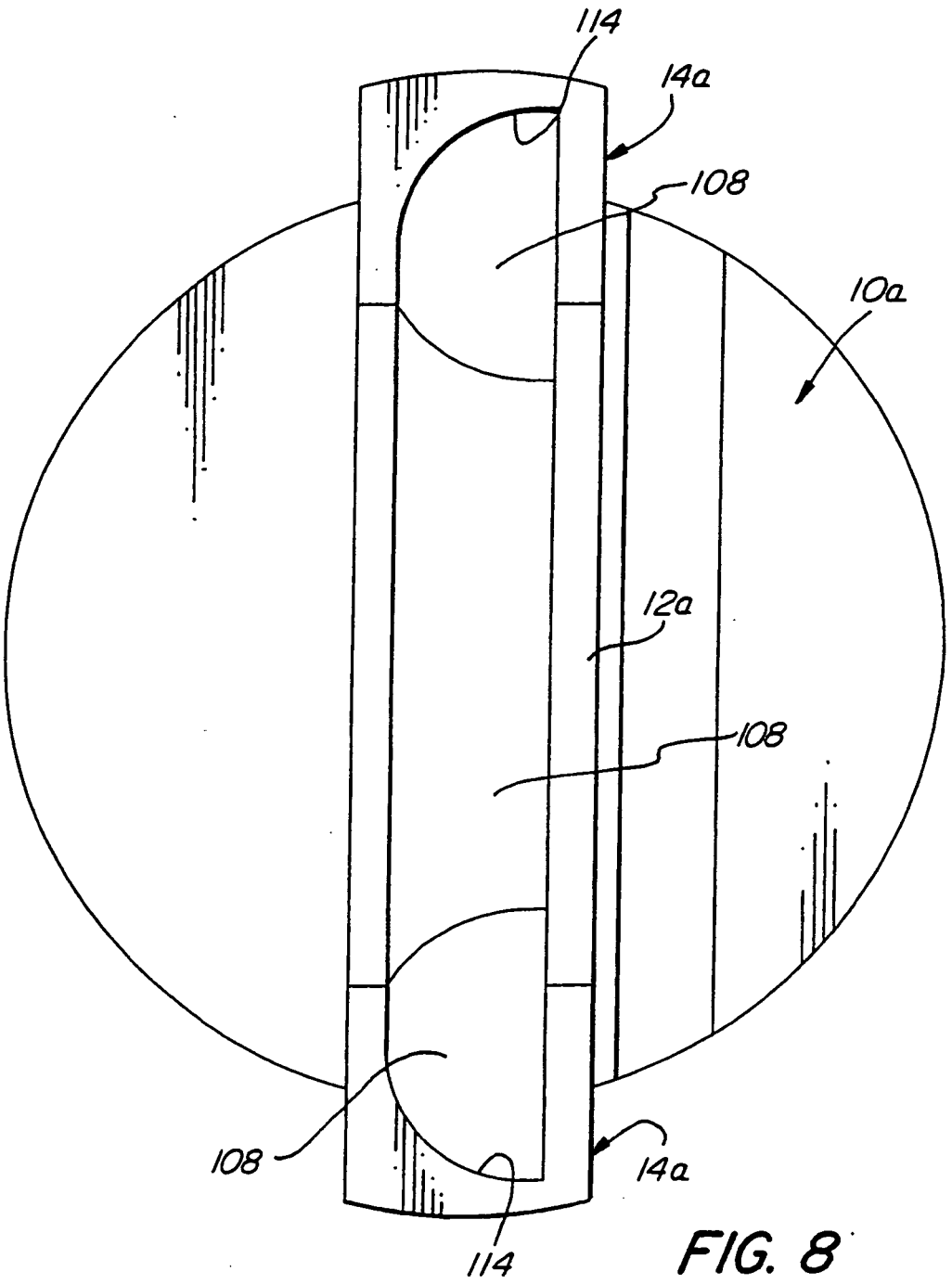


FIG. 8

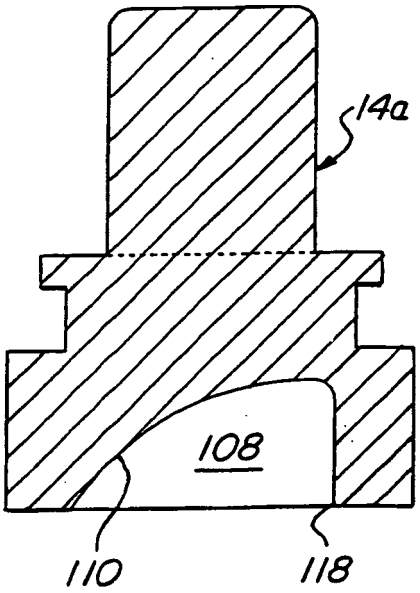


FIG. 9

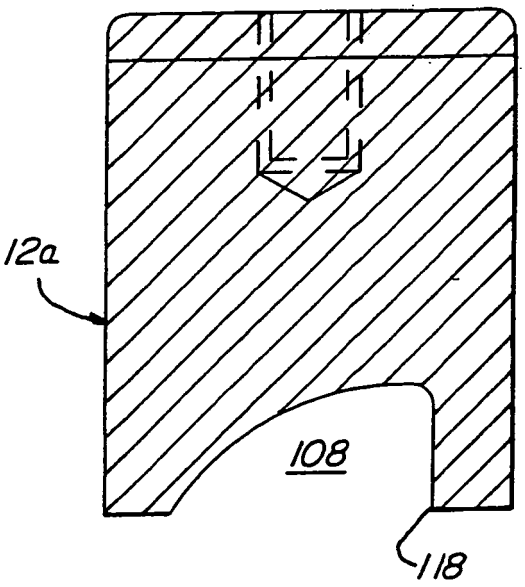


FIG. 10

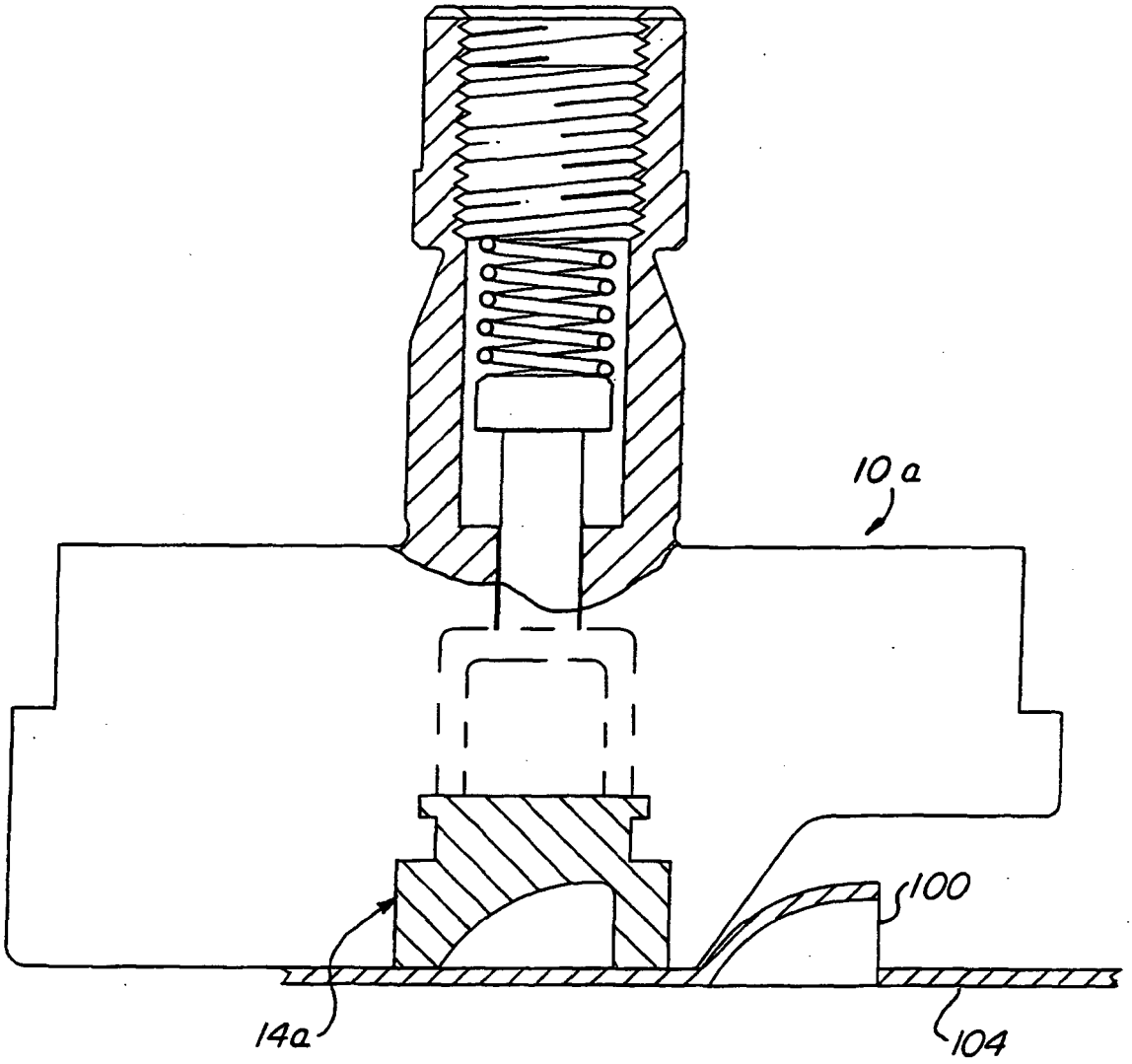


FIG. 11

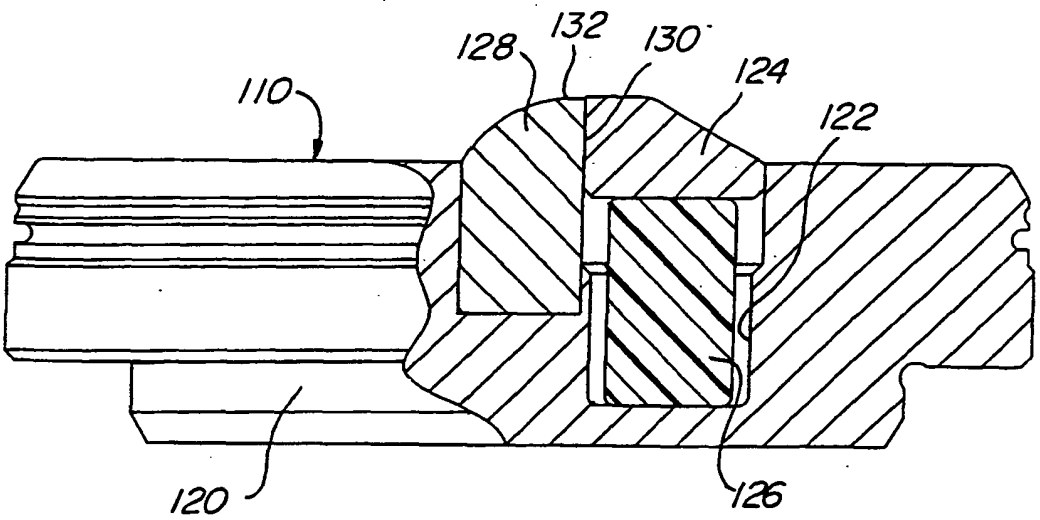


FIG. 12

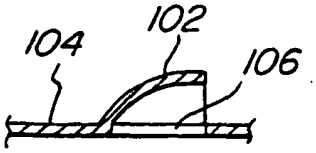


FIG. 14

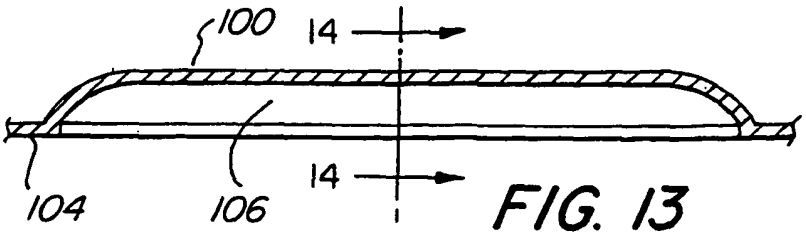


FIG. 13