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(54) Title: HYDROFORMED CAN BOTTOM EXPANSION PROCESS AND APPARATUS

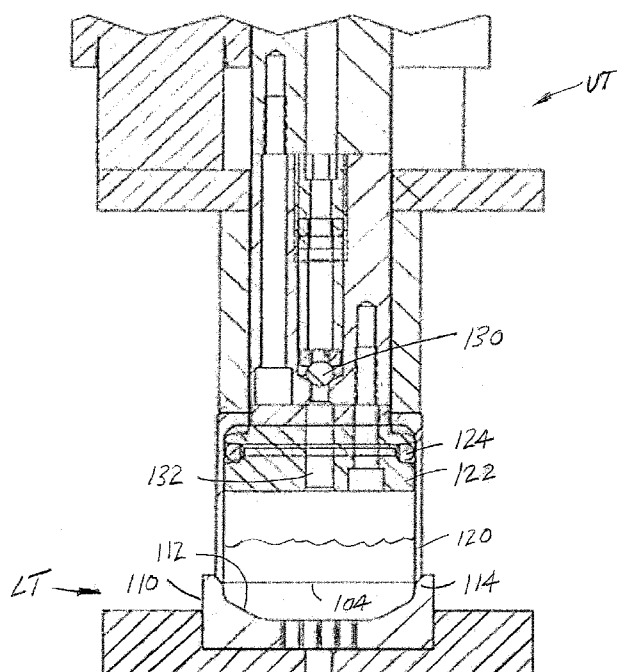


FIGURE 3

(57) Abstract: An apparatus, and associated process,
expands a wall of an associated metal container. The
apparatus includes a holder for retaining at least a por-
tion of the metal container. A first tool has a first sur-
face mounted for movement relative to the holder for
selective advancement toward and dimensioned to en-
gage at least a portion of the associated metal contain-
er. The first tool includes a seal so that fluid received
in the associated metal container is pressurized and
used to apply an expanding force to the associated
metal container as the first tool advances therein. A
bubble is formed in the bottom wall, and in a second
station, the combination of fluid pressure and metal
forming surfaces make the final configuration of the
bottom wall.



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HYDROFORMED CAN BOTTOM EXPANSION PROCESS AND APPARATUS

Background

[0001] The present exemplary embodiment relates to container or can formation, and more particularly to an apparatus and process for expanding an existing container. It finds application in conjunction with a metal container, and more particularly a steel container, and will be described with reference thereto. However, it is to be appreciated that the present exemplary embodiment is also amenable to other like applications, and may find application in connection with other metal containers such as aluminum, or the like.

[0002] The structure and method of manufacturing metal containers or cans are well known. Further, there are some features between different types of metal containers, such as steel or aluminum, that are commonly used during the manufacturing process and other features that are not universally used. Generally speaking, steel containers used in the food industry are formed from a cup shape. The cup shape has a circumferentially continuous sidewall that extends into and forms a bottom wall. The metal container is formed in part in a cupper and then proceeds into a wall ironer. Subsequently, strengthening ribs or ridges are added to the metal container, and a container end is seamed to the open end of the container.

[0003] By way of example only, it has been determined that there is sufficient material in the container that the volume of the can/container could be potentially increased without any adverse impact on the strength of the metal container. Heretofore, expanding the can bottom with punch and die tooling has not been feasible.

[0004] Therefore, a need exists for maximizing the volume in a metal container or can without adding larger presses, or significant revisions to existing equipment used to manufacture same.

Summary

[0005] An improved apparatus, tooling, or system, and the associated process or method of manufacturing, are provided for expanding a wall of a metal container.

[0006] The apparatus includes a holder for retaining at least a portion of the associated metal container. A first tool has a first surface mounted for movement relative to the holder for selective advancement toward and dimensioned to engage at least a portion of the associated metal container. The first tool includes a seal so that fluid received in the associated metal container is pressurized and the fluid advantageously used to apply an expanding force to the associated metal container as the first tool advances therein.

[0007] The first tool includes a fluid passage that communicates with a relief valve (such as a check valve) to limit the fluid pressure.

[0008] The first tool has a first end dimensioned for receipt in an open end of the associated metal container.

[0009] The first tool includes first and second portions that move in unison until the first portion abuts against a surface of the associated metal container. Thereafter, the second portion moves relative to the first portion and compresses the fluid in the associated metal container.

[0010] The seal is interposed between the first and second portions of the first tool.

[0011] A seal is also provided on an outer surface of a second tool in a second station that engages an inner wall surface of the associated metal container.

[0012] A first station includes the first tool dimensioned for receipt through an open end of the associated metal container. The first tool includes a leading end that is configured for engagement with the associated metal container at a location adjacent a sidewall connection with a bottom wall of the associated metal container.

[0013] The first tool includes first and second portions that move in unison until the first portion abuts against a surface of the associated metal container, the second portion then moves relative to the first portion and compresses the fluid in the associated metal container, and the seal is interposed between the first and second portions of the first tool.

[0014] The second station includes a second tool having a seal provided on the outer surface dimensioned for sealing engagement with an inner surface of the associated metal container. A metal forming surface on the second tool is configured to

engage a bottom wall of the associated metal container whereby the bottom wall is expanded and formed by a combination of fluid pressure and the metal forming surface.

[0015] A process for expanding a wall of a metal container includes positioning at least a portion of the metal container in a holder. The process further includes providing a fluid in the metal container, advancing a tool into an interior of the metal container to retain the metal container between the tool and holder, and further advancing the tool into the metal container to pressurize fluid and thereby expand a bottom wall of the metal container.

[0016] The process includes using a first portion of the tool to initially engage the metal container with the holder.

[0017] The process includes allowing a second portion of the tool to move relative to the tool first portion after the initial engagement of the tool first portion with the metal container.

[0018] The process includes sealing an interior cavity of the metal container with a seal on the tool to use fluid pressure to expand the metal container wall.

[0019] The process further includes using fluid pressure to form an outward bubble in a bottom wall of the container.

[0020] The process further includes using a combination of fluid pressure and metal forming to form the bubble into a desired configuration.

[0021] The process includes sealing between the metal container and the first tool while forming the bubble.

[0022] The process includes first and second portions of the first tool configured for movement relative to one another, the first portion engaging an interior surface of the metal container at an interface between a sidewall and bottom wall of the metal container to retain the metal container.

[0023] The process includes a second portion of the tool moving relative to the first portion to pressurize the fluid in the metal container and form a bubble extending outwardly in the bottom wall of the metal container.

[0024] The process includes transferring the metal container with the bubble into a second station where a second tool advances into the open end thereof, sealingly engaging an interior surface of the metal container and forming the bubble of the bottom

wall into a desired configuration with a combination of fluid pressure and a metal forming surface.

[0025] The process further includes providing a pressure relief valve to vent an interior cavity of the metal container if the pressure exceeds a predetermined level.

[0026] One advantage is the ability to advantageously increase the volume of a metal container without adding metal.

[0027] Another benefit is the ability to incorporate the tooling into conventional can making machinery.

[0028] Yet another advantage resides in the ability to more efficiently use existing material in a metal container.

[0029] Still other benefits and advantages of the present disclosure will become apparent upon reading and understanding the following description.

Brief Description

[0030] Figure 1 is a perspective view of a metal can after partial formation.

[0031] Figure 2 is a schematic representation of a first station tooling operation.

[0032] Figure 3 is a schematic representation of the first station showing the tooling clamping the container.

[0033] Figure 4 is a schematic representation of the first station at the bottom of the press stroke.

[0034] Figure 5 is a schematic representation of a second station tooling operation.

[0035] Figure 6 is a schematic representation of the second station showing the second tool advancing toward the bottom wall of the container.

[0036] Figure 7 is a schematic representation of the second station at the bottom of the press stroke.

[0037] Figure 8 is a perspective view of a metal container after ribs and ridges are formed thereon.

Detailed Description

[0038] With reference to Figure 1, there is shown a cup-shaped container 100 having a sidewall 102 and a bottom wall 104. At this stage of the container or can making

process, the sidewall 102 is a generally smooth, cylindrical surface that joins with the bottom wall 104 in a continuous fashion. The cup-shaped container 100 is thus shown with an upper, open end 106. By way of example only, the container 100 is a steel container and the sidewall 100 has a thickness of approximately 0.004 inches and the bottom wall 104 has a thickness of approximately 0.010 inches. As will be appreciated, the container has the shape and such dimensions after exiting the cupper and wall ironer tooling of conventional can making machinery. It is been found that the thickness of the bottom wall 104 can be reduced, although heretofore generally deemed impossible to provide for bottom expansion with a conventional punch and die structure only. However, the present disclosure describes the use of fluid to expand the bottom of the container. As a result of this expansion, the bottom wall 104 is reduced in thickness from 0.010 inches to 0.008 inches and the thickness of the sidewall 102 remains substantially unchanged.

[0039] Figures 2-7 illustrate a first station (Figures 2-4) and a second station (Figures 5-7) tooling operations that achieve this can bottom expansion. More particularly, in Figure 2, the container 100 is transferred into the press (not shown). A conventional can or container shuttle system (the details of which are omitted for ease of illustration) can be used to transfer the container into the first station when upper tooling UT and lower tooling LT are sufficiently separated (Figure 2) to allow the can to be introduced therebetween. The lower tooling LT includes a base 110 that has a recess 112, and a shoulder 114 configured to engage and receive the bottom wall 104 of the container 100 along its outer perimeter and at the connecting region with the sidewall 102.

[0040] The upper tooling UT includes a hollow, generally cylindrical first or lower end 120 that forms a first portion of the first tool and a second portion 122 of the first tool is received therein and spaced from the terminal end of the first portion 120 in the transfer position of Figure 2. A seal 124 such as an o-ring is received in an associated groove or recess of the second portion 122 of the upper tooling. A biasing member (not shown) may be used to urge the first portion 120 into the lower position shown in Figure 2.

[0041] The press ram then begins to move downwardly and the upper tooling UT proceeds through the open end 106 of the container (Figure 3) and advances toward the lower tooling LT, and likewise advances toward the bottom wall 104 of the container.

The position shown in Figure 3 illustrates engagement of the terminal end of the first portion 120 of the first tool at the interface of the sidewall 102 and bottom wall 104 of the container. This engagement between the first portion 120 of the first tool and the shoulder 114 grips or clamps the container 100 in place. Further downward movement of the press ram advances the second portion 122 of the first tool toward the lower tooling LT.

[0042] Fluid F is provided in the container, typically before introduction into the first station. The fluid is not intended to be a large amount, rather, as the second portion 122 of the first tool advances downwardly and the second portion moves relative to the first portion 120 from the position shown in Figure 3 to the position shown in Figure 4, the fluid is pressurized as a result of the seal 124 between the first and second portions 120, 122. The fluid is pressurized and is advantageously used to apply an expanding force to the container namely against the bottom wall 104. This fluid pressure forms a bubble represented by reference numeral 104' in Figure 4 where the bottom wall has expanded outwardly toward the surface 112 of the base 110 of the lower tooling LT.

[0043] In addition, a relief valve 130 is provided in the upper tooling. Particularly, the relief valve 130 is associated with passage 132 that communicates with the interior cavity of the cup shaped container 100 and particularly when the upper tooling is advanced through the upper, open end 106 of the metal container 100. The relief valve 130 allows the pressure to build up to a predetermined level, for example about 2000 psi. If the pressure builds beyond this predetermined level, the relief valve 130 opens. This ensures that the desired force is imposed on the bottom wall of the container to form the bubble 104'.

[0044] The press ram then moves upwardly and separates the upper tooling from the lower tooling. Again, a conventional shuttle system (not shown) is used to remove the metal container with the bubble 104' that was formed in the first station of Figures 2-4 and advances the container with the bubble into the second station of Figures 5-7. The upper and lower tooling LT are shown separated in Figure 5. A hollow cylindrical support portion 150 closely receives the sidewall 102 of the container and the bubble 104' generally abuts or is received over a central portion of a metal forming surface 152 of the lower tooling LT. As the press ram moves downwardly, the upper tooling UT

(second tool 154) advances through the open end 106 of the container. There is still residual fluid F in the container 100. As the ram continues downwardly, metal forming surface 156 of the second tool 154 is advanced toward metal forming surface 152 of the lower tooling LT. The combination of fluid pressure (as the fluid is compressed by the downwardly moving second tool 154) and the metal forming surfaces 152, 156 expands the bubble in the corner regions toward the diameter of the sidewall, and forms the final configuration of the bottom wall of the container (Figure 7). Seal 158 assures that sufficient fluid pressure is built up in the cavity of the container as the second tool 154 advances downwardly. The seal 158 is preferably received in an outer groove of the tooling 154 and sealingly engages along the inner surface of the sidewall 102.

[0045] Passage 160 is provided in the tool 154 and communicates with the cavity in the container. Relief valve 162 is provided in the passage and limits the force imposed by the pressurized fluid F. That is, the relief valve 162 opens if a preselected threshold pressure is reached.

[0046] Later operations in a standard metal container forming operation, such as forming ribs or ridges 170 in the sidewall and formation of flange 172 to receive a separate can end (not shown), are performed in a conventional manner. Since these tooling and operations are well known in the art, they are not described here for purposes of brevity and since one of ordinary skill in the art is well aware of their structure and operation.

[0047] In summary, the can or container(s) is transferred into the press, transferred between stations, and discharged out of the press with a shuttle system (not shown). The shuttle system moves forward and backward every stroke of the press. For example, a set of three pneumatic grippers may be mounted to the shuttle system to carry a container. While the press ram moves up, and the container is clear (the position of the press ram is monitored to provide electrical signals, for example, to initiate the container shuttle operation) the grippers close on the containers at the infeed, in the first station, and at the second station.

[0048] When the press ram the tooling is up high enough to clear the container (the position of the press ram is monitored to provide electrical signals, for example, to initiate the container shuttle operation), the container shuttle system will index forward.

The container shuttle system continues to move forward (toward the rear of the press or discharge) until the containers are placed into tooling and discharge stations. While the press ram is moving down on the next stroke, the grippers open and the container shuttle system moves backwards (towards the front of the press were infeed). Once the press ram goes through the bottom of the stroke and back up, the container shuttle system repeats the cycle.

[0049] The container bottom is expanded and formed by both the hydroform process and a punch and die tooling process as described above. The container bottom expansion process preferably uses, for example, two hydroform and punch and die tooling stations. A metered amount of fluid is fed into the container. The metered amount of fluid is used in the hydroforming process throughout tooling system. The same fluid is preferably used in both stations. The container with the fluid is transferred in the first station via the container shuttle system. The tooling moves downward into the container. The tooling makes first contact at about 0.750 inches off of bottom dead center (BDC). This first contact clamps the bottom of the container at about 0.100 inches in from the container sidewall. The tooling clamp is backed up springs or a similar biasing member. The clamp clamps the material wall forming the bubble in the container bottom and seals the container while creating pressure for the hydroforming process.

[0050] At first contact, the tooling clamp (first portion of first tool) downward motion is stopped and the inner tool (second portion of first tool) in the first station continues to move downwardly. When the inner tool, which continues to move downwardly, contacts the fluid in the container, the inner tooling compresses the fluid and pressure begins to build in the container. As the inner tooling continues to move downwardly, the pressure continues to build up to a preselected level, e.g. about 2000 psi. A relief valve in the tooling will limit the pressure to the preselected level. The internal pressure expands or hydroforms the container bottom wall downwardly into the lower die cavity, creating a bubble. The tooling continues downwardly to the bottom of the stroke. At the bottom of the stroke, the tooling reverses and begins to move upwardly toward the top of the stroke. While the tooling is moving upwardly toward the top of the stroke, a tooling knockout (not shown) in the first station pushes the container off of the tooling, leading

the container on the lower tool. A pad in the lower tool, for example, will lift the container to the transfer height. The tooling continues to move upwardly and the cycle repeats. The container that was formed in the first station will be transferred to the second station via the container shuttle system.

[0051] The container formed in the first station is transferred into the second station. The fluid used in the first station will be used again in the second station. The second station tooling moves downwardly into the container. The tooling contacts the fluid, for example at about 0.700 inches off of bottom dead center (BDC). The second station tooling compresses the fluid and pressure begins to build in the container. As the tooling continues to move downwardly, the pressure continues to build up to a preselected level, for example about 600 psi. A relief valve in the tooling limits the pressure to the preselected level.

[0052] The internal pressure expands or hydroforms the bubble in the container bottom, formed in the first station, outwardly to the desired container diameter. The bubble that was hydroformed in the first station is expanded back out to the original diameter. The tooling continues downwardly to the bottom of the stroke. At the bottom of the stroke, the countersink and bottom beads are die formed into the container bottom wall. At the bottom of the stroke, the tooling reverses and begins to move upwardly toward the top of the stroke. While the tooling is moving upwardly toward the top of the stroke, a tooling knockout (not shown) in the second station pushes the container off of the tooling, leaving the container on the lower tool. A pad in the lower tool, for example, will lift the container to the transfer height. The tooling continues upwardly and the cycle will repeat. The container that was formed in the second station will be transferred to the discharge via the container shuttle system. Once the container is moved out of the tooling, the container will be rotated to remove any fluid left over from the hydroforming process. The leftover fluid will be filtered and returned to the fluid tank reservoir for re-use.

[0053] For example, a pair of hydroforming machines producing 600 containers per minute each would be required. Each machine would be configured, for example, to have a mechanical press operating speed up to at least 60 strokes per minute and capable of generating 300 tons at 0.750 inches off of bottom dead center. Ten lanes of

tooling, for example, two stations in each lane, five container shuttle systems, each feeding first and second legs of tooling, and associated in feed and discharge conveyors would complete the system. Of course these are simply representative numbers.

[0054] This written description uses examples to describe the disclosure, including the best mode, and also to enable any person skilled in the art to make and use the disclosure. The patentable scope of the disclosure is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims. Moreover, this disclosure is intended to seek protection for a combination of components and/or steps and a combination of claims as originally presented for examination, as well as seek potential protection for other combinations of components and/or steps and combinations of claims during prosecution.

It is claimed:

1. An apparatus for expanding a wall of an associated metal container comprising:

a holder for retaining at least a portion of the associated metal container;

a first tool having a first surface mounted for movement relative to the holder for selective advancement toward and dimensioned to engage at least a portion of the associated metal container, and the first tool including a seal so that fluid received in the associated metal container is pressurized and used to applying an expanding force to the associated metal container as the first tool advances therein.

2. The apparatus of claim 1 wherein the first tool includes a fluid passage that communicates with a relief valve that opens in response to a preselected fluid pressure level in the associated metal container.

3. The apparatus of either of claims 1 or 2 wherein the first tool has a first end dimensioned for receipt into an open end of the associated metal container.

4. The apparatus of any one of claims 1-3 wherein the first tool includes first and second portions that move in unison until the first portion abuts against a surface of the associated metal container, and the second portion then moves relative to the first portion and compresses the fluid in the associated metal container.

5. The apparatus of claim 4 wherein the seal is interposed between the first and second portions of the first tool.

6. The apparatus of any one of claims 1-3 wherein a seal is provided on an outer surface of the second tool in a second station that engages an inner wall surface of the associated metal container.

7. The apparatus of claim 1 wherein a first station includes the first tool dimensioned for receipt through an open end of the associated metal container, and the first tool includes a leading end that is configured for engagement with the associated metal container at a location adjacent a sidewall connection with a bottom wall of the associated metal container.

8. The apparatus of claim 7 wherein the first tool includes first and second portions that move in unison until the first portion abuts against a surface of the associated metal container, the second portion then moves relative to the first portion and compresses the fluid in the associated metal container, and the seal is interposed between the first and second portions of the first tool.

9. The apparatus of either of claims 7 or 8 wherein a second station includes a second tool having a seal provided on an outer surface thereof dimensioned for engagement with an inner surface of the associated metal container, and a metal forming surface that is configured to engage a bottom wall of the associated metal container whereby the bottom wall is expanded by a combination of fluid pressure and the metal forming surface.

10. A process for expanding a wall of a metal container comprising:
- positioning at least a portion of the metal container in a holder;
- providing a fluid in the metal container;
- advancing a tool into an interior of the metal container to retain the metal container between the tool and holder; and
- further advancing the tool into metal container to pressurize the fluid and thereby expand a bottom wall of the metal container.
11. The process of claim 10 further comprising using a first portion of the tool to initially engage the metal container with the holder.
12. The process of claim 11 further comprising allowing a second portion of the tool to move relative to the tool first portion after the initial engagement of the tool first portion with the metal container.
13. The process of any one of claims 10-12 further comprising sealing an interior cavity of the metal container with a seal on the tool to use fluid pressure to expand the metal container wall.
14. The process of any one of claims 10-13 further comprising using fluid pressure to form an outward bubble in a bottom wall of the container.

15. The process of claim 14 further comprising using a combination of fluid pressure and metal tool forming to form the bubble into a desired configuration.

16. The process of claim 15 wherein forming the bubble into a desired configuration includes sealing between the metal container and the tool.

17. The process of claim 10 wherein in a first station, first and second portions of a first tool are configured for movement relative to one another, the first portion engaging an interior surface of the metal container at an interface between a sidewall and bottom wall of the metal container to retain the metal container.

18. The process of claim 17 wherein in the first station, a second portion of the first tool moves relative to the first portion to pressurize the fluid in the metal container and form a bubble extending outwardly in the bottom wall of the metal container.

19. The process of claim 18 further comprising transferring the metal container with the bubble into a second station where a tool advances into the open end thereof, sealingly engaging an interior surface of the metal container and forming the bubble of the bottom wall into a desired configuration with a combination of fluid pressure and a metal forming surface.

20. The process of any one of claims 10-19 further including providing a pressure relief valve to vent an interior cavity of the metal container if the pressure exceeds a predetermined level.

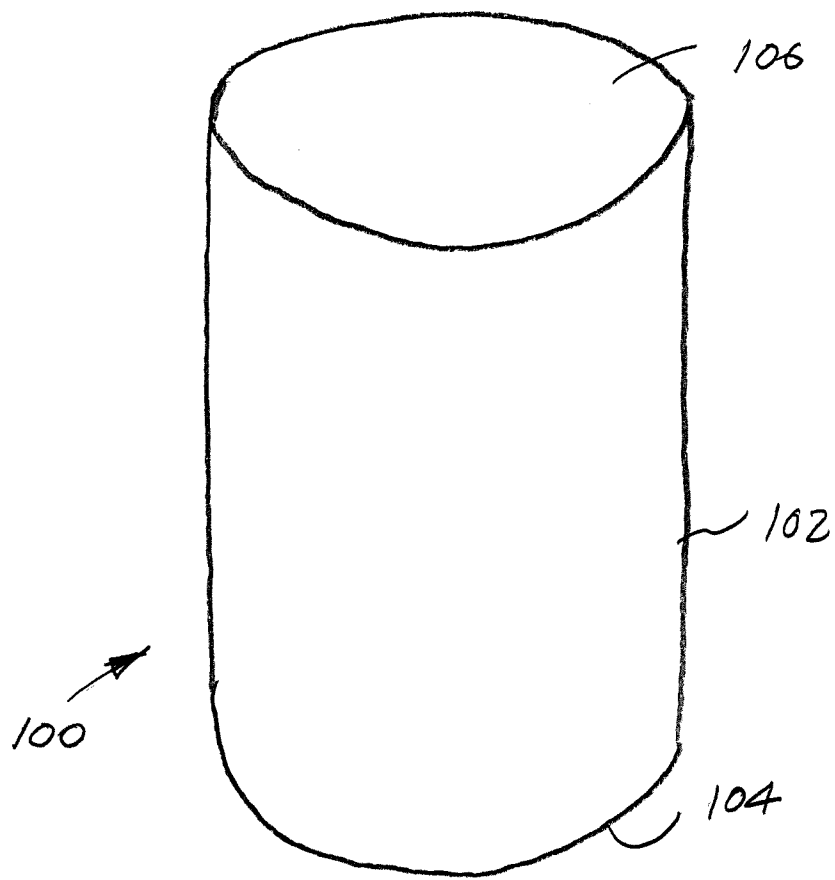


FIGURE 1

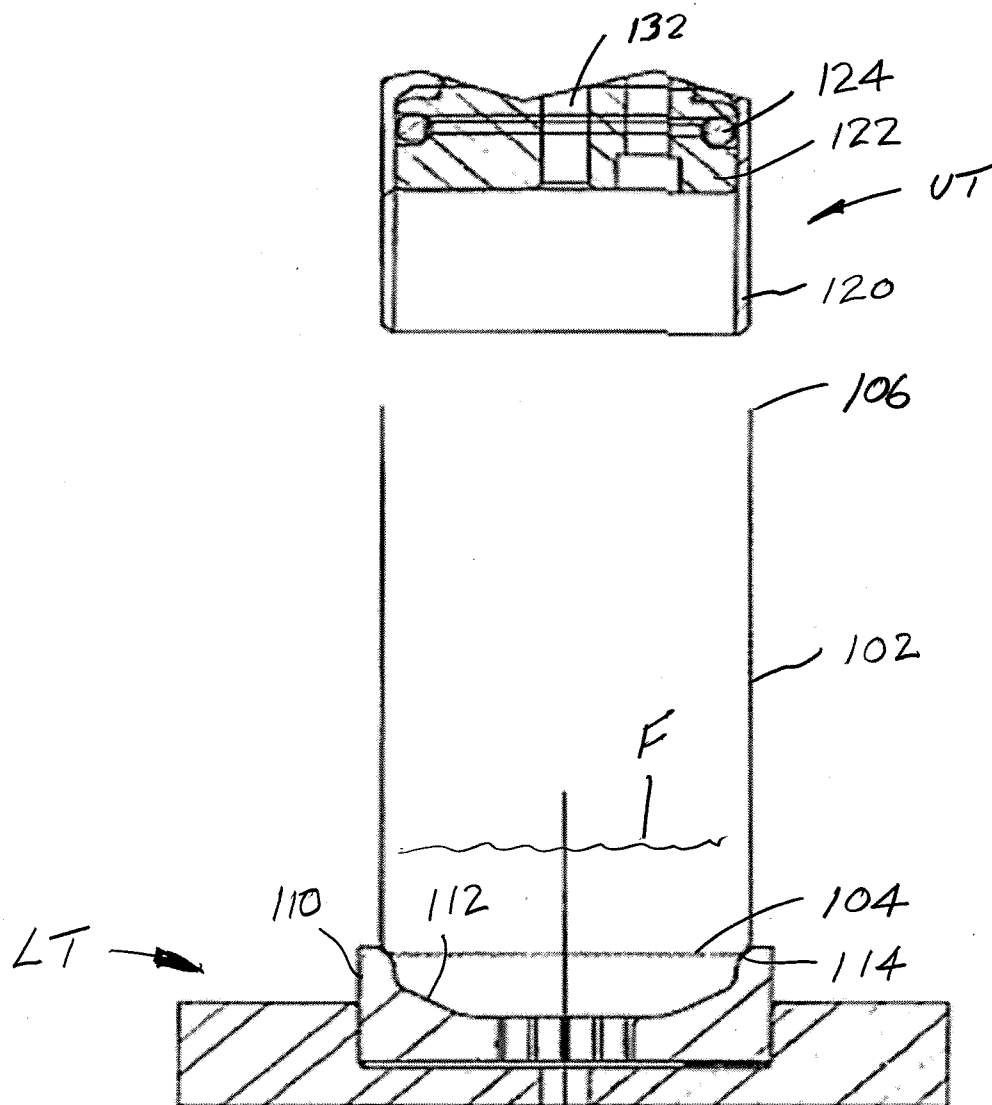


FIGURE 2

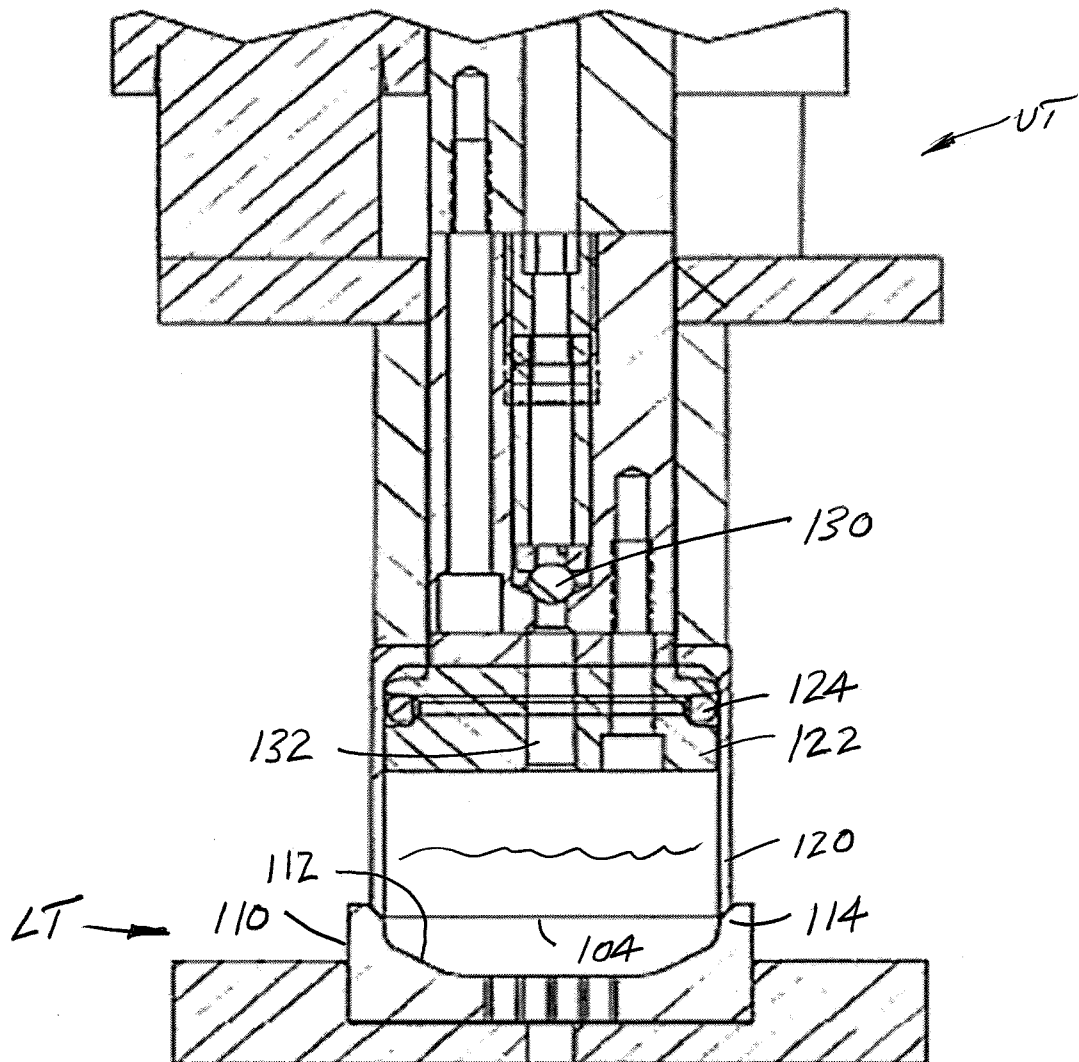


FIGURE 3

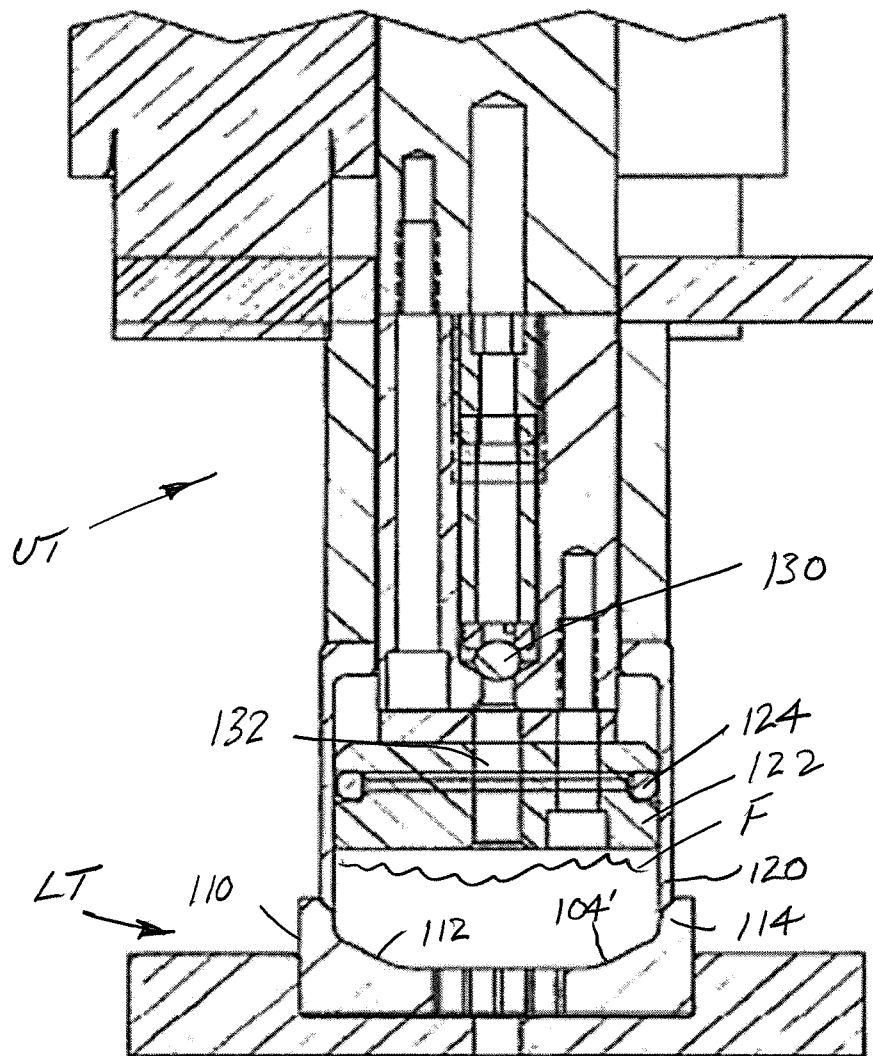


FIGURE 4

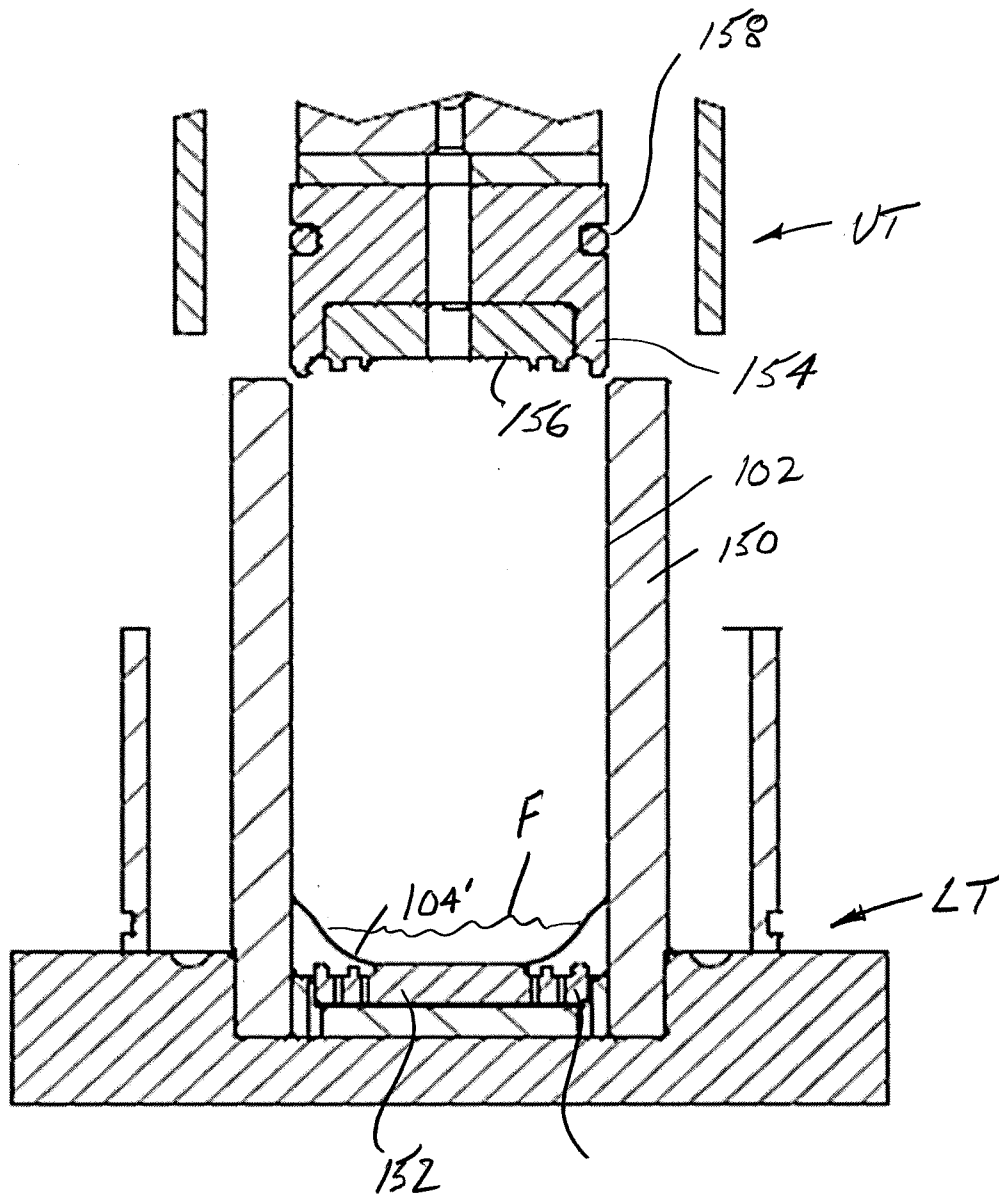


FIGURE 5

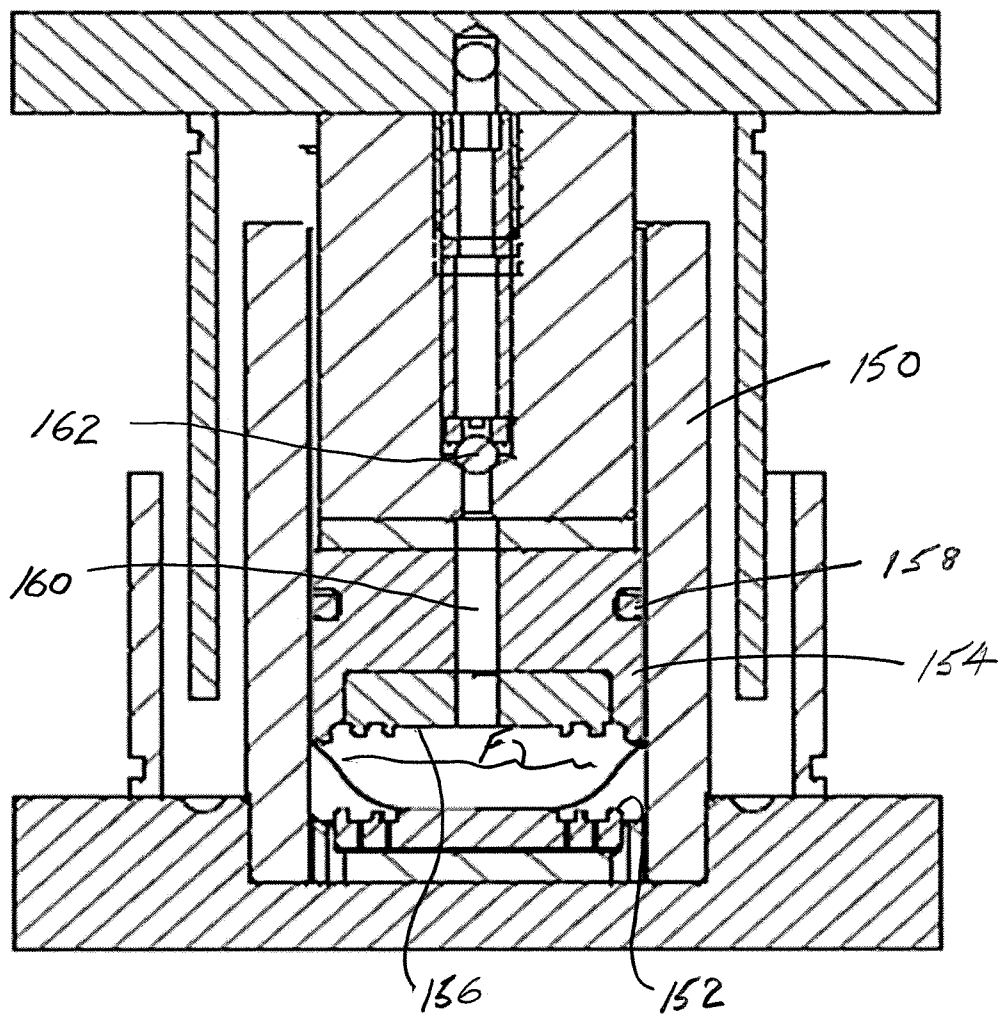


FIGURE 6

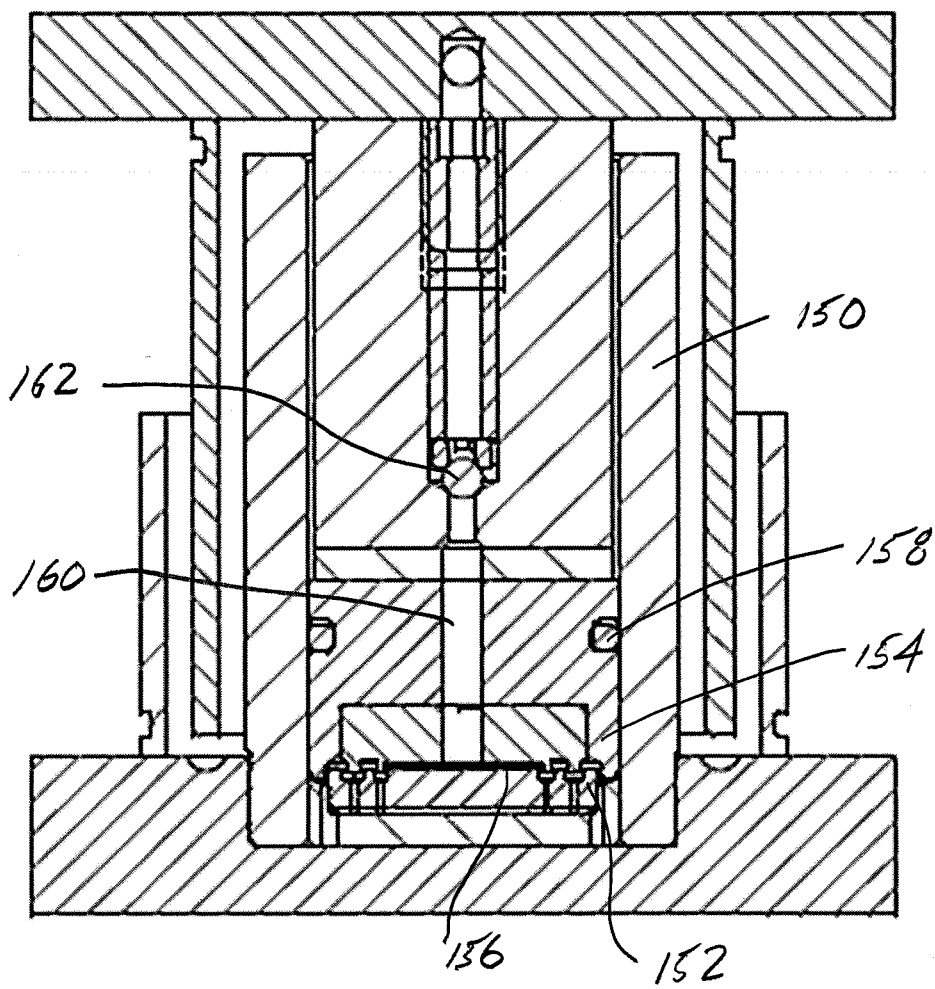


FIGURE 7

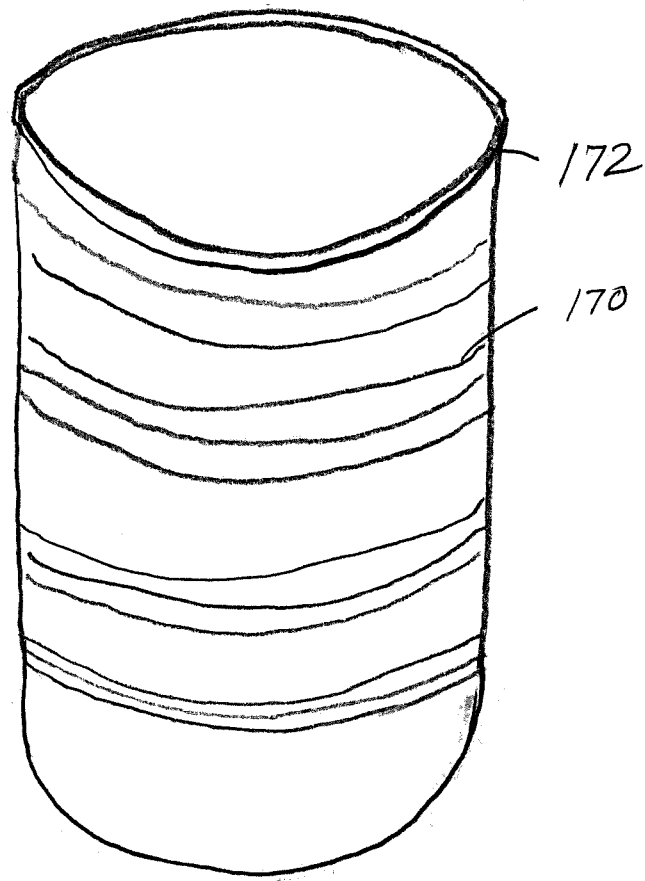


FIGURE 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US14/31506

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B21D 26/02, 26/033, 26/049 (2014.01)

USPC - 72/62, 57, 58

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): B21D 26/02, 26/033, 26/043, 26/049, 17/02, 21/00, 22/02 (2014.01)

USPC: 72/62, 57, 58

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C,B, DE-A, DE-T, DE-U, GB-A, FR-A); Google; Google Scholar; ProQuest;
SEARCH TERMS: fluid* hydraulic* water) pressur* forc* shap* expand* can container* metal* container* drum barrel bottle stamp*
press* emboss* tool* piston die stamp

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 5,275,033 A (RIVIERE, M) January 4, 1994; figures 5-7; column 3, line 15 to column 4, line 65	1, 3/1, 7, 8, 10-13 — 2, 3/2, 9, 17, 18
Y	US 4,183,124 A (HOFFMAN, R) January 15, 1980; figure 5; column 5, lines 53-64	2, 3/2
Y	US 7,036,348 B2 (MCCLUNG, J) May 2, 2006; figures 3C, 4, 4A, 4B, 5 and 5A; column 4, line 50 to column 4, line 14; column 5, lines 15-32	9, 17, 18
A	US 6,802,196 B2 (GONG, K et al.) October 12, 2004; entire document	9, 19

☐ Further documents are listed in the continuation of Box C.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

30 June 2014 (30.06.2014)

Date of mailing of the international search report

11 AUG 2014

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Shane Thomas

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US14/31506

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 4-6, 14-16, and 20
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.