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**Griffin et al.**

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[54] **PUSH-ON FUEL CAP**

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[73] Assignee: **Stant Manufacturing Inc.**, Connersville, Ind.

[21] Appl. No.: **08/785,710**

[22] Filed: **Jan. 17, 1997**

**Related U.S. Patent Documents**

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Issued: **Jan. 17, 1995**
Appl. No.: **08/138,399**
Filed: **Oct. 18, 1993**

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[52] **U.S. Cl.** ..... **220/326**; 220/89.1; 220/DIG. 32; 220/DIG. 33

[58] **Field of Search** ..... 220/307, 308, 220/86.2, 89.1, 746, DIG. 32, DIG. 33, 326, 784

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*Primary Examiner*—Steven Pollard
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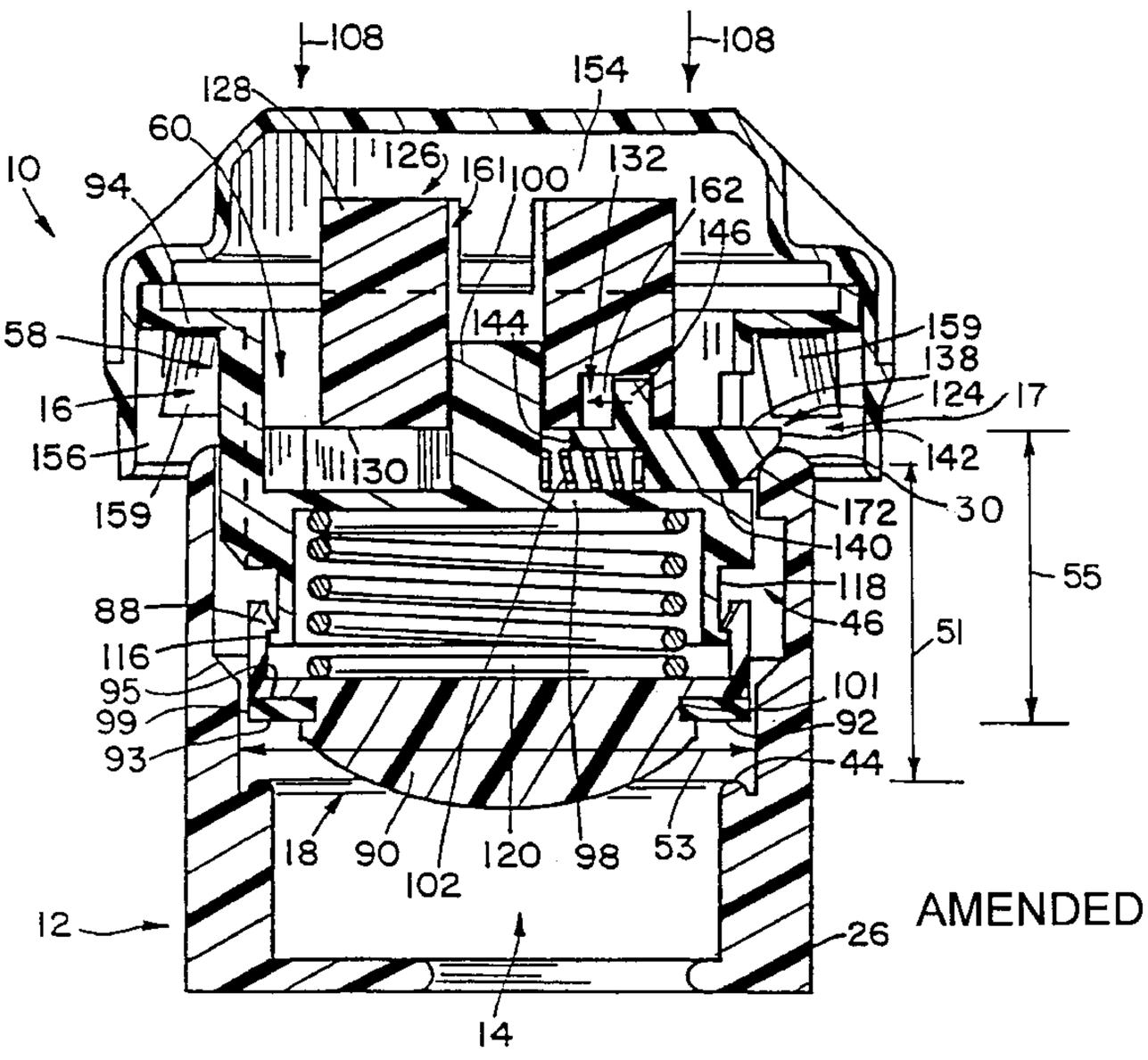
[57] **ABSTRACT**

According to the present invention, a push-on cap is provided for engaging a filler neck. The cap includes **[**means**]** *member* for closing the mouth of the filler neck. This closing **[**means**]** *member* includes a housing and an end member which is coupled to the housing while being axially movable relative to the housing. The cap further includes **[**means**]** *a mechanism* for gripping the filler neck in response to the sliding axially inward movement between a filler neck-engaging position and a filler neck-disengaging position.

**54 Claims, 5 Drawing Sheets**



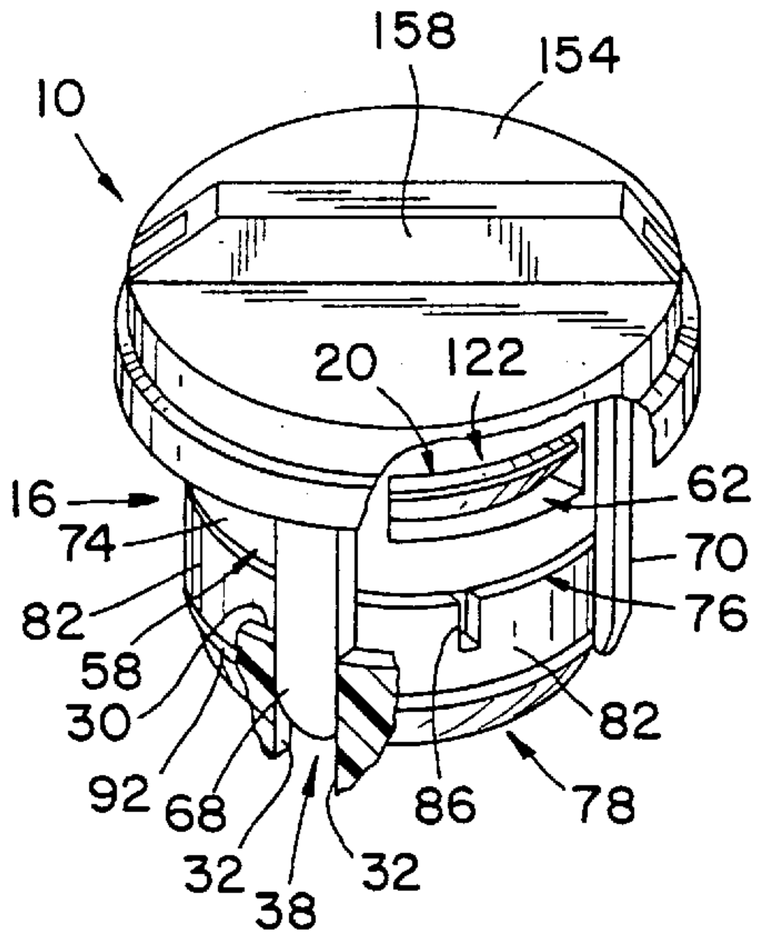



FIG. 1

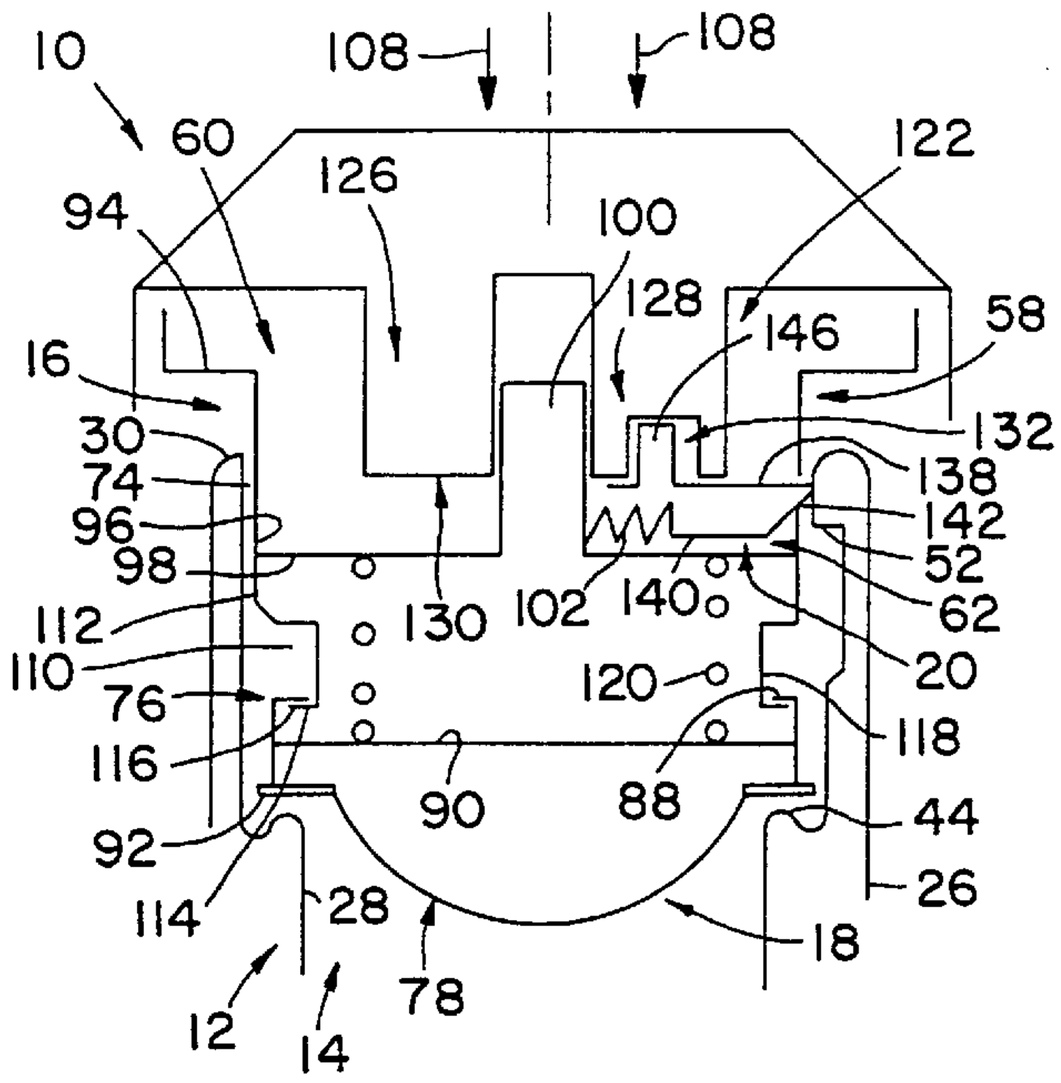



FIG. 2

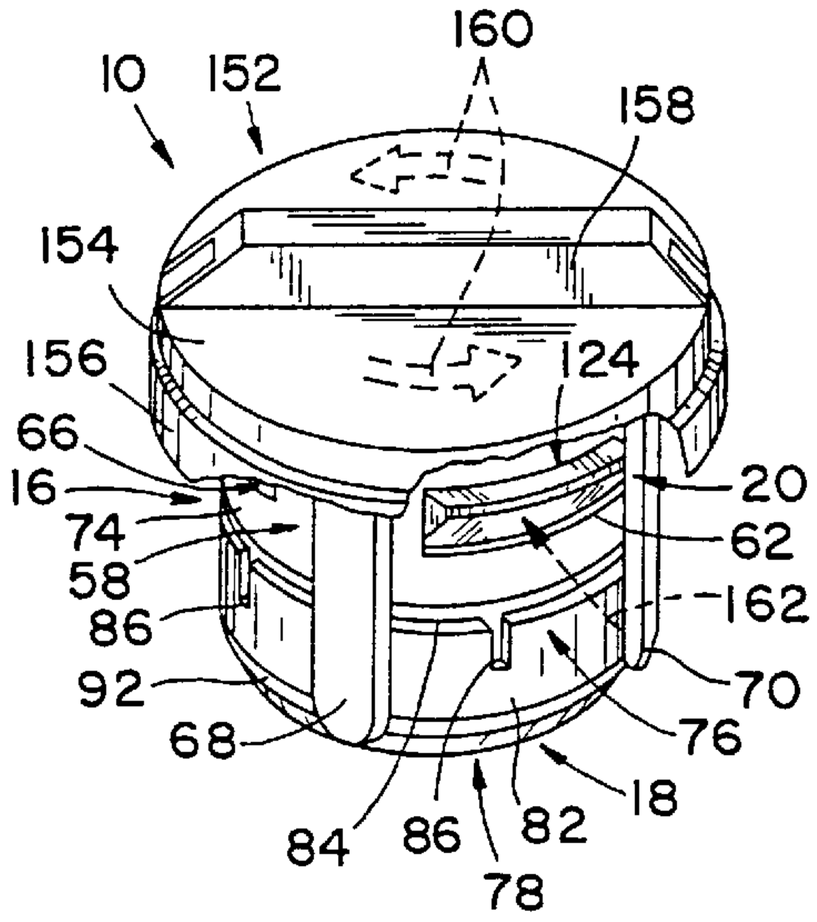



FIG. 3

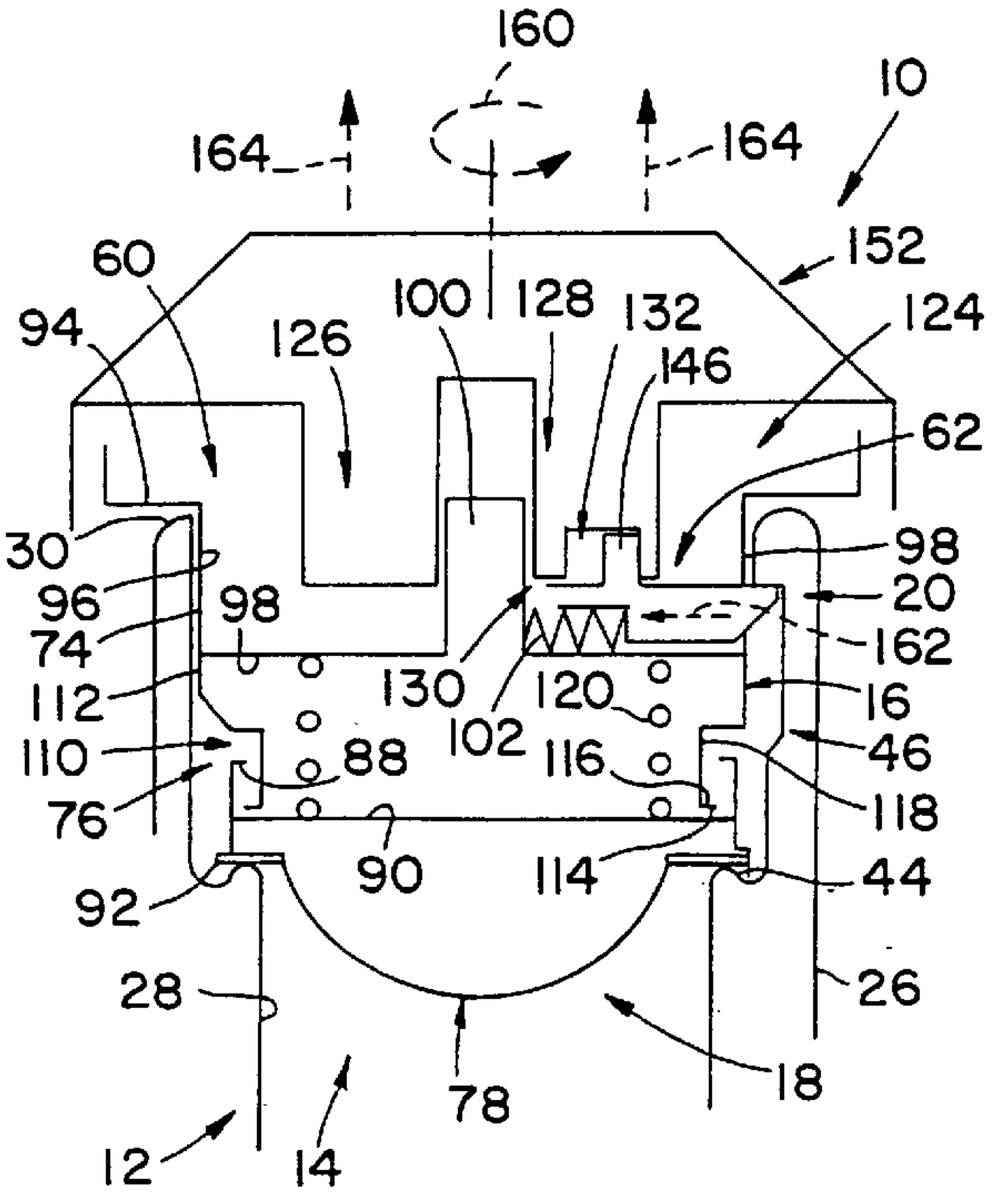



FIG. 4

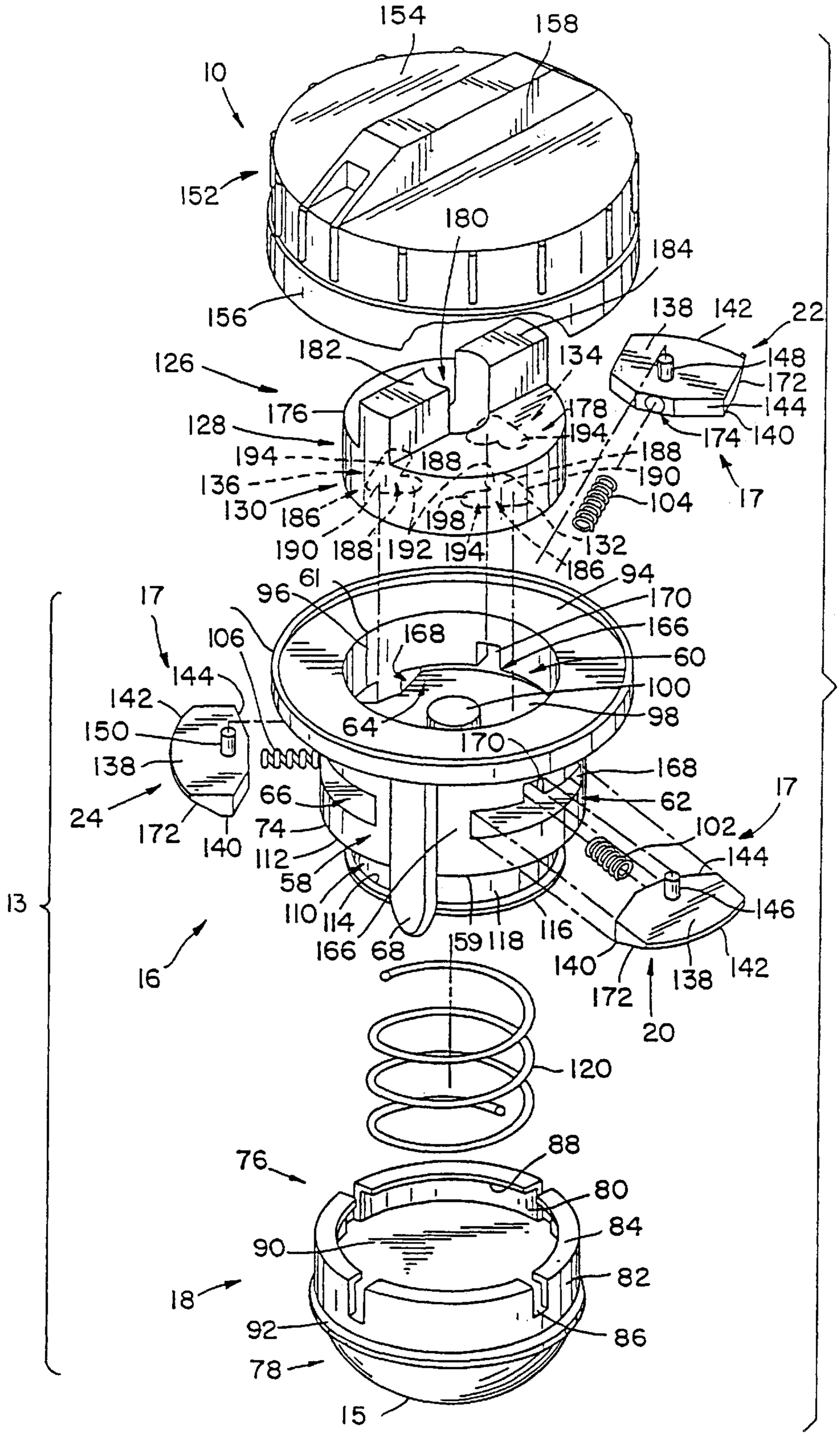



FIG. 5
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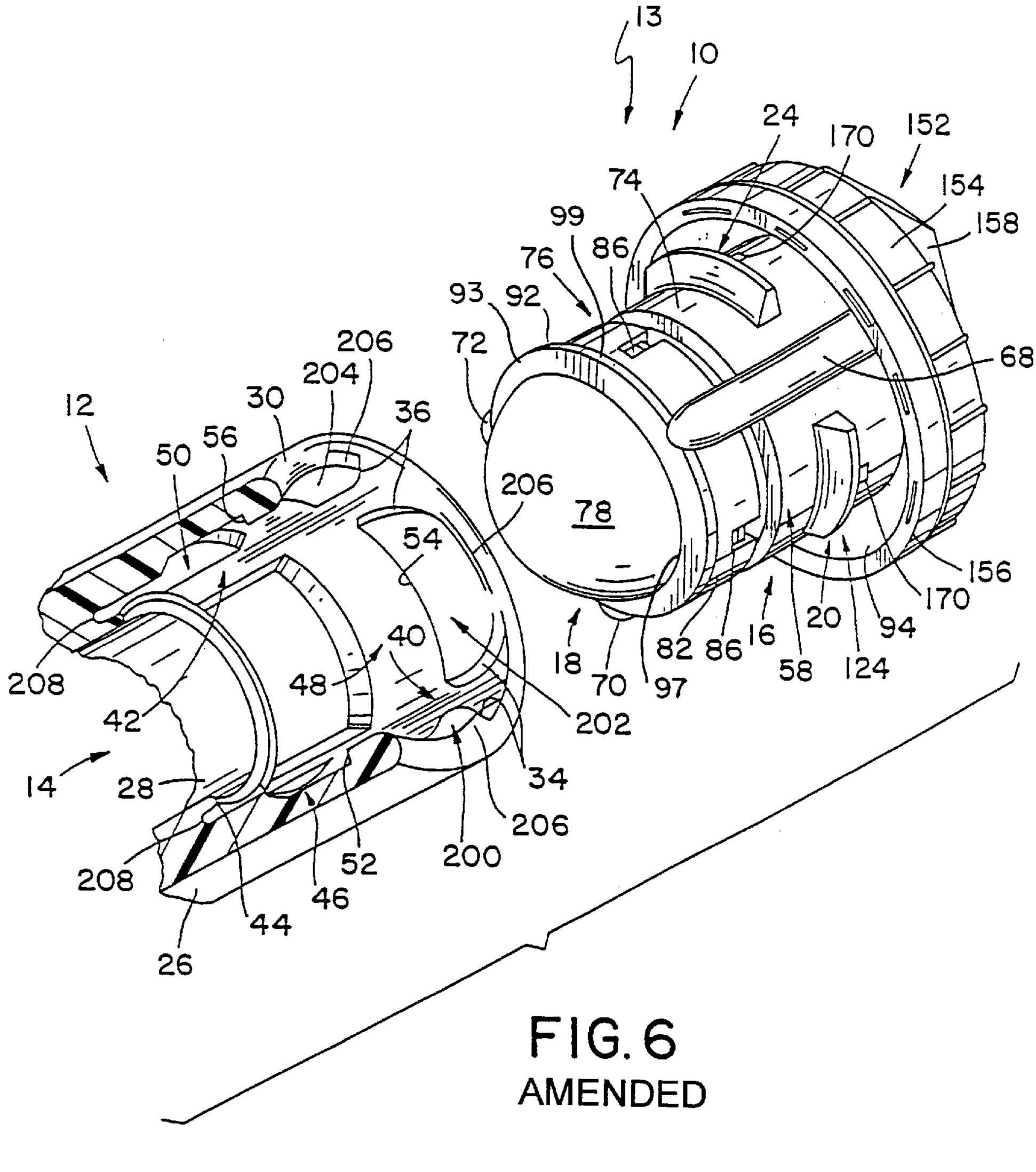


FIG. 6
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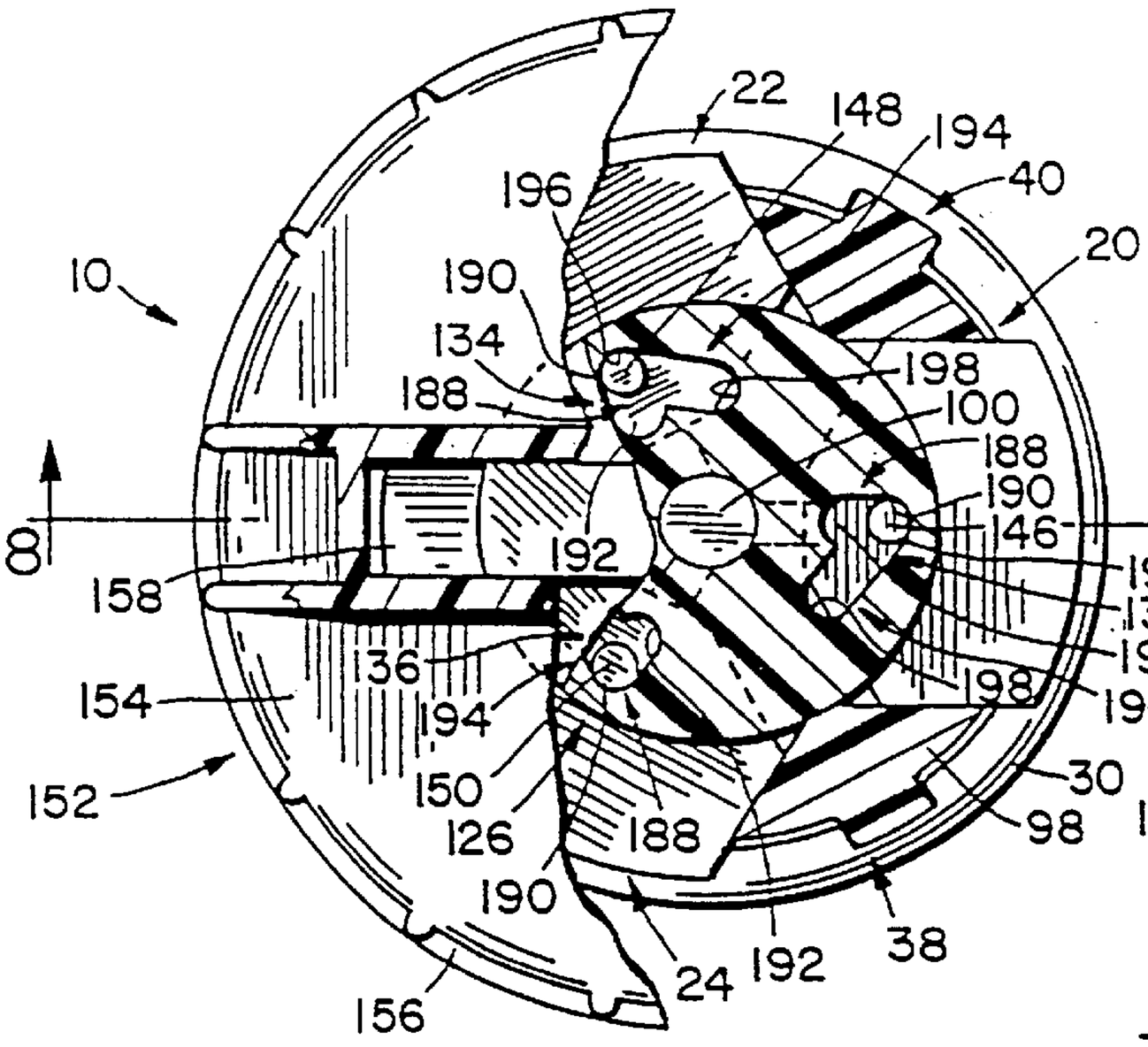


FIG. 7

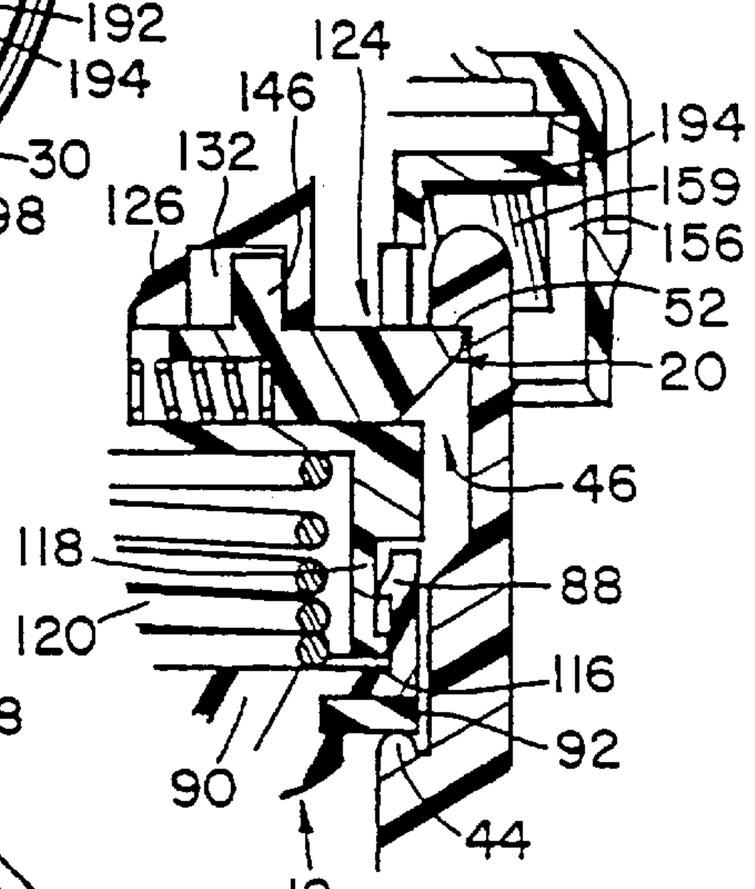


FIG. 9

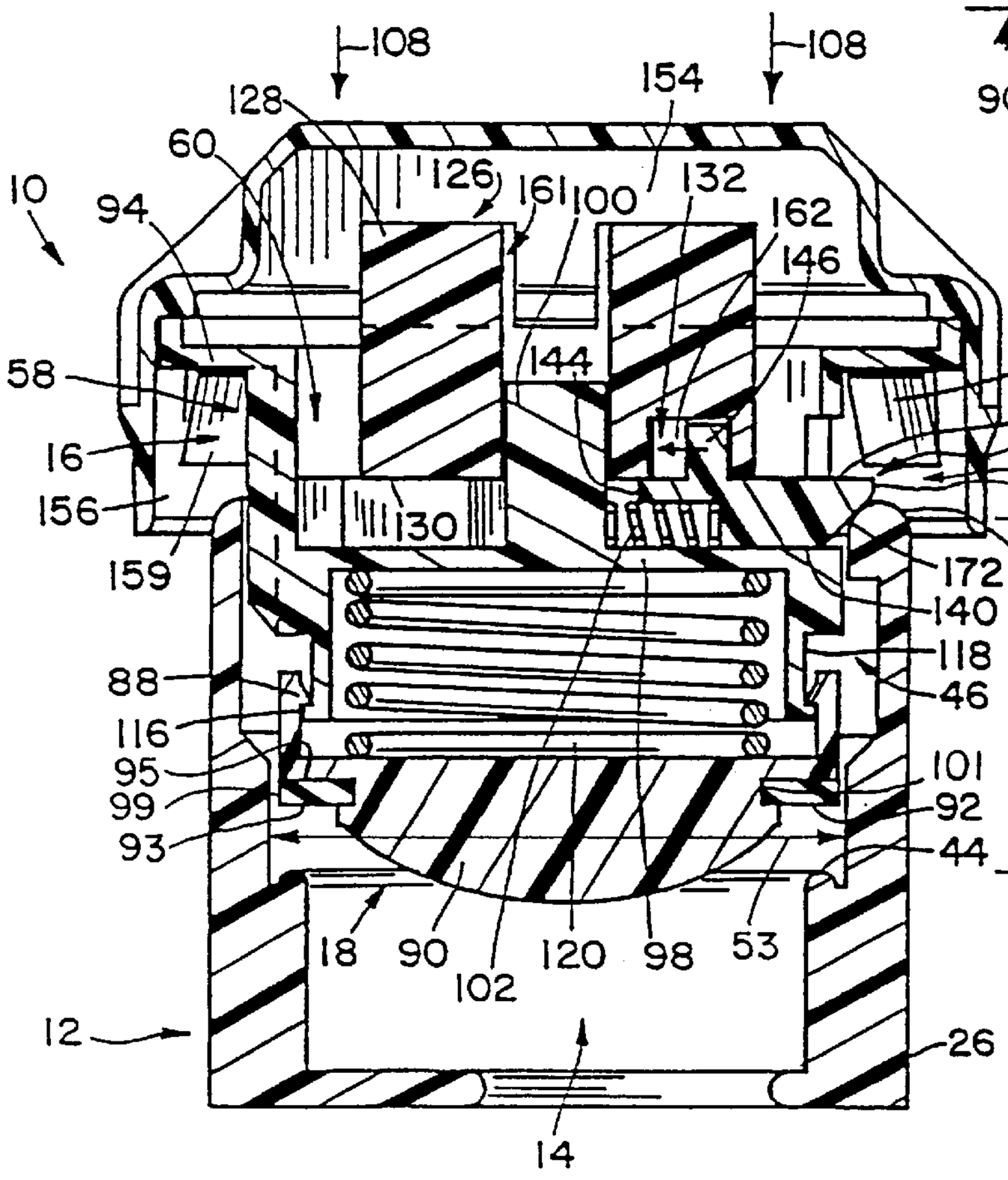


FIG. 8
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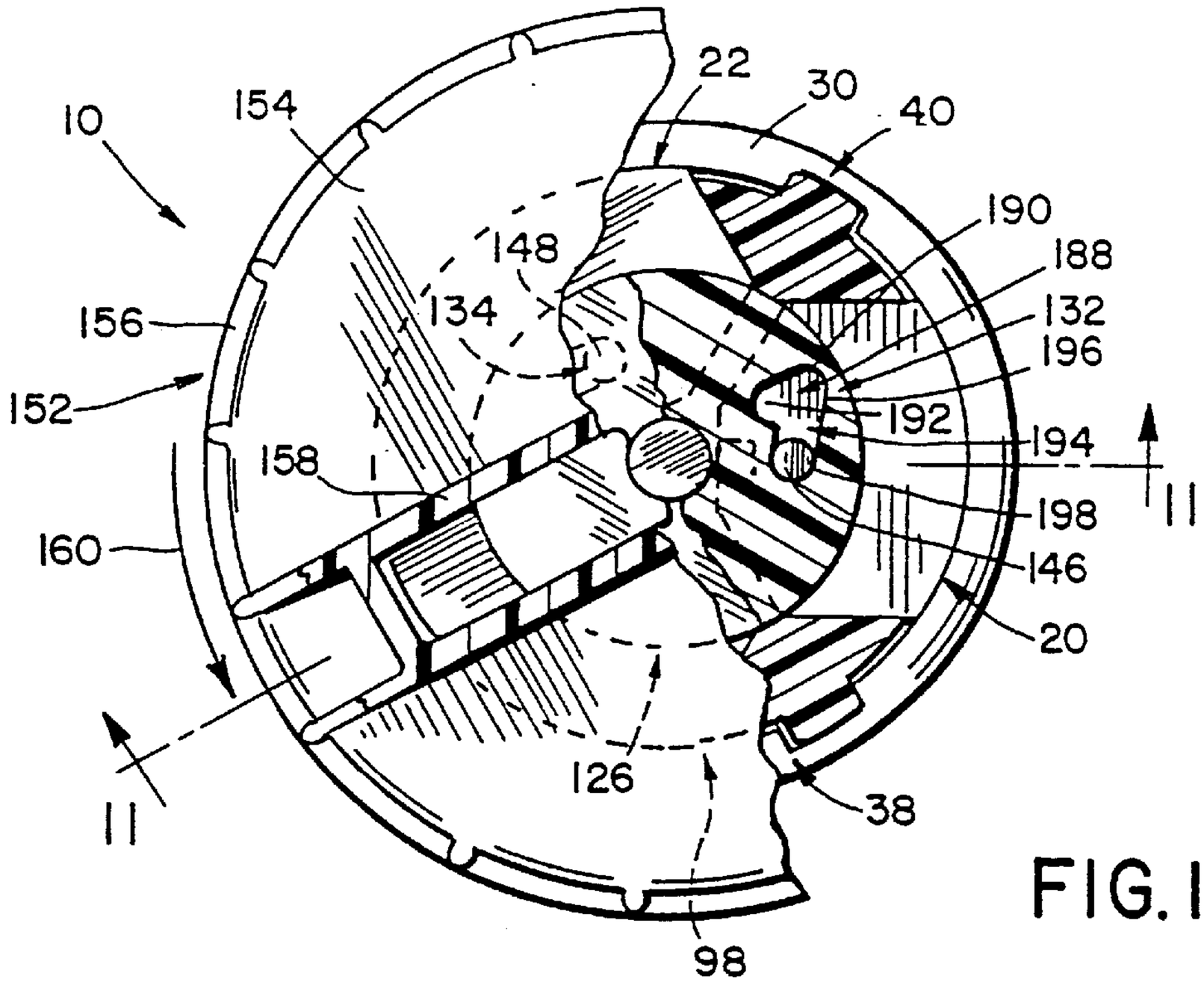
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FIG. 10

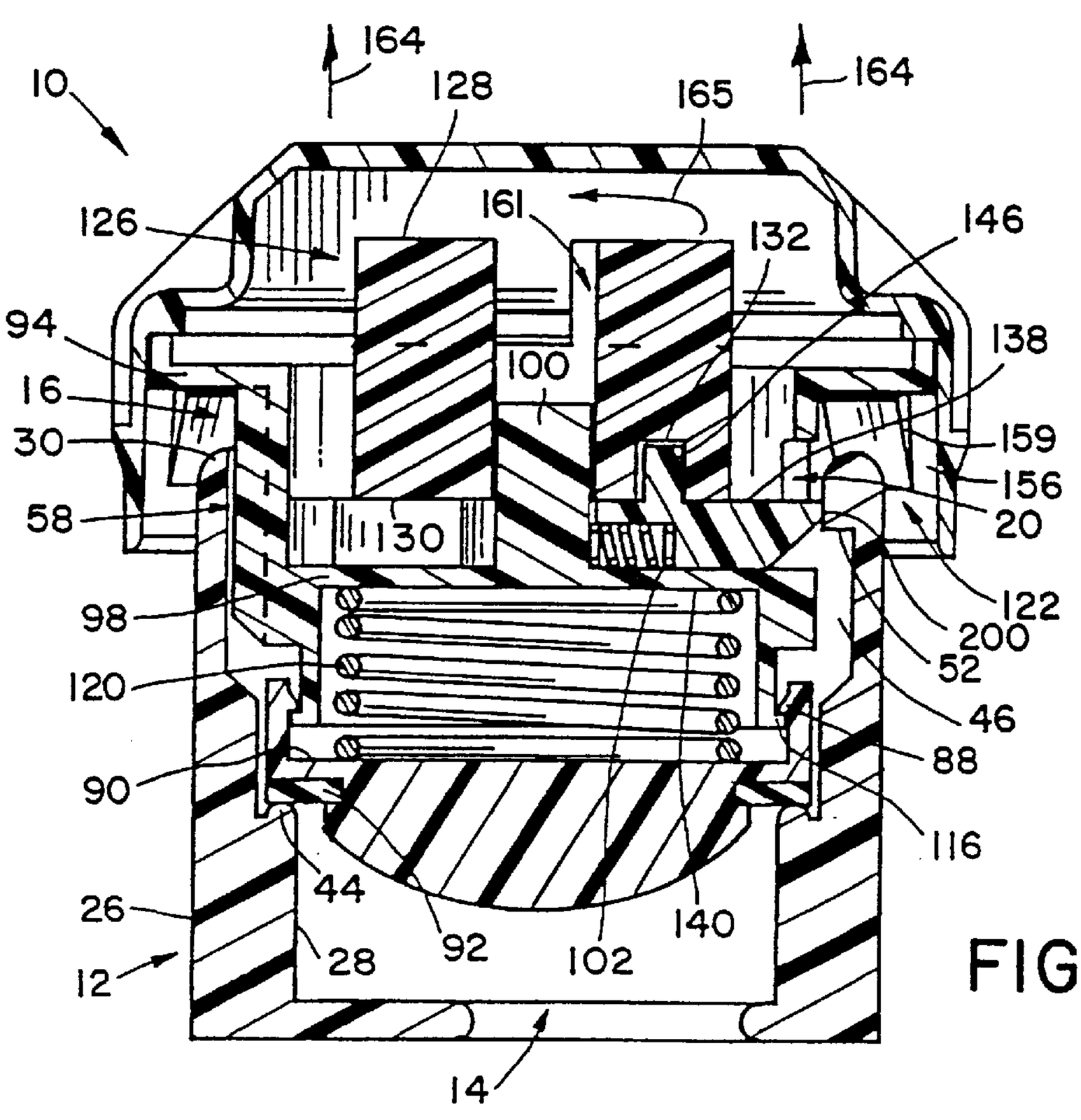
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FIG. 11

# PUSH-ON FUEL CAP

**Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.**

## BACKGROUND AND SUMMARY OF THE INVENTION

This present invention relates to fuel caps, and particularly, to a push-on filler neck cap. More particularly, the present invention relates to a filler neck cap which includes a gripping mechanism which enables a user to push the cap into the filler neck quickly and easily to establish a liquid fuel and vapor seal therein.

Conventional partial-turn cam-on caps and multiple-turn threaded caps are well-known types of caps for use in closing filler necks. See, for example, U.S. Pat. Nos. 4,877,733 to Harris and 3,820,680 to Friend. Although fuel caps are currently in widespread use, it would be desirable to provide an alternative cap that is simpler to install on and remove from a filler neck.

More and more gasoline stations are being equipped with self-service bays and are requiring that patrons fill their own fuel tanks. Some of those drivers have found that it is difficult to install a conventional partial-turn or multiple-turn filler neck cap during refueling. A cap that is readily installed onto and removed from a filler neck by a user without a lot of effort and that is configured to establish a sturdy sealed connection between the cap and the filler neck consistently during use would be a welcomed improvement over conventional caps. What is needed is a push-on filler neck cap that can be installed easily in the fill passageway of a filler neck.

According to the present invention, a push-on cap is provided for engaging a filler neck. The cap includes means for closing the mouth of the filler neck. This closing means includes a housing and an end member which is coupled to the housing while being axially movable relative to the housing. The cap further includes means for gripping the filler neck in response to the sliding axially inward movement of the housing into the filler neck. The gripping means is mounted in the housing for movement between a filler neck-engaging position and a filler neck-disengaging position.

In preferred embodiments of the present invention, a push-on cap is provided which slides into a filler neck to establish a liquid fuel and vapor seal therein. The cap *includes a closure for closing the filler neck and* is retained in the filler neck by *a closure retainer apparatus that is illustratively* at least one latch **[**which**]** *that* extends out from the housing and into a gripping portion of the filler neck. The latch is spring-loaded and moves into **[**the**]** *a* housing against the spring as the cap is first pushed into the filler neck and then snaps out from the housing under the urging of the spring after the cap is pushed far enough into the filler neck to cause a liquid fuel and vapor seal to be established between the cap and the filler neck. Illustratively, the cap includes three spring-loaded latches that are movable in radially outward and inward directions relative to the axis of rotation of the cap and arranged in spaced-apart relation around the circumference of the cap.

The housing itself has a body that is cylindrical in shape. This cylindrical body includes a disc-shaped support platform formed therein *that carries the closure retainer apparatus*, a rod extending in an upward direction from the support platform, and a hollow cylindrical mounting body extending in a downward direction from the opposite side of the support platform. Furthermore, *the closure retainer apparatus comprises at least one latch and* a slot is formed in the cylindrical body above the support platform for each latch. Each latch rests upon the support platform and protrudes through one of the slots.



When the user initially pushes the cap into the filler neck, a spring, which extends between each latch and the rod, yields to permit the latch to slide radially inwardly through the slot aperture into the housing. Once each latch has been retracted into the housing, the cap easily slides down into the filler neck until its sealing ring contacts a seal seat in the filler neck. At this point, the mounting body slides into the end member positioning the slot aperture adjacent to the gripping portion in the filler neck. The springs then snap the latches out through the apertures and into the gripping portion formed in the filler neck to lock the cap in the filler neck at three points and to secure a liquid fuel and vapor seal between the end member of the cap and the filler neck.

Ideally, the cap includes an internal mechanism that provides means for moving the latches simultaneously away from the gripping portion of the filler neck so that the cap will be disengaged from the filler neck where it can be withdrawn easily. The moving means is a donut-shaped core which is positioned in the housing above the latches so that the rod extends through a central aperture formed in the donut-shaped core. The core rotates independently from the housing in response to rotation of a handle cover relative to the filler **[**necks**]** *neck* thereby camming the latches through the apertures so that the latches are moved in unison to their retracted cap-releasing positions inside the housing.

The core includes a cam for engaging and moving each latch during rotation of the core. Moreover, each latch includes a cam follower that is positioned to engage a cam so that the cam moves the cam followers through a predetermined arc of rotation as the core is rotated during removal of the cap from the filler neck. This camming action causes the latches to slide through the apertures and into the housing in a direction away from the gripping portion formed in the filler neck. The core is also coupled to a handle cover connected to the core so that the user must only turn the handle cover one-eighth of a rotation in a counterclockwise or cap-removal direction to both release the liquid fuel and vapor seal and to unfasten the cap from the filler neck.

A user of a push-on fuel cap in accordance with the present invention will find that the internal gripping mechanism which is positioned in the housing and which secures a liquid fuel and vapor seal in the filler neck makes the cap easier to use than traditional fuel caps. Furthermore, the partial turn-to-remove feature of the cap which functions to pull the internal gripping mechanism away from the filler neck also provides advantages over traditional fuel caps by allowing the user to slide the cap out of the filler neck easily rather than requiring the user to turn the entire cap in the filler neck one or more revolutions.

Additional objects, features, and advantages of the invention will become apparent to those skilled in the art upon consideration of the following detailed description of preferred embodiments exemplifying the best mode of carrying out the invention as presently perceived.

## BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description particularly refers to the accompanying figures in which:

FIG. **1** is a perspective view of a push-on fuel cap according to the present invention showing the configuration of the cap as it is being inserted into a filler neck and showing the cap having a handle shell, a closure member and housing under the handle shell, and a rib extending downwardly from the handle shell along the closure member into a rib channel formed in the filler neck;

FIG. **2** is a diagrammatic view of the cap of FIG. **1** after it has been inserted into the mouth of the filler neck and showing a spring-loaded latch that has been moved to its filler neck-disengaging position by a filler neck wall and showing an uncompressed sealing ring positioned on a bottom portion of the end closure member of the cap;

FIG. **3** is a view similar to FIG. **1** of the cap as it would appear in the filler neck after installation of the cap and movement of the spring-loaded latch to its filler neck-engaging position and showing (in dotted lines) the direction of rotational movement of the handle shell relative to the closure member and housing which will cause radially inward movement of each latch into the closure member to disengage the cap from the filler neck;

FIG. **4** is diagrammatic view of the cap of FIG. **3** in place in the filler neck showing how one of the latches engages the filler neck, how the housing slides into the closure member, how the compression spring presses the sealing ring against the seal seat formed in the filler neck, and how independent counterclockwise rotational movement of the handle relative to the housing (in the direction shown by the curved dotted line arrow) causes the radially inward movement (in direction of straight horizontal dotted line arrow) of the latch away from the filler neck allowing for movement of the cap in an axially outward cap-disengagement direction;

FIG. **5** is an exploded, perspective view of a preferred embodiment of the push-on cap of FIG. **1** showing a handle cover, a core having a central aperture and V-shaped cams formed therein, a cylindrical housing having a support platform, three circumferentially spaced-apart latches having cam followers engaging the V-shaped cams formed in the core, springs for yieldably biasing the latches in radially outwardly extending directions, a cup-shaped end closure member, and a compression spring extending between the end closure member and the support platform;

FIG. **6** is a perspective view of the push-on cap of FIG. **5** as it is about to be inserted into a filler neck provided with rib channels, internal flanges, and gripping portions;

FIG. **7** is a top sectional view of the cap of FIG. **1** as it is about to be inserted into the filler neck and showing the three latches in their filler neck-engaging position extending across the mouth of the filler neck, a core having V-shaped cams with a short branch and a long branch, and cam followers positioned in first ends of the short branches of the V-shaped cams;

FIG. **8** is a section taken along lines **8—8** of FIG. **7** showing the cap as it is being pushed into the filler neck but before the cap is seated in its sealed and closed position in the filler neck;

FIG. **9** is a section through the cap of FIG. **8** after the cap has been pushed into the filler neck of FIG. **8** far enough to reach its filler-neck closing position and showing the loaded compression spring pressing the sealing ring against the seal seat and the latch against a gripping flange so that a liquid fuel and vapor seal is established and maintained in the filler neck;

FIG. **10** is a view similar to FIG. **7** of the cap of FIG. **9** after it has been turned to retract the spring-loaded latches into the housing to release the cap from the filler neck but before the cap has been removed from the filler neck and showing the cam followers positioned in a second end of the long branch of the V-shaped cams; and

FIG. **11** is a section taken along lines **11—11** of FIG. **10**.



## DETAILED DESCRIPTION OF THE DRAWINGS

A push-on cap **10** in accordance with the present invention is shown in FIG. **1** as it would appear to a user as the cap **10** is being inserted into a filler neck **12** to close a fill passageway **14** formed in filler neck **12**. Cap **10** includes a *closure 13 having an axially inner end 15 and an axially outer end 19. The closure 13 is formed for closing the filler neck 12. Closure 13 includes a* housing **16**, an end closure member **18** movably coupled to the housing **16**, and *a closure retainer apparatus 17 that is configured to engage the filler neck 12 when the cap 10 is installed in the filler neck 12 to block removal of the closure 13 from the filler neck 12. As shown in FIG. 5, the closure retainer apparatus 17 comprises* a latch **20** positioned in the housing **16** for movement into and out of engagement with the filler neck **12**. The housing **16** also includes a cylindrical wall **58** *having an axially inner end 59, an axially outer end 61,* and ribs **68**, **70** extending along the length of an outer portion **74** of the cylindrical wall **58** *between the axially inner and outer ends 59, 61.*

Ideally, a handle cover **152** is mounted on the *axially outer end 61 of the* housing **16** and three ribs and three latches (not shown in FIG. **1**—see, for example, FIG. **5**) are circumferentially spaced-apart about the cylindrical wall **58**. The filler neck **12** is configured to receive the cap **10** and includes a mouth **30** and a set of internal flanges **32** extending downward from the mouth **30** to define a rib channel **38**. This filler neck **12** is formed to include three sets of internal flanges and three rib channels (not shown in FIG. **1**—see, for example, FIG. **6**) to cooperate with the three ribs.

As the cap **10** is being inserted into the filler neck **12**, see FIG. **1**, the rib **68** extends into the rib channel **38** so that the rib **68** engages the set of internal flanges **32** to block rotation of the housing **16** relative to the filler neck **12**. Ideally, the *anti-rotation* ribs **68**, **70** extend over the end closure member **18** to inhibit rotation of the end closure member **18** relative to the filler neck **12** during insertion of the cap **10** into the filler neck **12**.

As shown diagrammatically in FIG. **2**, the cylindrical wall **58** defines a cavity **60** which extends into the housing **16**. Additionally, an aperture **62** extends through the cylindrical wall **58** so that the latch **20**, which is positioned in the cavity **60**, projects out from the housing **16** and presses against the filler neck **12**. The filler neck **12** has an outside wall **26**, an inside wall **28** defining the fill passageway **14**, and a seal seat **44** which is disposed axially inwardly from said mouth **30** internally in said filler neck **12**. Sliding axially inward movement **108** of the housing **16** during installation of the cap **10** into the fill passageway **14** forces the latch **20** to yieldably move in a radially inward direction relative to the filler neck **12** through the aperture **62** and into the cavity **60**. Once the latch **20** is positioned inside the housing **16** it is said to be in a filler neck-disengaging position **122**.

The cap **10** as it would appear following installation of the cap **10** in the filler neck **12** is shown in FIG. **3**. The latch **[16]** *20* protrudes through the aperture **62** to a filler neck-engaging position **124**. As shown diagrammatically in FIG. **4**, the latch **20**, in the filler neck-engaging position **124**, extends into a gripping portion **46** formed in the inside wall **28** of the filler neck **12** to secure the housing **16** in the fill passageway **14**. The extension of the latch **20** into the

gripping portion **46** forces the housing **16** to extend into the end closure member **18** and end closure member **18** to press against the seal seat **44**, thus maintaining a liquid fuel and vapor seal between the cap **10** and the seal seat **44**.

Furthermore, as illustrated by dotted lines in FIGS. **3** and **4**, independent rotational movement **160** of a handle cover **152** *about an axis of rotation* relative to the housing **16** causes the radially inward movement **162** of the latch **20** through the aperture **62** and into the cavity **60**. This radially inward movement **162** of the latch **20** to the filler neck-disengaging position **122** causes simultaneous axially outward movement **164** of the housing **16** relative to the filler neck **12**, as shown in FIG. **4**. Thus, the liquid fuel and vapor seal is released and the cap **10** may easily be withdrawn from the mouth **30** of the filler neck **12**.

The end closure member **18** of the cap **10** includes a top side **76** facing the housing **16**, a bottom side **78**, an internal wall **80**, and an external wall **82** as shown in FIG. **5**. The top side **76 [**is**]** includes a cup-shaped mouth **84** which is formed to extend over the housing **16**. The cup-shaped mouth **84** has notches **86** which permit expansion of the diameter of the cup-shaped mouth **84** so that the housing **16** may easily be inserted into the end closure member **18** during assembly. Furthermore, an engagement lip **88** is formed around the circumference of the cup-shaped mouth **84** for mounting the end closure member **18** onto the housing **16**. The end closure member **18** further includes a middle support platform **90** which is positioned in an axially inward direction relative to the cup-shaped mouth **84** and extends across the internal wall **80** of the end closure member **18**. A sealing ring **92** is mounted on the external wall **82** of the end closure member **18**. *The sealing ring 92 is annular in shape and includes a first surface 93 engaging the filler neck 12 and an opposite second surface 95 engaging the closure 13 so that the sealing ring 92 is compressed between the closure 13 and the filler neck 12 to sealingly engage the filler neck 12 and closure 13 to form the seal therebetween. As best shown in FIGS. 6 and 8, the sealing ring 92 includes an inner rim 97 engaging the closure 13 and an opposite outer rim 99. The end closure member 18 includes a slot 101 (FIG. 8) therein that receives the inner rim 97 of the sealing ring 92 therein.* It is contemplated that the sealing ring **92** may be mounted onto the end closure member **18** *of the closure 13* at various positions at or between the top side **76** and the bottom side **78** by pin, screw, adhesive, or comparable mounting means.

As further illustrated in FIG. **5**, the end closure member **18** *of the closure 13* is formed to be movably coupled to the housing **16**. This housing **16** includes an upper lip **94**, an inner portion **96**, and a support platform **98** which is mounted to the inner portion **96** axially inward from the upper lip **94** and which is extended in a radial direction across the cavity **60**. Three apertures **62**, **64**, **66** are formed in the cylindrical wall **58** axially outward from the support platform **98**. The support platform **98** is formed to support three latches **20**, **22**, **24** thereon and the apertures **62**, **64**, **66** are sized for extension of the latches **20**, **22**, **24** therethrough. A rod **100** is also mounted on the support platform **98** and extends in an axially outward direction therefrom. The rod **100** serves as an anchor for the springs **102**, **104**, **106** which extend from the latches **20**, **22**, **24** respectively. It is appreciated that the latches **20**, **22**, **24** may take a number of forms in extending from the housing **16** to grip the filler neck **12**.

Additionally, the housing **16** *of the closure 13* includes a hollow cylindrical mounting body **110** which extends in the axially inward direction from the support platform **98** to mount the end closure member **18** thereon. This mounting body **110** includes a first end **112** positioned at the support platform **98**, a second end **114** having a flange **116**, and a middle portion **118** extending therebetween. The second end **114** is formed to extend into the end closure member **18** so that the flange **116** may engage the lip **88** and so that the middle portion **118** will slide into and out of the end closure member **18**. Ideally, when the cap **10** is assembled, a compression spring **120** extends through the hollow mounting body **110** between the support platform **98** in the housing **16** and the middle support platform **90** in the end closure member **18** to press the flange **116** against the engagement lip **88**.

In a preferred embodiment illustrated in FIG. **5**, the cap **10** includes a core **126** which enables a user to pull the latches **20**, **22**, **24** into the cavity **60** so that the cap **10** can be withdrawn from the filler neck **12**. This core **126** has an exterior end **128** and an interior end **130** formed to cooperate with the latches **20**, **22**, **24**, and three cams **132**, **134**, **136** formed in the interior end **130**. The latches **20**, **22**, **24** include an outward side **138** formed to engage the interior end **130** of the core **126**, an inward side **140** *carried by and* formed to engage the support platform **98**, an outside portion **142** facing the filler neck **12**, and an inside portion **144** facing the rod **100**. Three cam followers **146**, **148**, **150** are attached to the outward side **138** of the latches **20**, **22**, **24** respectively and extend into the cams **132**, **134**, **136** to couple the core **126** with the latches **20**, **22**, **24**. It is appreciated that the core **126** may take a number of forms and positions relative to the latches **20**, **22**, **24** within the housing **16** to cooperate with the latches **20**, **22**, **24**.

The three apertures **62**, **64**, **66** are preferably arranged in spaced-apart relation about the circumference of the cylindrical wall **58** and are formed in an inverted T-shape **166** as shown in FIG. **5**. The inverted T-shape **166** allows each of the cam followers **146**, **148**, **150** to be inserted therethrough during assembly of the cap **10**. Each of the inverted T-shapes **166** includes a leg **168** positioned adjacent to the support platform **98**. This leg **168** is sized for insertion of each of the latches **20**, **22**, **24** therethrough. The inverted T-shape **166** also includes another leg **170** bisecting the leg **168** to form approximately a 90° angle relative thereto. The leg **170** is sized for insertion of each of the cam followers **146**, **148**, **150** therethrough. It is appreciated that the apertures **62**, **64**, **66** may take on various shapes to cooperate with the shapes of the latches **20**, **22**, **24** which are coupled to the cam followers **146**, **148**, **150**.

The latches **20**, **22**, **24** which are sized for insertion through each of the apertures **62**, **64**, **66** formed in the housing **16** are further formed to cooperate with the filler neck **12** to aid in the insertion of the housing **16** into the filler neck **12**. Each of the latches **20**, **22**, **24** include a tapered *ramp* portion **172** positioned on the outside portion **142** of the inward side **140**. This tapered *ramp* portion **172** engages the mouth **30** during insertion of the cap **10** into the filler neck **12** and guides the latches **20**, **22**, **24** in a radially inward direction relative to the filler neck **12**.

Furthermore, the latches **20**, **22**, **24** which rest upon the support platform **98** are formed to be securely attached in the housing **16** by the springs **102**, **104**, **106**. Each of the latches **20**, **22**, **24** include a spring aperture **174** formed in the inside portion **[142]** *144* into which the springs **102**, **104**, **106** extend respectively. The springs **102**, **104**, **106** are mounted in the apertures **174** so that the springs **102**, **104**, **106** extend between the latches **20**, **22**, **24** and the rod **100**. These springs **102**, **104**, **106** both yieldably permit radially inward movement **162** of the latches **20**, **22**, **24** and snap the latches **20**, **22**, **24** in a radially outward direction.

The core **126** is also securely mounted in the housing **16**. The core **126** includes an edge **176**, a middle portion **178**,

and a central aperture **180** extending through the middle portion **178**. The core **126** is positioned in the housing **16** so that the rod **100** extends through the central aperture **180** and so that the core **126** rests above the latches **20, 22, 24**. The core **126** further includes hubs **182, 184** positioned on the exterior end **128** at approximately a 180° angle relative to one another. The hubs **182, 184** are separated from one another by the central aperture **180** and extend upwardly adjacent the rod **100** into the handle cover **152** to couple the core **126** to the handle cover **152**.

The handle cover **152** includes a base **154** which is formed to engage the core **126** and a mount **156** which is formed to engage the upper lip **94** of the housing **16** as shown in FIG. **5**. Ideally, the base **154** includes a grasping portion **158** for enabling a user to more easily manipulate the cap **10**. As the user rotates the handle cover **152**, the base **154** engages the core **126** causing rotation of the core **126** on the rod **100** in the housing **16**. It is appreciated that the core **126** may be coupled to the handle cover **152** by pin, screw, adhesive or comparable coupling means.

The filler neck **12** is configured to receive the cap **10** as shown in FIG. **6**. The filler neck **12** has three guiding portions **200, 202, 204** arranged in spaced-apart relation about the circumference of the mouth **30**. The guiding portions **200, 202, 204** include a first end **206** positioned at the mouth **30** of the filler neck **12** and a second end **208** positioned at the seal seat **44**. Furthermore, three gripping portions **46, 48, 50** are arranged in spaced-apart relation about the circumference of the inside wall **28** between the first end **206** and the second end **208** of each of the guiding portions **200, 202, 204**.

The intersection of the guiding portions **200, 202, 204** and the gripping portions **46, 48, 50** forms three gripping flanges **52, 54, 56** within the filler neck **12**. *Illustratively, the axial distance between the mouth 30 and the annular seal seat 44 is a distance X, as shown by line 51. See FIG. 8. The radial diameter of the inside wall 28 axially outwardly from the annular seal seat 44 is a distance Y. Y is about 1.16X and illustrated by line 53. Moreover, as shown in FIG. 11, the axial distance between the closure retainer apparatus 17 that engages the gripping flanges 52, 54, 56 and the first surface 93 of the sealing ring 92 is a distance Z. Z is about 1.94X and illustrated by line 55.* Furthermore, three rib channels **38, 40, 42** extend in an axially inward direction between the spaced-apart guiding portions **200, 202, 204**. These channels **38, 40, 42** are configured for insertion of ribs **68, 70, 72** respectively therein. The intersection of the rib channels **38, 40, 42** and the guiding portions **200, 202, 204** forms three sets of internal flanges **32, 34, 36** therebetween. The internal flanges **32, 34, 36** permit the axial insertion of the ribs **68, 70, 72** into the fill-passageway **14** and prevent the rotation of the housing **16** in the filler neck **12**. It will be appreciated that such rib channels **38, 40, 42** may take a number of forms to cooperate with ribs **68, 70, 72**.

The three cams **132, 134, 136** which are formed in the core **126** are V-shaped **186** in order to allow for the radially inward movement **162** of the cam followers **146, 148, 150** during the axially inward movement **108** of the housing **16** in the mouth **30** of the filler neck **12**, see FIG. **7**. Each of the cams **132, 134, 136** include a short branch **188** having a first end **190** and second end **192** and a long branch **194** having a first end **196** and a second end **198**. The first end **190** of the short branch is positioned at the edge **176** of the core **126** and the second, end **192** is positioned in the middle portion **178** at approximately a 90° angle relative to the edge **176**. The first end **196** of the long branch **194** is positioned at the first end **190** of the short branch **188** at the edge **176** of the core **126**. The second end **198** of the long branch **194** is positioned in the middle portion **178** at approximately a 45° angle relative to the short branch **188**. Before insertion of the cap **10** into the mouth **30** of the filler neck **12**, the cam followers **146, 148, 150** are positioned in the first end **190** of the short branch **188**.

When the housing **16** is pushed into the mouth **30** of the filler neck **12**, as shown in FIG. **8**, the tapered portion **172** of the latch **20** engages the mouth **30** of the filler neck **12** pushing the latch **20** in a radially inward direction. This pressure causes radially inward movement **162** of the cam follower **146** through the short branch **188** of the cam **132** from the first end **190** toward the second end **192** and the radially inward movement **162** of the latch **20** through the aperture **62** and into the housing **16**.

Furthermore, the axially inward movement **108** of the housing **16** into the filler neck **12** following the engagement of the sealing ring **92** with the seal seat **44** forces the middle portion **118** to extend into the end closure member **18** *and the first surface 93 of the sealing ring 92 to establish a seal between the end closure member 18 and the seal seat 44,* see FIG. **9**. This extension *also* permits the spring **102** to snap the cam follower **146** through the short branch **188** from the second end **192** toward the first end **190** which causes movement of the latch **20** into the gripping portion **46**. Furthermore, the extension of the middle portion **118** into the end closure member **18** disengages the flange **116** from the engagement lip **88** thus loading the compression spring **120**. The compression spring **120** exerts pressure against the support platform **98** in the housing **16** and against the middle support platform **90** in the end closure member **18** forcing the latch **20** to engage the gripping flange **52** and the sealing ring **92** to engage *a sealing surface on* the seal seat **44**. Thus, a liquid fuel and vapor seal is established and maintained between the seal seat **44** and the sealing ring **92**.

Ideally, the core **126** rotates in the housing **16** in response to the independent rotational movement **160** of the handle cover **152**, *about the axis of rotation* relative to the housing **16** *and filler neck 12*, as shown in FIG. **10**. This rotation **160** causes the cam follower **146** which is initially positioned at the first end **196** to move through the long branch **194** from the first end **196** until it is positioned at the second end **198**. This movement of the cam follower **146** generates the radially inward movement **162** of the latch **20** into the filler neck **12**.

To permit rotational movement of the handle cover *152*, the mount **156** of the handle cover **152** includes a sloped portion **159** for trapping the upper lip **94** between the base **154** and the mount **156**, as shown in FIG. **11**. The upper lip **94** rests upon the sloped portion **159** thus preventing disengagement of the handle cover **152** from the housing **16** while permitting rotation of the handle cover **152** thereon. The sloped portion **159** also aids in the insertion of the handle cover **152** onto the housing **16** during manufacturing. The base **154** of the handle cover **152** is further formed to include core slots **161**. The hubs **182, 184** of the core **126** extend into the core slots **161** and engage the base **154** during rotation of the handle cover **152** causing simultaneous rotation of the core **126** in the housing **16**.

Rotation of the core **126** causes the cams **132, 134, 136** contact the cam followers **146, 148, 150** through a predetermined arc of rotation of the core **126** thus producing the radially inward movement **162** of the latches **20, 22, 24** relative to the filler neck **12**. This radially inward movement **162** causes the placement of the latches **20, 22, 24** in the filler neck-disengaging position **122**. Upon reaching the

filler neck-disengaging position **122**, the loaded compression spring **120** compels the axially outward movement **164** of the housing **16** from the filler neck **12**, as shown in FIG. **11**. This axially outward movement **164** is accomplished by forcing the middle portion **[86]** *118* of the mounting body **110** out from the end closure member **18** until the engagement lip **88** engages the flange **116**. Following the axially outward movement **164**, the latch **20** lies axially outward from the gripping portion **46** and is in its filler neck-disengaging position **122**, thus allowing for easy withdrawal of the cap **10** from the filler neck **12**.

The spring **102**, however, continues to urge the cam follower **146** in a radially outward direction so that the latch **20** continues to engage the inside wall **28** of the filler neck **12**. This urging results in rotational realignment **165** of the handle cover **152** relative to the housing **16**. Rotational realignment **165** continues following withdrawal of the cap **10** from the mouth **30** of the filler neck **12** until the cam followers **146**, **148**, **150** have moved through the long branch **194** toward the first end **190** of the short branch **188** and until the latch **20** is repositioned in the filler neck-engaging position **124**. Thus, the cap **10** is ready to be installed in the filler neck **12** at the end of the refueling process.

To install the cap **10** in the filler neck **12**, a user first grasps the handle cover **152** of the cap **10** in its filler neck-engaging position **124**. The *anti-rotation* ribs **68**, **70**, **72** are then aligned with the rib channels **38**, **40**, **42** formed along the inside wall **28** of the filler neck **12**. Once aligned, the user simply pushes the cap **10** in an axially inward cap-installation direction until the user feels the latches **20**, **22**, **24** snap into the gripping portions **46**, **48**, **50** of the filler neck **12**. The snapping of the latches **20**, **22**, **24** creates a clicking sound which also serves as a notice to the user that the cap **10** has been successfully installed and that a liquid fuel and vapor seal has been established between the seal seat **44** and the sealing ring **92**.

To remove the cap **10** from the filler neck **12**, a user simply turns the handle cover **152** approximately one-eighth of a rotation and pulls the disengaged cap **10** from the mouth **30** of the filler neck **12**. The independent rotational movement **160** of the handle cover **152** *about the axis of rotation relative to the filler neck 12* causes the core **126** to rotate within the housing **16** thereby camming the latches **20**, **22**, **24** through the apertures **62**, **64**, **66** away from the gripping portions **46**, **48**, **50** of the filler neck **12**. The latches **20**, **22**, **24** are then pushed in the axially outward cap-disengagement direction by the compression spring **120**. The cap **10** is now in its filler neck-disengaging position **122** so that it can be withdrawn easily from the mouth of the filler neck **12**. Conveniently, the withdrawn cap **10** undergoes rotational realignment **165** until it resumes its filler neck-engaging position **124** and thus, with the cam followers **146**, **148**, **150** positioned in the first end **190** of the short branch **188**, the cap **10** is ready to be installed in the filler neck **12** at the end of the refueling process.

It is easy to install and remove a push-on fuel cap **10** in accordance with the present invention using very little effort. The user must simply push the cap **10** into the filler neck **12** to create a sturdy sealed connection between the cap **10** and the filler neck **12**. Once installed, the user must simply turn the handle **[110]** *cover 152* approximately one-eighth of a rotation and slide the cap **10** out from the filler neck **12**.

Although the invention has been described in detail with reference to certain preferred embodiments, variations and modifications exist within the scope and spirit of the invention as described and defined in the following claims.



We claim:

**1**. A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising

means for closing the mouth of the filler neck, the closing means including a housing and an end closure member coupled to the housing, the end closure member being axially movable relative to the housing and having a sealing ring configured to engage the seal seat upon slidable insertion of the housing into the filler neck in an axially inward cap-installation direction, **[**and**]**

means for gripping the filler neck in response to sliding axially inward movement of the housing in the filler neck, the gripping means being mounted in the housing for movement between a filler neck-engaging position and a filler neck-disengaging position**[**.**]**,

*a handle cover rotatably coupled to the housing, and*

*a core coupled to the gripping means and to the handle cover so that the core rotates in the housing in response to rotational movement of the handle relative to the filler neck to move the gripping means in a radially inward direction relative to the housing to the filler neck-disengaging position.*

**[2**. The cap of claim **1**, further comprising means for moving the gripping means to the filler neck-disengaging position.**]**

**3**. **[**The cap of claim **2**, wherein**]** *A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising*

*means for closing the mouth of the filler neck, the closing means including a housing and an end closure member coupled to the housing, the end closure member being axially movable relative to the housing and having a sealing ring configured to engage the seal seat upon slidable insertion of the housing into the filler neck in an axially inward cap-installation direction,*

*means for gripping the filler neck in response to sliding axially inward movement of the housing in the filler neck, the gripping means being mounted in the housing for movement between a filler neck-engaging position and a filler neck-disengaging position,*

*means for moving the gripping means to the filler neck-disengaging position,* the moving means **[**includes**]** *including* a core rotatably coupled in the housing, a cam follower appended to the gripping means, and a cam formed in the core, and the cam includes means for contacting the cam follower through a pre-determined arc of rotation of the core to move the gripping means in a radially inward direction relative to the filler neck permitting movement of the housing in an axially outward cap-disengagement direction.

**[4**. The cap of claim **2**, wherein the moving means includes a handle cover and means for coupling the handle cover to the gripping means so that the gripping means is moved in a radially inward direction relative to the housing in response to rotational movement of the handle cover relative to the filler neck.**]**

**5**. **[**The cap of claim **4**, wherein**]** *A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising*

*means for closing the mouth of the filler neck, the closing means including a housing and an end closure member coupled to the housing, the end closure member being axially movable relative to the housing and having a*

*sealing ring configured to engage the seal seat upon slidable insertion of the housing into the filler neck in an axially inward cap-installation direction,*

*means for gripping the filler neck in response to sliding axially inward movement of the housing in the filler neck, the gripping means being mounted in the housing for movement between a filler neck-engaging position and a filler neck-disengaging position, and*

*means for moving the gripping means to the filler neck-disengaging position, the moving means including a handle cover and means for coupling the handle cover to the gripping means so that the gripping means is slidably moved in the radial direction relative to the housing in response to rotational movement of the handle cover relative to the filer neck, and* the gripping means includes three spring-loaded latches positioned in spaced-apart relation about the circumference of the housing and the coupling means includes a core positioned in the housing and configured to rotatably actuate the latches in response to rotational movement of the handle cover relative to the filler neck.

**6**. The cap of claim **[4]***1*, wherein the handle cover includes a base and means for movably mounting the base on the housing so that the base rotates independently of the housing.

**7**. The cap of claim **6**, wherein the housing includes a cylindrical wall defining a cavity therein, an outer wall, an inner wall, a support platform **[**being**]** mounted to the inner wall and extending in a radial direction across the cavity, and a rod mounted to the support platform *and* extending in an axially outward direction, the latch includes an inside portion and an outside portion, and the **[**yielding**]** *allowing* means includes a spring extending through the cavity *and positioned to lie* between the inside portion of the latch and the rod.

**8**. The cap of claim **1**, wherein the gripping means includes a latch and means for yieldably allowing passage of the latch in **[**the**]** *a* radially inward direction in response to the sliding axially inward movement of the housing in the mouth of the filler neck.

**9**. The cap of claim **8**, wherein the **[**yielding**]** *allowing* means includes means for snapping the latch in a radially outward direction relative to the housing for engagement with the filler neck.

**10**. The cap of claim **1**, wherein the housing includes a cylindrical wall extending in the axially inward direction, the wall **[**being**]** *is* formed to include an aperture, and the gripping means extends through the aperture.

**11**. The cap of claim **10**, wherein the gripping means is a latch having an inside portion positioned in the housing, an outside portion extending from the aperture outside the housing, and means for aiding radially inward movement of the outside portion through the aperture in response to pushing the latch into the mouth of the filler neck.

**12**. The cap of claim **1**, wherein the housing is formed to include means for supporting the gripping means and a mounting body extending downward from the supporting means, the mounting body having means for yieldably engaging the end closure member.

**13**. The cap of claim **12**, wherein the end closure member includes a cup-shaped mouth having an engagement lip, the mounting body extends into the cup-shaped mouth and the engagement lip interacts with the engagement means.

**14**. **[**The cap of claim **1**, wherein**]** *A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising*

*means for closing the mouth of the filler neck, the closing means including a housing and an end closure member coupled to the housing, the end closure member being axially movable relative to the housing and having a sealing ring configured to engage the seal seat upon slidable insertion of the housing into the filler neck in an axially inward cap-installation direction,* (*and*)

*means for gripping the filler neck in response to sliding axially inward movement of the housing in the filler neck, the gripping means being mounted in the housing for sliding movement in a radial direction between a filler neck-engaging position and a filler neck-disengaging position, and* the filler neck includes an internal flange and the housing includes means for contacting the internal flange to permit axial movement of the housing into and out of the filler neck and to block rotation of the housing relative to the filler neck.

**15**. The cap of claim **14**, wherein the housing includes an outer wall and an inner wall, and the contacting means is a rib formed on the outer wall.

**16**. The cap of claim **15**, wherein the rib includes means for inhibiting rotation of the end closure member relative to the filler neck during axial movement of the housing into and out of the filler neck.

**17**. The cap of claim **1**, wherein the housing includes a cylindrical wall defining a cavity extending therein, an inner wall, an outer wall, a support platform **[**being**]** mounted to the inner wall and extending in a radial direction across the cavity, and a rod mounted to the support platform *and* extending in an axially outward direction and the gripping means includes a latch being seated on the support platform and a spring extending between the latch and the rod.

**18**. The cap of claim **17** further comprising a cam follower positioned on an outward side of the latch and **[**a**]** *the* core **[**being**]** *is* formed to include a central aperture, an interior end and an exterior end relative to the mouth of the filler neck, and a cam formed in the interior end, the rod extending through the central aperture, the interior end of the core engaging the outward side of the latch, and the cam follower extends for engagement with the cam.

**19**. The cap of claim **18**, wherein the core further includes a hub extending in an axially outward direction from the **[**external**]** *exterior* end.

**20**. **[**The cap of claim **19**, further comprising**]** *A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising*

*means for closing the mouth of the filler neck, the closing means including a housing and an end closure member coupled to the housing, the end closure member being axially movable relative to the housing and having a sealing ring configured to engage the seal seat upon slidable insertion of the housing into the filler neck in an axially inward cap-installation direction, the housing including a cylindrical wall defining a cavity extending therein, an inner wall, an outer wall, a support platform mounted to the inner wall and extending in a radial direction across the cavity, and a rod mounted to the support platform and extending in an axial outward direction,*

*means for gripping the filler neck in response to sliding axially inward movement of the housing in the filler neck, the gripping means being mounted in the housing for sliding movement in a radial direction between a filler neck-engaging position and a filler neck-disengaging position, and including a latch being seated on the support platform and a spring extending between the latch and the rod,*

*a cam follower positioned on an outward side of the latch nad a core formed to include a central aperture, an interior end and an exterior end relative to the mouth of the filler neck, a hub extending in an axial direction from the exterior end, and a cam formed in the interior end, the rod extending through the central aperture, the interior end of the core engaging the outward side of the latch, and the cam follower extends for engagement with the cam, and* a handle having a base and means for mounting the base on the hub so that the core rotates in the housing in resonse to rotational movement of the handle relative to the filler neck.

**21**. A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising

means for closing the mouth of the filler neck, the closing means including an end closure member and means for establishing a seal between the end closure member and the seal seat,

a housing movably coupled to the closing means, the housing being sized to extend into the filler neck through the mouth and formed to include a cylindrical wall having an aperture, and

means for gripping the filler neck in response to the pushing of the establishing means against the seal seat establishing a liquid fuel and vapor seal therebetween, the gripping means being **[**formed**]** *positioned* for *sliding* movement *in a radial direction* between a filler neck-engaging position and a filler neck-disengaging position and mounted in the housing, the gripping means including a latch and a means for snapping the latch through the aperture for engagement with the filler neck,

*wherein the end closure member has a cup-shaped mouth extending over the housing and the cylindrical wall of the housing is formed for axial movement into the cup-shaped mouth in response to pushing the establishing means against the seal seat.*

**22**. The cap of claim **21**, further comprising means for releasing the liquid fuel and vapor seal, the releasing means including means for moving the latch to the filler neck-disengaging position and means for compelling movement of the housing in an axially outward cap-disengagement direction.

**23**. The cap of claim **22**, wherein the compelling means includes a compression spring extending between the housing and the end closure member so that the housing moves in the axially outward *cap-disengagement* direction in response to the movement of the gripping means to the filler neck-disengaging position.

**24**. **[**The cap of claim **22**, wherein**]** *A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising*

*means for closing the mouth of the filler neck, the closing means including an end closure member and means for establishing a seal between the end closure member and the seal seat,*

*a housing movably coupled to the closing means, the housing being sized to extend into the filler neck through the mouth and formed to include a cylindrical wall having an aperture, and*

*means for gripping the filler neck in response to the pushing of the establishing means against the seal seat establishing a liquid fuel and vapor seal therebetween, the gripping means being positioned for sliding movement in a radial direction between a filler nack-engaging position and a filler neck-disengaging position and mounted in the housing, the gripping means including a latch and a means for snapping the latch through the aperture for engagement with the filler neck,*

*means for releasing the liquid fuel and vapor seal, the releasing means including means for moving the latch to the filler neck-disengaging position and means for compelling movement of the housing in an axially outward cap-disengagement direction,* the moving means **[**includes**]** *including* a core formed of rotational movement within the housing and means for pulling the latch through the aperture when the core is rotated relative to the housing.

**25**. The cap of claim **24**, wherein the pulling means includes a cam follower attached to the latch and means for camming the cam follower **[**for movement of**]** *to move* the latch in a radially inward direction through the aperture to the filler neck-disengaging position.

**26**. The cap of claim **25**, wherein the core has an exterior end and an interior end relative to the mouth *of the filler neck* and the camming means is a cam formed in the interior end and configured to extend over the cam follower.

**27**. The cap of claim **25**, wherein the camming means is a cam, and the cam is formed to include means for permitting the radially inward movement of the cam follower when the latch is pushed into the mouth of the filler neck.

**[28**. The cap of claim **21**, wherein the end closure member has a cup-shaped mouth and the housing is formed for axial movement into the cup-shaped mouth in response to pushing the seal establishing means against the seal seat.**]**

**29**. The cap of claim **[28]***21*, further comprising means for yieldably allowing passage of the housing in the cup-shaped mouth, the allowing means extending between the housing and the end closure member.

**30**. The cap of claim **29**, wherein the filler neck contains a gripping portion having a flange, and the latch extends into the gripping portion engaging the flange.

**31**. The cap of claim **30**, wherein the **[**yielding**]** *allowing* means further includes means for pushing the housing in an axially outward direction so that the latch is pressed against the flange securing the housing in the filler neck.

**32**. The cap of claim **21**, wherein the cylindrical wall is formed to include three apertures and the gripping means includes three latches extending through the three apertures in the filler neck-engaging position.

**33**. **[**The cap of claim **21** having**]** *A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising*

*means for closing the filler neck, the closing means including an end closure member and means for establishing a seal between the end closure member and the seal seat,*

*a housing movably coupled to the closing means, the housing being sized to extend into the filler neck through the mouth and formed to include a cylindrical wall having an aperture, and*

*means for gripping the filler neck in response to the pushing of the establishing means against the seal seat establishing a liquid fuel and vapor seal therebetween, the gripping means being positioned for sliding movement in a radial direction between a filler nack-engaging position and a filler neck-disengaging position and mounted in the housing, the gripping means including a latch and a means for snapping the latch*

*through the aperture for engagement with the filler neck, and* means for inhibiting rotation of the cylindrical wall in the filler neck.

**34**. A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising

means for closing the filler neck, the closing means including a housing and means for establishing a seal on the seal seat, the seal means being coupled to the housing for axial movement therewith relative to the filler neck,

*a handle cover rotatably coupled to the housing,*

means for gripping the filler neck in response to the pushing of the housing the mouth of the filler neck, the gripping means being mounted for *sliding* movement *in a radial direction* between a filler neck-engaging position and a filler neck-disengaging position and

means for moving the gripping means from the filler neck-engaging position to the filler neck-disengaging position, *the moving means including a core coupled to the gripping means and to the handle cover so that the core rotates in the housing in response to rotational movement of the handle relative to the housing to move the gripping means in a radially inwardly direction to the filler neck-disengaing position.*

**35**. The cap of claim **34**, wherein the moving means includes means for engaging the gripping means and means for pulling the gripping means in a radially inward direction relative to the filler neck.

**36**. The cap of claim **35**, wherein the housing is formed to include an upper lip, a cylindrical wall extending axially inwardly from said upper lip, and means for inhibiting rotation of the *cylindrical* wall in the filler neck and the engaging means includes a handle and means for movably mounting the handle to the upper lip for rotational movement relative to both *of* the housing and **[**to the**]** filler neck.

**37**. **[**The cap of claim **35**, wherein**]** *A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising*

*means for closing the mouth of the filler neck, the closing means including a housing and means for establishing a seal on the seal seat, the seal means being coupled to the housing for axial movement relative to the filler neck,*

*means for gripping the filler neck in response to the pushing of the housing into the filler neck, the gripping means being mounted in the housing for sliding movement in a radial direction between a filler neck-engaging position and a filler neck-disengaging position, and*

*means for moving the gripping means from the filler neck-engaging position to the filler neck-disengaging position, the moving means including means for engaging the gripping means and means for pulling the gripping means in a radially inward direction relative to the filler neck and* the engaging means is a core mounted in the housing and the pulling means includes a cam formed in the core and means for following the cam so that the gripping means moves in the radially inward direction through the aperture in response to rotational movement of the core within the housing.

**38**. The cap of claim **34**, wherein the housing includes a cylindrical wall extending in the axially inward direction relative to the filler neck, the wall is formed to include an aperture and the gripping means extends through the aperture in the filler neck-engaging position.

**39**. The cap of claim **34**, wherein the filler neck is formed to include a gripping portion, the seal means includes an end closure member having a cup-shaped mouth and a seal ring coupled to the end closure member, and the gripping means includes a latch and means for snapping the latch into the gripping portion in response to pushing the housing into the cup-shaped mouth of the end closure member.

**40**. The cap of claim **39**, wherein the end closure member includes an internal wall and means for permitting yieldable sliding axially inward movement of the housing along the internal wall in response to the pressing of the seal ring on the seal seat so that the gripping means abuts the gripping portion of the filler neck.

**41**. The cap of claim **34**, wherein the housing includes a cylindrical wall defining a cavity extending therein, an inner wall, an outer wall, a support platform mounted to the inner wall and extending in a radial direction across the cavity, and a rod mounted to the support platform and extending in an axially outward direction, the gripping means includes a latch seated on the support platform and a spring extending between the latch and the rod, and the moving means **[**is**]** *includes* a cam follower positioned on the latch and **[**a**]** *the* core being formed to include a central aperture and a cam, the rod extends through the central aperture, and the core is seated on the latch so that the cam extends over the cam follower.

**42**. The cap of claim **34**, wherein the moving means **[**is**]** *includes* a cam follower positioned on the gripping means**[**, a**]** *and the* core **[**having**]** *has* an internal end and an external end relative to the mouth of the filler neck, and a cam formed in the internal end, the core is seated on the gripping means so that the cam extends over the cam follower.

**43**. A cap engageable with a filler neck having a mouth and a seal seat disposed axially inwardly from said mouth internally in said filler neck, the cap comprising

means for closing the mouth of the filler neck, the closing means including a housing and an end closure member coupled to the housing, the end closure member being axially movable relative to the housing and having a sealing ring configured to engage the seal seat upon slidable insertion of the housing into the filler neck in an axially inward cap-installation direction,

means for gripping the filler neck in response to sliding axially inward movement of the housing in the filler neck, the gripping means being formed for *sidable* movement *in a radial direction* between a filler neck-engaging position and a filler neck-disengaging position, and mounted in the housing, the gripping means includes three spring-loaded latches positioned in spaced-apart relation about the circumference of the housing, and means for moving the three *spring-loaded* latches from the filler neck-engaging position to the filler neck-disengaging position, the moving means including a handle cover and means for coupling the handle cover *relative* to the three spring-loaded latches so that the latches are rotatably actuated in response to rotational movement of the handle cover relative to the filler neck.

*44. A cap engageable with a vehicle filler neck having an inside wall defining a fill passageway and a seal seat disposed internally in said vehicle filler neck and extending from the inside wall into the fill passageway, the cap comprising*

*a housing,*

*an end closure member coupled to the housing and axially movable in the fill passageway relative to the housing, the end closure member carrying a seal configured to*

*engage the seal seat upon insertion of the housing into the vehicle filler neck in an axially inward cap-installation direction,*

*a latch positioned to extend from the housing, the latch being formed to grip the vehicle filler neck in a filler neck-engaging position in response to pressing the seal in the axially inward cap-installation direction against the seal seat and to move to a filler neck-disengaging position,*

*a handle cover, and*

*a core coupled to the handle cover and to the latch so that the latch is rotatably actuated toward the filler neck-disengaging position in response to rotational movement of the handle cover relative to the filler neck.*

*45. The cap of claim 44, wherein the end closure member includes an internal wall and a middle support platform that extends across the internal wall.*

*46. The cap of claim 44, wherein the housing includes a wall defining a cavity extending therein, an inner wall, a support platform mounted to the inner wall and extending in a radial direction across the cavity, a rod mounted to the support platform, and a spring extending between the rod and the latch.*

*47. The cap of claim 44, wherein the housing is formed to include a wall having an aperture and the latch extends through the aperture.*

*48. A cap engageable with a vehicle filler neck having having an inside wall defining a fill passageway and a seal seat disposed internally in said vehicle filler neck and extending from the inside wall into the fill passageway, the cap comprising*

*a housing formed to include a wall defining a cavity extending therein, apertures extending through the wall, and a support platform mounted to the wall and extending in a radial direction across the cavity,*

*an end closure member coulped to the housing, the end closure member being axially movable in the fill passageway relative to the housing and carrying a seal configured to engage the seal seat upon insertion of the housing into the vehicle filler neck in an axially inward cap-installation direction and latches formed for slidable movement in a radial direction mounted on the support platform and positioned to lie in alignment with the apertures in the wall, the latches being configured to grip the vehicle filler neck following pressing engagement of the seal of the end closure member angainst the seal seat in the vehicle filler neck.*

*49. The cap of claim 48, further comprising a core rotatably coupled in the housing, a cam follower appended to each of the latches, and cams formed in the core, each cam follower contacting one of the cams through a predetermined arc of rotation of the core in the housing and moving one of the latches in a radially inward direction relative to the vehicle filler neck to permit movement of the housing in an axially outward cap-disengagement direction.*

*50. The cap of claim 49, further comprising springs that are positioned to lie in the housing in engagement with the latches, the springs being configured to yieldably allow passage of the latches in the radially inward direction in response to the inward movement of the housing in the vehicle filler neck.*

*51. A cap engageable with a vehicle filler neck having a mouth, an inside wall defining a fill passageway, and a seal seat extending from the inside wall into the fill passageway and disposed axially inwardly from said mouth internally in said vehicle filler neck, the cap comprising*

*a housing sized to extend into the vehicle filer neck through the mouth,*

*an end closure member movably coupled to the housing,*

*a seal between the end closure member and the seal seat,*

*a latch mounted in the housing, and formed for slidable movement in a radial direction,*

*a spring mounted in the housing and engaging the latch, the spring being configured to snap the latch into engagement with the vehicle filler neck in respose to the pushing of the seal against the seal seat and the housing into the end closure member establishing a liquid fuel and vapor seal between the seal and seal seat.*

*52. The cap of claim 51, further comprising a compression spring that extends between the housing and the end closure member so that the housing moves in an axially outward direction in response to movement of the latch to the vehicle filler neck-disengaing position.*

*53. The cap of claim 51, wherein the end closure member has a cup-shaped mouth and the housing is formed for axial movement into the cup-shaped mouth in response to pushing the seal against the seal seat.*

*54. A cap engageable with a vehicle filler neck having a mouth, an inside wall defining a fill passageway, an a seal seat extending from the inside wall into the fill passageway and dispose axially inwardly from said mouth internally in said vehicle filler neck, the cap comprising*

*a handle,*

*a housing coupled to the handle,*

*an end closure member having a seal to engage the seal seat, the end closure member being coupled to the housing for axial movement therewith relative to the vehicle filler neck,*

*a latch mounted in the housing between the handle and the end closure member and configured for slidable movement in a radial direction to grip the vehicle filler neck in response to axial movement of the housing into the mouth of the vehicle filer neck, and*

*a spring mounted in the housing and configured to move the latch into engagement with the filler neck in response to the seal engaging the seal seat.*

*55. The cap of claim 54, wherein the housing is formed to include an upper lip, a wall extending axially inwardly from said upper lip, and a rib mounted on the wall and configured to inhibit rotation of the wall in the vehicle filler neck.*

*56. The cap of claim 54, wherein the housing includes a cylindrical wall that has an inner wall surface defining a cavity and an outer wall surface, a support platform that is mounted to the inner wall surface and extends across the cavity, and a rod mounted to the support platform, the latch is seated on the support platform, and the spring extends between the latch and the rod.*

*57. A cap engagable with a vehicle filler neck having a mouth, an inside wall defining a fill passageway, an a seal seat extending from the inside wall into the fill passageway and dispose axially inwardly from said mouth internally in said vehicle filler neck, the cap comprising*

*a housing formed to include a wall that has an inner wall surface defining a cavity and an outer wall surface, three spaced apart apertures extending between the outer and inner wall surfaces, a support platform mounted to the inner wall and extending across the cavity, and a rod mounted to the support platform,*

*an end closure member coupled to the housing, the end closure member being axially movable relative to the*

*housing and having a seal configured to engage the seal seat upon insertion of the housing into the vehicle filler neck in an axially inward cap-installation direction,*

*three spaced-apart latches seated on the support platform and aligned for slidable movement in a radial direction through the three spaced-apart apertures between a vehicle filler neck-engaging position and a vehicle filler neck-disengaging position,*

*springs extending between the rod and the three spaced-apart latches and configured to snap the three spaced-apart latches outwardly through the three spaced-apart apertures from the vehicle filler neck-disengaging position to the vehicle filler neck-engaging position,*

*a cam follower coupled to each of the three spaced-apart latches,*

*a core positioned to lie in the cavity of the housing and formed to include a central aperture, an interior end and an exterior end relative to the vehicle filler neck, a hub extending from the exterior end, and three spaced-apart cams formed in the interior end, the rod extending through the central aperture, the interior end of the core engaging the three spaced-apart latches, and the three spaced-apart cams contacting the three spaced-apart cam followers and pull the cam followers and the three spaced-apart latches in a radially inward direction toward the vehicle filler neck-disengaging position in response to rotational movement of the core, and*

*a handle cover including a base engaging the core and a mount engaging the housing, the base including a core slot that is sized to receive the hub of the core therein, the hub engaging the base during rotation of the handle cover to cause rotation of the core in the cavity of the housing.*

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