



USOORE36927E

**United States Patent** [19]  
**Griffin et al.**

[11] E

**Patent Number: Re. 36,927**

[45] **Reissued Date of Patent: Oct. 31, 2000**

- [54] **PUSH-ON FUEL CAP**
- [75] Inventors: **Jeffery Griffin; Robert S. Harris**, both of Connersville, Ind.
- [73] Assignee: **Stant Manufacturing Inc.**, Connersville, Ind.
- [21] Appl. No.: **08/785,710**
- [22] Filed: **Jan. 17, 1997**

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Reissue of:

- [64] Patent No.: **5,381,919**
- Issued: **Jan. 17, 1995**
- Appl. No.: **08/138,399**
- Filed: **Oct. 18, 1993**

- [51] **Int. Cl.<sup>7</sup>** ..... **B65D 55/00**
- [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  
*Attorney, Agent, or Firm*—Barnes & Thornburg

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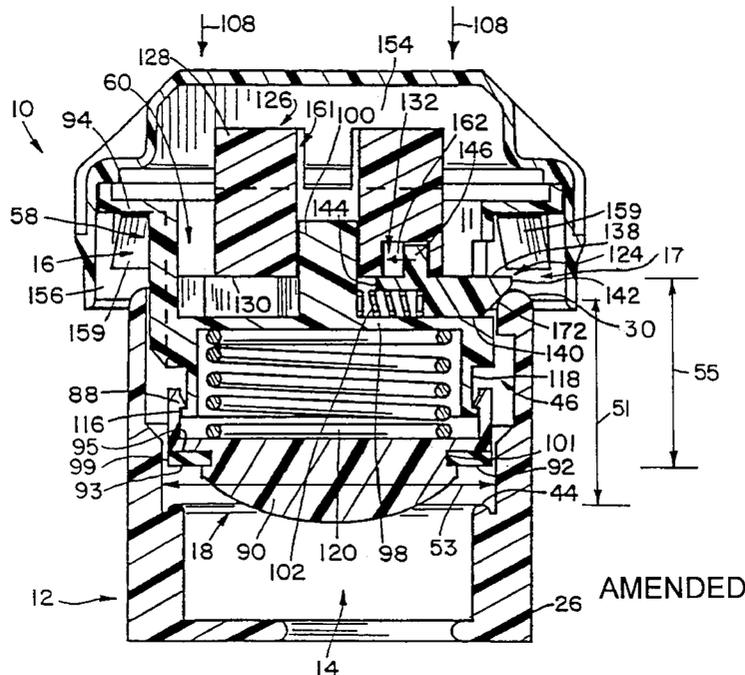
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[57] **ABSTRACT**

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**



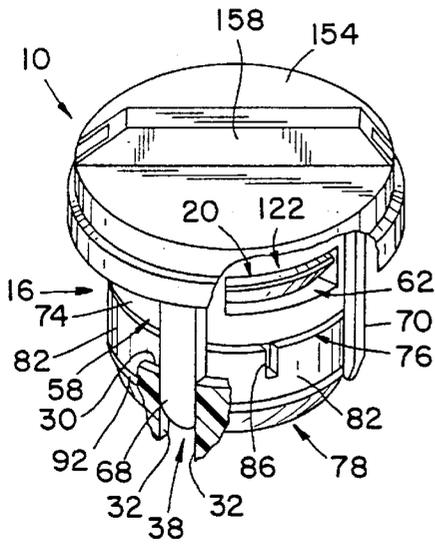


FIG. 1

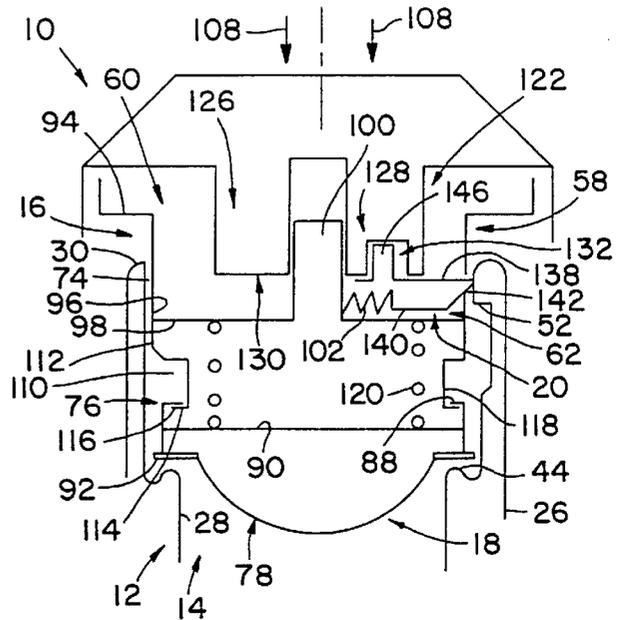


FIG. 2

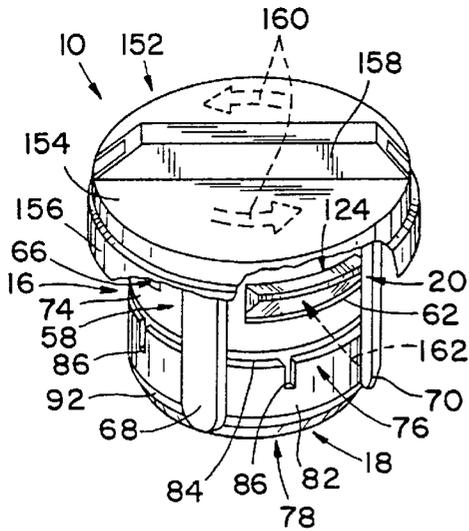


FIG. 3

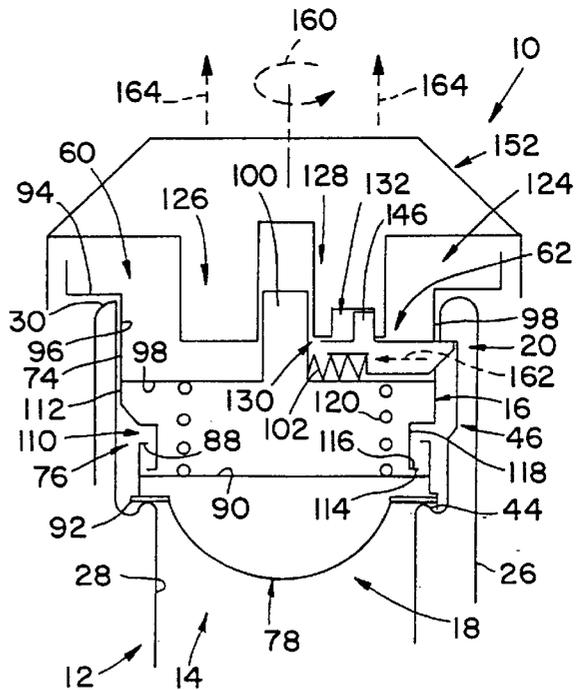


FIG. 4

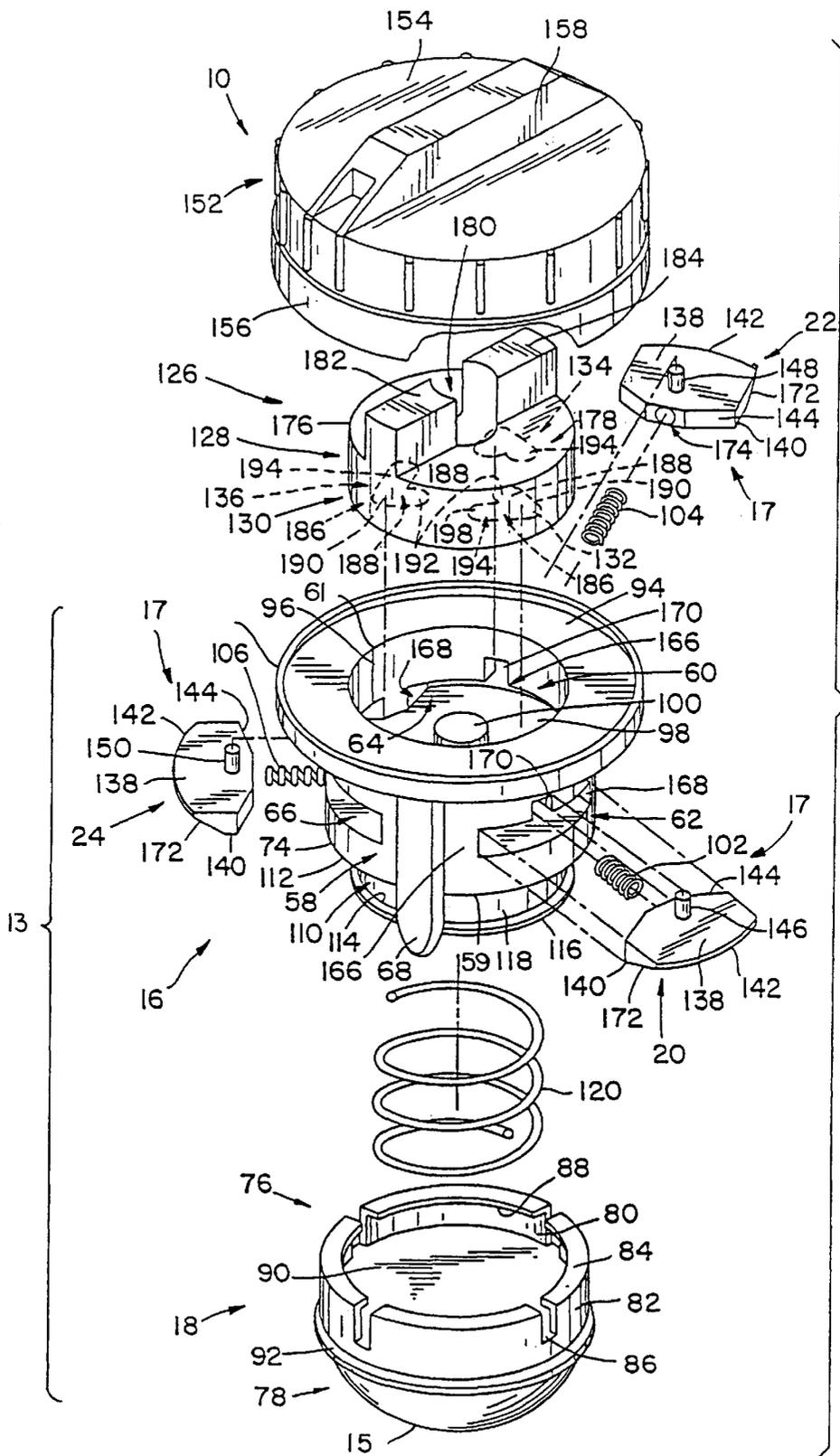


FIG. 5  
AMENDED



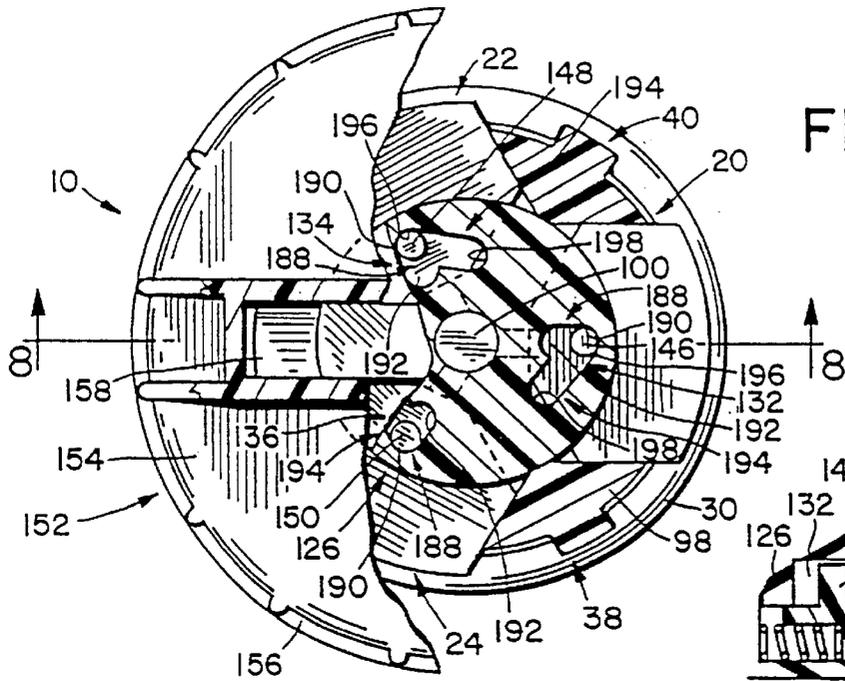


FIG. 7

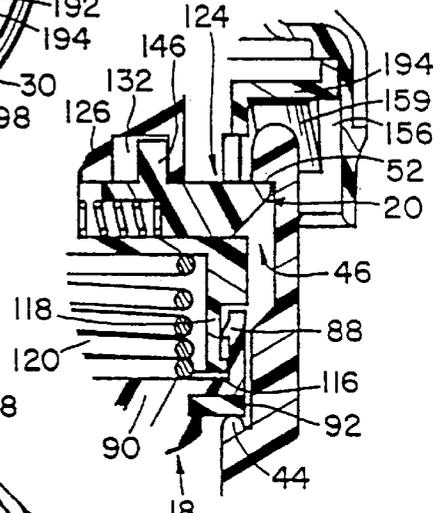


FIG. 9

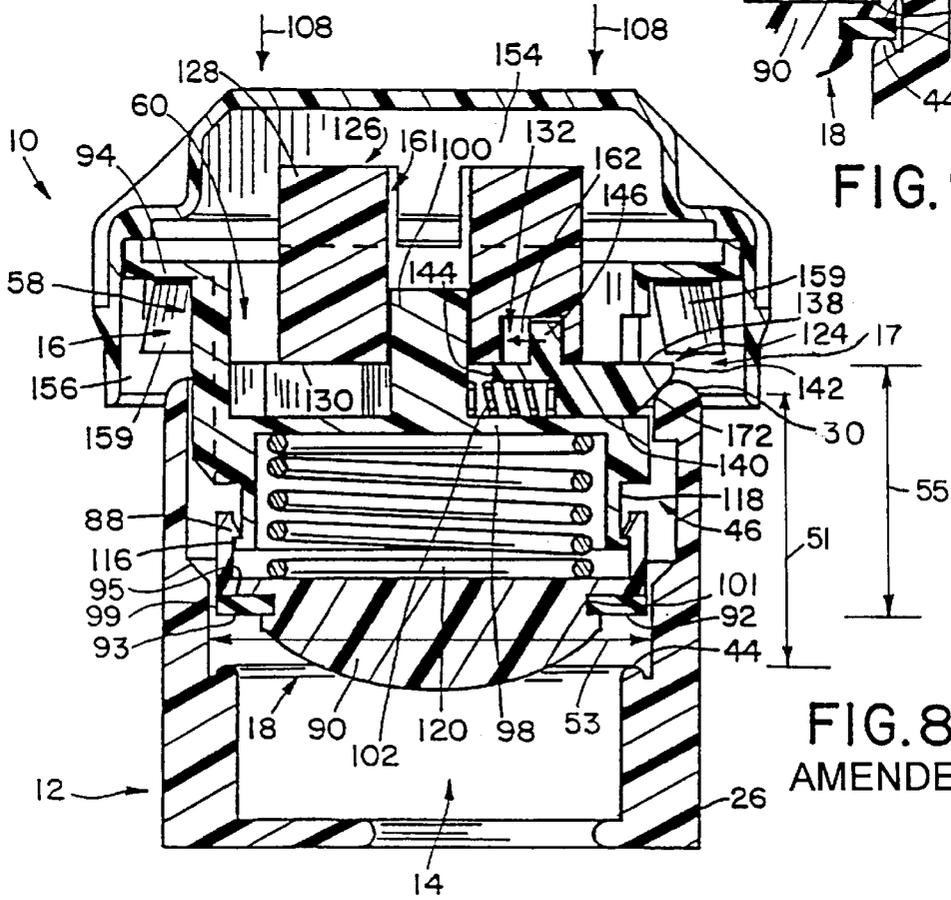
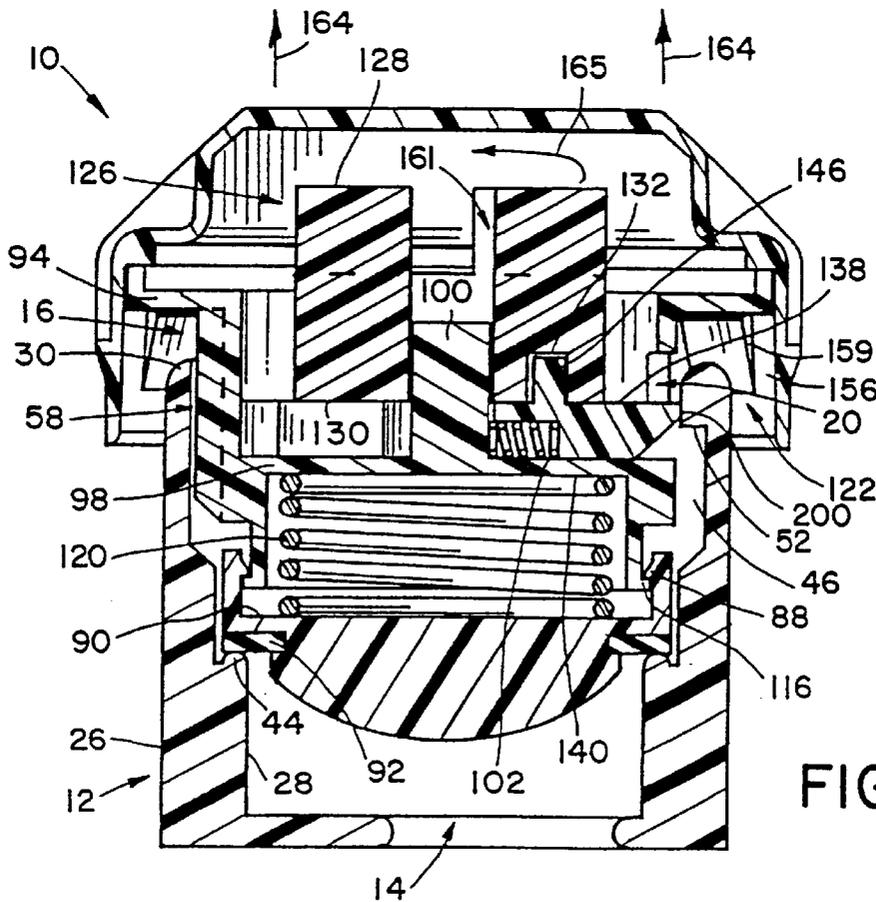
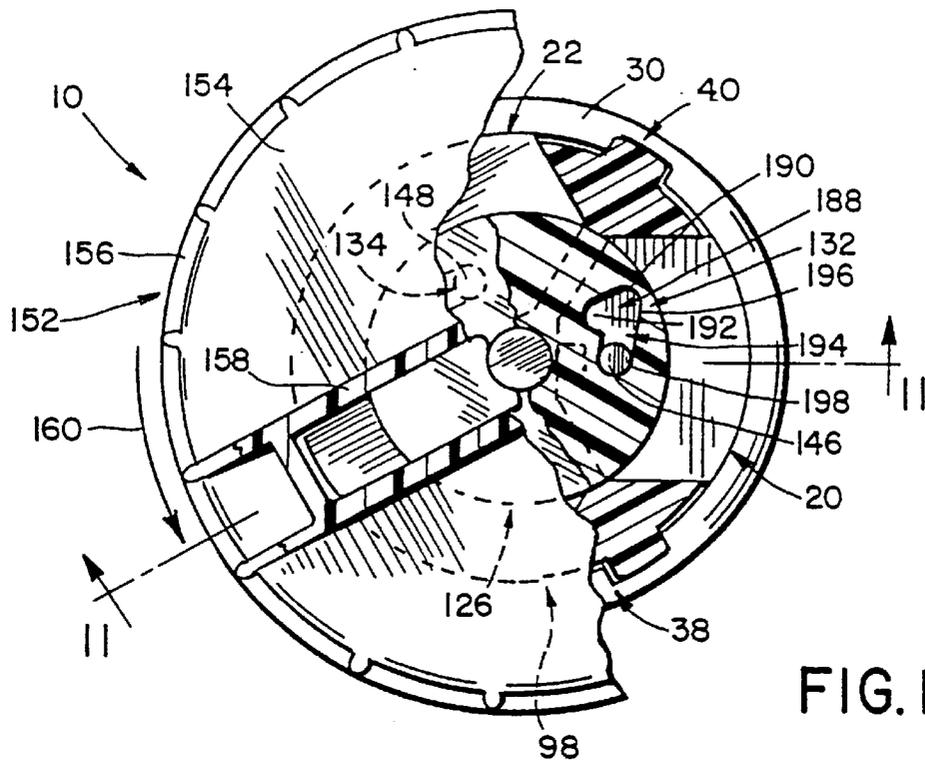


FIG. 8  
AMENDED



## 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 counter-clockwise 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 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*

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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 filler 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]**, 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*

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*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,*

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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 5  
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 resonance 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 15

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 20

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, 25

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. 30

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. 35

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. 40

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 45

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, 50

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 55

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 move- 60

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ment 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, 5

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. 10

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. 15

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. 20

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. 25

[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.] 30

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. 35

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. 40

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. 45

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. 50

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 55

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, 60

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 65

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 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 70

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*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-disengaging 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.

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**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 *slidable* 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 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 coupled 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 against 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 filler 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 response 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-disengaging 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 disposed 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 filler 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 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 disposed 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*

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*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 5 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, 15*

*a core positioned to lie in the cavity of the housing and formed to include a central aperture, an interior end*

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*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.*

\* \* \* \* \*