

July 9, 1968

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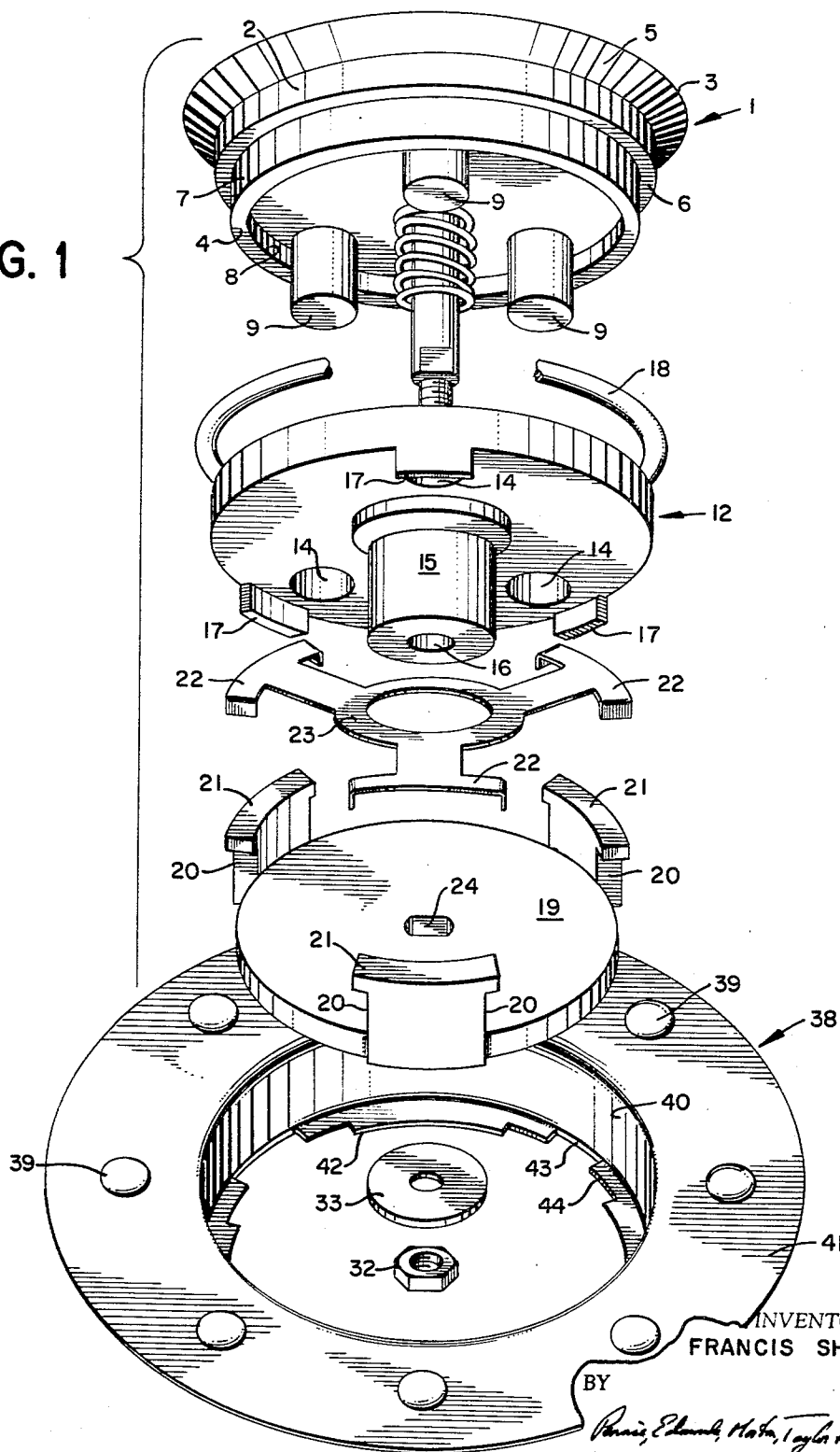
3,391,817

FILLER CAP

Filed July 19, 1967

6 Sheets-Sheet 1

FIG. 1



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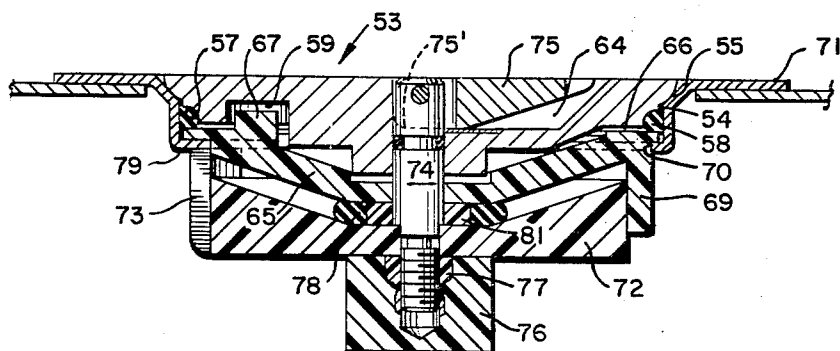
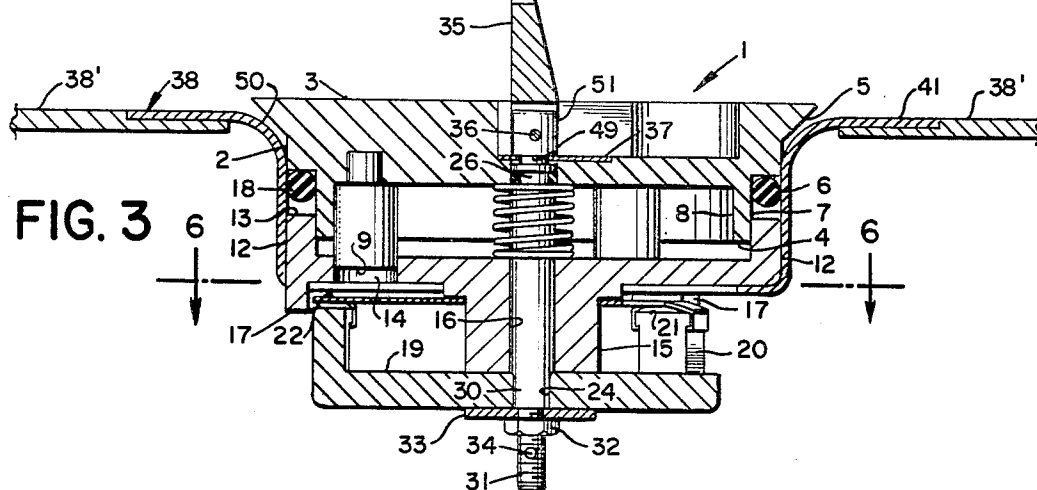
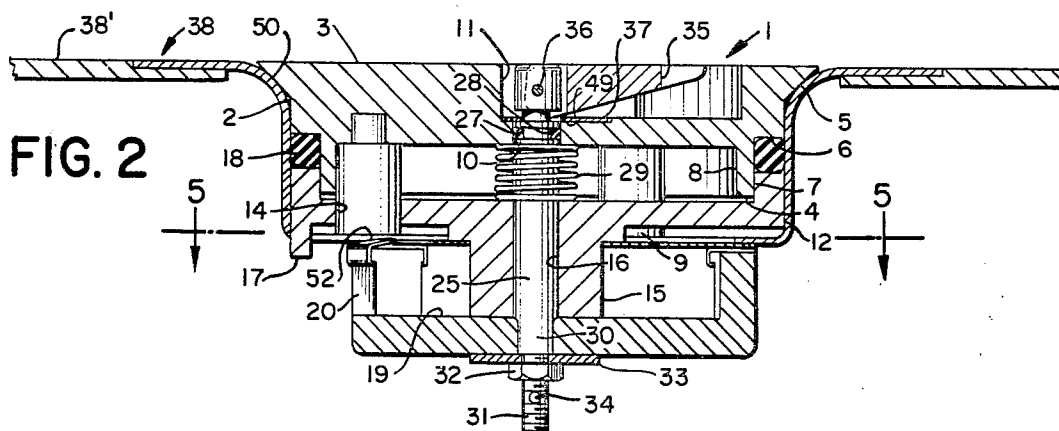
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FILLER CAP

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6 Sheets-Sheet 2



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FILLER CAP

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FIG. 4

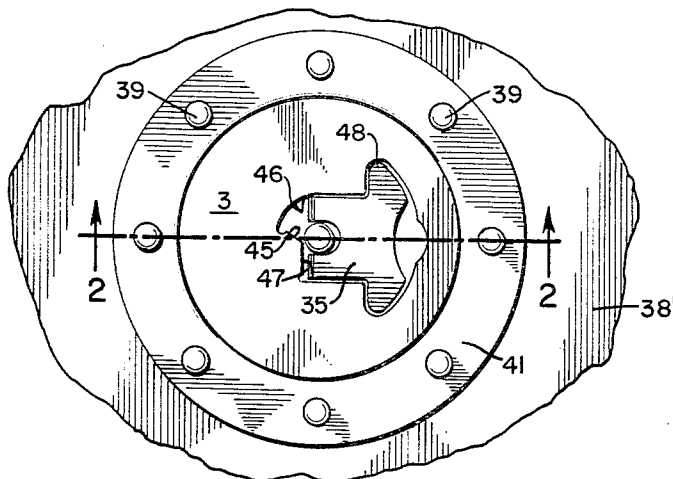


FIG. 6

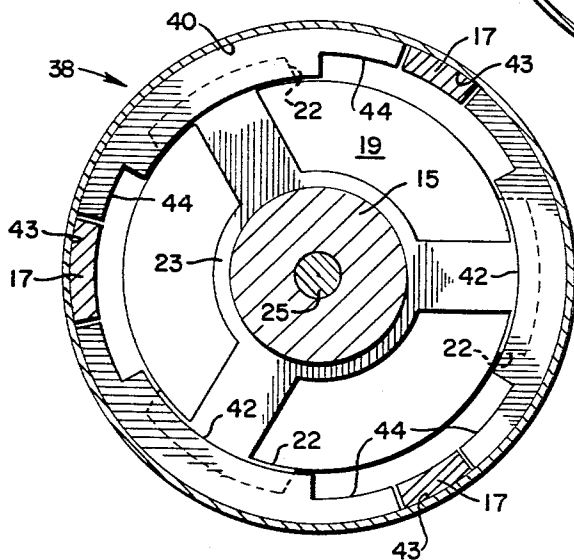
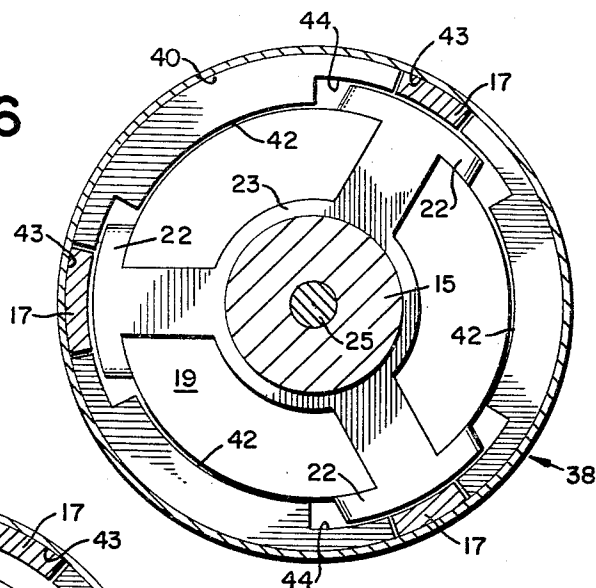


FIG. 5

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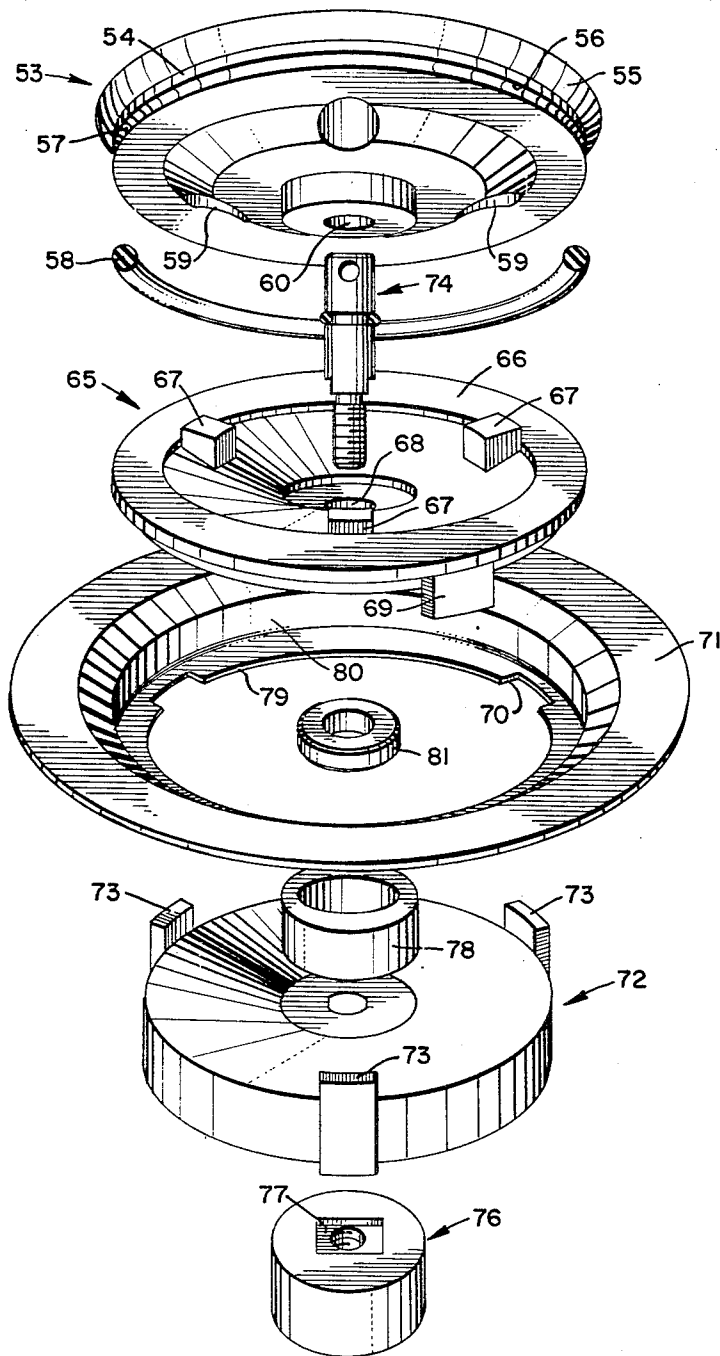
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FILLER CAP

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FIG. 7



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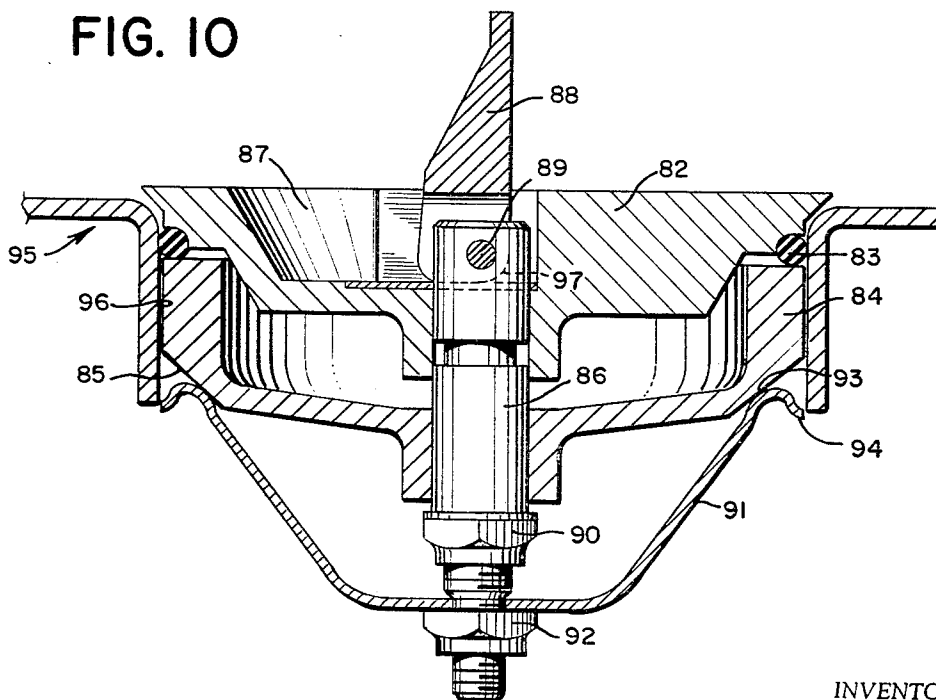
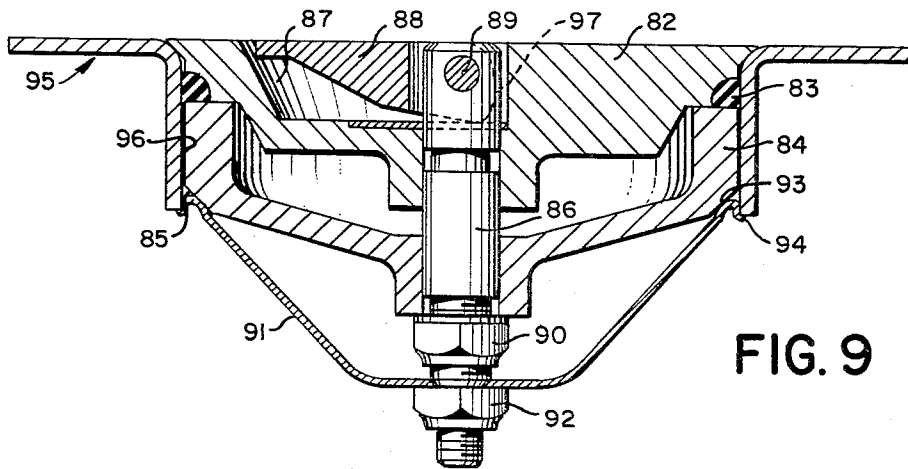
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FILLER CAP

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6 Sheets-Sheet 5



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FILLER CAP

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6 Sheets-Sheet 6

Fig. 11.

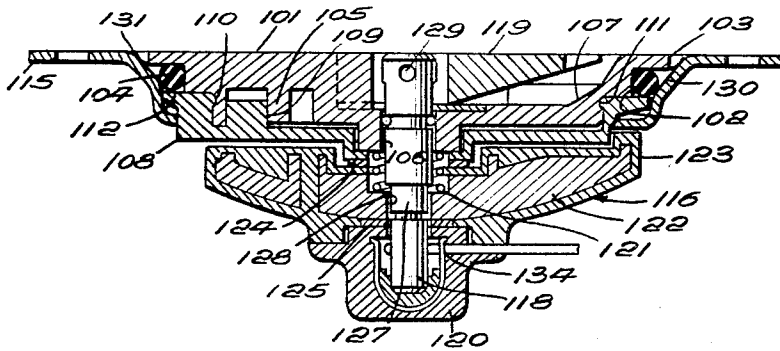
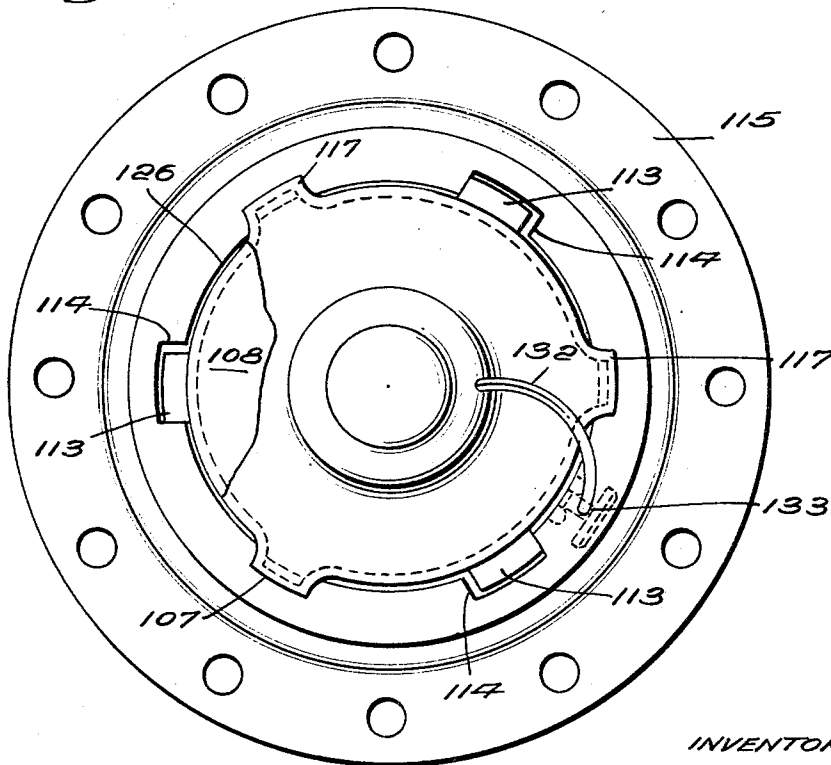


Fig. 12.



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3,391,817
FILLER CAP

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Continuation-in-part of application Ser. No. 496,574,
Oct. 15, 1965. This application July 19, 1967, Ser.
No. 671,902

24 Claims. (Cl. 220—25)

ABSTRACT OF THE DISCLOSURE

A filler cap for a tank having an opening defined by an annular wall, the cap having a plug member with an outwardly extending flange at its upper end, a sealing member disposed about the periphery of the plug member below the flange, a retaining member positioned below the sealing member for holding the sealing member in place, a locking mechanism disposed below the plug member, and an operating shaft extending through the plug member and connected to the locking mechanism for moving the locking mechanism toward the plug member when the cap is disposed within the opening to lock the cap in such opening with the flange of the plug engaging against the upper end of the wall surface of the opening and the sealing member against the annular wall surface of such opening.

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of applicant's copending application, Ser. No. 496,574 filed Oct. 15, 1965.

BACKGROUND OF THE INVENTION

Field of the invention

This invention pertains to filler caps for tanks such as gas tanks and more particularly to a manually operable filler cap constructed to seal the opening of the tank and to dissipate any electrical charge contacting the outer surface of the cap.

Description of the prior art

In providing a filler cap for the gasoline tank of an airplane, for example, it is desirable that the cap be manually operable so that it may be removed when refueling is necessary and also securely locked into the tank opening after refueling without necessitating the use of specialized tools. It is further desirable that the filler cap be constructed in such a way whereby visual observation of the cap will readily show whether it is properly locked into the tank. In addition, these caps have to be constructed to meet rigid specifications and standards and this is particularly true where the caps are to be used in airplanes. They must be able to withstand any internal pressure created within the tank, must not vibrate loose during use, and where the tank will contain explosive fumes such as created by high octane gasoline, it is of utmost importance that the filler cap be lightning safe, that is, immune to electrical sparking on the fuel side of the point of seal without adversely affecting the sealing function of the cap.

In the past, filler caps of this general type have been constructed with a plug member for effecting a sealing with the tank opening and a cooperating locking mechanism depending therefrom for locking the cap onto the tank in a sealed position. A shaft extending through the plug member is attached at its lower end to the locking mechanism and provided at its upper end with an actuating handle adapted to be received within a handle recess formed in the upper surface of the plug member. Move-

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ment of the handle into and out of the recess will cause longitudinal movement of the locking mechanism relative to the plug member while rotation thereof about the axis of the shaft will move the locking mechanism from a first position in which the cap may be readily removed from the tank opening to a second position where the locking mechanism may be moved toward the plug member to securely lock the cap in sealed relationship within the opening.

For receiving caps of this construction, the tank is provided with an adapter member which defines the tank opening. This adapter is constructed with an annular wall surface extending into the tank for receiving the plug member and an annular locking flange at the bottom of the wall surface. The annular flange is provided with openings or slots for permitting the locking mechanism to pass beyond it when the cap is inserted into the adapter so that the locking mechanism may then be rotated about the axis of the plug and into a position under the flange whereby movement of the locking mechanism toward the plug member will cause it to engage against the under-surface of the flange and lock the cap in sealed position within the tank opening.

With filler caps of this construction, the sealing of the plug member against the annular wall of the adapter member is effected by means of an O-ring fixed to the outer surface of the plug member. This O-ring extends beyond the outer periphery of the plug member and in some cases effects a spacing of the upper surface of the plug member from the surrounding adapter member and tank wall when the cap is oriented in locked position within the tank opening. This does not prevent a proper sealing of the cap but does expose the sealing O-ring to the ambient atmosphere rendering it more susceptible to deterioration. Also, by having the exposed outer surface of the cap spaced from the surrounding adapter and outer wall of the tank, a situation is created in which an electrical charge striking directly against the cap or passing from the outer wall surface of the tank onto the cap may tend to more readily pass through the cap and inwardly into the tank rather than across the cap and back onto the outer surface of the tank. It is apparent that any electrical charge entering the tank and creating internal sparking, where for example the tank contains gasoline, may cause the tank to explode.

SUMMARY OF THE INVENTION

In accordance with the teachings of the present invention, the filler cap is constructed so that its exposed upper surface seats directly upon the adapter defining the tank opening. In addition, the sealing of the cap within the tank opening is effected by a compressible seal in the form of an O-ring positioned about the periphery of the plug member. As the cap is locked into the tank opening, this O-ring is deformed into positive engagement with the opposed annular wall portion of the adapter and the flange of the plug member is seated directly upon the end of the annular wall of the adapter. To activate the seal member, it is positioned on the plug member of the cap in alignment with a slanted portion of the adapter member so that insertion of the cap into the opening will cause the sealing member to engage against the annular wall surface of the adapter at this slanted portion. Alternatively, a compression plate may be attached to the bottom of the plug member and slidably received over its lower end whereby upon locking of the cap into the opening, such compression member will be drawn into engagement with the O-ring to compress it and thereby cause it to deform outwardly of the plug member and into engagement with the annular wall surface of the adapter.

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Upon insertion of the cap into the opening, the locking mechanism disposed at the lower end of the cap will be drawn upwardly and into engagement with the lower portion of the adapter. This locking mechanism may be constructed to effect either rigid or resilient locking connection with the adapter. In one embodiment of the invention, the locking mechanism is constructed with compressible locking surfaces for cooperating with the locking flange of the adapter member so that it will maintain a positive locking engagement with the adapter flange over a limited range of movement relative to the plug member and flange. This assures that a positive locking of the cap within the opening will be effected when the operating handle has been moved fully into the handle recess of the plug member. In another embodiment, the entire locking structure is comprised of a single resilient spring member which, upon actuation, moves radially outwardly of the cap and into underlying engagement with the adapter to lock the cap within the tank opening.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view of the filler cap and tank adapter;

FIG. 2 is a cross-sectional view of the filler cap in locked position within a tank opening;

FIG. 3 is a cross-sectional view of the filler cap positioned within the tank opening in release position;

FIG. 4 is a top plan view of the filler cap as shown in FIG. 2;

FIG. 5 is a cross-sectional view taken through lines 5—5 of FIG. 2;

FIG. 6 is a cross-sectional view taken through lines 6—6 of FIG. 3;

FIG. 7 is an exploded view of a modified embodiment of the filler cap of the present invention;

FIG. 8 is a cross-sectional view of the cap of FIG. 7 in locked position within the tank opening;

FIG. 9 is a cross-sectional view of still another embodiment of the filler cap of the present invention in locked position within the tank opening;

FIG. 10 is a cross-sectional view of the cap of FIG. 9 in release position within the tank opening;

FIG. 11 is a cross-sectional view of still another embodiment of the filler cap of the present invention in locked position within the tank opening; and

FIG. 12 is a plan view of the lower end of the filler cap shown in FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. 1, the filler cap of the present invention comprises a plug member 1 having an outer cylindrical periphery 2 disposed intermediate its upper and lower ends 3 and 4, respectively. Upwardly of the cylindrical surface 2 is an outwardly extending frusto-conical flange 5. The lower end of the cylindrical surface 2 terminates in a transverse flange 6 facing the lower end of the plug member. Below this flange member, the surface 7 of the plug member 1 is of reduced diameter and the lower end of the plug member is recessed as shown at 8. Extending downwardly from the plug member in the recessed area are a plurality of aligning studs 9. As shown in FIG. 2, the plug member is provided with a centrally located bore 10 extending from the lower recessed portion 8 into a handle recess 11 formed in the upper end of the plug member.

Cooperating with the plug member is a compression member 12. This compression member is cup-shaped and is slidably received over the lower end of the plug member. The uppermost surface of the compression member defines an annular surface 13 facing the flange 6 of the plug member. Apertures 14 extend through the compression member for receiving the aligning studs 9 of the plug member. Extending downwardly from the compression member is a stem 15 of reduced diameter. A centrally

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located bore 16 extends through the compression member and is adapted to be in alignment with the bore 10 of the plug member when the two parts are assembled as shown in FIG. 2. Along the outer peripheral surface of the compression member are a plurality of positioning lugs 17. These lugs extend downwardly from the compression member and are adapted to cooperate with an adapter member attached to the tank opening as more fully described below. A compressible sealing member comprised of a rubber O-ring 18 is positioned between the flange portion 6 of the plug member and the annular surface 13 of the compression member as shown in FIG. 2.

A locking support 19 in the form of a plate is secured to the lower end of the stem portion of the compression member and is provided with locking fingers 20 disposed radially outwardly of the main body portion of the locking plate. These fingers extend in a direction upwardly toward the plug member and terminate in an upper surface 21. A compressible locking means in the form of a leaf spring member 22 is attached to each of the locking fingers in a bowed relationship relative to its upper surface so as to leave a gap between the spring and the associated locking finger. As shown in FIG. 1, these leaf springs are formed from a unitary spoked member. Alternatively, however, they may be formed individually for attachment to the locking fingers. A centrally located slot 24 is provided in the locking plate which is adapted to be in alignment with the bores 10 and 16 of the plug member and compression member when the parts are in assembled condition.

For connecting all of the parts of the filler cap together, an operating shaft member 25 is provided. This shaft member has a reduced upper end portion 26 passing through the plug member about which is positioned a sealing O-ring 27 for effecting a seal between the shaft and the plug member. The O-ring is held in position about the shaft portion by seating within a groove 28. A compression spring 29 surrounds the shaft intermediate the plug member and compression member and normally urges these members apart. The lower end of the shaft passes through the stem 15 of the compression member and is provided with a flattened portion 30 for reception into the complementary-shaped slot 24 of the locking plate. The end of the shaft is threaded as at 31 and a nut 32 and washer 33 are provided for securely attaching the locking plate to the bottom of the shaft. The lower end of the shaft is provided with an aperture 34 extending transversely therethrough to which may be secured a lanyard (not shown). This lanyard may be of polyurethane or other suitable material and is connected at its other end to the tank for preventing complete removal of the cap from the tank beyond the extent permitted by the lanyard.

For operating the cap, an actuating handle 35 is pivotally attached to the operating shaft at its upper end for movement about an axis 36 extending crosswise of the shaft. A washer member 37 is located on the bottom of the handle recess about the shaft 25 to provide a bearing surface for the handle as more fully described below. The shaft member 25 when secured in place by the nut 32 may be rotated relative to the plug and compression members but due to the flattened surface 30, the locking plate is fixed for rotation with the shaft. In addition, the shaft is fixed against movement longitudinally of the locking plate but is free to slide longitudinally through the bore 10 in the plug member.

The filler cap as described above is received within a suitable adapter member 38 which is connected to the tank 38' as by means of the rivets 39. This adapter member defines the opening in the tank; and as shown in FIGS. 1 and 2, is provided with an annular wall portion 40 extending downwardly from the upper surface 41. At the lowermost end of the wall portion 40, a locking flange 42 extends toward the center of the opening. This flange,

as shown in FIG. 1, is slotted at points spaced circumferentially therearound. The slots are each comprised of two sections with the sections disposed nearest the wall 40 defining positioning slots 43 and those disposed adjacent the inner periphery of the flange defining locking slots 44.

In attaching the filler cap to the adapter, the handle 35 is pivoted about the axis 36 to the vertical position shown in FIG. 3. This permits the compression plate and clamping plate to move in a direction away from the plug member under the influence of the spring 29. With the handle in this raised position, it is turned until it abuts against an end surface 45 of the finger recess 11. In turning the handle about the axis of the shaft, it will ride over a raised rib 46 on the washer member 37 and this rib will assist in holding the handle in position against the surface 45. When the handle is in this position, the locking fingers 20 will be in alignment with the downwardly extending positioning lugs 17 of the compression member and the filler cap may be readily inserted into the opening defined by the annular wall surface of the adapter with the lugs 17 disposed within the slots 43 and with the locking fingers 21 disposed directly below the slots 44. This is the release position of the adapter as shown in FIGS. 3 and 6.

Once the filler cap has been inserted into the opening as shown in FIG. 3, the handle 35 is then rotated about the axis of the shaft to rotate the shaft and the locking plate until the handle engages another surface 47 of the handle recess 11. In this position, the enlarged wing portions 48 of the handle will be in alignment with the complementary-shaped portions of the recess 11 so that the handle may be rotated about the axis 36 downwardly into the recess 11. This rotation of the handle about the axis 36 will cause the compression member 12 to be drawn upwardly against the action of the spring 29 due to a camming action effected between a camming surface 49 on the lower portion of the handle and the upper surface of the plug member in the area of the washer 37. As the compression member is drawn upwardly, the locking fingers will engage the undersurface of the flange portion 42 of the opening and assure that the plug member will be drawn downwardly into the adapter with the outwardly extending flange 5 seated directly against the rounded upper end of the adapter as shown at 50. As the compression member is drawn toward the plug member, the O-ring 18 is compressed between the flange 6 of the plug member and the annular surface 13 of the compression member. This compression deforms the O-ring and presses it outwardly into sealing engagement with the annular wall surface of the opening. As the handle is being rotated about the axis 36 and downwardly into the handle recess 11, the leaf springs 22 disposed on the locking fingers engage against the undersurface of the flange 42 of the adapter as shown at 52 in FIG. 2; and due to the compressibility of the leaf springs, it is possible to obtain a tight locking of the filler cap within the adapter over a limited range of longitudinal movement of the locking plate. If these leaf springs were not provided, final engagement of the locking fingers 20 with the flange 42 at 52 and of the flange 5 of the plug member with the adapter 38 at 50 would have to be effected at the same moment that the undersurface 51 of the handle engages the bottom of the recess 11. If this engagement were effected before the handle surface 51 engaged the bottom of the recess, further movement of the handle downwardly in the recess would be prevented due to the rigid connection at 50 and 52. If, on the other hand, engagement were not effected at 50 and 52 when the surface 51 of the handle was seated against the bottom of the recess, a loose connection would be effected. This, of course, is undesirable. The leaf springs 22 provided a degree of tolerance in addition to that otherwise present due to permissible deflection of the locking flange 42 and permit the locking fingers to positively engage the flange

42 before the handle is fully rotated into the recess; yet, because of the compressibility of these springs, further rotation of the handle is permitted to properly position it within the recess 11.

FIG. 7 shows a modified embodiment of the filler cap of the present invention in which all of the exposed parts that are positioned below the point of sealing of the cap within the tank opening are constructed of non-conductive material such as plastic to further prevent the possibility of sparking within the tank. This cap is comprised of a plug member 53 having an outer cylindrical periphery 54 upwardly of which is an outwardly extending flange 55. The lower end of the cylindrical surface terminates in a transverse flange 56; and below this flange the surface of the plug member is grooved at 57 for receiving an O-ring seal 58. The plug on its undersurface is provided with a plurality of aligning apertures 59; and a bore 60 extends centrally through the plug member and into a handle recess 64.

Positioned below the plug member is a compression member or plate 65 which, like the compression member shown in FIG. 1, is cup-shaped and slidably received over the lower end of the plug member. The uppermost surface of the compression member 65 is provided with an annular surface 66 which faces the flange 56 of the plug member; and a plurality of aligning studs 67 extending upwardly from the compression member into the apertures 59 of the plug member. The compression plate is also provided with a central bore 68 adapted to be in alignment with the bore 60 of the plug member when the two parts are assembled as shown in FIG. 8. A positioning lug 69 located at the periphery of the compression plate extends downwardly therefrom in the same manner as the lugs of the cap shown in FIG. 1. The lug 69 is adapted to cooperate with the slot 70 of the adapter member 71 attached to the tank opening to prevent rotation of the plug and compression members once they are inserted into the tank opening.

Below the compression member there is located a locking support or plate 72. This locking plate is provided with a plurality of locking fingers 73 similar to the locking fingers 20 of the plate shown in FIG. 1. The fingers are positioned radially outwardly of the plate and extend in an upward direction toward the compression and plug members.

The parts of the cap assembly shown in FIG. 7 are connected together by means of an operating shaft member 74. This shaft extends from the handle recess 64 of the plug member through the compression member and beyond the lower end of the locking member. An operating handle 75 which is of similar construction to the handle shown in FIG. 4 is connected to the upper end of the shaft and is adapted to be received within the handle recess. In order to hold the parts of the cap on the shaft, a locking cap 76 is provided. This cap is made of suitable material which is non-conductive such as plastic and has positioned therein a nut 77 which is adapted to be threaded upon the lower end of the shaft 74. The nut is molded directly into the locking cap 76 in a nonrotative relationship therewith so that the parts of the cap may be secured to the shaft by simply attaching the locking cap onto the end of the shaft disposed below the locking plate.

The cap shown in FIG. 7 is operated in essentially the same manner as the cap shown in FIG. 1. The shaft 74 is rotated about its own axis to bring the locking fingers 73 into and out of alignment with the slots of the adapter member. When the locking fingers are brought into such alignment, the handle will be in a raised position; and in order to hold the handle in this position so that one may readily observe that the cap has not been locked in the tank opening, a compressible rubber ring 78 is positioned about the shaft 74 between the compression member 65 and the locking support 72. This compression ring, which is made of material not affected by the contents of the tank, normally urges

the locking support in a downward direction and thus urges the shaft 74 in a downward direction. With the shaft urged in this direction, the handle will be held in its raised vertical position once the surface 75' has become seated on the bottom of the handle recess.

When it is desired to lock the cap into the tank opening, the handle is first rotated about the axis of the shaft to position the locking fingers under the inwardly directed flange 79 of the adapted member as shown in FIG. 8. Next the handle is rotated about its pivotal connection to the shaft 74 and into the handle recess. This movement draws the compression member 65 upwardly against the O-ring 58 to deform it outwardly into engagement with the annular wall surface 80 of the adapter; and at the same time, the locking fingers 73 of the plate 72 are brought into locking engagement with the flange 79 of the adapter. During this movement of the locking plate, the compressible rubber ring 78 is compressed between the plate and the compression member 65 and assumes the shape shown in FIG. 8. To prevent the rubber ring 78 from interfering with the shaft 74 and to prevent the ring itself from becoming damaged by the movement of the shaft, a spacer member 81 is disposed between the shaft and the rubber ring.

In the embodiment of the invention shown in FIGS. 7 and 8, the plug member is made of die cast aluminum while the operating shaft is made of steel. The compression member 65, locking member 72 and the locking cap 76 are each made of plastic material and thus all of the exposed parts of the cap positioned below the sealing ring 58 are of nonconductive material thereby preventing the creation of sparking in the interior of the tank.

FIGS. 9 and 10 illustrate another embodiment of the present invention in which the complete actuation of all of the parts of the cap is effected by rotation of the handle member in one direction about an axis extending crosswise of the shaft. As shown in FIGS. 9 and 10, the cap is comprised of a plug member 82 similar to that shown in FIG. 8. The plug member is provided with a sealing ring 83 which is adapted to be deformed outwardly thereof by the compression member 84. The compression member along its lower peripheral surface is provided with a tapered surface 85; and both the plug member and compression member are held together in assembled condition by means of an operating shaft 86 extending from a handle recess 87 formed in the plug member downwardly beyond the compression member. An operating handle 88 is pivotally attached to the shaft 86 at its upper end for rotation about the axis 89 extending crosswise of the shaft. A locking nut 90 is threaded onto the exposed lower end of the shaft 86 to hold the plug and compression members together. The shaft 86, however, extends beyond the nut 90 and receives a locking spring member 91 at a point below the compression member 84. This spring member is held against removal from the shaft by means of a seat member in the form of a nut 92 but is free to slide upwardly of the shaft. The spring member extends diametrically across the compression plate and at each free end is provided with a curved camming surface 93 adapted to ride along the tapered surface 85 of the compression member. The extreme ends of the spring 91 extend radially from the curved surfaces to form locking fingers 94.

The cap shown in FIGS. 9 and 10 is adapted to be received within an adapter member 95 having an annular wall surface 96. As shown in FIG. 10, the spring member 91 is normally disposed within the outer periphery of the compression member when the handle is oriented in a vertical released position and the curved surfaces 93 of the spring engage the tapered surface 85 of the compression member to urge the shaft 86 in a downward direction and thus hold the handle in this vertical position. With the parts of the cap so oriented, the cap may be readily inserted into the adapter member 95. To lock

the cap within the tank and seal the O-ring against the annular wall 96 of the adapter, the handle is rotated downwardly about the axis 89 and into the handle recess 87. With this movement of the handle, a camming action is effected between the handle surface 97 and the bottom of the handle recess to draw the shaft in an upward direction. This brings the nut 90 into engagement with the compression member and draws it upwardly to compress and deform the O-ring 83 outwardly into sealing engagement with the annular wall of the adapter. At the same time, the nut 92 draws the spring member upwardly and the curved surfaces 93 follow along the tapered surface 85 of the compression member. The spring member, and in particular the locking fingers 94, are thus caused to move radially outwardly of the compression member and into locking engagement with the undersurface of the adapter. Because of the compressibility of the spring member, initial contact of the fingers 94 with the adapter member may be effected before the operating handle 88 has been fully rotated into the handle recess so as to assure a positive locking of the cap within the tank opening.

FIGS. 11 and 12 show another modified embodiment of the filler cap of the present invention in which all of the exposed parts positioned below the point of sealing of the cap in the tank opening are constructed of non-conductive material such as plastic to prevent the possibility of sparking within the tank. This cap is comprised of a plug member 101 constructed of a suitable conductive material such as die cast aluminum having an outer cylindrical periphery 102 upwardly of which is an outwardly extending flange 103. Disposed below the flange 103 and encircling the periphery 102 of the plug member is an O-ring seal 104. An aligning aperture 105 is provided on the lower surface of the plug member and a bore 106 extends centrally through the plug member and into a handle recess 107.

Positioned below the plug member is a retaining member 108. This retaining member is provided with an aligning post 109 adapted to be received within the aligning aperture in the lower surface of the plug. Also, the retaining member, which as shown in FIG. 11 as being cup-shaped, is provided with a radially inwardly extending circumferential rib 110. This rib is adapted to cooperate with a complementary-shaped groove 111 formed in the outer periphery of the lower end portion of the plug member so as to hold the retaining member onto the plug member. The upper outer surface of the retaining member provides an annular surface 112 facing the lower surface of the flange 103 of the plug member. This annular surface holds the sealing ring 104 in position on the plug member.

Extending downwardly from the retaining member at the periphery thereof are a plurality of positioning lugs 113 shown in FIG. 12. These lugs are adapted to cooperate with slots 114 of the adapter member 115 which is attached to the tank opening so as to prevent rotation of the plug and retaining members once the cap is inserted into the tank opening.

Below the retaining member is located a locking member or plate 116. This locking plate is provided with a plurality of locking fingers 117, shown in FIG. 12, similar to the locking fingers 20 of the plate shown in FIG. 1. The fingers are positioned radially outwardly of the plate and extend in an upward direction toward the retaining and plug members of the cap.

The parts of the cap are connected together by means of an operating shaft 118. This shaft extends from the handle recess 107 of the plug member through the retaining member and beyond the lower end of the locking plate. An operating handle 119 which is similar to the construction of the handle shown in FIG. 4 is pivotally connected to the upper end of the operating shaft and is adapted to be received within the handle recess. In order to hold the parts of the cap on the shaft, a securing means in the form of a locking cap 120 is attached to

the exposed lower end of the operating shaft. Also, in assembling the parts of the cap together, a compression spring 121 is provided. This compression spring is positioned in encircling relationship with respect to the shaft between the plug member and locking plate so as to normally urge the locking plate away from the plug and retaining members.

As indicated above, all the parts of the cap disposed below the point of sealing to the adapter are constructed of non-conductive material. For this purpose, the retaining member is made of a suitable plastic such as that sold by duPont under the tradename Zytel 101. In addition, the locking plate 116 has an interior skeleton framework 122 of die cast aluminum which is coated on its exposed surfaces with a suitable plastic 123 such as Zytel 101. Similarly, the locking cap 120 is constructed of a non-conductive material such as Zytel 101. In the construction of the cap shown in FIGS. 11 and 12, the operating shaft is constructed of stainless steel and in order to isolate it and the compression spring from the interior of the tank, a non-conductive washer 124 is positioned between the retaining member and locking plate in encircling relationship with the compression spring as shown in FIG. 11. This washer may be constructed of a suitable material such as nylon. Also, a similar washer 125 is positioned between the lower surface of the locking plate and the locking cap; and the locking cap when secured to the exposed lower end of the operating shaft seals against the lower surface of the locking plate and isolates the lower end of the operating shaft from the interior of the tank.

The cap shown in FIGS. 11 and 12 is operated in a similar manner to that of the cap shown in FIG. 1. The shaft 118 is rotated about its own axis to bring the locking fingers into and out of alignment with the slots of the adapter member. When the locking fingers are brought into such alignment, the handle will be in a raised position and held in this position by the compression spring 121.

When it is desired to lock the cap in the tank opening, the handle is first rotated about the axis of the shaft to position the locking fingers 117 under the inwardly directed flange 126 of the adapter member as shown in FIG. 12. For permitting rotation of the locking plate, the portion 127 of the shaft surrounded by the locking plate is flattened and received within a complementary-shaped slot 128 in the locking plate. Next, the handle 119 which is pivotally connected to the operating shaft at 129 is rotated about this pivotal connection and into the handle recess 107. This movement draws the fingers of the locking plate upwardly into engagement with the lower surface of the flange 126 of the adapter and at the same time draws the plug member 101 downwardly into the opening. Upon downward movement of the plug member into the opening, the sealing ring 104 engages against the annular wall surface of the adapter along an inwardly and downwardly directed surface 130 until the flange 103 comes into direct contact with the upper end of the annular wall surface of the adapter as shown at 131.

It will be apparent from the above that removal of the cap from the tank will be effected by operating in the reverse manner from that described above. In order to prevent misplacement or loss of the cap when removed from the tank opening, it is preferably connected to the adapter member by a suitable lanyard 132. One end of the lanyard is connected to the adapter at 133 while the other end extends in sealing relationship through a slot in the locking cap 120 and is connected to the lower end of the operating shaft as at 134. This lanyard is constructed of polyurethane or other suitable non-conductive material.

The above is a description of the preferred embodiments of the present invention; however, it is to be understood that various changes may be made without depart-

ing from the scope of the invention as set forth in the following claims.

I claim:

1. A filler cap for a tank having an opening defined by an annular wall surface extending into said tank, said cap comprising:

(a) a plug member having:

- (1) upper and lower ends,
- (2) an outer peripheral surface intermediate its ends adapted to be received within said opening in opposed relationship with respect to the annular wall surface thereof,
- (3) an outwardly extending flange disposed adjacent to the upper end thereof and adapted to seat directly against the upper end of the wall surface of said opening;

(b) a retaining member received over the lower end of said plug below said flange and having:

- (1) an annular surface facing said flange;

(c) sealing means disposed between said flange and said annular surface for compression and distortion between said peripheral surface of said plug member and the annular wall surface of said opening;

(d) locking mechanism disposed below said retaining member; and

(e) a movable operating shaft extending through said plug member from the upper end thereof and operatively connected to said locking mechanism for moving said locking mechanism into an operative locking position to lock said cap within the opening of said tank and for simultaneously drawing the flange of said plug member into direct contact with said upper end of the wall surface of the opening and the sealing means into sealing engagement with said annular wall surface.

2. A filler cap according to claim 1 wherein:

(a) said retaining member is slidably received over the lower end of said plug for movement toward and away therefrom; and

(b) said retaining member is operatively connected to said locking mechanism for axial movement therewith into compressive engagement with said sealing means to deform the latter outwardly of the peripheral surface of said plug member and into said sealing engagement with the annular wall surface of said opening upon movement of said locking mechanism into said locking position.

3. A filler cap according to claim 1 wherein:

(a) the annular wall surface of said opening against which said sealing means engages extends radially inwardly of said opening at an acute angle relative to the longitudinal axis of said plug member and the operating shaft thereof.

4. A filler cap according to claim 3 wherein:

(a) said plug member is constructed of electrically conductive material;

(b) said retaining member has an outer lower surface of non-conductive material with the upper annular surface thereof engaging against said sealing means to isolate the outer peripheral portion of said plug disposed below said sealing means from the interior of said tank;

(c) said locking mechanism is constructed with its exposed surface of non-conductive material; and

(d) non-conductive securing means is attached to the lower end of said operating shaft in enclosing relationship therewith for securing said locking mechanism to said shaft with the lower end thereof isolated from the interior of said tank.

5. A filler cap according to claim 4 further including:

(a) means disposed between said plug and said locking mechanism and normally urging said plug and locking mechanism away from each other.

6. A filler cap according to claim 5 wherein:

(a) said means comprises a compression spring en-

circling said operating shaft between said plug and locking mechanism for normally urging said plug and locking mechanism away from each other; and

- (b) the upper surface of said locking mechanism and the lower surface of said plug include non-conductive axially opposed portions engaging each other upon movement of the locking mechanism into said locking position to isolate said compression spring from the interior of said tank.

7. A filler cap for a tank having an opening defined by an annular wall surface extending into said tank, said cap comprising:

- (a) a plug member having:
 - (1) upper and lower ends,
 - (2) an outer peripheral surface intermediate its ends adapted to be received within said opening in opposed relationship with respect to the annular wall surface thereof,
 - (3) an inwardly extending first flange disposed adjacent to and facing the lower end thereof, and
 - (4) an outwardly extending second flange disposed adjacent to the upper end thereof and adapted to seat directly against the upper end of the wall surface of said opening;
- (b) a compression member slidably received over the lower end of said plug for movement toward and away therefrom and having:
 - (1) an annular surface facing the first flange of said plug member;
- (c) compressible sealing means disposed between said first flange and said annular surface for compression therebetween and distortion outwardly of said peripheral surface of said plug member as said plug and compression members are moved toward each other;
- (d) locking mechanism disposed below said compression member; and
- (e) a movable operating shaft extending through said plug member from the upper end thereof and operatively connected to said compression member and locking mechanism for drawing said compression member into compressive engagement with said sealing means to deform the latter outwardly of said peripheral surface of the plug member and for moving said locking mechanism into an operative position to lock said cap within the opening of said tank.

8. A filler cap for a tank having an opening defined by an annular wall surface extending into said tank and a flange portion extending from said annular wall toward the center of said opening with circumferentially spaced slots therein, said cap, comprising:

- (a) a plug member having:
 - (1) upper and lower ends,
 - (2) an outer cylindrical surface intermediate its ends adapted to be received within said opening in opposed relationship with respect to the annular wall surface thereof,
 - (3) an inwardly extending first flange disposed adjacent to and facing the lower end thereof, and
 - (4) an outwardly extending second flange disposed adjacent to the upper end thereof and adapted to seat directly against the upper end of the wall surface of said opening;
- (b) a cup-shaped compression member slidably received over the lower end of said plug for movement toward and away therefrom and having:
 - (1) an annular surface facing the first flange of said plug member;
- (c) compressible sealing means disposed between said first flange and said annular surface for compression therebetween and distortion outwardly of the cylindrical surface of said plug member as said plug and compression members are moved toward each other;

- (d) a rotatable shaft extending through said plug and compression members from the upper end of said plug member to the lower end of said compression member in slidable and sealed relationship with respect to said plug member;

(e) means disposed between said plug and compression members for normally urging said members away from each other;

(f) a locking support operatively connected to said shaft for rotation therewith at a position below said said compression member;

(g) a plurality of locking fingers fixed to said locking support at a position disposed radially outwardly thereof with respect to the longitudinal axis of said shaft, said fingers extending in an upward direction toward said compression member and being adapted to pass through and beyond the slots in the flange portion of said tank opening in one position of rotation of said shaft; and

(h) actuating means connected to the upper end of said shaft for rotating said locking support about the axis of said shaft upon rotation of said shaft to a second position and for drawing said compression member and locking support upwardly relative to said plug member upon upward longitudinal movement of said shaft in said second position of rotation to compress said sealing means and deform it outwardly of the cylindrical surface of the plug member and to bring said locking fingers into locking engagement with said flange portion of said opening.

9. A filler cap for a tank having an opening defined by an annular wall surface extending into said tank and a flange portion extending from said annular wall toward the center of said opening with circumferentially spaced slots therein, said cap comprising:

- (a) a plug member having:
 - (1) upper and lower ends,
 - (2) an outer cylindrical surface intermediate its ends adapted to be received within said opening in opposed relationship with respect to the annular wall surface thereof; and
 - (3) an outwardly extending flange disposed adjacent the upper end thereof and adapted to seat directly against the upper end of the wall surface of said opening;
- (b) sealing means connected to the outer cylindrical surface of said plug member below said flange and extending radially outwardly thereof to seal said plug member against the annular wall surface of said opening;
- (c) a rotatable shaft extending through said plug member in slidable and sealing relationship therewith;
- (d) locking plate operatively connected to said shaft for rotation therewith at a position below said plug member;
- (e) spring means disposed between said plug member and said locking plate for normally urging said plate away from said plug member;
- (f) a plurality of locking fingers fixed to said locking plate at a position located radially outwardly thereof with respect to the longitudinal axis of said shaft, said fingers extending in an upward direction toward said plug member and being adapted to pass through and beyond the slots in the flange portion of said tank opening in one position of rotation; and
- (g) a handle pivotally connected to said shaft about an axis extending crosswise thereof at the upper end of said plug member for rotating said shaft to a second position about its axis to move said fingers under and into longitudinal alignment with the flange portion of said opening and having a camming surface in operable engagement with the upper end of said plug member for drawing said locking plate

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toward said plug member upon rotation of the handle about said crosswise axis when said shaft is disposed in said second position of rotation.

10. A filler cap according to claim 9 further comprising:

(a) compressible locking means disposed on the upper surfaces of said locking fingers and facing toward said compression member.

11. A filler cap according to claim 10 wherein:

(a) said compressible locking means are comprised of resilient spring members positioned over said locking fingers in bowed relationship.

12. A filler cap for a tank having an opening defined by an annular wall surface extending into said tank, said cap comprising:

(a) a plug member having:

- (1) upper and lower ends,
- (2) an outer peripheral surface intermediate its ends adapted to be received within said opening in opposed relationship with respect to the annular wall surface thereof, and
- (3) an inwardly extending flange facing the lower end thereof;

(b) a compression member slidably received over the lower end of said plug for movement toward and away therefrom and having:

(1) an annular surface facing the flange of said plug member;

(c) compressible sealing means disposed between said flange and said annular surface for compression therebetween and distortion outwardly of said peripheral surface of said plug member as said plug and compression members are moved toward each other;

(d) locking mechanism disposed below said compression member;

(e) compressible means disposed between said compression member and said locking mechanism for normally urging said locking mechanism in a downward direction away from said compression member; and

(f) a movable operating shaft extending through said plug member from the upper end thereof and operatively connected to said compression member and locking mechanism for drawing said compression member into compressive engagement with said sealing means to deform the latter outwardly of said peripheral surface of the plug member and for moving said locking mechanism into an operative position to lock said cap within the operating of said tank.

13. A filler cap for a tank having an opening defined by an annular wall surface extending into said tank and a flange portion extending from said annular wall toward the center of said opening with circumferentially spaced slots therein, said cap comprising:

(a) a plug member having:

- (1) upper and lower ends,
- (2) an outer cylindrical surface intermediate its ends adapted to be received within said opening in opposed relationship with respect to the annular wall surface thereof,
- (3) an inwardly extending first flange disposed adjacent to and facing the lower end thereof, and
- (4) an outwardly extending second flange disposed adjacent to the upper end thereof and adapted to seat directly against the upper end of the wall surface of said opening;

(b) a compression member disposed below said plug member for movement toward and away therefrom and having:

(1) an annular surface facing the first flange of said plug member;

(c) compressible sealing means disposed between said first flange and said annular surface for compression

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therebetween and distortion outwardly of the cylindrical surface of said plug member as said plug and compression members are moved toward each other,

(d) a rotatable shaft extending through said plug and compression members from the upper end of said plug member to the lower end of said compression member in slidable and sealed relationship with respect to said plug member;

(e) a locking support operatively connected to said shaft for rotation therewith at a position below said compression member;

(f) means disposed between said compression member and said locking support for normally urging said locking support away from said compression member and said shaft in a downward direction;

(g) a plurality of locking fingers fixed to said locking support at a position disposed radially outwardly thereof with respect to the longitudinal axis of said shaft, said fingers extending in an upward direction toward said compression member and being adapted to pass through and beyond the slots in the flange portion of said tank opening in one position of rotation of said shaft; and

(h) actuating means connected to the upper end of said shaft for rotating said locking support about the axis of said shaft upon rotation of said shaft to a second position and for drawing said compression member and locking support upwardly relative to said plug member upon upward longitudinal movement of said shaft in said second position of rotation to compress said sealing means and deform it outwardly of the cylindrical surface of the plug member and to bring said locking fingers into locking engagement with said flange portion of said opening.

14. A filler cap according to claim 13 wherein:

(a) said actuating means comprises:

- (1) a handle pivotally connected to said shaft at the upper end of said plug member for movement about an axis extending crosswise of said shaft and having a camming surface in operable engagement with the upper end of said plug for drawing said compression member and locking support toward said plug member upon rotation of the handle about the transverse axis when said shaft is disposed in said second position of rotation.

15. A filler cap according to claim 14 wherein:

(a) said compressible means between said compression member and said locking mechanism comprises an annular compressible rubber ring surrounding said operating shaft.

16. A filler cap according to claim 15 wherein:

(a) said annular ring is spaced from said operating shaft by an annular spacer member.

17. A filler cap according to claim 16 wherein:

(a) said operating shaft extends downwardly beyond said locking mechanism; and wherein

(b) a locking cap is threaded onto the exposed end of the shaft in engagement with the undersurface of said locking mechanism to hold the parts of the cap in assembled condition.

18. A filler cap according to claim 17 wherein:

(a) said locking cap includes an internally disposed nut non-rotatably fixed therein for threaded engagement with the downwardly extending end of said operating shaft; and

(b) said locking cap, locking mechanism and compression member are all of non-conductive material.

19. A filler cap according to claim 18 wherein:

(a) said second flange is obliquely inclined toward the upper end of said plug member.

20. A filler cap according to claim 19 further comprising:

(a) means connecting said plug member and com-

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- pression member together against relative rotation; and
- (b) positioning lugs extending downwardly from said compression member and adapted to be positioned within the slots of the flange portion of the tank opening to hold said plug and compression members against rotation relative to the annular wall portion of said opening.
21. A filler cap according to claim 20 further comprising:
- (a) a handle recess in the upper end of said plug having a shape complementary to that of the handle for receiving said handle when said shaft is disposed in said second position of rotation.
22. A filler cap for a tank opening having an opening defined by an annular wall surface extending into said tank, said cap comprising:
- (a) a plug member having:
- (1) upper and lower ends,
 - (2) an outer cylindrical surface intermediate its ends adapted to be received within said opening in opposed relationship with respect to the annular wall surface thereof,
 - (3) an inwardly extending first flange disposed adjacent to and facing the lower end thereof, and
 - (4) an outwardly extending second flange disposed adjacent to the upper end thereof and adapted to seat directly against the upper end of the wall surface of said opening;
- (b) a compression member positioned below the lower end of said plug for movement toward and away therefrom and having:
- (1) an annular surface facing the first flange of said plug member, and
 - (2) an annular inwardly extending surface facing away from said compression member;
- (c) compressible sealing means disposed between said first flange and said annular surface for compression therebetween and distortion outwardly of said cylindrical surface of said plug member as said plug and compression members are moved toward each other;
- (d) a movable operating shaft extending through the plug member from the upper end thereof, through the compression member, and downwardly therebeyond for movement in an axial direction;

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- (e) a locking mechanism disposed below said compression member and comprising:
- (1) a generally U-shaped spring member positioned on said shaft at a point spaced from said compression member with camming surfaces adjacent either end engaging the tapered annular surface of said compression member and radially outwardly extending locking fingers; and
 - (f) means for securing said compression member and locking mechanism to said shaft for movement therewith in an upward direction to move said compression member toward said plug member and to slide the camming surfaces of said locking mechanism upwardly along the annular surface of said compression member and said locking fingers outwardly of the cylindrical surface of said plug member.
23. A filler cap according to claim 22 further comprising:
- (a) an operating handle pivotally attached to the upper end of said operating shaft in a vertical position when said shaft is moved to its downward position and having a camming surface engaging the upper surface of said plug member for moving said shaft in said upward direction as said handle is rotated downwardly toward said plug member.
24. A filler cap according to claim 23 wherein:
- (a) said means for securing said locking mechanism to said shaft comprises a seat member connected to said shaft below said locking mechanism; and
- (b) said spring member is positioned between said compression member and said seat member to normally urge said shaft in a downward direction when said handle is in a vertical position to retain the handle in said position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,391,817

July 9, 1968

Francis Shaw

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 33, "1865" should read -- 1965 --. Column 5, line 72, "provided" should read -- provide --.

Signed and sealed this 23rd day of December 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents