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3,164,288

CLOSURE AND VALVE CONSTRUCTION

Filed Jan. 10, 1963

2 Sheets-Sheet 1

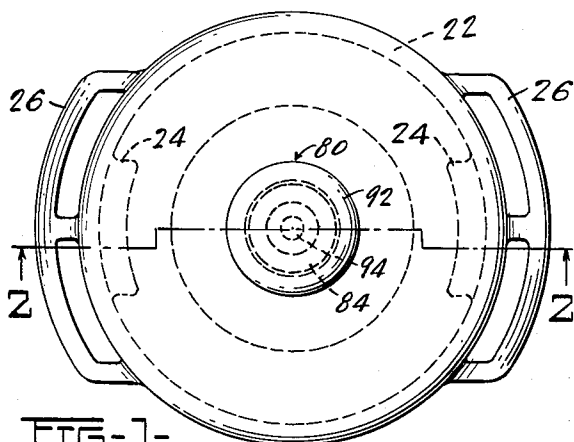


FIG-1-

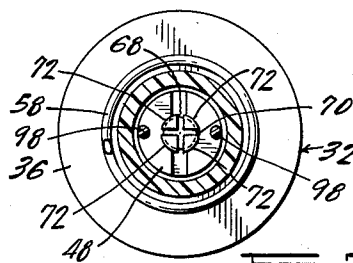


FIG-3-

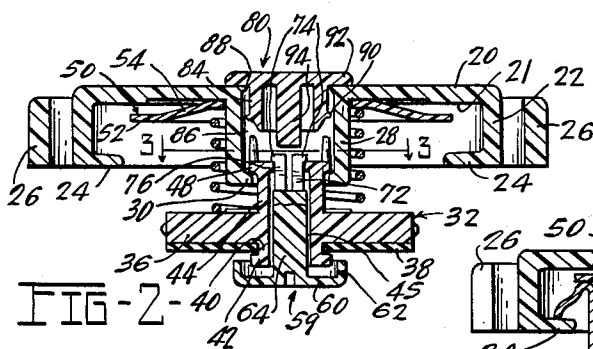


FIG-2-

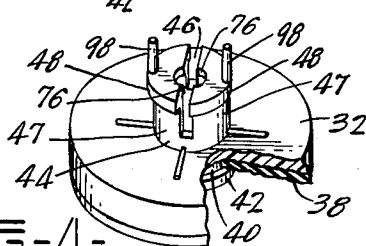


FIG-4-



FIG-9-

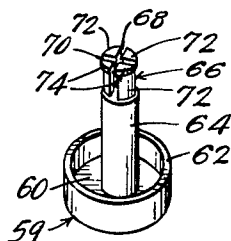


FIG-5-

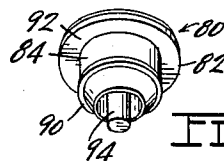


FIG-6-

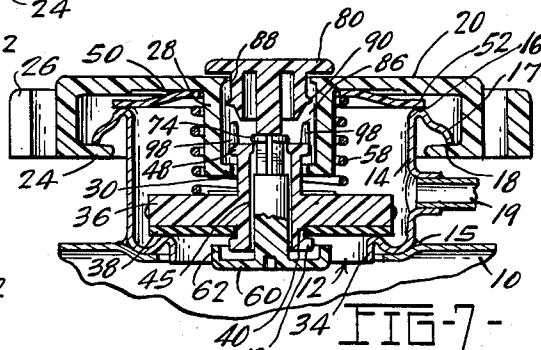


FIG-7-

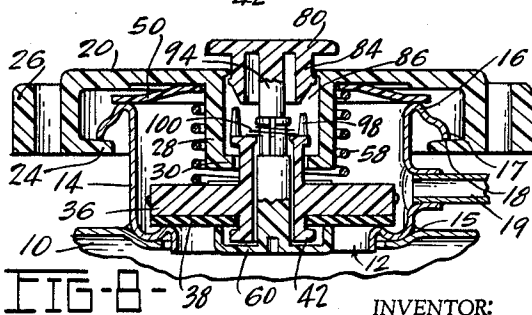


FIG-8-

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CLOSURE AND VALVE CONSTRUCTION

Filed Jan. 10, 1963

2 Sheets-Sheet 2

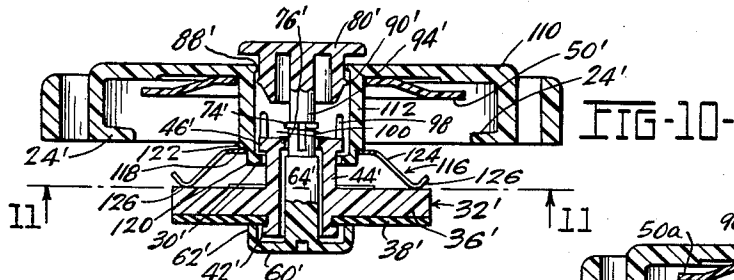


FIG-10-

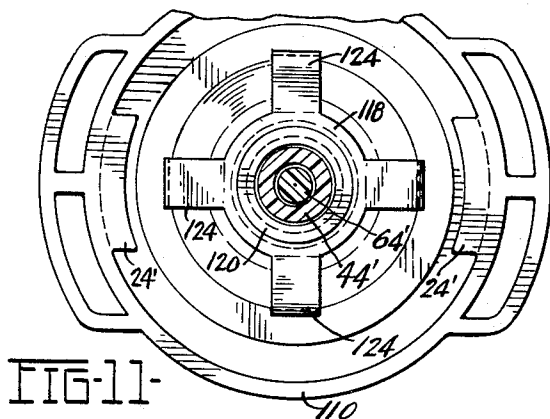


FIG-11-

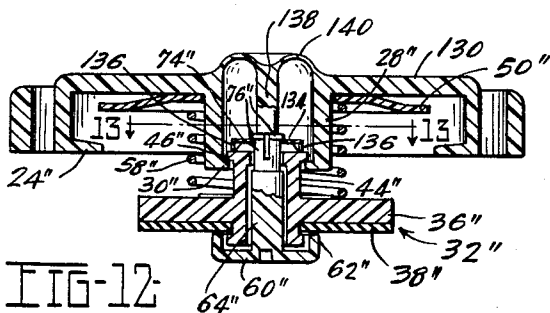


FIG-12-

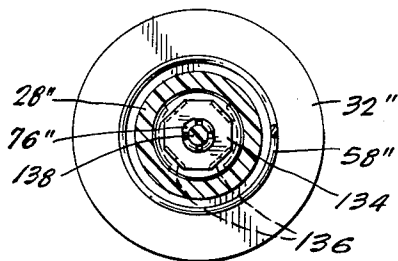


FIG-13-

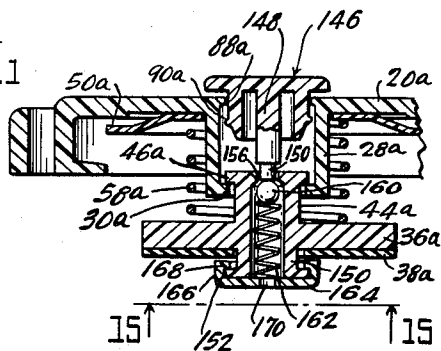


FIG-14-

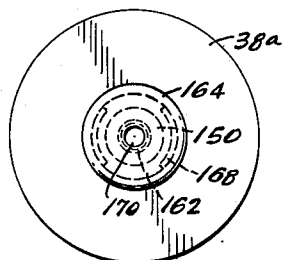


FIG-15-

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CLOSURE AND VALVE CONSTRUCTION

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11 Claims. (Cl. 220-44)

This invention relates to closures and more particularly to a pressure type cap or closure construction for a radiator or tank containing a body of liquid capable of being volatilized, the closure construction embodying relief valve means.

It is well-known that in heat exchange systems embodying a radiator forming a component of a closed cooling system for an internal combustion engine, excessive pressures may be developed upon the heating of the volatilizable coolant such as water. Upon subsequent cooling of the liquid or water, the closed system tends to establish a vacuum or subatmospheric pressure which may impair the circulation of the coolant.

Heretofore pressure caps, particularly for cooling radiators of engine cooling systems, have been fashioned of nonferrous metals such as copper-bearing alloys or ferrous metals or alloys treated or coated to resist rust. Copper-bearing alloys are costly and most ferrous metals are susceptible to oxidization particularly in an environment where they are exposed to steam and vapors.

The present invention embraces the provision of a closure or cap construction particularly for a heat exchanger of a cooling system wherein the major components of the construction are fashioned or fabricated of moldable resinous materials having comparatively high strength characteristics and which are stable and are unaffected by moisture.

Another object of the invention resides in the provision of a closure and valve construction for a cooling radiator wherein the major components are formed or molded of resinous plastic, the construction embodying valve means for maintaining predetermined pressures in the system and valve means for releasing the pressure in the system and for avoiding the establishment of subatmospheric or reduced pressures in the system upon reduction in the temperature of the cooling fluid.

Another object of the invention resides in a closure construction for a cooling radiator or heat exchange unit wherein the major components are fashioned of high strength resinous plastic and certain of the resinous components configured to be flexed or distorted during assembly whereby such components are held or interlocked in assembled relation without the use of screws or other fastening means.

Another object of the invention resides in a closure or cap and valve assembly for a cooling radiator for an internal combustion engine wherein the major components are fashioned of molded resinous plastic which is not affected by contact with steam or anti-freeze compounds that may be used in the radiator.

Another object of the invention resides in the provision of a radiator cap construction embodying pressure relief and vent valve means wherein several of the components are fashioned with ridges or projections interlockable by snap action for assembling and maintaining the components in proper operable relationship.

Still another object of the invention is the provision of a closure or cap construction for a cooling radiator embodying pressure and relief valve means fashioned of few components which may be assembled by unskilled operators and which require no adjustments.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of

parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

FIGURE 1 is a top plan view of one form of cap or closure construction of the invention;

FIGURE 2 is a sectional view taken substantially on the line 2-2 of FIGURE 1;

FIGURE 3 is a sectional view taken substantially on the line 3-3 of FIGURE 2;

FIGURE 4 is an isometric view illustrating one valve means of the construction;

FIGURE 5 is an isometric view illustrating a relief valve means forming a component of the construction;

FIGURE 6 is an isometric view illustrating a means for manipulating the relief valve;

FIGURE 7 is a sectional view illustrating the cap or closure construction associated with the filler neck of a container or radiator;

FIGURE 8 is a view similar to FIGURE 7 illustrating the construction embodying a relief valve biasing spring;

FIGURE 9 is an isometric view of a vent valve spring embodied in the construction shown in FIGURE 8;

FIGURE 10 is a sectional view illustrating a modified form of the construction of the invention;

FIGURE 11 is a sectional view taken substantially on the line 11-11 of FIGURE 10;

FIGURE 12 is a sectional view illustrating a modified form of the closure construction of the invention;

FIGURE 13 is a detail sectional view taken substantially on the line 13-13 of FIGURE 12;

FIGURE 14 is a sectional view illustrating another form of closure construction of the invention, and

FIGURE 15 is a detail sectional view taken substantially on the line 15-15 of FIGURE 14.

While the closure and valve construction of the invention has particular utility in closing the filler opening of a heat exchanger or radiator adapted to contain fluid for cooling an internal combustion engine, it is to be understood that the closure and valve arrangement may be utilized with other containers or receptacles wherever it is desirable or imperative to provide for release of pressure under certain operating conditions.

The form of the invention illustrated in FIGURES 1 through 7 is adapted to be associated with the filler neck of a container 10, which may be the header of a radiator or other receptacle having a filling aperture 12 provided by an upwardly extending generally cylindrical filler neck 14 brazed or welded as at 15 to the header 10 of a radiator and defining the aperture 12, the filler neck being connected with a conventional overflow or vent tube 19. The filler neck 14 is provided with a circular seat 16 and depending diametrically extending flanges 17, the lower edges 18 thereof being inclined in the conventional manner forming cam surfaces.

The closure or cap 20 is of generally circular shape, fashioned with a depending peripheral flange 22, having at diametrically opposed regions integral inwardly extending lugs, projections or abutments 24 adapted to interlock with the inclined or cam edge regions 18 of the depending portions 17 formed on the filler neck 14. The cap or closure member 20 is formed of resinous plastic material preferably of polyoxymethylene, marketed commercially under the trade name Delrin. The cap 20 may be fashioned with laterally extending grip portions 26 for ease in manipulating the cap.

The cap is fashioned with a circular depending flange defining a hollow hub portion 28, particularly shown in FIGURES 2 and 7, the lower terminus being formed with an inwardly extending flange or ridge 30 for purposes to be hereinafter explained.

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The closure construction is inclusive of a valve member or means 32 fashioned with a disc-like portion 36 which forms a backing or support for a sealing gasket or washer 38 formed of rubber, synthetic rubber or other suitable material which, in valve closing position, is engaged with the annular valve seat 34 formed on the filler neck 14, as shown in FIGURE 7.

Formed at the central region of the disc-like portion 36 is a tenon 40 fitted with the sealing gasket 38, the tenon terminating in an outwardly extending flange or bead 42 to retain the gasket 38 in a position contiguous with and engaging the disc-like portion 36 of the member 32. The sealing or valve gasket 38 is sufficiently yieldable to enable its assembly over the flange or bead 42 on the tenon 40. The member 32 is fashioned with a tubular extension or projection 44, the cylindrical passage 45 therein extending through the projection 44, the disc-like portion 36 and the tenon 40.

The upper end of the extension or projection 44 is fashioned with a diametrically arranged slot 46, shown in FIGURE 4, which divides the upper portion of the projection 44 into two semi-cylindrical sections 47 each having an outwardly extending ridge or flange 48. The purpose of the slot 46 is to render the two semi-cylindrical sections 47 of the portion 44 sufficiently resilient or yieldable so that the ridges 48 may be forced or snapped over the flange 30 formed on the hub portion 28 of the cap 20 so that the ridges 48 cooperate with the flange 30 forming interengaging or interlocking abutments to limit relative movement of the member 32 with respect to the cap 20.

The unit 32 comprising the disc 32 and its projections 40 and 44 is formed of resinous plastic material such as polyoxymethylene (Delrin) or other resinous plastics hereinafter mentioned. Arranged adjacent the planar portion of the cap 20 and interiorly of the cap is a disc-like member or diaphragm 50 preferably formed of resinous material, such as polyoxymethylene. The diaphragm 50 is of circular shape and has a circular opening to be received on the hub portion 28.

The diaphragm 50 has a peripheral portion 52 which is integral with a conically-shaped portion 54, the inner region of the conically-shaped portion engaging the interior or bottom surface 21 of the cap 20. When the cap construction is assembled with the metal filler neck 14, as shown in FIGURE 7, the peripheral portion 52 engages the annular seat 16 of the filler neck and effectively prevents escape of steam or liquid, except through the overflow pipe 19, that may enter the filler neck chamber upon opening or unseating of the valve gasket 38 from the annular seat 34 on the filler neck, shown in FIGURE 7.

An expansive coil spring 58 surrounds the hub portion 28 and the projection 44 and has its ends respectively engaging the disc-like member or diaphragm 50 and the upper surface of the disc-like portion 36 of valve member 32. The coil spring 58 is preferably made of stainless steel, bronze or other material which is immune to rust or rust resistant and which is not subject to deterioration upon contact with anti-freeze constituents that may be admixed with water or other coolant contained in the radiator or heat transfer unit.

A second or supplemental valve means 59 is associated with the disc-like member 32, the supplemental valve means serving dual purposes viz. as a vent means to relieve pressure in the radiator before the cap 20 is moved to release position and to vent the radiator to the atmosphere through the overflow pipe 19 should a vacuum be formed in the radiator upon cooling of the contents of the radiator. The vent valve or supplemental valve means 59 is inclusive of a disc-like member 60 of lesser diameter than the disc 36, the member 60 being fashioned with an upwardly extending circular flange or valve portion 62, which is adapted, upon upward movement of the valve means 59, to engage or seat against the gasket or washer 38 under the influence of increased pressure developed in the radiator as when steam or vapor is generated by heat transferred from the engine to the liquid coolant.

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The valve means 59 is particularly illustrated in FIGURE 5 and includes an upwardly extending stem, shaft or shank portion 64, the upper end region of which is fashioned with a tenon 66. The tenon 66 comprises four sections 72 provided by diametrically arranged kerfs or slots 68 and 70, the sections or projections 72 being of sector shape cross-section as shown in FIGURE 5. By fashioning the tenon 66 with the kerfs 68 and 70, the four sections 72 are rendered yieldable or distortable.

Each sector-shaped portion 72 is fashioned with an outwardly extending ridge or flange 74. The upper extremities of the two sections 47 of the hollow projection 44 defining the tubular passage 45 which receives the stem 64 is fashioned with integral inwardly extending ridges or flanges 76. In assembling the supplemental or vent valve means 59 with the valve member 32, the stem 64 is inserted in the passage 45 in member 32 engaging the outwardly extending ridges 74 of the tenon sections 72 with the flanges 76.

By exerting pressure against the disc portion 60 in an upward direction, as viewed in FIGURE 2, the sector-shaped sections 72 are deflected or forced inwardly by the flange 76. In this manner the projecting portions or ridges 74 snap over the flange 76 and provide abutments forming an interlock to prevent disassembly of the valve means 59 from the disc-like valve means 32 and gasket 38.

It should be noted from FIGURES 2 and 7 that when the vent valve portion 60 is in its lowermost or open position, further movement is prevented by engagement of the projections 74 with the flanges 76 fashioned on the sections 47 of the tubular portion 44 of member 32. The stem 64 of the valve member 60 is of lesser diameter than the diameter of the passage 45 in member 32 into which the stem extends so that when the valve means 59 is in its open position, as shown in FIGURES 2 and 7, a vent is provided by the space between the stem 64 and the inner cylindrical surface of the passage 45.

In the embodiment shown in FIGURES 1 through 8, means is provided for manually moving or releasing the supplemental or vent valve 59 to an open position. The manually operated vent valve release means 80 is in the form of a push button having an annularly shaped hub portion 84 extending into the cylindrically-shaped chamber 86 defined by the hub portion 28 on the cap 20. As particularly shown in FIGURES 2, 6, 7 and 8, the perimeter of the hub portion 28 defining the entrance to the opening or passage 86 is fashioned with an inwardly extending circular ridge, flange or bead 88.

The annular portion 84 on the button member 80 is fashioned with an outwardly extending bead or ridge 90, the ridge 90 being spaced vertically from the flange portion 92 of member 80 to permit relative vertical movement of the button from the position indicated in FIGURE 1 to the position indicated in FIGURE 8. The ridge 90 is of slightly greater diameter than the inner surface of the inwardly extending ridge 88 so that the button member 80 can be assembled with the cap member 20 simply by pressure exerted upon the button member sufficient to flex the material of the ridges 88 and 90 so that the ridge 90 snaps over the ridge 88 to form an interlock.

The inwardly extending ridge 88 on the cap member 20 and the outwardly extending ridge 90 provide abutment means engageable to prevent disassembly of the button 80 from the cap member 20.

The button valve release means 80 is fashioned of resinous plastic such as polyoxymethylene or other suitable resinous plastic which, while being rigid is sufficiently resilient or yieldable to permit assembly by snap action by forcing the ridge 90 past the ridge 88.

The member or push button 80 is formed with an axially arranged cylindrical projection or tenon 94 which is aligned with the cylindrical projection or stem 64 of the vent valve member 59 in the manner shown in FIGURES 2, 7 and 8. As shown in FIGURE 2, the tenon or cy-

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lindrical projection 94 of the button member 80 is of a length such that when the vent valve 59 is in its open or lowermost position as shown in FIGURE 2, slight clearance exists between the lower end of the tenon 94 and the upper surfaces of the sector shaped portions 72 of the projection or stem 64.

In this position the flange portion 92 of the button member 80 engages the upper surface of the cap 20. When the cap assembly is in operative position on the filler neck 14 and vapor pressure is developed in the radiator header 10 closing the vent valve 59 to the position shown in FIGURE 8, the button member 80 is elevated relative to the cap 20 through the engagement of the stem 64 on the vent valve portion 60 with the tenon 94 on the button member.

Formed on the hub portion 44 of the disc-like member 36 is a pair of diametrically arranged upwardly extending projections or abutments 98 which serve to prevent disengagement of the valve member 60 from the portion 44 of the member 36 in the event that the disc-like member 36 is moved to its extreme uppermost position with the member 36 adjacent the flange 30, as the projections 98 engage the annular projection 84 of the button 80 and prevent disassembly of the tenon portion 64 of the vent valve means 59 from the hollow hub 44 of the member 36.

In the arrangement shown in FIGURES 2 and 7, the valve member 59 is normally suspended by gravity in open position, this position being defined by engagement of the ridges 74 on the sector-shaped projections 72 with the inwardly extending ridges 76 on the hub portion 44. The vent valve means 59 is free to move vertically and, when vapor pressure develops in the radiator header 10, such pressure, acting upwardly upon the vent valve portion 60, engages the flange or valve seat 62 with the gasket or washer 38 to prevent the escape of vapor or gases through the clearance space between the stem 64 and the wall of the passage 45 in the disc 36 and its projection 44.

If it is desired to normally maintain the vent valve 60 in closed position, as shown in FIGURE 8, whether or not there is any vapor or increased pressure developed in the header 10, a coil spring 100 shown in FIGURE 9 may be assembled on the sector-shaped portions 72 of the tenon 64 in the position as illustrated in FIGURE 8.

The spring 100 is of frusto-conical shape and the small diameter of the spring is of a dimension to be snapped over the outwardly extending ridges 74 of the sector-shaped projections 72, the opposite end of the spring seating against the upper surface of the annular projection or hub 44. The spring 100 is comparatively weak so as to exert only a slight upward pressure on the valve member 59 to effect a seating of the valve flange or seat 62 against the washer or gasket 38, as shown in FIGURE 8.

The components of the radiator cap construction are assembled in the following manner: The button member 80 is positioned with the ridge 90 engaging the inwardly extending ridge 88. Downward force exerted upon the member 80 to snap the ridge 90 through or past the ridge 88, this action completing the assembly of the button member 80 with the cap 20. The diaphragm or flexible disc 50 is then telescoped over the annular hub portion 28 of the cap and the coil spring 58 telescoped over the annular hub portion 28. The flexible gasket 38 is stretched over the flange 42 to a position surrounding the tenon 44 and seating against the disc 36.

The cylindrical stem or tenon 64 of the valve member 60 is then inserted in the cylindrical passage 45 in the disc-like member 36 and its hub portion 44 and pressure exerted on the valve portion 60 to force the outwardly extending ridges 74 of the sector-shaped projections 72 past the inwardly extending ridge 76 on the hub portion 44.

The sector-shaped members 72 are sufficiently flexible by reason of their reduced cross-section to permit the outwardly extending ridges 74 to snap over the inwardly ex-

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tending flange portions 76, thus establishing an interlock of the valve means 59 with the disc-like member 36, the valve member having limited movement relative to the disc-like member 36 to facilitate opening and closing the vent valve portion 62.

The disc-like member 36, gasket 38 and the vent valve construction 59 is then assembled with the annular hub 28 on the cap 20 by forcing the outwardly extending ridges 48 past the inwardly extending ridge or flange 30 on the hub 28, the resinous plastic of which these components are formed being sufficiently flexible by reason of the slot 46 in the hub portion 44 to permit the ridges 48 to snap over the flange portion 30. This completes the series of steps or operations in assembling the several components of the cap construction.

It should be noted that the assembly operations do not require the use of special tools or any screws or extraneous fastening devices as the components, except for the metal spring 58, are fashioned of resinous plastic in such a manner as hereinbefore described to facilitate interlocking the components to prevent their disassembly but permitting the relative movements of the several components to perform their respective functions in use.

The operation and function of the various components of the radiator cap construction in use is as follows: The several components in their normal assembled positions are illustrated in FIGURE 2, the spring 100 being omitted from the form illustrated in FIGURE 2. It will be noted that the expansive pressure of the spring 58 holds the diaphragm 50 against the interior surface of the cap 20 and holds the disc-like member 36 at its extreme lowermost position limited by the abutment means provided by the ridges 48 engaging the ridge 30 on the sections 47 of the hub 44.

The cap assembly is installed in operative position upon the filler neck 14 of the header 10 of the cooling radiator by inserting the disc-like member 36 into the filler neck and engaging the washer or gasket 38 with the annular seat 34 formed on the filler neck. Downward pressure is then exerted upon the cap 20 to move the projections or lugs 24 of the cap 20 through slots existent in the flange portion 17 of a conventional filler neck 14.

The cap portion 20 is then rotated to move the projections 24 into engagement with the cam surfaces 18 of conventional character formed on the flange 17 of the filler neck construction. The angularity of the cam surfaces 18 move or draw the cap construction downwardly toward the filler neck, compressing the spring 58 which exerts pressure on the disc 36 and the gasket 38 to maintain the gasket 38 in sealing or seating engagement with the annular seat 34 formed on the filler neck construction. When atmospheric pressure exists in the header 10 the valve portion 62 is normally in its open position as shown in FIGURE 7.

In the event that pressure is generated within the radiator header 10 by the transfer of heat into the water or coolant in the radiator from the engine, such pressure acts on the vent valve portion 60 to move the valve portion 62 to closed position with the valve portion 62 thereof in sealing engagement with the gasket 38 providing a closed cooling system. Pressure may thereafter increase in the radiator header 10 until the pressure reaches an amount greater than the compression pressure of the spring 58 holding the gasket 38 upon its seat, under which condition the excessive pressure elevates the disc-like member 36 and the gasket 38 and permits the escape of vapor or gases into the chamber defined by the filler neck thence through the vent tube or overflow pipe 19 to the atmosphere.

When vapor pressure develops within the radiator header and elevates the vent valve means 59 to its closed position, the projection or tenon 64 on the valve member 60 engages the tenon or projection 94 on the button 82 and elevates the button approximately to the position relative to the cap 20 as illustrated in FIGURE 8. As long as pressure above atmospheric pressure exists in the radiator

and the vent valve 62 remains closed, the button 80 is maintained in its elevated position.

In event that it is desired to remove the radiator cap assembly while pressure exists within the radiator and header, the member or push button 80 is depressed, which action through the tenon 94 engaging the stem 64 moves the valve portion 60 downwardly and the valve portion 62 away from the gasket 38.

This permits vapor or gas to escape or flow from the radiator header through the clearance space between the projection 64 and the wall of passage 45 in member 32 into the interior of the hollow hub portion 28 thence downwardly through the clearance space between the annular hub portion 44 and the flange or ridge 30 into the filler neck chamber and through the vent tube or overflow pipe 19 until the pressure within the radiator and header is brought to an atmospheric pressure.

The radiator cap portion 20 may then be rotated to disengage the lugs or projections 24 from the cam surfaces 18 to remove the cap and valve assembly from the filler neck without liability of injury by hot vapor or gases which would otherwise escape under pressure should the gasket 38 be released by disengagement of the projections 24 on the cap with the cam surfaces on the filler neck without first relieving the pressure by the vent valve.

The valve means 59 also functions to prevent the formation of a vacuum within the radiator and header upon cooling of the contents of the radiator. As long as pressure is existent in the radiator the vent valve portion 62 is held in its closed position. Upon cooling of the contents of the radiator with a consequent pressure drop in the radiator, the valve means 59 moves downwardly to open position venting the interior of the radiator and header to the atmosphere through the overflow pipe 19.

In the arrangement illustrated in FIGURE 8, the comparatively weak coil spring 100 normally biases the valve 60 to a closed position. When it is desired to relieve the pressure in the radiator preparatory to removing the cap 20 and valve assembly from the filler neck, the button 80 is depressed to engage the tenon 94 and stem 64, compressing the spring 100 and opening the valve member 60. Where the coil spring 100 is employed, the attendant or operator holds the button in depressed position with the vent valve member 60 in open position, thus venting the radiator until the pressure is reduced to atmospheric pressure after which the cap 20 may be rotated and removed in the manner hereinbefore described.

As the pressure of the coil spring 100 is very small, the formation of a slight vacuum within the radiator upon cooling of the contents of the radiator will cause atmospheric pressure to compress the spring 100 and open the vent valve 60 and equalize the pressure within the radiator and header.

The cap construction 20, the push button 80, the disc-like member 36, the vent valve construction 60 and the diaphragm 50 are fashioned of molded resinous plastic and preferably polyoxymethylene, commercially known as Delrin. This resinous plastic has high strength characteristics, high resilience, low moisture sensitivity and is stable at elevated temperatures. It has high solvent resistance and hence is unaffected by anti-freeze compounds which are conventionally used in radiators. As the components of the construction are held in assembled relation by snap over interlock means hereinbefore described, no independent fastening means are required and the components will remain in assembled condition throughout the life of the cap construction. The components require no maintenance or service.

While polyoxymethylene resin has been found to be very satisfactory for the resinous plastic components of the construction, other resinous plastic materials may be used for fashioning the components such as polychlorotrifluoroethylene, commercially known as Kel-F, and polytetrafluoroethylene, commercially known as

Teflon, and a resinous plastic commercially known as Marblock.

FIGURES 10 and 11 illustrate a modified form of the arrangement shown in FIGURES 1 through 8. In this form the cap member 110 is fashioned with a hollow depending hub portion 112, the interior of the hub portion 112 accommodating a push button or member 80' of the same construction as the component 80 hereinbefore described. The button 80' is provided with an outwardly extending bead or ridge 90' which cooperates with an inwardly extending ridge or bead 88' for maintaining the button 80' and the cap member 110 in assembled relation.

The valve means 32' includes the disc-like member 36' and hub portion 44' which are the same construction as the corresponding components shown in the form of the invention illustrated in FIGURES 1 through 8, the projections 46' on the hub portion 44' being arranged to snap over the inwardly extending flange or ridge 30' formed on the hollow hub portion 112. The vent valve member 60', its tenon portion 64' and the means of interlocking the valve member 60' with the hub portion 44' are the same as hereinbefore shown and described in the form of the invention shown in FIGURES 2 through 8. The flange 62' of the vent valve 60' is adapted to seat against the washer or gasket 38'.

A thin disc-like diaphragm 50' is mounted on the hollow hub 112 and functions in the same manner as the diaphragm 50 shown in FIGURE 2. In the form of the invention illustrated in FIGURES 10 and 11 a modified resilient means or spring arrangement is provided for urging the gasket 38' into engagement with the seat on the filler neck of the character shown in FIGURE 7. The spring construction 116 comprises a central disc-like portion 118 having an opening of a size to fit over a tenon 120 formed on the lower exterior region of the hollow hub 112 on the cap member 110 and seating against an annular ledge 122 on the hub portion.

The spring 116 is fashioned with a plurality of radially extending flexible arms or fingers 124 configured as shown in FIGURE 10 and having their curved extremities 126 engaging the upper surface of the disc-like member 36'. While four resilient arms 124 are illustrated, it is to be understood that two or more arms may be employed for the purpose. The arms or fingers 124 are angularly arranged with respect to the central portion, as illustrated in FIGURE 10, in order to exert a downward bias or pressure upon the disc-like member 36' for the purpose of urging the washer or gasket 38' into engagement with the annular seat on the filler neck.

The components of the construction shown in FIGURES 10 and 11 are assembled in the following manner: The sealing gasket 38' is stretched over the flange 42' formed on a tenon portion of the disc-like member 36'. The shank or tenon portion 64' of the valve structure 60' is then inserted in the central passage through the disc-like member 36' and its hub portion 44' forcing the outwardly extending ridge portions 74' past the inwardly extending flange portions 76' on the hub 44'.

This action interlocks the valve member 60' with the disc-like member 36', the valve 60' being arranged for lengthwise movement with respect to the axis of the disc-like member to facilitate opening and closing movement of the vent valve 60'. The diaphragm 50' is fitted on the hub portion 112 of the cap 110 and the spring member 118 is seated against the ledge 122 formed on the hub portion 112. The shank of the button member 80' is then inserted in the hollow interior of the hub portion 112 of the cap by forcing the outwardly extending bead or ridge 90' to snap over the inwardly extending ridge or bead 88' on the cap 110.

The installation of the cap assembly illustrated in FIGURES 10 and 11 with a filler neck construction of the character shown at 14 in FIGURE 7 is the same as the installation of the cap construction shown in FIGURES

1 through 7. An attendant or operator installing the cap inserts the disc portion 36' in the filler neck 14 (shown in FIGURE 7) until the gasket 38' seats upon the annular seat 34 of the filler neck construction.

Downward pressure is then exerted upon the cap 110, flexing the arms or portions 24 of the spring outwardly until the lugs 24' on the cap 110 are in a position to engage the conventional cam surfaces 18 formed on the filler neck portion 17. The cap 110 is then rotated to a position wherein the cam surfaces on the filler neck draw or force the cap downwardly, further compressing the spring arms 124 as the sealing gasket 38' and member 36' are moved axially relative to the cap 110 during rotation of the cap 110 to its completely installed position.

The cap assembly of FIGURES 10 and 11 functions in substantially the same manner as the cap assembly illustrated in FIGURES 1 through 7. When vapor pressure rises in the radiator, the pressure moves the vent valve 60' into engagement with the gasket 38' sealing off the vent to the region above the member 36'. In event pressure exceeding the downward pressure of the spring fingers 124 is developed in the radiator, the member 32', the gasket 38' and the valve member 60' are moved upwardly to permit the escape of gases past the sealing gasket 38' in the manner hereinbefore described.

When it is desired to relieve the pressure in the radiator in order to safely remove the cap assembly, the operator or attendant depresses the button or member 80' moving the tenon 94' of the button downwardly into engagement with the shank 64' of the vent valve 60', thus moving the valve portion 62' away from the gasket 38' and permitting the escape of gases or vapor through the space between the shank 64' and the hub portion 44' into the chamber defined by the filler neck and through the conventional overflow pipe to the atmosphere.

After the pressure has been relieved in this manner, the cap 110 is rotated in a direction to release the lugs 24' from the cam surfaces on the filler neck, permitting the removal of the entire cap and valve assembly. The cap 110, diaphragm 50', the valve means 32' and the valve means 60' are fashioned of resinous plastic, such as polyoxymethylene or other resinous plastics of the character hereinbefore mentioned.

FIGURES 12 and 13 illustrate a further modified form of the invention. In this form the cap 130 is of a shape similar to the cap 20 shown in FIGURE 2 formed with a depending hollow hub portion 28'' terminating in an inwardly extending ridge or bead 30''. The movable valve member 36'' of the valve means 32'' is equipped with a washer or sealing gasket 38'' adapted to seat against the annular seat 34 of the filler neck shown in FIGURE 7 as hereinbefore described in connection with other forms of the invention. The member 36' is provided with a hub portion 44'' having at its upper end outwardly extending bead portions 46'' which snap over and interlock with the ridge portion 30'' to establish an interconnection between the cap 130 and the member 36''.

The valve member 60'' is of the same construction as the valve 60 shown in FIGURE 2, having a shank portion 64'' fashioned with sector-shaped portions 74'', each projection having an outwardly extending ridge 76'' which, in assembly with the hub portion 44'' snaps over the ridge portions 76'' to establish an interlocking connection between the valve member 60'' and the member 36''.

In this construction a spring means is provided normally biasing the seat portion 62'' of the vent valve member 60'' into closed position in engagement with the gasket 38''. Telescoped over the ridges 76'' on the shank 64'' is a plate spring 134 which, as shown in FIGURE 13, is of polygonal shape.

The peripheral region of the plate spring 134 is fashioned with a plurality of downwardly extending fingers or ears 136 which engage the upper end surface of the hub portion 44'' formed on the member 36''. As the body portion of the plate spring 134 engages the lower

surfaces of the beads or ridges 76'' and the fingers 136 engage the upper surface of the hub portion 24'', the resiliency of the plate 134 normally biases the valve seat portion 62'' of the vent valve 60'' into closed position in engaging relation with the washer or gasket 38'' to thereby close the vent passage provided by the clearance space between the shank 64'' and the interior wall of the central passage in the member 36'' and hub 44''.

The plate spring 134 is made very thin so as to offer only slight resistance to opening of the vent valve 60'' so that in event of formation of a vacuum in the radiator when the contents of the header are cooled, the vent valve 60'' will be opened by atmospheric pressure to equalize the pressure in the radiator. A diaphragm 50'' has a central opening whereby it is received on the hub portion 28'' of the cap 130. An expansive coil spring 58'' surrounds the hub portion 28'' and is disposed between the diaphragm 50'' and the member 36'' to bias the member 32'' downwardly to engage the washer or gasket 38'' with the seat on the filler neck.

Means is formed on or carried by the cap 130 for manually effecting release of the vent valve 60''. The cap member 130 is provided with an axially disposed tenon portion or shank 138 which extends downwardly and is adapted for engagement with the upper end of the shank or tenon 64'' on the vent valve member 60''. The cap 130, being formed of resinous plastic material, is fashioned or molded with a comparatively thin web or membrane portion 140 joining the upper surface of the cap member at its juncture with the hub portion 28'' and the upper end region of the shank or tenon 138.

The web portion 140 is preferably curved or configured in cross-section, as shown in FIGURE 12, to form an annular raised region. The membrane 140, being made comparatively thin, may be flexed downwardly by manual pressure applied to the central region of the web thereby moving the tenon portion 138 into engagement with the upper surface of the shank 64'', the downward pressure on the web 140 moving the valve member 60'' downwardly to move the valve seat portion 62'' away from the gasket 38'' and thereby vent the radiator to facilitate the escape of gases or vapor therefrom in the manner hereinbefore explained in reference to other forms of the invention.

After the pressure is thus relieved by opening the vent valve 60'', the cap 130' may be readily rotated to disengage the lugs 24'' from the cam surfaces on the filler neck to permit removal of the cap and valve assembly.

In this form of the invention, the plate spring 134 normally biases the vent valve 60'' to closed position, but the spring is sufficiently weak to permit downward movement or opening of the vent valve 60'' by atmospheric pressure above the valve in the event of the formation of a vacuum in the radiator.

It is to be understood that the cap construction 130, the diaphragm 50'', the member 36'' and the vent valve member 60'' are fashioned or molded of resinous plastic such as polyoxymethylene (Delrin) or fashioned of other resinous plastics of the character hereinbefore mentioned.

Another form of the invention is illustrated in FIGURES 14 and 15. In this form of the invention the vent valve is in the form a ball valve or check ball. The cap 20a is of the same construction as the cap 20 illustrated in FIGURE 2. The cap 20a is provided with a hollow hub portion 28a terminating in its lower end in an inwardly extending ridge or bead 30a. The member 36a is similar to the member 36 and is fashioned with a hollow hub portion 44a terminating in outwardly extending ridge portions 46a which, in assembly with the hub portion 28a, are adapted to snap over the ridge portion 30a to establish an interlocking connection between the member 36a and the cap member 20a.

A diaphragm 50a is received on the hub portion 28a and an expansive coil spring 58a is disposed between the diaphragm 50a and the member 36a.

A vent valve release member or button 146 is interlocked with the cap member through the snap over engagement of the outwardly extending ridge or bead 90a on the member 146 with the inwardly extending ridge or bead 88a on the cap member 20a. The central region of the button 146 is provided with a depending shank 148 terminating in a tenon portion 150.

The member 36a is fashioned with an annular depending extension 150, the lower end of which is provided with an outwardly extending ridge or flange 152. The member 36a has a central passage 154 the upper end of which is fashioned with a restricted opening defined by an inwardly extending flange or bead 156. Disposed in the passage 154 is a vent valve means in the form of a check ball 160 and a comparatively light expansive coil spring 162 is disposed in the passage 154 engaging the ball 160.

An abutment for the spring 162 is provided by a disc-like member 164 formed of resinous plastic and configured with a peripheral flange 166 terminating in an inwardly extending bead or ridge 168. The member 164 is formed with a comparatively small central opening or passage 170 in communication with the passage 154. A washer or gasket 38a of yieldable material is stretched over the outwardly extending ridge 152, the check ball 160 and the spring 162 inserted in the passage 154 and the resinous plastic cap 162 snapped over the flange or ridge 152 to occupy the position illustrated in FIGURE 14.

In this position the member 164 provides an abutment for the spring 162 and prevents dislodgement of the washer or sealing gasket 38a. In this form of the invention, the cap 20a, the diaphragm 50a, the member 36a, check ball 160 and the abutment member 164 are fashioned of molded resinous plastic such as polyoxymethylene (Delrin) or other resinous plastic materials of the character hereinbefore mentioned. Thus, in this construction the only metal components are the springs 58a and 162 which are fashioned of stainless steel or bronze or other material resistant to rust.

The installation and function of the cap construction shown in FIGURES 14 and 15 is substantially the same as the other forms of the invention hereinbefore described. When installed in a filler neck, the gasket 38a engages the annular seat 34 on the filler neck of lesser diameter, shown in FIGURE 7, while the diaphragm 50a engages the upper annular seat 16 of larger diameter fashioned on the filler neck construction. The spring 58a is compressed upon downward pressure and rotation of the cap 20a when the latter is interconnected with the cam surfaces on the filler neck to hold the sealing gasket 38a on the filler neck seat.

The spring 162 normally biases the vent valve 160 toward closed position so that pressure is maintained in the radiator.

In the event it is desired to relieve the pressure in the radiator preparatory to removing the valve assembly, the button or member 146 is depressed which, through the medium of the tenon 150, moves the check ball 160 downwardly away from its seat so as to facilitate the escape of gases or vapors from the radiator through the passage 154 and between the tenon 150 and the seat 156 for the ball check into the filler neck and through the overflow pipe to the atmosphere.

Upon cooling of the radiator and its contents tending to form a vacuum or reduced pressure in the radiator, the atmospheric pressure above the check ball will move the check ball away from its seat and admit air into the radiator to equalize the pressure.

It is to be understood that in all forms of the invention hereinbefore described, all of the components except the springs are fashioned of resinous plastic molded to the particular configurations shown and described having the interlocking features to establish interconnections between the components to facilitate their proper functioning as hereinbefore described. While it has been found preferable to mold these components of resinous plastic such as

polyoxymethylene, other resinous plastics having characteristics suitable for the purpose may be used. Among the salient features of the invention is the formation or shaping of the resinous plastic components with yieldable or distortable interlocking projections, ridges or beads whereby the components are held in their assembled relationship eliminating completely the use of extraneous fastening means.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than as herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

I claim:

1. A closure means for attachment to a filler neck of a receptacle including, in combination, a closure cap of molded polyoxymethylene provided with means arranged for engagement with the filler neck, a valve member of molded polyoxymethylene, means arranged to retain the valve member in assembled relation with the cap whereby the valve member is adapted for limited movement relative to the cap, and resilient means disposed between the valve member and cap biasing the valve member in a direction away from the cap.

2. A closure means for attachment to a filler neck of a receptacle including, in combination, a closure cap of nonmetallic material provided with means arranged for removable engagement with the filler neck, a valve member of nonmetallic material, laterally extending means on said member and cap arranged to be interengaged by distortion of said means whereby said member and cap are maintained in interlocked but relatively movable relation, and resilient means disposed between the valve member and cap biasing the valve member in a direction away from the cap.

3. A closure means for attachment to a filler neck of a receptacle including, in combination, a closure cap of molded polyoxymethylene provided with means arranged for removable interlocking engagement with the filler neck, a first valve member of molded polyoxymethylene, a second valve member of molded polyoxymethylene, said first valve member having a passage therein, means associated with said second valve member extending into said passage and being movable relative to the first valve member, laterally extending means on said first valve member and said cap arranged to be interengaged by distortion of said means whereby said first valve member and cap are maintained in interlocked relation, said interlocking connection providing limited movement of the first valve member relative to the cap, spring means disposed between the cap and the first valve member, said second valve member being arranged for limited movement relative to the first valve member.

4. A closure means for attachment to the filling neck of an internal combustion engine radiator including, in combination, a cap fashioned of nonmetallic material and formed with means arranged for removable interlocking engagement with the filling neck, a first valve member of nonmetallic material, a valve gasket associated with the valve member arranged to engage a seat formed on the filling neck, interengageable abutment means for establishing an interconnection of the cap with the first valve member whereby the said valve member is arranged for limited movement relative to the cap for relieving pressures in the radiator, resilient means arranged between the cap and valve member normally biasing the gasket of the first valve member into engagement with the seat on the filler neck, a second valve member formed of nonmetallic material having a valve surface arranged for engagement with the gasket associated with the first valve member, said second valve member having a shank portion provided with laterally extending means arranged to be distorted relative to the first valve member to establish interlocking engagement with the first valve member and arranged for limited movement relative to the first valve

member for admitting air into the radiator upon establishment of subatmospheric pressure in the radiator.

5. Closure means for attachment to the filling neck of an internal combustion engine radiator, including, in combination, a cap fashioned of nonmetallic material and formed with means arranged for removable interlocking engagement with the filling neck, a flexible diaphragm of nonmetallic material arranged adjacent and engaging the cap, a first valve member of nonmetallic material, a valve gasket associated with the valve member arranged to engage a seat formed on the filling neck, means connecting the cap with the first valve member whereby said valve member is arranged for limited movement relative to the cap for relieving pressures in the radiator, resilient means engaging the diaphragm and valve member normally biasing the valve member and gasket into engagement with the seat on the filler neck, a second valve member formed of nonmetallic material having a valve surface arranged for engagement with the gasket associated with the first valve member, said second valve member having a shank portion provided with laterally extending means arranged to be distorted relative to the first valve member to establish interlocking snap engagement with the first valve member and arranged for limited movement relative to the first valve member for admitting air into the radiator upon establishment of subatmospheric pressure in the radiator.

6. A closure means for attachment to a filler neck of a receptacle including, in combination, a closure cap provided with means arranged for removable engagement with the filler neck, a disc-like member, a valve gasket mounted on the disc-like member, abutment means establishing a snap-on interlocking connection between the disc-like member and the cap, said connection providing for limited relative movement between the disc-like member and cap, and resilient means between the cap and disc-like member biasing the member away from the cap.

7. A closure means for attachment to a filler neck of a receptacle including, in combination, a closure cap formed of nonmetallic material and provided with means arranged for removable interlocking engagement with the filler neck, a disc-like member formed of nonmetallic material, a valve gasket mounted on the disc-like member, abutment means establishing a snap-on interlocking connection between the disc-like member and the cap, said connection providing for limited relative movement between the disc-like member and cap, resilient means between the cap and disc-like member biasing the member away from the cap, and a supplemental valve element of nonmetallic material arranged to engage the valve gasket mounted on the disc-like member.

8. A closure means for attachment to a filler neck of a receptacle including in combination, a closure cap of nonmetallic material and provided with means arranged for removable interlocking engagement with the filler neck, a disc-like member formed of nonmetallic material, a valve gasket mounted on the disc-like member, means establishing a snap-on interlocking connection between the disc-like member and the cap, said connection providing for limited relative movement between the disc-like member and cap, resilient means between the cap and disc-like member biasing the member away from the cap, a supplemental valve element of nonmetallic material arranged to engage the valve gasket mounted on the disc-like member, said element having a snap-on interlocking connection with the disc-like member providing for limited movement of the valve element relative to the member, and means associated with the cap and accessible exteriorly thereof for moving the supplemental valve element out of engagement with the valve gasket.

9. A closure means for attachment to a filler neck of a receptacle including in combination, a closure cap of molded polyoxymethylene provided with means arranged for removable interlocking engagement with the filler neck, a disc-like member of polyoxymethylene, a diaphragm disposed adjacent the cap, a valve gasket mounted on the disc-like member, means establishing a snap-on interlocking connection between the disc-like member and the cap, said connection providing for limited relative movement between the disc-like member and cap, resilient means between the diaphragm and disc-like member biasing the member away from the cap, a supplemental valve element of molded polyoxymethylene arranged to engage the valve gasket mounted on the disc-like member, said element having a snap-on interlocking connection with the disc-like member and arranged for limited movement relative to the member, and means associated with the cap and accessible exteriorly thereof for manually moving the supplemental valve element out of engagement with the valve gasket.

10. A closure for a receptacle having a filling aperture defined by an upwardly extending filler neck fashioned with a valve seat and an opening in the filler neck communicating with the atmosphere, said closure comprising a cap having lugs engageable with cam surfaces on the filler neck for removably securing the cap to the filler neck, said cap being formed with a hollow hub portion, a valve member having a hub portion arranged to extend into the interior of the hub portion on the cap, said hub portions being formed with laterally extending means arranged to be interengaged by distortion of one of said hub portions whereby said hub portions are maintained in interlocked but relatively movable relation, a gasket on the valve member engageable with the valve seat formed on the filler neck, spring means disposed between the cap and the valve member biasing the valve member toward valve closing position, a pressure relief member associated with the valve member, and manually actuable means associated with the cap member for effecting relative movement of the pressure relief member to vent the receptacle, said cap, valve member and pressure relief member being of molded resinous plastic.

11. A closure for a receptacle having a filling aperture defined by an upwardly extending filler neck fashioned with a valve seat and an opening in the filler neck communicating with the atmosphere, said closure comprising a cap having lugs engageable with cam surfaces on the filler neck for removably securing the cap to the filler neck, said cap being formed with a hollow hub portion, a valve member having a hub portion arranged to extend into the interior of the hub portion on the cap, said hub portions being formed with laterally extending means arranged to be interengaged by distortion of one of said hub portions whereby said hub portions are maintained in interlocked but relatively movable relation, a gasket on the valve member engageable with the valve seat formed on the filler neck, spring means disposed between the cap and the valve member biasing the valve member toward valve closing position, a pressure relief member associated with the valve member, and a plunger associated with the cap member for effecting relative movement of the pressure relief member to vent the receptacle, said cap, valve member, plunger and pressure relief member being formed of molded polyoxymethylene.

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