June 11, 1940. A. L. SWANK 2,203,801

CLOSURE DEVICE FOR SEALED COOLING SYSTEMS

Filed Nov. 12, 1936 2 Sheets-Sheet 1

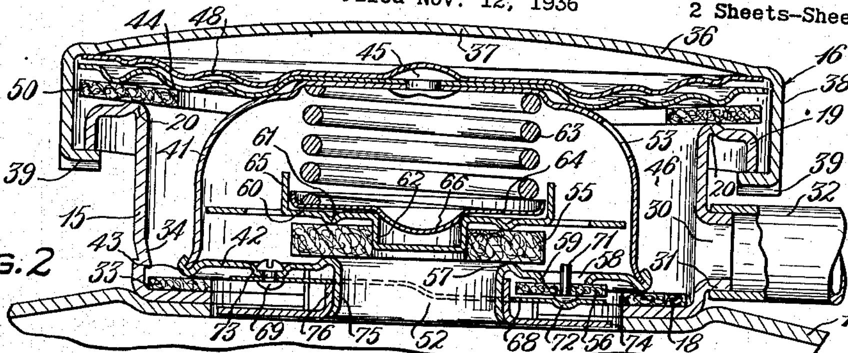

FIG. 2

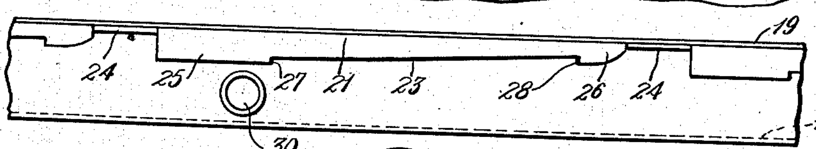

FIG. 3

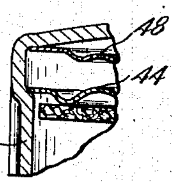

FIG. 4

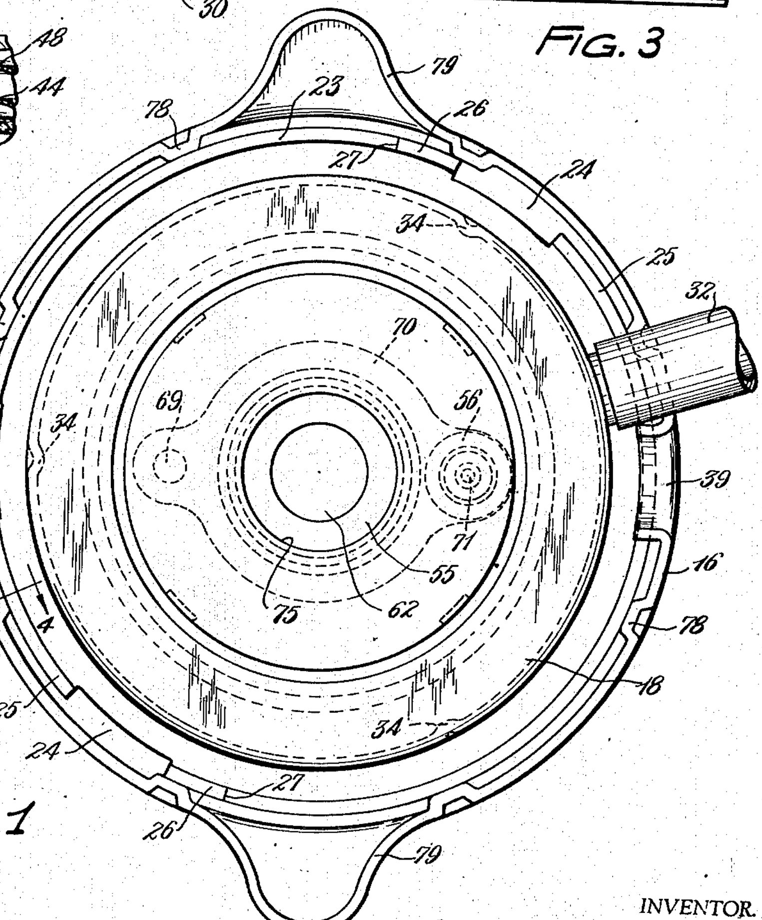

FIG. 1

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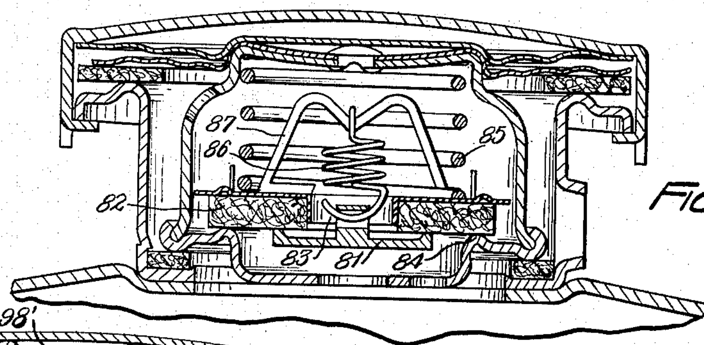

FIG. 5

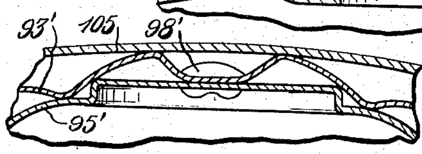

FIG. 7

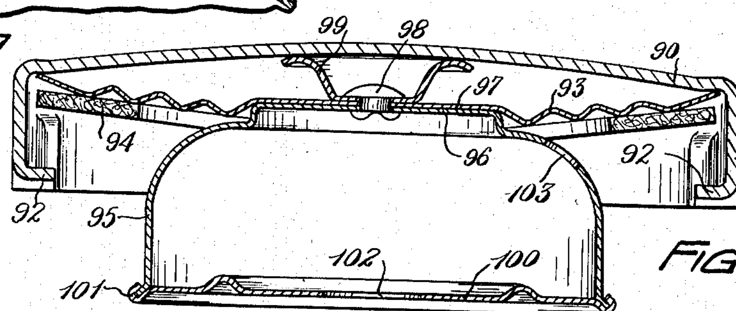

FIG. 6

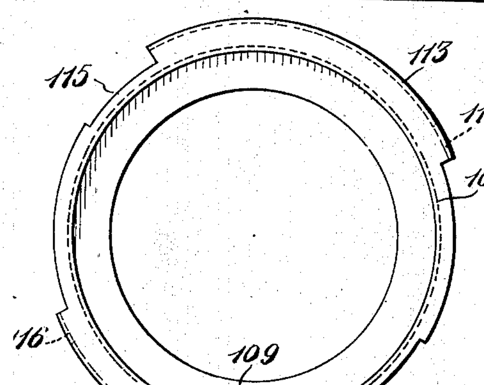

FIG. 10

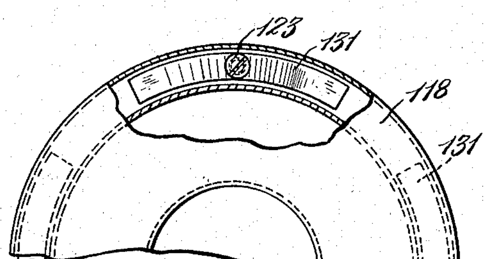

FIG. 9

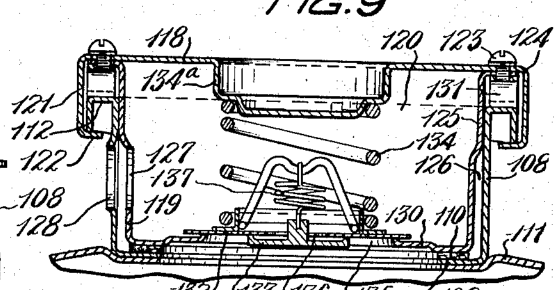

FIG. 8

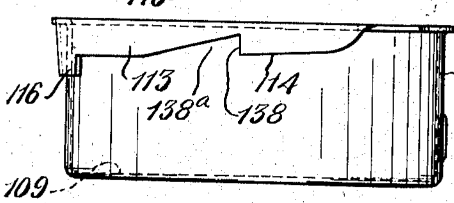

FIG. 11

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Patented June 11, 1940 2,203,801

UNITED STATES PATENT OFFICE

2,203,801

CLOSURE DEVICE FOR SEALED COOLING SYSTEMS

Arthur L. Swank, Detroit, Mich; Nellie L. Swank, special administratrix of said Arthur L. Swank, deceased; assignor to Eaton Manufacturing Company, Cleveland, Ohio, a corporation of Ohio

Application November 12, 1936, Serial No. 110,507

20 Claims. (Cl. 220—44)

This invention relates to closures for tank openings, and more particularly to an improved closure device for the radiator of an internal combustion engine cooling system.

It is well understood in the art to which this invention relates, that internal combustion engines are generally provided with a radiator through which a cooling fluid is circulated, and that such a radiator usually has a filling opening near the top thereof and a vent or overflow passage for maintaining the pressure within the cooling system substantially balanced with the atmospheric pressure outside of the system. It is also well known that water at sea level atmospheric pressure boils at approximately 212° F. and that every pound of pressure applied to it above sea level air pressure its boiling point will be raised approximately 3° F. In engine cooling systems which are open to the atmosphere 212° F. is generally considered to be the limit of the cooling range, but this limit is considerably reduced if the engine is operated at an altitude above sea level, and is still further reduced when an anti-freeze such as alcohol is added to the liquid of the cooling system. This reduction in the cooling range, the loss of cooling fluid through the vent and overflow passage, and certain other disadvantages are overcome in radiators on which my improved closure device is used.

It is therefore an object of the present invention to increase the efficiency and cooling capacity of an engine cooling system by providing a closure device adapted to maintain pressure in the system, whereby the boiling temperature of the cooling liquid may be raised substantially above the limit prevailing.

Another object of my invention is to provide a closure device for the filling and vent openings of the radiator of an engine cooling system whereby pressure may be formed inside the cooling system different from the pressure outside the system and in which the magnitude of the pressure differential is limited by a novel arrangement of valves, one of which is operable to limit the pressure in the system when it is above atmospheric pressure, and the other to limit the pressure in the system when it is below atmospheric pressure.

Still another object of my invention is to provide an improved closure device for the radiator of an engine cooling system in which loss of fluid through the vent or overflow passage of the radiator is substantially eliminated by novel baffle means embodied in the closure device.

A further object of my invention is to provide an improved closure device, of the type mentioned, having a filler neck with a sealing surface internally thereof and a cap adapted to be applied to the neck and having a depending hollow member adapted to be pressed against said sealing surface by a spring element of the cap.

Still another object of my invention is to provide an improved closure device comprising neck and cap members and in which the neck member is provided with an internal sealing surface and a gasket seat adjacent its outer end, and the cap member is provided with a pair of spring elements one of which is a disk for pressing a gasket against the gasket seat and the other of which acts to press a depending hollow part against said internal gasket seat.

Yet another object of my invention is to provide an improved closure device for a sealed cooling system in which neck and cap members have locking elements adapted to cooperate with each other for releasably connecting such members and in which bodily removal of the cap member is temporarily prevented while pressure within the sealed system is being safely released.

Another object of my invention is to provide an improved closure device for a sealed cooling system in which cap and neck members cooperate to provide inner and outer seals and are releasably connected by cooperating cam and finger elements, and in which a surmountable stop is provided for temporarily preventing bodily removal of the cap member after release of the inner seal.

Still another object of my invention is to provide a novel form of filler neck having integral external locking cams adjacent its outer end and an inturned integral annular surface at its inner end.

It is a further object of my invention to provide a novel filler neck having a gasket seat at its outer end and an internal sealing surface spaced axially therefrom and also having depending arcuate portions which form cams outwardly of the gasket seat and which have stops thereon for temporarily limiting disengagement of locking fingers along the cams.

Other objects and advantages of the invention will be apparent from the following description when taken in conjunction with the accompanying sheets of drawings, in which

Fig. 1 is a bottom plan view, on an enlarged scale, of a closure device embodying my invention.

Fig. 2 is a vertical sectional view, on an enlarged scale, taken through the closure device of

Fig. 1 and showing the same applied to the radiator of an engine cooling system.

Fig. 3 is a more or less diagrammatic view showing the filler neck in a flat or developed form.

Fig. 4 is a partial transverse sectional view of the cap member taken on line 4—4 of Fig. 1.

Fig. 5 is a vertical sectional view taken through another closure device of my invention and showing the same applied to the radiator of an engine cooling system.

Fig. 6 is a vertical sectional view taken through another cap of my invention which is adapted to be used on the filler neck of a radiator where a baffling of the overflow passage is desired.

Fig. 7 is a partial vertical sectional view taken through a similar type of closure but illustrating another form of spring element.

Fig. 8 is a vertical sectional view taken through still another closure device of my invention and showing the same applied to the radiator of an engine cooling system.

Fig. 9 is a partial plan view thereof.

Fig 10 is a plan view of the filler neck, and

Fig. 11 is a side elevation of the filler neck.

In the accompanying drawings, to which more detailed reference will presently be made, I have shown improved closure devices adapted to be applied to the radiators of engine cooling systems for producing a desired sealing or baffling effect. Although the drawings illustrate several different forms of devices for the accomplishment of these purposes it will be understood, of course, that these are by way of example and that the invention may be embodied in still other devices and forms of construction.

In Figs. 1 and 2 of the drawings I show my invention embodied in a form of closure device which may be used where sealed cooling is desired, that is to say, on a system in which the cooling fluid is maintained under pressure. This device includes a tubular filler neck **15** and a cap or closure **16** adapted to be detachably connected to the neck. The closure device is here shown as mounted on the upper part of the radiator **17** of an engine cooling system with the passage of the neck in register with an opening of the radiator wall.

The neck **15** may comprise a tubular metal member, preferably though not necessarily of cylindrical cross section, which is provided at or adjacent its inner end with an integral inturned flange **18** forming an annular internal gasket seat or sealing surface. The outer end of the tubular member is provided with an outwardly and downwardly turned flange **19** forming an annular gasket seat **20** extending around the neck opening and a pair of depending arcuate elements **21** outwardly of the gasket seat. These depending arcuate elements are provided along the lower edge thereof with sloping cam faces **23** and are spaced apart to provide recesses **24** therebetween which afford access to the cam faces.

Adjacent the ends of each cam the depending element **21** may be provided with lugs or stops **25** and **26**. The stop **25** provides a shoulder **27** adjacent the highest part of the cam which is engaged by the locking fingers or lugs of the cap member when the latter is fully connected with the neck member. The stop **26** which is located adjacent the start of the cam presents a shoulder **28** which is engaged by the fingers or lugs to temporarily prevent bodily removal of the cap from the neck for the accomplishment of a safety function in releasing the pressure of the radiator, as will be more fully explained hereinafter. The stops **26** may be conveniently referred to as surmountable stops or ratchet teeth because they are of such size and shape that while they temporarily prevent disengagement of the locking fingers of the cap from the cams of the neck, the fingers will nevertheless pass thereover if an increased rotative force is applied to the cap.

At a point intermediate the outer gasket seat **20** and the internal flange **18**, the wall of the neck is provided with a vent or overflow opening **30** which communicates with the neck passage. At this point the wall of the neck may be drawn or formed to provide a short tubular projection **31** with which a vent and drain pipe **32** may be connected.

An annular sealing gasket or washer **33**, formed of fiber or other suitable material, may be disposed in the neck in engagement with the flange **18** thereof. The gasket may be retained in place adjacent this flange by circumferentially spaced lugs **34** formed by partially shearing and displacing metal of the neck wall radially inward.

The cap **16**, which is adapted to be applied to the neck, may comprise a cup-shaped outer member or shell **36** formed as a sheet metal stamping havinga transverse top wall **37** and a depending marginal skirt **38**. The skirt may be provided at spaced points along its lower edge with inturned locking lugs or fingers **39** which are of a size and shape to pass freely through the recesses **24** of the neck and to cooperate with the cam surfaces **23** for releasably connecting the cap and neck members. In this instance I show the skirt as being provided with two locking fingers **39** to correspond in number with the recesses **24** of the filler neck.

The cap may include a hollow baffle member or valve housing **41** which extends in depending relation from the outer member **36** substantially centrally thereof and is adapted to enter the passage of the filler neck when the cap is applied thereto. The member **41** may be a sheet metal stamping of dome-like or inverted-cup form and, at its lower end, may be provided with a transversely extending plate **42** which forms the bottom wall of the housing and partially closes the same. The plate **42** may be connected with the dome-like member **41** by an annular bead **43** which presses against the gasket **33** when the cap is applied to the filler neck.

The valve housing may be connected with the outer member **36** by means of a spring element, preferably in the form of a disk or diaphragm **44**, which is retained in the annular skirt **38**. The top portion of the dome-like member **41** engages the center section of the disk **44** and may be connected with this disk by means of a rivet **45** which permits rotation of the member relative to the disk. The member **41** is thus centered with respect to the axis of the cap and when the cap is applied to the neck there is an intervening space **46** between this member and the wall of the neck with which space the overflow opening **30** communicates.

Between the spring disk **44** and the top wall **37** of the outer member **36** I may provide a second spring element **48** which is also preferably in the form of a disk. The resilient disk **48** is engaged substantially centrally thereof by the center section of the disk **44** and by the head of the rivet **45**, but outwardly of this engagement it is spaced from the disk **44**. The disks **44** and **48** may be corrugated, as shown in Fig. 2, and both are preferably bowed or dished away from the top wall **37** so that only the outer edge portion of the disk 48 will bear against the top wall.

A sealing gasket 50, of suitable material and preferably in the form of a ring, is also retained in the annular skirt 38 of the outer cap member and is adapted to be sealingly pressed by the resilient disk 44 against the gasket seat 20 of the neck when the cap is applied thereto. The resilient disk 48 is preferably somewhat stiffer than the resilient disk 44 so that when the cap is applied to the filler neck and is drawn down by the action of the sloping cams 23, the disk 44 will deflect ahead of the disk 48. The initial rotation of the cap causes the disk 44 to yieldingly press the gasket 50 into sealing engagement with the gasket seat 20, and further rotation of the cap causes the annular bead 43 of the valve housing to engage the gasket 33 and upon deflection of the resilient disk 48 the bead is sealingly pressed against the gasket.

It will be noted that the bottom plate 42 of the valve housing 41 is provided with a central opening 52 which communicates with the neck passage, and that the dome-shaped member of the valve housing is provided with one or more openings 53 connecting the interior of the valve housing with the intervening space 46. When the cap has been applied to the filler neck so that the inner and outer seals have been formed respectively at the gaskets 33 and 50, it will be seen that fluid can flow into or out of the radiator 17 through the passage 30 only by traveling through the openings 52 and 53 of the valve housing.

For controlling this flow out of or into the radiator 17, so that a desired pressure condition can be maintained therein, I provide main and auxiliary valves 55 and 56. The main valve 55 is a pressure-relief valve which normally engages the valve seat 57 of the plate 42 to close the passage 52, but is adapted to be opened by pressure in the radiator acting thereagainst. The auxiliary valve 56 is a vacuum-relief valve which controls an opening 58 of the valve housing and normally engages a valve seat 59 which is formed on the plate 42 as a raised ridge extending around the opening 58. The valve 56 is adapted to be opened by atmospheric pressure acting thereagainst through the opening 58 when a subatmospheric pressure exists in the radiator 17.

The main valve 55 may be backed or carried by a plate member 60 which is axially movable in and guided by the dome-like member 41. If desired, the plate member 60 may be provided with an annular rib 61 which engages the valve 55 substantially in line with the valve seat 57. The plate member 60 may also be provided with a depending extension 62 which engages in an opening of the valve 55 and centers the latter with respect to the axis of the cap.

For yieldingly pressing the main valve 55 against its seat 57 I provide a coiled compression spring 63 having one end thereof seating against a portion of the top wall of the dome-like member 41, and its other end in engagement with a spring plate 64. This spring plate is positioned and guided by lugs 65 struck up from the valve plate 60 and may be provided substantially centrally thereof with a localized convex projection 66 which forms a rocking connection between these two plates. The spring 63 presses the valve 55 against its seat 57 but yields to permit a flow of vapor or liquid from the radiator into the valve housing when the pressure in the radiator exceeds a predetermined value, for example four pounds per square inch.

The auxiliary or vacuum-relief valve 56 may be supported adjacent the opening 58 and yieldingly pressed against the valve seat 59 by a spring 68. This spring may be in the form of an arm which is connected to the plate 42 by means of a rivet 69, and which has an intermediate ring portion 70 surrounding the opening 52. The valve 56 may be retained in aligned relation with the seat 59 by means of a rivet 71 having its stem extending through the valve and into the opening 58. The valve is of a size such that when its lateral shifting is limited by the rivet 71 engaging the edge of the opening 58 at any point it will always overlap the valve seat 59. The valve 56 need not be directly connected with the spring arm 68 but, as shown in the drawings, may only be held against the valve seat 59 so that the stem of the rivet 71 cannot be withdrawn from the opening 58. If desired the arm 68 may be provided with a recess 72 in which the head of the rivet 71 engages to provide a rocking connection substantially centrally of the valve. At the point of connection of the arm 68 with the plate 42 the latter may be provided with a raised portion or shoulder 73 which holds the arm spaced from the plate so that dirt entering therebetween will not prevent the arm from pressing the valve 56 against its seat. This valve is relatively light in weight and the arm 68 need only be stiff enough to hold the valve against its seat when the pressures on opposite sides of the valve are equalized.

If desired, a guard may be provided for the valve 56 and its actuating arm 68, in the form of a disk 74 which overlies the valve and arm and is spaced from the bottom plate 42 of the valve housing. This guard may be supported from the valve housing by providing the bottom plate 42 with an extension flange 75 around the opening 52 which is engaged by a central annular flange 76 of the guard.

In assembling the parts of the cap the resilient disk 44, and the resilient disk 48 carrying the valve housing 41, are dropped into the annular skirt 38 and thereafter portions of the skirt are pressed inwardly at a plurality of points to form retaining lugs 78, as shown in Fig. 4. These lugs prevent the disks 44 and 48 from dropping out of the member 36 and when the cap is detached from the filler neck the disk 44 springs away from the disk 48 and engages these lugs. While the cap is detached from the neck the engagement of the disk 48 against the top wall of the member 36 and the engagement of the disk 44 against the lugs 78 holds the various parts against rattling while the cap is being handled.

If desired the depending skirt 38 of the outer member 36 may also be provided at diametrically opposed points with lateral projections 79 which afford a good hand grip on the cap for rotating the same on the filler neck.

From the description of my improved closure device as it has thus far progressed, it will be seen that when the device is connected to the radiator tank 17, as by brazing or welding of the internal annular neck flange thereto, a desired pressure condition can be maintained in the radiator and loss of cooling fluid and anti-freeze solution through the vent and overflow connection 32 will be substantially eliminated. By maintaining a pressure in the radiator the boiling temperature of the cooling fluid is raised and the cooling range and capacity of the radiator are considerably increased. Since the sealing of the radiator to maintain a pressure therein prevents the escape of the cooling fluid in the form of liquid or vapor, it will be seen that the supply of cooling fluid will not become diminished during operation of the engine and will require only occasional attention or replenishment.

The maintaining of the initial supply of cooling fluid is an important advantage because it eliminates the undesirable effects of scale and sediment accumulations which frequently result from the replenishment of the supply of cooling fluid by impure water. The maintaining of a pressure in the radiator also results in another important advantage in that the thermostatic valve, which is now common in the cooling systems of internal combustion engines, can be set at a value considerably higher than the usual 140° setting heretofore used without loss of alcohol or other anti-freeze which may be mixed with the cooling fluid and for increasing the effectiveness and capacity of car heaters operated from the cooling system.

The provision of means for temporarily preventing bodily removal of the cap from the neck during relative disconnecting movement constitutes a very important part of my invention because it furnishes a safety feature for the protection of persons operating or servicing vehicles having sealed cooling systems. This safety feature may be in the form of stops **26** located adjacent the starting ends of the cams **23**, and as I have already stated, these stops are engaged by the fingers **39** of the cap when the latter is rotated in a direction to disengage the same from the neck. The engagement of the fingers with these stops temporarily prevents release of the fingers through the recesses **24** and prevents bodily removal of the cap from the filler neck until the fingers have been forcibly moved over the stops. When the cap has been rotated sufficiently from its fully applied position to bring the fingers **39** into engagement with the stops **26**, the inner seal will be broken by the release of sealing pressure of the bead **43** against the gasket **33**. The release of this inner seal allows vapor pressure in the radiator to pass into the intervening space **46** and to be relieved through the discharge opening **30**. It will be understood, however, that when the inner seal is released by rotary movement of the fingers **39** into engagement with the stops **26**, the gasket **50** is still pressed against the gasket seat **20** by the resilient disk **44** so as to maintain the outer seal.

Under ordinary conditions of operation, the release of the inner seal results in the vapor pressure of the radiator **17** being released through the discharge opening **30** before the fingers **39** are forced over the stops **26** and the outer seal broken by bodily removal of the cap from the filler neck. If, however, there is a substantial pressure in the radiator **17** the release of the inner seal by rotation of the fingers **39** into engagement with the stops **26** allows the vapor pressure to enter the intervening space **46** and, acting against the relatively large area of the resilient disk **44**, causes the seal between the gasket **50** and the seat **20** to be broken. This results in a flow of heated vapor and cooling fluid out between the filler neck and the skirt flange **38** of the cap and at once causes the outer member **36** to become very hot, such that the operator who is opening the closure device will quickly remove his hand from the cap. This heating of the cap warns the operator that a pressure condition exists in the radiator and that the fingers **39** should not be forced over lugs **26** as is necessary for bodily removal of the cap from the filler neck. In a short period of time the pressure in the radiator will be released through the discharge opening **30** after which the operator can safely remove the cap from the filler neck.

It will be noted in respect to the neck member **15**, that when the locking elements thereof are in the form of external cams, as in this instance, the passage of the neck is not obstructed as it would be if the locking elements were located interiorly thereof. It will also be noted that in addition to forming a gasket seat for an inner seal the internal annular flange adjacent the inner end of the neck provides a means for readily connecting the neck with the top wall of the radiator **17**. With this novel form of construction the filler neck can be of relatively small diameter and can be closed either by a cap of the type which will seal the radiator opening and overflow passage and afford sealed cooling, or by the conventional and less expensive type of cap which has been in general use heretofore and which seals only the outer end of the filler neck.

In Fig. 5 of the drawings I have shown another closure device for the radiator of an engine cooling system. This closure device is generally similar in construction to the device of Figs. 1 and 2 and functions in the same manner to produce a sealed cooling system. The only important difference between the closure device of Fig. 5 and that of Fig. 2 is in the location and mounting of the vacuum-relief valve. In the closure device of Fig. 5 the vacuum-relief valve **81** is located on the main valve **82** and controls an opening **83** formed through the latter centrally thereof. The main valve **82** is normally urged towards its seat **84** by a coiled compression spring **85** and the auxiliary or vacuum-relief valve **81** is normally urged toward seating engagement with the lower face of the main valve by means of a tension spring **86**. One end of this tension spring is connected with the valve **81** and its other end is connected with a bridge member **87** which is carried by the main valve and disposed within the coiled spring **85**.

For certain reasons it may be desirable to use a cap on the filler neck **15** of the radiator of such form that it does not completely seal, but only baffles, the overflow passage. The use of a cap of this form may be found desirable for various reasons, for example, its simpler and less expensive construction or the reduced need for sealed-cooling operation of vehicles in portions of the country which are at a comparatively low altitude above sea level and where the boiling point of water is not materially less than 212° F.

In Fig. 6 of the drawings I show a cap of this type which can be applied to the same filler neck as would be used for sealed cooling, and which will effectively seal the outer end of the neck and, at the same time, provide an effective baffle for the vent and overflow passage of the radiator. As shown in Fig. 6, this cap comprises a cup-like sheet metal shell or outer member **90** having a transverse top wall and a depending annular marginal skirt **91**. The skirt is provided at two or more points around its lower edge with inturned locking lugs or fingers **92** adapted to cooperate with the external cams of the filler neck for releasably connecting the cap thereto. The cap is also provided with a resilient disk **93** which is retained in the skirt of the outer member by the locking fingers 92, and if desired, also by additional lugs formed thereon similar to the lugs 78 of Fig. 4. The resilient disk 93 may be corrugated and is preferably bowed or dished away from the top wall of the outer member so that only its outer marginal edge engages the top wall of the cap adjacent the depending skirt 91 thereof. An annular sealing gasket 94 formed of suitable material is also retained in the marginal skirt 91 of the outer member and is adapted to be pressed against the outer end of the filler neck by the resilient disk 93 when the cap is applied to the neck and locked thereon.

For baffling the vent and overflow passage 30 of the filler neck 15 I provide the cap with a hollow dome-like member 95 which extends in depending relation substantially centrally thereof and is carried by the resilient disk 93. The dome-like hollow member 95 may be similar to or identical with the dome-like member 41 which forms the valve housing of the cap illustrated in Fig. 2, and may be disposed with the flat portion 96 of the top thereof in engagement with the central plate section 97 of the resilient disk 93. The member 95 may be connected with the resilient disk, as by means of the rivet 98. This rivet also serves to hold in place a cup-like bearing member 99 which is disposed between the central plate section 97 of the resilient disk and the top wall of the outer member 90. The rivet preferably does not grip the members through which it extends, but permits the outer cap member and the disk 93 to rotate relative to the hollow baffle member 95. The lower end of the dome-shaped baffle member 95 is preferably provided with a transverse plate 100 which is connected therewith by an annular bead 101 and which has a central opening 102.

When the cap is applied to the filler neck 15 of the radiator 17 the gasket 94 seals the outer end of the neck and the annular bead 101 sealingly engages the gasket 33 adjacent the inner end of the neck. The central opening 102 of the plate 100 connects the radiator with the hollow interior or chamber of the baffle member 95 and one or more openings 103 formed in the latter member connect the chamber thereof with the passage of the filler neck above the gasket 33. Thus if a pressure condition is created in the radiator 17 by the generation of vapor or by the expansion of the cooling liquid, vapor or liquid can pass through the opening 102 into the baffle chamber and then through the opening 103 to the discharge or overflow opening of the neck. Because of the baffled and circuitous passage thus provided it will be seen that fluid will not be readily splashed out of the radiator and lost through the overflow passage.

Instead of providing the bearing member 99 in the form of a separate part, it may be desirable to construct this bearing member as an integral part 105 of the resilient disk 93', as illustrated in Fig. 7.

In Figs. 8 to 11 inclusive I have shown another closure device adapted to be used on the radiator of a vehicle cooling system to produce a sealed-cooling effect. This closure device is generally similar to the closure device of Figs. 2 and 5 in that it provides inner and outer seals, has main and auxiliary pressure and vacuum relief valves, and embodies a safety feature for preventing bodily removal of the cap from the filler neck until after the inner seal has been released.

As shown in Figs. 8, 10 and 11 the filler neck 108 of this closure device may have an internal annular flange 109 adjacent its inner end forming a seat for a sealing gasket 110 and providing an available means for connection with the tank of the radiator 111. At its outer end the neck is provided with an outturned flange 112 which carries a pair of depending arcuate flange-like members 113. These depending members 113 are provided at their lower edge with a cam surface 114 and are spaced apart to provide recesses or openings 115 in the flange 112 affording access to the cam surfaces. The depending arcuate members 113 may also be provided with lugs 116 which form stops adjacent the high ends of the cam surfaces.

The closure cap itself may comprise outer and inner members 118 and 119 which are connected together and provide a valve chamber 120 therebetween. The outer member is provided with a depending annular marginal skirt 121 which carries inturned locking lugs or fingers 122 for engagement with the cam surfaces 114 of the filler neck. The inner member 119 may be of substantially cup-like form and may be held with its open end against the cap member 118 by means of screws 123 extending through an external flange or lip 124 of the cup. Adjacent its upper end the cup-like inner member 119 has a wall portion 125 of a size and shape to snugly engage in and fill the passage of the neck 108 so as to provide a seal adjacent the outer end of the neck when the cap is applied thereto. Inwardly of the sealing portion 125 the cup-like member 119 is of reduced cross section so as to provide an intervening space 126 between the cap and the wall of the neck. This intervening space is connected with the chamber 120 of the cap by an opening 127 of the member 119 and is also connected with the atmosphere through the vent and overflow opening 128 of the filler neck.

The cup-like inner member 119 is of a length such that when the cap is applied to the filler neck the bottom wall 130 of this member will engage and press against the sealing gasket 110 to provide the inner seal. The cap may be provided with a pair of bowed acurately extending springs 131 which are retained in place by the screws 123 and which engage the flange 112 at the outer end of the filler neck when the cap is applied thereto. These springs act to hold the locking fingers 122 of the cap firmly against the cam surfaces 114 of the neck.

For controlling the flow of fluid out of or into the radiator through the cap I provide main and auxiliary pressure and vacuum relief valves 132 and 133. The main valve 132 is contained in the chamber 120 of the cap and under the action of a coiled compression spring 134 normally closes the opening 135 of the transverse bottom wall 130. This coiled spring may be centered with respect to the axis of the opening 135 by engagement with a depending boss 134*a* of the outer member 118. The vacuum-relief valve 133 controls an opening 136 of the main valve and is normally held in position to close this opening by means of a tension spring 137.

As mentioned above, this closure device also embodies a safety feature which temporarily prevents bodily removal of the cap from the neck opening until after the inner seal has been released. This feature consists in providing means for temporarily limiting the unlocking rotary movement of the cap and which may be in the form of a shoulder 138 and a notch 138*a* formed on each of the arcuate members 113 of the filler neck. When the cap is being removed from the filler neck the rotary movement applied thereto moves the locking fingers 122 away from the stops 116 and into the notch 138a to engage the shoulder 138 whereupon the rotary movement is temporarily arrested. When the locking fingers 122 have engaged the shoulders 138 the inner seal at the gasket 110 will have been released and pressure in the radiator 111 will be relieved through the vent and overflow opening 128. While this is taking place the outer seal formed by the wall portion 125 will be maintained and will not be broken until the operator disengages the fingers 122 from the shoulders 138 and rotates the cap further in a direction to disengage the fingers from the cam surfaces 114.

I have already mentioned certain important advantages which are obtained in a cooling system which is sealed or baffled by my improved closure device but, in addition, it will be understood that further advantages are attained in some cooling systems by the elimination of air being drawn into the cooling system on the suction side of the water pump and the presence of which tends to reduce the boiling temperature of the cooling fluid. It will also be seen that by maintaining a pressure in the radiator the sea level boiling temperature may be raised, for example, to 227° F. where five pounds pressure is used, thus providing an additional cooling margin which greatly increases the efficiency and capacity of the cooling system even in hot summer weather.

While I have illustrated and described the closure devices of my invention in a somewhat detailed manner it will be understood, of course, that I do not wish to be limited to the precise details of construction and arrangements of parts illustrated and described, but regard my invention as including such changes and modifications as do not involve a departure from the spirit of the invention and the scope of the appended claims.

Having thus described my invention I claim:

1. In a filler neck and closure combination for engine cooling systems, a receptacle, a neck having at one end an integral inturned flange and at its other end an outwardly and downwardly formed flange providing a sealing surface and cam portions adjacent thereto, a vent opening through a wall of said neck, a closure for said neck having a depending skirt with fingers adapted to engage said cam portions, a sealing element within said closure adapted to cooperate with said sealing surface, and a hollow dome-shaped member depending from said closure for cooperation with said inturned flange and adapted to form a baffle between said receptacle and said vent opening.

2. In a closure device the combination of a tubular neck having locking elements adjacent its outer end and an internal annular sealing surface spaced from said end, a cap having locking elements adapted for releasable engagement with the locking elements of the neck, a resilient disk retained in said cap, and a member carried by said disk and adapted to be yieldingly pressed thereby against said sealing surface, said member having a pivotal connection with the disk substantially centrally thereof to permit rotation of the cap and disk relative to said member while the latter engages said sealing surface.

3. In a closure device the combination of a filler neck having locking means adjacent its outer end and an internal annular sealing surface axially inward from said outer end, means providing a discharge connection leading from the neck between said outer end and said internal sealing surface, a cap adapted to be applied to said neck and having locking means adapted to cooperate with the locking means of the neck, a hollow member adapted to extend into the neck to engage said internal sealing surface and having openings for connecting the interior thereof with the neck passage on opposite sides of said sealing surface, and a resilient disk providing a connection between said cap and said hollow member and operable to press the latter against said internal sealing surface.

4. In a closure device the combination of a filler neck having locking means adjacent its outer end and an internal annular sealing surface axially inward from said outer end, means providing a discharge connection leading from the neck between said outer end and said internal sealing surface, a cap adapted to be applied to said neck and having locking means adapted to cooperate with the locking means of the neck for releasably connecting the same upon relative movement therebetween, a hollow member adapted to extend into the neck and engage said sealing surface with a space between such member and the wall of the neck, said member having an opening connecting the interior thereof with said space, a spring disk providing a connection between said hollow member and the cap and operable to press the hollow member against said sealing surface, and means effective during disengaging movement to temporarily prevent bodily removal of the cap from the neck after disengagement of said hollow member from said sealing surface.

5. In an engine cooling system a receptacle, a filler neck for said receptacle having a sealing surface and cam sections adjacent its outer end and a second sealing surface adjacent its inner end, a vent passage, and a closure for said neck including pressure control valves and a part engageable with said second sealing surface, each cam section having two lift portions one to attach the closure to the neck and a second to effect a seal at said second sealing surface.

6. In an engine cooling system a receptacle, a filler neck for said receptacle provided with an inturned bottom flange, a closure for said neck, a valve housing depending from said closure in the form of an open sheet metal cup, and a plate having an annular bead connecting the same to the open end of said valve housing, said plate adapted to cooperate in sealing relation with said neck flange and provided with a valve seating surface.

7. In a closure for cooling systems, a filler neck provided with an inturned bottom flange and an outwardly turned top flange, a cap adapted to be applied to the neck, a valve housing depending from said cap, and two spring elements between said cap and valve housing, one to effect a seal on the top neck flange and the second to effect a seal on the bottom neck flange.

8. In a closure device the combination of a tubular neck having axially spaced outer and inner annular sealing surfaces, a cap adapted to be releasably connected with the neck and having a disk part and a hollow part adapted to be pressed respectively against said outer and inner sealing surfaces when the cap is applied to the neck, said hollow part having an opening in the lower portion thereof, and a spring-pressed

relief-valve in said hollow part normally closing said opening.

9. In a closure device the combination of a tubular neck having axially spaced outer and inner annular sealing surfaces, a cap adapted to be releasably connected with the neck and having a disk part and a hollow part adapted to be pressed respectively against said outer and inner sealing surfaces when the cap is applied to the neck, said hollow part having an opening in the lower portion thereof, a spring-pressed relief-valve in said hollow part normally closing said opening, and means providing a second spring-pressed relief-valve adapted to open in the opposite direction.

10. In a closure device, a filler neck comprising a tubular member having an out-turned flange providing an annular sealing surface and having arcuate portions depending outwardly of said sealing surface, said depending arcuate portions having cam elements thereon and being spaced apart to provide recesses affording access to the cam elements, said arcuate portions also having stops thereon adjacent one end of the cam elements and surmountable stops adjacent the other end of the cam elements.

11. In a closure device the combination of a tubular neck having axially spaced outer and inner annular sealing surfaces, a cap adapted to be releasably connected with the neck and having a disk part and a hollow part adapted to be pressed respectively against said outer and inner sealing surfaces when the cap is applied to the neck, said hollow part being mounted for swiveling movement relative to the cap and having an opening in the lower portion thereof, and a spring-pressed relief-valve in said hollow part normally closing said opening.

12. In a closed pressure system, a vented filler spout, a pressure operated valve closing the spout on one side of the vent, a removable cap closing the spout on the other side of the vent, means joining the valve to the cap for removal as a unit therewith and a detachable connection between the spout and cap comprising camming abutments on the spout and cap, respectively, engageable upon relative rotation of the cap and a safety stop on one of said abutments for engagement with the other abutment to position the parts with the spout closed by the cap and opened by the valve.

13. In a device of the character described, a spout cap, a cage seating a pressure operated valve and being adapted for seating engagement with a spout to close the same, and a pivotal connection between the cap and cage.

14. In a pressure system, a filler spout having a pair of spaced seats, a system vent communicating with the spout intermediate said seats, a removable cap having camming engagement with the spout to draw the same downwardly upon rotation in one direction, a stop to resist reverse rotation of the cap at a predetermined relative position, a valve cage carried by the cap to extend within the spout for engagement with the innermost seat when the cap is rotated beyond said stop, a pressure relief valve within said cage and a pressure sealing member carried by the cap and engaging the outermost seal in all relative interengaged positions of the cap and spout.

15. In a pressure system, a filler spout, a removable cap therefor, interengaging camming abutments on the spout and cap, respectively, to draw the cap downwardly upon relative rotation, a stop associated with the camming abutments near the outer limit of reverse relative rotation, an overflow pipe leading from the spout below the cap, an overflow closure device carried by the cap for seating on the spout below the overflow pipe when the cap is drawn down and unseating when the cap is reversely rotated to a position wherein the stop resists cap removal.

16. In a closed cooling system for engines, a filler spout having an overflow pipe associated therewith, a spout closure cap, a bayonet type connection between the cap and spout including a camming member having a pair of spaced seats and a locking member engageable with either seat to retain the cap on the spout, and an overflow pipe valve adapted to be closed when said locking member is in engagement with one of said seats and to be opened when the locking member engages the other seat.

17. Radiator filler and closure structure, including a vented filler spout having an internal seat, a removable closure cap rotatable on the spout to and from closed position, a valve cage adapted to engage said internal seat to seal the spout, a pressure actuated valve operatively housed within said cage and swivel means connecting the cage and cap for relative movement during cap rotation.

18. In a pressure cooling system, a valve cage assembly comprising a cupped casing, a valve seating spring enclosed within the casing in bearing engagement with the base of the casing, an outwardly opening valve acting against said spring, an inwardly opening valve seated over an opening in the first mentioned valve, a spring seating the inwardly opening valve, and a closure plate for the open end of the casing to retain the valves and springs therein and to seat the first mentioned valve and the last mentioned spring.

19. In a device of the character described, a filler spout having a vent and spaced seats on opposite sides of the vent, a closure assembly including a valve seating cage to engage one of said seats, a flexible diaphragm for peripheral engagement with the other seat, means detachably securing the assembly on the spout and having spaced stations for selective engagement, at one of which the cage is seated and at the other of which the cage is unseated without complete detachment of said means from the spout and means out of engagement with the diaphragm at the first mentioned station but abutting the diaphragm to unseat the same at the next mentioned station.

20. In a closure device for an engine cooling system, a cap member, a hollow valve cage depending from said cap member and provided with a seat, and a spring seated valve structure housed in said cage and movable relative thereto for the relief of pressure, said valve structure comprising a sealing portion engageable with said seat and portions extending laterally beyond the sealing portion for guiding engagement with the cage.

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