Nov. 5, 1940. W. GROTHE 2,220,328

VENT STRUCTURE

Filed Sept. 7, 1937

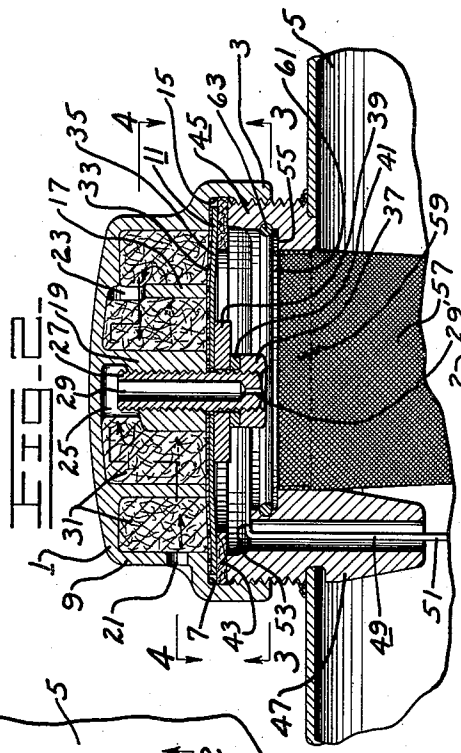


FIG. 2.

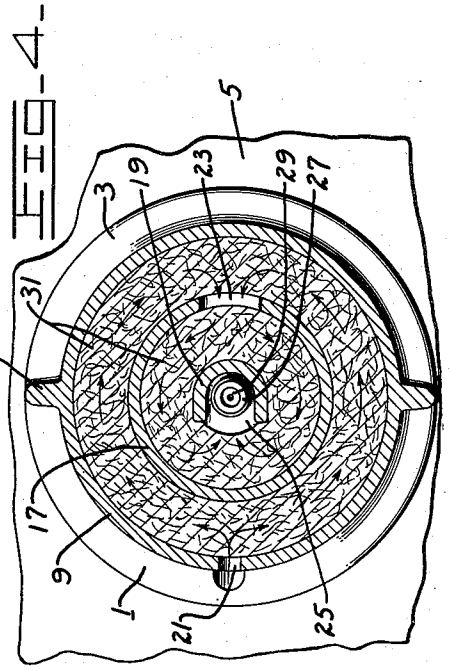


FIG. 4.

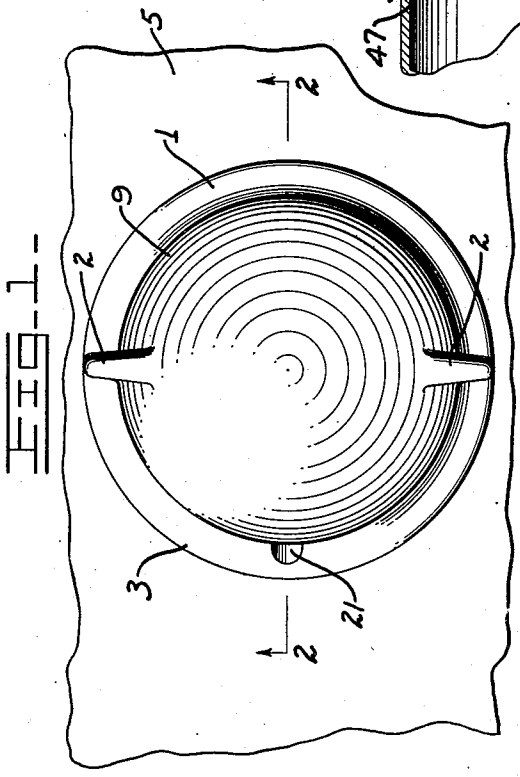


FIG. 1.

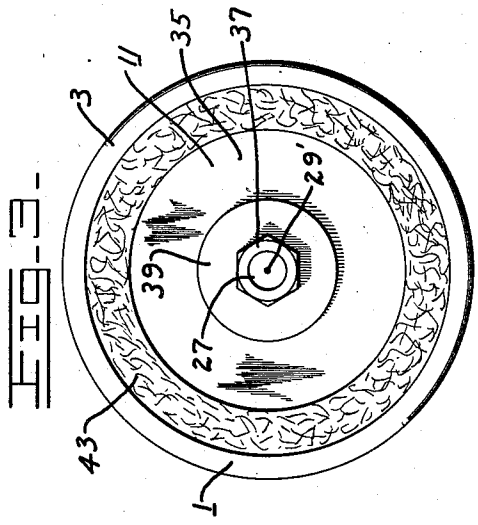


FIG. 3.

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# UNITED STATES PATENT OFFICE

2,220,328

## VENT STRUCTURE

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Application September 7, 1937, Serial No. 162,684

4 Claims. (Cl. 220—44)

My invention relates to fuel tanks employed in carrying a supply of fuel for use in internal combustion engines, and such other tanks as require venting to the atmosphere; and more particularly relates to a vent structure for such tanks.

In the operation of internal combustion engines, clean fuel is a necessity. This is of particular importance when the internal combustion engine is of the compression ignition type, due to the fact that mechanism, such as fuel injection pumps and valves, embodied in the fuel injection system of such engines, must be manufactured to exceedingly close tolerances in the order of hundred thousandths and millionths of an inch to obtain proper operation of the engine. Dirty fuel gaining access to such precisely fitted parts may result in seriously impairing the proper functioning of the mechanism and possibly result in injury thereto.

It has accordingly been the practice to incorporate in the fuel line to the fuel injection system, means in the form of filter units for separating out from the fuel, all dirt and other material which might injure the pump and valve mechanism or otherwise deleteriously affect the operation of the engine. As the filter units become more and more impaired in their operation due to the presence of deleterious material in the interstices thereof, which has been separated out from the fuel, it becomes necessary to either clean these units or replace them with new ones. Since the frequency with which these units must be cleaned or replaced depends in large measure upon the amount of deleterious material or matter filtered out from the fuel, it becomes desirable to keep the fuel in the fuel tank, free of contamination other than what may already be present in the fuel when placed in the tank, and this, normally is quite low, as it is common practice to introduce into the tank only fuel which has previously been filtered. Thus, by minimizing contamination of the fuel subsequent to its introduction into the tank, the load on the filter mechanism is maintained low, and the frequency with which it becomes necessary to clean the filter units is reduced. The useful life of a filter is furthermore increased thereby.

Fuel tanks, in general are normally provided with a vent to the atmosphere, to maintain atmospheric pressure within the tank and to permit breathing induced by sloshing of the fuel in the tank and in response to changes in the tank capacity and fuel volume as affected by changes in temperature. In many constructions, the vent is incorporated in the cap which serves as a closure for the filling opening in the tank. In prior constructions, such cap in many instances was provided with a horizontal baffle or similar construction to inhibit slopping of the fuel through the vent opening, but such was not adequate protection or safeguard against entrance of dust to the tank; and apparently the fact that the tank vent might constitute a possible source of fuel contamination, did not receive much consideration. Investigations to determine the extent to which fuel might become contaminated through the vent of the supply tank, indicate it to be quite appreciable, sufficient in fact to damage the fuel injection equipment of an engine after a few months service, were it not for the presence of the fuel filters with which such engines are provided.

It is accordingly an object of my invention to provide an improved vent structure for a fuel tank which shall embody improved:

(1) Means to permit efficient flow of air into the fuel tank, to the exclusion of dust or other matter present in the air;

(2) Long tortuous passageway for the incoming air within a relatively small space;

(3) Arrangement for filtering material which may be readily removed for cleaning or replacement;

(4) Means to prevent return flow into the tank of such fuel as may splash out and accumulate in the filler cap; and

(5) Mechanism that can be easily manufactured and assembled.

Additional objects of my invention will be brought out in the following description of my improved filler cap taken in connection with the accompanying drawing wherein:

Fig. 1 is a top plan view of the cap mounted on a tank, only a portion of the top wall of which tank is shown.

Fig. 2 is a vertical section taken along the line 2—2 of Fig. 1.

Fig. 3 is a bottom view of the cap only, taken along the line 3—3 of Fig. 2.

Fig. 4 is a horizontal section through the cap taken in planes indicated by the line 4—4 of Fig. 2, to expose the inside arrangement of the baffles within the cap.

The above views are substantially to scale.

In general my invention contemplates the provision of means which will enable power venting and breathing to take place in connection with the use of fuel tanks, and at the same time efficiently inhibit the entrance into the tanks of deleterious matter which might contaminate the

fuel in the tanks. This is realized by constructing the filler cap to incorporate a convolved tortuous passage having certain predetermined characteristics, and which is preferably filled or packed with filtering material to cooperate in screening out undesirable deleterious matter tending to flow or drift into the tank.

The convolved tortuous passage is most economically and conveniently formed by a nested arrangement of baffles within the filler cap, the portions of the tortuous passageway or path extending through the baffles having their lower edges progressively at higher levels as the path recedes from the vent opening in the cap, the purpose of this elevational relationship being twofold. Firstly, dust or other deleterious matter entering the vent hole will have to follow the equivalent of a continually rising spiral path, against the force of gravity, before it could gain entrance to the fuel tank. This fact coupled with the presence of the filtering material in the tortuous path, very effectively removes the dust content from the incoming air.

The other advantage contemplated by the elevational rise in the baffle openings pertains to preventing a return flow back into the tank, of such oil as may splash out from the tank into the tortuous passage in the filler cap. Such oil, should the accumulation become sufficient to overflow the intermediate baffles, will flow out through the vent opening and carry with it some of the sediment which may have previously settled out in the filtering material and at the bottom of the cap. In this respect, the cap construction may be looked upon as a self cleaning device. In no case, can the filtered out dust be washed into the tank by such oil as may accumulate within the cap, since the baffle opening which connects with the internal chamber of the tank is at a higher level than any of the other openings.

Discussing the invention in greater detail and with reference to the accompanying drawing, the cap comprises an outer shell 1, substantially circular in form, with suitable finger grips 2 integrally formed thereon. The shell is provided with an internally threaded depending skirt portion 3 of enlarged diameter for attachment to a tank 5. This construction results in the formation of a shoulder 7 adjacent the lower end of the smaller diameter portion 9 of the cap to receive in clamping engagement therewith, a sealing means 11 for closing the bottom opening to the cap. The portion of the depending skirt adjacent the aforementioned shoulder 7 is undercut to constitute an inner circumferential groove 15 for a purpose hereinafter described.

Depending from the roof of the cap and formed integrally therewith, as by casting or otherwise, are plurality of nested cylindrical baffles 17, 19, respectively, concentrically arranged with respect to the center of the cap and extending downwardly to a plane just slightly above the plane of the above mentioned shoulder 7.

The cap is vented to the atmosphere by means of an opening 21 therethrough preferably at a point close to the skirt portion 3, and the baffle 17 of largest diameter which is the one closest to the wall of the cap is provided adjacent the roof of the cap with a passageway or opening 23 therethrough at a point farthest removed from the aforementioned vent opening 21. The lower edge of the passageway through this baffle is at a higher level than that of the vent opening 21.

Similarly, the baffle 19 of next smaller diameter is also provided with a passageway or opening 25 therethrough, but at a point farthest removed from the opening 23 through the first baffle 17, and in this baffle 19 the passageway is also located adjacent the roof of the cap.

This baffle 19 of smaller diameter is internally threaded to receive a stud 27 of a length sufficient to extend from a point substantially below the plane of the shoulder 7 for the reception of a clamping nut and suitable washers, to a point above the level of the lower edge of the opening 23 through the larger diameter baffle 17. The stud 27 has an axial passage 29 therethrough to form a tube whereby it effects a connection with the opening 25 through the baffle 19 to which it is threaded. The passage 29 is constricted at its lower end at 29' to minimize escape of liquid therethrough from the tank. Tube 27 actually constitutes a portion of the last mentioned baffle 19 and may be considered as such, and when so considered, it will be noted that the vent opening 21 and the openings 23 and 25 through the various baffles 17 and 19 have their lower edges at successively higher levels.

The arrangement and construction of the baffles described above, provide convolved tortuous passages between the vent 21 and the tube 27, causing the inflowing air to divide and follow two courses, each of which is outlined by arrows in Fig. 2 and Fig. 4 of the drawing, and may be considered as defining a path equivalent to that of a rising spiral, beginning with the vent opening 21 and terminating at the top end of tube 27. Filtering material 31, such as corrugated copper ribbon for example, or screening wound or otherwise formed into annular shapes to fit the spaces between baffles, may be employed to fill these spaces.

The bottom of the cap is closed by sealing means 11 which may be of a composite type comprising a layer of cork 33 or other satisfactory sealing material applied around the tube 27, and retained in sealing engagement with the lower edges of the baffles and the shoulder 7 by means of a backing plate 35 of similar size but of stiffer material, such as molded plastic, metal, or the like and a nut 37 threaded upon the lower end of tube 27; with a washer 39 positioned between the nut and the backing 35. A lock washer 41 may conveniently be used to maintain the nut 37 in position on the tube 27.

The fact that the baffles 17 and 19 do not quite extend to the plane of the shoulder 7 insures a leak-proof fit of the sealing means 11 against the lower edges of baffles 17 and 19, and shoulder 7 because this enables the backing plate to be stretched under tension when nut 37 is tightened to hold sealing layer 33 tightly against the parts in question. A similar fit could be assured, even were the baffles extended to the plane of the shoulder 7, by slightly dishing the sealing means 11, or utilizing a thicker layer 33 of the sealing material. It is thus seen that the sealing means 11 is clamped with sufficent pressure to effect a dust and liquid tight seal for the vent structure to prevent leakage of fuel, air or dirt in either direction. A loose fitting gasket 43 of suitable material such as chrome leather, or the like, is sprung into the aforementioned groove 15, and is adapted to be clamped against a filler spout or tube 45 upon application of the cap to the tank 5, to preclude leakage of fluid from the tank at this point.

In the drawing, I have illustrated my improved filler cap mounted on the fuel tank 5, wherein the filler tube or spout 45 is in the form of an

externally threaded plug preferably welded to the upper wall of the tank and having a depending channeled portion 47 for receiving a level gauge 49, which gauge may include a length of stiff wire 51 having a right angle portion 53 for supporting it from the filler plug 45. The filler plug is recessed to form a shoulder 55 from which to hang a screen 57, the screen being affixed to a depending sleeve 59 having a circumferential flange 61 adapted to rest upon the shoulder 55 of the plug and be retained in position by a circular spring clip 63 adapted to be sprung into a groove formed in the wall of the recessed portion of the plug adjacent the aforementioned shoulder 55.

From the preceding description, it will be noted that the baffles are concentrically arranged without partitions therebetween, thus providing a simple construction to fabricate. Inasmuch as the baffles are preferably concentrically arranged without partitions therebetween, the fluid entering vent 21 will, as previously mentioned, have a divided flow through the vent structure along two paths or courses. The various openings 21, 23 and 25 in the concentric walls are preferably located so that each opening is at a point farthest removed from the similar opening in an adjacent wall or baffle, to cause the two courses along which the fluid flows, to be of equal length. Hence, a like or balanced settling of deleterious matter will occur in each of the paths. Openings 21, 23 and 25 need not be arranged in the manner described. However, any other arrangement would provide paths of unequal length, and this might result in insufficient settling of deleterious matter in the shortest path. If desired, only one long tortuous path for flow of fluid may be provided, for example, by rearrangement of the openings and positioning partitions between the baffles, but this would increase the cost of manufacture.

Each path, as previously stated, defines the equivalent of a rising spiral. This, of course, means that deleterious matter carried by the incoming air will have to travel the long tortuous paths against the force of gravity in order to gain entrance to the tank. It is unlikely that such deleterious matter will follow through a long tortuous or winding ascending path unless propelled by a stiff current of air, which of course is never present in a vented filler cap.

It is further to be noted that the portions of the rising paths lying between the baffles are of considerably greater cross sectional area than the portions of the paths which pass through the baffles. The effect of this is to considerably reduce the air velocity between baffles, and thereby permit the force of gravity to exercise a greater influence upon the deleterious matter in the air, in the matter of separating it out therefrom. When once settled out below openings 21, 23 and 25, the deleterious matter will pass beyond the influence of subsequent fluid flow because of the traps for such deleterious matter, which are provided by the portions of the baffles below such openings. It is not as if the path were defined by a tube or pipe, in which case such deleterious matter as might settle out in the tube would remain in a position to be urged forward with each new movement of air through the vent.

The likelihood of deleterious matter successfully traversing the upwardly winding path formed by the baffling is additionally precluded by the presence of the packing or filtering material positioned within the long tortuous paths formed by the baffles. The incoming air thus becomes thoroughly freed from the dust or other deleterious material in the atmosphere, which dust, etc. will settle out before the air emerges from the passage 29 into the tank to which the cap may be attached.

Where the fuel tank 5 forms part of the fuel system of an automotive or self propelled vehicle, considerable sloshing around of the fuel in the tank occurs, particularly when such vehicle is a tractor, operating over rough or hilly terrain; and a small amount of such fuel is apt to splash through the passage 29 of the tube 27 and settle in the cap between the two innermost baffles 17 and 19. This, if anything, adds to the advantages of the cap construction, as a means for removing deleterious matter from the incoming air, as the fuel will wet the filtering material 31 and thus enable it to function more effectively as a filter means, by causing the deleterious matter to adhere thereto.

The construction of the baffling within the cap, precludes a return flow of such fuel as may gain entrance to the cap through the orifice 29'. Should an appreciable amount of fuel accumulate between the two innermost baffles 17 and 19, it is apparent that it will spill through the outermost of these two baffles by reason of the fact that the lower edge of the opening or passage 23 through such baffle is purposely located at a lower level than the upper end of the passage 29 through tube 27 which is considered as part of the innermost baffle 19. Ultimately, such fuel will run through the vent opening 21 to the atmosphere, carrying with it some of the dust or other material which has previously settled out in the cap. Thus the flow of such fuel as may become trapped in the cap, will be in a direction away from the orifice 29' and toward the outside of the cap through the vent opening 21. This is a matter of some importance, when it is noted that such fuel will become saturated with deleterious matter in the cap and every precaution should be exercised to keep it from getting back into the tank.

From the preceding description of my improved filler cap, it will be apparent that the device may be very readily manufactured and assembled and just as easily disassembled when it is found necessary or desirable to either clean or replace the filler or packing material.

While I have described one specific embodiment of my invention, it is apparent that it is susceptible to variations within the scope of mechanical skill and without departing from the scope of my invention. The number of baffles, for example, may be varied as well as the arrangement thereof just so long as the advantages attributed to my invention will appear in the modified construction. The baffles need not be integrally formed with the cap but may be separately fabricated and retained in position in the cap by the sealing means 11 for example. And furthermore, in so far as my invention is concerned, the venting structure may be incorporated in a wall of the tank, independently of the filler cap, in which case the filler cap should be constructed to provide an air-tight closure for the filler tube or opening.

My invention is not limited in its application to tanks for the holding of fuel, nor is it limited for use in connection with internal combustion engines. It is applicable wherever one desires to permit flow of a gas to the exclusion of foreign filtrable material which may be present in the gas.

I, accordingly, do not desire to be limited in my protection to the specific details described nor the specific applications mentioned except as may be necessitated by the prior art and the appended claims.

I, therefore, claim as my invention:

1. A cap for a fuel tank or the like formed to provide an air path therethrough from the outside atmosphere to within the tank, a plurality of substantially concentrically arranged baffles in said cap and extending substantially the depth thereof, openings through said baffles located so that an opening through one baffle is farthest removed from an opening through an adjacent baffle to provide a convolved path for flow of air.

2. A vent structure for a fuel tank or the like, having a chamber, a vent in a side wall of said chamber, a passage for communication with said tank, and a plurality of baffles between said passage and said vent arranged one within another and extending from the roof of and substantially the depth of said chamber, each of said baffles having an opening therein and the positions of said openings being at increasingly higher levels starting from adjacent said vent.

3. A vent structure for a fuel tank or the like, having a chamber, a vent in a side wall of said chamber adjacent the bottom thereof, a passage for communication with said tank, and a plurality of baffles arranged one within another and extending substantially the depth of said chamber, each of said baffles having an opening, the outermost baffle having its opening disposed at a point substantially farthest removed from and above said vent, and the openings in adjacent baffles being so located that an opening in one baffle in substantially farthest removed from an opening in an adjacent baffle with an opening in an inner baffle above that in the adjacent outer baffle, whereby a plurality of ascending convolved paths are provided for flow of fluid between said vent and said passage.

4. A vent structure for a fuel tank or the like, having a chamber, a single vent in a side wall of said chamber adjacent the bottom thereof, an elongated substantially centrally disposed passage for communication with said tank, and a plurality of baffles arranged one within another and extending substantially the depth of said chamber, each of said baffles having a single opening, with the outermost baffle having its opening disposed at a point substantially farthest removed from and above said vent, and the openings in adjacent baffles being so located that an opening in one baffle is substantially farthest removed from an opening in an adjacent baffle with the opening in an inner baffle above that in the adjacent outer baffle, whereby a plurality of ascending convolved paths are provided for flow of fluid between said vent and said passage.

WALTER GROTHE.

CERTIFICATE OF CORRECTION.

Patent No. 2,220,328. November 5, 1940.

WALTER GROTHE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 51, for the word "power" read --proper--; page 2, first column, line 59, before "plurality" insert --a--; page 3, second column, line 33, after the word "run" insert --out--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of December, A. D. 1940.

Henry Van Arsdale,

(Seal) Acting Commissioner of Patents.