Sept. 13, 1966 F. G. REST ETAL 3,271,938

BREATHER CAP AND DIPSTICK COMBINATION FOR AN OIL FILLER PIPE

Filed June 5, 1963

Fig. 1

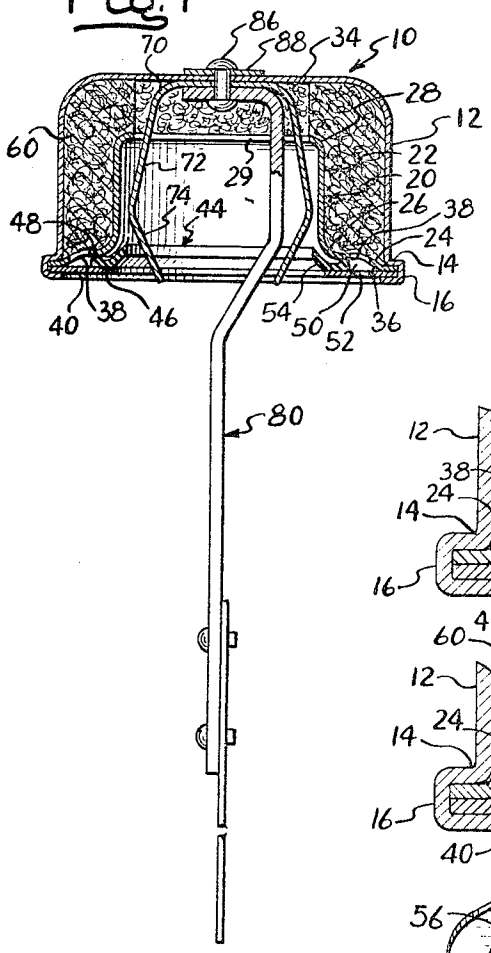


Fig. 3

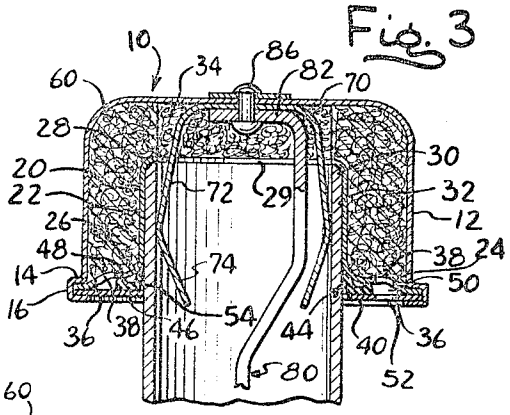


Fig. 4

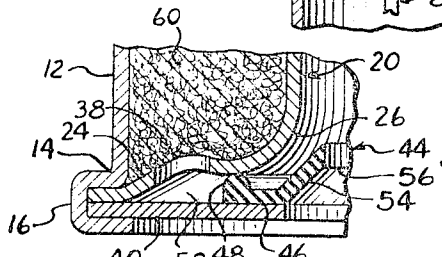


Fig. 5

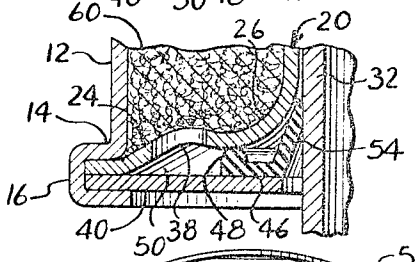


Fig. 6

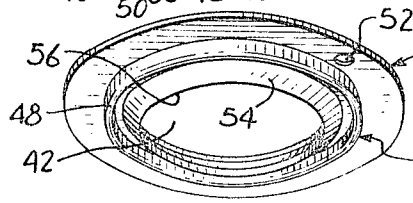


Fig. 2

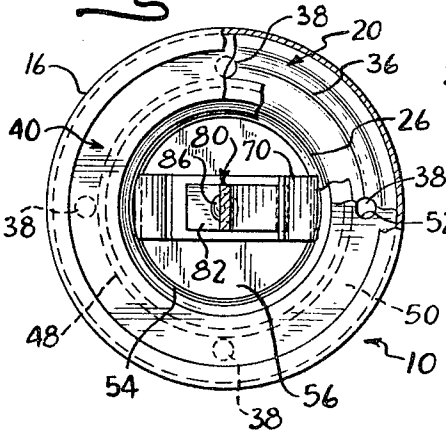
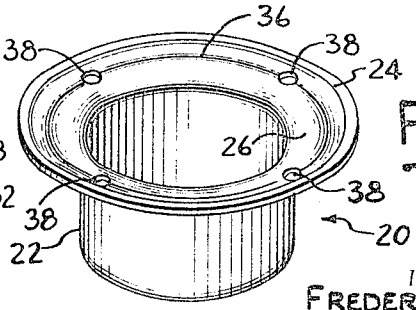


Fig. 7



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United States Patent Office

3,271,938

Patented Sept. 13, 1966

3,271,938

BREATHER CAP AND DIPSTICK COMBINATION FOR AN OIL FILLER PIPE

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Filed June 5, 1963, Ser. No. 285,756
1 Claim. (Cl. 55—385)

This invention relates to an improved sealing cap useful as a cover for the oil filler tube or pipe of an automobile engine.

It has been common to provide for the intake of air into the crankcase of automobile engines through openings in a breather cap covering the oil filler pipe. In some automobiles, the oil dip stick fits into the oil filler pipe in which case the breather cap is usually attached to the top of the oil dip stick. For reasons to be explained, recent modifications of the fuel feeding sections of these engines for the purpose of burning crankcase vapors to minimize the production of smog-producing hydrocarbons has created certain problems in the design caps which fit over the oil filler pipes of automobiles.

Investigations conducted by State and Federal Governmental agencies indicate that automobile engine emissions are a major source of air pollution and smog in many large metropolitan areas. The case against such emissions is based on the finding that typical smog effects are produced by the solar irradiation of mixtures of hydrocarbons found in these emissions which can form smog mixtures at concentrations as low as several hundred parts per million parts of air.

While much of the air polluting automobile exhaust emissions are discharged through the tail pipes thereof, another important source of these emissions is the crankcase. The referred to investigations have indicated that whereas it was formerly believed that emissions from crankcases sometimes referred to as "blowby" contributed only a negligible proportion of the pollution produced by motor vehicles, they in fact are responsible for from 20% to 40% of the total hydrocarbons discharged by automobiles. Blowby emissions normally consist of approximately 85% by volume of unburned fuel-air mixture and the remainder exhaust products which are blown past the pistons into the crankcase.

The crankcase is usually provided with an exhaust tube sometimes called a road draft tube extending below the engine into the air stream, which produces a small negative pressure in the crankcase due to the aspirating effect while the vehicle is in motion. This slight pressure reduction causes clean air to be drawn into the crankcase through a breather tube which, as indicated above, is usually the oil filler tube covered by an apertured breather cap.

To prevent, or at least reduce, air pollution from this "blowby" source, several systems have been proposed by which the crankcase emissions are returned to the engine intake system for consumption during operation. This approach to the control of blowby emissions uses the negative pressure of the engine induction system to establish a positive flow of the crankcase emissions through the crankcase. Two general types of such control systems have been developed and are now in use. One of these is referred to as the variable-orifice metering system and the other is referred to as the direct vent tube system. In the variable-orifice metering system a tube

of relatively small diameter connects the crankcase with the intake manifold. The direct vent tube system for preventing, or reducing, blowby emissions to the atmosphere utilizes a tube of relatively large diameter to connect the crankcase with the air horn of the carburetor or with the carburetor air cleaner.

An internal combustion engine employing these crankcase emission retarding systems operates like an air compressor pumping into a closed vessel. The successful functioning of such systems is dependent in large measure upon the internal pressures developed within the engine, and development of proper pressures and air-fuel mixture ratios for efficient operation of the engine are influenced to a considerable extent by the amount of fresh air entering the crankcase through the breather cap which covers the crankcase breather tube. It thus becomes necessary to exercise close consistent control over the amount of air entering the breather cap in engines incorporating crankcase emission retarding systems. One difficulty in obtaining this control is the difficulty heretofore encountered in maintaining an effective seal between the portion of the breather cap which fits over the oil filler pipe due, among other things, to irregularities in the dimensions of the oil filler pipes made for a given automobile model and the difficulty in properly manually seating the breather cap on the oil filler tube to provide a good seal. The presence of an imperfect seal will affect the amount of air entering the oil filler pipe since the air can then enter the pipe both through the breathing holes provided in the cap and through the clearance space left by the imperfect seal.

It has also been proposed to seal off the oil filler pipes of automobiles from the atmosphere and to draw the crankcase vapors into the engine intake manifold or directly into the carburetor through the oil filler pipe cap, which also requires a tight seal between the cap and the oil filler pipe.

An object of the present invention is to provide a breather cap preferably to be carried by the oil filler pipe of an automobile engine which enables close consistent control over the amount of air entering the oil filler pipe. A related object of the present invention is to provide a cap to be carried by the oil filler pipe which can with ease be applied in tight sealing relation with the oil filler pipe and wherein the obtainment of a tight seal is not adversely affected by irregularities in the size and shape of the oil filler pipe.

Another object of this invention is to provide a cap satisfying the aforesaid objectives and which can be mass produced from low cost easy to assemble parts, particularly die stamped metal parts and molded seal forming elastomeric parts made with simple, relatively inexpensive molds. A related object of the invention is to provide a cap as described where the air seal-forming element of the cap is formed by a separate piece which can easily be assembled with other parts of the cap and allows substantial freedom in the design of the other parts of the cap.

Briefly, in the preferred breather cap application of the present invention, the breather cap comprising an inverted cup-shaped cap member which carries a filter retained in position internally of the cap member by an open-ended sleeve having a flange at the bottom thereof. The bottom face of the flange has an annular depression or trough which intersects a plurality of spaced air passage holes in the flange which direct the air to the filter. The bottom of the flange is covered by a flat annular member pro-

vided with a small breather opening which opens onto the annular depression in the sleeve flange. The sleeve flange holes are fairly well distributed over the extent of the trough, and so the possible path lengths between the small breather hole and the nearest air pasage hole of the annular trough will not vary over too wide a range for different relative angular positions of the annular member and the sleeve flange. Precise positioning of these parts in assembly of the breather cap is thus not required.

The annular member has attached to the inner perimeter thereof a resilient, extremely pliant sealing ring. The ring is a thin walled, upwardly directed and tapering member which readily receives and closely conforms in air tight relation to the outer wall of irregularly sized and shaped oil filler pipes made within normal manufacturing tolerances commonly used in the construction of these pipes. An appreciable clearance space is provided for the flexure of the tapered sealing ring. The ring is further provided with a continuous raised annular ridge which sealingly engages with the flange inside of the annular trough thereof, to prevent air which enters the annular trough from by-passing the air passage holes leading to the filter.

Although some aspects of the invention are not so limited, the use of the aforesaid flat annular member as a carrier for the sealing ring enables the sealing ring to be molded in place on the annular member using simple dies. Also, the placement of the sealing ring on a separate carrier member formed by the exemplary annular member leaves substantial freedom in the design of the other parts of the cap.

Further objects, advantages and features of the present invention will become more readily apparent as the following description proceeds taken in conjunction with the accompanying drawing wherein:

FIG. 1 is a vertical sectional view of a breather cap embodying the improvements of the present invention;

FIG. 2 is a bottom plan view, with a portion broken away, of the breather cap illustrated in FIG. 1 showing the relationship of the various elements of the assembly;

FIG. 3 is a fragmentary vertical sectional view corresponding to the view shown in FIG. 1 with the breather cap mounted on an oil filler pipe;

FIG. 4 is an enlarged fragmentary sectional view of a portion of the breather cap illustrated in FIG. 1 showing the relationship of the elements of the assembly prior to positioning the cap on an oil filler pipe;

FIG. 5 is an enlarged fragmentary sectional view corresponding to the view of FIG. 4 showing the relationship of the elements of the assembly when the cap is mounted on an oil filler pipe;

FIG. 6 is a view in perspective of the flat annular member to which is attached the resilient sealing ring of the breather cap illustrated in FIG. 1; and

FIG. 7 is a view in perspective of the flanged sleeve of the breather cap illustrated in FIG. 1.

Referring now to the drawings, the breather cap assembly there shown and designated generally at **10** comprises an inverted cup-shaped cap member **12**, desirably a die-stamped metal member having an outwardly extending shoulder **14** at the bottom of the cap member and a skirt portion **16** depending a short distance from the outer margin of the shoulder **14**. Internally of the cup-shaped cap member **12** there is provided an open-ended flanged sleeve **20** having a substantially cylindrical portion **22** spaced from the side walls of the cup-shaped cap member **12**. The cylindrical portion **22** of the sleeve **20** is joined to a flange portion **24** extending outwardly from the bottom thereof. The cylindrical portion **22** and the flange portion **24** of the sleeve **20** advantageously form a radius **26** at their juncture, the lower end of said vertical wall thus being above the lower end of the vertical side wall of the cup member **12**, the function of which will become clear as the description proceeds. The end of the cylindrical portion **22** remote from the flange portion **24** has an inwardly extending shoulder **28** which defines an opening **29** and serves to intercept the rim **30** of an oil filler tube or pipe **32**, as illustrated in FIG. 3, thereby maintaining an air space **34** above the mouth of the pipe **32** through which filtered air can pass into the top of the oil filler pipe.

The bottom face of the flange portion **24** of the sleeve **20** desirably has a depression or trough **36** provided with a number of air inlet openings **38**, four such openings spaced 90° apart being shown in the illustrated embodiment of the invention. While optimum effects are achieved with this number of holes, perhaps only three, and many more than four holes could be utilized with good results. The flanged sleeve **20** may be constructed of any durable material, die-stamped metal being preferred.

The flange portion **24** of the sleeve **20** receives a flat annular member **40** which advantageously has attached to the inner margins thereof defining an opening **42**, a thin walled, resilient and highly pliant sealing ring **44**. The sealing ring **44** may be fabricated of various materials such as, for example, rubber or rubber-like compositions, and can be secured to the annular member **40** during the molding of the sealing ring in any manner known to the art. A very satisfactory bond between the ring **40** and the sealing member **44** can be easily attained by employing conventional vulcanization techniques. Other methods of attachment such as for instance, gluing, may, of course, be utilized, but are less desirable.

Referring now in particular to FIGS. 4, 5 and 6 of the drawing, the sealing ring **44** desirably has a substantially flat annular portion **46** which is attached to the flat upper face of the annular member **40**. At the perimeter of the flat portion **46** of the sealing ring **44** is a continuous raised annular ridge **48**, which presses against the radius **26** of the sleeve **20** at a point inwardly of the flange depression **36** to prevent escape of air inwardly of the trough. The annular member **40** covers the trough **36** to define therewith an annular air circulation passage or channel **50** which receives air from a small air intake hole **52** formed in the annular member **40**.

The inner margin of the flat annular portion **46** of the sealing ring **44** forms an inwardly and upwardly extending, thin upwardly tapering, resilient and highly pliant wall portion **54** which at its smallest diameter defines a cylindrical opening **56** concentric with the opening **42** of the ring **40**. The opening **56** of the wall portion **54** advantageously has a diameter less than the smallest expected dimension of the oil filler pipe **32** which due to irregularities in manufacture may deviate from a true cylinder (e.g. oval-shaped) and engages in snug, air sealing relation the outer surface of the oil filler pipe **32**.

The breather cap **10** has a filter **60** filling the space between the cylindrical portion **22** of the sleeve **20** and the cap member **12**. The filter **60** may be conveniently constructed of any suitable material such as, for example, crimped copper wire. The filter **60** serves the conventional function of removing dust and the like from the air passing into the crankcase of the engine and, the space occupied by the filter is in communication with the space **34** leading to the open top of the oil filler tube **32** and atmosphere through opening **52** in the annular member **40**, the annular space or channel **50**, and the sleeve flange holes **38**.

The flanged sleeve **20** and the annular member **40** are secured to the cup-shaped cap member **12** by crimping or spinning and bending the skirt portion **16** of the cap member **12** about the peripheral margins of the sleeve flange **24** and the annular member **40** to form an air tight joint.

In the preferred embodiment of the invention illustrated, the breather cap **10** desirably is provided with a U-shaped leaf spring **70** the legs **72** of which are advantageously angled outwardly to a distance that exceeds the inner diameter of the oil filler pipe **32** and then inwardly from their point of greatest separation to per-

mit the ends **74** of the legs **72** to receive the oil filler pipe **32** and to serve as guides therefor. Where the oil filler tube forms a receptacle for an oil dip stick **80** the breather cap **10** of this invention is attached to the dip stick as by a rivet **86** and a washer **88** which also anchors the leaf spring **70** in place. The dip stick **80** has the usual markings (not shown) at the lower end thereof to indicate the level of the oil in the crankcase at any given time.

In utilizing the improved breather cap of the present invention, the dip stick **80** is guided into the mouth of the oil filler pipe **32** and lowered therein until the rim **30** of the pipe **32** rests against the shoulder **28** of the flanged sleeve **20**. In this position the U-shaped spring **70** is biased inwardly causing a portion of the spring to be pressed against the inner wall of the pipe **32** whereby the breather cap **10** is held in snug frictional engagement on the pipe **32**. As the cap **10** is guided on the pipe **32**, the pipe passes through the opening **56** defined by the upwardly tapering wall portion **54** of the sealing ring **44**. The curvature of the portion **26** of the sleeve **20** provides a large clearance space for flexure of the resilient and highly pliant sealing ring portion **54** required to accommodate oil filler tubes of irregular size and shape. Since the diameter of the opening **56** is less than the smallest diameter of the pipe **32**, the wall portion **54** is depressed outwardly and caused to lie in snug, gas sealing relation against the radius **26** of the flanged sleeve **20**. The thin, resilient, pliant character of the sealing ring **44** and upwardly tapering shape enables the ring to be readily inserted in sealing relation on the oil filler pipe and to conform to irregularities in the outer wall of the pipe **32** where it effectively and efficiently prevents any flow of air between the outer wall of the pipe and the sealing ring. The sealing ridge **48** of the ring **44** prevents air in the annular channel **50** from by-passing the filler **60** by flowing between the outer side of the sealing ring and the sleeve **20**. Thus the flow of air into the crankcase can be closely controlled and metered, and cannot by-pass the filter **60**.

The distribution of the openings in the flange **24** of the flanged sleeve **20** minimizes the variation in gas flow resistance through the openings **38** and the channel **50**. Thus, in placing the annular member **40** on the flange portion **24** of the sleeve **20** during assembly of the breather cap, special care need not be given to the relationship of the opening **52** in the annular member **40** and the holes **38** in the flange portion **24**. When the annular member **40** is in position on the flange portion **24**, the opening will always be sufficiently close to a hole in the flange portion to permit ready, metered flow of gases into and from the crankcase of the engine.

It should be understood that numerous modifications may be made in the breather cap of the invention above-described without deviating from the broader aspects of the invention. Also, the construction of the sealing ring **44** and its attachment to a carrier member separate from the other parts of the oil filler pipe cap is applicable to the type of cap which is completely sealed from the atmosphere.

What is claimed is:

A cap for the oil filler pipe of a motor vehicle, said cap comprising:

a cup-shaped member having a cylindrical, substantially vertical side wall, a closed upper end and an open lower end, said cup member having an outwardly extending annular shoulder adjacent the open lower end thereof and an annular skirt portion extending a short distance axially beyond the outer margin of the shoulder and integral with said shoulder;

a dipstick and a leaf spring disposed in said cup member and fixed to the closed upper end thereof by a rivet and washer, said dipstick and leaf spring extending from said closed end through said open end of said cup member and being adapted for insertion into said oil filler pipe upon placement of said cap thereon;

an open ended, flanged sleeve encompassed by, concentric with and carried by said cup member and having an annular vertical wall defining an opening therein for receiving the oil filler pipe, said vertical side wall of said cup member and said annular vertical wall of said sleeve being spaced apart from one another and defining an annular chamber therebetween, said sleeve having an annular flange attached to and extending from the lower end of said annular vertical wall into contact with said skirt portion of said cup member, the lower end of said annular vertical wall being above the lower end of said vertical side wall of said cup member, said flange having at least three similar air passage openings distributed thereover;

an annular filter for said cup member, said filter substantially filling said annular chamber and being retained in position in said annular chamber by said flange, the upper end of said annular vertical wall being spaced apart from both said vertical side wall and said closed upper end of said cup member and defining a passage therebetween, said annular chamber communicating with the space encompassed by the annular vertical wall of said sleeve through said passage;

a thin, flat and annular sealing ring carrier member underlying said flange and having an air intake opening generally similar in size to said air passage openings, said air passage openings in said flange being evenly spaced from one another to minimize variation in the resistance to air flow characteristics with a variation in the relative angular positions of said annular carrier member and said annular flange, the outer edge of said carrier member engaging said skirt portion, said skirt portion having an annular bent over portion which clamps said carrier member and said flange between said bent over portion and said annular shoulder, the inner diameter of said carrier member being slightly less than the inner diameter of said annular vertical wall;

a resilient, pliant and sealing ring attached to said carrier member and disposed in said oil filler pipe receiving opening, said sealing ring having an opening therein for receiving the oil filler pipe and bounded by a pliant, upwardly converging wall portion, said wall portion being thin measured in a radial direction, said wall portion extending inwardly of said annular, vertical wall, the upper end of said upwardly converging wall portion being spaced apart from said annular vertical wall and said annular flange, the inner margins of said sealing ring wall portion being of lesser diameter than the smallest expected dimension of the oil filler pipe and being readily expandable to form an air tight seal with an irregularly shaped oil filler pipe to prevent air from by-passing the filler pipe, there being a substantial clearance space outside of said sealing ring for the outward expansion of said sealing ring when applied over said oil filler pipe;

a portion of said sealing ring together with said annular flange and said annular carrier member defining an annular channel in said cup member which communicates with the atmosphere through said air intake opening and with the space occupied by said filler through said air passage openings in said annular wall, said annular channel being formed by a depressed portion in said annular flange spaced away from said annular carrier member, said sealing ring having a continuous annular ridge which seals against said annular flange at points inwardly of the inner margin of said annular channel to prevent air entering the annular channel from by-passing the filter chamber, said carrier member and said annular flange

being spaced apart at all points except for those portions of said annular flange and said carrier member which are clamped between said bent over skirt portion and said annular shoulder.

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