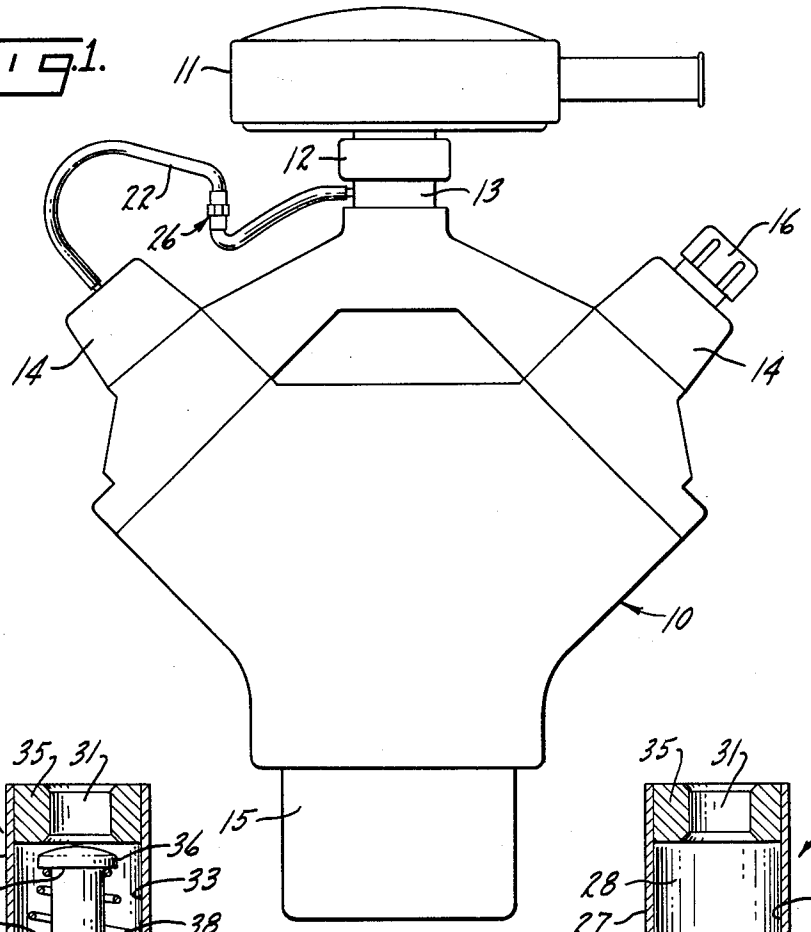
Jan. 12, 1965 W. W. LOWTHER 3,165,097

CRANKCASE VENTILATING SYSTEM

Filed Feb. 13, 1963 2 Sheets-Sheet 1

Fig. 1.



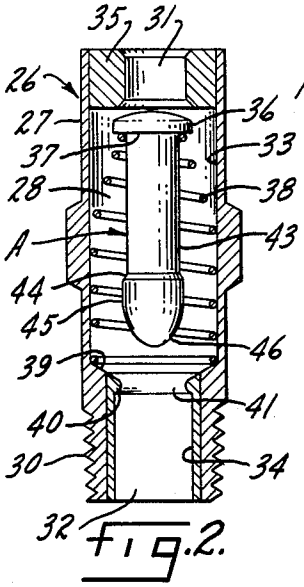


Fig. 2.

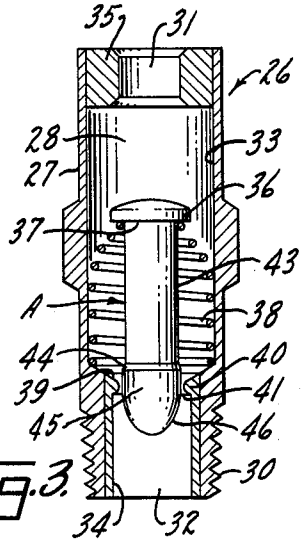


Fig. 3.

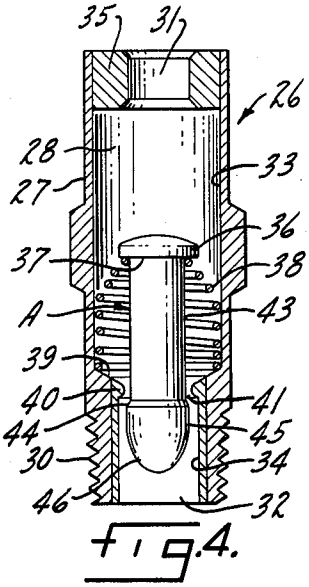


Fig. 4.

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Jan. 12, 1965 W. W. LOWTHER 3,165,097

CRANKCASE VENTILATING SYSTEM

Filed Feb. 13, 1963 2 Sheets-Sheet 2

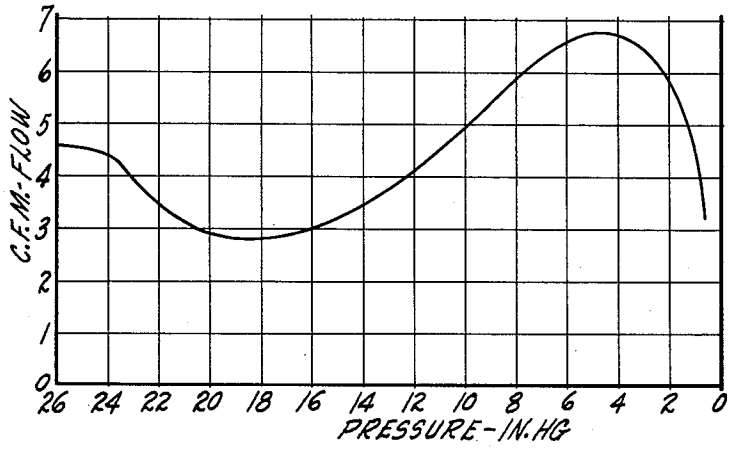


Fig. 5.

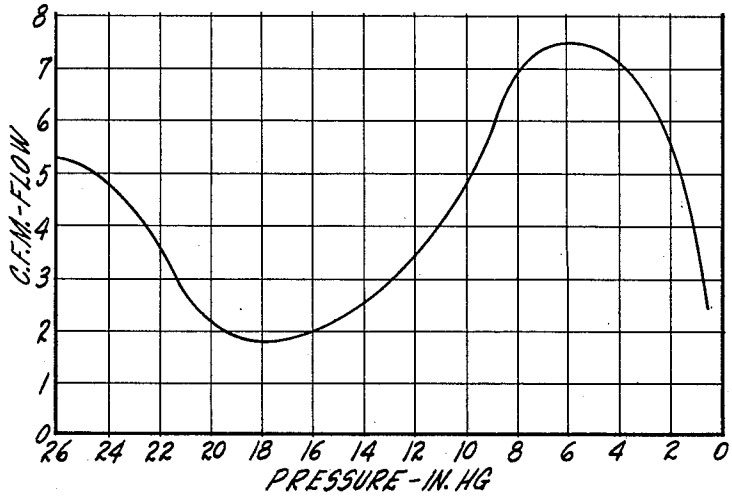


Fig. 6.

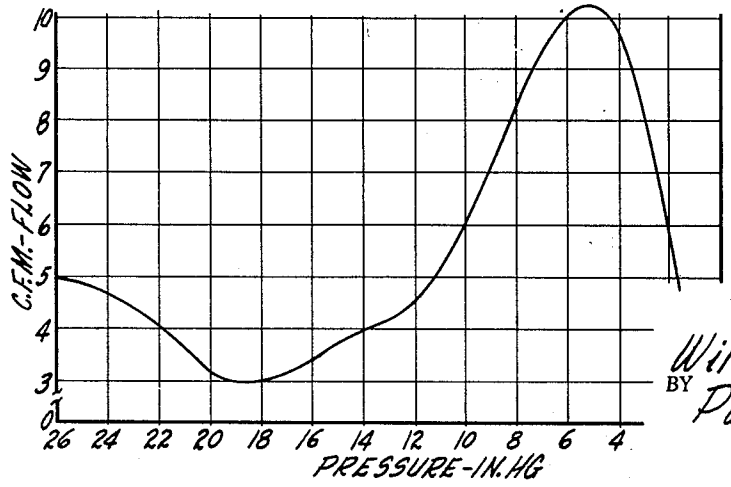


Fig. 7.

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United States Patent Office 3,165,097 Patented Jan. 12, 1965

3,165,097

CRANKCASE VENTILATING SYSTEM

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Filed Feb. 13, 1963, Ser. No. 258,292
16 Claims. (Cl. 123—119)

This invention relates to ventilating crankcases of internal combustion engines, and it particularly relates to a method and valve which efficiently ventilates the crankcase and reduces fuel exhaustion.

A primary object of this invention is a method for efficiently ventilating a crankcase by metering the blow-by so that ventilation flow is increased and the vacuum in the inlet manifold is at least partially relieved during deceleration.

Another object is a valve adapted for a conduit connection between the crankcase and the inlet manifold in order to efficiently ventilate the crankcase and to conserve fuel.

Another object is a valve which reduces air ventilation at low engine loads but permits modest ventilation at high vacuum levels to prevent fuel waste and pollution of the atmosphere.

Another object is a valve which efficiently permits ventilation under various operating conditions and guards against backfire.

Another object is a valve having a central passageway which holds a pin in a free state so that said pin responsively restricts and increases air flow under different engine conditions, while permitting some air flow at high vacuum to reduce fuel exhaustion.

Another object is a valve of the above type in which the pin is not in the orifice under certain operating conditions.

Another object is a valve of the above type that meters at each end under certain operating conditions.

Another object is a valve of the above type that meters normally through the general range but greatly increases flow in full load or low vacuum ranges.

Another object is a valve of the above type where the maximum flow is limited by the inlet orifice.

Another object is a valve that can be tailored to the blow-by of an engine.

Another object is a spring and pin that automatically scrub and clean the side walls of the housing.

Such objects are realized by a valve which will be described in detail and which is illustrated in the drawings wherein:

FIGURE 1 is a diagrammatic side view showing the installed valve on an engine;

FIGURE 2 is a sectional side elevational view showing the pin in one position of operation;

FIGURE 3 is another sectional side elevational view showing the pin in another position of operation;

FIGURE 4 is a sectional side elevational view showing the pin in another position of operation;

FIGURE 5 is an air flow curve of the valve characteristics;

FIGURE 6 is another curve of a modified valve; and

FIGURE 7 is another curve of a modified valve.

FIGURE 1 is a diagrammatic of an engine 10 with air cleaner 11, carburetor 12 and inlet manifold 13. Upper portions 14 are generally designated as rocker arm covers and the lower portion 15 is designated as the crankcase. A breather cap, such as 16, is shown on one of the rocker arm covers. A conduit 22 or the like is shown connecting the inlet manifold and a rocker arm cover, and is intended to illustrate a closed connection between the crankcase and the inlet manifold. A valve

shown generally at 24 may be placed anywhere along the length of this conduit and controls the flow of blow-by gases from the crankcase.

The sectional view of FIGURE 2 shows the valve 26 to have a body section 27 and a central passageway 28 extending through the body. The body may have a threaded end 30 which serves for installing the valve body. The passageway has one open end 31 which is directed towards the crankcase in the conduit connection, and another open end 32 which is directed towards the inlet manifold. The passageway is shown as modified into an upper chamber 33 and a lower smaller chamber 34.

The valve may have its inlet defined by a collar 35 press fitted or otherwise mounted or held in one end of the valve body. A pin, designated generally A, is disposed in the central passageway. The head 36 of the pin is shown with a crown to form a better seat against the collar opening upon backfire. The head has a peripheral flange or shoulder 37 which rests on the final turn of a coil spring 38. The other final turn of the coil spring is shown resting on a shoulder 39 which may be coextensive with a continuous restriction or annular band 40 which forms an orifice 41 leading to the small chamber of the passageway. The coil spring, however, may be otherwise seated.

The pin is shown as having a neck portion of reduced diameter 43 integrally joined to a lower enlarged body portion by an offset portion 44. The body is preferably, but not necessarily, annular and has an intermediate part with sides 45, and a tapered or reduced lower part 46. The sides of the body are intended to closely approach the restriction 40 as the pin moves downward. This substantially restricts the orifice which reduces the area available for air flow or ventilation through the valve.

Generally, the body is blunt or tapered or reduced so that it is not positioned in the orifice under normal operating loads as shown in FIGURE 2. The position of the pin is controlled by the coil spring which, in turn, is closely positioned to the wall of the upper chamber. This arrangement prevents misalignment of the pin relative to the orifice, and also provides a cleaning action of the upper chamber caused by the spring scrubbing the walls.

The sides of the body are shown as being straight, but they might be otherwise. They may be shaped and dimensioned to restrict the orifice for different time periods in order to vary the flow curve of the crankcase vapors. Such sides may be easily designed to obtained any blow-by curve for a given engine.

FIGURES 5–7 illustrate how such curves may be obtained by changes to the body or lower end of the pin. The curve of FIGURE 5 shows a maximum flow of nearly 7 cubic feet per minute at a low vacuum of about 2–8 inches of mercury, while the curves of FIGURES 6 and 7 are respectively nearly 8 c.f.m. and nearly 10 c.f.m. at the corresponding vacuum range. At higher vacuums of about 18 to 20 inches of mercury, the flow is at a minimum. The 18 to 20 inches of mercury vacuum may be considered to represent normal idling conditions, whereas 4 to 8 inches of mercury vacuum may be considered to represent full load operation. Manifold vacuum on the order of 22 to 26 inches of mercury may be considered to represent deceleration conditions.

The higher vacuum, for example 22 to 26 inches of mercury, is caused by deceleration, and this in turn causes the body portion 45 of the pin to move past the orifice or restriction 40. For example, consider the position of the pin in FIGURE 4. The coil spring is compressed and the neck portion of reduced diameter or dimension is shown alongside the orifice. This opens the orifice and permits an air flow or ventilation through the valve greater than when the pin substantially closes the orifice during idling, as shown in FIGURE 3.

The use, operation and function of my invention are as follows:

Valve bodies of the type shown here are used to efficiently ventilate the crankcase of an internal combustion engine to prevent emission of crankcase vapors to the atmosphere, and a valve with a floating pin of this type is described in my copending application, now U.S. Patent No. 3,105,477, issued October 1, 1963.

Different pressure gradients operate at different times in an engine. Such pressure gradients are more or less balanced when the car is operating normally. In such a case, the air flow through a conduit connecting the crankcase and the inlet manifold is not restricted, and blow-by gases are drawn out of the crankcase, through the conduit, and into the inlet manifold. This condition may be called normal operating load.

It is known that at low loads and idling, a substantial vacuum develops in the inlet because the butterfly valve in the carburetor is closed and the pistons are still attempting to draw in air. This situation is aggravated, so to speak, under deceleration conditions when the momentum of the car causes the pistons to be even more demanding because the engine is turning over at higher speeds. At the same time, the carburetor butterfly valve is closed. The result is that during what I have referred to as deceleration conditions, the vacuum in the inlet is known to reach 22 to 26 inches of mercury or thereabouts, or even possibly higher. This high vacuum will cause raw fuel to be pulled in at a greater rate through the carburetor idling jets, and a substantial portion of the raw fuel is pumped out the exhaust pipe, resulting in the smoke commoly observed from automobile exhaust pipes under conditions of deceleration.

The flow causes the pin to move towards the lower chamber 34 of the passageway and thereby restricts the air flow. At high vacuums, the body of the pin will tend to close the orifice 41 because the sides 45 of the enlarged portion of the pin will be within the annular band 40.

The high vacuum caused by deceleration will cause the pin to move to the position generally shown in FIGURE 4 in which the spring is more compressed and the enlarged lower end of the pin moves past the orifice. The result is that the stem or neck 43 is now within the orifice and the flow area has been increased. Thus, by an increased flow area, the valve tends to break or reduce the vacuum in the inlet by allowing more flow through the crankcase ventilating system.

In effect, the method and valve provides a metering or throttling of the blow-by at a zone in a line of communication between the crankcase and the inlet. The metering is performed by a valve which increases and decreases the ventilation flow under heavy loads, low loads and deceleration, respectively. During deceleration, when the vacuum is at a maximum in the inlet, the method and valve provide that ventilation is again increased so that more blow-by passes through the metering zone and the high vacuum in the inlet is relieved.

Whereas I have shown the neck or stem 43 of the pin as more or less round in cross section, it should be understood that any cross sectional configuration may be used. While I might prefer that the clearance between the orifice and the pin be uniform, it should be understood that the same results may be obtained by various cross sections. For example, the pin might be uniform from the body 45 and head 36, with flats ground on the side, for example above portion 44.

While I have shown the conduit connected to the cover for the rocker arms on top of an engine, it should be understood that it may be connected at any suitable point where access can be had to the crankcase of the engine. It will be understood in the form shown in FIGURE 1 that a free flow of the crankcase vapors will be obtained up through the push rod channels into the cover.

In the specification and claims, I may have referred to the pin as being generally upright and I have used the terms top, bottom, upper, lower, etc. But it should be understood that these terms are used merely for purposes of designation and orientation, and the valve will operate satisfactorily in a horizontal or upside down position; in fact, in any position. Thus, in the specification and claims, the terms "upper," "lower," and the like, should not be interpreted to mean that the valve has to be operated vertically.

In the claims, I may have made use of the term "upper portion" and "lower portion" and it should be understood that there may be additional structure below the "lower portion" or above the "upper portion." I use these terms simply to designate the position of the large and small diameter portions during the floating operation of the pin.

While I have referred to no metal-to-metal contact or no seating contact, it should be understood that the pin will contact the sides of the housing and orifice due to engine vibrations. However, this should be distinguished from metal-to-metal contact that occurs in a normal valve closing operation. In essence, there is no stop or seat in my structure to plug up. Further, the airflow itself tends to center the pin, but at the same time the pin is free for lateral oscillation since it is only supported at one end.

While I have shown the stem or neck portion as generally straight, it should be understood that it may be tapered, either up or down, or a combination. The important point is that the flow area with the pin in the orifice should increase under conditions of deceleration.

The foregoing invention can now be practiced by those skilled in the art. Such skilled persons will know that the invention is not necessarily restricted to the particular embodiments presented herein. The scope of the invention is to be defined by the terms of the following claims as given meaning by the preceding description.

I claim:

1. For use in an engine crankcase ventilating system wherein a conduit communicates between the engine crankcase and the air intake for the cylinders, a valve structure adapted to be positioned in the conduit including a valve element and a housing having an orifice therein, the valve element being positioned in the housing and being in the form of an elongated pin having a lower portion with a smaller exterior dimension than its intermediate portion, the body of the pin in between the two portions varying in cross sectional area, an upper portion above the intermediate portion constructed to define a greater flow area with the orifice than the intermediate portion, a spring to bias the pin away from the orifice at all times, the spring strength being such that under deceleration conditions on the engine resulting in high vacuum in the air intake, the upper portion will cooperate with the orifice to define a greater flow area resulting in an air flow through the valve greater than when the intermediate portion is cooperating with the orifice to regulate air flow, the at-rest position of the pin, when the spring is at its free length, being such that the flow area defined between the lower portion of the pin and the orifice is substantially greater than the flow area defined between the intermediate portion of the pin and the orifice, the proportioning and dimensioning of the housing, pin, spring and orifice being such that the pin is out of seating contact with the orifice under all load conditions.

2. The structure of claim 1 further characterized in that the cross section of the upper portion is uniform and generally circular.

3. The structure of claim 1 further characterized in that the elongated pin is solid.

4. The structure of claim 1 further characterized in that the orifice is in the form of an insert mounted in the housing.

5. The structure of claim 1 further characterized in

that the load characteristics of the spring are related to the vacuum and pressure conditions of the crankcase and air intake such that the pin is out of contact with the orifice under all load conditions.

6. The structure of claim 1 further characterized in that the spring is a compression spring.

7. The structure of claim 1 further characterized by and including a head portion on the pin above the upper portion having a shoulder disposed generally laterally thereon and in engagement with the upper end of the spring, the spring being a compression spring with the lower end thereof resting on the orifice.

8. The structure of claim 7 further characterized in that the spring is generally tapered at the small end, when in its free state, with the large end resting on the orifice, a number of turns of the spring adjacent the large end being of a diameter approximating the inside diameter of the housing.

9. The structure of claim 1 further characterized in that the housing includes an inlet opening spaced from the orifice with the pin suspended on the spring, when at rest, and positioned between the inlet opening and the orifice, the dimensioning being such that the end of the pin adjacent the inlet opening meters the air flow through the housing when vacuum in the inlet is least.

10. A method of operating an internal combustion engine to exhaust the crankcase vapors from the crankcase and to simultaneously reduce the high vacuum created in the engine inlet under deceleration conditions, which includes the steps of communicating the crankcase to the inlet by a separate passage, allowing the various conditions of vacuum normally existing in the inlet under various load conditions to cause a flow of crankcase vapors from the crankcase through the separate passage to the inlet, metering the flow through the separate passage in varying amounts dependent upon the load on the engine by metering the flow least at full load to allow the most flow, and most at no load to allow the least flow, and decreasing the metering and thereby increasing the flow, over the amount of metering at no load, under deceleration conditions.

11. The method of claim 10 further characterized by and including the step of varying the amount of metering of the flow between no load and full load on the engine in accordance with the blow-by characteristics of the engine.

12. For use in an engine crankcase ventilating system wherein a conduit communicates between the crankcase and the air intake for the cylinders, a valve structure adapted to be positioned in the conduit to control the flow of crankcase vapors therethrough, a flow control pin in the valve structure, a spring supporting the pin therein so that the pin is normally out of seating contact with the walls of the valve structure at all times other than through its spring support such that the air pressure differential through the valve structure operates the pin and spring, an orifice in the valve structure downstream from but closely adjacent to the pin and defining an effective flow passage therewith so that as the air pressure differential varies through the passage, causing differential movement of the pin, the effective flow passage between the pin and orifice will be varied in accordance with pin movement, the effective flow passage being tailored to provide various flow areas between the pin and orifice in response to various air pressure differentials through the valve structure so that the flow area is coordinated to the blow-by characteristics of the engine, and means defining an increased flow area between the pin and orifice when the pin is subject to an air flow resulting from an air pressure differential associated with deceleration conditions on the engine.

13. The structure of claim 12 further characterized in that the flow control pin is solid.

14. The structure of claim 12 further characterized in that the orifice is in the form of an insert mounted in the valve structure.

15. The structure of claim 12 further characterized in that the load characteristics of the spring are related to the vacuum and pressure conditions of the crankcase and air intake such that the spring is normally out of seating contact with the orifice under all load conditions.

16. The structure of claim 12 further characterized in that the spring is a compression spring.

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