July 22, 1952 R. C. BECKETT 2,604,186

CRANKCASE VENTILATOR

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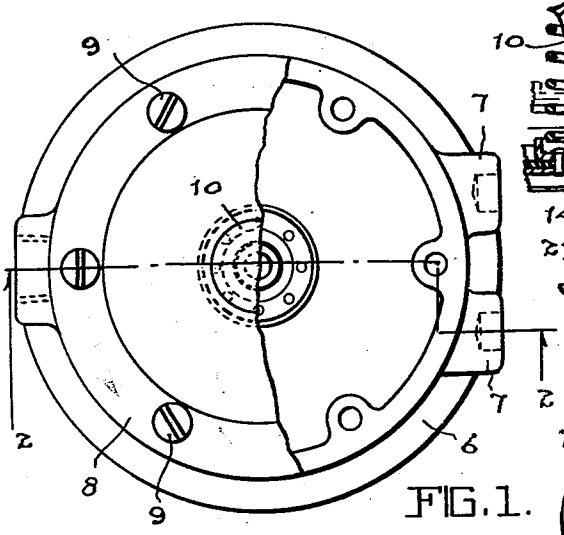


FIG. 1.

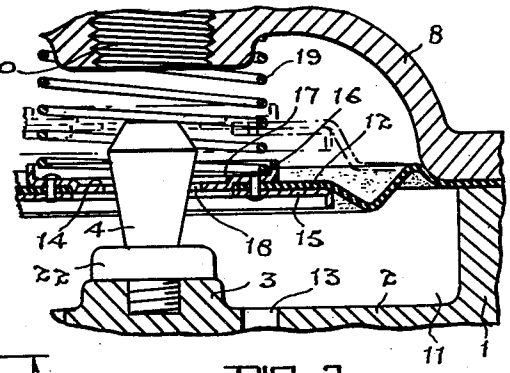


FIG. 3.

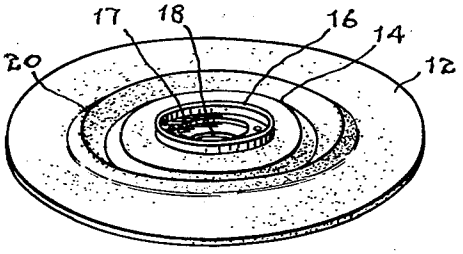


FIG. 4.

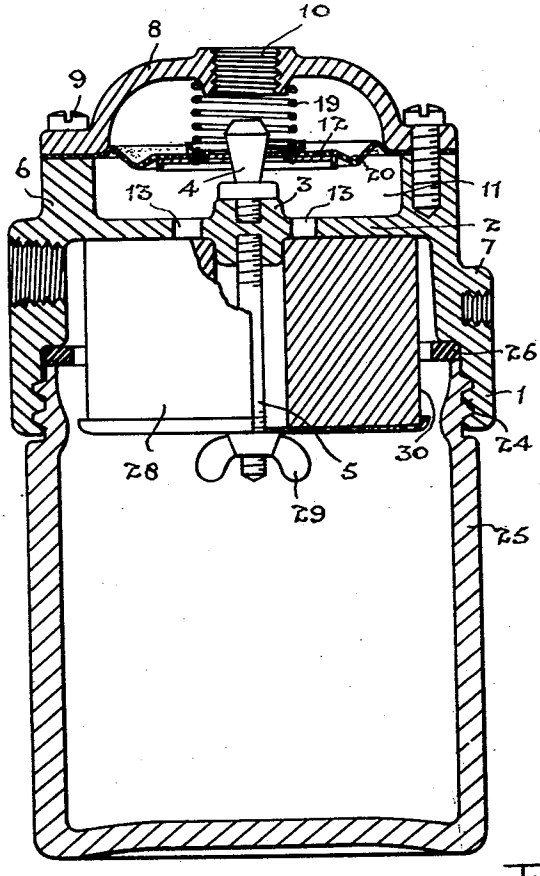


FIG. 2.

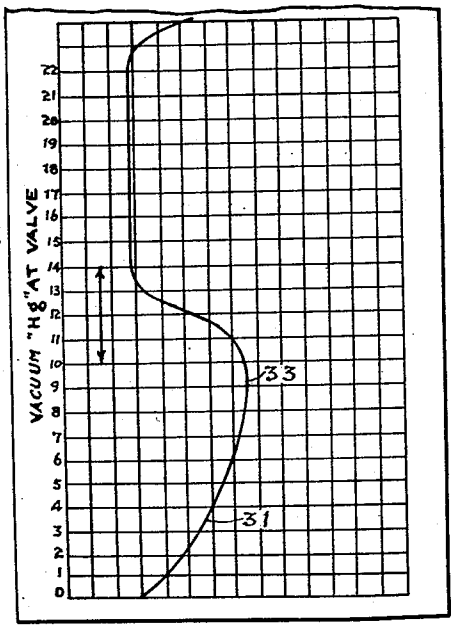


FIG. 5.

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CRANKCASE VENTILATOR

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6 Claims. (Cl. 183—41)

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This invention relates to improvements in crank case ventilator devices for internal combustion engines to be connected between the crank case and intake manifold.

The principal object of the invention is to provide a crank case ventilator which will afford an improved metering action in the metering of the flow between the crank case and manifold while eliminating clogging of the metering orifice and in which there will be no moving parts in contact, to provide improved performance, longer life and more dependable operation than previous ventilator devices.

A further important object is to provide efficiently for the settling out and filtering of contaminants drawn from the crank case before metering the manifold directed flow.

A further important object is to provide a crank case ventilator which will additionally function as a vacuum breaker to prevent excessively high manifold vacuums and consequent engine back-firing.

A still further object is to provide a simple and compact device in which the parts can be readily removed, cleaned and replaced.

The principal feature of the invention consists in the novel arrangement of a fixed tapered metering pin extended through a metering orifice in a flexible diaphragm moving relative to and independent of the pin in response to variations in intake manifold vacuum, to vary the annular flow opening around the pin in accordance with desired flow at that vacuum.

A further important feature consists in forming the tapered pin with a reverse taper to sharply increase flow passage under excessively high manifold vacuum to form a vacuum breaker to counteract the high vacuum and consequent engine back-firing or other improper operation, which might otherwise result.

A further important feature consists in arranging a filter element directly in the path of flow moving towards the metering orifice to filter out contaminants in the flow drawn from the crank case.

Another important feature resides in the provision of a sediment bowl beneath the filter element and arranging a baffle surface either as part of or separate from the filter element in the path of gas flow from the crank case previous to the filter element to settle the heavier contaminants and deposit them in the sediment bowl.

A still further feature of importance resides in the novel construction of parts wherein the metering device, filter element and sediment bowl form a compact simple structure.

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These and other objects and features will become apparent with reference to the accompanying drawings in which Figure 1 is a plan view of a crank case ventilator constructed in accordance with my invention with part of the cover broken away.

Figure 2 is a vertical mid-sectional view on the line 2—2 of Figure 1.

Figure 3 is a vertical sectional detail of the flow metering device.

Figure 4 is a perspective view of the diaphragm employed in the flow metering.

Figure 5 is a representative graph of flow rate against vacuum obtained with a metering device constructed in accordance with my invention.

It is well understood that, by connecting a valve between the crank case and intake manifold, the crank case can be ventilated to draw off contaminating materials in the bowl by gases or those formed as the result of oil deterioration.

The desirability of ventilation is well understood as the elimination of the contaminants prevent the inherent harmful effects such as rust, corrosion and improper lubrication occasioned thereby.

Various forms of valves have been provided. In nearly all of these there are moving parts in contact and the very nature of the contaminants being drawn therethrough act to soon clog the valve and "freeze" the moving parts. Consequently the valves operate efficiently to provide the desired flow metering action for relatively short periods when they must be serviced, cleaned or replaced.

It has also been attempted to eliminate contacting moving parts but insofar as I am aware no successful valving or metering action has been provided that will operate efficiently over extended periods.

One of the prime objects is therefore to overcome the disadvantages of previous valve constructions in the metering action, and further, to provide for filtering out the contaminants into a sediment bowl which can be readily removed and emptied.

With reference to the drawings, the device includes, as shown in Figure 2, a body portion 1 which may be in the form of a cylindrical casing having a transverse partition 2 extending thereacross subdividing the interior of the casing and formed with a central boss 3 extending on opposite sides of the partition and having a central screw-threaded bore in each face to receive the metering pin 4 and the filter-retaining wing bolt 5.

Formed in the wall of the body portion 1 be-

neath the partition 2 is a screw-threaded inlet 6 and in diametric relation thereto are the mounting bosses 7, although of course any mounting arrangement may be used.

Closing the upper portion of the body 1 is a cover 8 secured in position by screws 9 and formed with an outlet 10 adapted to be connected to the intake manifold of an internal combustion engine. The partition 2 and cover 8 thus define a closed chamber 11 which is referred to as the metering chamber.

Clamped between the upper edge of the body portion 1 and the cover is a diaphragm 12 which subdivides the chamber 11 extending thereacross between the inlet openings 13 in the partition 2 and the outlet 10 in the cover.

Carried centrally on the diaphragm 12 is an orifice plate 14 clamped to the diaphragm with the aid of the annular clamping plate 15. The orifice plate 14 is shown as provided with an upturned outer edge 16 and an offset inner edge 17 defining the metering orifice 18, the diaphragm being open beneath the metering orifice whereby communication between the partition inlet openings 13 and the cover outlet 10 is afforded through the metering orifice 18.

Figure 2 shows the normal position of the diaphragm under normal road load or driving condition with the biasing spring 19 counterbalancing the upward pull on the diaphragm by the vacuum in the intake manifold.

The spring 19 is located by the boss of the cover outlet 10 and the upturned outer edge 16 of the orifice plate.

As shown, the diaphragm is provided as at 20 with a corrugated formation to permit vertical movement of the orifice plate 14 relative the metering pin 4 over an extended vertical distance in accurate alignment with the pin.

Referring to Figures 2 and 3, the metering pin 4 tapers inwardly from 21 adjacent the top to the flange base 22 and above 21 is reversely tapered at 23. The significance of the shape of this pin will be more fully understood with reference to Figure 5 as hereinafter described.

The lower edge of the body portion 1 is shown as internally threaded at 24, and threading into the lower end is a sediment bowl 25. Sealing the connection between the sediment bowl and the body 1 is the gasket 26 compressed between the upper edge of the bowl and the shoulder 27 formed within the body portion of the device.

Surrounding the retaining bolt 5 and abutting the partition 2 is a removable filter element 28 held in place against the partition by the wing nut 29. The wall 30 of the filter element is spaced from the interior of the body portion 1, defining an annular passage therearound, and it will be seen from Figure 2 that gases delivered through the inlet 6, which is adapted to be connected in communication with a crank case to be ventilated, will impinge on the wall 30 which will form a baffle effect to settle out the heavier contaminants in the flow and these will fall or drop down into the sediment bowl.

The gases to reach the openings 13 in the partition must pass down beneath the filter element 28 and such contaminants as are not settled out by the baffle effect of the wall 30 will be filtered out by the filtering medium upon flowing upwardly to the metering chamber 11, so that no contaminants will be permitted to accumulate around or on the metering pin 4.

Referring now to Figure 5, the curve 31 represents the typical flow rate for varying vacuum

pressures obtainable with a metering arrangement in accordance with this invention. Under no vacuum in the intake manifold, that is, the engine dead, the orifice plate 14 will be urged to seat against the base 22 of the metering pin by the biasing spring 19, and it will be seen, with reference to both Figures 2 and 3, that as the vacuum increases to raise the diaphragm and plate 14 to the point 21, the flow orifice defined between the tapered portion of the pin and the orifice plate will become progressively smaller, while above 21, due to the reverse taper 23 of the pin, the area of flow through the orifice plate will sharply increase.

Under engine idling conditions the vacuum in the intake manifold is normally in the neighbourhood of 18 to 22 inches mercury and the bias of the spring 19 is such that at idling conditions the diaphragm is drawn up to bring the orifice plate 14 adjacent to the point 21 of the tapered metering pin which is the largest diameter of the pin.

Thus the flow area through the metering orifice 18 is at a minimum. Any further increase in vacuum in the manifold is prevented by the diaphragm moving still further upwardly to the dotted line position of Figure 3 to raise the orifice plate above the point 21 of the pin to increase the flow rate through the orifice 18. Thus the metering pin 4 and orifice plate 14, in addition to serving in a metering capacity, serve as a vacuum break.

The purpose of controlling the maximum manifold vacuum is to reduce engine oil consumption under high vacuum and to control engine backfire which occurs if the manifold vacuum reaches in the neighbourhood of 25 inches mercury pressure.

With reference to Figure 5, it will be seen that the rate of flow through the metering orifice 18 is substantially constant for manifold pressures in the neighbourhood of from 14 to 22 inches mercury. Above 22 inches mercury the curve breaks sharply at 32 to provide increased flow counteracting excessive manifold vacuum leading to the oil consumption, back-firing and other improper engine operation caused thereby.

Under normal road load conditions equivalent to a manifold vacuum of from 8 to 12 inches mercury where crank case ventilation is important the flow rate through the metering orifice, due to the taper of the metering pin, increases to a maximum, as shown by the knee 33 of the curve, that is, the taper is such in the pin 4 that, although the vacuum acting to draw the crank case gases through the inlet 6 in the ventilator device is reduced, the area of flow through the metering orifice 18 between the metering pin and the orifice plate is increased sufficiently to provide the increased flow required.

It will be understood that the specific curve of Figure 5 is by way of illustration only and the orifice plate 14 and metering pin 4 can be modified to provide the precise flow rate required for any particular engine design.

It is extremely important to note that in the metering action there are no moving parts in contact, the metering pin 4 is stationary and the orifice plate 14 carried by the diaphragm is not in contact with the pin. At the same time there is a wiping action between the pin and orifice plate to prevent any build-up or accumulation of contaminants which may happen to pass through the filter from bridging and sealing the metering orifice.

It is also important to note that the diaphragm is independent of the metering pin and carries a minimum of load, in the form of the orifice plate 14 and clamping plate 15, which would deleteriously affect the alignment of the diaphragm in moving relative the metering pin.

Further, both the clamping plate and orifice plate lying against the diaphragm and substantially in the plane of the diaphragm serve in clamping the diaphragm to prevent any turning or twisting movement therein in operation which would serve to alter the accuracy of the metering.

The provision in a single unit of a filtering medium and a sediment collector and a metering device is also important as the metering action is improved by the elimination of the contaminants and no special provisions, fittings or the like need be applied in using the ventilator device. Further, the baffle arrangement and large filter area provide for long periods of operation without attention by eliminating the necessity of the filter to handle all of the contaminants and by preventing any consequential accumulation of contaminants in the metering chamber.

Further, the simplicity, ease of removal of parts for cleaning, replacement or the like is apparent.

It will be understood that various modifications in the construction and assembly of the parts may be made without departing from the spirit and scope of this invention.

It is important to note that by providing for the filtering and collecting out of impurities and oil bodies and the like from the flow, not only is the metering action improved and build up of accumulations around the metering elements prevented, but further such foreign matter and accumulations is prevented from entering the engine manifold and consequent harmful effects which would be occasioned by such entry are prevented.

What I claim as my invention is:

1. In a crank case ventilator, a metering chamber having an inlet thereto for communication with a crank case and an outlet therefrom for communication with an intake manifold, a diaphragm extending across said chamber between said inlet and outlet and having a metering orifice opening therethrough, a tapered metering pin supported within said chamber and concentric with said metering orifice to project therethrough and tapering toward the inlet side of said diaphragm, and means biasing said diaphragm towards said inlet.

2. In a crank case ventilator device, a metering chamber having a crank case connecting inlet thereto and an intake manifold connecting outlet therefrom, a diaphragm extending across said chamber between said inlet and outlet, an orifice plate carried by said diaphragm and presenting a central metering orifice opening therethrough affording communication between said inlet and outlet, a metering pin supported within said chamber and concentric with said metering orifice and normally projecting therethrough with the portion normally projecting through said orifice tapering towards the inlet side of said diaphragm, and spring means biasing said diaphragm toward said inlet, the diameter of said orifice being greater than the maximum diameter of the tapered portion of said metering pin.

3. A device as claimed in claim 2 in which said pin is also tapered on the outlet side of said diaphragm.

4. A crank case ventilator device, comprising a body casing having a transverse partition subdividing said casing into an upper metering chamber and a lower filtering chamber and formed with a central boss and having an opening therein providing communication between said chambers, a metering pin threaded into said centre boss and tapering toward said boss, a cover member closing said upper metering chamber, a diaphragm clamped by said covering member and extending across said metering chamber and formed with a metering orifice receiving said metering pin, spring means biasing said diaphragm, a filter element arranged beneath said partition in said filtering chamber, retaining means threaded into said central boss removably retaining said filter element in said filtering chamber, a sediment bowl closing said filtering chamber, said filtering chamber having an inlet therein leading to said sediment bowl and said filter element.

5. A device as claimed in claim 4, in which said metering pin is provided with an enlarged base and a tip tapering in reverse from the taper of said pin towards said enlarged base.

6. A device as claimed in claim 4 in which said sediment bowl is threaded internally into said lower filtering chamber, and a sealing gasket is employed between the upper end of said sediment bowl and the shoulder formed within said filtering chamber.

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