Dec. 1, 1964 J. W. HUMPHREYS 3,159,150

CRANKCASE BLOW-BY EXHAUSTER

Filed May 10, 1962

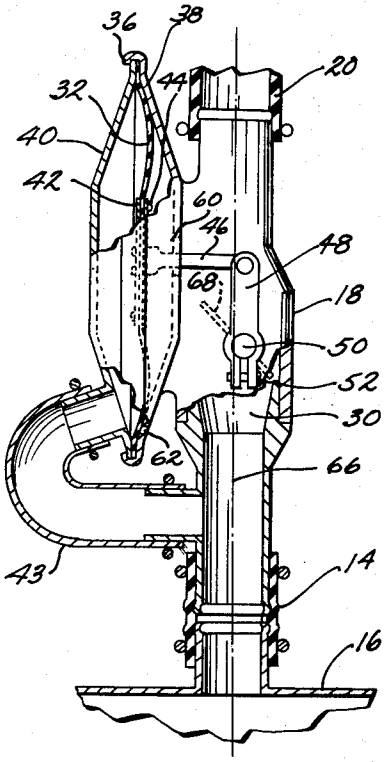


FIG. 2.

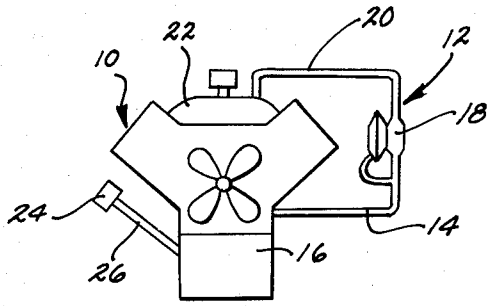


FIG. 1.

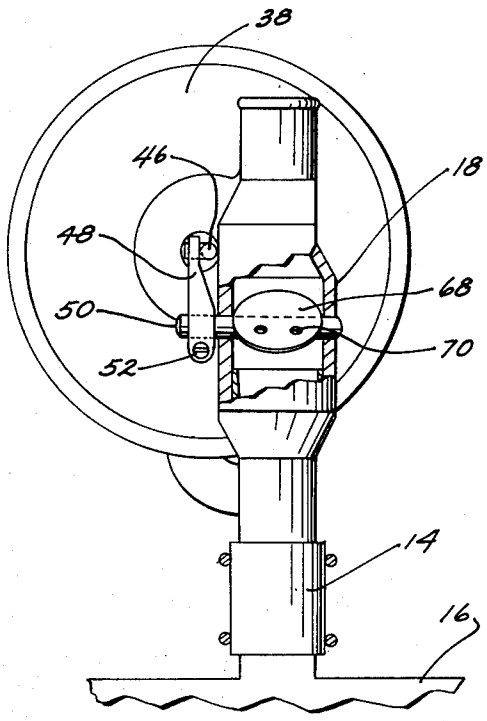


FIG. 3.

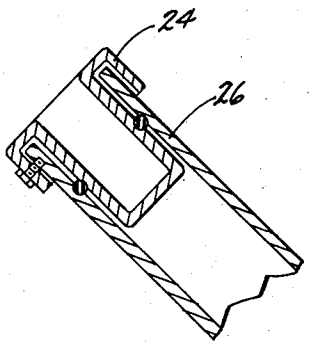


FIG. 4

INVENTOR.
JOHN W. HUMPHREYS
BY Price & Heneveld
ATTORNEYS

United States Patent Office 3,159,150 Patented Dec. 1, 1964

3,159,150

CRANKCASE BLOW-BY EXHAUSTER

John W. Humphreys, Muskegon, Mich., assignor to Johnson Products, Inc., Muskegon, Mich., a corporation of Michigan

Filed May 10, 1962, Ser. No. 193,797
6 Claims. (Cl. 123—119)

This invention relates to internal combustion engines, and more particularly to a controlled exhausting system for an engine crankcase.

This is an improvement of my invention in patent application, Serial No. 167,562, filed January 22, 1962, now Patent No. 3,108,581 and entitled Crankcase Pressure Controller. Control of noxious fumes and vapor from the crankcase of internal combustion engines by conventional vacuum-responsive regulators involves inherent control problems, since the desired rate of vapor flow must vary roughly inversely with the amount of manifold vacuum. This is because maximum vacuum occurs at periods of low engine blow-by, and minimum vacuum occurs at periods of maximum blow-by. At full load operation of the engine, intake vacuum is practically nil. Consequently, it is almost impossible to draw all of the crankcase gases through the regulator into the manifold, especially if the engine is somewhat worn. Further, at all other loads it is necessary to draw excess air through the flow system. With these manifold vacuum-responsive systems therefore, the crankcase must be vented to the atmosphere to allow exit of excess gases under maximum blow-by, low-vacuum conditions, and to allow excess air entry under high vacuum low blow-by conditions. Moreover, as is well known, each flow regulator device of the vacuum-type must be matched to the particular engine displacement to provide proper interrelated action between the independently varying manifold vacuum and blow-by volume.

Thus, applicant devised the apparatus disclosed in the above identified patent application to provide crankcase ventilation controlled by pressure of gases in the crankcase to regulate the flow from the crankcase to the intake system of the engine. Thereby, the flow was regulated in direct proportion to the positive crankcase pressure due to a flow valve controlled by a pressure responsive element exposed to the crankcase pressure on one side and to the atmosphere on the other side. Slight positive pressure variations in the crankcase govern the opening of the valve to provide a constant, accurate control.

It has been found that under some operating conditions, it is preferable to have a slight vacuum in the sealed crankcase, rather than the slight positive pressure over atmospheric, but to still utilize a regulator controlled by the crankcase pressure rather than the manifold vacuum. It has been found that the pressure in the crankcase over atmospheric tends to cause slight engine oil leakage past gaskets and bearings under some operating conditions.

Therefore, it is an object of this invention to provide a crankcase ventilation regulation system, especially for a sealed crankcase, wherein the regulation is governed by the crankcase pressure, and the crankcase is maintained at the pressure slightly below atmospheric.

It is another object of this invention to provide a novel, crankcase-pressure controlled ventilation system wherein the control valve is operated in response to crankcase pressure, and includes a slight vacuum assist to open the valve when the pressure in the crankcase exceeds a certain, predetermined pressure slightly below atmospheric pressure.

It is another object of this invention to provide such a crankcase exhausting system enabling the crankcase to be completely sealed to the atmosphere to prevent any undesirable exhausting of noxious vapors into the atmosphere. The novel regulator causes the crankcase pressure to constantly seek a norm slightly below atmospheric pressure, thereby removing any tendency of blow-by gases from seeping out to the atmosphere or backing up through the engine. The regulator further needs no special calibration for different sized engines. It accommodates any engine no matter what the displacement or age thereof. It is relatively simple and inexpensive in construction and completely dependable in operation. It neither utilizes nor needs any spring elements but rather is capable of operation with a simple butterfly valve and pressure diaphragm. It does not require excess air to be passed into the engine through the crankcase, and is extremely sensitive in operation. It further is not conducive to collecting carbon deposits, since it is self-washing in nature.

Other objects and advantages of this invention will be apparent upon studying the following specification and drawings in which:

FIG. 1 is an elevational schematic view of an internal combustion engine embodying the invention;

FIG. 2 is an elevational, partially sectioned view of the novel apparatus;

FIG. 3 is an elevational view of the front of the apparatus; and

FIG. 4 is a sectional view of a suitable filler tube plug utilized with this invention.

Basically, the invention comprises, in an engine assembly, a conduit means extending between the crankcase of the sealed internal engine and the intake manifold means, and including a flow valve, preferably a butterfly valve, and a pressure responsive regulator member operably linked to the valve. One side of the pressure responsive member is exposed to atmospheric pressure, and the opposite side to crankcase pressure. The pivotal butterfly valve is responsive to and regulated by crankcase pressure. The valve includes a slight vacuum assist in its opening action by having a slightly greater area on one side of its pivotal mounting responsive to the pressure differential between the crankcase and the intake manifold tending to open the valve, than the area on the opposite side of the pivot responsive to the differential in a manner tending to close the valve. This is achieved by mounting the butterfly in a slightly offset manner in the conduit with respect to the centerline of the conduit.

Referring now to the drawings, in FIG. 1 is disclosed an internal combustion engine **10** having a regulated crankcase ventilation system **12** including a conduit portion **14** extending from the crankcase **16** of the engine, a regulator **18** and a conduit portion **20** extending between the regulator and the intake manifold **22** of the engine. Thus, conduits **14** and **20**, as well as the passageway **30** through regulator **18**, form a conduit means adapted to conduct the vapors from the crankcase to the intake manifold. The crankcase of the engine is sealed to the atmosphere in the preferred form of the invention by utilizing a suitable sealing cap **24** in the filler spout **26** as illustrated in FIG. 4.

The regulator housing includes a first portion defining a passageway **30** between conduits **14** and **20**, and a second portion enclosing an annular diaphragm **32**. The diaphragm is sealingly secured at its outer periphery and its inner central portion. The outer periphery is preferably secured by crimping edge **36** of the first generally pie-shaped sheet metal member **38** over the peripheral edge of the facing pie-shaped member **40**. Obviously, other equivalent means could be used. The inner portion of the diaphragm is secured between a pair of connected plates **42** and **44** which are secured to link **46**. Link **46** is in turn pivotally mounted to lever **48**

which is connected onto shaft 50 by squeezing the ears of lever 48 together with a suitable screw 52.

A conduit portion 43 enables gaseous communication between conduit portion 14 from the crankcase 16, and one side of the diaphragm. A port 60 enables communication between the atmosphere and the opposite side of the diaphragm 32. A supplementary peripherally positioned port 62 may also be utilized if desired.

Shaft 50 is offset from the centerline 66 through passageway 30. Butterfly valve disc 68 is mounted as by screws 70 to shaft 50. Since the shaft is offset with respect to the circular passageway, the disc is mounted with a larger area on one side of the shaft than on the other, i.e. on the left side of the shaft as compared to the right as illustrated in FIG. 2.

It will be noted that the disc pivots clockwise as illustrated in FIG. 2 to open the passageway and pivots counterclockwise to close the passageway. Thus, since the area of the disc on the left side of the shaft 50 is larger than the area on the right, the pressure differential between the crankcase 16 and the intake manifold 22 will tend to assist the butterfly disc to open, since it will tend to move it in a clockwise direction.

As a consequence of these particular structural features, the basic regulatory control of valve 68 is achieved by action of the pressure responsive diaphragm 32 as determined by the differential pressure between crankcase pressure and atmospheric pressure. Since, however, the valve disc has a slight vacuum assist, the pressure of the crankcase does not have to rise to that of atmospheric or slightly above in order to open valve disc 68. Rather, as soon as the crankcase pressure approaches a predetermined value, still slightly less than atmospheric pressure, the small amount of force due to the vacuum assist will cause the disc to open and the pressure responsive member 32 to move to allow flow between the crankcase and the intake manifold. The exact pressure below atmospheric at which the valve opens and which it tends to seek during continuous operation is determined by the off-center position of shaft 50 and the differential area between the two sides of the butterfly valve 68. By carefully controlling this offset condition, the differential force added will be made very small so that the crankcase can be sealed to the atmosphere without buckling of the pan or other detrimental effects, while still maintaining a definite vacuum, i.e. sub-atmospheric pressure, in the crankcase. In other words, the regulator is a crankcase pressure controlled regulator with a vacuum assist.

Certain obvious modifications may occur to those in the art upon studying the foregoing invention. Such obvious modifications are deemed to be part of this invention which is to be limited only by the scope of the appended claims and the reasonably equivalent structure to those defined therein.

I claim:

1. An engine assembly comprising: an internal combustion engine including a sealed crankcase and an intake manifold means; conduit means extending between said crankcase and manifold means; flow regulator means for said conduit means including a flow valve in said conduit means and a pressure responsive member having one side exposed to crankcase pressure and the other side exposed to atmospheric pressure; said pressure responsive member being adapted to shift said valve generally in proportion to crankcase pressure; and said valve including a small, vacuum-assist, opening action by having a slightly greater area responsive to the pressure differential between the crankcase and the intake manifold tending to open said valve than the area responsive to said differential tending to close said valve.

2. The apparatus in claim 1 wherein said valve comprises a butterfly valve mounted in an off-center position in said conduit means.

3. The apparatus in claim 1 wherein said pressure responsive member comprises a diaphragm operably linked to said valve and said valve comprises a butterfly valve mounted in an off-center position in said conduit means.

4. A flow regulator means adapted to be mounted in a conduit means between the crankcase and the intake manifold of an internal engine, comprising: a housing including a first portion having a passageway adapted to communicate with the conduit means and a second portion adapted to house a pressure responsive member; a pressure responsive member in said second portion exposed to the atmosphere on one side and to the end of said passageway adapted to communicate with the crankcase on the other side; said pressure responsive member being operably linked to a valve member in said passageway; and said valve member having a slightly greater area adapted to be responsive to a differential pressure across said valving member tending to open said valving member when exposed to manifold vacuum and crankcase pressure, to assist the action of said pressure responsive member.

5. The apparatus in claim 4 wherein said valve member comprises a butterfly valve mounted in an off-center position in said passageway.

6. The apparatus in claim 4 wherein said pressure responsive member comprises a diaphragm operably linked to said valve and said valve comprises a butterfly valve mounted in an off-center position in said passageway.

References Cited in the file of this patent

UNITED STATES PATENTS

2,423,592	Foster	July 8, 1947
2,775,960	Druzynski	Jan. 1, 1957