

March 30, 1965

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3,175,546

POSITIVE CRANKCASE VENTILATION

Filed July 2, 1963

FIG. 1

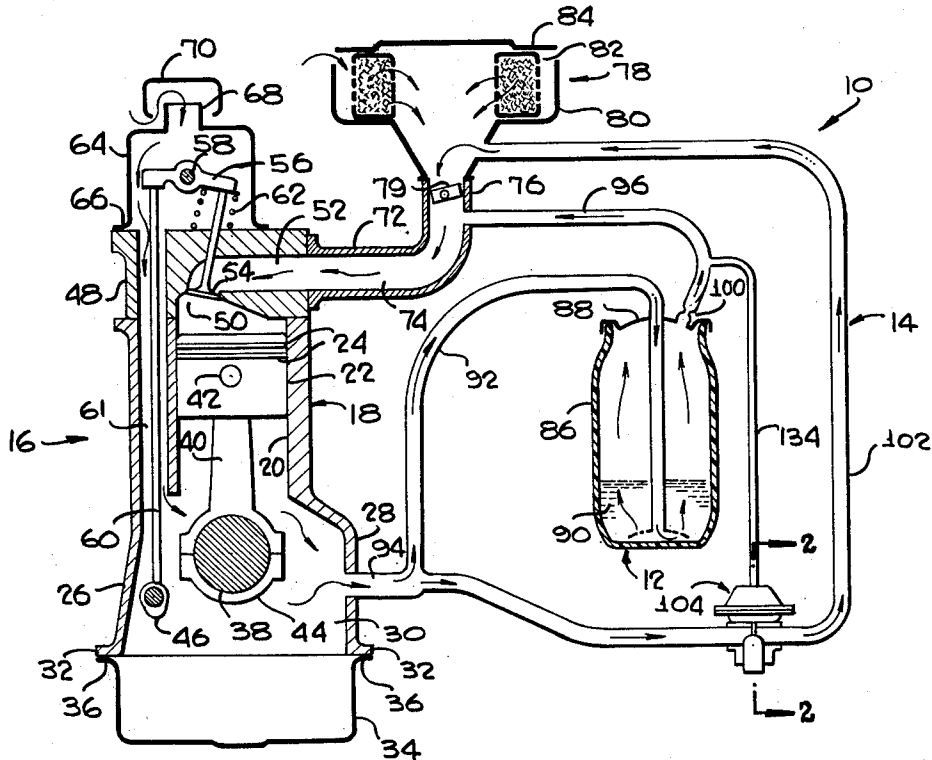
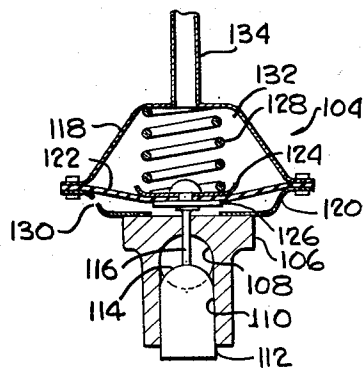


FIG. 2



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3,175,546
POSITIVE CRANKCASE VENTILATION
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Filed July 2, 1963, Ser. No. 292,336
3 Claims. (Cl. 123-119)

This invention relates to means for ventilating the crankcase of an internal combustion engine, and more particularly to a system connected between the crankcase and inlet manifold of an internal combustion engine whereby fumes and vapors within the crankcase are drawn into the system, filtered by the system, drawn into the inlet manifold and ultimately passed into the combustion chambers of the engine where the fumes and vapors are oxidized.

The Motor Vehicle Pollution Control Board of California has caused a state law to be enacted under the heading "Standard for Crankcase Emissions" chapter 3 (sections 2000 through 2006): Sections 24386 and 24388, Health and Safety Code. New chapter 3 (section 2000-2006) filed 5-31-61; Public Health in Title 17 the California Administrative Code, chapter 5, subchapter 5, article 1, section 30530. The substance of this law is known as the Formula Blowby, A.C.F.M. at 110° F., 30" Hg (in population deciles). The existing motor vehicles are assorted in seven classes based on cubic inches displacement. A table of data known as Table #1 (11-14-62) has proven its worth to its authors and to California in relieving the auto smog to such a degree that six other states have written the code into their state codes. Accordingly, it is a primary object of this invention to provide a crankcase scavenging or ventilating device for internal combustion engines which will fully comply with the above law.

It is another object of the invention to provide a device for venting the crankcases of internal combustion engines that satisfy the requirements of all current State codes.

Conventional crankcase ventilating devices conduct the crankcase fumes and gases of an internal combustion engine directly from the crankcase thereof to the combustion chamber thereof by way of the inlet manifold. These conventional devices have caused considerable trouble in use because sludge and other substances in the crankcase fumes and gases deposit on the inlet valves and other internal parts of the internal combustion engine, thereby causing the inlet passages to the combustion chambers to be restricted as much as 70% and greatly reducing the efficiency and maximum power output of the engine. Also, these deposits on the inlet valves insulate the valves thereby preventing them from being adequately cooled by the fuel-air mixture flowing from the carburetor to the combustion chambers. This causes the inlet valves in a relatively short time to become overheated, resulting in warpage, and burning thereof. Accordingly, it is another object of this invention to provide a device that not only vents the crankcase of an internal combustion engine, but also removes sludge and other impurities from gases that are conducted from the crankcase to the combustion chambers so as to prevent the accumulation of undesirable deposits on the inlet valves thereby preventing them from being burned and warped.

It is yet another object of the invention to provide a device for withdrawing blowby gases and fumes from the crankcase of an internal combustion engine in an efficient manner so as to prevent the engine lubricating oil in the crankcase from being contaminated by these gases and fumes. In using my invention to remove crankcase gases and fumes, it has been found that the lubricating oil within the crankcase may be safely used and remains clean for many more miles of operation. Since the lubricating oil within the crankcase of an internal combustion engine

receives most of its contamination from blowby gases within the crankcase, use of my invention for effectively removing these gases will permit elimination of the conventional oil filter and still permit the oil to be safely used for as many miles and for at least as long a time as an engine employing an oil filter and not employing my invention.

One of the principal sources of smog is the fumes and vapors exhausted from the crankcase of internal combustion engines, particularly those used on road vehicles. Accordingly, it is another object of this invention to provide a device for scrubbing or cleaning the gases in the crankcase of an internal combustion engine so as to remove solid particles and other constituents of the gases, and then passing the gases into the combustion chambers of the internal combustion engine so as to oxidize the remainder of the gases so that when they are exhausted by the engine, they are capable of producing very little, if any, smog.

It is still another object of the invention to provide a device for conducting gases from the crankcase of an internal combustion engine to the combustion chambers thereof that will remove solid particles and other contaminants from the gases before they are conducted to the combustion chambers so as to reduce wear of the piston rings, cylinder walls and pistons.

Normally, the gases which blow by the pistons of an internal combustion engine create a positive pressure within the crankcase of the engine which is slightly above atmospheric pressure. This positive pressure within the crankcase tends to force lubricating oil from the bearings of the engine and through other cracks and crevices therein to the exterior of the engine thereby increasing the oil consumption of the engine. This positive pressure also increases the density of the gases within the crankcase thereby causing an increased drag on the rotating crankshaft and other parts of the engine. Accordingly, it is another object of this invention to provide a device for reducing the pressure of gases within the crankcase of an internal combustion engine so as to reduce the oil consumption of the engine and so as to increase the efficiency thereof by reducing drag on its moving parts.

The crankcase of a conventional internal combustion engine usually contains considerable raw fuel as well as other combustible products which are normally expelled from the crankcase and thereby wasted. Accordingly, it is yet another object of this invention to provide a device for conducting the combustible gases from the crankcase of an internal combustion engine to the combustion chambers of the engine so as to increase the fuel economy and efficiency of the engine.

It is still yet another object of this invention to provide a device which not only withdraws fumes and contaminated gases from the crankcase of an internal combustion engine, but also replaces these gases and fumes by fresh clean air.

It is yet another object of this invention to provide a crankcase ventilating device which is economical to manufacture, reliable, safe and quiet in use, requires a minimum of maintenance, and substantially reduces the cost of operation of the engine on which it is used.

This invention constitutes an improvement over the device disclosed in my prior Patent 3,072,112.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings wherein:

FIG. 1 is a vertical cross sectional view through one type of internal combustion engine and showing my crankcase ventilating system connected thereto;

FIG. 2 is an enlarged vertical cross sectional view taken substantially on the plane of line 2-2 in FIG. 1;

As illustrated in the drawings wherein like reference numerals indicate the same parts throughout the various views, my novel crankcase ventilating system 10 is connected to a conventional internal combustion engine 16.

The engine 16 illustrated in FIG. 1 is of the in-line type and includes a cylinder block 18 having a plurality of parallel and vertically extending cylinder bores 20 therein. Slidably mounted within each cylinder bore 20 is a piston 22 having expansible rings 24 located within annular grooves formed in the upper portion of the piston.

The block 18 also includes integral downwardly and outwardly extending side walls 26 and 28 which define part of the engine's crankcase and enclose part of the crankcase chamber 30. The lower edges of the side walls 26 and 28 are flared outwardly to form flanges 32. A hollow oil pan 34 has side walls which terminate in peripheral flanges 36 directly below the flanges 32. The flanges 32 and 36 are secured together in sealing relationship in a conventional manner by screws or bolts, not shown. The oil pan 34 has an open top and encloses part of the crankcase chamber 30.

Rotatably journaled to block 18 and within chamber 30 is a conventional crankshaft 38.

A connecting rod 40 is pivotally connected to each piston 22 at its upper end by a wrist pin 42 which extends diametrically through a bore in its respective piston. The lower end of each connecting rod 40 is pivotally and removably secured to crankshaft 38 by a bearing cap 44 in a conventional manner.

A conventional cam shaft 46 is rotatably journaled within crankcase chamber 38 and drivingly connected to the crankshaft 38 by conventional means, not shown.

A conventional cylinder head 48 is secured to the top of block 18 and is provided with a plurality of combustion chambers 50 which overlie and are aligned with the cylinder bores 20. Each combustion chamber is provided with an inlet duct 52 which is normally sealed therefrom by an inlet valve 54 slidably mounted within head 48.

A plurality of rocker arms 56 are pivotally connected to head 48 by means of a rocker shaft 58 secured above head 48. As shown in FIG. 1, each rocker arm is provided with a push rod 60 which extends through a vertical passage 61 in block 18 and head 48 so that one end of the push rod contacts one end of a rocker shaft and the other end of the push rod slidably abuts cam shaft 46. The other end of each rocker arm abuts the upper end of an inlet valve 54, and a coil spring 62 is compressed between each rocker arm and the upper surface of head 48, and also surrounds the stem of an inlet valve.

Engine 16 is also provided with a plurality of exhaust valves, not shown, mounted within head 48 and operated by push rods and rocker arms in a manner similar to the operation of the inlet valves.

The rocker arms and the upper ends of the valve stems are all enclosed by a hollow box-like conventional valve cover 64 which has a lower peripheral flange 66 secured in sealing relationship to the top of head 48 in a conventional manner. Valve cover 64 is provided with a flanged inlet opening 68 which is normally covered by a removable oil filler cap 70. Cap 70 preferably contains an air filtering material.

An inlet manifold 72 is connected to head 48 and has a passage 74 communicating with the inlet passages 52. A carburetor 76 is connected to the inlet of manifold 72, and a conventional air cleaner or filter 78 is connected to the inlet of the carburetor. Carburetor 76 includes a conventional butterfly throttle valve 79 for opening and closing the inlet to passage 74 and thereby controlling the amount of fuel and air mixture supplied to engine 16. Air filter 78 includes a conventional circular and hollow housing 80 containing an annular filter cartridge 82 which is secured within housing 80 by a cover plate 84 removably secured to the housing by conventional means, not shown.

The crankcase ventilating system 10 includes two cir-

cuits, a primary or cleaning circuit 12 and a secondary or auxiliary circuit 14.

The primary or cleaning circuit 12 includes a container 86 preferably composed of a transparent material such as glass or plastic and having an open top which is normally closed by a removable cover or cap 88. Container 86 contains a cleaning liquid 90 having a high boiling point and suitable lubricating characteristics. A conduit 92 extends through cap 88 in sealing relationship therewith and one end thereof terminates adjacent to the bottom of container 86. The other end of the conduit 92 is connected to and communicates with the interior of the engine crankcase by means of a hollow fitting 94 secured within an opening in wall 28. An outlet conduit 96 is connected to cap 88 at one of its ends and communicates with the interior of container 86 by means of an opening through the cap. The other end of conduit 96 is connected to the inlet manifold 72 or carburetor 76 so as to communicate with the chamber or passage 74 directly below the throttle valve 79. Conduit 96 contains a restriction 100 so as to permit a maximum of 4.5 cubic feet per minute of gases per minute to flow therethrough regardless of the pressure within passage 74 during operation of the engine 16.

The secondary circuit 14 includes a conduit 102 having one end connected to crankcase chamber 30 by means of fitting 94 and having its other end connected to carburetor 76 or air filter 78 directly above throttle valve 79.

A gate valve 104 is connected in series with conduit 102, and includes a body portion 106 having a cylindrical passage 108 therethrough connected to the conduit 102. Body 106 also contains a cylindrical valve chamber 110 extending at right angles to passage 108 and having one end in communication therewith as shown in FIG. 2. A cylindrical valve plunger 112 is slidably mounted within chamber 110 and has a semi-spherical end 114 adapted to extend into passage 108 for completely blocking same. A valve stem 116 is coaxial with plunger 112 and is secured to its end 114. Stem 114 extends through and is slidably mounted within a bore through one side of body 106.

As shown in FIG. 2, valve 104 also includes a housing comprising upper cup-shaped member 118 and lower cup-shaped member 120. Members 118 and 120 have peripheral flanges which are the same size and shape and parallel to one another. A flexible diaphragm separates the flanges of the members 118 and 120, and is clamped between the flanges by conventional securing means, not shown. Member 120 is secured to the body 106 by conventional means, and valve stem 116 extends through a central opening in member 120.

The other end of stem 116 extends through the center of diaphragm 122 and a pair of washers 124 and 126 on opposite sides of the diaphragm. The end of stem 116 is peened or enlarged on opposite sides of the washers so as to cause the washers to sealingly grip diaphragm 122. A coil spring 128 is compressed between member 118 and washer 124 so as to urge valve stem 116 and valve plunger 112 downwardly so as not to block passage 108. The inside of member 120 is vented by means of an opening 130. Member 118 and diaphragm 122 form a closed valve chamber 132 which is connected to outlet conduit 96 by means of a conduit 134.

Although a specific form of the valve 104 has been illustrated and described, it is to be understood that the specific structure and design of this valve is not critical, and other valves having different details of design, but which operate in a similar manner, may be substituted therefor.

During operation of the engine 16, a substantial quantity of gases in the combustion chambers 50 are blown by the pistons 22, rings 24, and valve stems and pass into the crankcase chamber 30. This is particularly true in badly worn engines and engines of poor design or construction. These blowby gases normally contain considerable amounts of unburned fuel, sludge, fine solid par-

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ticles and other impurities. If the blowby gases are allowed to be exhausted into the atmosphere, they are dispersed and converted into smog.

The engine 16 represents a conventional internal combustion engine in conventional road vehicles, but may be of any type or design. When the engine is operating at substantially 75% maximum power or less, the intake manifold vacuum within passage 74 is equal to 2" of mercury or more. The more the throttle valve 79 is closed and the less the power output of the engine, the higher the vacuum within passage 74. The vacuum within passage 74 of the intake manifold 72 is the same as the vacuum within valve chamber 132 since the valve chamber is connected to the intake manifold by conduit 134 and outlet conduit 96. When the vacuum in passage 74 and chamber 132 is 2" of mercury or more (the pressure differential between passage 74 or chamber 132 and atmospheric pressure is more than 2" of mercury) the pressure differential on opposite sides of the diaphragm 122 will cause the diaphragm to move into chamber 132 so as to compress spring 108 and move valve plunger 112 into passage 108 so as to close this passage. In use, the intake manifold passage 74 of the engine 16 contains a vacuum of at least 2" of mercury 80% of the time. Thus, the vacuum in valve chamber 132 is sufficient 80% of the time to maintain passage 108 and conduit 102 closed. Therefore, it is apparent that 80% of the time the primary circuit 12 is operating while the secondary circuit 14 is inoperative. When the pressure in passage 74 is 2" or more below atmospheric, valve plunger 112 closes conduit 102 and the blowby gases flow from crankcase chamber 30 to the inlet manifold by fitting 94, conduit 92, container 86, restriction 100, and outlet conduit 96. Since the gases blown from the compression or combustion chambers 50 into the crankcase chamber 30 tend to create a pressure above atmospheric in chamber 30, and since the pressure in passage 74 is always below atmospheric, it is apparent that gases will readily flow through the primary circuit from the crankcase chamber into the inlet manifold. However, the restriction 100 is preferably of such a size that no more than 4½ cubic feet of gases will flow therethrough per minute regardless of the operating pressure within the intake manifold 72. This is because the carburetor 76 is designed to provide a proper fuel-air mixture to the engine even though the primary circuit 12 is providing up to 4½ cubic feet per minute of blowby gases to the intake manifold below the carburetor.

When throttle 79 is opened sufficiently to cause engine 16 to produce more than 75% of its maximum power output, the pressure within inlet passage 74 is less than 2" of mercury below atmospheric pressure. Under these conditions, the pressure differential across opposite sides of the diaphragm 122 is insufficient to maintain spring 128 compressed, thereby the spring expands and partially opens or fully opens the passage 108 by urging valve plunger 112 downwardly as viewed in FIG. 2. Of course, the exact degree of opening of the valve plunger 112 will depend upon the pressure differential across opposite sides of the diaphragm 122.

When the manifold pressure within passage 74 differs from atmospheric by less than 2" of mercury, the pressures produced by combination within chambers 50 are very high because engine 16 is operating near its maximum output and large volumes of fuel and air are admitted to the combustion chambers. Due to the increased pressures within the combustion chambers, the rate of blowby is increased, thereby causing larger quantities of blowby gases to be passed into crankcase chamber 30 per unit of time. In a badly worn engine, or an engine in poor condition, the primary circuit is incapable of handling all of the blowby gases when the intake manifold vacuum is 2" of mercury or less. However, since the gate valve or spill gate 104 is open under these conditions, additional blowby gases are permitted to flow

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through the secondary circuit 14 whereupon they are exhausted into the air cleaner 78 or inlet to the carburetor 76. Since there is a slight vacuum created within the inlet to the carburetor due to the air resistance of the filter 82 and since this pressure is lower than the pressure in chamber 30, the blowby gases readily flow from chamber 30 through the secondary circuit when gate valve 104 is open.

When the engine 16 is operating at maximum power output, the pressure within passage 74 approaches atmospheric pressure and the spill gate 104 is fully open thereby permitting the secondary circuit to operate at maximum capacity. Under these conditions, there is substantially equal flow of blowby gases through the primary and secondary circuits and the circuits are capable of conducting at least 8½ cubic feet per minute of blowby gases from the crankcase to the intake manifold and combustion chambers of the engine.

It is to be noted that when the blowby gases are flowing through primary circuit 12, they exhaust from the lower end of circuit 92 into container 86 and bubble upwardly through the cleaning liquid 90 whereupon the cleaning liquid removes all foreign solid particles suspended in the blowby gases and condenses or absorbs many of the impurities in the blowby gases. Since, over an extended period of time, the secondary circuit 14 is closed and not operating 80% of the time, it is apparent that at least 90% of the gases conducted by the ventilating system 10, pass through cleaning liquid 90.

The gate valve or spill gate 104 will operate in every gear change of the vehicle on which engine 16 is installed because when accelerating through the various gear ratios, the vacuum in the inlet manifold normally passes through a range in which it is less than 2" of mercury.

Although my system 10 may operate without the vacuum controlled spill gate 104, the spill gate is a desirable feature since it causes all of the blowby gases to pass through the cleaning liquid 90 80% of the time in which it is in operation.

The specific form of my invention described above meets the requirements of all current state codes. However, it is to be understood that the flow capacities of the primary and secondary circuits may be modified if desired and the invention may be used on any type or design of internal combustion engine, as for example, a diesel engine.

Since blowby gases are the prime sources of lubricating oil contaminants, the removal of these gases by my system maintains the oil clean for a much longer period of time and permits the oil to be used up to 12,000 miles of use before the detergent is so exhausted as to require a change.

Since the blowby gases contain considerable amounts of raw fuel and other combustible gases, and since my novel system conveys these gases to the combustion chambers of the engine where they are burned, it is apparent that any engine using my system has a substantially increased fuel efficiency.

Since the cleaning fluid 90 removes the solid particles and other undesirable constituents before the blowby gases are passed to the combustion chambers, it is apparent that an engine using my system has a much longer life than an engine using a conventional crankcase ventilating system.

Since my system completely oxidizes all the blowby gases in the crankcase of an engine on which the system is used, it is readily apparent that the smog produced by the engine is substantially reduced or completely eliminated.

Inasmuch as various changes may be made in the form, location and relative arrangement of the several parts without departing from the essential characteristics of the invention, it will be understood that the invention is not to be limited except by the scope of the appended claims.

I claim:

1. A device for use with an internal combustion engine having a crankcase, a carburetor and an inlet manifold connected between the carburetor and a combustion chamber of the engine, said device adapted to vent blowby gases from said crankcase and comprising primary and secondary circuits adapted to be connected in parallel between the crankcase and combustion chamber of the internal combustion engine, said primary circuit being adapted to be connected to the inlet manifold and the secondary circuit being adapted to be connected to the air intake of the carburetor, said primary circuit including cleaning means connected in series therewith, at least part of said blowby gases being adapted to pass through said cleaning means whereby solid particles, sludge and other substances are removed from said blowby gases, valve means in said secondary circuit, operating means being connected to said valve means and responsive to pressure within said intake manifold whereby said valve means is open when the pressure in said intake manifold is between 0 and 2" of mercury below atmospheric pressure, and said valve means being closed when the pressure in said intake manifold is more than 2" of mercury below atmospheric pressure, said operating means including spring means urging said valve to an open position, a fluid motor, conduit means being connected to said fluid motor and being adapted to be connected to said intake manifold, said fluid motor urging said valve towards a closed position when the pressure in said manifold is below atmospheric.

2. In combination, an internal combustion engine having a crankcase and at least one combustion chamber, a carburetor having a throttle valve, an air cleaner connected to an air inlet of said carburetor, an inlet manifold connecting the carburetor to the combustion chamber, a vent system for removing blowby gases from said crankcase including a cleaning circuit and a secondary circuit, said cleaning circuit including means for removing solid particles and sludge from said blowby gases, conduit means connected between said crankcase and said inlet manifold and connected in series with said cleaning means, and secondary circuit connected between said crankcase and the air inlet of said carburetor, valve means

operatively connected to said secondary circuit and being adapted to close said secondary circuit when the pressure in said inlet manifold is below a predetermined amount, said crankcase being provided with a fresh air inlet port.

3. In combination, an internal combustion engine having at least one combustion chamber, said engine including a crankcase which receives blowby gases from said combustion chamber, a carburetor having a throttle valve, air inlet means connected with said carburetor and disposed upstream of said throttle valve for providing air to the carburetor, and inlet conduit connected with said carburetor downstream of said throttle valve and also being connected with said engine to provide communication between said carburetor and the combustion chamber of said engine, a vent system for removing blowby gases from said crankcase including a cleaning circuit and a secondary circuit, said cleaning circuit including cleaning means for removing solid particles and sludge from blowby gases and first conduit means connected between said crankcase and said inlet conduit downstream of said throttle valve and being connected in series with said cleaning means, said secondary circuit including second conduit means connected between said crankcase and said air inlet means upstream of said throttle valve, valve means connected in said second conduit means, means normally biasing said valve means toward an open position, and control means for moving said valve means to a closed position, said control means including conduit means in communication with said inlet conduit downstream of said throttle valve and being adapted to close said secondary circuit when the vacuum in the inlet conduit is more than a predetermined amount.

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