

Nov. 24, 1964

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CRANKCASE VENTILATION

3,158,142

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3 Sheets-Sheet 1

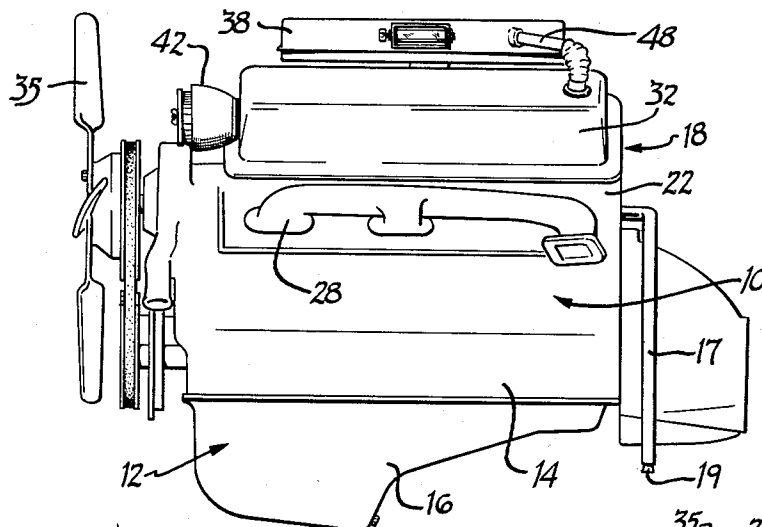


FIG. 1

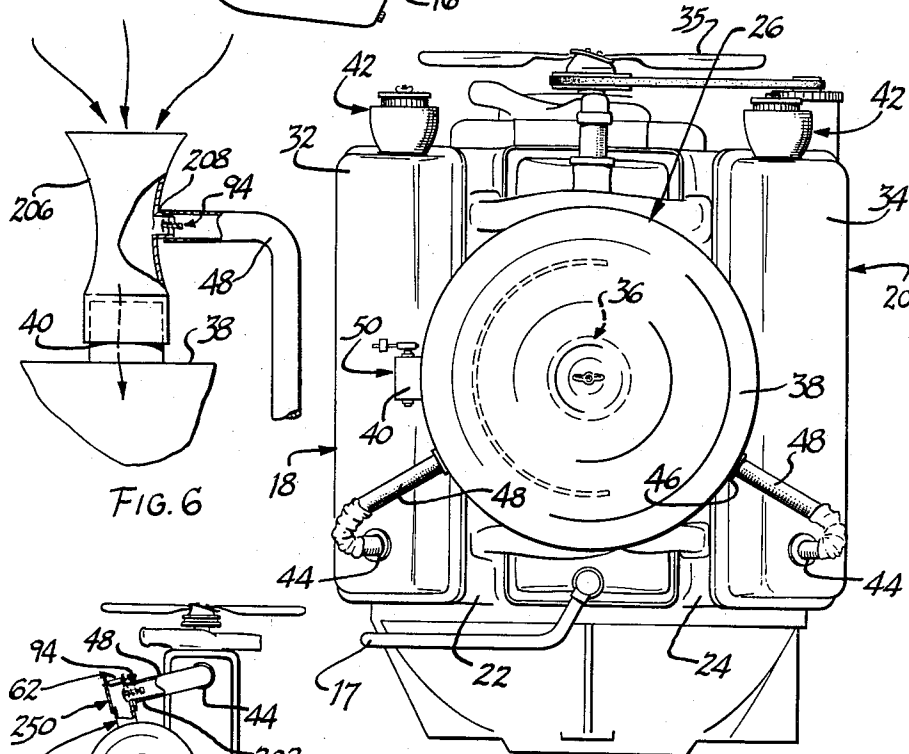


FIG. 2

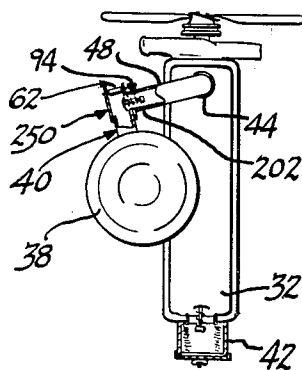


FIG. 3

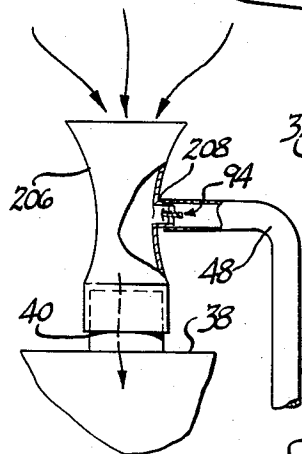


FIG. 6

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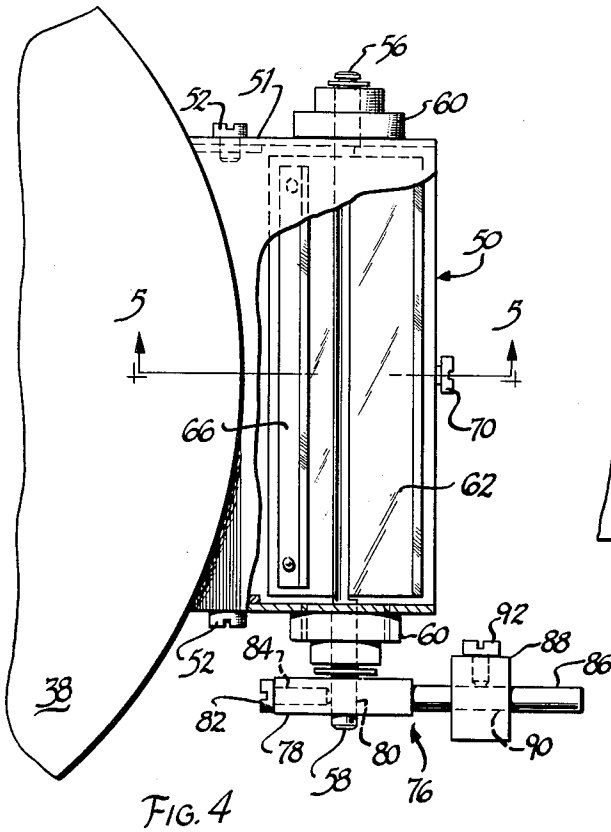


FIG. 4

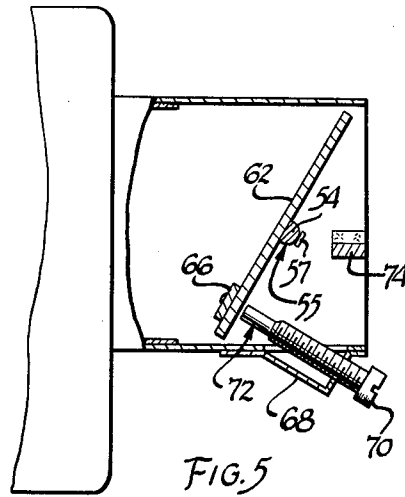


FIG. 5

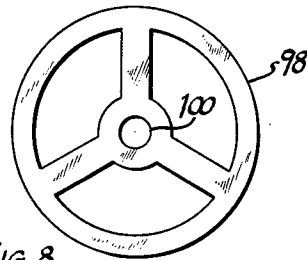


FIG. 8

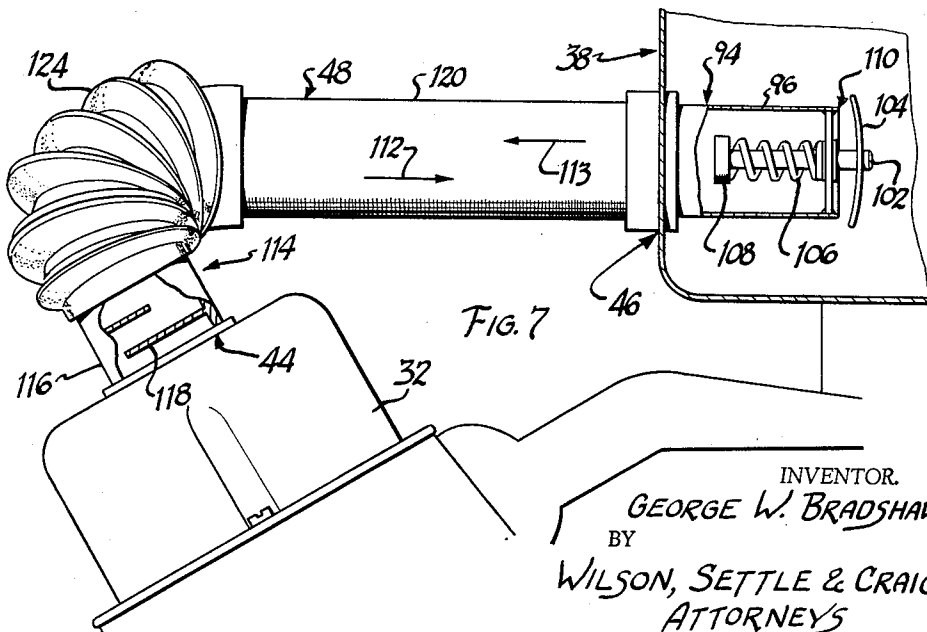


FIG. 7

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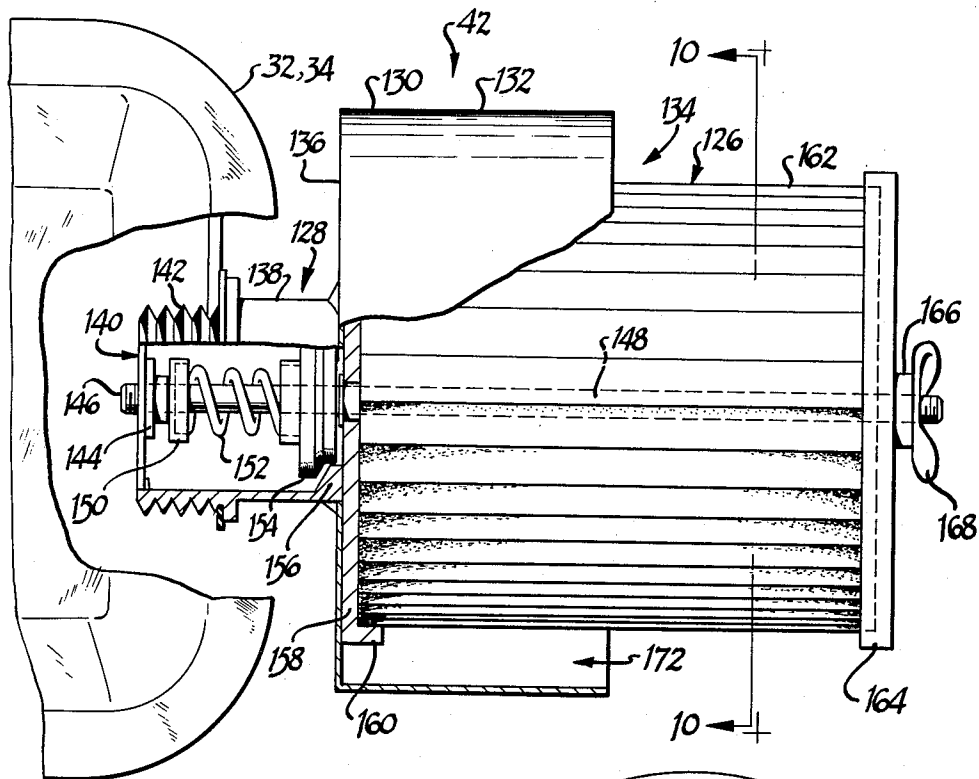


FIG. 9

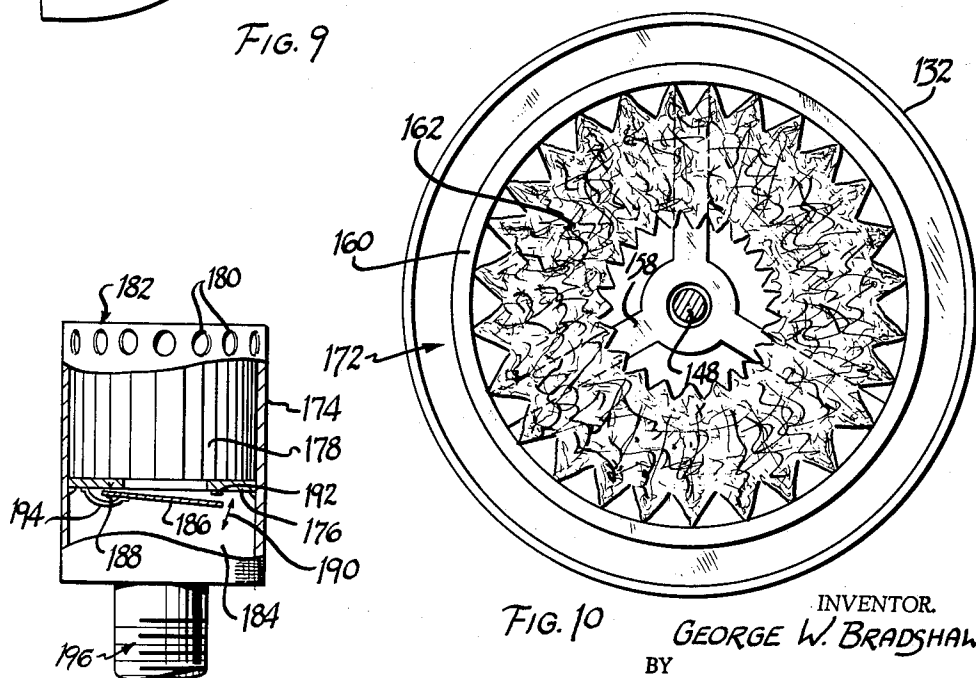
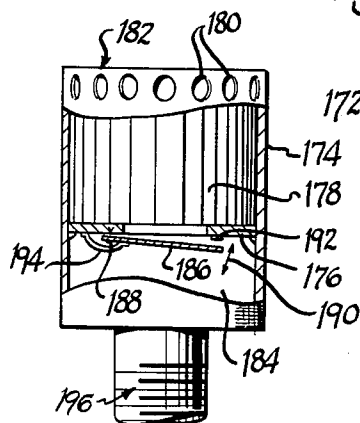


FIG. 10

FIG. 11



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CRANKCASE VENTILATION

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12 Claims. (Cl. 123--119)

This invention relates to the operation of internal combustion engines, and more particularly to a method and apparatus for improved operation of an internal combustion engine wherein blow-by vapors directed into the crankcase are drawn along with the combustion air to be admixed with the fuel charge and be re-burned in the combustion chambers during the operation of the engine by the combustion taking place therein, and additionally wherein a sealed crankcase system is provided when the engine is at rest, to reduce atmospheric contamination.

Over the past years, a number of efforts have been made to provide appropriate ventilation for the crankcases of an internal combustion engine such as utilized on an automobile, to remove blow-by vapors and moisture from the crankcase to prevent the formation of acids in the lubricating oil which contribute to corrosion and eventual destruction of the engine. However, the discharge of crankcase gases to the atmosphere particularly where the automobile population is of high density, as around coastal and Great Lakes' cities has contributed substantially to smog conditions. Accordingly, efforts have been and are being made by a number of State governments to enact laws requiring automotive engines to be operated in a manner to dispose of the blow-by products in order to prevent atmospheric pollution.

At present, there are also indications of national legislation requiring all automobile engines to be fitted with anti-smog devices. Thus, a growing need and requirement is becoming rapidly mandatory that automobiles be fitted with apparatus for either consuming or rendering non-obnoxious the vapor products generated within the engine crankcase.

The prior efforts at solving this problem have included a number of approaches, including the passage of the crankcase vapors into the intake manifold beneath the carburetor. However, the prior art devices have not been universally accepted for a number of reasons, not the least of which is their expense. Thus, many of the prior efforts have required substantial and expensive modifications of a stock engine to fit it with an appropriate adaptor. No simple and highly effective kit-like adaptor has been provided that can be readily fitted to either production or used engines. Further, those prior art devices which have directed the crankcase vapors into the intake manifold below the carburetor have required some kind of a vacuum metering device, such as a check valve or the like, to preserve carburetor balance, particularly at idle speeds, and these have been characterized by clogging after a few months or few miles of operation, resulting in poor carburetor balance and rough engine operation when the check valve becomes plugged.

Another undesirable feature of the prior art devices resides in the fact that, particularly in today's overhead valve engines, there is no positive cleaning provided for the rocker arm or valve covers to prevent sludging because of the vapors which enter and condense in the covers by rising upwardly around the valve stems from the crankcase. Thus, the prior art devices have not provided good carburetor balance and have not provided a clean engine to prolong engine life. Further, the prior art devices have not provided a closed system to prevent evolution of atmosphere contaminating vapors when the engine is shut down. Some State laws are even being enacted to make this a requirement and efforts to this date have not solved this problem.

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Another and serious problem of the prior art devices is that at high speeds where a substantial amount of blow-by is produced in an engine, there is not sufficient capacity in the system to treat all of the fumes. Thus, the problem of air pollution and improved engine operation has definitely not been solved by the prior art efforts.

If a simplified apparatus adapted to be readily and easily applied to both new production engines and to used engines alike, could be provided wherein engine cleanliness and efficiency would be improved to promote longer life and wherein a method of operation of an internal combustion engine would be provided to reduce atmospheric smogging and pollution while at the same time improving engine performance and economy, a substantial step forward in the art of internal combustion engines and their operation would be provided.

Accordingly, it is an important object of the present invention to provide a novel method and apparatus for the operation of internal combustion engines.

Another object is to provide a method for purging blow-by gases from the crankcase or other vapor chamber of an internal combustion engine by directing the purge gases into the combustion chamber in admixture with the combustion air in a positive flow.

Another important object is to provide a method for operating an internal combustion engine wherein all vapors generated in the crankcase are re-burned to improve the efficiency of operation and life of the engine and at the same time to reduce atmospheric pollution substantially.

A still further object is to provide an internal combustion engine having a sealed crankcase and wherein all vapors generated in the crankcase are directed through the carburetor in admixture with incoming combustion air, proportioned to provide complete consumption of the generated gases without upsetting carburetion balance.

A further object is to provide a method of operating an internal combustion engine having a sealed crankcase wherein all vapors generated in the crankcase are directed into the carburetor air cleaner bonnet in admixture with incoming air that is passed through the entire length of the valve rocker arm covers, thus reducing atmospheric pollution and simultaneously cleaning the crankcase of vapors and reducing sludging of the valve covers and improving engine efficiency and economy by re-burning the combustible gases, which being characterized by catalytic properties, actually aid and improve engine efficiency.

A further object is to provide an engine modification kit whereby air is filtered and passed the length of the rocker arm covers to sweep hydrocarbon and other blow-by gases introduced thereto from the crankcase into the carburetor, utilizing a modulation of the normal carburetor inlet air to assure complete consumption of all gaseous crankcase products at all engine speeds and wherein a closed crankcase system is automatically provided when the engine is at rest.

Another object is to provide a method for operating an internal combustion engine having a sealed crankcase wherein blow-by products thrown into the crankcase are recovered in a manner to keep the entire lubrication system clean and wherein the blow-by products are completely aspirated into the carburetor air inlet without disturbing carburetor balance, and providing a closed crankcase system when the engine is at rest.

A further object is to provide an internal combustion engine wherein the blow-by products entering the crankcase are drawn into the combustion chamber by modulating the flow of intake air to the combustion chamber in a manner to positively draw all gaseous crankcase products for re-burning.

A further object of the invention is to provide a kit for modifying a stock internal combustion engine which

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includes a modulator attached to the normal air inlet of the carburetor air cleaner, a gas conduit connecting the crankcase with the carburetor air inlet bonnet, and filtered air for the valve covers to provide positive aspiration flow of all gaseous crankcase products in careful admixture into the incoming fuel mixture at all engine speeds and providing a closed system when the engine is at rest, to prevent vapor products therein from contaminating the atmosphere.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a side elevation view of an overhead valve V-8 engine of current design, fitted with the crankcase ventilation and anti-atmosphere pollution system of the present invention;

FIGURE 2 is a top plan view of FIGURE 1, illustrating the relation of the components of the system of the present invention;

FIGURE 3 is a schematic top plan view of an overhead valve engine of the straight type, such as 8, 6, 4 or other, showing the valve cover air inlet filter connected to the back end of the rocker cover in non-ram air receiving relation to the engine fan, with the outlet from the valve cover being directed into a branch inlet of the carburetor air inlet modulating valve adaptor kit housing;

FIGURE 4 is a top plan view, with parts broken away in section, of a modulating valve kit assembly of the invention;

FIGURE 5 is a vertical section view taken along line 5—5 of FIGURE 4;

FIGURE 6 is a longitudinal section view of an aspirator-type carburetor air kit modulator;

FIGURE 7 is a side elevation view with parts broken away in section showing a valve cover oil baffle and anti-backfire check valve that may be used in the present invention;

FIGURE 8 is an enlarged plan view of the support spider used for supporting the check valve of FIGURE 7;

FIGURE 9 is a top plan view with parts broken away in section of the combination filter and check valve unit of the invention;

FIGURE 10 is a section view taken along line 10—10 of FIGURE 9; and

FIGURE 11 is a top plan view of a second embodiment of the combination filter-check valve unit of the invention, made in "throw-away" form.

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Brief Perspective

According to the present invention, a novel method and apparatus are provided for the operation of an internal combustion engine wherein vapors generated in the crankcase by blow-by past the pistons, including unburned hydrocarbons, water and the like, are circulated to the carburetor air intake or air filter bonnet and are positively drawn into the carburetor proportional to the speed of the engine, thus assuring positive consumption of all vaporous products from the crankcase under all operating conditions of the engine.

Also, provision is made for a closed crankcase system when the engine is not operating so that vapors are prevented from contaminating the atmosphere when the engine is at rest.

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The objects of the present invention are attained by providing a sealed crankcase and drawing the vapors generated therein into the carburetor air inlet stream by aspiration or by modulating the normal air inlet flow to the carburetor. This is effected by providing either an aspirator or a modulating valve adaptor kit unit for the normal carburetor air inlet opening of the air filter housing, and in the case of an overhead valve engine, drawing vapors from the crankcase out of the valve covers with the result that sludging of the valve covers is overcome, the lubricating oil of the engine system is cleaned, and atmospheric pollution is reduced by reburning all crankcase vapors. By operating in accordance with the present invention it is possible to extend the oil change interval of an automobile to as long as 30,000 to 50,000 miles and in many instances no oil change during the life of the car is anticipated.

The Environment

As shown in FIGURES 1 and 2 of the drawings, the present invention is superimposed upon an internal combustion engine, typified by an overhead valve V-8 engine of the kind currently being used in a wide variety of automobiles. This type of internal combustion engine is called a 4-cycle and has a crankcase to provide a reservoir for holding a quantity of lubricating oil that is pumped to the various working parts of the engine, and where blow-by vapors collect with damaging effects unless removed.

Typically, the engine includes a cylinder block 10 containing cylinders and pistons connected by rods to a crankshaft, not shown, positioned within a crankcase 12 defined by the lower part 14 of the cylinder block 10 and by an oil pan 16 fastened to the bottom of the block. The oil pan 16 contains a quantity of oil, and a pump having a suitable intake is located therein, being driven from the camshaft or by other appropriate means, for the purpose of circulating the oil to the various working parts of the engine.

A road draft tube 17 is also typically provided that is connected into the crankcase so that blow-by gases can be vented to the atmosphere as the auto moves along a highway or road.

In the engine shown, each of the banks of cylinders 18 and 20 is provided with a head 22 and 24 and these are connected to a common intake manifold 26 for distributing a fuel charge to the cylinders, and with exhaust manifolds 28 to direct the products of combustion through an exhaust pipe and muffler assembly, not shown.

On top of each of the heads 22 and 24 there are provided valve rocker covers 32 and 34 which enclose the upper ends of the valve push rods, the top ends of the valve stems and the actuating rocker arms and rocker arm shaft. The covers 32 and 34 are connected to the heads 22 and 24 in sealed relationship so that oil pumped to these working parts can be recovered and drained back through appropriate ports into the crankcase 12 for recirculation.

In this regard it should be mentioned that the valve covers are in fluid communication with the crankcase, by passage of fluids such as crankcase vapors around the valve stems between the crankcase and valve covers.

Situated atop the intake manifold 26 is a carburetor 36, shown in dotted outline in FIGURE 2, that is adapted to provide an appropriate fuel-air mixture for the engine, and on top of the carburetor there is provided an air filter housing 38 having an inlet 40 to clean the air before it enters the carburetor for mixing and passage to the cylinders.

Also, for cooling purposes, the engine typically includes a coolant radiator, not shown, situated at the front end of the engine, with a fan 35 between it and the engine to draw air through the radiator at lower road speeds and when standing, to assure proper cooling. As shown, the periphery of the fan 35 typically extends to about the top

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of the engine, blowing a substantial amount of air in a positive manner over the engine and past the valve covers 32, 34, the effect of which and the energy contained therein, being normally lost or wasted.

The Invention

Upon this typical environmental engine background, the present invention is superimposed and provides method and apparatus whereby vapors that are forced into the crankcase 12 by blow-by are directed upwardly into the valve covers 32 and 34 and swept completely therefrom into the carburetor in a positive aspirated and carefully mixed manner to provide complete consumption and re-burning of the vapors at all speeds and conditions of operation of the engine.

In modifying and operating an engine in accordance with the present invention, the first step is to provide a sealed crankcase 12. This is done by closing the normal road draft tube 17 by plugging or the like as at 19. Thus, in this modified form, the vapors developed in the crankcase will be completely forced upwardly around the valve stems and into the rocker covers 32 and 34. In accordance with the present invention, fresh, filtered air is passed the entire length of the rocker covers to sweep out the vapor products accumulated therein in accordance with their rate of formation under all engine operating conditions and are forced directly into the carburetor or into the air filter housing above the carburetor in careful admixture with the normal incoming combustion air, without disturbing carburetor balance.

In accordance with one embodiment of the invention, a full sweep of the rocker covers 32 and 34 is provided by positioning a combined filter-check valve assembly 42 at the front end of each of the rocker covers. It will be noted that these filter-check valve assemblies 42 are positioned in ram-air receiving relation to the fan 35 positioned at the front end of the cylinder block 10 to make use of the benefit of moving air produced by the fan, consuming energy normally wasted by the fan, and thus improving engine breathing. The filter-check valve assemblies 42 are described hereinafter in greater detail.

Also, as shown in FIGURE 2 of the drawings, an outlet opening 44 is provided at the back end of each of the rocker covers 32 and 34 and spaced openings 46 are provided along the back side of the air filter housing 38. Gas conduits 48 are connected between the openings 44 and 46 so that the vapors collected in the rocker covers 32 and 34 will pass into the air filter housing or bonnet 38 and thus be prevented from condensing in and sludging the covers 32 and 34.

The Air Intake Modulating Valve Assembly

As best shown in FIGURES 4 and 5, the air filter inlet 40 is provided with an air modulating carburetor air inlet adaptor 50 that is of either circular, oval or other suitable configuration to connectingly mate with inlet 40, and is formed as a generally elongated hollow housing or wall 51. The interior of the housing is of a dimension to fit slidably over or within the air filter inlet 40 in gas-tight relationship and is suitably fastened in place by two sheet metal screws 52. As best shown in FIGURE 4, a shaft 54 is provided in suitable apertures formed transversely of the adaptor 50 and has its ends 56 and 58 extending outwardly through the wall 51 of the adaptor 50 into suitable bearings 60 secured thereon.

Along the central portion of shaft 54, i.e. the portion within the inlet adaptor 50, the shaft 54 is provided with a flat 55 and a valve plate 62 of appropriate configuration is attached by screws 57 to the shaft by suitable threaded apertures provided therein. As shown in FIGURE 5, one edge of the valve plate 62 is provided with a weight 66 that biases the valve plate toward a closed position. This tends to limit normal flow into housing 38 through inlet 40 and forces a draw through covers 32 and 34 via filters 42 and conduits 48 at all engine

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speeds to provide positive scavenging of crankcase and valve covers.

In order to provide for partial open adjustment of the valve plate 62, the air inlet adaptor housing wall 51 is provided along its lower side with a triangular bracket 68, secured as by spot welding, and an adjusting screw 70 is passed angularly into the interior of the adaptor 50 through suitably threaded and aligned apertures, so that the inner end 72 thereof abuts the lower edge of the valve plate 62. The screw 70 can be threaded inwardly a desired distance to hold the plate 62 in a desirable partially open position, if desired.

As shown in FIGURE 5, a stop bracket 74 is provided in engageable alignment with the valve plate 62 to prevent the plate from moving past a horizontal or fully open position. Thus, there is no danger of the plate moving over center to a reversely locked, closed position.

To facilitate balance and proper adjustment of the valve plate 62 in accordance with requirement of different engines, the end 58 of shaft 54 is provided with a counterbalance arm 76 having a hub 78, bored as at 80, to fit upon the shaft 54, being secured by a set screw 82 in adjusted position thereon. The set screw 82 is passed through a threaded aperture 84 provided in hub 78. The counterbalance arm 76 also includes a rod portion 86, upon which a counterweight 88 is slidably mounted by means of a bore 90 formed therein and is secured in adjusted relation along rod portion 86 by means of a set screw 92.

Oil Baffle and Anti-Backfire Check Valve

As shown in FIGURE 7, the inlet openings 46 of the air filter housing or bonnet 38 into which the rear ends of the gas conduits 48 are positioned, are provided with spring-loaded check valves 94 to prevent backfire through the carburetor and through the gas conduits 48 into the valve covers 32 and 34. Thus, possible ignition of combustible vapors within the valve covers 32 and 34 is safeguarded against.

As shown in FIGURE 7 each check valve 94 comprises a tubular housing 96, suitably threaded at one end into the end of the conduit 48 and a spider 98, having a central aperture 100, is formed on the innermost end of the tubular housing 96. Into the central aperture 100, there is fitted a support rod 102 in slidably movable relation, having a valve disc 104 on its innermost end. On the other side of the spider 98, a spring 106 is positioned around the rod 102 and a spring retainer 108 is applied, as by threading, to retain the spring which normally biases valve disc 104 to a closing relation with respect to an annular seat 110 formed on the inner end of the tubular housing 96. The spring 106 is of light weight readily permitting gas passing in the arrow 112 direction to open the valve disc 104 whereby vapors may be readily drawn from the rocker covers 32 and 34. However, in the event of backfire through the carburetor in the arrow 113 direction, the valve disc 104 quickly is press-closed, and thus the backfire into the valve covers 32 and 34 is prevented.

The other end of the conduit 48, adjacent each valve cover 32, may be provided with an oil baffle 114, comprising a tubular housing 116, into which is fitted a plurality of staggered plates 118, which prevent droplets of oil from passing therethrough by collecting the droplets and draining them back into the valve covers 32 and 34.

Also, as shown in FIGURE 6, the gas conduit 48 can be made of upper and lower metal tubes 120 and 116, connected by a short length of accordion-walled hose 124 to dampen vibrations between the valve cover and the carburetor air intake bonnet. However, as regards this detail, it is to be included within the scope of the invention to make the gas conduit 48 of hydrocarbon vapor-resistant flexible tubing such as synthetic rubber and certain of the more resilient and heat-resistant plastics.

The Combined Filter and Check-Valve Unit of the Present Invention

As shown in FIGURES 9 and 10, each of the filter-check valve assemblies 42 utilized for admitting air into the valve covers 32 and 34, includes a filter element 126 and a check valve 128 positioned within a common housing.

As best shown in FIGURE 9, the supporting casing of the unit comprises a stepped housing 130 having an enlarged tubular or cylindrical body portion 132, with an open front 134 and an annular back wall 136 to which is connected a tubular valve housing 138 having a spider back wall 140 as in FIGURE 8. The back end of the housing portion 138 is threaded as at 142 so that it can be threaded into a suitable opening formed in a valve cover 32 or 34. The spider back wall 140 of the valve housing 138 is provided centrally or coaxially with an internally threaded nut 144 to receive the threaded end 146 of a support rod 148. A spring retainer shoulder 150 is formed on the support rod 148 and rests against the nut 144 and a compression spring 152 is positioned around the left end of support rod 148 to bias an annular valve plate 154 against an annular valve seat 156 provided at the forward end of the tubular valve housing 138. This completes the mechanism of the check valve 128.

Over the support rod 148 and positioned adjacent the annular back wall 136 of the enlarged tubular or cylindrical body 132 of the stepped housing 130, is positioned a spider-like filter retainer 158, having an annular filter-retaining lip 160. A tubular paper filter element 162 has one end fitted within the filter-retaining lip 160 and is positioned coaxially of the support rod 148 and a disc-like filter element retainer 164 is then positioned on the right end of support rod 148, followed by a washer 166 and wing nut 168 to complete the assembly.

It will be noted that the enlarged tubular or cylindrical body 132 of the stepped housing 130 is somewhat larger than the tubular filter element 162 providing an annular space 172 for receiving ram air from the fan 35 of the engine. This provides a pocket or space 172 whereby the air propelled over the engine by the fan 35 is forced through the filter 162. This ram air facilitates passage through the rocker covers 32 and 34 and up into the carburetor housing or bonnet 38 and is believed to provide improved free-breathing for the engine as evidenced by better engine economy.

It is to be considered within the scope of the invention that a combined filter-check valve 42 can be formed as a disposable or "throw-away" unit whereby when the filter is dirty, the entire assembly is removed and discarded, being replaced by a new unit. Thus, further simplification of parts to reduce costs can be made to the filter-check valve unit 42 to encourage use of this disposable assembly.

This type of unit, admirably adapted to use in the invention, as shown in FIGURE 11, includes a tubular housing 174, suitably of "tin-can" or "paper-tube" configuration, with an annular partition 176 in a median portion, to support an annular air filter 178 in one end, openings 180 being provided for inlet air. The front end 182 is closed so that inlet air is forced through the filter 178 via openings 180.

The annular partition 176 provides a check valve chamber 184 in the back end of the housing 174 and a disc check valve plate 186 is hinged at 188 for movement in the arrow 190 direction. An annulus 192 of felt is provided to assure gas-tight seal. A spring 194 is employed to bias the valve disc 186 toward a closed position, but is of very light weight so that the disc operates readily for good valve cover ventilation.

The back end of housing 174 is provided with a threaded connector 196 for attachment to a valve cover 32, 34 as desired.

Economy of construction is evident from the foregoing description.

Optional Embodiment

The illustrations of the invention as shown in FIGURES 1 and 2 of the drawings have related to the provision of the filter element and check valve assemblies 42 on the front ends of the rocker covers 32 and 34 in ram air receiving relation to the engine cooling fan 35. However, it is to be included within the broad scope of the invention to position the filter-valve assemblies 42 on either end of the valve cover, and this is illustrated in FIGURE 3 of the drawings. As there shown, the present invention is applied to an overhead valve engine of the straight type, such as 8, 6, 4 or other, and since similar components as described with respect to the showing of FIGURES 1 and 2 are utilized, similar designating numerals will be employed. Thus, the engine includes a rocker cover 32 and a cooling fan 35 positioned at the front end thereof. Also, one of the engine components is an air filter housing or bonnet 38 having an air inlet 40. In accordance with this aspect of the invention, the valve-filter unit 42 is positioned at the back end of the rocker cover 32, since, due to the use of the modulator valve 62, ram air is not absolutely required for the efficient functioning of the present invention. Accordingly, a gas outlet opening 44 is provided at the front end of the rocker cover 32, and a gas conduit 48 extended to a slightly modified version 250 of the carburetor air inlet adaptor 50, previously described. Thus, as shown in FIGURE 3, the carburetor air inlet adaptor includes a T-branch take-off 202 formed in the sidewall of the adaptor 250, rearwardly of the modulating valve plate 62, which is the same as that previously described. Also, as in the previous embodiment described with reference to FIGURE 7, a check 94, as per FIGURE 7, as utilized to prevent backfire into the valve cover 32, 34.

Thus by this embodiment, it is not necessary to cut into the air cleaner bonnet 38.

The Aspirator Kit

As regards the description of the invention as shown in FIGURE 3, it is to be included within the broad scope of the invention to utilize an aspirator for drawing the crankcase and valve cover gases into the carburetor, either through the air inlet bonnet 38 or between the bonnet 38 and the throat of the carburetor 36.

Thus, as shown in FIGURE 6, the normal air inlet 40 of the carburetor air inlet housing 38 can be fitted with a venturi horn 206, having a low pressure inlet opening 208 to which an exhaust tube 48 from the rocker cover 32, 34 is connected. Suitably a check valve 94 will be provided, in accordance with FIGURE 7, to provide a closed crankcase system when the engine is at rest.

According to this embodiment, air entering the carburetor through the inlet housing 38 will positively draw the gases from the crankcase or the rocker cover as desired. Also a careful mixing of the inlet air and crankcase vapors in the venturi throat will be provided and the catalytic effect of the vapors and their unused energy as the result of incomplete combustion will be fully realized in the combustion process.

It will be also noted that in this aspect of the invention no moving parts are required other than the check valve as at 94 to give a closed system when the engine is at rest. This reduces cost of manufacture and obviates maintenance and adjustment during the life of the engine.

Also as regards this embodiment of the invention, the aspirator can be formed to fit on top of the carburetor between the carburetor and the bonnet, if desired. However, it has been found most desirable to position the aspirator at the air intake inlet to provide improved mixing of the crankcase and/or valve cover gases before reaching the carburetor to avoid upsetting carburetor balance.

Operation of the Present Invention

From the foregoing, it will be observed that since the crankcase is sealed, vapors developed therein by blow-by past the pistons of the engine will move upwardly by crankcase pressure into the valve covers 32, and 34, FIGURES 1 and 2, where they will collect. At idle speeds, the weight 66 on valve plate 62 will tend to close the valve plate 62 to the position shown in FIGURE 5. This will cause air to be drawn through the filter-check valve assembly 42 as in FIGURES 1, 2 or 3, and cause it to pass the full length of each of the valve covers 32 and 34, thereafter passing through the gas conduit 43 into the carburetor air filter housing 38. Inasmuch as the filter-check valve assemblies 42 include the enlarged tubular or cylindrical body 132 to catch air from the fan in FIGURES 1 and 2, the air will be forced into the covers 32 and 34 to provide improved flow of air into the carburetor and contribute to free breathing and improved fuel-air ratio and better economy.

At higher engine speeds, the valve plate 62 will be opened to a generally parallel position and will be counterbalanced by the weight 66 so that an appropriate draft through the valve covers will be provided at all times, balanced with the incoming air through the air filter inlets 42, providing the engine with appropriate amounts of air yet providing a positive sweep and scavenging through the valve covers 32 and 34 to fully ventilate the crankcase system while reducing atmospheric pollution by reburning these waste vapors.

As the air sweeps through the valve covers it will pick up any vaporous material, such as water vapor, hydrocarbons and other blow-by products, and will sweep them out of the valve covers, thereby completely eliminating sludging conditions that have heretofore been encountered in these areas.

As regards the FIGURE 3 embodiment of the invention, a clean sweep of the valve covers 32 will be provided even though the filter-check valve assembly unit 42 is on the back end of the rocker cover out of ram air receiving relation to the fan 35. This is effected by the modulator valve 62 or by the venturi horn 206 of FIGURE 6, that provides positive movement of cleansing air the full length of the valve cover 32 at any engine speed.

During engine operation, it will be noted that the check valve 128 of the filter-check valve assembly 42 is open to provide a free flow of cleansing, incoming air. Also, the check valve 94 at the inner end of the gas conduit 43 is also open. However, when the engine is stopped, both of these check valves are immediately closed to seal the rocker covers and prevent evolution of vapors therefrom when the engine is shut down, as contrasted to the prior art, wherein these vapors were permitted to escape either through the road draft tube or through the vented oil filler cap usually positioned on top of one of the valve covers. Thus definitely improved anti-atmosphere pollution characteristics are accorded the invention.

Extended Scope of Invention

Although the present invention has been described with respect to an overhead valve engine, such as an overhead valve engine of the V-8 type as used in current automobiles, it is to be included within the scope of the invention to apply the system to engines of all types which utilize a crankcase containing a quantity of lubricating oil, be the engine movable or stationary. Thus, the present invention provides for cleaning the lubrication system of all crankcase-type internal combustion engines, including 2-cycle sleeve valve diesels, 4-cycle diesels, etc., in a very positive manner of prolong their life and prevent sludging and corrosion as the result of vapors not being properly removed from the crankcase during operation, as has been a particular problem with not only moving engines utilizing a road draft tube, but more especially stationary engines having no positive draft-producing means.

Also, it is to be included within the scope of the invention to apply the present system to any type of carburetor air cleaner. That shown typifies the currently used paper cartridge type cleaner of the dry type. However, the invention is adapted for use with engines using oil bath air cleaners, wherein the air cleaner housing is provided with a single air inlet.

Also, the present invention is applicable to use for scavenging gaseous products from the crankcase of valve-in-block engines, typified by the absence of a valve cover on the top of the engine head. When so operating, the crankcase is sealed, and the vapors normally directed out of the crankcase vent, such as a road-draft tube, are directed from the road draft tube opening into the bonnet encasing the carburetor air inlet cover and due to the modulating valve 62 or the venturi horn 206, the vapors developed in the crankcase are positively drawn into the carburetor. When utilized with engines of the valve-in-block type, it is not required that any air inlet be provided into the crankcase. Thus, the screened oil filler caps now commonly used for this purpose may be discarded in favor of an ordinary vapor-proof cap. However, if desired, for more positively scavenging the crankcase vapors, the filter-check valve assembly 42 of the present invention may be substituted for the vented filler cap now commonly employed so that the check valve provides a closed system when the engine is at rest.

This same principle would apply to overhead valve engines having a screened opening, as for adding oil. Thus the gas flow would be into the valve cover and out through the road draft tube via the crankcase.

It is also to be included within the broad scope of the invention to utilize an open road draft tube, as where state law does not require closing the same as when the engine is at rest. Thus, the valve covers will be positively swept by the invention. However, when so operating, it will be advisable to filter the road draft tube because the suction of the system will tend to empty the crankcase, even when vapors are removed from the valve covers, and this may draw air with entrained dust through the road draft tube and into the crankcase with resultant sludging and abrasion.

Still further, it is to be included within the scope of the invention to utilize the system on diesel engines, even though they do not utilize a carburetor as such. However, they do use a crankcase that needs scavenging and they also use air to provide a fuel mixture, with the fuel being injected into the combustion chamber on the compression stroke. Thus, the invention broadly includes fuel injection engines also—as long as an air inlet stream is utilized, the energy of which can be harnessed according to the invention to provide a positive draft of crankcase and/or valve cover gases to the combustion zone.

Still further, it is to be included within the scope of the invention to control the modulating valve by a suitable bellows-fluid conduit connection to the intake manifold as in the manner of a spark advance mechanism.

Except with respect to the aspirator kit, the foregoing description has related to the introduction of the crankcase system gases into the carburetor air inlet filter housing. However, at least in some instances, it may be desirable to place a collar or conduit between the air filter housing and carburetor, as in larger engines where the filter is outside the engine compartment, and introduce the throw-off gasses into such collar or conduit. This is also to be included within the scope of the invention.

Thus in its broadest aspect the invention relates to the purging of crankcase gases into the combustion chamber of an internal combustion engine by modulating the combustion air flow to draw the crankcase gases into the combustion chamber, or by aspirating the crankcase gases into the combustion air stream at the inlet to the air filter housing to provide improved mixing and avoid upsetting carburetor balance.

Although the present invention has been described with respect to a full sweep from one end to the other of the valve covers, to prevent sludging conditions therein and thus provide greater engine cleanliness, it is to be included within the broad scope of the invention to position the filter-check valve assemblies 42 at any point on the valve cover 32, 34. Thus, on engines having oil filler caps at a central point on the valve cover, the present system can be utilized. When so operating, it may be desirable for best valve cover cleanliness to provide outlets at each end of the valve cover so that a full sweep of the valve cover is provided. However, for operators who are not concerned with longest engine life and greatest engine cleanliness, less than a full sweep of the valve cover can be provided by positioning the inlet and outlets a distance apart which is less than the length of the valve cover. This may result in starvation or a lack of clean sweeping of a portion of the valve cover and provide a pocket of sludging. However, a substantial benefit from the present system will be provided by positively evacuating or removing crankcase vapors to keep the lubrication oil clean during its eventual entire circulation in that portion of the valve cover positively swept by the present inventive concept.

Advantages of the Present Invention

From the foregoing, it will be evident that a number of advantages accrue from the system and method of the present invention. Thus, it is an important advantage of the invention that air pollution, particularly in areas of high density automobile population is reduced. This is effected by utilizing a sealed crankcase and by scavenging the gases produced therein for re-burning by directing them in a positive manner into the carburetor in admixture with combustion air.

Another important advantage of the invention resides in the fact that all vapors are positively swept from the crankcase and valve cover housings so that the lubrication oil is kept in a highly refined and purified condition and sludging conditions in the crankcase and valve cover as a result of the accumulation of these vaporous materials therein in condensed sludge and corrosion forming form with the lubrication oil is overcome. In accordance with the present invention it is not unusual that an automobile engine can be operated for periods of 30,000 to 50,000 miles without requiring oil change. The oil still retains a high degree of lubricating characteristic; in fact, by the re-refining which is taking place in the engine by this system, oil which has been used a substantial length of time in accordance with the present invention is believed to have better lubricating properties than original oil. The only requirement of operating an engine in accordance with this invention is that the oil be kept up to a proper operating level to compensate for consumption losses and that the filter-check valve assemblies 42 be periodically replaced, to assure that the filters are operating at top efficiency with least resistance to flow of gas therethrough.

Another advantage of the present invention resides in the fact that, if desired, ram air can be utilized from the fan to recapture some of the normal energy losses from an engine, and thus provide a type of supercharging to actually improve engine efficiency and breathing. Actual tests utilizing the present system have shown improvement in fuel economy believed to result partially from the ram air technique and partially from the energy derived by re-burning the partially burned blow-by products that appear to be combustion catalysts.

Having thus described my invention, I claim:

1. In a ventilation system for an internal combustion engine having a crankcase, a carburetor connected in fluid-flow relation to an air filter housing having an air inlet opening, the improvement of
an air modulating flow control valve connected to the inlet opening,

and conduit means connected at one end into the crankcase and at the other end into the air filter housing.

2. The combination defined in claim 1, including a check valve in said fluid conduit means to provide a free flow of gas only from the crankcase system into the air filter housing.

3. In a ventilating system for an internal combustion engine having a crankcase, a valve cover connected in fluid-flow relation to the crankcase, and a carburetor having an air inlet opening, a fluid outlet opening in the valve cover, a fluid conduit connected between said outlet opening and the air inlet opening of the carburetor, and means at the inlet of the carburetor for modulating the flow of air to the inlet opening in response to changes in air flow upon changes in engine speed, whereby a positive draft is developed in said fluid conduit.

4. In a ventilating system for an internal combustion engine having a crankcase, a valve cover connected in fluid-flow relation to the crankcase, a carburetor connected with an air intake filter housing having an air inlet opening, a fluid inlet adjacent one end of the valve cover, a fluid outlet adjacent the other end of the valve cover, a fluid conduit connected between said fluid outlet and the carburetor, and a modulating flow valve connected to the air inlet opening of the air intake filter housing and adapted to proportionately restrict flow of air through the air inlet opening at all engine speeds to effect a positive draft in said fluid conduit.

5. The combination defined in claim 4 including a check valve in said fluid conduit permitting free flow of gas from the valve cover into the carburetor and preventing backfire from the carburetor into the valve cover.

6. In a ventilating system for an internal combustion engine having a crankcase, a valve cover connected in fluid flow relation to the crankcase, a cooling fan positioned adjacent one end of the valve cover, and a carburetor connected with an air intake filter housing having an air inlet opening, the improvement of a fluid inlet in the end of the valve cover adjacent the cooling fan, a combination filter and check valve in said fluid inlet and positioned in ram-air receiving relation to the fan, said check valve permitting flow only into said valve cover, a fluid outlet adjacent the other end of the valve cover, a fluid conduit connected between said fluid outlet and the carburetor intake filter housing, and a check valve in said fluid conduit to permit flow only into the filter housing.

7. The combination defined in claim 6 and including a modulating flow valve connected to the air inlet opening of the carburetor air intake filter housing.

8. In a ventilating system for an internal combustion engine having a crankcase and a carburetor having an air inlet, the improvement of a fluid conduit connected between the crankcase and the carburetor air inlet, and a modulating flow control valve arranged to modulate air flow in addition to the function of the carburetor and being connected to the air inlet of the carburetor.

9. In a method of operating an internal combustion engine having a combustion chamber, a crankcase wherein gaseous blow-by products collect from the combustion chamber, and using a flowing stream of air to produce a gaseous fuel mixture for use in the combustion chamber and a carburetor having an air inlet, the steps of

modulating the flowing stream of air at the inlet of the carburetor and in response to changes in air flow upon changes in engine speed to produce a positive draft at all times on the crankcase vapors, and thereby moving gaseous blow-by products from the crankcase into the combustion chamber in admixture with the fuel-producing air stream.

10. In a ventilating system for an internal combustion engine having a crankcase, a valve cover connected in fluid-flow relation to the crankcase, a cooling fan, and a carburetor having a combustion air inlet opening, the improvement of
an opening in the valve cover,

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a first conduit positioned in ram-air receiving relation to the fan and connected to said valve cover opening, second conduit means extending between the crankcase and the air inlet opening of the carburetor, and a modulating flow valve connected to the air inlet opening upstream of said second conduit connection to proportionally restrict flow of air to the inlet opening at all engine speeds to effect sub-atmospheric pressure conditions in said second conduit to positively draw from the crankcase.

11. In a method of operating an internal combustion engine having a crankcase, a valve cover in fluid communication with the crankcase where blow-by products from the crankcase collect, and a carburetor utilizing an air stream to produce a fuel mixture, the steps of

introducing air into the valve cover to admix with the blow-by products and produce a valve cover gas mixture, moving the gases from the valve cover into the carburetor in admixture with the utilized air by modulating the flow of the utilized air stream at the inlet of the carburetor and in response to changes in the utilized air stream flow upon changes in engine speed to provide a positive draft of the cover gases into the carburetor,

and sealing the crankcase system when the engine is at rest.

12. In a method of operating an internal combustion engine having a crankcase, a valve cover in fluid communication with the crankcase where blow-by products from the crankcase collect, and a carburetor connected with an air intake housing having an air inlet opening, the steps of

introducing air into the valve cover to admix with the blow-by products and produce a valve cover gas mixture,

moving the gases from the valve cover into the carburetor,

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modulating the flow of air into the inlet opening of the intake housing at the inlet of the carburetor and in response to the flow of the latter air upon changes in engine speed to provide a draft of the valve cover vapors into the carburetor, and sealing the crankcase when the engine is at rest.

References Cited by the Examiner

UNITED STATES PATENTS

10	771,390	10/04	Plantinga	55-420
	1,200,202	10/16	Kroyer	123-119
	1,448,708	3/23	Leonard	123-119
	1,555,072	9/25	Patton	55-420
	1,843,503	2/32	Corey	123-119
15	2,056,762	10/36	Barr et al.	123-119
	2,128,154	8/38	Masters	123-119
	2,191,940	2/40	Meckl	123-119
	2,281,124	4/42	Westcott	123-119
	2,537,117	1/51	Alward	123-119
20	2,581,748	1/52	Blum	137-499
	2,639,701	5/53	Bales	123-119
	2,670,756	3/54	Granberg	137-499
	2,717,585	9/55	Bradshaw	123-119
	2,797,674	7/57	Dolza	123-119
25	2,906,252	9/59	Beardsley	123-119
	3,056,420	10/62	Dietrich	123-119

References Cited by the Applicant

UNITED STATES PATENTS

30	1,276,262	8/18	Pettitt.
	1,312,190	8/19	Lundgren.
	2,185,501	1/40	Dressler.
	2,244,403	6/41	Root.
35	2,731,958	1/56	Robley.
	2,933,075	4/60	Geffroy.

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