May 7, 1968 W. R. DRYSDALE 3,381,673

CRANKCASE VENTILATION SYSTEM

Filed Nov. 22, 1965

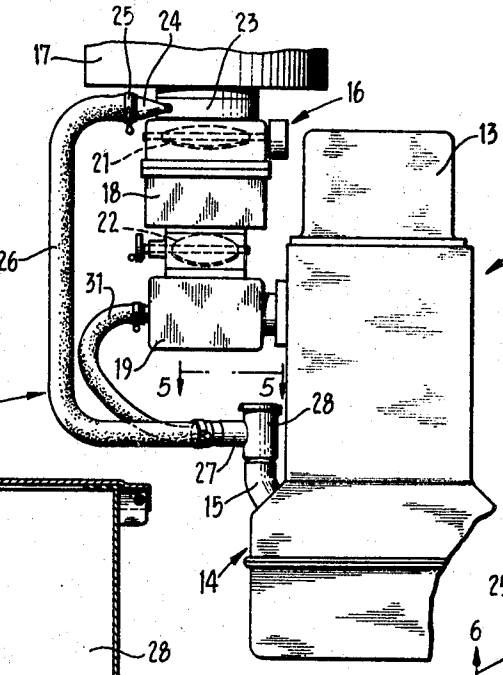


Fig. 1

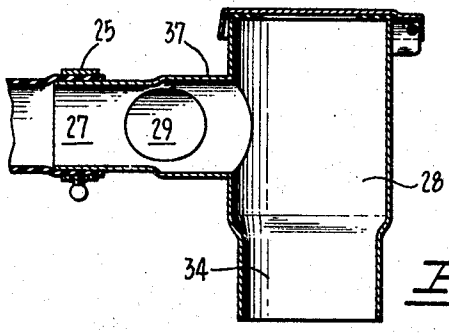


Fig. 6

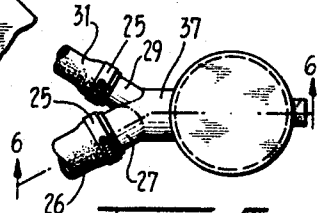


Fig. 5

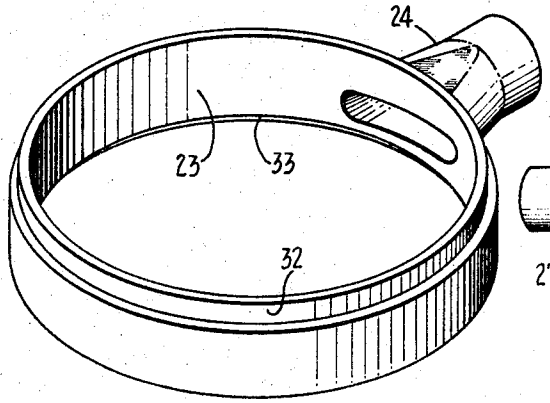


Fig. 2

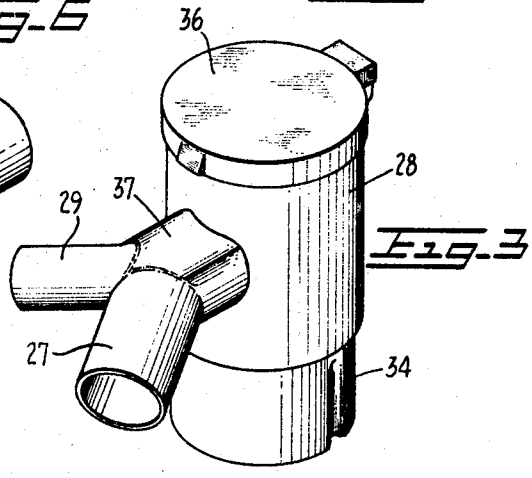


Fig. 3

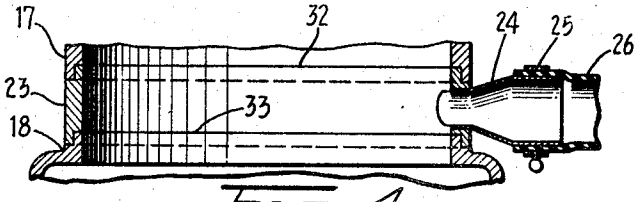


Fig. 4

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CRANKCASE VENTILATION SYSTEM

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ABSTRACT OF THE DISCLOSURE

An apparatus is described for conveying fumes from the crankcase of an engine into its fuel induction system without allowing escape of such fumes to the atmosphere or permitting them to adversely affect the air-fuel ratio of the induction system. The apparatus includes two separate conduits which communicate the engine crankcase with the fuel induction passage of the engine, one of the conduits terminating at the induction passage at a position above the throttle valve and the other terminating below the throttle valve. An oil filler cap is provided with a Y-extension to facilitate connection of the conduits to the crankcase, and a ring is adapted for positioning in the induction passage between the air cleaner and carburetor to provide a means for connecting one of the conduits to the induction passage at a position above the throttle valve.

This invention relates to a system for removing fumes from the crankcase of an internal combustion engine and preventing the same from harming the engine or contaminating the atmosphere. More particularly, the invention relates to apparatus for conveying fumes from the crankcase of an engine into its fuel induction system without allowing escape of such fumes to the atmosphere, or permitting them to adversely affect the fuel charge mixture in the induction system. The instant apparatus accomplishes this while being easily installable on existing engines and without requiring the use of diaphragms, complicated valves or other impediments to the free flow of the fumes.

As is known, fumes tend to accumulate in the crankcase of an internal combustion engine as a result of oil and moisture vaporization in the crankcase, and flow of gases and carbon particles by the engine pistons. These fumes not only act deleteriously on the oil and engine parts, but normally escape into the atmosphere to become one of the major causes of atmospheric contamination. In an effort to obviate the results of these fumes, various methods and apparatuses have been devised to convey the same from the crankcase of an engine to its induction system so that the fumes maybe burned with the incoming fuel charge. Most common arrangements involve the use of one or more conduits connecting the crankcase to the induction system, and either the vacuum created in the induction system or the pressure build-up within the crankcase is utilized to cause the desired flow of the fumes.

There are, in general, two types of ventilation systems now in use; the so-called "closed" system wherein the crankcase is sealed to the atmosphere, and the so-called "open" system wherein the crankcase is vented to the atmosphere. In systems of both of these types, it is usually necessary to provide valves, restrictions or other impediments in the conduits in order to control and limit the flow of fumes through the conduits so that such fumes will not unduly affect the air-fuel mixture of the fuel charge. However, fumes generally contain a relatively large proportion of particulate and liquid matters, such as carbon, tars, and condensibles. The valves or restrictions act as impediments to the free flow of fumes through

the conduits and cause the particulates and liquid matters to separate from the fumes. These tars, etc. quite often cause the valves to stick and the conduits to become clogged at the restrictions. Besides resulting in poor engine performance, this sticking or clogging results in venting of the fumes into the atmosphere in the open systems, and bursting of crankcase seals and gaskets in the closed systems. At best, the provision of these valves or restrictions requires continual maintenance of the system to assure proper operation and to prevent harm from occurring to the engine.

Moreover, due to the criticality of the place of introducing the fumes into the induction passage with most of these systems, specialized knowledge and engine modification is necessary for their installation. Presently, improper installations are often made and cause the systems to malfunction to the detriment of the engine and its performance.

Accordingly, it is an object of the present invention to provide an improved crankcase ventilation system which will be effective under all engine operating conditions to convey all the fumes accumulating in a crankcase to the induction system and yet which does not require the use of valves or any other type of mechanical control.

Another object of the invention is to provide a crankcase ventilation system which introduces the fumes from the crankcase into the fuel induction system without adversely affecting the carburetor or the air-fuel mixture of the fuel charge.

A further object of the invention is to provide a ventilation system of the character described which can be quickly and easily incorporated in existing engines without requiring alteration of the engine or specialized knowledge.

Still another object of the invention is to provide a ventilation system of the character described which is free of all impediments such as valves or impeding line restrictions to the free and even flow of crankcase fumes from the crankcase to the induction system.

One other object of the invention is to provide a crankcase ventilation system which can be utilized as either an open or closed system with equally as good results.

A still further object of the invention is to provide a chankcase ventilation system for an internal combustion engine which improves the engine's performance and starting characteristics.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to such drawings:

FIGURE 1 is an end elevation of an internal combustion engine having incorporated therewith the present invention in a preferred form, parts of such engine being shown broken away and in phantom;

FIGURE 2 is a perspective view of a ring of the ventilation system especially adapted to facilitate attachment of the ventilation system with the induction passage of an engine;

FIGURE 3 is a perspective view of a hollow fitting of the invention which facilitates communication of the system with the crankcase of an engine through the oil filter pipe thereof;

FIGURE 4 is a cross-sectional view of the ring of FIGURE 2 depicting such ring incorporated into the induction system of an engine;

FIGURE 5 is a top plan view of the hollow fitting of

FIGURE 3 taken from a plane indicated by the lines 5—5 of FIGURE 1; and

FIGURE 6 is a cross-sectional view of the hollow fitting of FIGURE 3 taken on planes indicated by the lines 6—6 of FIGURE 5.

In FIGURE 1 there is depicted generally schematically a conventional internal combustion engine 11 of the straight block type having incorporated therewith a crankcase ventilation system 12 of the present invention. As shown the engine includes a valve chamber cover 13 and a crankcase 14, which crankcase has an oil inlet defined by oil filler pipe 15. The valve chamber and crankcase are in communication with each other through the block of the engine as is well known. Engine 11 also includes a conventional induction system 16 defining an induction passage in which the fuel charge is mixed and fed to the cylinders of the engine. The induction passage of this system 16 is generally defined by an air cleaner 17, a carburetor 18, and an intake manifold 19. As is shown in phantom, the carburetor is provided with a conventional choke valve 21 and throttle valve 22.

The crankcase ventilation system 12 includes a ring 23 adapted to be positioned between the air cleaner and carburetor to define a portion of the induction passage. This ring 23 has a tubular extension 24 extending outwardly therefrom to which is suitably secured one end of a conduit 26 such as by means of a ring clamp 25. The other end of conduit 26 is secured in a similar manner to a tubular extension 27 on a hollow fitting 28 which is adapted to fit within the oil filler pipe 15 in place of the usual cap therefor. A second tubular extension 29 extends from hollow fitting 28 and has one end of another conduit 31 suitably secured thereto. The other end of this conduit 31 is adapted for securance into the intake manifold 19 of the engine below the throttle valve 22. In this regard, it is to be appreciated that most intake manifolds are provided with one or more fittings for communicating various apparatuses such as a windshield wiper system or a conventional valve operated ventilation system to the intake. One of these fittings can be advantageously utilized to communicably connect the conduit 31 to the intake to obviate the necessity of drilling or boring into the manifold.

From the above description and the drawing, it will be apparent that two substantially separate passageways are provided between the crankcase and the induction passage, with one of these passageways terminatnig in the induction passage just above or anterior of carburetor 18 and the other terminating in the induction passage below or posterior of throttle valve 22. With this arrangement, it has been found that by properly sizing the passageways as will be discussed below, all of the fumes accumulating in the crankcase can be introduced into the induction system without dirtying the carburetor, adversely affecting the air-fuel mixture, and without the necessity of providing valves or other mechanical controls or flow restricting impediments. In fact, it has been ascertained that the presence of valves, restrictions or any other substantial impediment, projection or obstruction in the passageways interfering with the free flow of fumes therethrough will cause the particulates in the fumes to separate therefrom and clog the passageways. This reduces the predetermined capacity of the passageways, thus preventing the adequate withdrawal of the fumes from the crankcase and detrimentally upsetting the air-fuel ratio of the charge delivered to the engine.

It has been further found that by properly sizing the capacity of the passageways as will be discussed, the system can be utilized as either an open or closed system with equally good results. Moreover, the system increases the engine's fuel utilization and improves the engine's performance under certain operating conditions. Furthermore, because of the placement of the ring between the air cleaner and carburetor, i.e., directly above the carburetor, fumes entering the induction passage from the upper passageway will not get into or clog the air horns of the carburetor. That is, as is known, the air horns of most carburetors are located at the top of the carburetor in the central portion of the induction passage. Thus, the placement of the ring directly on top of the carburetor results in the upper conduit communicating with the induction passage in approximately the same horizontal or lateral plane as the carburetor air horns. However, since the air horns are in the middle of the passageway, and air is being drawn down through the carburetor, the fumes from the conduit are drawn downward before reaching the air horns. This is aided by the fact that a vortex action is imparted to the fumes as they are drawn downward, and the heavy particulate matter therein is caused by centrifugal force to remain adjacent the walls of the passageway away from the air horns.

All of the above is accomplished while, in addition, because of the ring and hollow fitting, the system can be easily and quickly installed on existing engines. There is no necessity of drilling into the carburetor, or air cleaner to provide connection with the induction passage, nor is it necessary to drill into or provide special valved openings into the crankcase. Because of the foregoing and the fact that the passageways are so sized, improper installations of the system are greatly minimized.

The combined capacity of the two passageways should be such, with respect to the fumes generated and the vacuum in the induction passage, that when the throttle valve 22 is open, all the accumulating fumes are drawn from the crankcase and the pressure in the latter is maintained approximately at or below atmospheric pressure. However, the capacity of the passageway terminating below the throttle valve should be limited with respect to the fumes generated and the vacuum in the induction passage posterior of the throttle valve when it is closed so as to maintain the leaning of the air-fuel mixture ratio due to the introduction of the fumes within acceptable limits. In this regard, a leaning of the mixture by up to about 4 percent of its original air-fuel ratio is considered by authorities to be acceptable. To satisfy these criteria, the minimum cross-sectional area of the paasageway terminating with the ring 23 should not be less than about .44 square inch (.75 inch in diameter), and the minimum cross-sectional area of the passageway terminating below the throttle valve should be in the range between about 4.4×10^{-3} square inches (.075 inch in diameter) and 1.6×10^{-2} square inches (.14 inch in diameter) depending on the engine size.

With engines having combustion chamber capacities up to 140 cubic inches, it has been found that for best results under all operating conditions, the minimum cross-sectional area of the upper passageway, terminating with ring 23 should be no less than .44 square inch (.75 inch in diameter) and the minimum cross-sectional area of the other lower passageway should be 5.8×10^{-3} square inches (.086 inch in diameter). For engines having combustion chamber capacities between 140 cubic inches and 250 cubic inches, the minimum cross-sectional area of the upper passageway is desirably no less than .78 square inch (one inch in diameter) and the minimum cross-sectional area of the lower passageway should be 8.8×10^{-3} square inches (.016 inch in diameter). For all engines having combustion chamber capacities greater than 250 cubic inches, excellent results are obtained if the minimum cross-sectional area of the upper passageway is at least .994 square inch (1.125 inches in diameter) and the lower passageway has a minimum cross-sectional area of 1.25×10^{-2} square inches (.126 inch in diameter). For all engines, it is desirable that each of the passageways have a generally constant cross-sectional area throughout its length so that the free and even flow or fumes therethrough is not appreciably disturbed.

For a more detailed description of the ring 23 of the ventilation system, reference is made to FIGURES 2 and 4. The ring is adapted for securance between the air

cleaner 17 and carburetor 18 to provide a portion of the induction passage without requiring alteration of the carburetor or air cleaner. More particularly, as will be apparent from FIGURE 4, the air cleaner 17 is usually secured to the carburetor 18 by means of a scarf joint. For this reason, the upper and lower rim edges of the ring 23 are provided with inwardly stepped chamfered surfaces 32 and 33, respectively, adapted to mate with the corresponding chamfered surfaces on the air cleaner 17 and carburetor 18. With this construction, the joints between the ring and the air cleaner and carburetor are smooth and continuous so that the surfaces defining the induction passage are unbroken.

The engine induction systems of most automobiles are so designed that when the hood of the automobile is down, very little clearance exists between the air cleaner and the hood. Thus, it is to be appreciated that it is not possible to lengthen the induction passage to any great extent without having to modify the automobile hood or induction system. As a particularly salient feature of the invention, the ring 23 is adapted for insertion into the induction passage without appreciably lengthening it. More particularly, as can be seen from the drawing, the ring is relatively thin. However, as noted above, the minimum cross-sectional area tubular extension 24 can have is .44 square inch. To provide this cross-sectional area and yet permit the ring 23 to be relatively thin, it will be noted that the tubular extension 24 is constricted in the ring's axial direction and correspondingly lengthened in the ring's transverse direction at the point at which it is joined to the ring.

As best depicted in FIGURES 3 and 6, hollow fitting 28 is provided with a stem 34 adapted to fit within, and frictionally engage, oil filler pipe 15. The upper end of the fitting is closed by a cap 36 hingedly connected thereto. This cap provides access to the oil filler pipe, and hence the crankcase, for the introduction of oil.

A Y extension member 37 extends laterally from the hollow fitting 28 and is in communication with the interior thereof. The aforementioned tubular extensions 27 and 29 are formed by the arms of this Y member. With both of the passageways to the induction passage communicating with the crankcase in this manner, it has been found that when the throttle valve 22 is in its closed position and a high vacuum is consequently formed within intake manifold 19, all the crankcase fumes flow through the extension 29 and conduit 31 to the manifold, while fresh air, after passing through the air cleaner 17, is pulled into the crankcase through the conduit 26 and extension 27. This is particularly true in closed systems and is advantageous therein in providing a means for introducing clean fresh air into the crankcase without the necessity of a one-way check valve or the like in the crankcase.

As mentioned before, the crankcase ventilation system of the invention is equally applicable to both open and closed systems. When it is to be utilized as an open system, it is desirable that the fresh air inlet into the crankcase be provided by an opening within the hollow fitting 28. More particularly, while not depicted, it is to be appreciated that a hole can be easily drilled or otherwise provided within the cap 36 for this purpose. By providing an opening in the hollow fitting in this manner, it is not necessary to modify the crankcase structure. I order to assure sufficient air flow into the crankcase with an open system without adversely affecting the air fuel mixture of the induction system, it is preferred that such an opening have a cross-sectional area of approximately 5×10^{-2} square inches (.25 inch in diameter).

It is to be readily appreciated from the above that the crankcase ventilation system of the invention provides for the conveyance of all the fumes generated in the crankcase to the induction system without the necessity of providing any valves or other impediments in the passageways. This is accomplished by the invention although it affords a very simple structure which can be easily installed on existing engines. To install the system, the hollow fitting 28 can be inserted in the oil filler pipe in place of the conventional cap, and the ring 23 inserted between the air cleaner and carburetor. It is to be noted that with this arrangement, in contrast to some others, it is not necessary to pass the fumes through the air cleaner or other filter to remove particulates therefrom before the fumes are introduced to the induction passage above the carburetor. This increases the life of the air cleaner and, furthermore, does not hinder the removal of the air cleaner for changing of its filter or addition of oil.

What is claimed is:

1. A crankcase fume ventilation system for an internal combustion engine having a crankcase and members defining a fuel induction passage in which is provided a throttle valve, said system comprising a pair of conduits communicably connecting the interior of said crankcase with said induction passage at points anterior and posterior of said throttle valve, each of said conduits extending separately from at least adjacent said crankcase to said induction passage and each being devoid of all impediments to the free and uniform flow at all times of fumes therethrough from said crankcase to said induction passage whereby two substantially separate and clear passageways are defined between said crankcase and said induction passage with a first one of such passageways terminating anterior of the throttle valve in said induction passage and the second one terminating posterior of said throttle valve, the combined capacity of said two passageways with respect to the fume generated in the crankcase and the vacuum in said induction passage being such that when said throttle valve is open the pressure in said crankcase is maintained approximately at or below atmosphere pressure, and the capacity of the second passageway being limited with respect to the fumes generated in the crankcase and the vacuum in said induction passage posterior of said throttle valve when said throttle valve is closed to maintain the air-fuel ratio due to fumes entering the induction passage from said second passageway within about 4 percent lean, the minimum cross-sectional area of said second passage being in the range between about 4.4×10^{-2} square inches and 1.6×10^{-2} square inches.

2. The crankcase ventilation system of claim 1 adapted for use with an internal combustion engine having a combustion chamber capacity of 140 cubic inches or less and in which the minimum cross-sectional area of said second passageway is about 5.8×10^{-3} square inches.

3. The crankcase ventilation system of claim 1 adapted for use with an internal combustion engine having a combustion chamber capacity in the range between about 140 cubic inches and 250 cubic inches and in which the minimum cross-sectional area of said second passageway is about 8.8×10^{-3} square inches.

4. The crankcase ventilation system of claim 1 adapted for use with an internal combustion engine having a combustion chamber capacity of greater than 250 cubic inches and in which the minimum cross-sectional area of said second passageway is about 1.25×10^{-2} square inches.

5. A crankcase fume ventilation system for an internal combustion engine having a crankcase with an oil filler inlet and an induction system including an air cleaner and a carburetor defining a fuel induction passage in which is provided a throttle valve, said system comprising a ring adapted for insertion between said air cleaner and carburetor and which has a central opening for defining a portion of the induction passage, said ring having an outwardly extending tubular extension defining a lateral passage in communication with said central opening; a hollow fitting mountable to said crankcase in communication with said oil filler inlet of said crankcase, said hollow fitting having an outwardly extending extension communicating with the interior thereof and a displaceable cap for the introduction of oil into said crankcase; a first conduit communicably connecting the extension on said

fitting with the extension on said ring to define a first passageway from said crankcase to said induction passage anterior of said throttle valve, conduit means substantially separate from said first conduit and extending separately from at least adjacent said crankcase to said induction passage, said conduit means adapted for connection to said induction passage posterior of said throttle valve to define a second passageway from said crankcase substantially separate from said first passageway, both said first and second passageway being devoid of all impediments to the free and uniform flow at all times of fumes therethrough from said crankcase to said induction passage, and both passageways having generally constant interior cross-sectional areas throughout their length with the minimum cross-sectional area of said first passageway being not less than .44 square inch and the minimum cross-sectional area of said second passageway being in the range between about 4.4×10^{-3} square inches and 1.6×10^{-2} square inches.

6. The crankcase fume ventilation system of claim 5 wherein said ring is relatively thin and the tubular extension of said ring is constricted at its joinder to said ring in the ring's axial direction and correspondingly lengthened in the ring's transverse direction.

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