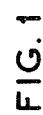


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PURGE SYSTEM FOR BLOW-BY RETURN VALVE

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

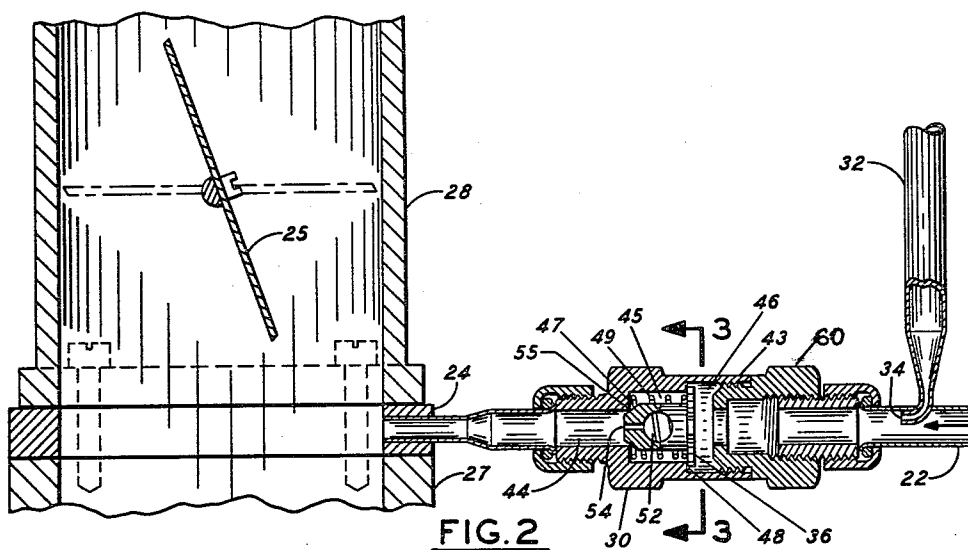


FIG. 2

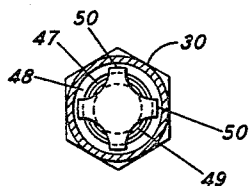


FIG. 3

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PURGE SYSTEM FOR BLOW-BY RETURN VALVE
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The present invention relates to blow-by return systems for internal combustion engines. More particularly, it relates to apparatus for maintaining in an operating condition the reciprocating elements of a vacuum control valve in a blow-by return line connecting a crankcase breather pipe to the fuel-air intake system of an internal combustion engine.

It has been known heretofore that smog and other noxious fumes created by internal combustion engines using a splash-type lubrication system can be reduced by connecting the crankcase breather pipe to the intake system, such as the intake manifold or carburetor, of the engine. Because of the widely varying pressure conditions in both the crankcase and in the carburetor, it has been common to connect these units together through a crankcase recirculation control valve. The function of this valve is to prevent abnormally high vacuums, normally produced in a carburetor during acceleration or high-speed operation, from imposing a vacuum on the crankcase which might pull oil, as well as fumes, from the crankcase. It has been found in practice, however, that such blow-by return line valves are easily clogged with carbon deposits, such as oil vapors condensing thereon. As a result, the pressure-differential, spring-operated reciprocating throttling element in the line becomes lodged (stuck) in one position. This position is one where the valve is normally closed so that no gases are in fact returned to the carburetor. Due to this blocking of the control valve in the blow-by return line, the return of the vapors (fumes) from the crankcase breather to the intake system of the engine is rendered impossible. The fumes then escape under the engine hood and thence pass into the outside atmosphere, contributing to air pollution (smog), and also penetrate into the passenger compartment, causing irritation and discomfort to the driver and passengers.

It is a particular object of the present invention to provide a system for assuring continued operation of the crankcase recirculation control valve in a blow-by return line, which connects the crankcase breather pipe to the intake of an internal-combustion, spark-ignition engine, by supplying, at least intermittently, and independently of the flow rate of vapors in the blow-by return line, a small but effective quantity of liquid gasoline from the engine supply to the return line ahead of the valve so that said valve is washed to remove deposits of oil and carbon, which would otherwise clog the moving elements of the valve.

In a preferred form of apparatus for carrying out the invention, a jet nozzle, shaped in the fashion of a Pitot tube, is directly connected to the engine fuel supply and enters the blow-by return line ahead of the recirculation control valve so that a small but effective amount of fresh, uncontaminated liquid gasoline can be sprayed directly on all of the reciprocating elements of the valve. These

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elements consists of a piston-like throttling member that reciprocates in line with the flow of vapors and a spring to hold the throttling element in a normally closed position. Fresh liquid gasoline is sprayed on these elements by a jet located in the blow-by return line directly ahead of the valve. Gasoline is supplied to this jet each time the accelerator jets are actuated on the carburetor proper. Since the accelerator jets operate only intermittently, the volume of gasoline will also be small. Additionally, this supply of gasoline is independent of the pressure differential applied to the blow-by return line. In operation, such washing will thus occur oftener in start-and-stop driving than under continuous, high-speed driving conditions. Since such intermittent driving tends to deposit materials on the reciprocating elements, washing action is most needed under these conditions.

Desirably, but not necessarily, the fuel should contain dispersed or dissolved therein a detergent additive in sufficient quantity to dissolve varnish, lacquer, carbon, and other oil-vapor deposits that may build up on prolonged operation of the blow-by return system at high-load conditions. Such high-load blow-by conditions exist in delivery trucks and taxicabs where prolonged periods of idling operation permit vapors to build up without high-cooling air flow over and through the engine compartment.

Further objects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings which form an integral part of the present specification.

In the drawings:

FIG. 1 is a schematic view of an automobile engine to which the present invention has been applied; the engine is shown partially in cross section to explain the purpose and function of the present invention in preventing breather-pipe fumes from clogging the crankcase recirculation valve in the blow-by return line to the carburetor.

FIG. 2 is an enlarged cross-sectional elevation view through the circulation control valve and a part of the throttle body of the carburetor mounted on the engine, as shown in FIG. 1.

FIG. 3 is an end elevation view through the control valve seen in FIG. 2, and taken in the direction of arrow 3-3.

Referring now to the drawings, and in particular to FIG. 1, there is illustrated a typical automobile engine 10 to which the present invention has been applied. For a clearer understanding of the purpose and reason for the present invention, it is necessary at this point to disgress slightly and explain how "blow-by" is produced in a typical internal combustion engine. The term "blow-by" as used in the art is meant to include any fumes or gases that are created in the crankcase, or oil sump, 11 wherein lubricating oil, introduced into the engine through filler pipe 12 is contained in sufficient volume, so that rotation of the crankshaft, not shown, and connecting rods, such as 13, connected to piston 14, lubricates the engine by splashing the oil. Since the temperature of the lubricating oil varies with the temperature of the engine, it is necessary to provide air vents for the crankcase. For this purpose, filler pipe cap 15 on filling tube 12 has air passages formed therein, and in this way, as indicated by the arrows, air enters the crankcase through filler tube 12. At the same time, the crankcase is also provided with

a breather tube located below the pistons, but above normal oil level in crankcase 11. This is indicated by 16 in FIG. 1, and, as shown in phantom at 17, the breather tube normally is open and turned down so that fumes exhaust beneath the automobile and in the vicinity of the engine exhaust pipe.

It has been known for a long time that fumes coming from a breather tube, such as 17, can create smog and other noxious fumes in the atmosphere. The varying temperature of the oil creates such fumes, but a more serious source of fumes from the crankcase is both burned and unburned gases generated in combustion chambers 18. Upon slight wear of the cylinder walls 19, these combustion gases pass between walls 19 and piston rings 20. Flow of these gases is also indicated by arrows. It is particularly these gases, which are truly and correctly termed "blow-by," that constitute one of the major sources of smog when they are permitted to exit directly to the atmosphere as through a breather pipe 17.

With the foregoing explanation in mind, it will be understood why it has been proposed heretofore that a breather-pipe return line 22 be used for piping such gases back into the intake of the automobile. Normally, such a line may be introduced to any part of the intake system, but in the present arrangement, and in accordance with a preferred form of this invention, return line 22 is connected to the engine intake through a spacer plate 24 that is easily and readily installed merely by removing carburetor 26 from its mounting on the intake manifold mounting block 27.

It will be readily understood by those skilled in the art that the pressures both in crankcase 11 and in throttle body 28 will vary considerably during operation of the automobile. For example, when an automobile is decelerating, the negative pressure, or vacuum, in throttle body 28 will sharply increase due to suction created by pistons 14 on their intake strokes, and the closing of the throttle blade by release of accelerator pedal 29 (FIG. 1). At the same time, the pressure in the crankcase may be positive due to excessive blow-by past the pistons and piston rings of the engine. Under these circumstances, the pressure differential across blow-by return line 22 may be excessive, and would normally cause oil being splashed about in the crankcase to be drawn into line 22. For this purpose, there has been proposed use of a back-pressure control valve 30. Construction of valve 30 is shown in greater detail in FIGS. 2 and 3. As indicated above, however, clogging of this valve has been frequent, and when it becomes clogged the blow-by return line is inoperative.

For the foregoing reasons, and in accordance with the present invention, there is provided apparatus for injecting a small, but effective, amount of uncontaminated, fresh liquid gasoline into blow-by return line 22 upstream from valve 30 so that all of the reciprocating elements of the valve are at least intermittently washed with a small amount of the engine-operating gasoline. For this purpose, as illustrated in FIGS. 1 and 2, conduit 32 is connected between carburetor 26 and blow-by return line 22. As best seen in FIG. 2, tube 32 ends in a Pitot, or jet, tube arrangement identified as 34, so that liquid can be sprayed directly onto the throttling element 36, spring 49, and the valve seats of valve 30. While not shown in detail, pipe 32 is directly connected to the fuel accelerator jets of carburetor 26. These jets are operated intermittently by the linkage indicated generally as cam 38 and rod 39 in carburetor 26, as shown in FIG. 1. As is understood in the construction of carburetors, when foot feed, or accelerator, 29 is depressed sharply against the action of spring 40, linkage rod 41 not only opens the throttle blade 25 (FIG. 2) in the throttle body 28, but also actuates the accelerator jets through cam linkage 38 and rod 39. This action sends a metered amount of fresh fuel to the carburetor. By the present arrangement, at least a part of this fuel in liquid form, and before it is

mixed with air, is supplied to conduit 32. By so directing part of the accelerator jet fuel supply, it is possible not only to supply the needed burst of fuel to the engine, but at the same time to wash throttle element 36, spring 49, and the valve seats of valve 30.

For a full understanding of why the present invention is needed to prevent blocking of the blow-by return line, reference is now made to the detailed construction of the back-pressure control valve 30, as best seen in FIGS. 2 and 3. As there indicated, body 43 of valve 30 includes three axially aligned bores identified as 44, 45, and 46. It will be noted that bore 44 is smaller than 45, and in turn bore 45 is smaller than 46. The bottom of bores 45 and 46, respectively, forms shoulders or seats 47 and 48 against which movable element 36 may seat and unseat by action of the pressure differential between bores 44 and 46 and spring 49.

It will be further noted that movable element 36 includes four wing segments 50 that seat on shoulder 48 and in turn form a seat for one end of spring 49. When seated, as shown in FIG. 2, gas flows through element 36 by way of the spaces formed between wing sections 50 and transverse bore 52 and needle 54 in tapered end 55 of element 36. In the position of FIG. 2, valve element 36 seats against shoulder 47 by the combined force of vacuum in throttle body 28, due to the closing of throttle plate 25, and the pressure differential between line 22 and throttle body 28. When the intake manifold vacuum is reduced, valve element 36 moves toward the right by the action of spring 49. In its extreme position, wing sections 50 can rest against the end of fitting 60.

Other obvious arrangements to supply fresh liquid gasoline to wash intermittently the reciprocating elements of the control valve in the blow-by return line include a pump electrically actuated by the ignition key or mechanically actuated by application of the emergency brake. Other electrical, hydraulic, or mechanical means may be effectively used to spray gasoline onto the valve in the blow-by return line between the crankcase and the fuel-air intake system of the engine to forestall blocking of the control valve.

As mentioned before, it may be found desirable to use an engine fuel which contains an effective amount of detergent or solvent material when using the apparatus of the present invention. Such an additive will assure continued operation even under heavy blow-by conditions, such as prolonged idling of the engine while hot.

While various modifications and changes in our apparatus to prevent blocking of the movable elements in a crankcase recirculation control valve in a blow-by return line will occur to those skilled in the art, all such modifications and changes comprehended by the claims are intended to be included therein.

This application is a continuation in part of our application Serial No. 67,639, filed November 7, 1960 and now abandoned.

We claim:

1. Apparatus for assuring continued operation of a pressure-responsive check valve all of whose reciprocating elements are directly in the flow path of a blow-by return line that connects a crankcase breather pipe to the intake system of an internal-combustion spark-ignition engine which comprises means for spraying liquid gasoline directly on said reciprocating elements of said control valve, said spray means including a spray jet in said return line and conduit means connecting said spray jet to a supply of liquid gasoline, and means for at least intermittently injecting liquid gasoline into said conduit, said injecting means being operative independently of the vapor flow rate through said return line whereby said reciprocating elements of said valve are washed to remove oil and carbon deposits therefrom that would inactivate said check valve.

2. Apparatus for washing the reciprocating elements

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of a flow-responsive check valve with liquid gasoline to keep said valve operating in a blow-by return line that connects a crankcase breather pipe to the intake system of an internal-combustion spark-ignition engine which comprises means for injecting liquid gasoline directly into said return line at a position to spray directly onto said reciprocating elements of said control valve, said injecting means including a spray jet in said return line and conduit means connecting said spray jet to a supply of liquid gasoline, and means for at least intermittently applying pressure to liquid gasoline in said conduit to spray said gasoline independently of the flow rate of vapors in said return line whereby said reciprocating

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parts of said valve are washed to remove oil and carbon deposits therefrom that would inactivate said control valve.

3. Apparatus in accordance with claim 2 in which said pressure-applying means is operative with the accelerator jets of the carburetor for said spark-ignition engine.

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