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CRANKCASE VENTILATION SYSTEM CONTROL DEVICE

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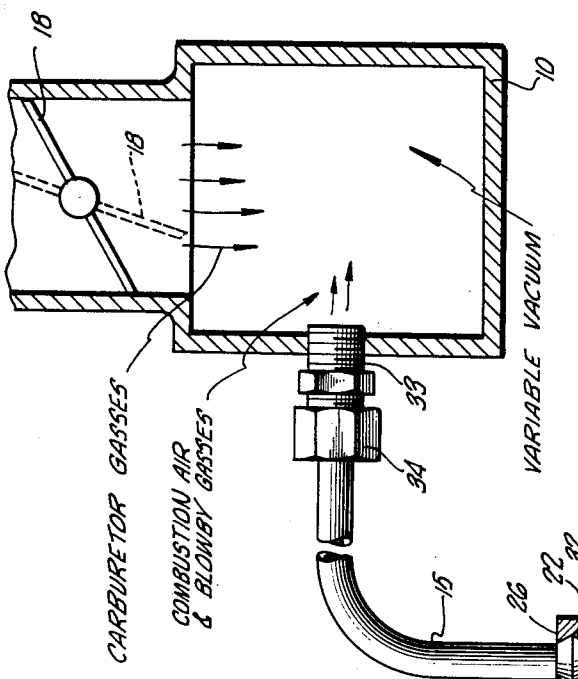


FIG. 1

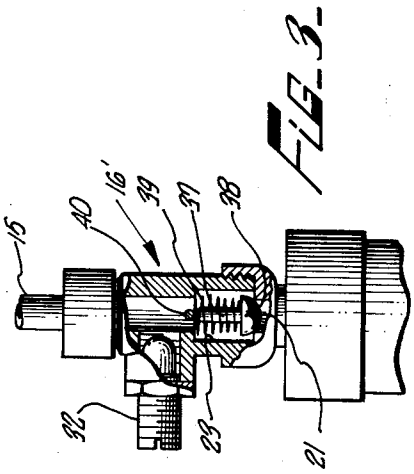


FIG. 3

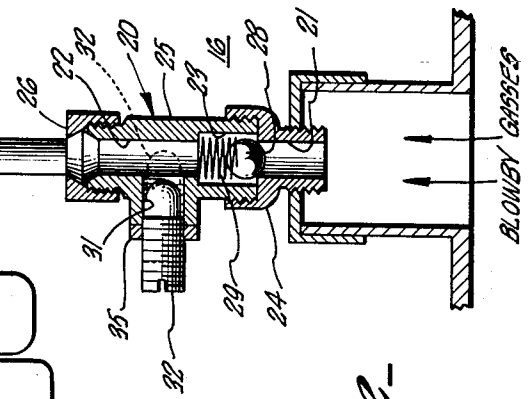
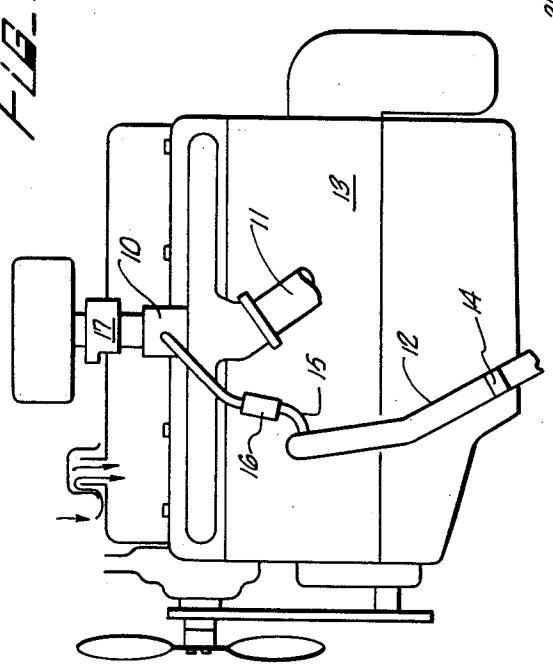


FIG. 2



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CRANKCASE VENTILATION SYSTEM CONTROL DEVICE

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This invention relates to a crankcase ventilation system control device and, more particularly, to an improved blowby gas recirculation control arrangement.

In the operation of an internal combustion engine the unburned gasoline mixture is known to blow past the piston rings into the crankcase of the vehicle. These crankcase fumes then have been commonly known as blowby gases. The existence of these blowby gases in the crankcase has been known for quite a number of years. The blowby gases have been conventionally released or emitted into the atmosphere through an outlet vent or through the oil filler cap. The material blowing by the piston rings into the crankcase generally contains moisture derived from the atmospheric humidity as well as the product of combustion in the engine cylinders leading to condensation. This water condensate would mix with the oil in the crankcase to form a water-oil sludge emulsion. To eliminate the water emulsion sludge, early models of the internal combustion engines used various types of crankcase ventilating systems. The objectives of these early systems was to draw sufficient air through the crankcase to scavenge out the blowby material, thereby reducing or preventing water condensation from occurring. Various other techniques have been employed during the intervening years. Presently, however, the blowby gases or crankcase fumes are still vented or emitted into the atmosphere, particularly on an automobile.

With the ever-increasing amount of pollutants being emitted into the atmosphere and particularly the pollutants that lead to the formation of "smog," the source of "smog" generating pollutants have been carefully studied. As a consequence of these studies, it has become known that the crankcase emissions due to the operation of internal combustion engines is the source of a portion of the hydrocarbons emitted into the atmosphere that lead to the formation of "smog." Consequently, even though the volume of the crankcase emission is low when compared to the quantity emitted from the exhaust line of an engine, the blowby gases or crankcase fumes have been found to be rich in the material that forms "smog." In one specific geographical area it has been determined that the hydrocarbons leading to the production of "smog" that are present in the crankcase fumes or blowby gases are approximately 16 to 22 percent of the amount of these hydrocarbons derived from exhaust fumes of an engine. As a result of these findings and studies, it has become very important to provide a means for handling of the crankcase emissions leading to a reduction in the formation of "smog." An inexpensive arrangement for modifying motor vehicles to reduce the amount of blowby gases emitted into the atmosphere that is presently in use includes a recirculation arrangement whereby the crankcase fumes or gases are recirculated from the crankcase back through either the intake manifold or the air cleaner or the like for re-entry into the cylinder to be re-used or ignited again. These recirculation systems have included control devices that are responsive to the vacuum condition created through the operation of the engine to control the flow of the blowby gases in the recirculation loop in accordance with the induction control afforded by the vacuum.

Since the crankcase fumes or blowby gases are gases

that are accumulated in the crankcase as a result of their passage between the cylinder walls and the piston rings, the amount of these gases that are accumulated will depend not only upon the degree of combustion in the cylinder but also upon the wear and/or clearance of the piston rings and piston with the walls of the cylinders. Therefore, the amount of crankcase fumes that are accumulated will vary from internal combustion engine to internal combustion engine and in any one engine will vary over the life of the engine in accordance with the change of the variables that lead to the formation and accumulation of these gases in the crankcase.

The present invention provides an improved, simple, and inexpensive blowby gas or crankcase fume control device for use in combination with a recirculating crankcase ventilating system that includes means for the adjustment of the quantity of blowby gases that are recirculated in accordance with the particular operating characteristics of the engine. The simplicity of the invention lends itself to ease of manufacture in large quantities such as through the use of a screw machine. When the invention is incorporated in an internal combustion engine of the type presently employed in a motor vehicle, for example, it has been found that a reduction in the crankcase pressure results along with increased gasoline mileage and increased power available from the engine. In addition, the blowby gas control system of the present invention has been found to afford a more effective control of the blowby gases to thereby reduce the formation of "smog" due to these gases.

Structurally, the invention is applied to a conventional internal combustion engine having a crankcase and an intake manifold interconnected with conduit means wherein the conduit means functions as the sole outlet or vent for the crankcase fumes and whereby they may be recirculated back into the combustion chambers of the engine by means of the intake manifold. The conduit means further includes a control or check valve that is normally arranged to seal off the flow of the crankcase fumes into the intake manifold and which control valve includes a control member that is responsive to the vacuum conditions of the intake manifold to open and pass the crankcase fumes to the intake manifold in accordance with the vacuum conditions created therein. The control apparatus further includes means for adjusting the annular area available for the flow of the crankcase fumes through at least a portion of the conduit means to allow for the variations of the amount of blowby gases accumulated in the crankcase in accordance with the individual amounts of said gases accumulated in the crankcase.

These and other features of the present invention may be more fully appreciated when considered in the light of the following specification and drawings, in which:

FIGURE 1 is a diagrammatic representation of a conventional internal combustion engine modified with a recirculation blowby system embodying the present invention;

FIGURE 2 is a cross-sectional view, with portions shown in elevation, of the blowby gas control apparatus of the invention in a typical installation of the type shown in FIG. 1; and

FIGURE 3 is a partial cross-sectional view, with portions shown in elevation, of a modified control valve for use in the invention.

Now referring to FIG. 1 the organization of a conventional internal combustion engine for the purposes of explaining the invention will be examined. The usual internal combustion engine includes an intake manifold **10** to deliver the fuel-air mixture to the engine combustion chamber and an exhaust pipe **11** to accumulate and emit into the atmosphere the products of combustion and partially unburned gases passed by the exhaust valves

from the combustion chamber. In addition, the crankcase is usually provided with a vent tube similar to the tube 12 connected to the crankcase 13 at a point thereon to allow the crankcase fumes or blowby gases to escape into the atmosphere. The fuel is supplied to the intake manifold 10 for mixture with the air through the provisions of a carburetor 17. It will be recognized that in the normal crankcase ventilation system that the fresh air or atmospheric air may enter through the oil filler cap which includes provisions for the admission of air to ventilate the crankcase and carry and expel the crankcase fumes through the tube 12. For the purposes of this invention, the tube 12 may be closed off as represented by the closure element 14 arranged in the tube 12, or alternatively, the tube 12 may be removed in its entirety provided there is more than one vent and they are not all closed. The recirculation system of the invention includes a conduit means or tubing 15 interconnected with the usual vent tube 12 or directly with the crankcase 13 and with the intake manifold 10. The conduit means 15 includes a control valve 16 for controlling the flow of the crankcase fumes or blowby gases from the crankcase 13 into the intake manifold 10.

The arrangement of the conduit 15 and the control valve 16 is best seen from a detailed examination of FIG. 2. The intake manifold 10 is shown as it is normally arranged to receive the air to be mixed with the gas delivered by the carburetor 17 for passage into the combustion chamber under the control of a throttle 18. The gas-air mixture flowing into the engine cylinder includes the recirculated blowby gases induced into the intake manifold in accordance with the position of the throttle 18, shown in the closed position. It will be recognized that with the throttle 18 arranged in the closed position, the pressure in the intake manifold 10 can be far below atmospheric pressure, while the pressure at the end of the exhaust stroke of the engine is always close to atmospheric. For the purposes of this invention it need merely be noted that the positions of the throttle 18 along with the positions of the intake valve (not shown) is effective to control the pressure or vacuum condition of the intake manifold 10 and thereby the passage of the combination of the combustion air and blowby to be delivered to the combustion chamber of the engine.

The control valve 16 includes a main body portion 20 having an axial gas passage including an inlet passage 21 and an outlet passage 22 with an enlarged passageway 23 defined intermediate its ends. The body portion 20, as shown, comprises a central annular section 25 defining the outlet passage 22 and enlarged passage 23 and has externally threaded end portions for cooperating with a yoke-like element 24. The element 24 defines the inlet passage 21 communicating with the passage 23 through the provision of an open end to receive an end of the central body portion 25 therein. The open end of the element 24 is internally threaded to be connected with the threaded end of the central body portion 25 and which element has its opposite end externally threaded to be connected to the tube 12 or directly to the crankcase 13, whichever is more convenient. The opposite end section of the body portion 25 is connected with a U-shaped, internally threaded locking member 26 that is threaded to the opposite end section of the central body portion 25 and is further adapted to receive and secure an end of the tubular element 15. The enlarged passageway 23 forms a shoulder at opposite ends of the passageway and the gas inlet to said passageway is adapted to seat a valve control member, shown as a ball 28, to seal off the gas inlet passageway 21. The control member or ball 28 is urged into sealing engagement with the inlet passage 21 and, more particularly, the shoulder defined thereat, through the provision of a yieldable means shown as a compression spring 29 seated between the ball 28 and the shoulder defined at the opposite end of the passageway 23 to normally maintain the control member closed and

thereby prevent the passage of the blowby gases into the intake manifold 10.

The control valve 16 is further defined with a transverse passageway 31 communicating with the outlet passage 22. The transverse passageway is shown as being internally threaded and receiving an adjustable capacity control element 32. The capacity control element 32 is shown as an externally threaded member which may be threaded in and out of the passageway 31 and, more particularly, into the outlet passage 22 of the control valve to vary the annular area available therethrough for the flow of the crankcase fumes into the conduit means 15. The control element 32 may be secured in any desired position through the provision of a locking element shown as a lock nut 35 fastened thereto. The opposite end of the conduit means 15 is connected to the intake manifold 10 by means of a nipple 33 provided for the intake manifold 10. The nipple 33 is threaded into the wall of the intake manifold 10 and is adapted to receive in a telescoping relationship the end of the conduit means 15 and be securely connected thereto by a nut 34.

It will be recognized by those skilled in the art that the operation of the control valve 16 is dependent upon the vacuum condition of the intake manifold 10 as mentioned hereinabove. When the engine is accelerated it normally demands a rich mixture and, as the throttle is opened, the mixture can be made leaner in relation to the motor speed or revolutions per minute. The operation of the control valve 16 is consistent with these requirements due to the vacuum responsiveness of the control member 28. With no vacuum in the manifold 10 the control valve 16 is closed and assumes a position as shown in FIG. 2. More specifically, the ball 28 seals off the inlet passage 21 and maintains the passage sealed off as a result of the force exerted thereon by the compression spring 29. Under these conditions, then, the crankcase fumes or blowby gases accumulate in the crankcase and are not recirculated into the intake manifold 10 or vented into the atmosphere. The operation of the control member 28 of the control valve 16 is essentially the same as a check valve and is dependent upon the differential in pressures between the intake manifold 10 and the pressure existing in the crankcase 13. Accordingly, when a sufficient amount of vacuum is present in the intake manifold 10, the blowby bases exert more pressure against the control member 28 than the spring 29 forcing it to open to a position in accordance with this differential in pressures. As the vacuum increases, of course, the opening of the control member 28 increases and, as the vacuum decreases with the increased opening of the throttle 18, the control member 28 once again is urged into a sealing position by the spring 29.

An important aspect of the present invention is the provision of the individual control of the amount of blowby gases that are recirculated into the intake manifold. It will be recalled that the amount of blowby gases that accumulate in the crankcase vary from engine to engine and from time to time with any particular engine. Although the use of a control valve of the type represented by the valve 16 affords satisfactory operation, it has been found that improved control of the blowby gases as well as savings in fuel and increased power results when the amount of these gases that are recirculated can be controlled in accordance with the individual characteristics of the engine. To this end, the capacity element or valve 32 may be moved into the outlet passage 22 in predetermined increments to control the amount of blowby gases that are recirculated back into the intake manifold 10 in combination with the control member 28. The capacity control member 32, therefore, is effective to control the annular area in the outlet passageway 22 that is available for the passage of the blowby gases.

It should be recognized that although the capacity control element 32 has been shown and described in combination with the control valve 16 that the function thereof

may also be provided through the provision of a similar capacity control element for the conduit **15**, that is, the capacity control element may be mounted with the conduit means **15** to provide the manual adjustment of at least a portion of the conduit means that is available for the flow of the crankcase fumes and, in the same fashion, function in cooperation with the control valve **16** to vary the flow of the gases into the intake manifold **10**.

Now referring to FIG. 3, a modified control valve **16'** that may be employed in a recirculation system will be examined. The control valve **16'** is essentially the same as the control valve previously described except that the control member in this instance includes a plunger **37** mounting a semi-spherical element **38** for sealing the inlet passage **21**. The yieldable means in this instance again comprises a compression spring **39** seated between the control member **38** and the outlet shoulder defined by the enlarged passageway **23**. In addition, the control valve **16'** includes a stop member shown as a pin **40**. The stop member is utilized to control the maximum opening movement of the control member **38** in accordance with predetermined operating conditions of the automobile.

What is claimed is:

In a check valve having a body member defined with inlet and outlet passageways and a control member mounted intermediate the inlet and outlet passageways for controlling the fluid passing through the check valve, the improvement comprising the control member is a ball check valve and a threaded member mounted adjacent the outlet end of the control member including a nose having cylindrical sides terminating in a hemispherical end disposed transverse to the outlet passageway having a shape to mate with the outlet passageway and being manually adjustable to vary the fluid capacity of the outlet passageway and thereby the capacity of the check valve.

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