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PRESSUURE REGULATING DEVICE

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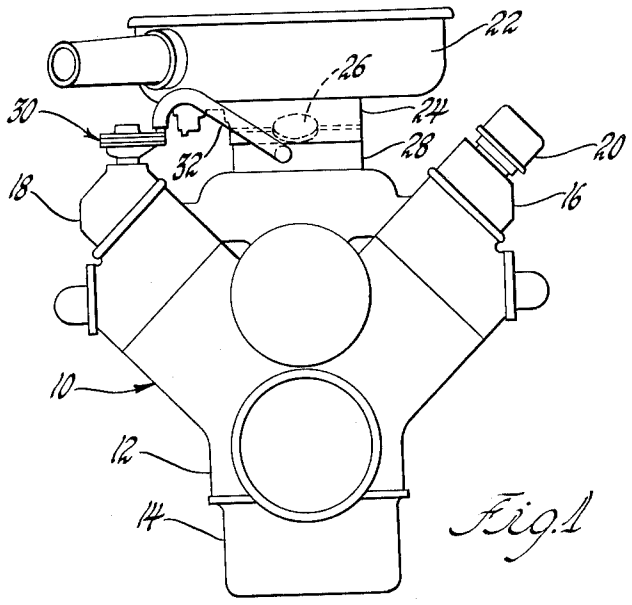

Fig. 1

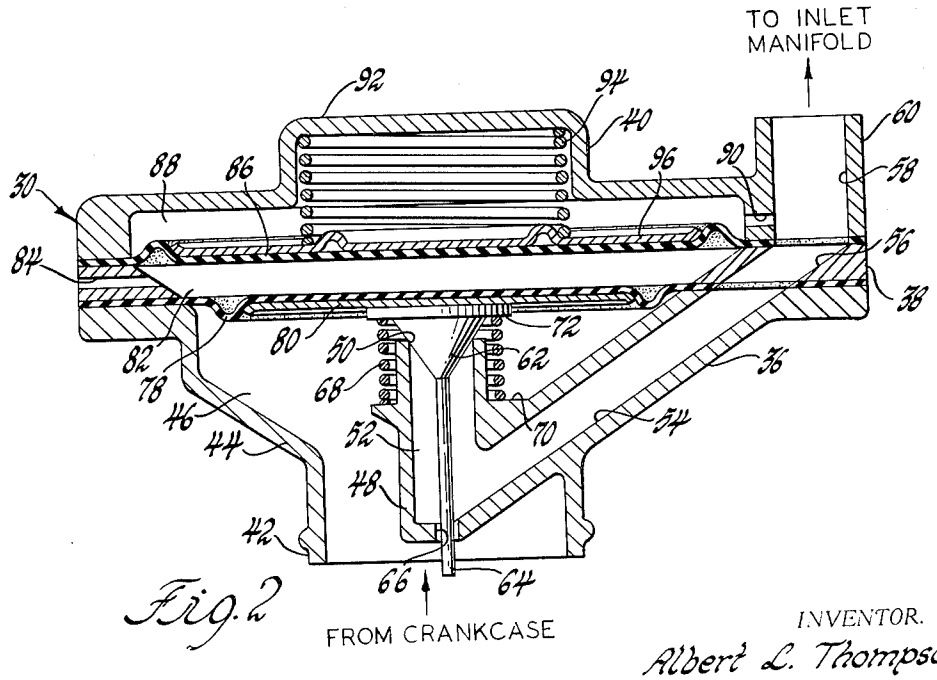

Fig. 2

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PRESSURE REGULATING DEVICE

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This invention relates to pressure regulating devices for internal combustion engines and, more particularly, to pressure regulating devices adapted for connection between the crankcase and the induction system of an internal combustion engine to regulate the flow of crankcase vapors into the induction system.

It is well known in the art to ventilate the crankcase of an internal combustion engine by drawing vapors therefrom into some portion of the engine induction system. Commonly, in systems of this type, means are provided to admit fresh air into the engine crankcase to scavenge the crankcase vapors therefrom. In addition, it is usually desirable to provide some means of regulating the flow of the mixed crankcase vapors and fresh air from the crankcase to the induction system. As in the present invention, this may take the form of a pressure regulating device which senses the crankcase pressure and regulates the flow of vapors therefrom so as to limit the crankcase pressure to a predetermined desired value.

In a common application of such a regulator as disclosed herein, the crankcase vapors are drawn into the engine inlet manifold in which a varying degree of vacuum is present under normal engine operating conditions due to the restriction of the throttle valve located upstream of the inlet manifold. In such an application, the pressure regulating device is normally constructed to maintain a slight vacuum in the crankcase and is commonly referred to as a crankcase depression regulator.

The present invention relates primarily to crankcase depression regulators which include valve means biased toward the open position. In the embodiment shown herein, the valve means is spring biased and diaphragm means, responsive primarily to crankcase vacuum, are urged by atmospheric pressure against the valve means moving the valve means toward the closed position and regulating the flow of crankcase vapors through the crankcase depression regulator.

When using this type of regulator in an automotive engine, starting of the engine is made difficult by the fact that the valve means is normally open when the engine is stopped. As a result, a large flow of crankcase vapors is drawn into the intake manifold during starting which tends to dilute the combustible mixture supplied by the carburetor. In order to overcome this problem, the present invention provides overriding means to close the valve means when the engine is stopped and during engine starting when intake manifold vacuum is relatively low. These means take the form of an overriding spring combined with a restraining diaphragm. When the engine is stopped, the overriding spring forces the valve means closed. However, after starting of the engine, a sufficient buildup of manifold vacuum actuates the auxiliary diaphragm forcing the overriding spring to an inoperative position, thus allowing the regulating diaphragm and valve means to operate in the normal manner.

A feature of this invention is that it provides a crankcase pressure regulator including valve means biased in the opening direction and having overriding means for closing the valve means when the engine is stopped and during engine starting.

A further feature is that restraining means are provided for holding the overriding means in an inoperative position during normal engine operation.

Yet another feature of the invention is that the overriding means comprise a coil spring within the regulator and movable into operative engagement with the valve means.

Still another feature is that the restraining means include a diaphragm actuated by atmospheric pressure in response to the presence of sufficient vacuum in the induction system.

These and other novel features of the invention will be more apparent from the following specification and drawings in which:

FIGURE 1 is an elevational view of an internal combustion engine including a pressure regulator according to the invention; and

FIGURE 2 is a cross-sectional view of the pressure regulator shown in FIGURE 1.

Referring now to the drawings, numeral **10** generally indicates an internal combustion engine including a crankcase **12** which is closed by the usual oil pan **14** and communicates internally with rocker compartments closed by rocker covers **16** and **18**. An oil filler cap **20** is provided on rocker cover **16** and may include air filtration media and an orifice through which a limited supply of ventilating air may be drawn into the engine crankcase. Engine **10** further includes an induction system comprising an air cleaner silencer **22** mounted upon the usual carburetor **24** having a throttle valve **26**. Carburetor **24** is in turn carried by an inlet manifold **28** which distributes the combustible charge from the carburetor to the engine cylinders, not shown.

A crankcase ventilation system is provided for the engine including a pressure regulator generally indicated by numeral **30**. This regulator is mounted on rocker cover **18** and connects with the interior thereof to draw crankcase vapors through the rocker compartment from the engine crankcase. A connecting tube **32** is provided connecting the pressure regulator to the inlet manifold **28** through which the crankcase vapors are drawn from the pressure regulator into the engine cylinders.

The construction of pressure regulator **30** is shown in FIGURE 2 to comprise a housing formed of a main body portion **36**, an intermediate portion **38** and a cover portion **40**.

Main body portion **36** includes an enlarged inlet portion **42** which is adapted to be received in a mounting device, not shown, forming a part of rocker cover **18**. Extending upwardly from inlet portion **42**, wall members **44** enclose a lower chamber **46** which communicates at all times with the engine crankcase. Centrally disposed within chamber **46** is a tubular means **48** terminating at its upper end in a valve seat **50** and including an internal passage **52** which connects with outlet passages **54**, **56** and **58** extending through the main body, intermediate and cover portions, respectively. Passage **58** terminates within outlet connection means **60** provided in the cover portion for connection with tube **32**.

Communication between chamber **46** and passage **52** is controlled by a frusto-conical valve member **62** which seats against valve seat **50** and includes a stem portion **64** extending downwardly through a guide opening **66** in the lower wall surrounding passage **54**. A coil spring **68** extends between a spring seat **70** provided on tubular means **48** and an annular flange **72** around the top of valve **62** to bias the valve toward its open position.

In order to provide for regulating action of the valve, a flexible diaphragm **78** is mounted between body portion **36** and intermediate portion **38** closing the upper portion of chamber **46**. Diaphragm **78** operatively engages valve **62** through a large disc member **80** located therebetween. Diaphragm **78** and intermediate portion **38** partially define an intermediate chamber **82** which is open to atmospheric pressure through an orifice **84** provided in an outer wall of portion **38**.

Cover portion **40** and intermediate portion **38** retain therebetween a second flexible diaphragm which closes the upper side of chamber **82** and defines with cover **40** an upper chamber **88**. Chamber **88** connects with outlet passage **58** through an orifice **90** and is thereby always in communication with inlet manifold vacuum. Within chamber **88** and seated in an extending portion of cover **40** is a relatively heavy coil spring **94** which actuates diaphragm **86** through an intermediate disc member **96**.

The operation of the above described regulator is as follows. With the engine operating normally, manifold vacuum in chamber **88** allows atmospheric pressure in chamber **82** to force diaphragm **86** upwardly compressing spring **94** to an inoperative position such as that shown in FIGURE 2. The normal leakage of blow-by gases into the engine crankcase tends to increase the crankcase pressure in chamber **46** allowing spring **68** to force valve **72** upwardly against the force of atmospheric pressure exerted downwardly on diaphragm **78**. When valve **62** is open, manifold vacuum draws crankcase vapors from chamber **46** past valve seat **50** and through passages **52**, **54**, **56**, **58** and connecting tube **32** into the inlet manifold **28**. As this flow tends to exceed the volume of blow-by gases drawn into the crankcase and the volume of fresh air drawn into the crankcase through filler cap **20**, the crankcase pressure is reduced, allowing atmospheric pressure on diaphragm **78** to move valve **62** toward the closed position. In this manner the flow is restricted, causing a balance between flow into and out of the engine crankcase and maintaining crankcase vacuum at a predetermined value.

When the engine is stopped, all chambers of the regulator return to atmospheric pressure, balancing pressures on the diaphragms. Spring **94** is thereby released from its compressed position and is allowed to force diaphragm **86** downwardly into engagement with diaphragm **78** and, since it is stronger than spring **68**, it forces valve **62** into its closed position. When the engine is being started, the manifold vacuum is generally insufficient to lift diaphragm **86** against the force of spring **94** and, therefore, valve **62** remains in the closed position, preventing any excessive passage of crankcase vapors into the inlet manifold and consequent dilution of the fuel charge. Should engine starting vacuum be excessive in a particular application, the action of manifold vacuum on diaphragm **86** may be delayed by controlling the size of orifice **90** so that the bleed down of pressure in chamber **88** is delayed past the time when engine starting normally occurs and thus the regulating valve **62** will remain closed during starting even though manifold vacuum builds up almost immediately.

After the engine is started, of course, chamber **88** reaches normal manifold vacuum and diaphragm **86** is forced upwardly compressing spring **94** to its operative position. As before mentioned, this allows normal regulating action of valve **62** to occur in response to pressures acting on diaphragm **78**.

It should be understood that numerous changes might be made in the embodiment of the invention described within the scope of the instant invention which is intended to be limited only by the language of the following claims.

I claim:

1. For use in a crankcase ventilation system of an internal combustion engine of the type having a crankcase and an induction system:

valve means normally operable to regulate the flow of crankcase vapors from the crankcase to the induction system;

and supplementary means responsive to pressures in the engine induction system to close the valve means during engine starting and to permit said flow regulation during normal engine operation.

2. For use in a crankcase ventilation system of an internal combustion engine of the type having a crankcase and an induction system:

valve means biased in an opening direction and normally operable to regulate the flow of crankcase vapors from the crankcase to the induction system;

actuating means operatively connected with the valve means and responsive primarily to crankcase pressure to accomplish said flow regulation by movement of the valve means;

and supplementary means responsive to pressures in the engine induction system to close the valve means during engine starting and to permit flow regulation during normal engine operation.

3. The device of claim **2** wherein said supplementary means includes overriding means operable to actuate the valve means in the closed position against the opening bias and restraining means operatively connected with the overriding means and responsive to pressures in the engine induction system to restrain the overriding means from acting against and closing the valve means during normal engine operation.

4. A crankcase pressure regulator for use in connection with an engine including a crankcase and an induction system and adapted to be connected therebetween to regulate the flow of crankcase vapors from the crankcase to the induction system, said regulator comprising:

a housing having inlet and outlet means connectible with the crankcase and the induction system, respectively;

valve means in the housing and adapted to control the flow of fluids from the inlet to the outlet;

biasing means urging the valve means toward the open position;

actuating means engageable with the valve means to control the position of the valve means primarily in response to crankcase pressure;

supplementary biasing means operative to close the valve against the first mentioned biasing means; and

supplementary actuating means operatively engaging the supplementary biasing means and responsive to induction system vacuum to prevent the supplementary biasing means from closing the valve means whenever induction system vacuum is greater than a predetermined value;

whereby crankcase vapor flow regulation is permitted during normal engine operation while such flow is substantially cut off under engine starting conditions.

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