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CRANKCASE EVACUATION SYSTEM

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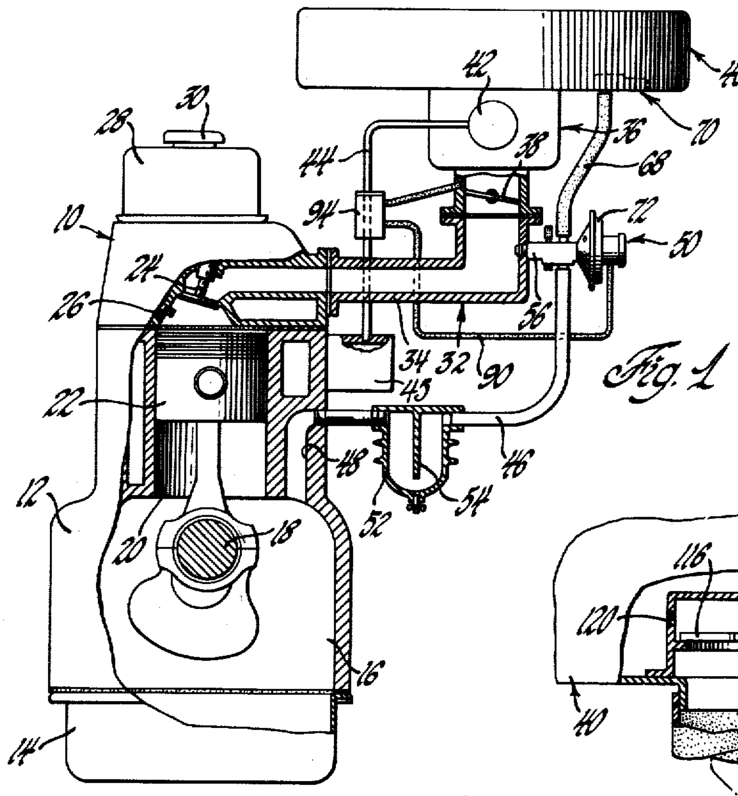

Fig. 1

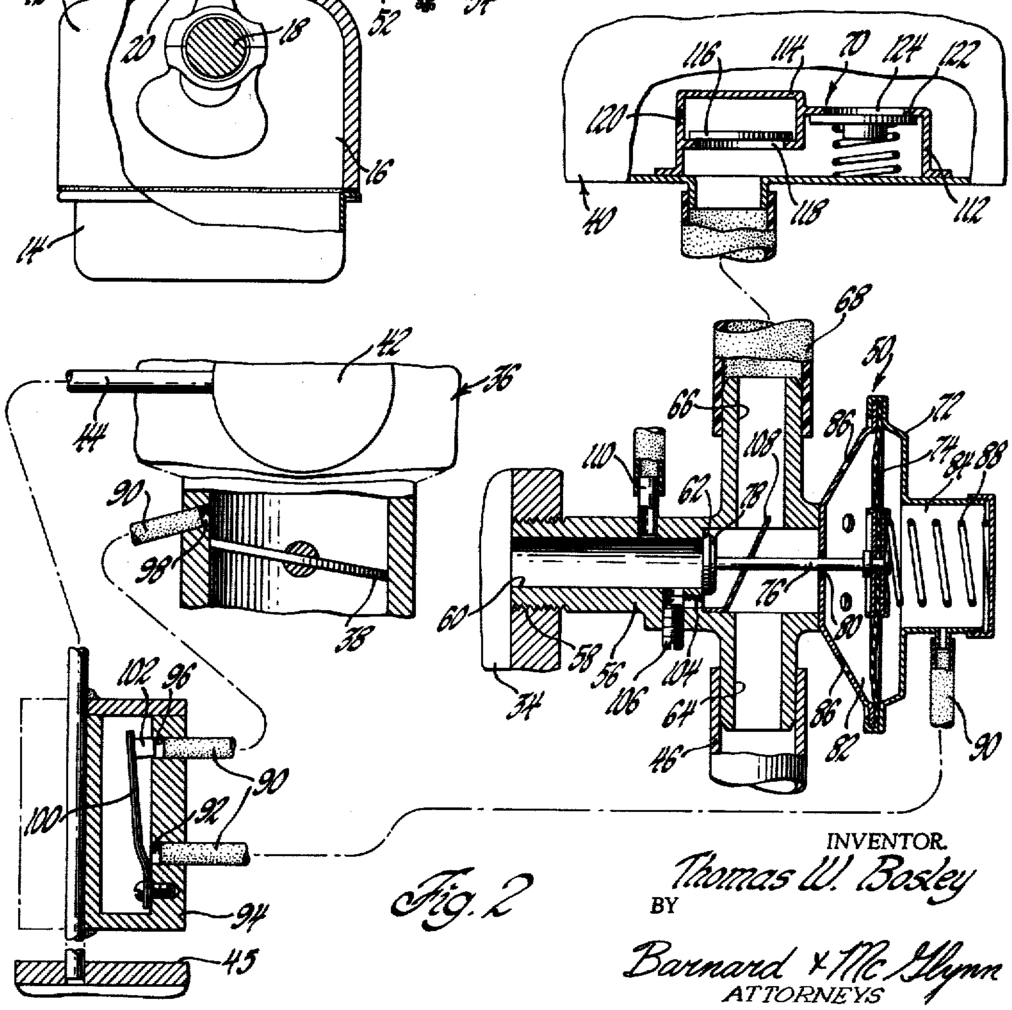

Fig. 2

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CRANKCASE EVACUATION SYSTEM

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This invention pertains to a crankcase evacuation system for an internal combustion engine and, in particular, to such a system for controlling and substantially reducing air pollution caused by crankcase emission, reducing oil consumption in the engine, and removing byproducts of combustion, such as water, corrosive acids and the like, which otherwise tend to dilute the lubricating oil in the crankcase resulting in sludge deposits which ultimately cause sticking piston rings, valves, valve lifters and extensive engine corrosion.

During the operation of an internal combustion engine of the reciprocable piston and cylinder type conventionally employed on automotive vehicles, a combustible mixture of air and hydrocarbon fuel is burned in the combustion chambers of the engine to perform work on the pistons reciprocating therein. This combustion process produces a vaporous mixture of unburned hydrocarbons or fuel, water, oil, corrosive acids and the like, some of which vaporous mixture blows by the piston rings and valve stem seals of the engine and are consequently termed blow-by gases or vapors. In one typical ventilated engine construction in use today, part of the aforementioned blow-by gases or vapors enters the air stream which is circulated through the crankcase by the ventilation system, resulting in oxidation when the cool air comes into contact with the warm oil vapors which is a primary source of sludge in the engine. Furthermore, part of the blow-by vapors or gases will condense as it travels down to the cooler area of the oil pan. The products of such oxidation and condensation eventually drain into the lubricating oil and are commonly called a crankcase dilution or emulsion which, as is well known, is undesirable.

During certain engine operating conditions such as at high speeds or at engine overrun with the throttle valve closed, manifold vacuum will cause some of the blow-by vapors to be drawn up through the intake and exhaust valve stem seals and ports and to be carried into the firing chambers of the engine and out of the engine exhaust system producing unpleasant odors and smog. In colder weather, lower ambient air temperatures reduce the ability of the crankcase ventilation system to remove water vapor and partly burnt fuel from the crankcase, thereby resulting in excessive oil consumption and frequent oil and filter cartridge changes are necessary. Thus, a high rate of crankcase emission, air pollution and objectionable odors will occur.

To combat conditions such as those aforementioned, one practice has been to provide a vent tube type crankcase ventilation system including the well known road draft or vent tube communicataing with the crankcase and atmosphere and so located that the forward motion of the vehicle over approximately 20 miles per hour would cause a partial vacuum in the crankcase and draw through atmospheric air to remove blow-by gases from the crank case. However, under normal road loads and speed, the incoming atmospheric ventilating air carries with it moisture, abrasive dusts, salts and other contaminants into and through the engine and, in the final analysis, such air and the blow-by gases picked up thereby are directed out of the crankcase to the atmosphere through the aforementioned vent or road draft tube. Furthermore, at idle speeds, the blow-by gases within the crankcase will escape through the oil breather cap while at

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full throttle a pressure within the crankcase will force blow-by and oil vapors through all openings in the crankcase causing bad odors, smog and an increase in oil consumption.

To combat these difficulties and particularly the smog condition, another practice has been to provide a positive crankcase ventilation system which provides fresh atmospheric air to circulate through the crankcase in a manner similar to the vent tube type system aforedescribed. However, instead of the ventilating air being discharge to atmosphere, it is returned to the intake manifold by means of a conduit connecting the engine crank case to the intake manifold through a regulator or control valve which regulates the amount of air flow therethrough to meet changing operating conditions in the engine. Such a positive crankcase ventilation system has been found to give good results when used on a new engine because each such positive system is carefully engineered for each engine design and with particular regard to carburetion and manifold conditions thereof. Unfortunately, well over fifty percent of the vehicles in use on the roads today are at least fours years old and, because of excessive wear on piston rings, valve stem seals and the like, these older models have a particular blow-by problem wherein the positive crankcase type of ventilation system aforementioned is incapable of handling the added blow-by emission. In fact, it may be said that a given positive crankcase ventilation system installed on a new car will, after the car ages three or four years, be only about fifty percent as effective as when new in reducing smog due to crankcase emission. Furthermore, even on a new car which is generally operated at turnpike speeds, the regulator or control valve requires constant cleaning to remove sludge.

In such positive crankcase ventilation systems used in conjunction with an air tight or sealed crankcase system, the regulator or control valve maintains a partial vacuum on the crankcase at idle and road loads. However, under certain engine operating conditions such as during deceleration or preparing to idle, the blow-by gases being drawn into the intake manifold dilute and prevent the build-up of a sufficient vacuum or pressure differential to close the regulating valve causing carburetion difficulties such as misfiring and sometimes stalling. At full throttle, the blow-by flow rate often exceeds the capacity of the positive ventilation system resulting in a high pressure build-up in the crankcase. This pressure may force the lubricating oil and blow-by gases out through the main bearing seals, gaskets, dipstick tube, backflow outlet and all other points of escape to the atmosphere resulting in excessive air pollution and high oil consumption. Furthermore, due to the high crankcase pressure aforementioned, some oil and water vapor may collect in the regulating valve and conduit associated therewith which are exposed to ambient temperature resulting in condensation thereof to form a sludge and varnish. This sludge and varnish results in sticking of the regulating or control valve and its cooperating valve seat, and sticking of the exposed return spring thereof. Consequently, the valve must be cleaned or replaced constantly.

It is, therefore, a principal object and feature of this invention to provide an improved crankcase evacuation system which solves these and other problems in the prior art.

It is yet another object and feature of this invention to provide a crankcase evacuating system operable in conjunction with a substantially air tight or sealed crankcase of an internal combustion engine to effectively remove blow-by gases therefrom and supply them through the intake manifold means of the engine for reburning within the combustion chambers thereof, thereby controlling and substantially reducing smog-producing crankcase emission while avoiding the necessity of supplying fresh ambient air to the crankcase to substantially eliminate the sludge forming oxidation action thereof.

It is yet another object and feature of this invention to provide a crankcase evacuating system for an internal combustion engine comprising an evacuating conduit means including a control valve therein communicating blow-by vapors within the engine crankcase to the intake manifold means of the engine, the aforementioned control valve having a first position closing communication between the crankcase and the intake manifold means and a second position opening communication therebetween in response to a pressure signal generated anteriorly of the throttle valve located in the intake manifold means, whereby an excessive volume of blow-by gases will not be supplied to the air and fuel mixture within the intake manifold means during cranking or idle operation of the engine so as not to lean out the air-fuel mixture under these conditions.

It is yet another object and feature of this invention to provide a crankcase evacuating system including evacuating conduit means and control valve means as aforementioned further characterized in that the control valve means includes a control spring normally biasing the control valve to its closed position and adapted to be overcome by the aforementioned pressure signal to open the conduit means in response to a predetermined absolute pressure drop or vacuum increase anteriorly of the throttle valve, and wherein said control spring is completely isolated from all blow-by and other vapors passing through the evacuating conduit means to prevent sticking and malfunctioning thereof.

It is yet another object and feature of this invention to provide a crankcase evacuating system of the type aforementioned including an evacuating conduit means and control valve therein further characterized by means, preferably but not necessarily engine temperature responsive, for preventing communication of the inlet manifold means and the control valve means below a predetermined engine temperature.

It is yet another object and feature of this invention to provide a crankcase evacuating system of the type aforementioned including control valve means further characterized by adjustable bypass means for bypassing the control valve means at certain engine operating conditions, such as at idle or during cranking of the engine, to impose under such conditions a predetermined minimum vacuum within the crankcase to draw blow-by vapors therefrom to the intake manifold means without pulling an excessive amount which would lean the fuel mixture under such conditions to an undesirable extent.

It is yet another object and feature of this invention to provide, in combination with a crankcase evacuating system of the type aforementioned, an idle bypass and crankcase pressure control valve means communicating the evacuating conduit means with atmosphere, preferably through the air cleaner of the engine, said valve means being operable at all engine operating conditions, particularly at idle and cranking engine conditions, to prevent ambient atmospheric air from entering the evacuating conduit means whereby blow-by gases may be evacuated from the crankcase through the bypass conduit means aforementioned to the intake manifold means, and further operable automatically to a position communicating the evacuating conduit means with atmosphere in response to crankcase back pressures in excess of a predetermined maximum.

It is yet another object and feature of this invention to provide an equalizer valve means communicating with the aforementioned evacuating conduit means and atmosphere, again preferably through the engine air cleaner, and which equalizer valve means is normally closed but will open automatically in response to a predetermined maximum amount of vacuum within the crankcase to

supply atmospheric air under pressure through the evacuating conduit means and past the control valve means to the intake manifold means, thereby providing an unthrottled air charge under corresponding load conditions increasing the efficiency of combustion within the combustion cylinders of the engine, preventing the vacuum within the crankcase from exceeding a predetermined maximum to insure the prevention of oil vapor pullover from the crankcase into the evacuating conduit means, diluting hydrocarbons being expelled from the engine exhaust system and giving more evacuation capacity at high speed operation.

It is yet another object and feature of this invention to provide, in an engine crankcase evacuating system including an evacuating conduit means connecting the crankcase to the intake manifold means of the engine, a condensing or settling chamber in the lowest portion of the evacuating conduit means to trap various emission byproducts of combustion and remove same from the blow-by hydrocarbon gases passing through the evacuating conduit means to the intake manifold means of the engine.

These and other objects, features and advantages of the invention will appear more fully hereinafter as the description of the invention proceeds, and in which reference is made to the drawing in which:

FIGURE 1 is a view, partially fragmentary and schematic, illustrating a preferred embodiment of the invention as mounted on an internal combustion engine; and

FIGURE 2 is a exploded and enlarged view of various components of the system illustrated in FIGURE 1.

Referring now to the drawings, the numeral **10** generally indicates an internal combustion engine of the type typically employed with automobiles and comprising the usual engine block **12** and cooperating oil pan **14** forming a substantially sealed or air tight crankcase **16** in which the crankshaft **18** is mounted in a conventional manner. The engine further includes according to conventional practice a plurality of combustion chambers each of which includes a cylinder **20** in which the piston **22** is reciprocably mounted and suitably connected to the crankshaft, the usual inlet valves **24**, exhaust valves (not shown), spark plugs **26** and the usual cover member **28**, including a substantially sealed oil filler cap **30**, for the valve gearing.

An intake manifold means indicated generally at **32** is provided for supplying an air and fuel charge to the respective combustion chambers of the engine, and comprises the usual intake manifold **34** including a riser on which the carburetor construction indicated generally at **36** and including the throttle valve **38** may be mounted in any conventional manner. An air cleaner assembly is indicated generally at **40** as being mounted above the carburetor construction **36** in communication therewith for supplying a filtered charge of air to the intake manifold means. Furthermore, the numeral **42** schmatically represents a conventional engine temperature responsive automatic choke mechanism connected in the usual manner through the thermally conductive heat conduit **44** to the usual exhaust manifold **45**, whereby the choke is positioned automatically between opened and closed positions in response to engine temperature as will be readily appreciated by those acquainted with this art.

The crankcase evacuation system of the present invention comprises an evacuating conduit means or tube **46** connected between a passage **48** in the engine block **12** communicating with the sealed crankcase **16** and, through the control valve means indicated generally at **50**, to the intake manifold **34** posteriorly of the throttle valve **38**. A condensing or settling chamber **52** including one or more suitably positioned baffle means **54**, by way of example, is interposed in the lowest portion of the evacuating conduit means **46** between the engine block **12** and control valve means **50**. As will appear more fully hereinafter, in response to a vacuum imposed within the sealed crankcase **16** as communicated from the intake manifold **34** through the control valve means **50**, blow-by vapors of unburned hydrocarbons or fuels as well as heavier vaporous emulsion components such as water, corrosive acids and the like flow from the crankcase into the evacuating conduit means **46**. As a result, since the evacuating conduit means and condensing chamber are exposed to ambient temperatures, the heavier vaporous emulsion components condense and settle within the condensing chamber for subsequent complete removal, while the lighter reburnable hydrocarbons still in vaporous form pass on through the evacuating conduit means and to the intake manifold for reburning in a manner to be described. While the condensing chamber **52** has been illustrated in the drawing as including a lower drain valve for draining same, it will be readily apparent that the condensate collected within the chamber can be removed in any suitable manner.

The control valve means **50** comprises a valve body **56** adapted to be suitably connected, as by the threadable connection indicated at **58**, to a wall of the intake manifold **34** posteriorly of the throttle valve **38**. The valve body further includes a first passage **60** terminating in a valve seat **62** communicating with the intake manifold as aforedescribed, a second passage **64** angularly related, as at right angles as shown in FIGURE 2, to the first passage **60** and connected to one end of the evacuating conduit means **46**, and a third passage **66** which may be opposite the second passage **64** and connected through a conduit means **68** to a valve assembly indicated generally at **70** and preferably, although not essentially, located within the air cleaner assembly **40**.

A pressure housing or chamber **72** is provided on the valve body **56** opposite the passage **60**, and has secured therein the periphery of a conventional flexible diaphragm member **74** to which there is secured the stem **76** of a control valve member **78**. The valve stem **76** slidably passes through a suitable sealed joint **80** in the pressure housing or chamber, whereby the flexible diaphragm divides the pressure chamber **72** into a first pressure signal chamber **82** on one side of the diaphragm and a second pressure signal chamber **84** on the other side thereof. A plurality of apertures **86** formed in a wall portion of the pressure chamber communicate ambient atmospheric pressure with the first pressure signal chamber **82**, while the control spring **88** is mounted in the second pressure signal chamber **84** to normally bias the valve member **78** to a closed position on valve seat **62** as illustrated in FIGURE 2; that is, the force of the control spring **88** is suitably selected so as to overcome ambient atmospheric pressure in signal chamber **82** to always bias the valve member **78** to the closed position illustrated. However, the valve member **78** is movable to the right in FIGURE 2 completely off of its seat **62** in response to the imposition of a predetermined low absolute pressure or, otherwise speaking, sufficiently high vacuum within the second pressure signal chamber **84**, whereby ambient atmospheric pressure in the first signal chamber will overcome the control spring.

This predetermined low absolute pressure or predeterminedly high vacuum is adapted to be transmitted to the second signal chamber **84** through pressure signal conduit means **90** communicating with a port **92** in an engine temperature responsive enclosed thermally conductive heat chamber **94**, a second portion or continuation of the pressure signal conduit means **90** being connected between another port **96** in the heat chamber and a port **98** in the intake manifold means **32** anteriorly of the throttle valve **38**. The heat tube **44** previously described and associated with the automatic choke mechanism **42** of the carburetor construction is welded or otherwise secured in thermally conductive relation with an exterior wall portion of the heat chamber **94** whereby heat conducted to the heat chamber controls the operation of a suitable temperature responsive member, such as the conventional bimetallic element indicated at **100**, suitably mounted within the heat chamber and having one end thereof equipped with a valve plug **102** adapted to open or close the port **96**. As a consequence, an absolute pressure or vacuum signal is incapable of being communicated from the port **98** in the intake manifold means **32** to the second pressure signal chamber **84** of the control valve means **50** below any desired predetermined engine temperature. However, after a desired predetermined engine temperature is reached, it will be understood that the temperature responsive bimetallic element **100** will respond to disengage the valve plug **102** from the port **96**, thereby resulting in the pressure signal at the port **98** in the intake manifold means being communicated with the second pressure signal chamber **84** in the control valve means **50**.

The valve body **56** further includes a bypass passage **104** around the control valve seat **62** in the closed position of FIGURE 2. Suitable means such as the adjustable threaded screw **106** is preferably employed to adjust the bipass flow around the control valve seat in its closed position for reasons and in a manner to appear more fully hereinafter. Furthermore, the valve body is provided with a deflector plate **108** suitably apertured to slidably receive the valve stem **76**, and positioned directly in front of the first valve body passage **60** communicating with the intake manifold **34** and relative to the second valve body passage **64** communicating with the sealed crankcase whereby, in the event of a backfire and flame attempting to pass from the intake manifold through the passage **60** to the interior of the valve body **56**, such backfire or flame will be deflected positively away from the valve body passage **64** thereby avoiding the danger of any fire resulting within the crankcase of the engine. Finally, the valve body may also be provided with a connection indicated at **110** communicating with the passage **60** and the intake manifold for driving various manifold vacuum operated accessories on the vehicle.

As previously described, the conduit means **68** communicates the third passage **66** of the control valve body **56** with the valve assembly **70** preferably, although not necessarily, located within the interior of the air cleaner assembly **40**. The valve assembly **70** comprises a body member **112** including a cage **114** confining a crankcase pressure control valve **116** in the form of the well known plate type gravity check valve. In the position illustrated in FIGURE 2 of the drawings, the gravity check valve **116** closes the port **118** in the cage **114** and prevents communication of atmospheric air pressure, in this case through the air cleaner assembly, with the conduit **68**. However, in the event that the valve **116** is shifted off of port **118**, the conduit **68** and evacuating conduit means **46** will be communicated with atmosphere through one or more ports **120** in cage **114**. As will appear hereinafter, the gravity check valve is normally in the position illustrated in FIGURE 2 during idling, cranking and normal loading conditions of the engine, but will operate to its open position to vent the passage means **68** and evacuating conduit means **46** to atmosphere in response to a predetermined absolute pressure or minimum vacuum within the crankcase **16** as will result, for example, from slight back pressures in the crankcase which may occur at full throttle of the engine and high speeds. Naturally, with the valve assembly **70** located interiorly of the air cleaner assembly **40** as preferred and aforementioned, blow by gasses so vented from the conduit **68** and through the valve **116** will be drawn from the air cleaner assembly back into the intake manifold **34** while the engine is operating. Under idling conditions of the engine in which the throttle valve **38** is closed, and as will appear more fully hereinafter, a relatively high absolute pressure or low vacuum anteriorly of the throttle valve **38** in the intake manifold means **32** is insufficient to operate the diaphragm **74** to open the control valve member **78**. Under these circumstances, a predetermined minimum vacuum is drawn within the crankcase through the evacuating conduit means **46** and bypass passage means **104** of the control valve means **50** to insure a predetermined minimum flow of blow-by gases in the system even at idle. Under idling conditions as aforementioned, the gravity check valve **116** prevents the ingress of atmospheric air through the passage **68** to the bypass passage means to prevent dilution or leaning of the idle combustion mixture.

Under certain engine conditions, as for example as the engine is being decelerated and the throttle valve has almost reached its closed position illustrated in the drawings, manifold vacuum will reach a peak value which, unless otherwise compensated for, can result in the imposition of an extremely high manifold vacuum or relatively low absolute pressure in the sealed crankcase **16** which can result in oil vapor pull-over; that is, drawing over into the evacuating conduit means **46** an undesired and inordinate amount of oil vapors which should be retained within the crankcase for lubricating purposes. This condition could be prevented by restricting the blow-by flow capacity of the evacuating system, but this would in turn restrict overall operating efficiency. Hence, in accordance with the preferred way of preventing this condition from occurring, the valve assembly **70** also includes a spring loaded one way equalizer check valve means or plate **122** normally biased by its spring to a closed position over the port **124** in valve body **112** communicating with the interior of the air cleaner assembly **40** as illustrated in FIGURE 2 of the drawing. In the event that engine operating conditions result in a peaking of manifold vacuum as aforedescribed, it will be readily apparent that the control valve member **78** is fully off its seat **62** due to the pressure signal in the conduit means **90**. At this time and under these conditions, the oil vapor pull-over problem aforementioned is presented due to the excessive, relatively speaking, manifold vacuum imposed on the crankcase **16** through the evacuating conduit means **46**. To prevent the absolute pressure in the crankcase from decreasing below a predetermined minimum or, otherwise stated, the manifold vacuum in increasing above a predetermined maximum, the spring biased equalizer valve means **122** is set to open at the desired pressure level to provide an unthrottled charge of fresh ambient air through the conduit means **68** and control valve means **50** into the intake manifold **34** posteriorly of throttle valve **38**. For example, if it is desired to limit the vacuum within the sealed crankcase **16** to a value not to exceed approximately five inches of mercury, the equalizer valve is set to open at this value whereby any tendency of the vacuum to increase therebeyond within the crankcase is compensated for by the equalizer valve opening and a fresh charge of ambient air provided to the manifold. Furthermore, under these conditions, the fresh unthrottled charge of ambient air adds to the efficiency of combustion within the chambers further contributing to the overall economy of the engine, and diluting the hydrocarbons being expelled from the engine exhaust system.

As will now be apparent from the foregoing description, the blow-by and emission vapors contained within the engine crankcase are adapted to be completely evacuated through the evacuating conduit means **46**. As these vapors are so evacuated, the heavier emulsion factors including water, corrosive acids and other harmful constituents impinge upon and within the baffled condensing chamber **52** which is cool, relative to the engine, resulting in condensing of these undesirable emulsion constituents for subsequent removal from the condensing chamber as previously described. Furthermore, in view of the fact that the condensing chamber is located in the low spot or point in the evacuating conduit means **46**, any of these emulsion constituents which may be able to pass by the baffle members or their equivalent will tend to condense posteriorly of the condensing chamber and run back into said chamber. The reburnable lighter fractions or hydrocarbons do not condense but are pulled under vacuum pressure along the evacuating conduit means and pass the open control valve means **50** into the intake manifold means. Thus, under general running conditions of the vehicle engine, blow-by gases and vapors and emulsion constituents are completely evacuated or substantially so from the engine, and the undesirable emulsion constituents permanently separated and removed from the lubricating oil within the system while the reburnable hydrocarbons are returned for reburning within the combustion chambers.

In particular, it will be noted that the pressure signal for opening the control valve means **50** is connected to the intake manifold means anteriorly of the throttle valve **38**. In view of this construction, and the control spring **88**, the control valve member **78** remains closed on its seat as illustrated in FIGURE 2 under cranking and idling conditions of the engine. As a result, the blow-by gases passing into the control valve means are prevented from diluting or leaning the fuel-air mixture under these conditions to prevent upsetting carburetion of the engine and possible stalling thereof. However, the adjustable bypass passage **104** is preset so that under idling conditions there is a sufficient vacuum imposed upon the crankcase **16** to remove blow-by vapors therefrom. Under such idling conditions, for example, the spring loaded equalizer valve means **122** is biased to a closed position, while the gravity check valve construction **116** is closed over the port **108** so as to prevent the entry of additional air into the evacuating system.

However, under certain engine operating conditions as, for example, at full throttle, the control valve means **50** may close due to insufficient vacuum in the intake manifold means being communicated to the second pressure signal chamber **84** thereof or, further by way of example, simply because of there being insufficient vacuum communicating with the passage **60** of the control valve means to draw excess blow-by gases from the crankcase to the intake manifold. As a result, back pressures may be generated within the crankcase which, upon reaching a predetermined maximum in terms of absolute pressures, will cause the gravity check valve **116** to lift off of its seat to discharge excess pressure fluid to the air cleaner assembly **40**. Furthermore, it might be mentioned that the same back pressure conditions might occur at other than full throttle in the example referred to above simply because the engine has not warmed up, thereby preventing signal pressure from communicating through the conduit means **90** to the control valve means **50** to open the latter.

Furthermore, under certain extreme vacuum conditions, the equalizer valve means **122** is operable to open automatically to provide a fresh unthrottled charge of air through the conduit means **68** and the passage **60** in control valve means **50** to the intake manifold. Thus, and as aforedescribed by way of example, during deceleration of the engine in which the throttle valve is gradually closed but has not quite closed, the vacuum adjacent the throttle valve and the port **98** will reach a peak, relatively speaking, which is imposed through the open control valve means **50** and the evacuating conduit means **46** on the sealed crankcase **16**. To further prevent oil vapor pull-over, the spring pressure of the equalizer valve is set to open at some predetermined maximum vacuum or minimum absolute pressure within the sealed crankcase to provide the unthrottled charge of fresh air as aforementioned, and to prevent the vacuum within the crankcase from exceeding such predetermined maximum.

Also, and as will be readily apparent, the engine temperature responsive control means **100** is provided to prevent opening of the control valve means **50** by blocking the pressure signal in the pressure signal conduit means **90** while the engine is cold, thereby preventing too lean a mixture under these cold engine conditions which could otherwise result in misfiring or even stalling of the engine.

Finally, it will be noted that the control spring 88 of control valve means 50 is completely isolated and sealed from the various gases flowable through valve body 56. Hence, such gases are unable to form sticky deposits on the spring thereby contributing to a long, trouble and maintenance free life for the latter.

While but one form of the invention has been shown and described, other forms will now be apparent to those skilled in the art. Therefore, it will be understood that the embodiment shown in the drawing and described above is merely for illustrative purposes, and is not intended to limit the scope of the invention which is defined by the claims which follow.

I claim:

1. A crankcase evacuating system for an internal combustion engine having a crankcase and intake manifold means including a throttle valve, said system comprising evacuating conduit means adapted to connect said crankcase to said intake manifold means posteriorly of said throttle valve, and pressure operated control valve means in said evacuating conduit means controlling the flow of vapor therein from said crankcase to said intake manifold means, said control valve means being movable between a first position closing said evacuating conduit means and a second position opening said evacuating conduit means in response to a predetermined absolute pressure in said intake manifold means anteriorly of said throttle valve.

2. A crankcase evacuating system for an internal combustion engine having a crankcase and intake manifold means including a throttle valve, said system comprising evacuating conduit means adapted to connect said crankcase to said intake manifold means posteriorly of said throttle valve, control valve means in said evacuating conduit means controlling the flow of vapor therein from said crankcase to said intake manifold means, said control valve means being movable between a first position closing said evacuating conduit means and a second position opening said evacuating conduit means, and means controlling movement of said control valve means between said positions including signal conduit means adapted to connect said control valve means to said intake manifold means anteriorly of said throttle valve.

3. A crankcase evacuating system for an internal combustion engine having a crankcase and intake manifold means including a throttle valve, said system comprising evacuating conduit means adapted to connect said crankcase to said intake manifold means posteriorly of said throttle valve, pressure differential responsive control valve means in said evacuating conduit means controlling the flow of vapor therein from said crankcase to said intake manifold means, said control valve means being movable between a first position closing said evacuating conduit means and a second position opening said evacuating conduit means in response to a predetermined pressure differential between atmospheric pressure and a signal pressure in said intake manifold means anteriorly of said throttle valve, and signal conduit means adapted to connect said control valve means to said intake manifold means anteriorly of said throttle valve to communicate said signal pressure therebetween.

4. A crankcase evacuating system for an internal combustion engine having a crankcase and intake manifold means including a throttle valve, said system comprising evacuating conduit means adapted to connect said crankcase to said intake manifold means posteriorly of said throttle valve, control valve means in said evacuating conduit means controlling the flow of vapor therein from said crankcase to said intake manifold means, said control valve means being movable between a first position closing said evacuating conduit means and a second position opening said evacuating conduit means in response to a predetermined absolute pressure in said intake manifold means anteriorly of said throttle valve, and means for preventing movement of said control valve means to said second position below a predetermined engine temperature.

5. In an internal combustion engine having a substantially sealed crankcase and intake manifold means including a throttle valve, a crankcase evacuating system comprising evacuating conduit means connecting said crankcase to said intake manifold means posteriorly of said throttle valve, pressure differential responsive control valve means in said evacuating conduit means controlling the flow of vapor therein from said crankcase to said intake manifold means, said control valve means being movable between a first position closing said evacuating conduit means and a second position opening said evacuating conduit means in response to a predetermined pressure differential between atmospheric pressure and a signal pressure in said intake manifold means anteriorly of said throttle valve, signal conduit means connecting said intake manifold means anteriorly of said throttle valve to said control valve means to communicate said signal pressure therebetween, and means for preventing communication of said signal pressure with said control valve means below a predetermined engine temperature.

6. A crankcase evacuating system for an internal combustion engine having a substantially sealed crankcase and intake manifold means including a throttle valve, said system comprising evacuating conduit means adapted to connect said crankcase to said intake manifold means posteriorly of said throttle valve, and equalizer valve means operable to supply atmospheric air to said evacuating conduit means upon the vacuum in said crankcase exceeding a predetermined maximum.

7. A crankcase evacuating system for an internal combustion engine having a substantially sealed crankcase and intake manifold means including a throttle valve, said system comprising evacuating conduit means adapted to connect said crankcase to said intake manifold means posteriorly of said throttle valve, and equalizer valve means operatively communicating said evacuating conduit means with atmosphere, said equalizer valve means having a closed position preventing communication between atmosphere and said evacuating conduit means and being movable to an open position to communicate atmosphere with said evacuating conduit means upon the vacuum in the latter exceeding a predetermined maximum.

8. In an internal combustion engine having a substantially sealed crankcase and intake manifold means including a throttle valve, a crankcase evacuating system comprising evacuating conduit means connecting said crankcase to said intake manifold means posteriorly of said throttle valve, and equalizer valve means operatively communicating said evacuating conduit means with atmosphere, said equalizer valve means having a closed position preventing communication between atmosphere and said evacuating conduit means and being movable to an open position to communicate atmosphere with said evacuating conduit means upon the vacuum in the latter exceeding a predetermined maximum.

9. A crankcase evacuating system for an internal combustion engine having a substantially sealed crankcase and intake manifold means including a throttle valve, said system comprising evacuating conduit means adapted to connect said crankcase to said intake manifold means posteriorly of said throttle valve, and crankcase pressure control valve means operable to communicate said evacuating conduit means with atmosphere upon the absolute pressure in said crankcase exceeding a predetermined maximum.

10. In an internal combustion engine having a substantially sealed crankcase and intake manifold means including a throttle valve, a crankcase evacuating system comprising evacuating conduit means connecting said crankcase to said intake manifold means posteriorly of said throttle valve, control valve means in said evacuating conduit means controlling the flow of vapor therein from said crankcase to said intake manifold, said control valve means

being movable between a first position closing said evacuating conduit means and a second position opening said evacuating conduit means in response to a predetermined absolute pressure in said intake manifold means anteriorly of said throttle valve, bypass conduit means bypassing said control valve means to permit the flow of vapor from said crankcase to said intake manifold means with said control valve means in said first position, and crankcase pressure control valve means operatively communicating said evacuating conduit means with atmosphere, said crankcase pressure control valve means having a first position preventing communication between said evacuating conduit means and atmosphere to maintain a predetermined minimum vacuum in said crankcase with said control valve means in its first position for flow of vapor through said bypass conduit means, and being movable to a second position communicating said evacuating conduit means with atmosphere upon the vacuum in said crankcase exceeding a predetermined minimum.

11. In an internal combustion engine having a substantially sealed crankcase and intake manifold means including a throttle valve, a crankcase evacuating system comprising conduit means extending exteriorly of said engine and connecting said crankcase to said intake manifold means posteriorly of said throttle valve, and pressure differential responsive control valve means in said evacuating conduit means controlling the flow of vapor therein from said crankcase to said intake manifold means, said control valve means being movable between a first position closing said evacuating conduit means and a second position opening said evacuating conduit means in response to a predetermined pressure differential between atmospheric pressure and a signal pressure in said intake manifold means anteriorly of said throttle valve.

12. The invention as defined in claim 11 further comprising means for preventing communication of said signal pressure to said control valve means below a predetermined engine temperature.

13. The invention as defined in claim 11 further comprising equalizer valve means communicating said evacuating conduit means with atmosphere, said equalizer valve means being normally closed and operable automatically to an open position to communicate air at substantially atmospheric pressure with said evacuating conduit means upon the vacuum in the latter exceeding a predetermined maximum.

14. The invention as defined in claim 12 in which said engine further includes air cleaner means communicating with said intake manifold means anteriorly of said throttle valve, and in which said equalizer valve means communicates said evacuating conduit means to atmosphere through said air cleaner means.

15. The invention as defined in claim 11 further comprising bypass conduit means bypassing said control valve means to permit the flow of vapor from said crankcase to said intake manifold means with said control valve means in said first position, and crankcase pressure control valve means communicating said evacuating conduit means with atmosphere, said crankcase pressure control valve means having a first position preventing communication between said evacuating conduit means and atmosphere to maintain a predetermined minimum vacuum in said crankcase with said control valve means in said first position for flow of vapor through said bypass conduit means, and being operable automatically to a second position communicating said evacuating conduit means with atmosphere upon the absolute pressure in said crankcase exceeding a predetermined maximum.

16. The invention defined in claim 14 in which said bypass conduit means includes adjustable throttling means.

17. The invention as defined in claim 14 in which said engine further includes air cleaner means communicating with said intake manifold means anteriorly of said throttle valve, and in which said crankcase pressure control valve means communicates said evacuating conduit means to atmosphere through said air cleaner means.

18. The invention as defined in claim 11 in which said control valve means comprises a valve body including first and second ports respectively communicating with said crankcase and said intake manifold means, a valve seat within said valve body, a valve member cooperable with said valve seat and being movable between said first position engaged with said valve seat to close said evacuating conduit means and said second position disengaged therefrom to open said evacuating conduit means, a pressure chamber in said valve body substantially sealed from said valve seat, flexible diaphragm means mounted within said pressure chamber and dividing the latter into first and second pressure signal chambers on opposite sides of said diaphragm means, means operatively connecting said diaphragm means to said valve member to move the latter between said first and second positions, means communicating said first pressure signal chamber to atmospheric pressure, means communicating said signal pressure to said second pressure signal chamber, and spring means in said pressure chamber continuously biasing said valve member toward said first position.

19. The invention as defined in claim 18 further comprising deflector means within said valve body and positioned relative to said first and second ports so that any backfire entering said valve body through said first port will be deflected away from said second port.

20. The invention as defined in claim 11 further comprising a chamber communicating with said evacuating conduit means exteriorly of said engine to collect condensate therefrom for subsequent removal.

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