Dec. 31, 1963 R. I. HAHN ETAL 3,115,873

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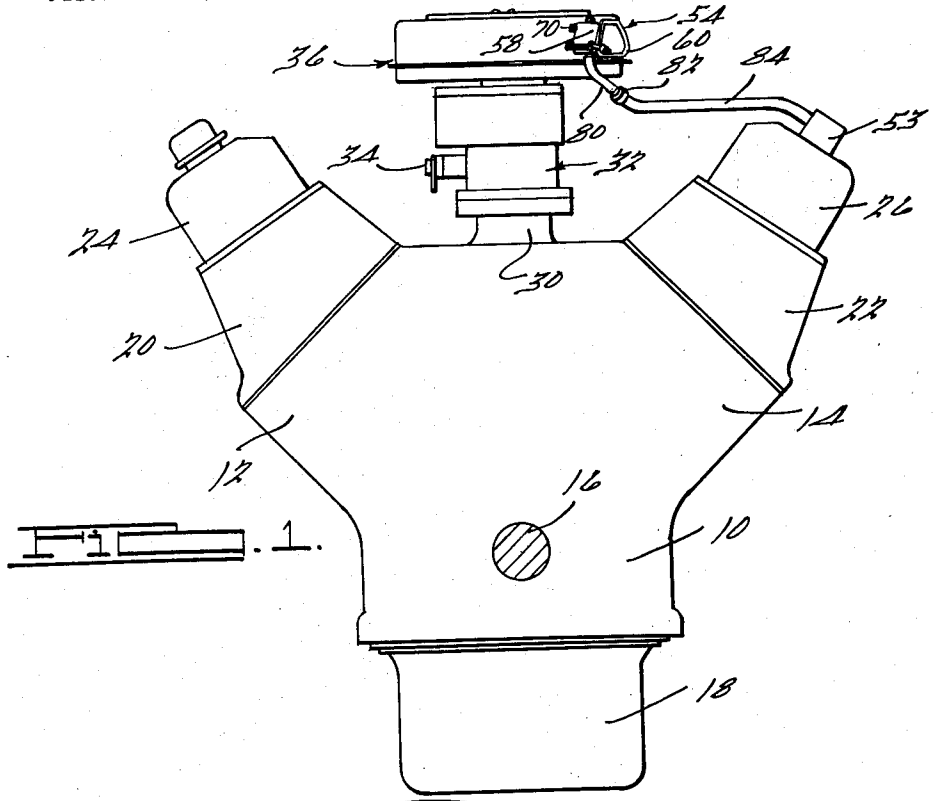


Fig. 1.

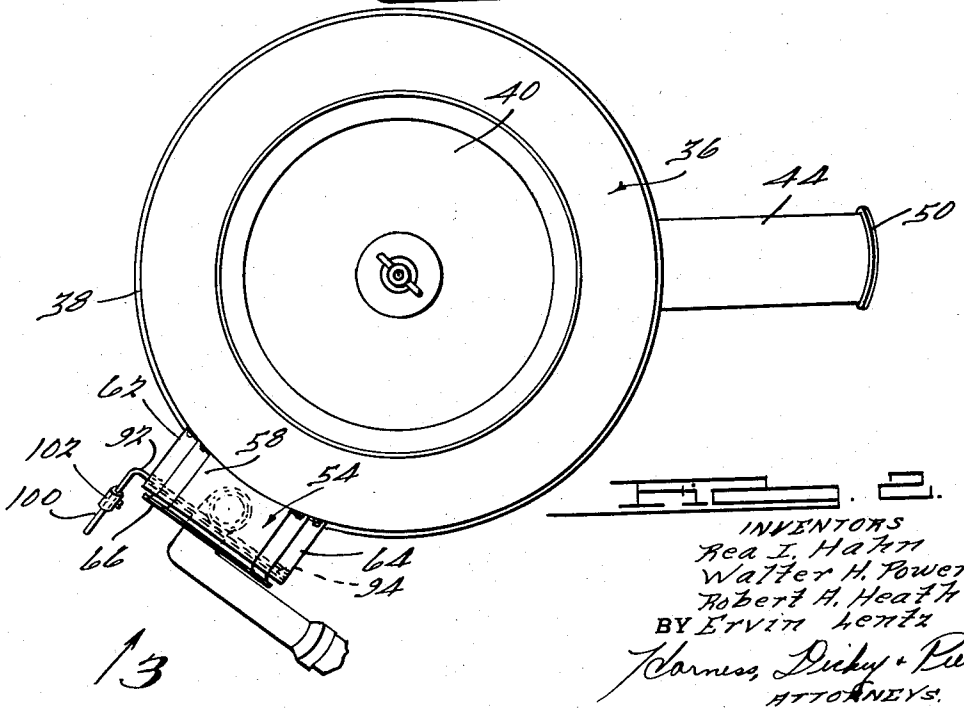


Fig. 2.

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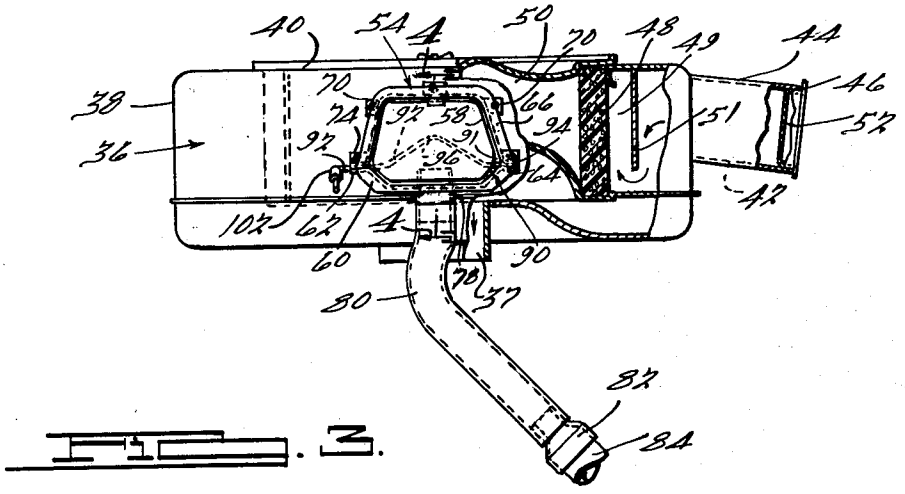


FIG. 3.

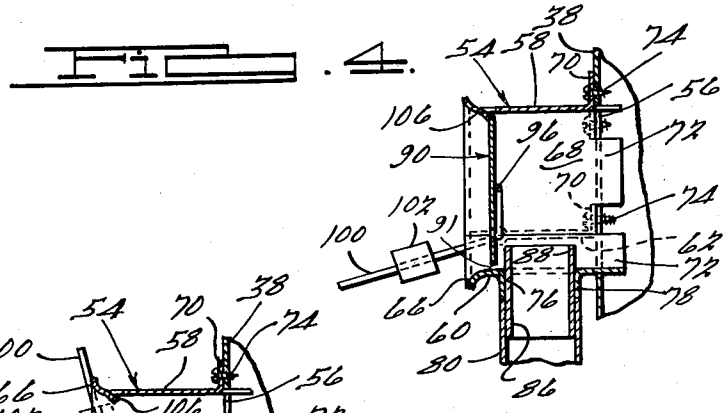


FIG. 4.

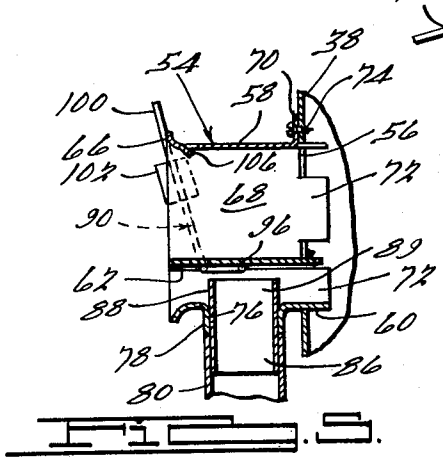


FIG. 5.

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Filed Dec. 6, 1961 3 Sheets-Sheet 3

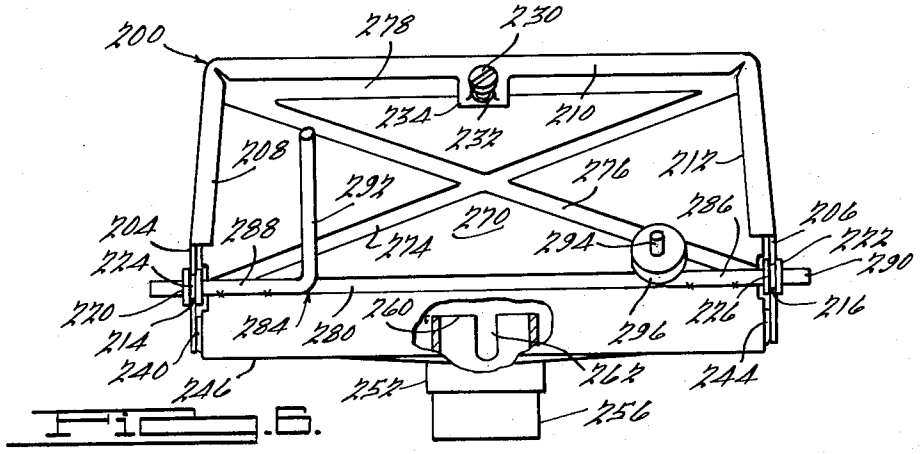


FIG. 6.

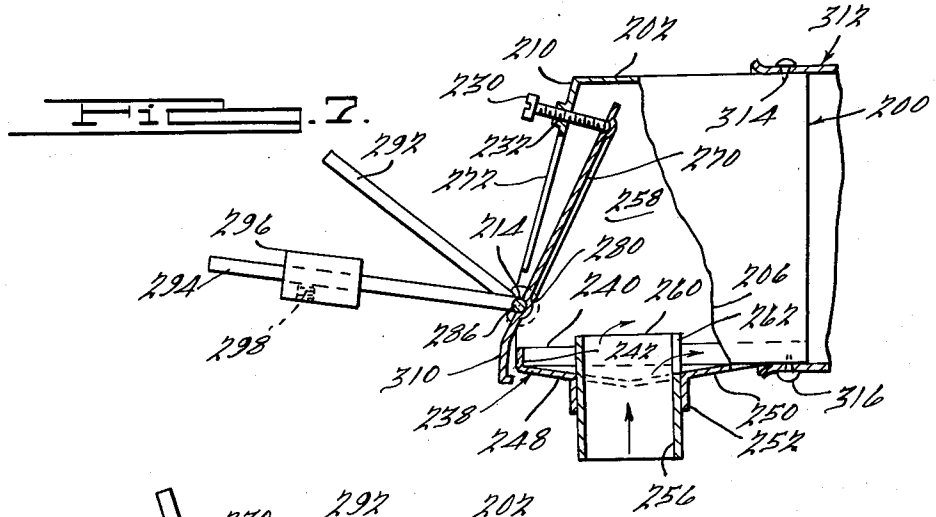


FIG. 7.

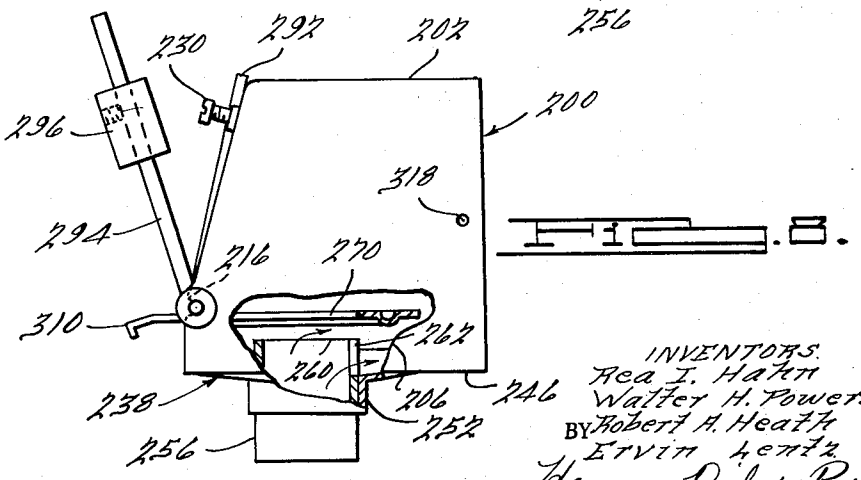


FIG. 8.

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United States Patent Office 3,115,873 Patented Dec. 31, 1963

3,115,873

FILTER

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Filed Dec. 6, 1961, Ser. No. 157,403
30 Claims. (Cl. 123—119)

This invention relates to internal combustion engines and more particularly to a ventilation system for delivering blow-by gases and oil vapor to the engine cylinders for combustion.

During operation of an internal combustion engine, some of the incompletely burned gases in the cylinders are often blown by the piston rings into the crankcase where they can contaminate the lubricating oil. The aforementioned gases and other vaporous by-products of internal combustion engine operation which collect in the crankcase are commonly referred to as blow-by. The blow-by is commonly vented to the atmosphere by means of the familiar down draft tube extending out of the crankcase which is used in conjunction with a crankcase breather tube to circulate fresh air through the crankcase and drive out the blow-by to the atmosphere. The delivery of blow-by in this way to atmosphere is most undesirable because the gases and vapors thereof are believed to contribute to the formation of smog. No fully satisfactory means to recirculate the blow-by back to the engine cylinders has been commercially presented prior to the present invention. One of the big problems in recirculation of blow-by is to maintain an adequate but not excessive flow at all of the various engine speeds and loads. Another is to prevent the passage of sparks or flames into the crankcase should a malfunction of the engine components cause flames to occur in the induction manifold. Another is to provide a system that is not excessive in cost and which does not have to be designed and built into the engine at the factory, in other words, to provide a system that can be easily installed at low cost on cars now on the road.

The present invention provides a solution to the above and various other problems by means of a ventilating system in which a conventional air filtering unit, comprising an air intake passage, an air filter, and a filtered air outlet, is incorporated. A ventilating passage means connects the crankcase to the air intake passage so that blow-by may be removed from the crankcase, mixed with the incoming air, filtered, delivered to the carburetor, and returned to the combustion chambers of the engine through the intake manifold. In order to induce flow of the blow-by through the ventilating passage means, an air flow restrictor means is placed in the air intake passage to create a reduced pressure zone at the end of the ventilating passage where the blow-by is fed into the intake air stream above the air filter and passes through the filter with the incoming air. The air filter is preferably made of open cell polyurethane material which will normally permit flow of blow-by therethrough; but which will act as a barrier to prevent excessively hot blow-by from reaching the combustible mixture in the carburetor or intake manifold; and, in the reverse direction, to prevent hot intake manifold gases from back-flow into the crankcase. The filter material removes oil entrained in the blow-by and the filtering operation is improved by deposition of the oil carried by the blow-by thereon. The restrictor is arranged to be variably positioned in accordance with air flow and thereby maintain a substantially constant pull on the blow-by in the ventilating passage sufficient to remove substantially all of the blow-by from the crankcase without affecting the lubricating oil therein. The restrictor is preferably provided by an air operated, adjustable, baffle valve which is located at the juncture of the air intake passage and the ventilating passage means so that it may simultaneously affect flow in both passages.

Accordingly, it is an object of this invention to provide a new and improved engine ventilating system which is simple in construction, reliable in operation, and which may be readily installed on various types of internal combustion engines without resorting to extensive modifications thereof.

Another object of the present invention is to provide a crankcase ventilating system having flow inducing and control means which is simple in design but positive in operation and properly responsive to engine operating conditions.

An additional object is to provide a ventilating system having flow control means which will be rugged enough to withstand normal engine operating conditions but sufficiently responsive to changes in engine operating conditions to provide positive and accurate control of gaseous flow through the engine in a particular relationship to engine operating conditions and which is adjustable to different engines or different relationships.

Still another object of the present invention is to provide means for filtering blow-by withdrawn from the lubricating system.

Another object of this invention is to provide apparatus for filtering the blow-by by passing it through a conventional air intake filter along with incoming air for combustion.

A further object of the present invention is to utilize a conventional air intake filter to filter blow-by withdrawn from an engine crankcase, and provide a means for preventing excessively hot blow-by from reaching a combustible mixture.

Still another object of the present invention is to filter blow-by withdrawn from an engine crankcase by passing the blow-by through an air intake filter and to remove oil entrained in the blow-by and to simultaneously provide an oil film over the surface of the filter to improve the filtering characteristics thereof.

Other objects and advantages will be apparent or become apparent by reference to the following detailed description wherein:

FIGURE 1 is a side elevational view of a conventional internal combustion engine embodying illustrative apparatus of the present invention;

FIGURE 2 is an enlarged top view of the air intake filter unit shown in FIGURE 1;

FIGURE 3 is a side elevational view taken in the direction of the arrow 3 in FIGURE 2;

FIGURE 4 is an enlarged cross sectional view taken along the line 4—4 in FIGURE 3;

FIGURE 5 is another enlarged sectional view of the apparatus shown in FIGURE 4 in another operational position;

FIGURE 6 is a side elevational view partially in section, of an alternative embodiment of the present invention;

FIGURE 7 is another side elevational view, partly in section, of the apparatus shown in FIGURE 6; and

FIGURE 8 is another side elevational view, partly in section, of the apparatus of FIGURE 6 in another operational position.

Referring now to FIGURE 1, an illustrative conventional internal combustion engine arrangement is shown. The engine arrangement comprises an engine block 10 having banks of cylinders 12, 14, a crankshaft 16, and a crankcase enclosing oil pan 18. Cylinder heads 20, 22 are suitably fastened to each of the engine banks 12, 14

and support rocker arm covers 24, 26. The oil filter tube cap (not shown) is normally formed as a breather tube to admit a small amount of air to the crankcase and a suitable outlet for vapors in the lubricating system is also provided. Often this outlet is in the form of a suction producing down draft tube (not shown) extending from the crankcase, but in the present illustrative engine this outlet is on the top of cover 26 as will be described. The present invention is applicable no matter where the outlet is located.

A conventional intake manifold is indicated at 30 and a conventional charge forming device is indicated at 32. The charge-forming device is of any conventional design such as a down draft carburetor having an air inlet at its upper end and an air-fuel mixture outlet at its lower end which communicates with the intake manifold 30. The quantity of air-fuel mixture delivered to the manifold 30 is controlled by a butterfly type throttle valve 34 in a conventional manner. A conventional air cleaner filtering unit 36 is mounted on the carburetor unit 32 and has a filtered air outlet 37, shown in FIGURE 3, in communication with the air inlet of the carburetor in order to supply filtered air for combination with the fuel to form a combustible mixture. The present invention is illustrated as embodied in parts that adapt the air cleaner 36 to use as a part of a crankcase ventilation system.

Referring now to FIGURES 2 and 3, the type of conventional air cleaner unit 36 illustrated comprises a cylindrical metallic shell 38 having a removable cover 40. The cleaner 36 has an air inlet passage 42 formed in an outwardly extending conduit 44 which terminates in an inlet opening 46. A cylindrical filter element 48 is mounted within a filter unit chamber 49 so that incoming air must pass through the filter prior to reaching the air outlet passage 37 through a connecting passage 50. A baffle plate 51 is provided around the periphery of some conventional filters to prevent incoming air from impinging directly on the filter. The filter element 48 is preferably made of open cell polyurethane foam such as described in U.S. Patent No. 2,961,710. The air intake conduit 44 extends from the side wall of the air cleaner casing and would normally be open to the atmosphere in order to draw air into the filter shell. However, as shown in FIGURE 3, when a conventional air cleaner is converted by means of this invention, the normal air inlet 46 is closed off by a plug element 52 and a new inlet is provided as will be hereinafter described.

It is to be understood that the particular air cleaner design illustrated is not critical and that the ventilating system apparatus to be hereinafter described is applicable to a variety of structures and may also be incorporated in the original cleaner design or adapted to existing designs currently in use in other ways. For example, instead of plugging the normal air inlet it is possible to provide an adapter which would utilize the normal air inlet. However, there are particular advantages in the use of a plug element and an adapter arrangement as hereinafter described. It is also to be understood that the subject ventilating system is applicable to any of a variety of types of engines, and that the engine and engine components shown are for illustrative purposes only. The ventilating system may be connected to the crankcase in the most convenient place. Thus, in the illustrative embodiment, it is connected to the rocker arm cover 26 through a suitable fitting 53. In other engines it could be connected to the down draft tube. The idea is, of course, to take off all blow-by that would normally be emitted to the atmosphere.

The apparatus of the illustrated crankcase ventilating system may be provided in the form of an adapter kit including the plug 52. The system comprises an air inlet housing, indicated generally at 54, which is adapted to be secured by convenient means to the side wall 38 of the air cleaner shell and communicate with an inlet opening 56 formed in the air cleaner shell to provide for installation of the present ventilating system. The peripheral configuration of the inlet opening 56 corresponds to the peripheral configuration of the housing 54. While the location of the hole 56 is primarily determined by convenience of connection to the vapor outlet, it is preferable to form the opening in line with the interior baffle 51 so that the incoming blow-by initially impinges on the baffle rather than directly on the filter material.

The air inlet housing 54 is formed from an upper sheet metal shell 58 and a lower sheet metal shell 60 which are permanently joined in a conventional manner along longitudinally extending flanges 62, 64. The outer edges of the shells 58, 60 are transversely outwardly turned to form a funnel-like peripheral flange 66 that acts as an inlet to the air intake passage 68 defined by the interior of shells. This passage, of course, replaces the plugged intake 44 in this particular air filter.

The inner ends of the shells are slotted and portions 70 are transversely bent to define stops which are engageable with the side wall 38 of the air filter shell. The adjacent axial portions 72 of the shells extend inwardly within the air filter shell around the periphery of the opening 56 to stabilize the connection of the housing 54 to the shell 38. Suitable fastening means such as screw elements 74 are provided to securely fasten the flanges 70 to the side wall 38 of the air cleaner unit and mount the air inlet housing 54 thereon.

The lower shell 60 of the air inlet housing 54 is provided with an opening 76 defined by an outwardly extending tubular portion 78 which is adapted to be connected to a flexible conduit 80 or the like. Ventilating passage means are formed by connecting the conduit 80 to a crankcase outlet, in this case the rocker arm cover fitting 52, through a coupling member 82 and a second conduit 84. A sleeve element 86 extends between the tubular portion 78 and the flexible conduit 80. The upper portion 88 of the sleeve extends upwardly into the air inlet passage 68 and terminates in an opening 89. Thus, it may be seen that the ventilating passage means is connected at one end to a point in the lubricating system of the engine and at the other end to a point in the air inlet passage which is upstream of the air filter 48. Consequently, blow-by flowing from the lubricating system to the air inlet passage will be mixed with the incoming air and filtered therewith prior to passage into the charge forming means. The blow-by is removed from the crankcase at elevated temperatures and oil from the lubricating system is entrained therein and carried along therewith through the ventilating passage. By using a filter element 48 of open cell polyurethane foam material or the like, which is temperature and oil resistant, the filter will have long life. In addition, the oil entrained in the blow-by will be removed by the filter and the filtering ability thereof will be improved. Further, the filter provides a hot gas barrier. Should sparks or flames occur in the induction manifold or carburetor through malfunction of the inlet valves, ignition system or other means, the filter will act as an effective barrier against the passage of such sparks or flames into the crankcase.

In accordance with the present invention, the incoming air to the engine is forced to pass through a variably restricted opening formed by restrictor means provided in the air inlet passage. The restriction to passage of the incoming air through the air inlet passage produces a reduced pressure zone downstream of the restriction which creates a "suction" that is used as a means to induce circulation of the blow-by. The restrictor means is movably mounted to vary the restriction in proper relation to the engine speed and load so as to provide flow control means which will make it possible to control the flow of vapors from the lubricating system. Gases in the ventilating passage are pulled into the air passage 68 by the suction created behind the restrictor at the inlet end of the air passage. The restrictor is formed by a pivoted baffle valve 90 which is pivotally movable from

a substantially closed position relative to the closed air passage 68 to varying open positions relative thereto. In the vertical position of FIGURES 3 and 4, the periphery of the baffle valve may be suitably spaced inwardly away from the adjacent walls of passage 68 so that a gap 91 is provided which forms an inlet opening of sufficient size to admit air for engine idling while at the same time producing suction to the draw gases out through opening 89. The valve 90 swings on a pivot rod element having spaced coaxial portions 92, 94 rotatably mounted in bushings formed in opposite sides of the mating flanges 62, 64. The intermediate portion 96 of the rod element is offset above the pivot axis defined by the coaxial portions 92, 94 and is rigidly fastened to the baffle valve 90 by suitable means such as welding. The offset intermediate portion facilitates assembly, increases strength of the baffle valve, and provides a stronger connection which is more resistant to torsional stresses resulting from movement of the baffle valve. The pivot axis is offset below the center of mass of the baffle valve and located above and upstream of the ventilating passage inlet 89. One end of the pivot rod terminates in a transversely bent control arm 100 which extends radially outwardly relative to the axis of rotation of the baffle valve. Baffle valve control means in the form of a weight element 102 is slidably mounted on the control arm and adjustable lengthwise on the arm to vary the moment arm tending to move the baffle valve toward the idle position of FIGURE 4. A set screw is provided to secure the weight element in a particular adjusted position. A stop 106 is engaged by the baffle valve in its extreme vertical position and is formed by a downwardly depending tab which is struck out from the upper shell 58. In the other extreme position (FIG. 5), the valve 90 will normally attain a substantially horizontal position spaced above the inlet 89. At extremely high flow rates, the baffle valve may seat on the end of the tube 86. The pivotal axis of the baffle valve is located upstream and above the upper end of the sleeve 86 so that reduced pressure zone formed by the restrictive effect of the baffle valve will overlie the ventilating passage opening 89 and so that the baffle valve will substantially restrict flow of blow-by at high engine speeds and loads. As the baffle valve moves from the position of FIGURE 4 toward the position of FIGURE 5, which corresponds to a gradual increase in the amount of intake air, it will provide less and less restriction to air flow and more and more restriction to flow of the blow-by.

The weight 102 may be adjusted on the arm 100 to obtain a particular movement of the baffle valve in relation to engine speed and load, and provides a means whereby the same device can be used on different engines. The weight is adjusted so that the baffle valve will attain positions during and in response to engine operation which will produce optimum blow-by flow. The baffle valve is designed so as to attain the horizontal attitude of FIGURE 5 when engine operating conditions demand supplies of intake air which would create undesirably high rates of flow of blow-by that would adversely affect the lubricating oil. By gradually closing off opening 89, the baffle valve prevents greater suction at higher air flows from inducing too high a rate of flow of the blow-by vapors, otherwise, at high air flow, the lubricating oil might actually be drawn into the ventilating system. The baffle valve opens relatively slowly through the initial part of its movements and then more rapidly until it attains the horizontal position. It will be noted that an optimum amount of suction is provided at all times not too much and not too little, so that all blow-by is consumed and there is no danger that liquid lubricating oil will be pulled into the ventilating system.

To briefly restate the operation, the restriction to air flow provided by the baffle valve in passage 68 into the air cleaner creates sufficient suction in the tubular conduits 80 and 84 to cause a flow of blow-by from the lubricating system to the air intake passage 68 where the blow-by is mixed with the intake air and filtered by the polyurethane filter 48. The blow-by is then delivered to the engine cylinders to be burned. The filter collects oil entrained in the blow-by and, consequently, an oil film is provided over the surface of the filter which promotes the filtering action thereof. Relatively constant circulation of blow-by occurs at all conditions of engine operation as the restrictor means adjusts in response to varying conditions of engine speed and load so that an adequate flow rate is always maintained. The polyurethane filter 48 acts as a positive barrier to prevent excessively hot blow-by from reaching the combustible mixture and causing premature ignition thereof.

An alternative embodiment of the invention is shown in FIGURES 7–9. The restrictor housing comprises a three wall upper member 200 providing a top wall 202 and spaced side walls 204, 206. Transverse flanges 208, 210, 212 are formed on the front edge of the upper member 200. Arcuate notches 214, 216 are formed below the flanges 208 and 212 on the side walls. The notches extend circumferentially substantially more than 180° and are adapted to provide retaining seats for nylon bushings 220, 222. Circumferential grooves 224 and 226 are around the bushings and are adapted to be received within the notches 214, 216. The diameter of the reduced portion of the bushings defined by the grooves 224, 226 is larger than the diameter of the openings to notches so that bushings must be compressed upon insertion into the notches and are resiliently retained therewithin.

An adjusting screw 230 is threadably mounted in a bore 232 provided in an enlarged portion 234 of the upper flange 210. The adjusting screw is preferably made of nylon or the like, and extends inwardly into the housing 200 for a purpose to be hereinafter described.

The bottom wall portion of the housing 200 is formed by bottom member 238 which is provided with upwardly bent flanges 240, 242, 244 at the front and side edges of a bottom wall 246. The upper member is secured to the lower member by welding or other suitable fastening means between the side walls 204, 206 and the side flanges 240, 244. Portions 248, 250 of the bottom wall taper downwardly and terminate in an inlet bushing 252.

A sleeve 256 is secured within the inlet bushing in any suitable manner and the upper end thereof extends upwardly into the passage 258 defined by the housing 200 and terminates in an inlet opening 260. A slot 262 is formed in the side wall of the sleeve and terminates at a point 264 substantially flush with the tapered surface 250 for a purpose to be hereinafter described.

A restrictor means 270 is movably mounted in an air inlet opening 272 defined by the upper and lower members 200, 238. The restrictor is made from a flat plate and is provided with embossments 274, 276, 278, 280 for strength. The embossment 280 extends longitudinally along the pivotal axis of the restrictor and is adapted to receive a pivot rod 284, 286 which are welded therein. Coaxial portions 288, 290 of the rods extend through the bushings 220, 224 and pivotally support the restrictor relative to the housing. Radially extending arms 292, 294 are provided on each pivot rod. A control weight element 296 is slidably mounted on the arm 294 and is adjustable therealong to vary the moment arm tending to close the restrictor. Screw means 298 may be provided to secure the weight element in varying adjusted positions. The control arm 292 serves as a stop to limit movement of the restrictor in the position shown in FIGURE 9 by abutting engagement wtih the flange 210. The lower edge 310 of the restrictor is rearwardly bent to provide a flange which cooperates with the flange 242 in the completely closed position of the restrictor.

The housing is adapted to be incorporated with a conventional air cleaner unit as hereinbefore described. In the illustrative arrangement shown in FIGURE 8, the rear edges of the top wall 202, side walls 204, 206, and

bottom wall 246 are received within a correspondingly dimensioned conduit 312. The conduit 312 may be the normal air intake passage of a conventional air cleaner unit or may be an adapter sleeve which would be connected thereto. Suitable fastening means 314, 316 are provided to secure the housing within the conduit. A plurality of fastening holes 318 may be provided around the periphery of the housing for this purpose as shown in FIGURE 9. In operation with the housing mounted on the air intake passage of a conventional air cleaner unit and forming a continuation thereof, ventilating passage means (not shown) are connected to the inlet sleeve 256 as hereinbefore described with reference to FIGURES 1–6. The normal position of the restrictor 270 would be substantially vertical with the upper and side edges thereof abutting the flanges 208, 210, 212 under the influence of the control weight 296. In the substantially vertical position, the passage 258 is maximumly restricted; but gaps are provided around the side and top edges of the restrictor to permit sufficient air to reach the engine for idling. The bottom edge of the restrictor is provided with a flange 310 adapted to seat on the flange 242 and provide a better restriction to air flow along the bottom edge. In this way a maximum pressure drop may be obtained at idle conditions. However, in many installations, it will be possible to provide a much smaller restriction and still obtain sufficient flow of blow-by through the opening 260. It is desirable to provide means to adjust the restrictor to a maximum opening at idle conditions whereat sufficient blow-by flow will still be obtained. Consequently, the inner end of adjusting screw 230 is adapted to abut the restrictor as shown in FIGURE 8. The screw may be adjusted to vary the opening afforded by the restrictor at idle conditions. As the engine speed and load increases, the restrictor moves toward the horizontal position shown in FIGURE 9 in response to the rate of air flow through the passage 258 and against the counter force exerted by the weight 296. The weight 296 may be adjusted for a particular engine to obtain the most satisfactory rate of opening of the restrictor in response to air flow and thereby obtain maximum blow-by ventilating results. As the restrictor approaches the horizontal position, flow of blow-by through the opening 260 will be restricted to prevent oil pull-over in the crankcase. The slot 262 provides an additional flow channel for the blow-by so that restrictive effect of the restrictor on blow-by flow in the horizontal position will not unduly hamper blow-by flow under some operating conditions.

Some of the oil entrained in the blow-by tends to collect beneath the restrictor 270. Accordingly, the bottom wall 246 is provided with the tapered portions 248, 250 which convey oil back into the sleeve 256 through the slot 262. The bottom of the slot terminates adjacent the bottom of the sloping surfaces 248, 250. Accordingly, the slot 262 and the rear sloping surface 250 serve the dual functions of providing an additional flow path for blow-by and an oil return path.

The blow-by is mixed with the incoming atmospheric air, passed through the conventional air cleaner unit, and formed into a combustible mixture in the engine carburetor as hereinbefore described. Accordingly, the operation of the alternative embodiment is substantially the same as the afore described embodiment except insofar as previously related.

The systems described are relatively simple and inexpensive and can be used on all types of engines. The weights 102 and 296 may be adjusted to accommodate any of a wide variety of engine conditions and carburetor designs. The simplicity of design of the systems and simplicity of operation make them substantially foolproof. While the invention has been shown in the form of a kit to be used to adapt currently used air cleaners so that blow-by can be consumed, it is evident that the principles of the invention can be embodied as a part of original vehicular equipment. Various other modifications and changes in the details of construction of the illustrative apparatus can also be made without departing from the spirit and scope of the invention.

What is claimed is:

1. Ventilating apparatus for an internal combustion engine having a charge-forming means and an air intake filtering means associated therewith, and comprising conduit means forming an air intake passage upstream of said air intake filtering means, said air intake passage having a flow of combustion air from the atmosphere flowing therethrough during engine operation, ventilating passage means connecting the crankcase of said engine to said conduit means whereby blow-by vapors within the crankcase of said engine may be removed and mixed with incoming engine air in said air intake passage and passed through said filtering means therewith and delivered to said charge-forming means for delivery to the combustion chambers of said engine, and adjustable restrictor means movably mounted in said conduit means to control the rate of flow of blow-by through said ventilating passage means in response to engine operating conditions by movement of said restrictor means in accordance with the rate of combustion air flow through said air intake passage.

2. In an engine ventilating system for an internal combustion engine having a charge-forming means and an air intake filtering means associated therewith, said air intake filtering means comprising in series, an air inlet conduit communicating with the atmosphere, air filter means, a filtered air outlet conduit communicating with said charge-forming means; the invention comprising: ventilating passage means connecting the crankcase of said engine to said air inlet conduit whereby a gaseous flow may be established from the crankcase of said engine to said air inlet conduit and whereby blow-by vapors within the crankcase of said engine may be removed and mixed with incoming air in said air inlet conduit and passed through said filter means therewith and into said charge-forming means, and adjustable restrictor means mounted in said air inlet conduit to control the rate of flow of gases through said ventilating passage means in direct proportion to engine operating conditions as determined by the rate of air flow through said air inlet conduit by movement of said adjustable restrictor means in accordance with the rate of air flow through said air inlet conduit.

3. The engine ventilating system as defined in claim 2 and wherein said adjustable restrictor means comprises, baffle means mounted in said air inlet conduit upstream of the opening connecting said ventilating passage means to said air inlet conduit, said baffle means having a peripheral configuration substantially corresponding to the peripheral configuration of said air inlet conduit, said baffle means being mounted within said air inlet conduit for movement from a closed position relative to said air inlet conduit whereat a minimum flow rate of air therethrough is attained to a fully open position relative to said air inlet passage whereat a maximum flow rate of air therethrough is attained, and said baffle means being movable between said closed position and said open position in response to the rate of air flow through said air intake passage as determined by engine operating conditions and being simultaneously effective to control the rate of flow of blow-by vapors through said ventilating passage means.

4. The ventilating system as defined in claim 3 and wherein adjustable control means are associated with said baffle means for variation of the response of said baffle means to air flow through said air inlet passage to obtain predetermined ventilating results regardless of engine operating variables.

5. The ventilating system as defined in claim 4 and having pivot means movably mounting said baffle means in said air inlet conduit, said baffle means being mounted eccentrically relative to said pivot means, a control arm extending radially from said pivot means, a portion of

said control being provided with weight receiving means, and an adjustable weight mounted on said control arm and being movable therealong to vary the response of said baffle means to the rate of flow through said air inlet conduit.

6. The ventilating system as defined in claim 2 and wherein said blow-by vapors flowing from the crankcase of said engine through said ventilating passage means have oil entrained therein, said filter means being formed from an open celled plastic material permitting passage of said blow-by vapors therethrough and restricting the passage of the entrained oil whereby the oil entrained in the blow-by vapors flowing through said filter means is deposited thereon in an oil film to improve the filtering properties thereof.

7. The ventilating system as defined in claim 2 and wherein said filter means is made from relatively high temperature resistant open celled plastic material, said blow-by vapors flowing from the crankcase of said engine through said ventilating passage means having elevated temperatures, and said open celled plastic material having a melting point below a temperature range at which said blow-by gases could cause premature ignition of the fuel-air mixture formed in said charge-forming means whereby portions of said filter means will melt upon contact with gases in said temperature range to make said filter impervious to blow-by vapors in the temperature range to prevent passage of blow-by gases within the temperature range to said charge-forming means.

8. In an engine ventilating system adapted for use with any of a plurality of conventional internal combustion engines of varying designs, each engine having a charge-forming means and an air intake filtering means of any of a plurality of conventional designs associated therewith, said air intake filtering means having an air inlet conduit, a filter chamber, and a filtered air outlet communicating with said charge-forming means; the improvement comprising: a restrictor housing, an alternate air inlet passage formed in said restrictor housing, means to mount said restrictor housing on said air intake filtering means on the upstream side of said filter chamber with said filter chamber in communication with the atmosphere through the alternate air inlet passage in said restrictor housing, ventilating passage means connecting said alternate air inlet passage to the crankcase of said engine to establish a gaseous flow from the crankcase of said engine to and through said air intake filtering means, and restrictor means movably mounted in said restrictor housing to control the rate of gaseous flow through said ventilating passage means.

9. In an engine ventilating system as defined in claim 8 and having means forming an alternate inlet opening in said air intake filtering means, the alternate air inlet passage formed in said restrictor housing communicating with said filter chamber through said alternate inlet opening, and plug means to block the air inlet conduit of said air intake filtering means whereby air delivered to said charge-forming means must pass through said alternate air inlet passage.

10. In the system defined in claim 8 and wherein said restrictor housing comprises a plurality of sheet metal shells, flange means provided in said shells to secure said shells to one another and define said alternate air inlet passage, and the inlet and outlet openings therefor bearing means integrally formed on one end of said shells adjacent said inlet opening to movably support said restrictor means, ventilating passage inlet means integrally formed in a wall of said shells between said inlet and outlet opening and adapted to be connected to said ventilating passage means, and fastening means formed on the other end of said shells to connect said shells to said air intake filtering means.

11. In the system defined in claim 9 and wherein said bearing means comprises aligned notches provided in opposite walls of said shells, and plastic bushings for pivotally supporting said restrictor means adapted to be received and retained by said notches.

12. In the system defined in claim 9 and wherein stop means are provided on said shells to limit movement of said restrictor means between predetermined positions.

13. In the system defined in claim 12 and wherein said stop means comprises an adjustable screw means extending through a wall of said shells for abutting engagement with said restrictor means to limit movement of said restrictor means between predetermined positions within said restrictor housing.

14. In the system as defined in claim 9 and further comprising tube means having an opening communicating with said inlet means and extending inwardly within said shells and terminating therein in spaced relationship to the side walls of said shells, said restrictor means being located within said shells to variably restrict said opening of said tube means, and slot means formed in the side of said tube means facing said outlet opening.

15. In the system as defined in claim 14 and wherein said tube means extend upwardly through the bottom wall of said shells, and the lower edge of said slot means terminates in substantial alignment with the bottom wall of said shells to provide a return passage to the inlet means for oil accumulating within said shells.

16. In an engine ventilating system adapted for use with any of a plurality of conventional internal combustion engines of varying design, each engine having a charge-forming means and an air intake filtering means of any of a plurality of conventional designs associated therewith, said air intake filtering means having a conventional air inlet conduit, a filter chamber, and a filtered air outlet communicating with said charge-forming means; the improvement comprising: a baffle housing, an alternate air inlet passage formed in said baffle housing, means forming an alternate inlet opening in said conventional air intake filtering means, means to mount said baffle housing on said air intake filtering means on the upstream side of said filter chamber with said alternate inlet opening in communication with the atmosphere through the alternate air inlet passage in said baffle housing, plug means to block the conventional air inlet conduit of said conventional air intake filtering means whereby air delivered to said charge-forming means must pass through said alternate air inlet passage, ventilating passage means connecting said alternate air inlet passage to the crankcase of said engine to establish a gaseous flow from the crankcase of said engine to and through said air intake filtering means, and a baffle means mounted in said alternate air inlet passage and being movable therein from a first closed position relative to said air inlet passage to a second open position relative thereto in response to pressure differentials in said alternate air inlet passage, said baffle means being simultaneously effective to control the rate of gaseous flow from the crankcase of said engine to and through said air intake filtering means.

17. The engine ventilating system as defined in claim 16 and wherein said last mentioned means comprises pivot rod means pivotally supporting said baffle means for pivotal movement between said first position and said second position, said pivot rod means having an arm extending transversely therefrom, and adjustable control means provided on said arm to control the responsiveness of said baffle means to pressure differentials in said alternate air inlet passage.

18. In an engine ventilating system for an internal combustion engine including an air intake filtering unit of conventional design, the combination comprising: means to plug the normal air intake passage means of said conventional air intake filtering unit, an alternate air intake opening being formed in said conventional air intake filtering unit, housing means adapted to be secured to said conventional air intake filtering unit and including alternate air intake passage means communicating at one end with the atmosphere and at the other end with said alternate

air intake opening, ventilating passage means communicating with said air intake passage means at one end and being connected to the crankcase of said engine at the other end whereby a pressure differential existing between said ends during engine operation causes a flow of gaseous by-products from the crankcase of said engine to said alternate air intake opening, and flow control means associated with said ventilating passage means, said flow control means being responsive to engine operating conditions to control the rate of flow of gaseous by-products from the crankcase of said engine into said alternate air intake passage.

19. The engine ventilating system as defined in claim 18 and wherein said flow control means comprises baffle means movably mounted in said alternate air intake passage means, said baffle means being movable from a first extreme position whereat said ventilating passage means is relatively unrestricted to a second extreme position whereat said ventilating passage means is maximumly restricted, and said baffle means being movable in response to air flow through said alternate air intake passage from said first extreme position at minimum air flow to said second extreme position at maximum air flow whereby the flow of gaseous by-products through said ventilating passage means is limited to a rate of flow which will substantially completely remove the gaseous by-products from the interior of said engine without affecting the lubricating oil in said engine.

20. The engine ventilating system as defined in claim 19 and wherein a filter element is mounted in said air intake filtering unit, said gaseous by-products flowing from the interior of said engine through said ventilating passage means having oil entrained therein and having elevated temperatures, and said filter having a temperature resistant structure made of open cell polyurethane foam, said open cell polyurethane foam having a cellular structure permitting passage of said gaseous by-products therethrough and restricting and retaining oil products whereby oil entrained in the gaseous by-products flowing through said filter element is deposited on the surfaces thereof to form an air cleaning oil film thereon.

21. In an engine ventilating system for an internal combustion engine having a charge forming means and an air filtering means associated therewith; said air filtering means comprising in series, combustion air inlet passage means communicating with the atmosphere, air filter means, and filtered air outlet passage means communicating with said charge forming means; the improvement comprising: ventilating passage means connecting the crankcase of said engine to a point in said air inlet passage means upstream of said air filtering means to provide a flow passage for ventilating blow-by gases from the crankcase of said engine to the charge forming means of said engine through said air inlet passage means and said air filtering means, and restrictor means provided in said air inlet passage means in the flow path of combustion air flowing through said air inlet passage means to establish a reduced pressure zone in said air inlet passage over said ventilating passage means for mixing with the incoming combustion air for delivery to the charge-forming means through said air filtering means and thereby creating a flow of blow-by gases from the crankcase of said engine to said air inlet passage means.

22. The system as defined in claim 21 and having pivotal means mounting said restrictor means in said air inlet passage means for pivotal movement therein from an approximate passage closed position to an approximate passage fully open position, said flow control means being responsive to and actuated by the rate of air flow through said air inlet passage means for movement between said passage open position and said passage closed position to provide a substantially constant flow of blow-by through said ventilating passage means.

23. The system as defined in claim 22 and said restrictor means being in the form of a baffle valve having a peripheral configuration substantially corresponding to the cross-sectional configurational of said air inlet passage means so that said air inlet passage is substantially closed in said closed position, said baffle valve providing a restriction to air flow through said air inlet passage means producing a reduced pressure zone adjacent the connection of said ventilating passage means to said air inlet passage means whereby controlled flow of blow-by from the crankcase of said engine is established.

24. The system as defined in claim 23 and wherein the pivotal axis of said baffle valve is located adjacent the connection of said ventilating passage means to said air inlet passage means, and said baffle valve being mounted relative to said ventilating passage means to overlie said ventilating passage means in said open position and thereby provide a restriction to flow of blow-by therethrough during periods of maximum air intake through said air inlet passage means.

25. In an engine ventilating system adapted for use with any of a plurality of conventional internal combustion engines of varying design, each engine having a charge-forming means and an air intake filtering means of any of plurality of conventional designs associated therewith, said air intake filtering means having an air inlet, a filter chamber, and a filtered air outlet communicating with said charge-forming means; the improvement comprising: a restrictor housing having an air inlet passage for said air intake filtering means, means mounting said restrictor housing on said air intake filtering means on the upstream side of said filter chamber with said filter chamber in communication with the atmosphere through the air inlet passage in said restrictor housing, ventilating passage means connecting said air inlet passage to the crankcase of said engine to establish a gaseous flow from the crankcase of said engine to and through said air intake filtering means, and restrictor means movably mounted in said restrictor housing to control the rate of gaseous flow through said ventilating passage means.

26. In an engine ventilating system adapted for use with any of a plurality of conventional internal combustion engines of varying design, each engine having a charge-forming means and air intake filtering means of any of a plurality of conventional designs associated therewith, said air intake filtering means having an air inlet conduit, a filter chamber, and a filtered air outlet communicating with said charge-forming means; the improvement comprising: a baffle housing, means mounting said baffle housing on said air intake filtering means on the upstream side of said filter chamber, said air inlet conduit communicating with the atmosphere through said baffle housing, ventilating passage means connecting said air inlet conduit to the crankcase of said engine to establish a gaseous flow from the crankcase of said engine to and through said air intake filtering means, and a baffle means mounted in said air inlet conduit and being movable therein from a first closed position relative to said air inlet conduit to a second open position relative thereto in response to pressure differentials in said air inlet conduit, said baffle means being simultaneously effective to control the rate of gaseous flow from the crankcase of said engine to and through said air intake filtering means.

27. In an engine ventilating system for an internal combustion engine including an air intake filtering unit of conventional design, the combination comprising: housing means adapted to be secured to said conventional air intake filtering unit, air intake passage means provided in said air intake filtering unit and communicating with the atmosphere through said housing means, ventilating passage means communicating with said air intake passage means at one end and being connected to the crankcase of said engine at the other end whereby a pressure differential existing between the ends during engine operation causes a flow of gaseous by-products from the crankcase of said engine to said air intake passage means, and flow control means associated with said ventilating pas-

sage means, said flow control means being responsive to and adjustable by the rate of flow of air through said air intake passage means to control the rate of flow of gaseous by-products from the crankcase of said engine into said air intake passage means in accordance with engine operation conditions.

28. In an engine ventilating system for an internal combustion engine having a charge-forming means and an air intake filtering means associated therewith, said air intake filtering means comprising in series, an air inlet conduit communicating with the atmosphere, air filter means, a filtered air outlet conduit communicating with said charge-forming means, ventilating passage means connecting the crankcase of said engine to said air intake filtering means at the upstream side of said air filter means whereby a gaseous flow may be established from the crankcase of said engine to said air inlet conduit and whereby blow-by vapors within the crankcase of said engine may be removed and mixed with incoming air in said air inlet conduit and passed through said filter means therewith into said charge-forming means, the invention comprising: a filter means formed from an open celled plastic material permitting passage of said blow-by vapors therethrough and restricting the passage of oil entrained in said blow-by vapors whereby the oil entrained in the blow-by vapors flowing through said filter means is deposited thereon in an oil film to improve the filtering properties thereof.

29. In an engine ventilating system for an internal combustion engine having a charge-forming means and an air intake filtering means associated therewith, said air intake filtering means comprising in series an air inlet conduit communicating with the atmosphere, air filter means, a filtered air outlet conduit communicating with said charge-forming means, crankcase ventilating passage means connecting the crankcase of said engine to said air inlet conduit whereby a gaseous flow may be established from the crankcase of said engine to said air inlet conduit and whereby blow-by vapors within the crankcase of said engine may be removed and mixed with incoming air in said air inlet conduit and passed through said filter means therewith and into said charge-forming means; the invention comprising: a filter means made from relatively high temperature resistant open celled plastic material, said blow-by vapors flowing from the crankcase of said engine through said ventilating passage means having elevated temperatures, and said open celled plastic material having a melting point below a temperature range at which said blow-by gases could cause premature ignition of the fuel-air mixture formed in said charge-forming means whereby portions of said filter means will melt upon contact with gases in said temperature range to make said filter impervious to blow-by vapors in the temperature range to prevent passage of blow-by gases within the temperature range to said charge-forming means.

30. In an engine ventilating system for an internal combustion engine having ventilating passage means connecting the crankcase of said engine to the air-fuel system of said engine for ventilating gaseous by-products, the improvement comprising: a filter element mounted in the flow path of said gaseous by-products, the gaseous by-products flowing from the interior of said engine through said ventilating passage means having oil entrained therein and having elevated temperatures, and said filter having a temperature resistant structure made of open cell polyurethane foam, said open cell polyurethane foam having a cellular structure permitting passage of said gaseous by-products therethrough and restricting and retaining oil products whereby oil entrained in the gaseous by-products flowing through said filter element is deposited on the surfaces thereof to form an air cleaning oil film thereon, said open cell polyurethane foam having a melting point below a temperature at which gaseous by-products flowing in said ventilating passage means could cause a backfire condition whereby portions of said filter element will melt upon contact with gaseous by-products in said temperature range to make said filter element impervious to gaseous by-products in the temperature range to prevent flow of gaseous by-products within the temperature range through said filter element.

References Cited in the file of this patent

UNITED STATES PATENTS

1,906,390	McKinley	May 2, 1933
1,954,198	Cochrane	Apr. 10, 1934
2,198,790	Roddewig	Apr. 30, 1940
2,731,958	Robley	Jan. 24, 1956