Jan. 27, 1959 F. A. STANDIFORD 2,870,758

DECONTAMINATION SYSTEM

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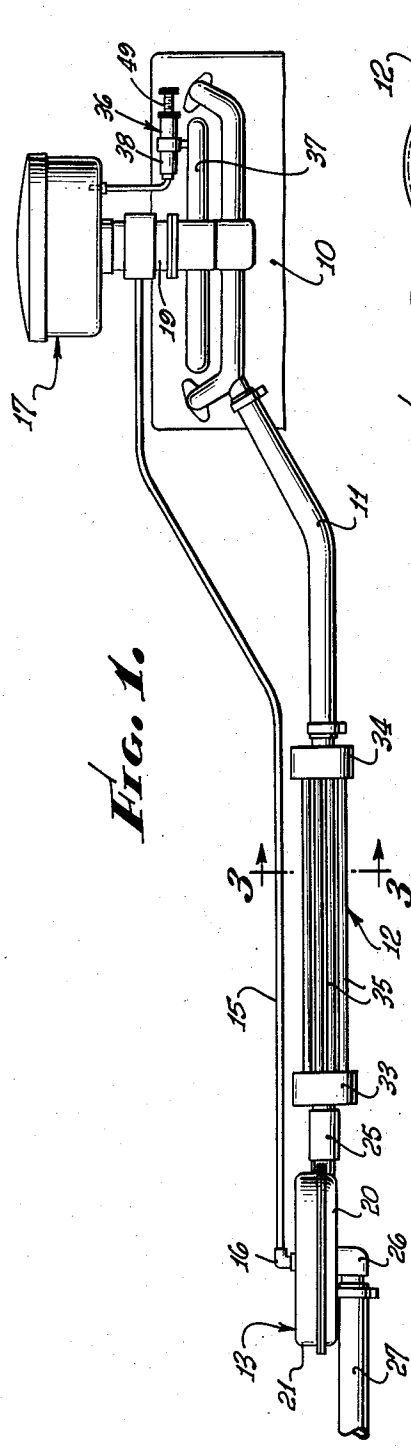


FIG. 1.

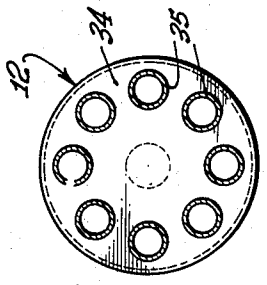


FIG. 3.

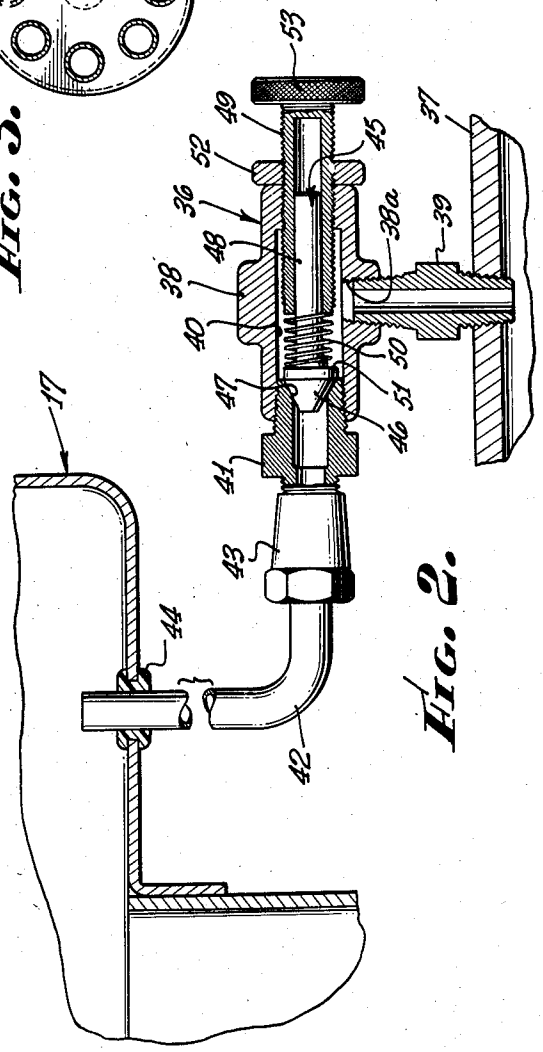


FIG. 2.

INVENTOR.
FRED A. STANDIFORD
BY
Flam and Flam
ATTORNEYS.

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FIG. 4.

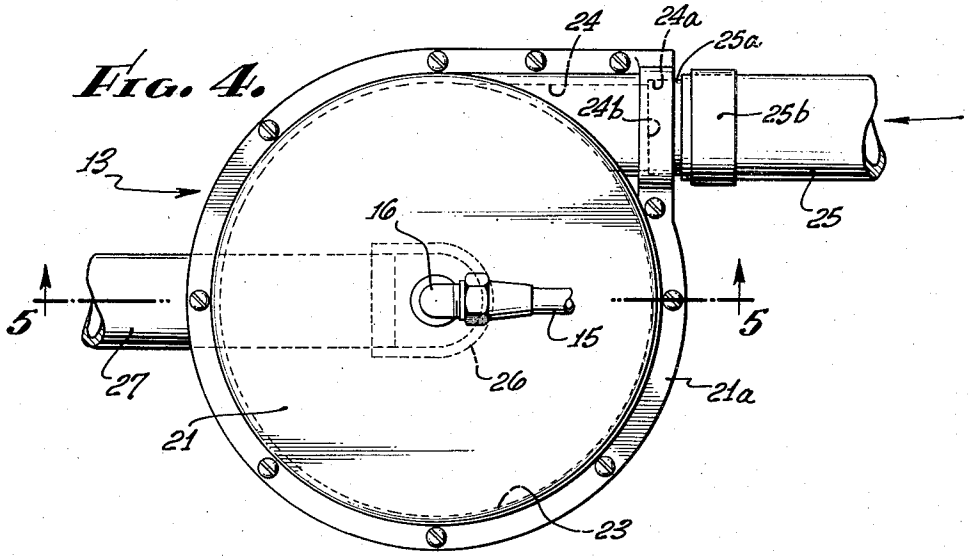


FIG. 5.

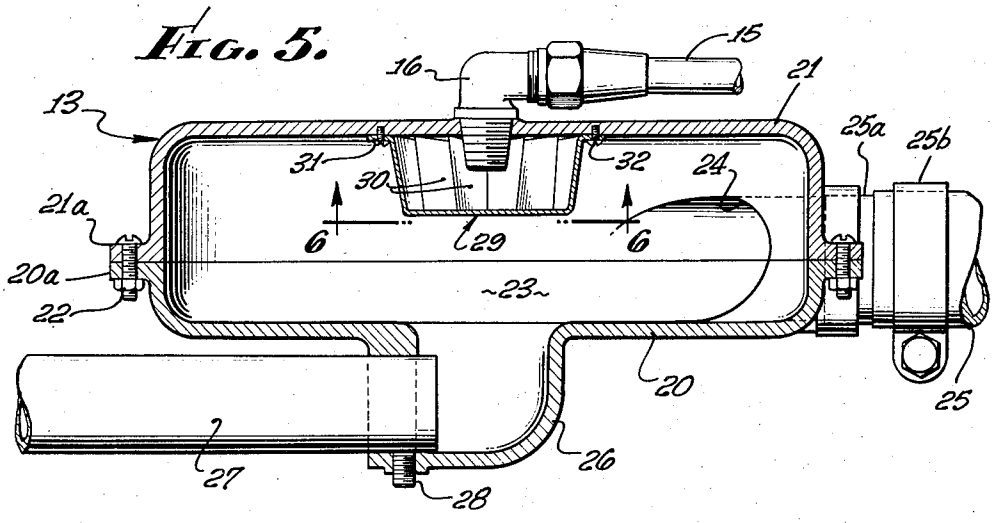
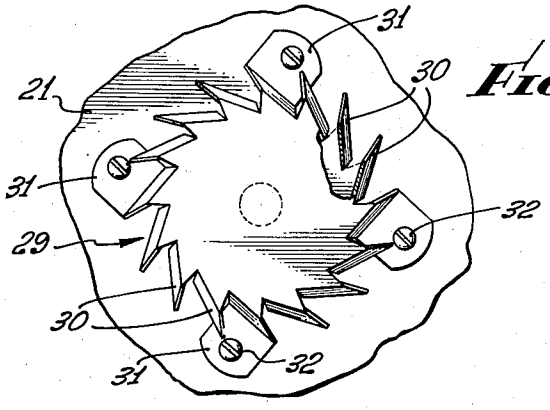


FIG. 6.



INVENTOR.
FRED A. STANDIFORD,
BY
Flam and Flam
ATTORNEYS.

United States Patent Office

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DECONTAMINATION SYSTEM

Fred A. Standiford, San Pedro, Calif.

Application January 7, 1958, Serial No. 707,543

10 Claims. (Cl. 123—119)

This invention relates to apparatus for removing, or rendering inert, air pollutants normally produced in combustion or chemical processes. This invention relates particularly to apparatus of this character for use in connection with an internal combustion engine of an automobile.

Exhaust gases from an automobile engine contain hydrocarbons in addition to water and carbon dioxide as a result of incomplete combustion. The primary object of this invention is to provide apparatus that makes it impossible for these hydrocarbons to contaminate the air.

In order to accomplish this purpose, a separator device is utilized. By the aid of this device, the heavy hydrocarbons are carried out through the exhaust pipe with the condensed moisture, and the lighter hydrocarbons are reburned by the engine. The heavy hydrocarbons do not rise in the air, and hence create no problem.

Another object of this invention is to provide improved apparatus for more completely burning the fuel supplied to the internal combustion engine, whereby not only is the engine efficiency improved, but there is the additional advantage that a small separator can operate efficiently. Thus, according to this invention, an exceedingly rich mixture of fuel is admitted into the intake manifold when the automobile is decelerating and when the throttle is closed. In order to minimize the job required to be done by the separator, air is bypassed about the carburetor to the intake manifold during conditions of high vacuum. Accordingly, the fuel is more completely burned and the separator can more effectively operate.

In order to ensure effective operation of the separator, gases are cooled in advance of the separator to a temperature below the boiling point of water. Accordingly, water vapor can be used as a medium for conducting the heavy hydrocarbons to the roadway.

Another object of this invention is to provide apparatus for improving the efficiency of an internal combustion engine.

Another object of this invention is to provide simple apparatus for accomplishing these results and which is readily installed in an automobile.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a diagrammatic view illustrating the various parts embodying the present invention;

Fig. 2 is an enlarged fragmentary sectional view illustrating a portion of the air cleaner and the bypass structure;

Fig. 3 is an enlarged sectional view taken along the plane indicated by line 3—3 of Fig. 1;

Fig. 4 is an enlarged top plan view of the separator illustrated in Fig. 1;

Fig. 5 is a further enlarged sectional view taken along the plane indicated by line 5—5 of Fig. 4; and

Fig. 6 is an enlarged plan view of the collector device incorporated within the separator and taken along the plane indicated by line 6—6 of Fig. 5, a portion of the apparatus being broken away and illustrated in section.

In Fig. 1, an engine block **10** is illustrated. Exhaust gases, including water vapor and carbon dioxide, pass from the engine via a conduit **11** to a cooler **12** and thence to a separator **13**. The temperature of the gases in the separator **13** is below the boiling point of water. The moisture thus condensed in cooler **12** acts as a vehicle for carrying the heavy, incompletely burned hydrocarbons out of the separator **13** and to a tailpipe **27**.

The lighter gases in the separator **13** are returned to the engine. For this purpose, a conduit **15** is provided. One end of the conduit **15** connects with a fitting or elbow **16** at the upper side of the separator **13**, and the other end of the conduit **15** projects into the carburetor **19**. The light gases are accordingly discharged and recirculated to the engine and burned.

The separator **13** is shown in detail in Figs. 4, 5 and 6. It comprises a circular casing made of two parts **20** and **21**. These parts have peripheral flanges **20***a* and **21***a* held together by a series of nuts and bolts **22** or other fastening means. The casing parts **20** and **21** provide a flattened, generally circular chamber **23**. Exhaust gases at a temperature below 212° F. are fed into the chamber **23** in a tangential direction. For this purpose, the casing parts **20** and **21** provide a tangential inlet **24** to the chamber **23**. A conduit **25** from the cooler **12** telescopes over a nipple **25***a* that projects into the opening **24***a* of the inlet **24**, the end of the conduit **25** abutting a shoulder **24***b* formed by the complementary casing parts **20** and **21**. A clamp **25***b* compresses conduit **25** over nipple **25***a*.

The circular motion of exhaust gas in the chamber **23** causes the heavy particles, including water, to collect along the outer walls of the chamber **23** and the light particles to collect at the center of the chamber **23**. The heavy impurities are carried by the water to a central drain **26** formed integrally on the lower casing part **20**. The drain **26** is in the form of an elbow with which the tail piece **27** cooperates. The tailpiece **27** projects within the drain **26** and is held in position by the aid of a set screw **28** or other suitable means.

The lighter gases at the upper central portion of the chamber **23** pass into the fitting **16**. The fitting **16** is in the form of an elbow, one end being threadedly accommodated centrally of the upper casing part **21**.

The normal pressure of gases at the area of the fitting **16** is low by virtue of the circular motion of fluid. In order to ensure that the gases are at a pressure sufficient to be drawn into the intake manifold through the carburetor **19**, a collector **29** is provided. This collector **29** acts virtually as a pump in order to increase the pressure of gases at the center of the chamber **23**. The collector **29** is in the form of a cup, the sides of which provide a series of vanes **30** equiangularly located about the axis of the collector **29** and providing communication between the inside and outside of the collector. The vanes effectively scoop gases to the interior of the collector **29** into which the fitting **16** projects. To ensure this result, the vanes **30** extend angularly in a direction opposite the motions of the gases in the chamber **23**. Although stationary, the collector **29** acts as a centrifugal impeller.

The collector **29** conveniently can be made of flat

sheet metal material or the like, appropriately cut and bent to provide the desired configuration. The flat metal is radially cut, providing a series of tabs. The tabs are each bent along lines L that are inclined to a line radially of the collector. The ends of the tabs are squared off so that they fit the upper casing part 21. Ears 31 are formed at the ends of some of the vanes to provide a means of attachment of the collector 29 to the casing part 21. Screws 32 or the like serve to secure the ears 31 in position. By providing a sufficient angularity of the vanes 30, sufficient pressure is developed at the interior of the collector 29 such that the lighter gases may be effectively recirculated to the engine.

It is vital that the separation accomplished by the separator 13 takes place at a temperature below the boiling point of water. To ensure this result, the cooler 12 is provided between the separator 13 and the exhaust manifold of the engine block 10. The cooler 12 comprises two end elements or headers 33 and 34, respectively providing means for connection of the conduits 11 and 25 to the cooler. A series of tubes 35 (see also Fig. 3) interconnect the headers 33 and 34 and provide a substantial area exposed to the ambient air for effective transfer of heat thereto. Preferably the tubes 35 are made of good heat-conducting material such as aluminum. The gases expand as they enter the tubes 35 from the inlet header 34, and are accordingly cooled. Both the velocity and temperature of the gases are reduced at the outlet header 33, and the gases pass to the separator 13 via the conduit 25.

In order to minimize the work required of the separator 13, provisions are made for more completely burning the fuel supplied to the engine, especially when a rich mixture would otherwise be present. A valve structure 36 is provided for this purpose. The function of the valve structure 36 is to draw air from the filter 17 to the intake manifold 37 when high vacuum conditions corresponding to rich mixtures exist in the intake manifold 37. The valve structure 36 has a tubular body 38 supported adjacent the intake manifold 37 by the aid of a fitting 39. The fitting 39 has one end secured to the intake manifold 37, and another end fits within a transverse threaded bore 38*a* of the body 38. The bore 38*a* intersects the main chamber 40 of the body 38, and hence, communication between the intake manifold 37 and the internal chamber 40 is established.

A generally tubular seat-forming insert 41, threadedly accommodated in the left-hand end of the body 38, provides an inlet fitting. A conduit 42 is attached at one end to the outer end of the seat-forming insert 41. A fitting 43 is provided for this purpose. The other end of the conduit 42 projects upwardly through a rubber grommet 44 attached at an opening of the air filter 17 so located that the air entering the conduit 42 is filtered. The grommet 44 grips the conduit and restrains movement thereof.

A movable closure structure 45, accommodated in the body chamber 40, is movable toward and away from the seat insert 41. The closure 45 has a conical head 46 engageable with a conical seat 47 formed at the inner end of the insert 41 to close the inlet. A stem 48 of the closure structure 45 extends within a hollow guide 49 threadedly accommodated in the right-hand end of the valve body 38, whereby the closure is guided for movement toward and away from the seat 47. A compression spring 50, interposed between the end of the guide 49 and the rearwardly facing shoulder 51 formed by the head 46, urges the valve toward the seat 47. Adjustment of the position of the guide 49 determines the seating force exerted by the spring 50 on the head 46. A knurled lock nut 52 holds the guide 49 in adjusted position. The outer end of the guide 49 carries a knurled knob 53 for facilitating appropriate adjustment of the guide.

Depending upon the extent of vacuum in the intake manifold 37, more or less force is exerted upon the closure head 46, tending to retract it away from the seat 47. During normal running conditions of the engine, the vacuum condition in the intake manifold 37 is insufficient to cause retraction of the closure 45. However, during conditions of idling and deceleration, high vacuum is created in the intake manifold 37, and the valve closure 46 opens. Accordingly, air is bypassed from the filter 17 directly into the intake manifold 37, and adequate air is provided for assuring more complete combustion of fuel supplied at this time. The air bypassed into the intake manifold 37 exerts no effect upon the jets in the carburetor 19 since it bypasses the carburetor structure. Accordingly, the added air does not increase the fuel drawn into the system. The separator operates efficiently because the quantity of incompletely burned hydrocarbons is minimized by the bypass valve structure.

By carefully adjusting the force exerted by the coil spring 50, just enough air is introduced for all conditions of operation.

The cooler 12 and separator 13 are readily suspended at the frame of an automobile by bracket means (not shown). The structural modifications of an existing system required for connecting the parts of the present apparatus are quite insignificant. Installation is accomplished in an expeditious manner.

The inventor claims:

1. In apparatus for removing air contaminants from an internal combustion engine having an intake manifold, a fuel admission device, and an exhaust manifold: a device for cooling exhaust gases below the boiling point of water; a separator fed by said device for precipitating heavy hydrocarbons in water vapor, said separator having a drain outlet for heavy hydrocarbons or the like and a second outlet for light hydrocarbons or the like; means for conducting said light hydrocarbons from said second outlet to the intake manifold of the engine; and means for bypassing air independently of said admission device into said intake manifold to prevent the existence of an unduly rich mixture in said intake manifold.

2. The combination as set forth in claim 1 in which said bypassing means comprises a normally closed valve structure, and means actuated by the pressure drop in said intake manifold by opening said valve structure to admit air into said intake manifold.

3. The combination as set forth in claim 1 in which said separator provides a circular chamber and a tangential inlet for centrifugal separation of light and heavy hydrocarbons, the said second outlet being located at the center of said chamber.

4. The combination as set forth in claim 1 in which said separator provides a circular chamber and a tangential inlet for centrifugal separation of light and heavy hydrocarbons, the said second outlet being located at the center of said chamber, and means for pumping the light hydrocarbons from said second outlet to the intake manifold.

5. The combination as set forth in claim 1 in which said separator provides a circular chamber and a tangential inlet for centrifugal separation of light and heavy hydrocarbons, the said second outlet being located at the center of said chamber, and collector means in said chamber and having vanes directed oppositely to the direction of movement of the gases in said chamber for elevating the pressure at said outlet at least substantially to atmospheric pressure.

6. The combination as set forth in claim 1 in which said separator provides a circular chamber and a tangential inlet for centrifugal separation of light and heavy hydrocarbons, the said second outlet being located at the center of said chamber, and a collector cup in the chamber made of sheet metal and having radial tabs bent along lines inclined to the length thereof to provide a series of vanes directed oppositely to the direction of movement of the gases in said chamber for elevating the pressure

at said outlet at least substantially to atmospheric pressure.

7. The combination as set forth in claim 1 in which said cooling device comprises a pair of headers and a series of tubular elements joining the headers.

8. The combination as set forth in claim 1 wherein there is provided an air filter, in which said bypassing means draws air from said filter at a place dependent upon the filtering action thereof.

9. The combination as set forth in claim 1 in which said bypassing means comprises a valve structure having an air inlet, an outlet connected to said intake manifold, a closure element, and adjustable means for urging the closure element to closing position, the closure element being subjected on opposite sides to inlet and outlet pressure respectively, whereby the valve closure is moved to opening position upon a sufficient preponderance in atmospheric pressure.

10. The combination as set forth in claim 1 in which said bypassing means comprises a valve structure having an air inlet, an outlet connected to said intake manifold, a closure element, and adjustable means for urging the closure element to closing position, the closure element being subjected on opposite sides to inlet and outlet pressure respectively, whereby the valve closure is moved to open the valve to an extent corresponding to the difference in inlet and outlet pressure.

No references cited.