United States Patent [19]

Hensler

[11] **3,727,597**

[45] **Apr. 17, 1973**

[54] **DEVICE FOR PRECIPITATING FUEL FROM THE VAPOR DISCHARGING FROM THE FUEL SUPPLY SYSTEM OF AN INTERNAL COMBUSTION ENGINE**

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[22] Filed: **May 8, 1970**

[21] Appl. No.: **35,666**

[30] **Foreign Application Priority Data**

May 28, 1969 Germany.....P 19 27 046.3

[52] **U.S. Cl.** **123/136,** 55/316, 55/387, 55/472, 55/486, 210/493

[51] **Int. Cl.**.....**B01d 50/00,** F02m 59/00

[58] **Field of Search** 123/136; 55/316, 55/387, 524, 472, 485–487; 98/2.05–2.08; 210/498, 502, 503, 508, 493

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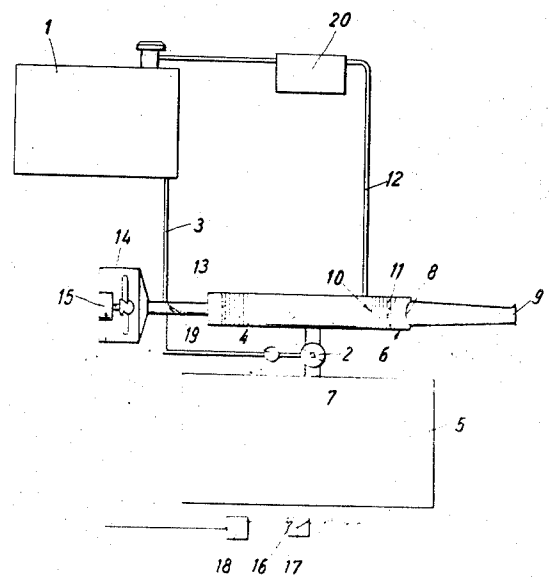
[57] **ABSTRACT**

A device for precipitating fuel from the vapor discharging from the fuel supply system of an internal combustion engine in which the fuel tank and the mixture-forming system, especially the carburetor float chamber, is connected through pipe lines to a chamber sealed to the atmosphere and defined by the volume of the intake air filter. A filter insert is placed ahead of the air intake and has a layer of activated carbon which absorbs the fuel particles from the vapor passing through the filter. The intake air filter is also provided with an exhaust-connecting piece which is connected to the suction side of a blower exhausting into the atmosphere. The blower is driven by an electric motor which is supplied with power through a contact provided in the starting-ignition switch and a time-control element which automatically interrupts the current supply to the blower motor after a predetermined time period.

13 Claims, 4 Drawing Figures



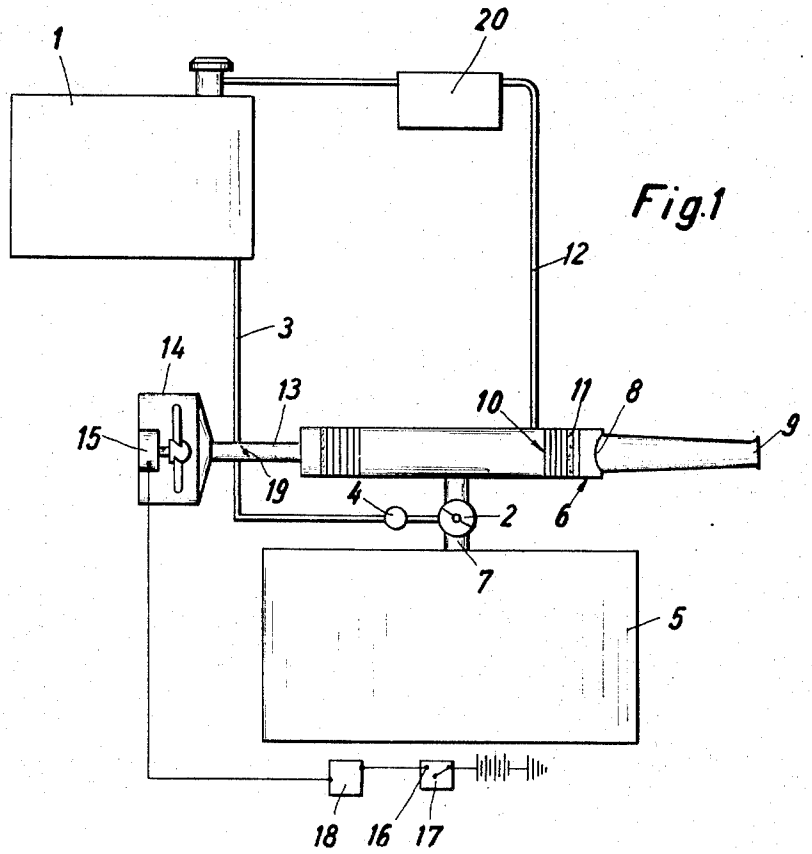


Fig.1

Fig.2

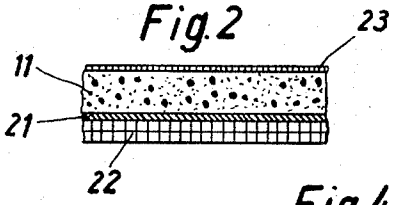


Fig.3

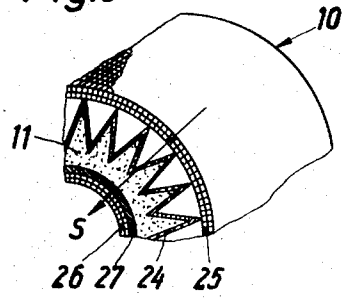
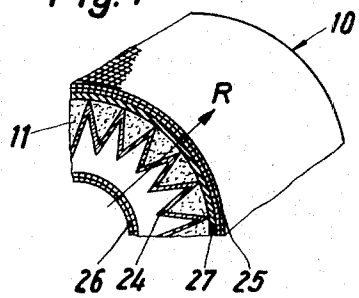


Fig.4



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DEVICE FOR PRECIPITATING FUEL FROM THE VAPOR DISCHARGING FROM THE FUEL SUPPLY SYSTEM OF AN INTERNAL COMBUSTION ENGINE

BACKGROUND OF THE INVENTION

The present invention relates to a device for precipitating fuel from the air discharging from the fuel supply system of an internal combustion engine, especially for motor vehicles driven by an internal combustion engine, and more particularly, to a device wherein the fuel tank and the mixture-forming system, especially the carburetor float chamber, is connected through pipelines to a chamber sealed to the atmosphere.

As seen in the Sept. 15, 1968 issue of "Automotive Industries" at page 50, it is known to provide a device for mounting into a motor vehicle for stopping polution of the air by fuel vapor exhaust from the fuel supply system of the internal combustion engine of a stopped motor vehicle. In this known device, the fuel tank and the mixture-forming system are connected through pipelines to a separator sealed against the atmosphere. The separator is subdivided in a number of sections by means of baffles which are arranged in sequence so that step-like mechanical separation of the fuel particles from the air takes place and the fuel collected in the last section is sucked off when the engine is started. This section is in communication with the suction intake pipe of the internal combustion engine through a suction pipe.

Separation of the fuel from the air by purely mechanical means requires a separator of large volume, the volume of which must become larger as the temperature of the fuel vapor to be treated becomes warmer. In motor vehicles of modern construction, it is hardly possible to house an adequately large separator which can cope with the accumulated fuel vapor from the mixture-forming system, especially when the internal combustion is still hot. A heat insulation of the larger portion of the mixture-forming system and, especially, the carburetor float chamber against the motor block must be provided in known arrangements.

In order to prevent a discharge of fuel vapor from the air filter of the internal combustion engine, a controlled valve or flap is finally required to close the suction opening of the air filter during shut-down of the internal combustion engine. Aside from the considerable expense for the heat insulation and the closure of the mixture-forming system, the housing of the separator volume and placing of the required piping of such an installation presents considerable difficulties in modern motor vehicles.

SUMMARY OF THE INVENTION

It is the aim of the present invention to overcome the above-mentioned problems and disadvantages of known devices.

It is a main object of the present invention to stop polution of the air by fuel vapor exhausting from the fuel supply system of the internal combustion engine of a stopped motor vehicle.

It is a further object of the present invention to provide a device which may be installed subsequently without requiring structural changes to the internal combustion engine of the motor vehicle and which assures an optimum degree of trouble-free operation and functional safety.

The underlying problems are solved in accordance with the present invention by providing that the chamber onto which the fuel tank and the mixture-forming system are connected is formed through the volume of the suction air or intake filter of the internal combustion engine, whereby a filter is placed ahead of the air intake or other openings in the suction air filter which prevents passage of fuel particles. The filter ahead of the opening in the suction air filter is provided with a layer of activated carbon which absorbs the fuel particles from the air passing through the filter.

In accordance with a preferred embodiment of the present invention, it is provided that the filter, which is placed ahead of the openings of the suction air filter, is formed through a filter insert of the suction air filter and coated with activated carbon. In order to obtain a quick and sure removal of the fuel vapor present in the fuel tank and mixture-forming system immediately after shut-down of the internal combustion engine, it may be further provided that the suction air filter has a special exhaust connecting piece which is connected to the suction side of a blower exhausting into the atmosphere, whereby a filter coated with activated carbon is arranged ahead or in this exhaust connecting piece.

In an especially advantageous manner, use can be made of the blower for the heat and cold air supply in the air-conditioning installation of the motor vehicle which is available. In accordance with the present invention the blowers which are driven by electric motors are, in an inventive manner, supplied with current for the suction process through a contact provided in the starting-ignition switch, whereby a time-control element is also provided which automatically interrupts the current supply to the blower motor after a predetermined time period, which blower motor is sufficient for exhausting the fuel vapor from the fuel supply system of the internal combustion engine.

In addition, provision may also be made for inserting an expansion tank in the piping from the fuel tank to the intake or suction air filter at a suitable point for the mechanical separation of fuel particles from the air discharging from the fuel tank. In this manner, an overloading of the activated carbon filter through the continuously discharging fuel vapor from the fuel tank is prevented, especially when the motor vehicle is stopped for longer times and, for example, heated by the rays of the sun.

Through utilization of the available volume of the suction filter of the internal combustion engine and the use of activated carbon filters for cleaning the air discharging from this volume, the present invention minimizes the discharge of fuel vapor from the fuel supply system of the internal combustion engine of a motor vehicle and the device may subsequently be built into the motor vehicle without structural changes of the motor vehicle or the internal combustion engine.

The use of an activated carbon filter has the further advantage in that the filter insert of the intake air filter which is also available anyhow is simply matched to the requirements of the device of the present invention through a coating of activated carbon, whereby use of activated carbon has the further advantage that it is

constantly regenerated during operation of the internal combustion engine by the fresh air sucked through the filter and, therefore, is available for absorption of the fuel particles at each shut-down to a full degree.

Further, inasmuch as the air filter insert must be renewed after certain time periods depending upon the driving power of the motor vehicle, renewal of the activated carbon filter at certain intervals is also assured. The device of the present invention therefore does not require special attention either by the user or by the customer service department so that an optimum operational safety is assured.

In accordance with still further advantageous features of the present invention, it is provided that the filter ahead of the openings of the suction air filter consists of a mesh as a support covered with linen cloth, a coating of activated carbon and filter paper covering the same. Filter inserts in which a layer of folded filter paper is arranged in a basket consisting of a mesh or the like may be provided at the inner circumference of the basket with a covering of linen cloth, whereby the hollow spaces between the folds of the filter paper and the outer circumference of the basket is filled with activated carbon. Both constructions of an air filter insert have the advantage of simple manufacture and allow the installation of a sufficient amount of activated carbon without deviating from the customery shape of filter inserts.

BRIEF DESCRIPTION OF THE DRAWING

These and further aims, advantages and features of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawing which shows, for purposes of illustration only, several embodiments in accordance with the present invention and wherein:

FIG. **1** is a schematic view of a fuel supply system for the internal combustion engine of a motor vehicle in connection with the fuel separating device of the present invention;

FIG. **2** is a partial cross-sectional view of the general construction of a filter coated with activated carbon for the device of the present invention;

FIG. **3** is a partial, sectionalized perspective view illustrating a filter insert coated with activated carbon for a suction air filter; and

FIG. **4** is a view similar to FIG. **3** showing another construction of a filter insert coated with activated carbon for a suction air filter.

DETAILED DESCRIPTION OF THE DRAWING

Referring now to the drawing and, in particular, to FIG. **1**, it is seen that fuel is to be delivered from a fuel tank **1** to a float chamber of carburetor **2** through a line **3** and a fuel booster pump **4**. During operation of an internal combustion engine **5**, the fuel which is simultaneously mixed with combustion air drawn in through an air intake or suction filter **6** arrives in the intake pipe **7** of the internal combustion engine **5** through which the fuel-air mixture is fed into the combustion chambers of the internal combustion engine. It is also clear that a conventional fuel injection pump can be provided in place of the carburetor **2**.

The air intake or suction filter **6** is provided with a suction opening **8** ahead of which is arranged an air funnel **9**. A filter insert **10** is arranged inside the air filter **6** and covers the entire height of the air intake filter **6**. The filter insert **10** is provided with a coating **11** of activated carbon which absorbs the fuel particles from the air passing through the filter insert **10**.

Aside from the intake pipe **7** of the internal combustion engine **5**, a passage **12** leading to the fuel tank **1** is connected to the volume of the intake air or suction filter **6** defined by the filter insert **10** so that the developing or existing fuel vaper inside the fuel supply system when the internal combustion engine **5** is not in operation cannot escape into the atmosphere without passing through the filter insert **10**, whereby the fuel portion is removed by the activated carbon coating **11** so that the vapor is essentially fuel-free, that is, clean air may emerge from the intake filter **6**.

In order to attain a quick removal of the existing and developing fuel vapor after the internal combustion engine **5** is shut-down, the air intake filter **6** is provided with a special exhaust-connecting piece **13** which is connected with the intake side of a blower **14** discharging into the atmosphere. The fuel vapor drawn by the blower **14** from the fuel supply system must pass through the activated carbon-coated filter insert **10** in its path to the atmosphere, whereby the fuel particles are removed by the activated carbon **11**. The blower **14** is driven by an electric motor **15**, the power source of which includes a contact **16** in the starting-ignition switch **17** and a time-control element **18**, whereby the power source of the electric motor **15** is automatically energized through the contact **16** in the starting-ignition switch **17** when the internal combustion engine **5** is shut-down and is automatically disconnected through the time-control element **18** after a predetermined time period or span.

In order to avoid an impairment of the flow characteristics in the intake system through the exhaust-connecting piece **13** during operation of the internal combustion engine **5**, a closing flap **19** is inserted into the exhaust-connecting piece **13** which prevents air passage in the direction of suction to the intake air filter **6**. To avoid overloading, the activated carbon coating layer **11** through continuously emerging fuel vapor from the fuel tank during longer periods of storing the motor vehicle, an expansion tank **20** is inserted into the flow path **12** at an appropriate position through which at least a considerable portion of the vapor emerging from the fuel tank **1** is separated mechanically.

The activated carbon coated filter, shown in FIG. **2**, consists of a mesh **22** as a support and is covered with linen cloth **21**, a coating of activated carbon **11** and filter paper **23** covering the activated carbon **11**. This arrangement is selected so that the more intensely flowing intake air of the internal combustion engine **5** flows first through the filter paper **23**, then through the activated carbon layer **11** and finally through the support covered with linen cloth **21** and mesh **22**.

Practical embodiments of such a construction of a filter insert **10** are exemplified in FIGS. **3** and **4**. As seen in FIG. **3**, the filter insert **10** has a layer of folded filter paper **24** arranged in a circular basket consisting of an outer mesh **25** and an inner mesh **26** whereby the inner mesh **26** is covered with linen cloth **27**. The coating **11** with activated carbon is thereby formed so that

the hollow spaces formed between the folds of the filter paper **24** and the inner mesh **26**, that is the linen cloth **27** covering it, are filled with activated carbon **11**. With this particular construction of the filter insert **10**, the fuel vapor enters the filter through the inner mesh **26** and is freed of fuel particles through the activated carbon layer **11**. The intake air for the internal combustion engine **5**, on the other hand, enters through the outer mesh **25** and passes through the activated carbon layer **11** in the direction of arrow S, whereby simultaneously a regeneration of the activated carbon layer takes place.

The filter insert **10** illustrated in FIG. **4** is of basically the same construction as that shown in FIG. **3**. However, the difference resides in the consideration of the reversed flow direction in the direction of arrow R of the intake air with the hollow spaces formed between the folds of the filter paper **24** and the outer mesh **25** provided with linen cloth covering **27** being filled with activated carbon **11**.

With the fuel supply system in accordance wih the present invention, the fuel vapor rising either through internal heat energy or under the effect of blower **14** in the intake filter **6** is partially precipitated by mechanical means through the chamber of the intake filter **6** or is freed of fuel particles with the passage through the activated carbon coated filter insert **10**, whereby the activated carbon **11** absorbs the fuel particles. During operation of the internal combustion engine **5**, fresh air passes through the activated carbon layer **11** and is regenerated under the effect of fresh air so that at the time of the shut-down of the internal combustion engine **5**, regenerated activated carbon is always available for renewed absorption of fuel particles.

While I have shown and described several embodiments in accordance with the present invention, it is to be clearly understood that the same is susceptible to numerous changes and modifications as will be apparent to a person skilled in the art, and I, therefore, do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as encompassed by the scope of the present invention.

I claim:

1. Device for adsorbing fuel from the vapor emerging from the fuel supply system of an internal combustion engine, especially for motor vehicles, comprising a fuel tank, mixture-forming means, an air filter housing having air-intake means and first and second air outlet means, said first air outlet means communicating with the internal combustion engine, air filter means arranged in said air filter housing between said intake air means and said first air outlet means and between said first air outlet means and said second air outlet means said air filter means forming a chamber within said air filter housing, passage means connecting said fuel tank and said mixture-forming means to said chamber such that said passage means communicates with atmosphere only by way of said air filter means, said air filter means filtering air and adsorbing fuel from the vapor passing therethrough, and suction means connected to said second air outlet means for drawing vapor within said chamber from said chamber through said air filter means such that the fuel portion of the vapor is adsorbed by said air filter means and filtered air is discharged to atmosphere.

2. Device according to claim **1**, wherein expansion tank means is provided in the passage means from the fuel tank to said chamber.

3. Device according to claim **1**, wherein the mixture-forming means connected to the chamber includes a carburetor float chamber.

4. Device according to claim **1**, wherein the mixture-forming means connected to the chamber includes a carburetor float chamber.

5. Device according to claim **1**, wherein the air filter means is provided with a layer of activated carbon for adsorbing fuel vapor.

6. Device according to claim **1**, wherein said suction means connected to said second air outlet means includes blower means.

7. Device according to claim **6**, wherein electric motor means is provided for driving the blower means, the power source of the motor means being provided through a contact in the starting-ignition switch and a time control means so that the power source for the blower motor is switched on during disconnecting of the starting-ignition switch and is switched off after a certain time by the time control means.

8. Device according to claim **1**, wherein the air filter means includes a mesh constructed as a support, a linen cloth covering arranged on the mesh, filter paper associated therewith, and activated carbon coating arranged between the cloth covering and the filter paper for adsorbing fuel vapor.

9. Device according to claim **8**, wherein the mesh is in the form of a basket having an inner and outer circumference, the filter paper being in a folded condition and inserted in the basket, the linen cloth covering being arranged at the inner basket circumference, and the activated carbon being provided in the folds of the filter paper creating hollow spaces.

10. Device according to claim **8**, wherein the mesh is in the form of a basket having an inner and outer circumference, the filter paper being in a folded condition and inserted in the basket, the linen cloth covering being arranged at the outer basket circumference, and the activated carbon being provided between the cloth covering and the folds of the filter paper creating hollow spaces.

11. Device according to claim **8**, wherein said suction means connected to said second air outlet means includes blower means.

12. Device according to claim **11**, wherein electric motor means is provided for driving the blower means, the power source of the motor means being provided through a contact in the starting-ignition switch and a time control means so that the power source for the blower motor is switched on during disconnecting of the starting-ignition switch and is switched off after a certain time by the time control means.

13. Device according to claim **12**, wherein expansion tank means is provided in the passage means from the fuel tank to said chamber.

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