United States Patent

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[54] **UNITARY ENGINE VAPOR RECYCLING DEVICE**
16 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **123/119**
[51] **Int. Cl.** **F02f 9/02**
[50] **Field of Search** ..... 123/119 (B), 119

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ABSTRACT: A unitary engine vapor recycling device for connection between the sealed crankcase and manifold of an engine. The device has a jacketed sleeve forming an outer chamber, and valve means are disposed in the sleeve which are responsive to manifold vacuum (or crankcase pressure). The sleeve is provided with ports at various levels, and the sleeve interior is blocked so that gases must pass through the chamber to get to the discharge end of the device. A restriction is placed in the chamber adjacent the blocked portion of the sleeve.

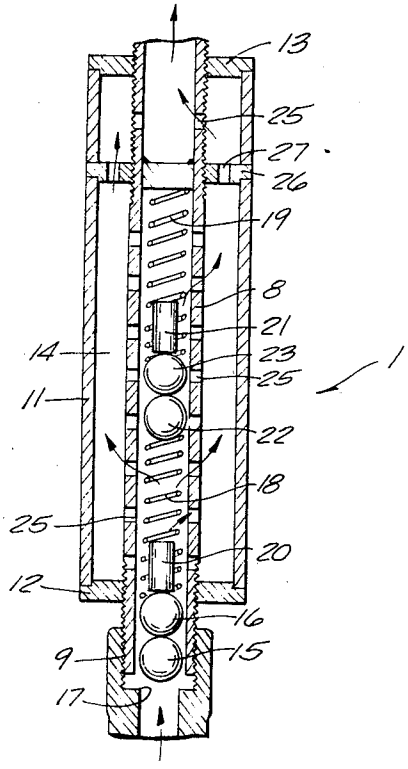
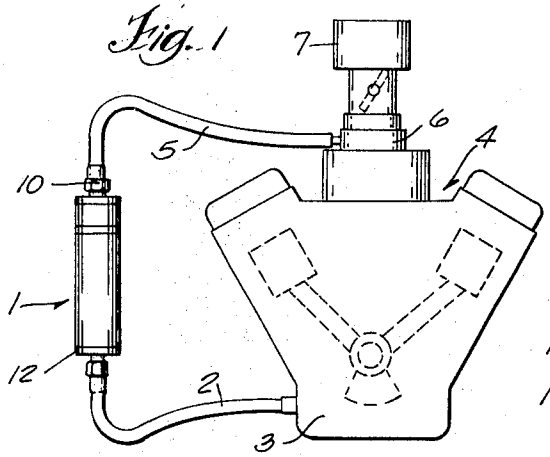


Fig. 1



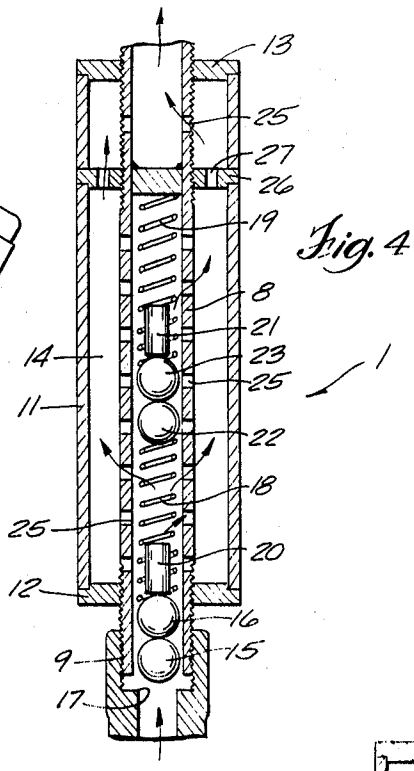


Fig. 4

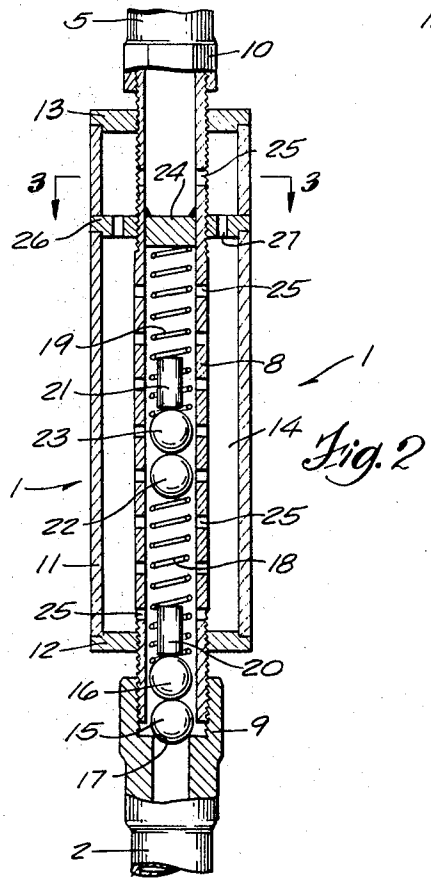


Fig. 2

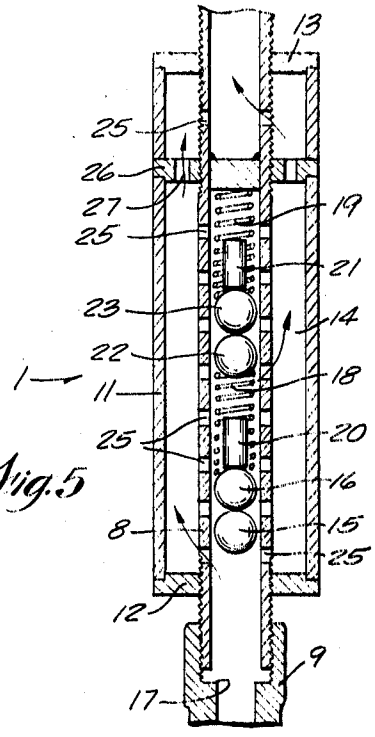


Fig. 5

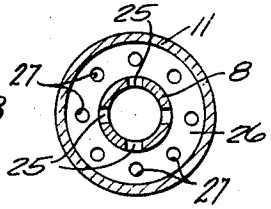


Fig. 3

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UNITARY ENGINE VAPOR RECYCLING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to a unitary engine vapor recycling device, which is an improvement on the device disclosed in the present inventor's copending application Ser. No. 632,038, filed Apr. 19, 1967 now U.S. Pat. No. 3,450,114, entitled "ENGINE VAPOR RECYCLING," and assigned to a common assignee.

In that application, a multivalve system was utilized in connection with separation of undesirable constituents from engine gases. One separate valve means was disclosed which opened in response to low manifold vacuum (or low pressure in a sealed crankcase) to return the gases to the manifold of an engine. A second separate valve means, which included several valves, was responsive to high vacuum or pressure to also return the gases.

SUMMARY OF THE INVENTION

The present invention is directed to a simplified arrangement which combines the low and high vacuum (pressure) valve-responsive function in a single unitary valve structure. While a separate gas filter might be utilized, if desired, it has been found that the device of the invention alone provides extremely adequate impurity removal.

DESCRIPTION OF THE DRAWING

The accompanying drawing illustrates the best mode presently contemplated by the inventor for carrying out the invention.

In the drawing:

FIG. 1 is a schematic showing of an engine having the improved engine vapor recycling device connected thereto;

FIG. 2 is a central vertical section of the recycling device shown in FIG. 1, and showing the position of the valve means when the engine is off;

FIG. 3 is a transverse section taken on line 3–3 of FIG. 2;

FIG. 4 is a view similar to FIG. 2, when the engine is idling; and

FIG. 5 is a view similar to FIGS. 2 and 4, when the engine is throttled to above idling speed.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown generally in FIG. 1 of the drawing, the invention is embodied in a gas treatment device 1 which is connected through a suitable passage or conduit 2 to the sealed crankcase 3 of a conventional internal combustion engine 4. Similarly, device 1 is connected through a suitable passage or conduit 5 to the intake manifold 6 of engine 4. A carburetor 7 of any suitable design is mounted adjacent manifold 6.

Device 1 is adapted to receive polluted gases from crankcase 3 through conduit 2, treat them, and then discharge the treated gases through conduit 5 where they return to manifold 6. For this purpose, and as shown in FIGS. 2 & 3, device 1 includes a gas passage comprising an elongated tubular sleeve 8 which is preferably connected directly between conduits 2 and 5. The lower or gas-entrance end of sleeve 8 is connected to conduit 2, as through a coupling 9; while the upper or gas-discharge end of sleeve 8 is connected to conduit 5, as through a coupling 10. At least the lower and upper ends of sleeve 8 are threaded to provide the connection to couplings 9 and 10.

In accordance with the invention, sleeve 8 is sealingly jacketed throughout the major portion of its extent between the end couplings. For this purpose, a cylindrical jacket 11 is disposed in outwardly spaced concentric relationship with the sleeve, and is sealingly secured at its ends to the sleeve as by ringlike closed end caps 12 and 13 which may be threaded thereonto. The jacketed space around sleeve 8 forms a chamber 14, for purposes to be described.

Sleeve 8 forms a portion of a valve means which is responsive to both low and high manifold vacuum (and crankcase pressure) for permitting transfer of engine gases. As shown, a

pair of engaging valve balls 15, 16 are slideably disposed in the lower end of sleeve 8, with ball 15 being normally seated against a valve seat 17 disposed in lower coupling 9 when the engine is off, as in FIG. 2. Ball 15 is biased against its seat by an assembly including a pair of springs 18 and 19 having suitable internal supports 20 and 21. A pair of intermediate engaging balls 22 and 23 are disposed between springs 18 and 19 and form therewith a biasing assembly confined within sleeve 8 between ball 16 and an upper stop 24. Stop 24 is separate from the valve and also serves to block off the interior of the sleeve to gas movement, as will be described.

Balls 15, 16, 22 and 23 are all very slightly smaller in diameter than the inside diameter of sleeve 8 to provide free sliding and a loose fit therewithin and to permit passage of a very small controlled amount of gases thereby.

A plurality of openings or ports 25 are provided in sleeve 8 between jacket end caps 12 and 13. Ports 25 are axially spaced a distance equal to a ball diameter, so that in FIG. 2, balls 22 and 23 are positioned on adjacent port centers. As shown, there may be more than one port 25 at each level of the sleeve, with the lowermost set of ports disposed just slightly inside of cap 12. In the engine-off condition of FIG. 2, balls 15 and 16 are disposed just below the lowermost ports 25 with ball 15 seated on seat 17.

To provide a bypassing communication between the interior of the lower and upper sleeve portions, which are sealingly separated by an operatively fixed stop 24, at least one set of ports 25 must be disposed above the stop in the sleeve wall. While the drawing shows only one such set of ports, ports at two or more axial levels may be utilized without departing from the spirit of the invention.

As shown in FIG. 4, after the engine is started and is in idling condition, a relatively low manifold vacuum and crankcase pressure will cause ball 15 to unseat from seat 17, and rise slightly therefrom. However, the vacuum (pressure) is insufficient to raise either ball 15 or 16 to the level of lowermost sleeve ports 25. That is, both balls will remain below these lowermost ports. A small amount of engine gases will thus be permitted to bypass balls 15 and 16 into the lower portion of sleeve 8. Hence a portion of the gases will pass radially outwardly through ports 25 below balls 22 and 23 and into jacket chamber 14. Another portion of the gases will move up through sleeve 8 and will bypass balls 22 and 23, and will pass radially outwardly into chamber 14 through ports 25 which are between balls 22, 23 and stop 24. In order to be discharged from the device, all of the gases must now pass from chamber 14 radially inwardly through uppermost ports 25 above stop 24 into sleeve 8 and hence back to the engine through conduit 5.

As shown in FIG. 5, when the engine throttle is initially actuated, a higher vacuum (pressure) will cause ball 15 to unseat further, and to rise freely against the spring biasing force until it is disposed above lowermost ports 25. This will quickly increase the volumetric rate of gas flow into the unit. While a portion of the gases will bypass balls 15, 16, 22 and 23, the major portion will now flow into chamber 14 through lowermost ports 25, and ultimately hence to conduit 5.

In accordance with the invention, a restriction means is provided to control the volumetric rate of gas discharge from the device. For this purpose, a restriction is placed in chamber 14, and in the present embodiment comprises an annular baffle plate or ring 26 sealingly disposed with the jacket walls and positioned about at the same axial position or level as stop 24, below the uppermost set of ports 25. A plurality of restrictive openings 27 of selected size and number are disposed in ring 26, through which all gases must pass in order to be discharged from chamber 14 and to gain entrance to the discharge end of sleeve 8 through uppermost ports 25.

In the case of high engine operating speeds, wherein a large volume of gases will pass from crankcase 3 into the recycling device, the restriction created by ring 26 will cause a pressure rise within the device below ring 26, which will force ball 15 downwardly from the position shown in FIG. 5 to approxi-

mately that shown in FIG. 4. This will put an even greater back pressure on the sealed crankcase, and serves as an equalizer.

In all cases, the space between the inner sleeve walls and the balls, together with ports **25** and baffle ring **26**, will provide a frictional resistance to gas flow as well as a highly tortuous path therefor. It has been found that the effect of these elements is to cause the undesirable unburned fumes and other pollutants in the engine gases to be separated therefrom to a large degree. These unwanted materials will collect on the various surfaces and edges of the device and will drain downwardly in the form of sludge and collect and accumulate at the level of lower cap **12**, both within sleeve **8** and in chamber **14**. When ball **15** is disposed above lowermost ports **25**, during throttled high speed engine operation, the sludge will drain out through lowermost ports **25** and through coupling **9**. If desired, the drained sludge may be removed from conduit **2** by an automatic drain valve system such as that disclosed in the above-identified application.

Various modes of carrying out the invention are contemplated by the inventor.

The following claims particularly point out and distinctly claim the subject matter which is regarded as the invention.

I claim:

1. An engine vapor recycling device for connection between the crankcase and manifold of an internal combustion engine, comprising, in combination:

a. a sleeve forming a gas passage and having a gas entrance end and a gas discharge end;

b. said sleeve having a plurality of axially spaced ports therein;

c. a jacket sealingly and concentrically surrounding said sleeve and forming an annular chamber therebetween for receiving gases passing through said ports;

d. valve means disposed adjacent the said entrance end of said sleeve, said valve means being normally closed but being openable in response to manifold vacuum or crankcase pressure to allow engine gases to enter the device;

e. and gas blocking means sealingly disposed in said sleeve passage separate from said valve means; and

f. at least one of said sleeve ports being disposed between said blocking means and said discharge end of said sleeve so that gases bypassing said blocking means through said chamber will pass back into the discharge end of said sleeve.

2. The device of claim **1** which includes restriction means in said chamber for controlling the volumetric rate of gas discharge from said chamber so that high speed engine operation will create a gas pressure buildup within the device.

3. The device of claim **2** wherein said restriction means comprises a baffle member having a plurality of restrictive openings therein.

4. The device of claim **3** in which said baffle member is disposed in relation to said sleeve discharge end so that at least one said sleeve port is disposed therebetween within said chamber.

5. The device of claim **4** in which said baffle member is disposed at about the same axial level of said sleeve as said blocking means.

6. The device of claim **1** wherein said valve means comprises:

a. a valve seat disposed adjacent the entrance end of said sleeve;

b. a valve ball freely slideable and loosely fitting in said sleeve; and

c. and means within said sleeve for biasing said ball against said seat.

7. The device of claim **6** wherein said biasing means comprises spring means extending between said blocking means and said ball.

8. The device of claim **6** wherein said ball, when seated, is disposed between the lowermost sleeve port and said sleeve entrance end.

9. The device of claim **8** wherein said ball, during at least a portion of engine operation, is disposed axially inwardly of the lowermost sleeve port, within said chamber.

10. The device of claim **9** wherein said last-named lowermost sleeve port comprises a drain means for pollutants collected within said chamber.

11. The device of claim **1** wherein said valve means comprises:

a. a valve seat disposed adjacent the entrance end of said sleeve;

b. and a valve assembly comprising:

1. a pair of springs disposed within said chamber,

2. a first pair of engaging valve balls disposed between said springs,

3. a second pair of engaging valve balls disposed between the outer end of one spring and said seat, with one of said balls being normally engaged with said seat,

4. said balls being freely slideable and loosely fitting within said sleeve for passage of gases thereby.

12. The device of claim **11** wherein said sleeve ports are axially spaced a distance equal to a ball diameter.

13. The device of claim **11** wherein said valve assembly is biasingly disposed between said blocking means and said seat.

14. An engine vapor recycling device for connection between the crankcase and manifold of an internal combustion engine, comprising, in combination:

a. a sleeve forming a gas passage and having a gas entrance end and a gas discharge end;

b. said sleeve having a plurality of axially spaced ports therein;

c. a jacket sealingly and concentrically surrounding said sleeve and forming an annular chamber therebetween for receiving gases passing through said ports;

d. valve means disposed adjacent the said entrance end of said sleeve, said valve means being normally closed but being openable in response to manifold vacuum or crankcase pressure to allow engine gases to enter the device and comprising:

1. a valve seat disposed adjacent the entrance end of said sleeve,

2. a valve ball freely slideable and loosely fitting in said sleeve to permit passage of gases therebetween,

3. and means within said sleeve for biasing said ball against said seat,

e. and a baffle member disposed in said chamber end having a plurality of restrictive openings therein;

f. said ports, ball and baffle member providing frictional resistance to and a tortuous path for the passage of gases to thereby separate undesireable pollutants therefrom.

15. The device of claim **14** wherein the lowermost of said ports provides a drain means for pollutants accumulated in said chamber.

16. The device of claim **1** in which said blocking means is operatively fixed in said sleeve.