

[54] **BUTTON VALVE EXHAUST GAS RECIRCULATION SYSTEM**

3,675,633 7/1972 Nakajima et al. 123/119 A

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[58] Field of Search 123/119 A; 251/263

[56] **References Cited**

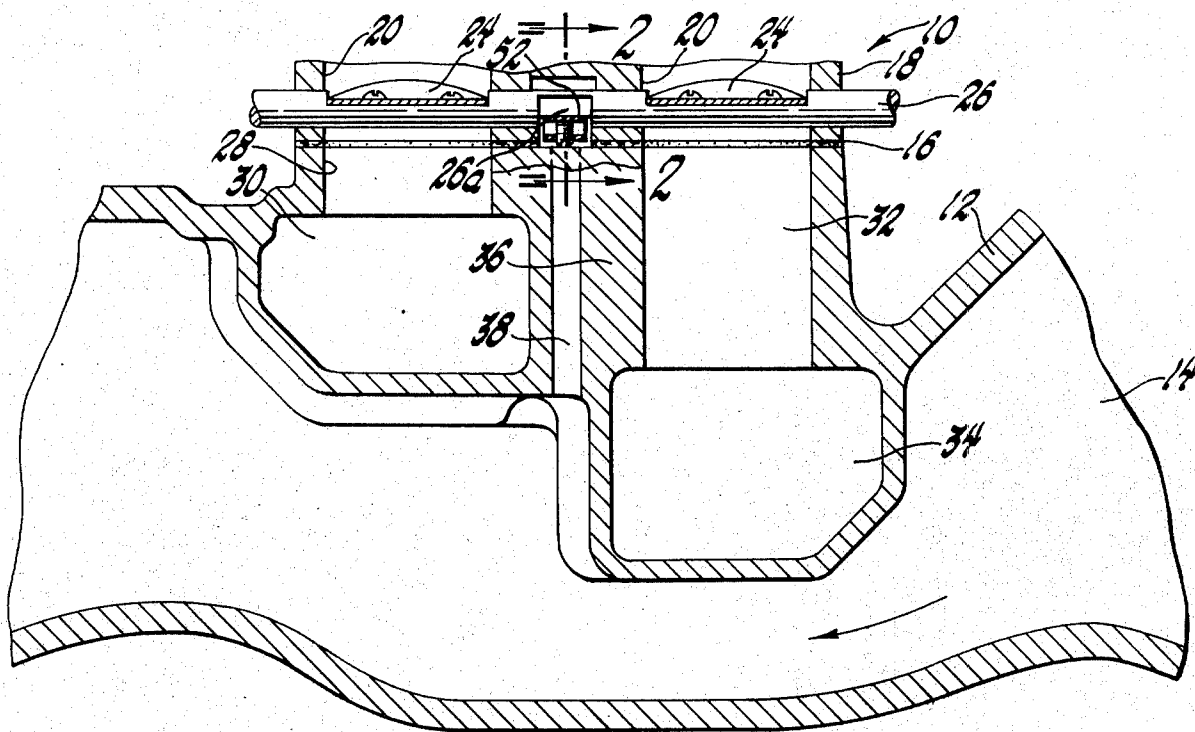
UNITED STATES PATENTS

3,237,615 3/1966 Daigh 123/119 A

[57] **ABSTRACT**

A button valve secured by a leaf spring to the engine carburetor is operated by a flat on the throttle shaft of the carburetor to meter exhaust gases from the engine exhaust cross-over passage into a cross passage in the carburetor leading to the induction bores of the carburetor.

3 Claims, 3 Drawing Figures



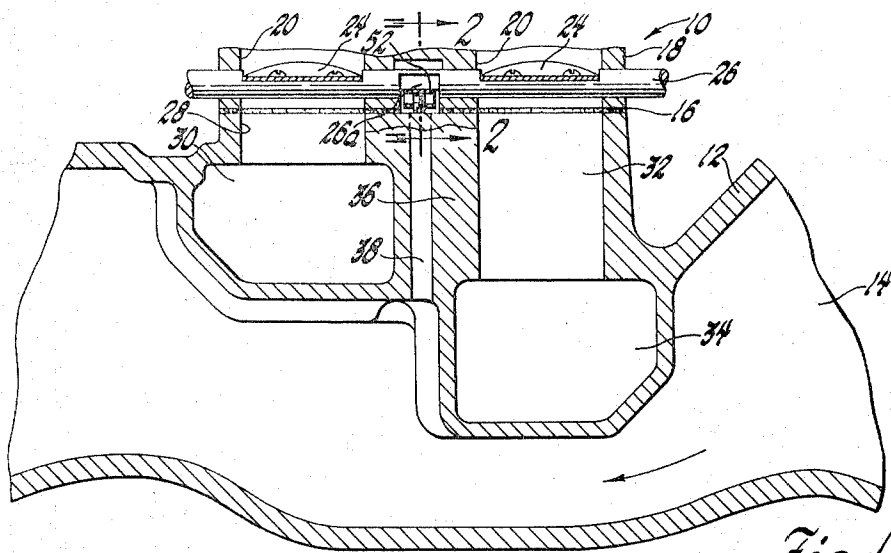


Fig. 1

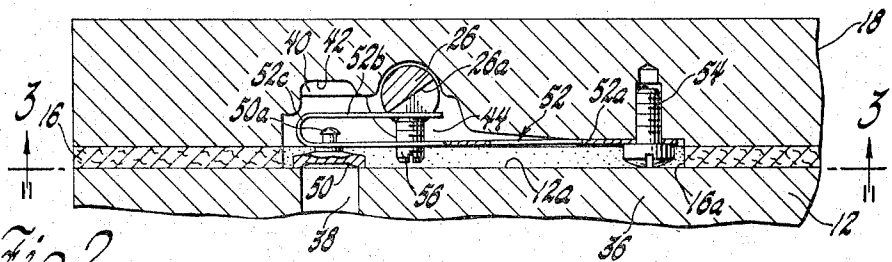


Fig. 2

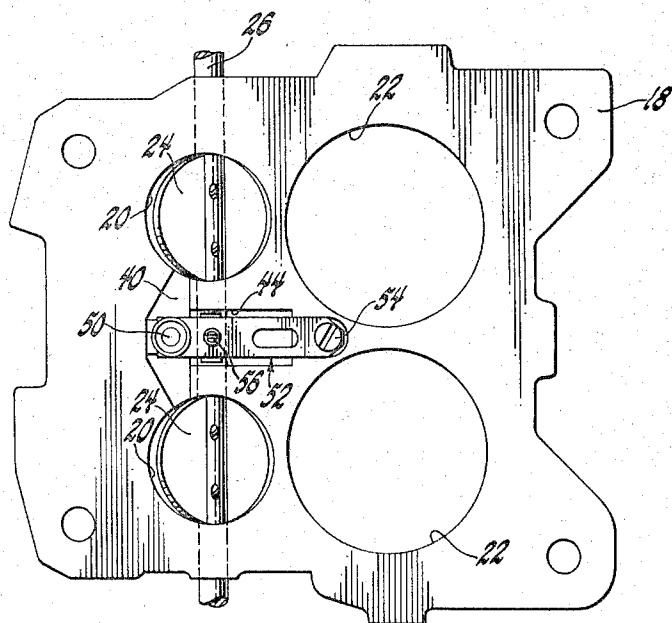


Fig. 3

BUTTON VALVE EXHAUST GAS RECIRCULATION SYSTEM

This invention relates to an exhaust gas recirculation system and, in particular, to an exhaust gas recirculation system in which a throttle shaft actuated valve is used to meter exhaust gases to the intake manifold of an internal combustion engine.

In the prior art, numerous systems have been devised to recycle exhaust gas into the induction system of an internal combustion engine as an aid in reducing emissions exhausted from the engine. In some of these systems, the recycling of exhaust gases into the induction system of the engine is controlled by connecting the accelerator mechanism to an exhaust recycle valve so that opening of this valve is correlated with the throttle valve accelerator mechanism position. However, in these last mentioned systems, excessively complicated mechanisms are used which reduce the reliability of such systems.

Accordingly, it is therefore the principal object of this invention to provide an exhaust gas recirculation system whereby a valve provided as an integral part of a carburetor and operated by the throttle shaft thereof is used to meter exhaust gases to the induction bores of the carburetor.

Another object of this invention is to provide an exhaust gas recirculation system which is reliable and simple in structure and, wherein the exhaust recycle valve is mounted to the carburetor to control the recycling of exhaust gases from the engine exhaust system to the induction system as a function of throttle shaft position.

These and other objects of the invention are attained by a leaf spring mounted recycle valve movably mounted on the carburetor and operated by a flat on the throttle shaft to meter exhaust gases from the engine exhaust crossover passage into a cross passage in the carburetor leading to the induction bores of the carburetor.

For a better understanding of the invention, as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings, wherein:

FIG. 1 is a sectional view of a portion of an internal combustion engine having an intake manifold with an exhaust crossover passage therein and a carburetor having an exhaust gas recirculation system recycle valve structure in accordance with the invention;

FIG. 2 is an enlarged view taken along line 2-2 of FIG. 1 showing the recycle valve structure; and,

FIG. 3 is a view taken along line 3-3 of FIG. 2 showing the bottom of the carburetor with the recycle valve.

Referring now to FIG. 1, there is illustrated a cross sectional view through a portion of a conventional V-8 internal combustion engine having a carburetor 10 and an intake manifold 12 with an exhaust crossover passage 14 formed integral therewith and positioned so that a portion of the exhaust gases emitted from the combustion chambers, not shown, of the engine is used to heat and vaporize the air-fuel mixture coming from the carburetor prior to its passage into the combustion chambers of the engine through the intake manifold. As is conventional, a spacer or gasket 16 is sandwiched between the bottom of the carburetor 10 and the flat surface of the carburetor pad 12a on the top of the intake manifold.

For purposes of illustration, the engine is provided with a four-barrel carburetor of the downdraft type with only the base or throttle body portion 18 of the carburetor and its associated elements being shown. As best seen in FIG. 3 which shows only the portion of the carburetor necessary for an understanding of the invention, the carburetor is provided with the usual air-fuel induction passages, such as primary induction bores or mixture conduits 20 and secondary induction bores or mixture conduits 22 in the embodiment shown. Air flow through the primary induction bores 20, as seen in FIGS. 1 and 3, is controlled by throttle valves 24 fixed to the primary throttle shaft 26, the throttle shaft being suitably journaled in the body portion 18 and is connected through suitable linkage, not shown, for operation in a conventional manner by a throttle pedal. As seen in FIG. 1, the left-hand primary induction bore 20 is in communication via an intake bore 28 with the upper intake passage 30 of the intake manifold while the right-hand primary induction bore 20 is in communication via intake bore 32 with the lower intake passage 34 of the intake manifold 12, the intake bore 28 and upper intake passage 30 being separated from the intake bore 32 and the lower intake passage 34 by an upright central wall 36 of the intake manifold.

Now in accordance with the invention, the exhaust crossover passage 14 is placed in communication with the induction bores 20 of the carburetor by means of a passage 38 in the wall 36 of the intake manifold between the upper and lower intake passages 30 and 34, respectively, and bores 28 and 32, and by a cross passage 40 formed by an undercut wall portion or channel 42 in the bottom of the base body portion 18 extending to the induction bores 20, the carburetor pad 12a of the intake manifold forming a wall of the cross passage 40 in the embodiment illustrated. Gasket 16 is provided with a suitable aperture 16a therein to provide, with the undercut wall portion of the carburetor and the carburetor pad, a chamber 44, including the cross passage 40, for a purpose to become apparent.

The flow of exhaust gases through passage 38 into cross passage 40, as a function of throttle valve position during engine operation, is controlled by a button-type, recycle valve 50 which is loosely mounted by its stem 50a on a throttle shaft controlled movable lever, which in the embodiment disclosed is a cantilevered spring member 52 secured to the undercut base portion of the carburetor within chamber 44 by screw fastener 54. Spring member 52 in the form of a leaf spring is provided with a base portion 52a and an arm portion 52b extending back over the base portion from an integral junction portion 52c with and doubled back over the base portion. Arm portion 52b of this spring member extends back to a position above and between the opposite ends of the base portion 52a for engagement by the throttle shaft. The height of the arm portion 52b relative to the base portion 52a can be varied, as desired, by means of an adjusting screw 56 adjustably secured in a suitable threaded aperture in the leaf spring. The spring can be, as shown, formed so as to normally bias the recycle valve 50 to a position in which passage 38 is unblocked.

As shown in FIG. 2, throttle shaft 26 is provided with an undercut portion to provide a flat 26a whereby this portion of the throttle shaft forms a cam controlling the movement of the spring member 52 and therefor recycle valve 50 as a function of the throttle valve rotative

position. In this figure, the throttle shaft 26 with the flat 26a thereon is shown in its engine slow idle position essentially closing the primary induction bores 20 by means of throttle valves 24 and is rotatable in a clockwise direction to move the throttle valves to a nearly vertical position or wide open throttle position, not shown, essentially unblocking primary induction bores 20.

Since the recycle valve 50 is held on the free end of the thin spring member 52 having its arm portion 52b positioned to ride against the flat 26a on the throttle shaft, the opening and closing of the recycle valve 50 is effected as the throttle shaft is rotated from its slow idle position through high idle position up to the wide open throttle position.

The flat 26a is oriented on the throttle shaft 26 so that when throttle shaft 26 is at the idle position shown, the end of the flat 26a where it merges with the outer periphery of the throttle shaft engages the spring member to close recycle valve 50 as shown and to begin opening the recycle valve 50 at high idle rotative position of the throttle shaft and return the valve to a closed position relative to passage 38 at wide open throttle rotative position of the throttle shaft when the opposite end of the flat 26a engages the spring member. Thus, when the throttle shaft 26 is rotated from high idle position to low idle position or to wide open throttle position, the edge portions of the flat 26a deflects the spring member in a counterclockwise direction, as seen in FIG. 2, to seat valve 50 against the flat surface of carburetor pad 12a to block off flow from passage 38 when the engine is operating either at slow idle or at wide open throttle.

Thus, rotation of the throttle shaft from the high idle position to slow idle position deflects the spring member, producing a load on the valve 50 to resist intake manifold vacuum and seal off the exhaust gases at slow idle. At engine operating conditions other than at slow idle or wide open throttle, the flat 26a of the throttle shaft 26 is positioned to allow the free end of spring member to deflect upward in a clockwise direction, as seen in FIG. 2, so that valve 50 becomes unseated to unblock passage 38 for the recycling of exhaust gases into the induction system of the engine via the induction bores of the carburetor.

With this arrangement, during engine operation, the recycle valve 50 is closed initially at low idle, begins to open at high idle and then progressively opens at a predetermined throttle position and then begins to progressively close again and is again closed at wide open throttle position thereby controlling and metering the recycling of exhaust gases as a function of engine operating conditions as reflected by throttle shaft rotative position.

What is claimed is:

1. An exhaust gas recirculation system comprising a carburetor having induction passages with throttle plates mounted on a throttle shaft to control flow through said induction passages, an engine intake manifold having intake passages and an exhaust gas crossover passage therein, said carburetor being mounted on a surface of said intake manifold with said induction passages in communication with said intake passages, a passage in said intake manifold in communication at one end with said exhaust crossover passage and extending at its other end to said surface, means associated with said carburetor forming a cross passage in

communication with said passage and said induction passages below said throttle plates, a valve, support means secured to said carburetor and supporting said valve for movement from a first position in which said passage is open to a second position in which said passage is blocked, said support means being operatively associated with said throttle shaft to effect movement of said valve between said first position and said second position upon rotation of said throttle shaft, said support means being a leaf spring secured at one end to said carburetor with said valve secured to its free end and said throttle shaft being provided with an undercut flat positioned thereon to move said valve to said second position at low idle and at wide open throttle position of said throttle plates.

2. An exhaust gas recirculation system comprising a carburetor having induction passages with throttle plates mounted on a throttle shaft to control flow through said induction passages, an engine intake manifold having intake passages and an exhaust gas crossover passage therein, said carburetor being mounted on a surface of said intake manifold with said induction passages in communication with said intake passages, a passage in said intake manifold in communication at one end with said exhaust crossover passage and extending at its other end to said surface, means associated with said carburetor forming a cross passage in communication with said passage and said induction passages below said throttle plates, a valve, support means secured to said carburetor and supporting said valve for movement from a first position in which said passage is open to a second position in which said passage is blocked, said support means being operatively associated with said throttle shaft to effect movement of said valve between said first position and said second position upon rotation of said throttle shaft, said support means being a leaf spring having a base portion, a junction portion integral with and doubled back over said base portion, and an arm portion integral with said junction portion and extending back over the base portion, said base portion being connected at one end opposite said junction portion to said carburetor, said valve being loosely supported on the opposite end of said base portion, an adjusting means movably secured to said base portion intermediate the ends thereof and positioned to abut against said arm portion for adjusting the height of said arm portion relative to said base portion and, cam means on said throttle shaft engageable with said arm portion.

3. An exhaust gas recirculation system for an internal combustion engine comprising a carburetor having a throttle body with through induction bores extending from opposite sides thereof, a throttle shaft journaled in said throttle body, throttle valves mounted on said throttle shaft and disposed in said induction passages and rotatable therein below low idle and wide open throttle positions for controlling air flow therethrough, a cavity and groove means provided on one side of said throttle body, an intake manifold having intake passages and an exhaust gas crossover passage therein, said carburetor being mounted on a surface of said intake manifold with said induction bores in communication with said intake passages, said cavity and said groove means in said throttle body forming with the surface of said intake manifold a chamber and cross passages in communication with said induction bores downstream of said throttle valves, a passage in said in-

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take manifold in communica-tion at one end with said exhaust crossover passage and at its other end with said chamber, valve means mounted within said chamber and including a valve movable from a closed position seated against the surface of said intake manifold to block the flow of exhaust gases through said passage to an open position unseated from said surface, said throttle shaft having cam means thereon positioned to con-

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trol the operation of said valve means, said valve means includes a leaf spring secured at one end to said throttle body within said cavity, with said valve being secured to the free end of said leaf spring and wherein said throttle shaft is provided with a cam flat thereon positioned to move said valve to said closed position at low idle and wide open throttle position.

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