United States Patent [19]

Hertfelder

[11] **3,807,375**

[45] **Apr. 30, 1974**

[54] **VALVE MEANS FOR THE RECYCLING OF WASTE GAS IN INTERNAL COMBUSTION ENGINES**

[75] Inventor: **Wilhelm Hertfelder,** Steinenbronn, Germany

[73] Assignee: **Robert Bosch GmbH,** Stuttgart, Germany

[22] Filed: **Mar. 13, 1973**

[21] Appl. No.: **340,668**

[30] **Foreign Application Priority Data**

Mar. 13, 1972 Germany 2212007

[52] **U.S. Cl.** ..... **123/119 A**

[51] **Int. Cl.** **F02m 25/06**

[58] **Field of Search** ..... 123/119 A

[56] **References Cited**

UNITED STATES PATENTS

2,969,800	1/1961	Skirvin et al.	123/119 A
3,465,736	9/1969	Daigh et al.	123/119 A
3,542,004	11/1970	Cornelius	123/119 A
3,621,825	11/1971	Ojala	123/119 A
3,675,633	7/1972	Nakasima et al.	123/119 A

Primary Examiner—Wendell E. Burns

Attorney, Agent, or Firm—Edwin E. Greigg

[57] **ABSTRACT**

Valve means for recycling waste gas in internal combustion engines of the type wherein, in order to reduce the noxious components in the waste gases, a part of these waste gases is returned to the air aspirating system, are described.

The valve means comprise a valve stem, a double acting valve closing body fastened thereon and obturating one of two valve seats; and cam means are provided to control the movement of the valve stem. A distancing tube surrounds the valve stem and bears at its inner open end one of the two valve seats, the other valve seat being located in a passageway for the recycling waste gas through the valve. The outer end of the distancing tube is closed off by a membrane of sufficient flexibility to permit a full stroke of the valve closing body from one to the other valve seat. The membrane prevents the escape of noxious waste gases to the surrounding atmosphere and their access to the control means, thereby preventing the corrosion of the latter by the waste gases. Guide means are provided on the inner end of the valve stem to prevent oscillations of the stem.

5 Claims, 2 Drawing Figures

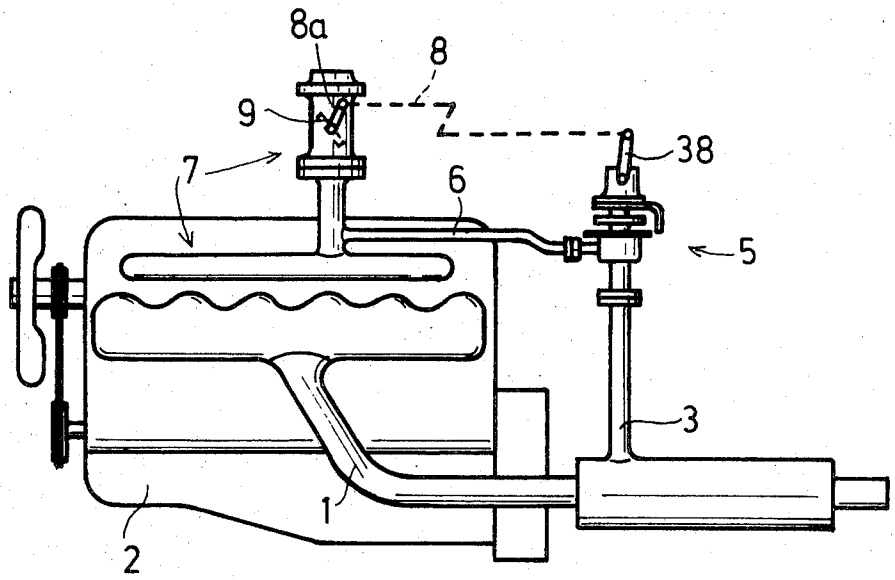


Fig.1

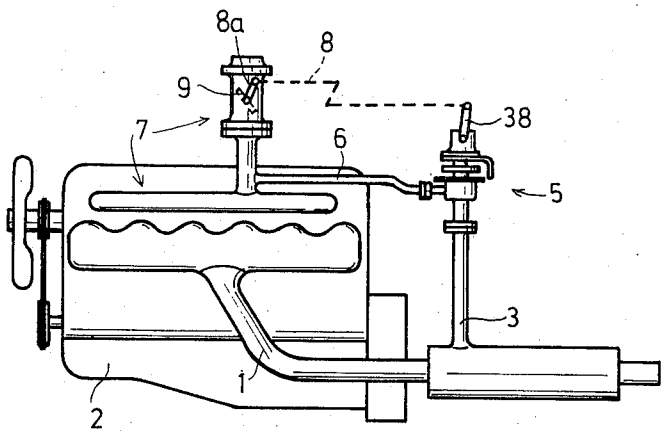
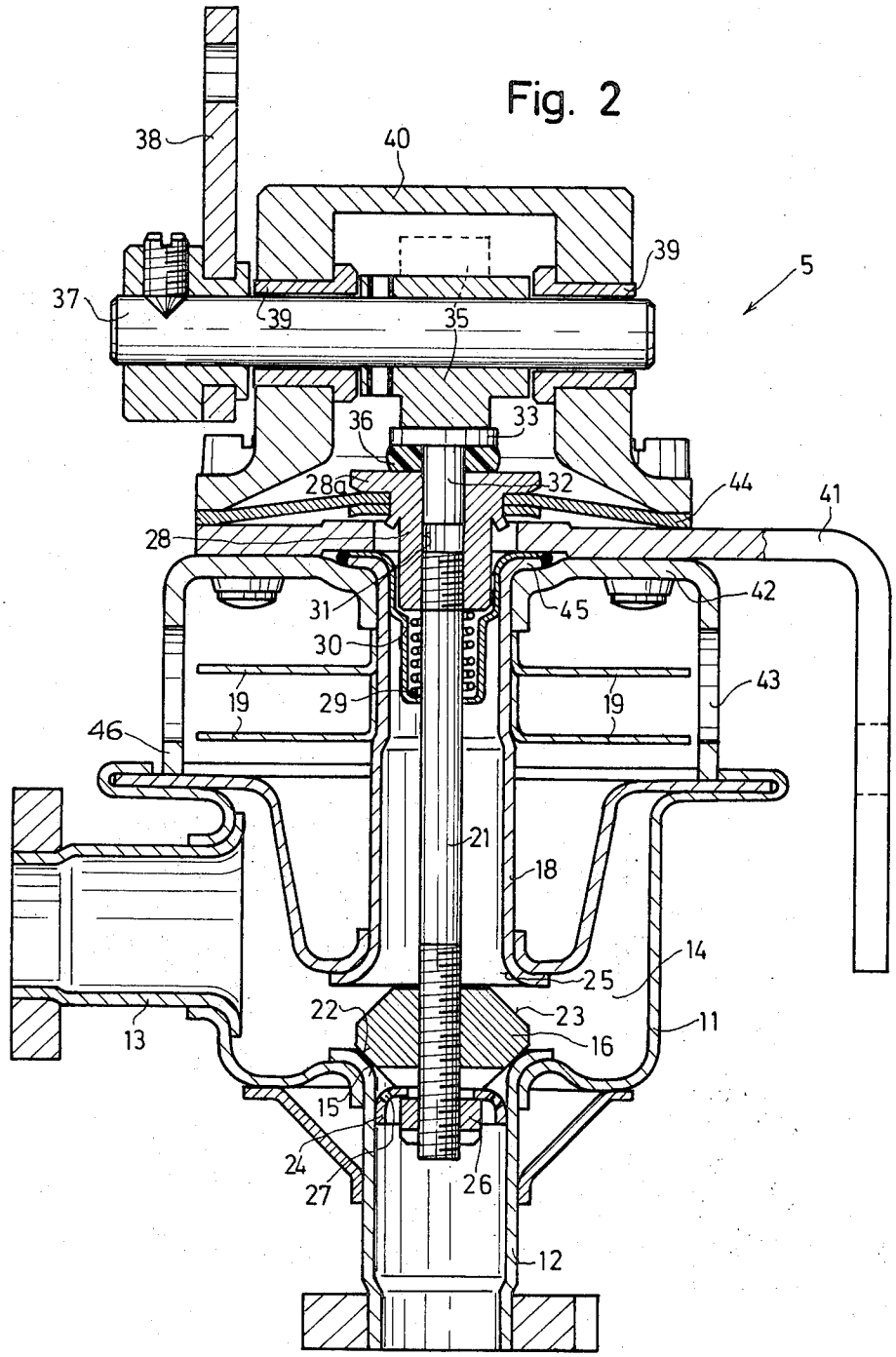


Fig. 2


38
40
39
5
37
39
35
36
33
28a
32
44
41
28
42
31
45
30
43
19
29
19
46
21
18
14
25
22
23
11
13
16
15
24
27
26
12

VALVE MEANS FOR THE RECYCLING OF WASTE GAS IN INTERNAL COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

This invention relates to valve means for the recycling of waste gas in internal combustion engines of the type wherein, in order to reduce the noxious components in the waste gases, a part of these waste gases is returned to the air aspirating system, which valve means comprises a double acting valve closing body which is actuated via a valve stem by a control member and which, in one of its end positions (closing position), closes the valve, thereby blocking a passage for the flow of the waste gases through the housing of the valve, and which in its other end position (opening position) opens the said passage, while simultaneously obturating a valve seat and thereby blocking the passage of the waste gases to the control member, and which valve further comprises a distancing tube disposed between the control member and the valve-closing body and surrounding the valve stem, which distancing tube is of low thermal conductivity and high resistance to corrosion, and bears cooling fins on its exterior surface.

In German Pat. application No. 2,105,583.4 there is described a valve wherein an electromagnet is used as the control member which, on energization, moves the valve into closing position. This valve permits the passage for waste gases to be either open or closed. An intermediate position is not possible. The valve stem of this type of valve is comparatively long and is only guided at the part thereof surrounded by the electromagnet. Owing to the lack of proper centering the valve may soon become leaky. The valve seat which is freed in the open position, is formed as a flat seat. This involves the risk that particles of impurities may be deposited on the horizontal annular surface of the valve closing body, thereby impairing the sealing effect of this surface. In spite of measures taken for cooling the electromagnet, the latter is exposed to a comparatively large amount of heat which affects adversely the duration of its operability.

In German Offenlegungsschrift 1,940,469, a further valve of similar construction for the waste gas return is described. This valve is controlled by the depression in the air suction conduit of the internal combustion engine, whereby it is possible to adjust the cross sectional area of the passageway for recycling waste gas through the valve, in dependence on the rpm of the engine. This valve suffers from the disadvantage that the valve closing member is disposed at the end of a comparatively long valve stem without accurate guiding means. Furthermore, it is possible that, in intermediate positions of the valve-closing body, waste gases and impurities may reach a control membrane of the control means, thereby deteriorating its effectiveness. In intermediate positions of the valve and particularly when oscillations of the pressure in the waste gas system occur, the valve may also begin to oscillate and the waste gas return may become irregular.

In the French Pat. No. 2,039,819, a waste gas return valve is described which is opened and closed by means of a magnet. The control of the magnet is effected by means of a cam disk associated with the throttling flap in the suction channel, which closes the magnet circuit in the range from idling to full-load by means of a contactor, by which the magnet is energized and the waste gas return valve is opened. In this arrangement, heat of the waste gases is completely transferred to the windings of the magnet, whereby the life of the magnet is reduced. Furthermore, it is not possible to move this valve to an intermediate position and thereby to dosify the waste gas return.

OBJECTS AND SUMMARY OF THE INVENTION

It is the principal object of this invention to provide a valve for the recycling of waste gas in internal combustion engines, by means of which it is possible to admit an adequate quantity of waste gases to the fuel air mixture in the suction channel of the engine in dependence on the load, thus avoiding the aforementioned disadvantages, and by means of which it is possible in particular to maintain constant the cross-sectional area of waste gas flow, once it has been adjusted, without any oscillations occurring in the valve, to have the valve close fluid-tight in its end positions even when large quantities of impurities are being deposited in the waste gas system, to provide for an operation of the valve which is independent of temperature changes and whereby no waste gases can escape from the valve into its surroundings.

This object is attained in a valve of the type initially described, wherein the control means comprise a cam actuated depending on the changes in the position of a throttling flap of the air aspiration system of the internal combustion engine, which cam acts on the valve stem via a flexible intermediate member against the force of a spring, and a membrane which is mounted on the end of the valve stem toward the cam, which membrane seals off the distancing tube and allows the valve stem to carry out a complete stroke. This has the advantage that the control member is insensitive to changes of temperature, that in no position of the valve can waste gases escape to its surroundings, and that owing to a flexible intermediate member which transmits force of pressure, a closing pressure is attainable which ensures fluid-tight sealing of the valve in closing position.

In a further embodiment of the invention the transmission of power from the cam to the valve stem is effected by means of a plug having a flat head part serving as a pressure plate, wherein the plug is axially movable in a bore in a head member of the valve stem and wherein the resilient intermediate member is disposed between the pressure plate and the head member of the valve stem. This has the advantage that there is no wear of the resilient intermediate member and that favorable sliding contact is assured between the cam and pressure plate. Furthermore, this arrangement makes it possible to compensate the wear of the cam and of the valve seat and to attain a valve-closing force which ensures fluid-tight obturation by the valve.

In a further embodiment of the invention the valve-closing body is provided with two frustoconical sealing faces. This has the advantage that impurities, which would affect the obturation adversely are less likely to be deposited on the upper frustoconical face which, in opening position of the valve, serves to seal the distancing tube against the penetration of waste gases. Furthermore, the valve-closing body is provided with guiding means which prevent oscillation of the body transversely to the direction of closing and opening, when it is in half-opened position.

The cam controlling the valve is preferably of such shape that it opens the valve only when the engine operates at partial load, but holds the valve closed at idling or under full load.

The invention will be better understood and further objects and advantages will become apparent from the ensuing detailed specification of preferred but merely exemplary embodiments taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows in schematical view the arrangement of the valve according to the invention in an internal combustion engine;

FIG. 2 shows a sectional view of a preferred embodiment of the valve according to the invention.

DETAILED DESCRIPTION OF THE EMBODIMENT

From the waste gas conduit **1** of the internal combustion engine **2**, waste gas is admitted through the supply pipe **3** to the valve **5**. From this valve another conduit **6** leads the waste gas amount which is controlled by the said valve **5**, to the air aspiration system **7** of the internal combustion engine. The valve **5** is actuated by linkage means **8** and a lever **8***a* fastened to a shaft of the throttle flap **9**. In the arrangement shown schematically in FIG. **1**, valve **5** is not drawn to scale and is shown standing out from the general arrangement. In actual practice, this valve is flange-connected close to the carburettor.

As shown in FIG. **2**, the valve **5** comprises a valve housing **11** having a waste gas inlet socket **12** and a waste gas outlet socket **13** and is designed as an angle valve. Both sockets communicate at a right angle to one another with a valve chamber **14**. The portion of the inlet socket **12** opening into the valve chamber **14** is flanged outwardly to form a first valve seat **15**, which is adapted for being obturated by the valve-closing body **16**. Aligned with the inlet socket **12**, a thin-walled distancing tube **18**, made from a material of low thermal conductivity, extends upwardly from the valve chamber **14**, and bears on its outer face a number of cooling fins **19**. This tube **18** surrounds a valve stem **21**, the diameter of the distancing tube **18** being substantially larger than the diameter of the valve stem **21**. Due to this difference in diameters, particles of impurities, entrained in the waste gases cannot be deposited and movement of the valve stem is not impeded. Preferably, a high-alloyed chrome nickel steel is used for the manufacture of the distancing tube **18**, which material, besides being of low thermal conductivity, has the advantage of a high resistance to corrosion. At its lower open end facing toward the valve seat **15**, tube **18** is crimped outwardly to form a second valve seat **25**.

The valve-closing body **16** is screw-connected to that end of the valve stem **21** which projects into the valve chamber **14**. The valve-closing body **16** has two frusto-conically shaped sealing surfaces **22** and **23** which are adapted for engaging one or the other of valve seats **15** and **25**, whereby it can obturate either the inlet socket **12** or the distancing tube **18**. Owing to the fact that the valve-closing body **16** is screwed on the valve stem **21**, its position thereon can be adjusted as desired.

To the inner end of the valve stem **21**, on which the valve-closing body **16** is mounted and which projects into the inlet socket, a guide member **24** having openings **27** therein for the passage of waste gases is fastened by means of a nut **26**; this guide member **24** is adapted for sliding in the inlet socket **12** and prevents the valve-closing body **16** from radial oscillations. By means of this guide member **24**, the valve-closing body **16** is centered in every intermediate position between its valve opening and closing end positions.

A sleeve member **28** bearing a head flange **28***a* is screwed on to the opposite end of the valve stem **21**, and serves to transmit the force of a spring **29**, which is supported by a cup-shaped insert member **30** in the distancing tube **18**, to the valve stem **21**. The sleeve member **28** is provided with an axial bore **31** in which a plug **32** is loosely inserted. This plug **32** is provided with a head flange designed as a pressure plate **33**, which transmits the closing forces produced by a cam **35** to a resilient intermediate annular cushion **36** disposed between the pressure plate **33** and the head flange of sleeve member **28**. The annular cushion **36** is adapted for transmitting closing forces and for compensating the changes of the valve stem stroke caused by wear. It can consist of a compression spring, a rubber disk, or the like means.

The position of cam **35** which is frictionally connected with the cam shaft **37**, is adjustable by means of a lever **38** which is positively mounted on shaft **37**. The shaft **37** is guided in bearing sleeves **39** which are mounted in a top casing **40**. The part of the distancing tube **18** remote from the valve chamber **14** is provided with an outwardly flanged rim portion **45** which is clamped in on both sides thereof between a pair of flanges. The upper flange **41** is bent to have an extension thereof serve as the fastening flange for the entire valve **5**; the lower flange **42** extends inwardly from a generally cup-shaped member **46** the lower rim of which is supported on the valve housing **11**. This flange **42** serves for stabilizing the distancing tube **18** and is provided with large apertures **43** through which the cooling fins **19** can be air-cooled without obstruction to air flow. The top casing **40** is placed on the flange **41**, so as to clamp a membrane **44** between these two parts, which membrane has a central opening in which the head portion of sleeve member **28** is secured in a fluid-tight manner. The top opening of valve **5** through the distancing tube **5** is thus sealed off fluid-tight by membrane **44**.

The opening and closing of the valve **5** is achieved by means of turning the lever **38**, which is actuated via linkage means **8** from the throttling flap **9**. The turn given lever **38** is transmitted to the cam **35** which, depending on its shape, depresses the valve stem **21** and accordingly changes the cross sectional area of flow at the valve seat **15**. The guide member **24** prevents the thus set cross sectional area at the valve seat **15** from being influenced by oscillations of the valve stem **21**. In the opening position, in which the valve remains during the major part of its operating time, the distancing tube **18** is obturated by the valve-closing body **16** engaging valve seat **25**, so that impurities cannot be deposited therein and no hot gases can enter the tube **18**. In the intermediate range between the opening and closing position of the valve **5**, it is possible, by means of a corresponding shaping of the cam **35**, to recycle any desired quantity of waste gas in accordance with the position of the throttling flap **9**.

What is claimed is:

1. In a waste gas recycling system for use in internal combustion engines, wherein a portion of the waste gases, determined by control means comprising a throttle flap means, is recycled to the air aspiration system of the engine in order to reduce the content of noxious components in the waste gas,

improved waste gas return valve means comprising

a. a valve housing having a passageway for waste gas therethrough;

b. a first valve seat located in said passageway;

c. a valve stem having one end thereof extending into the vicinity of said first valve seat;

d. a valve-closing body mounted on said valve stem adjacent said first valve seat and having two sealing surfaces;

e. a distancing tube about said valve stem intermediate said valve-closing body and the stem end remote from said valve seat and having an open end portion facing said valve-closing body and forming a second valve seat for the latter; said remote end of said valve stem protruding from the other open end of said distancing tube;

f. a resiliently flexible membrane fastened on said valve housing across said other open end of said distancing tube and having a central membrane aperture;

g. said valve stem being sealingly mounted in said central membrane aperture near the protruding stem end, the flexibility of said membrane being such as to permit a stroke of said valve stem sufficiently long for displacing said valve-closing body from sealing engagement with one of said first and second valve seats to sealing engagement with the other valve seat;

h. spring means biassing said valve stem toward engagement of said valve-closing body with said second valve seat and thereby closing said tube against the penetration of waste gas thereinto;

i. cam means the position of which is responsive to the position of said throttle flap means; and

j. a resilient force-transmitting means intermediate said cam means and said protruding end of said valve stem and being frictionally engaged by said cam means, said cam means being adapted, depending on their position controlled by said throttle flap means, to urge said valve shaft via said force-transmitting means and against the force of said spring means into said housing so as to move said valve-closing body away from said second valve seat and toward said first valve seat and, when sealingly engaging the latter, to obturate said passageway.

2. Valve means as described in claim 1, wherein said resilient force-transmitting means comprise a radially extending annular head flange provided on the protruding end of said valve stem, an axial bore in said head flange, peg means having a peg portion inserted in said axial bore in said head flange, and a flat disc portion facing toward said cam means for frictional engagement thereby, and resilient annular means about said peg portion and held intermediate said head flange and the underside of said flat disc portion of said peg means.

3. Valve means as described in claim 1, wherein said sealing surfaces of said valve closing body are frustoconical surfaces the apexes of which are located on the axis of said valve stem, one apex toward the protruding stem end and the other toward the opposite stem end.

4. Valve means as described in claim 1, wherein said passageway is angular, one branch of said angular passageway being aligned with said distancing tube and said first valve seat being at the inner end of the thus aligned portion of said passageway and facing toward the adjacent open end portion of said distancing tube.

5. Valve means as described in claim 4, wherein said valve stem has its end portion bearing said valve-closing body project from the latter past said first valve seat into said aligned portion of said passageway, said valve stem comprising guiding means mounted on the projecting end of said valve stem and being guided in said aligned portion of said passageway.

* * * * *