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Goto et al.

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[54] **CONTROL VALVE ASSEMBLY FOR A GAS PASSAGEWAY**

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[52] **U.S. Cl.** ..... **251/61.5,** 137/DIG. 8, 251/282, 123/119 A

[51] **Int. Cl.** **F16k 31/12**

[58] **Field of Search** ..... 251/61.5, 282; 137/DIG. 8; 123/119 A

[56] **References Cited**

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Attorney, Agent, or Firm—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

A control valve assembly for a passageway for gases.

The device comprises a valve body adapted to open and close communication between a gas inlet duct and a gas outlet duct, a diaphragm having the valve body attached to a middle portion thereof for resiliently urging the valve body normally to move into engagement with an opening of the gas inlet duct to close the same, compensation apparatus provided in one portion of a diaphragm chamber in which the valve body is disposed for eliminating or minimizing the influence of the pressure of gases on a surface of the diaphragm on which the valve body is mounted, and apparatus for permitting the other portion of the diaphragm chamber which is disposed opposite to the first mentioned diaphragm chamber portion with respect to the diaphragm to communicate with a negative pressure source.

The force of resilience adapted to urge the valve body into engagement with the opening of the gas inlet duct to close the same is set at the same level as the force of negative pressure adapted to operate the diaphragm.

2 Claims, 2 Drawing Figures

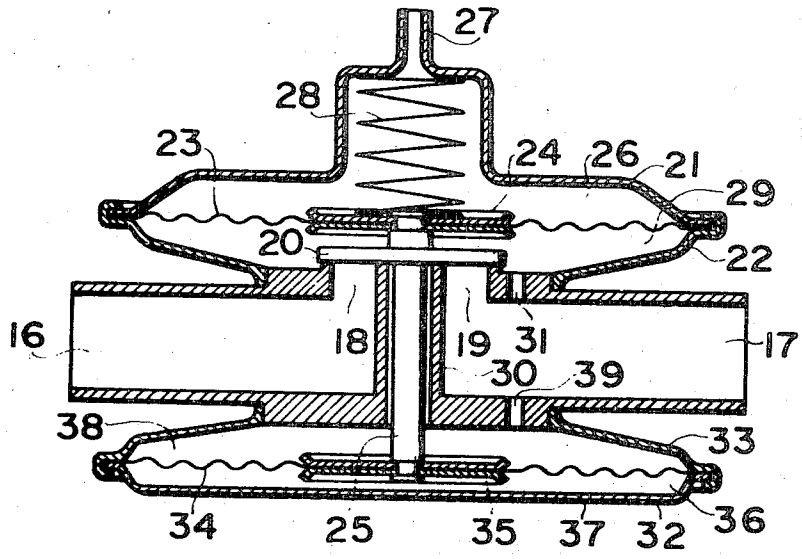

FIG. 1

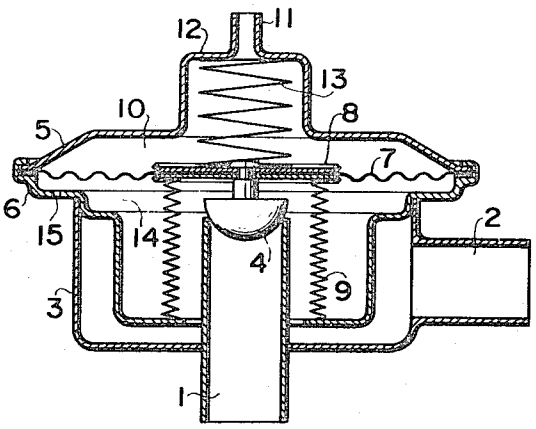
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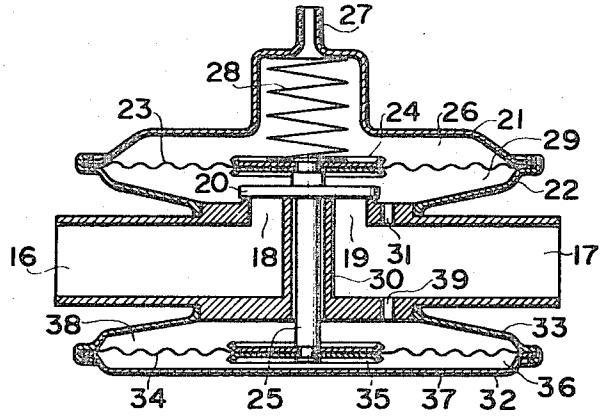
FIG. 2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CONTROL VALVE ASSEMBLY FOR A GAS PASSAGEWAY

This invention relates to a control valve assembly provided in a passageway for gases and adapted automatically to open and close the passageway irrespective of the pressure of gases passing therethrough when the negative pressure at which the control valve assembly is set for operation exceeds a predetermined level. More particularly, the invention deals with a control valve assembly having particular utility for use in a passageway for the exhausts of an internal combustion engine which are high in temperature and highly corrosive and which tend to contain minute particles of carbon, lead compounds and other materials which tend to adhere to the passageway.

Attempts have in recent years been made in the automobile industry to effect control of exhaust emission of internal combustion engines, particularly motor vehicle engines. In order specifically to reduce the amounts of oxides of nitrogen which are among the noxious components of the exhausts from motor vehicle engines, proposals have been made to incorporate an exhaust emission recirculation system in motor vehicle engines. When this system is used, it is necessary to provide means for controlling exhaust emission such that exhausts are permitted to recirculate through this system in the intermediate and lower load ranges of engine operation in which the oxides of nitrogen produced are relatively low in amount while the exhausts are kept from recirculating through this system in a higher load range of engine operation in which the oxides of nitrogen produced are relatively high in amount.

This invention has as its object the provision of a control valve assembly, simple in construction, compact in size and light in weight, which permits control of exhaust emission of a motor vehicle engine to be effected smoothly and positively in the manner described above without being affected by external conditions, such for example as the pressure of exhausts.

Additional and other objects as well as features and advantages of the invention will become evident from the description set forth hereinafter when considered in conjunction with the accompanying drawing, in which:

FIG. 1 is a vertical sectional view of the control valve assembly comprising one embodiment of this invention; and

FIG. 2 is a vertical sectional view of the control valve assembly comprising another embodiment of the invention.

In FIG. 1 in which an embodiment of this invention is illustrated in a vertical sectional view, the control valve assembly is shown as comprising a valve body 4 of the semi-spherical shape mounted in an inlet duct 1, for exhausts from the engine or other gases, which is connected to a valve casing 3 to which an outlet duct 2 for the exhausts is also connected. Provided over an upper opening of casing 3 is a lower cover 6 on which an upper cover 5 is mounted with a diaphragm 7 being interposed between the two covers. Valve body 4 is firmly secured to a support plate 8 attached to a middle portion of diaphragm 7.

A flexible tube 9 made of metal is arranged between an outer periphery of support plate 8 and a lower portion of lower cover 6 for mounting therein valve body 4 and inlet duct 1.

An upper diaphragm chamber portion 10 of a diaphragm chamber defined by diaphragm 7 and upper cover 5 is maintained in communication, through a negative pressure inlet port 11 formed in upper cover 5, with a mixing passage in the engine or other negative pressure source (not shown). A spring 13 is mounted between an upper wall 12 of upper diaphragm chamber portion 10 and an upper surface of support plate 8 normally to urge valve body 4 by its biasing force to move downwardly into engagement with an upper end of inlet duct 1 to close the same.

A lower diaphragm chamber portion 14 of the diaphragm chamber defined by a lower cover 6, metallic flexible cylinder 9 and diaphragm 7 is maintained in communication with atmosphere through an opening 15 formed in lower cover 6.

According to the invention, the biasing force of spring 13 normally urging valve body 4 to move into engagement with the upper opening of exhausts inlet duct 1 is set at the same level as the negative pressure which actuates diaphragm 7.

If the engine is operated while the control valve assembly is in the position shown in FIG. 1, the negative pressure of mixing passage will be introduced into upper diaphragm chamber portion 10 through negative pressure inlet port 11 to act on diaphragm 7 therein. If the negative pressure exceeds the level of operation pressure of diaphragm 7 which is determined by the biasing force of spring 13, diaphragm 7 will be actuated and displaced upwardly in FIG. 1 so as to thereby move valve body 4 upwardly. This permits communication to be established between inlet duct 1 and outlet duct 2.

Since metallic flexible cylinder 9 has a small diameter, the area of diaphragm 7 which is subjected to the influence of the pressure of exhausts flowing through exhausts inlet and outlet ducts 1 and 2 is restricted and almost confined to a portion thereof which corresponds to support plate 8. Thus, the operation of diaphragm 7 is not substantially affected by the pressure of the stream of exhausts, so that it is only the negative pressure acting in upper diaphragm chamber portion 10 that actuates valve body 4.

It will be evident that in this embodiment metallic flexible cylinder 9 serves as a sort of compensation means for minimizing the influence of the stream of exhausts exerted on diaphragm 7.

FIG. 2 illustrates another embodiment of the invention in a vertical sectional view. A valve body 20 is juxtaposed to an opening 18 of an inlet duct 16 for exhausts from the engine and an opening 19 of an outlet duct 17 for the exhausts simultaneously to open and close the two ducts. Attached to an upper portion of a casing 30 in which ducts 16 and 17 are formed is a first lower cover 22 to which is firmly secured a first upper cover 21 with a first diaphragm 23 being interposed between the two covers. Attached to a middle portion of diaphragm 23 is a first support plate 24 to which a stem 25 supporting a valve body 20 is firmly secured at one end thereof.

A first diaphragm chamber 26 defined by first upper cover 21 and first diaphragm 23 is maintained in communication with a mixing passage in the engine or other negative pressure source (not shown) through a negative pressure inlet duct 27 formed in first upper cover 21. A spring 28 is mounted between an upper wall of first upper diaphragm chamber 26 and an upper sur-

face of first support plate **24** so as to normally urge valve body **20** to move downwardly into engagement with the openings **18** and **19** of exhaust inlet and outlet ducts **16** and **17** respectively.

A second diaphragm chamber **29** defined by first diaphragm **23** and first lower cover **22** is maintained in communication with exhausts outlet duct **17** through a first port **31** in casing **30.**

The stem **25** supporting valve body **20** extends through casing **30** and the other end thereof reaches a position which is symmetrical with the position of the mechanism including first diaphragm **23** with respect to the axes of exhausts inlet and outlet ducts **16** and **17.**

Firmly secured to a lower portion of casing **30** is a second upper cover **33** to which is firmly secured a second lower cover **32** with a second diaphragm **34** being interposed between the two covers. The other end of stem **25** is firmly secured to a second support plate **35** attached to a middle portion of second diaphragm **34.** The mechanism including second diaphragm **34** has characteristics which are identical with those of the aforementioned mechanism including first diaphragm **23.**

A third diaphragm chamber **36** defined by second lower cover **32** and second diaphragm **34** is maintained in communication with atmosphere through a second port **37** formed in second lower cover **32** while a fourth diaphragm chamber **38** defined by second upper cover **33** and second diaphragm **34** is maintained in communication with exhausts outlet duct **17** through an exhausts introducing third port **39.**

In the aforementioned construction, the mechanism including stem **25,** third port **39** and second diaphragm **34** constitutes a sort of compensation means for minimizing the influence of the stream of exhausts exerted on first diaphragm **23.**

If the engine is operated while the control valve assembly is in the position shown in FIG. **2,** the negative pressure of the mixing passage will be introduced into first diaphragm chamber **26** through negative pressure inlet duct **27** to act on first diaphragm **23.** If the negative pressure exceeds the level of operation pressure which is determined by the biasing force of spring **28,** first diaphragm **23** will be actuated and displaced to move upwardly the valve body **20** supported by stem **25,** thereby permitting communication to be established between the openings **18** and **19** of exhausts inlet and outlet ducts **16** and **17** respectively.

At this time, the pressure of the stream of exhausts is applied to first diaphragm **23** in second diaphragm chamber **29.** However, the pressure is introduced through a third port **39** into fourth diaphragm chamber **38** associated with second diaphragm **34** simultaneously to be applied to second diaphragm **34.** Since the two diaphragm mechanisms are disposed symmetrically with each other with respect to the axes of inlet and outlet ducts **16** and **17,** the actions of the stream of exhausts exerted on the two diaphragms **23** and **34** cancel each other out, so that little or no influence of the stream of exhausts is exerted on first diaphragm **23.** Since third diaphragm chamber **36** is maintained in communication with atmosphere through second port **37,** no other influence is exerted on first diaphragm **23** than the influence of the negative pressure introduced into first diaphragm chamber **26** through negative pressure inlet duct **27.**

From the foregoing description, it will be evident that the control valve assembly according to this invention has no sliding parts. Because of this, the invention offers the advantage of having particular utility for use in a passageway for exhausts from an internal combustion engine which are high in temperature and highly corrosive and which contain minute particles of carbon, lead compounds and other materials which tend to adhere to the passageway, because the invention is free from mechanical failures due to corrosion of sliding parts or adherence of the minute particles of these materials thereto. The danger of leakage of exhausts is eliminated by virtue of the provision of the diaphragm mechanism for sealing the valve.

Besides, means is provided according to the invention to eliminate or minimize the influence of the pressure of a stream of exhausts on the diaphragm which is adapted to be operated by negative pressure. Thus, misoperation of the valve that might otherwise be caused by external conditions, such for example as the pressure of exhausts, can be precluded. The construction of the control valve assembly according to this invention is relatively simple so that its size is compact and its weight is light. Thus, the control valve assembly can be mounted in any limited space.

The control valve assembly according to this invention lends itself to use not only as a control valve for any exhaust emission control devices for motor vehicle engines but also as a control valve for passageways for exhausts, of any type, because it has particular utility for use in the passageway of exhausts which are high in temperature and highly corrosive and which contain minute particles of materials tending to adhere to the passageway.

What is claimed is:

1. A control valve assembly for exhausts mounted in a passageway for exhausts for controlling a stream of exhausts moving through said passageway comprising a valve body disposed in a horizontal plane in which an opening of an up stream portion of said passageway for exhausts and an opening of a downstream portion thereof are disposed, said valve body being adapted to move vertically relative to said horizontal plane to open and close communication between the two openings, a plurality of diaphragm chambers each having a diaphragm of the same area of a pressure receiving surface, said diaphragms being disposed opposite each other with respect to said horizontal plane, a spring mounted in one portion of one of said diaphragm chambers for urging said valve body by its biasing force to move into engagement with said openings of said upstream and downstream portions of said passageway for exhausts to interrupt the movement of exhausts through said passageway, said one portion of said one diaphragm chamber in which said spring is mounted being connected to a negative pressure source, the other portion of said one diaphragm chamber and a portion of the other diaphragm chamber which are interposed between the two diaphragms each being maintained in communication with the downstream portion of said passageway for exhausts, and the other portion of said other diaphragm chamber being maintained in communication with atmosphere.

2. A control valve assembly for a passageway for gases comprising:

a casing (**30**) having a gas inlet duct (**16**) and a gas outlet duct (**17**), said casing (**30**) having openings

(18) and (19) provided in a central portion thereof for said gas inlet and outlet ducts (16) and (17);

a valve body (20) for simultaneously closing and opening said openings (18) and (19), said valve body (20) being supported on top of a stem (25) for movement in a direction normal to the plane of the openings (18) and (19);

a first diaphragm mechanism provided in an upper portion of said casing (30), said first diaphragm mechanism including a first upper cover (21), a first lower cover (22), a first diaphragm (23) and a first support plate (24) provided in a central portion of said first diaphragm (23), said first support plate (24) being secured to one end of said stem (25);

a first diaphragm chamber (26) defined by said first upper cover (21) and said first diaphragm (23);

a negative pressure inlet duct (27) provided so as to communicate said first upper cover (21) to a negative pressure source;

a spring (28) provided between an upper portion of said first diaphragm chamber (26) and said support plate (24), said spring always urging the valve body (20) toward said openings (18) and (19);

a second diaphragm chamber (29) defined by said first lower cover (22) and said first diaphragm (23), said casing (30) having a first port (31) to provide communication between said second diaphragm chamber (29) and said gas outlet duct (17);

a second diaphragm mechanism provided in a lower portion of said casing (30), said second diaphragm mechanism including a second lower cover (32), a second upper cover (33), a second diaphragm (34) and a second support plate (35) provided in a central portion of said second diaphragm (34), said second support plate (35) being secured to the other end of said stem (25);

a third diaphragm chamber (36) defined by said second lower cover (32) and said second diaphragm (34), said second lower cover (32) having a second port (37) communicating with atmosphere; and

a fourth diaphragm chamber (38) defined by said second upper cover (33) and said second diaphragm (34), said casing (30) having a third port (39) communicating with said gas inlet duct (17).

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