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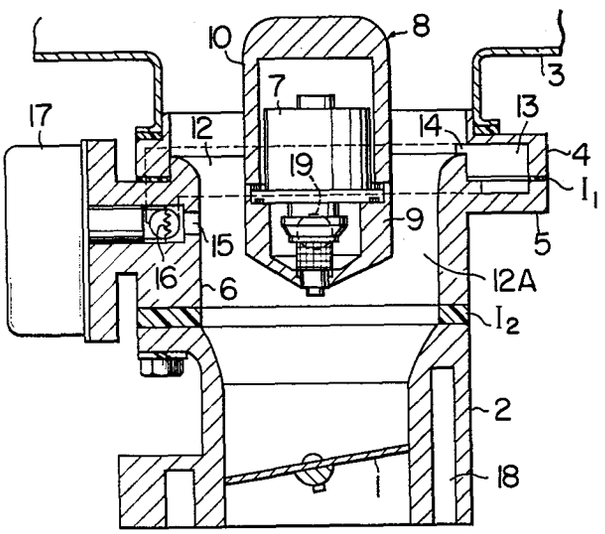
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(54) Air-intake conduit comprising a fuel injector for internal-combustion engines.

(57) A fuel injector body assembly including an injector (7) located upstream of a throttle chamber (2) connected to a venturi chamber (5) formed with a venturi (6). An air chamber (2) is connected to an upstream end of the venturi chamber, and a bypass passageway (13) in the form of an arc is located at the interface between the venturi chamber and the air chamber and has a hotwire air flow meter (6) is mounted therein.



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FUEL INJECTOR BODY ASSEMBLY

TITLE MODIFIED
see front page

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

This invention relates to fuel injector body assemblies, and more particularly it is concerned with a fuel injector body assembly of the type comprising an injector and an air flow meter located upstream of the throttle valve.

DESCRIPTION OF THE PRIOR ART

Attention has in recent years been attracted to a fuel injector body assembly comprising an injector located upstream of the throttle valve for effecting fuel injection, when a fuel is supplied to an engine, by pressurizing the fuel in accordance with the amount of air intake and operating conditions of the engine.

One type of fuel injector body assembly known in the art is disclosed in Japanese Patent Laid-Open No. 73858/82 (priority date, August 26, 1982, West Germany, P 30 32 067.3; Applicant, Robert Bosch GmbH).

In the fuel injector body assembly described in the document referred to hereinabove, air intake measuring means comprising a bypass passageway having a hot-wire air flow meter arranged therein is provided as an entity separate from the air conduit constituting a main air passagewat in which an injector is mounted. The air intake measuring means which is a separate entity

is connected to the air conduit from outside.

Some disadvantages are associated with the fuel injector body assembly of the aforesaid construction of the prior art. Such disadvantages include the following:

(1) Firstly, since the air intake measuring means is located outside the air conduit, the air intake measuring means would suffer damage when foreign matters of a large mass impinge thereon; and

(2) Secondly, the longer the bypass passageway, the higher is the precision with which measurements are made by the hot-wire air flow meter (if the length of the bypass passageway is small, pulsations of air intake would not be damped in the bypass passageway and would be sensed by the hot-wire air flow meter, so that the precision with which measurements of air intake are made could be improved by increasing the length of the bypass passageway). However, if the length of the bypass air passageway inceases, the overall length of the fuel injector body assembly would also increase and consequently the size thereof would increase, thereby raising the problem that difficulties would be encountered in designing an engine room layout.

SUMMARY OF THE INVENTION

(1) Object of the Invention

This invention has as its object the provision of a fuel injector body assembly, compact in size and high in precision with which measurements of air intake

are made, which is capable of avoiding damage which would be caused to air intake measuring means by foreign matters which might otherwise impinge thereon.

(2) Statement of the Invention

The outstanding characteristics of the invention are that an air conduit located upstream of a throttle chamber for supporting a throttle valve is constituted by a venturi chamber providing a venturi and an air chamber connected to an air cleaner; a lower injector support and an upper injector support for supporting an injector in a central portion of the air conduit are located in the venturi chamber and the air chamber respectively; and a bypass passageway allowing a portion of air intake to flow therethrough by bypassing the air conduit is provided at the interface between the venturi chamber and the air chamber and has an air flow meter mounted therein.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of the fuel injector body assembly comprising one embodiment of the invention;

Fig. 2 is a sectional view taken along the line II-II in Fig. 1;

Fig. 3 is a plan view of the fuel injector body assembly comprising a second embodiment of the invention;

Fig. 4 is a sectional view taken along the line IV-IV in Fig. 3;

Fig. 5 is a plan view of the fuel injector

body assembly comprising a third embodiment of the invention;

Fig. 6 is a sectional view taken along the line VI-VI in Fig. 5;

Fig. 7 is a plan view of the fuel injector body assembly comprising a fourth embodiment of the invention;

Fig. 8 is a sectional view taken along the line VIII-VIII in Fig. 7;

Fig. 9 is a diagrammatic representation of the amount of air intake in relation to the output of the hot wire;

Fig. 10 is a sectional view of the fuel injector body assembly comprising a fifth embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the invention will be described by referring to the accompanying drawings.

Fig. 1 and 2 show a first embodiment of the fuel injector body assembly in conformity with the invention. As shown, a throttle valve 1 is mounted in a throttle chamber 2, and an air chamber 4 and a venturi chamber 5 constituting an air conduit 12 are interposed between the throttle chamber 2 and an air cleaner 3. The air conduit 12 is composed of two members which are intimately connected together. The air chamber 4 is connected at one end thereof to an outlet tube section

of the air cleaner 3 and joined at the other end thereof to the venturi chamber 5 through an insulator I_1 for avoiding air leaks, while the venturi chamber 5 joined at one end thereof to the air chamber 4 to define therein a suction passageway is connected at the other end thereof to the throttle chamber 2 through an insulator I_2 for avoiding heat transfer. Particularly the venturi chamber 5 has a venturi provided on its inner peripheral surface and is open in the form of the mouth of a bell at a portion thereof which is joined to the air chamber 4 to thereby reduce the diameter of the air conduit 12.

An injector 7 is supported by an injector support located in a central portion of the air conduit 12 constituted by the air chamber 4 and the venturi chamber 5 and comprises a lower injector support 9 secured to the venturi chamber 5 and an upper injector support 10 secured to the air chamber 4. The lower injector support 9 is open at its upstream end for receiving the injector 7 so that a nozzle thereof is directed against the throttle valve 1. The upper injector support 10 is open at its downstream end and connected to the open upstream end of the lower injector support 9 so as to support the injector 7 in hermetically sealed condition in the injector support 8. The upper and lower injector supports 9 and 10 are secured to the venturi chamber 5 and the air chamber 4 through upper support arms 11A and lower support arms 11B respectively. Thus the air conduit 12 provides an annular air passageway 12A through which

air is supplied to the throttle valve 1. The lower injector support 9 has a conical forward end portion to obtain good mixing of air with a fuel injected through the nozzle of the injector 7.

The interface between the two members of the air conduit 12 connected together at the joint between the air chamber 4 and the venturi chamber 5 has a groove formed therein to provide a bypass passageway 13 to allow a portion of air intake to flow in bypass stream. As can be clearly seen in Fig. 1, the bypass passage 13 is in the form of an arc and concentric with the annular air passageway 12A and has an inlet 14 opening in the air chamber 4 and an outlet opening in the venturi 6 of the venturi chamber 5. The inlet 14 opens peripherally at the inner peripheral surface of the air chamber 4. Thus the inlet 14 is open in the form of an arc which is concentric with the annular air passageway 12A. A hot wire 16 is mounted in the vicinity of the outlet 15 in the bypass passageway 13. More specifically, the hot wire 16 is located inwardly of the outlet 15 of the bypass passageway 13 so that it will be cooled by air flowing in bypass stream through the bypass passageway 13. The hot wire 16 is electrically connected to an air flow rate measuring circuit 17 mounted on an outer surface of the venturi chamber 5 to thereby measure the amounts of air supplies.

Formed at a side wall of the throttle chamber 2 in which the throttle valve 1 is mounted is an annular

groove 18 which is connected for circulating cooling water for an engine so as to heat the throttle chamber 2 and the throttle valve 1. Thus a mixture of fuel and air flowing past an outer periphery of the throttle valve 1 can be heated, thereby accelerating atomization of the fuel and avoiding icing tending to develop on the outer periphery of the throttle valve under condition of high humidity.

In the fuel injector body assembly according to the invention, air drawn by suction into the engine flows through the annular passageway 12A. A portion of the air intake is introduced into the bypass passageway 13 formed at the interface between the air chamber 4 and the venturi chamber 5 by virtue of the pressure differential existing between the inlet 14 and outlet 15 of the bypass passageway 13, so that the amount of air intake is measure by the hot wire 16 while the hot wire 16 itself is cooled. The fuel supply is pressurized by a fuel pump, not shown, and fed through a fuel pipe 19 located in the lower support arms 11B into the injector 7 where it is controlled by the period of time during which an injector valve remins open and the number of times the injector valve is opened.

The air-fuel ratio of the fuel-air mixture supplied to the engine is controlled by processing information, such as the amount of air intake, the opening of the throttle valve, pressure of the air intake, engine rpm, atmospheric pressure, environmental temperature,

of the engine, etc., by means of a microcomputer and deciding the amount of fuel injected through the injector 7 and the time at which such injection takes place.

The embodiment of the fuel injector body assembly constructed as aforesaid in conformity with the invention offers the following advantages. The arrangement whereby the air intake measuring means comprising the bypass passageway 13 and the hot-wire air flow meter is mounted inside the fuel injector body assembly enables the length of the bypass passageway 13 to be increased without the risk of having the air measuring device damaged by foreign matters impinging thereon and without requiring an increase in the length of the fuel injector body assembly which would otherwise be necessary because of the bypass passageway 13 being in arcuate form. This is conducive to increased precision with which measurements of air intake are made and makes it possible to obtain a compact size in a fuel injector body assembly. The arrangement whereby the air suction conduit is composed of two members provided by the air chamber 4 and the venturi chamber 5 makes it possible to mount the injector 7 and form the bypass passageway 13 at the same time, thereby improving productivity.

Figs. 3 and 4 show a second embodiment which is distinct from the first embodiment in that the bypass passageway 13 of the second embodiment has an inlet 20 of the dynamic pressure type. More specifically, the inlet 20 of the bypass passageway 13 opens toward the

upstream side of the suction passageway to thereby directly introduce a portion of the air intake into the bypass passageway 13.

In the second embodiment of this construction, air in turbulent flow tending to develop at a starting end of the venturi 6 is prevented from being introduced into the bypass passageway 13. This enables variations in the output of the hot wire with regard to the air intake caused by introduction of the air in turbulent flow to be avoided and makes it possible to eliminate the need to additionally mount a correction circuit for a control circuit of the hot-wire air flow meter. Simplification of the control circuit enables the amount of air intake to be measured relatively stably.

A third embodiment will be described by referring to Figs. 5 and 6 in which parts similar to those shown in Figs. 1-4 are designated by like reference characters. In Figs. 5 and 6, an inlet 21 for introducing a portion of air intake into the bypass passageway 13 opens in a side wall surface of the upper injector support 10. To this end, an inlet portion 22 of the bypass passage 13 is formed in the upper support arms 11A of the upper injector support 10 and maintained in communication with an inner space of the injector support 8. By this arrangement, a portion of air intake is led through the inlet 21 opening at the side wall of the upper injector support 10 into the bypass passageway 13 through the inner space of the injector support 8 and

the inlet portion 22 of the upper support arm 11A. The inlet 21 is of course disposed upstream of the outlet 15.

In the embodiment of the fuel injector body assembly of the aforesaid construction, air intake is led through the air conduit 12 to the throttle valve 1. A portion of the air intake is introduced into the bypass passageway 13 by virtue of the differential pressure existing between the inlet 21 and the outlet 15 thereof. After being measured at the hot wire 16, the portion of the air intake flowing through the bypass passageway 13 joins a stream of air flowing through the suction conduit at the outlet 15. In this embodiment, a turbulent flow B of air develops at a starting end of the venturi 6 at which the inner diameter of the suction conduit shows a sudden change. However, since the inlet 21 opens at the side wall of the injector support 8 located in a central portion of the conduit, the turbulent flow B of air exerts almost no influences on the inlet 21 of the bypass passageway 13.

A fourth embodiment is shown in Figs. 7 and 8 in which the inner space of the injector support 8 is merely shaped to contain the injector 7 and the inlet portion 22 of the bypass passageway 13 is formed in a head portion of the upper injector support 10 while an inlet 23 is formed to open in a side wall of the head portion. Thus the fourth embodiment is distinct from the other embodiments in that the inlet 23 directly opens in the side wall, not through the inner space of the injector

support 8. The embodiment shown in Figs. 7 and 8 operates in the same manner and achieved the same results as the embodiments shown in Figs. 1-6.

When the air cleaner is directly mounted on the air chamber 4 in the third and fourth embodiments, a problem might be raised with regard to the positions of an inlet of the air cleaner and the inlet 21, 23 of the bypass passageway 13. More specifically, an output V_{out} of the hot wire 16 in relation to the amount of air intake G_A shows changes as shown in Fig. 9 depending on the directionality of the inlet of the air cleaner and the inlet 21, 23 of the bypass passageway 13. For example, when the inlet of the air cleaner is disposed in the same direction as the inlet 21, 23 of the bypass passageway 13, the amount of air flowing through the bypass passageway 13 increases as shown by a broken line in Fig. 9 due to the influence of dynamic pressure applied to the inlet 21, 23 and the output V_{out} increases. However, when the inlet 21, 23 of the bypass passageway 13 is displaced 45 or 90 degrees with respect to the inlet of the air cleaner, the amount of air flowing through the bypass passageway 13 decreases and the output V_{out} also decreases as shown by a solid line or a dash-and-dot line. Since the pulse duration of fuel jetted from the injector 7 may vary depending on the amount of air intake G_A, it is necessary to increase the precision with which calculation is done to thereby increase the precision with which control of fuel consumption is effected by

avoiding production of variations in the output V_{out} of the hot wire 16 in relation to the amount of air intake G_A as shown in Fig. 9.

To cope with this situation, a shield wall is provided, in a fifth embodiment shown in a sectional view in Fig. 10, to render the inlet 21, 23 of the bypass passageway 13 impervious to the influences exerted by the dynamic pressure of air drawn through the air cleaner. As shown, an annular shield wall 25 is provided in a manner to surround an outer periphery of the upper injector support 10 at which an inlet 24 of the bypass passageway 13 is formed. The shield wall 25 is juxtaposed against the inlet 24 with a predetermined spacing therebetween and surrounds the peripheral surface as a whole including the inlet 24. The shield wall 25 extends unitarily from the upper injector support 10 and is set at an inlet 26 of the air cleaner 3 mounted on the air chamber 4 in such a manner that it is in face-to-face relation to the inlet 24.

In the fifth embodiment of the aforesaid construction, air introduced through the inlet 26 of the air cleaner 3 is led circuitously from an opening of the annular shield wall 25 at its upper end to the inlet 24 of the bypass passageway 13. By this arrangement, dynamic pressure is prevented from exerting influences on the hot wire 16 in the bypass passageway 13. This eliminates the difference which might otherwise be produced between the amount of air intake based on the output of the hot

wire 16 and the real amount of air intake due to dynamic pressure. As a result, fuel injection can be controlled to achieve the desired air-fuel ratio under all engine operation conditions.

WHAT IS CLAIMED IS:

1. A fuel injector body assembly comprising:

(a) an air chamber (4) connected at one end thereof to an air cleaner (3);

(b) a venturi chamber (5) joined to the other end of said air chamber and secured in place;

(c) a throttle chamber (2) having a throttle valve (1) connected to an end of the venturi chamber opposite the end thereof to which said air chamber is joined;

(d) an injector (7) mounted in the vicinity of the center of an air conduit (12) constituted by said air chamber and said venturi chamber for air to flow therethrough;

(e) a bypass passageway (13) having an inlet (14, 20, 21, 23, 24) opening on the upstream side of said venturi chamber and an outlet (15) opening in said venturi chamber, said bypass chamber being formed between said air chamber and said venturi chamber when said two chambers are joined together to connect said inlet with said outlet; and

(f) an air flow meter mounted in said bypass passageway.

2. A fuel injector body assembly as claimed in claim 1, wherein said bypass passage is located in a cross section at right angles to an air current and conforming in configuration to an inner peripheral wall of the air conduit.

3. A fuel injector body assembly as claimed in claim 1, wherein said air conduit has a circular cross section located at right angles to an air current, and said bypass passageway is in the form of an arc centered at the center of said air conduit.

4. A fuel injector body assembly as claimed in claim 3, wherein said inlet of said bypass passageway opens in the inner peripheral wall of said air conduit in the form of an arc.

5. A fuel injector body assembly as claimed in claim 4, wherein said inlet opens in such a manner that it is disposed against an air current flowing through said air conduit.

6. A fuel injector body assembly as claimed in claim 1, wherein said injector is held between an upper injector support (9) located on upper support arms (11A) secured to said air chamber and a lower injector support (10) located on lower support arms (11B) secured to said venturi chamber.

7. A fuel injector body assembly as claimed in claim 6, further comprising a fuel pipe (19) located in said lower support arms for feeding a fuel into said injector.

8. A fuel injector body assembly as claimed in claim 1, wherein said injector is held between an upper injector support (9) located on upper support arms (11A) secured to said air chamber and a lower injector support (10) located on lower support arms (11B) secured to said

venturi chamber, and said inlet (23) of said bypass passageway opens in said upper injector support through an inlet portion (22) formed in said upper support arms.

9. A fuel injector body assembly as claimed in claim 8, wherein said inlet (23) opening in said upper injector support is disposed at right angles to an air current flowing through said air conduit.

10. A fuel injector body assembly as claimed in claim 9, wherein said upper injector support is formed with an annular wall portion (25) located at right angles to the direction in which said inlet (24) opens.

11. A fuel injector body assembly as claimed in claim 1, wherein an air insulator (I_1) for avoiding air leaks is mounted at the interface between said air chamber and said venturi chamber.

12. A fuel injector body assembly as claimed in claim 1, wherein said throttle chamber having said throttle valve is connected through an insulator (I_2) for avoiding heat transfer to the end of the venturi chamber opposite the end thereof to which said air chamber is joined.

13. A fuel injector body assembly as claimed in claim 12, wherein a groove (18) is formed in said throttle chamber to allow cooling water to flow in circulation.

14. A fuel injector body assembly as claimed in claim 1, wherein an air flow rate measuring circuit (17) is mounted on an outer wall surface of said venturi chamber.

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FIG. 1

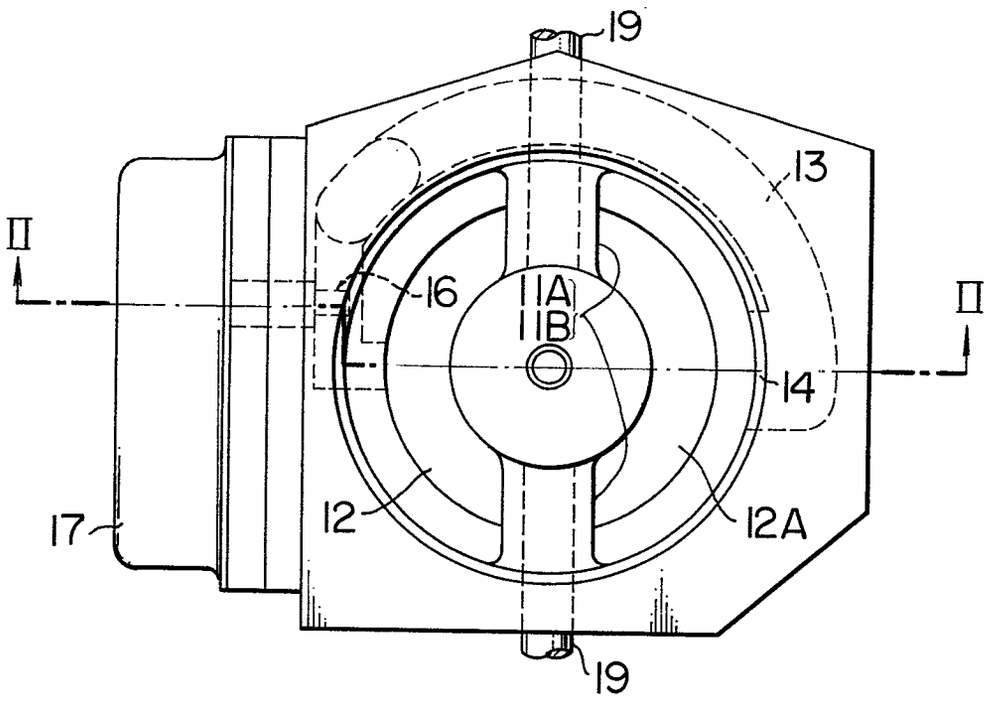


FIG. 2

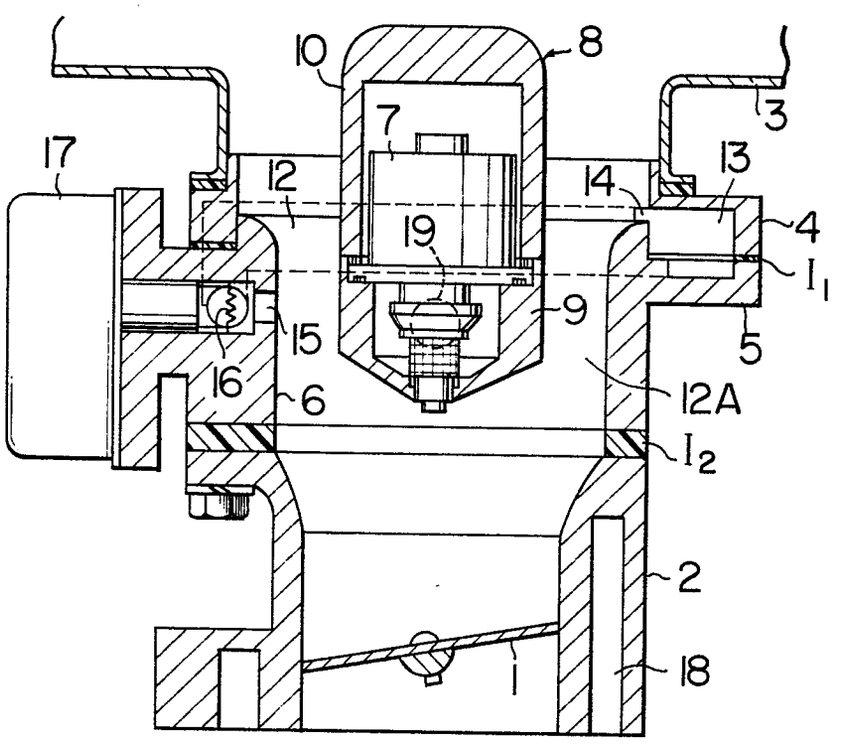


FIG. 3

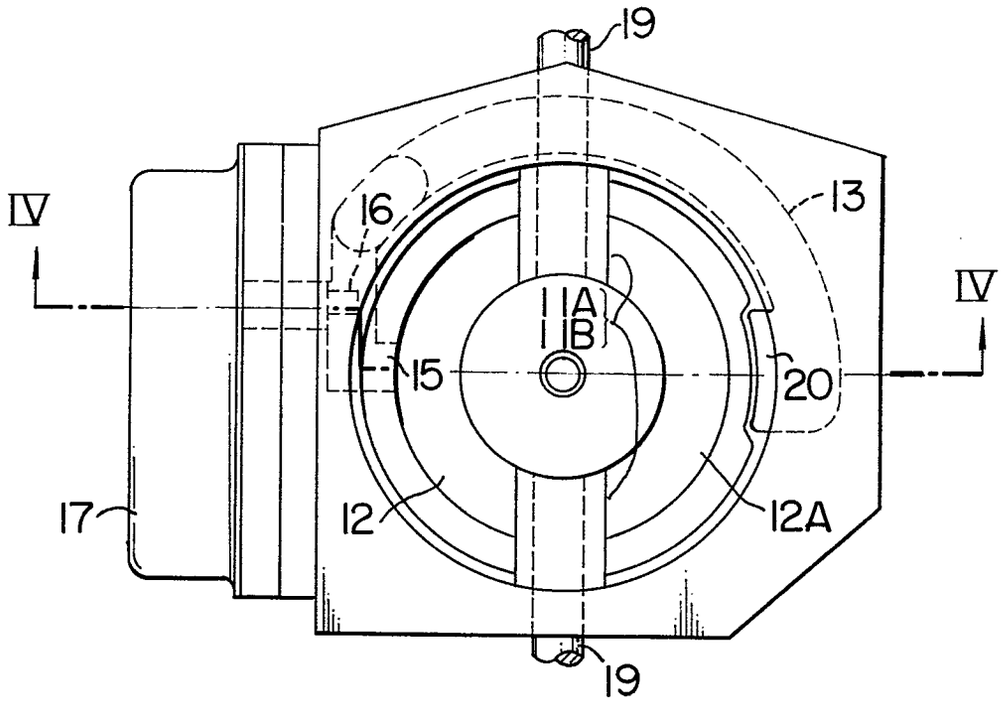

19
IV
16
13
IV
IIA
IIB
15
20
17
12
12A
19

FIG. 4

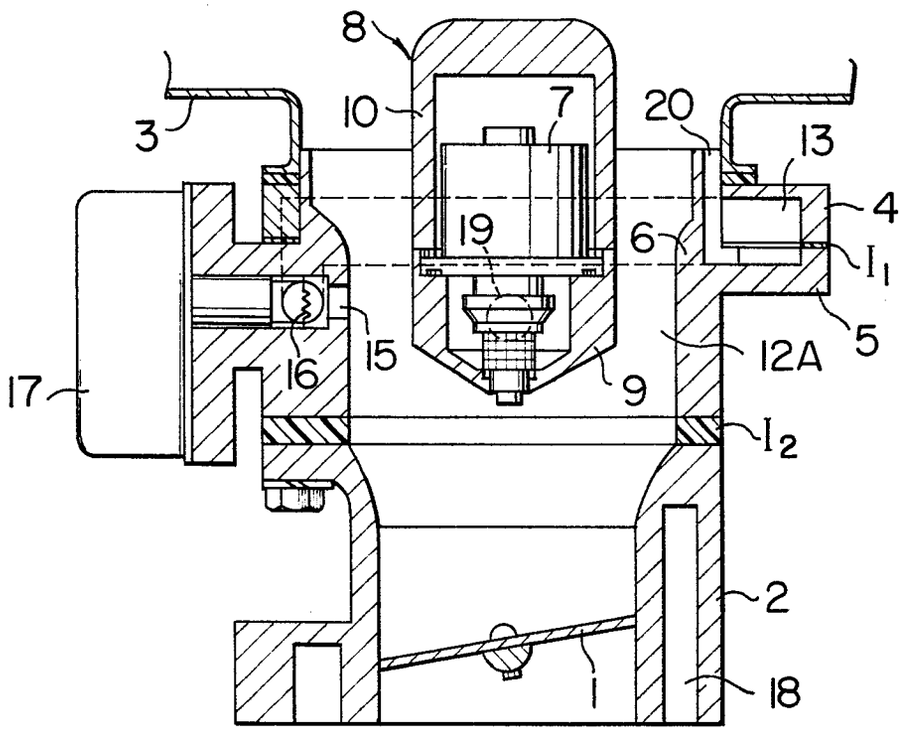

8
3
10
7
20
13
4
19
6
I_1
5
16
15
12A
17
9
I_2
2
1
18

FIG. 5

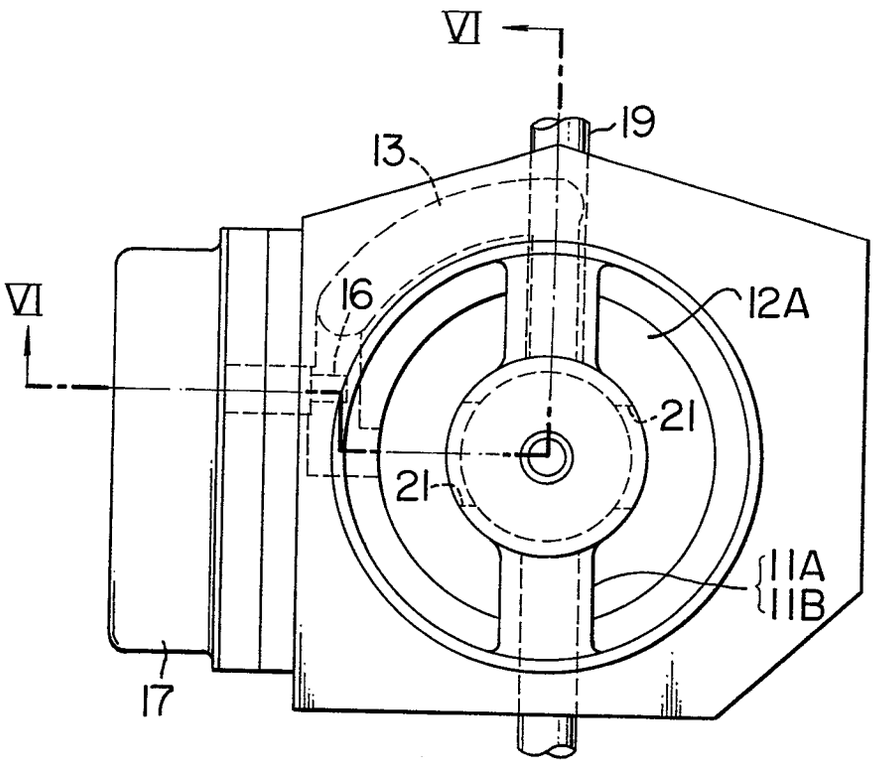

VI
19
13
16
12A
VI
21
21
11A
11B
17

FIG. 6

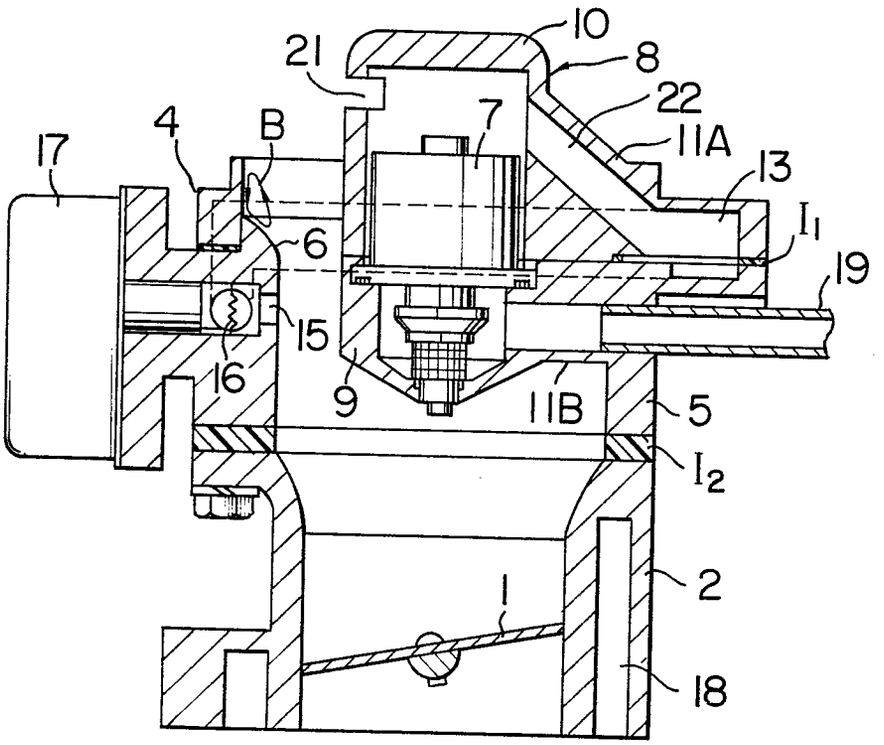

10
21
8
22
4
B
7
11A
17
13
I1
6
19
15
16
9
11B
5
I2
2
1
18

FIG. 7

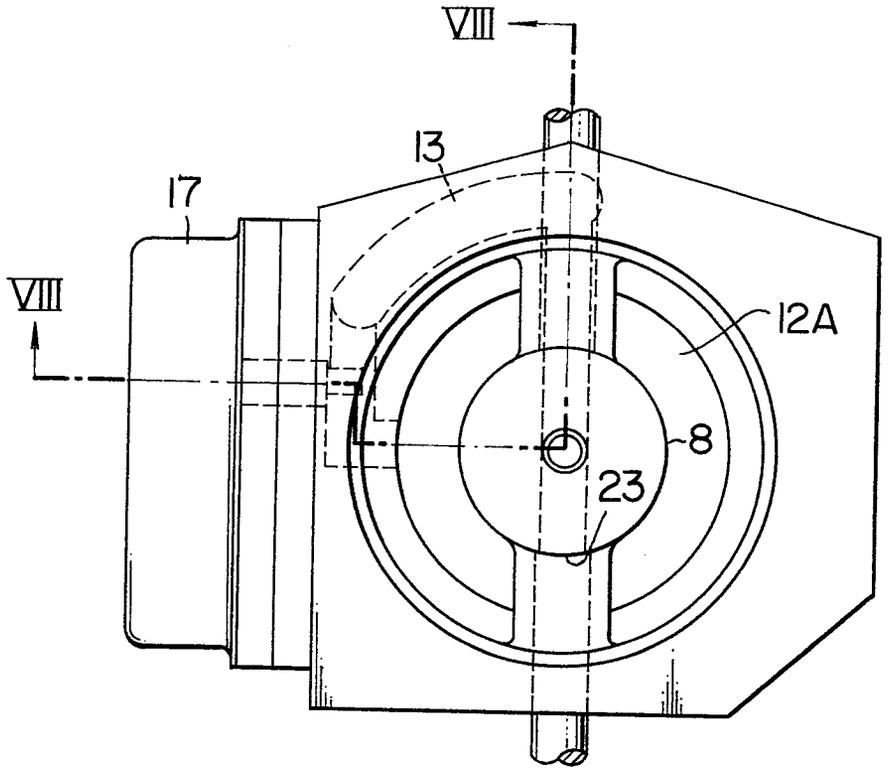

VIII
13
17
VIII
12A
8
23

FIG. 8

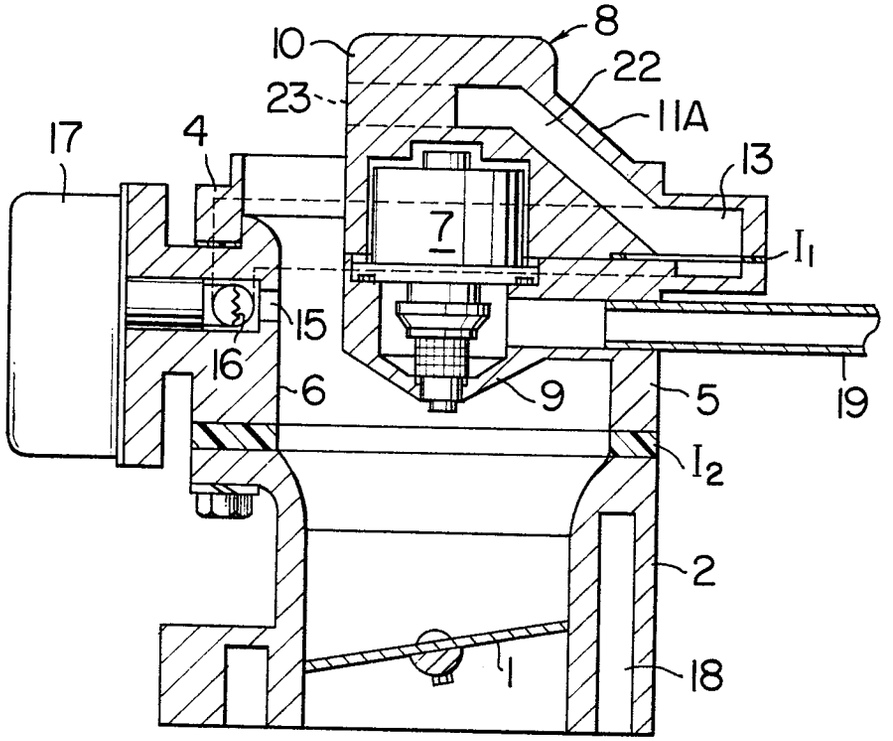

10
8
23
22
11A
17
4
13
7
I1
15
16
6
9
5
19
I2
2
1
18

FIG. 9

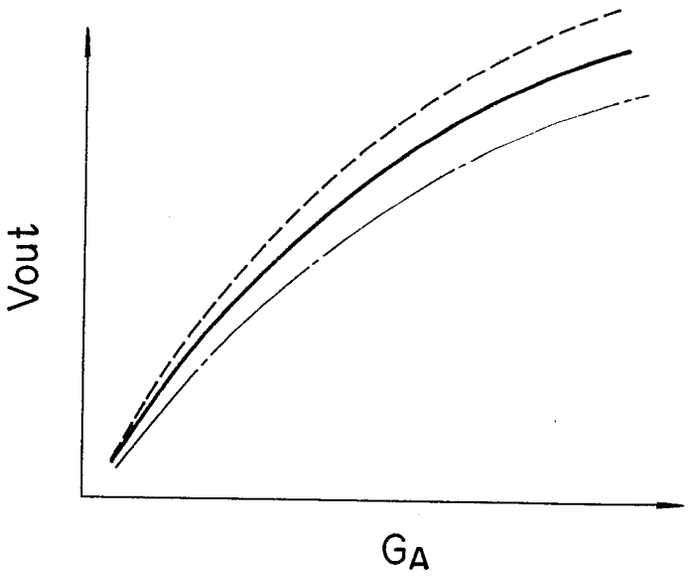
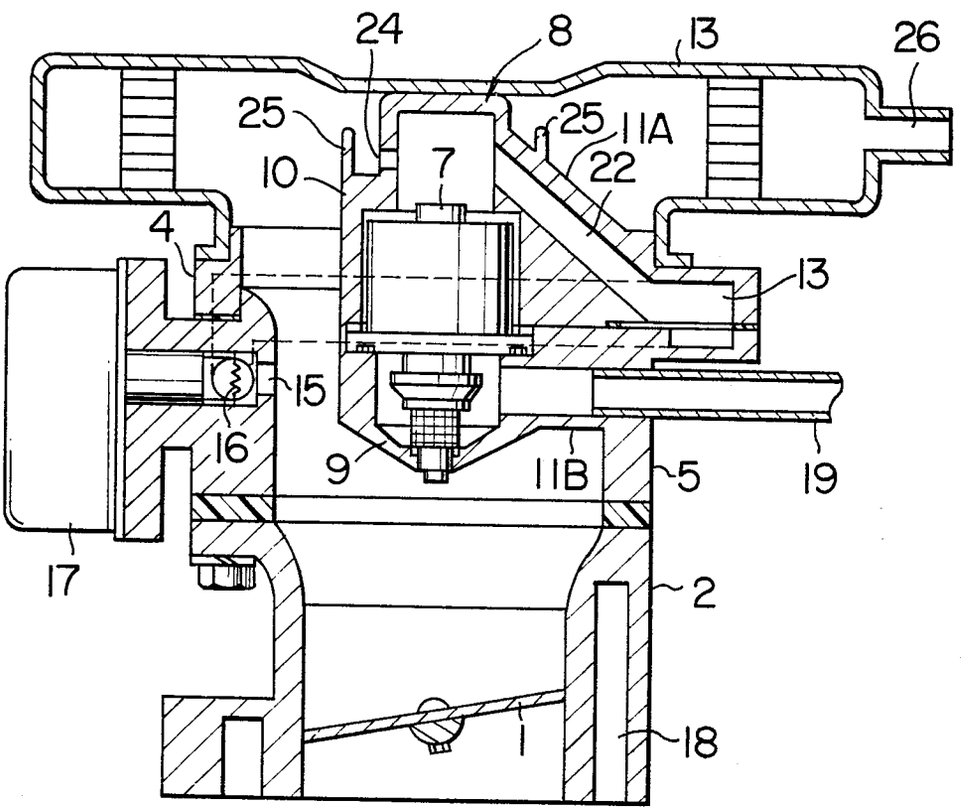


FIG. 10



European Patent Office

EUROPEAN SEARCH REPORT

0096842
Application number

EP 83 10 5627

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	DE-A-3 019 544 (BOSCH) * Page 4, line 8 - page 5, line 24; figure 1 *	1,14	F 02 M 69/00
X	GB-A-2 082 252 (BOSCH) * Page 1, line 116 - page 3, line 125; figures 1,2 *	1,6,7, 8,9,14	
A	US-A-4 264 961 (HITACHI)		
A	FR-A-2 461 112 (NISSAN)		
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
			F 02 M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-08-1983	SCHMID R.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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