AUSTRALIA 620980 CONVENTION

Patents Act

APPLICATION FOR A STANDARD PATENT

Mitsubishi Jidosha Kogyo Kabushiki Kaisha
33-8, Shiba 5-chome, Minato-ku, Tokyo, JAPAN

Mitsubishi Denki Kabushiki Kaisha
2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo, JAPAN

hereby applies for the grant of a standard patent for an invention entitled:

VORTEX FLOWMETER

which is described in the accompanying complete specification.

Details of basic application(s):-

106656/1989	JAPAN	25 April 1989
129333/1989	JAPAN	23 May 1989

Address for Service:

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367 Collins Street
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DATED this TWENTY FOURTH day of APRIL 1990

PHILLIPS ORMONDE & FITZPATRICK
Attorneys for:
Mitsubishi Jidosha Kogyo Kabushiki Kaisha, Mitsubishi Denki Kabushiki Kaisha

By:

Our Ref : 171472
POF Code: 1594/49230

6010

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-P/41 (...) 29-287-(?)

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DECLARATION FOR A PATENT APPLICATION

▼ INSTRUCTIONS
(a) Insert "Convention" if applicable
(b) Insert FULL name(s) of applicant(s)

In support of the (a) Convention application made by
(b) MITSUBISHI DENKI KABUSHIKI KAISHA

(c) Insert "of addition" if applicable
(d) Insert TITLE of invention

(hereinafter called "applicant(s)" for a patent (c) for an invention entitled (d)
VORTEX FLOWMETER

(e) Insert FULL name(s) AND address(es) of declarant(s) (See headnote*)

I/We (e) Masuo OIWA, General Manager of Patent Department of Mitsubishi Denki Kabushiki Kaisha of 2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan

do solemnly and sincerely declare as follows:

1. ~~I am/We are the applicant(s).~~
(or, *in the case of an application by a body corporate*)
1. I am/~~We are~~ authorized to make this declaration on behalf of the applicant(s).
2. ~~I am/We are the actual inventor(s) of the invention.~~
(or, *where the applicant(s) is/are not the actual inventor(s)*)

(f) Insert FULL name(s) AND address(es) of actual inventor(s)

2. (f) Yoshihiko TANIMURA and Hisato AZUMA of c/o Mitsubishi Jidosha Kogyo Kabushiki Kaisha of 33-8, Shiba 5-chome, Minato-ku, Tokyo, Japan, respectively and Hisato ISHIKURO and Yasuo TADA of c/o Himeji Seisakusho of Mitsubishi Denki Kabushiki Kaisha of 840, Chiyoda-cho, Himeji-shi, Hyogo-ken, Japan, respectively is/are the actual inventor(s) of the invention and the facts upon which the applicant(s) is/~~are~~ entitled to make the application are as follows:

(g) Recite how applicant(s) derive(s) title from actual inventor(s) (See headnote**)

(g) The applicant is the assignee of the invention from the said actual inventors.

(Note: *Paragraphs 3 and 4 apply* only *to Convention applications*)

(h) Insert country, filing date, and basic applicant(s) for the/or EACH basic application

3. The basic application(s) for patent or similar protection on which the application is based is/are identified by country, filing date, and basic applicant(s) as follows:
(h) Japan on April 25, 1989 and May 23, 1989 by MITSUBISHI JIDOSHA KOGYO KABUSHIKI KAISHA and MITSUBISHI DENKI KABUSHIKI KAISHA

4. The basic application(s) referred to in paragraph 3 hereof was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

(k) Insert PLACE of signing
(l) Insert DATE of signing
(m) Signature(s) of declarant(s)
Note: No legalization or other witness required

Declared at (k) Tokyo, Japan
Dated (l) April 10, 1990
(m) MITSUBISHI DENKI KABUSHIKI KAISHA
[signature]
Masuo Oiwa
General Manager
Patent Department

To: The Commissioner of Patents

P18/7/78

PHILLIPS ORMONDE & FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia

AUSTRALIA

Patents Act

DECLARATION FOR A PATENT APPLICATION

▼ INSTRUCTIONS
(a) Insert "Convention" if applicable
(b) Insert FULL name(s) of applicant(s)
(c) Insert "of addition" if applicable
(d) Insert TITLE of invention
(e) Insert FULL name(s) AND address(es) of declarant(s) (See headnote*)
(f) Insert FULL name(s) AND address(es) of actual inventor(s)
(g) Recite how applicant(s) derive(s) title from actual inventor(s) (See headnote**)
(h) Insert country, filing date, and basic applicant(s) for the/or EACH basic application
(k) Insert PLACE of signing
(l) Insert DATE of signing
(m) Signature(s) of declarant(s)
Note: No legalization or other witness required

In support of the (a) Convention application made by
(b) MITSUBISHI JIDOSHA KOGYO KABUSHIKI KAISHA

(hereinafter called "applicant(~~s~~) for a patent (c) for an invention entitled (d)
VORTEX FLOWMETER

I/~~We~~ (e) Toshiaki SAWAMURA, Executive Director of Mitsubishi Jidosha Kogyo Kabushiki Kaisha of 33-8, Shiba 5-chome, Minato-ku, Tokyo, Japan

do solemnly and sincerely declare as follows:

1. ~~I am/We are the applicant(s).~~
(or, *in the case of an application by a body corporate)*
1. I am/~~We are~~ authorized to make this declaration on behalf of the applicant(~~s~~).
2. ~~I am/We are the actual inventor(s) of the invention.~~
(or, *where the applicant(s) is/are not the actual inventor(s))*
2. (f) Yoshihiko TANIMURA and Hisato AZUMA of c/o Mitsubishi Jidosha Kogyo Kabushiki Kaisha of 33-8, Shiba 5-chome, Minato-ku, Tokyo, Japan, respectively and Hisato ISHIKURO and Yasuo TADA of c/o Himeji Seisakusho of Mitsubishi Denki Kabushiki Kaisha of 840, Chiyoda-cho, Himeji-shi, Hyogo-ken, Japan, respectively ~~is~~/are the actual inventor(s) of the invention and the facts upon which the applicant(~~s~~) is/are entitled to make the application are as follows:
(g) The applicant is the assignee of the invention from the said actual inventors.

(Note: *Paragraphs 3 and 4 apply* **only** *to Convention applications)*

3. The basic application(s) for patent or similar protection on which the application is based ~~is~~/are identified by **country, filing date, and basic applicant(s)** as follows:
(h) Japan on April 25, 1989 and May 23, 1989 by MITSUBISHI JIDOSHA KOGYO KABUSHIKI KAISHA and MITSUBISHI DENKI KABUSHIKI KAISHA

4. The basic application(s) referred to in paragraph 3 hereof ~~was~~/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at (k) Tokyo, Japan
Dated (l) April 12, 1990

(m) MITSUBISHI JIDOSHA KOGYO KABUSHIKI KAISHA
Toshiaki Sawamura
TOSHIAKI SAWAMURA
EXECUTIVE DIRECTOR

To: The Commissioner of Patents

P18/7/78

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(12) PATENT ABRIDGMENT (11) Document No. AU-B-53826/90
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 620980

(54) Title
VORTEX FLOWMETER

International Patent Classification(s)
(51)[5] G01F 001/32 G01F 015/00 G01F 015/02 G01F 015/04

(21) Application No. : 53826/90 (22) Application Date : 24.04.90

(30) Priority Data

(31) Number	(32) Date	(33) Country
1-106656	25.04.89	JP JAPAN
1-129333	23.05.89	JP JAPAN

(43) Publication Date : 01.11.90

(44) Publication Date of Accepted Application : 27.02.92

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(56) Prior Art Documents
US 4446824
JP 58021517
US 4759213

(57) Claim

1. A vortex flowmeter arrangement for an internal combustion engine, including an air cleaner defined by an upper, cup-shaped cover and a lower, cup-shaped cover, a filter element disposed between open sides of the upper and lower covers to divide the air cleaner into upper and lower chambers, an air inlet defined in a side wall of the lower cover, an air outlet defined in a side wall of the upper cover, opposite the air inlet, such that an asymmetrical air flow velocity distribution prevails at an inlet zone of the air outlet, an elongate flowmeter duct having an outwardly flared bell mouth inlet coupled to said air outlet, and vortex generating means disposed inside the duct, means for correcting the air flow velocity to a substantially uniform or symmetrical distribution at the inlet zone of the air outlet, said correcting means including a tubular projection extending from the air outlet into the upper chamber, said projection having a concave taper in a direction toward the air outlet to define an outwardly flared air intake mouth.

.../2

3. A vortex flowmeter arrangement for an internal combustion engine, including an air cleaner defined by an upper, cup-shaped cover and a lower, cup-shaped cover, a filter element disposed between open sides of the upper and lower covers to divide the air clearner into upper and lower chambers, an air inlet defined in a side wall of the lower cover, an air outlet defined in a side wall of the upper cover, opposite the air inlet, such that an asymmetrical air flow velocity distribution prevails at an inlet zone of the air outlet, an elongate flowmeter duct having an outwardly flared bell mouth inlet coupled to said air outlet, and vortex generating means disposed inside the duct, means for correcting the air flow velocity to a substantially uniform or symmetrical distribution at the inlet zone of the air outlet, said correcting means including a base portion of the upper cover merging smoothly with an upper edge of the air outlet, and defining a concave, outwardly flared air intake guide.

620980

AUSTRALIA

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COMPLETE SPECIFICATION
(ORIGINAL)

	Class	Int. Class

Application Number:
Lodged:

Complete Specification Lodged:
Accepted:
Published:

Priority

Related Art:

Applicant(s):

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Complete Specification for the invention entitled:

VORTEX FLOWMETER

Our Ref : 171472
POF Code: 1594/49230,65523

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

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VORTEX FLOWMETER

The present invention relates to a vortex flowmeter and, more particularly, to a vortex flowmeter for use in an internal combustion engine.

In general, when a vortex flowmeter is employed in an internal combustion engine, it is always provided at th downstream side of an air cleaner provided to remove dust from air sucked into the engine, as shown, for example, in Japanese Patent Publication No. 62-26686 and Japanese Patent Public Disclosure No. 58-21517.

Incidentally, if the flow of a fluid which is to be measured is not stable, measuring accuracy thereof will be lowered and in some cases measurement may not be possible at all. Since a vortex flowmeter employed in an internal combustion engine is provided at the downstream side of an air cleaner, as described above, it is in many cases impossible to ensure sufficient space for a fluid to flow with the required level of stability and consequently drift and turbulent flows increase considerably when the flow rate is high. If a known straightening mechanism is employed in such an arrangement, generation of vortices may be obstructed.

Fig. 1 is a sectional view of a conventional vortex flowmeter 1 which is provided at the downstream side of an air cleaner of an engine. The vortex flowmeter 1 comprises a duct 11 having a quadrilateral cross-sectional configuration for passing a fluid which is to be measured, a first vortex generating column 12 provided inside the duct 11 to generate a Karman vortex, a second vortex generating column 13 provided inside the duct 11 at the downstream side of the first vortex generating column 12 to generate a Karman vortex, the second vortex generating column 13 having a vortex detecting pressure introducing port, a honeycomb straightening 14 provided at the upstream end of the duct 11, and a control circuit 15 provided outside the duct 11. An air cleaner 2 comprises an upstream cover 21 having a fluid inlet, a downstream cover 22 having a fluid outlet which is connected to the duct 11, and a dust removing element 23 provided between the upstream cover 21 and the downstream cover 22. An intake pipe 3 is connected to the downstream end of the duct 11 to lead a fluid to the engine through a throttle valve (not shown).

In the above-described arrangement, a fluid which is to be measured, that is, air, flows into the upstream cover 21 of the air cleaner 2, as shown by the streamline F_{IN}, and then flows inside the downstream cover 22, as shown by the streamlines F_1 to F_4, to reach the inlet of the vortex flowmeter 1. Since the fluid tends to flow through a region where the resistance is relatively low, in general the air flow along the streamline F_2 has the highest flow velocity, those along the streamlines F_1 and F_3 follow it, and the air flow along the streamline F_4 has the lowest flow velocity. The velocity of the air flow along the streamline F_4 is extremely unstable. The fluid reaching the inlet of the vortex flowmeter 1 flows into the intake pipe 3 along the streamline F_{OUT}.

The following is a description of the flow velocity distribution in the vortex flowmeter 1 of the fluid streams flowing along the streamlines F_1 to F_4 in the air cleaner 2. Fig. 2 is an enlarged sectional view showing the outlet side of the air cleaner 2 and the upstream side of the vortex flowmeter 1. Reference numeral 11a in the figure denotes a bell mouth portion which is provided along the entire circumference of the inlet of the duct 11, the bell mouth portion 11a being disposed at the downstream side of the honeycomb straightening device 14. Accordingly, after reaching the honeycomb straightening device 14, the fluid streams flowing along the streamlines F_1 to F_4, which would otherwise flow in the respective directions shown by the chain lines, are straightened by the honeycomb straightening device 14 so as to flow in the respective directions shown by the solid lines. Then, the fluid streams along the streamlines F_1 and F_3 are accelerated in the bell mouth portion 11a so that the flow velocities of these fluid streams approach that of the fluid stream along the streamline F_2 that has the highest flow velocity. Accordingly, if it is assumed that there is no fluid stream along the streamline F_4, the flow velocity distribution inside the duct 11 immediately in front of the first vortex generating column 12 is relatively uniform, as shown by the solid line V_L. In actuality, however, there is a fluid stream flowing along the streamline F_4, and the fluid stream along the streamline F_3 is therefore forced to shift downwardly by the fluid stream along the streamline F_4, resulting in a reduction in the flow velocity of this fluid stream in the vicinity of the bell mouth portion 11a. Thus, the flow velocity distribution is distorted, as shown by the chain line V_L'. A vortex that is generated when the flow velocity distribution is distorted as described above varies in intensity and sometimes disappears. Such a vortex condition is shown in Fig. 3. V_C shown in Fig. 3(a) denotes the center of a vortex column generated in the duct 11, that is, the position of the vortex line. V_0 shown in Fig. 3(b) denotes the intensity of the vortex, that is, the vortex pressure. It is assumed that six vortices V_1 to V_6 are successively generated while the time T elapses from the right to the left as viewed in the figure. In the vortex V_1, the distortion of the vortex line is not yet large. However, as the vortices V_2 to V_4 are successively generated, the degree of distortion increases, and the vortex line finally breaks in the vortex V_5. In the meantime, the vortex intensity V_0 gradually decreases and reaches zero at the time of generation of the vortex V_5 in which the vortex line breaks. More specifically, there is practically no vortex V_5. After the vortex line has broken, a vortex V_6 having a relatively low vortex intensity V_0 is generated, and the vortex intensity V_0 gradually increases thereafter. However, the vortex disappears again after the vortices V_1 to V_4 have been successively generated.

Thus, the conventional vortex flowmeter suffers from the following problems. The vortex disappears periodically, and the accuracy of the measurement is substantially lowered in the case of a fluid which is likely to cause many drift and turbulent flows, with the end result that the vortex flowmeter fails to serve its purpose.

It is an object of the present invention to provide a vortex flowmeter which is designed so that, even if a fluid which is to be measured is likely to cause many drift and turbulent flows, the flow of the fluid is stabilized so as to enable accurate and stable measurement of the flow rate.

To this end, the present invention provides in one aspect a vortex flowmeter arrangement for an internal combustion engine, including an air cleaner defined by an upper, cup-shaped cover and a lower, cup-shaped cover, a filter element disposed between open sides of the upper and lower covers to divide the air cleaner into upper and lower chambers, an air inlet defined in a side wall of the lower cover, an air outlet defined in a side wall of the upper cover, opposite the air inlet, such that an asymmetrical air flow velocity distribution prevails at an inlet zone of the air outlet, an elongate flowmeter duct having an outwardly flared bell mouth inlet coupled to said air outlet, and vortex generating means disposed inside the duct, means for correcting the air flow velocity to a substantially uniform or symmetrical distribution at the inlet zone of the air outlet, said correcting means including a tubular projection extending from the air outlet into the upper chamber, said projection having a concave taper in a direction toward the air outlet to define an outwardly flared air intake mouth.

The present invention provides in another aspect a vortex flowmeter arrangement for an internal combustion engine, including an air cleaner defined by an upper, cup-shaped cover and a lower, cup-shaped cover, a filter element disposed between open sides of the upper and lower covers to divide the air clearner into upper and lower chambers, an air inlet defined in a side wall of the lower cover, an air outlet defined in a side wall of the upper cover, opposite the air inlet, such that an asymmetrical air flow velocity distribution prevails at an inlet zone of the air outlet, an elongate flowmeter duct having an outwardly flared bell mouth inlet coupled to said air outlet, and vortex generating means disposed inside the duct, means for correcting the air flow velocity to a substantially uniform or symmetrical distribution at the inlet zone of the air outlet, said correcting means including a base portion of the upper cover merging smoothly with an upper edge of the air outlet, and defining a concave, outwardly flared air intake guide.

VF

the velocity of a normal flow.

The above and other objects, features and advantages of the present invention will become more apparent from the following description of the preferred embodiments thereof, taken in conjunction with the accompanying drawings, in which like reference numerals denote like elements, and of which:

Fig. 1 is a sectional view of a conventional vortex flowmeter which is connected to an air cleaner of an internal combustion engine;

Fig. 2 is an enlarged sectional view of an essential part of the arrangement shown in Fig. 1;

Figs. 3(a) and 3(b) show the way in which vortices are generated in the conventional vortex flowmeter;

Fig. 4 is a sectional view of one embodiment of the vortex flowmeter according to the present invention which is connected to an air cleaner of an internal combustion engine;

Figs. 5(a) and 5(b) show the way in which vortices are generated in the vortex flowmeter according to the present invention;

Figs. 6 and 7 are a sectional view and a fragmentary enlarged sectional view of another embodiment of the vortex flowmeter according to the present invention which is connected to an air cleaner of an internal combustion engine; and

Figs. 8 and 9 are a sectional view and a fragmentary enlarged sectional view of still another embodiment of the vortex flowmeter according to the present invention which is connected to an air cleaner of an internal combustion engine.

One embodiment of the present invention will be described below in detail with reference to Figs. 4 and 5. Fig. 4 is a sectional view of a vortex flowmeter 41 according to this embodiment, the vortex flowmeter 41 being connected between an air cleaner 2 and an intake pipe 3 of an internal combustion engine. Reference numeral 11b denotes a funnel portion of a duct 11. The funnel portion 11b has a quadrilateral cross-sectional configuration and projects upstream of a honeycomb straightening device 14, that is, it extends into the air cleaner 2. The funnel portion 11b is provided over the entire circumference of the inlet of the duct 11 in the same way as in the case of the bell mouth portion 11a. The arrangement of the rest of the vortex flowmeter 41 is the same as that of the conventional vortex flowmeter 1 shown in Fig. 1.

In the above-described arrangement, a fluid which is to be measured flows through the air cleaner 2 in the same way as in the prior art and reaches the funnel portion 11b of the duct 11. Among the fluid streams, those flowing along the streamlines F_1 to F_3 pass through the funnel portion 11b to reach the honeycomb straightening device 14 where the fluid flow is straightened, and the fluid streams then pass through the bell mouth portion 11a. In this course, the fluid stream along the streamline F_1 is throttled and consequently the flow velocity of this fluid stream immediately in front of the honeycomb straightening device 14 becomes closer to that of the fluid stream along the streamline F_2 than in the case of the prior art. The fluid stream along the streamline F_4, which forces the fluid stream along the streamline F_3 to shift downwardly in the prior art, is directed so as to flow in a direction in which it increases the velocity of the fluid stream along the streamline F_3 by the throttling function of the funnel portion 11b. As a result, the flow velocity distribution V_L inside the duct 11 immediately in front of the first vortex generating column 12 becomes uniform. In consequence, the vortex line position V_C and the vortex intensity V_0 are kept extremely stable as the time T elapses and vortices are therefore generated under normal conditions, as shown in Figs. 5(a) and 5(b), resulting in an increase in the accuracy of the measurement. Since the funnel portion 11b is provided along the entire circumference of the inlet of the duct 11, the flow velocity distribution which is perpendicular to the first vortex generating column 12 is also made uniform, so that the generation of vortices is even more stabilized. It should be noted that the drawing rate of the funnel portion 11b, that is, the dimensional ratio of the inlet to the outlet of the funnel portion 11b is preferably set at from 1.1:1 to 1.5:1 in the direction parallel to the vortex generating column 12 and at from 1.2:1 to 1.5:1 in the direction perpendicular to it with a view to obtaining a vortex flowmeter having superior stability.

Fig. 6 is a sectional view of a vortex flowmeter 41 according to another embodiment of the present invention, which is connected between an air cleaner 2 and an intake pipe 3 of an internal combustion engine, and Fig. 7 is an enlarged sectional view showing an essential part of the arrangement shown in Fig. 6. Reference numeral 11b denotes a funnel portion 11b of the duct 11 which projects upstream of the honeycomb straightening device 14, that is, extends into the air cleaner 2. The funnel portion 11b is provided only on that portion of the duct 11 which faces the side of the downstream cover 22 that is remote from the dust removing element 23. The funnel portion 11b has such a confuguration that a fluid which is to be measured is throttled toward the inlet of the duct 11. The arrangement of the rest of this embodiment is the same as that of the first embodiment stated above.

In the above-described arrangement, a fluid which is to be measured flows through the air cleaner 2 to reach the inlet of the duct 11, that is, the honeycomb straightening device 14, in the same way as in the prior art. Among the fluid streams, those flowing along the streamlines F_1 to F_3 are straightened by the honeycomb straightening device 14 and then pass through the bell mouth portion 11a. In this course, the fluid stream along the streamline F_4, which forces the fluid stream along the streamline F_3 to shift downwardly in the prior art, is directed so as to flow in a direction in which the velocity of the fluid stream along the streamline F_3 is increased by the throttling function of the funnel portion 11b. As a result, the flow velocity distribution V_L inside the duct 11 immediately in front of the first vortex generating column 12 becomes uniform, and vortices are therefore generated under normal conditions, resulting in an increase in the accuracy of the measurement.

Figs. 8 and 9 are a sectional view and a fragmentary enlarged sectional view of still another embodiment of the present invention. Reference numeral 22a denotes a throttle portion formed by shaping into a throttle-like configuration that portion of the downstream cover 22 of the air cleaner 42 which is remote from the dust removing element 23 and which is connected to the duct 11. The arrangement of the rest of this embodiment is the same as that of the foregoing embodiments.

In the above-described arrangement, the fluid streams along the streamlines F_1 to F_3 flow in the same way as in the prior art. However, the fluid stream along the streamline F_4 is directed by the throttle portion 22a so as to flow along the streamline F_3, thus increasing the velocity of the fluid stream along the streamline F_3. As a result, the flow velocity distribution V_L inside the duct 11 immediately in front of the first vortex generating column 12 becomes uniform, and vortices are therefore generated under normal conditions, resulting in an increase in the accuracy of the measurement.

Although the present invention has been described through specific terms, it should be noted here that the described embodiments are not necessarily exclusive and that various changes and modifications may be imparted thereto without departing from the scope of the invention which is limited solely by the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A vortex flowmeter arrangement for an internal combustion engine, including an air cleaner defined by an upper, cup-shaped cover and a lower, cup-shaped cover, a filter element disposed between open sides of the upper and lower covers to divide the air cleaner into upper and lower chambers, an air inlet defined in a side wall of the lower cover, an air outlet defined in a side wall of the upper cover, opposite the air inlet, such that an asymmetrical air flow velocity distribution prevails at an inlet zone of the air outlet, an elongate flowmeter duct having an outwardly flared bell mouth inlet coupled to said air outlet, and vortex generating means disposed inside the duct, means for correcting the air flow velocity to a substantially uniform or symmetrical distribution at the inlet zone of the air outlet, said correcting means including a tubular projection extending from the air outlet into the upper chamber, said projection having a concave taper in a direction toward the air outlet to define an outwardly flared air intake mouth.

2. A vortex flowmeter arrangement according to claim 1, wherein said projection only partially surrounds said air outlet, and extends towards a base of the upper cover whereat the air flow velocity is lowest.

3. A vortex flowmeter arrangement for an internal combustion engine, including an air cleaner defined by an upper, cup-shaped cover and a lower, cup-shaped cover, a filter element disposed between open sides of the upper and lower covers to divide the air clear er into upper and lower chambers, an air inlet defined in a side wall of the lower cover, an air outlet defined in a side wall of the upper cover, opposite the air inlet, such that an asymmetrical air flow velocity distribution prevails at an inlet zone of the air outlet, an elongate flowmeter duct having an outwardly flared bell mouth inlet coupled to said air outlet, and vortex generating means disposed inside the duct, means for correcting the air flow velocity to a substantially uniform or symmetrical

distribution at the inlet zone of the air outlet, said correcting means including a base portion of the upper cover merging smoothly with an upper edge of the air outlet, and defining a concave, outwardly flared air intake guide.

4. A vortex flowmeter arrangement substantially as hereinbefore described with respect to any one of the embodiments as shown in Figures 4 to 9 of the accompanying drawings.

DATED: 3 December 1991

PHILLIPS ORMONDE & FITZPATRICK
Attorneys for:
MITSUBISHI JIDOSHA KOGYO KABUSHIKI KAISHA and
MITSUBISHI DENKI KABUSHIKI KAISHA

David B Fitzpatrick

1243b

Fig. 1

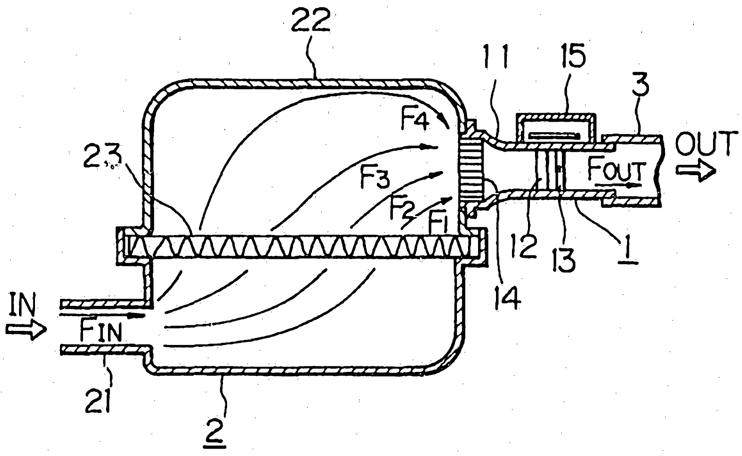
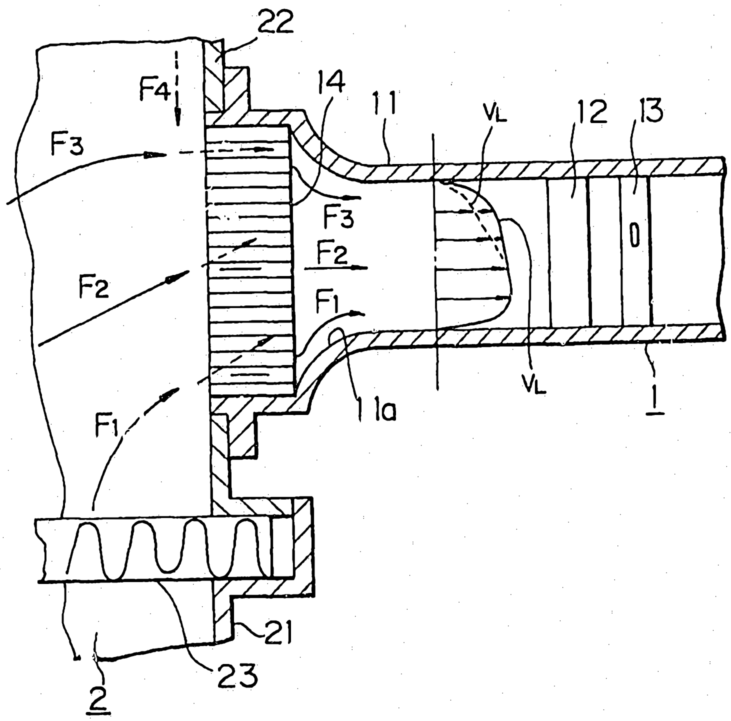


Fig.2


22
F4
14
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VL
12
13
F3
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F2
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F1
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11a
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1
21
23
2

Fig.3

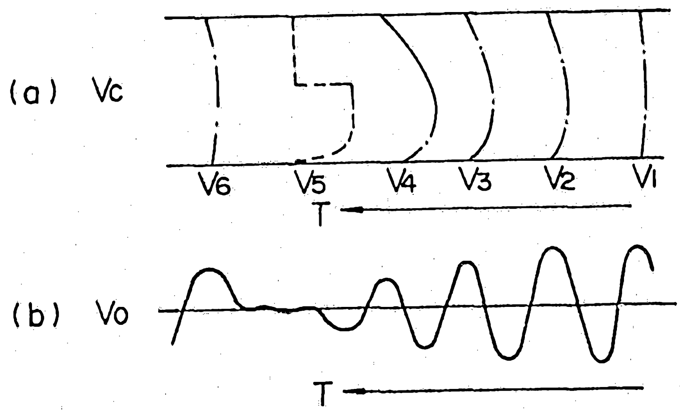

(a) Vc
V6
V5
V4
V3
V2
V1
T
(b) Vo
T

Fig.4

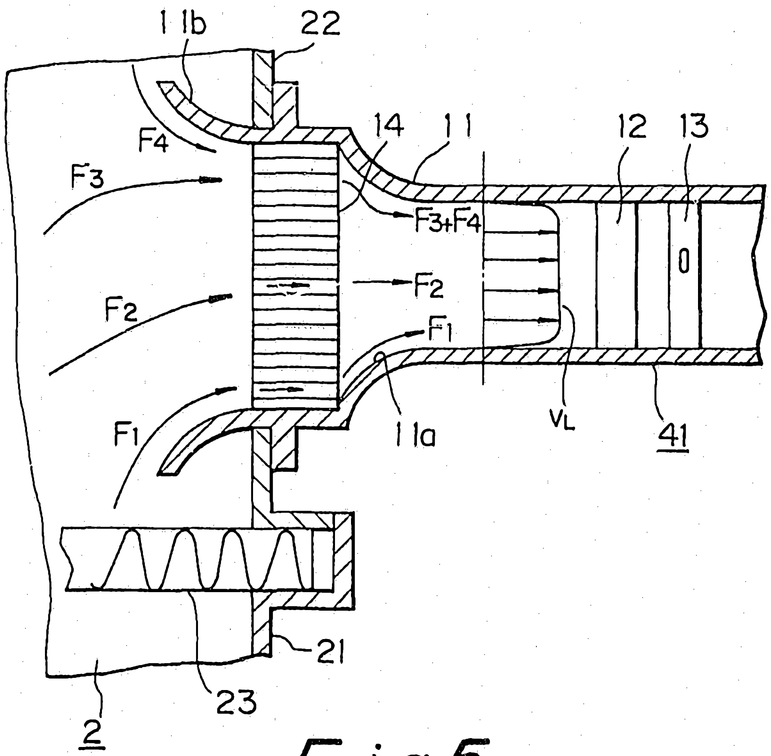
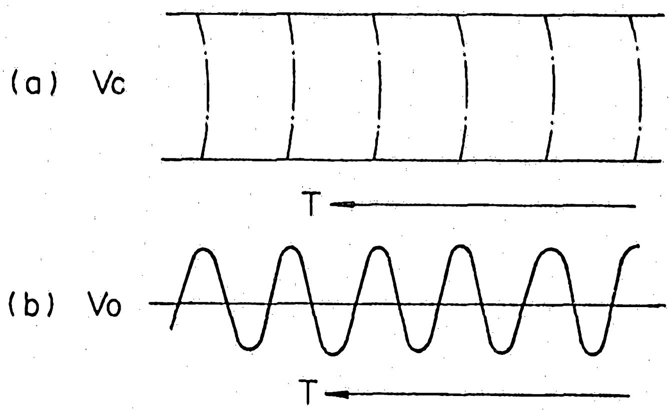


Fig.5



MITSUBISHI DENKI KABUSHIKI KAISHA and
MITSUBISHI JIDOSHA KOGYO KABUSHIKI KAISHA

53826/90

Fig.6

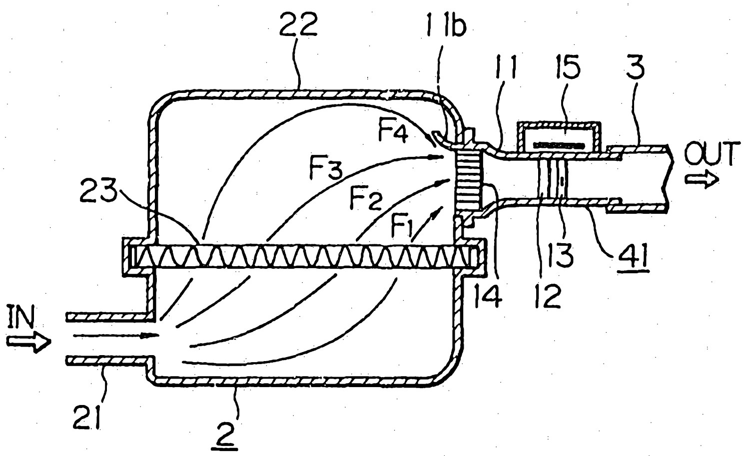


Fig.7

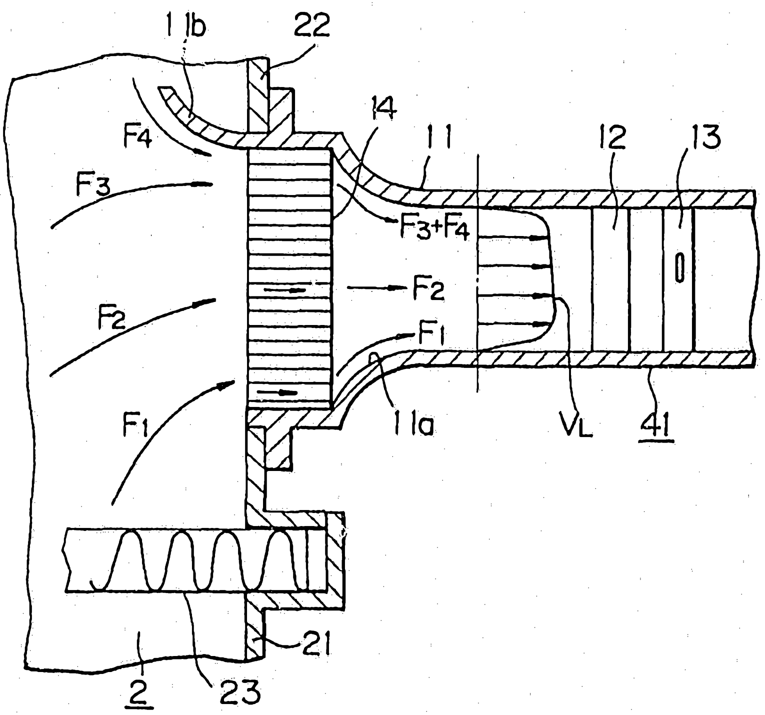


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Fig.8

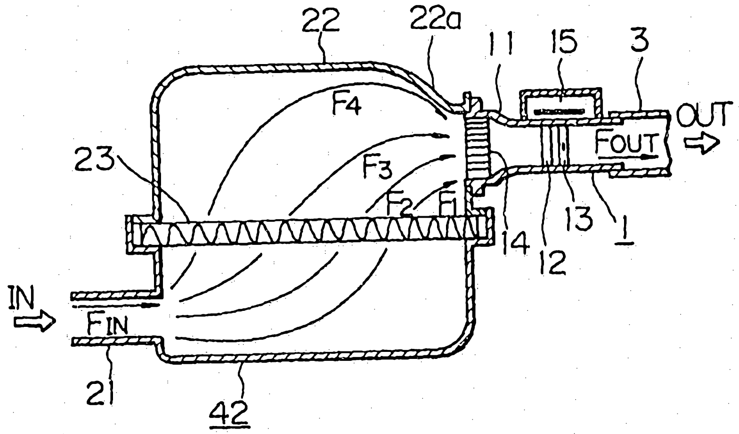

Fig.9