

⑫

EUROPEAN PATENT APPLICATION

⑲ Application number: **82104720.6**

⑤① Int. Cl.³: **F 02 M 35/04**

⑳ Date of filing: **28.05.82**

④③ Date of publication of application: **07.12.83**
Bulletin 83/49

⑦① Applicant: **mitsubishi denki kabushiki kaisha, 2-3,
Marunouchi 2-chome Chiyoda-ku, Tokyo 100 (JP)**

⑦② Inventor: **Asayama, Yoshiaki c/o Mitsubishi Denki K.K.,
Himeji Works No. 840, Chiyoda-ku, Himeji-shi Hyogo (JP)**

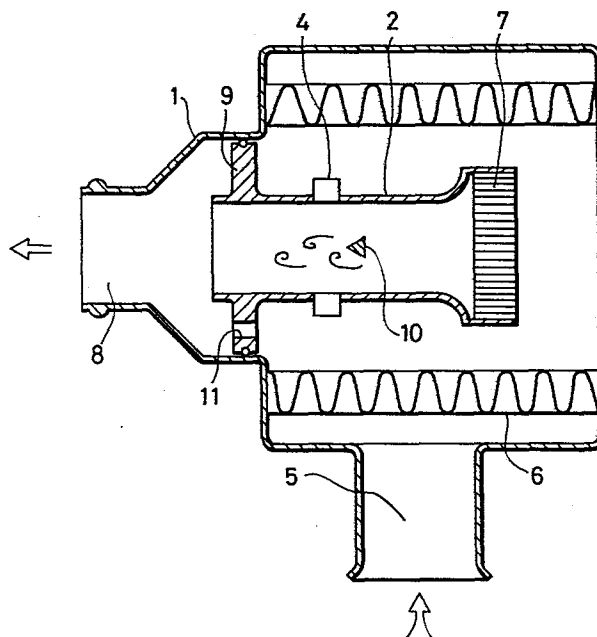
⑧④ Designated Contracting States: **DE FR GB**

⑦④ Representative: **Lehn, Werner, Dipl.-Ing. et al, Hoffmann,
Eitle & Partner Patentanwälte
Arabellastrasse 4 (Sternhaus), D-8000 München 81 (DE)**

⑤④ **Detection arrangement suitable for detecting the intake air flow rate in an internal combustion engine.**

⑤⑦ An apparatus for measuring the flow rate of intake air into an internal combustion engine is designed such that conduit-mounted ultrasonic transducers (4) can respond quickly to changes in the intake air temperature. In this manner, any modulation of the emitted ultrasonic energy due to temperature effects can be eliminated, so that the device may accurately measure the flow.

The detector portion (2) carrying the sensors (4) is mounted within a casing (1) (e.g. the air filter casing) by a partition wall (9) which is downstream of the sensors (4).



- 1 -

DETECTION ARRANGEMENT SUITABLE FOR DETECTING THE
INTAKE AIR FLOW RATE IN AN INTERNAL COMBUSTION ENGINE

The present invention relates to a detection arrangement suitable for detecting an intake air flow rate in an automotive engine, comprising: a casing into which intake air is introduced; a detector for detecting the air flow
05 rate; and a partition extending between said detector and said casing for bounding upstream and downstream regions of the intake air. An arrangement according to the invention may be housed in a casing of an air cleaner or the like.

There has been previously used a vortex-shedding flow-
10 meter for ultrasonically detecting the generation frequency of von Karman vortices to determine the flow rate of air drawn into automotive engines. The known vortex-shedding flowmeter comprises an ultrasonic transducer or emitter for radiating ultrasonic energy into a flow of intake or suction air, and
15 further ultrasonic transducer or receiver for receiving the ultrasonic energy as modulated by von Karman vortices generated in the air flow. The ultrasonic transducers are mounted on the wall of a pipe through which the suction air to be measured flows.

20 A typical prior air flow rate measuring construction, and an electronic apparatus therefor, is illustrated in U.S. Patent 3,818,877 to Barrera. In this patent, means by which the modulated ultrasonic energy is converted into a control signal for use with a fuel injector is disclosed.

25 It is known that the temperature of intake air in automotive engines rises 10 to 20 degrees Celsius in a few

- 2 -

minutes when the engine is idling in the sun in midsummer. Since the propagation velocity of ultrasonic energy in air varies with temperature as is well known, the ultrasonic energy as it passes through the air to be measured is subject to modulation due to both von Kármán vortices and this temperature change while the von Kármán vortices are being detected with air undergoing a sharp temperature rise. When the temperature distribution is uniform throughout the suction air, it is an easy task to detect only ultrasonic modulations due to the von Kármán vortices. However, where there are temperature differences in the flow of intake air, ultrasonic modulations which are caused by the von Kármán vortices and other ultrasonic modulations that are dependent upon the temperature differences are superimposed, resulting in difficulties in detecting only the vortex-dependent ultrasonic modulations. Therefore, the prior vortex-shedding flowmeter has been unable to detect only von Karman vortices under such conditions.

20 The present invention has been designed to eliminate or at least reduce the delay with which the wall of a pipe passing air there-

through follows a temperature rise of the air, a delay which has caused the temperature differences described above. The present invention thus provides a device for detecting an intake air flow rate in an automotive engine, the device

25

being suitable for use with engines in which the suction air is subjected to a wide range of temperature changes.

According to the invention, there is provided that
05 said partition is positioned downstream of an air flow sensing means of said detector.

For a better understanding of the invention, and to show how the same way be carried into effect, reference will now be made, by way of example, to the accompany-
10 ing drawings, in which:

Fig. 1 is a view showing the structure of a conventional flow detecting arrangement;

Fig. 2 is a view showing the structure of another known device; and

15 Fig. 3 is a view illustrative of a measurement device according to an embodiment of the present invention.

The present invention will now be described with
20 reference to the drawings. Fig. 1 shows a conventional detecting device in which a pipe 2 for detecting an air flow rate is disposed downstream of an air cleaner casing 1. Fig. 2 illustrates another prior detecting arrangement having a detector including a pipe 2 and
25 an air cleaner casing 1 housing the pipe 2. A partition 3 which divides the casing 1 into upstream and downstream regions is disposed upstream of flow sensing elements 4. With these conventional detecting devices, air which is introduced through an air intake port 5 passed through
30 a cleaner element (filter paper) 6, is rectified by a flow rectifier 7, and is introduced into the pipe 2 in which the rate of flow is detected by the sensing elements 4. When the temperature of the air introduced through the air intake port 5 is subjected to an abrupt
35 temperature change, a temperature variation of the wall

of the pipe 2 is delayed with respect to the temperature change of the air. Particularly, the pipe 2 shown in Fig. 1 has its outer surface out of contact with the intake air, and hence can not rapidly follow the temperature change of the air. While the pipe 2 illustrated in Fig. 2 is kept in contact with the intake air at the outer surface thereof, the air tends to be stagnant at the outer surface. Furthermore, the heat of the pipe wall located upstream of the pipe 2 is conducted to the air cleaner casing 1. Therefore, the rate at which the temperature of the wall of the pipe 2 follows the temperature change of the intake air is relatively low.

Fig. 3 shows a device for detecting the intake air flow rate according to an embodiment of the present invention. The device includes a partition 9 extending between a pipe or conduit 2 forming a detector for measuring the air flow rate and an air cleaner casing 1 which bounds upstream and downstream regions for the air, the partition 9 being positioned downstream of air flow sensing means 4. Preferably the sensing means includes a transmitter for transmitting ultrasonic sound waves across the pipe 2 and a receiver for receiving the ultrasonic sound waves modulated in accordance with the air flow rate, e.g. by the formation of von Karman vortices in the flow. A flow rate adjustment port 11 may be added in the partition with no adverse effect.

With the detecting arrangement of Fig. 3, air which is introduced through an air intake port 5 passes through an air cleaner element 6, is brought into contact with the outer surface of the pipe 2, is rectified by a flow rectifier 7, and then is introduced into the pipe 2.

Since the air thus drawn in is maintained in contact with the inner and outer surfaces of the wall of the pipe 2, the temperature of the pipe wall varies quickly in response to a temperature change of the intake air. Such
05 rapid temperature response is required of the pipe wall positioned upstream of the air flow sensing means 4. Temperature differences in the air as it leaves the sensing means 4 after the air flow rate has been detected do not adversely affect the detection of the air
10 flow rate. Therefore, the air flow rate detection is not adversely affected even when the heat of a pipe wall positioned downstream of the pipe 2 is conducted to the air cleaner casing 1 through the partition 9 disposed downstream of the sensing means 4.

15 With the arrangement of Figure 3 according to the present invention, there is thus provided a detector 2 for detecting the intake air flow rate on an engine, the detector being mounted in a casing, into which air for
20 the engine is introduced, and a partition 9 extends between the detector and the casing and bounds upstream and downstream regions of the air, the partition 9 being positioned downstream of sensing means 4 forming a detecting portion of the detector. The temperature of
25 the pipe 2 of the detector can thus follow the air temperature at an improved rate. The detector can therefore stably detect the flow rate of the air even when the temperature of the intake air is changed abruptly. Accordingly, the illustrated device according to the
30 invention is highly suitable for use as a device for detecting the intake air flow rate in an automotive engine, but of course the invention is not limited to use in such an application.

Claims:

1. A detection arrangement suitable for detecting intake air flow rate in an internal combustion engine, comprising: a casing (1) into which intake air is introduced; a detector (2) for detecting the air flow rate; and a partition (9) extending between said detector (2) and said casing (1) for bounding upstream and downstream regions of the intake air, characterized in that said partition (9) is positioned downstream of an air flow sensing means (4) of said detector (2).
2. An arrangement according to Claim 1, in which said detector (2) comprises a vortex-shedding flowmeter for ultrasonically detecting von Karman vortices.
3. An arrangement according to Claim 1 or 2, in which said casing (1) comprises a casing of an air cleaner for an internal combustion engine.
4. An arrangement according to Claim 1, wherein said detector (2) includes an air conduit (2) housing, said sensing means (4), said conduit (2) being located in the path of intake air such that said conduit (2) assumes the temperature of said intake air relatively rapidly.
5. An arrangement according to any one of Claims 1 to 4, wherein said casing (1) is arranged to receive an inlet air flow substantially perpendicular to the air flow through said detector (2).
6. An arrangement according to any one of the preceding Claims, wherein said partition (9) is connected to one end of said detector (2).
7. An internal combustion engine including an air filter casing having a detection arrangement according to any one of the preceding claims.

FIG. 1
PRIOR ART

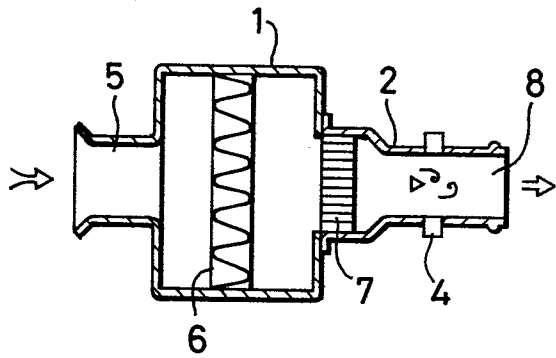


FIG. 2
PRIOR ART

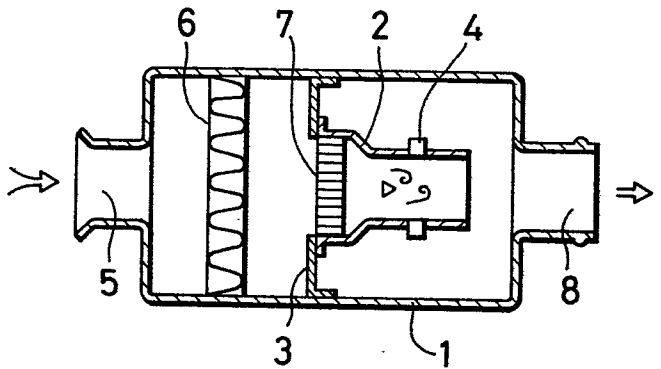
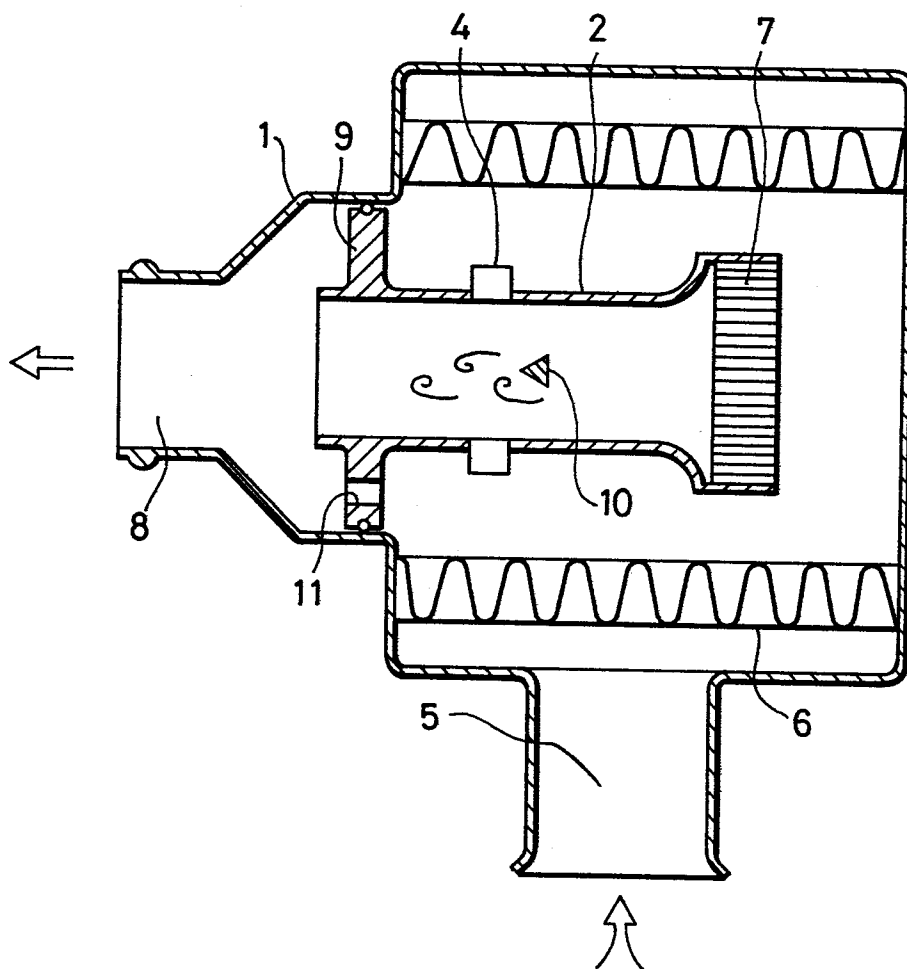


FIG. 3





European Patent
Office

EUROPEAN SEARCH REPORT

0095516
Application number

EP 82 10 4720

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)
A	--- GB-A-2 044 352 (MITSUBISHI) *Page 1, lines 3-6, 47-55, 76-94, 105-113; figure 2*	1, 2, 3, 4, 6, 7	F 02 M 35/04
A	--- FR-A-2 479 339 (MITSUBISHI) *Page 6, lines 1-13; figure 2*	1, 2, 3, 7	
A	--- DE-A-3 025 431 (NISSAN) *Page 1, claim 1; page 2, claims 2, 3*	1, 2, 3, 7	
D, A	--- US-A-3 818 877 (FORD) *Column 1, lines 5-15; figures 1, 2*	1, 2, 3, 7	TECHNICAL FIELDS SEARCHED (Int. Cl. 3) F 02 M G 01 F F 02 D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25-01-1983	Examiner TATUS W.D.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention 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	