FORM 1

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

596381

APPLICATION FOR A STANDARD PATENT

I\We,

VDO ADOLF SCHINDLING AG

of GRAFSTRASSE 103
6000 FRANKFURT/MAIN
FEDERAL REPUBLIC OF GERMANY

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

ARRANGEMENT FOR AN AIR-MASS METER FOR AN INTERNAL COMBUSTION ENGINE

which is described in the accompanying complete specification

Details of basic application(s):

Number of basic application	Name of Convention country in which basic application was filed	Date of basic application
P3539013.1	DE	02 NOV 85

My/our address for service is care of CLEMENT HACK & CO., Patent Attorneys, 601 St. Kilda Road, Melbourne 3004, Victoria, Australia.

DATED this 13th day of October 1986

VDO ADOLF SCHINDLING AG

CLEMENT HACK & CO.

TO: The Commissioner of Patents.

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 13 2 90

LODGED AT SUB-OFFICE
13 OCT 1986
Melbourne

FEE STAMP TO VALUE OF $195 ATTACHED
MAIL OFFICER

PATENT OFFICE 100 AUSTRALIA ONE HUNDRED DOLLARS

PATENT OFFICE 40 AUSTRALIA FORTY DOLLARS

PATENT OFFICE 5 AUSTRALIA FIVE DOLLARS

GRIFFITH HACK & CO.
601 ST. KILDA ROAD, MELBOURNE,
VICTORIA 3004, AUSTRALIA
TELEPHONE: (03) 529 8800
FAX: 613 529 6296

Forms 7 and 8

63901/86

AUSTRALIA

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

Name(s) of Applicant(s)

In support of the application made by VDO ADOLF SCHINDLING AG

for a patent for an invention entitled

Title

Arrangement for an Air-mass Meter for an Internal Combustion Engine

Name(s) and address(es) of person(s) making declaration

I/We,

Herbert Könekamp
Im Haak 14
6242 Kronberg

do solemnly and sincerely declare as follows:—

1. I am/~~we are the applicant(s) for the patent~~, or authorised by the abovementioned applicant to make this declaration on its behalf.

2. The basic application(~~s~~) as defined by Section 141 of the Act was/~~were~~ made in the following country or countries on the following date(s) by the following applicant(s) namely:-

Country, filing date and name of Applicant for the or each basic application

in Germany on 2nd November 19 85
by VDO ADOLF SCHINDLING AG
in ____ on ____ 19 ____
by ____

3. The said basic application(s) was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

4. The actual inventor(s) of the said invention is/are

Name(s) and address(es) of the or each actual inventor

Wolfgang Porth, Rohrborngasse 70 6000 Frankfurt am Main 60 Germany;
Dr. Wolfgang Weibler, Vor der Heide 14 6238 Hofheim a. T. Germany;
Eckhart Kern, Hofheimer Str. 35 6238 Hofheim a. T. 7, Germany;
Thomas Hannewald, Feldmannstr. 6 6103 Griesheim, Germany; and
Reiner Weingartner, Wilh.-Leuschner-Str. 9 6238 Hofheim a.T. Germany

5. The facts upon which the applicant(s) is/are entitled to make this application are as follows:-

See reverse side of this form for guidance in completing this part

The applicant would be entitled to have assigned to it a patent granted to the actual inventors in respect of this invention

DECLARED at Schwalbach/Ts. this 31st day of May 1989

Herbert Könekamp

This form may be completed and filed after the filing of a patent application but **the form must not be signed until after it has been completely filled in as indicated by the marginal notes. The place and**

(12) PATENT ABRIDGMENT (11) Document No. AU-B-63901/86
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 596381

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AIRFLOW METER ARRANGEMENT

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(71) Applicant(s)
VDO ADOLF SCHINDLING AG

(72) Inventor(s)
REINER WEINGARTNER; THOMAS HANNEWALD; ECKHART KERN; Dr. WOLFGANG WEIBLER; WOLFGANG PORTH

(74) Attorney or Agent
GRIFFITH HACK & CO. MELBOURNE

(56) Prior Art Documents
AU 520799 41792/78 F02B 1/06,F02M 25/06,35/10,F02D 9/02
US 4375204
US 4445368

(57) Claim

1. Arrangement for a meter for the measurement of the mass of air suppplied to an interral combustion engine, comprising a housing for supporting an air filter, said housing having a measurement tube in which the point of measurement of the meter is located and a partition wall, said measurement tube forming a flow channel which, when the arrangement is located on the engine, connects an empty space communicating with the suction opening of the internal combustion engine with the interior space of the air filter having a flat cylindrical shape, said empty space having a flat cylindrical shape and being arranged concerntrically to said interior space, said empty space and said interior space being separated by the partition wall, said measurement tube having at least one curved section and one straight section and wherein the point of measurement is situated in the straight section of the measurement tube.

AUSTRALIA

PATENTS ACT 1952

596381

Form 10

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Short Title:

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Application Number: 63901/86
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Complete Specification-Lodged:
Accepted:
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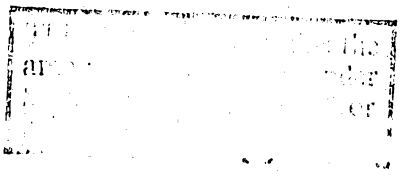

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant:
VDO ADOLF SCHINDLING AG

Address of Applicant: GRAFSTRASSE 103
6000 FRANKFURT/MAIN
FEDERAL REPUBLIC OF GERMANY

Actual Inventor:

Address for Service: CLEMENT HACK & CO.,
601 St. Kilda Road,
Melbourne, Victoria 3004,
Australia.

Complete Specification for the invention entitled:
ARRANGEMENT FOR AN AIR-MASS METER
FOR AN INTERNAL COMBUSTION ENGINE

The following statement is a full description of this invention including the best method of performing it known to me:-

The present invention relates to an arrangement with a meter for the mass of air supplied to an internal combustion engine, in which case the point of measurement of the meter for the mass of air is located in a measuring tube.

In the regulation of internal combustion engines with fuel injection, the measurement of the mass of air sucked into the engine is essential. Mechanical systems are already known for this purpose which, by way of example, operate with movable flaps or baffle plates in the air stream. In addition to this, sensors have become known for the measurement of the mass of air, for example heated-wire meters for the mass of air. These have the advantage that they do not have any moving parts and, compared with the mechanical systems, they only occupy a very small space in the air stream. In addition, the measurement result is independent of height differences, which is not the case with mechanical systems which primarily measure the volume of air.

Many pathways were followed to arrive at the arrangement of the meter for measuring the mass or volume of the air. Thus, it has become known, for example, that an air-mass meter operating ultrasonically may be installed within the air filter. Under these conditions, the point of measurement of the air-mass meter is located within a measurement tube arranged concentrically with the air filter. Because of the short length of the measurement tube it is only within certain limits that suitable flow conditions are established at the point of measurement which should be very largely the same under the various operating conditions with the same mass of air, so that the accuracy of the measurements does not satisfy all the requirements.

Therefore the problem to be solved by the present invention is how to provide an arrangement with an air-mass meter in which suitable flow conditions are ensured within the measurement tube so that accurate results may be obtained. In addition to this, the air-mass meter must be economical to manufacture and it must function reliably. It must also be suitable with regard to the space it occupies and the ease of carrying out maintenance work on it for use with an internal combustion engine, in particular for motor vehicles.

This problem is solved in accordance with the invention by the provision of arrangement for a meter for the measurement of the mass of air supplied to an internal combustion engine, comprising a measurement tube in which the point of measurement of the meter is located, said measurement tube forming a flow channel for connecting an empty space communicating with the suction opening of the internal combustion engine with the interior space of an air filter having a flat cylindrical shape, said empty space having a flat cylindrical shape and being arranged concentrically to said interior space, said empty space and said interior space being separated by a partition wall, said measurement tube having at least one curved section and one straight section and wherein the point of measurement is situated in the straight section of the measurement tube.

By means of this arrangement in accordance with the invention, appropriate flow conditions at the point of measurement are established. The arrangement in accordance with the invention is therefore a very compact structural unit which occupies only a small amount of space.

A preferred feature of the invention is that a first curved section of the flow channel is connected to an opening which forms the inlet opening of the flow channel in the partition wall, and that adjoining the first curved section of the flow channel there is a straight section which runs at least partly in the empty space, and that after the straight section there is a second curved section which opens into the empty space. Under

these conditions, an additional straight section may follow on after the second curved section to open substantially at a tangent into the empty space.

An especially compact construction is arrived at when a fuel injection valve is installed within the space so that its nozzle is opposite to a tube, containing a throttle valve, which leads to the internal combustion engine.

In order to avoid the situation where portions of the injected fuel do not go directly into the suction pipe of the motor but instead pass into the space, in accordance with a further development of the invention the tube which leads to the motor may have a funnel shape at the end projecting into the space.

For better control of the direction of flow of air within the space, guide elements may be provided in the region of the nozzle.

An advantageous configuration of the arrangement in accordance with the invention may also be achieved if the space is enclosed within a housing on which the partition wall and the air filter may be mounted.

In order to be able to use proven types of air filters with the saving of space, in accordance with another development of the invention it is possible to configure the interiors of the air filter and the space respectively in the form of a flat cylinder.

Other ~~developments~~ preferred features of the invention provide for an aerodynamically favorable configuration of the flow channel in such a fashion that the area of the inlet opening is greater than the cross-sectional area of the flow channel and that the flow channel, in the vicinity of the inlet opening runs in a plane which intersects the partition wall at an acute angle and/of the flow channel, in the vicinity of the inlet opening is provided with a flow rectifier and/or in the vicinity of the outlet opening it contains a protective grille. In order to improve the flow in the vicinity of the sensor, the diameter of the flow channel at the point of measurement may be smaller than it is at the inlet opening.

Even though the primary intention of the invention is to use thermal sensors, for example hot-wire sensors, it is also quite possible to make advantageous use of other types of sensors, for example ultrasonic sensors.

Electrical circuits are required to operate the sensors under consideration and these circuits are expediently located in the vicinity of the sensors. In accordance with further developments of the invention, the electrical circuit allocated to the sensor is located in the vicinity of the sensor on the partition wall. The necessary cooling of the electrical circuit may be effected by means of the filtered suction air or by way of the partition wall acting as a cooling element when, in accordance with a further development of the invention, the electrical circuit is in thermally-conducting contact with the partition wall.

Lastly, it is also possible to arrange for additional electrical circuits, for example a control circuit which evaluates the signals from the air-mass meter, and optionally from other sensors, to be located within the air filter on the partition wall. Under these conditions, apart from the advantage of the cooling effect, there is yet another advantage, namely that the different elements, which belong to a control system and are thus functionally related, may all be incorporated into a single structural unit.

The invention provides for numerous forms of embodiment. One of these is represented diagrammatically in the two Figures of the drawings and is described in detail in what follows. There is shown in :

Fig. 1 a cross-section and

Fig. 2 a longitudinal section of the example of embodiment.

Similar components are indicated in the Figures with the same reference numerals.

The air filter 1 with a housing 2 is in the shape of a flat cylinder which is known per se and which is employed for the great majority of carburettor engines. However, instead of having a flanged socket for the suction pipe connection, it is open at the bottom. It is closed by means of a partition wall 7 which separates the interior space 4 of the filter from the empty space, situated beneath it, which will be described in greater detail in what follows. The actual ring-shaped filter which is only depicted diagrammatically, is indicated by the reference number 3.

The housing 5, which supports the air filter 1 and the partition wall 7 is connected to a pipe 10 which forms the suction channel of the internal combustion engine which is not depicted here. A throttle valve 11 is located within the pipe 10. An injection valve 8 which is located above the injection opening of the pipe 10 injects the fuel into the air which enters directly into the pipe 10. So that a portion of the fuel particles sprayed out from the nozzle 9 does not get into the zone of the air which does not flow directly into the pipe 10, a funnel-shaped enlargement 12 of the end of the pipe 10 may be provided. Baffle plates 13 contribute to the reduction of turbulence in the region upstream of the nozzle 9.

For greater clarity of illustration, the means of holding the injection valve within the housing 5 is not depicted. The design of such a holding means lies within the competence of the technical expert.

The injection valve 8 may be incorporated into a single constructional unit with a system pressure regulator 21, which is known per se. Tubes for the supply and return of the fuel are provided but they are not depicted here.

The space 6 within the housing 5 forms the pulsation-damping chamber. It is well known that the suction in an internal combustion piston engine takes place with pulsation.

This pulsation is discernible throughout the whole suction system. For exact measurement of the air masses, however, it is necessary to have uniformity of flow through the air-mass meter; pulsations falsify the results of the measurement.

There is an opening in the partition wall 7 through which the inlet opening 17 of the flow channel 14 enters the interior space 4 of the air filter 1.

In order to ensure the least possible resistance to the flow the rim of the inlet opening 17 is furnished with a collar. The flow channel 14 penetrates the partition wall at an angle so that an enlergement of the inlet opening 17 is achieved and this also contributes to the improvement of the flow conditions.

Depending upon requirements in the individual case, the flow channel in its upper and lower portions respectively may be fabricated as integral units with the partition wall 7 and with the housing 5. It may, however, be expedient to fabricate the flow channel in accordance with the aforementioned portions as two individual units and then assemble them later. Thus, as shown in Fig. 1 for example, there are sites of division 28 and 29 shown between the sections 25 and 26 as well as between sections 26 and 27 respectively, whereas each of the individual sections 25 and 26 are fabricated in one piece. The arrangement in Fig. 2 is based upon an integral unit for the whole of the flow channel.

In the vicinity of the outlet opening 19 there is a protective screen 20 installed, whereas, close to the inlet opening 17 there is a flow rectifier 18 which, in a manner known per se, consists of a plurality of parallel channels through a suitable work material.

In the region of the sensor 15, the flow channel 14 can have a smaller cross-sectional area than in the other regions, in which case the transition takes place gradually. In order to avoid the deposition of contaminants on the sensor 15 it is possible, in a manner known per se, to install a rod-shaped

As already mentioned, various different types of sensors may be employed with the arrangement in accordance with the invention. A preferred form of embodiment of the sensor 14 consists of a thermal sensor, in which a wire under tension in the measurement tube, or a conductor mounted on an insulating platelet has a current passing through it so that it is heated to a temperature well above that of the air stream flowing past it. The temperature of the conductor may be regulated to a constant value by means of a temperature dependent resistance in an electrical circuit 16, under which conditions, depending upon the air mass flowing past it, a stronger or weaker current is passed through the conductor. To compensate for the influence of the air temperature, a comparison conductor may be located in the vicinity of the electrically-heated measurement conductor and this has only a very small current flowing through it, so that its temperature is practically the same as that of the air flowing past it.

Because of the electrical connection of the sensor 15 with the associated electrical circuit 16, this latter is mounted in the immediate vicinity of the sensor 15 or of the measurement tube 14. Under these conditions it has been found to be particularly favorable to have the electrical circuit 16 installed within the interior space of the air filter where it is fastened to the partition wall 7. The air which is sucked in through the filter 3 serves for the cooling of the electrical circuit 16, in which case, with good thermal contact between the circuit 16 and the partition wall 7, the effectual cooling surface, which radiates heat to the air, is substantially increased in area.

Apart from the electrical circuit 16, it is also possible to have an additional circuit 22 connected to the circuit 16 within the interior space 4 of the air filter 1. The circuit 22 contains the necessary circuitry which is known per se for the electronic regulation of the fuel injection.

Because of the arrangement of the additional circuit 22 in this region on the partition wall 7, along with good cooling, the effect is also achieved that the arrangement of conductors between circuit 16 and circuit 22 and the injection valve 8 is simplified very substantially. Furthermore, it is also favorable for maintenance work, because the three named components of the injection regulating system are arranged within an integral constructional unit.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Arrangement for a meter for the measurement of the mass of air suppplied to an internal combustion engine, comprising a housing for supporting an air filter, said housing having a measurement tube in which the point of measurement of the meter is located and a partition wall, said measurement tube forming a flow channel which, when the arrangement is located on the engine, connects an empty space communicating with the suction opening of the internal combustion engine with the interior space of the air filter having a flat cylindrical shape, said empty space having a flat cylindrical shape and being arranged concerntrically to said interior space, said empty space and said interior space being separated by the partition wall, said measurement tube having at least one curved section and one straight section and wherein the point of measurement is situated in the straight section of the measurement tube.

2. The arrangement in accordance with Claim 1, wherein a first curved section of the measurement tube is connected to an opening which forms the inlet opening of the measurement tube in the partition wall, and a straight section adjoining the first curved section of the measurement tube, said straight section extending at least partly in the empty space, and that after the straight section there is a second curve section which opens into the empty space.

3. The arrangement in accordance with Claim 2, wherein an additional straight section follows on after the second curve section to open substantially at a tangent into the empty space.

4. The arrangement in accordance with Claim 2 or 3, wherein the section which opens into the empty space possesses a discharge opening which lies in a plane making an acute angle with the axis of the section at the discharge opening.

5. The arrangement in accordance with Claim 2, wherein the inlet opening of the measurement tube projects beyond the partition wall and is provided with a collar.

6. The arrangement in accordance with Claim 1, wherein a fuel injection valve is located within the empty space and its nozzle is situated opposite a pipe which contains a throttle valve and leads to the internal combustion engine.

7. The arrangement in accordance with Claim 6, wherein the pipe has a funnel-shaped end which projects into the empty space.

8. The arrangement in accordance with claim 6, wherein guide elements are located in the region of the nozzle.

9. The arrangement in accordance with Claim 1, wherein the empty space is enclosed within a housing on which the partition wall and the air filter may be mounted.

10. The arrangement in accordance with Claim 6, wherein the fuel-injection valve and the pipe are arranged asymmetrically to the centre of said interior space of said air filter.

11. The arrangement in accordance with Claim 6, wherein the partition wall is airtight.

12. The arrangement in accordance with Claim 1, wherein the measurement tube is provided with a flow rectifier in the vicinity of the inlet opening.

13. The arrangement in accordance with Claim 1, wherein the measurement tube has a discharge opening and is provided with a protective screen in the vicinity of the discharge opening.

14. The arrangement in accordance with Claim 1, wherein the measurement tube is configured as a Venturi meter, with the measurement point at the region of greatest constriction.

15. The arrangement in accordance with Claim 1, wherein a sensor is located at the measurement point.

16. The arrangement in accordance with Claim 15,

electrical circuit associated with the sensor is located on the partition wall in the vicinity of the measurement point.

17. The arrangement in accordance with Claim 16, wherein the electrical circuit is in thermal-conducting contact with the partition wall.

18. The arrangement in accordance with Claim 17, wherein additional electrical circuits are located on the partition wall.

DATED this 24th day of October, 1989

VDO ADOLF SCHINDLING AG
By Its Patent Attorneys:

GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia

FIG.1

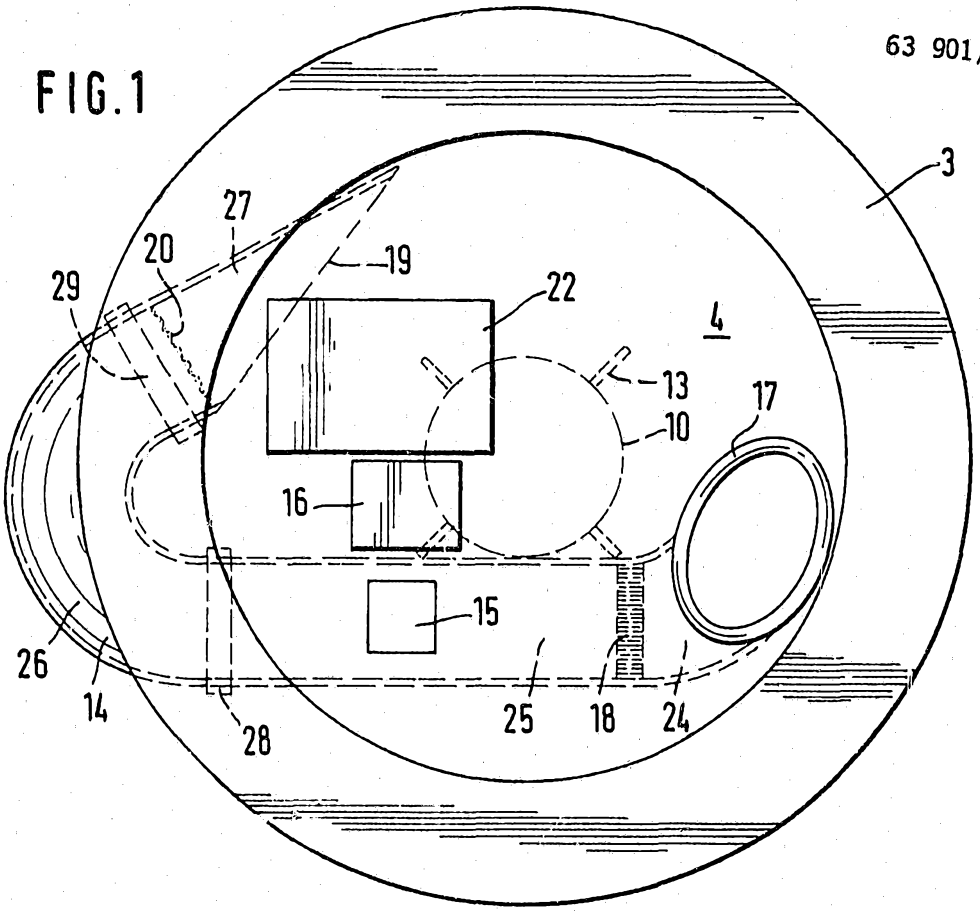
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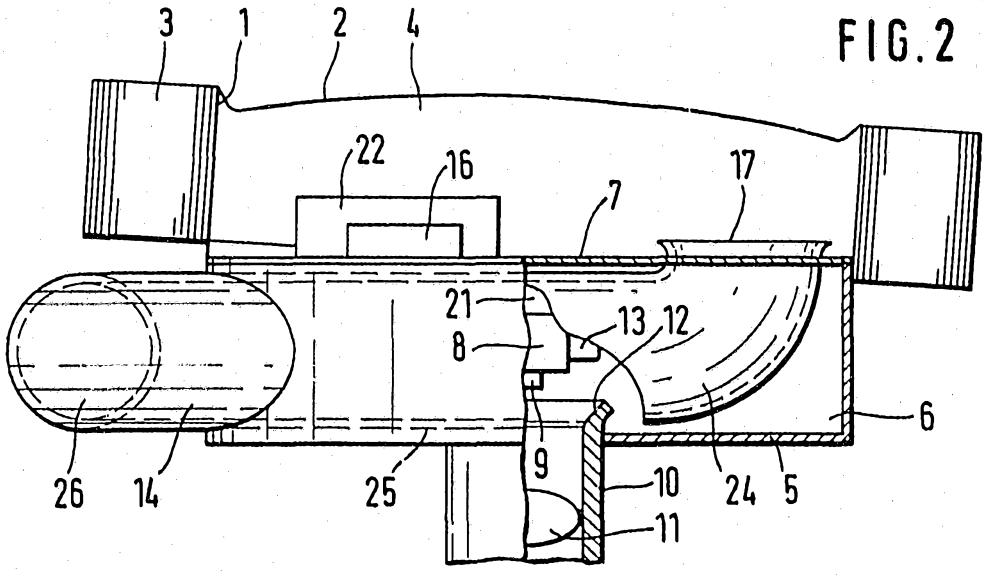
FIG.2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