(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 017 440 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.01.2009 Bulletin 2009/04

(21) Application number: **08159563.9**

(22) Date of filing: **02.07.2008**

(51) Int Cl.:
F01N 1/00 *(2006.01)* ***F01N 1/08*** *(2006.01)*
F01N 7/00 *(2006.01)* ***F02M 35/00*** *(2006.01)*
F02M 35/12 *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(30) Priority: **17.07.2007 IT TO20070529**

(71) Applicant: **OFFICINE METALLURGICHE G. CORNAGLIA S.p.A.**
10092 Beinasco (IT)

(72) Inventors:
- **Cornaglia, Umberto**
  10027 Moncalieri (TO) (IT)
- **Rocca, Giorgio**
  10131 Torino (IT)

(74) Representative: **Robba, Pierpaolo**
Interpatent
Via Caboto 35
10129 Torino (IT)

(54) Silencer device for a fluid conduit and method for its production

(57) A silencer device (221; 321; 421) for a fluid conduit (211; 311; 411) comprises a dissipating element (223; 323; 423) having orifices (219; 319; 419) and is characterised in that said orifices put the inside of the conduit in communication with the outside. The invention also concerns a method of manufacturing the device and is applied in particular to conduits of the air intake system of internal combustion engines

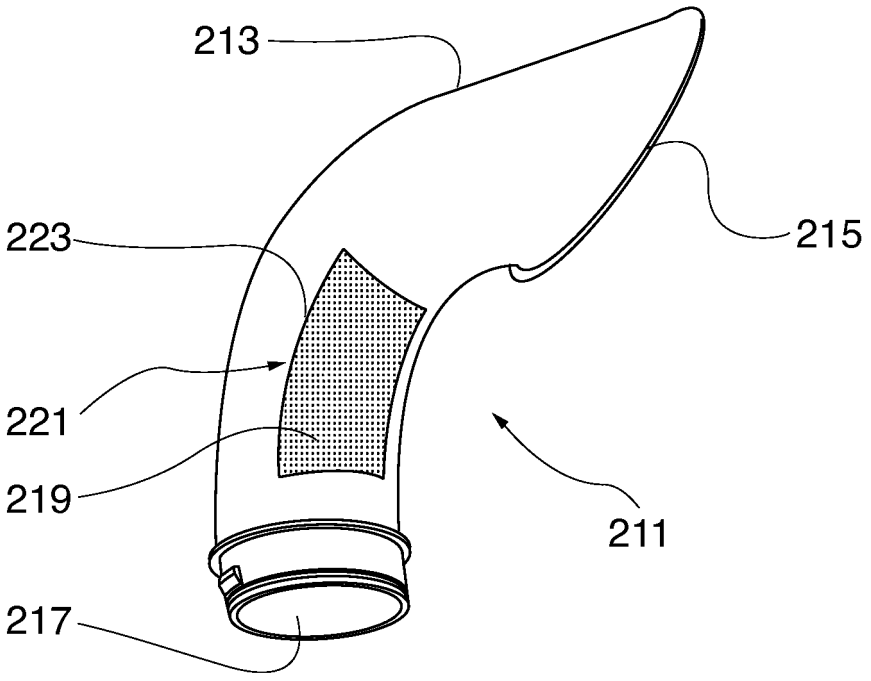

Fig. 2

EP 2 017 440 A1

Description

[0001] The present invention concerns a silencer device for a fluid conduit and the method for its production.

[0002] More precisely, the invention concerns a silencer device for intake conduits of air intake systems in internal combustion engines, in particular engines for vehicles and especially motor vehicles.

[0003] In the field of internal combustion engines, for instance engines for vehicles and in particular motor vehicles, silencer devices have been developed aiming at reducing the noise level associated with exhaust gas discharge from and air intake into the engine.

[0004] Thus, in such field, two kinds of silencer devices are generally known, namely the exhaust silencer and the intake silencer.

[0005] Intake silencer generally operates by exploding the principle of destructive interference and, in its simplest form, it consists of an expansion chamber and two hoses with such shapes and sizes that air passes therethrough with minimum noise.

[0006] In order to reduce the amount of harmful emissions and to increase the delivered power, modem internal combustion engines, especially diesel cycle engines, are generally equipped with a turbocharger and nowadays they are fed with air at higher and higher pressure.

[0007] For that reason, noise associated with air inlet into the intake manifold of such supercharged engines has consequently significantly increased.

[0008] Fig. 7 shows a scheme of a conventional intake system for supercharged internal combustion engines.

[0009] An engine MT is equipped with an exhaust manifold CR for discharging exhaust gases, and an intake manifold CA for air inlet into the combustion chambers.

[0010] Intake manifold CA receives air from intake system AS that preferably includes a heat exchanger SC, generally of the air-to-air type, known as "intercooler" device, a turbine TR or turbocharger, generally operated by the exhaust gases, and a filter FT, for instance equipped with a cartridge of corrugated paper, which removes particles with too big a size, which could damage the engine, from the inlet air flow. Air arriving at filter FT is taken from the external environment through an intake conduit CS having an intake mouth BS.

[0011] As known, the intake mouth is to be suitably positioned in order to prevent entrance of foreign bodies.

[0012] In certain applications, especially in the vehicle field, due to the arrangement of the engine and its components and to the need to properly position the intake mouth, for instance to prevent water entrance during travel, intake conduit CS will have different shapes and will often be winding, whereby application of conventional silencer devices will consequently be difficult.

[0013] In the past, silenced conduits made of reinforced fabric have been developed, which however have the drawback of being heavy and expensive and of demanding connecting joints in order they are associated with the remaining portions of the intake system.

[0014] Thus, it is the main object of the invention to solve the problem of how to reduce in simple and cheap manner the level of noise generated in fluid conduits.

[0015] It is another object of invention to provide a silencer device suitable for application to the intake conduits of internal combustion engines of vehicles, especially motor vehicles.

[0016] It is a further, but not the last object of the invention to provide a simple and cheap method of producing the silencer device.

[0017] The above and other objects are achieved as claimed in the appended claims.

[0018] Advantageously, thanks to the provision of some orifices in the conduit wall, it is possible to cut down the noise level generated by pressure variations of the fluid flowing along the conduit.

[0019] An advantage of the invention is the possibility of equipping any conduit with the silencer device, thereby obtaining an integral body having no connecting joint.

[0020] Advantageously, according to the invention, the device could be applied only on one or some conduit portions. More particularly, the orifices could be provided only in the conduit portions that are less subject to smearing, whereby the performance of the silencer device is preserved in time.

[0021] Further advantages of the invention, which are mainly related with the possibility of integrating the device into the conduit wall, are the reduction of the number of components, the reduction of the manufacturing time and the reduction of the mounting time.

[0022] The reduction of the number of components further allows reducing the weight and results in a greater capability of recycling materials.

[0023] Advantageously, the method according to the invention can be implemented by using the conventional technologies for producing fluid conduits.

[0024] Some embodiments of the invention, given by way of non-limiting examples, will be disclosed in detail hereinafter with reference to the accompanying drawings, in which:

- Fig. 1 is a scheme showing the operation principle of the device according to the invention;
- Fig. 2 is a schematic view of a first embodiment of the invention;
- Fig. 3 is a schematic view of a second embodiment of the invention;
- Fig. 4 is a perspective view of an intake conduit for internal combustion engines;
- Fig. 5A is a plan view of a half-mould;
- Fig. 5B is an enlarged view of a detail of Fig. 5A;
- Fig. 6A is a cross-sectional view taken along line VI-VI of fig. 5A;
- Fig. 6B is an enlarged view of a detail of Fig. 6A with the needles in idle condition;
- Fig. 6C is an enlarged view of a detail of Fig. 6A with the needles pulled out;
- Fig. 7 is a diagram of an intake system for an internal

combustion engine.

[0025] Referring to Fig. 1, the principle on which the present invention is based is schematically shown.

[0026] Acoustic waves emitted by a loudspeaker AP in axial direction, from the left to the right in the Figure, as shown by arrow F, travel along a conduit 11 having a wall 13, an inlet mouth 15 and an outlet mouth 17.

[0027] Advantageously, said conduit 11 further has a set of orifices 19 along wall 13 defining conduit 11 itself, said orifices putting the inside of the conduit in communication with the outside.

[0028] In the illustrated system, overall acoustic power W_{tot} emitted by loudspeaker AP is given by relation:

$$W_{tot} = W_{out} + W_{rad} + W_{dis};$$

where:

- W_{out} is the acoustic power at outlet mouth 17 of conduit 11;
- W_{rad} is the acoustic power transmitted by wall 13 of conduit 11 in the direction shown by arrows C;
- W_{dis} is the acoustic power thermally and mechanically dissipated through orifices 19.

[0029] For a same amount of acoustic power being produced, an increase of acoustic power W_{dis} dissipated through orifices 19 will result in a corresponding reduction of acoustic power W_{out} at the outlet mouth.

[0030] The present invention is based on the discovery that such a physical principle can be advantageously applied to produce silencer devices for conduits along which a fluid, in particular a gaseous fluid, flows, in order to reduce the noise produced by the pressure variations the fluid is subjected to, in particular the variations due to the fluid inflow into the conduit and to the shape of the conduit itself.

[0031] According to the invention, the silencer device comprises a dissipating element, which has at least two and preferably at least four orifices and is formed or applied at least in correspondence of a portion of the wall defining the conduit, said orifices putting the inside of the conduit in communication with the outside.

[0032] Said device will preferably be formed directly integrated into the conduit wall, which therefore will have orifices in at least a portion thereof, but it can also be made by applying, for instance in correspondence of a window formed on the conduit wall, a body having orifices.

[0033] The silencer device thus obtained advantageously allows cutting down the noise propagating along the conduit.

[0034] Said device can be applied in particular in the conduits of the intake system of internal combustion engines, for instance engines used in vehicles.

[0035] Referring to Fig. 2, there is shown a first embodiment of the invention, where a generic conduit 211, defined by a wall 213 and having an inlet mouth 215 and an outlet mouth 217, includes a silencer device 221 consisting of an element 223 with a plurality of orifices 219. which is directly formed on wall 213 of conduit 211.

[0036] In the illustrated exemplary embodiment, silencer device 221 is formed in correspondence of one side of a curved portion of conduit 211, and it can be seen through the section made in the Figure on the opposite side.

[0037] In accordance with this first embodiment of the invention, monolithic conduits of a material homogeneous with the integrated silencer device can be produced, and the device can extend over the whole or part of the surface of the wall defining the conduit.

[0038] Referring now to Fig. 3, there is shown a second embodiment of the invention, where a generic conduit 311, defined by a wall 313 and having an inlet mouth 315 and an outlet mouth 317, includes a silencer device 321 consisting of an element 323 with a plurality of orifices 319, which is applied on wall 313 of conduit 311, for instance by soldering or gluing, in correspondence of a window 325 formed on the wall of said conduit.

[0039] In the illustrated exemplary embodiment, silencer device 321 is applied in correspondence of one side of a curved portion of conduit 311, corresponding to the front side that can be seen in the Figure.

[0040] In accordance with this second embodiment of the invention, existing conduits can be equipped with the silencer device, which can be a separate body applied to the conduit wall or a hose inserted between two successive sections of the same conduit or of different conduits.

[0041] Referring now to Fig. 4, there is shown a generic intake conduit 411 for a turbocharged diesel cycle internal combustion engine for a motor vehicle, which conduit has been equipped with a silencer device 421 according to the invention.

[0042] Conduit 411 is of the kind associated with the intake system in the initial portion conveying fresh air from the external environment towards the filter.

[0043] Said conduit 411 is defined by a wall 413 and has an inlet mouth 415 and an outlet mouth 417. Conduit 411 has a winding shape and is equipped with at least one bellows 429 integrated into conduit wall 413.

[0044] Advantageously, wall 413 of conduit 411 has orifices 419, highlighted in the enlarged portion of Fig. 4, which are distributed over a portion 423 of wall 413. Said orifices are formed by piercing wall 413 and they have a diameter "d" of about 0.8 mm and a pitch "p" of about 4.0 mm.

[0045] In accordance with this embodiment, conduit 411 can advantageously be made of plastics, preferably as an integral piece, and orifices 419 may be formed in wall 413 either while conduit 411 is being formed or subsequently.

[0046] Reference is now made to Figs. 5A to 6C in

order to disclose a preferred embodiment of the method according to the invention.

[0047] The silencer device according to the invention is preferably directly formed on the wall of a fluid conduit by piercing, in at least one conduit portion, at least two and preferably at least four circular micro-orifices with a diameter lower than 5.0 mm and preferably ranging from about 0.5 to 1.5 mm, and with a pitch of the order of some millimetres, e.g. ranging from 1 to 10 mm and preferably of about 4.0 mm.

[0048] In a preferred embodiment of the invention, the conduit is made of a thermoplastic material, e.g. thermoplastic polyester (TEEE) or rigid-soft polyamide (PA) or polypropylene (GF) and thermoplastic rubber (PPGF + PP/EPDM).

[0049] Advantageously, such materials enable dispensing with the use of non-recyclable materials, such as rubber, while reducing at the same time the weights.

[0050] The manufacture of the conduit preferably takes place by exploiting the blow-moulding technology, which, among its main advantages, enables manufacturing special products having a complex geometry and combining, in a single piece, characteristics of stiffness, resilience and capability of deformation with high dimensional precision and stability.

[0051] According to the technique of blow-moulding plastics, a tube-shaped extruded blank, the so-called parison, is placed on one of the half-moulds of the mould of a blow-moulding machine.

[0052] The parison is then clenched between the half-moulds and compressed air is blown into the clenched parison that expands until taking the shape of the mould cavity.

[0053] In the whole, the blow-moulding process comprises therefore the steps of: placing the parison in the half-mould; closing the mould; blowing; removing the formed piece.

[0054] According to the invention, at least one of half-moulds 551 of a machine for blow-moulding plastics is equipped with a piercing assembly 553.

[0055] In an exemplary embodiment of the invention, said piercing assembly 553 comprises a support 555 slidable in a seat 556 formed in the half-mould body, thanks to a control unit 557 for instance of pneumatic type. Such a support 555 has associated therewith needles 559 that, when sliding, jointly with support 555, in corresponding seats 561 formed in the body of half-mould 551, penetrate during blowing into the body of parison 563, a portion of which can be seen, and enable forming corresponding orifices on the wall of the conduit obtained at the end of the blowing step.

[0056] In the illustrated example, piercing assembly 553 has nine needles 559 in order to pierce an equal number of holes into parison 563, which holes have axes substantially perpendicular to the wall of the conduit obtained by moulding the parison.

[0057] According to the invention, piercing assemblies with a different number of needles and/or multiple piercing assemblies in one or both half-moulds, and even with different penetration directions, can be envisaged.

[0058] Always according to the invention, the piercing assembly (assemblies) are pneumatically controlled while the parison blowing takes place.

Claims

1. A silencer device (221; 321; 421) for a conduit (211; 311; 411) where a fluid can flow, the device comprising a dissipating element (223; 323; 423) having orifices (219; 319; 419), the device being **characterised in that** said orifices put the inside of the conduit in communication with the outside.

2. The device as claimed in claim 1, wherein said orifices are substantially perpendicular to the wall defining said conduit.

3. The device as claimed in claim 1 or 2, wherein said orifices are micro-orifices with substantially circular cross-section.

4. The device as claimed in claim 3, wherein said micro-orifices have a diameter lower than 5.0 mm.

5. The device as claimed in claim 4, wherein said micro-orifices have a diameter from 0.5 to 1.5 mm.

6. The device as claimed in claim 5, wherein said micro-orifices have a diameter of about 0.8 mm.

7. The device as claimed in claim 1, wherein the pitch of said orifices is about 4.0 mm.

8. The device as claimed in any preceding claim, wherein said device is integrated into the conduit wall.

9. The device as claimed in claim 1, wherein said device extends over a portion of the wall (213; 313; 413) of said conduit, the remaining conduit portion lacking the device.

10. An intake conduit for air intake systems of internal combustion engines, **characterised in that** it comprises at least one silencer device as claimed in any of claims 1 to 9.

11. A method of manufacturing a silencer device for a conduit where a fluid can flow, comprising the step of providing said conduit with a plurality of orifices that put the inside of the conduit in communication with the outside.

12. The method as claimed in claim 11, wherein said step of providing said conduit with a plurality of ori-

fices includes a step of blow-moulding a parison of plastic material.

13. The method as claimed in claim 12, wherein said blow-moulding step is performed in a mould of a blow-moulding machine including at least two half-moulds.

14. The method as claimed in claim 13, wherein said blow-moulding step includes the steps of: placing the parison in a half-mould; closing the mould; blowing; removing the formed piece.

15. The method as claimed in claim 14, wherein at least one of said half-moulds is equipped with at least one piercing assembly (553) comprising a slidable support (555) moved by a control unit (557) and having associated therewith needles (559) that, by sliding jointly with the support (555) in corresponding seats (561), penetrate into the body of the parison (563) and form said orifices.

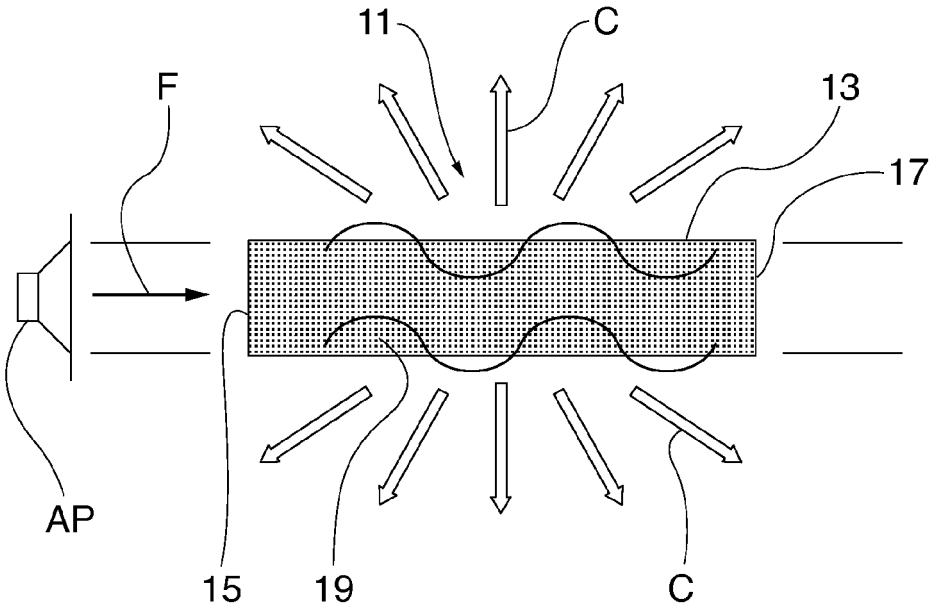

Fig. 1

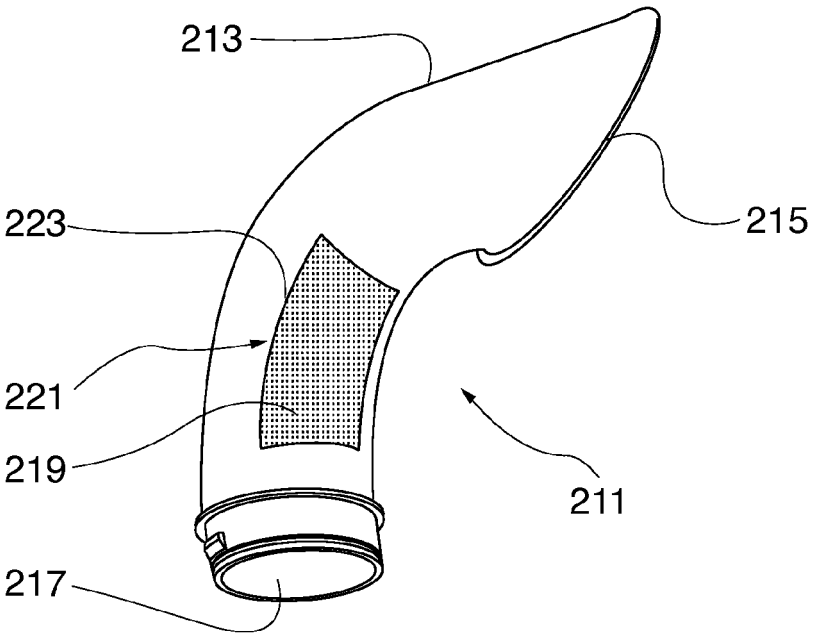

Fig. 2

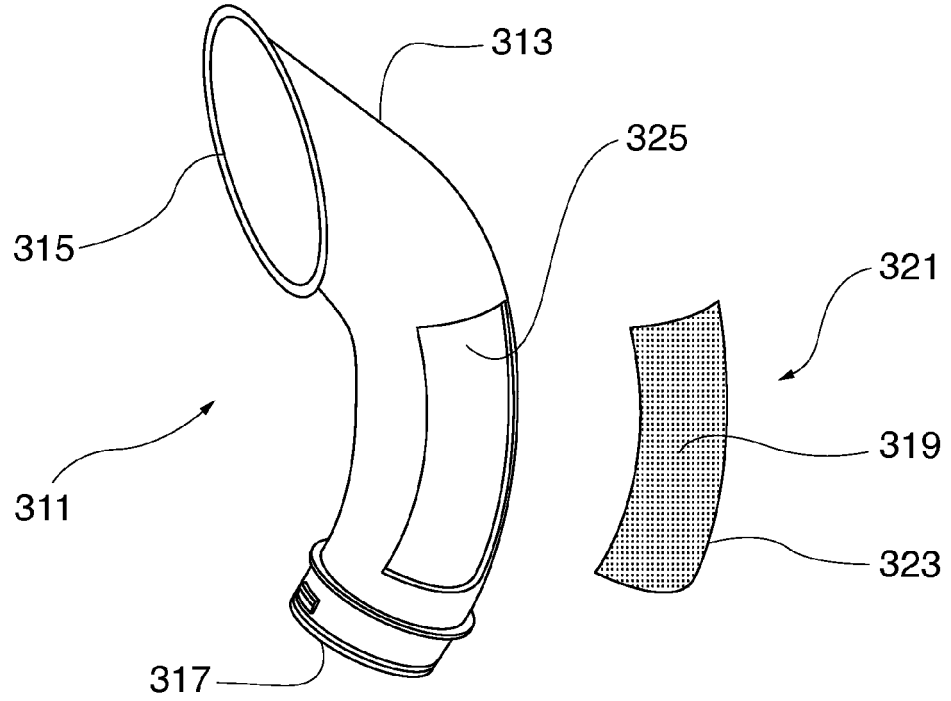
313
325
315
321
319
311
323
317

Fig. 3

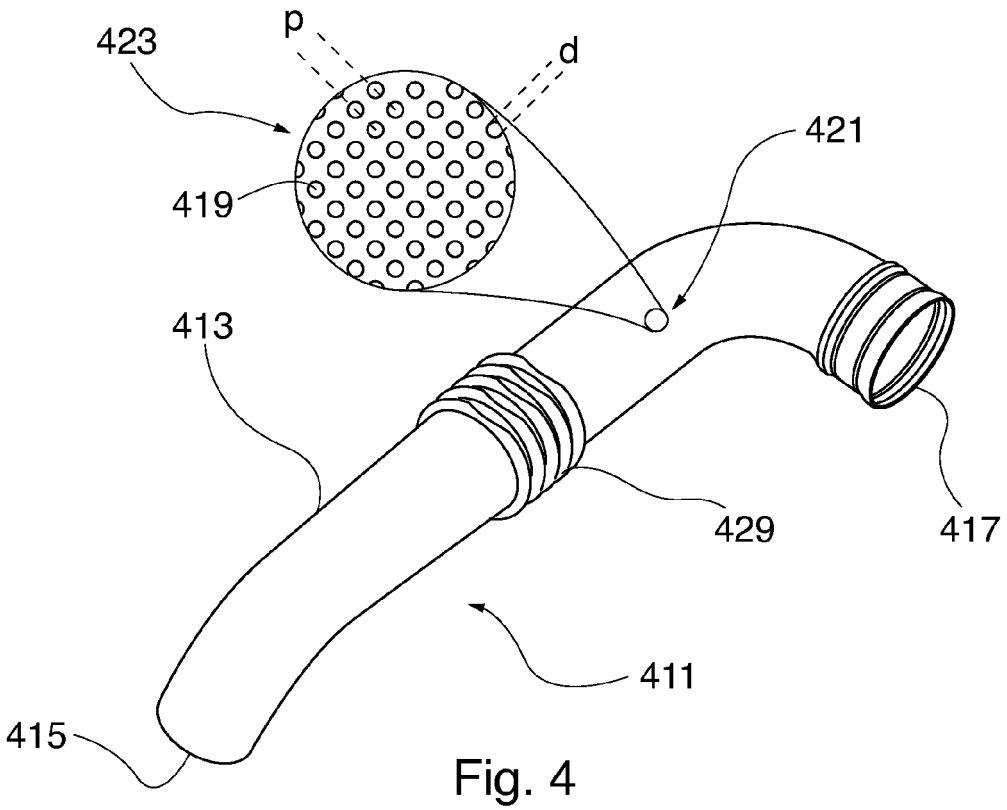
p
423
d
421
419
413
429
417
411
415

Fig. 4

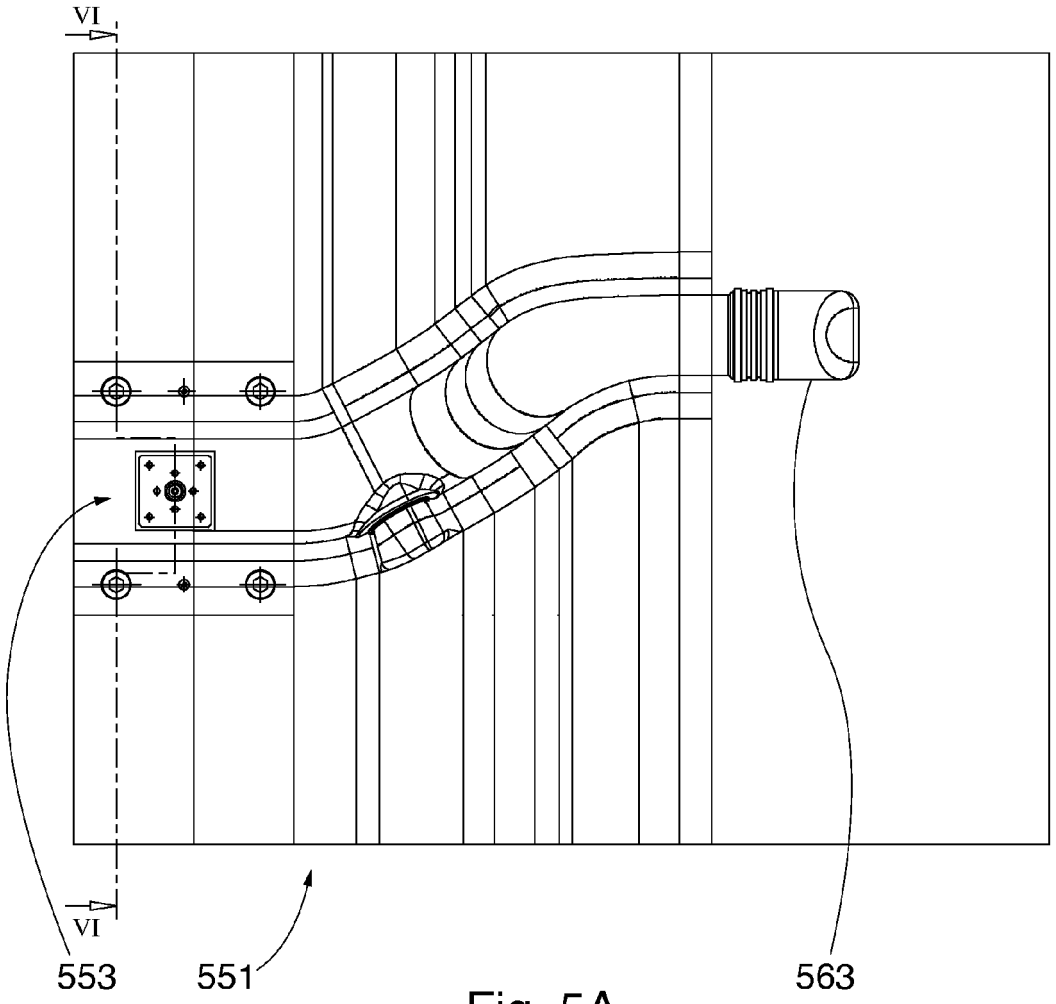
VI
VI
553
551
563

Fig. 5A

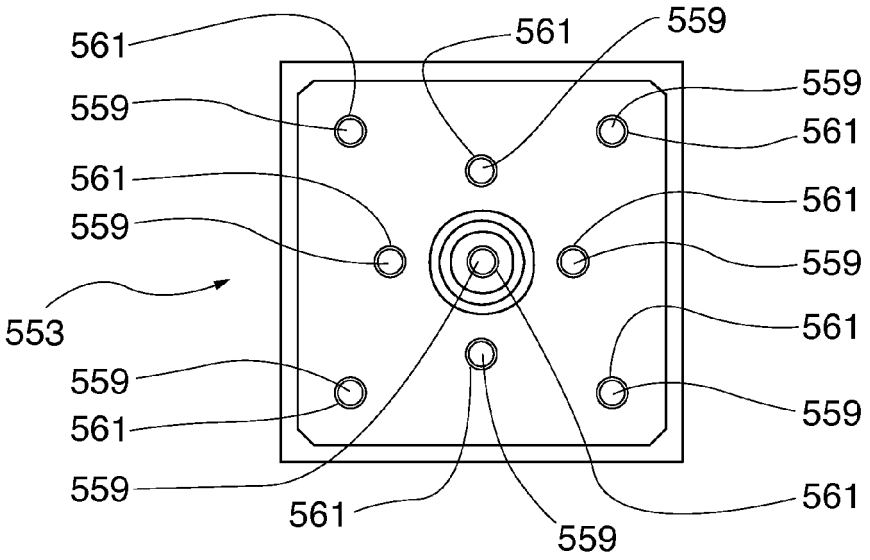
561
561
559
559
559
561
561
561
559
559
553
561
559
559
561
559
561
559

Fig. 5B

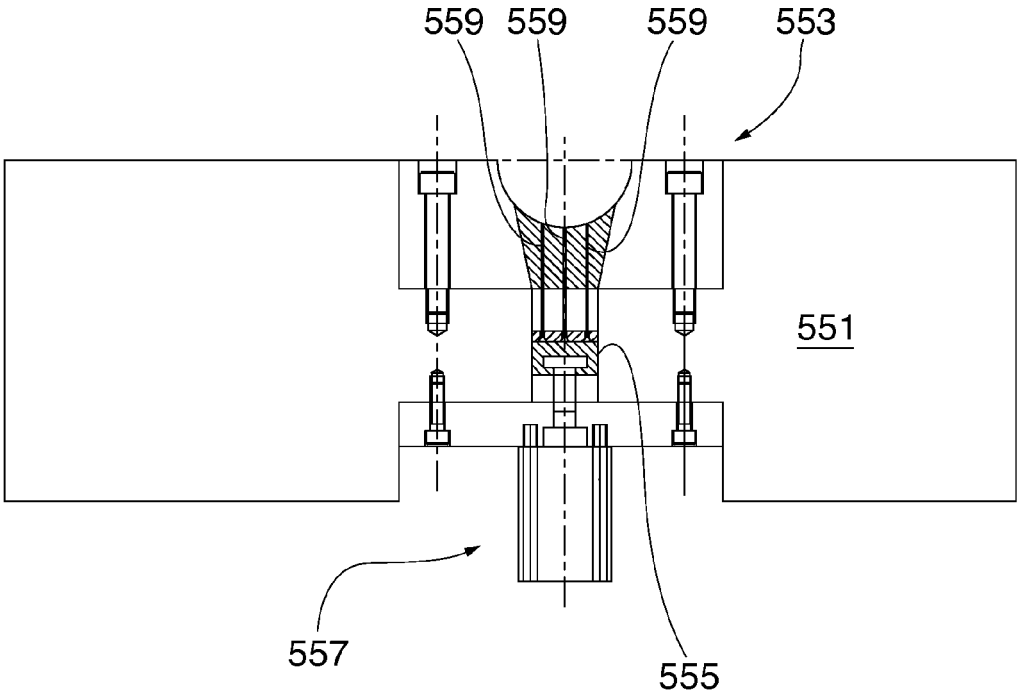
559
559
559
553
551
557
555

Fig. 6A

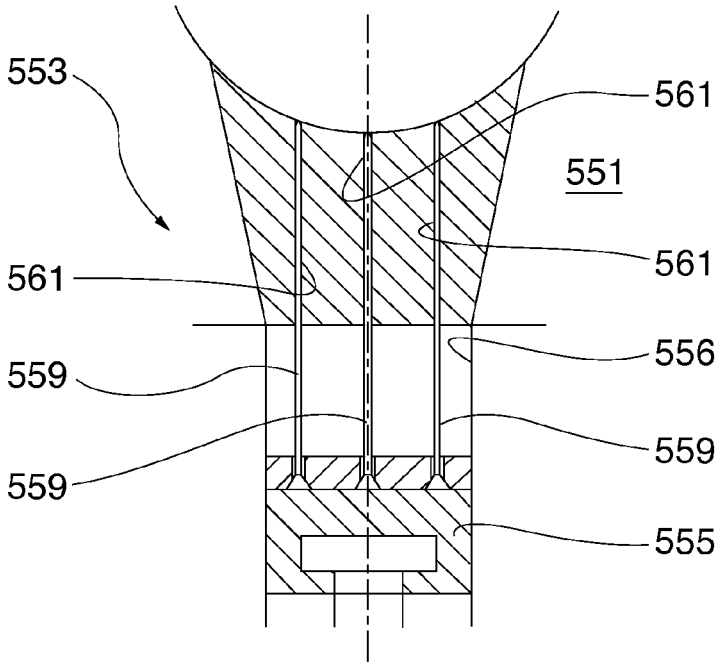
553
561
551
561
561
556
559
559
559
555

Fig. 6B

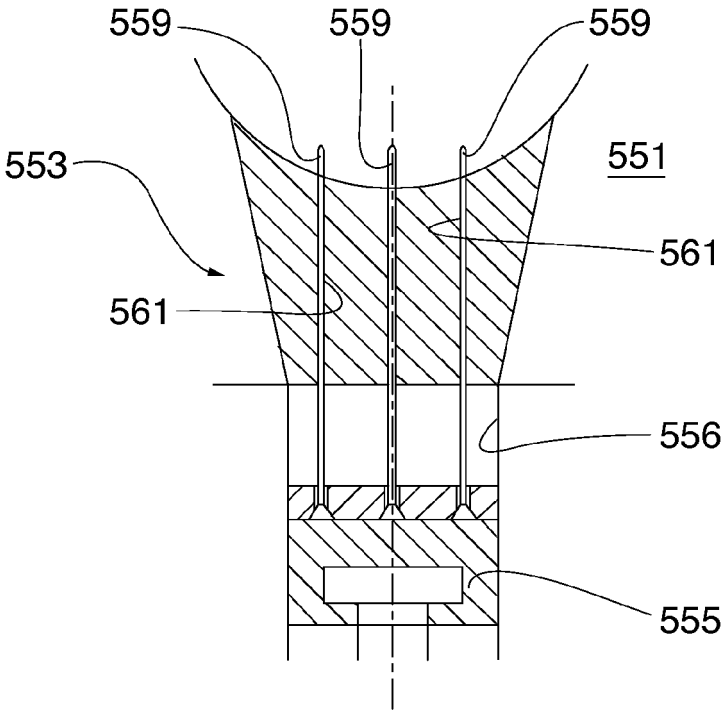

Fig. 6C

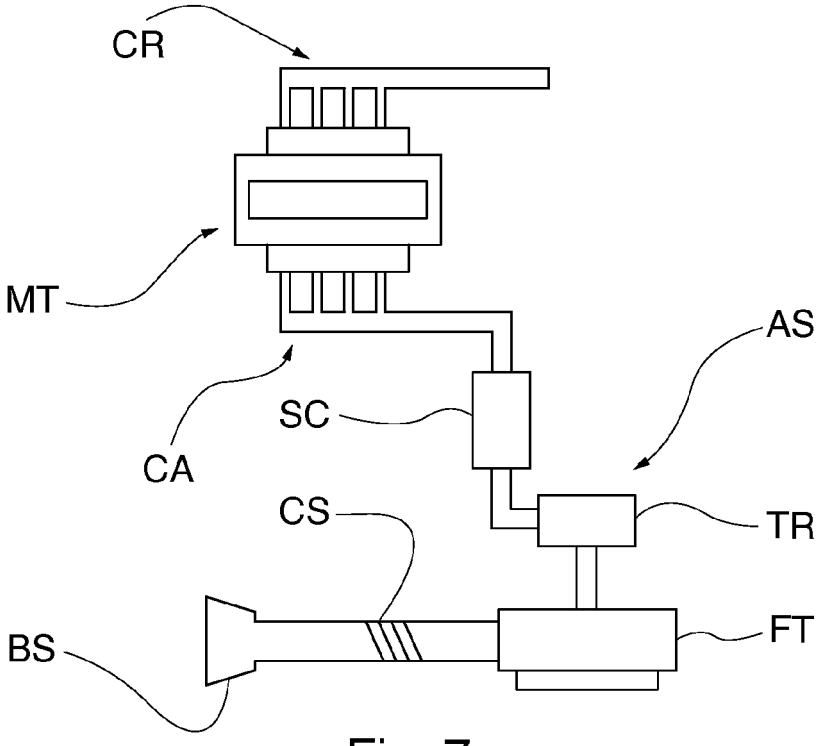

Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 9563

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 2 814 778 A (PEUGEOT CITROEN AUTOMOBILES SA [FR]) 5 April 2002 (2002-04-05) * page 4, line 16 - line 25 * * page 5, line 6 - line 8; figures 1-4 *	1,2,7-12	INV. F01N1/00 F01N1/08 F01N7/00 F02M35/00 F02M35/12
X A	FR 2 867 234 A (PEUGEOT CITROEN AUTOMOBILES SA [FR]) 9 September 2005 (2005-09-09) * page 5, line 8 - line 17; figure 6 *	1-4,8-12	
X	EP 1 170 499 A (TRELLEBORG AB [SE]) 9 January 2002 (2002-01-09) * column 1, line 42 - column 2, line 16; figures 1-4 *	1-3,8-11	
X	JP 11 280479 A (CALSONIC CORP) 12 October 1999 (1999-10-12) * abstract *	1-3,8-11	
X	WO 02/066798 A (VOLVO LASTVAGNAR AB [SE]; WAHLSTROEM GERT-OVE [SE]; HENRIKSSON BJOERN) 29 August 2002 (2002-08-29) * page 3, line 8 - line 38 * * page 5, line 4 - line 8; figures 1,2,7 *	1-3,8,9, 11	TECHNICAL FIELDS SEARCHED (IPC) F01N F02M
X	DE 196 29 368 A1 (GILLET HEINRICH GMBH [DE]) 22 January 1998 (1998-01-22) * the whole document *	1-3,8,9, 11	
X	DE 199 03 165 A1 (MANN & HUMMEL FILTER [DE]) 3 August 2000 (2000-08-03) * claims 1-3 *	1-9,11	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 November 2008	Zebst, Marc

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 15 9563

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-11-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2814778 A	05-04-2002	NONE	
FR 2867234 A	09-09-2005	NONE	
EP 1170499 A	09-01-2002	GB 2364352 A	23-01-2002
JP 11280479 A	12-10-1999	NONE	
WO 02066798 A	29-08-2002	BR 0207389 A	10-02-2004
		EP 1373689 A1	02-01-2004
		JP 4159032 B2	01-10-2008
		JP 2004519575 T	02-07-2004
		SE 522546 C2	17-02-2004
		SE 0100585 A	22-08-2002
		US 2004104071 A1	03-06-2004
DE 19629368 A1	22-01-1998	FR 2751375 A1	23-01-1998
DE 19903165 A1	03-08-2000	AT 245767 T	15-08-2003
		WO 0045044 A1	03-08-2000
		EP 1147304 A1	24-10-2001
		ES 2205911 T3	01-05-2004
		US 2002029927 A1	14-03-2002

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82