



(11) **EP 2 017 440 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**24.02.2010 Bulletin 2010/08**

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

(21) Application number: **08159563.9**

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

(54) **Method for manufacturing a silencer device and an apparatus for manufacturing said device**

Herstellungsverfahren eines Schalldämpfers und Vorrichtung zur Herstellung dieses Schalldämpfers

Procédé de réalisation d'un silencieux et appareil permettant de le réaliser

(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**

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

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

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(56) References cited:  
**EP-A- 1 170 499 WO-A-02/066798  
DE-A1- 19 629 368 DE-A1- 19 903 165  
FR-A- 2 814 778 FR-A- 2 867 234  
JP-A- 11 280 479**

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**EP 2 017 440 B1**

## Description

[0001] The present invention concerns a method and apparatus for manufacturing silencer device in a single piece with a fluid conduit.

[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 there-through with minimum noise.

[0006] In order to reduce the amount of harmful emissions and to increase the delivered power, modern 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] FR 2 867 234 discloses an acoustic attenuation device, particularly for an intake duct of an internal combustion engine. This document discloses the manufacturing of the intake duct by forming apertures on such duct during a blow moulding process.

[0015] It is an object of the invention to provide a simple and cheap method and apparatus for producing the silencer device in a single piece with a fluid conduit.

[0016] The above and other objects are achieved as claimed in the appended claims.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] The reduction of the number of components further allows reducing the weight and results in a greater capability of recycling materials.

[0022] Advantageously, the method according to the invention can be implemented by using the conventional technologies for producing fluid conduits.

[0023] 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 manufactured by the method and apparatus according to the invention;
- Fig. 2 is a schematic view of a first embodiment of a silencer device manufactured by the method and apparatus according to the present invention;
- Fig. 3 is a schematic view of an embodiment which does not form part 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.

**[0024]** Referring to Fig. 1, the principle on which a silencer device manufactured by the method and apparatus according to the present invention is based is schematically shown.

**[0025]** 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.

**[0026]** 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.

**[0027]** 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.

**[0028]** 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.

**[0029]** 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.

**[0030]** The silencer device manufactured by the method and apparatus according to the present invention 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.

**[0031]** 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.

**[0032]** The silencer device thus obtained advantageously allows cutting down the noise propagating along

the conduit.

**[0033]** Said device can be applied in particular in the conduits of the intake system of internal combustion engines, for instance engines used in vehicles.

**[0034]** Referring to Fig. 2, there is shown a first embodiment of a silencer device manufactured by the method and apparatus according to the invention, where a generic conduit 211, defined by a wall 213 and having an inlet mouth 215 and an outlet mouth 217, includes said silencer device 221 consisting of an element 223 with a plurality of orifices 219, which is directly formed on wall 213 of conduit 211.

**[0035]** 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.

**[0036]** In accordance with this first embodiment of the silencer device manufactured by the method and apparatus according to 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.

**[0037]** Referring now to Fig. 3, there is shown an embodiment which does not form part 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.

**[0038]** In the illustrated exemplary embodiment, which does not form part of the present invention, 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.

**[0039]** In accordance with this embodiment which does not form part 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.

**[0040]** 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 manufactured by the method and apparatus according to the invention.

**[0041]** 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.

**[0042]** 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.

**[0043]** 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.

[0044] In accordance with this embodiment, conduit 411 can advantageously be made of plastics, preferably as an integral piece, and orifices 419 are formed in wall 413 either while conduit 411 is being formed.

[0045] Reference is now made to Figs. 5A to 6C in order to disclose a preferred embodiment of the method according to the invention.

[0046] The silencer device manufactured by the method and apparatus according to the invention is 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.

[0047] 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).

[0048] Advantageously, such materials enable dispensing with the use of non-recyclable materials, such as rubber, while reducing at the same time the weights.

[0049] The manufacture of the conduit 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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.

5 [0055] 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.

10 [0056] 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.

15 [0057] Always according to the invention, the piercing assembly (assemblies) are pneumatically controlled while the parison blowing takes place.

## Claims

20 1. A method for manufacturing a silencer device in a single piece with a conduit where a fluid can flow, wherein said conduit is provided with a plurality of orifices that put the inside of the conduit in communication with the outside by forming said orifices on said conduit during a blow-moulding process; said method being **characterised in that** said blow-moulding process comprises the following steps:

- providing a blow-moulding machine comprising a mould with at least two half-moulds;
- providing a parison made of plastic material and intended to be blown
- placing said parison in one of said half-moulds;
- clenching said parison between said half moulds by closing said mould;
- blowing compressed air into the parison contained in said mould;
- forming said orifices on said conduit by:

moving a slidable support (555) by means of a control unit (557); said slidable support (555) belonging to a piercing assembly (553) provided in at least one of said half moulds, and making needles (559), which are associated with said slidable support (555), to slide jointly therewith into corresponding seats (561) formed in the body of at least one of said moulds, and to penetrate into the body of the parison (563) in order to form said orifices during said blowing step; and

- removing the formed conduit from the mould.

2. The method of claim 1, wherein said orifices are formed by moving a plurality of said piercing assemblies (553).

3. The method of claim 2, wherein said piercing assemblies (553) are provided in the same half mould.
4. The method of claim 2, wherein said piercing assemblies (553) are provided in different half moulds.
5. The method of any of claims 2 to 4, wherein said piercing assemblies (553) act in different penetration directions.
6. The method of any of the preceding claims, wherein said slidable support (555) is moved by a pneumatic control unit (557).
7. Apparatus for manufacturing a silencer device in a single piece with a conduit where a fluid can flow, wherein said conduit is provided with a plurality of orifices that put the inside of the conduit in communication with the outside; said apparatus being **characterised in that** comprises:
  - a blow-moulding machine having a mould comprising at least two half-moulds and intended to clench a parison therebetween; said parison being made of plastic material and intended to be blown into said mould by means of compressed air; one of said half moulds being suitable for receiving said parison;
  - at least one piercing assembly (553) provided in at least one of said half moulds and including a slidable support (555) having associated needles (559); and
  - a control unit (557) arranged for sliding said slidable support (555) jointly with said needles (559) into corresponding seats (561) formed in the body of at least one of said half moulds, so as to make said needles (559) to penetrate the body of said parison in order to form said orifices when said parison is blown.
8. The apparatus of claim 7, wherein it comprises a plurality of piercing assemblies (553).
9. The apparatus of claim 8, wherein said piercing assemblies (553) are provided in the same half mould.
10. The apparatus of claim 8, wherein said piercing assemblies (553) are provided in different half moulds.
11. The apparatus of any of claims 8 to 10, wherein said piercing assemblies (553) are arranged to act in different penetration directions.
12. The apparatus of any of the claims 7 to 11; wherein said control unit (557) is of the pneumatic kind.

## Patentansprüche

1. Herstellungsverfahren eines Schalldämpfers, der einstückig mit einem Rohr ausgebildet ist, in dem ein Fluid strömen kann und das mit einer Vielzahl von Öffnungen versehen ist, über die die Innenseite des Rohrs mit der Außenseite in Verbindung steht, indem die Öffnungen im Rohr während eines Blasformverfahrens gebildet werden;  
das Verfahren ist **dadurch gekennzeichnet, dass** der Blasformprozess folgende Schritte umfasst:
  - Bereitstellung einer Blasformmaschine, die eine Form mit mindestens zwei Formhälften aufweist;
  - Bereitstellung eines aus Kunststoff zu blasenden Blasrohrlings,
  - Platzierung des Blasrohrlings in einer der Formhälften;
  - Einklemmen des Blasrohrlings zwischen den Formhälften durch Schließen der Form;
  - Einblasen von Druckluft in den in der Form enthaltenen Blasrohrling;
  - Bildung der Öffnungen auf dem Rohr durch:
    - Bewegen eines Gleitschiebers (555) mittels einer Steuereinheit (557), der zu einer Locheinheit (553) gehört, die in mindestens einer der Formhälften vorgesehen ist, sowie Herstellen von mit dem Gleitschieber (555) verbundener Nadeln (559), um mit ihnen in entsprechenden, im Körper mindestens einer der Formhälften ausgebildeten Aufnahmen (561) zu gleiten und die Wandung des Blasrohrlings (563) zu durchstoßen, um beim Blasvorgang die Öffnungen zu bilden; sowie
  - Entnehmen des geformten Rohrs aus der Form.
2. Verfahren nach Anspruch 1, wobei die Öffnungen durch Bewegen einer Vielzahl von Locheinheiten (553) geformt werden.
3. Verfahren nach Anspruch 2, wobei die Locheinheiten (553) in derselben Formhälfte vorgesehen sind.
4. Verfahren nach Anspruch 2, wobei die Locheinheiten (553) in unterschiedlichen Formhälften vorgesehen sind.
5. Verfahren nach einem der Ansprüche 2 bis 4, wobei die Locheinheit (553) in verschiedene Stoßrichtungen wirken.
6. Verfahren nach einem der vorhergehenden Ansprü-

che, wobei der Gleitschieber (555) durch eine pneumatische Steuereinheit (557) bewegt wird.

7. Vorrichtung zur Herstellung eines Schalldämpfers, der einstückig mit einem Rohr ausgebildet ist, in dem ein Fluid strömen kann und das Rohr mit einer Vielzahl von Öffnungen versehen ist, über die die Innenseite des Rohrs mit der Außenseite in Verbindung steht;  
**dadurch gekennzeichnet, dass** die Vorrichtung Folgendes umfasst:
  - eine Blasformmaschine mit einer Form, die mindestens zwei Formhälften aufweist, zwischen denen ein Blasrohling einklemmbar ist; der aus Kunststoff besteht und der in der Form mittels Druckluft geblasen werden kann, wobei eine der Formhälften zur Aufnahme des Blasrohlings vorgesehen ist;
  - mindestens eine Locheinheit (553), die mindestens in einer der Formhälften angeordnet ist und einen Gleitschieber (555) mit integrierten Nadeln (559) aufweist; und
  - eine Steuereinheit (557), die zum gemeinsamen Verschieben des Gleitschiebers (555) mit den Nadeln (559) in entsprechende, im Körper mindestens einer der Formhälften ausgebildete Aufnahmen (561) angeordnet ist, damit die Nadeln (559) die Wandung des Blasrohlings durchdringen, um die Öffnungen beim Blasen des Blasrohlings zubilden.
8. Vorrichtung nach Anspruch 7, dass sie eine Vielzahl von Locheinheiten (553) aufweist.
9. Vorrichtung nach Anspruch 8, dass die Locheinheiten (553) in derselben Formhälfte vorgesehen sind.
10. Vorrichtung nach Anspruch 8, dass die Locheinheiten (553) in unterschiedlichen Formhälften vorgesehen sind.
11. Vorrichtung nach einem der Ansprüche 8 bis 10, dass die Locheinheiten (553) so angeordnet sind, dass sie in verschiedene Stoßrichtungen wirken.
12. Vorrichtung nach einem der Ansprüche 7 bis 11, dass die Steuereinheit (557) pneumatischer Art ist.

## Revendications

1. Procédé de fabrication d'un dispositif de silencieux en une seule pièce dotée d'un conduit dans lequel un fluide peut s'écouler, dans lequel ledit conduit est prévu avec une pluralité d'orifices qui mettent l'intérieur du conduit en communication avec l'extérieur en formant lesdits orifices sur ledit conduit lors d'un

processus de moulage par extrusion-soufflage ; ledit procédé étant **caractérisé en ce que** ledit processus de moulage par extrusion-soufflage comporte les étapes suivantes consistant à :

- fournir une machine de moulage par extrusion-soufflage comportant un moule formé d'au moins deux moitiés de moule ;
- fournir une préforme constituée de matériau plastique et conçue pour être soufflée ;
- placer ladite préforme dans l'une desdites moitiés de moule ;
- serrer ladite préforme entre lesdites moitiés de moule en fermant ledit moule ;
- souffler de l'air comprimé dans la préforme contenue dans ledit moule ;
- former lesdits orifices sur ledit conduit en :

déplaçant un support pouvant coulisser (555) au moyen d'une unité de commande (557) ; ledit support coulissant (555) appartenant au dispositif de perçage (553) prévu dans au moins l'une desdites moitié de moule, et fabriquer des aiguilles (559), lesquelles sont associées au dit support coulissant (555), afin de les faire coulisser conjointement à celui-ci dans des embases correspondantes (561) formées dans le corps d'au moins l'un desdits moules, et de pénétrer dans le corps de la préforme (563) afin de former lesdits orifices pendant ladite étape d'extrusion-soufflage ; et

- retirer du moule le conduit formé.

2. Procédé selon la revendication 1, dans lequel lesdits orifices sont formés en déplaçant une pluralité desdits dispositifs de perçage (553).
3. Procédé selon la revendication 2, dans lequel lesdits dispositifs de perçage (553) sont fournis dans la même moitié de moule.
4. Procédé selon la revendication 2, dans lequel lesdits dispositifs de perçage (553) sont fournis dans des moitiés de moule différentes.
5. Procédé selon l'une quelconque des revendications 2 à 4, dans lequel lesdits dispositifs de perçage (553) agissent suivant des directions de pénétration différentes.
6. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit support coulissant (555) est déplacé par une unité de commande pneumatique (557).

7. Appareil de fabrication d'un dispositif de silencieux en une seule pièce doté d'un conduit où un fluide peut s'écouler, dans lequel ledit conduit est doté d'une pluralité d'orifices qui mettent l'intérieur du conduit en communication avec l'extérieur ;  
 ledit appareil étant **caractérisé en ce qu'il** comporte : 5
- une machine de moulage par extrusion-soufflage comprenant au moins deux moitiés de moule et conçu pour serrer entre elles une préforme ; ladite préforme étant constituée d'un matériau plastique et conçue pour être soufflée dans ledit moule au moyen d'air comprimé ;  
 l'une desdites moitiés de moule étant appropriée pour recevoir ladite préforme ; 10
  - au moins un dispositif de perçage (553) fourni dans au moins l'une desdites moitiés de moule et comprenant un support coulissant (555) comportant des aiguilles associées (559) ; et 15
  - une unité de commande (557) agencée pour faire coulisser ledit support coulissant (555) conjointement avec lesdites aiguilles (559) dans des embases correspondantes (561) formées dans le corps d'au moins l'une desdites moitiés de moule, de façon à faire que lesdites aiguilles (559) pénètrent dans le corps de ladite préforme afin de former lesdits orifices lorsque ladite préforme est soufflée. 20
8. Appareil selon la revendication 7, dans lequel il inclut une pluralité de dispositifs de perçage (553). 25
9. Appareil selon la revendication 8, dans lequel lesdits dispositifs de perçage (553) sont fournis dans la même moitié de moule. 30
10. Appareil selon la revendication 8, dans lequel lesdits dispositifs de perçage (553) sont fournis dans des moitiés de moule différentes. 35
11. Appareil selon l'une quelconque des revendications 8 à 10, dans lequel lesdits dispositifs de perçage (553) sont agencés pour agir suivant différentes directions de pénétration. 40
12. Appareil selon l'une quelconque des revendications 7 à 11, dans lequel ladite unité de commande (557) est du type pneumatique. 45

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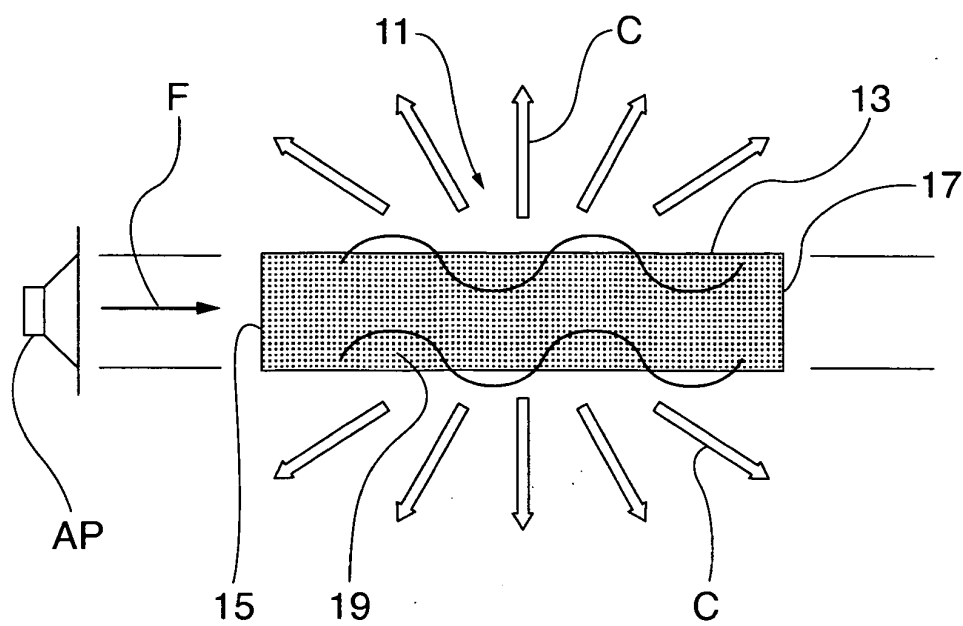


Fig. 1

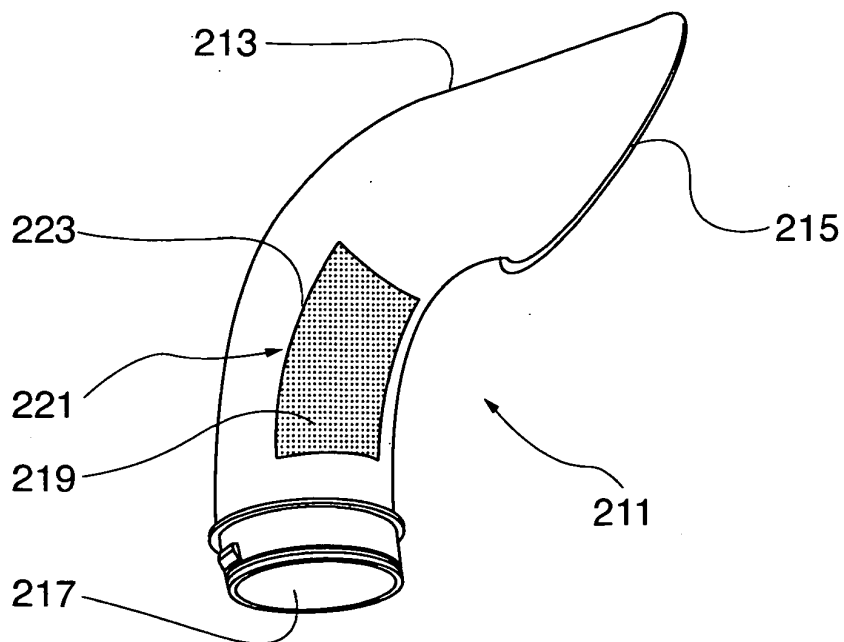


Fig. 2

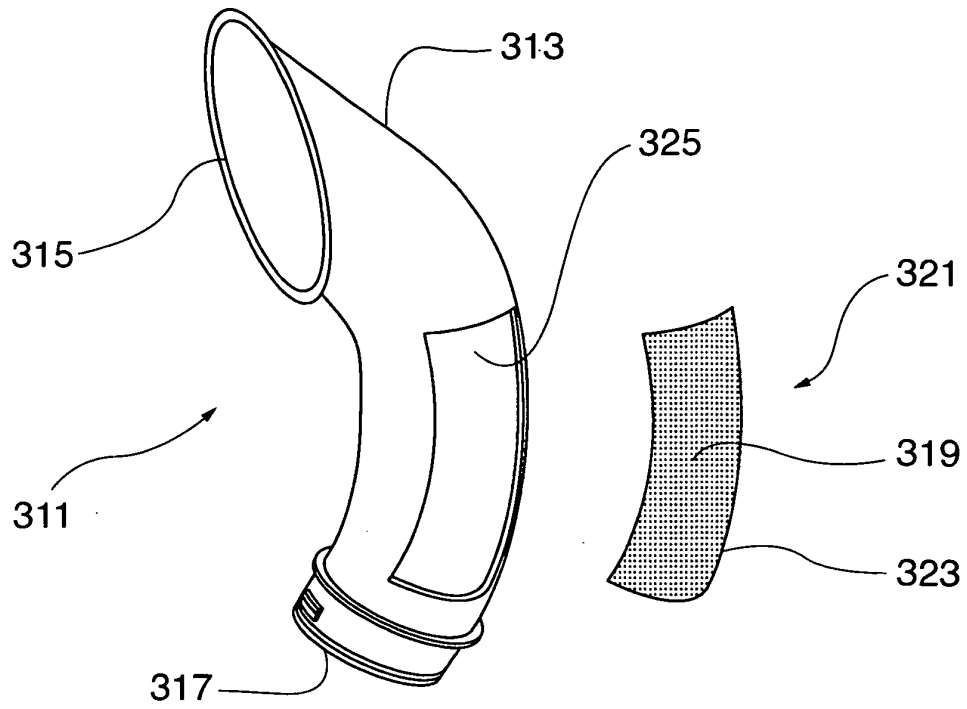


Fig. 3

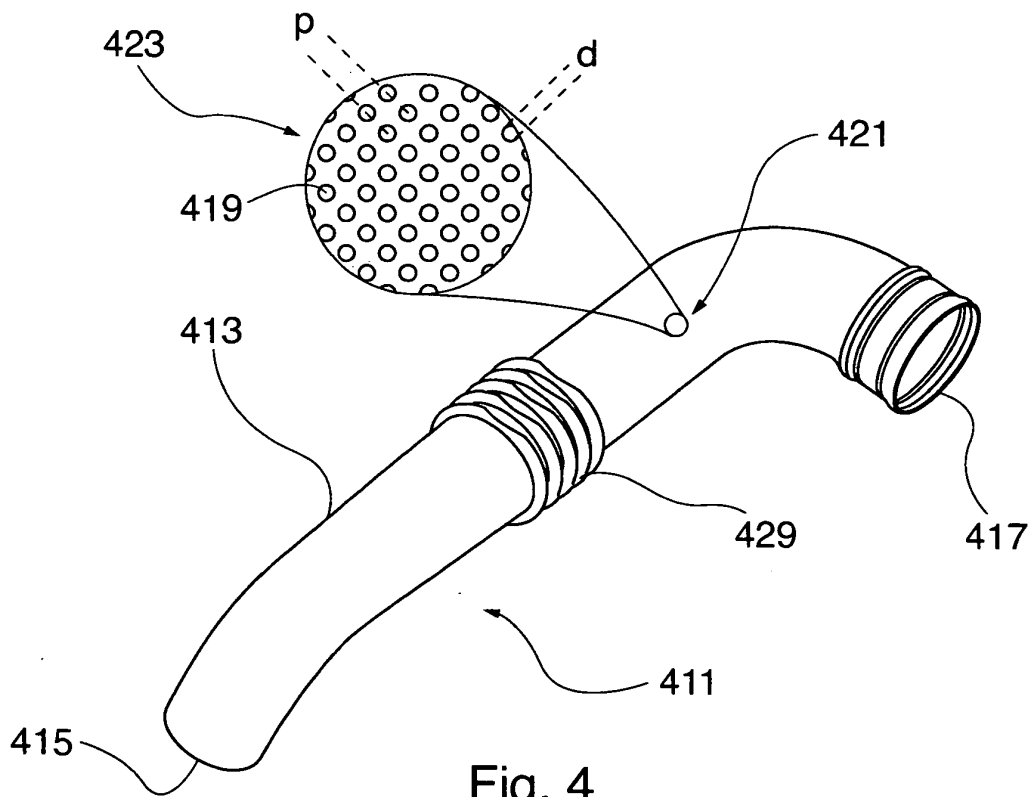


Fig. 4

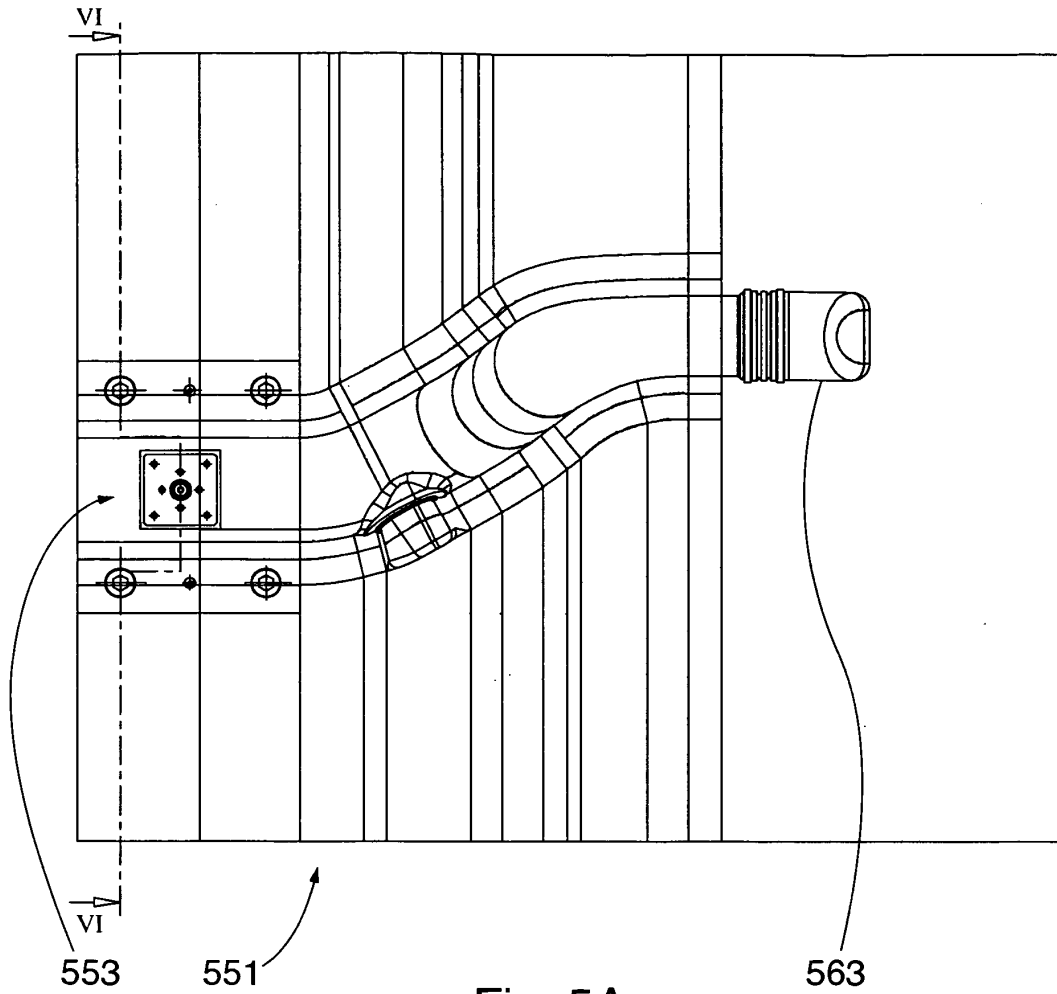


Fig. 5A

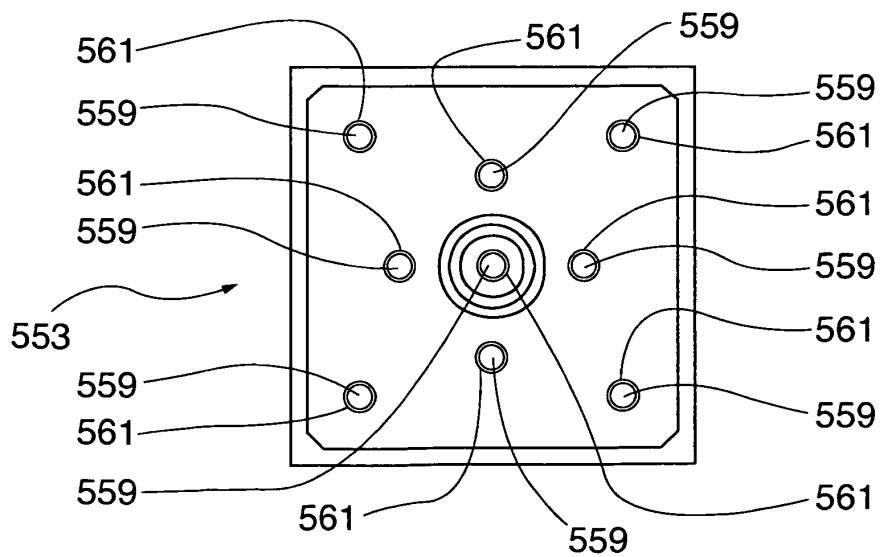


Fig. 5B

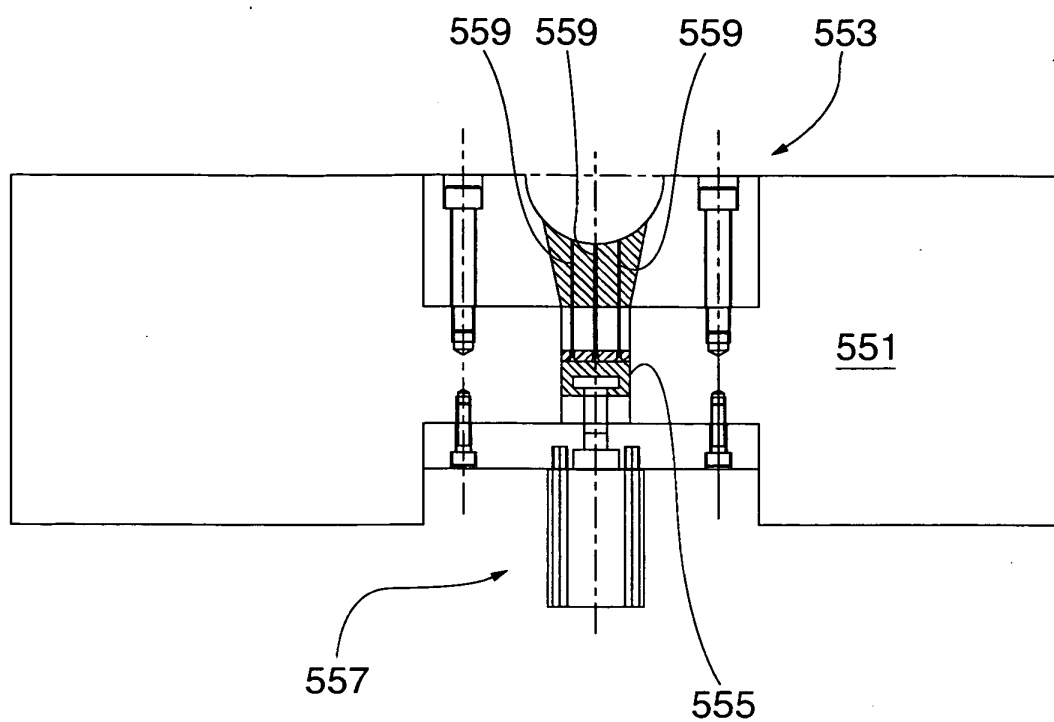


Fig. 6A

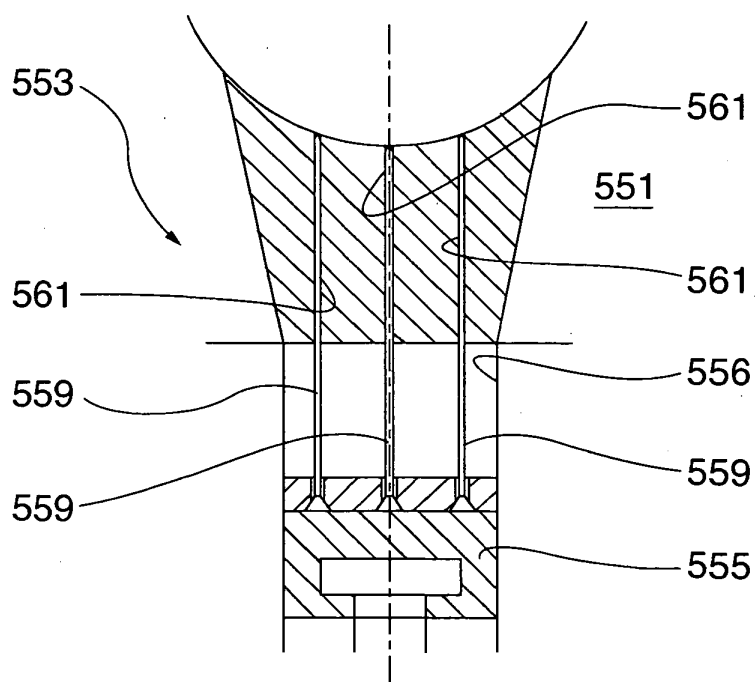


Fig. 6B

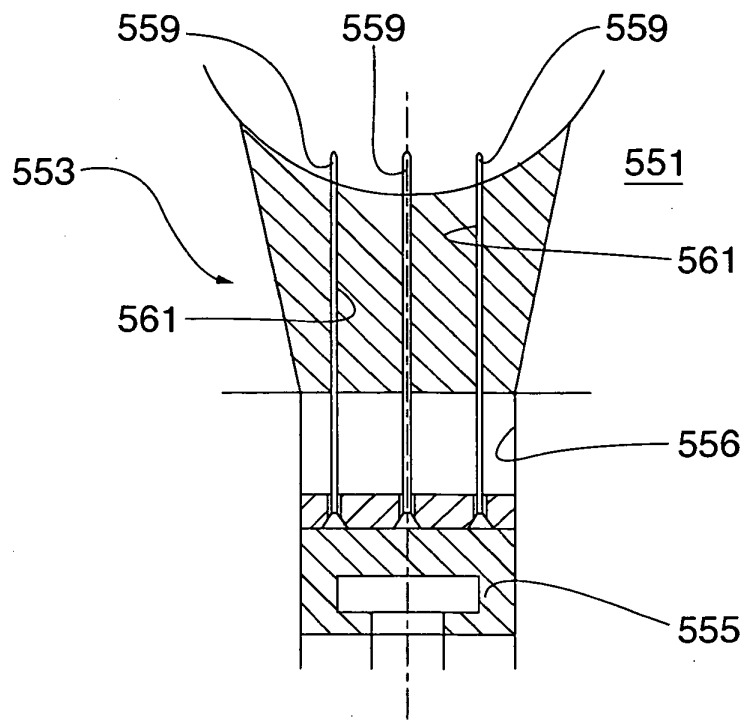


Fig. 6C

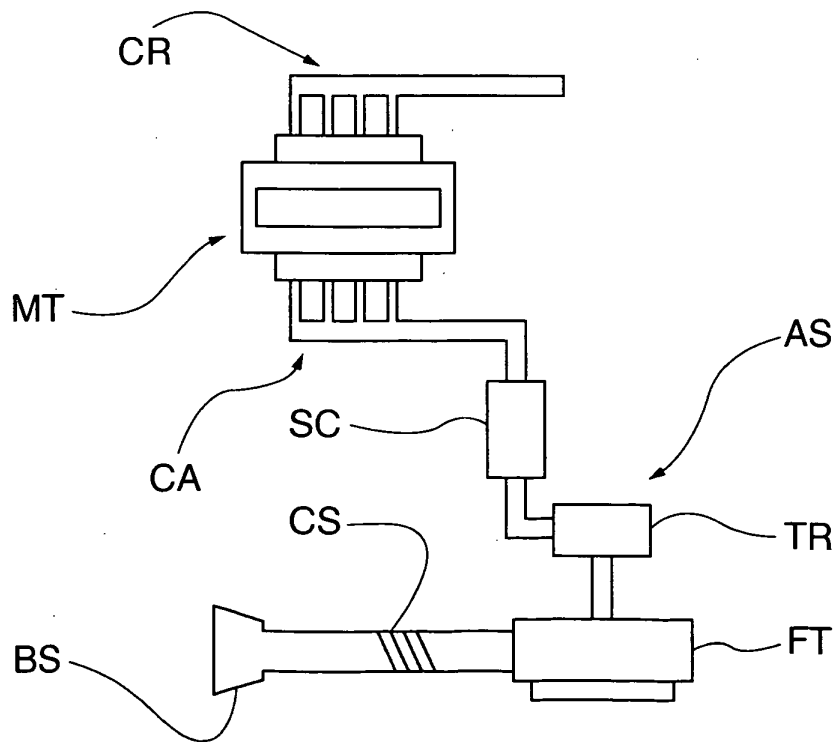


Fig. 7

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- FR 2867234 [0014]