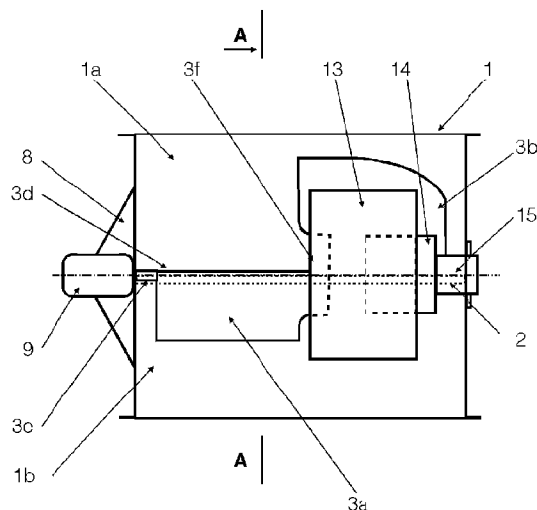




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(54) Titre : DISPOSITIF POUR DIRIGER UN ECOULEMENT D'AIR DANS LE CONDUIT D'AIR
(54) Title: DEVICE FOR DIRECTING AIR FLOW IN THE AIR DUCT



(57) Abrégé/Abstract:

A device for directing air flow in the air duct (1) according to the invention is provided with a rotary, profiled damper (3), where the working machine in the form of a fan or turbine is placed, and the damper (3) has a central opening and two connected canopies (3a, 3b) provided as rotating bodies, forming a shutter closing the air duct (1), wherein the common axis of rotation of said canopies (3a, 3b) coincides with the axis of rotation of the damper (3), characterized in that equipped with a single plane damper (3), the canopies (3a, 3b) of which are located on the opposite sides of the shutter plane closing the air duct (1) and are mutually placed such that a central opening is formed in the plane perpendicular to the plane of the damper (3) and simultaneously perpendicular to its axis of rotation. The device according to the invention is used in ventilation systems.

Abstract

A device for directing air flow in the air duct **(1)** according to the invention is provided with a rotary, profiled damper **(3)**, where the working machine in the form of a fan or turbine is placed, and the damper **(3)** has a central opening and two connected canopies **(3a, 3b)** provided as rotating bodies, forming a shutter closing the air duct **(1)**, wherein the common axis of rotation of said canopies **(3a, 3b)** coincides with the axis of rotation of the damper **(3)**, characterized in that equipped with a single plane damper **(3)**, the canopies **(3a, 3b)** of which are located on the opposite sides of the shutter plane closing the air duct **(1)** and are mutually placed such that a central opening is formed in the plane perpendicular to the plane of the damper **(3)** and simultaneously perpendicular to its axis of rotation. The device according to the invention is used in ventilation systems.

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Device for directing air flow in the air duct

Field of technology:

The subject of the invention is a device for directing air flow in the air duct by reversing the direction of an air stream driven by a fan or a unidirectional air turbine.

Prior art:

The airflow reversal device for a ventilation system currently used comprises of a fan, and is provided with a cylindrical damper comprising at least two coaxial cylinders. One of these, preferably the inner cylinder, is movable and rotatable and placed in the second cylinder, which is preferably a fixed outer cylinder. Inside the inner cylinder there is an attached partition, to which the suction port of the fan is connected. The partition is permanently fixed to the inner cylinder, and together with the two discs that close this cylinder at both ends, it constitutes the fan chamber. The internal cylinder is mounted in the casing and is driven by the rotary actuator. The inner cylinder rotates at a 180° angle to the left and at a 180° angle to the right, or the rotation takes place in one direction, cyclically stopping every 180 degrees. The cylindrical damper has openings which constitute air flow windows, located on the outer and inner surfaces of the cylinders.

The inside of the rotary cylinder constitutes the fan chamber, which is divided into a lower part, the so-called suction chamber, and an upper part. The upper part constitutes the casing for the fan rotor, driven by the electrical motor. Both upper and lower parts are connected by a suction port. In the outer cylinder there are four rectangular openings with rounded corners. They have the following dimensions: the width expressed by the obtuse angle (the opening angle no greater than 180°) and the height smaller than half the height of the outer cylinder. These are arranged in pairs, one above the other, where both pairs are symmetrically opposite each other. The outer cylinder has the following openings: bottom right, top right, bottom left and top left. The outer cylinder is connected to the expansion chamber, and one of its openings, for example the bottom right opening, forms a connection to exhaust air valve and respectively, the top right opening forms a connection to the fresh inlet air valve. There are two rectangular rounded corner openings in the inner cylinder in the upper right and lower left, with the following dimensions: the width expressed by the obtuse angle (the opening angle not greater than 180°) and the height smaller than half the height of the outer cylinder. During the rotation of the inner cylinder, while it stop opening coincides with the top left opening of the outer cylinder, the right bottom opening of the inner cylinder coincides with the lower right opening of the outer cylinder; and, the lower left opening and top right opening remain closed. After the inner cylinder has rotated by 180°, the windows in the outer cylinder open, and the windows which were open now close.

The patent publication WO 2012/155913A1 discloses a device controlling the flow of air in an air duct with a rotating, cylindrical damper containing the working machine formed as an axial fan. The damper is provided with two fused canopies formed as rotating spheres, which form a shutter closing the air duct. Each of the canopies is a section of its cylindrical side and is provided with an arc-shaped sealing surface, sliding against the cylindrical surface of the air duct. The common axis of rotation of both canopies coincides with the axis of rotation of the damper. Two opposite, arc-shaped notches are formed between the canopies of the damper, comprising its inner opening. The fan motor is installed in the cylindrical damper such that it rotates together with the damper, inside the air duct. A similar device was disclosed in the patent publication JP 2001193979A, where the damper is formed as a rotating, cylindrical insert placed inside a cylindrical housing. Both cylindrical parts of the damper are provided with a group of openings made in their sides and bottoms. The fan of this device is located outside the damper.

The disadvantages of prior art:

Existing devices designed to change the direction of air flow have an extensive construction and limited use.

Purpose of the invention:

This invention is constructed in order to overcome the above disadvantages.

Summary of the invention:

A device for directing air flow in the air duct according to the invention is equipped with a rotary, profiled damper, where the working machine in the form of a fan or turbine is placed, and the damper has a central opening and two connected canopies provided as rotating bodies, forming a shutter closing the air duct, wherein the common axis of rotation of said canopies coincides with the axis of rotation of the damper. The device according to the invention is characterized in that it is provided with a single plane damper, the canopies of which are located on the opposite sides of the shutter closing the air duct and placed against each other such that a central opening is formed within a plane perpendicular to the plane of the damper and also perpendicular to the axis of its rotation. Canopies: the suction/inlet and compression/outlet are connected by two symmetrical flat ribs, so that a sealing with edges tightly fitting to the partition-sealing shelf, separating the upper part and the lower part of the air duct.

The working machine is preferably a radial machine which is arranged in the suction/inlet canopy of the damper, and a central hole is located in the suction port that is positioned in a compression-outlet canopy. The radial working machine is a fan comprising a rotor and a motor that is mounted on a fixed pin.

In another embodiment of the invention, the working machine is an axial fan with a rotor and a

motor, arranged in a tunnel in which the central hole is located, wherein this tunnel connects the suction/inlet with the compression/outlet canopies of the damper, the stationary axis of which is attached to the air duct by means of a flanged bushing.

The tunnel has a circular cross-section, and its axis coincides with the symmetrical axis and with the axis of rotation of the damper.

Benefits of the invention:

The embodiment of the device according to the invention simplifies the damper structure by eliminating the outer cylinder used in known apparatus, changing the cylindrical shape damper to a flat one with suction/inlet and compression/outlet canopies. The damper design allows it to cooperate not only with a radial fan, but also with an axial fan and with an axial turbine and a radial turbine.

Brief Description of the Figures:

The subject of the invention is shown in the exemplary drawings where:

- Figure 1 shows the vertical cross-section through the device for directing air flow inside an air duct, with a rotating profiled damper and a radial fan;
- Fig. 2 damper with the radial fan in taken from Figure 1
- Fig. 3 damper with the radial fan in a horizontal cross-section
- Fig. 4 damper with the radial fan in the A – A cross-section taken from Figure 3
- Fig. 5 damper with the radial turbine in a horizontal cross-section
- Fig. 6 damper with the radial turbine in the A – A horizontal cross-section taken from Figure 5
- Fig. 7 damper with the radial turbine in a vertical cross-section
- Fig. 8 damper with the radial turbine in the A - A horizontal cross-section taken from Figure 7
- Fig. 9 damper with the axial fan in a vertical cross-section
- Fig. 10 damper with the axial fan in the A - A horizontal cross-section taken from Figure 9
- Fig. 11 damper with the axial fan in a horizontal cross-section
- Fig. 12 damper with the axial fan in the A – A horizontal cross-section taken from Figure 11
- Fig. 13 damper with the axial turbine in a horizontal cross-section
- Fig. 14 damper with the axial turbine in the A – A horizontal cross-section taken from Figure 13
- Fig. 15 perspective view of the damper, in one of the extreme positions
- Fig. 16 perspective view of the damper, in the second extreme position
- Fig. 17 perspective view of the damper with an axial fan, in one of the extreme positions
- Fig. 18 perspective view of the damper with an axial fan, in the second extreme position

Detailed Description of the Invention

An example embodiment of the invention:

The device for directing air flow in the air duct according to the invention consists of an air duct 1

In another embodiment of the invention, the working machine is an axial fan with a rotor and a motor, arranged in a tunnel in which the central hole is located, wherein this tunnel connects the suction/inlet with the compression/outlet canopies of the damper, the stationary axis of which is attached to the air duct by means of a flanged bushing.

The tunnel has a circular cross-section, and its axis coincides with the symmetrical axis and with the axis of rotation of the damper.

Benefits of the invention:

The embodiment of the device according to the invention simplifies the damper structure by eliminating the outer cylinder used in known apparatus, changing the cylindrical shape damper to a flat one with suction/inlet and compression/outlet canopies. The damper design allows it to cooperate not only with a radial fan, but also with an axial fan and with an axial turbine and a radial turbine.

Brief Description of the Figures:

The subject of the invention is shown in the exemplary drawings where:

- Figure 1 shows the vertical cross-section through the device for directing air flow inside an air duct, with a rotating profiled damper and a radial fan;
- Fig. 2 damper with the radial fan in the A – A horizontal cross-section
- Fig. 3 damper with the radial fan in a horizontal cross-section
- Fig. 4 damper with the radial fan according to claim 3 in the A – A cross-section
- Fig. 5 damper with the radial turbine in a horizontal cross-section
- Fig. 6 damper with the radial turbine in the A – A horizontal cross-section
- Fig. 7 damper with the radial turbine in a vertical cross-section
- Fig. 8 damper with the radial turbine according to claim 7 in the A - A horizontal cross-section
- Fig. 9 damper with the axial fan in a vertical cross-section
- Fig. 10 damper with the axial fan in the A - A horizontal cross-section
- Fig. 11 damper with the axial fan in a horizontal cross-section
- Fig. 12 damper with the axial fan according to claim 11 in the A – A horizontal cross-section
- Fig. 13 damper with the axial turbine in a horizontal cross-section
- Fig. 14 damper with the axial turbine in the A – A horizontal cross-section
- Fig. 15 perspective view of the damper, in one of the extreme positions
- Fig. 16 perspective view of the damper, in the second extreme position
- Fig. 17 perspective view of the damper with an axial fan, in one of the extreme positions
- Fig. 18 perspective view of the damper with an axial fan, in the second extreme position

Detailed Description of the Invention

An example embodiment of the invention:

The device for directing air flow in the air duct according to the invention consists of an air duct 1

with a rotary, profiled damper **3** containing the working machine. The device may be equipped, depending on the detailed embodiment, with a working machine in the form of a radial or axial fan and a radial or axial turbine. The rotary damper is a one-plane rotary damper **3** with a circular central opening and two embosses formed as canopies: a suction/inlet canopy **3a** and a compression/outlet canopy **3b**, forming a shutter closing the air duct **1**. Canopies **3a**, **3b** are so arranged that they are on opposite sides of the plane of this shutter and have the shape of a rotary body with a common axis of rotation coinciding with the rotation axis of the damper **3**. The relative positioning of the canopies **3a** and **3b** causes the central opening is placed in a plane perpendicular to the plane of the damper **3**, and perpendicular to the axis of its rotation.

The damper **3** obtains the drive from the actuator **9**, which is fixed by the stationary support **8** to the air duct **1** wall. The damper **3** has the ability to shuttle rotation by an angle of no more than 180 degrees. In extreme positions, the damper **3**, fits the edges **4** of its shutter to the partition/sealing shelf **2** provided inside the air duct **1** and tightly separates the upper part **1a** of air duct **1** from the lower part **1b**.

The damper **3**, driven by the actuator **9**, can rotate by an angle of no more than 180 degrees. During such rotations the position of the canopy **3a** and **3b** relative to the air duct **1** changes, so that the canopy that is in the upper part **1a** of the air duct **1** moves to its lower part **1b**, and the canopy that is in the lower part **1b** of the air duct **1** moves to its upper part **1a**. The rotation takes place in the shortest possible time, during which the system is not airtight, and the air streams can mix.

The device according to the invention can be made in two variants. The first variant, presented in Fig. 9 to Fig. 14, is a device equipped with a radial working machine, and in the second variant, presented in Fig. 9 to Fig. 14, it is equipped with an axial working machine.

In the first variant, the radial working machine has the form of a radial fan or a radial turbine. The radial machine is placed in the compression/outlet canopy **3b** and the central hole is placed in the suction port **3f**, located in the compression/outlet canopy **3b**. If a fan is used, the working machine draws in the air, and if a turbine is used, the working machine collects the air from the suction/inlet canopy **3a**, directing it through the central hole in the suction port **3f** to the suction/outlet canopy **3b**.

According to Fig. 1 – 4, the device in the first variant is used to reverse the direction of the air flow in the air duct **1**, by a radial fan provided with a rotor **13** and a motor **14**. As shown in Fig. 5 – 8, this device is used to direct air coming from different directions into the air duct **1** on to the proper side of the radial turbine **5** provided with the generator **6a**. The single-leaf pivoting damper **3** in this variant has a profile shape formed by: a suction/inlet canopy **3a**, a compression/outlet canopy **3b** and a central hole with a suction port **3f**. Two symmetrical flat ribs **3d** connect the suction/inlet canopy **3a** and the compression/outlet canopy **3b** forming a tight diaphragm with its sealing edges **4**, tightly attached to the partition-sealing shelf **2**. In extreme positions the damper **3**, by attaching the edges **4** to the partition-sealing shelf **2**, tightly separates the upper part **1a** from the lower part **1b** of the air

duct **1**. The damper **3** is rotatable mounted in the air duct **1**, either on the fixed shaft **15**, holding the radial fan motor **14**, or on the fixed shaft **15a**, holding the radial turbine generator **6a**, as well as on the hollow connector **3e** mounted in the air duct **1**. The actuator **9** of the rotary drive of the profiled damper **3** is attached via the fixed support **8** to the air duct **1** housing.

In the second variant of the device an axial working machine is used in the form of an axial fan or an axial turbine. The axial machine is located in the tunnel **3c**, in which the central hole is also positioned. The axial working machine, in the form of an axial fan, sucks in the air from the suction/inlet canopy **3a**, causing the air to flow through the tunnel **3c** to the compression/outlet canopy **3b**. In case the axial working machine is in the form of an axial turbine, the air driven by the pressure difference, flows from the suction/inlet canopy **3a**, through the tunnel **3c** to the compression/outlet canopy **3b** driving the turbine.

According to Fig. 9 – 12, the device in the second variant is used to reverse the direction of air flow in the air duct **1** by means of an axial fan provided with a rotor **13a** and a motor **14a**. This device is also used to direct the air coming from different directions into the air duct **1** to the proper side of the axial turbine **5** provided with a generator **6** and is driven by air flowing through the air duct **1**.

Also in this embodiment, the damper **3** is formed from the tunnel **3c** connecting the suction/inlet canopy **3a** to the compression/outlet canopy **3b**, and two symmetrical flat-shaped ribs **3d**. Canopies **3a** and **3b** are placed symmetrically, relative to the center of the damper **3**. Tunnel **3c** has a circular section, and its longitudinal axis coincides with the axis of rotation of the damper **3**. The ribs **3d** connect the suction/inlet canopy **3a** to the compression/outlet canopy **3b** and the tunnel **3c**, forming a sealing diaphragm, edges **4** of which tightly attached to the partition/sealing shelf **2**.

The profiled damper **3** is mounted on rotary bearings, on a stationary axis **7** attached to the air duct **1** by means of a flange sleeve **11** and has the ability to rotate pendulously at an angle of no more than 180 degrees. In extreme positions the damper **3**, due to the fit of the edges **4** and the partition/sealing shelf **2**, tightly separates the upper part **1a** of air duct **1** from the lower part **1b** of the air duct **1**.

The generator **6** is mounted on the fixed axis **7** so that the generator **6** stator and the fixed axis **7** both remain motionless, and the rotating winding of the generator **6** is connected to the axial turbine **5** rotor. The actuator **9** of the damper **3** is mounted on the fixed axis **7** to the air duct **1** housing by the fixed support **8**. The shaft of the actuator **9** is connected to the rotary damper **3** by the hollow connector **3e** mounted on bearings in the air duct **1**.

In the first variant of the device the only way for the air to flow through the sealed air duct **1** is through central hole of the suction port **3f** formed in the compression/outlet canopy **3b**, in which the radial working machine formed as an radial fan or a radial turbine is mounted.

In the second variant of the device, the only way for the air to flow through the sealed air duct **1** is through the tunnel **3c** in which an axial working machine formed as an axial fan or an axial-flow turbine machine is arranged.

The cyclical rotation of the damper **3** at an angle of no more than 180 degrees cause temporary unsealing of the air duct **1**. If a fan is used, after the profiled damper **3** is placed in the next extreme position, the reversal of direction of air flow in the air duct **1** occurs, while the radial fan **13** or the axial fan **13a** rotor continuously rotates in one direction. If a turbine is used, there is a constant flow of air to the turbine rotor, despite the fact that the air in the air duct **1** changes its flow direction cyclically.

Claims

1. A device for directing air flow in an air duct with a rotary, profiled damper, where a working machine in the form of a fan or turbine is placed, and the damper has a central opening and two connected canopies provided as rotating bodies, forming a shutter closing the air duct, wherein a common axis of rotation of the connected canopies coincides with an axis of rotation of the damper; characterized in that the profiled damper is a single plane damper **(3)** defining a single plane; the canopies **(3a, 3b)** being located on opposite sides of a shutter plane closing the air duct **(1)** and are mutually placed such that a central opening is formed in a plane perpendicular to the single plane of the damper **(3)** and simultaneously perpendicular to the axis of rotation thereof.
2. The device according to claim 1, wherein one of the connected canopies is a suction/inlet canopy **(3a)** and the other is a compression/outlet canopy **(3b)** with two symmetrical flat ribs **(3d)** forming a closing shutter with edges **(4)** fitted to a partition/sealing shelf **(2)** separating an upper part **(1a)** and a lower part **(1b)** of the air duct **(1)**.
3. The device according to claim 2, wherein the working machine is a radial working machine, which is placed in the compression/outlet canopy **(3b)** of the damper **(3)**; the central opening being in a tunnel **(3f)** in the suction/inlet canopy.
4. The device according to claim 3, wherein the radial working machine is a radial fan rotor **(13)** connected with a motor **(14)** which is mounted on a fixed pin **(15)**.
5. The device according to claim 2, wherein the working machine is an axial fan with a rotor **(13a)** and a motor **(14a)**, arranged in a tunnel **(3c)** in which a central hole is located, where the tunnel **(3c)** connects the suction/inlet canopy **(3a)** with the compression/outlet canopy **(3b)** of the damper **(3)**; the damper **(3)** having a stationary axis **(7)** of rotation which is attached to the air duct **(1)** by means of a flange sleeve **(11)**.
6. The device according to claim 5, wherein the tunnel **(3c)** has a circular cross section and a longitudinal axis coinciding with the axis of rotation of the profiled damper **(3)**.

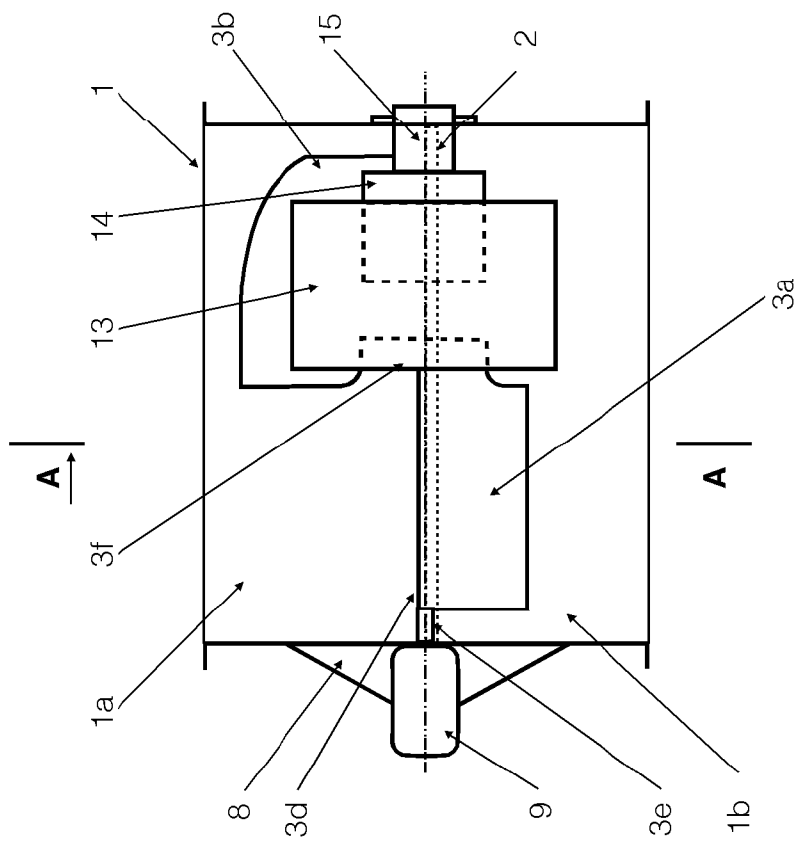


Fig. 1

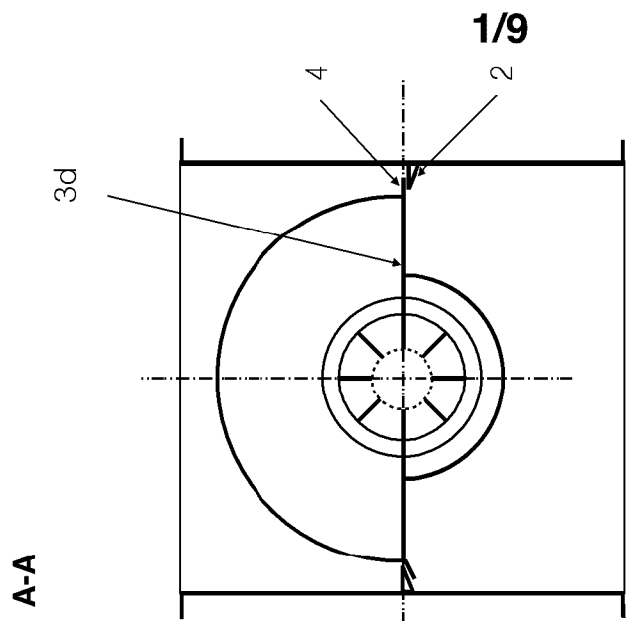


Fig. 2

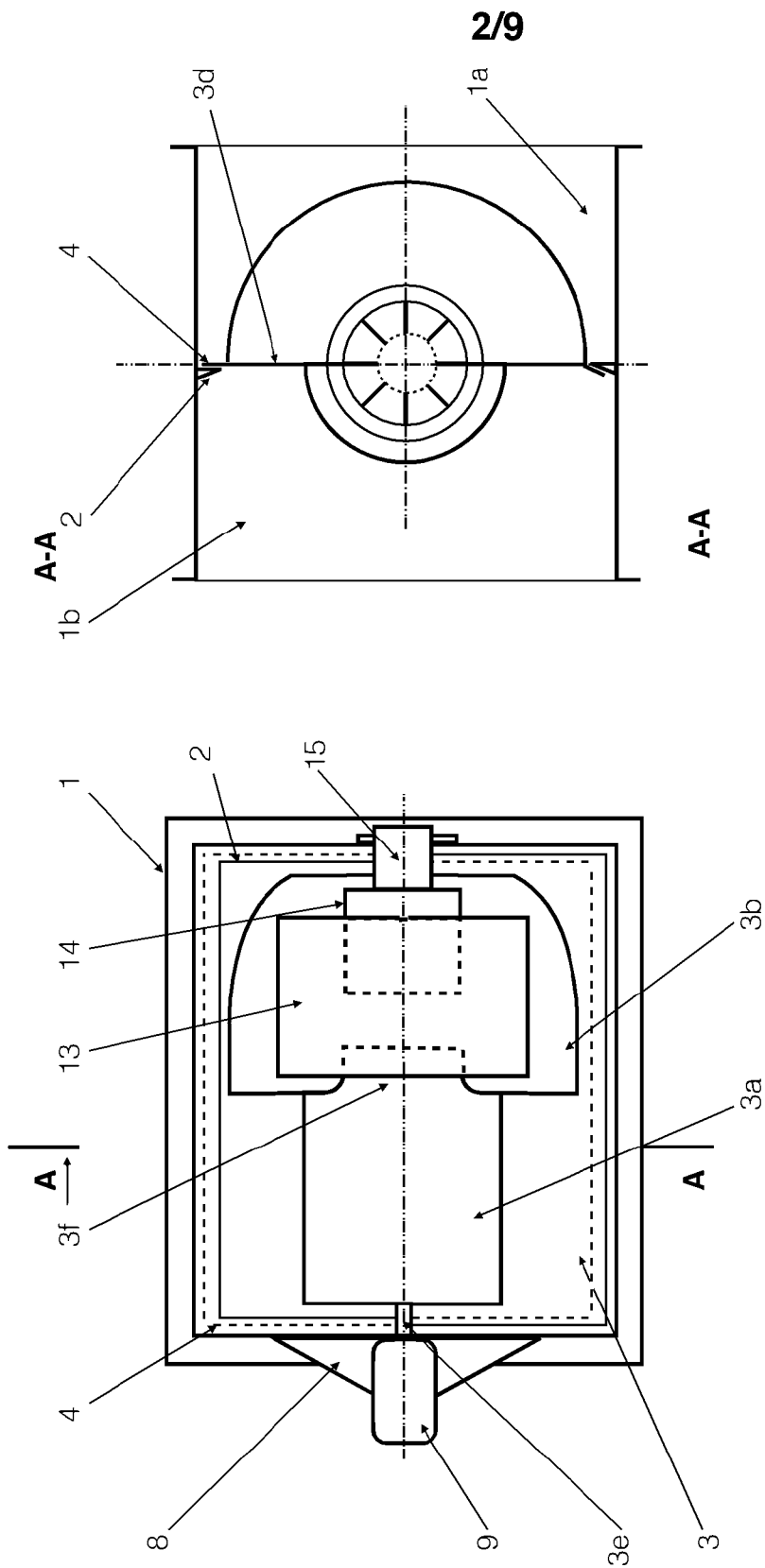


Fig. 4

Fig. 3

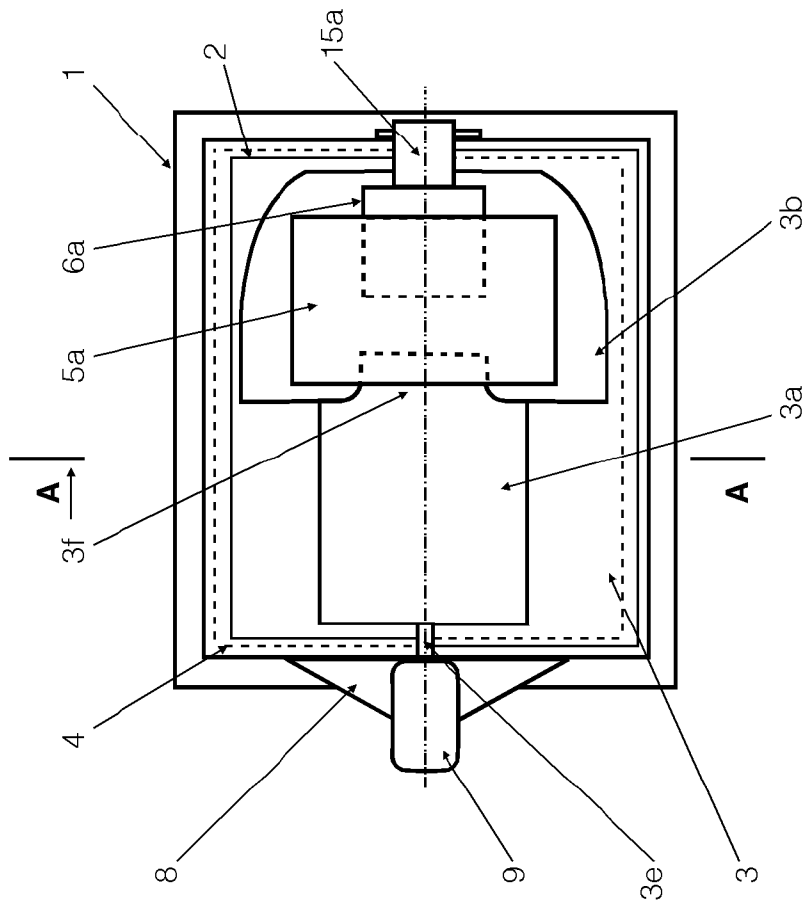


Fig. 5

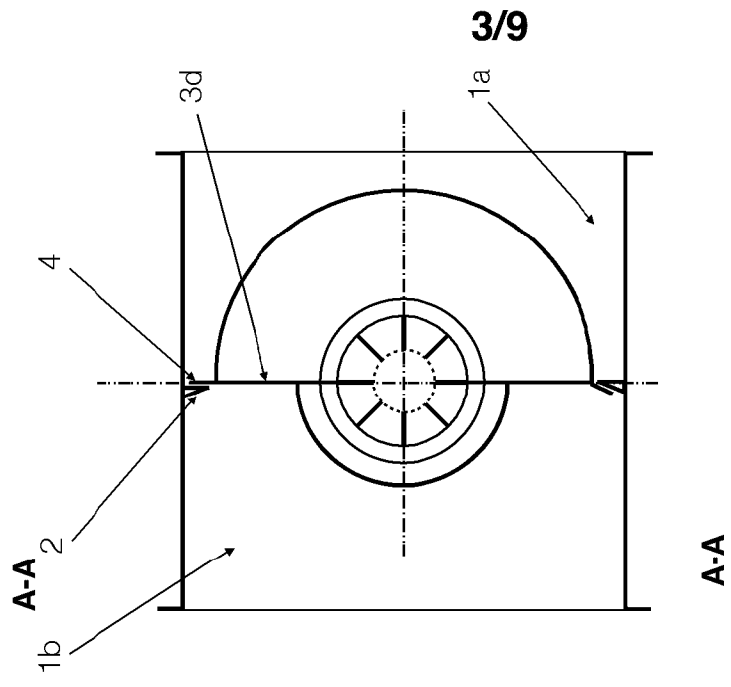
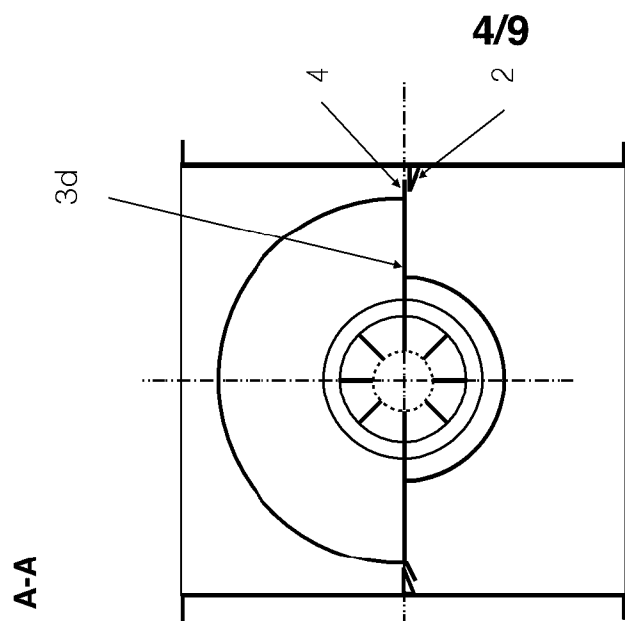
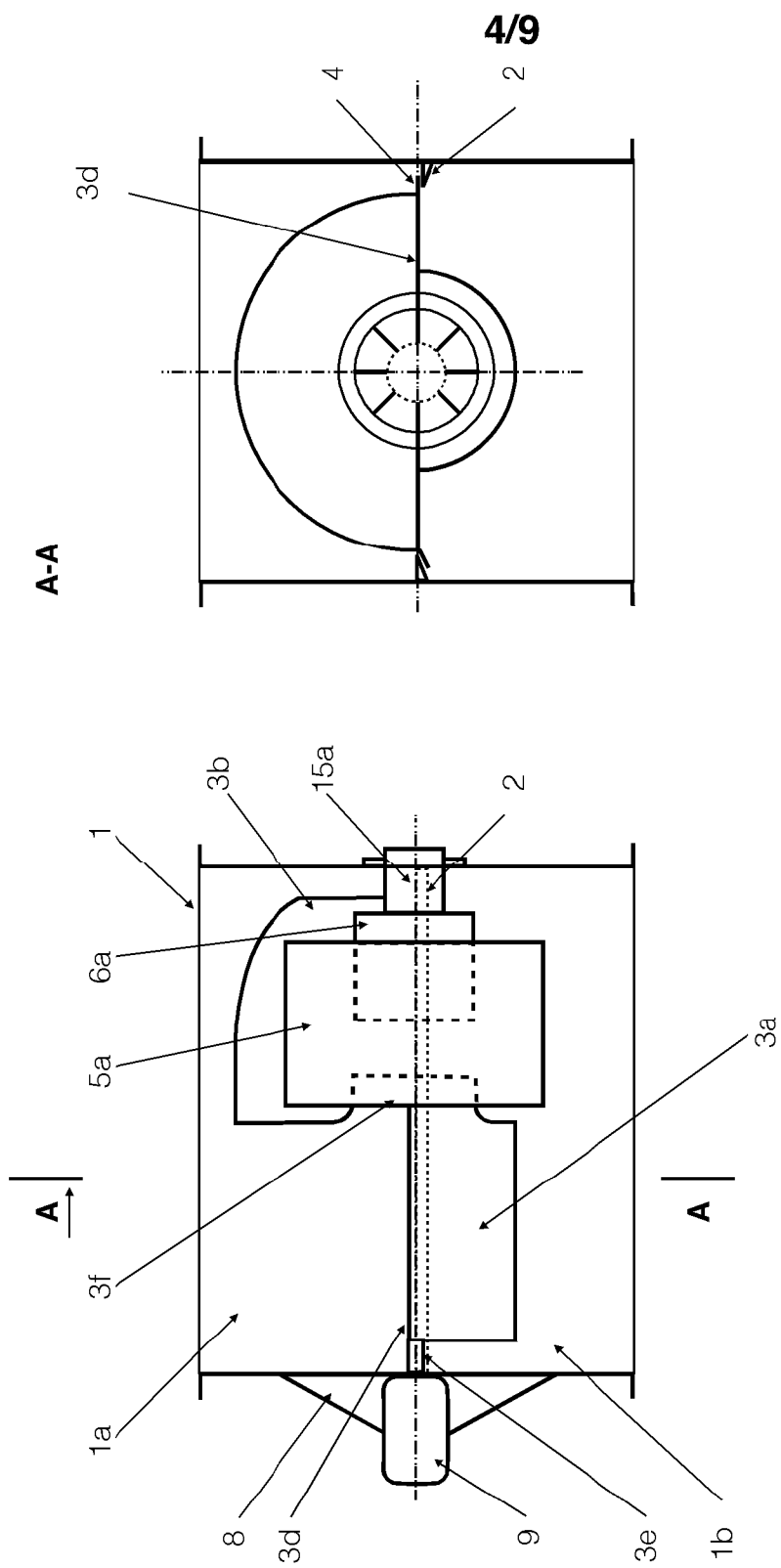


Fig. 6



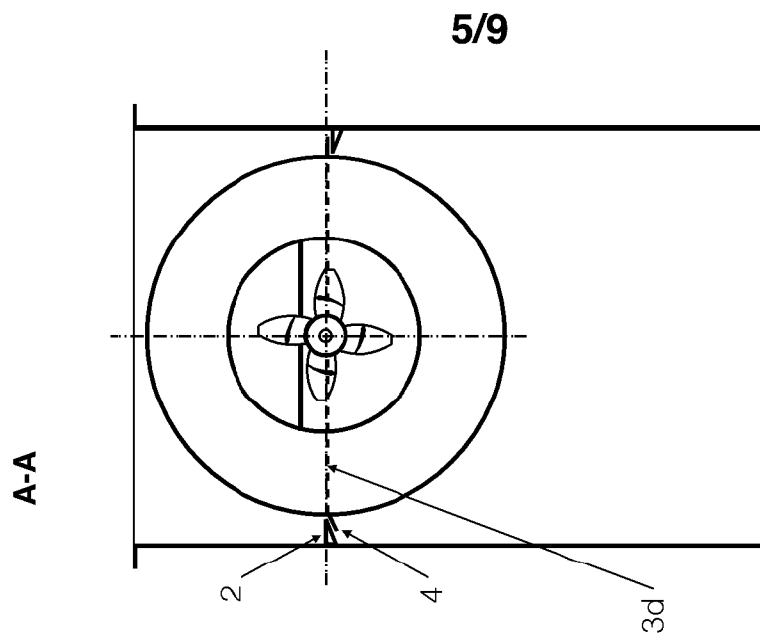


Fig. 10

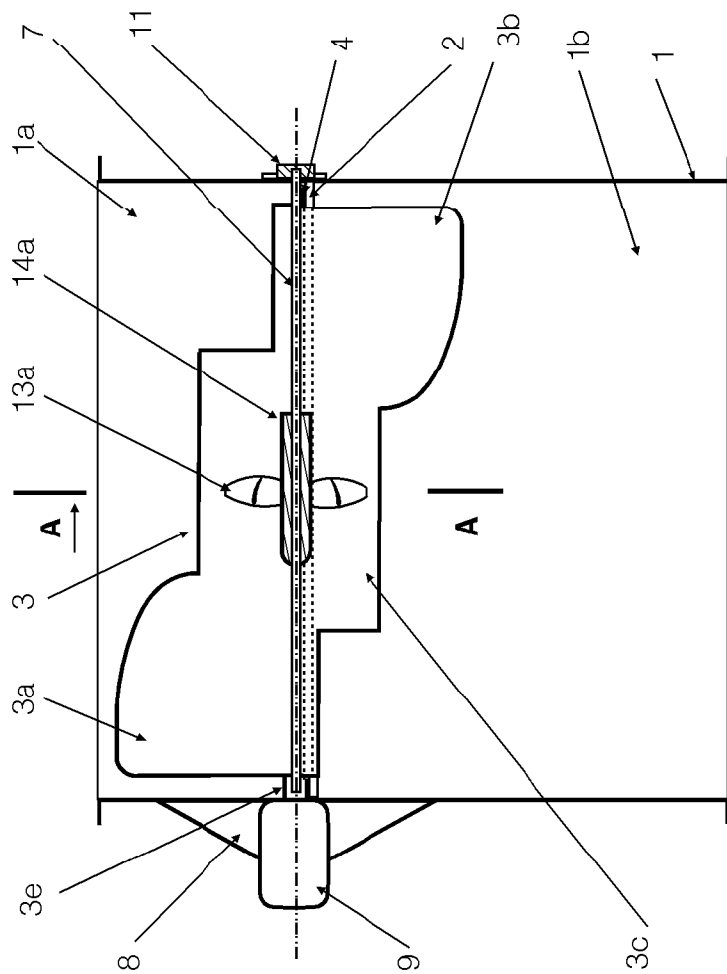


Fig. 9

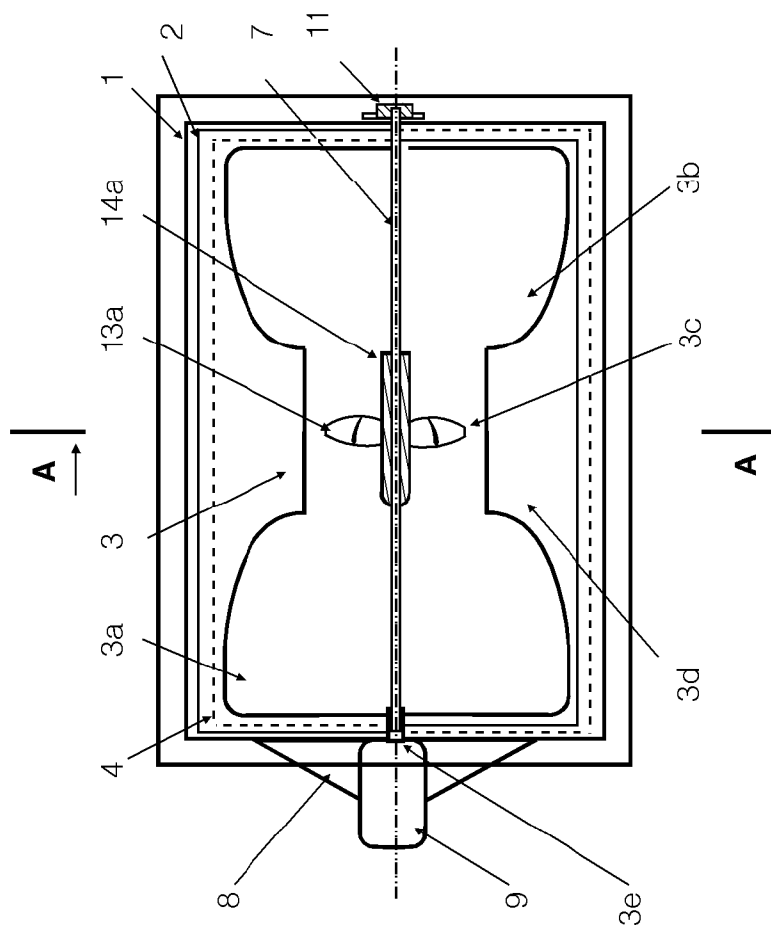


Fig. 11

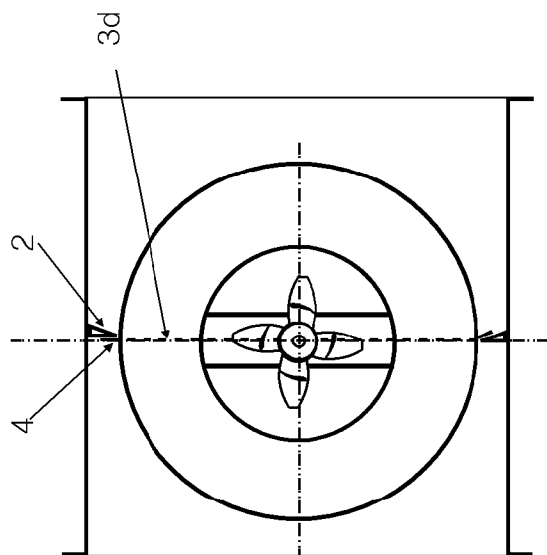


Fig. 12

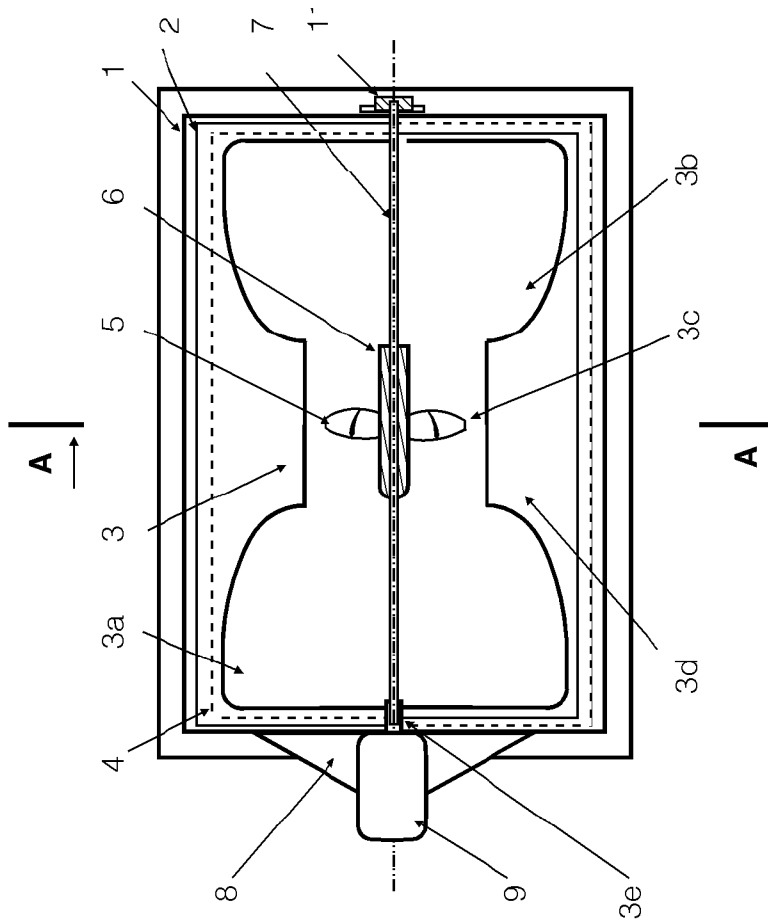


Fig. 13

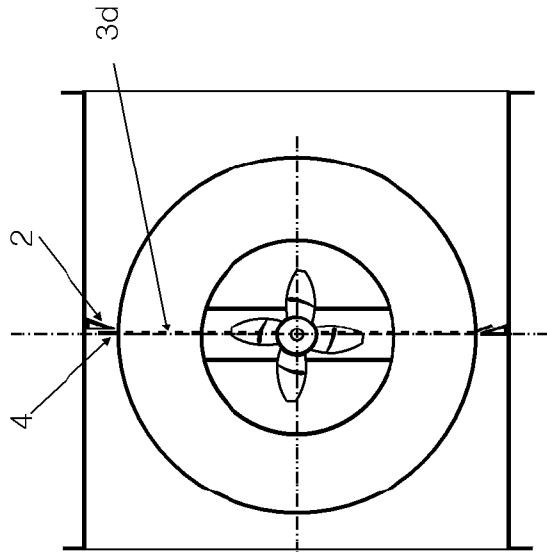


Fig. 14

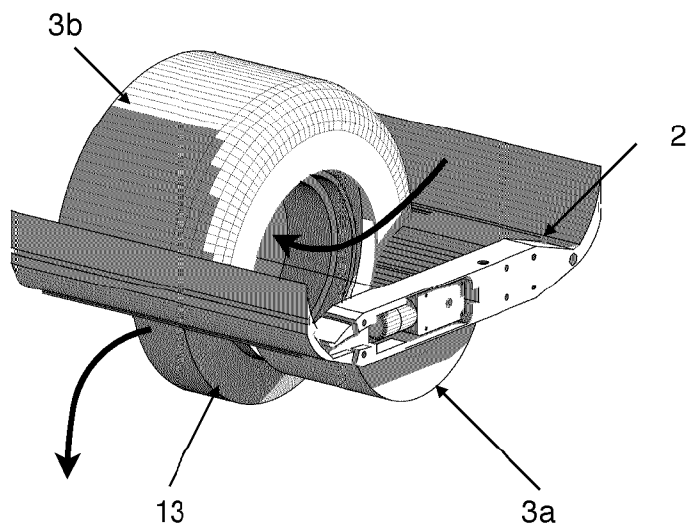


Fig. 15

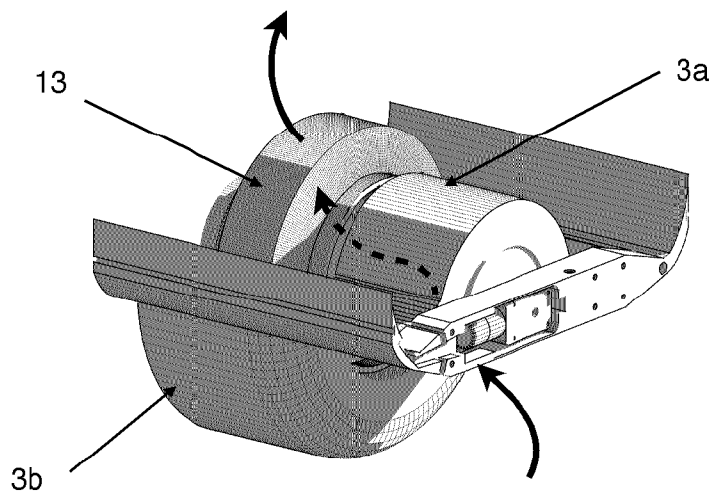


Fig. 16

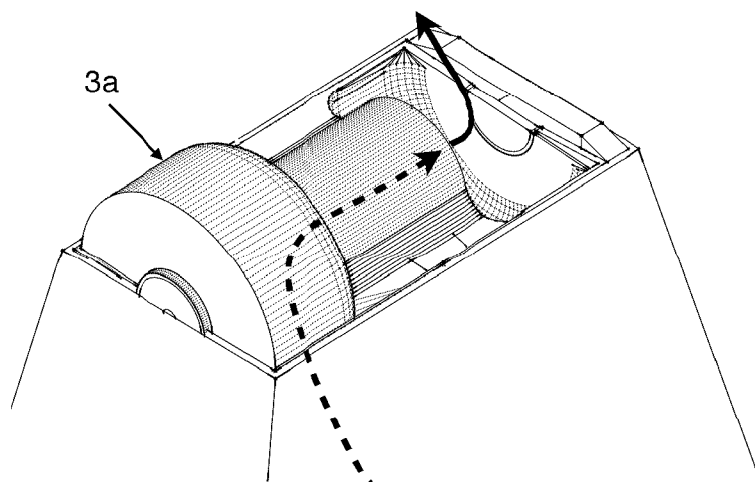


Fig. 17

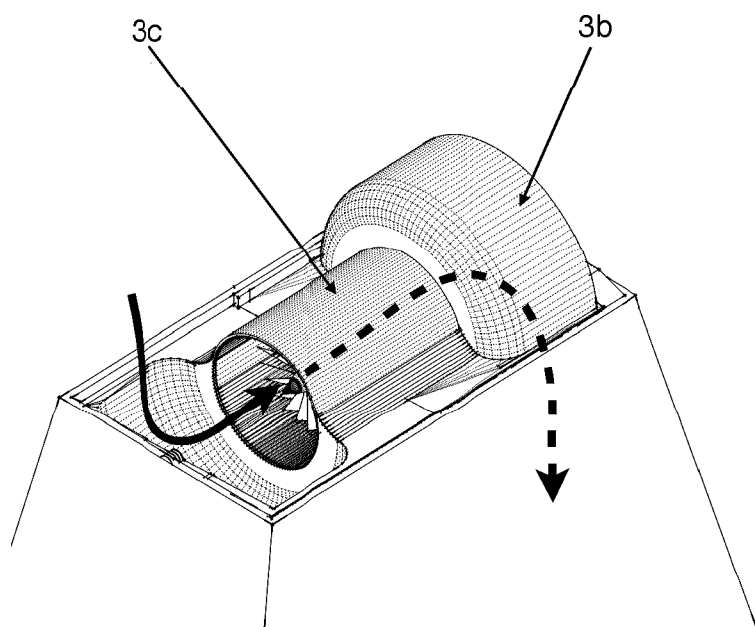


Fig. 18

