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(54) AN AIR-GAS MIXER DEVICE FOR PREMIX COMBUSTIBLE GAS BURNERS

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DISPOSITIF DE MÉLANGE AIR-GAZ POUR BRÛLEURS À GAZ COMBUSTIBLE À PRÉMÉLANGE

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Description

TECHNICAL FIELD

[0001] The present invention relates to a mixer device for premix gas burners having the characteristics stated in the preamble to Claim 1, which is the principal claim. Such a mixer device is known from DE 10 2007 022 008 A1.

TECHNOLOGICAL BACKGROUND

[0002] The invention relates particularly, although not exclusively, to the technical field of boilers for domestic use, designed for space heating and/or water heating.

[0003] In this field, boilers for domestic use must meet various requirements including some relating to the comfort of users and to safety. The safety requirements include provision for action in response to any obstructions that may occur in the outlet flue.

[0004] A boiler can normally be considered as a system in which the inputs are gas and cold water and the outputs are hot water and combustion products created by the combustion of gas and air. The combustion products are evacuated through a duct, or flue, which carries them to the outside of the building in which the equipment is installed, and expels them into the external environment.

[0005] The flue is typically a cylindrical tube with one end connected to the combustion chamber and the other end connected to an outside terminal. Since the terminal is in the external environment, it may become obstructed or blocked by external agents, such as birds building nests or objects carried by the wind and landing on the terminal. In such conditions, in other words if the terminal is blocked, the boiler must be turned off or must operate with its carbon monoxide output reduced below the limits set by regulations.

[0006] The combustion process in the boiler takes place in a combination of air and combustible gas, the air being supplied to the inside of the equipment by a fan. Before reaching the fan, the intake air flows into a mixer and creates a vacuum, thereby drawing in the combustible gas. In compact systems, the mixer is made in the form of a converging duct and the vacuum is created in the part with the smallest cross section. The gas is injected into the flow of air through a duct coaxial with the converging duct.

[0007] In other systems where compactness is not required, a diverging duct, whose length is at least equal to that of the converging duct, is fitted downstream of the minimum cross section.

[0008] The quantity of gas drawn in by the vacuum is regulated by a gas valve which keeps the gas to air ratio constant if the rotation speed of the fan varies.

[0009] If the outlet flue is obstructed, the flow of air supplied by the fan decreases even if the fan speed remains the same, and consequently the gas flow rate also decreases.

[0010] In an ideal system, the gas to air ratio should remain constant when the air flow rate falls below the minimum required flow rate. Thus the combustion process is continued, with carbon monoxide output kept within the limits, and below a certain level of thermal power the boiler is turned off.

[0011] The boiler is turned off either because the flame can no longer be kept stable or because the safety system of the boiler, which detects the presence of a flame by means of an electrode, measures an ionization current in the flame which is lower than the reference limit set in the electronic circuit board of the boiler, and therefore acts to close the gas valve.

[0012] Mixer systems having a converging duct only, such as those described above, do not usually operate satisfactorily when the flue is obstructed. As the duct becomes obstructed, the gas to air ratio tends to increase, resulting in a carbon monoxide output well above the limits set by the regulations.

[0013] In the known system described above, the gas to air ratio increases when the flue is obstructed. The increase in the ratio is due to an increase in the vacuum and consequently in the quantity of gas injected. This phenomenon arises because of the different fluid dynamic conditions which are created in the area of the aperture (the intake section) of the impeller. In these conditions, vortices are generated with their axes coaxial with the axis of rotation of the impeller, with recirculation between the inlet and outlet of the blade channel.

DESCRIPTION OF THE INVENTION

[0014] The problem to be solved by the present invention is that of providing an air-gas mixer device of the aforesaid type which is structurally and functionally designed so as to overcome the limitations of the prior art described above.

[0015] This problem is resolved by the invention by means of an air-gas mixer device made in accordance with the attached claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Other features and advantages of the invention will be made clear by the following detailed description of some preferred examples of embodiment thereof, illustrated, for the purposes of guidance and in a non-limiting way, with reference to the appended drawings, in which:

- Figure 1 is a schematic view of an installation in which the device according to the invention is to be used,
- Figure 2 is a schematic view in axial section of a mixer device according to the prior art,
- Figure 3 is a view, corresponding to that of Figure 2, of a device according to the invention;
- Figures 4 and 5 are schematic views in axial section

of a detail of Figure 3, in different variant embodiments,

- Figure 6 is a schematic front view of the device according to the invention shown in the preceding drawings, and
- Figure 7 is a perspective view of a detail of a further exemplary embodiment of the device according to the invention.

PREFERRED EMBODYMENTS OF THE INVENTION

[0017] With reference to Figure 1 initially, the number 1 indicates a boiler with a combustible gas burner with air and gas premixing, for example a boiler used for heating an environment 2, in which the combustion chamber (not shown) is connected, via a combustion fume outlet duct 3, to a discharge terminal 4, shown schematically, located outside the environment.

[0018] The boiler 1 contains a burner which is supplied with the combustible air-gas mixture previously mixed in a mixer device 5, shown schematically in Figure 2 in a known configuration. The device comprises a fan unit 6 with an impeller 7, driven about an axis of rotation X, which is provided with radial blades 8 extending between an axial intake section 9 and a radially opposed delivery section 10. The impeller 7 is housed in an enclosure 11 in which the sections 9 and 10 are formed.

[0019] Each of the impeller blades 8 projects from a base surface 12 of the impeller, extends transversely to the axis X, and has one edge 13 in the intake section 9, pairs of adjacent edges delimiting the leading edges or mouths of corresponding blade channels extending between pairs of adjacent blades along the extension of the blades between sections 9 and 10.

[0020] In the manifold 11 housing the impeller 7 there is formed a front surface facing the sides of the blades axially opposed to the base surface 12, the profile of this surface being identified by the number 14 in the axial section of Figure 2.

[0021] Upstream of the intake section 9 of the fan, from which the air is drawn by the fan and sent to the burner, the mixer device comprises a tubular duct 15 designed to guide the air, this duct being positioned coaxially with the axis X and having a terminal portion 15a converging towards the intake section 9, the free end of this portion having the minimum cross section. A vacuum is created in this section by the convergent geometry and draws in a flow of gas which is guided through a second tubular duct 16 formed at least partially inside the duct 15 and coaxially therewith. Alternatively, the duct 16 can also extend outside the duct 15.

[0022] The quantity of gas drawn in by the vacuum is regulated, in a conventional way, by a gas valve (not shown) which keeps the gas to air ratio constant if the rotation speed of the fan varies.

[0023] According to a principal feature of the invention, the device 1 also comprises at least one appendage in the form of a stator blade element 20, projecting from the lateral profile of the duct 15 on the outside of the duct, away from the axis X.

[0024] With reference to Figure 3, assuming that a median section of the blade element 20 is represented in the plane of axial section (the plane of the page) in the drawing, the blade element extends in an area (indicated in broken lines in the drawing) delimited jointly by:

- the profile of the terminal portion of the converging duct 15,
- the extension of the terminal portion to a point close to the surface 12, parallel to the axis X,
- the part of the base surface 12 of the impeller in the proximity of the corresponding blade edges 13,
- the corresponding leading edge 13 of the blade channel,
- and the surface profile 14 of the impeller housing manifold 11, positioned frontally with respect to the blades 8 in the proximity of the corresponding edges 13.

[0025] In the area delimited as stated above, indicated in broken lines in Figures 3 to 5, the at least one blade element 20 can extend from the lateral profile of the converging element so as to occupy this area at least partially, while being spaced apart from the blades of the impeller in order to avoid interference with these blades.

[0026] Figures 4 and 5 show alternative configurations of the area delimiting the blade element 20, according to different frontal profiles of the manifold 11.

[0027] More specifically, the blade element 20 has a platelike shape with opposing faces 20a, delimiting a transverse thickness 20b.

[0028] In an exemplary embodiment, the stator blade element 20 extends radially with respect to the axis of rotation X, and its opposite faces 20a are flat. Clearly, other shapes or positions are possible. The number and angular positioning of the blade elements 20 can also vary.

[0029] In a further exemplary embodiment, shown in Figure 7, four blade elements 20 are provided and are located circumferentially at equal angular intervals. The blade elements extend radially with a flat surface profile having a rectangular geometry.

[0030] Preferably, each of the blade elements 20 has a thickness 20b greater than 0.2 mm, and conveniently made equal to 1 mm, while the converging duct 15 has a wall with a thickness 21 of less than 3 mm at its end with the minimum cross section.

[0031] The functions of the stator blade element according to the invention are described in detail below.

[0032] When the flue is at least partially obstructed, the gas to air ratio tends to increase. This increase is due to an increase in the vacuum and consequently in the quantity of gas injected. This phenomenon arises because of the different fluid dynamic conditions which are created in the area of the aperture of the impeller. In these conditions, vortices are generated with their axes coaxial

with the axis of rotation X, with recirculation between the inlet and outlet of the blade channel. The provision of at least one appendage or blade 20, located in the area described above, tends to oppose these fluid dynamic actions of the combustible mixture, leading to an improvement in performance during the obstruction of the flue. Thus the air to gas ratio tends to decrease when the obstruction increases, causing the boiler to be turned off safely.

[0033] The solution described above enables a compact configuration of the mixer to be maintained, and moreover the decrease of the gas to air ratio is a further safety parameter, since when the gas to air ratio decreases the flame also tends to be extinguished because of instability, without causing carbon monoxide production.

[0034] Thus the invention resolves the problem which was proposed and provides the described advantages over the known solutions.

Claims

1. A mixer device for combustible gas burners, comprising:

- a fan unit (6) with an impeller (7) having radial blades (8) driven about an axis (X) of rotation and with an axial intake section (9) and a radially opposed delivery section (10),
- a manifold (11) for housing the impeller of said fan,
- a first duct (15) having a terminal portion (15a) converging towards the intake section (9) for supplying a flow of air to the intake section, said first duct being coaxial with the axis (X) of rotation, the free end of said portion having a minimum cross section,
- a second tubular duct (16) for supplying a flow of gas at the end of the terminal portion (15a) having the minimum cross section, said second tubular duct being formed at least partially inside the first duct (15) and coaxial with the first duct (15), in such a way that the flow of air is mixed with the flow of gas upstream of the fan intake section (9),
- the blades (8) of the impeller projecting from a base surface (12) of the impeller, each blade (8) having a leading edge (13) located in the intake section (9), these leading edges forming the mouths of corresponding blade channels between adjacent pairs of blades, extending between the intake section (9) and the delivery section (10) of the fan,
- the fan housing manifold (11) having a front surface profile (14) positioned in front of the impeller blades (8) and spaced apart from them, **characterized in that** it comprises at least one appendage (20) which is located outside the first converging duct (15) and projects from said first converging duct (15) in a direction away from said axis (X), the at least one appendage extending in an area delimited jointly by the terminal portion of the first converging duct (15), by the imaginary extension of this portion (15a) towards the base surface (12) of the impeller, on the side of the impeller base surface (12) nearer to the leading edges (13) of the blades, by the leading edges (13) of the blades, with said appendage being spaced apart from the blades of the impeller in order to avoid interference with said blades, and by the front surface profile (14) of the fan housing manifold (11) which is positioned in front of the blades (8) of the impeller in the proximity of the corresponding leading edges (13) of the blades, said at least one appendage (20) being located in said area such as to oppose fluid dynamic actions of the combustible mixture created at the intake section (9) of the impeller.

2. A device according to Claim 1, wherein the at least one appendage (20) is shaped in the same way as a stator blade element.

3. A mixer device according to Claim 2, wherein at least one blade element (20) has a plate-like shape.

4. A mixer device according to Claim 2 or 3, wherein the at least one blade element (20) extends radially from the axis (X) of rotation and has flat opposite faces (20a).

5. A mixer device according to any one of Claims 2 to 4, comprising at least four blade elements (20) positioned circumferentially at regular angular intervals.

6. A mixer device according to Claim 5, wherein each of the blade elements (20) has a rectangular flat profile.

7. A mixer device according to Claim 6, wherein each of the blade elements (20) has a thickness of more than 0.2 mm measured between the opposite faces (20a), the converging duct (15) having a thickness of less than 3 mm at its end with the smallest cross section.

Patentansprüche

1. Mischvorrichtung für Gasbrenner, umfassend:

- eine Gebläseeinheit (6) mit einem Laufrad (7) mit radialen Schaufeln (8), die über eine Drehachse (X) angetrieben werden, und mit einem

axialen Ansaugabschnitt (9) und einem radialen gegenüberliegenden Zuführabschnitt (10),
- einen Verteiler (11) zum Aufnehmen des Laufrads des Gebläses,
- einen ersten Kanal (15), der einen Anschlussbereich (15a) aufweist, der zum Ansaugabschnitt (9) konvergiert, zum Zuführen eines Luftstroms zum Ansaugabschnitt, wobei der erste Kanal mit der Drehachse (X) koaxial ist, wobei das freie Ende des Bereichs einen minimalen Querschnitt aufweist,
- einen zweiten rohrförmigen Kanal (16) zum Zuführen eines Gasstroms am Ende des Anschlussbereichs (15a) mit dem minimalen Querschnitt, wobei der zweite rohrförmige Kanal zumindest teilweise innerhalb des ersten Kanals (15) und koaxial mit dem ersten Kanal (15) derart ausgebildet ist, dass der Gasstrom mit dem Gasstrom stromaufwärts des Gebläse-Ansaugabschnitts (9) gemischt wird,
- wobei die Schaufeln (8) des Laufrads von einer Basisfläche (12) des Laufrads hervorstehen, wobei jede Schaufel (8) eine Vorderkante (13) aufweist, die im Ansaugabschnitt (9) angeordnet ist, wobei diese Vorderkanten die Mündungen der entsprechenden Schaufelkanäle zwischen benachbarten Schaufelpaaren bilden, die sich zwischen dem Ansaugabschnitt (9) und dem Zuführabschnitt (10) des Gebläses erstrecken,
- wobei der Gebläsegehäuseverteiler (11) ein vorderes Flächenprofil (14) aufweist, das vor den Laufradschaufeln (8) positioniert und von ihnen beabstandet ist, **dadurch gekennzeichnet, dass** er zumindest einen Fortsatz (20) aufweist, der außerhalb des ersten konvergierenden Kanals (15) angeordnet und vom ersten konvergierenden Kanal (15) in eine Richtung weg von der Achse (X) hervorsteht, wobei der zumindest eine Fortsatz sich in einen Bereich erstreckt, der gemeinsam durch den Anschlussbereich des ersten konvergierenden Kanals (15), durch die imaginäre Ausdehnung dieses Bereichs (15a) zur Basisfläche des Laufrades auf der Seite der Laufrad-Basisfläche (12), die näher zu den Vorderkanten (13) der Schaufeln ist, durch die Vorderkanten (13) der Schaufeln mit dem Fortsatz, der von den Schaufeln des Laufrades beabstandet ist, um eine Beeinflussung der Schaufeln zu vermeiden, und durch das vordere Flächenprofil (14) des Gebläsegehäuseverteilers (11), der vor den Schaufeln (8) des Laufrades in der Umgebung der entsprechenden Vorderkanten (13) der Schaufeln positioniert ist, begrenzt wird, wobei der zumindest eine Fortsatz (20) in dem Bereich so angeordnet ist, um Fluiddynamikaktionen der brennbaren Mischung entgegenzuwirken, die am Ansaugabschnitt (9) des Laufrads erzeugt wird.

2. Vorrichtung gemäß Anspruch 1, wobei der zumindest eine Fortsatz (20) in der gleichen Weise wie ein Stator-Schaufelelement ausgebildet ist.

3. Mischvorrichtung gemäß Anspruch 2, wobei zumindest ein Schaufelelement (20) plattenförmig ist.

4. Mischvorrichtung gemäß Anspruch 2 oder 3, wobei sich das zumindest eine Schaufelelement (20) radial von der Drehachse (X) aus erstreckt und gegenüberliegende ebene Flächen (20a) aufweist.

5. Mischvorrichtung gemäß einem der Ansprüche 2 bis 4, die zumindest vier Schaufelelemente (20) aufweist, die umlaufend in regelmäßigen Intervallen positioniert sind.

6. Mischvorrichtung gemäß Anspruch 5, wobei jedes der Schaufelelemente (20) ein rechtwinkliges ebenes Profil aufweist.

7. Mischvorrichtung gemäß Anspruch 6, wobei jedes der Schaufelelemente (20) eine Dicke von mehr als 0,2 mm aufweist, die zwischen den gegenüberliegenden Flächen (20a) gemessen wird, wobei der konvergierende Kanal (15) eine Dicke von weniger als 3 mm an seinem Ende mit dem kleinsten Querschnitt aufweist.

Revendications

1. Dispositif mélangeur pour des brûleurs à gaz combustible, comprenant :

- une unité de ventilateur (6) avec une turbine (7) ayant des aubes radiales (8) entraînées autour d'un axe (X) de rotation et avec une section d'admission axiale (9) et une section de refoulement (10) radialement opposée,
- un collecteur (11) pour loger la turbine dudit ventilateur,
- un premier conduit (15) ayant une portion terminale (15a) convergeant vers la section d'admission (9) pour fournir un flux d'air à la section d'admission, ledit premier conduit étant coaxial avec l'axe (X) de rotation, l'extrémité libre de ladite portion ayant une section transversale minimale,
- un second conduit tubulaire (16) pour fournir un flux de gaz au niveau de l'extrémité de la portion terminale (15a) ayant la section transversale minimale, ledit second conduit tubulaire étant formé au moins partiellement à l'intérieur du premier conduit (15) et coaxial avec le premier conduit (15), de manière à ce que le flux

d'air soit mélangé avec le flux de gaz en amont de la section d'admission de ventilateur (9),
- les aubes (8) de la turbine faisant saillie depuis une surface de base (12) de la turbine, chaque aube (8) ayant un bord d'attaque (13) situé dans la section d'admission (9), ces bords d'attaque formant les orifices de canaux d'aube correspondants entre des paires d'aubes adjacentes, s'étendant entre la section d'admission (9) et la section de refoulement (10) du ventilateur,
- le collecteur de logement de ventilateur (11) ayant un profil de surface avant (14) positionné à l'avant des aubes de turbine (8) et espacé de celles-ci, **caractérisé en ce qu'**il comprend au moins un appendice (20) qui est situé à l'extérieur du premier conduit convergent (15) et fait saillie depuis ledit premier conduit convergent (15) dans une direction à l'opposé dudit axe (X), l'au moins un appendice s'étendant dans une zone délimitée conjointement par la portion terminale du premier conduit convergent (15), par le prolongement imaginaire de cette portion (15a) vers la surface de base (12) de la turbine, sur le côté de la surface de base de turbine (12) plus près des bords d'attaque (13) des aubes, par les bords d'attaque (13) des aubes, ledit appendice étant espacé des aubes de la turbine afin d'éviter une interférence avec lesdites aubes, et par le profil de surface avant (14) du collecteur de logement de ventilateur (11) qui est positionné à l'avant des aubes (8) de la turbine à proximité des bords d'attaque (13) correspondants des aubes, ledit au moins un appendice (20) étant situé dans ladite zone de façon à opposer des actions dynamiques de fluide du mélange de combustible créé au niveau de la section d'admission (9) de la turbine.

2. Dispositif selon la revendication 1, dans lequel l'au moins un appendice (20) a la même forme qu'un élément d'aube de stator.

3. Dispositif mélangeur selon la revendication 2, dans lequel au moins un élément d'aube (20) a une forme de type plaque.

4. Dispositif mélangeur selon la revendication 2 ou 3, dans lequel l'au moins un élément d'aube (20) s'étend radialement depuis l'axe (X) de rotation et a des faces opposées plates (20a).

5. Dispositif mélangeur selon l'une quelconque des revendications 2 à 4, comprenant au moins quatre éléments d'aube (20) positionnés de façon circonférentielle à des intervalles angulaires réguliers.

6. Dispositif mélangeur selon la revendication 5, dans lequel chacun des éléments d'aube (20) a un profil rectangulaire plat.

7. Dispositif mélangeur selon la revendication 6, dans lequel chacun des éléments d'aube (20) a une épaisseur supérieure à 0,2 mm mesurée entre les faces opposées (20a), le conduit convergent (15) ayant une épaisseur inférieure à 3 mm au niveau de son extrémité avec la section transversale la plus petite.

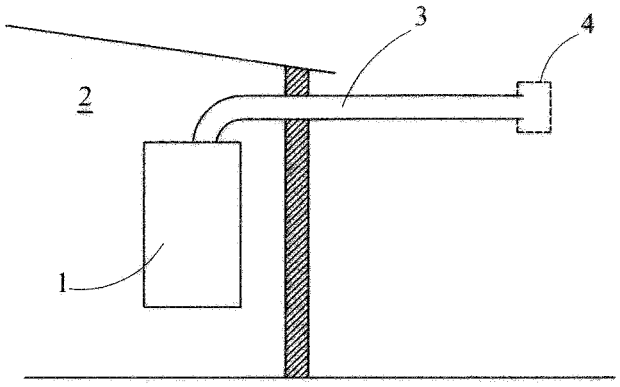

Fig. 1

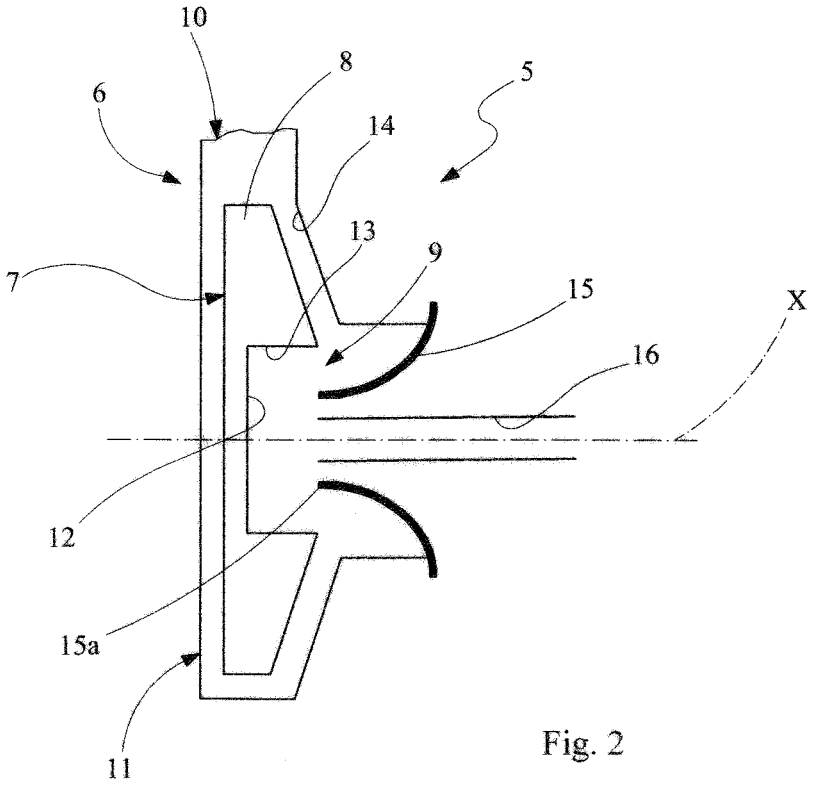

Fig. 2

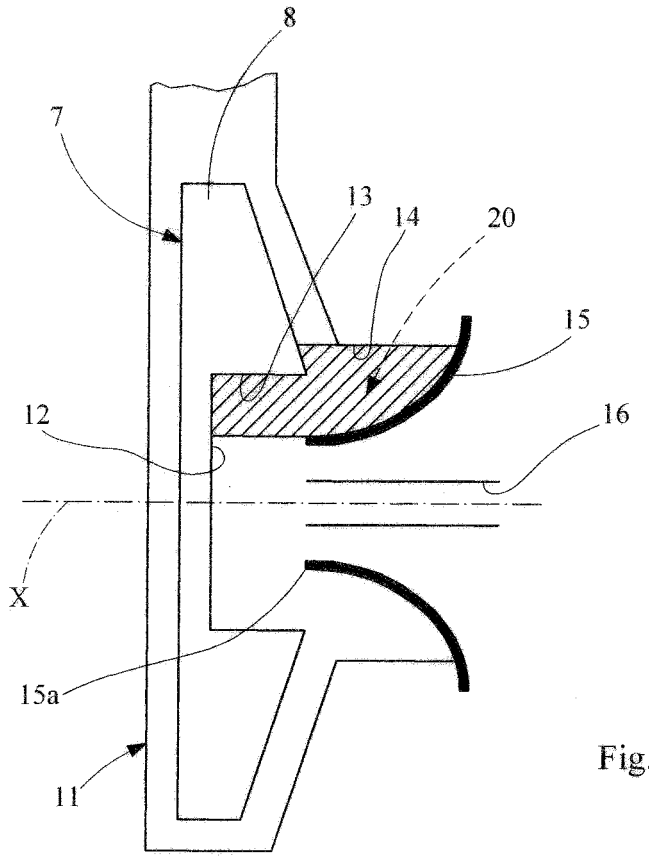

Fig. 3

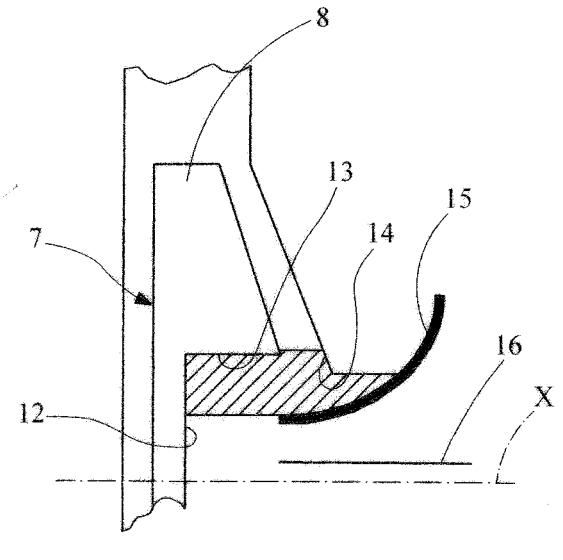

Fig. 4

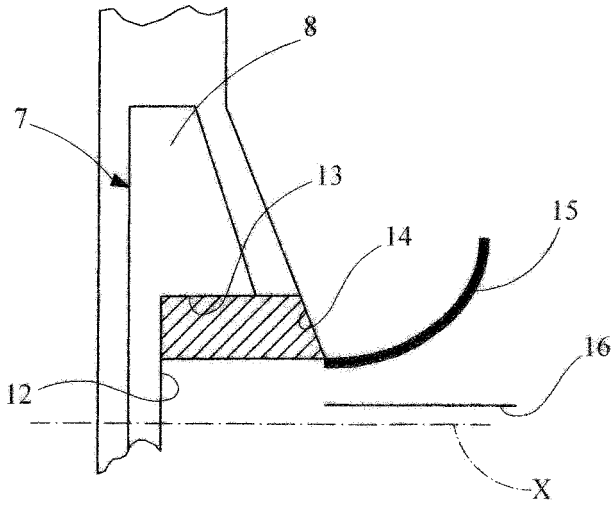

Fig. 5

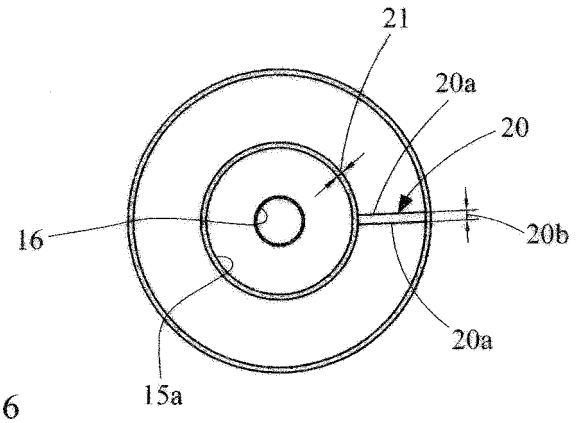

Fig. 6

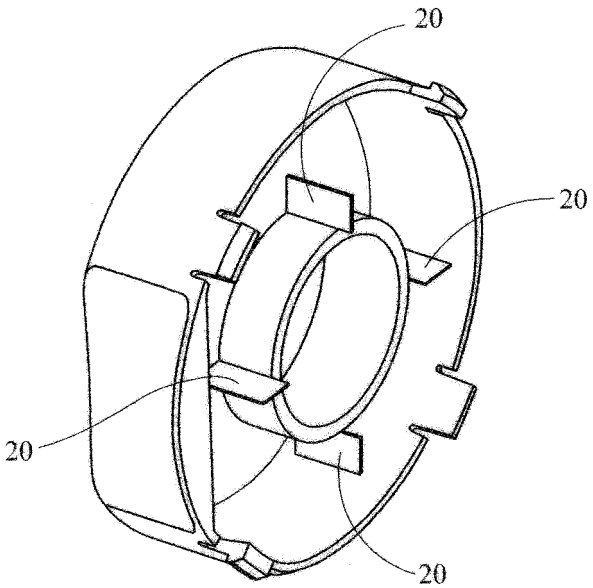

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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