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(54) AIR/GAS MIXING DEVICE, PARTICULARLY FOR PRE-MIXING BURNER APPARATUSES

LUFT-/GAS-MISCHVORRICHTUNG, INSBESONDERE FÜR VORMISCH-BRENNERVORRICHTUNGEN

DISPOSITIF DE MÉLANGE D'AIR ET DE GAZ, DESTINÉ EN PARTICULIER À DES APPAREILS BRÛLEURS À PRÉMÉLANGE

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Description

Technical field

[0001] The present invention relates to an air/gas mixing device, in particular for burner apparatuses with pre-mixing, having the characteristics mentioned in the preamble of principal claim No. 1.

Technological background

[0002] An air/gas mixing device having the features outlined above is known from EP 1096201.

[0003] Devices of the aforesaid type are used particularly in gas burner apparatuses with pre-mixing, in which a combustible air/gas mixture is pre-mixed upstream of the combustion head of the burner.

[0004] Typical applications provide for the use of Venturi-effect mixers, in which the combustible gas is injected into the restricted section of a Venturi tube arranged for conveying to the burner the predetermined flow of air for combustion.

[0005] Other applications provide for air/gas pre-mixing upstream of a fan unit intended to supply, at the delivery side, the pre-mixed air/gas flow to the burner. In the known solutions relating to the latter application, the combustible gas is typically injected in proximity to an axial zone of the mixing device, with reference to the axis of the impeller of a centrifugal fan associated with the pre-mixing device. The device, provided in general with stator blades intended to impart a rotational component to the pre-mixed flow, is fed with a flow of air which is then mixed, in the device, with the gas injected axially, to form a combustible mixture to be conveyed to the intake section of the fan.

[0006] A burner with a air/gas pre-mixing unit upstream of a fan is described by EP896191.

Description of the invention

[0007] The principal aim of the invention is that of providing an air-gas mixing device structurally and functionally designed to improve the capacity thereof and the efficiency of mixing of the flows of air and gas introduced, and also to facilitate the conveyance thereof to an intake section of a fan unit associated with the device.

[0008] These and other aims which will become clear hereinafter are achieved by the invention by means of a device produced according to the attached claims.

Brief description of the drawings

[0009] Further characteristics and advantages of the invention will become clearer from the following detailed description of a preferred exemplary embodiment thereof, illustrated by way of non-limiting example with reference to the appended drawings, in which:

- Figure 1 is a perspective view of a mixing device produced according to the invention,
- Figure 2 is a front view of the device of Figure 1,
- Figure 3 is a further perspective view of the device of the preceding Figures,
- Figure 4 is a diagrammatic side view of the device according to the invention in combination with a fan of a pre-mixed burner apparatus.

Preferred embodiment of the invention

[0010] With reference to the drawings cited, the reference 1 indicates as a whole an air/gas mixing device, particularly designed for gaseous fuel burners with pre-mixing, and produced according to the invention.

[0011] In particular, the device is arranged to receive the flows of air and gas admitted into the device, and to mix the flows so as to form a combustible air/gas mixture intended to be fed to the intake section of a centrifugal fan 2, which is itself arranged to supply, at the delivery side, the combustible mixture to a combustion head 3 of a gas burner 4. Figure 4 shows only diagrammatically a preferred configuration in which the mixing device, the fan and the burner are operationally associated with one another and also disposed, one after the other, in an axial direction X. The axis X further forms the axis of rotation of the impeller 2a of the fan 2, which is housed in a manifold 5 provided with an axial intake section 5a and with a delivery section 5b, disposed in a position remote from the axis X, at the outside diameter of the impeller.

[0012] The device 1 comprises first conveying means for conveying the flow introduced into it, which are indicated as a whole by 6, and are of the centripetal type, i. e. are designed to convey the flow, admitted in a position remote from the axis X, in the direction of said axis in a substantially centripetal movement, as will become clear from the following detailed description.

[0013] The conveying means 6 comprise a plurality of stator conveying ducts, all indicated by 7, which extend in directions having a predominant radial component, with respect to the axis of rotation X, and are angularly spaced from one another along a circumferential profile concentric with the axis X, as is clearly illustrated in Figures 1 and 2.

[0014] The ducts 7 are conveniently formed on a discoid base 8 having its main axis coaxial with the axis X, and from which rise in the same direction a plurality of walls 9, each pair of walls adjacent to each other defining a respective duct 7. Each of said ducts 7 is therefore delimited by a pair of opposed and facing walls 9, by the base 8 and, on the opposite side from the base, by at least part of the manifold 5.

[0015] As illustrated in Figures 1 and 2, each duct 7 is open at its opposed longitudinal ends, at which are respectively formed an opening 7a, remote from the axis X, constituting an opening for the entry of the flow into the device, and an opening 7b, close to the axis X, constituting an opening for the exit of the flow from the cor-

responding duct 7.

[0016] The openings 7a are therefore distributed along a common circumferential profile, in a position remote from the main axis X, and are conveniently angularly spaced at a regular pitch. Similarly, the openings 7b are also distributed at an equal angular pitch on a second profile, close to the axis X and concentric therewith. The passage cross-section of the flow in each conveying duct 7 has an amplitude which increases from the corresponding opening 7a in the direction of the opposed outlet opening 7b. In this way, each corresponding duct 7 has a characteristic divergent configuration, in the direction of the flow conveyed.

[0017] Furthermore, the walls 9 delimiting the plurality of ducts 7 conveniently have a curved profile in the longitudinal direction predominantly radially directed, as is clearly illustrated in Figure 2. The curved profiles of the entire plurality of walls 9 are moreover provided with a configuration in which they have a curvature of the same sign.

[0018] The reference 10 also defines a zone formed in the device, downstream of the ducts 7 and contained between the outlet openings 7b and the main axis X of the device, in which zone takes place the mixing of the individual flows conveyed, in a centripetal movement, along the ducts 7 and delivered at the outlet of said ducts.

[0019] The mixing device 1 also comprises second conveying means, designed for conveying the flow of combustible gas, admitted into the device, into each individual duct 7 of the first conveying means, such that in each duct 7 air/gas pre-mixing takes place downstream of the inlet zone for the gas in the corresponding duct 7, in the direction of the axis X.

[0020] Said second conveying means comprise a distributing channel 11 extending along a circular profile, concentric with the axis X, contiguous with the ducts 7 and also provided with a plurality of through openings 12, each of which places the channel in fluid communication with a respective duct 7. As illustrated in the preferred example of Figure 1, the openings 12 are disposed, angularly spaced at a regular pitch, along the circular profile of the length of the channel 11.

[0021] More particularly, the channel 11 preferably has a toroidal configuration, a partial middle section of which is shown in Figures 1 and 2. The channel 11 is interrupted circumferentially at a preselected duct 7 (indicated by 7' in the drawings), the latter being intended for the admission of the combustible gas into the device. The duct 7' therefore (via the corresponding opening 7a) places the outside of the mixer in fluid communication with the channel 11, via the passage 11a delimited by the aforesaid circumferential interruption.

[0022] Each opening 12 is further positioned at a respective portion of each duct 7, contained between the respective ends 7a, 7b, and conveniently behind the end opening 7a, such that the air/gas mixing, between the flow of air, conveyed along a duct 7, and the flow of combustible gas, fed via the channel 11 into the corresponding opening 12, takes place in a section of the duct 7 from which a divergent portion of the duct itself extends in the direction of the main axis. This configuration, provided in each of the ducts 7, substantially reflects the mixing process obtained with a Venturi effect from the restricted section of a divergent duct. Such mixing is however effected in each of the ducts 7, for each respective individual flow of air admitted by the corresponding duct 7, and mixed with the gas distributed by means of the channel 12.

[0023] In a typical application, therefore, the ducts 7, with the exception of the duct 7', are dedicated to conveying air inside the mixer, and the air/gas pre-mixing takes place in each duct 7 in the manner described above, to form a combustible mixture to be fed to the fan 2 and thence to the burner 4.

[0024] The mixing zone 10, provided at least in part in the base 8 of the device, is arranged to be placed in fluid communication with the axial intake section 5a of the centrifugal fan 2, such that the fan is fed on the intake side with the pre-mixed air/gas flow.

[0025] Indicated in Figure 3 by suitable arrows (by solid lines for the air, by dash-dotted lines for the gas and by dashed lines for the air/gas mixture) are the directions of the respectively centripetal conveying movement of the flow of air inside the device, of the gas inlet flow and of the flow of the air/gas mixture fed to the fan.

[0026] It should be noted that the mixing device of the invention, in functional terms, forms a system equivalent to a plurality of Venturi tubes in parallel with one another, where each individual mixing takes place in the corresponding duct of the plurality of ducts provided in the mixer.

[0027] This plurality of individual mixing systems advantageously permits more efficient management of the mixing, inasmuch as it ensures in the individual duct greater efficiency and uniformity of the flow rates of the air/gas mixture.

[0028] Moreover, the plurality of mixing venturis ensures uniform distribution of the air/gas mixture already before the impeller.

[0029] Another advantage is the possibility of increasing the return under-pressure of the combustible gas, necessary in air/gas systems.

[0030] It is further possible to obtain an advantageous silencing effect with suitable configuration of the system.

Claims

1. An air/gas mixing device, particularly for pre-mixing burner apparatuses, comprising:

   - first conveying means (6) with centripetal flow including a plurality of ducts (7) having a predominant radial direction and disposed along a circumferential profile concentric with a main axis (X) and having a divergent configuration in the direction of the flow conveyed, the flow of air,

intended for mixing with the gas, being intended to be admitted into said ducts (7),
- second gas conveying means (11) for conveying the gas, admitted into the device, into each duct (7) of the first conveying means (6), such that in each duct air/gas pre-mixing takes place downstream of the zone for admission of the gas into the duct, in the direction of said axis (X), said second conveying means comprising a gas-distributing channel (11) extending along a circular profile concentric with said main axis (X) and also provided with a plurality of respective through openings (12), each of which places the channel (11) in communication with a respective duct (7) of the first conveying means (6), each duct (7) of said plurality being delimited at least by a pair of opposed walls (9) facing each other and rising in the same direction from a discoid base (8) of said device, arranged for coaxial mounting with a fan, the duct (7) being capable of being delimited, on the opposite side from the base, by at least part of a manifold (5) for housing the impeller of the fan, each duct (7) being open at the opposed ends of its length, with a first opening (7a) for the entry of the flow at one of the ends, in a position remote from the main axis of the base (8), and with a second opening (7b) for the exit of the flow at the other end, positioned in proximity to said axis (X), wherein the corresponding opening (12) for communication of the channel (11) with the corresponding duct (7) is disposed in a position between said ends, and wherein the passage cross-section for the flow in each conveying duct (7) has an amplitude increasing from the entry opening (7a) in the direction of the exit opening (7b) for the flow, such that the air/gas mixing, between the flow of air, conveyed along each duct (7), and the flow of combustible gas, fed via said channel (11) into the corresponding opening (12), takes place in a section of the duct (7) from which a divergent portion of the duct itself extends in the direction of the main axis (X).

2. A mixing device according to claim 1, wherein said channel (11) has a substantially toroidal configuration.

3. A mixing device according to claim 1 or 2, wherein said channel (11) is provided with an opening (11a) for admission of the gas into the channel (11), and which places the channel in fluid communication with at least one (7') of the ducts of said first conveying means (6) along which the flow of gas is admitted into the mixing device.

4. A device according to any one of the preceding claims, wherein each pair of opposed walls (9) of said base (8) delimiting a respective duct (7) has a profile curved in the longitudinal direction and also radial with respect to the main axis (X) of said base (8).

5. A device according to claim 4, wherein the curved profiles of each pair of walls (9) facing each other and delimiting a corresponding duct (7) have a curvature of the same sign.

6. A device according to any one of the preceding claims, wherein downstream of each duct (7), with respect to the centripetal direction of the flow, between the outlet opening (7b) of the duct (7) and the main axis (X) of the device a second zone is defined for the mixing of the individual flows of air/gas mixture conveyed by the respective ducts (7) towards the intake section of the fan.

7. A device according to claim 6, wherein said second mixing zone is suitable to be placed in fluid communication with an axial intake section of a centrifugal fan with impeller coaxial with said device, such that the fan is fed at the intake side with the mixed air/gas flow coming from said mixing zone.

Patentansprüche

1. Luft/Gas Mischvorrichtung, insbesondere für vormischende Brennereinrichtungen, umfassend:

- erste Fördermittel (6) mit zentripetalem Durchfluss aufweisend eine Vielzahl an Kanälen (7) mit einer vorwiegend radialen Ausrichtung und angeordnet entlang eines Umfangsprofils konzentrisch mit einer Hauptachse (X) und mit einer divergenten Konfiguration in Richtung des geförderten Durchflusses,
wobei der Durchfluss der Luft zur Mischung mit dem Gas bestimmt ist, welches bestimmt ist für ein Zugeben in die Kanäle (7),
- zweite Fördermittel (11) zur Förderung des Gases, welches in die Vorrichtung zugegeben ist, in jeden Kanal (7) der ersten Fördermittel (6), derart dass in jedem Kanal Luft/Gas Vormischung stromab des Bereichs zum Zugeben des Gases in den Kanal erfolgt, in Richtung der genannten Achse (X), wobei die zweiten Fördermittel umfassen

eine Gasverteilungsrinne (11),
die sich entlang eines kreisförmigen Profils konzentrisch mit der genannten Hauptachse (X) erstreckt und ferner versehen ist mit einer Vielzahl an entsprechenden Durchgangsöffnungen (12), von denen jede die Rinne (11) in Verbindung mit einem entsprechenden Kanal (7) des ersten Fördergeräts (6)

bringt,
wobei jeder Kanal (7) der genannten Vielzahl von wenigstens einem Paar gegenüberliegender Wände (9) begrenzt ist, die zueinander gewandt sind und in dieselbe Richtung von einer scheibenförmigen Grundfläche (8) der Vorrichtung ansteigen, angeordnet zur koaxialen Montage mit einem Gebläse, wobei der Kanal (7) dazu geeignet ist, auf der gegenüberliegenden Seite der Grundfläche, durch wenigstens einen Teil eines Verteilers (5) zur Aufnahme des Impellers des Gebläse begrenzt zu werden, wobei jeder Kanal (7) offen ist an den in seiner Längsrichtung gegenüberliegenden Enden, mit einer ersten Öffnung (7a) für den Eintritt des Durchflusses an einem der Enden, in einer Position fern der Hauptachse der Grundfläche (8), und mit einer zweiten Öffnung (7b) für den Austritt des Durchflusses am anderen Ende, positioniert in der Nähe der genannten Achse (X),
wobei die zugehörige Öffnung (12) zur Verbindung der Rinne (11) mit dem zugehörigen Kanal (7) angeordnet ist in einer Position zwischen genannten Enden, und
wobei der Durchgangsquerschnitt für den Durchfluss in jedem fördernden Kanal (7) eine zunehmende Amplitude von der Eingangsöffnung (7a) in Richtung der Austrittsöffnung (7b) für den Durchfluss hat, derart dass die Luft/Gas Mischung, zwischen dem Durchfluss der Luft, die entlang jedes Kanals (7) gefördert, und dem Durchfluss des brennbaren Gases, das mittels der Rinne (11) in die zugehörige Öffnung (12) zugeführt ist, in einem Abschnitt des Kanals (7) erfolgt, von welchem sich ein divergenter Anteil des Kanals selbst in die Richtung der Hauptachse (X) erstreckt.

2. Mischvorrichtung gemäß Anspruch 1, wobei die Rinne (11) eine im Wesentlichen ringförmige Konfiguration hat.

3. Mischvorrichtung gemäß Anspruch 1 oder 2, wobei die Rinne (11) mit einer Öffnung (11a) zum Zugeben des Gases in die Rinne (11) versehen ist, und welche die Rinne in Fluidverbindung mit wenigstens einem (7') der Kanäle der ersten Fördermittel (6) bringt, entlang welchem der Durchfluss des Gases in die Mischvorrichtung zugegeben ist.

4. Vorrichtung gemäß einem der vorhergehenden Ansprüche, wobei jedes Paar gegenüberliegender Wände (9) der Grundfläche (8), die einen entsprechenden Kanal (7) begrenzen, ein Profil gekrümmt in Längsrichtung und ferner radial bezüglich der Hauptachse (X) der genannten Grundfläche (8) hat.

5. Vorrichtung gemäß Anspruch 4, wobei die gekrümmten Profile von jedem Paar von Wänden (9), die zueinander gewandt sind und einen zugehörigen Kanal (7) begrenzen, eine Krümmung gleichen Vorzeichens haben.

6. Vorrichtung gemäß einem der vorhergehenden Ansprüche, wobei stromab von jedem Kanal (7), bezüglich der zentripetalen Richtung des Durchflusses, zwischen der Auslassöffnung (7b) des Kanals (7) und der Hauptachse (X) der Vorrichtung ein zweiter Bereich definiert ist für die Mischung der einzelnen Durchflüsse der Luft/Gas Mischung, die von den zugehörigen Kanälen (7) zu dem Eintrittsteil des Gebläses gefördert ist.

7. Vorrichtung gemäß Anspruch 6, wobei der zweite Mischungsbereich geeignet ist, um in Fluidverbindung mit dem axialen Eintrittsteil eines Zentrifugalgebläses mit Impeller koaxial mit der Vorrichtung gebracht zu werden, derart dass dem Gebläse auf der Eintrittsseite der gemischte Luft/Gas Durchfluss, kommend von genanntem Mischungsbereich, zugeführt ist.

Revendications

1. Dispositif de mélange air/gaz, en particulier pour des appareils de brûleur à pré-mélange, comprenant :

- un premier moyen de transport (6) avec un flux centripète comportant une pluralité de conduites (7) ayant une direction radiale prédominante et disposées le long d'un profil circonférentiel concentrique avec un axe principal (X) et ayant une configuration divergente dans la direction du flux transporté, le flux d'air, destiné à être mélangé avec le gaz, étant destiné à être admis dans lesdites conduites (7),
- un second moyen de transport de gaz (11) pour transporter le gaz, admis dans le dispositif, dans chaque conduite (7) du premier moyen de transport (6), de sorte que dans chaque conduite, un pré-mélange air/gaz ait lieu en aval de la zone pour l'admission du gaz dans la conduite, dans la direction dudit axe (X), ledit second moyen de transport comprenant un canal de distribution de gaz (11) s'étendant le long d'un profil circulaire concentrique avec ledit axe principal (X) et également pourvu d'une pluralité d'ouvertures traversantes (12) respectives, dont chacune place le canal (11) en communication avec une conduite (7) respective du premier moyen de transport (6),

chaque conduite (7) de ladite pluralité étant délimitée au moins par une paire de parois opposées (9) en regard l'une de l'autre et s'élevant dans la même direction depuis une base discoïde (8) dudit dispositif, agencée pour un montage coaxial avec un ventilateur, la conduite (7) étant capable d'être délimitée,

sur le côté opposé de la base, par au moins une partie d'un collecteur (5) pour loger la turbine du ventilateur, chaque conduite (7) étant ouverte au niveau des extrémités opposées de sa longueur, avec une première ouverture (7a) pour l'entrée du flux au niveau de l'une des extrémités, dans une position éloignée de l'axe principal de la base (8), et avec une seconde ouverture (7b) pour la sortie du flux au niveau de l'autre extrémité, positionnée à proximité dudit axe (X),
dans lequel l'ouverture correspondante (12) pour une communication du canal (11) avec la conduite (7) correspondante est disposée dans une position entre lesdites extrémités, et dans lequel
la section transversale de passage pour le flux dans chaque conduite de transport (7) a une amplitude croissante depuis l'ouverture d'entrée (7a) dans la direction de l'ouverture de sortie (7b) pour le flux, de sorte que le mélange air/gaz, entre le flux d'air, transporté le long de chaque conduite (7), et le flux de gaz combustible, fourni via ledit canal (11) dans l'ouverture (12) correspondante, ait lieu dans une section de la conduite (7) depuis laquelle une portion divergente de la conduite elle-même s'étend dans la direction de l'axe principal (X).

2. Dispositif de mélange selon la revendication 1, dans lequel ledit canal (11) a une configuration sensiblement toroïdale.

3. Dispositif de mélange selon la revendication 1 ou 2, dans lequel ledit canal (11) est pourvu d'une ouverture (11a) pour l'admission du gaz dans le canal (11), et qui place le canal en communication fluidique avec au moins l'une (7') des conduites dudit premier moyen de transport (6) le long desquelles le flux de gaz est admis dans le dispositif de mélange.

4. Dispositif selon l'une quelconque des revendications précédentes, dans lequel chaque paire de parois opposées (9) de ladite base (8) délimitant une conduite (7) respective a un profil incurvé dans la direction longitudinale et également radiale par rapport à l'axe principal (X) de ladite base (8).

5. Dispositif selon la revendication 4, dans lequel les profils incurvés de chaque paire de parois (9) en regard l'une de l'autre et délimitant une conduite (7) correspondante ont une courbure du même signe.

6. Dispositif selon l'une quelconque des revendications précédentes, dans lequel en aval de chaque conduite (7), par rapport à la direction centripète du flux, entre l'ouverture de refoulement (7b) de la conduite (7) et l'axe principal (X) du dispositif, une seconde zone est définie pour le mélange des flux individuels de mélange air/gaz transporté par les conduites (7) respectives vers la section d'admission du ventilateur.

7. Dispositif selon la revendication 6, dans lequel ladite seconde zone de mélange est appropriée pour être placée en communication fluidique avec une section d'admission axiale d'un ventilateur centrifuge avec turbine coaxiale avec ledit dispositif, de sorte que le ventilateur soit alimenté au niveau du côté d'admission avec le flux air/gaz mélangé provenant de ladite zone de mélange.

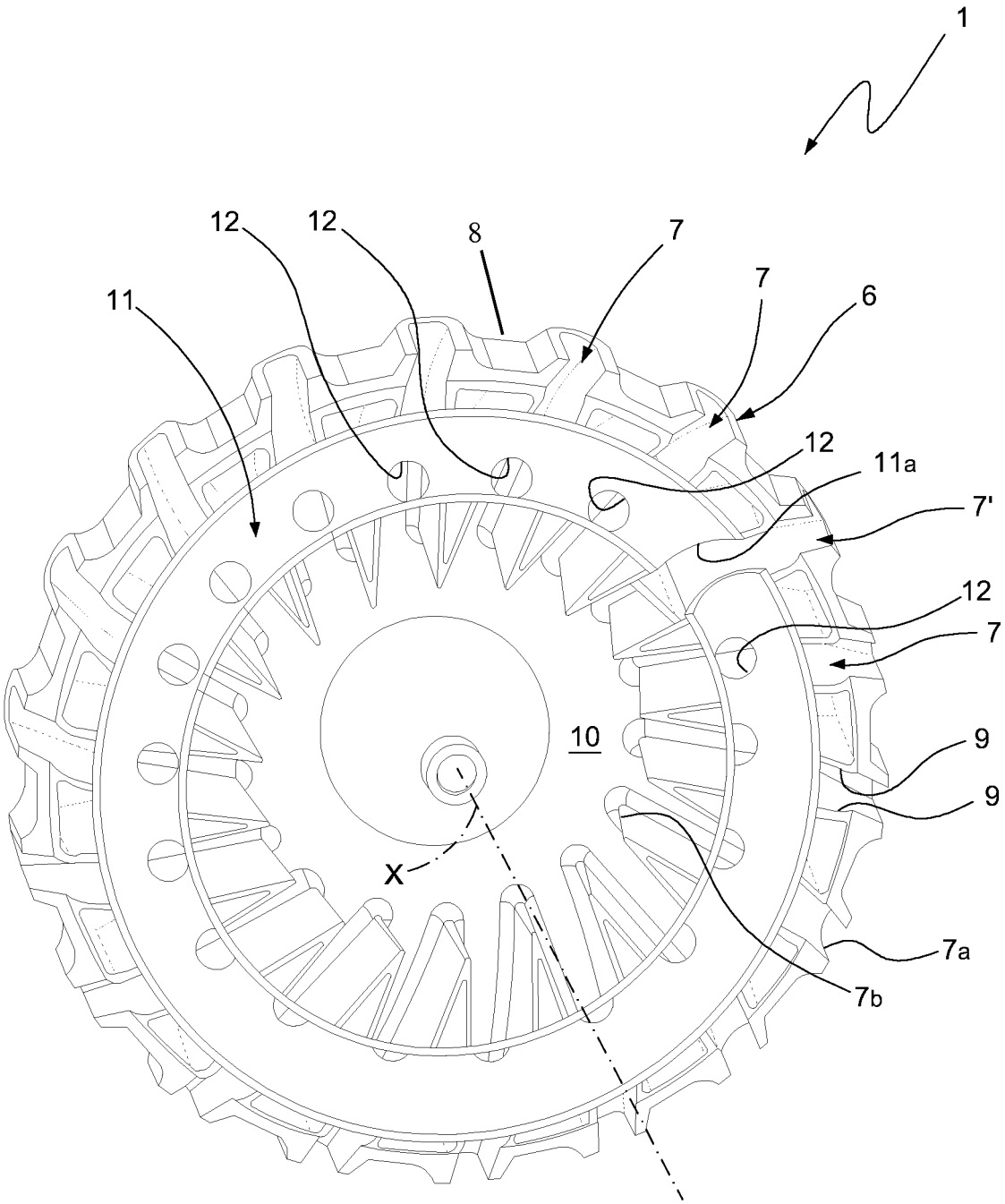


Fig.1

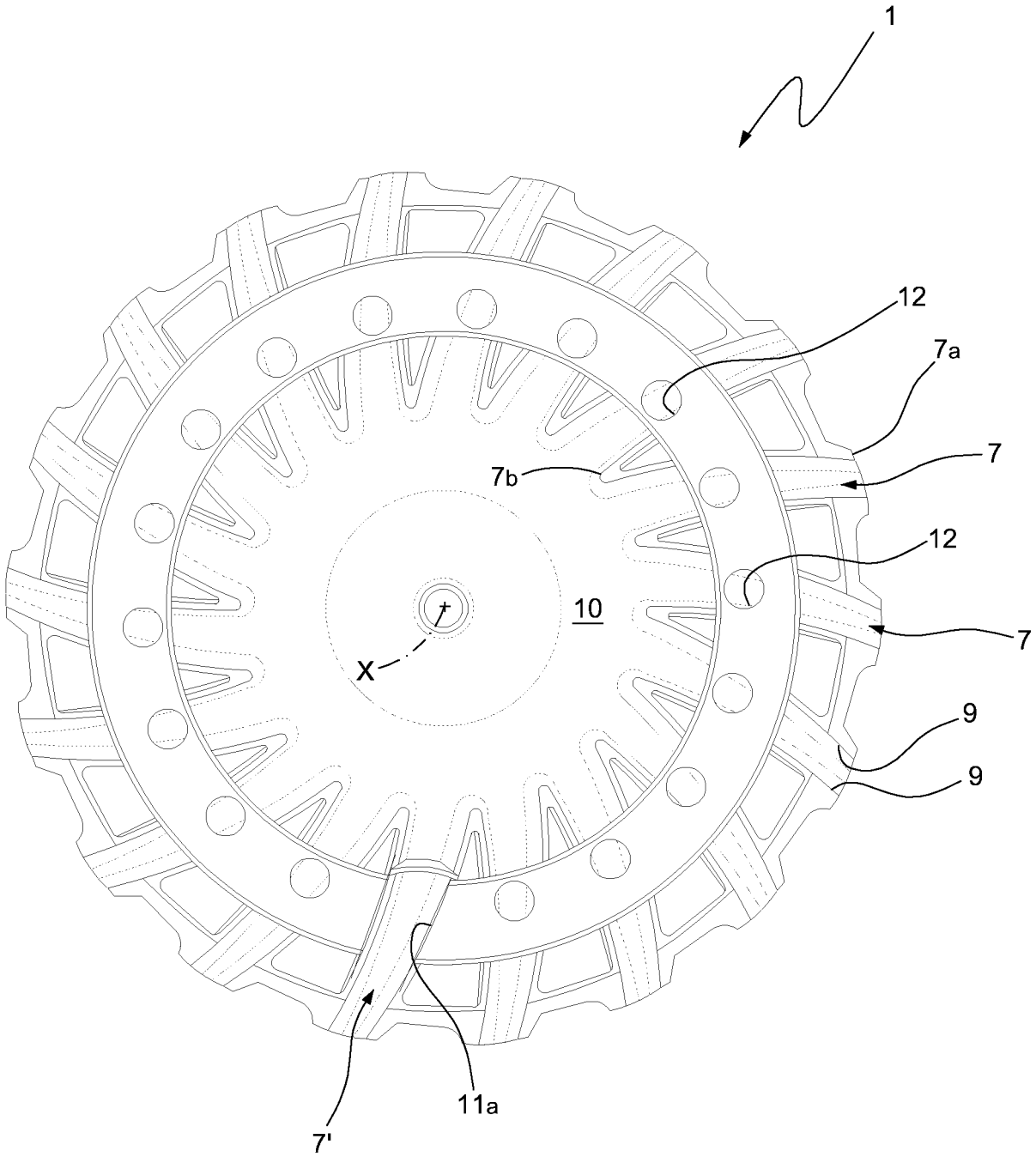


Fig.2

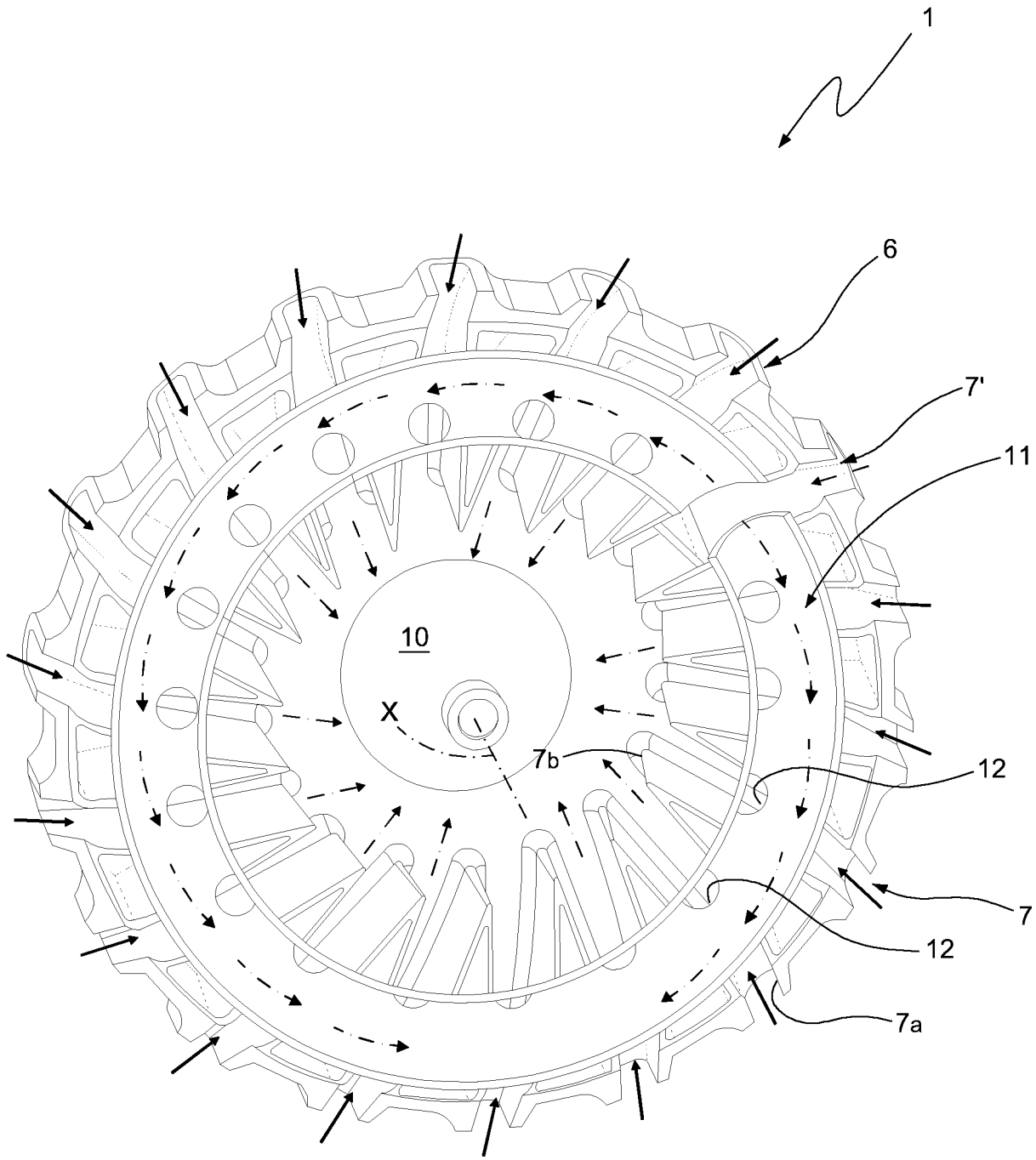


Fig. 3

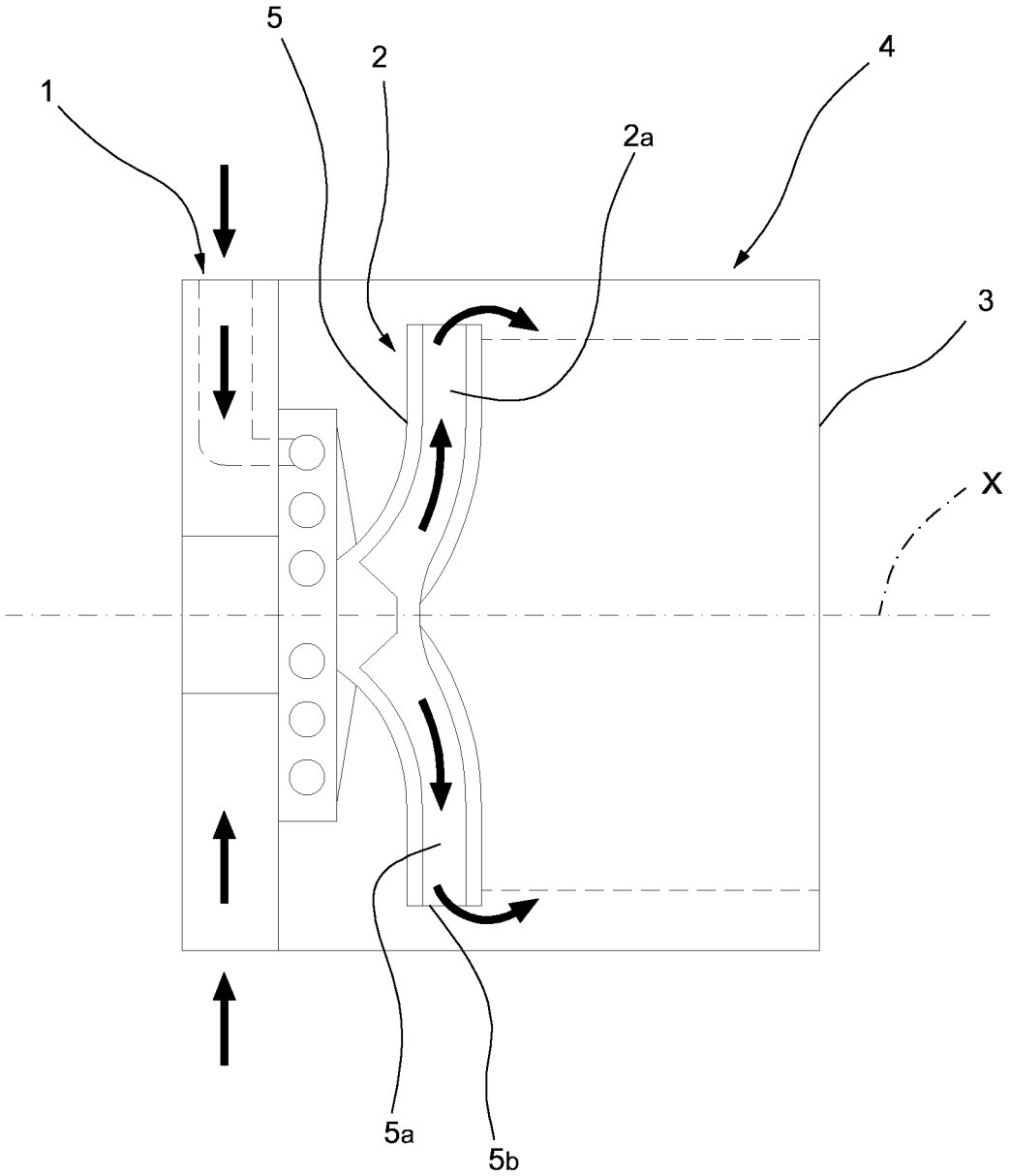


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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- EP 896191 A **[0006]**