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(54) **AN AIR-GAS MIXER DEVICE, PARTICULARLY FOR GAS BURNERS AND SIMILAR APPARATUS**

LUFT-GAS-MISCHVORRICHTUNG, INSBESONDERE FÜR GASBRENNER UND ÄHNLICHE
APPARATE

DISPOSITIF DE MELANGE AIR-GAZ, NOTAMMENT POUR BRULEURS A GAZ ET APPAREIL
SIMILAIRE

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Description

Technical field

[0001] The present invention relates to an air-gas mixer device, designed particularly but not exclusively for gas burners with forced ventilation, according to the preamble to main Claim 1.

Technological background

[0002] As is well known, devices of the above-mentioned type are used in boilers and similar apparatus with gas burners, mainly for domestic use and, in particular, in applications with forced ventilation.

[0003] A device having the characteristics specified above is also known from the Applicant's International application PCT/IT01/00087, published as WO-A-02/061336.

[0004] In these devices, the combustible air-gas mixture is proportioned by axial injection of gas into an air-flow and subsequent mixing of the air-gas mixture produced with a further air-flow. The homogeneity of the combustion mixture obtainable with a device of this type is also increased by the suction effect of a fan disposed downstream of the mixer.

Description of the invention

[0005] A main object of the invention is to improve the precision of the proportioning of the combustible mixture as well as to extend the effective range of modulation of the flow delivered (and consequently of the power obtainable).

[0006] Another object is to reduce resonance phenomena which are triggered by flame fronts in the burner and are responsible for the generation of noise outside the apparatus in which the device is installed; typically, these phenomena are amplified as a result of the pressure losses which are necessarily produced in order to perform the flow-rate modulation and regulation functions.

[0007] Yet another object is to provide an air-gas mixer device which is compact and inexpensive in comparison with known solutions but which, at the same time, satisfies the above-mentioned requirements.

[0008] This and other objects which will become clear from the following description are achieved by an air-gas mixer device formed in accordance with the appended claims.

Brief description of the drawings

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

- Figure 1 is a schematic axial section through apparatus equipped with an air-gas mixer device formed in accordance with the present invention,
- Figure 2 is a schematic view in partial section, taken on the line II-II of Figure 1, and
- Figure 3 is a view corresponding to that of Figure 1, of a variant of the invention.

Preferred embodiment of the invention

[0010] With reference to the drawings mentioned, an air-gas mixer device formed in accordance with the invention, in particular for supplying a forced-ventilation burner (not shown), is generally indicated 1.

[0011] The device 1 comprises a tubular body 2 with a cylindrical shell of axis X, and having two opposite ends 2a, 2b. A first duct 3 for directing a flow of fuel gas into the mixer extends inside the tubular body 2, coaxially therewith, between the ends 2a and 2b. A second axial duct 4 of annular cross-section is defined between the tubular body 2 and the first duct 3, for directing an air-flow admitted to the device 1 at the end 2a.

[0012] According to the invention, the flow admitted to the duct 4 can be regulated by means of a choke element, generally indicated 5. The element 5 is movable axially along the axis X inside the second duct, between a first position and a second position in which a minimum annular cross-section and a maximum cross-section are defined for the air-flow admitted at the end 2a. More particularly, the choke element 5 comprises a sleeve-like element 6 which is mounted for sliding on the first duct 3 and from an axial end of which a disc-shaped portion 7 extends radially. In the path of the element 5 between the two above-mentioned positions, the second duct 4 has a part 8 which diverges in the direction of the flow so as to define, jointly with the portion 7, flow cross-sections which increase from the first position towards the second position. In Figure 1, the element 5 is shown in solid outline in the first position of minimum cross-section and in broken outline in the second, maximum-flow position.

[0013] Preferably, the part 8 of the duct 4 and the portion 7 are axially symmetrical and the part 8 has a preselected taper.

[0014] At the end 2b, the device 1 further comprises a tubular section 9 disposed coaxially between the first and second ducts 3, 4 and arranged downstream of the choke element 5, with reference to the direction the air and gas flow, indicated by the arrow F of Figure 1.

[0015] Advantageously, the tubular section 9 is connected axially to the first duct and has a converging wall 10 which defines a third duct 11 having an annular cross-section extending outside the first duct.

[0016] The wall 10 in turn defines a fourth duct 12 disposed in an annular arrangement outside the third duct 11 and communicating with the second duct through one or more radial openings 13 (two openings in the embodiment shown) provided in the outer cylindrical shell 14 of

the tubular section 9. The third and fourth ducts 11, 12 constitute diverting means for directing the air-flow supplied through the duct 4 into respective and distinct primary and secondary air-flows.

[0017] The shell of the second duct also has at least one recess 15 formed in the inner surface of the duct and extending axially downstream of the part 8 in a position facing the openings 13 so as to form a passage for putting the second and fourth ducts into communication through the openings. The cylindrical shell advantageously has two recesses 15 of equal circumferential extent and spaced apart uniformly. The tubular body 2 is also fitted at least partially on the tubular section 9 so as to be movable rotatably relative to the section 9 about the axis X in order to constitute means for choking the openings 13. More particularly, cylindrical shell portions, indicated 16, which are disposed between adjacent recesses 15, are movable away from and towards a position in which they are completely superimposed on the openings 13, consequently closing them.

[0018] The circumferential extent of the recesses 15 is selected in a manner such that the openings 13 are closed or are fully open simultaneously as a result of the relative rotation between the tubular body 2 and the section 9.

[0019] A radial fan, indicated 17, disposed downstream of the tubular body 2 in the direction of the air and/or gas flow, has an intake opening 17a extending in front of the outlet end 2b from which the air/gas mixture emerges. Defined between the fan 17 and the tubular body 2 is a mixing chamber 18 which is supplied by the above-described ducts 3, 11 and 12 and the operation of which will become clearer from the following description.

[0020] In use, the mixer device 1 is suitable for applications in which the choke element 5 is mounted with a vertical path, that is, applications in which the axis X is the axis along which the force of gravity acts. In this case, the choke element 5 is subject to the gravitational force correlated with its own weight and to the pressures induced in the duct 4.

[0021] With a minimum-pressure signal produced by the minimum rate of revolution of the fan 17 in suction, the choke element 5 is moved vertically by its own weight to the first position (shown in solid outline in Figure 1) in which it is in abutment with an abutment element 19 extending radially in the duct 4. In this position, the minimum cross-section for the gas-flow admitted at the end 2a of the duct 4 is defined.

[0022] Upon an increase in the pressure-signal produced by an increase in the rate of revolution of the fan, the consequent reduction in pressure tends to move the element 5 towards the second position (shown in broken outline in Figure 1), in opposition the effect of the gravitational force. In this position, the maximum cross-section for the air-flow is defined. Between the minimum and maximum positions, it is possible to define intermediate flow cross-sections each of which is obtained by equilib-

rium of the gravitational force and the pressure acting on the choke element 5. The air-flow which is to be mixed with the gas-flow delivered through the duct 3 is thus modulated.

[0023] The flow is also separated into the primary and secondary air-flows directed through the ducts 11 and 12, respectively. In the maximum-flow condition (choke element 5 in the second position) the secondary air-flow is directed through the openings 13 and the fourth duct 12 into the mixing chamber 18. The secondary air-flow can also be modulated by adjustment of the outflow cross-sections of the openings 13, for example, by partial closure thereof.

[0024] It is thus possible to modulate the air-flow at the intake of the fan, extending the range of modulation in comparison with known applications.

[0025] In a variant of the invention, shown in Figure 3, in which details similar to those of the previous embodiment are indicated by the same reference numerals, the choke element 5 is urged resiliently into the first position (of minimum flow cross-section), for example, by a spring 20 fitted on the first duct 3 and having opposite ends acting on the tubular section 9 and on the element 5, respectively. This variant of the invention is usable effectively in all applications in which the element 5 is not subject to the force of gravity, for example, owing to horizontal mounting of the mixer device 1. In this case, the element 5 is subject to the pressures and to the resilient forces of the spring 20 along the axis X and the flow-modulation positions (including the minimum and maximum flow positions) are reached as a result of the equilibrium which is brought about between the above-mentioned forces acting on the element 5.

[0026] The invention thus achieves the objects proposed, affording many advantages over known solutions.

[0027] A first advantage is that, by virtue of the modulation of the flow which can be achieved with the device according to the invention, the flow-modulation range, and consequently the power range, is advantageously extended.

[0028] A further advantage is that the maximum flow achieved with the modulation of the device according to the invention is further adjustable by selective modulation of the secondary air-flow.

[0029] Yet another advantage is that the choke element according to the invention brings about pressure losses such as to reduce the effects of resonance and the consequent noise phenomena induced in the device.

[0030] One of the chief advantages is greater axial and radial compactness of the device, by virtue of the fact that the means for choking the radial openings of the mixer are incorporated in the air-diverting duct.

Claims

1. An air-gas mixer device, particularly for gas burners with forced ventilation, comprising:

- an air-gas mixing chamber (18) supplied by a gas-flow and by an air-flow which are directed in the device through a first duct (3) and a second duct (4), respectively, **characterized in that** it further comprises:
 - first means for choking the second duct (4) in order to choke the air-flow admitted to the mixer device through the second duct,
 - air-flow diverting means (9) for separating and directing the choked air-flow into a primary air-flow and a separate and distinct secondary air-flow, and
 - second choke means associated with the secondary air-flow so as to direct the secondary air-flow selectively towards the mixing chamber (18).
- 2. A mixer device according to Claim 1 in which the first choke means comprise a choke element (5) movable axially inside the second duct (4) between a first position and a second position in which a minimum cross-section and a maximum cross-section for the air-flow admitted to the second duct (4) are defined, respectively.
- 3. A mixer device according to Claim 2 in which the second duct (4) diverges in the direction of the air-flow, at least in a part extending in the region of the axial path of the choke element (5) between the first and second positions, so that the choke element (5) defines, jointly with the second duct (4), flow cross-sections in the second duct which increase from the first position towards the second position.
- 4. A mixer device according to Claim 3 in which the first and second ducts (3, 4), as well as the choke element (5), are coaxial with one another.
- 5. A mixer device according to any one of Claims 3 to 4 in which the choke element (5) and the second duct (4) are axially symmetrical, at least along the said part (8).
- 6. A mixer device according to any one of Claims 2 to 5 in which the first gas duct (3) extends axially inside the second duct (4) and the choke element (5) is fitted slidably on the first duct (3).
- 7. A mixer device according to any one of Claims 2 to 6 in which the choke element (5) comprises a disc-shaped portion (7) extending radially from a sleeve element (6), the sleeve element being associated slidably with the first duct (3).
- 8. A mixer device according to any one of the preceding claims in which the diverting means comprise a tubular section (9) disposed coaxially between the first and second ducts (3, 4), downstream of the choke element (5) with reference to the direction of the air-flow, the tubular section (9) defining a third duct (11) which converges in the direction of the flow and which can divert the primary air-flow, as well as a fourth duct (12), communicating with the first duct (3) through one or more radial openings (13) which are associated with the second choke means and are provided in the tubular section (9), so as to direct the secondary air-flow selectively towards the mixing chamber (18).
- 9. A mixer device according to Claim 8 in which the second duct (4) is at least partially fitted on the tubular section (9) in order to constitute means for choking the openings, the second duct (4) being movable rotatably on the tubular section (9) away from and towards a position in which the openings (13) are completely closed.
- 10. A mixer device according to Claim 8 or Claim 9 in which the conveyor means comprise at least one axial passage defined between the second duct (4) and the tubular section (9) for putting the second and fourth ducts into communication through the one or more openings.
- 11. A mixer device according to Claim 10 in which the at least one passage comprises a respective recess (15) which is provided in the inner surface of the second duct (4), extends for at least a circumferential portion of the cross-section of the duct, and is elongate axially in the duct in the region of the openings (13).
- 12. A mixer device according to Claim 11 in which two angularly spaced-apart recesses (15) are provided, defining respective axial passages associated with two openings, the recesses having a circumferential extent such that the second duct and the tubular section are movable rotatably relative to one another between a position in which the openings are completely closed and a fully-open position in which the recesses are superimposed on the respective openings.
- 13. A mixer device according to any one of the preceding claims in which the first choke means are urged resiliently towards the first operative position of minimum gas-flow cross-section.
- 14. A mixer device according to Claim 13 in which a spring is provided, fitted on the first duct and having opposite ends acting on the tubular section and on the choke element.
- 15. A mixer device according to any one of the preceding claims in which the mixing chamber is disposed in the region of an intake opening of a fan the output

of which is connected to a gas burner.

Patentansprüche

1. Luft-Gas-Mischvorrichtung, insbesondere für Gasbrenner mit Zwangsentlüftung, umfassend:

- eine Luft-Gas-Mischkammer (18), die mit einem Gasstrom und einem Luftstrom versorgt wird, die in der Vorrichtung durch einen ersten Durchgang (3) bzw. einen zweiten Durchgang (4) geleitet werden, **dadurch gekennzeichnet, dass** sie ferner umfasst:

- eine erste Einrichtung zum Drosseln des zweiten Durchgangs (4), um den durch den zweiten Durchgang auf die Mischvorrichtung aufgebrachten Luftstrom zu drosseln,
- eine Luftstrom-Umleitungseinrichtung (9) zum Trennen und Leiten des gedrosselten Luftstroms in einen Haupt-Luftstrom und einen getrennten und verschiedenen Neben-Luftstrom, und
- eine zweite Drosseleinrichtung, die mit dem Neben-Luftstrom in Verbindung steht, um so den Neben-Luftstrom wahlweise zur Mischkammer (18) zu leiten.

2. Mischvorrichtung nach Anspruch 1, wobei die erste Drosseleinrichtung ein Drosselement (5) umfasst, das innerhalb des zweiten Durchgangs (4) zwischen einer ersten Position und einer zweiten Position axial beweglich ist, wobei ein Minimalquerschnitt bzw. ein Maximalquerschnitt für den auf den zweiten Durchgang (4) aufgebrachten Luftstrom definiert wird.

3. Mischvorrichtung nach Anspruch 2, wobei der zweite Durchgang (4) in der Richtung des Luftstroms abzweigt, zumindest in einem Teil, der sich in dem Bereich des axialen Pfades des Drosselements (5) zwischen der ersten und der zweiten Position erstreckt, so dass das Drosselement (5) zusammen mit dem zweiten Durchgang (4) die Durchflussquerschnitte im zweiten Durchgang definiert, die sich von der ersten Position hin zur zweiten Position vergrößern.

4. Mischvorrichtung nach Anspruch 3, wobei der erste und der zweite Durchgang (3, 4) sowie das Drosselement (5) coaxial zueinander angeordnet sind.

5. Mischvorrichtung nach einem der Ansprüche 3 bis 4, wobei das Drosselement (5) und der zweite Durchgang (4) axial symmetrisch sind, zumindest entlang des Teils (8).

6. Mischvorrichtung nach einem der Ansprüche 2 bis

5, wobei sich der erste Gasdurchgang (3) axial innerhalb des zweiten Durchgangs (4) erstreckt und das Drosselement (5) gleitfähig auf dem ersten Durchgang (3) eingepasst ist.

7. Mischvorrichtung nach einem der Ansprüche 2 bis 6, wobei das Drosselement (5) einen scheibenförmigen Bereich (7) umfasst, der sich radial von einem Hülselement (6) erstreckt, wobei das Hülselement gleitfähig mit dem ersten Durchgang (3) in Verbindung steht.

8. Mischvorrichtung nach einem der vorhergehenden Ansprüche, wobei die Umleitungseinrichtung einen rohrförmigen Abschnitt (9) umfasst, der coaxial zwischen dem ersten und dem zweiten Durchgang (3, 4) angeordnet ist, stromabwärts des Drosselements (5) in Bezug auf die Richtung des Luftstroms, wobei der rohrförmige Abschnitt (9) einen dritten Durchgang (11), der sich in der Richtung des Stroms annähert und der den Haupt-Luftstrom umleiten kann, sowie einen vierten Durchgang (12) definiert, der über eine oder mehrere radiale Öffnungen (13), die mit der zweiten Drosseleinrichtung in Verbindung stehen und in dem rohrförmigen Abschnitt (9) angeordnet sind, mit dem ersten Durchgang (3) in Verbindung steht, um so den Neben-Luftstrom wahlweise in Richtung zur Mischkammer (18) zu leiten.

9. Mischvorrichtung nach Anspruch 8, wobei der zweite Durchgang (4) zumindest teilweise auf dem rohrförmigen Abschnitt (9) eingepasst ist, um eine Einrichtung zum Drosseln der Öffnungen zu bilden, wobei der zweite Durchgang (4) auf dem rohrförmigen Abschnitt (9) weg von und hin zu einer Position, in der die Öffnungen (13) vollständig geschlossen sind, drehbar beweglich ist.

10. Mischvorrichtung nach Anspruch 8 oder 9, wobei die Fördereinrichtung zumindest einen axialen Übergang umfasst, der zwischen dem zweiten Durchgang (4) und dem rohrförmigen Abschnitt (9) definiert ist, um den zweiten und den vierten Durchgang über eine oder mehrere Öffnungen zu verbinden.

11. Mischvorrichtung nach Anspruch 10, wobei der zumindest eine Übergang eine entsprechende Vertiefung (15) umfasst, die in der Innenoberfläche des zweiten Durchgangs (4) vorgesehen ist, sich um zumindest einen Umfangsbereich des Querschnitts des Durchgangs erstreckt und sich axial in dem Durchgang im Bereich der Öffnungen (13) ausdehnt.

12. Mischvorrichtung nach Anspruch 11, wobei zwei winkelig voneinander beabstandete Vertiefungen (15) vorgesehen sind, die entsprechende axiale Übergänge in Zusammenhang mit den zwei Öffnungen definieren, wobei die Vertiefungen eine Um-

fangserstreckung aufweisen, so dass der zweite Durchgang und der rohrförmige Abschnitt relativ zueinander drehbar beweglich sind, zwischen einer Position, bei der die Öffnungen vollständig geschlossen sind, und einer vollständig offenen Position, bei der die Vertiefungen die entsprechenden Öffnungen überlagern.

13. Mischvorrichtung nach einem der vorhergehenden Ansprüche, wobei die erste Drosseleinrichtung elastisch in Richtung zur ersten Betriebsposition' des minimalen Gasstrom-Querschnitts gedrängt wird.

14. Mischvorrichtung nach Anspruch 13, wobei eine Feder vorgesehen ist, die auf dem ersten Durchgang eingepasst ist und gegenüberliegende Seiten aufweist, die auf den rohrförmigen Abschnitt und das Drosselelement wirken.

15. Mischvorrichtung nach einem der vorhergehenden Ansprüche, wobei die Mischkammer in dem Bereich einer Einlassöffnung eines Gebläses angeordnet ist, dessen Ausgang mit einem Gasbrenner verbunden ist.

Revendications

1. Dispositif de mélange air-gaz, en particulier pour les brûleurs à gaz avec une ventilation forcée, comprenant :

une chambre de mélange air-gaz (18) alimentée par un écoulement de gaz et un écoulement d'air qui sont dirigés dans le dispositif par un premier conduit (3) et un second conduit (4) respectivement, **caractérisé en ce qu'il** comprend en outre :

des premiers moyens pour étrangler le second conduit (4) afin d'étrangler l'écoulement d'air admis dans le dispositif de mélange par le second conduit,

des moyens de déviation d'écoulement d'air (9) pour séparer et diriger l'écoulement d'air étranglé dans un écoulement d'air principal et un écoulement d'air secondaire séparé et distinct, et

des seconds moyens d'étranglement associés à l'écoulement d'air secondaire afin de diriger l'écoulement d'air secondaire sélectivement vers la chambre de mélange (18).

2. Dispositif de mélange selon la revendication 1, dans lequel des premiers moyens d'étranglement comprennent un élément d'étrangleur (5) axialement mobile à l'intérieur du second conduit (4) entre une première position et une seconde position dans laquelle une

section transversale minimum et une section transversale maximum pour l'écoulement d'air admis dans le second conduit (4) sont définies, respectivement.

3. Dispositif de mélange selon la revendication 2, dans lequel le second conduit (4) dévie dans la direction de l'écoulement d'air, au moins dans une partie s'étendant dans la région de la trajectoire axiale de l'élément d'étrangleur (5) entre les première et seconde positions, de sorte que l'élément d'étrangleur (5) définit, conjointement au second conduit (4), des sections transversales d'écoulement dans le second conduit qui augmentent de la première position vers la seconde position.

4. Dispositif de mélange selon la revendication 3, dans lequel les premier et second conduits (3, 4), ainsi que l'élément d'étrangleur (5), sont coaxiaux les uns par rapport aux autres.

5. Dispositif de mélange selon l'une quelconque des revendications 3 à 4, dans lequel l'élément d'étrangleur (5) et le second conduit (4) sont axialement symétriques, au moins le long de ladite partie (8).

6. Dispositif de mélange selon l'une quelconque des revendications 2 à 5, dans lequel le premier conduit de gaz (3) s'étend axialement à l'intérieur du second conduit (4) et l'élément d'étrangleur (5) est monté de manière coulissante sur ledit premier conduit (3).

7. Dispositif de mélange selon l'une quelconque des revendications 2 à 6, dans lequel l'élément d'étrangleur (5) comprend une partie en forme de disque (7) s'étendant radialement à partir d'un élément de manchon (6), l'élément de manchon étant associé de manière coulissante au premier conduit (3).

8. Dispositif de mélange selon l'une quelconque des revendications précédentes, dans lequel les moyens de déviation comprennent une section tubulaire (9) disposée de manière coaxiale entre les premier et second conduits (3, 4), en aval de l'élément d'étrangleur (5) en référence à la direction de l'écoulement d'air, la section tubulaire (9) définissant un troisième conduit (11) qui converge dans la direction de l'écoulement et qui peut dévier l'écoulement d'air principal, ainsi qu'un quatrième conduit (12), communiquant avec le premier conduit (3) par une ou plusieurs ouvertures radiales (13) qui sont associées au second moyen d'étrangleur et sont prévues dans la section tubulaire (9), afin de diriger l'écoulement d'air secondaire sélectivement vers la chambre de mélange (18).

9. Dispositif de mélange selon la revendication 8, dans lequel le second conduit (4) est au moins partielle-

ment monté sur la section tubulaire (9) afin de constituer des moyens pour étrangler les ouvertures, le second conduit (4) étant mobile de manière rotative sur la section tubulaire (9) à distance et vers une position dans laquelle les ouvertures (13) sont complètement fermées.

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- 10.** Dispositif de mélange selon la revendication 8 ou la revendication 9, dans lequel les moyens de convoyeur comprennent au moins un passage axial défini entre le second conduit (4) et la section tubulaire (9) pour placer les second et quatrième conduits en communication par les unes ou plusieurs ouvertures.

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- 11.** Dispositif de mélange selon la revendication 10, dans lequel au moins un passage comprend un évidement respectif (15) qui est prévu dans la surface interne du second conduit (4), s'étend sur au moins une partie circonférentielle de la section transversale du conduit, et est allongé axialement dans le conduit dans la région des ouvertures (13).

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- 12.** Dispositif de mélange selon la revendication 11, dans lequel on prévoit deux évidements (15) angulairement espacés, définissant des passages axiaux respectifs associés aux deux ouvertures, les évidements ayant une étendue circonférentielle de sorte que le deuxième conduit et la section tubulaire sont mobiles de manière rotative l'un par rapport à l'autre entre une position dans laquelle les ouvertures sont complètement fermées et une position complètement ouverte dans laquelle les évidements sont superposés sur les ouvertures respectives.

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- 13.** Dispositif de mélange selon l'une quelconque des revendications précédentes, dans lequel les premiers moyens d'étrangleur sont poussés de manière élastique vers la première position opérationnelle de la section transversale d'écoulement de gaz minimum.

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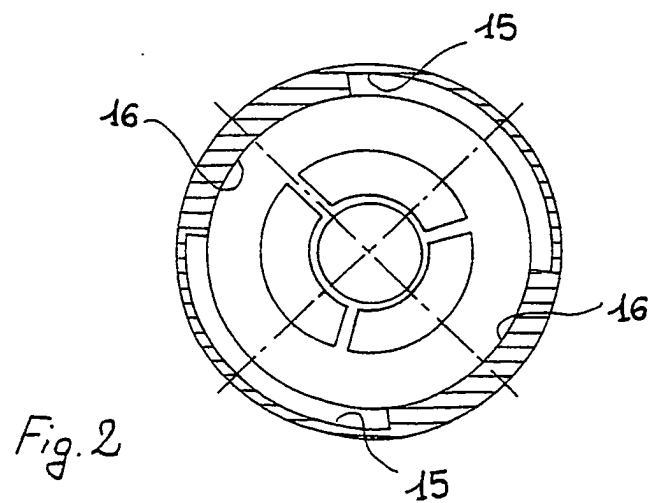
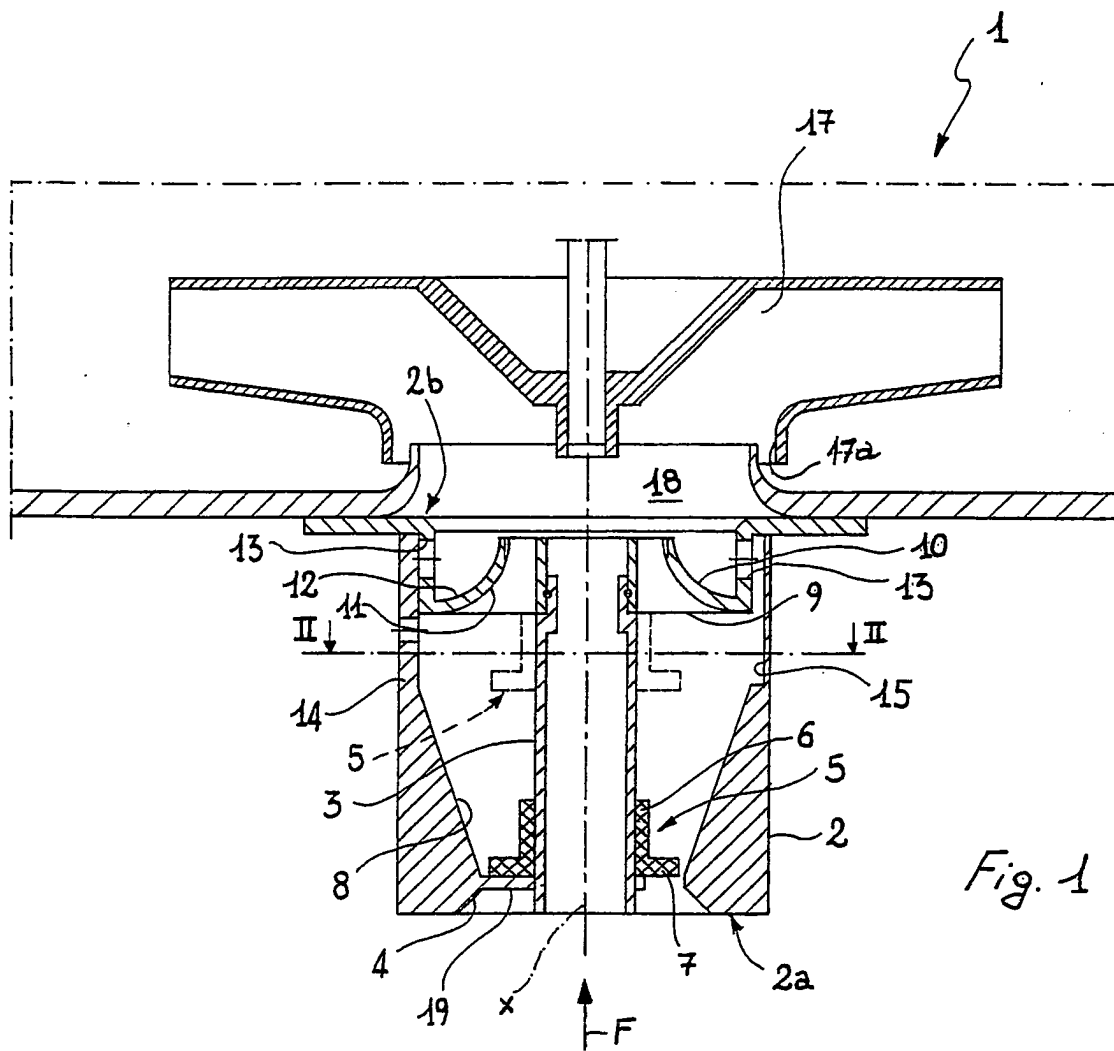
- 14.** Dispositif de mélange selon la revendication 13, dans lequel on prévoit un ressort, monté sur le premier conduit et ayant des extrémités opposées agissant sur la section tubulaire et sur l'élément d'étrangleur.

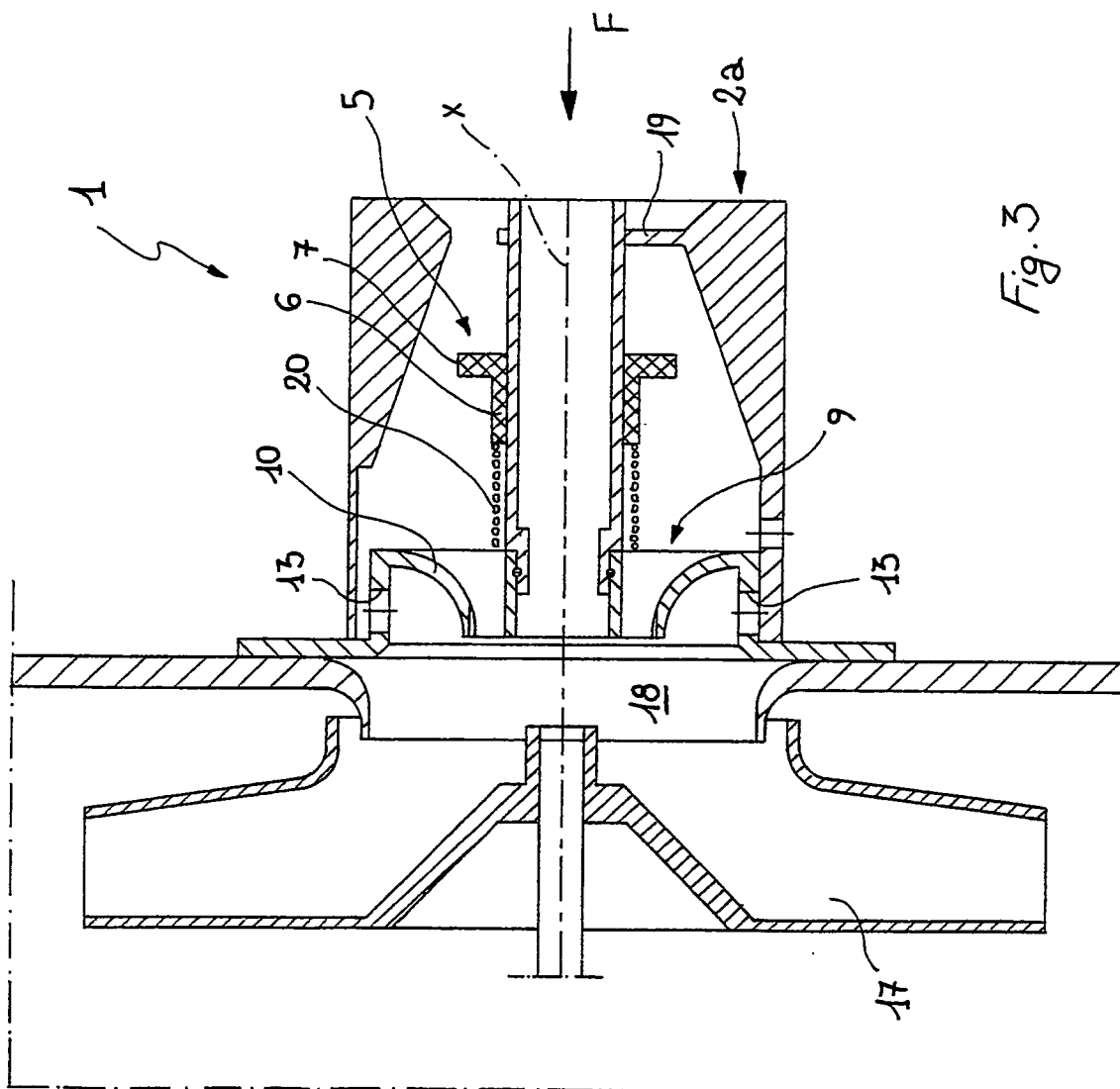
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- 15.** Dispositif de mélange selon l'une quelconque des revendications précédentes, dans lequel la chambre de mélange est disposée dans la région d'une ouverture d'admission de ventilateur, dont la sortie est raccordée à un brûleur à gaz.

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REFERENCES CITED IN THE DESCRIPTION

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