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(54) **A PREMIX GAS BURNER**

VORMISCHGASBRENNER

BRÛLEUR À GAZ À PRÉMÉLANGE

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Description

Technical field

[0001] The present invention relates to a premix gas burner designed for operation with a premixing of a combustible air and gas mixture.

Background art

[0002] The invention relates in particular to the specific technical field of modulating gas burners, in which the burner power can be modulated within a predetermined range of modulation, according to the specific operating requirements.

[0003] Conventional burners can be classified according to the form of combustion, as either diffusion flame or premixed flame burners. The term "diffusion flame" denotes a combustion process in which the reagents are mixed by fluid-dynamic action downstream of the burner head. The term "premixed flame" denotes a process in which the mixture is ready for burning when it reaches the burner head.

[0004] In the case of diffusion flame combustion, there are two principal phenomena, namely a mixing phenomenon (characterized by a mixing time) and a combustion phenomenon (characterized by a combustion time). In premixed combustion, the mixing time is zero and only the combustion time remains; therefore flames of this type generally have a higher velocity. Moreover, a premixed flame takes up less space than a diffusion flame, for a given burner power, because the reaction is faster since it is independent of the mixing time.

[0005] As regards the combustion products, nitrogen oxide emissions are related to various aspects such as the mixing of the reagents, the time for which the combustion products remain in "hot spots", the general temperature within the flame, and the uniformity of the flame. The premixing of the reagents upstream of the burner head tends to eliminate the presence of "hot spots" in the combustion area and thus tends to make the temperature more uniform. This characteristic cannot be obtained with diffusion flames in which there is a lack of uniformity of the thermal field.

[0006] In the field of diffusion flames, however, combustion conditions have been developed which lead to a reduction in nitrogen oxide emissions by fluid dynamic methods, that is, by making the thermal field more uniform and reducing the mean temperature in the combustion chamber. Burners which have been developed, in the diffusion combustion field, to reduce nitrogen oxides by acting on the fluid dynamics of the combustion are called "swirl" burners or recirculation burners. These cause the combustion products to be recirculated in the combustion area and this recirculation tends to reduce the mean temperature in the combustion area, thus reducing the nitrogen oxides of thermal origin. These burners are usually operated with limited modulation ratios,

for example, with a ratio of 1 to 2, because the recirculation phenomenon is a fluid dynamic phenomenon which is present only in specific reagent velocity conditions. Burners of this type are not widely used in the domestic field because of the limited range of modulation and because of the space taken up by the flame. In the domestic field, the use of premix burners is preferred in condensation boilers. This type of burner has a valve and a mixing system upstream of the burner. With conventional premix burners, it is possible to achieve modulation ratios of 1 to 5 whilst limiting nitrogen oxides because the thermal field in the flame is made uniform and the periods spent in the combustion area are reduced. The possibility of providing wider modulation ranges, that is, of reducing the power at the burner head, is dependent on the availability of a burner head with apertures that are designed to stabilize the flame above them and to eliminate the effects of flash-back or flame detachment. With known condensation boiler technology, one possible method of reducing nitrogen oxides is to increase the quantity of air whilst keeping the quantity of fuel constant. Thus, the maximum temperature which can be reached within the flame is reduced and the nitrogen oxides of thermal origin are consequently also reduced. However, this method is subject to two drawbacks the first of which lies in the fact that the heat exchanger associated with the burner operates optimally only for certain air/fuel ratios and, consequently, the exchanger no longer works at maximum efficiency if these ratios are varied; the second drawback is due to the fact that excessively lean flames, that is, flames with a large excess of air, are unstable.

[0007] US 5407347 and US2005/227195 are also prior art to the present invention.

Description of the invention

[0008] The problem underlying the present invention is that of providing a modulating burner of the above-mentioned type which is designed structurally and functionally to overcome the limitations discussed with reference to the prior art mentioned.

[0009] This problem is solved by the invention by means of a burner constructed in accordance with the appended claims.

Brief description of the drawings

[0010] Further characteristics and advantages of the invention will become clearer from the following detailed description of some preferred embodiments thereof which are described by way of example with reference to the appended drawings, in which:

Figure 1 is a perspective view of a first embodiment of a burner formed in accordance with the invention, Figure 2 is a front elevational view of the burner of Figure 1, Figure 3 is a section taken on the line III-III of Figure 2,

Figure 4 is a schematic side elevational view of the burner of the preceding drawings in which the field of fluid dynamic motion of the "swirl" motion operating condition is shown,

Figure 5 is a perspective view of a second embodiment of a burner formed in accordance with the invention,

Figure 6 is an exploded perspective view of the burner of Figure 5,

Figure 7 is a perspective view of a first variant of the burner of Figure 5,

Figure 8 is an exploded perspective view of the burner of figure 7,

Figures 9 and 10 are a plan view and a side elevational view of the burner of Figure 7, respectively,

Figure 11 is a section taken on the line XI-XI of Figure 9,

Figures 12 and 13 are a perspective view and an exploded perspective view of a second variant of the burner of Figure 5.

Preferred embodiments of the invention

[0011] With reference to the drawings mentioned, a first embodiment of a burner, in particular a modulating burner for combustible gas of the premixed type, formed in accordance with the present invention, is generally indicated 1. The burner 1 comprises a burner body 2 with a burner head 3 downstream of which the air and gas mixture that is supplied to the burner, for example, by means of a fan device, not shown, is burnt.

[0012] The burner is designed to be housed in a combustion chamber, not shown, of a heating apparatus, also not shown, which also houses a heat exchanger within which a working fluid circulates and is heated by the burner.

[0013] The burner body 2 comprises, at the end axially remote from the head 3, a connecting flange 4 for fixing the burner body to a shutter element which is provided for removably sealing the combustion chamber.

[0014] More specifically, starting from the flange 4, the burner body has a first, cylindrical portion 5 which is axially symmetrical with a principal axis X and is extended axially by a second, tapered portion 6.

[0015] The cylindrical shell portion 5 is connected, upstream of the tapered portion 6, to a front surface 7 of the head 3 extending transversely to the axis X. The tapered portion 6 has generatrices which converge towards the surface 7, as shown in Figure 3; the function of this taper is explained in detail in the following part of the description.

[0016] Upstream of the burner head 3, with respect to the axial direction of the flow, there is a device, shown only schematically and generally indicated 8, for premixing the air and gas flows that are supplied to the burner.

[0017] This device may have a conventional system for injecting the combustible gas into the air flow supplied to the burner and may also be associated with a fan unit

the intake end of which is supplied with an air and gas mixture which is thus subjected to premixing.

[0018] The burner head 3 is also provided with a device for guiding the flow of the mixture, which device can impart rotational components to the velocity of the flow that is supplied through the burner head, as well as with a device for preventing flashback.

[0019] In particular, a plurality of distributor compartments 9 are provided in the surface 7 of the head; the compartments extend below the profile of the surface 7 towards the flange 4 and are spaced apart from each other. In a preferred configuration, the distributor compartments 9 are spaced at regular angular intervals and radiate from the centre of the circular surface 7 located on the axis X.

[0020] Each compartment 9 is delimited by a pair of walls 9a, 9b which are interconnected along an edge 10 which extends radially and is connected to the surface 7. At the ends radially remote from the axis X, the walls 9a, 9b are connected to a further lateral wall 11 which defines the corresponding compartment 9 jointly with them.

[0021] In each compartment 9, the walls 9a, 9b are inclined to one another to define an obtuse angle inside the compartment, about the edge 10, as shown in the drawings.

[0022] The wall 9a of each compartment 9 also has a plurality of slotted and/or circular through apertures 12 which are arranged in a preselected configuration and through which the air and gas mixture to be burnt on the surface 7 of the head is supplied. The configuration of the apertures 12 is also selected so as to prevent flashback when the burner is operating at low power, thus ensuring stable attachment of the flame to the burner. In each compartment, the wall 9b is a solid wall and its inclination to the contiguous wall 9a is such that the flow of the mixture supplied through the head is diverted and a recirculation phenomenon is created by means of a rotational component imparted to the flow of reagents, as explained further below.

[0023] The flow guide device which can cause the above-mentioned recirculation is thus formed by the plurality of walls 9b formed in the compartments 9 of the burner head 3.

[0024] The flash-back prevention device is formed by the plurality of through apertures 12 in a suitable quantity and of suitable size, which are created in the plurality of walls 9a of the distributor compartments 9.

[0025] In operation, the air and gas reagent mixture, premixed upstream of the burner head 3, is supplied through the apertures 12 of each distributor compartment 9 and is diverted by the inclined profile of the compartment. A low pressure region is thus created in the centre of the burner, in the area downstream of the head, as shown in the diagram of Figure 2; in certain conditions, the low pressure region can draw the flow into itself, thus forming a toroidal recirculation bubble which serves to stabilize the flame and reduce the mean temperature of

the flame front, thus reducing nitrogen oxide (NO_x) emissions. In this phase, the burner operates in a manner typical of a recirculation burner with a predetermined number of "swirls" and this manner of operation is maintained, in the modulation range, as the power gradually increases up to the maximum power permitted for the burner.

[0026] Conversely, if the power, and consequently the reagent flow rate, is reduced, the low pressure region in the centre of the burner can no longer draw the flow towards it and the burner tends to operate as a conventional premix burner, without recirculation. In this operating phase, moreover, the burner is not affected by flash-back problems, by virtue of the operation of the flash-back prevention device provided in the burner, or by instability problems due to flame detachment, by virtue of the stabilizing function of the device.

[0027] Consequently, the burner can adapt to the combustion conditions as the burner power varies, in the range of modulation in which it is used.

[0028] During the transition from a recirculation burner to a conventional premix burner, a fluid-dynamically unstable transition area may be present, with fluctuations of the reagent flow which may lead to pulsations or extinction of the flame during this phase. To ensure the presence of a stabilized flame even in this transition area, the lateral wall (portion 6) of the burner body is tapered, as described above. The presence of this tapered wall creates a flame attachment area and thus makes the transition between the two combustion conditions stable.

[0029] With reference to Figures 5 and 6, a second embodiment of the burner is generally indicated 1'; in particular, this is a premix, modulating combustible gas burner formed in accordance with the present invention. For greater clarity and simplicity, details similar to those of the preceding embodiment are indicated, by the same reference numerals followed by an apostrophe (').

[0030] The burner 1' comprises a burner body 2' with a burner head 3' downstream of which the air and gas mixture that is supplied to the burner, for example, by means of a fan device, not shown, is burnt.

[0031] The burner is designed to be housed in a combustion chamber, not shown, of a heating apparatus, also not shown, which also houses a heat exchanger within which a working fluid circulates and is heated by the burner.

[0032] The burner body 2' comprises, at the end axially remote from the head 3', a connecting flange 4' for fixing the burner body to a shutter element (not shown) which is provided for removably sealing the combustion chamber. More specifically, starting from the flange 4', the burner body 1' has a cylindrical portion 5' which is axially symmetrical with a principal axis X' and is connected, at its opposite end, to the front portion of the head 3' which extends transversely to the axis X'.

[0033] Upstream of the burner head 3', with respect to the axial direction of the flow, there may also be a device, shown only schematically in the drawings, for premixing

the air and gas flows that are supplied to the burner.

[0034] This device may have a conventional system for injecting the combustible gas into the air flow supplied to the burner and may also be associated with a fan unit the intake end of which is supplied with an air and gas mixture which is thus subjected to premixing.

[0035] The burner head 3' may also be provided with a device, generally indicated 20, for guiding the flow of the mixture, which device can impart rotational components to the velocity of the flow that is supplied through the burner head, as well as with a flash-back prevention device.

[0036] In particular, the above-mentioned devices are constructed so as to be structurally independent of one another and the flash-back prevention device is advantageously arranged downstream of the flow guide device 20. The flow guide device 20 comprises a plurality of radial deflector fins 21 spaced at regular angular intervals and radiating from a central support area 22 extending in the region of the axis X'.

[0037] The fins 21 are preferably inclined to the axial direction of the flow through the head so as to impart a rotational component to the flow that is conveyed through respective passageway sections 23 which are defined between each pair of adjacent fins 21.

[0038] More particularly, each fin 21 comprises a first surface portion 21a extending radially between the support 22 and the circumferential edge of the burner body and a second surface portion 21b which forms an extension of the first portion and is inclined to the axial direction X', as shown in the drawings.

[0039] The surface portion 21b of each fin also has a substantially flat surface which is inclined at 45° to a plane perpendicular to the axis X'. In each fin 21, the second surface portion 21b is also advantageously obtained by cutting and subsequent bending of a respective portion of a flat disk extending transversely to the axis X in the region of the burner head.

[0040] This disk may be produced integrally with the tubular burner body 2' or, alternatively, may be structurally independent of the body 2' and connectible to the body by suitable connection means, for example, by welding along the circumferential edge.

[0041] The flash-back prevention device comprises a plate-like element 24 provided with a plurality of slotted and/or circular through apertures 25 which extend through its thickness in a preselected configuration and through which the air and gas mixture to be burnt on the surface of the head is supplied. The configuration of the apertures 25 is also selected so as to prevent flash-back when the burner is operating at low power, thus ensuring stable attachment of the flame to the burner.

[0042] Preferably, the plate-like element 24 has a flat disk-like shape and is produced so as to be structurally independent of the burner body and to be fixable thereto, for example, by welding or clinching along the circumferential profile thereof.

[0043] Moreover, the element 24 may be made of

blanked sheet-metal with apertures 25 produced by drilling or punching.

[0044] Alternatively, the flash-back prevention device may be formed with a mesh structure, for example, with a metal mesh suitably connected to the burner along the circumferential profile of the tubular body 2'.

[0045] As a further alternative, the flash-back prevention device may be made of metal fibre.

[0046] In a first variant of the embodiment just described, which is shown in Figures 7 to 11, in which details similar to those of the previous embodiment are indicated by the same reference numerals, the burner body 2' has a lateral wall 26 with a tapered profile extending in the region of the front surface of the head and coaxial therewith. More particularly, the tapered wall 26, which converges towards the burner head 3', is provided downstream of the front surface of the head, with respect to the axial direction X' of the flow supplied to the head, as shown clearly in Figures 7 and 8.

[0047] In operation, the air and gas reagent mixture premixed upstream of the burner head 3' is supplied through the apertures 25 and is diverted beforehand by the inclined profiles of the deflector fins 21. A low pressure region is created in the centre of the burner, in the area downstream of the head; in certain conditions, the low pressure region can draw the flow into itself, thus forming a toroidal recirculation bubble which serves to stabilize the flame and reduce the mean temperature of the flame front, thus reducing nitrogen oxide (NOx) emissions. In this phase, the burner operates in a manner typical of a recirculation burner with a predetermined number of "swirls" and this manner of operation is maintained, in the modulation range, as the power gradually increases up to the maximum power permitted for the burner.

[0048] Conversely, if the power, and consequently the reagent flow rate, is reduced, the low pressure region in the centre of the burner can no longer draw the flow towards it and the burner tends to operate in the manner of a conventional premix burner, without recirculation. In this operating phase, moreover, the burner is not affected by flash-back problems, by virtue of the operation of the flash-back prevention device provided in the burner, or by instability problems due to flame detachment, by virtue of the stabilizing function of the device.

[0049] Consequently, the burner can adapt to the combustion conditions as the burner power varies, in the modulation range in which it is used.

[0050] During the transition from recirculation burner to conventional premix burner, a fluid-dynamically unstable transition area may be present with fluctuations of the reagent flow which may lead to pulsations or extinction of the flame during this phase. To ensure the presence of a stabilized flame even in this transition area, the lateral wall (wall 26) of the burner body is tapered, as described above. The presence of this tapered wall creates a flame attachment area and thus makes the transition between the two combustion conditions stable.

[0051] In a second variant, shown in Figures 12 and 13, in which details similar to those of the previous embodiments are indicated by the same reference numerals, a second device 27 for guiding the flow of mixture supplied through the burner head 3' is provided downstream of the flash-back prevention device.

[0052] The second device 27 is structurally and functionally equivalent to the guide device 20 described above to which reference should be made for a detailed description. The device 27 also comprises a plurality of deflector fins, all of which are indicated 21 for simplicity, and which are structurally identical to those provided in the device 20. In this case, the fins 21 are connected to the outer circumferential edge by a ring 28 with a cylindrical wall which is intended to be connected to the cylindrical burner body 2'. The second guide device 27 provides an additional contribution to the rotational component imparted to the flow of the mixture. Moreover, since it is disposed downstream of the flash-back prevention device, it performs its function in an area in which flame is already present, in contrast with the guide device 20 which is active in a mixing area of the burner, in the absence of flame.

[0053] A tapered lateral wall 26 is provided in the burner body 2' and extends in the region of the front surface of the head, coaxially therewith. More particularly, the tapered wall 26, which converges towards the burner head 3', is provided downstream of the second finned guide device 27, with respect to the axial direction X' of the flow supplied to the head 3', as is clearly shown in the respective drawings. The function of the tapered wall is substantially that already described above with reference to the embodiment of Figures 7 and 8.

[0054] The invention thus solves the problem posed, affording many advantages over known solutions.

[0055] The dual operating conditions incorporated in the modulating boiler according to the invention afford, in the first place, a greater power modulation range and greater efficiency with lower nitrogen oxide emissions.

[0056] It is also possible to produce a burner which is smaller than conventional burners for the same burning power. Moreover, it is possible to provide burners which are interchangeable with conventional burners both with respect to their dimensions and with respect to the connection flange. Furthermore, the nitrogen oxide emissions are reduced in the burner of the invention in comparison with a conventional boiler, owing to the recirculation of the combustion products in the flame area.

[0057] By virtue of the combustion conditions with maximum flame detachment, the burner head of the burner according to the invention is less prone to overheating than conventional burners.

[0058] It is also possible to reduce the cost of the burner in comparison with conventional systems of the same power by virtue of the smaller dimensions of the burner and the fact that it can be produced from a single component, as well as the fact that less expensive materials can be used by virtue of the less critical thermal operating

conditions.

[0059] In comparison with the preceding solutions, the solution of the second embodiment described and of its variants also resolves the technological aspects of construction since the construction is much simpler, given the known sheet-metal processing techniques. This constructional simplicity also leads to reduced stressing of the various parts of the burner and hence to an increase in its life and strength.

Claims

1. A modulating gas burner (1; 1') which is designed for operation with premixing of a combustible air and gas mixture, the burner (1; 1') comprising a burner head (3; 3') to which the combustible air and gas mixture can be supplied, a device (6; 20) for guiding the flow of the mixture, which device imparts rotational components to the velocity of the flow to the burner head (3; 3'), and a flash-back prevention device (12; 24) positioned in the burner head (3; 3'), in such a way that the power at the burner can be modulated within a predetermined modulation range between a minimum power condition in which the burner (1; 1') operates predominantly in the manner of a premix burner without flame detachment or flash-back, and a maximum power condition in which the burner operates predominantly in the manner of a burner with recirculation of the flows of the reagents of the combustible mixture, said burner head (3) comprising a plurality of compartments (9) for distributing the combustible mixture, the compartments being provided on a surface (7) of the head (3) and spaced apart from each other, each compartment being delimited by at least a first wall and a second wall (9a, 9b) which are connected to each other and to the surface (7) of the head, the walls (9a, 9b) being inclined to the surface (7) of the head, the first wall (9a) having a plurality of through apertures (12) for the passage of the mixture through the head (3), the second wall (9b) being solid and inclined to the first wall so as to impart a rotational component to the mixture distributed through the apertures (12) with respect to the axial direction of the flow through the head (3), the surface (7) of the head having a circular profile and the plurality of compartments (9) extending over the surface (7) at regular angular intervals, said burner comprising a burner body (2) extending axially from a fastening flange (4) towards the surface of the head, the lateral wall of the burner body (2) having a profile which is tapered in the region of the head (3) and is coaxial with the circular profile of the burner head, and the tapered profile of the lateral wall being provided downstream of the front surface (7) of the head (3), with respect to the axial direction of the flow supplied to the head.
2. A burner according to Claim 1 in which the flow guide device (6) is formed by the plurality of second walls (9b) of the distributor compartments (9).
3. A burner according to Claim 1 in which the flash-back prevention device is formed by the plurality of apertures (12) formed in the first walls (9a) of the distributor compartments (9).
4. A burner according to Claim 1 in which the flow guide device (20) and the flash-back prevention device (24) are structural independent of one another and the flash-back prevention device (24) is arranged downstream of the flow guide device (20), with respect to the direction of the flow supplied to the burner head (3').
5. A burner according to Claim 4 in which the flow guide device (20) comprises a plurality of radial deflector fins (21) which are spaced apart circumferentially, the fins being inclined to the axial direction of the flow through the head (3') so as to impart a rotational component to the flow that is conveyed through respective passageway sections (23) defined between each pair of adjacent fins (21).
6. A burner according to Claim 5 in which the fins (21) extend in the region of the head (3') at regular angular intervals.
7. A burner according to Claim 6, comprising a tubular burner body (2') carrying the burner head (3') at one of its ends, each of the fins (21) comprising a first surface portion (21a) extending radially between a central support (22) coaxial with the tubular body and a circumferential edge of the body (2'), and a second surface portion (21b) which forms an extension of the first portion and is inclined to the axis of the tubular burner body.
8. A burner according to Claim 7 in which the second surface portion (21b) of each fin (21) has a substantially flat surface.
9. A burner according to Claim 8 in which the second surface portion (21b) of each fin (21) is inclined at about 45° to a plane perpendicular to the axis of the tubular burner body (2').
10. A burner according to any one of Claims 5 to 9 in which each deflector fin (21) is produced by the cutting and bending of a portion of a flat disk extending in the region of the burner head, the flat disk being produced integrally with the tubular burner body (2') at that end thereof at which the burner head is provided.
11. A burner according to anyone of 5 to 9 Claims in

which each deflector fin (21) is produced by the cutting and bending of a portion of a flat disk extending in the region of the burner head, and the flat disk in which the fins (21) are formed is constructed so as to be structurally independent of the tubular burner body (2'), connection means being provided for its connection to the burner body.

12. A burner according to any one of Claims 4 to 11 in which the flash-back prevention device comprises a plate-like element (24) provided with a plurality of through apertures (25) extending through its transverse thickness for the passage of the combustible mixture through the head (3')
13. A burner according to Claim 12 in which the plate-like element (24) has a disk-like configuration.
14. A burner according to Claim 12 or Claim 13 in which the plate-like element (24) has a flat configuration.
15. A burner according to Claim 14 in which the plate-like element (24) is made of blanked sheet-metal and the through apertures (25) are formed by drilling or punching.
16. A burner according to Claim 14 in which the plate-like element (24) of the flash-back prevention device is constructed with a mesh structure.
17. A burner according to Claim 14 in which the plate-like element (24) of the flash-back prevention device is made of metal fibre.
18. A burner according to any one of Claims 4 to 17 in which the burner body (2') has, in the region of the head (3'), a lateral wall (26) with a tapered profile extending coaxially with the burner head.
19. A burner according to Claim 18 in which the tapered profile of the wall (26) is provided downstream of the front surface of the head (3'), with respect to the axial direction of the flow supplied to the head.
20. A burner according to any one of Claims 4 to 19, comprising a second device (27) for guiding the flow of the mixture, which device imparts rotational components to the velocity of the flow to the burner head (3'), and is structurally distinct from the guide device (26) and disposed downstream of the flash-back prevention device (24), with respect to the direction of the flow of mixture supplied to the burner head (3').

Patentansprüche

1. Regulierender Gasbrenner (1; 1'), der zum Vormischbetrieb eines brennbaren Luft- und Gasgemisches

eingerrichtet ist, wobei der Brenner (1; 1') einen Brennerkopf (3; 3') aufweist, dem das brennbare Luft- und Gasgemisch zugeführt werden kann, eine Vorrichtung (6; 20) zum Leiten des Gemischstroms aufweist, wobei die Vorrichtung drehbare Komponenten für die Geschwindigkeit des Stroms zum Brennerkopf (3; 3') übermitteln, und eine Flammenrückschlag-Schutzvorrichtung (12; 24) aufweist, die im Brennerkopf (3; 3') positioniert ist, und zwar in der Weise, dass die Energie am Brenner innerhalb eines vorbestimmten Regelbereichs zwischen einem minimalen Energiezustand, in dem der Brenner (1; 1') überwiegend wie ein Vormischbrenner ohne Flamm-trennung oder Flammenrückschlag in Betrieb ist, und einem maximalen Energiezustand reguliert werden kann, in dem der Brenner überwiegend wie ein Brenner mit Rückführung der Ströme der Reagenzien des brennbaren Gemisches in Betrieb ist, wobei der Brennerkopf (3) eine Mehrzahl von Abteilungen (9) zum Verteilen des brennbaren Gemisches aufweist, wobei die Abteilungen auf einer Oberfläche (7) des Kopfes (3) vorgesehen und voneinander beabstandet sind, wobei jede Abteilung durch zumindest eine erste Wand und eine zweite Wand (9a, 9b) abgegrenzt ist, die miteinander und mit der Oberfläche (7) des Kopfes verbunden sind, wobei die Wände (9a, 9b) zur Oberfläche (7) des Kopfes geneigt sind, wobei die erste Wand (9a) eine Mehrzahl von Durchflussöffnungen (12) für den Durchfluss des Gemisches durch den Kopf (3) aufweist, wobei die zweite Wand (9b) durchgehend und zur ersten Wand geneigt ist, um somit eine Drehkomponente für das Gemisch, das durch die Öffnungen (12) verteilt wird, bezüglich der Axialrichtung des Stroms durch den Kopf (3) zu übermitteln, wobei die Oberfläche (7) des Kopfes ein kreisförmiges Profil aufweist und sich die Mehrzahl von Abteilungen (9) über die Oberfläche (7) in regelmäßigen winkelförmigen Intervallen erstreckt, wobei der Brenner einen Brennerkörper (2) aufweist, der sich axial von einem Befestigungsflansch (4) zur Oberfläche des Kopfes erstreckt, wobei die seitliche Wand des Brennerkörpers (2) ein Profil aufweist, das am Bereich des Kopfes (3) verjüngt ist und mit dem kreisförmigen Profil des Brennerkopfes coaxial ist, und das verjüngte Profil der seitlichen Wand stromabwärts der vorderen Fläche (7) des Kopfes (3) bezüglich der Axialrichtung des Stroms, der dem Kopf zugeführt wird, vorgesehen ist.

2. Brenner gemäß Anspruch 1, in dem die Stromführungsvorrichtung (6) durch die Mehrzahl von zweiten Wänden (9b) der Verteilungsabteilungen (9) ausgebildet ist.
3. Brenner gemäß Anspruch 1, in dem die Flammenrückschlag-Schutzvorrichtung durch die Mehrzahl von Öffnungen (12) ausgebildet ist, die in den ersten

Wänden (9a) der Verteilungsabteilungen (9) ausgebildet sind.

4. Brenner gemäß Anspruch 1, in dem die Stromführungsvorrichtung (20) und die Flammenrückschlag-Schutzvorrichtung (24) strukturell unabhängig voneinander sind und die Flammenrückschlag-Schutzvorrichtung (24) stromabwärts der Stromführungsvorrichtung (20) bezüglich der Richtung des Stroms, der dem Brennerkopf (3; 3') zugeführt ist, angeordnet ist. 5
5. Brenner gemäß Anspruch 4, in dem die Stromführungsvorrichtung (20) eine Mehrzahl von radialen Umlenkrippen (21) aufweist, die umfangsmäßig voneinander beabstandet sind, wobei die Rippen zur Axialrichtung des Stroms durch den Kopf (3') geneigt sind, um somit eine Drehkomponente zum Strom zu übermitteln, der durch jeweilige Durchgangsbereiche (23), die zwischen jedem Paar von benachbarten Rippen (21) ausgebildet sind, geleitet wird. 10
6. Brenner gemäß Anspruch 5, in dem sich die Rippen (21) in den Bereich des Kopfes (3') in regelmäßigen winkelförmigen Intervallen erstreckt. 15
7. Brenner gemäß Anspruch 6, der einen rohrförmigen Brennerkörper (2') aufweist, der an einem seiner Enden den Brennerkopf (3') trägt, wobei jede der Rippen (21) einen ersten Oberflächenbereich (21a), der sich radial zwischen einer mittleren Stütze (22), die mit dem rohrförmigen Körper coaxial ist, und einer Umfangskante des Körpers (2') erstreckt, und einen zweiten Oberflächenbereich (21b) aufweist, der eine Ausdehnung des ersten Bereichs bildet und zur Achse des rohrförmigen Brennerkörpers geneigt ist. 20
8. Brenner gemäß Anspruch 7, in dem der zweite Oberflächenbereich (21b) jeder Rippe (21) eine im Wesentlichen ebene Oberfläche aufweist. 25
9. Brenner gemäß Anspruch 8, in dem der zweite Oberflächenbereich jeder Rippe (21) um ungefähr 45° zu einer Ebene geneigt ist, die senkrecht zur Achse des rohrförmigen Brennerkörpers (2') ist. 30
10. Brenner gemäß einem der Ansprüche 5 bis 9, in dem jede Umlenkrippe (21) durch Ausschneiden und Biegen eines Bereichs einer ebenen Scheibe, die sich in den Bereich des Brennerkopfs erstreckt, hergestellt ist, wobei die ebene Scheibe einstückig mit dem rohrförmigen Brennerkörper (2') an dem Ende davon, an dem der Brennerkopf vorgesehen ist, hergestellt ist. 35
11. Brenner gemäß einem der Ansprüche 5 bis 9, in dem jede Umlenkrippe (21) durch Ausschneiden und Biegen eines Bereichs einer ebenen Scheibe herge- 40

stellt ist, die sich in den Bereich des Brennerkopfes erstreckt, und die ebene Scheibe, in dem die Rippen (21) ausgebildet sind, so konstruiert ist, um strukturell unabhängig vom rohrförmigen Brennerkörper (2') zu sein, wobei ein Verbindungsmittel für die Verbindung mit dem Brennerkörper vorgesehen ist.

12. Brenner gemäß einem der Ansprüche 4 bis 11, in dem die Flammenrückschlag-Schutzvorrichtung ein plattenförmiges Element (24) aufweist, das mit einer Mehrzahl von Durchflussöffnungen (25) versehen ist, die sich durch seine diagonale Dicke für den Durchfluss des brennbaren Gemisches durch den Kopf (3') erstrecken. 45
13. Brenner gemäß Anspruch 12, in dem das plattenförmige Element (24) eine scheibenförmige Konfiguration aufweist. 50
14. Brenner gemäß Anspruch 12 oder 13, in dem das plattenförmige Element (24) eine ebene Konfiguration aufweist. 55
15. Brenner gemäß Anspruch 14, in dem das plattenförmige Element (24) aus blankem Blech hergestellt ist und die Durchflussöffnungen (25) durch Bohren oder Stanzen ausgebildet sind.
16. Brenner gemäß Anspruch 14, in dem das plattenförmige Element (24) der Flammenrückschlag-Schutzvorrichtung mit einer Netzstruktur konstruiert ist.
17. Brenner gemäß Anspruch 14, in dem das plattenförmige Element (24) der Flammenrückschlag-Schutzvorrichtung aus Metallfasern hergestellt ist.
18. Brenner gemäß einem der Ansprüche 4 bis 17, in dem der Brennerkörper (2') im Bereich des Kopfes (3') eine seitliche Wand (26) mit einem verjüngten Profil aufweist, das sich coaxial mit dem Brennerkopf erstreckt.
19. Brenner gemäß Anspruch 18, in dem das verjüngte Profil der Wand (26) stromabwärts der Vorderfläche des Kopfes (3') bezüglich der Axialrichtung des Stroms, der dem Kopf zugeführt wird, vorgesehen ist.
20. Brenner gemäß einem der Ansprüche 4 bis 19, der eine zweite Vorrichtung (27) zum Führen des Gemischstroms aufweist, dessen Vorrichtung Drehkomponenten für die Geschwindigkeit des Stroms zum Brennerkopf (3') übermittelt, und strukturell von der Führungsvorrichtung (26) verschieden ist und stromabwärts der Flammenrückschlag-Schutzvorrichtung (24) bezüglich der Richtung des Gemischstroms, der dem Brennerkopf (3') zugeführt wird, angeordnet ist.

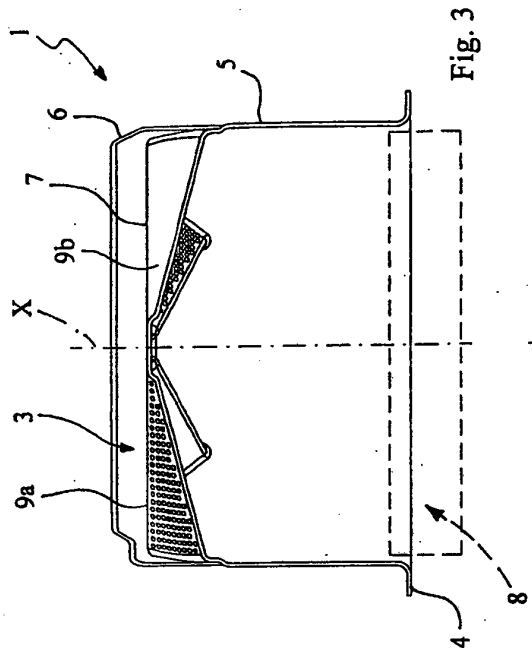
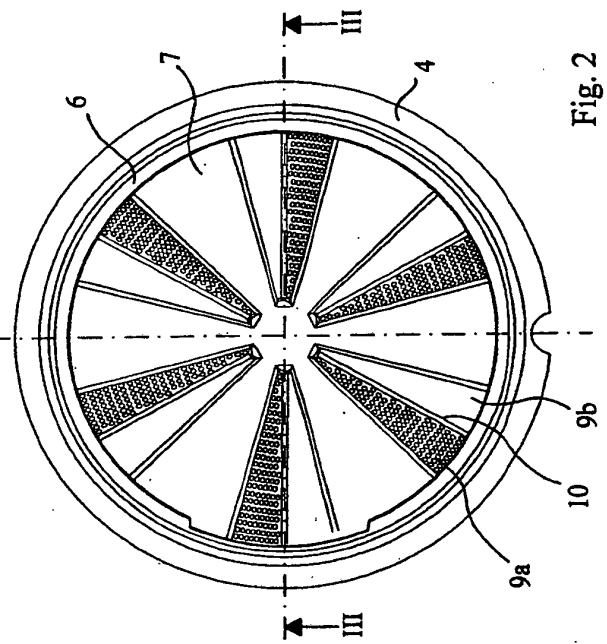
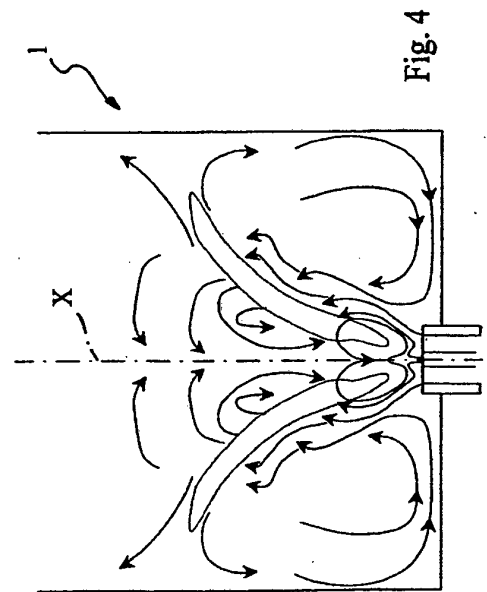
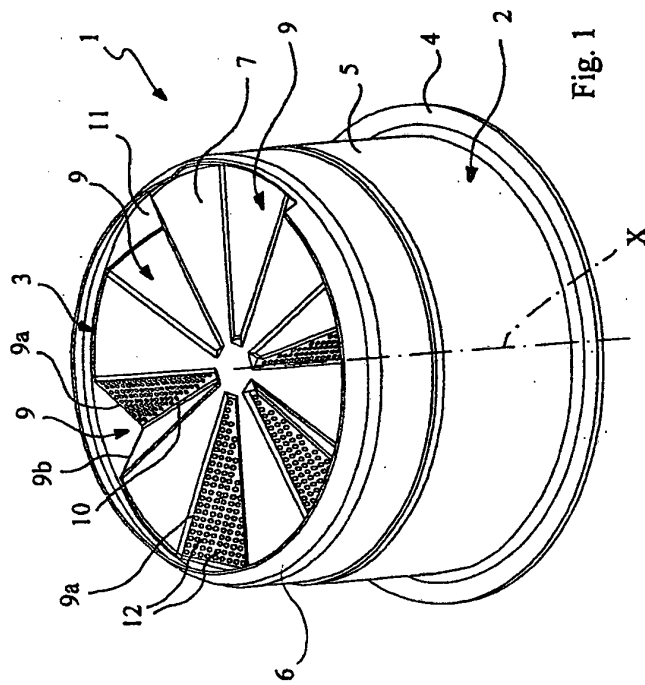
Revendications

1. Brûleur à gaz modulaire (1 ; 1') qui est conçu pour fonctionner avec un pré-mélange d'un mélange d'air et de gaz combustible, le brûleur (1 ; 1') comprenant une tête de brûleur (3 ; 3') à laquelle le mélange d'air et de gaz combustible peut être amené, un dispositif (6 ; 20) pour guider l'écoulement du mélange, lequel dispositif communique des composantes de rotation à la vitesse de l'écoulement à la tête de brûleur (3 ; 3'), et un dispositif de prévention de retour (12 ; 24) positionné dans la tête de brûleur (3 ; 3'), de sorte que la puissance au niveau du brûleur peut être modulée dans une plage de modulation prédéterminée entre une condition de puissance minimum dans laquelle le brûleur (1 ; 1') fonctionne de manière prédominante à la manière d'un brûleur à pré-mélange sans détachement de flamme ou retour, et une condition de puissance maximum dans laquelle le brûleur fonctionne de manière prédominante à la manière d'un brûleur avec recirculation des écoulements des réactifs du mélange combustible, ladite tête de brûleur (3) comprenant une pluralité de compartiments (9) pour distribuer le mélange combustible, les compartiments étant prévus sur une surface (7) de la tête (3) et espacés les uns des autres, chaque compartiment étant délimité par au moins une première paroi et une seconde paroi (9a, 9b) qui sont raccordées entre elles et à la surface (7) de la tête, les parois (9a, 9b) étant inclinées vers la surface (7) de la tête, la première paroi (9a) ayant une pluralité d'ouvertures débouchantes (12) pour le passage du mélange par la tête (3), la seconde paroi (9b) étant pleine et inclinée vers la première paroi afin de communiquer une composante de rotation au mélange distribué par les ouvertures (12) par rapport à la direction axiale de l'écoulement à travers la tête (3), la surface (7) de la tête ayant un profil circulaire et la pluralité de compartiments (9) s'étendant sur la surface (7) à intervalles angulaires réguliers, ledit brûleur comprenant un corps de brûleur (2) s'étendant axialement à partir d'une bride de fixation (4) vers la surface de la tête, la paroi latérale du corps de brûleur (2) ayant un profil qui est progressivement rétréci dans la région de la tête (3) et est coaxial avec le profil circulaire de la tête de brûleur, et le profil progressivement rétréci de la paroi latérale étant prévu en aval de la surface avant (7) de la tête (3), par rapport à la direction axiale de l'écoulement amené à la tête.
2. Brûleur selon la revendication 1, dans lequel le dispositif de guidage d'écoulement (6) est formé par la pluralité de secondes parois (9b) des compartiments de distributeur (9).
3. Brûleur selon la revendication 1, dans lequel le dispositif de prévention de retour est formé par la pluralité d'ouvertures (12) formées dans les premières parois (9a) des compartiments de distributeur (9).
4. Brûleur selon la revendication 1, dans lequel le dispositif de guidage d'écoulement (20) et le dispositif de prévention de retour (24) sont structurellement indépendants l'un de l'autre et le dispositif de prévention de retour (24) est agencé en aval du dispositif de guidage d'écoulement (20), par rapport à la direction de l'écoulement amené à la tête de brûleur (3').
5. Brûleur selon la revendication 4, dans lequel le dispositif de guidage d'écoulement (20) comprend une pluralité d'aillettes de déflecteur radiales (21) qui sont espacées de manière circonférentielle, les ailettes étant inclinées vers la direction axiale de l'écoulement à travers la tête (3') afin de communiquer une composante de rotation à l'écoulement qui est transporté à travers des sections de voie de passage (23) respectives définies entre chaque paire d'aillettes (21) adjacentes.
6. Brûleur selon la revendication 5, dans lequel les ailettes (21) s'étendent dans la région de la tête (3') à intervalles angulaires réguliers.
7. Brûleur selon la revendication 6, comprenant un corps de brûleur tubulaire (2') portant la tête de brûleur (3') à l'une de ses extrémités, chacune des ailettes (21) comprenant une première partie de surface (21a) s'étendant radialement entre un support central (22) coaxial avec le corps tubulaire et un bord circonférentiel du corps (2') et une seconde partie de surface (21b) qui forme une extension de la première partie et est inclinée vers l'axe du corps de brûleur tubulaire.
8. Brûleur selon la revendication 7, dans lequel la seconde partie de surface (21b) de chaque ailette (21) a une surface sensiblement plate.
9. Brûleur selon la revendication 8, dans lequel la seconde partie de surface (21b) de chaque ailette (21) est inclinée à environ 45° par rapport à un plan perpendiculaire à l'axe du corps de brûleur tubulaire (2').
10. Brûleur selon l'une quelconque des revendications 5 à 9, dans lequel chaque ailette de déflecteur (21) est produite par la découpe et la flexion d'une partie d'un disque plat s'étendant dans la région de la tête de brûleur, le disque plat étant produit de manière solidaire avec le corps de brûleur tubulaire (2') au niveau de son extrémité à laquelle la tête de brûleur est prévue.
11. Brûleur selon l'une quelconque des revendications 5 à 9, dans lequel chaque ailette de déflecteur (21)

est produite par la découpe et la flexion d'une partie d'un disque plat s'étendant dans la région de la tête de brûleur, et le disque plat dans lequel les ailettes (21) sont formées, est construit afin d'être structurellement indépendant du corps de brûleur tubulaire (2'), des moyens de raccordement étant prévus pour son raccordement au corps de brûleur.

retour (24) par rapport à la direction d'écoulement du mélange amené à la tête de brûleur (3').

12. Brûleur selon l'une quelconque des revendications 4 à 11, dans lequel le dispositif de prévention de retour comprend un élément en forme de plaque (24) prévu avec une pluralité d'ouvertures débouchantes (25) s'étendant à travers son épaisseur transversale pour le passage du mélange de combustible à travers la tête (3'). 5
13. Brûleur selon la revendication 12, dans lequel l'élément en forme de plaque (24) a une configuration en forme de disque. 10
14. Brûleur selon la revendication 12 ou la revendication 13, dans lequel l'élément en forme de plaque (24) a une configuration plate. 15
15. Brûleur selon la revendication 14, dans lequel l'élément en forme de plaque (24) est réalisé à partir d'une feuille de métal découpée et les ouvertures débouchantes (25) sont formées par perçage ou poinçonnage. 20
16. Brûleur selon la revendication 14, dans lequel l'élément en forme de plaque (24) du dispositif de prévention de retour est construit avec une structure de maille. 25
17. Brûleur selon la revendication 14, dans lequel l'élément en forme de plaque (24) du dispositif de prévention de retour est réalisé à partir de fibres métalliques. 30
18. Brûleur selon l'une quelconque des revendications 4 à 17, dans lequel le corps de brûleur (2') a, dans la région de la tête (3'), une paroi latérale (26) avec un profil progressivement rétréci s'étendant de manière coaxiale avec la tête de brûleur. 35
19. Brûleur selon la revendication 18, dans lequel le profil progressivement rétréci de la paroi (26) est prévu en aval de la surface avant de la tête (3'), par rapport à la direction axiale de l'écoulement amené à la tête. 40
20. Brûleur selon l'une quelconque des revendications 4 à 19, comprenant un second dispositif (27) pour guider l'écoulement du mélange, lequel dispositif communique des composantes de rotation à la vitesse de l'écoulement à la tête de brûleur (3'), et est structurellement distinct du dispositif de guidage (26) et est disposé en aval du dispositif de prévention de 45



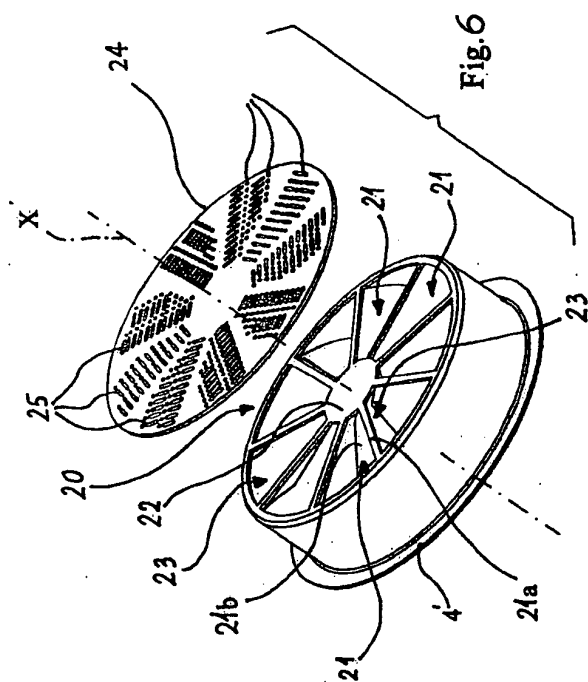


Fig. 6

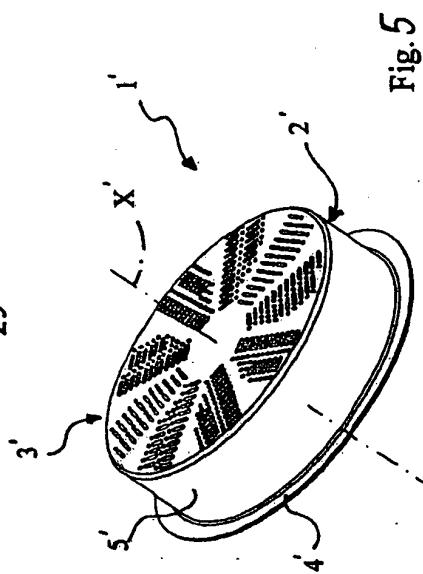


Fig. 5

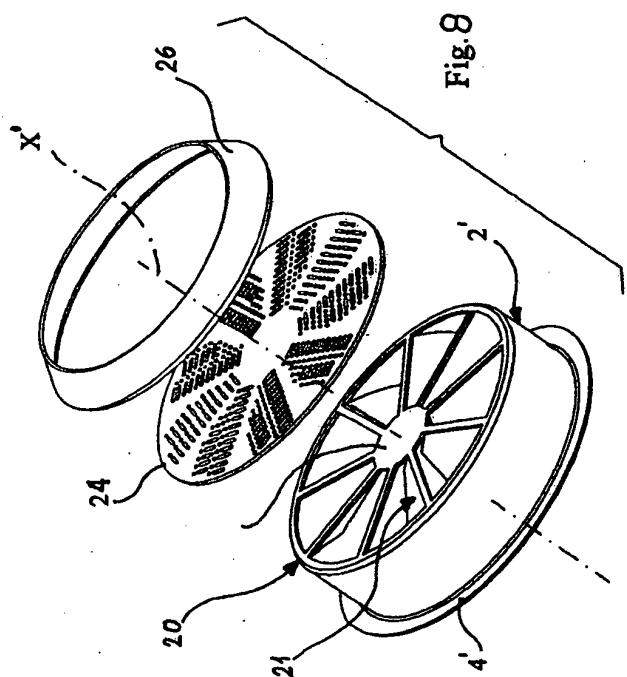


Fig. 8

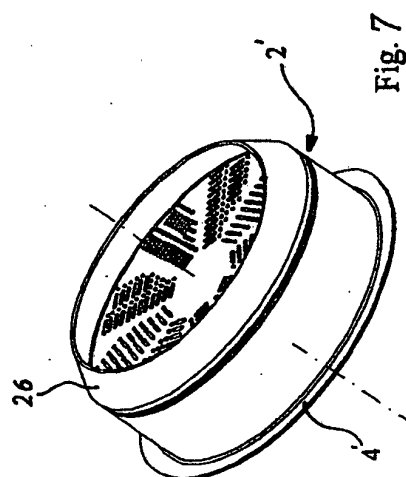
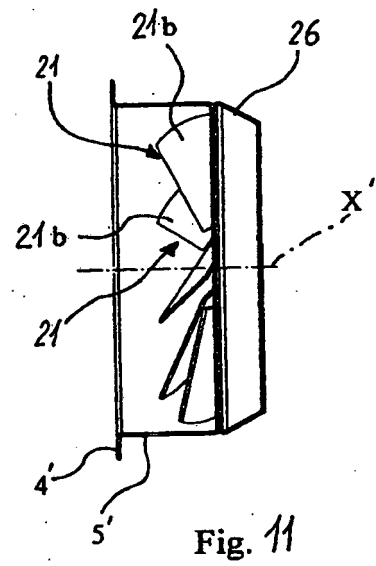
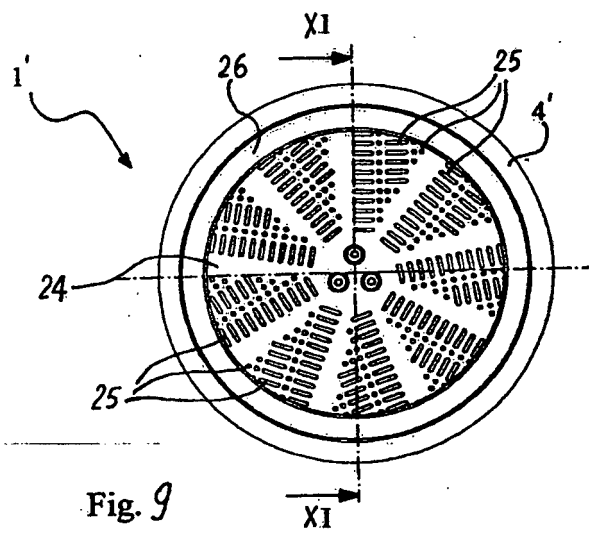
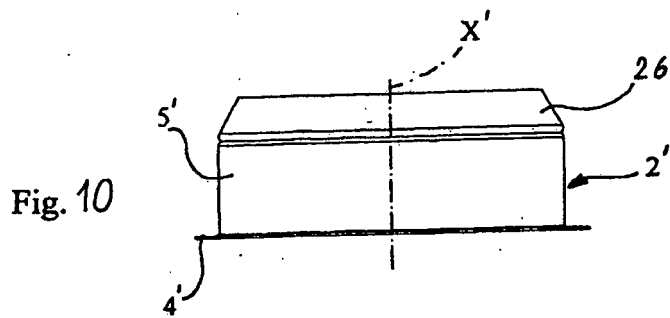


Fig. 7



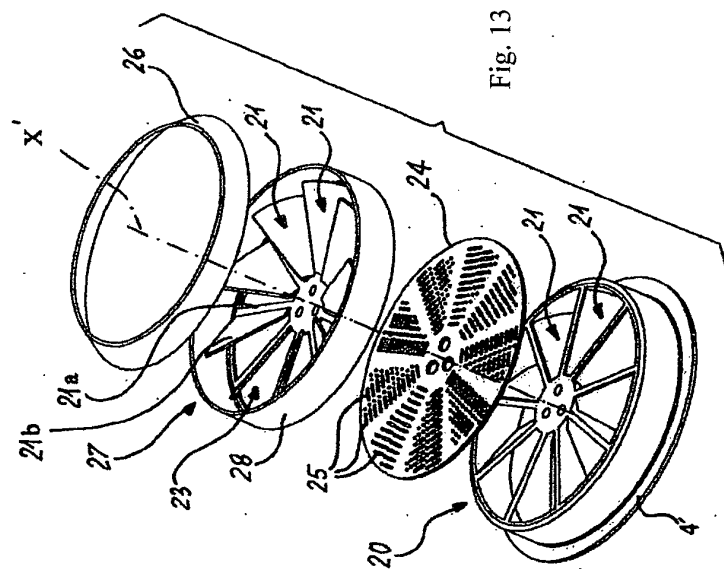


Fig. 13

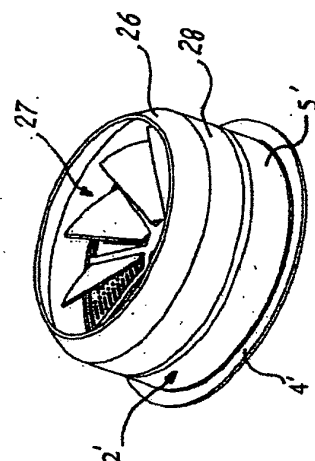


Fig. 12

REFERENCES CITED IN THE DESCRIPTION

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