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(54) **BURNER**

(57) A gas burner (1) comprises a diffuser (4) made of perforated sheet metal forming a combustion surface (5), wherein the diffuser (4) is formed by a plurality of diffuser segments (11) made of perforated sheet metal not belonging to the same piece of sheet metal and completely separated from one another by means of separation slits (12) and placed side-by-side along the separation slits (12), and wherein the separation slits (12) extend over the entire transverse extension of the diffuser (4), wherein on an inner side (13) of the diffuser (4), opposite to the combustion surface (5), a plurality of covering strips (14) made of sheet metal is arranged, and each covering strip (14) extends along respectively one of the separation slits (12) overlapping and at least partially in contact with the free edges (15) of the two bordering diffuser segments (11), delimiting the separation slit (12), so as to cover each of said separation slits (12).

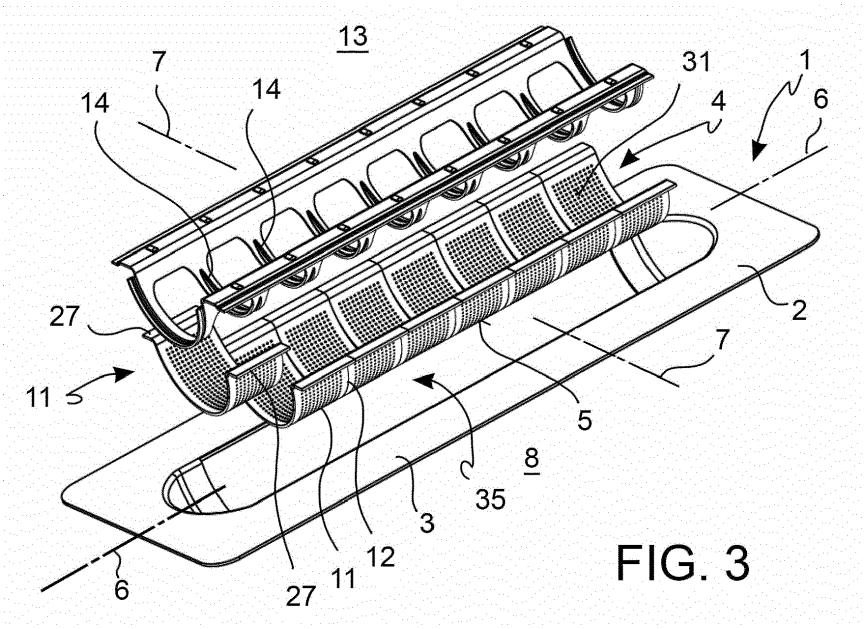

FIG. 3

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Description

[0001] The present invention relates to a burner for a combustion unit, e.g., for gas boilers.

[0002] Prior-art combustion units comprise a combustion chamber with a heat exchanger, a burner connected to the combustion chamber for generating heat through the combustion of a mixture of combustible gas and combustion air in the combustion chamber, and a supply conduit for supplying the gas and air mixture to the burner.

[0003] The known burner comprises:

- a framework made of impermeable material, connectable to the combustion chamber and supporting a diffuser made of gas permeable material, and
- a combustion surface (the so-called combustion head) formed by a portion of the diffuser and intended to face the combustion chamber and be surrounded by the framework, so that a gas mixture conveyed through the diffuser can be combusted in the form of a flame pattern on the combustion surface.

[0004] In a known solution, the combustion surface and the framework are made of a single piece of sheet metal which is resistant to high temperatures, perforated at the combustion surface, and impermeable at the framework. This solution is disadvantageous due to the formation of breaks caused by high temperature gradients between very hot zones and relatively cold zones.

[0005] Similar breaks have also been observed in a further known solution, where the perforated sheet metal combustion surface and the impermeable sheet metal framework were assembled, for example, by welding spots.

[0006] In order to obviate breaks due to thermal stresses, it is known to the inventors to position a flexible porous layer on the perforated sheet metal, for example a fabric or a metal fiber mesh which acts both as a combustion surface and flame spacer which spaces the combustion zone apart from the perforated sheet metal, and insulating material which shields the sheet metal from the high temperatures of the gases present in the combustion chamber, at the cost of needing to provide for and assemble an additional expensive component.

[0007] It is also known to perforate the perforated sheet metal of the diffuser with circular pinholes and through slots, arranged in alternate groups, for the purpose of obviating the formation of localized breaks between two adjacent perforations. In this case, the through slots still have very small dimensions, of the same order of magnitude as the circular pinholes.

[0008] In addition to thermal stresses and localized thermal breaks (between adjacent perforations), sheet metal diffusers are subject to buckling (uncontrolled deformations of instability from a modal form to another modal form of the diffuser) due to the high rigidity of the sheet metal in the plane thereof and the impossibility to fully extend freely according to the thermal stresses. This results in uncontrolled mechanical stresses combined with thermal stresses which increase the risk of premature breakage of the diffuser.

[0009] Mesh diffusers are easily deformable both in the extension plane and outside the extension plane and do not have the aforesaid buckling problem. On the other hand, metal meshes for burners are very expensive, the porosity thereof is subject to statistical variations which cannot be controlled with certainty, and the manufacturing of burners with diffusers made of metal mesh is more complex, slower and expensive than the manufacturing of burners with diffusers made of perforated sheet metal.

[0010] Publication EP3412967A1 describes a burner with:

- a framework made of impermeable sheet metal having an outer peripheral connection portion,
- a perforated sheet metal diffuser, the diffuser forming a combustion surface surrounded by the framework and having an extension in a longitudinal direction and an extension in a transverse direction, orthogonal to the longitudinal direction, where the extension of the combustion surface in the transverse direction is less than the extension of the combustion surface in the longitudinal direction,

  where the combustion surface is intended to face a combustion space so that a gas mixture conveyed through the diffuser can be combusted in the form of a flame pattern on the combustion surface,
  where the diffuser forms a plurality of perforated sheet metal diffusor segments, separated from one another by partial separation slits, and
  where the partial separation slits extend in the transverse direction over at least half of the extension of the combustion surface in the transverse direction.

[0011] This known burner achieves within certain limits an uncoupling of the thermal deformations of the individual segments formed by the diffuser and reduces the onset of buckling due to thermal expansion. In order to reduce or eliminate an undesired notching effect at the ends of the partial separation slits, one or both of the ends of the partial separation slits of the diffuser forms/form relaxation grooves or holes, which are rounded and enlarged as compared to the width of the partial separation slit.

[0012] The critical features of known burners, which were designed for traditional combustion gases such as methane, propane, butane and mixtures thereof, for example, are further accentuated with the use of hydrogen or mixtures of combustible gases containing significant percentages of hydrogen gas. Examples of particularly accentuated negative phenomena with the use of hydrogen gas are overheating, flash back, light back, excessively high combustion speed, and higher temperature

gradients which result in greater thermal stresses on the components of the burner.

[0013] When using the burner described in EP3412967A1 with gas mixtures having high combustion speed, an undesired light back tendency occurs from the combustion surface towards the inside of the burner exactly at the partial separation slits between the diffuser segments, since to date is has not been possible or at least is not easy and inexpensive to make such partial separation slits narrow enough to avoid light back even with high and very high combustion speeds. In simple terms, for the use of hydrogen gas, the gas path through the sheet metal layer of the diffuser at the slits is too short, too wide and not suitable for preventing light back. Furthermore, due to higher temperature gradients, the end zones of the slits of the burner described in EP3412967A1 are subject to the onset of fatigue fractures.

[0014] However, for reasons of environmental protection, containment of greenhouse gas production, and increase of the efficiency of energy resources, the need is felt to also use hydrogen as a combustible gas or as a part of combustible gas mixtures for generating heat.

[0015] Therefore, it is the object of the present invention to provide an improved burner having features such as to obviate at least some of the drawbacks of the prior art.

[0016] It is a particular object of the invention to provide a burner with a diffuser made of perforated sheet metal, having features such as to withstand even better the mechanical and thermal stresses, and to reduce the risk of flash back in the presence of gases and gas mixtures having high combustion speed.

[0017] Further objects of the invention relate to the simplification and the manufacturing precision of the burner.

[0018] At least some of the objects are achieved by a burner according to claim 1. Dependent claims are directed to preferred and advantageous embodiments.

Summary description of the invention

[0019] According to an aspect of the invention, a gas burner, for example a premixed gas burner, for example suitable for gases and gas mixtures having high combustion speed, e.g., hydrogen gas and mixtures thereof, comprises:

- a framework made of impermeable sheet metal, having an outer peripheral portion connectable to a combustion chamber,
- a perforated sheet metal diffuser, supported by the framework, the diffuser forming a combustion surface possibly surrounded by the framework and having an extension in a longitudinal direction and an extension in a transverse direction, orthogonal to the longitudinal direction, where the extension of the combustion surface in the transverse direction is less than the extension of the combustion surface in the longitudinal direction,

  where the combustion surface is intended to face a combustion space of the combustion chamber, so that a gas mixture conveyed through the diffuser can be combusted in the form of a flame pattern on the combustion surface,

  where the diffuser is formed by a plurality of diffuser segments made of perforated sheet metal not belonging to the same piece of sheet metal and completely separated from one another by means of separation slits and placed side-by-side along said separation slits, and where the separation slits extend in the transverse direction over the entire extension of the diffuser, where on an inner side of the diffuser, opposite to the combustion surface, a plurality of covering strips made of sheet metal is arranged, and each covering strip extends along respectively one of the separation slits overlapping and at least partially in contact with both the free edges of the two diffuser segments which are bordering and delimiting said separation slit, so as to cover each of said separation slits.

[0020] The construction of the diffuser with a plurality of diffuser segments completely separated from one another, but only connected indirectly by further components of the burner not belonging to the same sheet metal thereof, further improves the uncoupling of the thermal deformations of the individual segments, the thermal resistance, the resistance against the onset of fatigue fractures, and obviates the onset of thermal expansion buckling, also in the presence of higher temperature gradients.

[0021] The complete separation of the individual diffuser segments and their juxtaposition side-by-side at a freely definable and lockable distance further allows creating, in an easy, inexpensive and industrially repeatable manner, a much narrower gap than a minimum cutting width obtainable using traditional sheet metal cutting technologies. Moreover, the juxtaposition of diffuser segments completely separated from one other allows creating freely definable and not necessarily uniform slit profiles in an easy and inexpensive manner, while remaining within a very small slit width range. This possibility to create very narrow separation slits reduces per se the risk of light back even when the burner is supplied with gas, e.g., hydrogen, having high combustion speed.

[0022] In addition, the covering of the separation slits with the covering strips further extends the gas path through the diffuser at the separation slits and reduces the overall passage section and thus the local porosity. This further reduces the risk of light back. On the other hand, the covering strips stabilize the position of the free edges of the diffuser segments, thus obviating undesired, unplanned thermal or mechanical deformations. This

leads to a synergetic anti-light back and thermal resistance effect.

Brief description of the drawings

[0023] In order to better understand the invention and appreciate the advantages thereof, some non-limiting exemplary embodiments will be described below with reference to the accompanying drawings, in which:

figure 1 is a top perspective view of a burner according to an embodiment,
figure 2 is a bottom perspective view of the burner in figure 1,
figures 3 and 4 are exploded perspective views of the burner in figure 1,
figure 5 is a sectional view of the burner in figure 1,
figure 6 shows an enlarged detail of the burner in figure 2,
figure 7 shows a further enlarged detail of the burner in figure 2,
figure 8 is a perspective view of an assembly of a diffuser and a covering framework of a burner according to an embodiment,
figure 9 is a perspective view of a covering framework of a burner according to an embodiment, figure 10 shows an enlarged detail of the covering framework in figure 9,
figure 11 is a plan view of a diffuser of a burner according to an embodiment,
figure 12 is a perspective view of an individual segment of the diffuser of the burner according to an embodiment,
figure 13 is an enlarged view of a separation slit between two diffuser segments of the burner according to an embodiment,
figure 14 is a perspective view of an assembly of a distributor also acting as a covering framework of the burner according to an embodiment,
figure 15 is a sectional view of a burner according to figure 1, but containing the distributor and covering framework in figure 14.

Detailed description of embodiments

[0024] The figures show a gas burner 1 suitable for a combustion unit of the type having a first housing part (combustion housing) which internally delimits a combustion space, a second housing part (gas supply housing) which internally delimits a gas supply space, and indeed the burner 1 connected between the first housing part and the second housing part.

[0025] The burner 1 comprises:

- a framework 2 made of impermeable sheet metal, having an outer peripheral portion 3 connectable to a combustion chamber 9,
- a diffuser 4 made of perforated sheet metal supported by the framework 2, the diffuser 4 forming a combustion surface 5 having a longitudinal extension in a longitudinal direction 6 and a transverse extension in a transverse direction 7, orthogonal to the longitudinal direction 6, wherein the transverse extension of the combustion surface 5 is less than the longitudinal extension of the combustion surface 5.

[0026] The combustion surface 5 faces an outer side 8 of the burner 1 (the outer side 8 defines the combustion space 8 of the combustion chamber 9) so that a gas mixture 10 conveyed through the diffuser 4 can be combusted in the form of a flame pattern on the combustion surface 5.

[0027] The diffuser 4 is formed by a plurality of diffuser segments 11 made of perforated sheet metal not belonging to the same piece of sheet metal and completely separated from one another by means of separation slits 12 and placed side-by-side along the separation slits 12, and wherein the separation slits 12 extend in the transverse direction 7 over the entire transverse extension of the diffuser 4.

[0028] On an inner side 13 of the diffuser 4, opposite to the combustion surface 5, a plurality of covering strips 14 made of sheet metal is arranged, and each covering strip 14 extends along respectively one of the separation slits 12 overlapping and at least partially in contact with both the free edges 15 of the two diffuser segments 11 which are bordering and delimiting the separation slit 12, so as to cover each of said separation slits 12. The diffuser segments 11 are preferably not connected directly to one another, but individually with the framework 2.

Detailed description of diffuser 4

[0029] According to an embodiment, the combustion surface 5 or the entire diffuser 4 can be substantially flat and the separation slits 12 can be substantially straight and, possibly, parallel to one another.

[0030] According to a further embodiment, the part of the diffuser forming the combustion surface 5 can be in the shape of a shell rounded towards the combustion side 16, advantageously a half-cylinder or a portion of cylinder, preferably with a constant cross section (in a transverse plane orthogonal to the longitudinal direction 6) with the exception of local interruptions due to the separation slits 12 and perforation.

[0031] In this embodiment, the separation slits 12 are advantageously straight in the top view and shaped like an arc of a circle in the cross-section view, as shown in figures 1, 3, 8, 11, 12. The separation slits 12 are advantageously parallel to one another.

[0032] According to an embodiment, the separation slits 12 have a maximum width 16 in the longitudinal direction 6 of less than 1 mm (figure 13).

[0033] According to an embodiment, the separation slits 12 have a gradually converging shape from a central region 17 (about half the central length or a third of the

central length of the separation slit 12) towards the two opposite ends 18 (figure 13).

[0034] According to an embodiment, the separation slits 12 form zero-thickness contact sections or points 19 where the free edges 15 of the bordering diffuser segments 11 abut in contact with one another. This allows a certain relative positioning between consecutive diffuser segments 11, without any need to measure distances or adjust the position of the diffuser segments 11 during the assembly of the burner 1.

[0035] Advantageously, the contact sections 19 are positioned at opposite ends 18 of the separation slits 12.

[0036] According to an embodiment, the diffuser 4 or the diffuser segments 11 are formed from (obviously heat resistant) sheet steel having a thickness of the individual sheet metal in the range from 0.3 mm to 3 mm, preferably from 0.5 mm to 1.5 mm, for example 0.9 mm.

[0037] According to an embodiment, the diffuser 4 or the diffuser segments 11 are stacked steel sheet metal multi-layer structures, wherein the thickness of the individual sheets (individual layers) is preferably within the thickness values and ranges described above for the individual sheet.

[0038] According to an embodiment, the perforation 20 of the diffuser 4 does not extend as far as the separation slits 12. The separation slits 12 are delimited by the free edges 15 of the diffuser segments 11 preferably smooth or with a continuous shape to obviate the onset of notching effects and the formation of cracks.

[0039] The diffuser segments 11 advantageously have a substantially constant and/or substantially equal length 22 in the longitudinal direction 6, to facilitate manufacturing, storage and assembly and for the purpose of ensuring that properties of thermal capacity, temperature distribution, and thermal and mechanical stresses, as well as the distribution of gas mixture permeability are as uniform as possible, and thus to obtain burner operating properties which are as uniform, certain and predictable as possible.

[0040] According to an embodiment, the diffuser segments 11 advantageously have a length 22 in the longitudinal direction 6 which is less than a width 23 thereof in the transverse direction 7. This means that the individual diffuser segments 11 are "locally" elongated in the transverse direction 7, while the entire combustion surface 5 is "globally" elongated in the longitudinal direction 6. In this way, the thermal expansions of the individual diffuser segments 11 in the longitudinal direction 6 cannot be added together due to the separation slits 12, and the thermal expansions of the individual diffuser segments 11 in the transverse direction 7 can be absorbed thanks to an out-of-plane bulging of the framework 2. Such a bulging will systematically take place in the direction of the combustion space (outer side 8 of the burner 1) due to the thermal bending of the diffuser 4 towards the hotter side thereof.

[0041] In accordance with an embodiment (figures 11, 12), the diffuser segments 11 consist of or are formed by a plate bent in an arc shape, where opposite ends 27 of the plate form two arc bases and are bent towards the outside and, preferably, oriented in a common plane parallel to a plane of the framework 2. The opposite ends 27 of the plate form connection ends 27 for connecting the diffuser segment 11 to the framework 2.

[0042] In accordance with another embodiment, the diffuser 4 is a planar diffuser, the diffuser segments 11 consist of or are formed by an elongated planar plate, wherein opposite ends of the plate are oriented in a common plane parallel to the plane of the framework 2 and form connection ends 27 of the diffuser segment 11 to the framework 2.

[0043] In accordance with a further embodiment, the diffuser 4 is tubular, e.g., cylindrical or frustoconical, the diffuser segments 11 consist of or are formed by an elongated plate bent in a closed loop or a continuous tubular wall, and connected by a small connection frame or one or more appendices of the framework 2 of the burner.

[0044] According to an embodiment (figures 3, 4), the burner 1 comprises two closing portions 24 made of sheet metal which extend outside the plane of the framework 2 and close longitudinal end zones 25 between the combustion surface 5 and the framework 2.

[0045] This allows simplifying the manufacturing of the diffuser 4, due to the easier forming of the perforated sheet metal by calendering or simple bending (about a single longitudinal axis), e.g., in a press, and the use of simple "cap" portions made of preferably impermeable sheet metal for closing the burner 1 in the longitudinal end zones 25.

[0046] In the embodiment shown in the figures, the two closing portions 24 are made of unperforated sheet metal.

[0047] The closing portions 24 can be shaped (e.g., by a press) as a part (e.g., a quarter) of a spherical cap for creating a gradual transition between the plane of the framework 2 and an apical region of the combustion surface 5. Alternatively, the closing portions 24 can be shaped like flat portions with or without stiffening ribs.

[0048] It is particularly advantageous to form at least one or both of the closing portions 24 together with the framework 2 using a single piece of sheet metal, e.g. by forming or bending the closing portions 24 outside the plane of the framework 2 along transverse edges 21 of a front opening 22 of the framework 2 (figures 3, 4).

[0049] This saves on material and connection costs and increases the tightness of the connection between the combustion surface 5 and the framework 2.

The perforation or piercing of the diffuser 4 can comprise, by way of advantageous but non-limiting example, holes having diameters in the range from 0.2 mm to 0.7 mm and/or slots with lengths in the range from 5 mm to 50 mm and width less than 0.5 mm.

Detailed description of covering strips 14

[0050] According to the shape of the diffuser 4, e.g.,

planar, convex, cylindrical, frustoconical, half-cylinder shaped, etc., the covering strips 14 can be separate pieces of sheet metal connected individually to the framework 2, or the covering strips 14 are portions of a covering framework 28 formed by a single piece of sheet metal (figures 3, 4, 9, 10).

[0051] According to an embodiment, the covering strips 14 are made of continuous sheet metal, without perforation, in order to really ensure a deviation of the gas flow at the separation slits 12 and to facilitate manufacturing and reduce the manufacturing cost of the burner 1.

[0052] According to an embodiment, the covering strips 14 form:

- two outer strip portions 29 extending along the separation slit 12 and forming a contact surface 30 facing the diffuser 4 (i.e., towards the outer side of the burner 1) and having a smooth shape complementary to the shape of an inner surface 31 of the diffuser segments 11 (to create a wide contact support between the two surfaces 30, 31),
- a central rib 32 extending centrally between the two outer strip portions 29 and projecting towards the inside of the burner 1 for stiffening the covering strips 14 without creating an undesired spacer effect (Figures 6, 10).

[0053] According to an embodiment, the covering framework 28 forms an outer frame 33, consisting for example of two opposite sheet metal strips, which supports and positions the covering stripes 14. Advantageously, the outer frame 33 lies in a plane parallel to the plane of the framework 2.

[0054] According to an embodiment, the outer frame 33 forms one or more local stiffening ribs 34, e.g., a plurality of bosses equidistant from one another (figures 4, 7).

[0055] According to an embodiment, the covering strips 14 are formed from sheet steel having a thickness of the individual sheet metal in the range from 0.3 mm to 1.5 mm, preferably from 0.5 mm to 1.0 mm, for example of 1 mm.

Description of framework 2

[0056] According to an embodiment, the framework 2 is formed by a flat metal sheet, preferably substantially elongated and rectangular, which delimits a passage opening 35 at which the diffuser 4 is arranged.

[0057] The framework 2 can be made of sheet steel having a thickness of the individual sheet metal in the range from 0.5 mm to 2 mm, preferably from 0.8 mm to 1.5 mm, for example of 1 mm.

Description of the distributor

[0058] According to a further embodiment, the burner 1 can comprise a distributor 36, preferably made of perforated sheet metal with larger openings than the perforation openings of the diffuser 4. The distributor 36 is placed on the side of the diffuser 4 opposite to the combustion side and can have a similar shape to that of the combustion surface 5, e.g., a planar or convex shape or a portion of a cylinder, or half-cylinder, or a tubular, e.g., cylindrical or frustoconical shape.

[0059] In accordance with an embodiment, the covering strips 14 can be formed by unperforated portions of sheet metal of the distributor 36 which protrude with respect to perforated portions 37 of the distributor 36 towards the outside of the burner 1 and which rest in contact against the diffuser segments 11 (figures 14, 15). The perforated portions 37 of the distributor 36 are instead spaced apart from the diffuser 4 so as to be able to correctly perform the task of distributing the gas mixture towards the diffuser 4.

[0060] According to an embodiment, the diffuser 36 can be made from the covering framework 28.

Assembly of burner 1

[0061] According to an embodiment, the diffuser 4 is sandwiched and held between the framework 2 and the covering framework 28.

[0062] Advantageously, the outer strip portions 29 of the diffuser segments 11 are sandwiched between an edge of the framework 2 and the outer frame 33 of the covering framework 28.

[0063] For example, the framework 2 and the covering framework 28 can be connected to each other by welding spots or by mechanical fixing without welding, e.g., Tox clinching, in a plurality of discrete connection positions, spaced apart from one another.

[0064] The diffuser segments 11 can be fixed into the burner 1 only by friction interlocking or clamping or welding or Tox clinching.

[0065] When fixing the diffuser segments 11 by friction interlocking between the framework 2 and the covering framework 28, the direct fixing between the framework 2 and the covering framework 28 may not involve the diffuser segments 11, allowing the diffuser 4 and the individual segments thereof to have greater freedom of deformation and movement to accommodate thermal expansions.

Reference numerals

[0066]

1 burner
2 framework
3 connection portion
4 diffuser
5 combustion surface
6 longitudinal direction
7 transverse direction

8 outer side of the burner, combustion space
9 combustion chamber
10 gas mixture
11 diffuser segments
12 separation slits
13 inner side
14 covering strips
15 free edges of segments 11
16 maximum width
17 central region
18 end
19 contact sections
20 perforation
21 transverse edges of segments
22 segment length
23 segment width
24 closing portions
25 longitudinal end zones
26 transverse edges of the framework
27 connection ends of segments 11
28 covering framework
29 outer strip portions
30 contact surface of the covering strips
31 inner surface of the diffuser
32 central rib of the strips
33 outer frame of the covering framework
34 local stiffening ribs
35 passage opening of the framework
36 distributor
37 perforated portions of the distributor

Claims

1. A gas burner (1), in particular a premixed gas burner, comprising:

- a framework (2) made of impermeable sheet metal, having an outer peripheral portion (3) connectable to a combustion chamber (9),
- a diffuser (4) made of perforated sheet metal supported by the framework (2), the diffuser (4) forming a combustion surface (5) and having a longitudinal extension in a longitudinal direction (6) and a transverse extension in a transverse direction (7), orthogonal to the longitudinal direction (6), wherein:
- the transverse extension of the combustion surface (5) is less than the longitudinal extension of the combustion surface (5),
- the combustion surface (5) faces an outer side (8) of the burner (1) so that a gas mixture (10) conveyed through the diffuser (4) can be combusted in the form of a flame pattern on the combustion surface (5),
- the diffuser (4) is formed by a plurality of diffuser segments (11) made of perforated sheet metal not belonging to the same piece of sheet metal and completely separated from one another by means of separation slits (12) and placed side-by-side along the separation slits (12), and wherein the separation slits (12) extend in the transverse direction (7) over the entire transverse extension of the diffuser (4),
- on an inner side (13) of the diffuser (4), opposite to the combustion surface (5), a plurality of covering strips (14) made of sheet metal is arranged, and each covering strip (14) extends along respectively one of the separation slits (12) overlapping and at least partially in contact with the free edges (15) of the two bordering diffuser segments (11), delimiting the separation slit (12), so as to cover each of said separation slits (12).

2. A burner (1) according to claim 1, wherein:

a) the combustion surface (5) is substantially flat and the separation slits (12) are substantially straight and parallel to one another, or
b) the combustion surface (5) is in the shape of a shell bulged towards the outer side (8).

3. A burner (1) according to claim 1, wherein:

- the combustion surface (5) is in the shape of a half-cylinder or a cylinder portion, with constant cross-section, with the exception of the local interruptions due to the separation slits (12) and the perforation, and
- the separation slits (12) are straight in a top view and are in the shape of an arc of a circle in cross-section,
- the separation slits (12) are parallel to one another.

4. A burner (1) according to any one of the preceding claims, wherein the separation slits (12) have a maximum width (16) in the longitudinal direction (6) of less than 1 mm.

5. A burner (1) according to any one of the preceding claims, wherein the separation slits (12) have a shape gradually converging from a central region (17) towards two opposite ends (18) of the separation slit (12).

6. A burner (1) according to any one of the preceding claims, wherein the separation slits (12) form zero-thickness contact sections (19) where the free edges (15) of the bordering diffuser segments (11) abut in contact with one another.

7. A burner (1) according to claim 6, wherein the contact sections (19) are positioned at opposite ends (18) of the separation slits (12).

8. A burner (1) according to any one of the preceding claims, wherein the diffuser segments (11) are formed from sheet steel having a thickness of the single sheet metal in the range from 0.3 mm to 3 mm, or in the range from 0.5 mm to 1.5 mm, or of 0.9 mm.

9. A burner (1) according to any one of the preceding claims, wherein the diffuser segments (11) are multilayer structures made of stacked sheet steel.

10. A burner (1) according to any one of the preceding claims, wherein:

- the diffuser segments (11) consist each of a plate bent in the shape of an arc,
- opposite ends (27) of the plate form two arc bases and are bent towards the outside of the arc and oriented in a common plane parallel to a plane of the framework (2),
- the opposite ends (27) of the plate form connection ends for connecting the diffuser segment (11) to the framework (2).

11. A burner (1) according to any one of the preceding claims, wherein the covering strips (14) are portions of a covering framework (28) formed from a single piece of sheet metal.

12. A burner (1) according to any one of the preceding claims, wherein the covering strips (14) form:

- two outer strip portions (29) extending along the separation slit (12) and forming a contact surface (30) facing the diffuser (4) and having a smooth shape complementary to the shape of an inner surface (31) of the diffuser segments (11), the contact surface (30) and the inner surface (31) being in wide contact with each other,
- a central rib (32) extending centrally between the two outer strip portions (29) and forming a relief towards the inside of the burner (1) so as to stiffen the covering strips.

13. A burner (1) according to claim 11, wherein:

- the covering framework (28) forms an outer frame (33), consisting of two opposite sheet metal strips, from which the covering strips (14) extend and which lies on a plane parallel to the plane of the framework (2), or
- the diffuser (4) is sandwiched and held between the framework (2) and the covering framework (28).

14. A burner (1) according to claim 13, wherein the outer frame (33) forms one or more local stiffening ribs (34).

15. A burner (1) according to any one of the preceding claims, comprising a distributor (36) made of perforated sheet metal with larger openings than the perforation openings of the diffuser (4), wherein the distributor (36) is placed on the inner side (13) of the diffuser (4),
wherein the covering strips (14) are formed by unperforated portions of the distributor (36) which protrude with respect to perforated portions (37) of the distributor (36) towards the outside of the burner (1) and which rest in contact against the diffuser segments (11).

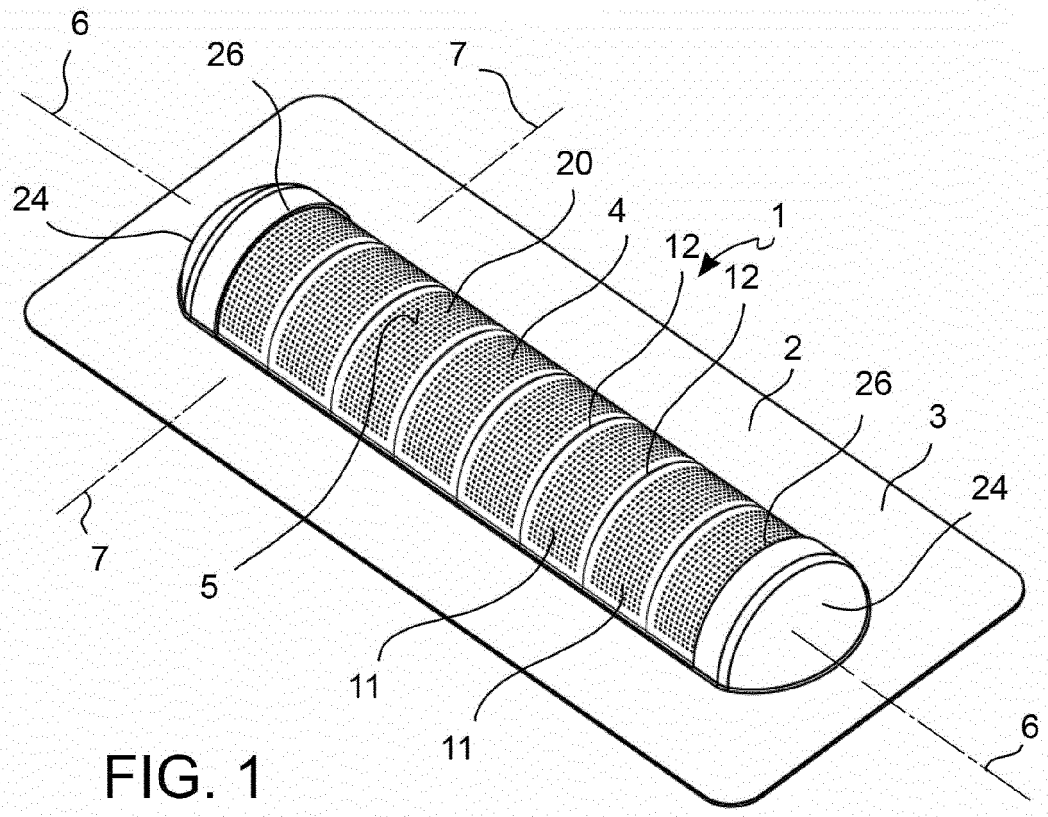


FIG. 1

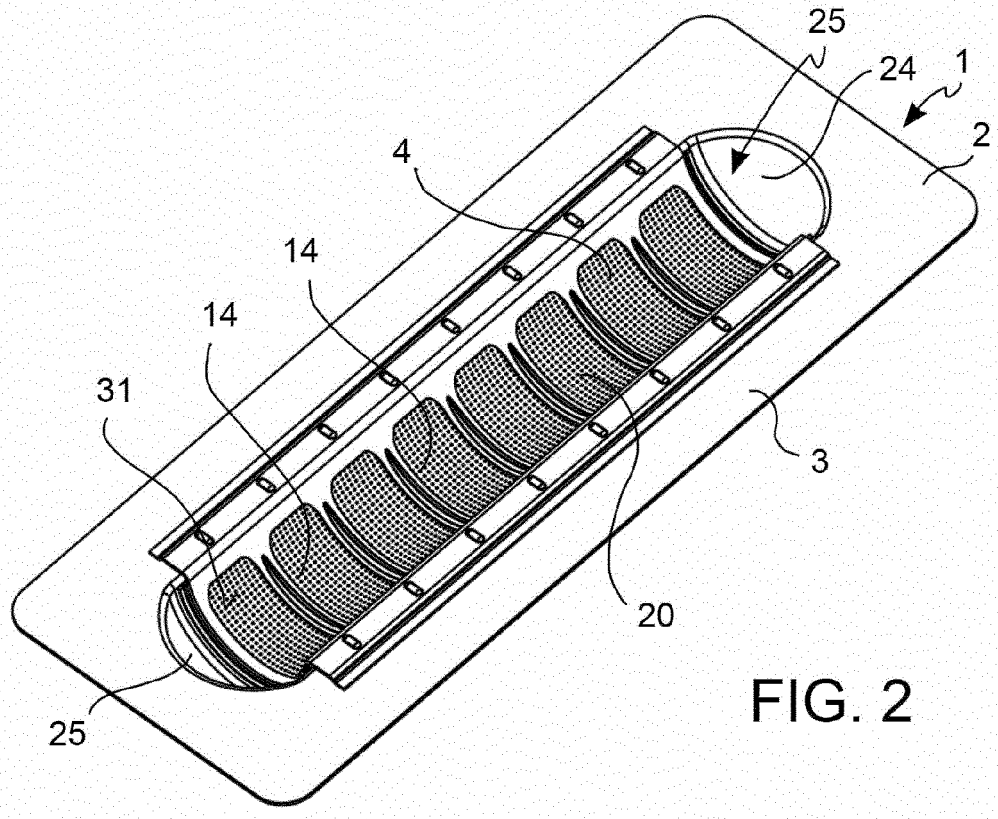


FIG. 2

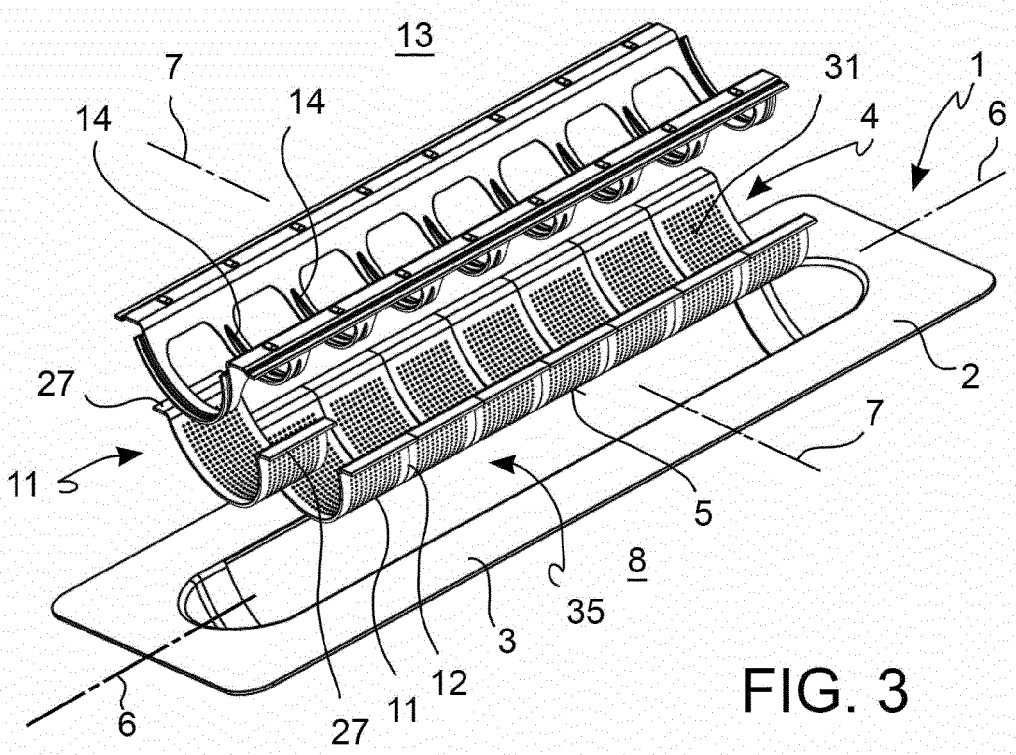
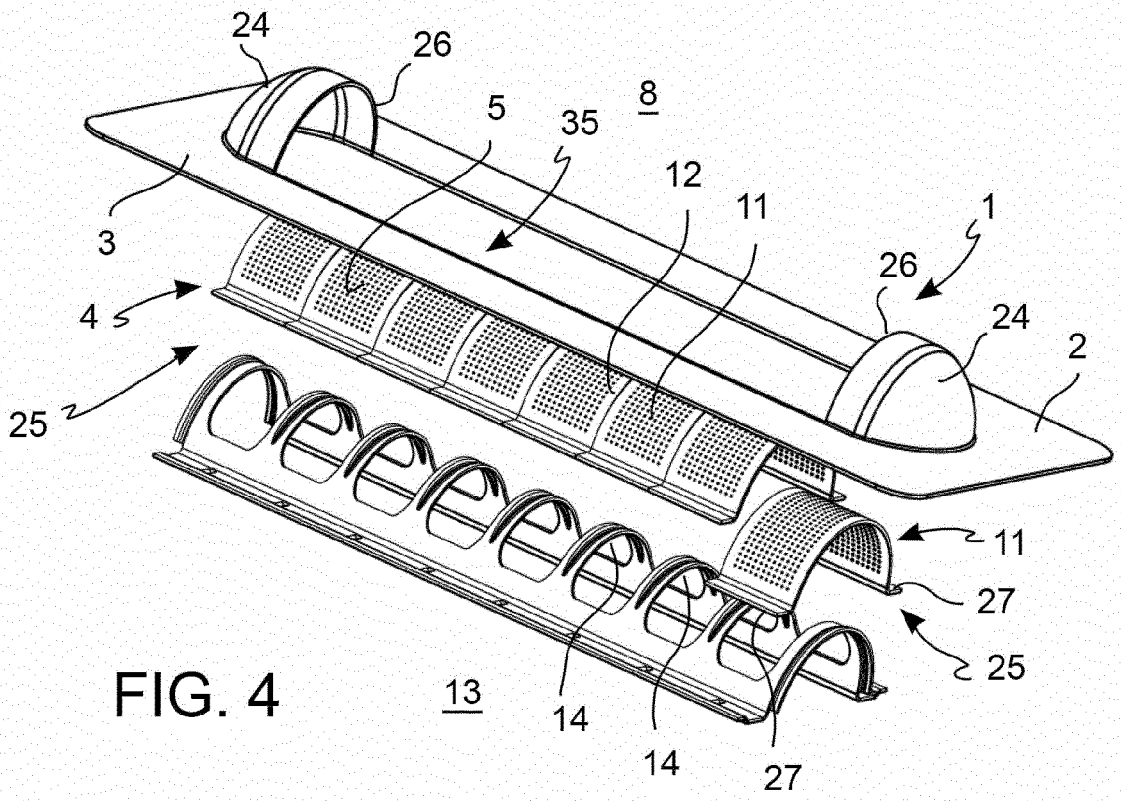

13
7
14
14
31
1
4
6
27
2
11
7
5
8
35
3
12
27
11
6

FIG. 3


24
26
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14
27
13

FIG. 4

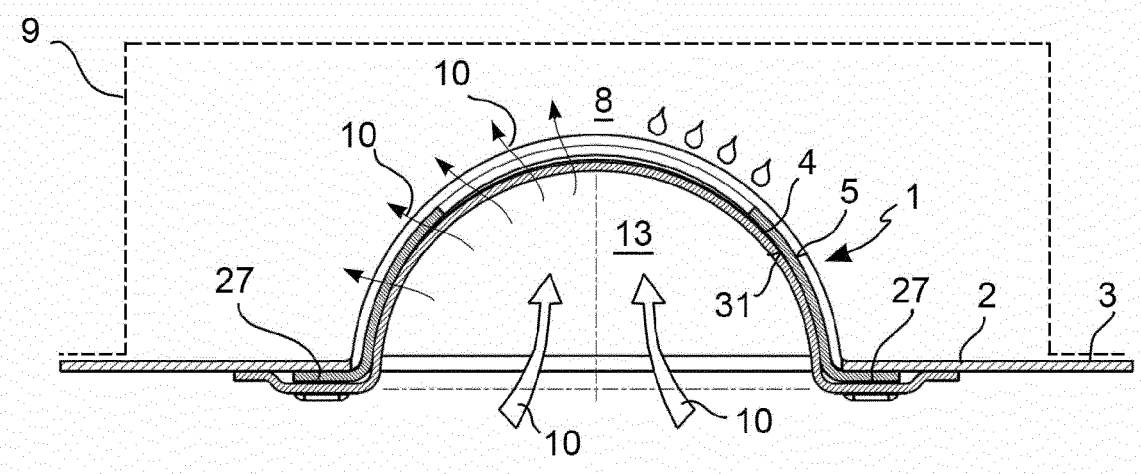

FIG. 5

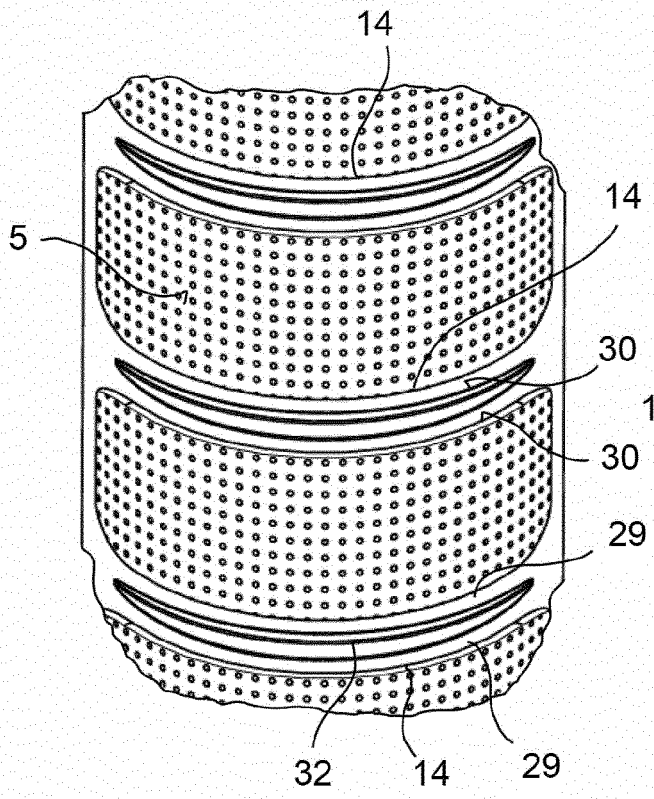

FIG. 6

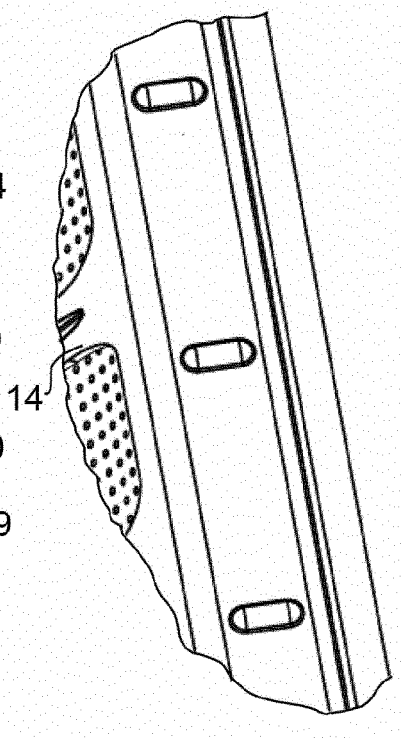

FIG. 7

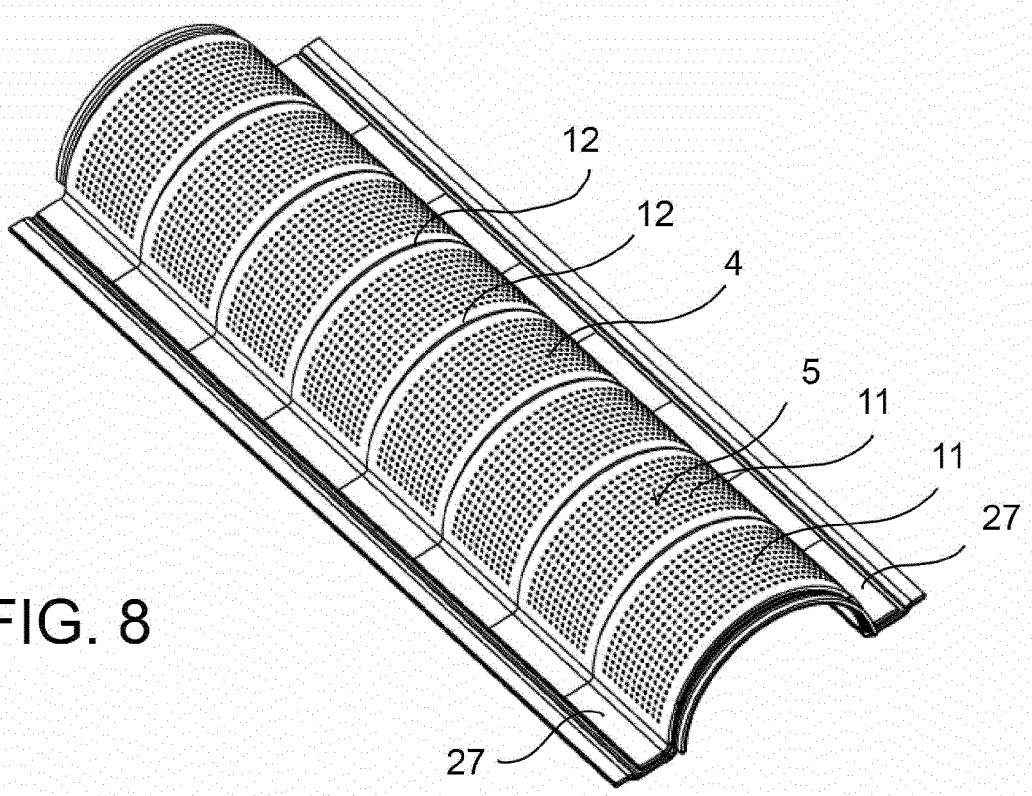

FIG. 8

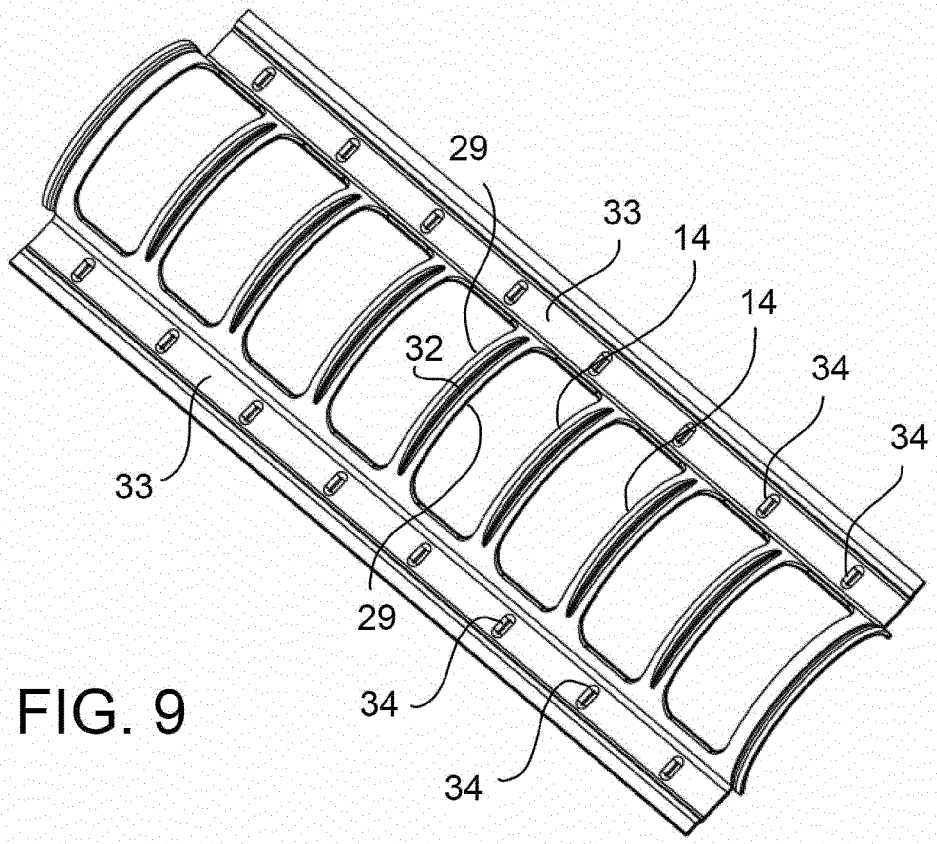

FIG. 9

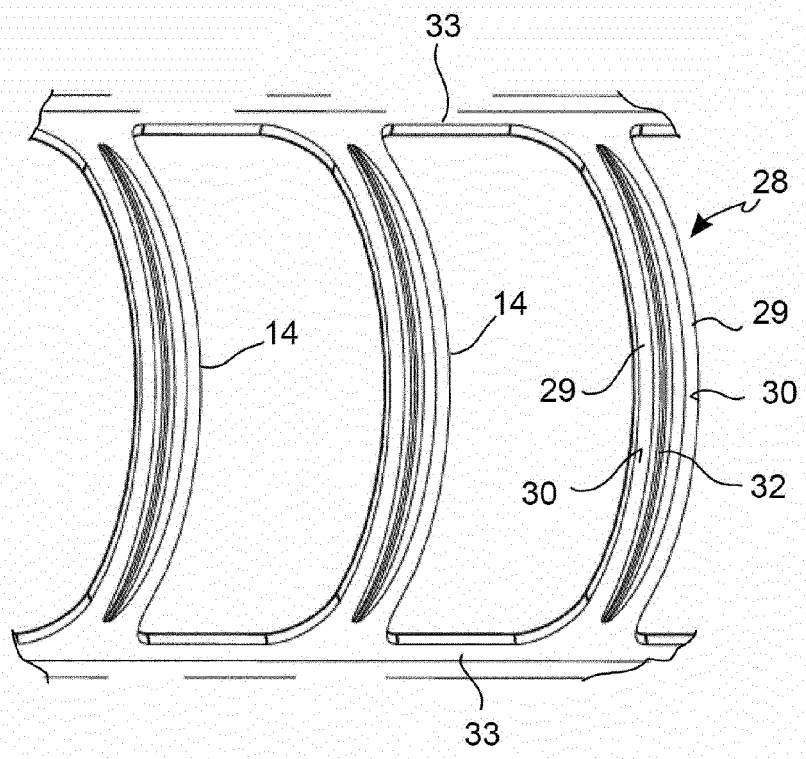

FIG. 10

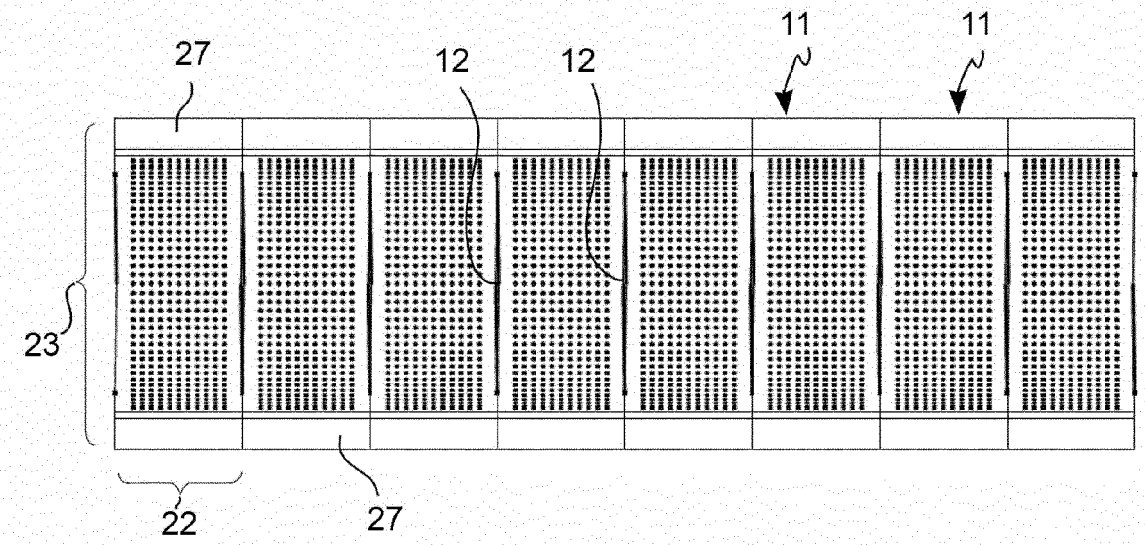

FIG. 11

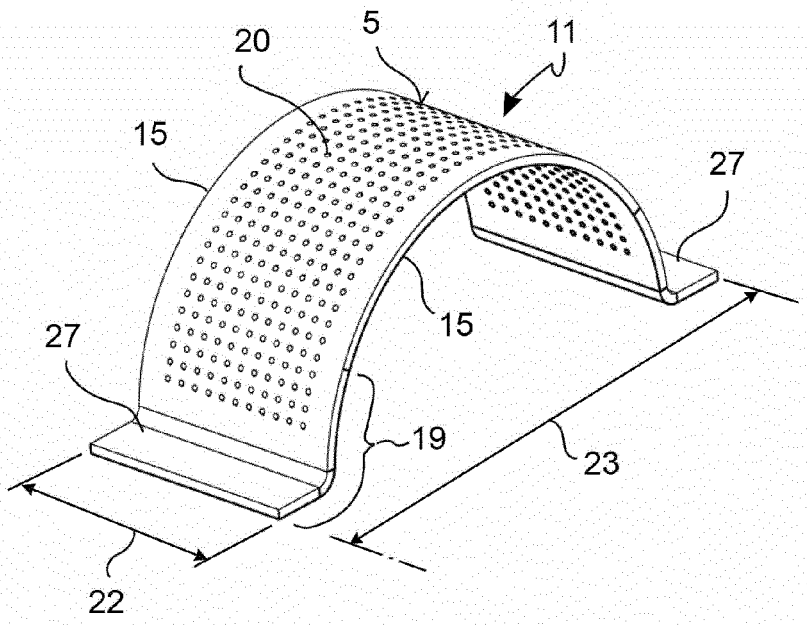

FIG. 12

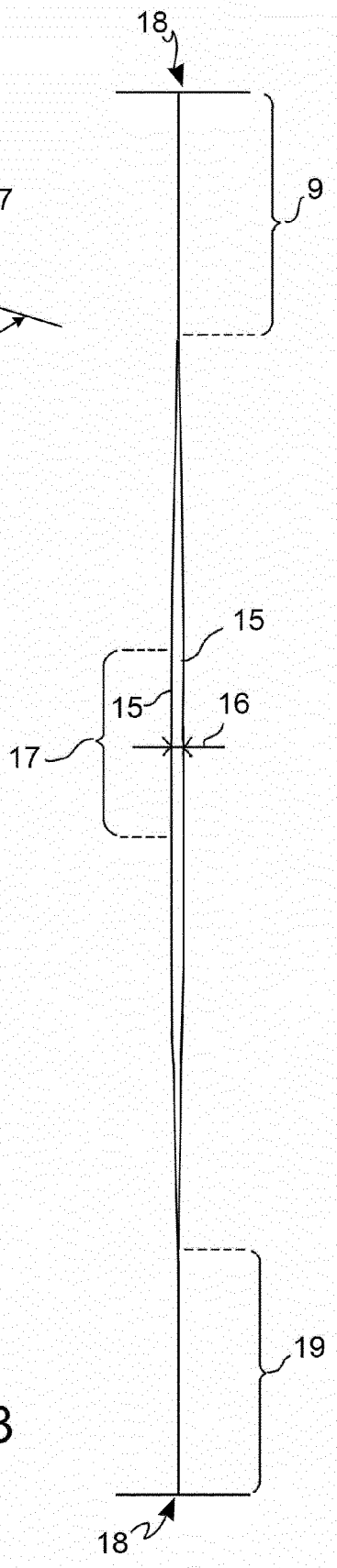

FIG. 13

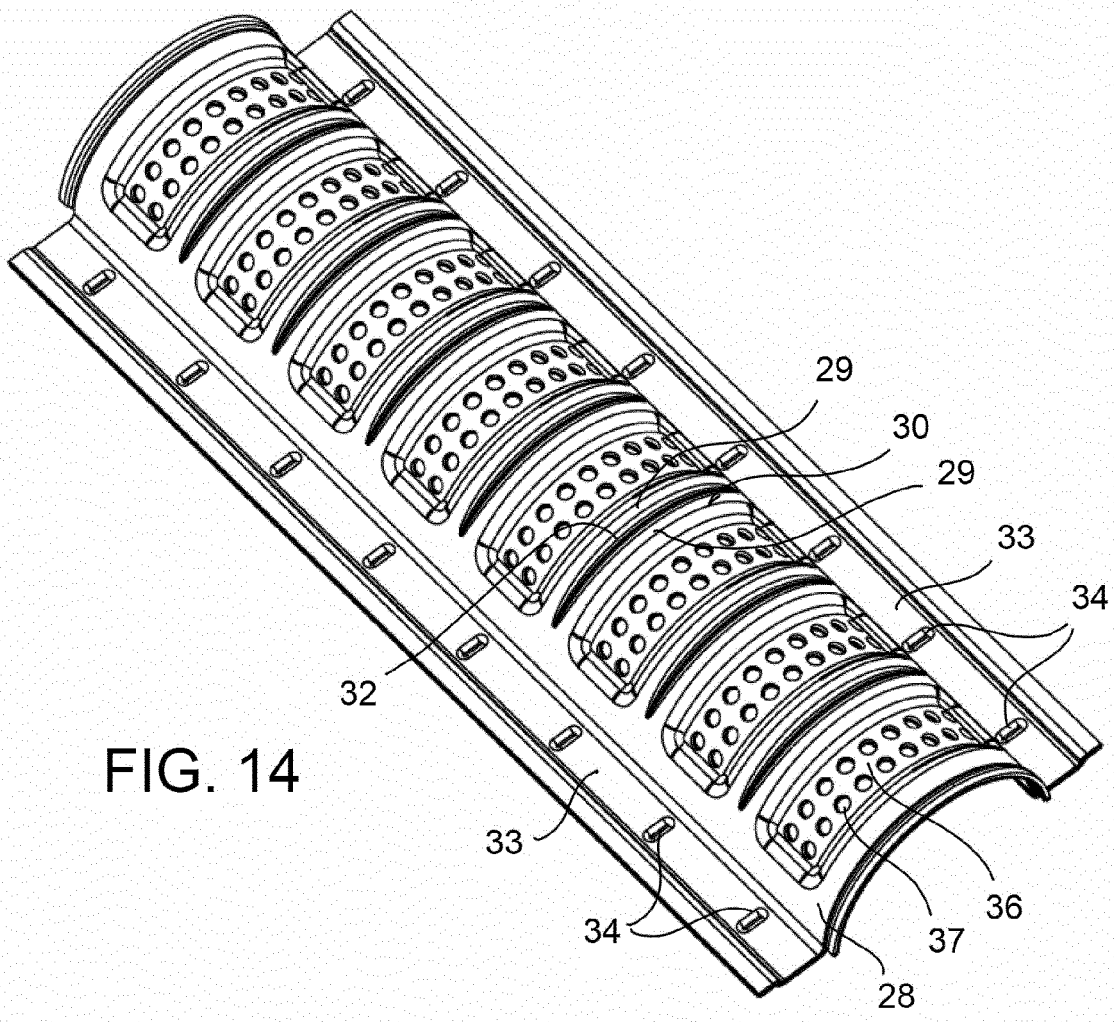

FIG. 14

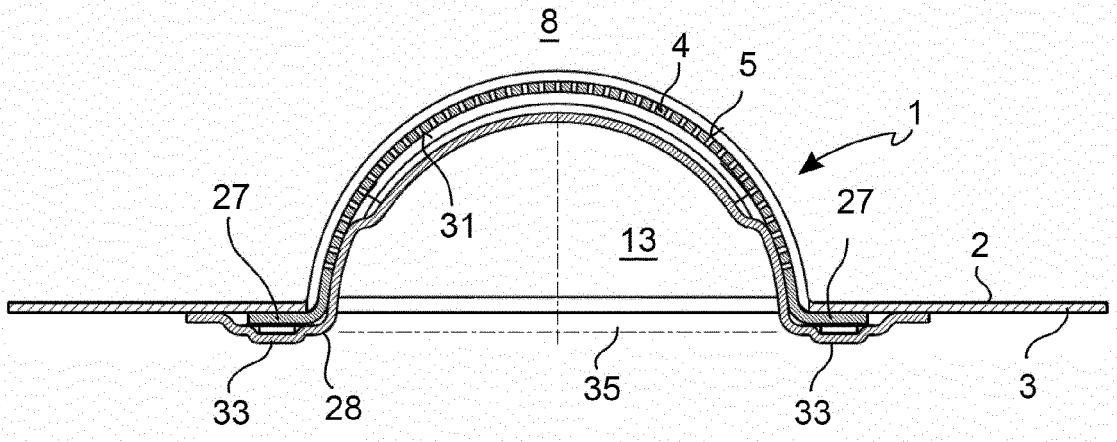

FIG. 15

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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 6528

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 3 412 967 A1 (WORGAS BRUCIATORI SRL [IT]) 12 December 2018 (2018-12-12) * paragraphs [0001] - [0003], [0014], [0015]; figures 1,3-8,12 * * paragraph [0017] - paragraph [0028] * * paragraph [0035] - paragraph [0043] * * paragraph [0046] - paragraph [0049] *	1-15	INV. F23D14/10
A	NL 8 801 383 A (NEFIT NV) 18 December 1989 (1989-12-18) * page 1, line 1 - line 4; figures 1,2 * * page 1, line 36 - page 2, line 15 * * page 2, line 22 - line 34 * * page 3, line 6 - page 4, line 12 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	1 June 2023	Hauck, Gunther

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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01-06-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3412967 A1	12-12-2018	CN 109000251 A	14-12-2018
		EP 3412967 A1	12-12-2018
NL 8801383 A	18-12-1989	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- EP 3412967 A1 **[0010] [0013]**