(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 111 139 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
15.07.2020 Bulletin 2020/29

(21) Application number: **15714673.9**

(22) Date of filing: **11.02.2015**

(51) Int Cl.:
F23C 3/00 *(2006.01)* ***F23C 7/00*** *(2006.01)*
F23D 14/22 *(2006.01)* ***F23L 13/00*** *(2006.01)*

(86) International application number:
PCT/IT2015/000030

(87) International publication number:
WO 2015/121883 (20.08.2015 Gazette 2015/33)

(54) **BURNER**

BRENNER

BRÛLEUR

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **11.02.2014 IT MO20140029**

(43) Date of publication of application:
04.01.2017 Bulletin 2017/01

(73) Proprietor: **Ancora S.p.A.**
41049 Sassuolo (MO) (IT)

(72) Inventor: **Benfenati, Alberto**
41049 Sassuolo (MO) (IT)

(74) Representative: **Feltrinelli, Secondo Andrea**
APTA S.r.l.
Patent Department
Via Ca' di Cozzi, 41
37124 Verona (IT)

(56) References cited:
WO-A1-2011/120597
DE-A1- 1 401 798
GB-A- 1 536 166
US-A- 2 839 080

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 3 111 139 B1

Description

Technical Field

[0001] The present invention relates to a burner, usable in both the industrial and civil sector.

Background Art

[0002] Burners are used in the ceramic industry, for example, inside the equipment for the heat treatment of ceramic products, such as kilns and dryers.

[0003] The burners of known type generally comprise a first tubular element, which defines a flow duct of a combustion fluid, a second tubular element arranged externally to the first tubular element, where the volume placed between them defines a flow duct of a combustive fluid, generally air, and a third tubular element arranged externally to the second tubular element and defining the outlet mouth of the flame of the burner itself.

[0004] In correspondence to the extremity of the first tubular element is arranged a combustion head, in correspondence to which the mixing occurs between the combustion fluid and the combustive fluid and the combustion of this mixture.

[0005] On the external surface of the second tubular element are defined a plurality of openings able to allow the flow of one part of the combustive fluid flowing along the relevant duct inside the gap defined between the second and the third tubular element.

[0006] The air flowing inside the duct defined between the first and the second tubular element is also called "primary air", as it participates directly in the combustion, while the air escaping from said openings and flowing between the second and the third tubular element, reaching the combustion head laterally, is defined as "secondary air".

[0007] These openings have in particular the function of allowing venting of any combustive fluid in excess, so as to avoid phenomena of flame detachment that might occur in case of the flow of combustive fluid reaching the combustion area with an excessive speed, causing the detachment of the flame and the consequent stop of the burner.

[0008] These burners of known type do have a number of drawbacks.

[0009] In particular, the burners on the market today do not allow to adjust the amount of combustive fluid which passes through the openings defined on the second tubular element, or the amount of secondary air which crosses the gap placed between the second and the third tubular element.

[0010] This considerably limits the maximum flow rate of the combustive fluid that can be sent to the burner in the pre-heating zones, since an excessive flow rate can not be disposed of.

[0011] The amount of combustive fluid that passes through these openings only depends on the load losses incurred along the path, thus making it difficult to manage the flame in the various areas of a ceramic kiln in which excesses of air different to one another are required. A burner having the features specified in the preamble of claim 1 is known from WO 2011/120597 A1.

Description of the Invention

[0012] The main aim of the present invention is to provide a burner which allows to adapt to the specific operating needs, by adjusting the flow rate of secondary air and, therefore, without resulting in the detachment of the flame.

[0013] Within this aim, one object of the present invention is to adapt the stoichiometric ratio, by adjusting the flow rate of secondary air, depending on the specific area of the ceramic kiln in which the burner is located.

[0014] One object of the present invention is to optimize the efficiency of the burner according to the specific operating needs.

[0015] Another object of the present invention is to avoid detachment of the flame in the pre-heating zones of a ceramic kiln and at the same time to reduce the firing cycles of the kiln itself.

[0016] Another object of the present invention is to provide a burner which allows to overcome the mentioned drawbacks of the prior art within the ambit of a simple, rational, easy and effective to use as well as affordable solution.

[0017] The above mentioned objects are achieved by the present burner according to claim 1.

Brief Description of the Drawings

[0018] Other characteristics and advantages of the present invention will become better evident from the description of a preferred, but not exclusive embodiment of a burner, illustrated by way of an indicative, but not limitative example in the accompanying drawings in which:

Figure 1 is an axonometric view of a burner according to the invention;
Figure 2 is a longitudinal sectional view of the burner of Figure 1;
Figure 3 is a partial axonometric view of the burner of Figure 1, with the covering element in a closing configuration;
Figure 4 is a partial axonometric view of the burner of Figure 1, with the covering element in an opening configuration.

Embodiments of the Invention

[0019] With particular reference to these figures, it is globally indicated by reference number 1 a burner according to the invention, usable for both civil and industrial applications.

[0020] The burner 1 comprises a body 2 having a first

tubular element 3 defining a first duct 3a for the flow of a combustion fluid, a second tubular element 4 arranged externally to the first tubular element 3, where the volume placed between the first and the second tubular element 3 and 4 defines a second duct 4a for the flow of a combustive fluid, and a third tubular element 5 arranged externally to the second tubular element 4 and defining the outlet mouth 6 of the flame of the burner itself, where the volume interposed between the second and third tubular element 4 and 5 defines a gap 5a external to the second duct 4a.

[0021] The second tubular element 4 has a plurality of first openings 7 which allow the flow of the combustive fluid from the second duct 4a towards the gap 5a.

[0022] As already mentioned above, it is hereinafter referred to as "primary air" the air that passes through the second duct 4a and as "secondary air" the air that runs through the gap 5a.

[0023] The burner 1 also comprises at least a combustion head 8 associated with the body 2 and arranged in correspondence to the extremity of the first tubular element 3.

[0024] The combustion head 8 defines a combustion area 9 in correspondence to which the mixing occurs between the combustion fluid and the combustive fluid as well as the ignition of the flame.

[0025] More particularly, flame ignition means 10 are provided, such as, e.g., a pair of electrodes that pass through the second duct 4a and the extremities of which are arranged in correspondence to the combustion area 9.

[0026] As is known to the expert in the field, the first openings 7 are able to convey inside the gap 5a the amount of combustive fluid in excess, in particular in the pre-heating zones of a ceramic kiln, in order to avoid detachment of the flame that might occur in the event of the combustive fluid reaching the combustion area 9 with an excessive speed.

[0027] The third tubular element 5 therefore covers the outside of the first and the second tubular element 3 and 4 and contains the combustion head 8. The outlet mouth 6 defined by the third tubular element 5 is spaced away from the combustion head 8.

[0028] According to the invention, the burner 1 comprises at least a covering element 11 arranged externally to the second tubular element 4 and movable with respect to it to vary the flow section of the first openings 7.

[0029] The covering element 11 is then interposed between the second and the third tubular element 4 and 5.

[0030] Advantageously, the covering element 11 has a plurality of second openings 12 which can be superimposed to the first openings 7 as a result of the movement of the covering element 11 with respect to the second tubular element 4.

[0031] More in detail, the covering element 11 is movable between a closing configuration, wherein it obstructs the first openings 7 at least partially so as to partialize the amount of combustive fluid entering the gap 5a, and an opening configuration, wherein the second openings 12 are completely superimposed to the first openings 7 so as to allow the flow of the combustive fluid through the entire flow section of the first openings themselves, passing through at least one intermediate configuration between the closing configuration and the opening configuration. In the closing configuration, the flow section of the combustive fluid through the first openings 7 is minimum and increases as it moves close to the opening configuration.

[0032] Preferably, the covering element 11 has a tubular shape, is fitted externally to the second tubular element 4 and is movable in rotation with respect to the latter, the first and second openings 7 and 12 being angularly spaced from one another.

[0033] More particularly, the first and second openings 7 and 12 have the same angular distance between them, so that in the opening configuration each second opening 12 is superimposed to a respective first opening 7.

[0034] Suitably, the covering element 11 is movable in a continuous manner with respect to the second tubular element 4, so as to allow its positioning in a plurality of intermediate configurations.

[0035] Advantageously, the burner 1 also comprises locking means 13 of the angular position of the covering element 11 with respect to the second tubular element 4.

[0036] More in detail, the locking means 13 comprise at least a through hole defined on the covering element 11 and in which a locking element (not shown in the illustrations), such as a threaded element, is insertable in a removable manner and is able to rest against the external surface of the second tubular element 4.

[0037] The operation of the present invention, with specific reference to the use in a ceramic kiln, is as follows.

[0038] Depending on the area of the kiln in which the burner 1 is positioned and based therefore on the operating condition required, intervention is made on the covering element 11 in order to adjust the flow section of the first openings 7 and, consequently, the amount of primary air that reaches the combustion head 8.

[0039] More particularly, in the burners 1 arranged in correspondence to the pre-heating zones of a ceramic kiln the covering element 11 is positioned in the opening configuration, so as to let the greater amount of air as possible pass through the first openings 7 and, therefore, along the gap 5a.

[0040] In this way the flow rate of the combustive fluid that reaches the combustion head 8 is not excessive and such as to "tear the flame", thereby making only the amount of combustive fluid participate in the combustion sufficient for the ignition and maintenance of the flame itself.

[0041] More particularly, by placing the covering element 11 in the opening configuration a large amount of air may be sent inside the burner 1, but only the amount needed to ignite and maintain the flame is conveyed along the second duct 4a and the remaining part diverted inside the gap 5a.

[0042] The position of the covering element 11 is therefore modified according to the required needs in the specific area of the kiln in which the burner 1 is positioned and, therefore, according to the parameters one wishes to control, such as the size of the environment to be heated, the air-gas stoichiometric ratio and the geometry of the flame.

[0043] For example, during the firing phase of a ceramic article, whenever one wishes to minimize the firing cycle and maximize production, the covering element 11 is brought to the closing configuration, so that the flow rate of the combustive fluid is almost entirely sent to the combustion head 8.

[0044] Each time the covering element 11 is positioned in the configuration of interest its position must be secured with respect to the second tubular element 4 by means of the locking means 13, i.e. by inserting the locking element within the relevant hole made in the covering element itself.

[0045] In practice it has been observed how the described invention achieves the proposed objects and in particular the fact is underlined that the burner making the subject of the present invention allows to adjust the amount of combustive fluid which participates directly in the combustion according to the specific requirements of the case.

[0046] More in detail, by adjusting the position of the covering element with respect to the second tubular element, the amount of primary air reaching directly the combustion head and of the secondary air passing through the outer gap is adjusted accordingly.

[0047] This allows to prevent the flame from tearing in the pre-heating positions of the kiln and at the same time to optimize the production cycle in the firing step.

[0048] Furthermore, by making a high amount of air passing through the gap interposed between the second and the third tubular element, in particular in the pre-heating zones, a very long flame geometry is obtained, thus facilitating the removal of the so-called "black heart" present in ceramic articles.

[0049] The burner according to the invention therefore allows to adjust the flow rate of the combustive fluid which participates directly in the combustion so as to maintain it within the stoichiometric ratio or even much above the same as is required in the pre-heating zones of a ceramic kiln.

[0050] This flexibility of use allows to maximize the efficiency of the burner itself in all areas of a ceramic kiln, optimizing the flow rate of air that directly participates in the combustion, thus overcoming the construction and adjustment drawbacks of the burners known so far.

[0051] In particular, by making the pre-heating phase of a ceramic article more efficient, the evacuation of the drying residual water is speeded up, as well as of the water of reaction and of the carbonaceous substances, thereby reducing the duration of the firing cycle.

Claims

1. Burner (1) comprising:

a body (2) having a first tubular element (3) defining a first duct (3a) for the flow of a combustion fluid, a second tubular element (4) arranged externally to said first tubular element (3), where the volume placed between said first and second tubular elements (3, 4) defines a second duct (4a) for the flow of a combustive fluid, and a third tubular element (5) arranged externally to said second tubular element (4) and defining an outlet mouth (6) of the flame, where the volume interposed between said second and third tubular elements (4, 5) defines an external gap (5a), said second tubular element (4) having a plurality of first openings (7) able to allow the flow of the combustive fluid from said second duct (4a) towards said external gap (5a),
at least a combustion head (8) associated with said body (2) in correspondence to the extremity of said first tubular element (3);
characterized in that it comprises at least a covering element (11) arranged externally to said second tubular element (4) and movable with respect to it to adjust the flow section of said first openings (7).

2. Burner (1) according to claim 1, **characterized in that** said covering element (11) is interposed between said second and said third tubular elements (4, 5).

3. Burner (1) according to claim 1 or 2, **characterized in that** said covering element (11) has a plurality of second openings (12) which can be superimposed to said first openings (7) as a result of the movement of said covering element (11) with respect to said second tubular element (4).

4. Burner (1) according to claim 3, **characterized in that** said covering element (11) is movable between a closing configuration, wherein it at least partially obstructs said first openings (7) and the flow section of the combustive fluid inside said gap (5a) is minimum, and an opening configuration, wherein the flow section of the combustive fluid through said first openings (7) is maximum.

5. Burner (1) according to claim 4, **characterized in that** said covering element (11) is positionable in at least an intermediate configuration between said opening configuration and said closing configuration, wherein said second openings (12) are partially superimposed to said first openings (7).

6. Burner (1) according to one or more of the preceding

claims 3 to 5, **characterized in that** said covering element (11) has a tubular shape, is fitted externally to said second tubular element (4) and is movable in rotation with respect to the latter, said first and said second openings (7, 12) being angularly spaced from one another.

7. Burner (1) according to the preceding claim, **characterized in that** said first and said second openings (7, 12) have the same angular distance between them.

8. Burner (1) according to one or more of the preceding claims, **characterized in that** it comprises removable locking means (13) of the angular position of said covering element (11) with respect to said second tubular element (4).

9. Burner (1) according to claim 8, **characterized in that** said locking means (13) comprise at least a through hole defined on said covering element (11) and engageable in a removable manner by at least a locking element able to rest against the external surface of said second tubular element (4).

Patentansprüche

1. Brenner (1) umfassend:

einen Körper (2) mit einem ersten rohrförmigen Element (3), das einen ersten Kanal (3a) für das Strömen eines Verbrennungsfluids definiert, einem zweiten rohrförmigen Element (4), das außerhalb des besagten ersten rohrförmigen Elements (3) angeordnet ist, in dem das zwischen dem besagten ersten und zweiten rohrförmigen Element (3, 4) angeordnete Volumen einen zweiten Kanal (4a) für das Strömen eines brennbaren Fluids definiert, und einem dritten rohrförmigen Element (5), das außerhalb des besagten zweiten rohrförmigen Elements (4) angeordnet ist und eine Auslassmündung (6) der Flamme definiert, in dem das zwischen dem zweiten und dritten rohrförmigen Element (4, 5) angeordnete Volumen einen äußeren Spalt (5a) definiert, wobei das besagte zweite rohrförmige Element (4) eine Vielzahl von ersten Öffnungen (7) aufweist, die in der Lage sind, das Strömen des brennbaren Fluids von dem besagten zweiten Kanal (4a) zu dem besagten äußeren Spalt (5a) zu ermöglichen,
mindestens einen Brennkopf (8), der mit dem besagten Körper (2) in Übereinstimmung mit dem Ende des besagten ersten rohrförmigen Elements (3) verbunden ist;
dadurch gekennzeichnet, dass er mindestens ein Abdeckelement (11) umfasst, das außerhalb des besagten zweiten rohrförmigen Elements (4) angeordnet und in Bezug auf dieses bewegbar ist, um den Strömungsabschnitt der besagten ersten Öffnungen (7) einzustellen.

2. Brenner (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** das besagte Abdeckelement (11) zwischen dem besagten zweiten und dem besagten dritten rohrförmigen Element (4, 5) angeordnet ist.

3. Brenner (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das besagte Abdeckelement (11) eine Vielzahl von zweiten Öffnungen (12) aufweist, die über den besagten ersten Öffnungen (7) als ein Ergebnis der Bewegung des besagten Abdeckelements (11) in Bezug auf das besagte zweite rohrförmige Element (4) gelagert werden können.

4. Brenner (1) nach Anspruch 3, **dadurch gekennzeichnet, dass** das besagte Abdeckelement (11) zwischen einer Schließkonfiguration, worin es die besagten ersten Öffnungen (7) mindestens teilweise versperrt und der Strömungsabschnitt des brennbaren Fluids innerhalb des besagten Spalts (5a) minimal ist, und einer Öffnungskonfiguration, worin der Strömungsabschnitt des brennbaren Fluids durch die besagten ersten Öffnungen (7) maximal ist, bewegbar ist.

5. Brenner (1) nach Anspruch 4, **dadurch gekennzeichnet, dass** das besagte Abdeckelement (11) in mindestens einer Zwischenkonfiguration zwischen der besagten Öffnungskonfiguration und der besagten Schließkonfiguration positionierbar ist, worin die besagten zweiten Öffnungen (12) teilweise über den besagten ersten Öffnungen (7) gelagert sind.

6. Brenner (1) nach einem oder mehreren der vorangegangenen Ansprüche 3 bis 5, **dadurch gekennzeichnet, dass** das besagte Abdeckelement (11) eine rohrförmige Form aufweist, außen an dem besagten zweiten rohrförmigen Element (4) angebracht ist und in Bezug auf das letztere drehbeweglich ist, wobei die besagten ersten und die besagten zweiten Öffnungen (7, 12) winkelmäßig voneinander beabstandet sind.

7. Brenner (1) nach dem vorangegangenen Anspruch, **dadurch gekennzeichnet, dass** die besagten ersten und die besagten zweiten Öffnungen (7, 12) den gleichen Winkelabstand zueinander aufweisen.

8. Brenner (1) nach einem oder mehreren der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** er lösbare Verriegelungsmittel (13) der Winkelposition des besagten Abdeckelements (11) in Bezug auf das besagte zweite rohrförmige Element (4) umfasst.

9. Brenner (1) nach Anspruch 8, **dadurch gekennzeichnet, dass** die besagten Verriegelungsmittel (13) mindestens ein Durchgangsloch umfassen, das auf dem besagten Abdeckelement (11) definiert ist und in einer lösbaren Weise mit mindestens einem Verriegelungselement in Eingriff bringbar ist, das in der Lage ist, an der Außenfläche des besagten zweiten rohrförmigen Elements (4) anzuliegen.

Revendications

1. Brûleur (1) comprenant :

un corps (2) ayant un premier élément tubulaire (3) définissant un premier conduit (3a) pour l'écoulement d'un liquide de combustion, un deuxième élément tubulaire (4) agencé à l'extérieur dudit premier élément tubulaire (3), dans lequel le volume placé entre ledit premier et ledit deuxième éléments tubulaires (3, 4) définit un deuxième conduit (4a) pour l'écoulement d'un liquide de combustion, et un troisième élément tubulaire (5) agencé à l'extérieur dudit deuxième élément tubulaire (4) et définissant un orifice de sortie (6) de la flamme, dans lequel le volume intercalé entre ledit deuxième et ledit troisième éléments tubulaires (4, 5) définit un espace extérieur (5a), ledit deuxième élément tubulaire (4) comportant une pluralité de premières ouvertures (7) permettant l'écoulement du liquide de combustion dudit deuxième conduit (4a) vers ledit espace extérieur (5a), au moins une tête de combustion (8) associée audit corps (2) au niveau de l'extrémité dudit premier élément tubulaire (3) ;
caractérisé en ce qu'il comprend au moins un élément de couverture (11) agencé à l'extérieur dudit deuxième élément tubulaire (4) et mobile par rapport à celui-ci pour ajuster la section d'écoulement desdites premières ouvertures (7).

2. Brûleur (1) selon la revendication 1, **caractérisé en ce que** ledit élément de couverture (11) est intercalé entre ledit deuxième et ledit troisième éléments tubulaires (4, 5).

3. Brûleur (1) selon la revendication 1 ou 2, **caractérisé en ce que** ledit élément de couverture (11) comporte une pluralité de deuxièmes ouvertures (12) pouvant être superposées auxdites premières ouvertures (7) en conséquence du mouvement dudit élément de couverture (11) par rapport audit deuxième élément tubulaire (4).

4. Brûleur (1) selon la revendication 3, **caractérisé en ce que** ledit élément de couverture (11) est mobile entre une configuration de fermeture, dans laquelle il obstrue au moins partiellement lesdites premières ouvertures (7) et la section d'écoulement du liquide de combustion à l'intérieur dudit espace (5a) est minimale, et une configuration d'ouverture, dans laquelle la section d'écoulement du liquide de combustion à travers lesdites premières ouvertures (7) est maximale.

5. Brûleur (1) selon la revendication 4, **caractérisé en ce que** ledit élément de couverture (11) peut être positionné dans au moins une configuration intermédiaire entre ladite configuration d'ouverture et ladite configuration de fermeture, dans laquelle lesdites deuxièmes ouvertures (12) sont partiellement superposées sur lesdites premières ouvertures (7).

6. Brûleur (1) selon l'une ou plusieurs des revendications 3 à 5 qui précèdent, **caractérisé en ce que** ledit élément de couverture (11) a une forme tubulaire, est disposé à l'extérieur dudit deuxième élément tubulaire (4) et est mobile en rotation par rapport à ce dernier, lesdites premières et lesdites deuxièmes ouvertures (7, 12) étant espacées angulairement les unes des autres.

7. Brûleur (1) selon la revendication précédente, **caractérisé en ce que** lesdites premières et lesdites deuxièmes ouvertures (7, 12) ont la même distance angulaire entre elles.

8. Brûleur (1) selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce qu'**il comprend des moyens de verrouillage amovibles (13) de la position angulaire dudit élément de couverture (11) par rapport audit deuxième élément tubulaire (4).

9. Brûleur (1) selon la revendication 8, **caractérisé en ce que** lesdits moyens de verrouillage (13) comprennent au moins un trou traversant défini sur ledit élément de couverture (11) et pouvant être accouplé de manière amovible par au moins un élément de verrouillage pouvant reposer contre la surface extérieure dudit deuxième élément tubulaire (4).

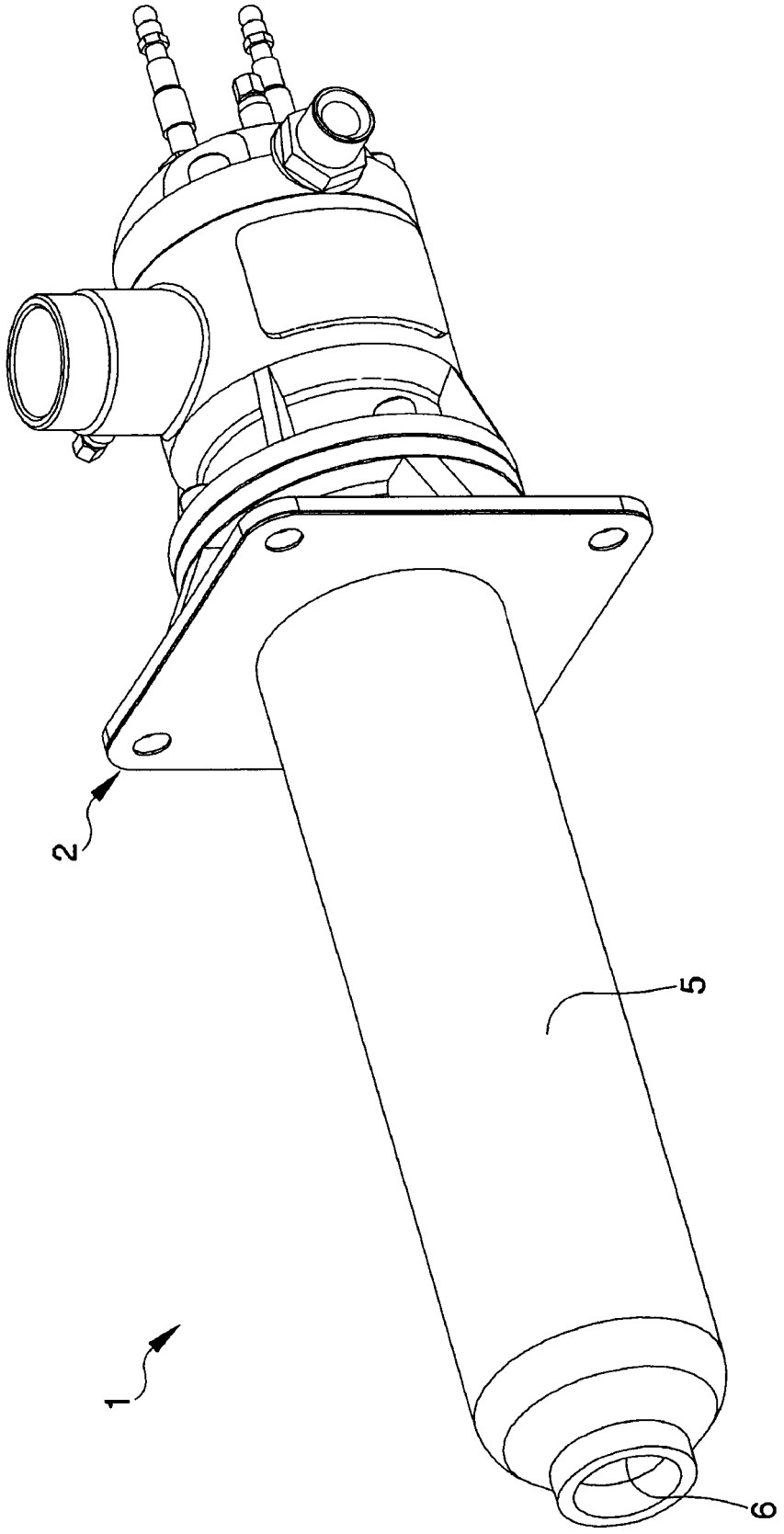


Fig. 1

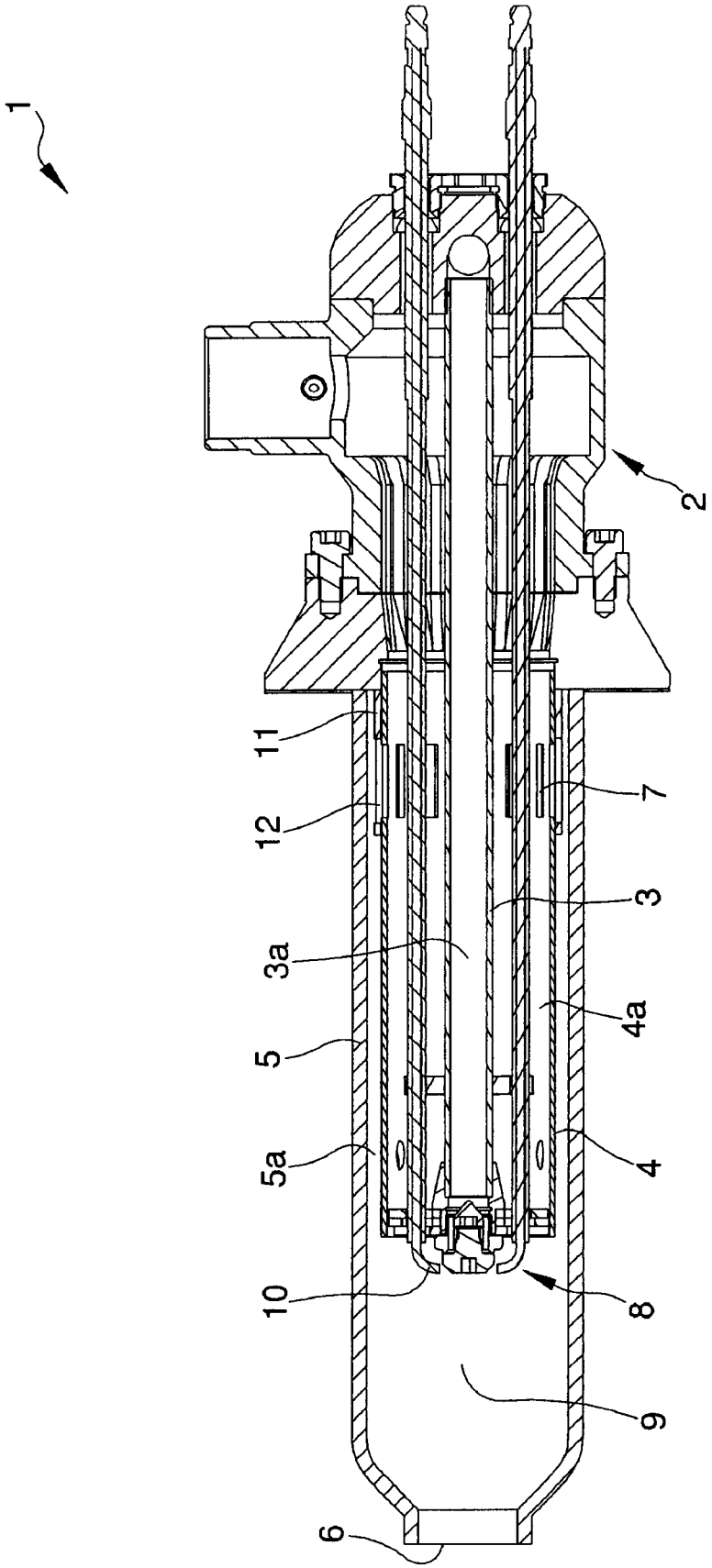


Fig. 2

Fig. 3

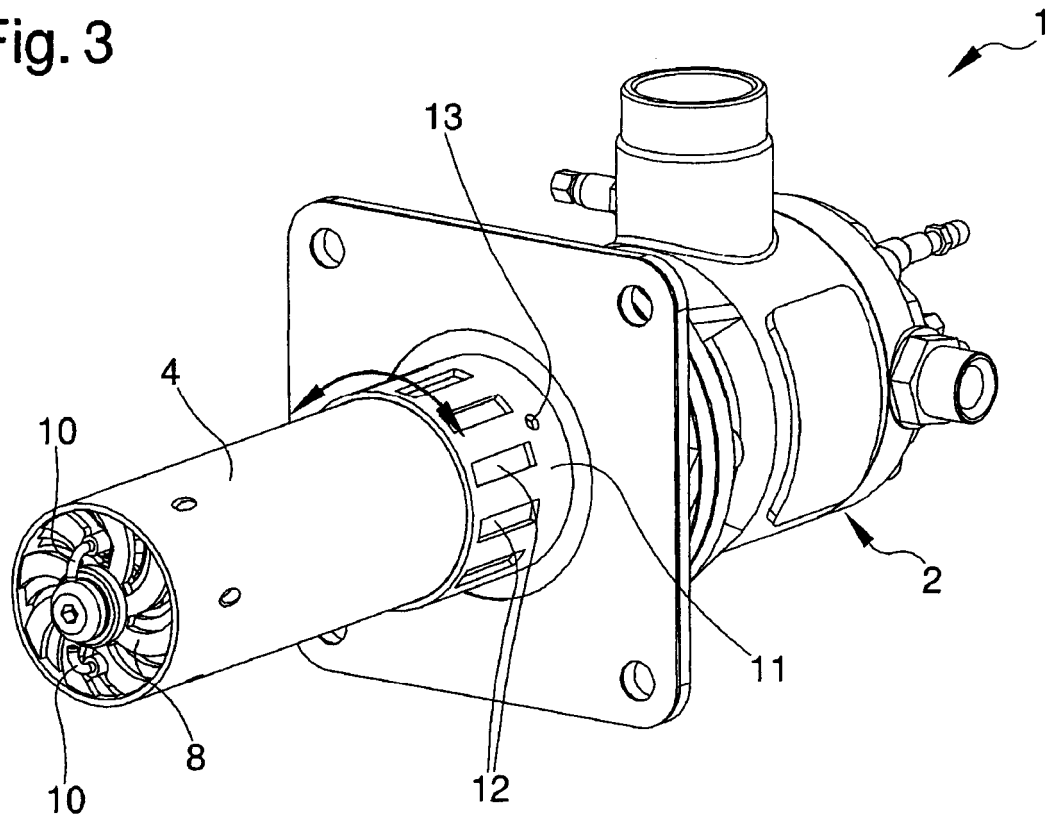
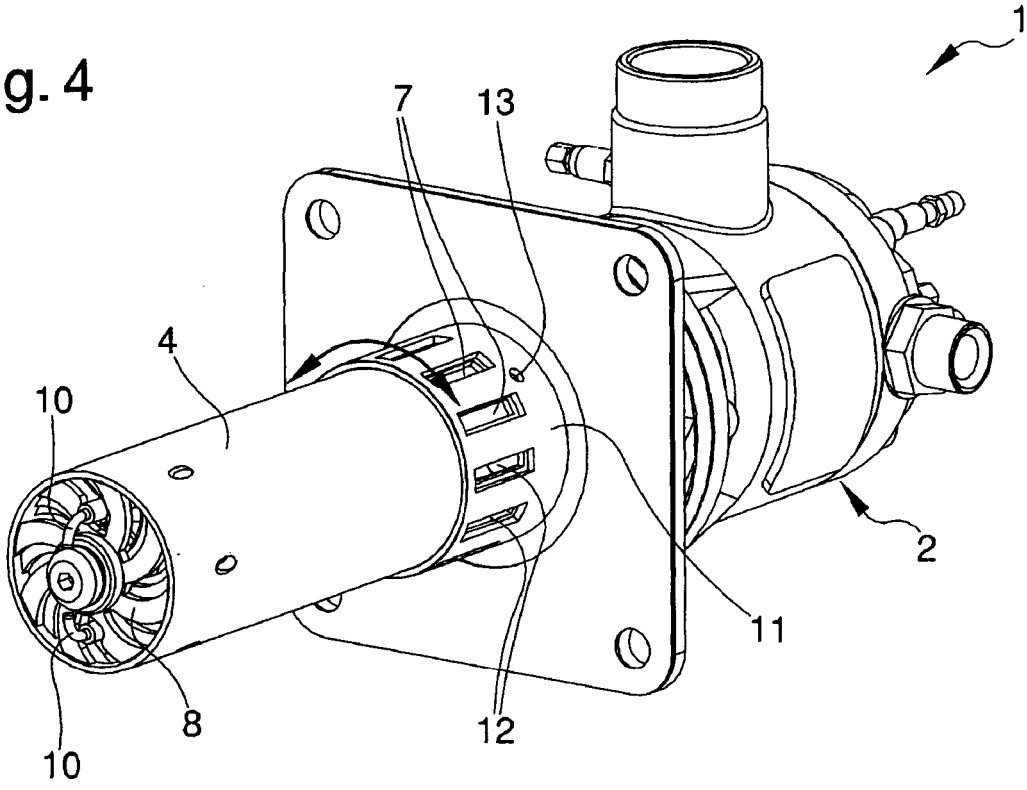


Fig. 4



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2011120597 A1 **[0011]**