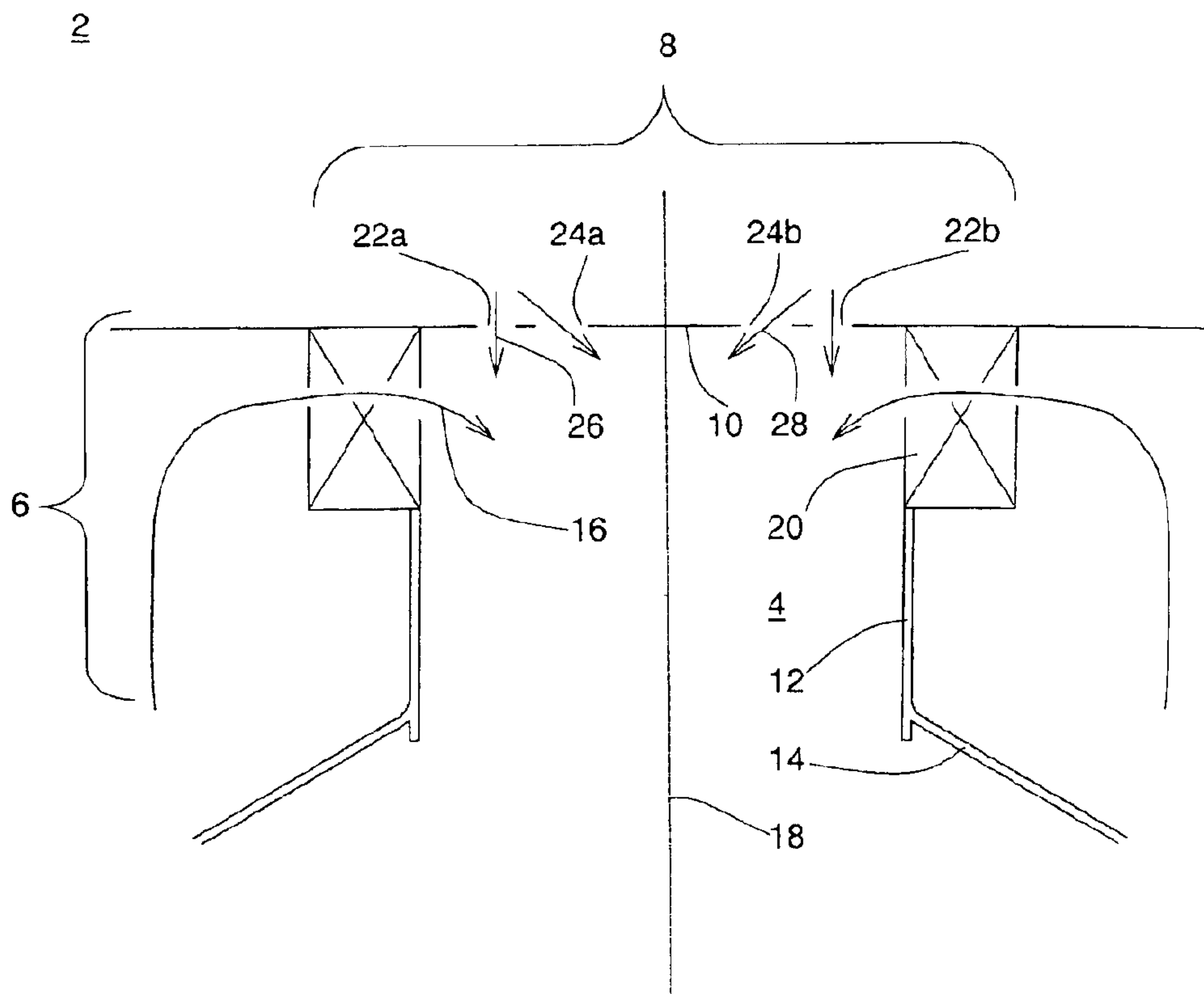




(86) Date de dépôt PCT/PCT Filing Date: 2008/11/03
(87) Date publication PCT/PCT Publication Date: 2009/10/23
(45) Date de délivrance/Issue Date: 2013/01/29
(85) Entrée phase nationale/National Entry: 2010/09/01
(86) N° demande PCT/PCT Application No.: EP 2008/009256
(87) N° publication PCT/PCT Publication No.: 2009/127240
(30) Priorité/Priority: 2008/04/16 (DE10 2008 019 117.5)

(51) Cl.Int./Int.Cl. *F23R 3/28* (2006.01),
F23R 3/34 (2006.01)
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(54) Titre : PROCEDE DE FONCTIONNEMENT D'UN BRULEUR A PRE-MELANGE ET BRULEUR A PREMELANGE
APPROPRIE POUR METTRE LEDIT PROCEDE EN OEUVRE
(54) Title: METHOD FOR OPERATING A PREMIX BURNER, AND A PREMIX BURNER FOR CARRYING OUT THE
METHOD



(57) Abrégé/Abstract:

A method is disclosed for operating a premix burner for gaseous fuels having a multi-stage pilot gas system (8) whose diffusion fuel is injected into a flame chamber (4) of the premix burner as at least two partial streams (26, 28) with different orientations, and a premix burner is disclosed for carrying out the method.

Abstract

A method is disclosed for operating a premix burner for gaseous fuels having a multi-stage pilot gas system (8) whose diffusion fuel is injected into a flame chamber (4) of the premix burner as at least two partial streams (26, 28) with different orientations, and a premix burner is disclosed for carrying out the method.

METHOD FOR OPERATING A PREMIX BURNER, AND A PREMIX BURNER FOR CARRYING OUT THE METHOD

The invention is directed to a method for operating a premix burner and to a premix burner for carrying out a method of this kind.

In order to reduce harmful emissions, combustion processes which are spark-ignited but which are then self-running are frequently operated in gas turbines by means of a main-flow fuel system or a main injection with a lean gas-air mixture generated outside the respective flame chamber. However, the lean gas-air mixture results in a narrow stability range in the respective combustion process. The narrower the stability range, the more susceptible the combustion process to changing operating conditions, which can result in an unintentional termination of the combustion process. For purposes of stabilizing the combustion process, known premix burners have a pilot gas system by means of which a pilot flame is formed in the flame chamber from a fuel that is not premixed. Apart from stabilizing the combustion process, the pilot flame often also serves to ignite the respective combustion process. Consequently, it is positioned in the vicinity of an ignition orifice of the premix burner. In so doing, stabilization of the combustion process is given priority over harmful emissions.

A premix burner for gaseous fuels and a method for controlling this premix burner are shown in DE 10 2005 054 442 A1. This premix burner has a multi-stage main injector with a plurality of main nozzles for injecting a gas-air mixture into a flame chamber and a central pilot gas system. In order to ignite the gas-air mixture, a pilot flame is formed by the pilot gas system from unmixed main fuel. Only a defined quantity of main nozzles are opened from the start until a predetermined load ratio. When falling below or exceeding a predetermined load ratio, additional main nozzles are switched on or main nozzles which are already operating are increased, respectively.

Another premix burner for gas turbines and a method for operating a premix burner of this kind are described in DE 103 34 228 A1. This premix burner for

gaseous fuels has a main injector and a central multi-stage pilot gas system. The main injector has a group of main nozzles for injecting a premixed main fuel. The central multi-stage pilot gas system has a group of diffusion nozzles for injecting unmixed diffusion fuel and an independently controllable group of premix nozzles for additional injection of premixed main fuel.

When the premix burner is ignited, the greater portion of fuel is introduced by the diffusion stages of the pilot gas system. As the load increases, the premix nozzles of the pilot gas system and the main nozzles of the main injector are switched on. The diffusion nozzles are reduced. At full load, the premix nozzles and main nozzles are fully operated and the diffusion nozzles are reduced to a minimum of the total mass flow of fuel.

This method has the disadvantage that the stability range of the combustion process is not substantially enlarged in spite of the multi-stage pilot gas system. Further, a complicated control of the fuel supply is necessary. Further, the premix burner reacts sensitively to changing fuel compositions.

It is an object of the present invention to provide a method for operating a premix burner for gaseous fuels that is more stable under changing ambient conditions and can be easily adapted to changing fuel compositions and fuel qualities, and a premix burner for carrying out a method of this kind.

It is also the object of the present invention to provide a method for the operation of a premix burner (2) for gas turbines with the following steps: injection of a gas/air mixture as primary fuel (16) through a swirl generator (20) into a flame chamber (4) positioned lengthwise to a burner longitudinal axis (18), central injection of a first partial flow (26) of a diffusion fuel into the flame chamber, which is added through a burner base (10) downstream of the primary fuel (16), central injection of a second partial flow (28) of the diffusion fuel into the flame chamber (4) that is added through the burner base (10) downstream of the primary fuel (16), characterized in that the injection of the first partial flow (26) is effected through at least one diffusion nozzle (22a, 22b, ...) positioned in the burner base (10) and arranged parallel to the burner longitudinal axis (18), thus lateral to the primary fuel flow formed in the flame chamber (4), and the injection of the second partial flow (28) is effected through at least one diffusion nozzle (24a, 24b, ...) positioned in the burner base and arranged at an angled position to the burner longitudinal axis (18).

In the method according to the invention, a gas-air mixture is injected by a main injector into a flame chamber as main fuel via a swirler. A diffusion fuel of a central pilot gas system is injected into the flame chamber in the form of at least two partial streams with different directions or orientations.

The injection of the diffusion fuel according to the invention as at least two partial streams with different orientations causes an effect similar to a premixing. At the same time, a combustion process with the injection according to the invention shows a substantially improved stability and increased flexibility under varying fuel compositions and fuel qualities.

In a preferred embodiment example, the first partial stream is injected transverse or perpendicular to the flow direction of a main fuel flow forming in the

flame chamber. The second partial stream is injected in the flow direction of the main fuel flow. The first partial stream transverse to the flow direction of the main fuel flow causes an effect similar to a premixing. The second partial stream in the flow direction of the main fuel flow shows less swirling and less mixing than the first partial stream transverse to the flow direction so that the proportion of diffusion fuel in the flow direction is less sensitive to changes and the respective combustion process runs in a more stable manner.

The gas-air mixture of the main injector is preferably introduced radially into the flame chamber.

10 In an embodiment example, the gas-air ratio of the main fuel is controlled by means of the air supply and not by means of turning the main fuel nozzles on or off.

A premix burner according to the invention for gaseous fuels has a flame chamber, a main injector for injecting a gas-air mixture as main fuel into the flame chamber, a swirler for swirling the main fuel, and a central pilot gas system arranged in the burner bottom for injecting a diffusion fuel. According to the invention, the pilot gas system is constructed so as to have multiple stages with at least one axial diffusion nozzle for injecting a first partial stream of the diffusion fuel and one or more diffusion nozzles which are arranged at an inclination to the longitudinal axis of the burner for injecting a second partial stream.

20 In an embodiment example, the at least one inclined diffusion nozzle is inclined in the flow direction of the main fuel flow.

A plurality of axial diffusion nozzles and inclined diffusion nozzles are preferably provided. The axial diffusion nozzles are positioned on the radially outer side of the burner bottom and the inclined diffusion nozzles are positioned on the radially inner side of the burner bottom.

The axial diffusion nozzles and inclined diffusion nozzles can form two or more concentric circles whose common center lies on the longitudinal axis of the burner.

The diffusion nozzles can have different geometries. For example, the diffusion nozzles are formed as bore holes, grooves or longitudinal slits.

The pilot gas system preferably has more axial diffusion nozzles than inclined diffusion nozzles. In particular, twice as many axial diffusion nozzles as inclined diffusion nozzles can be provided.

In one embodiment example, the premix burner is constructed as a can-shaped burner with an at least partially cylindrical flame tube which is at a distance from the burner bottom over the swirler.

Other advantageous embodiment examples of the invention are indicated below.

A preferred embodiment example of the invention is described more fully in the following with reference to schematic diagrams. The drawings show:

FIG.1 a longitudinal section through a premix burner according to the invention in the bottom region of the burner; and

FIG. 2 a top view of the burner bottom from FIG. 1.

FIG. 1 shows a highly simplified partial longitudinal section through a premix burner 2 according to the invention for a gas turbine. The premix burner 2 is constructed as a can-shaped burner with a cylindrical flame chamber 4 for gaseous or liquid fuel. It has a main injector 6 and a central multi-stage pilot gas system 8 according to the invention.

The flame chamber 4 is defined in axial direction on one side by a burner bottom 10 and radially by a flame tube 12. An end portion 14 of the flame tube 12 remote of the burner bottom 10 is widened in a funnel-shaped manner.

The main injector 6 serves to inject a gas-air mixture as premixed main fuel 16. The injection is carried out radially to the longitudinal axis 18 of the burner by means of main nozzles, not shown, which open into a radial swirler 20. The main injector 24 preferably has main nozzles.

The radial swirler 20 is arranged between the burner bottom 10 and the flame tube 12. It causes the main fuel 16 to be acted upon by a swirling momentum and to enter the flame chamber 4 in a swirling manner. A main fuel flow whose direction is indicated by its respective arrows is formed in the flame chamber 4.

The pilot gas system 8 serves to inject a diffusion fuel which is not premixed and has a plurality of axial diffusion nozzles 22a, 22b and a plurality of diffusion

nozzles 24a, 24b which are arranged at an inclination to the burner longitudinal axis 18. The diffusion fuel is injected into the flame chamber 4 by the axial diffusion nozzles 22a, 22b and the inclined diffusion nozzles 24a, 24b as two partial streams 26, 28.

5 The axial diffusion nozzles 22a, 22b and the inclined diffusion nozzles 24a, 24b are arranged in the burner bottom 10 so that an injection of the partial streams 26, 28 is carried out downstream of the entrance of the main fuel flow 16. The axial diffusion nozzles 22a, 22b transverse to or perpendicular to the flow direction of the main fuel 16 in the flame chamber 4 cause the first partial stream 26 to be mixed with
10 the main fuel 16 in a particularly intensive manner. The inclined diffusion nozzles 24a, 24b are oriented in such a way that the second partial stream 28 is injected into the flame chamber 4 in the flow direction of the swirled main fuel 16 and the mixing is accordingly minimized, which promotes the stability of the combustion process.

 According to the front view of the burner bottom 10 in Figure 2, the axial
15 diffusion nozzles 22a, 22b, ... and the inclined diffusion nozzles 24a, 24b, ... form two concentric circles whose common center 30 lies on the burner longitudinal axis 18. The axial diffusion nozzles 22a, 22b, ... are accordingly positioned on the radially outer side and the inclined diffusion nozzles 24a, 24b, ... are positioned on the radially inner side. The diffusion nozzles 22a, 22b, ..., 24a, 24b, ... are uniformly
20 distributed over the respective circle. In the present embodiment example, 24 axial diffusion nozzles 22a, 22b, ... and 12 inclined diffusion nozzles 24a, 24b, ... are provided. Accordingly, there are twice as many axial diffusion nozzles 22a, 22b, ... as inclined diffusion nozzles 24a, 24b, The quantity of axial diffusion nozzles 22a, 22b, ... corresponds to the quantity of main nozzles.

25 The axial diffusion nozzles 22 and the inclined diffusion nozzles 24 are formed as bore holes in this embodiment example.

 In a preferred method according to the invention for operating the premix burner 2, a swirled gas-air mixture of the main injector 6 is injected radially into the flame chamber 4 via the radial swirler 20. A diffusion fuel is injected into the flame
30 chamber 4 as a first partial stream 26 and a second partial stream 28 by means of the multi-stage pilot gas system 8. The first partial stream 26 is injected into the flame chamber 4 by the axial diffusion nozzles 22a, 22b, ... and the second partial stream 28

is injected into the flame chamber 4 by the inclined diffusion nozzles 24a, 24b,....
The gas-to-air ratio of the main fuel 16 is adapted to the respective load state by
changing the air supply to the main fuel 16. Accordingly, the gas-air mixture is not
adapted by switching the main nozzles on and off in a known manner.

5 It is also conceivable to divide the diffusion fuel into more than two partial
streams 26, 28. This application is also not confined to two identical or two different
partial streams 26, 28 of the diffusion fuel stream.

 Further, the geometry of the diffusion nozzles 22a, 22b, ..., 24a, 24b, ... is not
restricted to bore holes; rather, grooves or longitudinal slits are also conceivable. The
10 geometry of the axial diffusion nozzles can also differ from that of the inclined
diffusion nozzles. Further, the arrangement of the diffusion nozzles 22a, 22b, ..., 24a,
24b, ... is not limited to a circular arrangement; rather, other arrangements such as,
for example, a star-shaped configuration are also conceivable. A non-uniform
distribution of the diffusion nozzles is likewise possible.

15 Herein disclosed are a method for operating a premix burner for gaseous fuels
with a multi-stage pilot gas system, whose diffusion fuel is injected into a flame
chamber of the premix burner as at least two partial streams with different
orientations, and a premix burner for carrying out the method.

Reference Numbers

	2	premix burner
	4	flame chamber
	6	main injector
5	8	pilot gas system
	10	burner bottom
	12	flame tube
	14	end portion
	16	main fuel
10	18	burner longitudinal axis
	20	swirler
	22a, 22b, ...	axial diffusion nozzle
	24a, 24b, ...	inclined diffusion nozzle
	26	first partial stream of the diffusion fuel
15	28	second partial stream of the diffusion fuel
	30	center

Claims

1. Method for the operation of a premix burner (2) for gas turbines with the following steps:

- injection of a gas/air mixture as primary fuel (16) through a swirl generator (20) into a flame chamber (4) positioned lengthwise to a burner longitudinal axis (18),
- central injection of a first partial flow (26) of a diffusion fuel into the flame chamber, which is added through a burner base (10) downstream of the primary fuel (16),
- central injection of a second partial flow (28) of the diffusion fuel into the flame chamber (4) that is added through the burner base (10) downstream of the primary fuel (16),

characterized in that

the injection of the first partial flow (26) is effected through at least one diffusion nozzle (22a, 22b, ...) positioned in the burner base (10) and arranged parallel to the burner longitudinal axis (18), thus lateral to the primary fuel flow formed in the flame chamber (4), and the injection of the second partial flow (28) is effected through at least one diffusion nozzle (24a, 24b, ...) positioned in the burner base and arranged at an angled position to the burner longitudinal axis (18).

2. Method in accordance with Claim 1, wherein the primary fuel (16) is radially injected.

3. Method in accordance with Claim 1 or 2, wherein the gas/air ratio of the primary fuel (16) is regulated through air supply.

4. Premix burner for gas turbines for execution of the method according to Claim 1 with a flame chamber (4), a main injector (6) for the injection of a gas/air mixture as primary fuel (16) into the flame chamber (4), a swirl generator (20) for swirling the primary fuel (16), and a central pilot gas system (8) positioned in the burner base (10) for the injection of a diffusion fuel, characterized in that, in the burner base (10), there are at least one axial diffusion nozzle (22a, 22b) for the injection

of a first partial flow (26) of the diffusion fuel transversely to the main fuel flow formed in the flame chamber (4), and at least one diffusion nozzle (24a, 24b, ...) positioned at an angle to the burner longitudinal axis (18) for the injection of a second partial flow (28) of the diffusion fuel.

5. Premix burner in accordance with Claim 4, wherein at least one diffusion nozzle in angled position (22a, 22b, ...) is arranged in the direction of the main fuel flow.
6. Premix burner in accordance with Claim 5, wherein a multiplicity of radial exterior axial diffusion nozzles (22a, 22b, ...) and a multiplicity of radial interior diffusion nozzles positioned at an angle (24a, 24b, ...) are provided.
7. Premix burner in accordance with Claim 5 or 6, wherein the axial diffusion nozzles (22a, 22b, ...) and the diffusion nozzles positioned at an angle (24a, 24b, ...) form at least two concentric circles, of which the common centre (30) is on the burner longitudinal axis (18).
8. Premix burner in accordance with Claims 4 through 7, wherein the axial diffusion nozzles (22a, 22b, ...) demonstrate a geometry different to that of the diffusion nozzles in angled position (24a, 24b, ...).
9. Premix burner in accordance with Claim 8, wherein the axial diffusion nozzles (22a, 22b, ...) and the diffusion nozzles in angled position (24a, 24b, ...) are bores.
10. Premix burner according to one of the Claims 4 through 9, wherein the pilot gas system (8) has more axial diffusion nozzles (22a, 22b, ...) than diffusion nozzles in angled position (24a, 24b, ...), in particular twice as many axial diffusion nozzles (22a, 22b, ...) as diffusion nozzles positioned at an angle (24a, 24b, ...).
11. Premix burner according to claim 10, wherein the pilot gas system (3) has twice as many axial diffusion nozzles (22a, 22b,...) as diffusion nozzles positioned at an angle (24a, 24b,...).

- 10 -

12. Premix burner according to one of the Claims 6 through 10, wherein the flame chamber (4) is radially bordered near the burner base (10) by the swirl generator (20) and a cylindrical flame tube (12).

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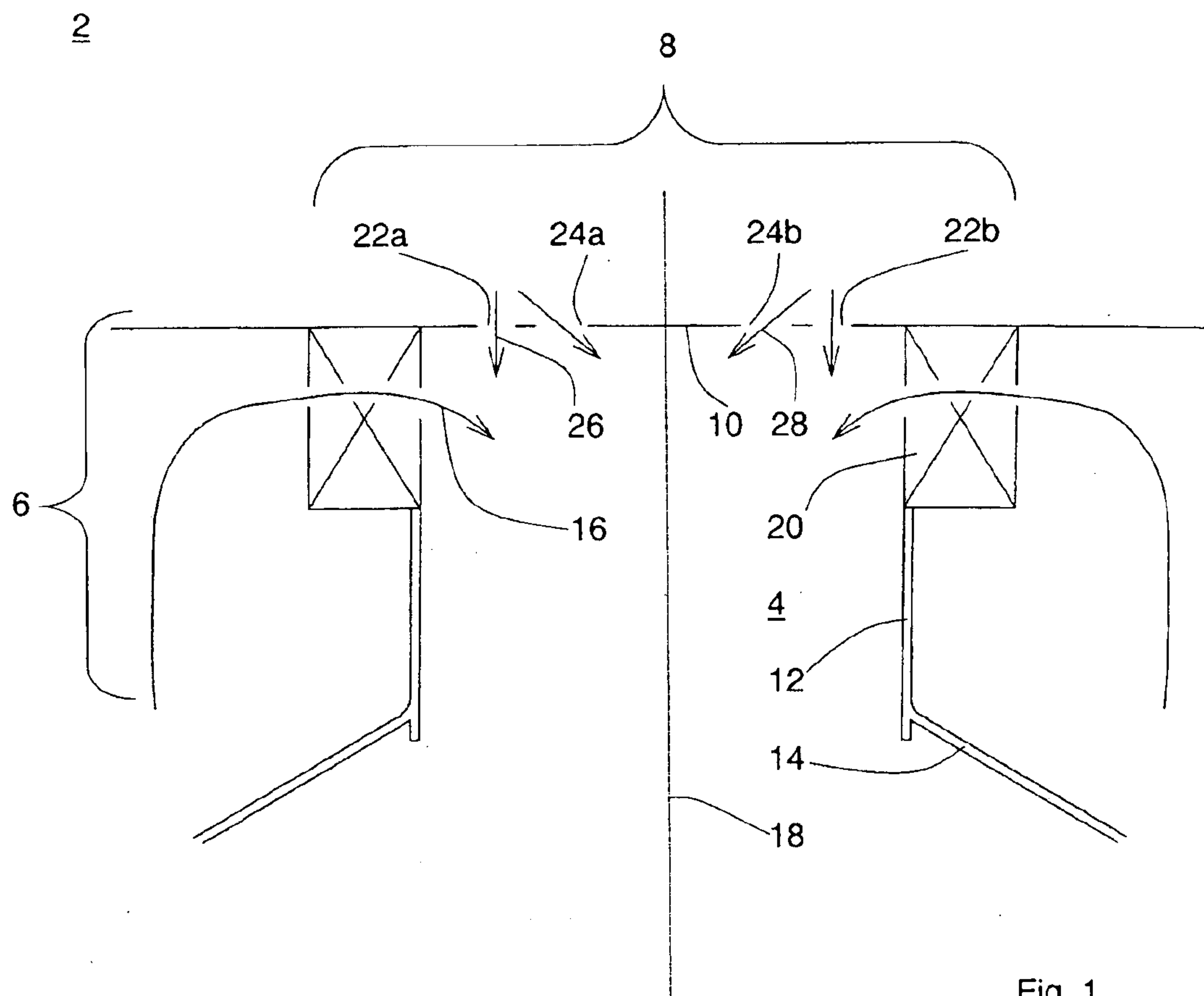


Fig. 1

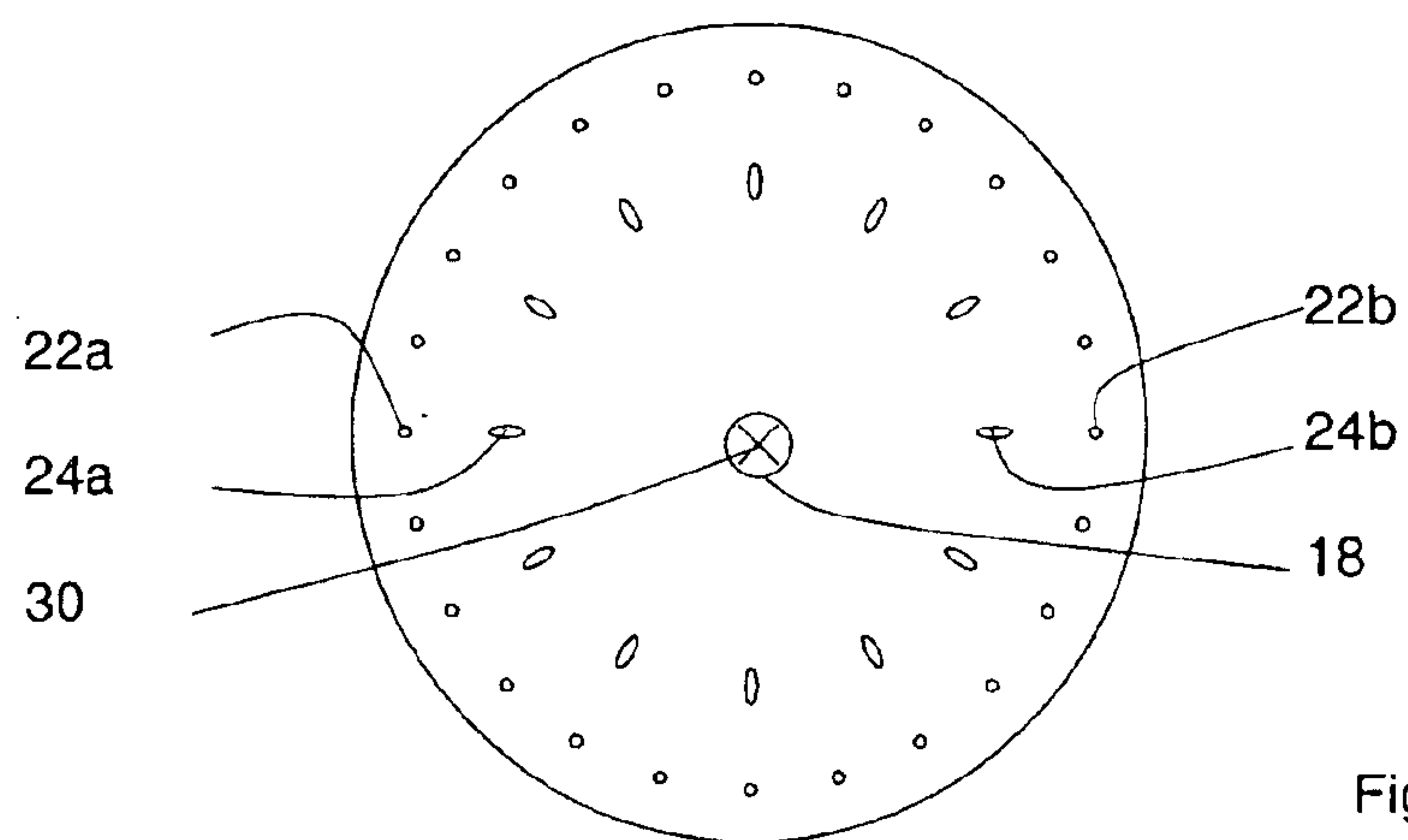
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Fig. 2

