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(71) Applicant: **Riello S.p.A.**
37045 Legnago (VR) (IT)

(72) Inventors:
- **Toniato, Guiseppe**
  37045 Legnago (IT)
- **Spadini, Ilario**
  37045 Legnago (IT)

(74) Representative: **Jorio, Paolo et al**
STUDIO TORTA S.r.l.,
Via Viotti, 9
10121 Torino (IT)

(54) Burner

(57) A burner (1), a combustion head (2) of which, fitted inside a combustion chamber (4), has a tubular body (5) for supplying a liquid combustion supporter, and having, at an outlet end, a tubular nozzle (7) having a central outlet (8) and a tapered annular wall (9) tapering towards the central outlet (8); the tubular body (5) being fitted through with a liquid fuel supply pipe (18), which terminates inside the nozzle (7) with a number of diverging outlet conduits (31), each of which is oriented towards a respective opening (10) formed through the tapered annular wall (9) of the nozzle (7), connected to the central outlet (8), and having a substantially tubular, axial peripheral shell (11).

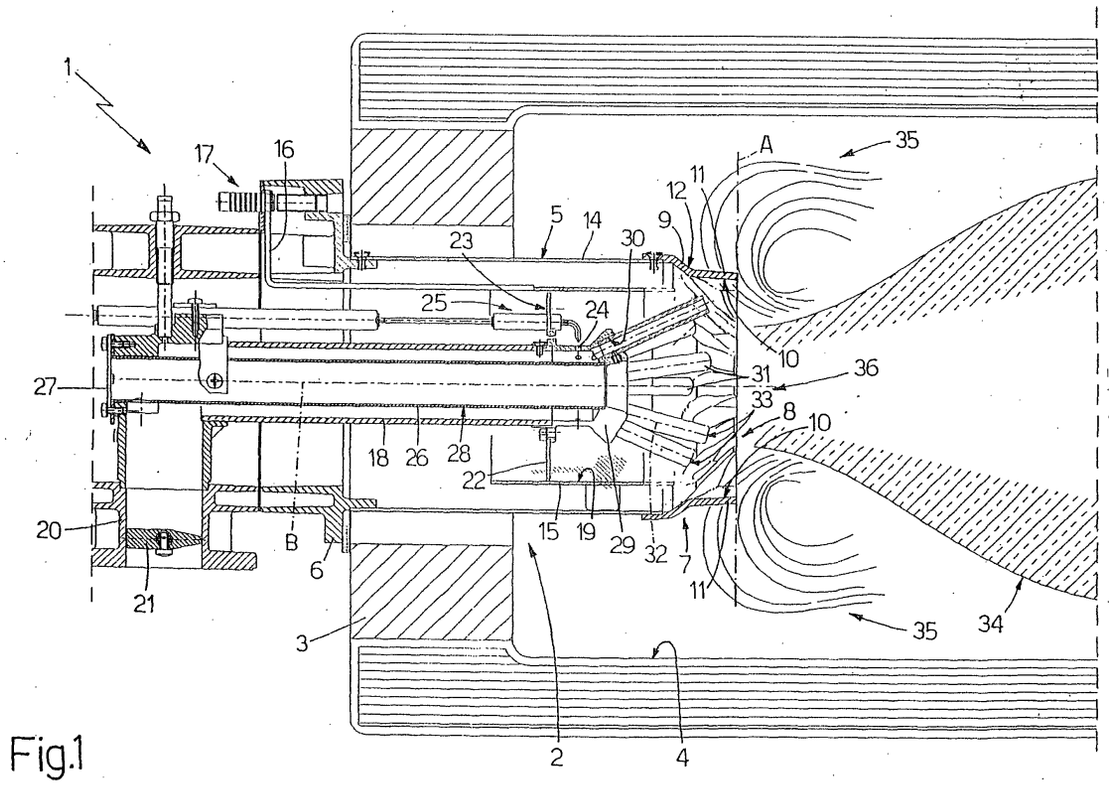

Fig.1

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Description

[0001] The present invention relates to a burner and to a relative burner nozzle.

[0002] The present invention may be used to advantage in heating systems, to which the following description refers purely by way of example.

[0003] More specifically, the present invention relates to a burner of the type comprising a combustion head fitted inside a combustion chamber and in turn comprising a tubular body for feeding a liquid combustion supporter into the combustion chamber, said tubular body comprising an end portion defined by a tubular nozzle having a central outlet and a tapered annular wall tapering towards said central outlet, and housing at least one pipe for supplying a liquid fuel; said pipe terminating inside said nozzle with at least one outlet conduit, and said tapered annular wall having at least one opening connected to said central outlet.

[0004] The present invention also relates to a combustion head nozzle of innovative characteristics.

[0005] The nozzle comprises a central outlet and a tapered annular wall tapering towards the central outlet; the tapered annular wall having openings arranged radially with respect to the central outlet; and the nozzle being characterized in that each opening is substantially U-shaped and has a substantially tubular peripheral shell extending outwards from an outer surface of the tapered annular wall.

[0006] Since, in the case of heating system burners, combustion is known to produce contaminating NO_X by-products in amounts directly proportional to the temperature of the flame produced, design solutions for known burners of the above type have been proposed to reduce the flame temperature.

[0007] Patent US 5015174, for example, describes a burner of the above type, in which the fuel supply pipe has a number of axial outlet conduits, the outlets of which, set back with respect to the nozzle, are located upstream from a deflecting plate which, together with the nozzle, defines a fuel ignition chamber and radially deflects fuel flow from the outlet conduits to produce, inside the ignition chamber, sufficient turbulence to mix the fuel and combustion supporter in correct stoichiometric proportions and substantially completely ignite the fuel-combustion supporter mixture inside the ignition chamber, i.e. upstream from the central outlet of the nozzle.

[0008] In the above known burner, the gases from the ignition chamber, by interacting with the contours of the central outlet and openings formed along the tapered annular wall of the nozzle and not related in number to the number of fuel outlet conduits, generate, downstream from and all around the nozzle, a low pressure capable of drawing towards the nozzle the colder burnt gases inside the combustion chamber.

[0009] The aim of the above known structure is to mix the stream of colder burnt gases drawn towards the nozzle with the stream of hotter combustion gases from the nozzle, so as to reduce the temperature of the flame and, therefore, the amount of NO_X produced. Since, however, in ,the known burner described above, the fuel, as stated, is ignited substantially completely inside the ignition chamber, i.e. upstream from the central outlet of the nozzle, the outflow speed of the combustion gases from the nozzle and the violent expansion of the combustion gases downstream from the nozzle prevent the two different-temperature streams from mixing as required, and which can only be achieved by acting mechanically on the two streams by providing, immediately downstream from the nozzle, a flame pipe forming, with the outer surface of the nozzle, an annular opening through which the colder burnt gases are drawn to mix with the combustion gases inside the flame pipe.

[0010] It is an object of the present invention to provide a burner, the combustion head of which is designed to mix the two streams with no need for a flame pipe immediately downstream from the combustion head nozzle.

[0011] It is a further object of the present invention to provide a burner, the combustion head of which is so designed as to delay fuel ignition as long as possible, so as to move the root of the flame into a position extremely close to the central outlet of the nozzle, so that the stream of burnt gases correctly penetrates the stream of combustion gases with no need for a flame pipe.

[0012] It is a further object of the present invention to provide a burner, the combustion head of which is designed to mix the two streams substantially upon initiation of the fuel oxidation process, so as to reduce the temperature of the flame not only by mixing the two different-temperature streams, but also by "diluting" fuel ignition in space by forming a substantially oxygen-poor combustion supporter-fuel-burnt gas mixture.

[0013] According to the present invention, there is provided a burner comprising a combustion head fitted inside a combustion chamber and in turn comprising a tubular body for feeding a liquid combustion supporter into the combustion chamber, said tubular body comprising an end portion defined by a tubular nozzle having a central outlet and a tapered annular wall tapering towards said central outlet, and housing at least one pipe for supplying a liquid fuel; said pipe terminating inside said nozzle with at least one outlet conduit, and said tapered annular wall having at least one opening connected to said central outlet; characterized in that said outlet conduit diverges with respect to a longitudinal axis of said tubular body, and has an outlet which is located inside said nozzle, in a position adjacent to said tapered annular wall, and is oriented towards said tapered annular wall and towards said opening.

[0014] In a preferred embodiment of the burner defined above, said opening has a substantially tubular peripheral shell extending outwards from an outer surface of said tapered annular wall in a direction substantially

parallel to said longitudinal axis.

[0015] Preferably, the burner defined above comprises a number of said outlet conduits arranged about said longitudinal axis; said tapered annular wall having a number of said openings equal to the number of said outlet conduits; and the outlet of each said outlet conduit facing a respective said opening.

[0016] Preferably, said openings extend in a substantially radial direction with respect to said central outlet; each said tubular shell defining, with each adjacent tubular shell and with said tapered annular wall, a tapered passage tapering towards said central outlet.

[0017] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic partial axial section of a preferred embodiment of the burner according to the present invention;

Figure 2 shows a larger-scale detail of Figure 1;

Figure 3 shows a larger-scale front view of the Figure 2 detail;

Figure 4 shows a view in perspective of a detail in Figure 3.

[0018] Number 1 in Figure 1 indicates as a whole a burner comprising a combustion head 2 extending through a hole formed through an end wall 3 of a combustion chamber 4.

[0019] Combustion head 2 comprises an outer tubular body 5, which has an outer flange 6 for connection to wall 3 and is connected to a known feed line (not shown) to feed air into combustion chamber 4. Tubular body 5 comprises an end portion defined by a tubular nozzle 7 having a central outlet 8, and a truncated-cone-shaped tapered annular wall 9 tapering towards central outlet 8 and lying in a plane A perpendicular to a longitudinal axis B of tubular body 5.

[0020] Tapered wall 9 has a number of openings 10 (ten in the Figure 3 example) arranged radially with respect to central outlet 8 and equally spaced about longitudinal axis B. Each opening 10 is substantially in the form of a U connected laterally to central outlet 8, and has a substantially tubular peripheral shell 11 extending outwards from an outer surface 12 of tapered wall 9 in a direction substantially parallel to longitudinal axis B of tubular body 5. Each shell 11 tapers outwards, terminates at plane A, and defines, with each adjacent shell 11, a substantially radial passage 13 tapering towards central outlet 8.

[0021] A tubular wall 15 is housed inside a portion 14 of tubular body 5 immediately upstream from nozzle 7, is coaxial with tubular body 5, and is connected to flange 6 by a bracket 16 having a known adjusting device 17 for adjusting the axial position of wall 15 with respect to tubular body 5.

[0022] A pipe 18 for feeding fuel into combustion chamber 4 extends inside tubular body 5 and a chamber 19 defined externally by wall 15. Pipe 18 is fixed to flange 6 and is connected to a known fuel feed line (not shown) by a conduit 20 crosswise to pipe 18 and having a known flow regulating device 21.

[0023] The outer surface of pipe 18 is fitted with an annular partition 22 crosswise to longitudinal axis B and having airflow openings 23. Downstream from partition 22, pipe 18 has a ring of radial holes 24 for supplying a stream of fuel to an ignition device 25 fitted through and supported by partition 22.

[0024] A pipe 26 is fitted inside pipe 18 along longitudinal axis B, is fixed to conduit 20 by a fastening member 27, and defines, with pipe 18, an annular conduit 28 closed, at the end facing nozzle 7 and located inside tubular body 5 downstream from partition 22, by a rim 29 integral with the end of pipe 18 facing nozzle 7, and engaged by a corresponding end of pipe 26.

[0025] Holes 30 are formed through rim 29, are equally spaced about axis B, are equal in number to openings 10, and each house the end of a respective outlet conduit 31 communicating with annular conduit 28 and having an end portion inside nozzle 7. More specifically, each outlet conduit 31 extends along an axis 32 diverging with respect to axis B, extends through a respective opening 10 to intercept respective shell 11, and has an outlet 33 immediately adjacent to tapered annular wall 9 and facing respective opening 10.

[0026] Given the location of outlets 33 and respective openings 10, the combustion supporter and the fuel are therefore mixed correctly in an extremely small portion inside nozzle 7, and for the most part substantially at plane A containing central outlet 8 and the outer ends of shells 11. In other words, the root of the flame 34 produced, in use, by ignition of the fuel is located very close to plane A, i.e. very close to where a stream 35 of burnt gases - drawn towards axis B by the low pressure produced by stationary vortexes generated by a stream 36 of the air-fuel mixture issuing from central outlet 8 and the channels defined by shells 11 - mixes with stream 36.

[0027] In connection with the above, it should be pointed out that, given the location of the root of flame 34 and the presence of shells 11, the stream 35 of burnt gases tends to flow towards plane A along the outer surface 12 of tapered wall 9 of nozzle 7, and therefore along passages 13, the taper of which accelerates the burnt gases to thoroughly mix streams 35 and 36 substantially at the root of flame 34.

[0028] In other words, the temperature of the flame 34 produced by burner 1 described is reduced by mixing the hotter combustion gases with the colder burnt gases, and by also "diluting" flame 34 along axis B, by moving the root of flame 34 outwards of nozzle 7, and by also mixing streams 35 and 36 substantially at the start of combustion, so that combustion mostly takes place in a substantially oxygen-poor atmosphere.

Claims

1. A burner comprising a combustion head (2) fitted inside a combustion chamber (4) and in turn comprising a tubular body (5) for feeding a liquid combustion supporter into said combustion chamber (4), said tubular body (5) comprising an end portion defined by a tubular nozzle (7) having a central outlet (8) and a tapered annular wall (9) tapering towards said central outlet (8), and housing at least one pipe (18) for supplying a liquid fuel; said pipe (18) terminating inside said nozzle (7) with at least one outlet conduit (31), and said tapered annular wall (9) having at least one opening (10) connected to said central outlet (8); **characterized in that** said outlet conduit (31) diverges with respect to a longitudinal axis (B) of said tubular body (5), and has an outlet (33) which is located inside said nozzle (7), in a position adjacent to said tapered annular wall (9), and is oriented towards said tapered annular wall (9) and towards said opening (10).

2. A burner as claimed in Claim 1, wherein said opening (10) has a substantially tubular peripheral shell (11) extending outwards from an outer surface (12) of said tapered annular wall (9) in a direction substantially parallel to said longitudinal axis (B).

3. A burner as claimed in Claim 2, wherein said tubular shell (11) tapers outwards.

4. A burner as claimed in Claim 2 or 3, wherein said tubular shell (11), in cross section, is substantially U-shaped and connected laterally to said central outlet (8).

5. A burner as claimed in one of Claims 2 to 4, wherein said central outlet (8) lies in a plane (A) perpendicular to said longitudinal axis (B); said tubular shell (11) terminating at said plane (A).

6. A burner as claimed in one of the foregoing Claims, and comprising a number of said outlet conduits (31) arranged about said longitudinal axis (B); said tapered annular wall (9) having a number of said openings (10) equal to the number of said outlet conduits (31); and the outlet (33) of each said outlet conduit (31) facing a respective said opening (10).

7. A burner as claimed in Claims 2 and 6, wherein said openings (10) extend in a substantially radial direction with respect to said central outlet (8); each said tubular shell (11) defining, with each adjacent tubular shell (11) and with said tapered annular wall (9), a tapered passage (13) tapering towards said central outlet (8).

8. A nozzle (7) for a combustion head (2), having a central outlet (8) and a tapered annular wall (9) tapering towards said central outlet (8); said tapered annular wall (9) having at least one opening (10) positioned radially with respect to said central outlet (8); and the nozzle (7) being **characterized in that** said at least one opening (10) is substantially U-shaped, and has a substantially tubular peripheral shell (11) extending outwards from an outer surface (12) of said tapered annular wall (9).

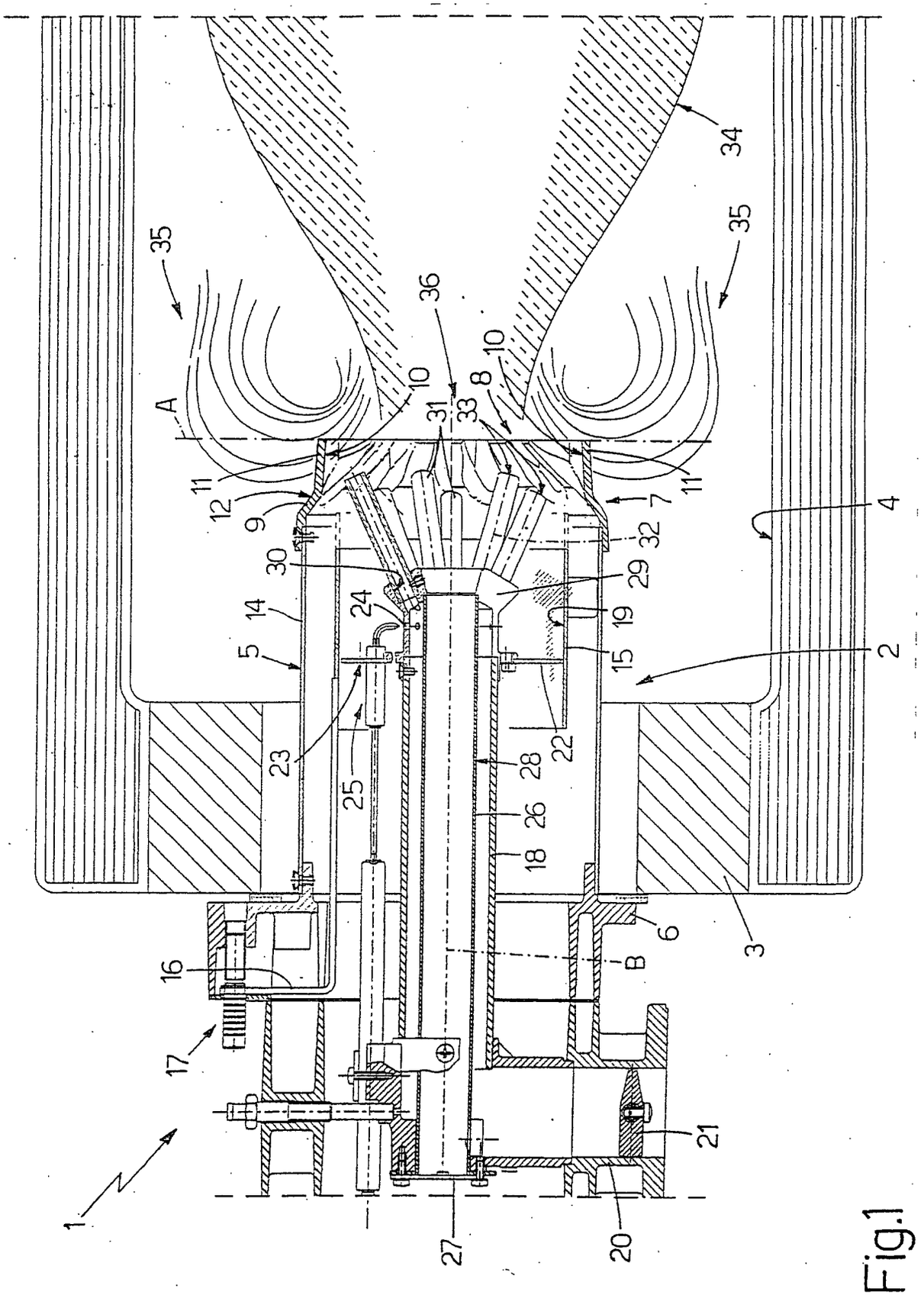
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Fig.1

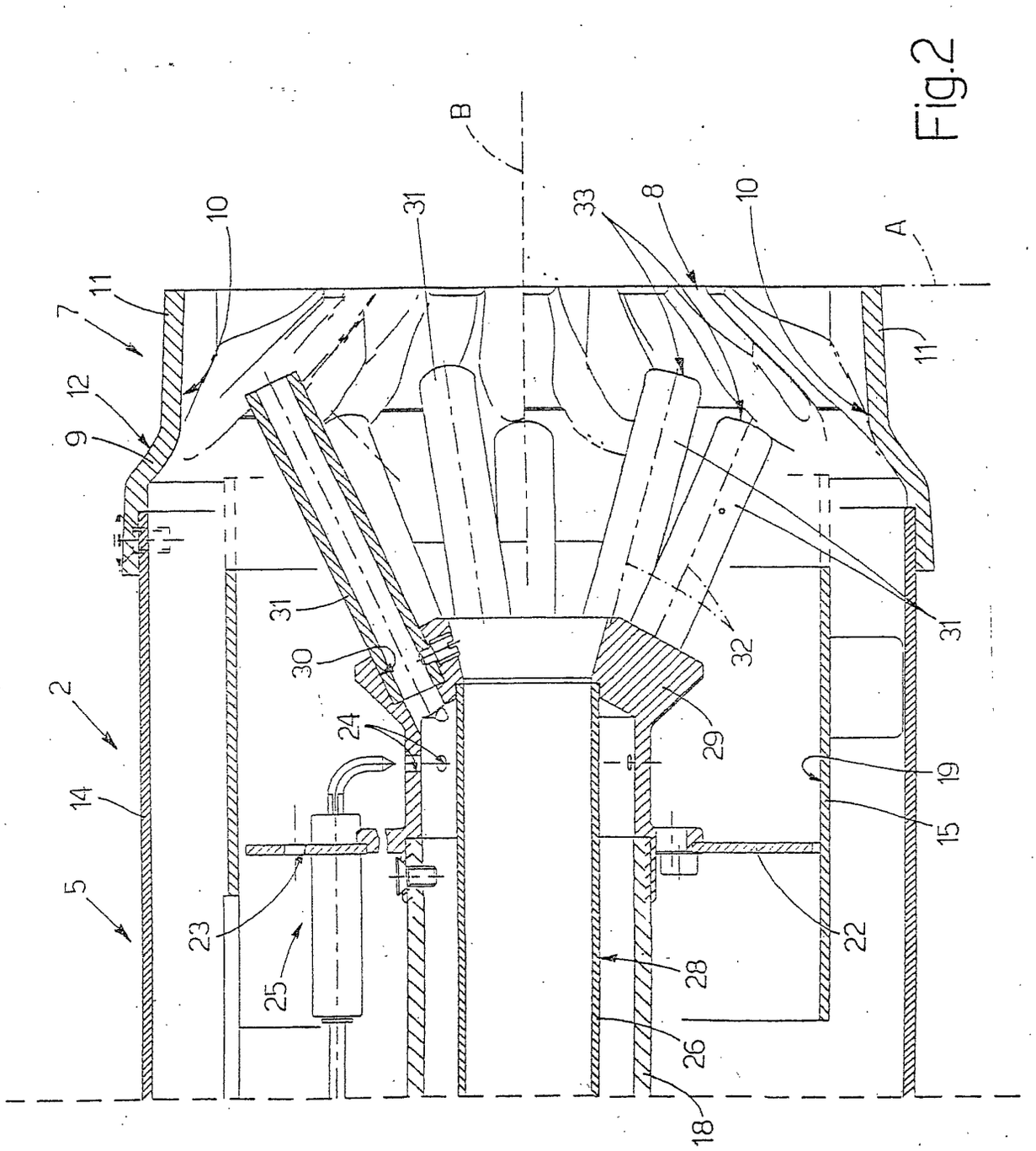
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Fig.2

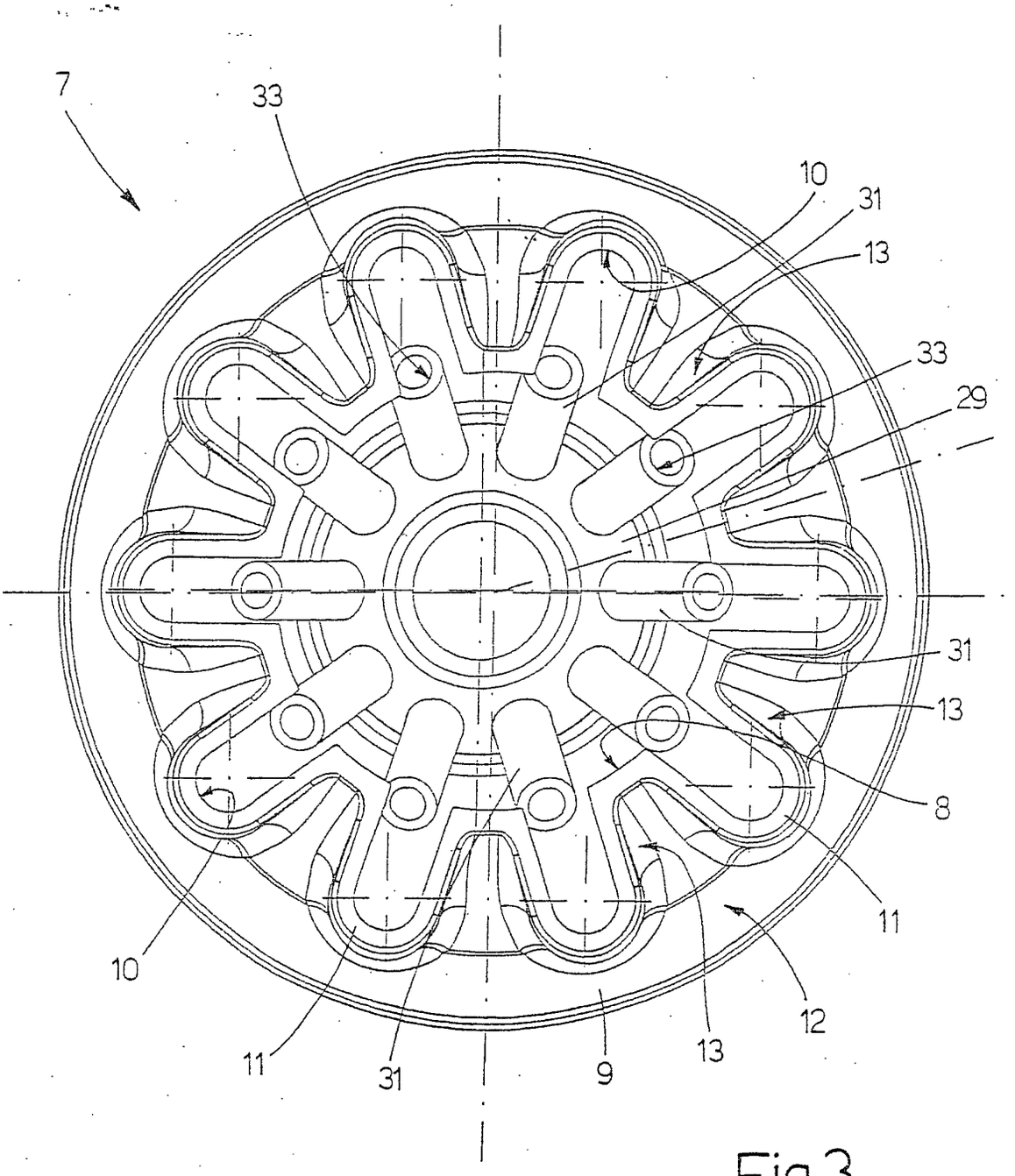

Fig.3

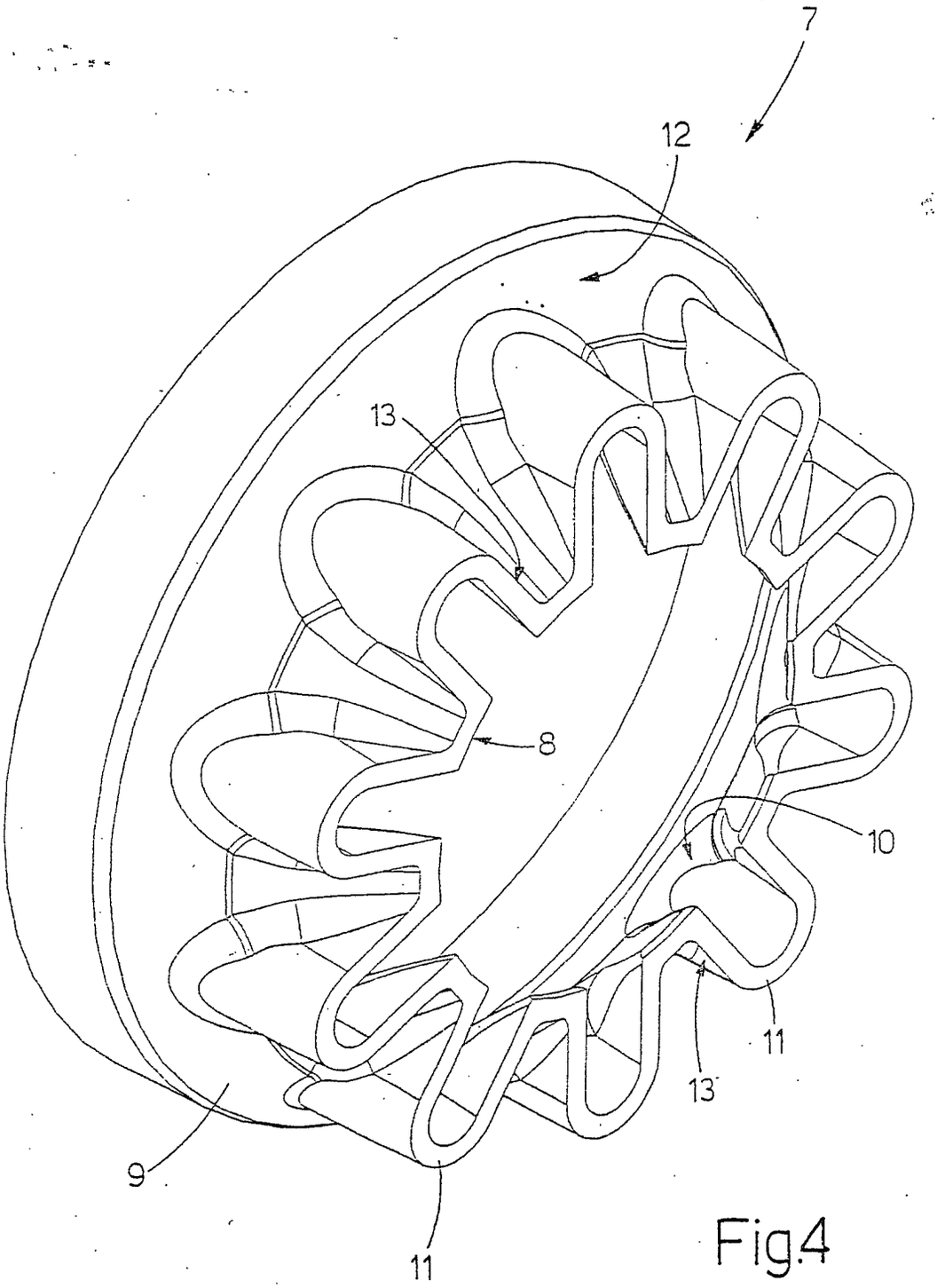

Fig.4

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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 6779

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F23D
F23C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	23 May 2002	Theis, G

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