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(54) Burner for industrial kiln

(57) Burner for an industrial kiln, comprising at least one first fuel inlet opening (15), at least one second comburent inlet opening (16) and at least one nozzle (31) afferent to the firing chamber (3) of the kiln (2), **characterised in that** it comprises suction means (34) that place said firing chamber (3) in communication with said second comburent inlet opening (16).

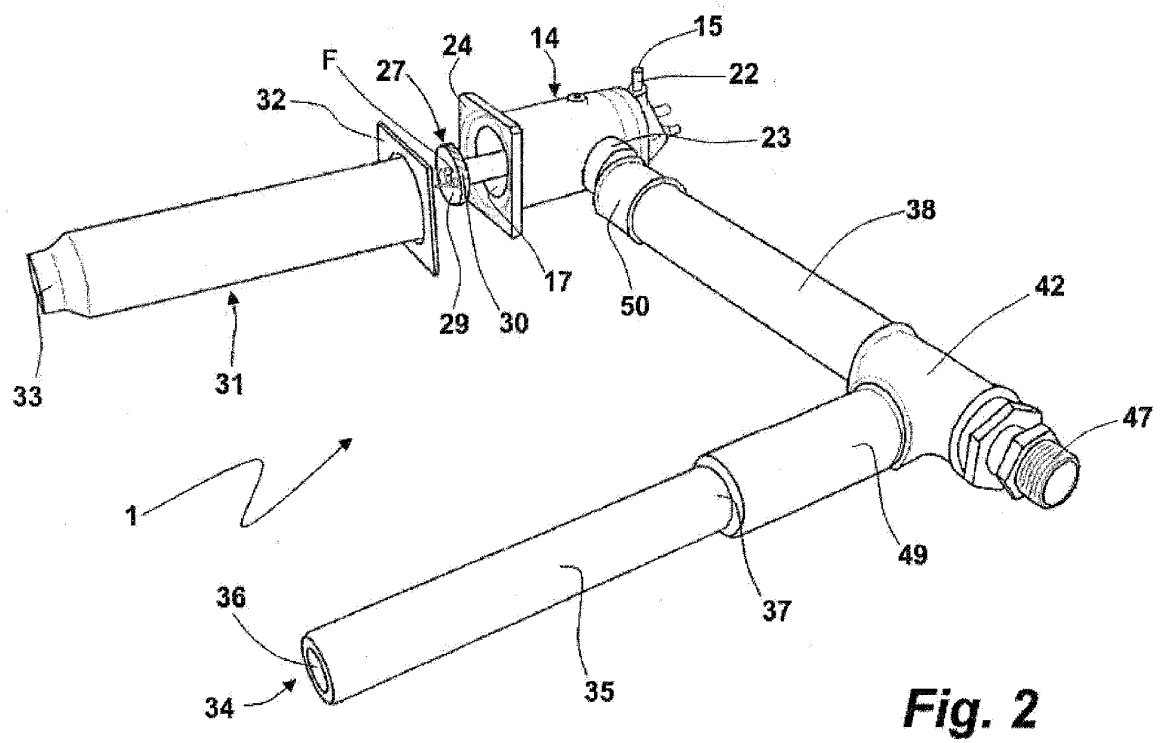

Fig. 2

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention concerns a burner for industrial kiln.

[0002] More in particular, the invention concerns a burner for kilns suitable for firing items such as ceramic tiles, sanitary ware and the like.

STATE OF THE ART

[0003] In the field of industrial kilns, for example kilns suitable for firing items such as ceramic tiles, sanitary ware and the like, particular types of burners are used which, in a set phase of the productive cycle, fire the items thanks to high temperatures that are reached inside by combustion, for example, of methane gas, or of other equivalent types of combustibles.

[0004] Such types of burners are typically installed in some known types of kilns, like continuous kilns or periodic kilns, tunnel kilns or roller kilns: for example, in the latter, a high number of such burners are installed, normally arranged side by side along the path of the products, with nozzles substantially orthogonal with the advancing direction of the products themselves.

[0005] In the field of industrial kilns it is known to be the problem of high dispersion of heat energy that is generated during combustion, which is generally not adequately exploited in the firing chamber of the kiln. In particular, for example, in roller kilns for ceramic tiles there is typically a heat accumulation mainly in the central area, whereas the areas near to the side walls, or near to the top wall, are at a substantially lower temperature.

[0006] This circumstance has the direct and undesirable consequence of having an uneven and not optimal firing of the products, thus affecting their end quality negatively.

[0007] Another considerable drawback of the known types of industrial kilns consists of the high flow of exhaust gases produced by the combustion, which are then expelled through the chimney, and of the same composition of the gases themselves.

[0008] The need to eliminate these high gas flow rates, indeed, requires that large filtering devices be installed, having high operation and maintenance costs, directly proportional to the volumes involved. Moreover, such huge gas flow rates to be discharged require large suction plants, which also means a great expenditure of energy and high maintenance costs.

[0009] Another known drawback of the industrial kilns currently common on the market consists of the fact that the recycling of heat energy, typically used to heat the air in inlet to the burner, is quite low, since air coming from areas at low temperature is used: consequently, high energy intake is required, which substantially weighs down upon the management costs of the plant itself, to obtain an adequate flame temperature in the burner.

PURPOSES OF THE INVENTION

[0010] The technical task of the present invention is to improve the state of the art by eliminating the aforementioned drawbacks.

[0011] In such a technical task, one purpose of the present invention consists of making a burner for industrial kilns which, if compared to conventional types of burners, makes it possible to recycle a greater quantity of heat energy from the exhaust gases of the firing area, to then reuse it so as to pre-heat the air in inlet to the burner even more.

[0012] Another purpose of the present invention is that of devising a burner for industrial kilns that makes it possible to obtain, during operation, a more even temperature inside the firing chamber, more in particular that makes it possible to even out the temperatures between the central area and the peripheral areas of the firing area itself.

[0013] Another purpose of the present invention is that of implementing a burner for industrial kilns that, through a direct recirculation system, makes it possible to reduce the quantity of exhaust gases in the chimney and thus to reduce the filtering and suction requirements of such gases.

[0014] A further purpose of the present invention is that of implementing a burner for industrial kilns that makes it possible to reintroduce, inside the firing chamber, polluting substances present in the fumes, which can be reabsorbed by the ceramic material, and that in conventional types of kilns on the other hand are all dispersed with the fumes in the chimney.

[0015] These and other purposes are all reached by the burner for industrial kilns according to one or more of the attached claims.

[0016] A first advantage achieved by the burner according to the invention consists in the fact that it makes it possible to recycle a high quantity of heat energy from the exhaust gases coming from the firing chamber to directly preheat the air in inlet to the burner itself.

[0017] Another advantage achieved by the burner according to the invention consists in the fact that it makes it possible to make the temperature in the firing chamber of the industrial kiln more even.

[0018] Yet another advantage achieved by the burner according to the present invention consists in the fact that it makes it possible to substantially reduce the quantity of exhaust gases to be eliminated from the firing chamber.

[0019] Another further advantage achieved by the burner according to the present invention consists in the fact that it makes it possible keep part of the polluting substances, which can be directly reabsorbed by the products, inside the firing chamber.

BRIEF DESCRIPTION OF THE DRAWINGS.

[0020] These and further advantages shall become

clearer to any man skilled in the art from the following description and from the attached drawings, given as an example and not for limiting purposes, in which:

figure 1 is a typical section view of a roller kiln for firing items such as ceramic tiles and the like, in which burners according to the invention are installed;

figure 2 is an exploded perspective view of the burner according to the invention;

figure 3 is a partial section view of the burner according to the invention.

EMBODIMENTS OF THE INVENTION.

[0021] With reference to figures 1-3, a burner for industrial kilns according to the invention is wholly indicated with reference numeral 1.

[0022] In figure 1 an industrial kiln, of the type having a single layer of rollers is illustrated, wholly indicated with reference numeral 2, suitable for firing products such as ceramic tiles and the like, in which burners 1 are installed according to the present invention.

[0023] It should be noted however, that the particular structure of the kiln 2, briefly described hereafter, does not constitute the object of the present invention: therefore, instead of in a roller kiln, the burner according to the present invention can be installed in any other type of industrial kiln, for example in a periodic kiln with a chamber, or in other types of kilns such as tunnel or double layer roller, without any limitation.

[0024] In general the roller kiln 2, as schematically shown in figure 1, comprises, in a known way, a firing chamber 3 contained within a top wall 4, a lower wall 5 and two side walls 6 made from insulating refractory material, i.e. a material which is capable of thermally insulating and of withstanding high temperatures without reacting chemically with the other materials with which it is in contact. Inside the firing chamber 3, typically having a main dimension, the longitudinal one, along which the firing cycle occurs, a plane 7 is defined, for example arranged horizontally, in which the products 8 advance. In the embodiment of the kiln 2 of figure 1 such an advancement plane 7 is defined by a series of parallel rollers 9 that allow the products 8 to translate along the kiln 2. The rollers 9 are associated with actuation means 10, of the essentially known type, for example comprising one or more groups of electric geared motors 11 with - known but not represented - transmission means which are associated with the rollers 9 themselves. The typical firing cycle that the products 8 undergo inside of the kiln 2 shall not be described in detail hereby, since it is completely of the conventional type and since, in any case, it does not specifically constitute the object of the present invention.

[0025] As can be observed in figure 1, along the firing chamber 3 of the kiln 2 some pluralities of burners 1 are arranged, along both sides of the firing chamber 3 itself; the burners 1, in the embodiment represented hereby, are arranged both above and below with respect to the plane 7 in which the products 8 advance.

[0026] More in detail the burners 1 are, for example, installed along the side walls 6 of the kiln 2, mounted at respective through holes 12; outside the side walls 6 pipeline networks are arranged, wholly indicated with reference numeral 13, for supplying fuel and comburent to the burners 1, as well as for eliminating exhaust gas from the firing chamber 3. The fuel used in the kiln 2 can be made up of, for example, methane gas; the comburent, however, can be for example made up of slightly overpressurized air, taken from outside. Other types of combustibles and/or comburents can be used, however, without limiting the purposes and the effects of the present invention.

[0027] In the rest of the present description we shall explicitly and directly refer to the methane gas as fuel, and to the air as comburent, only as an example and not for limiting purposes.

[0028] The burner 1, represented in figures 2, 3, comprises in detail a body 14, which defines a first fuel inlet opening 15, a second comburent inlet opening 16, and a third discharge opening 17 of the comburent afferent to the firing chamber of the kiln 3.

[0029] With reference to figure 1, the pipeline networks 13 comprise, more in detail, first pipelines 18 for supplying gas to the first openings 15 of each burner 1, and second pipelines 19 for supplying air to the second openings 16 of each burner.

[0030] Along the first pipelines 18 and the second pipelines 19 respective first pumping means 20 and second pumping means 21 are foreseen, not further described since they are absolutely of the type known in the field.

[0031] The body 14, made for example from metallic material with suitable mechanical characteristics, has a substantially cylindrical tube-shaped configuration; the first gas inlet opening 15 is defined by a tubular appendix 22 which extends externally from the body 14, for example substantially orthogonal to the latter and in communication with it.

[0032] Laterally, the body 14 also forms a substantially tubular mouth 23, which defines the second air inlet opening 16.

[0033] The third air discharge opening 17 is defined at a flange 24, formed by the body 14 and opposite to the first gas inlet opening 15.

[0034] Inside the body 14, means 25 for triggering the combustion of the air-methane gas mixture are foreseen.

[0035] Such triggering means 25 are of the known and conventional type and are suitable for causing a spark to be set off that provides for igniting the mixture.

[0036] Again inside the body 14 flame detection means 26 are also foreseen. Such detection means 26 are also of the known and conventional type.

[0037] The triggering means 25 and the detection means 26, as well as other components of the kiln 2, are both slaved to a unit for controlling and managing the

operation of the kiln 2 itself, said unit not being represented in the attached figures but also being of the known and conventional type, made up of for example a programmable logic controller or other equivalent devices.

[0038] Inside the body 14 means for generating a swirl 27 within the flow of the air-methane gas mixture are foreseen, so as to indeed promote the mixing process; a manifold 28 is also foreseen, communicating with the first opening 15, from which the methane gas comes out - through the foreseen holes F - towards the firing chamber 3. The generation means 27 comprise, for example, a disc 29 equipped with substantially helical grooves 30 through which the air flows, so that it can take up a discharge velocity having a certain tangential component.

[0039] The burner 1 comprises a nozzle 31, associated with the body 14; the nozzle 31 is in communication with the firing chamber 3 of the products, i.e. in other words flows directly into it.

[0040] In the embodiment of the burner 1 described hereby, the nozzle 31 is of the axial flame type, i.e. it is essentially made up of a cylindrical tube-shaped jacket, made from a suitable material resistant to high temperatures, open at a first base 32 and a second base 33. More in detail, at the first base 32, the nozzle 31 is fixed to the flange 24 of the body 14, whereas at its second base 33 the gas combustion flame comes out: such a flame extends inside the firing chamber 3 of the kiln 2, and in particular substantially at the central area of the chamber 3 itself.

[0041] Alternatively, the nozzle 31 can be of the radial flame type - not represented in the figures but however of the known type - i.e. essentially made up of a jacket having a plurality of radial holes, through which respective flames come out that substantially extend out near to the side walls 6 of the kiln 2.

[0042] The burner comprises suction means, wholly indicated with reference numeral 34, that place the firing chamber 3 in communication with the second comburent inlet opening 16, i.e. the air. The suction means 34, therefore, make it possible to achieve the recycling of the gases contained inside the firing chamber 3 during the productive cycle towards the second opening 16. Such a recycling of the gases of the firing chamber 3 makes it possible to obtain numerous technical advantages, as shall become clearer in the rest of the description.

[0043] The suction means 34 comprise an suction pipe 35, which can be seen in particular in figures 2, 3. The suction pipe 35 is made for example in refractory material. It also has, more in detail, a first extremity 36 that directly flows into the firing chamber 3, and a second extremity 37 that is in communication with the second air inlet opening 16. The suction means 34 also comprise a Venturi tube 38 that has an inlet 39 communicating both with means for supplying air to the burner 1, wholly indicated with reference numeral 40, as well as with the suction pipe 35, and an outlet 41 in communication with the second air inlet opening 16 in the body 14 of the burner. The effect of having a Venturi tube 38 is, as is known, that of causing a depression of the air flow coming from the supply means 40 and that is directed towards the second opening 16, said depression in turn drawing back the gas coming from the firing chamber 3 through the suction pipe 35. For this purpose, the suction means comprise a "T" union 42 having a first branch 43 communicating with the air supply means 40, a second branch 44 communicating with the suction pipe 35 and a third branch 45 communicating with the Venturi tube 38. More in detail, the air supply means 40 comprise a tubular portion 46, as can be observed in figure 3, associated with the first branch 43 of the "T" union 42 which extends, inside the union 42 itself, substantially as far as the inlet 39 of the Venturi tube 38. In particular, the tubular portion 46 is fixed to an externally threaded bushing 47 engaged with a reducer 48 coupled with the first branch 43 of the union 42. The bushing 47, in turn, directly or with the interposition of known connection means that are not represented, couples with the second pipelines 19 supplying air taken in from outside. The suction pipe 35 is coupled, on the other hand, with a sleeve 49 having an outer female screw received into the branch 44 of the "T" union 42.

[0044] In particular, the Venturi tube 38 has the inlet 39 equipped with an outer female screw which engages with the third branch 45 of the "T" union. Moreover, a cylindrical union 50 is also foreseen for the screw connection of the outlet 41 of the Venturi tube 38 to the mouth 23 of the body 14.

[0045] As can be observed in figures 2, 3, in the embodiment of the burner described hereby, the suction pipe 35 is orthogonal with the axis of the Venturi tube 38; moreover, the axis of symmetry of the mixing chamber 14 is in turn orthogonal with the axis of the Venturi tube 38, so as to give the burner 1 a sort of "U"-shaped configuration.

[0046] In an embodiment of the burner according to the present invention, the suction means 34 are provided with adjustment means 51 of the flow and/or of the pressure of the gases extracted from the firing chamber 3. Such adjustment means 51 are schematically represented with a broken line in figure 3. They can be made up of, for example, a valve, a gate valve or any other means for intercepting the opening foreseen in the second extremity 37 of the suction pipe 35. Alternatively, such adjustment means 51 can also be positioned along the suction pipe 35 itself, or even at the second branch 44 of the "T" union 42.

[0047] In practice, the burner 1 is installed in the kiln 2 in a conventional way, i.e. with the axis of the nozzle 31 substantially orthogonal to the advancing direction of the products 8 inside the firing chamber 3. Therefore, the suction pipe 35, is also arranged with its own axis orthogonal to the advancing direction of the products, and thus side by side with the nozzle 31.

[0048] The slightly over-pressurised air, pumped from outside by the second pumping means 21, flows through the second pipelines 19 and the supply means 40, and

thus along the tubular portion 46, so as to enter in the Venturi tube 38 and then reach the second opening 16 of the body 14 of the burner.

[0049] The methane gas, or other fuel, pumped by the first pumping means 20, flows through the first pipelines 18 and reaches the first opening 15 of the body 14. In the nozzle 31, the combustion of the methane gas occurs, activated by the triggering means 25, said gas generating a flame the combustion products of which are sent inside the firing chamber 3 of the kiln 2 at high speeds.

[0050] The passage of air provided by the supply means 40 through the Venturi tube 38 generates, as known, a certain depression that draws back the gas present in the firing chamber 3; these gases flow through the suction pipe 35, and mix with the air.

[0051] The gases coming from the firing chamber 3 are typically made up of at least the combustion products of the methane gas and of residual air, and have a temperature, which can vary according to the areas, between 700°C and 1200°C.

[0052] In a typical firing cycle of these products, the "fresh" air that flows in the burner through the supply means 40 is at a temperature of 40-50 °C. Consequently, the mixing of "fresh" air and gas coming from the firing chamber 3 essentially generates an air-combustion products mixture that enters the burner 1 at a temperature, on average, of between about 500°C and about 600°C, i.e. much greater than that of preheated air usually introduced in conventional types of burners, in which currently used energy recycling systems are adopted.

[0053] This makes it possible to obtain some important advantages. Firstly, the air entering the burner has a substantially greater temperature with respect to that of conventional burners, and this makes it possible to reduce the expenditure of energy required to obtain an adequate flame temperature. Another important advantage which can be obtained with the burner according to the present invention consists of the fact that the action of the suction means 34 tends to draw back the hot gases which accumulate in the central area of the firing chamber 3 towards the side walls 6 of the kiln 2, so as to make the temperature inside the chamber 3 itself more even: this fact makes it possible to make products 8 with certainly greater quality than those which can be obtained in kilns equipped with conventional type burners.

[0054] Another important advantage which can be obtained with the burner according to the present invention consists in the fact that the action of the suction means 34, which draw back the gases contained in the firing chamber 3 in a continuous cycle, makes it possible to substantially reduce the gas flow - i.e. the combustion products and other possible gases developed during the firing - that are conveyed towards the chimney of the kiln 2. In other words, the continuous drawing back of a fraction of gas, inside the burner 1, from the firing chamber 3 substantially reduces the flow of the gas to be eliminated from inside the chamber 3 itself of the kiln 2. This fact consequently translates into a smaller need of filtering the gases eliminated from the firing chamber 3, and thus makes it possible to save resources and energy specially dedicated to the phase of filtering the exhaust gas, and also their possible cooling in outlet, if present or if needed.

Another advantage which can be achieved with the burner according to the present invention consists in the fact that the continuous drawing back of the gas from the firing chamber 3 towards the body 14 of the burner - which, as mentioned, causes an increase of the temperature at which the combustion occurs and a more even temperature inside the firing chamber 3 itself - makes it possible to obtain reabsorbtion within the products 8 - in particular within ceramic tiles - of phosphorous compounds, indeed thanks to the high temperature that is possible to be kept inside the firing chamber 3. Indeed, usually, when firing in kilns equipped with burners of the conventional type, these substances are directly expelled by the chimney.

[0055] Yet a further advantage which can be obtained with the burner according to the present invention consists in the fact that the drawing back of gas from the firing chamber 3 towards the body 14 of the burner makes it possible to reduce the quantity of carbon dioxide that is expelled as a combustion product.

[0056] It has thus been seen how the invention achieves the aforementioned purposes.

[0057] The present invention has been described according to preferred embodiments, but equivalent variants can be conceived without departing from the scope of protection offered by the following claims.

Claims

1. Burner for industrial kiln, comprising at least a first fuel inlet opening (15), at least a second comburent inlet opening (16) and at least a nozzle (31) afferent to the firing chamber (3) of the kiln (2), **characterised by** the fact that it comprises suction means (34) that place said firing chamber (3) in communication with said second comburent inlet opening (16).

2. Burner according to the claim 1, in which said suction means have adjustment means (51) for adjusting the flow and/or pressure of the gas extracted from said firing chamber (3).

3. Burner according to the claim 1 or 2, in which said suction means (34) comprise at least an suction pipe (35) having a first extremity (36) communicating with said firing chamber (3), and a second extremity (37) communicating with said second comburent inlet opening (16).

4. Burner according to any of the preceding claims, in which said suction means (34) comprise at least a Venturi tube (38) having an inlet (39) communicating with comburent supply means (40) and with said suc-

tion pipe (35), and an outlet (41) communicating with said second comburent inlet opening (16).

5. Burner according to the claim 4, in which said suction means (34) comprise at least a "T" union (42) having a first branch (43) communicating with said comburent supply means (40), a second branch (44) communicating with said suction pipe (35) and a third branch (45) communicating with said Venturi tube (38).

6. Burner according to one of the claims 4 or 5, in which said comburent supply means (40) comprise at least a tubular portion (46) associated with said first branch (43) of said T union (42) which extends inside said union (42), substantially as far as said inlet (39) of said Venturi tube (38).

7. Burner according to any of the claims from 4 to 6, in which the axis of said suction pipe (35) is orthogonal to the axis of said Venturi tube (38).

8. Burner according to any of the claims from 4 to 7, comprising at least a body (14) having a mouth (23) communicating with said outlet (41) of said Venturi tube (38) and defining said second comburent inlet opening (16).

9. Burner according to the claim 8, in which the axis of said body (14) is orthogonal to the axis of said Venturi tube (38).

10. Burner according to the claim 8 or 9, comprising at least a cylindrical union (50) which connects said Venturi tube (38) with said body (14).

11. Burner according to any of the claims from 8 to 10, comprising at least a nozzle (31), associated with said body (14), communicating with said firing chamber (3).

12. Burner according to any of the preceding claims, comprising flame detection means (26).

13. Burner according to any of the preceding claims, comprising means for generating a swirl (27) within the flow of the fuel-comburent mixture inside said nozzle (31).

14. Burner according to any of the claims from 3 to 13, in which said suction pipe (35) is made of refractory material.

15. Burner according to any of the preceding claims, in which said nozzle (31) is of the axial flame type.

16. Burner according to any of the preceding claims, in which said nozzle (31) is of the radial flame type.

17. Industrial kiln, **characterised by** the fact that it comprises at least a burner (1) according to any of the claims from 1 to 18.

18. Method for recycling heat energy in an industrial kiln (2) comprising at least a firing chamber (3) and at least a burner (1), comprising the phases of:

- Sucting gas from the firing chamber(3) of the kiln;
- Mixing said gas with the comburent and with the fuel inside the burner (1) of the kiln (2).

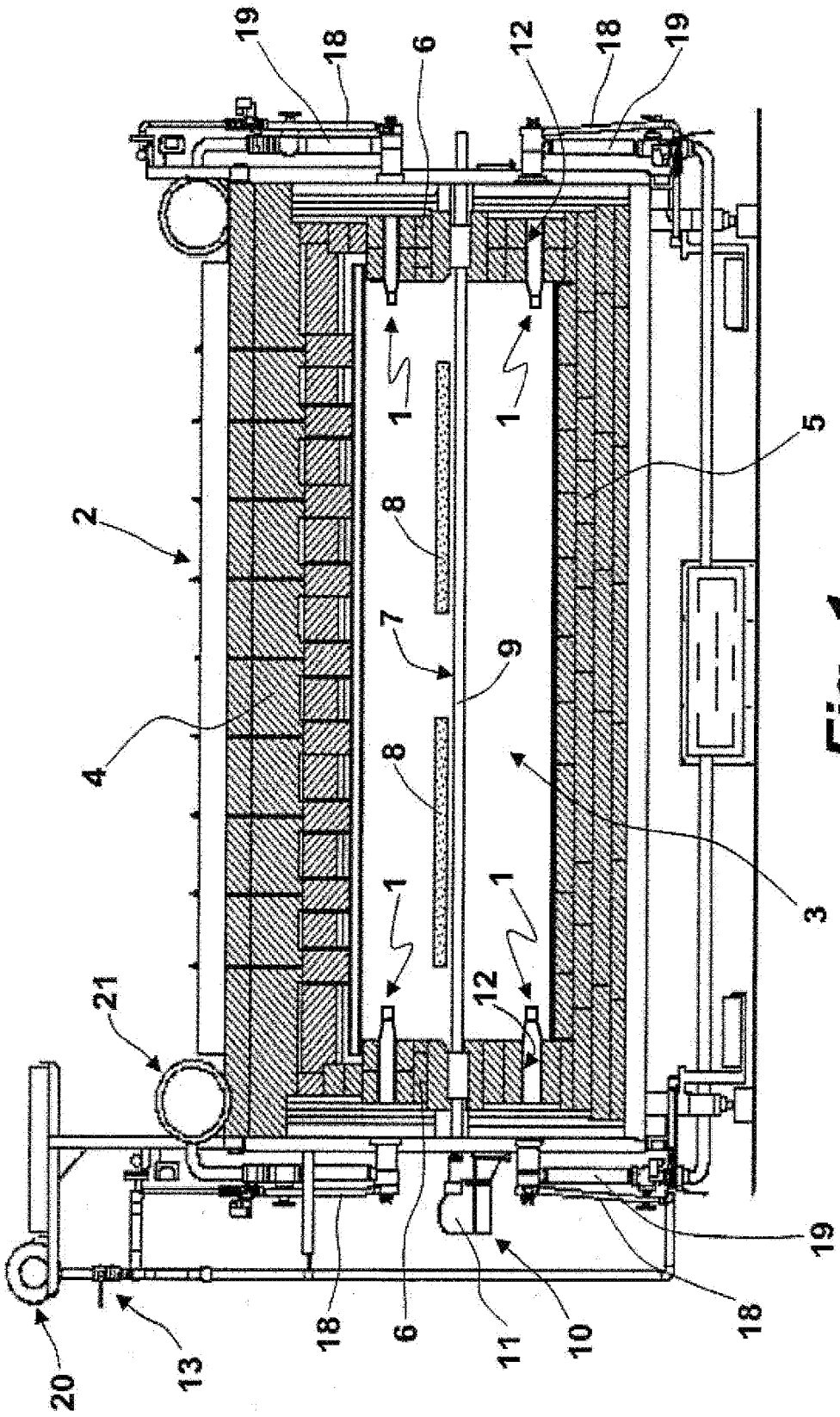

Fig. 1

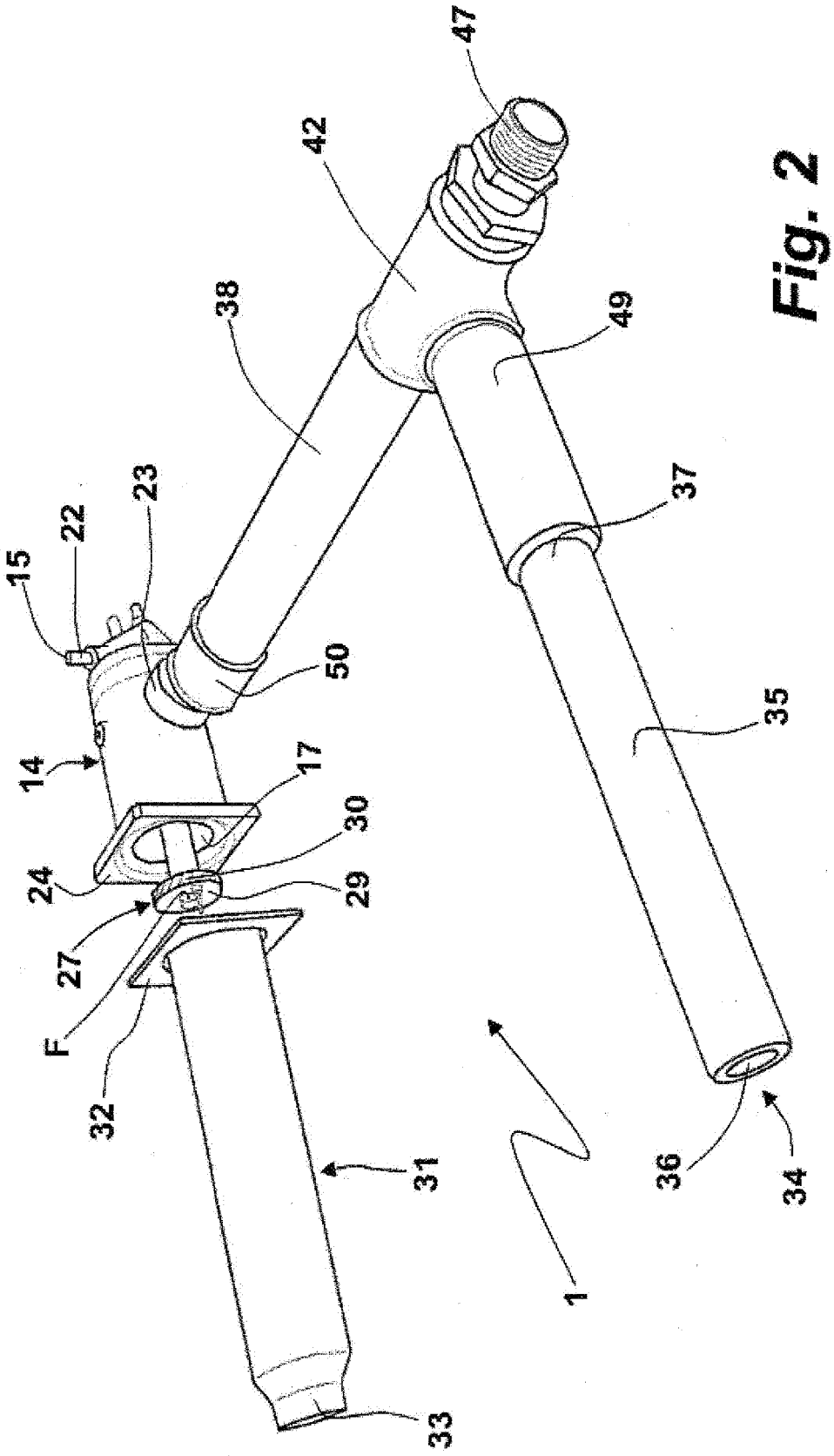

Fig. 2

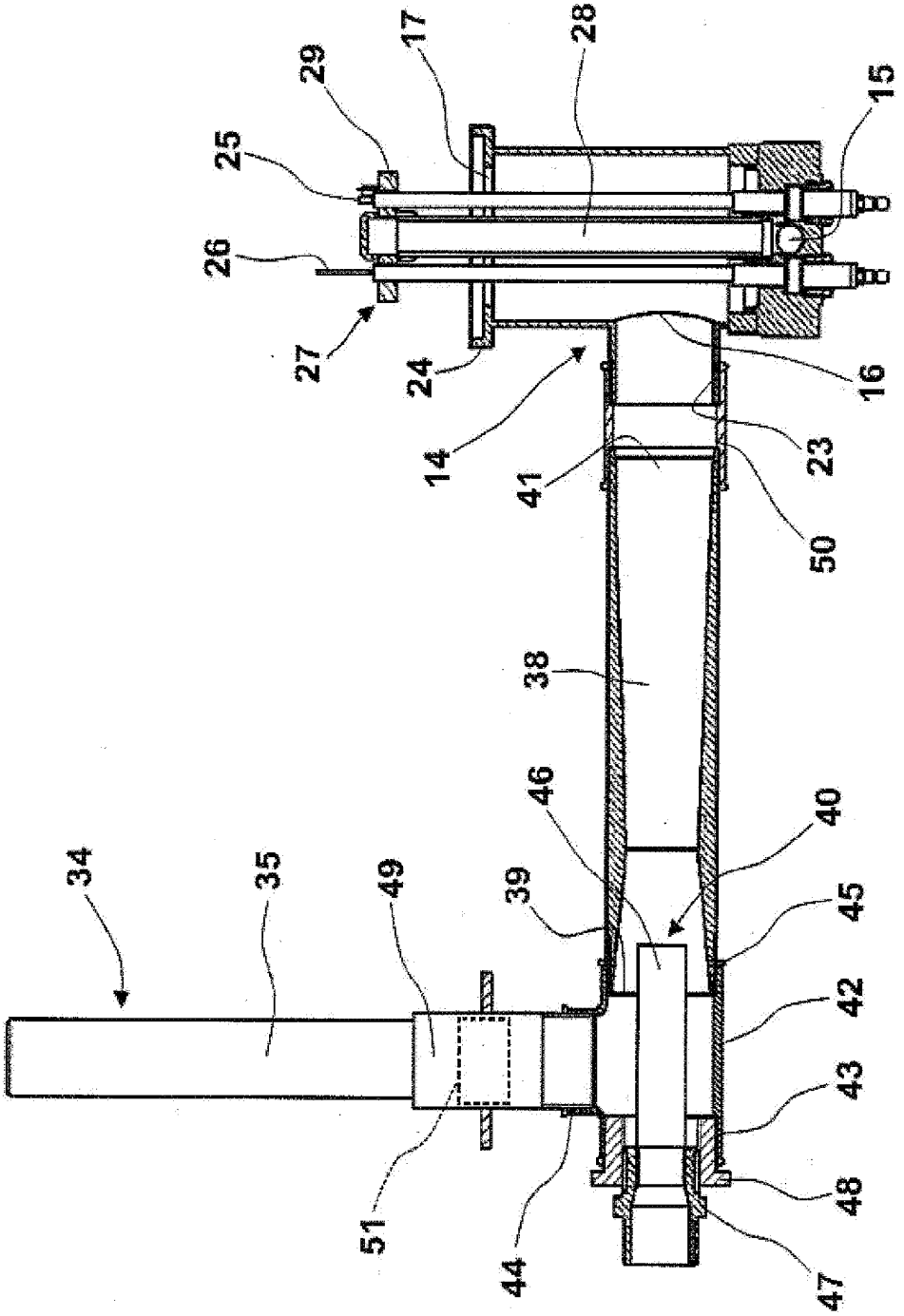
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Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 10 17 5132

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	29 November 2010	Gavriliu, Costin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 17 5132

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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