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(54) Burner unit for steel making facilities

(57) The present invention proposes a burner unit (10) for steel making facilities, in particular for use in connection with a regenerative or recuperative heat generator, wherein the burner unit (10) comprises a mixing zone (18); a plurality of fuel feed channels (32) for feeding combustible fuel to the mixing zone (18); and a plurality of air feed channels (34) for feeding combustion air to the mixing zone (18). According to an important aspect of the invention, the burner unit (10) comprises a primary burner (42) with an annular feed arrangement (30) comprising circumferentially alternating fuel feed channels (32) and air feed channels (34); a central channel (44) through the annular feed arrangement (30) and a secondary burner (46) arranged in the central channel (44) of the burner unit (10), the central channel (44) being coaxial with the annular feed arrangement (30).

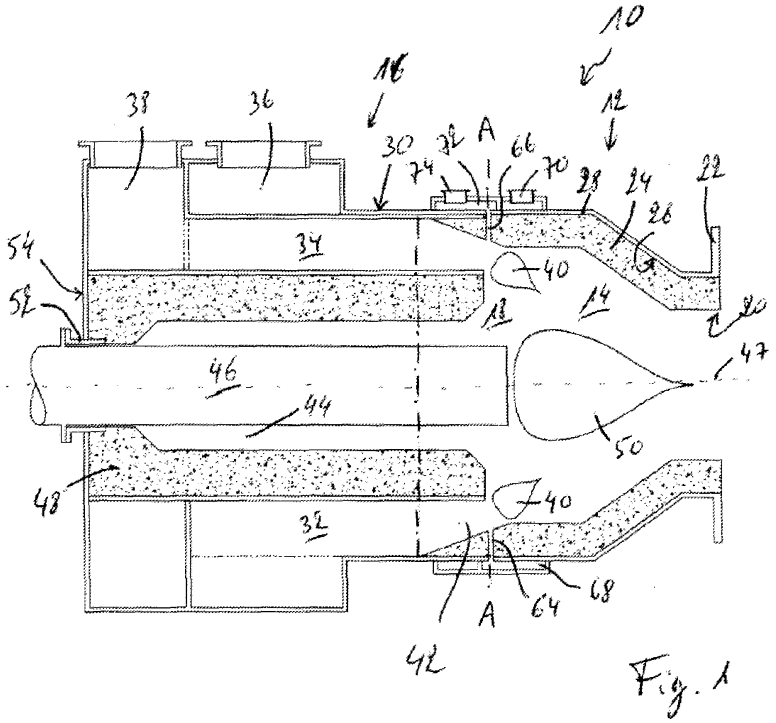

Fig. 1

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Description

Introduction

[0001] The present invention relates to a burner unit for steel making facilities. More particularly, the present invention relates to an external burner unit of a regenerative or recuperative heat generator. The regenerative heat generator may e.g. be a hot blast stove of a blast furnace.

[0002] The preheating of air for blast furnaces is conventionally carried out in adjacent regenerative heat generators known as hot blast stoves. Such stoves generally comprise a combustion chamber and a heat-retention shaft. In case of an internal combustion chamber stove, the combustion chamber and the heat-retention shaft are separated from one another by a wall constructed from refractory bricks. A burner unit is generally located in a bottom section of the combustion chamber. Combustion air and combustible fuel, generally combustible gases, are supplied to the burner unit and a mixture of the combustion air and fuel is burned in the combustion chamber of the stove. The flue gases emanating from the combustion rise upwards in the combustion chamber, are diverted via a dome and then pass through the heat-retention shaft filled with checker bricks. Heat from the flue gases is absorbed by the checker bricks. The flue gasses which have now cooled down escape the stove via an exhaust gas chamber and at least one discharge port.

[0003] Once the checker bricks have been heated to a sufficient temperature, the supply of combustion air and fuel is discontinued and air is blown through the stove in the opposite direction. The air is heated as it passes through the heat-retention shaft containing the hot checker bricks, diverted via a dome into the combustion chamber, where it leaves the stove via a hot blast outlet in the shell of the stove to be fed to the blast furnace.

[0004] Generally, the burner unit comprises a ceramic burner arranged within the stove, i.e. in the bottom section of its combustion chamber. It is also possible to provide external burner units, which are installed outside the shell of the stove. One or more such external burner units may be used instead of an internal ceramic burner. Alternatively, such external burner units may be used as additional heaters if used in conjunction with an internal ceramic burner.

[0005] One advantage of such external burner units is that they are easily accessible, i.e. for maintenance or regulation purposes. Indeed, it may be advantageous to regulate the burner unit in order to achieve different temperatures or different flue gas compositions. This is of particular interest if the stove is used for experimental purposes.

Object of the invention

[0006] Consequently, the object of the present invention is to provide an improved burner unit for steel making facilities, in particular in connection with regenerative or recuperative heat generators. This object is achieved by a burner unit as claimed in claim 1.

General description of the invention

[0007] In order to achieve this object, the present invention proposes a burner unit for steel making facilities, in particular for use in connection with a regenerative or recuperative heat generator, wherein the burner unit comprises a mixing zone, a plurality of fuel feed channels for feeding combustible fuel to the mixing zone; and a plurality of air feed channels for feeding combustion air to the mixing zone. According to an important aspect of the invention, the burner unit comprises a primary burner with an annular feed arrangement comprising circumferentially alternating fuel feed channels and air feed channels; a central channel through the annular feed arrangement and a secondary burner arranged in the central channel of the burner unit, the central channel being coaxial with the annular feed arrangement.

[0008] The primary burner may be considered as main burner, dimensioned to generally work like a conventional burner. The secondary burner may be considered as auxiliary burner for carrying out additional tasks, such as e.g. heating up the burner unit before the primary burner is switched on or aiding the combustion of the primary burner. Indeed, the secondary burner can be used as post combustion burner for using up any excess combustible fuel or combustion air from the primary burner, thereby altering the composition of the flue gasses exiting the burner unit. Whereas, in conventional burner units, only one type of combustible fuel and one type of combustion air can be used at any one time, regulation of the flue gases composition may be difficult. A mixing of different types of combustible fuel or combustion air may be carried out before feeding it to the burner unit. This is however generally cumbersome and sometimes dangerous. The present invention allows, through the use of the secondary burner, to mix different types of combustible fuel or combustion air within the burner unit; i.e. two different types of combustible fuel or combustion air may be fed to the mixing zone, thereby altering the burning conditions and the flue gas temperature and/or composition. The burner unit according to the present invention is therefore much more flexible, where operation modes are concerned, than conventional burner units.

[0009] The burner unit may also be used to directly supply fumes of a particular composition to the steel making facility to which it is connected.

[0010] It should be noted that the air feed channels may also be referred to as oxygen feed channels. Indeed, instead of combustion air, oxygen O_2 may be fed through the air feed channels to the mixing zone.

[0011] The fuel feed channels and the air feed channels are preferably high flow rate channels. The combustible fuel fed through the fuel feed channels may be blast furnace gas and/or the combustion air fed through the air feed channels may be air or low calorific gas.

[0012] Advantageously, the burner unit further comprises auxiliary fuel feed channels for feeding combustible fuel to the mixing zone. Similarly, the burner unit may also further comprise auxiliary air feed channels for feeding combustion air to the mixing zone. Both the auxiliary fuel feed channels and the auxiliary air feed channels are preferably low flow rate channels. The combustible fuel fed through the auxiliary fuel feed channels may be high calorific gas, such as natural gas or coke oven gas and/or the combustion air fed through the auxiliary air feed channels may be oxygen.

[0013] The auxiliary fuel or air feed channels allow feeding additional combustible fuel or combustion air to the mixing zone, thereby altering the combustion conditions of the primary burner.

[0014] The additional combustible fuel or combustion air may be of the same type than that fed through the main fuel and air feed channels, thereby adjusting the burning combustion conditions of the primary burner. Preferably however, the additional combustible fuel or combustion air is of a different type than that fed through the main fuel and air feed channels, thereby also altering the composition of the flue gasses. The additional combustible fuel or combustion air may also provide the primary burner with a non-stoichiometric mixture, whereby the primary burner only achieves a partial combustion of the mixture. The secondary burner may then be used to complete the combustion of the mixture.

[0015] The auxiliary fuel and air feed channels further contribute to the flexibility of the burner unit.

[0016] The secondary burner preferably comprises air and fuel feed lines, thereby allowing the secondary burner to be used independently from the primary burner. It should be noted however that it is not excluded to provide the secondary burner with only one of the air and fuel feed lines. Indeed, the secondary burner may be used as post combustion burner, receiving air or fuel from the flue gasses from the primary burner.

[0017] The secondary burner may be of any appropriate type, depending on the fuel to be used. Such fuel may be chosen from the non-exhaustive list comprising oil, coke oven gas, blast furnace gas or natural gas.

[0018] The annular feed arrangement is preferably formed by an annular channel comprising a plurality of inner channels therein, wherein the annular channel is connected for conveying one of the combustible fuel or the combustion air and the inner channels are used for conveying the other one of the combustible fuel or the combustion air. By providing inner channels arranged in the annular channel, a gastight separation can be formed between the fuel feed channels and the air feed channels, thereby avoiding any leaks from one channel to the other within the annular feed arrangement.

[0019] The air feed channels and fuel feed channels are preferably parallel to the central axis if the burner unit. Other configurations should however not be excluded. The air and fuel feed channels may e.g. be twisted around the central axis, which may provide a swirling of the combustible fuel and the combustion air when entering the mixing zone. Although generally not desired, in some instances such a swirl may be advantageous. It should be noted that other means for achieving a swirl may also be used.

[0020] According to one embodiment of the invention, the auxiliary fuel feed channels and/or the auxiliary air feed channels pass through a circumferential wall of the burner unit. Annular feed chambers may be arranged around an exterior wall of the burner unit, the annular feed chambers being arranged for feeding combustible fuel or combustion air to the auxiliary fuel feed channels and the auxiliary air feed channels.

[0021] According to another embodiment of the invention, the auxiliary fuel feed channels and/or the auxiliary air feed channels pass through a rear wall of the burner unit, the auxiliary fuel feed channels and/or the auxiliary air feed channels being arranged parallel to the axis of the burner unit. The auxiliary fuel feed channels and/or the auxiliary air feed channels may be arranged between the annular feed arrangement of the primary burner and the secondary burner. Alternatively, the auxiliary fuel feed channels and/or the auxiliary air feed channels may be arranged within the annular feed arrangement of the primary burner.

[0022] It should be noted that, although the present application mainly describes a burner unit in connection with a hot blast stove, the burner unit may also be used in connection with other steel making facilities, such as e.g. pulverised coal injection (PCI) installations or direct recuperative heat exchangers.

Brief description of the figures

[0023] The present invention will be more apparent from the following description of a not limiting embodiment with reference to the attached drawings. In these drawings, wherein identical reference numerals are used to indicate identical or similar elements,

Fig.1: is a cut through a burner unit according to a first embodiment of the present invention;
Fig.2: is a partial section view across the burner unit along line A-A of Fig.1;
Fig.3: is a cut through a burner unit according to a second embodiment of the present invention; and

Fig.4: is a partial section view across the burner unit along line B-B of Fig.3.

Detailed description with respect to the figures

[0024] Fig.1 shows a cut through a burner unit 10 according to a first embodiment of the present invention. The burner unit 10 comprises a front section 12 with a combustion chamber 14 and a rear section 16 with feed lines for feeding combustible fuel and combustion air to a mixing zone 18 of the combustion chamber 14. The front section 12 comprises an opening 20 for feeding flue gases from the burner unit 10 to a steel making facility such as e.g. a hot blast stove (not shown). The burner unit 10 is connected to the hot blast stove via a connection flange 22. In the front section 12, refractory material 24 is applied against the inner surface 26 of the circumferential wall 28 to protect the latter from the heat generated in the combustion chamber 14.

[0025] The rear section 16, which comprises the feed lines, is more easily described by referring to both Fig.1 and Fig.2, the latter being a partial section view along line A-A of Fig.1. The rear section 16 comprises an annular feed arrangement 30 alternately comprising fuel feed channels 32 and air feed channels 34. The fuel and air feed channels 32, 34 are arranged circumferentially, in alternating manner, preferably in regular sectors. The fuel feed channels 32 and air feed channels 34 respectively lead combustible fuel and combustion air from a fuel inlet 36 and an air inlet 38 to the mixing zone 18 of the combustion chamber 14.

[0026] In the mixing zone 18 the combustible fuel and combustion air meet and the mixture thereof is ignited to form a first combustion, represented by flames 40. The annular feed arrangement 30 with its fuel and air feed channels 32, 34 forms a primary burner 42 of the burner unit 10.

[0027] The annular feed arrangement 30 surrounds a central channel 44, which is configured so as to receive a secondary burner 46 therein. The annular feed arrangement 30 and central channel 44 are coaxial with a central axis 47 of the burner unit 10. The central channel 44 is lined with refractory material 48. The secondary burner 46 feeds combustible fuel and combustion air to the mixing zone 18, where a mixture thereof ignites to form a second combustion, represented by flame 50. The secondary burner 46 is inserted into the burner unit 10 though a socket 52 in a rear wall 54 of the burner unit 10.

[0028] The construction of the annular feed arrangement 30 of the primary burner 42 can be more closely described by referring to Fig.2. The annular feed arrangement 30 is formed by two coaxial pipes —an outer pipe 56 and an inner pipe 58 —between which an annular channel 60 is formed. Within the annular channel 60, a plurality of inner channels 61 are formed by inserting pipe-like elements 62 connected to the inner pipe 58. The pipe-like elements 62 form a gas tight separation wall between the inner channels 61 and the annular channel 60, thereby forming the fuel feed channels 32 and air feed channels 34.

[0029] Auxiliary fuel feed channels 64 and auxiliary air feed channels 66 may be provided for feeding further combustible fuel and further combustion air to the mixing zone 18. Although, Fig.1 shows both the auxiliary fuel feed channels 64 and the auxiliary air feed channels 66, it should be noted that it is also possible to provide the burner unit 10 with only one of these auxiliary feed channels 64, 66.

[0030] The auxiliary fuel feed channels 64 are arranged so as to feed further combustible fuel from an annular fuel feed chamber 68 connected to a fuel inlet 70 through the circumferential wall 28 of the burner unit 10 into the mixing zone 18. Similarly, the auxiliary air feed channels 66 are arranged so as to feed further combustion air from an annular air feed chamber 72 connected to an air inlet 74 through the circumferential wall 28 of the burner unit 10 into the mixing zone 18.

[0031] The auxiliary fuel and air feed channels 64, 66 are low flow rate channels arranged so as to deliver high calorific gas, such as natural gas or coke oven gas or oxygen to the mixing zone 18, thereby altering the combustion conditions of the primary burner 42. The further fuel and/or air fed to the mixing zone 18 may be in quantities such that the mixture in the mixing zone 18 is non-stoichiometric, thereby only achieving a partial combustion with the primary burner 42. Further combustion of the flue gases from the first combustion may then be achieved with the aid of the secondary burner 46.

[0032] Figs 3 and 4 show a burner unit 10 according to a second embodiment of the invention, wherein Fig.4 is a partial section view along line B-B of Fig.3. This burner unit is very similar to the one shown in Figs 1 and 2 and will therefore not be described herein in detail. Same reference numerals refer to identical features in both embodiments. The burner unit of Fig. 2 and 3 differs from the first embodiment in the location of the auxiliary feed channels.

[0033] An auxiliary air feed channel 76 is arranged between the fuel feed channels 32 and air feed channels 34 of the annular feed arrangement 30 and the refractory material 48 of the central channel 44. At one end, the auxiliary air feed channel 76 is connected to an air inlet 78 arranged in the rear wall 54 of the burner unit 10; at the opposite end, the auxiliary air feed channel 76 comprises a port 80 opening into the mixing zone 18 of the burner unit 10.

[0034] Although Fig.2 shows an auxiliary air feed channel 76 only, it should be noted that it is also possible to provide the burner unit 10 with an auxiliary fuel feed channel in a similar manner.

[0035] During typical operation of the burner unit 10, combustible fuel and combustion air are generally fed through

the fuel feed channels 32 and air feed channels 34, so as to form a combustible mixture in the mixing zone 18. The flue gases from the combustion of this combustible mixture by the primary burner 42 is then fed through the opening 20 into the hot blast stove.

[0036] The auxiliary fuel and air feed channels 64, 66 allow the introduction of additional combustible fuel and combustion air into the mixing zone 18, thereby creating a combustible mixture potentially comprising two distinctive types of combustible fuel and two distinctive types of combustion air. The flue gas composition can therefore be altered without having to resort to a potentially dangerous mixture upstream of the burner unit 10.

[0037] The secondary burner not only allows burning any excess component in the flue gases from the primary burner, it also allows heating up the burner unit and any downstream equipment before the primary burner is switched on.

[0038] To adjust the temperature, flow rated or composition of the flue gases fed to the hot blast stove, numerous combinations of burners and combustion media are available due to the innovative design of the present burner unit.

[0039] It should be noted that, in the context of the present invention, the expressions "high flow rate" and "low flow rate" of the fuel and air feed channels and auxiliary fuel and air feed channels are relative to each other. The flow rate or section size of the feed channels will strongly depend on the combustion media used. Purely for the purpose of providing an example, the high flow rate, fuel and air feed channels 32, 34 may have a section in the region of 1500 cm^2; and the low flow rate, auxiliary fuel and air feed channels 64, 66 may have a section in the region of 200 cm^2.

[0040] A non-exhaustive list of examples for operation modes of the burner unit according to the present invention is shown in Table 1.

Table 1

Operation mode	Combustion air	Combustible fuel	Further combustion air	Further combustible fuel	Secondary burner
Typical hot blast stove operation	Air	Blast furnace gas	---	Coke oven gas	---
Typical hot blast stove operation	Air	Blast furnace gas	---	---	Post combustion burner[1]
Hot blast stove heating-up operation	---	---	---	---	Heating up burner[2]
Hot blast stove temperature maintenance operation	Air	---	---	Natural gas	---
Hot blast stove temperature maintenance operation	Air	---	---	---	Heat maintenance burner[3]
Hot blast stove N2 free operation	---	Blast furnace gas	Oxygen	---	---
Hot blast stove N2 free operation	Flue gas	Blast furnace gas	Oxygen	Natural gas	Post combustion burner[4]

[1] post combustion burner using coke oven gas and flue gas from primary burner
[2] heating up burner using coke oven gas and air
[3] heat maintenance burner using oil and air
[4] post combustion burner using blast furnace gas and flue gas from primary burner

Reference signs

[0041]

10 burner unit

12 front section

14 combustion chamber

16 rear section

18 mixing zone

20 opening

22 connection flange

24 refractory material

26 inner surface

28 circumferential wall

30 annular feed arrangement

32 fuel feed channels

34 air feed channels

36 fuel inlet

38 air inlet

40 flames

42 primary burner

44 central channel

46 secondary burner

50 flame

52 socket

54 rear wall

56 outer pipe

58 inner pipe

60 annular channel

61 inner channels

62 pipe-like elements

64 auxiliary fuel feed channels

66 auxiliary air feed channels

68 annular fuel feed chamber

70 fuel inlet

72 annular air feed chamber

74 air inlet

76 auxiliary air feed channel

78 air inlet

80 port

Claims

1. Burner unit for steel making facilities, in particular for use in connection with a regenerative or recuperative heat generator, wherein the burner unit comprises:

   a mixing zone;
   a plurality of fuel feed channels for feeding combustible fuel to said mixing zone; and
   a plurality of air feed channels for feeding combustion air to said mixing zone
   characterised by
   a primary burner with an annular feed arrangement comprising circumferentially alternating fuel feed channels and air feed channels;
   a central channel through said annular feed arrangement, said central channel being coaxial with said annular feed arrangement; and
   a secondary burner arranged in said central channel of said burner unit.

2. Burner unit according to claim 1, wherein said fuel feed channels and said air feed channels are high flow rate channels.

3. Burner unit according to claim 2, wherein said burner unit further comprises auxiliary fuel feed channels for feeding combustible fuel to said mixing zone, said auxiliary fuel feed channels being low flow rate channels.

4. Burner unit according to claim 2 or 3, wherein said burner unit further comprises
   auxiliary air feed channels for feeding combustion air to said mixing zone, said auxiliary air feed channels being low flow rate channels.

5. Burner unit according to claim 1 to 4, wherein
   said combustible fuel is blast furnace gas, and/or
   said combustion air is air or low calorific gas.

6. Burner unit according to claim 4 or 5, wherein
   said combustible fuel fed through said auxiliary fuel feed channels is high calorific gas, such as natural gas or coke oven gas, and/or
   said combustion air fed through said auxiliary air feed channels is oxygen.

7. Burner unit according to any one of the preceding claims, wherein said secondary burner comprises air and fuel feed lines.

8. Burner unit according to any one of the preceding claims, wherein said annular feed arrangement is formed by an annular channel comprising a plurality of inner channels therein, said annular channel being connected for conveying one of said combustible fuel or said combustion air, said inner channels being used for conveying the other one of said combustible fuel or said combustion air.

9. Burner unit according to any one of the preceding claims, wherein said air feed channels and fuel feed channels are parallel to the central axis of said burner unit.

10. Burner unit according to any one of claims 3 to 9, wherein said auxiliary fuel feed channels and/or said auxiliary air feed channels pass through a circumferential wall of said burner unit.

11. Burner unit according to claim 10, wherein annular feed chambers are arranged around an exterior wall of said burner unit, said annular feed chambers being arranged for feeding fuel or air to said auxiliary fuel feed channels and said auxiliary air feed channels.

12. Burner unit according to any one of claims 3 to 9, wherein said auxiliary fuel feed channels and/or said auxiliary air feed channels pass through a rear wall of said burner unit, said auxiliary fuel feed channels and/or said auxiliary air feed channels being arranged parallel to the axis of said burner unit.

13. Burner unit according to claim 12, wherein said auxiliary fuel feed channels and/or said auxiliary air feed channels are arranged between said annular feed arrangement of said primary burner and said secondary burner.

14. Burner unit according to claim 12, wherein said auxiliary fuel feed channels and/or said auxiliary air feed channels are arranged within said annular feed arrangement of said primary burner.

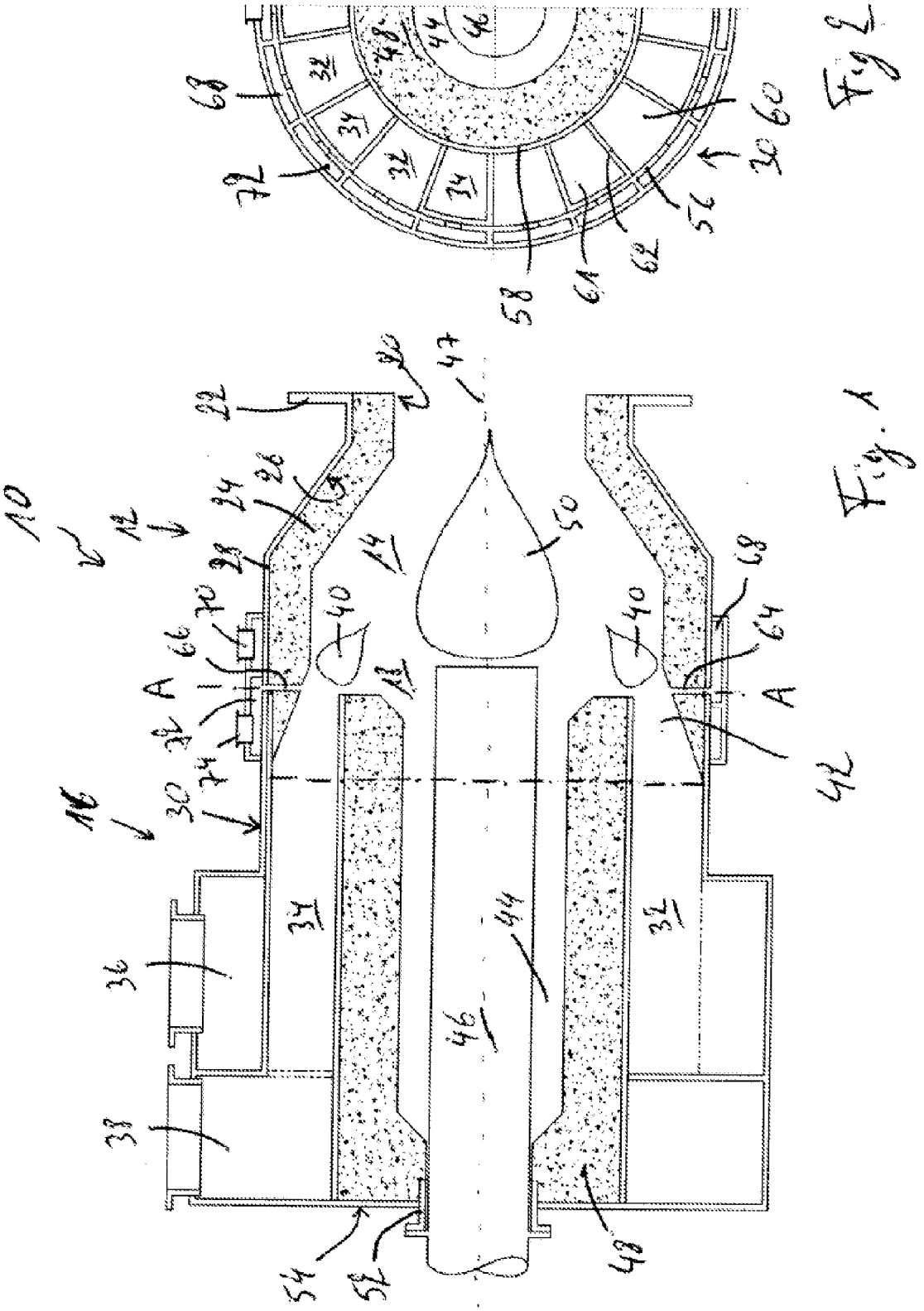
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Fig. 1

Fig 2

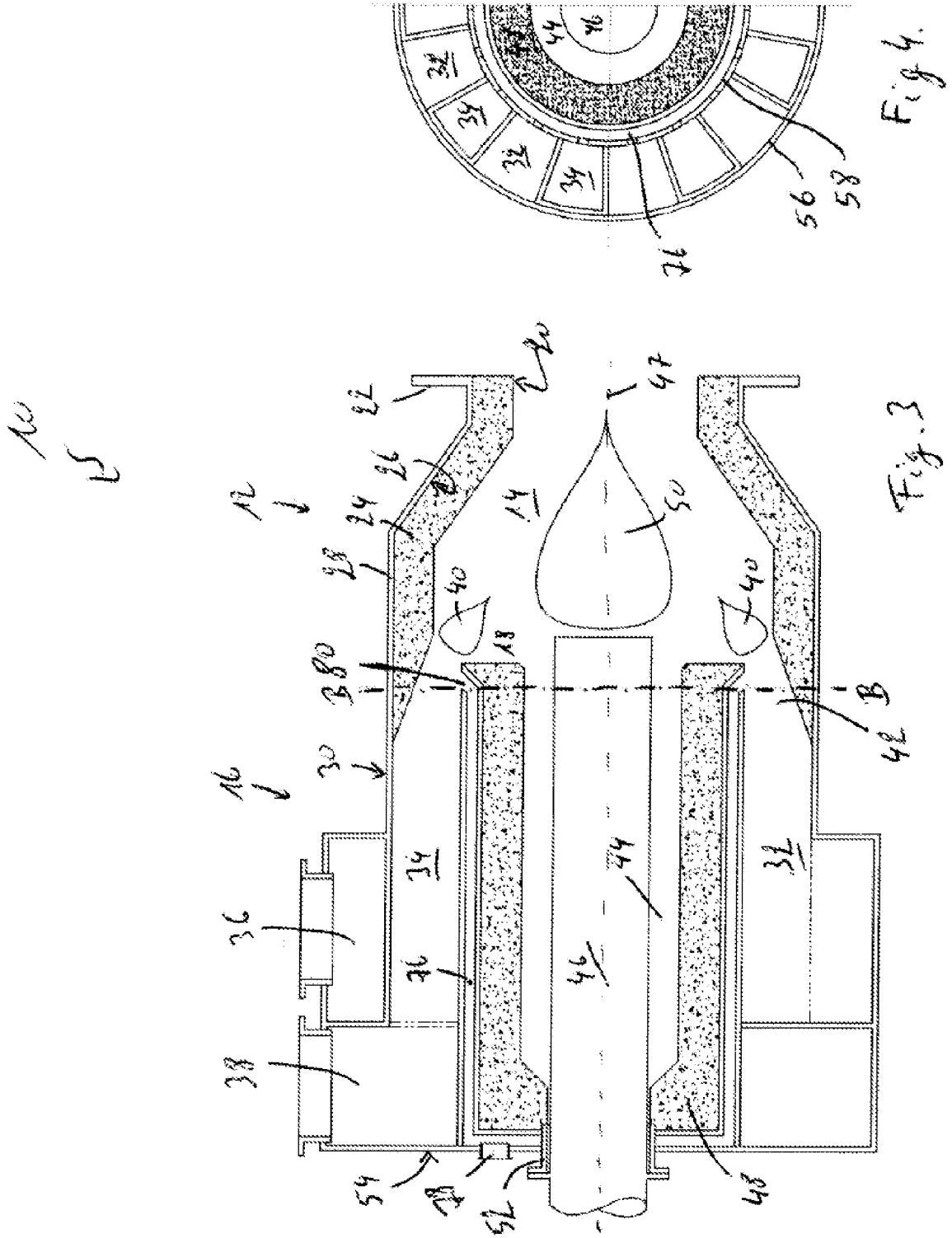
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Fig. 3

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Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 8385

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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
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CATEGORY OF CITED DOCUMENTS

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