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(54) **Method and arrangement for stabilising operation of an impingement dryer**

(57) The invention relates to a method and arrangement for stabilising operation of an impingement dryer (1) in a paper or board machine or the like. The method comprises arranging air to be heated to enter a burner chamber (4) of the impingement (1) dryer through an air inlet opening (11) of the burner chamber (4), the air entering in an angle in relation to at least one burner head (7) in the burner chamber (4), the burner head (7) having a flame opening (8) in its first end, heating air in the burner chamber (4) by bringing the air into a contact with a flame (9), and transferring heated air from the burner chamber

(4) to blowing members of the impingement dryer (1). Between the air inlet opening (11) of the burner chamber (4) and the flame opening (8) of the at least one burner head (7) is arranged, in the direction of the air flow, a guiding member (13) comprising at least one aperture, and the air flow, which enters through the air inlet opening (11) of the burner chamber (4) is divided so that a first air flow (14) travels through the at least one aperture of the guiding member (13) and a second air flow (15) travels through a gap (16) formed between the guiding member (13) and the burner head (7).

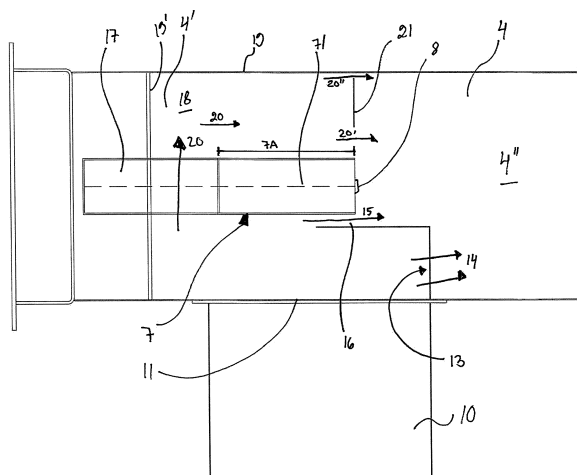


FIG. 2

Description

[0001] The present invention relates to a method and arrangement for stabilising operation of an impingement dryer in a paper or board machine according to the preambles of the enclosed independent claims.

[0002] Impingement dryer in a paper machine or the like uses burners for heating the air which is used for drying the fibrous web. The burner chamber may be integrated inside the hood of the impingement dryer in order to save space and minimise heat losses. Ideally the flame of the burner head should burn steadily in the burner chamber and be surrounded by the combustion gases. Ideally the air to be heated should flow from the air inlet of the burner chamber past the flame, almost parallel to it and without disturbing the flame. The hottest combustion gases should be directed to the pressure manifolds of the impingement dryer, from which manifolds the heated air is distributed to the drying members, such as drying nozzles.

[0003] In practice, however, the space inside the hood of the impingement dryer is limited. Therefore air is often brought towards the burner head and the flame in an angle, sometimes even at straight angle to burner head and the flame. The result is that the air entering to the burner chamber pushes the flame towards the wall of the burner chamber, which may become overheated when the extremely hot flame comes into a contact with it. The flame temperature may typically be, for example, around 1500 °C at the core of the flame. This kind of temperature is too high for normal heat-resistant steel qualities, which easily results in damages in the burner chamber wall. If the burner chamber wall is damaged, the hood of the impingement dryer is damaged and/or the outer surface of the hood is locally overheated. This leads to risks for other equipment and for operating personnel of the paper machine. It has not been possible to solve these problems by selecting materials with better heat-resistance for the burner chamber wall constructions, as the heat is also transferred by conduction through the wall material to the structures of the impingement dryer, which leads to local overheating and damage. A solution, where an insulation layer is arranged around the burner chamber walls, has been in use. However, it is difficult to cover the whole surface of the burner chamber, and the insulation layer reduces the already scarce space available inside the impingement dryer hood. Furthermore, the insulation layer is typically attached to the dryer structures by using fasteners or supports made of metal, which easily lead heat to unwanted locations. Also, if an interstice is accidentally left or formed between the individual slabs of the insulation layer, the heat leakage from the interstice forms a serious local overheating problem.

[0004] Impingement dryers with integrated burner heads may also suffer from flame instability and flame control problems, which are due to the incoming air disturbing the burner chamber conditions.

[0005] An object of the present invention is to minimise

or even completely eliminate the problems existing in the prior art.

[0006] One object of the present invention is to stabilise the function of the burner chamber of an impingement dryer and to reduce the damages and downtime due to the overheating.

[0007] These objects are attained with the invention having the characteristics presented below in the characterising parts of the independent claims.

[0008] Some preferred embodiments of the present invention are presented in the dependent claims.

[0009] The embodiments mentioned in this text relate, where applicable, to the impingement dryer as well as to the method according to the invention, even if this is not always separately mentioned.

[0010] Typical method according to the present invention for stabilising operation of an impingement dryer in a paper or board machine or the like, comprises

- arranging air to be heated to enter a burner chamber of the impingement dryer through an air inlet opening of the burner chamber, the air entering in an angle in relation to at least one burner head in the burner chamber, the burner head having a flame opening in its first end,
- heating air in the burner chamber by bringing the air into a contact with a flame,
- transferring heated air from the burner chamber to blowing members, such as blowing nozzles, of the impingement dryer,
- arranging between the air inlet opening of the burner chamber and the flame opening of the at least one burner head, in the direction of the air flow, a guiding member comprising at least one aperture, and
- dividing the air flow, which enters through the air inlet opening of the burner chamber so that a first air flow travels through the at least one aperture of the guiding member and a second air flow travels through a gap formed between the guiding member and the burner head.

[0011] Typical arrangement according to the present invention for stabilising flame conditions in a burner chamber of an impingement dryer in a paper machine, board machine or the like, comprises

- a burner chamber, delimited by burner chamber walls, and comprising an air inlet opening for entry of air to be heated,
- an air inlet channel connected to the air inlet opening of the burner chamber,
- at least one burner head comprising
 - a flame opening for a flame at a first end of the burner head,
 - at least one feed connection at an opposite second end of the burner head,
 - a burner axis extending from the first end to the

second end of the burner head,

whereby the burner head is arranged in the burner chamber in vicinity of the air inlet opening, the burner axis being in an angle in relation to the gas inlet channel. The arrangement comprises further a guiding member, which comprises at least one aperture, is arranged between the air inlet opening of the burner chamber and the flame opening of the at least one burner head, the guiding member covering,

[0012] in the flow direction, the flame opening, whereby a gap is formed between the burner head and the guiding member.

[0013] Now it has been surprisingly found out that the flame of a burner head can be easily stabilized if a guiding member with apertures, preferably a guiding plate, is arranged between the air inlet opening of the burner chamber and the flame opening of the burner head. The guiding member divides the air flow entering the burner chamber into a first air flow and a second air flow, the first air flow travelling through the apertures of the guiding member and a second air flow travelling chamber through a gap, which is formed between the guiding member and the burner head. In this manner the air flow entering the burner chamber does not collide with full force with the flame, but the air flow is directed further away from the flame opening as well as at least partially aligned with the flame direction. It has been observed that in the impingement dryer comprising an arrangement according to the present invention the flame is more stable, and it does get into contact with chamber walls as much, if at all, as in conventional impingement dryers.

[0014] According to one preferred embodiment of the invention the guiding member is preferably a guiding plate, which comprises at least one aperture, preferably a plurality of adjacent apertures. Guiding member may be made of heat-resistant steel. The guiding member comprises preferably a plurality of apertures, which have a height of 100 - 500 mm, preferably 150 - 250 mm, and width of 300 - 2500 mm, preferably 500 - 1500 mm. The distance between two adjacent apertures is typically 10 - 200 mm, preferably 20 - 120 mm. The guiding member may be curved or otherwise formed in an appropriate way. Usually the guiding member extends through the whole burner chamber, from its first side wall to the second side wall.

[0015] The guiding member is arranged between the air inlet opening of the burner chamber and the flame opening(s), so that a gap is formed between burner head and the guiding member. Typically the height of the gap is 10 - 70 mm, preferably 20 - 50 mm. Furthermore, the guiding member is arranged between the air inlet opening and the flame opening of the burner head so that a straight flow from the air inlet opening to the flame opening is prevented. One purpose of the guiding member is to divide the air flow, and to guide the first part of the air flow away from the area around the flame opening so

that the first air flow comes into contact with the flame and the surrounding combustion gases first in the main part of the burner chamber. At the same time, another purpose of the guiding member is to guide the second part of the air flow to the burner chamber in a direction, which is parallel to the flame, and thus reduce the flame disturbance.

[0016] The first and second air flows are selected appropriately, depending on the design of the burner chamber, burner head(s) and flame temperatures. Generally it may be concluded that if the second air flow is too small the guiding member may be overheated by the flame. On the other hand, if the second air flow is too large the pressure loss of the arrangement increases and the second air flow may even start to disturb the flame. According to one embodiment of the invention the proportion of the first air flow to the second air flow is 80:20 - 97:3, preferably 85:15 - 95:5.

[0017] The arrangement according to present invention is especially suitable for use in impingement dryers, where the air flow entering the burner chamber is introduced into the chamber from the side of the burner, i.e. the flow direction of the entering or incoming air flow is not parallel with the direction of an undisturbed burner flame. In other words, there is an angular relationship between the incoming air flow and the undisturbed flame. Typically the angle between the incoming air flow and the undisturbed flame is in the range of 70 - 100 degrees, typically about 90 degrees. In other words, the angle between the length axis of the air inlet channel and the burner head axis is in the range of 70 - 100 degrees, typically about 90 degrees.

[0018] In this application the term "impingement dryer" describes a drying device located at the drying section of a paper machine or the like. Typical impingement dryer comprises a burner chamber, which is integrated inside the hood of the impingement dryer. In the burner chamber the air is heated to a temperature 200 - 500 °C by bringing it into a contact with a flame(s) of the burner head(s). The heated air is led from the burner chamber through pressure manifolds to blowing members, such as blowing nozzles, which blow the air with high velocity towards a web to be dried. The drying of the web occurs without contact, i.e. the impingement dryer is a contactless drying device.

[0019] The burner chamber walls are typically made of heat resistant steel. The burner chamber comprises an air inlet opening for the incoming air which is to be heated and outlet opening(s) for leading the heated air out of the burner chamber to the pressure manifolds. At least one burner head is arranged in the burner chamber near the vicinity of the air inlet opening. Preferably the burner chamber comprises a plurality of adjacent burner heads, each with a flame opening. The number of burner heads depends on the width of the burner chamber. Normally there is 1 - 6 adjacent, preferably 2 - 5, burner heads in one burner chamber. Distance between two adjacent burner heads may be 200 - 2000 mm, preferably

400 - 1200 mm.

[0020] The burner head comprises a first end and a second end, and a burner head axis extending from the first end to the second end of the burner. The burner head axis is usually arranged in an angle in relation to the air inlet channel. The first end of the burner head faces the main part of the burner chamber and comprises a flame opening. The main part of the burner chamber is here understood as that part of the burner chamber, which extends from the flame opening of the burner head to the outlet opening(s) of the burner chamber. The second end of the burner head is connected to at least one feed connection for feeding the appropriate fuel and combustion air to the burner head and the flame. Typically the temperature of the flame is 800 - 2500 °C, more typically 1000 - 1500 °C and natural gas, liquefied natural gas, liquefied petroleum gas, diesel oil or kerosene may be used as fuel.

[0021] According to one preferred embodiment of the present invention the total cross-sectional area of the feed connection(s) is smaller than the cross-sectional area of the burner head. In case the burner head is connected to several feed connections, their cross-sectional areas are summed together in order to obtain the total cross-sectional area. The total cross-sectional area of the feed connection(s) is normally compared to the cross-sectional area of the burner head at the flame opening. The narrow feed connection(s) enable that air may also flow behind the burner from the first side surface of the burner head to the second side surface of the burner head. Thus it is possible to form a flow channel between the second end of the burner head and a burner chamber end wall, i.e. behind the burner head, as well as between the burner head and a burner chamber wall, and divide the air flow, which enters through the air inlet opening of the burner chamber, so that a third air flow travels through the flow channel. The third air flow thus enters the burner chamber between the burner head and the burner chamber wall, on the opposite side of the burner head than the second air flow. The volume of the third air flow may be 10 - 50 %, preferably 20 - 45 %, more preferably 30 - 45 %, of the total volume of the air flow, which enters the burner chamber through the air inlet opening.

[0022] According to one embodiment of the invention a division plate may be arranged in the flow channel between the burner chamber wall and the burner head in order to divide the third air flow further into a cooling flow and a heated flow, which passes the flame. The division plate is typically made of heat-resistant steel. In this manner it is possible to use the air flow nearest to the burner chamber wall for cooling the burner chamber wall and the air flow nearest to the flame for transfer of thermal energy, while minimising the flame disturbance. Thus, the local overheating may be avoided and the thermal energy is better transferred to the air flow, which is to be heated. Typically the third air flow is divided so that the proportion of the cooling flow to the heated flow may be 5 - 50 %, preferably 10 - 35 %. An appropriate arrange-

ment of the division plate provides sufficient flow between the division plate and the burner chamber wall. If the distance between the burner chamber wall and the division plate is too small, the cooling air flow may not effectively inhibit heat conduction to the burner chamber wall. The division plate is typically arranged at a first distance of 5 - 50 mm, preferably 10 - 30 mm from the burner chamber wall, and at a second distance of 50 - 300 mm, preferably 80 - 200 mm from the burner head.

[0023] At least a part of the air flow entering through the air inlet opening of the burner chamber may be recirculated from the space between the blowing members, such as blowing nozzles, and the web. The impingement dryer may thus comprise means for removing humid air from the space between the blowing members and the web as well as means for circulating this air back to the air inlet opening of the impingement dryer. The temperature of the circulated air may be typically 100 - 350 °C, more typically approximately 250 °C. Use of circulated air reduces the need for heating of the air in the burner chamber and saves thus energy.

[0024] According to one embodiment of the invention at least a part of the air flow entering through the air inlet opening of the burner chamber is preheated air, which taken from outside of the impingement dryer, for example from machine room or from outdoors. For example, machine room air may be preheated to a temperature of 100 - 250 °C, typically 150 - 200 °C by using available heat recovery means, such as heat recovery means of the drying section of a paper mill or heat recovery means of the gas heated dryer(s) itself. The preheated air may also be used as combustion air which is fed to the burner head(s) through feeding connection(s). Thus the waste heat of the drying section of a paper machine may be used for preheating the air flow and/or the combustion air.

[0025] According one embodiment of the invention air from the preheated air is mixed before the burner chamber with the air recirculated from the space between the blowing members and the web. In other words, machine room air and/or outdoor air may be added to and mixed as makeup air to circulated air before the air flow enters the burner chamber. Typically the amount of makeup air from outside the impingement dryer hood is 3 - 20 weight-%, preferably 5 - 15 weight-%.

[0026] The invention is described in more detail below with reference to the enclosed schematic drawings, in which

Figure 1 shows a schematic view of an impingement dryer,

Figure 2 shows a burner chamber arrangement of an impingement dryer according to the present invention.

[0027] Figure 1 shows a schematic view of an impingement dryer. The impingement dryer 1 comprises a hood 2 and a number of blowing nozzles 3, 3', 3'', with which

heated air is blown against the web to be dried (not shown). Inside the hood 2 have been arranged a burner chamber 4, in which the drying air is heated to an elevated temperature, as well as pressure manifolds 5 for transferring the heated air from the burner chamber 4 to the blowing nozzles 3, 3', 3". The air in the impingement dryer is circulated by using a circulating fan 6. The fan 6 causes the air to flow through an air inlet channel 10 to the burner chamber 4 through an air inlet opening 11. The air flowing through the burner chamber 4 from the air inlet opening 11 to the inlets of the pressure manifolds 5 is heated to a desired temperature when it is flowing past a flame 9. The air flows inside the impingement dryer are described in Figure 1 by using arrows.

[0028] To the first end 4' of the burner chamber 4 is arranged a burner head 7. The burner head 7 comprises a flame opening 8 at the first end of the burner head 7. In the second end of the burner head 7 there is feed connections 12 for feeding the fuel, such as natural gas, as well as combustion air to the burner 7.

[0029] The flame 9 is presented in Figure 1 as undisturbed, under optimal conditions. However, it is easily conceivable from Figure 1 that in a conventional impingement dryer there is a risk that the air flow entering the burner chamber via the air inlet opening 11 disturbs the flame 9 and "pushes" it towards the wall of the burner chamber 4.

[0030] Figure 2 shows a burner chamber arrangement of an impingement dryer according to the present invention. A burner head 7 is arranged in the first end 4' of the burner chamber 4. In the vicinity of the burner head 7, perpendicularly to the burner axis 71, an air inlet channel 10 is connected to the burner chamber 4 through an air inlet opening 11. A guiding member 13 is arranged between the flame opening 8 and the air inlet opening 11. The guiding member 13 is formed to divide the air flow coming from the air inlet channel 10 and entering the burning chamber 4 through the air inlet opening 11 into a first air flow 14 and to a second air flow 15. The air flows 14, 15 are designated with arrows. The first air flow 14 enters the main burner chamber 4" through apertures (not shown) of the guiding member 13. In this manner the entry of the first air flow 14 in to the main burner chamber 4" is displaced in relation to the flame opening 8, and shifted towards the centre of the burner chamber 4. In other words, the disturbances to the flame originating from the first air flow 14 are minimised, even totally eliminated. The second air flow 15 enters the main burner chamber 4" through a gap 16, which is formed between the burner head 7 and the guiding member 13. In this manner the second air flow 15 flows parallel to the flame past the flame opening 8. In other words, the second air flow 15 minimises, even totally eliminates the disturbances around the flame (not shown). At the same time the second air flow 15 cools the guiding member 13 and reduces the risk that the guiding member 13 is overheated by the flame.

[0031] A feed connection 17 for feeding fuel and com-

bustion air to the burner head 7 is arranged to the second end of the burner head 7. It is possible to arrange the cross-sectional area of the feed connection 17 smaller than the cross-sectional area of the flame part 7A of the burner head 7. In this manner it is possible, if so required, to form a flow channel 18 between the second end of the burner head 7 and a burner chamber end wall 19'. The flow channel 18 continues between the burner head 7 and a burner chamber wall 19 in the burner chamber 4. Thus a part of the air flow, which enters the burner chamber 4 through the air inlet opening 11, forms a third air flow 20, depicted with arrows.

[0032] Further, it is possible, but optional, to arrange a division plate 21 to the flow channel 18, to the space between the burner chamber wall 19 and the burner head 7. This division plate 21 divides the third air flow 20 to a heated flow 20' and to a cooling flow 20". The heated flow 20' is guided past the burner head 7 so that the flow 20' is heated by the flame. The cooling flow 20" is guided past the burner chamber wall 19 so that it cools and flushes the wall 19. In this manner, the risk for wall overheating is reduced. The division plate 21 may be arranged perpendicularly in relation to the burner axis 71 or it may be curved, bent or L-shaped, preferably curved, bent or L-shaped.

[0033] Even if the invention was described with reference to what at present seems to be the most practical and preferred embodiments, it is appreciated that the invention shall not be limited to the embodiments described above, but the invention is intended to cover also different modifications and equivalent technical solutions within the scope of the enclosed claims.

[0034] The invention relates to a method and arrangement for stabilising operation of an impingement dryer (1) in a paper or board machine or the like. The method comprises arranging air to be heated to enter a burner chamber (4) of the impingement (1) dryer through an air inlet opening (11) of the burner chamber (4), the air entering in an angle in relation to at least one burner head (7) in the burner chamber (4), the burner head (7) having a flame opening (8) in its first end, heating air in the burner chamber (4) by bringing the air into a contact with a flame (9), and transferring heated air from the burner chamber (4) to blowing members of the impingement dryer (1). Between the air inlet opening (11) of the burner chamber (4) and the flame opening (8) of the at least one burner head (7) is arranged, in the direction of the air flow, a guiding member (13) comprising at least one aperture, and the air flow, which enters through the air inlet opening (11) of the burner chamber (4) is divided so that a first air flow (14) travels through the at least one aperture of the guiding member (13) and a second air flow (15) travels through a gap (16) formed between the guiding member (13) and the burner head (7).

Claims

1. Method for stabilising operation of an impingement dryer (1) in a paper or board machine or the like, the method comprising
 - arranging air to be heated to enter a burner chamber (4) of the impingement (1) dryer through an air inlet opening (11) of the burner chamber (4), the air entering in an angle in relation to at least one burner head (7) in the burner chamber (4), the burner head (7) having a flame opening (8) in its first end,
 - heating air in the burner chamber (4) by bringing the air into a contact with a flame (9),
 - transferring heated air from the burner chamber (4) to blowing members of the impingement dryer (1),**characterised in**
 - arranging between the air inlet opening (11) of the burner chamber (4) and the flame opening (8) of the at least one burner head (7), in the direction of the air flow, a guiding member (13) comprising at least one aperture, and
 - dividing the air flow, which enters through the air inlet opening (11) of the burner chamber (4) so that a first air flow (14) travels through the at least one aperture of the guiding member (13) and a second air flow (15) travels through a gap (16) formed between the guiding member (13) and the burner head (7).
2. Method according to claim 1, **characterised in that** proportion of the first air flow (15) to the second air flow (14) is 80:20 - 97:3, preferably 85:15 - 95:5.
3. Method according to claim 1 or 2, **characterised in**
 - forming a flow channel (18) between the second end of the burner head (7) and a burner chamber end wall (19') as well as between the burner head (7) and a burner chamber wall (19), and
 - dividing the air flow, which enters through the air inlet opening (11) of the burner chamber (4), so that a third air flow (20) travels through the flow channel (18).
4. Method according to claim 3, **characterised in that** volume of the third air flow (20) is 10 - 50 %, preferably 20 - 45 %, more preferably 30 - 45 %, of the total volume of the air flow, which enters through the air inlet opening (11).
5. Method according to claim 3, **characterised in** arranging a division plate (21) to the flow channel (18) between the burner chamber wall (19, 19') and the burner head (7) in order to divide the third air flow (20) further into a cooling flow (20'') and a heated flow (20').
6. Method according to claim 5, **characterised in that** the proportion of the cooling flow (20') to the heated flow (20'') is 5 - 30 %, preferably 10- 50 %.
7. Method according to any of preceding claims 1 - 6, **characterised in that** at least a part of the air flow entering through the air inlet opening (11) of the burner chamber (4) is recirculated from the space between the blowing members and a web.
8. Method according to any of preceding claims 1 - 7, **characterised in that** a part of the air entering through the air inlet opening (11) of the burner chamber (4) is preheated air, which taken from outside of the impingement dryer (1).
9. An arrangement for stabilising flame conditions in a burner chamber (4) of an impingement dryer (1) in a paper machine, board machine or the like, the arrangement comprising
 - a burner chamber (4), delimited by burner chamber walls (19, 19'), and comprising an air inlet opening (11) for entry of air to be heated,
 - an air inlet channel (10) connected to the air inlet opening (11) of the burner chamber (4),
 - at least one burner head (7), comprising
 - a flame opening (8) for a flame (9) at a first end of the burner head (7), and
 - at least one feed connection (17) at an opposite second end of the burner head (7),
 - a burner axis (71) extending from the first end to the second end of the burner head (7),
 whereby the burner head (7) is arranged in the burner chamber (4) in vicinity of the air inlet opening (11), the burner axis (71) being in an angle in relation to the gas inlet channel (10),**characterised in that** a guiding member (13), which comprises at least one aperture, is arranged between the air inlet opening (11) of the burner chamber (4) and the flame opening (8) of the at least one burner head (7), the guiding member (13) covering, in the flow direction, the flame opening (8), whereby a gap (16) is formed between the burner head (7) and the guiding member (13).
10. Arrangement according to claim 9, **characterised in that** the height of the gap (16) is 10 - 70 mm, preferably 20 - 50 mm.

11. Arrangement according to claim 9 or 10, **characterised in that** the guiding member (13) comprises a plurality of apertures, which have a height of 100 - 500 mm, preferably 150 - 200 mm, and width of 300 - 2500 mm, preferably 500 - 1500 mm. 5
12. Arrangement according to claim 9, 10 or 11, **characterised in that** the arrangement comprises a plurality of adjacent burner heads (7), each with a flame opening (8). 10
13. Arrangement according to claim 12, **characterised in that** the distance between two adjacent burner heads (7) is 200 - 2000 mm, preferably 400 - 1200 mm. 15
14. Arrangement according to any of preceding claims 9 - 13, **characterised in that** the total cross-sectional area of the feed connection(s) (17) is smaller than the cross-sectional area of the the burner head (7). 20
15. Arrangement according to claim 14, **characterised in that** a division plate (21) is arranged between the burner head (7) and the burner chamber wall (19), at a first distance of 5 - 50 mm, preferably 10-30 mm 25
from the burner chamber wall (19), and at a second distance of 50 - 300 mm, preferably 80 - 200 mm from the burner head (7).

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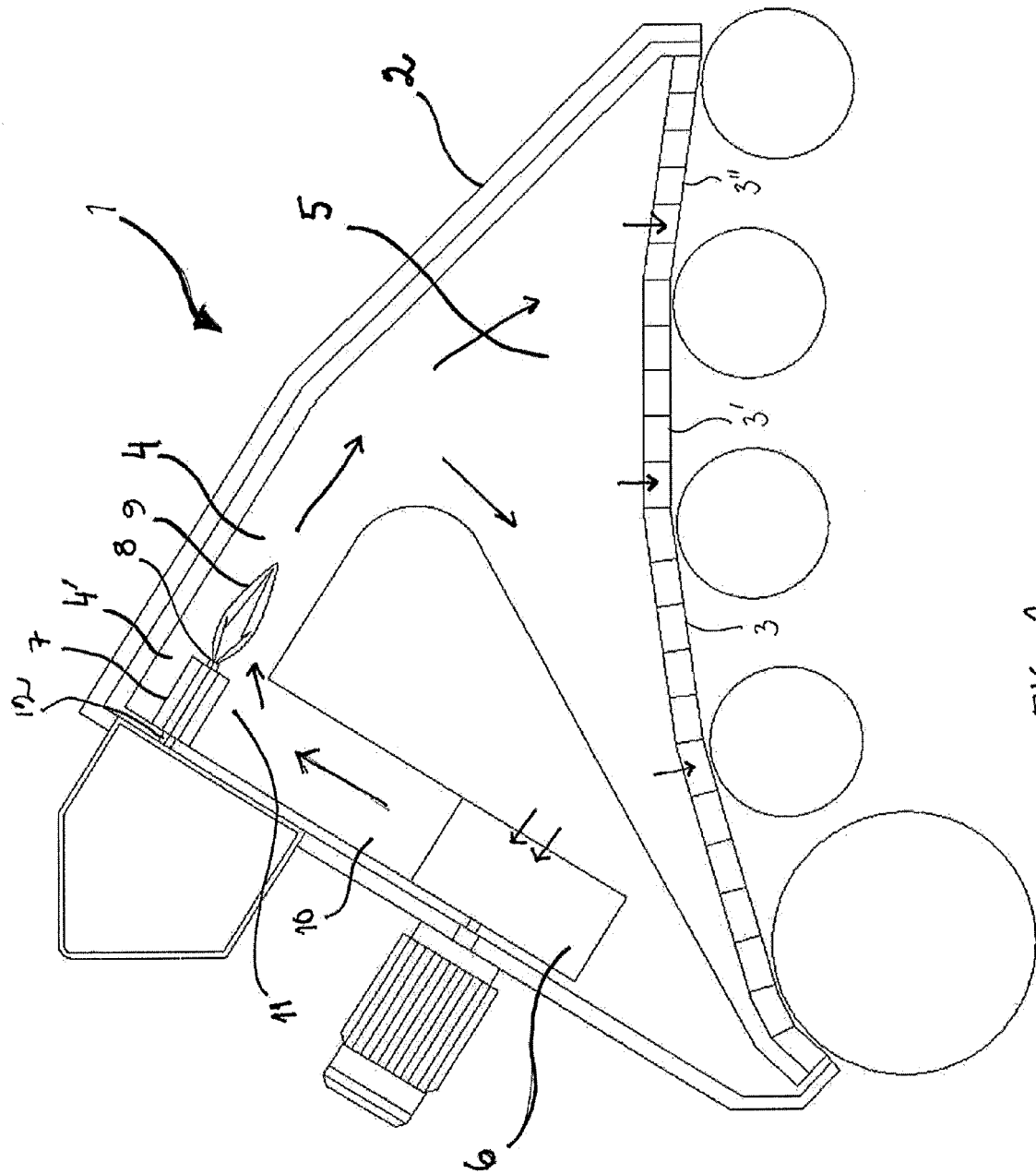


FIG. 1

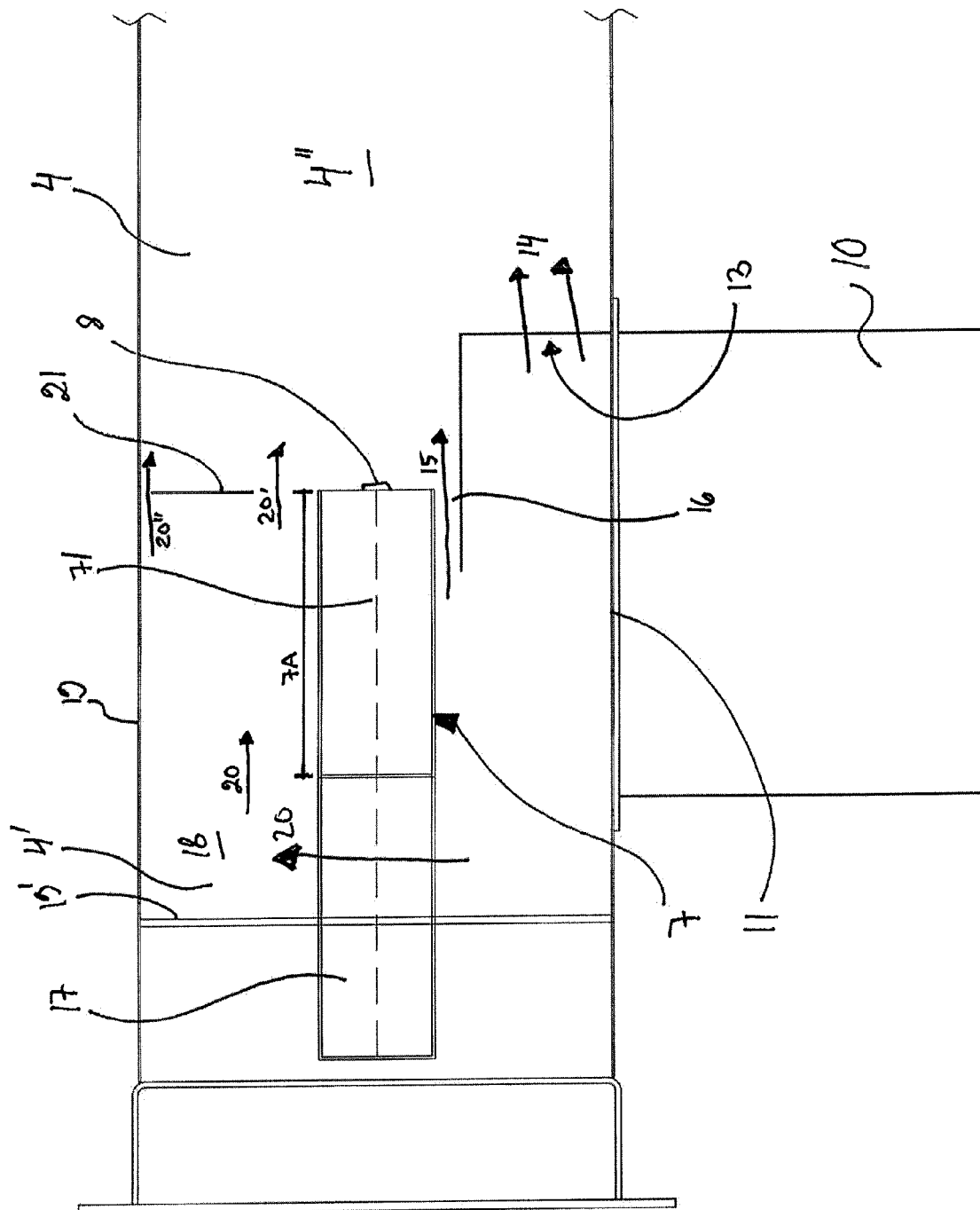


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 14 16 6956

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 03/000987 A1 (METSO PAPER AUTOMATION OY [FI]; ALMI JARI [FI]; VEIJOLA JARKKO [FI]; N) 3 January 2003 (2003-01-03) * paragraph [0020] - paragraph [0025]; figure 2 *	1,3,7-9, 12,14	INV. D21F5/04 D21F5/18
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A		1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			D21F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 October 2014	Examiner Beckman, Anja
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 14 16 6956

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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14-10-2014

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