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(54) **Title:** PLANT FOR MANUFACTURING CEMENT CLINKER

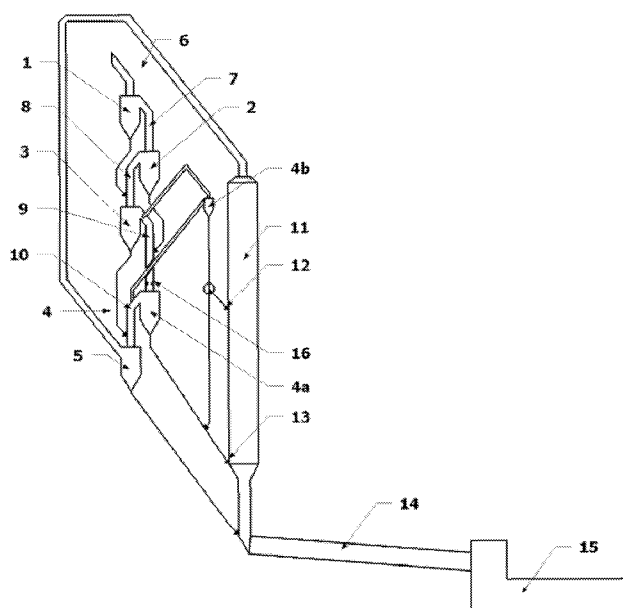


FIG. 1

(57) **Abstract:** Described is a plant for manufacturing cement clinker comprising a preheater (6) for preheating cement raw meal by contact with hot gases which preheater comprises a number of cyclone stages (1, 2, 3, 4) which are connected in series via gas ducts (7, 8, 9, 10), a heat treatment unit (11) which comprises at least one inlet opening (12) for introducing preheated raw meal from at least one preheater cyclone (4b) in a selected cyclone stage (4), where a gas outlet of said at least one preheater cyclone (4b) in the selected cyclone stage (4) in a vertical plane is located at a higher level than a gas/material inlet of the preceding cyclone stage (3) as seen in the direction of movement of the cement raw meal. The plant is peculiar in that the selected cyclone stage comprises an additional cyclone which is placed in parallel to the other cyclone(s) in said cyclone stage and having in said vertical plane a gas outlet located at a lower level than said gas/material inlet of said preceding cyclone stage, and in that the gas ducts from the cyclones in the selected cyclone stage are merged into one single gas duct for conducting the mixed gases to said preceding cyclone stage. Hence, without affecting the installation height of the preheater, it will be possible to locate at least one of the cyclones of the selected cyclone stage at an arbitrary height relative to the other cyclone(s) in said cyclone stage, while simultaneously ensuring that raw meal from a preceding cyclone stage in an optimum way may be introduced into an upwardly flowing gas stream from said selected cyclone stage,

i.e. in the gas duct from the additional cyclone. Preheated raw meal from the selected cyclone stage can therefore be introduced at any point into the heat treatment unit without any use of special lifting equipment. By proper mutually sizing of the cyclones of the selected cyclone stage, the amount of raw meal, which is lifted to a higher level, may be tailored the actual quantity needed for introduction at the higher located intake point.

PLANT FOR MANUFACTURING CEMENT CLINKER

The present invention relates to a plant for manufacturing cement clinker comprising a preheater for preheating cement raw meal by contact with hot gases which preheater comprises a number of cyclone stages which are connected in series via gas ducts, a heat treatment unit which comprises at least one inlet opening for introducing preheated raw meal from at least one preheater cyclone in a selected cyclone stage, where a gas outlet of said at least one preheater cyclone in the selected cyclone stage in a vertical plane is located at a higher level than a gas/meal inlet of the preceding cyclone stage as seen in the direction of movement of the cement raw meal.

A plant of the aforementioned kind for manufacturing cement is known for example from EP1322899. In this known plant, raw meal is introduced into the gas duct for conducting hot gases from the second cyclone of the cyclone preheater to the first cyclone. The raw meal is then preheated as it is led through the cyclones of the preheater in counterflow to a flow of hot exit gases from the subsequent calciner and kiln. In the known plant the preheated raw meal is extracted from the last cyclone of the preheater and introduced into the calciner for calcination therein. In order to enabling introduction of preheated raw meal from this last cyclone at a higher intake point of the calciner, this last cyclone of the preheater has been located at a higher level than the highest desired location of the intake point, whereas the next-to-last cyclone as seen in the direction of movement of the cement raw materials in order to keep the overall installation height of the preheater at a minimum has been located at lower level. In this way the gas duct connecting the gas outlet of the last cyclone with the gas/meal inlet of the next-to-last cyclone must include a downwardly directed section. This means that the raw meal from a cyclone preceding the next-to-last cyclone to be introduced into the gas flow in said gas duct either has to be introduced into a downwardly flowing gas stream or the gas duct has to include a U formed section, thus enabling the meal to be introduced into a upwardly flowing gas stream. As recognized by the skilled person both these alternatives are far from optimum. In the first alternative it is difficult to obtain proper suspension of the

meal in the gases and thus obtaining the desired heat exchange, whereas in the second alternative meal will inevitably accumulate at the bottom of the U formed section. A further disadvantage by the known plant is that all the raw meal is lifted to the higher level although most often it is only a small portion that has to be introduced at a higher intake point of the heat treatment unit.

It is the objective of the present invention to provide a plant by means of which a desired amount of preheated raw meal from a selected cyclone stage of the preheater can be introduced into an intake point located at a higher level without causing the installation height of the preheater to be increased, where the above problems are eliminated or essentially reduced.

This is achieved by a plant of the kind mentioned in the introduction and being characterized in that the selected cyclone stage comprises an additional cyclone which is placed in parallel to the other cyclone(s) in said cyclone stage and having in said vertical plane a gas outlet located at a lower level than said gas/material inlet of said preceding cyclone stage, and in that the gas ducts from the cyclones in the selected cyclone stage are merged into one single gas duct for conducting the mixed gases to said preceding cyclone stage.

Hence, without affecting the installation height of the preheater, it will be possible to locate at least one of the cyclones of the selected cyclone stage at an arbitrary height relative to the other cyclone(s) in said cyclone stage, while simultaneously ensuring that raw meal from a preceding cyclone stage in an optimum way may be introduced into an upwardly flowing gas stream from said selected cyclone stage, i.e. in the gas duct from the additional cyclone. Preheated raw meal from the selected cyclone stage can therefore be introduced at any point into the heat treatment unit without any use of special lifting equipment. By proper mutually sizing of the cyclones of the selected cyclone stage, the amount of raw meal, which is lifted to a higher level, may be tailored the actual quantity needed for introduction at the higher located intake point.

When a cyclone stage comprises two or more parallel cyclones of which at least one is located at a higher level, the pressure drop over this higher located cyclone will mutatis mutandis be higher, thus demanding some kind of means for regulating the gas flows through each cyclone in said cyclone stage. Such means  
5 may be traditional damper devices placed in the respective gas ducts from at least some of the cyclones in said cyclone stage. As an alternative or supplement, it is preferred that the raw meal being introduced into the gas from said selected cyclone stage is introduced into the gas duct from the additional cyclone before the gas ducts from the cyclones in the selected cyclone stage are  
10 merged into one single gas duct. In this way, the higher pressure drop over the higher located cyclone will in at least to a certain extent be balanced.

In principle, the heat treatment unit may be any kind of unit requiring the introduction of a certain amount of preheated raw meal. As non-limiting examples  
15 of the heat treatment unit may be mentioned a calciner for calcination of preheated raw meal and a waste combustion apparatus, such as the Hot Disc being marketed by the applicant of the present application.

The invention will now be described in further details with reference to drawing,  
20 the only figure of which shows a plant according to the invention.

In the figure is shown a kiln plant for manufacturing cement clinker. The plant comprises a cyclone preheater 6 with four cyclone stages 1, 2, 3 and 4, which are connected in series and fed with gas/raw meal suspension via gas ducts 7, 8,  
25 9 and 10. The plant also comprises a heat treatment unit in form of a calciner 11 which comprises inlet openings 12 and 13 for introducing preheated raw meal from the cyclone stage 4, which calciner 11 is connected to a separating cyclone 5, a rotary kiln 14 and a clinker cooler 15. As seen the figure cyclone stage (4) comprises a preheater cyclone (4b), which in a vertical plane is located at a  
30 higher level than a gas/meal inlet of the preceding cyclone stage (3) as seen in the direction of movement of the cement raw meal, hence facilitating introduction of preheated raw meal into the calciner 11 at a higher, preferably predetermined level.

In order to enabling that a desired amount of preheated raw meal from a selected cyclone stage 4 of the preheater 6 can be introduced into an intake point 12 located at such a higher level without causing the installation height of the preheater to be increased and simultaneously ensuring that raw meal from a preceding cyclone stage 2 in an optimum way may be introduced into an upwardly flowing gas stream from said selected cyclone stage 4 it is suggested according to the invention that the selected cyclone stage 4 comprises two parallel cyclones 4a and 4b, where cyclone 4a may be regarded as an additional cyclone, which has in a vertical plane a gas outlet located at a lower level than said gas/material inlet of the preceding cyclone stage 3, and that the gas ducts from the cyclones 4a and 4b in the selected cyclone stage 4 are merged into one single gas duct for conducting the mixed gases to said preceding cyclone stage 3.

Hence, without affecting the installation height of the preheater, cyclone 4b may be located at an arbitrary height relative to the other cyclone 4a in cyclone stage 4, while simultaneously ensuring that raw meal from a preceding cyclone stage 2 in an optimum way may be introduced into an upwardly flowing gas stream from cyclone 4a. Preheated raw meal from the selected cyclone stage 4 can therefore be introduced at any point into the calciner 11 unit without any use of special lifting equipment.

By proper mutually sizing of the cyclones 4a and 4b of the selected cyclone stage 4, the amount of raw meal, which is lifted to a higher level, may be tailored the actual quantity needed for introduction at the higher located intake point. Most often, during normal operation, only a minor part of the preheated raw meal from cyclone stage 4 needs to be lifted to a higher intake point of the calciner 11, and thus cyclone 4b would normally be dimensioned relatively small compared to cyclone 4a.

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In the shown plant, the pressure drop over cyclone 4b will be higher than over 4a. In order to balance this difference in pressure drop at least to a certain extent, the raw meal from cyclone stage 2 being introduced into the gas from cyclone stage

4 is introduced into the gas duct from the cyclone 4a before the gas ducts from the cyclones 4a and 4b are merged into one single gas duct. Further, some kind of damper or restriction device 16 may be fitted in the gas duct from cyclone 4a.

- 5 In the figure, the heat treatment unit is shown as a calciner 11; however it may in principle be any kind of unit requiring the introduction of a certain amount of preheated raw meal. Also, the plant may comprise more than one such unit.

## Claims

1. Plant for manufacturing cement clinker comprising a preheater (6) for preheating cement raw meal by contact with hot gases which preheater  
5 comprises a number of cyclone stages (1, 2, 3, 4) which are connected in series via gas ducts (7, 8, 9, 10), a heat treatment unit (11) which comprises at least one inlet opening (12) for introducing preheated raw meal from at least one preheater cyclone (4b) in a selected cyclone stage (4), where a gas outlet of said at least one preheater cyclone (4b) in the selected cyclone stage (4) in a vertical  
10 plane is located at a higher level than a gas/meal inlet of the preceding cyclone stage (3) as seen in the direction of movement of the cement raw meal, **characterized in** that the selected cyclone stage (4) comprises an additional cyclone (4a) which is placed in parallel to the other cyclone(s) (4b) in said cyclone stage (4) and having in said vertical plane a gas outlet located at a lower  
15 level than said gas/material inlet of said preceding cyclone stage (3), and in that the gas ducts from the cyclones (4a, 4b) in the selected cyclone stage (4) are merged into one single gas duct for conducting the mixed gases to said preceding cyclone stage (3).
- 20 2. Plant according to claim 1, **characterized in** that the raw meal being introduced into the gas from said selected cyclone stage (4) is introduced into the gas duct from the additional cyclone (4a) before the gas ducts from the cyclones (4a, 4b) in the selected cyclone stage (4) are merged into one single gas duct.
- 25 3. Plant according to claim 1, **characterized in** that the heat treatment unit (11) is a calciner for calcination of preheated raw meal or a waste combustion apparatus.

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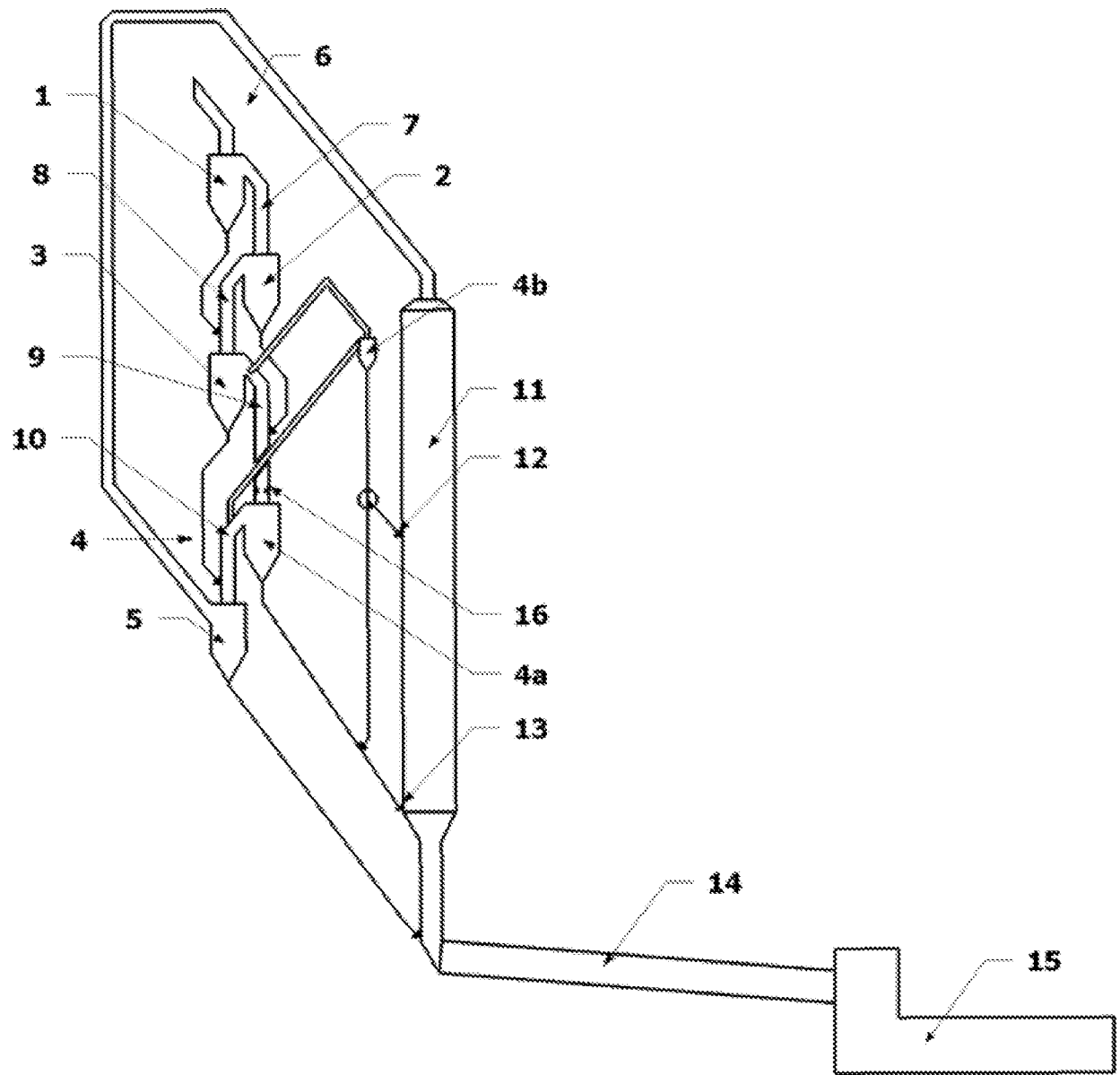


FIG. 1

# INTERNATIONAL SEARCH REPORT

International application No

PCT/DK2013/050282

## A. CLASSIFICATION OF SUBJECT MATTER

INV. F27B7/20

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F27B C04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                     | Relevant to claim No. |
|-----------|--------------------------------------------------------------------------------------------------------|-----------------------|
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| Y         | -----<br>EP 1 322 899 B1 (SMIDTH AS F L [DK])<br>13 December 2006 (2006-12-13)<br>figures 1-4<br>----- | 1-3                   |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

### \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

30 January 2014

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05/02/2014

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/DK2013/050282

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