(19) Europäisches Patentamt
European Patent Office
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(11) EP 1 167 907 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.01.2002 Bulletin 2002/01

(51) Int Cl.[7]: **F26B 21/02**, F26B 15/16

(21) Application number: **01202259.6**

(22) Date of filing: **12.06.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **23.06.2000 IT RE000070**

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(54) Plant for the continuous drying of brick products

(57) A plant for the continuous drying of hollow brick products, comprising a tunnel (2) provided with at least one entry door (20) for trolleys (5) carrying the products (6) to be dried, and at least one exit door (21) therefor, the interior of said tunnel (2) being divided into a plurality of spaced-apart chambers (C' and C"), of which at least one is fed with a drying fluid, and at least one is provided with suction means for said fluid, said chambers mutually communicating via a port (40) through which said trolleys (5) are made to advance, each of these latter being provided with a plate (300) for closing said port (40); said plurality of chambers (C' and C") are connected together by a duct to which there is connected, associated with each chamber (C' and C"), at least one blower means (8) positioned to the side of said products (6) and arranged to direct the drying fluid onto them.

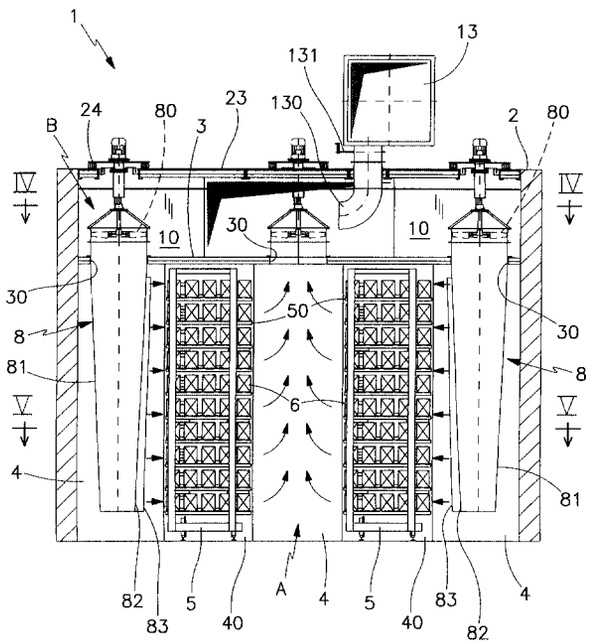

FIG.2

EP 1 167 907 A1

Description

[0001] This invention relates to a plant for drying products formed from clay mixes, in particular products presenting through holes.

[0002] Plants of known type for drying brick products presenting through holes, such as hollow bricks and hollow tiles, generally comprise a tunnel through which hot air is circulated and through which trolleys carrying the product to be dried, known as greenware by the expert of the art, are fed.

[0003] The hot air stream, heated to a temperature between 100°C and 120°C, which grazes the material to be dried, must have a direction parallel to the direction of the holes present in the material. As the material is generally disposed on the trolleys such that the axis of the holes is perpendicular to the trolley advancement direction, it is not possible to prevent the air stream from grazing the material in the trolley advancement direction, with consequent non-uniform drying of the material.

[0004] The typical drawback of this type of plant is hence that air flows are created in the tunnel countercurrent to the material advancement direction. These flows cause irregular drying of the material surface, and during the subsequent firing stage can generate cracks which irreparably damage the material.

[0005] To solve this problem, drying plants are known comprising a plurality of drying chambers connected in series, each defining a drying region isolated from and operating independently of the adjacent chamber. The hot air is fed to and withdrawn from each chamber by suitable fans, to enable the drying process to be controlled independently for each chamber.

[0006] Although these plants do not present the countercurrent flow problem of tunnel plants, they are very costly and difficult to operate.

[0007] The object of the present invention is to solve the problems of the known art within the framework of a rational and reliable solution, the constructional and operating costs of which are low.

[0008] The invention attains said object by a drying plant comprising a tunnel in which there are defined a plurality of communicating chambers disposed in succession and provided with apertures through which the products to be dried are passed, with each of said chambers there being associated at least one hot air blower means positioned to the side of the material to be dried, and arranged to cause the material to be grazed with a stream of drying fluid, for example hot air, perpendicular to the product advancement direction within said chamber. The chambers mutually communicate via a duct to which said at least one blower means associated with each chamber is connected.

[0009] According to the invention the drying fluid, heated by suitable and usual means, is fed at least into that chamber positioned in proximity to the tunnel end region through which the dried material leaves, said fluid being extracted from said chamber before being conveyed to the next chamber by said duct.

[0010] Conveniently according to the invention, said duct is provided in the false ceiling of said tunnel, and connects said at least one blower means associated with each chamber in such a manner that the drying fluid which grazes the products has the same direction but opposite sense in adjacent chambers.

[0011] The products to be dried are preferably disposed on trolleys provided at their front and rear with a wall (or plate) able to close the aperture through which the trolleys pass from one chamber to the other, and so prevent air passage from one chamber to the adjacent chamber in a direction countercurrent to the trolley advancement direction.

[0012] According to a preferred embodiment of the invention, each chamber accommodates at least two mutually parallel trolleys (disposed in two parallel rows), said blower means being disposed such as to graze the material in one chamber from the centre of the chamber towards its periphery, and in the next chamber from the periphery towards the centre.

[0013] According to a variant of the invention, at least one of the plant chambers close to the region of entry of the green material to be dried is provided with heating means for the drying fluid, for example at least one burner, which raise the temperature of the drying fluid without decreasing its moisture content. This means that, for equal calories necessary for drying a certain quantity of material, the flow rate of the drying fluid fed into the plant can be reduced, with the advantage of being able to reduce the overall plant dimensions and consequently its cost of construction. Moreover, by virtue of said at least one heating means the total energy consumption necessary for operating the plant is reduced, as the decrease in overall fluid throughput enables blower means of lower power to be used.

[0014] Further characteristics of the invention are defined in the claims.

[0015] The constructional and operational characteristics of the invention will be more apparent from the ensuing description of a preferred embodiment thereof given by way of non-limiting example and illustrated in the accompanying drawings.

[0016] Figure 1 is a plan view of the plant according to the invention.

[0017] Figure 2 is an enlarged view of the section II-II of Figure 1.

[0018] Figure 3 is an enlarged view of the section III-III of Figure 1.

[0019] Figure 4 shows the section IV-IV of Figure 2.

[0020] Figure 5 shows the section V-V of Figure 2.

[0021] Said figures show the plant 1, comprising a tunnel 2 into which are inserted the trolleys 5 on which the products to be dried, such as hollow bricks or tiles, are disposed.

[0022] With reference to Figures 2, 3 and 5, the trolleys 5 are inserted into the tunnel through two doors 20 and extracted through two doors 21 located at the op-

posite end of the tunnel 2.

[0023] The tunnel 2 presents a horizontal false ceiling 3 which separates its interior into a lower region A and an upper region B, as can be seen from Figures 2 and 3.

[0024] The lower region A of the tunnel is further divided into a plurality of chambers C' and C" (Figure 5) disposed in succession and spaced one from another, they comprising free openings, corresponding with and aligned with each other, through which the tunnels 5, disposed in two parallel rows, are passed.

[0025] At each of the chambers C' and C", the false ceiling 3 presents three parallel equidistant apertures 30 elongate in the advancement direction of the tunnels 5. Some of said apertures 30 receive the lower part of suitable blower means 8, which descend from the upper region B of the tunnel 2 and are provided to feed the drying fluid, for example hot air, into the chambers C' and C".

[0026] In greater detail, the chambers C' and C" are of equal dimensions but differ from each other by the number and arrangement of the blower means 8. In this respect, with reference to Figures 4 and 5, in the chambers C' four equal blower means 8 are present descending in pairs from the apertures 30 positioned in proximity to the side walls of the chamber, whereas in the chambers C" three blower means are present all descending from the aperture 30 at the centre of the chamber.

[0027] The blower means 8 associated with the chambers C' direct the drying fluid from the periphery of the chamber towards the centre, whereas the blower means 8 associated with the chambers C" direct the drying fluid from the centre of the chamber towards its periphery.

[0028] It should be noted that the sum of the flow rates of the four identical blower means 8 present in the chambers C' is equal to the flow rates of the three blower means 8 present in the chambers C".

[0029] The blower means 8 comprise a fan 80 and a frusto-conical distributor 81, in the side wall of which at least one vertical slit 82 is provided facing the products 6 to be dried.

[0030] Said slit 82 is provided with a parallelepiped perimetral rim arranged to direct the flow of drying fluid in a direction perpendicular to the direction in which the tunnels 56 advance within the tunnel 2.

[0031] With reference to Figure 5, the position of the slit 82 and hence of its rim 83 varies on the basis of the location of the blower means within the chamber C' and C", such that the drying flow grazes the entire lateral surface of the tunnels 5.

[0032] As can be seen from the figures the blower means 8 associated with the chambers C' comprise only one slit 82, whereas the blower means 8 associated with the chambers C" are provided with two equal and opposite slits 82.

[0033] In the illustrated embodiment the blower means 8 can traverse along the apertures 30 as they are supported on the upper wall 23 of the tunnel 2 by a rack and pinion system 24. The blower means 8 are made to traverse by a usual drive motor, not shown, to enable all the products present in the chambers C' and C" to be grazed by the drying flow.

[0034] It should be noted that in other embodiments of the invention the blower means 8 can be fixed, and be rotated about their axis through a predetermined angle by known means. In this case, to enable all the products 6 present in one of the chambers C' or C" to be grazed, said perimetral rim 83 must be of frusto-conical shape, flared outwards, its opening angle being a function of the length of the tunnels 5 on which the products 6 are disposed.

[0035] With particular reference to Figures 2, 3 and 4, the upper region B of the tunnel 2 forms the duct which enables the drying fluid to be controlled and directed from one chamber to the adjacent chamber. This duct comprises a series of total-height vertical constricting baffles 10 disposed in positions corresponding with the underlying walls 4, to create an obligatory path for the drying fluid by which it is directed from the sides to the centre and vice versa alternately.

[0036] In addition, at those chambers C' close to the entry doors to the tunnel 2, in the tunnel upper region B, burners 12 (or heating means) are provided, one of which is visible in Figure 4, for heating the drying fluid before it is fed into the next chamber.

[0037] The burners 12 are positioned in the aperture bounded by said baffles 10 such that all the drying fluid passes through said burners before passing into the next chamber.

[0038] The drying fluid, for example hot air, is fed, via the ports 130 of a conduit 13 and a delivery fan 14, only into those chambers C' and C" of the tunnel 2 dose to the doors 21 through which the dried products 6 are extracted from the tunnel 2, and is extracted from the tunnel 2 at the first chamber C' through which the products are fed into the tunnel. The drying fluid is extracted by a suitable fan 15, as shown in Figure 1.

[0039] With reference to Figures 2 and 3, it should be noted that a damper device is interposed between the delivery ports 130 and the conduit 13, to limit the flow rate of the drying fluid to the chambers C' and C".

[0040] The drying fluid can conveniently be air heated to a temperature between 100°C and 180°C by usual heating means, not shown.

[0041] The trolleys 5, which are as tall as the lower region A of the tunnel 2, comprise a series of parallel shelves 50 on which the products 6 to be dried are located. Specifically, the products 6 are orientated, on each shelf 50, such that the axis of the holes with which they are provided is perpendicular to the advancement direction of the trolleys 5 within the tunnel 2, and in the same direction as the stream of drying fluid fed by said blower means 8.

[0042] Each trolley 5 also presents at its rear and/or front a plate 300 for closing the ports 40 of each chamber C' and C" to prevent, within the tunnel lower region A, air flows countercurrent to the direction of advancement of the material within the tunnel 2.

[0043] The operation of the invention is described hereinafter, starting from the position shown in Figure 3.

[0044] The drying fluid, for example air heated to a temperature between 100°C and 180°C is fed, with reference to Figure 1, to those upper regions B corresponding to the six chambers C' and C" closest to the tunnel doors 21. The fluid fed into that upper region B corresponding to the last tunnel chamber C' is directed by the four blower means 8 against the products 6, so that in passing through them it transfers heat to the products and absorbs a certain quantity of water in the form of steam.

[0045] After passing through the products, the air tends to rise through the central aperture 30 and into the upper region B above the false ceiling 3 of the chamber by virtue of the vacuum created in the chamber upper region by the blower means 8 of the next chamber C".

[0046] It should be noted that in passing from one chamber to the next, the fluid flow never grazes the material in a direction countercurrent to the advancement direction of the trolleys 5 because of the plates 300 with which the trolleys 5 are provided at their front and/or rear.

[0047] The drying fluid then passes through the central aperture bounded by the baffles 10 to the upper region B corresponding to the next chamber C" where it is mixed with hot air fed by the conduit 13 and then redirected towards the products to be dried, by the three blower means 8 present in said chamber C".

[0048] It should be noted that whereas in the preceding chamber C' the flow impressed on the fluid was directed from the chamber periphery towards the centre, in the chamber C" the flow is directed from the centre towards the periphery, in order to make drying of the products 6 more homogeneous.

[0049] From the chamber C" the drying fluid is fed into the next chamber C' through the two lateral apertures 30, and from there the cycle is repeated identically until the end of the tunnel 2.

[0050] As stated, the fluid passing from one chamber to the next transfers heat to the products and absorbs a quantity of water, to increase its water content and relative humidity, so that when the fluid finally grazes the products present in the initial tunnel chambers it has a relatively low temperature, generally between 40°C and 45°C, and a high relative humidity, close to 100%. In this case the drying effect of the fluid is less incisive and the quantity of water yielded by the material is less. To increase the water quantity removed by the fluid the invention uses the burners 12, which are positioned at those chambers C' close to the doors 20 through which the trolleys 5 enter the tunnel 2. Said burners 12 heat the drying fluid (air) to a temperature between 70°C and 75°C, without substantially changing its water content. In this manner the plant of the invention is able to remove from the material a water quantity between 40 and 50 g/m^3 of drying fluid fed into the tunnel, against the 20-25 g/m^3 of drying fluid in those plants of the known art.

[0051] Moreover by virtue of this air heating, for equal calories fed into the tunnel to dry a certain amount of products, the invention advantageously uses a smaller volume of drying fluid (air), so enabling a plant of smaller dimensions to be constructed, able to use drying fluid delivery fans and blower means less powerful than those used in plants of the known art, so resulting in considerable energy saving.

Claims

1. A plant for the continuous drying of hollow brick products, comprising a tunnel (2) provided with at least one entry door (20) for trolleys (5) carrying the products (6) to be dried, and at least one exit door (21) therefor, the interior of said tunnel (2) being divided into a plurality of spaced-apart chambers (C' and C"), of which at least one is fed with a drying fluid, and at least one is provided with suction means for said fluid, said chambers mutually communicating via a port (40) through which said trolleys (5) are made to advance, each of these latter being provided with a plate (300) for closing said port (40), **characterised in that** said plurality of chambers (C' and C") are connected together by a duct to which there is connected, associated with each chamber (C' and C"), at least one blower means (8) positioned to the side of said products (6) and arranged to direct the drying fluid onto them.

2. A plant as claimed in claim 1, **characterised in that** said blower means (8) are directed, in successive chambers (C' and C"), alternately onto one side and onto the opposite side of the products.

3. A plant as claimed in claim 1, **characterised by** comprising two lines of trolleys (5).

4. A plant as claimed in claim 1, **characterised by** comprising blower means (8) alternately positioned, in successive chambers (C' and C"), to the sides of the tunnel (2) and at the centre of the tunnel (2).

5. A plant as claimed in claim 1, **characterised in that** said duct is bounded by a false ceiling (3) of said tunnel (2).

6. A plant as claimed in claim 5, **characterised in that** said duct comprises constricting baffles (10) positioned at the walls (4) which separate said chambers (C' and C") from each other.

7. A plant as claimed in claim 6, **characterised in that** said constricting baffles (10) are positioned at the sides and at the centre of said duct.

8. A plant as claimed in claim 1, **characterised in that** said at least one blower means (8) can traverse within each chamber (C' and C").

9. A plant as claimed in claim 1, **characterised in that** said at least one blower means (8) is fixed to the interior of each chamber (C' and C") and can rotate about its axis through a predetermined angle.

10. A plant as claimed in claim 1, **characterised in that** at least one heating means (12) for the drying fluid is associated with those chambers (C' and C") close to said at least one entry door (20).

11. A plant as claimed in claim 10, **characterised in that** said at least one heating means (12) is positioned in said duct.

12. A plant as claimed in claim 10, **characterised in that** said at least one heating means (12) is a burner.

13. A plant as claimed in claim 1, **characterised in that** said drying fluid is hot air.

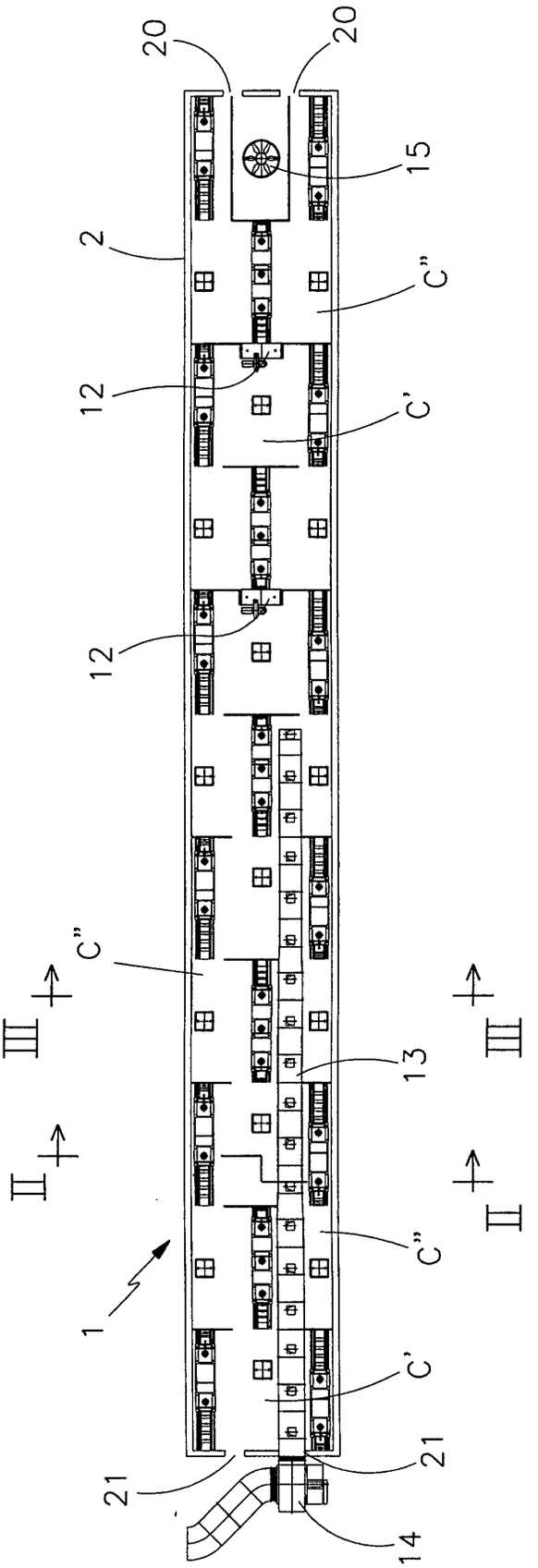

FIG.1

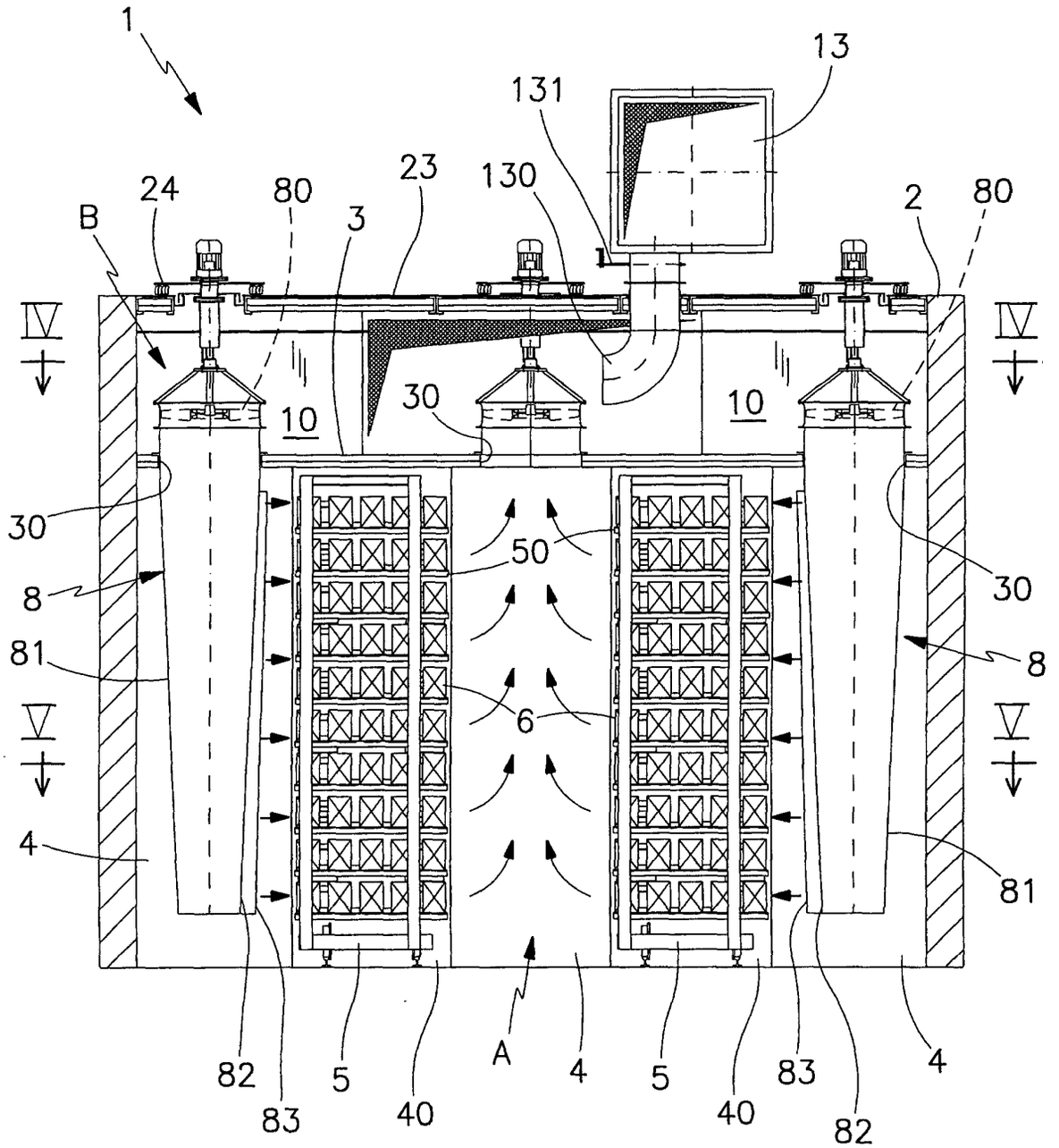
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FIG.2

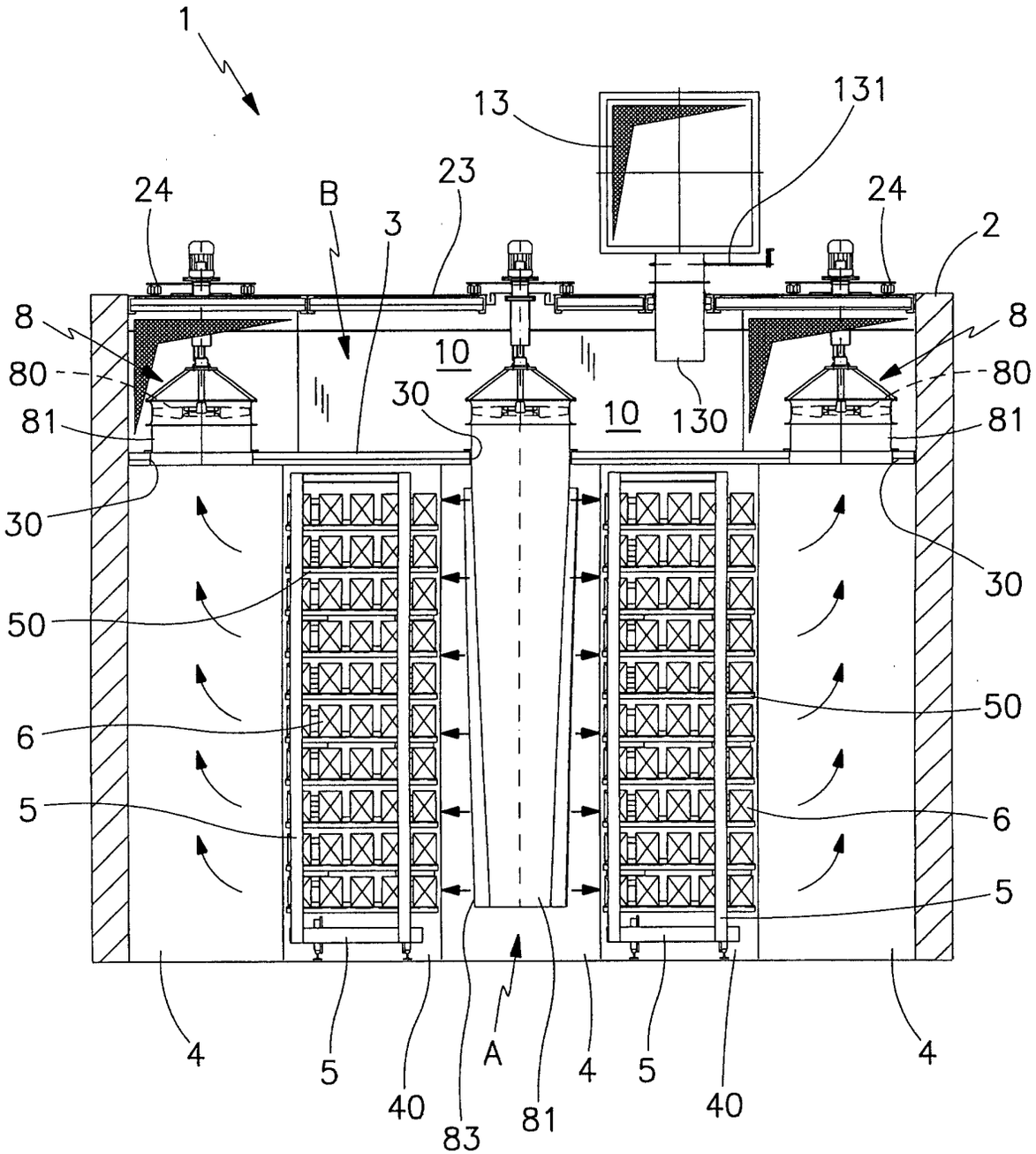
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FIG.3

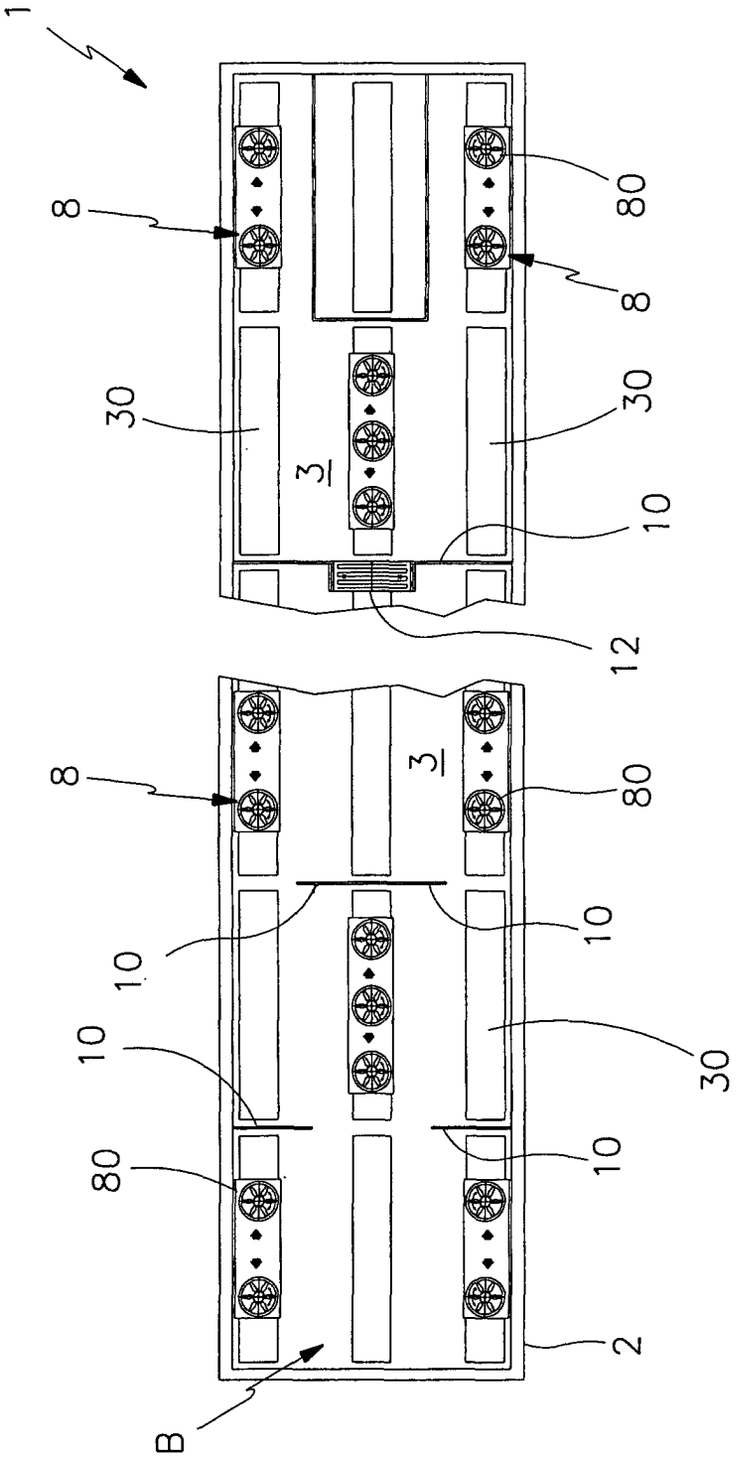

FIG.4

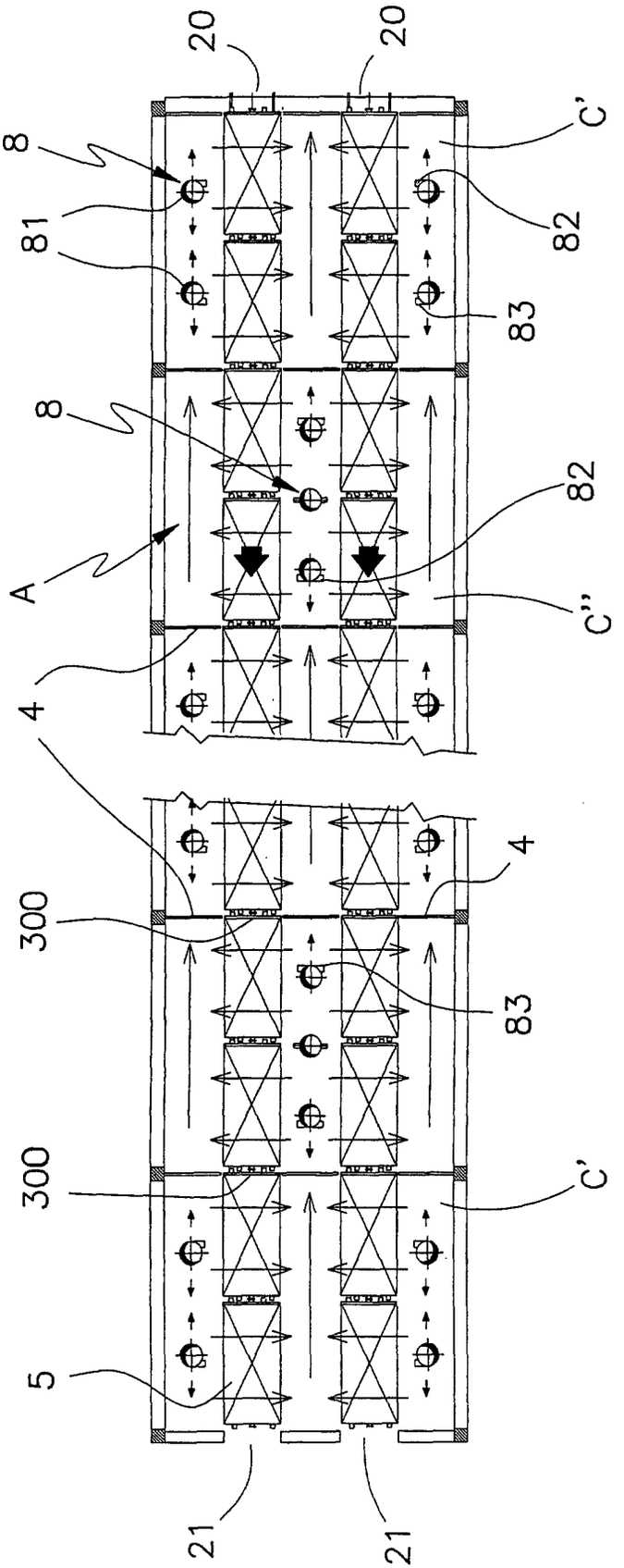

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
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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
THE HAGUE	1 October 2001	Silvis, H

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

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The present search report has been drawn up for all claims

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