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(54) **Method and plant for forming ceramic slabs or tiles**

(57) Method for forming ceramic tiles, comprising the following operative steps: creating a continuous layer of powders on a conveyor belt; advancing said belt through a first pressing station of continuous type, with which means for laterally retaining the powders are as-

sociated, to effect a first pressing of the powders during the advancement of the belt, and obtain a coherent article of compacted powders; and, by suitable means, controlling and limiting the expansion of said powder article on termination of said first compaction.

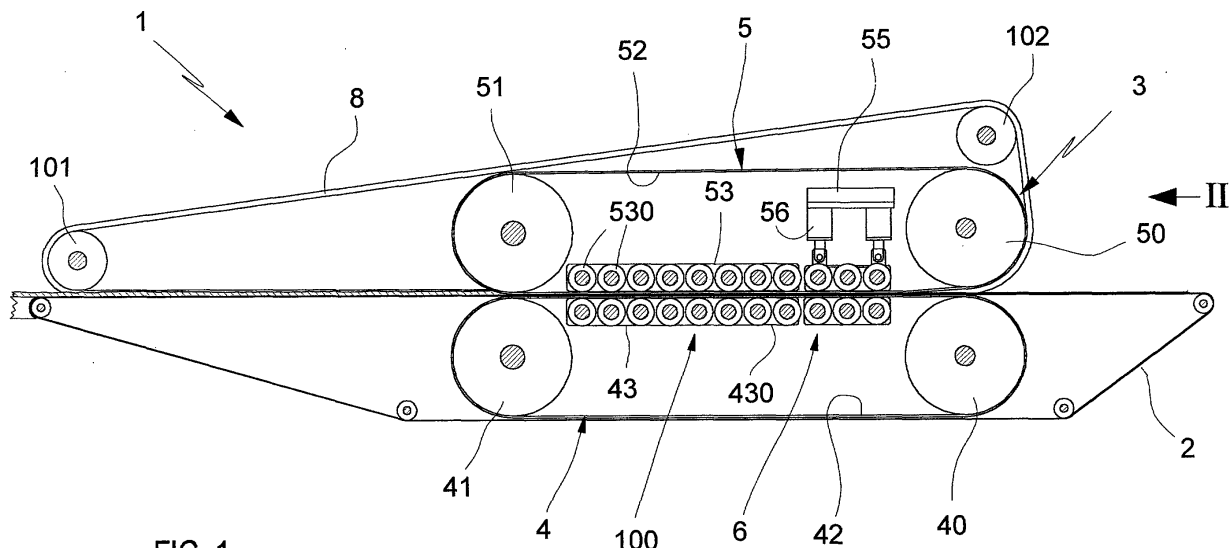


FIG. 1

Description

[0001] This invention relates generally to a method for manufacturing ceramic tiles or slabs, and in particular to a method for pre-forming said slabs and the relative plant for its implementation.

[0002] Ceramic tile forming methods are known comprising the following operative steps:

- depositing a continuous layer of powders on a flexible belt with which walls are associated to laterally retain the powders,
- advancing said belt through a pre-pressing station of continuous type, generally consisting of at least one roller (or a compactor belt) which effects a first pressing of the powders on the flexible belt to obtain a coherent article of compacted powders, and
- subjecting the article to a second pressing.

[0003] According to this method the article can be decorated with a further powder layer before being fed to the second pressing.

[0004] The aforesaid method and the relative plant for its implementation are fully described in International Patent Application WO 98/23424, to the text of which reference should be made for further information.

[0005] Tests carried out using the method described in the aforesaid patent application have shown that on leaving the first pressing station, the strip of pre-compacted material presents cracks which extend into the bulk of the strip and are randomly disposed over the entire surface, being concentrated in proximity to the longitudinal edges of the article.

[0006] This is due to the fact that on termination of compaction, the compressed powders slightly re-expand to form the said cracks, which are not made good by the second pressing and render the article unusable or at least unsuitable for subsequent division into blanks of smaller dimensions.

[0007] The object of the invention is to overcome the drawbacks of the known art within the framework of a simple and rational solution.

[0008] The invention attains said object by providing a method for forming ceramic tiles or slabs which comprises a powder compaction step, on termination of which the subsequent slight expansion of the compacted article is controlled in such a manner as to prevent formation of the cracks which affect the products of the known art.

[0009] The expansion control concerns both the extent of the expansion and its duration, which must be the greatest possible compatible with the production cycle.

[0010] Specifically, the method of the invention comprises the following operative steps:

- depositing a continuous layer of powders on a conveyor belt with which walls are associated to later-

ally retain the powders,

- advancing said belt through a first pressing station of continuous type, in such a manner as to compact the powders during the advancement of the belt, to obtain a coherent article of compacted powders which is of virtually parallelepiped form,
- limiting and slowing down the expansion of said powder article on termination of the first pressing.

[0011] According to the invention, the linear expansion of the article following the first pressing must be controlled at least in the direction perpendicular to the upper face of the article, and preferably also in the directions parallel to said face. In these latter directions the linear expansion must be preferably contained within a range between 0.1 and 1.0% of the article width measured in the direction perpendicular to the direction of advancement of the belt.

[0012] According to the invention said first pressing station can either be a first pressing station suitable only for making said powder layer coherent, to be then subjected to a second and definitive pressing, or can constitute the only pressing and compaction station. In the first case the pressure for compacting the material in the first pressing station must preferably progressively reach a maximum value between 30 and 70 kg/cm².

[0013] In the second case the pressure to which the material is subjected must preferably reach a maximum value between 300 and 450 kg/cm².

[0014] In certain embodiments the method of the invention provides for the article to be reduced to blanks of smaller dimensions. Reduction of the article into blanks takes place after the first pressing even if the first pressing is the only pressing.

[0015] The invention also includes a plant for implementing the aforescribed method. This plant comprises a conveyor belt on which a continuous strip of powder material is formed, means for laterally retaining the material on said belt, continuous pressing means of band form which enable the powder strip on said belt to be compacted (first pressing) to obtain a coherent article of compacted powders, and means for controlling the expansion of the material on termination of said first pressing.

[0016] Said means for controlling the expansion of the article are preferably associated with said continuous first pressing means and positioned downstream thereof.

[0017] According to a preferred embodiment of the invention the means for controlling the expansion of the compacted article comprise two opposing flat roller tables, of which one is positioned below said belt and one above it at a distance therefrom which can be adjusted on the basis of the physical and dimensional characteristics of the article. The upper roller table is inclined at a predetermined adjustable angle diverging from the direction of advancement of the belt.

[0018] It should be noted that said means for control-

ling the expansion of the material on termination of the first pressing can also comprise, for example, at least one fixed plate inclined to the direction of advancement of the strip of compacted material, or any other means suitable for the purpose, for example a compactor band the axis of which is inclined to the direction of advancement of the compacted strip of material.

[0019] Further characteristics of the invention are defined in the claims.

[0020] To better understand the operation of the method of the invention and the constructional characteristics and merits of the relative means for its implementation, reference is made hereinafter to the accompanying drawings which show by way of example a particular preferred embodiment of the plant for implementing the aforescribed method.

[0021] Figure 1 is a schematic side section through the plant of the invention.

[0022] Figure 2 is a view in the direction II of Figure 1.

[0023] Figure 3 is an enlarged view of a detail of the invention.

[0024] Figures 4 and 5 are a cross-section through the lateral retention means with which the invention is provided, shown under different working conditions respectively.

[0025] Said figures show the plant 1, which comprises a motorized lower conveyor belt 2 on which a continuous strip of powders is deposited by usual devices, not shown as they are of known type.

[0026] The belt passes through a pre-compacting station 3, or first pressing station, the purpose of which is to compact the strip powders to obtain an article, of substantially parallelepiped form, of coherent material. This article can then be decorated if required and then divided into blanks of suitable dimensions depending on the final product size to be obtained. The first pressing station 3 comprises two mutually superposed motorized compactor devices 4 and 5, one of which is positioned below the belt 2 and the other above it at a distance from the belt 2 which can be adjusted on the basis of the thickness of the powder strip to be compacted and of the pressure at which the first pressing is to be carried out. Generally this pressure is between 20 and 100 kg/cm².

[0027] Each of the compactors 4 and 5 comprises a motorized roller and an idle roller, indicated respectively by the reference numerals 40, 41 and 50, 51, about which there passes a respective band 42, 52. Between each pair of rollers 40, 41 and 50, 51 there is positioned a roller table 43 and 53, consisting of a plurality of idle rollers 430 and 530. The purpose of the two roller tables 43 and 53 is to maintain the bands 42 and 52 pressed to compact the strip of powder material. The roller table 53 can also be inclined in the direction of advancement of the belt 2 so as to make the compaction of the strip powders gradual.

[0028] The roller tables 43 and 53 delimit the compaction (or first pressing) zone 100 of the powder strip, downstream of which there is provided a decompression zone 6 in which the powder strip expands, by virtue of suitable means, in a controlled manner to prevent the formation of cracks in the compacted article.

sion zone 6 in which the powder strip expands, by virtue of suitable means, in a controlled manner to prevent the formation of cracks in the compacted article.

[0029] In the illustrated embodiment, said decompression zone 6 comprises two superposed roller tables 44 and 54 positioned downstream of the roller tables 43 and 53 respectively. With reference to Figure 3, it can be seen that the roller table 44 is fixed and horizontal, whereas the roller table 54 is supported by a frame 55 via two actuators 56 of hydraulic or mechanical type which enable the roller table to be adjusted in level and also to be inclined to the belt 2 to enable the compacted powder mass to expand with a very low deformation gradient compatible with the intrinsic characteristics of the powders.

[0030] In other embodiments the means present in the decompression zone 6 can for example comprise at least one rigid plate, not shown, inclined to the plane of advancement of the compacted powder strip. In this case the plate maintains the belt 52 pressed against the compacted article.

[0031] The pre-compacting or first pressing station also comprises means for laterally retaining the powders, these means in the illustrated embodiment being in the form of two straps 8 and 9 associated with the compactor device 5.

[0032] In this respect, each of the two straps passes partially about the compactor device 5 and about two deviator wheels 101 and 102. It should be noted that the deviator wheels are of adjustable distance apart, in order to be able to vary the dimension of the strip of compacted powders in the direction perpendicular to the direction of advancement of the belt in accordance with the format to be obtained.

[0033] The two straps 8 and 9 are formed of a mixture of elastomeric material of high friction coefficient so that they become squeezed within the compaction zone between the compactors 4 and 5, and then contract laterally and increase their height in the decompression zone, to then return to their undeformed rest position in the other portions.

[0034] The lateral contraction of the straps in the decompression zones enables the expansion of the compacted article to be controlled in the direction of the article width, i.e. in a direction perpendicular to the advancement direction of the belt 2.

[0035] It should be noted that the elastic material mixture with which the two straps are formed and the their particular profile are such as to counteract the lateral thrusts exerted by the material on the inner side of the straps during pressing.

[0036] In the illustrated embodiment the straps are formed of closed-cell expanded EPDM rubber.

[0037] Moreover the profile of the straps is such that during pressing, the inner side of the strap is practically flat and perpendicular to the conveyor belt 2. This minimizes the loss of material involved in making the compacted article perfectly parallelepiped.

[0038] In this respect, Figure 4 shows that the profile of each of the straps comprises in its two lateral faces a depressed central portion 103 connected to the ends by a curved portion 104. When the straps deform by squeezing, between the compactors 4 and 5 the central portion 103 moves outwards to make the lateral face of the strap substantially flat, as shown in Figure 5. Finally it should be noted that as a result of this squeezing, the height of the cross-section through the strap decreases by about 50% from its undeformed height. This value can however vary on the basis of the type of profile used and the material with which the straps are formed.

Claims

1. A method for forming ceramic tiles, comprising the following operative steps:
 - creating a continuous layer of powders on a conveyor belt,
 - advancing said belt through a first pressing station of continuous type, with which means for laterally retaining the powders are associated, to effect a first pressing of the powders during the advancement of the belt, and obtain a coherent article of compacted powders,
 - by suitable means, controlling and limiting the expansion of said powder article on termination of said first compaction.
2. A method as claimed in claim 1, **characterised in that**, on termination of the expansion of the article, this latter is reduced into blanks of suitable dimensions for subsequent processing.
3. A method as claimed in claim 1 or 2, **characterised by** subjecting the article or the blanks obtained therefrom to a second pressing.
4. A method as claimed in claim 1, **characterised in that** the compaction of the material in the first pressing station is progressive.
5. A method as claimed in claim 4, **characterised in that** the maximum powder compacting pressure in the first pressing station is between 20 and 200 kg/cm².
6. A method as claimed in claim 1, **characterised in that** the control of the material expansion takes place at least in the direction perpendicular to the major-dimension surface of the article.
7. A method as claimed in claim 1, **characterised in that** the control of the material expansion takes place at least in the direction perpendicular to the preceding and to the direction of advancement of

the article.

8. A method as claimed in claim 1, **characterised in that** the allowable value of said expansion in one direction is proportional to the article dimensions in the same direction.
9. A method as claimed in claim 8, **characterised in that** said allowable value is between 0.1 and 1%.
10. A plant for forming ceramic tiles or slabs, comprising a conveyor belt on which a continuous strip of powder material is formed, means for laterally retaining the material on said belt, and first continuous pressing means which enable the powder strip on said belt to be subjected to a first pressing to obtain a coherent article of compacted powders, **characterised by** comprising means for controlling the expansion of the material on termination of the first pressing.
11. A plant as claimed in claim 10, **characterised in that** said first continuous pressing means are positioned at least above the belt at a level which is adjustable on the basis of the thickness of the continuous powder strip to be compacted, and comprise means for laterally retaining the powders.
12. A plant as claimed in claim 10, **characterised in that** said first continuous pressing means are positioned both above the belt at a level which is adjustable on the basis of the thickness of the continuous powder strip to be compacted, and below the belt.
13. A plant as claimed in claim 10, **characterised in that** said first continuous pressing means, positioned above the belt, comprise a material compaction zone, downstream of which there is present at least one material decompression zone in which said means for controlling the expansion of the material on termination of the first pressing act.
14. A plant as claimed in claim 10, **characterised in that** said continuous pressing means comprise at least two motorized rollers about which a flexible band passes.
15. A plant as claimed in claim 14, **characterised in that** within said compacting zone, said flexible band is inclined at an incident angle in the direction of advancement of said strip.
16. A plant as claimed in claim 14, **characterised in that** the angle of inclination of said flexible band is a function of the compacting pressure.
17. A plant as claimed in claim 13, **characterised in that** within said decompression zone said flexible

band is inclined at a diverging angle to the direction of advancement of the strip.

18. A plant as claimed in claim 10, **characterised in that** said continuous pressing means comprise, within said first pressing zone, at least one roller table arranged to maintain the flexible band pressed against said powder strip. 5
19. A plant as claimed in claim 10, **characterised in that** said means for controlling the material expansion are adjustable in level. 10
20. A plant as claimed in claim 19, **characterised in that** the level adjustment of said means is achieved by at least one cylinder-piston unit. 15
21. A plant as claimed in claim 10, **characterised in that** said means for controlling the material expansion are inclined at a diverging angle to the direction of advancement of the strip. 20
22. A plant as claimed in claim 10, **characterised in that** said means for controlling the material expansion comprise a roller table. 25
23. A plant as claimed in claim 10, **characterised in that** said means for controlling the material expansion comprise a plate. 30
24. A plant as claimed in claim 11, **characterised in that** said lateral retention means comprise two parallel straps. 35
25. A plant as claimed in claim 24, **characterised in that** said straps pass partially about said pressing means. 40
26. A plant as claimed in claim 24, **characterised in that** said straps are formed of elastically deformable material. 45

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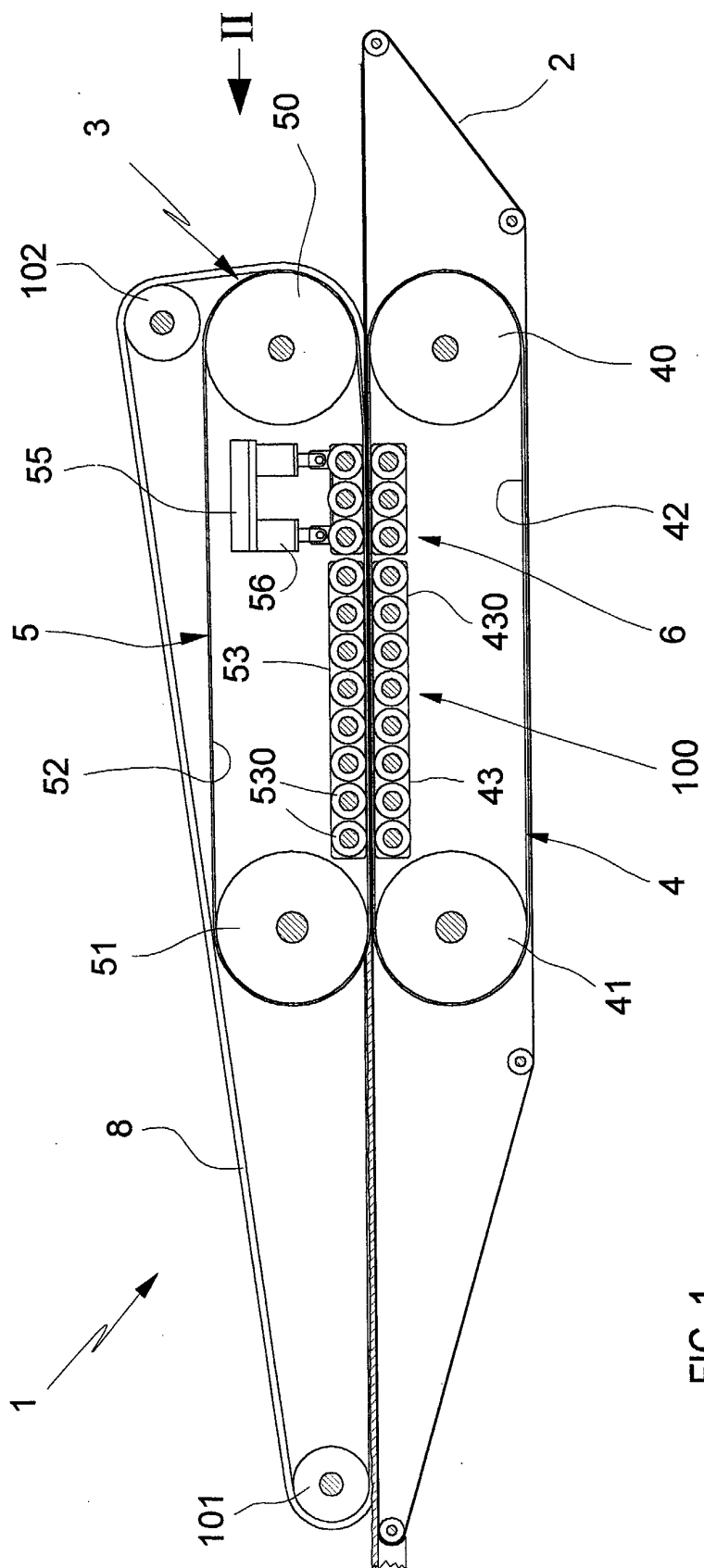


FIG. 1

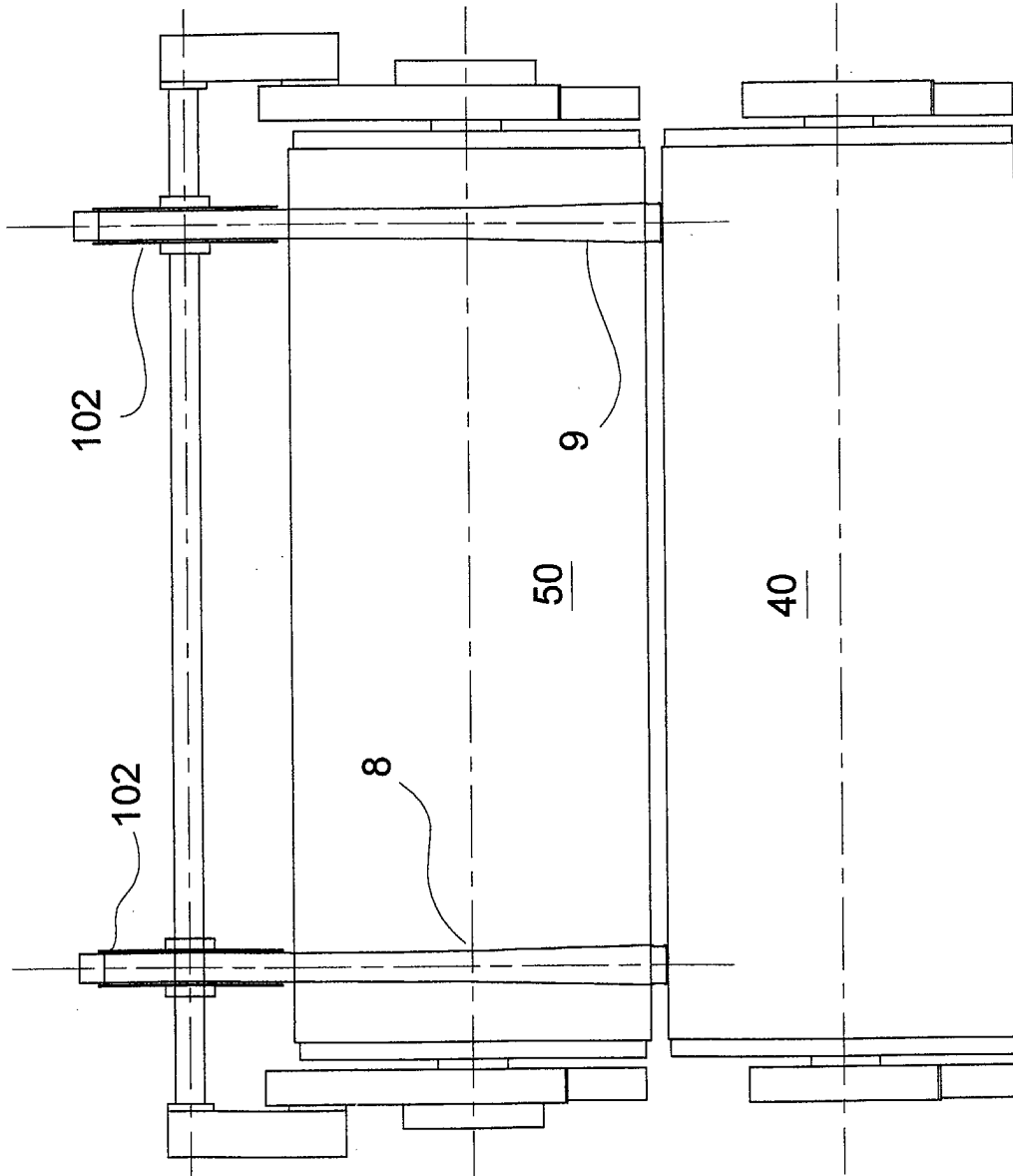


FIG. 2

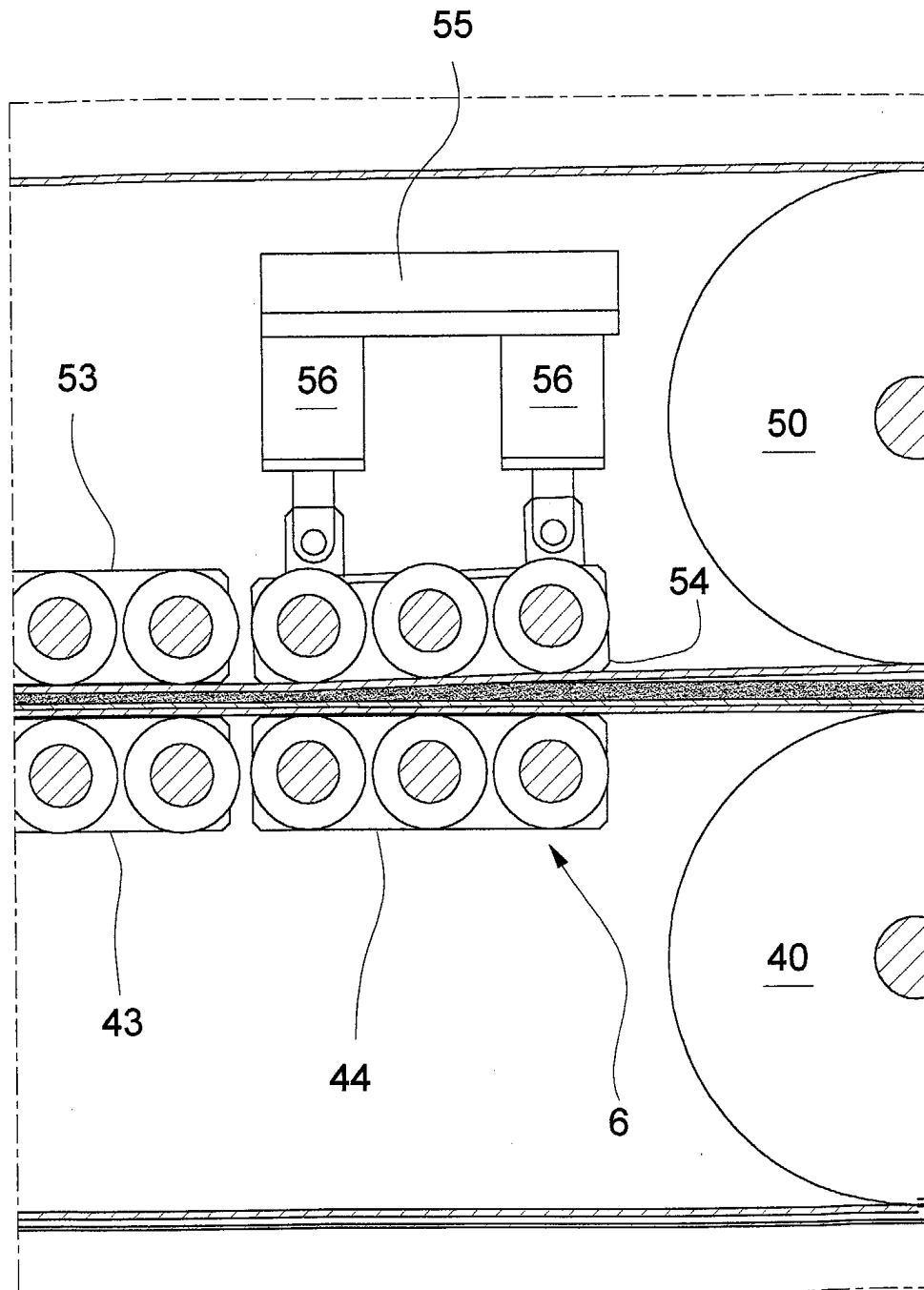


FIG. 3

