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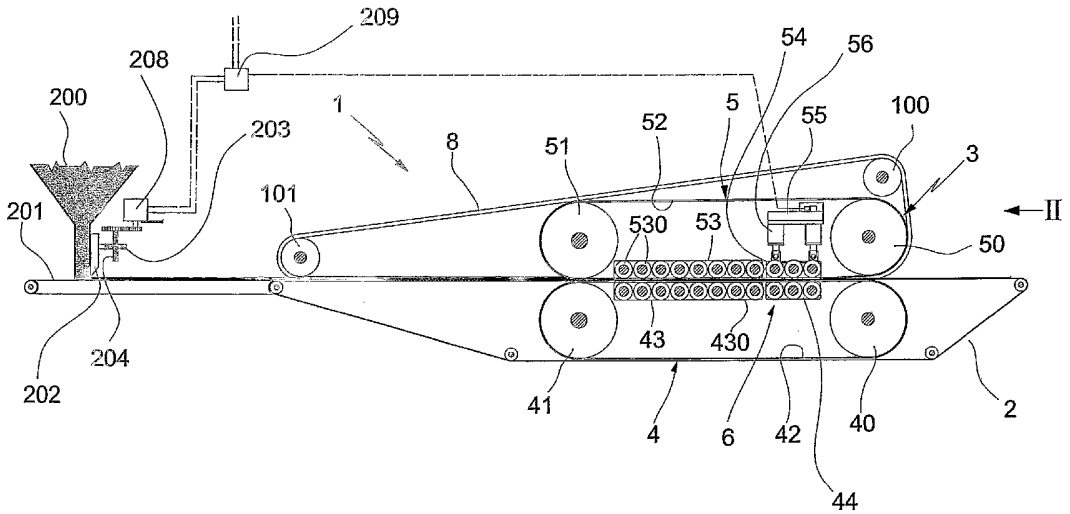
(54) Title: METHOD AND PLANT FOR FORMING CERAMIC SLABS OR TILES OF CONTROLLED THICKNESS



(57) Abstract: Method for forming ceramic tiles, comprising the following operative steps: creating a continuous layer of powders on a flexible belt, advancing said belt through a pressing station of continuous type, with which means are associated to laterally retain the powders, and which presses the powders during belt advancement to obtain a coherent article of compacted powders, measuring the thickness of the slab of compacted material and, on the basis of the slab thickness measurement, regulating the powder thickness of the layer before compaction.

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BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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DESCRIPTION

METHOD AND PLANT FOR FORMING CERAMIC SLABS OR TILES OF CONTROLLED THICKNESS

TECHNICAL FIELD

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.

PRIOR ART

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, and of which the upper portion slides on a flat body,
- advancing said belt through a pre-pressing station of continuous type, generally consisting of at least one roller (or a compactor band) 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 final pressing.

The aforesaid method, and the relative plant for its implementation, are fully described in international patent application No. WO 98/23424, to the text of which reference should be made for further information.

Subsequent improvements to this method have enabled certain drawbacks regarding compaction regularity consequent on pre-pressing to be eliminated.

Said improvements are described in patent application RE2002A000035 in the name of the present applicant.

Although the method described in the aforesaid patent applications has given excellent results, it does not enable the thickness of the pre-compacted article and of the final tile to be continuously controlled to obtain a product of constant thickness.

In this respect it has been noted that the slab or tile thickness can vary during the course of the day.

This is imputable to factors which are also very different from each other but which taken together can substantially influence the quality of the finished product.

As the pressure exerted during the pre-compaction and final pressing cycle is constant, the product thickness variations are imputable to variations in the moisture content of the compacted powder, which influence its particle size distribution, and also to wear of the powder feed outlets, which widen with consequent increase in the powder quantity and hence in the thickness of the powder layer intended for pre-compaction and final pressing.

DISCLOSURE OF THE INVENTION

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

The invention attains said object by providing a method for forming ceramic tiles or slabs which includes controlling the powder quantity, and indirectly the thickness of the powder later to be compacted, on the basis of the thickness of the compacted article.

In the case of continuous plants in which the powder is fed onto a belt, such as that described in patent application RE2002A000035, the object of the invention is attained by controlling the height of that side of the powder feed outlet to the belt which acts as the powder layer scraper, to control the thickness of the powder layer conveyed by the belt.

This control is effected on the basis of the measured thickness of the pre-compacted article.

Specifically, the method of the invention comprises the following operative steps:

- depositing a continuous layer of powders on a conveyor belt by means positioned at an adjustable distance from the belt to scrape the layer to a desired thickness;
- 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 powders pre-compacted at a determined constant pressure;
- measuring the thickness of said powder layer after compaction;
- continuously controlling the distance from the belt of that side of the powder feed outlet to the belt which acts as the powder layer scraper, to control the thickness of the powder later conveyed by the belt.

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 20 and 100 kg/cm^2, and preferably between 30 and 70 kg/cm^2.
In the second case the pressure to which the material is subjected must preferably reach a maximum value between 300 and 450 kg/cm^2.
The invention also includes a plant for implementing the aforedescribed method.
This plant comprises a conveyor belt on which a continuous layer of powder material is created, means for laterally retaining the material on said belt, continuous pressing means of band form which enable the powder layer on said belt to be compacted at a predetermined constant pressure to obtain a coherent article of pre-compacted powders, and means for measuring the thickness of the article on termination of said first pressing.
Said means for measuring the thickness of the article are preferably associated with a processor which controls the distance of the scraper means from the belt.
Said means for measuring the article thickness on termination of the first pressing can comprise usual measurement transducers, or any other device suitable for the purpose. Instead, the means for controlling the distance of that side of the powder feed outlet to the belt which acts as the scraper are normal mechanical micro-regulating means, such as a controlled advancement motor operating a male-female screw combination.
Further characteristics of the invention are defined in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

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 aforedescribed method.

In the example the invention is illustrated applied to a pre-compaction plant, but can be equally applied to a final compaction plant.

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

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

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

Figures 4 is a block diagram of the invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Said figures show, for loading the powder to be compacted, a hopper 200 positioned above a belt 201 onto which the powder is discharged.

The belt is driven by usual means, not shown.

That side of the feed outlet of the hopper 200 facing the belt advancement direction is defined by a vertically movable wall 202 acting as scraper for the layer of discharged powder.

The wall 202 is engaged, via the appendix 203 in which the female thread is provided, by a screw 204 which regulates the distance of the lower edge of the wall 202 from the belt 201.

The female thread provided in the appendix 203 is engaged by the screw 204, the head of which carries a gearwheel 205.

The gearwheel 205 engages a pinion 206 (Figure 4) keyed onto the shaft 207 of a controlled advancement motor 208. The motor 208 is controlled to rotate in both directions by a usual control circuit linked to a processor 209.

The conveyor belt 201 transfers the material onto a motorized conveyor belt 2 which passes through a station 3, which in the illustrated example is a pre-compacting station, or first pressing station, the purpose of which is to compact the powder layer to obtain a pre-compacted article of coherent material having a rectangular cross-section.

This article can then be decorated and divided into blanks of suitable dimensions depending on the final product size to be obtained.

The article must finally be subjected to final pressing.

The 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 layer 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/cm^2.

Each of the compactor devices 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 layer of powder material. The roller table 53 can

also be inclined in the direction of advancement of the belt 2 in order to make the compaction of the powders of the layer gradual.

The roller tables 43 and 53 define the compaction (or first pressing) zone of the powder layer, downstream of which there is provided a decompression zone 6 in which the powder layer is allowed to expand by suitable means, in a controlled manner to prevent the formation of cracks in the compacted article.

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 Figures 1 and 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 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 desired deformation gradient, to maintain the compaction pressure constant and to measure the thickness of the compacted layer leaving.

For this purpose the rod 561 of the actuator 56 emerges at its top where it is associated with a position transducer 560 which feeds its signals to the processor 209.

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 deformable straps 8 and 9, associated with the compactor device 5.

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 pressing of the powders during the advancement of the belt, and obtain a coherent article of compacted powders,

characterised by

- measuring the thickness of the slab of compacted material; and
- on the basis of the slab thickness measurement, regulating the powder thickness of the layer before compaction.

2. A method as claimed in claim 1, characterised in that the pressing relates to a first compaction, which is followed by a final compaction.

3. A method as claimed in claim 2, characterised in that the maximum pressure to which the powders are subjected during their first compaction is between 20 and 100 kg/cm^2, and preferably between 30 and 70 kg/cm^2.

4. A method as claimed in claim 1, characterised in that the pressing relates to the final compaction.

5. A method as claimed in claim 4, characterised in that the maximum pressure to which the powders are subjected during said final compaction is between 300 and 450 kg/cm^2.

6. A method as claimed in claims 1 and 2, characterised in that the slab thickness is measured after the final compaction.

7. A plant for forming ceramic tiles or slabs, comprising a conveyor belt on which a continuous layer of powder material is created, and continuous

pressing means which enable the powder layer on said belt to be pressed to obtain a coherent article of compacted powders, characterised by comprising means for measuring the layer thickness on termination of pressing, associated with means for regulating the powder quantity fed to the layer.

8. A plant as claimed in claim 7, characterised in that said means for measuring the layer thickness on termination of pressing comprise a measurement transducer.

9. A plant as claimed in claim 7, characterised by comprising a second pressing station positioned downstream of said continuous pressing station.

10. A plant as claimed in claim 7, characterised in that said means for measuring the layer thickness on termination of pressing are associated with said second pressing station.

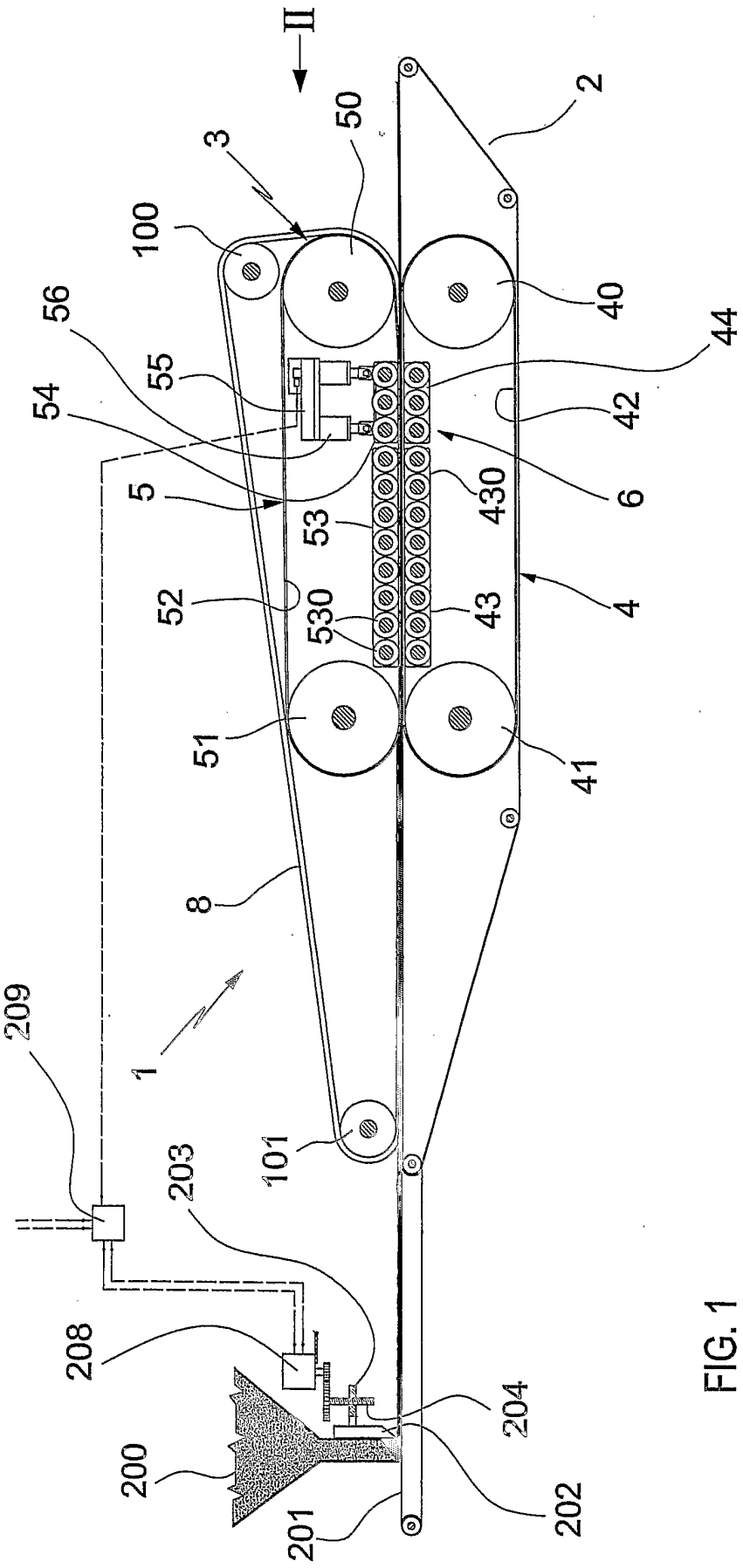
11. A plant as claimed in claim 7, characterised in that said continuous layer of powders is deposited on the belt by a hopper.

12. A plant as claimed in claim 11, characterised in that the means for regulating the powder quantity determining the layer thickness are associated with the hopper feed outlet.

13. A plant as claimed in claim 11, characterised in that said means for regulating the powder quantity determining the layer thickness are associated with a scraper positioned downstream of said hopper feed outlet, to scrape the powder layer discharged onto the belt.

14. A plant as claimed in claim 13, characterised in that said scraper is adjustable in level by suitable operating means.

15. A plant as claimed in claim 14, characterised in that said scraper operating means comprise a controlled advancement motor operationally connected to said scraper by a male-female thread linkage, and controlled by said processor on the basis of the thickness measurement of the compacted slab.


II
3
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201

FIG. 1

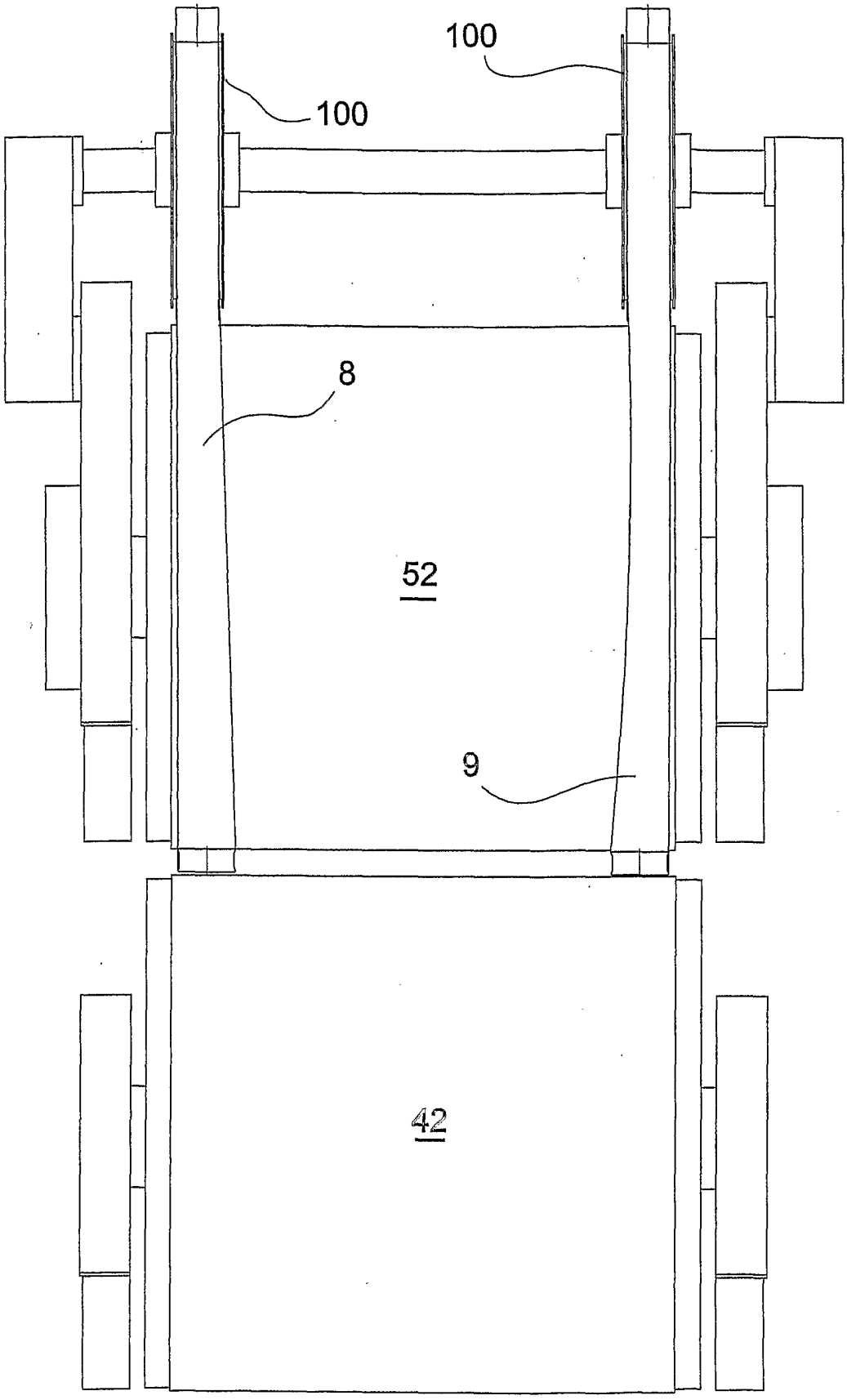

FIG. 2

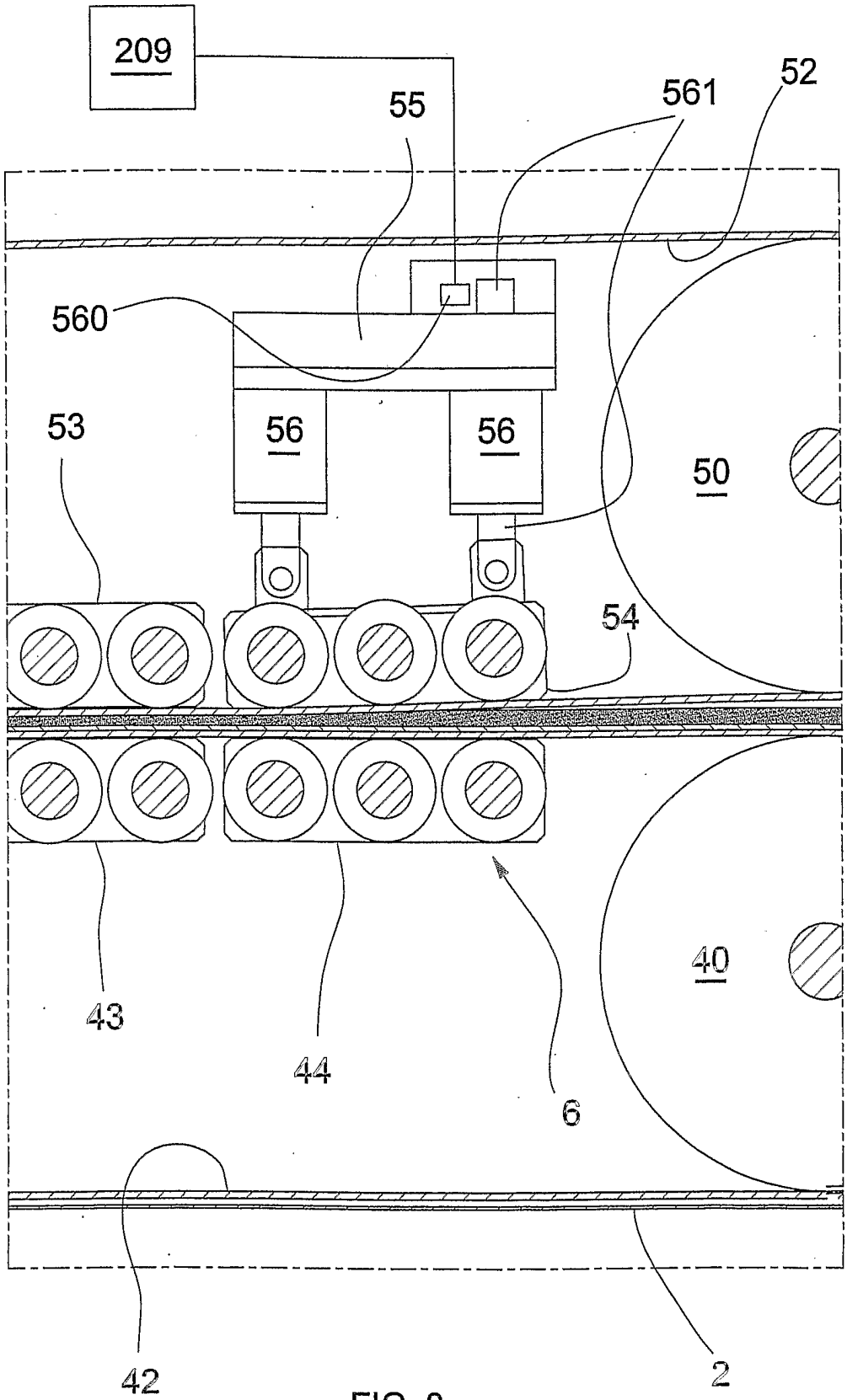

FIG. 3

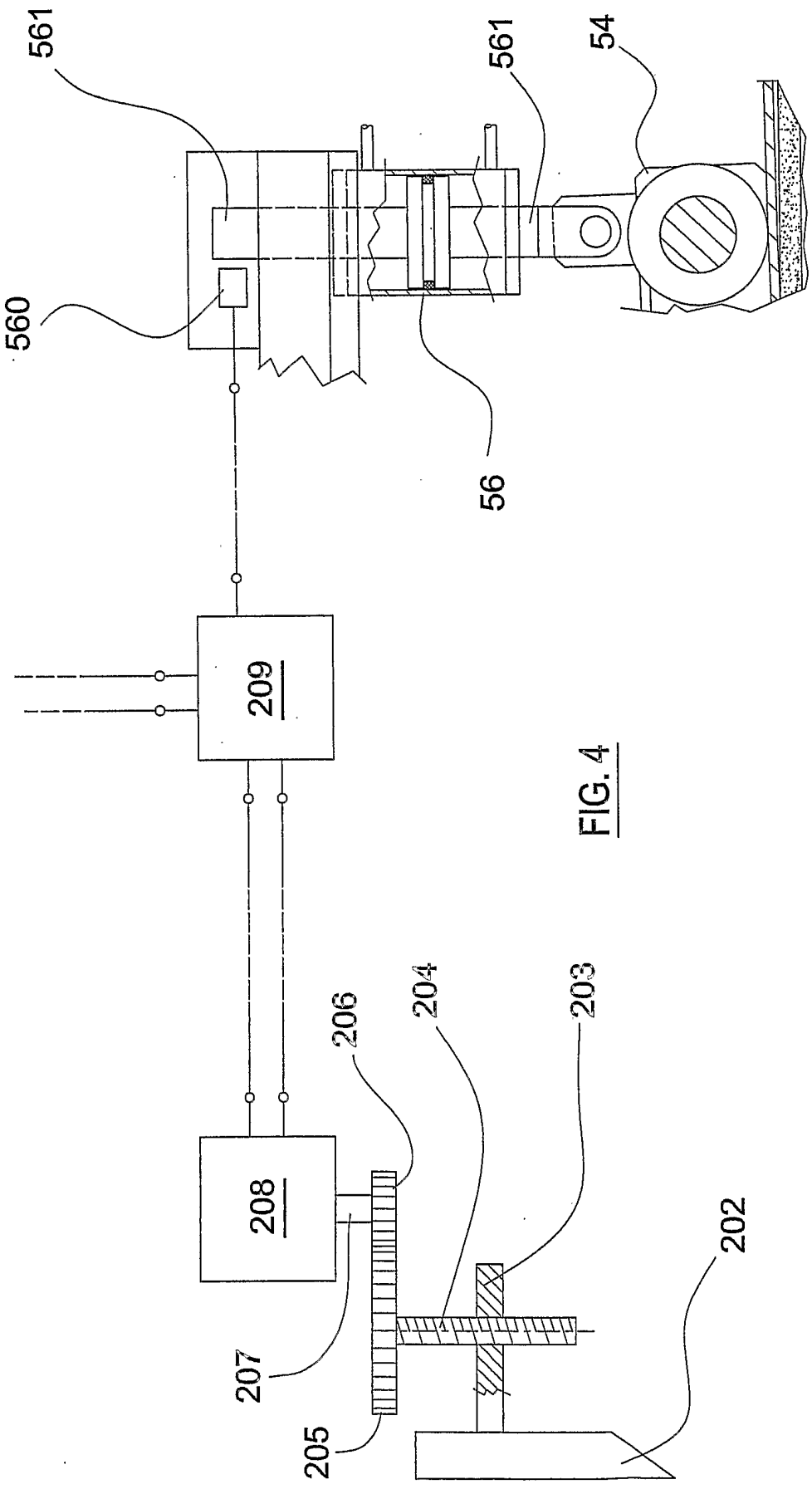

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/007495

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B28B3/12 B28B5/02 B28B13/02 B28B17/00 B30B5/06

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)
IPC 7 B28B B30B

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 practical, 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.
Y	WO 98/23424 A (ALGERI MARIS ; CAMORANI CARLO ANTONIO (IT)) 4 June 1998 (1998-06-04) cited in the application page 16, lines 24,25 page 17, lines 11-27 page 19, lines 13-19 page 20, lines 8-15 claims 1,6,7 figures	1,2,4, 7-9, 11-15
Y	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 02, 31 March 1995 (1995-03-31) -& JP 06 320520 A (KUBOTA CORP), 22 November 1994 (1994-11-22) abstract; figures 1-3	1,2,4, 7-9, 11-15

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

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
1 November 2004	08/11/2004

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

information on patent family members

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PCT/EP2004/007495

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