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(54) **METHOD AND PLANT FOR FORMING CERAMIC SLABS OR TILES**

VERFAHREN UND ANLAGE ZUR HERSTELLUNG VON KERAMIKPLATTEN ODER -FLIESEN

PROCEDE ET INSTALLATION DE FORMAGE DE DALLES ET DE TUILES EN CERAMIQUE

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GB-A- 640 018
US-A- 3 991 149

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Description

TECHNICAL FIELD

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

BACKGROUND ART

[0002] Ceramic tile forming methods are known consisting of depositing a continuous layer of powders on a flexible belt with which walls are associated to laterally retain the powders. The belt on which said layer of powders is created is then advanced through a pressing station of continuous type, which compacts the powders on the flexible belt to obtain a coherent article of compacted powders. On termination of compacting, the article is divided into blanks, and possibly subjected to a second pressing. This method is described in detail in patent application No. RE2002A000035 in the name of the same applicant, to the text of which reference should be made for more complete information.

[0003] According to the known art described in said patent application, the pressing station generally comprises both powder compacting means, in the form of rollers or compacting belts, and means for controlling the expansion of the material on termination of compacting. In both cases, said compacting means and said expansion control means are adjustable in height to enable the thickness of the article to be varied.

[0004] The height adjustment of the compacting means ensures planarity of the article, and a constant compacting ratio in the transverse direction, but gives no assurance with regard to the mechanical characteristics of the article, which are a function of the maximum pressure with which the compacting means act on the powders.

[0005] In this respect, it can happen that the thickness of the strip of powders deposited on the belt varies both in the transverse direction and in the longitudinal direction either for aesthetic reasons or because of loading defects, or that for the same thickness the powders have a particle size distribution or other physical characteristics different in the transverse direction and hence are compacted to a different extent in the transverse direction.

[0006] All this means that the mechanical characteristics of the compacted article can vary both in the transverse and in the longitudinal direction until such values are achieved as not to guarantee the mechanical coherence of the article, which hence cracks and crumbles, becoming unusable.

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

[0008] US 3 991 149 discloses a method for the manufacture of ceramic items and particularly concerns improvements in the manufacture of thin flat ceramic substrates by the tape casting process. The ceramic items which the such document refers to are thin flat ceramic items developed to meet the need for capacitor dielectrics and for substrates in microelectronic and semiconductor circuitry, among other uses.

[0009] A roller is used in order to smooth out variations in thickness of the cast slip, the location of and pressure exerted by the roller being critical elements of this prior device.

[0010] In this prior device the value of the predetermined force is critical to the successful practice of the method. The force must be sufficient to redistribute the surface of the layer in contact with the roller into a straight line but not so great as to break the surface skin.

[0011] This device leaves open problems that are specific of ceramic powder compressing.

[0012] Specifically, after compacting the powders there occurs an expansion of the powders which must be controlled in order to prevent defects in the resulting final product and the prior device does not have means to control the force on the cast slip after the compaction.

DISCLOSURE OF THE INVENTION

[0013] The invention attains said object by providing a method for forming ceramic tiles according to claims 1 and 9.

[0014] According to a preferred embodiment of the aforesaid method, the powder pressing step comprises both compacting said powders and controlling the expansion of said powders after compacting. According to the invention the force exerted on said powders during pressing can be controlled either during powder compacting alone or during powder expansion control alone or during both.

[0015] It should also be noted that the plant of the invention can be used both for obtaining a completely compacted article, and for obtaining a pre-compacted article which must then be subjected to a second pressing. The invention also includes a plant for implementing the aforesaid method. This plant comprises a conveyor belt on which a continuous strip of material in powder form is created and which is arranged to advance said strip through a pressing station provided with means for laterally retaining the material on said belt, means being associated with said pressing station to control the force exerted on said powders.

[0016] According to the invention said pressing station comprises compacting means enabling the powders to be continuously compacted on the belt advancing through the station, with which said compaction control means are associated.

[0017] Said continuous compacting means can be either in the form of a compacting roller or in the form of a compacting belt.

[0018] According to a preferred variant of the invention, said pressing station also comprises, downstream of said

continuous compacting means, a device for controlling the expansion of the material after compaction.

[0019] The means for controlling the force exerted on the powders comprises a control unit for at least one hydraulic cylinder-piston unit with which the powder compaction means or said device for controlling material expansion after compaction are associated.

[0020] In a variant of the invention, said expansion means comprise a flexible plate, with which a plurality of hydraulic cylinder-piston units controlled by said control unit are associated. According to the invention said hydraulic cylinder-piston units can be disposed in several parallel rows to enable the force exerted on the powders to be also controlled along the powder advancement direction.

[0021] Further characteristics of the invention are defined in the claims.

[0022] To better understand the operative modalities 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 figures of the accompanying drawings which show by way of example a particular preferred embodiment of the plant for implementing the aforedescribed method.

[0023] Figure 1 is a schematic side section through the plant of the invention.

[0024] Figure 2 is an enlarged view of a detail of the invention.

[0025] Figure 3 is the section III-III of Figure 1.

[0026] Figure 4 is the section IV-IV of Figure 2.

[0027] Figure 5 is an enlarged view of a detail of a variant of the invention.

[0028] Figure 6 is a schematic cross-section through Figure 5.

[0029] Figure 7 shows an enlarged detail of Figure 6.

[0030] Said figures show the plant 1, which comprises a motorized lower conveyor belt 2 on which a continuous strip 100 of powders is deposited by usual devices of known type, and hence not shown.

[0031] The belt passes through a pressing station 3, the purpose of which is to compact the powders of the strip 100 to obtain an article, of substantially parallelepiped form, of coherent material.

[0032] According to the degree of pressing to which the powders on the belt are subjected, the article can form the final tile, or a pre-compacted slab which must then be subjected to a second pressing.

[0033] The article can be decorated if required and then divided into blanks of suitable dimensions depending on the final product size to be obtained. The pressing station 3 comprises a powder compaction first zone 30, downstream of which there is a second zone 31 in which the article formed in the compaction zone 30 is decompressed.

[0034] The powder compaction zone 30 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 pressing is to be carried out.

[0035] Each of the compactors 4 and 5 is provided with 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, the purpose of which is to maintain the bands 42 and 52 pressed to compact the strip of powder material. In the illustrated embodiment the roller table 53 is inclined in the direction of advancement of the belt 2 so as to make the compaction of the strip powders gradual.

[0036] Downstream of the roller tables 43 and 53 there are provided two opposing rollers 6 and 7, of which the roller 6 is positioned below the band 42, whereas the roller 7 is positioned above the band 43 and presses this latter against the powder strip 100 advancing on the belt 2.

[0037] With reference to Figure 4 it can be seen that the roller 7 is associated with two hydraulic cylinder-piston units 8 and 9 supported by a frame 10 and arranged to transmit a controlled force to the roller 7, in order to regulate the pressure which said roller exerts on the powder strip 100. For this purpose the cylinder-piston units 8 and 9 are connected by a hydraulic circuit 11 to a control unit 12 comprising a pump 13 for delivering a fluid, typically oil, under pressure, a pressure regulating valve 14 provided with a pressure transducer in feedback, and a pressure gauge 15 measuring the pressure in the feed circuit of the cylinder-piston units.

[0038] The roller 7 separates the compaction zone 30 for the powder strip 100 from the subsequent decompression zone 31 in which the powder strip 100 expands in a controlled manner to prevent cracks arising in the compacted article.

[0039] In the illustrated embodiment (Figures 2 and 3) said decompression zone 31 comprises two superposed plates 16 and 17, of which the lower plate 17 is positioned below the belt 2 and the upper plate 16 is positioned above the belt 2, in contact with the band 52. The lower plate 17 is fixed and horizontal, whereas the plate 16 is supported on a crosspiece 18 by hydraulic cylinder-piston units 19 which enable the force exerted on the powders by the plate to be regulated.

[0040] As can be seen from the figures the plate 16 can also swivel about the cylinder-piston units so that it can be inclined to the belt 2 to enable the compacted strip of powders to expand with a very small deformation gradient compatible with the intrinsic characteristics of the powders.

[0041] The cylinder-piston units 19 are connected by a hydraulic circuit 21 to a control unit 20 identical with the control unit 12 shown in Figure 4.

[0042] The pressing station also comprises lateral powder retention means, which in the illustrated embodiment are in the form of two parallel deformable straps

60 associated with the compactor device 5.

[0043] In this respect, each of the two straps passes partially about the compactor device 5 and about deviator wheels 101, 102 and 103. 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.

[0044] According to a variant of the invention illustrated in Figures 5, 6 and 7, the decompression zone 31 comprises a fixed body 32 supporting a flexible plate 35 via a plurality of hydraulic cylinder-piston units 36.

[0045] In detail, each cylinder-piston unit comprises a cylinder, consisting of a cavity 320 present in the body 32, within which there slides a piston 321 the base of which is fixed to the flexible plate 35. The plate 35 is fixed by screws 37, each of which is received in a socket piece 38 inserted into a hole 39 in the plate 35. As can be seen from the figure, the socket piece 38 is substantially smaller than the hole 39, so that the plate can undergo small swivel movements relative to the support body 32. In practice the plane in which the plate lies during plant operation depends on the inclination of the band 52.

[0046] All the cavities 320 are connected to a hydraulic circuit 49 connected to a control unit 20.

[0047] From the aforegoing description it is apparent that, advantageously, the plate 35 behaves as an isostatic buffer, to distribute the force uniformly over the powders both in the transverse direction and in the longitudinal direction.

Claims

1. A method for forming ceramic tiles using ceramic powders materials, **characterized in that** of comprising the following operative steps:

   a. depositing on a conveyor belt (2) a continuous layer of powders (100), means (60) being associated with the belt (2) for lateral retention of the powders,
   b. pressing said powders to obtain a coherent article of compacted powders by advancing said belt (2) through a pressing station (3) of continuous type,
   c. controlling the force exerted on the powders (100) during pressing, using plate means (16, 35).

2. A method as claimed in claim 1, **characterised in that** the pressing of said powders (100) comprises both the compaction of said powders (100) and the controlled expansion of said powders (100) after compaction.

3. A method as claimed in claim 2, **characterised in that** the control of the force exerted on the powders (100) during pressing is associated with the powder compaction step.

4. A method as claimed in claim 2, **characterised in that** the control of the force exerted on the powders during pressing is associated with the powder expansion step.

5. A method as claimed in claim 2, **characterised in that** the control of the force exerted on the powders during pressing is associated both with the powder compaction step and with the powder expansion step.

6. A method as claimed in claim 1, **characterised in that** the powder compaction in the pressing station is progressive in the powder advancement direction.

7. A method as claimed in claim 1, **characterised in that** the article or the blanks obtained therefrom are subjected to a second pressing.

8. A method as claimed in claim 1, **characterised in that** the material expansion control takes place at least in the direction perpendicular to that article surface of greatest dimensions.

9. A plant (1) for forming ceramic tiles or slabs using ceramic powders materials, comprising a conveyor belt (2) on which a continuous strip of material in powder form is created and which is arranged to advance said strip through a continuous pressing station (3) which enables the powder strip on said belt to be compacted to obtain a coherent article of compacted powders, means (60) being associated with said pressing station to laterally retain the material on said belt, **characterised in that** said pressing station (3) is provided with plate (16, 35) means for controlling the force exerted on said powders.

10. A plant as claimed in claim 9, **characterised in that** said pressing station (3) comprises a first zone in which the powders (100) are compacted and a second zone in which the powders (100) are decompressed.

11. A plant as claimed in claim 9, **characterised in that** said means for controlling the force exerted on the powders (100) are associated with said first compaction zone.

12. A plant as claimed in claim 9, **characterised in that** said means for controlling the force exerted on the powders (100) are associated with said second powder decompression zone.

13. A plant as claimed in claim 9, **characterised in that**

said means for controlling the force exerted on the powders are associated both with said first compaction zone and with said second powder decompression zone.

14. A plant as claimed in claim 9, **characterised in that** said means for controlling the force exerted on the powders comprise a unit (12) for controlling at least one hydraulic cylinder-piston unit (8) with which said powder compaction means are associated.

15. A plant as maimed in claim 9, **characterised in that** said compaction means comprise at least one compactor roller.

16. A plant as claimed in claim 9, **characterised in that** said means for controlling the force exerted on the powders comprise a unit for controlling at least one hydraulic cylinder-piston unit with which said device for controlling the expansion of the compacted powders is associated.

17. A plant as claimed in claim 16, **characterised in that** said device for controlling powder expansion comprises at least one plate (17).

18. A plant as claimed in claim 16, **characterised in that** said device for controlling the expansion of the compacted powders comprises a plate (17) associated with a plurality of parallel hydraulic cylinder-piston units (19) disposed in several rows.

19. A plant as claimed in claims 14 and 16, **characterised in that** said control unit (12) for at least one cylinder-piston unit comprises at least one pump (13) for delivering a pressurized fluid, and a valve (14) for regulating the pressure of said fluid.

Patentansprüche

1. Ein Verfahren zur Herstellung von Keramikfliesen unter Verwendung von Keramikpulvermaterialien, **gekennzeichnet durch** die folgenden Arbeitsschritte:

a. Ablegen auf einem Förderband (2) einer durchgehenden Pulverschicht (100) mit dem Band (2) zugeordneten Mitteln (60) zur seitlichen Halterung der Pulverschicht,
b. Pressen der Pulverschicht, um ein einheitliches Erzeugnis aus verdichtetem Pulver **durch** Fortlaufen des Förderbands (2) **durch** eine kontinuierlich arbeitende Pressstation (3) zu erhalten,
c. Kontrolle der auf das Pulver (100) beim Pressvorgang einwirkenden Kraft **durch** Plattenmittel (16, 35).

2. Ein Verfahren nach Patentanspruch 1, **dadurch gekennzeichnet, dass** das Pressen des Pulvers (100) sowohl die Verdichtung des Pulvers (100) als auch die kontrollierte Ausdehnung des Pulvers (100) nach der Verdichtung beinhaltet.

3. Ein Verfahren nach Patentanspruch 2, **dadurch gekennzeichnet, dass** die Kontrolle der während des Pressvorgangs auf das Pulver (100) einwirkenden Kraft dem Schritt der Pulververdichtung zugeordnet ist.

4. Ein Verfahren nach Patentanspruch 2, **dadurch gekennzeichnet, dass** die Kontrolle der während des Pressvorgangs auf das Pulver einwirkenden Kraft dem Schritt der Pulverausdehnung zugeordnet ist.

5. Ein Verfahren nach Patentanspruch 2, **dadurch gekennzeichnet, dass** die Kontrolle der während des Pressvorgangs auf das Pulver einwirkenden Kraft den beiden Schritten der Pulververdichtung und der Pulverausdehnung zugeordnet ist.

6. Ein Verfahren nach Patentanspruch 1, **dadurch gekennzeichnet, dass** die Pulververdichtung in der Pressstation progressiv in der Pulvervorschubrichtung stattfindet.

7. Ein Verfahren nach Patentanspruch 1, **dadurch gekennzeichnet, dass** das Erzeugnis oder die daraus entstehenden Zuschnitte einer zweiten Pressung unterworfen werden.

8. Ein Verfahren nach Patentanspruch 1, **dadurch gekennzeichnet, dass** die Kontrolle der Materialausdehnung wenigstens in senkrechter Richtung zu der Oberfläche des Artikels stattfindet, welche die größten Abmessungen aufweist.

9. Eine Anlage (1) zur Herstellung von Keramikfliesen oder -platten aus Keramikpulvermaterialien, einschließlich eines Förderbandes (2), auf dem eine durchgehende Schicht aus Pulvermaterial erzeugt wird und das so angeordnet ist, dass es diese Schicht durch eine kontinuierlich arbeitende Pressstation (3) schiebt, welche eine Verdichtung der Pulverschicht auf dem Förderband ermöglicht, um ein einheitliches Erzeugnis aus verdichtetem Pulver zu erhalten, wobei der Pressstation Mittel (60) zugeordnet werden zur seitlichen Halterung des Materials auf dem Förderband, **dadurch gekennzeichnet, dass** die Pressstation (3) mit Plattenmitteln (16, 35) zur Kontrolle der auf das Pulver einwirkenden Kräfte versehen ist.

10. Eine Anlage nach Patentanspruch 9, **dadurch gekennzeichnet, dass** die Pressstation (3) einen ersten Bereich zur Verdichtung des Pulvers (100) und

einen zweiten Bereich zur Dekomprimierung des Pulvers (100) beinhaltet.

11. Eine Anlage nach Patentanspruch 9, **dadurch gekennzeichnet, dass** die Mittel zur Kontrolle der auf das Pulver (100) einwirkenden Kraft dem ersten Verdichtungsbereich zugeordnet sind.

12. Eine Anlage nach Patentanspruch 9, **dadurch gekennzeichnet, dass** die Mittel zur Kontrolle der auf das Pulver (100) einwirkenden Kraft dem zweiten Dekomprimierungsbereich zugeordnet sind.

13. Eine Anlage nach Patentanspruch 9, **dadurch gekennzeichnet, dass** die Mittel zur Kontrolle der auf das Pulver einwirkenden Kraft sowohl dem ersten Verdichtungsbereich als auch dem zweiten Dekomprimierungsbereich zugeordnet sind.

14. Eine Anlage nach Patentanspruch 9, **dadurch gekennzeichnet, dass** die Mittel zur Kontrolle der auf das Pulver einwirkenden Kraft eine Einheit (12) zur Kontrolle wenigstens einer hydraulischen Zylinderkolbeneinheit (8) beinhalten, der die Pulververdichtungsmittel zugeordnet sind.

15. Eine Anlage nach Patentanspruch 9, **dadurch gekennzeichnet, dass** die Verdichtungsmittel wenigstens eine Verdichtungsrolle beinhalten.

16. Eine Anlage nach Patentanspruch 9, **dadurch gekennzeichnet, dass** die Mittel zur Kontrolle der auf das Pulver einwirkenden Kraft eine Einheit zur Kontrolle wenigstens einer hydraulischen Zylinderkolbeneinheit beinhalten, der die Vorrichtung zur Kontrolle der Ausdehnung des verdichteten Pulvers zugeordnet ist.

17. Eine Anlage nach Patentanspruch 16, **dadurch gekennzeichnet, dass** die Vorrichtung zur Kontrolle der Ausdehnung des verdichteten Pulvers wenigstens eine Platte (17) beinhaltet.

18. Eine Anlage nach Patentanspruch 16, **dadurch gekennzeichnet, dass** die Vorrichtung zur Kontrolle der Ausdehnung des verdichteten Pulvers eine Platte (17) beinhaltet, die einer Vielzahl paralleler hydraulischer Zylinderkolbeneinheiten (19) zugeordnet ist, die in zahlreichen Reihen angeordnet sind.

19. Eine Anlage nach den Patentansprüchen 14 und 16, **dadurch gekennzeichnet, dass** die Kontrolleinheit (12) für wenigstens eine Zylinderkolbeneinheit wenigstens eine Pumpe (13) zum Fördern einer unter Druck stehenden Flüssigkeit und ein Ventil (14) zur Druckregulierung der Flüssigkeit beinhaltet.

Revendications

1. Une méthode pour la formation de carreaux en céramique à l'aide de matériaux en poudres de céramique, **caractérisée par le fait qu'**elle comprend les étapes opérationnelles suivantes :

a. Dépôt sur un tapis roulant (2) d'une couche continue de poudres (100), un dispositif (60) étant associé au tapis (2) pour la rétention latérale des poudres,
b. Pressage desdites poudres pour obtenir un article cohérent de poudres compactées en faisant avancer ledit tapis (2) à travers une station de pressage (3) de type continu,
c. Contrôle de la force exercée sur les poudres (100) pendant le pressage, en utilisant un dispositif à plaque (16, 35),

2. Une méthode selon la revendication 1, **caractérisée par le fait que** le pressage desdites poudres (100) comprend le compactage desdites poudres (100) et l'expansion contrôlée desdites poudres (100) après le compactage.

3. Une méthode selon la revendication 2, **caractérisée par le fait que** le contrôle de la force exercée sur les poudres (100) pendant le pressage est associé à l'étape de compactage de la poudre.

4. Une méthode selon la revendication 2, **caractérisée par le fait que** le contrôle de la force exercée sur les poudres pendant le pressage est associé à l'étape d'expansion de la poudre.

5. Une méthode selon la revendication 2, **caractérisée par le fait que** le contrôle de la force exercée sur les poudres pendant le pressage est associé à l'étape de compactage de la poudre et à l'étape d'expansion de la poudre.

6. Une méthode selon la revendication 1, **caractérisée par le fait que** le compactage de la poudre dans la station de pressage est progressif dans la direction d'avancement de la poudre.

7. Une méthode selon la revendication 1, **caractérisée par le fait que** l'article ou les pièces brutes obtenues par celle-ci sont sujets à un deuxième pressage.

8. Une méthode selon la revendication 1, **caractérisée par le fait que** le contrôle de l'expansion du matériau s'effectue au moins dans la direction perpendiculaire à celle de la surface de l'article ayant les plus grandes dimensions.

9. Une installation (1) pour la formation de carreaux ou dalles en céramique à l'aide de matériaux en pou-

dres de céramique, comprenant un tapis roulant (2) sur lequel une bande continue de matériau sous forme de poudre est créée et qui est disposé pour faire avancer ladite bande à travers une station de pressage (3) continue qui permet à la bande de poudre sur ledit tapis d'être compactée pour obtenir un article cohérent de poudres compactées, un dispositif (60) étant associé à ladite station de pressage pour retenir latéralement le matériau sur ledit tapis, **caractérisée par le fait que** ladite station de pressage (3) est dotée d'un dispositif à plaque (16, 35) pour le contrôle de la force exercée sur lesdites poudres.

10. Une installation selon la revendication 9, **caractérisée par le fait que** ladite station de pressage (3) comprend une première zone dans laquelle les poudres (100) sont compactées et une deuxième zone dans laquelle les poudres (100) sont décompressées.

11. Une installation selon la revendication 9, **caractérisée par le fait que** ledit dispositif pour le contrôle de la force exercée sur les poudres (100) est associé à ladite zone de compactage.

12. Une installation selon la revendication 9, **caractérisée par le fait que** ledit dispositif pour le contrôle de la force exercée sur les poudres (100) est associé à ladite deuxième zone de décompression de la poudre.

13. Une installation selon la revendication 9, **caractérisée par le fait que** ledit dispositif pour le contrôle de la force exercée sur les poudres est associé avec ladite première zone de compactage et avec ladite deuxième zone de décompression de la poudre.

14. Une installation selon la revendication 9, **caractérisée par le fait que** ledit dispositif pour le contrôle de la force exercée sur les poudres comprend une unité (12) pour le contrôle d'au moins un ensemble piston-cylindre hydraulique (8) avec lequel est associé ledit dispositif de compactage de la poudre.

15. Une installation selon la revendication 9, **caractérisée par le fait que** ledit dispositif de compactage de la poudre comprend au moins un rouleau compacteur.

16. Une installation selon la revendication 9, **caractérisée par le fait que** ledit dispositif pour le contrôle de la force exercée sur les poudres comprend une unité pour le contrôle d'au moins un ensemble piston-cylindre hydraulique avec lequel est associé ledit dispositif pour le contrôle de l'expansion des poudres compactée.

17. Une installation selon la revendication 16, **caractérisée par le fait que** ledit dispositif pour le contrôle de l'expansion de la poudre comprend au moins une plaque (17).

18. Une installation selon la revendication 16, **caractérisée par le fait que** ledit dispositif pour le contrôle de l'expansion des poudres compactées comprend une plaque (17) associée avec plusieurs ensembles piston-cylindre hydrauliques (19) parallèles disposés sur plusieurs rangées.

19. Une installation selon les revendications 14 et 16, **caractérisée par le fait que** ladite unité de contrôle (12) pour au moins un ensemble piston-cylindre hydraulique comprend au moins une pompe (13) pour la fourniture d'un fluide sous pression et une valve (14) pour la régulation de la pression dudit fluide.

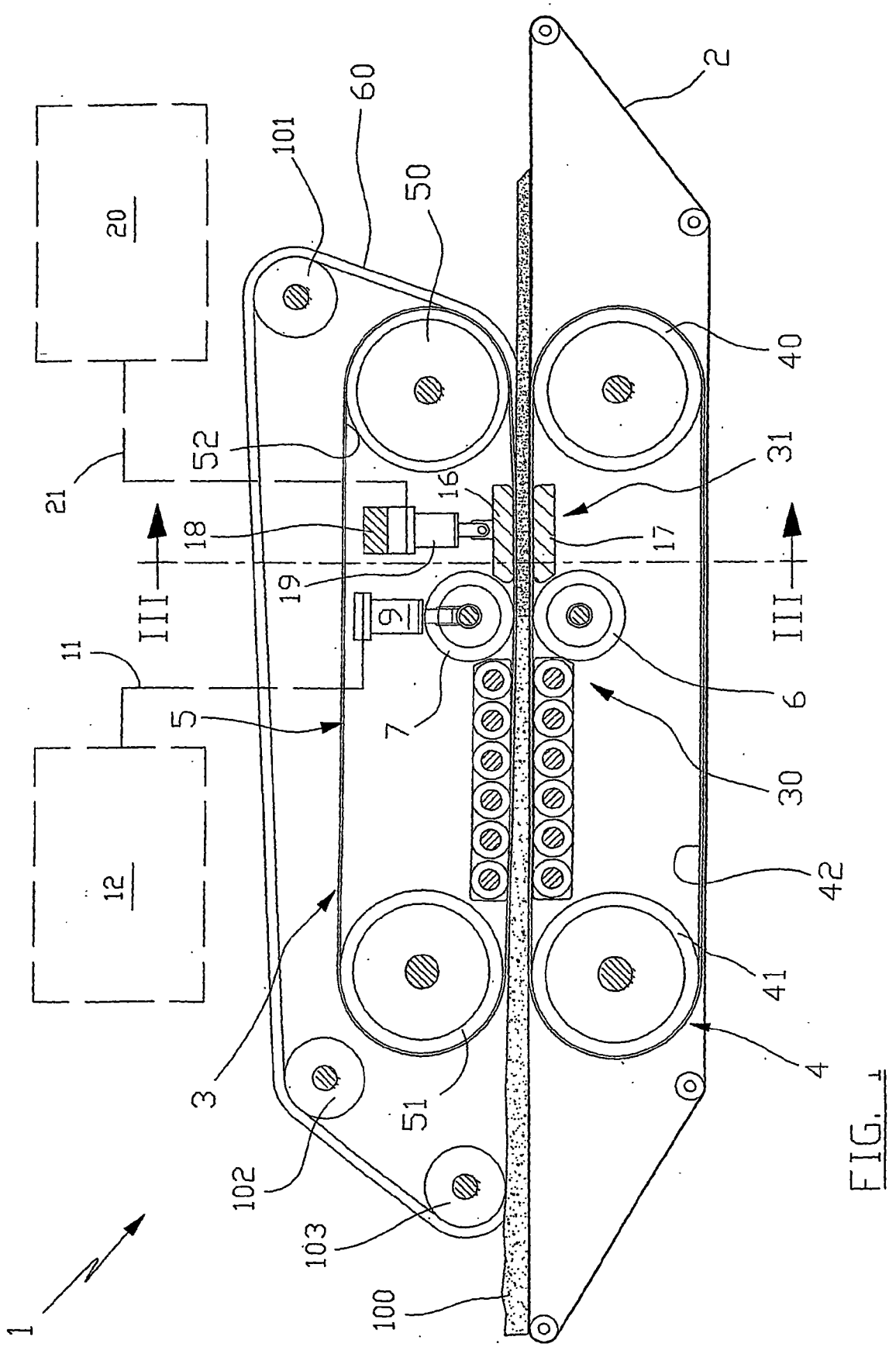
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FIG. 1

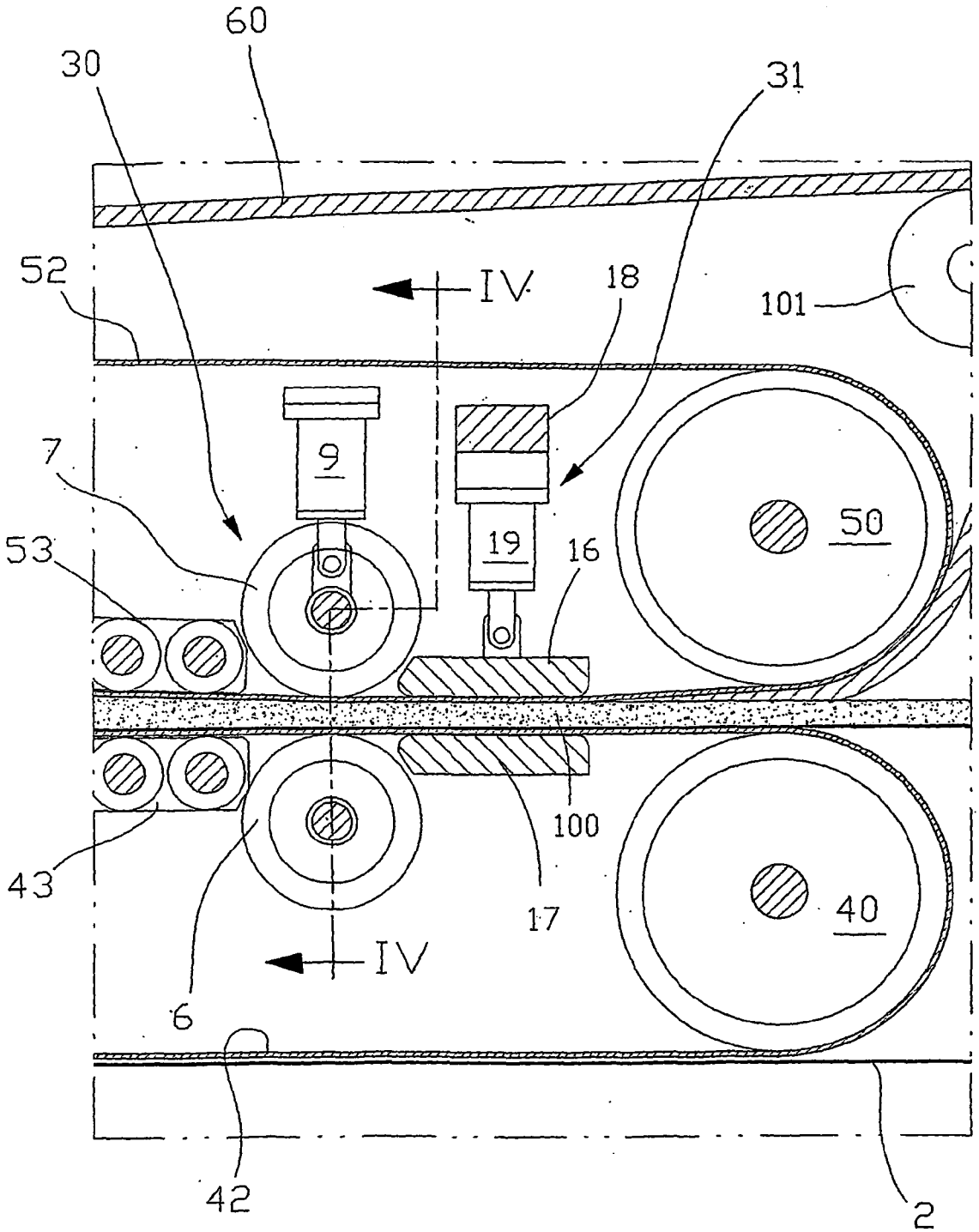

FIG. 2

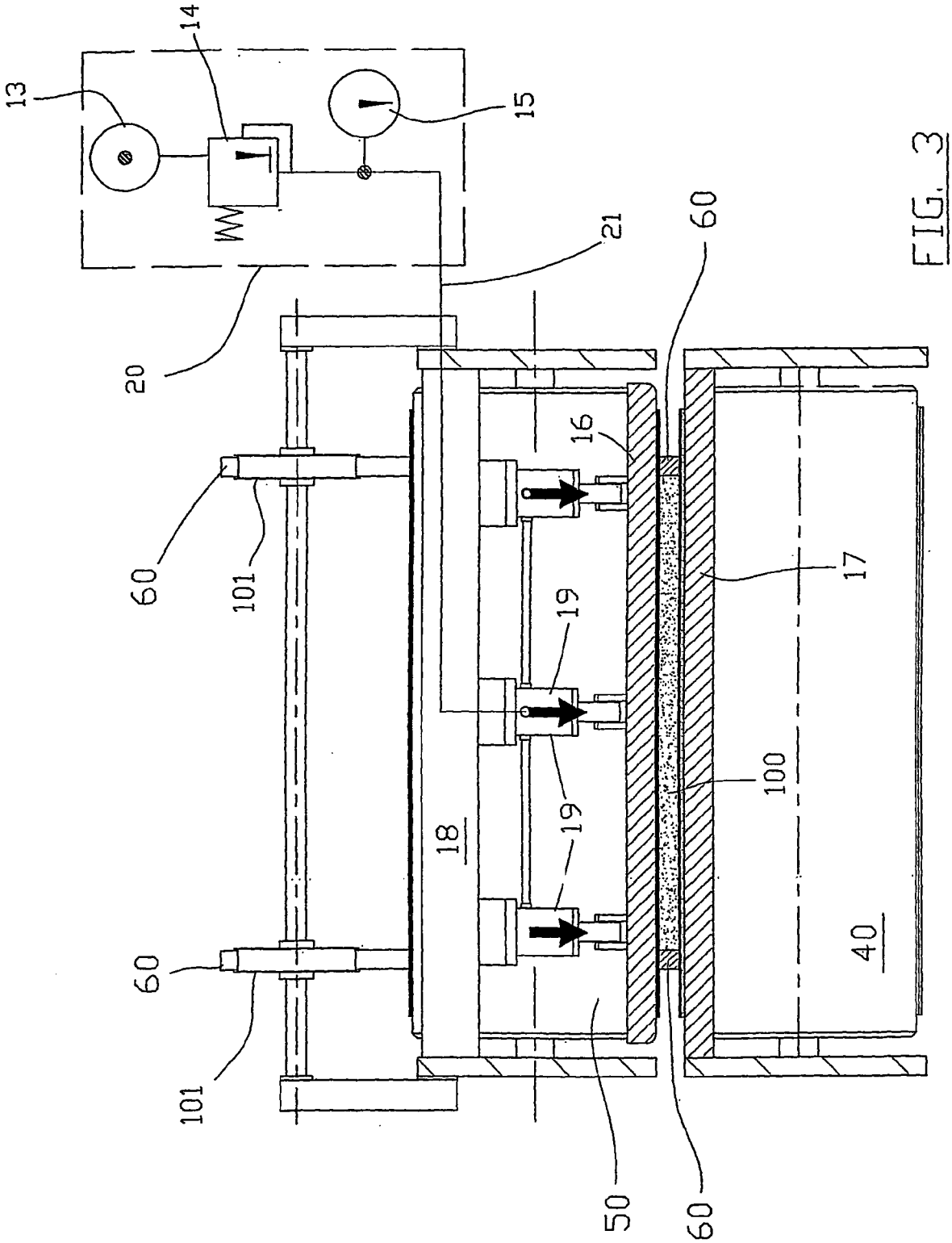

FIG. 3

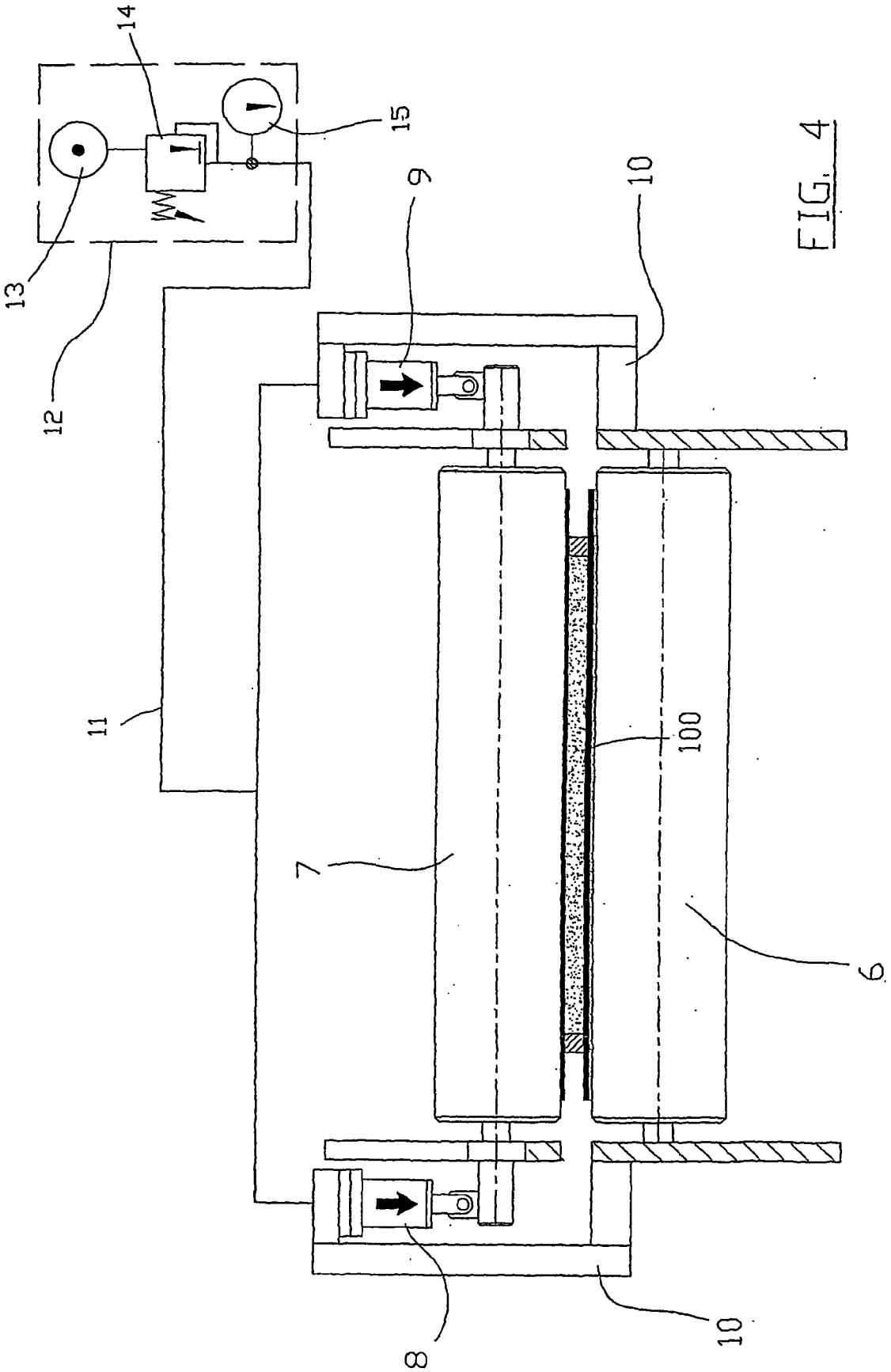

FIG. 4

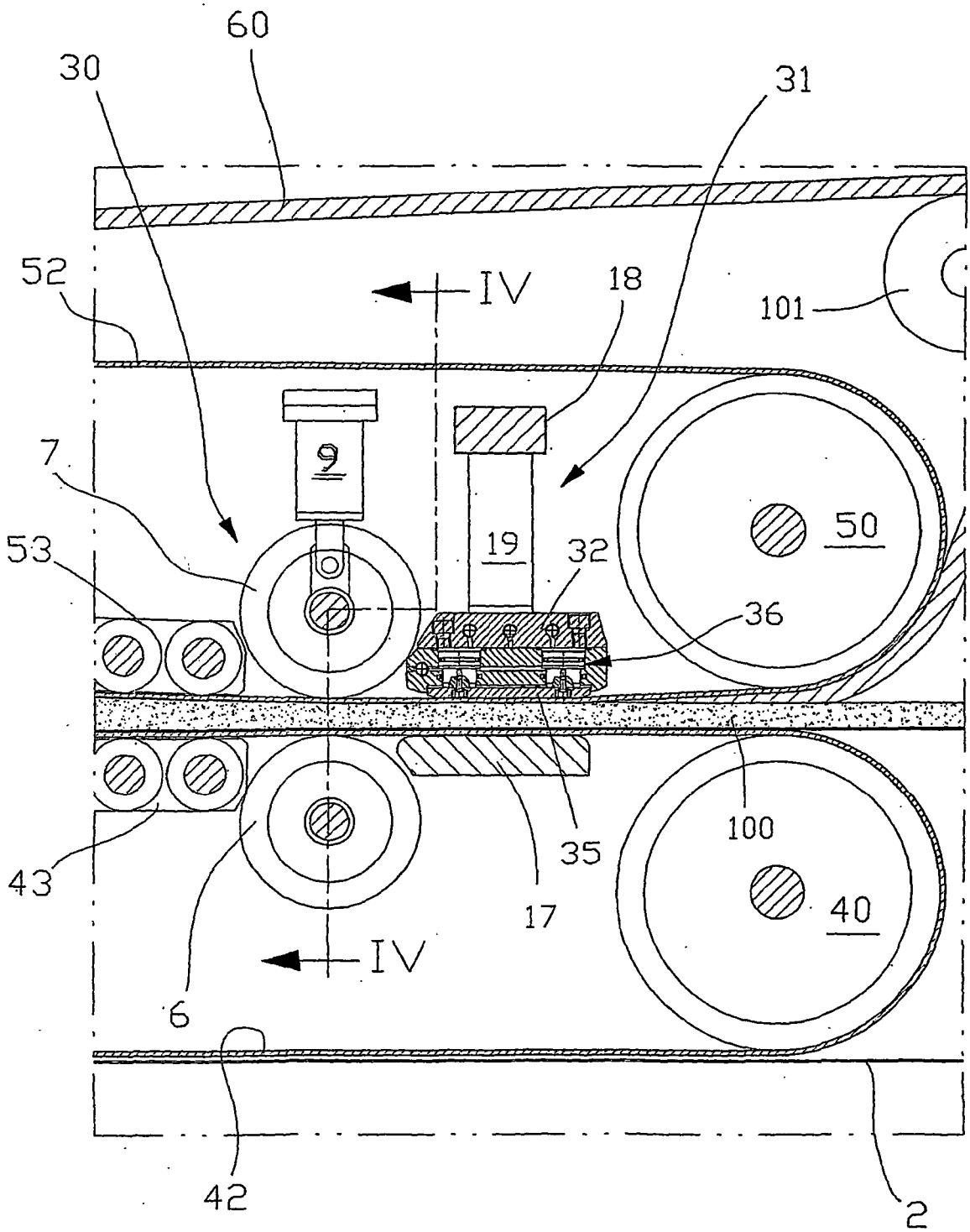

FIG. 5

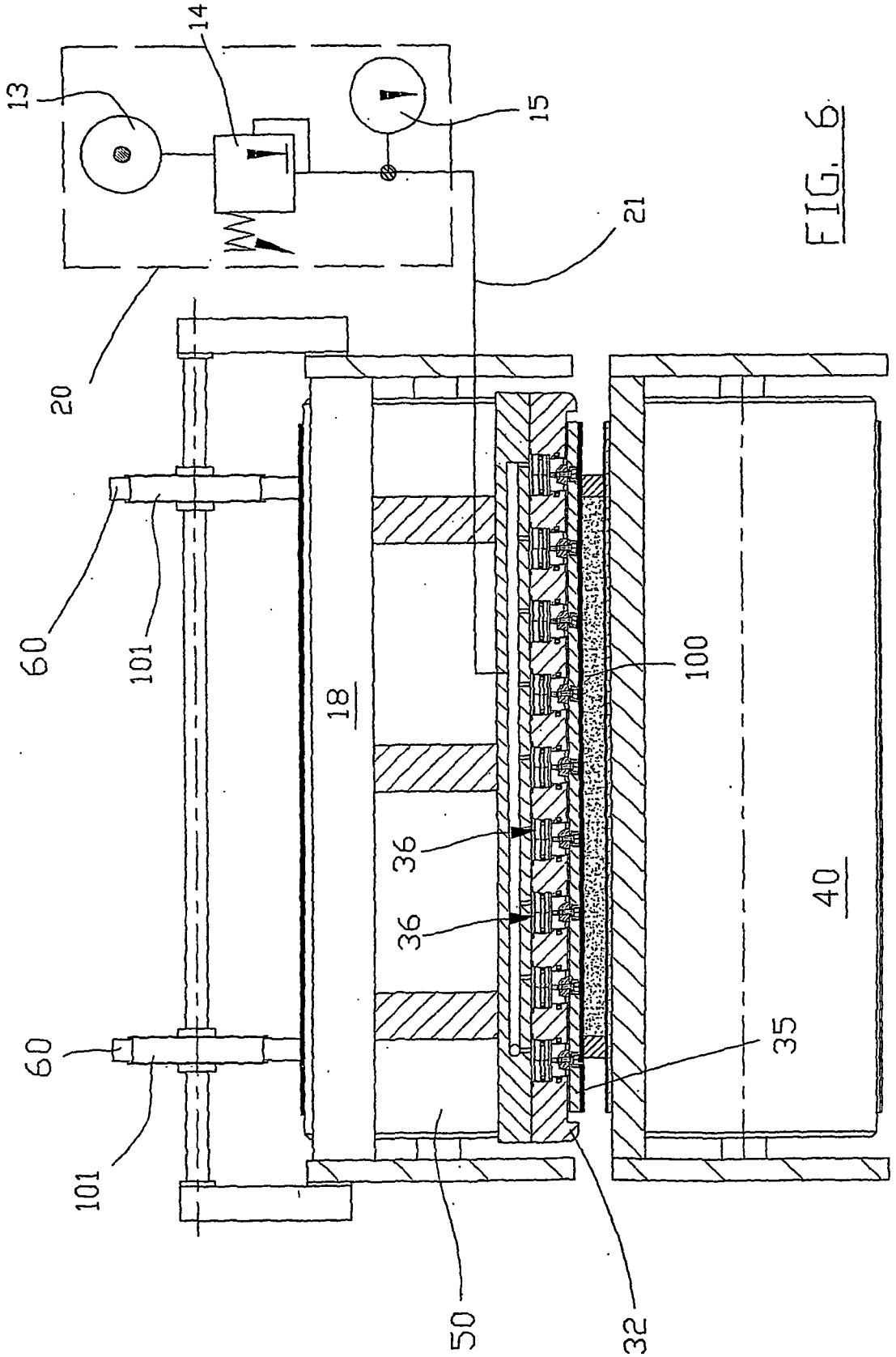

FIG. 6

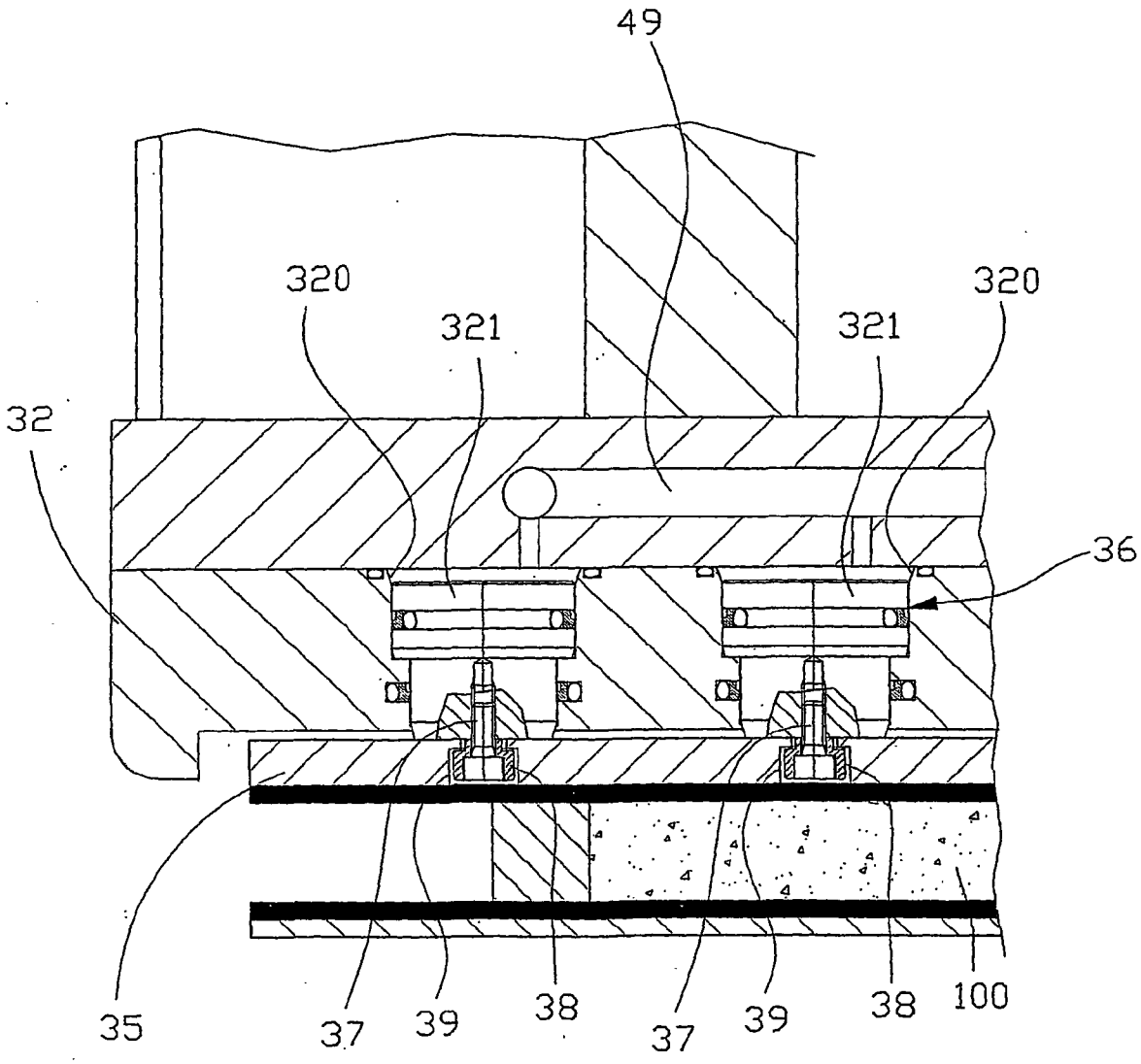

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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