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- **CHEN, Yanlin**  
Foshan, Guangdong 528137 (CN)
- **QIU, ZhaoWu**  
Foshan, Guangdong 528137 (CN)
- **SU, Longbao**  
Foshan, Guangdong 528137 (CN)
- **LIANG, Chaohuan**  
Foshan, Guangdong 528137 (CN)

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(74) Representative: **Petraz, Gilberto Luigi et al**  
**GLP S.r.l.**  
**Viale Europa Unità, 171**  
**33100 Udine (IT)**

(71) Applicant: **Foshan Henglitai Machinery Co., Ltd.**  
**Foshan City, Guangdong 528137 (CN)**

(72) Inventors:  
• **WEN, Yizhang**  
**Foshan, Guangdong 528137 (CN)**

(54) **ROLLING FORMING APPARATUS USED FOR TEXTURES ON CERAMIC AND ROLLING FORMING METHOD**

(57) Disclosed is a roller press forming apparatus for ceramic textures, including: an upper pressing roller assembly; a lower pressing roller assembly, the upper pressing roller assembly and the lower pressing roller assembly being arranged opposite to each other, and an embossing channel being formed at an interval between the upper pressing roller assembly and the lower pressing roller assembly, an upper steel belt of the upper pressing roller assembly and/or a lower steel belt of

the lower pressing roller assembly being wound with a roller press pattern member having elastic properties, a surface of the roller press pattern member being provided with embossing protrusions; the roller press pattern member being configured for roller press forming a textured ceramic slab blank from ceramic powder material passing through the embossing channel along a conveying direction.

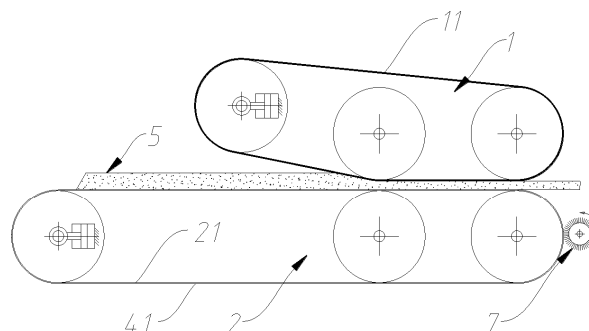


FIG. 1

## Description

## TECHNICAL FIELD

[0001] The present application relates to the field of roller presses, and particularly to a roller press forming apparatus for ceramic textures and a roller press forming method.

## BACKGROUND

[0002] Roller press forming process refers to a process that relies on the plastic flow characteristics of materials and uses the principle of rolling extrusion to form various complex workpieces. During operation of the roller press, a movable roller is driven to rotate by a motor. Loose material is conveyed into the gap between the two rollers, where it is subjected to crushing and compression to form a compacted material bed. Under conditions of bed comminution, the energy consumption required for pure pressure crushing is much lower compared to pure shearing and impact crushing. The roller press precisely utilizes pure pressure during the bed comminution process, achieving the goals of improving efficiency and saving energy.

[0003] For example, in an existing roller press forming apparatus and method thereof, the application publication number of which is CN115922879A and published on April 7, 2023, the existing roller press forming apparatus includes a conveying assembly, configured to convey powder material along a conveying direction; a pressing assembly including a first forming roller and a second forming roller, the first forming roller and the second forming roller being spaced apart in a vertical direction, the first forming roller and the second forming roller together forming a compacting space; the compacting space being configured to receive the powder material from the conveying assembly and compact the powder material to form a brick blank; and a limiting plate, the first forming roller and the limiting plate being arranged in sequence along the conveying direction, the limiting plate being configured to abut against the brick blank to restrict expansion of the surface of the brick blank.

[0004] This existing roller press forming apparatus may prevent expansion of the upper surface of the brick blank and gradually allow internal stress within the brick blank to release, reducing the occurrence of cracks in the brick blank, thereby ensuring the quality of the brick blank. However, since the surface of the compacting belt is smooth, it may not form textures on the surface of the brick blank. Therefore, it fails to meet the requirement for forming rich decorative textures on the surface of ceramic slab blanks. Simultaneously, due to the lack of textures on the surface of the ceramic slab blank, the adhesion of the ceramic slab blank during tiling is also weakened.

## SUMMARY

[0005] To overcome at least one of the defects described in the above prior art, the present application provides a roller press forming apparatus for ceramic textures and a roller press forming method, solving the problem that the existing roller press forming apparatus may not form textures on the surface of brick blanks.

[0006] The technical solution adopted by the present application to address the problems is as follows:

a roller press forming apparatus for ceramic textures, including:

an upper pressing roller assembly;

a lower pressing roller assembly, the upper pressing roller assembly and the lower pressing roller assembly being arranged opposite to each other, and an embossing channel being formed at an interval between the upper pressing roller assembly and the lower pressing roller assembly, an upper steel belt of the upper pressing roller assembly and/or a lower steel belt of the lower pressing roller assembly being wound with a roller press pattern member having elastic properties, a surface of the roller press pattern member being provided with embossing protrusions;

the roller press pattern member being configured for roller press forming a textured ceramic slab blank from ceramic powder material during a process of the ceramic powder material passing through the embossing channel along a conveying direction.

[0007] In some embodiments of the present application, a perimeter of the roller press pattern member is shorter than a perimeter of the upper steel belt by 0% to 10%, or, a perimeter of the roller press pattern member is shorter than a perimeter of the lower steel belt by 0% to 10%.

[0008] In some embodiments of the present application, the upper pressing roller assembly comprises an upper forming press roller and an upper power roller assembly, the upper forming press roller cooperating with the upper power roller assembly to tension the upper steel belt;

the lower pressing roller assembly comprises a lower forming press roller and a lower power roller assembly, the lower forming press roller cooperating with the lower power roller assembly to tension the lower steel belt, the upper forming press roller and the lower forming press roller being arranged opposite to each other.

[0009] In some embodiments of the present application, the upper power roller assembly comprises a first driving roller, a first driven roller and a first tensioning cylinder, the upper forming press roller is disposed between the first driving roller and the first driven roller, a movable telescoping end of the first tensioning cylinder is connected to the first driven roller;

the lower power roller assembly comprises a second

driving roller, a second driven roller and a second tensioning cylinder, the lower forming press roller is disposed between the second driving roller and the second driven roller, a movable telescoping end of the second tensioning cylinder is connected to the second driven roller.

**[0010]** In some embodiments of the present application, a lateral constraint member is disposed on the roller press pattern member, the lateral constraint member extends along a length direction of the roller press pattern member, the lateral constraint member has elastic properties, enabling the lateral constraint member to be compressed and deformed when passing through the embossing channel.

**[0011]** In some embodiments of the present application, the roller press pattern member is provided with the lateral constraint member on both opposite sides in the conveying direction, one of the roller press pattern member and the lateral constraint member is provided with a positioning protrusion, the other of the roller press pattern member and the lateral constraint member is provided with an adjustment slot configured to engage the positioning protrusion, the positioning protrusion and the adjustment slot cooperate to adjust a spacing between the two lateral constraint members.

**[0012]** In some embodiments of the present application, the roller press pattern member and the lateral constraint member are formed in a single piece.

**[0013]** In some embodiments of the present application, the roller press forming apparatus for ceramic textures further includes a cleaning device configured to remove ceramic powder material remaining on a surface of the roller press pattern member.

**[0014]** In some embodiments of the present application, the upper steel belt between the upper forming press roller and the first driven roller forms a feed guiding section, the lower steel belt between the lower forming press roller and the second driven roller forms a feed conveying section, and the feed guiding section is arranged obliquely relative to the feed conveying section.

**[0015]** Disclosed in the present application is further a roller press forming method applied to the aforementioned roller press forming apparatus, including the following steps:

Step 1, conveying ceramic powder material to the lower pressing roller assembly quantitatively;

Step 2, conveying the ceramic powder material along a conveying direction to the embossing channel; and

Step 3, compacting and embossing the ceramic powder material into a textured ceramic slab blank through a combined action of the upper pressing roller assembly, the lower pressing roller assembly, and the roller press pattern member.

**[0016]** In summary, the roller press forming apparatus for ceramic textures and the roller press forming method

provided in the present application provide the following technical effects:

By winding a roller press pattern member having elastic properties around the upper steel belt of the upper pressing roller assembly and/or the lower steel belt of the lower pressing roller assembly, the original upper steel belt and lower steel belt may maintain their original structural strength, effectively ensuring the quality of the formed ceramic slab blank. Simultaneously, utilizing the roller press pattern member to form textures on the ceramic slab blank solves the problem that the existing roller press forming apparatus may not form textures on the surface of the brick blank (i.e., the ceramic slab blank in the present application), not only improving the aesthetic appeal of the ceramic slab blank but also enhancing the adhesion of the ceramic slab blank during tiling. Furthermore, the assembly of the roller press pattern member is also very convenient, facilitating the quick disassembly, assembly, and production of the roller press forming apparatus.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0017]**

FIG. 1 is a schematic diagram of rolling of a roller press forming apparatus for ceramic textures according to the present application;

FIG. 2 is a first structural diagram of a roller press forming apparatus for ceramic textures according to the present application;

FIG. 3 is a partial enlarged schematic view at position A in FIG. 2;

FIG. 4 is an enlarged cross-sectional schematic view at position B in FIG. 2;

FIG. 5 is a second structural diagram of a roller press forming apparatus for ceramic textures according to the present application.

**[0018]** Reference Numerals: 1, upper pressing roller assembly; 11, upper steel belt; 12, upper forming press roller; 13, first driving roller; 14, first driven roller; 15, first tensioning cylinder; 2, lower pressing roller assembly; 21, lower steel belt; 22, lower forming press roller; 23, second driving roller; 24, second driven roller; 25, second tensioning cylinder; 3, embossing channel; 41, roller press pattern member; 5, ceramic powder material; 6, lateral constraint member; 7, cleaning device.

## DETAILED DESCRIPTION

**[0019]** For a better understanding and implementation, the technical solutions in the embodiments of the present application are clearly and completely described below in conjunction with the attached drawings of the present application.

**[0020]** In the description of the present application, it is to be noted that the terms "up", "down", "front", "back",

"left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside" and other orientation or position relationships are based on the orientation or position relationships shown in the attached drawings. It is only intended to facilitate description of the present application and simplify description, but not to indicate or imply that the referred device or element has a specific orientation, or is constructed and operated in a specific orientation. Therefore, they should not be construed as a limitation of the present application.

**[0021]** Unless otherwise defined, all terms including technical and scientific terms used herein have the same meaning as commonly understood by those skilled in the art to which the present application belongs. The terms used herein in the specification of the present application are used only to describe specific embodiments and are not intended as a limitation of the application.

### Embodiment 1

**[0022]** Roller press forming of ceramic tiles/ceramic slab blanks still belongs to a new forming method in the current field of ceramic tile/ceramic slab blank forming. Through experimental testing and analysis during the roller press forming process of ceramic tiles/ceramic slab blanks, it is known that parameters such as the diameter, rotational speed, structural strength of the press rollers, reduction amount, and plasticity of the ceramic powder material during roller press forming all have varying degrees of influence on the forming quality of the ceramic tile blanks. This includes: the influence on the surface flatness of the formed slab blank, i.e., whether there are obvious concave-convex wave phenomena on the surface; and the influence on the quality of the ceramic powder material after forming, i.e., whether the ceramic powder material is deformed or cracked after roller pressing.

**[0023]** Therefore, the present application aims to improve upon the existing roller press forming apparatus, so that under the condition that parameters such as the diameter, rotational speed, structural strength of the press rollers, reduction amount, and plasticity of the ceramic powder material during roller press forming remain unchanged or are only slightly adjusted, required texture textures can be generated on the surface of the formed ceramic tile/ceramic slab blank. In this way, the generation of defective ceramic tiles/ceramic slab blanks is minimized to the greatest extent, the quality of the ceramic tile/ceramic slab blank products is effectively ensured, and the process production cost of roller press forming ceramic tiles/ceramic slab blanks (hereinafter collectively referred to as ceramic slab blanks) is also reduced.

**[0024]** Specifically, referring to FIG. 1, the present application discloses a roller press forming apparatus for ceramic textures, including an upper pressing roller assembly 1 and a lower pressing roller assembly 2. The upper pressing roller assembly 1 and the lower pressing

roller assembly 2 are arranged opposite to each other, and an embossing channel 3 is formed at an interval between the upper pressing roller assembly 1 and the lower pressing roller assembly 2.

**[0025]** During the process where the ceramic powder material 5 passes through the embossing channel 3, the cooperation between the upper steel belt 11 of the upper pressing roller assembly 1 and the lower steel belt 21 of the lower pressing roller assembly 2 compacts and evens out the ceramic powder material 5, forming a ceramic slab blank with good surface flatness and relatively small and uniform overall internal residual stress.

**[0026]** As the core solution of the present embodiment, in order to form a textured ceramic slab blank on the smooth and flat surface of the ceramic slab blank, specifically referring to FIG. 2 and FIG. 3, the upper steel belt 11 of the upper pressing roller assembly 1 is wound with a roller press pattern member 41 having elastic properties. That is, when the roller press pattern member 41 is sleeved on the upper steel belt 11, the roller press pattern member 41 will extend along the length direction of the upper steel belt 11, and the roller press pattern member 41 is connected end-to-end to form a closed-loop structure. Furthermore, the surface of the roller press pattern member 41 is provided with embossing protrusions. In this way, during the continuous operation of this roller press forming apparatus, the roller press pattern member 41 may utilize its embossing protrusions to continuously perform roller press forming of the ceramic powder material 5 into a textured ceramic slab blank during the process where the ceramic powder material 5 passes through the embossing channel 3 along the conveying direction.

**[0027]** In the present embodiment, it is only necessary to assemble the roller press pattern member 41 onto the upper steel belt 11 of the upper pressing roller assembly 1. No processing of the upper steel belt 11 or modifications to the upper pressing roller assembly 1 and the lower pressing roller assembly 2 are required. Therefore, the structural strength of the upper pressing roller assembly 1 and the lower pressing roller assembly 2 is maintained, and there is no need to adjust the process parameters for roller press forming ceramic slab blanks, minimizing the research, development, and production costs to the greatest extent.

**[0028]** When it is necessary to change the texture of the ceramic slab blank according to design or requirements, it is only required to remove the roller press pattern member 41 from the upper steel belt 11 of the upper pressing roller assembly 1 and then replace it with another roller press pattern member 41. The assembly and replacement are convenient, which is also beneficial for the efficient production of ceramic slab blanks and reduces the difficulty of production and manufacturing.

**[0029]** It should be noted that, in addition to assembling the roller press pattern member 41 onto the upper steel belt 11 of the upper pressing roller assembly 1 as described above, the roller press pattern member 41 may

also be assembled onto the lower steel belt 21 of the lower pressing roller assembly 2. Alternatively, as shown in FIG. 5, both the upper steel belt 11 of the upper pressing roller assembly 1 and the lower steel belt 21 of the lower pressing roller assembly 2 are assembled with roller press pattern members 41.

**[0030]** In the above, specifically referring to FIG. 2 and FIG. 5, the upper pressing roller assembly 1 comprises an upper forming press roller 12 and an upper power roller assembly. The upper forming press roller 12 cooperates with the upper power roller assembly to tension the upper steel belt 11. That is, the upper steel belt 11 is pressed against and subjected to force by the upper forming press roller 12 and the upper power roller assembly, keeping the upper steel belt 11 in a tensioned state during the roller pressing process.

**[0031]** Similarly, the aforementioned lower pressing roller assembly 2 includes a lower forming press roller 22 and a lower power roller assembly. The lower forming press roller 22 cooperates with the lower power roller assembly to tension the lower steel belt 21. That is, the lower steel belt 21 is pressed against and subjected to force by the lower forming press roller 22 and the lower power roller assembly, keeping the lower steel belt 21 in a tensioned state during the roller pressing process. In this way, when the roller press pattern member 41 is assembled onto the upper steel belt 11 of the upper pressing roller assembly 1, the roller press pattern member 41 and the upper steel belt 11 maintain uniform pressing contact. Then, the upper steel belt 11 can smoothly drive the roller press pattern member 41 to move, thereby ensuring that the roller press pattern member 41 can uniformly press the ceramic slab blank. Simultaneously, when the roller-pressed ceramic slab blank is conveyed in translational motion within the embossing channel 3, the roller press pattern member 41 can also uniformly and steadily press against the ceramic slab blank, avoiding the problem of unclear textures caused by partial shape recovery of the ceramic slab blank, which has a certain plasticity, after roller press forming.

**[0032]** When the roller press pattern member 41 is assembled onto the lower steel belt 21 of the lower power roller assembly, the roller press pattern member 41 and the lower steel belt 21 maintain uniform pressing contact. Then, the lower steel belt 21 may smoothly drive the roller press pattern member 41 to move, not only smoothly conveying the ceramic powder material 5 but also effectively ensuring that the roller press pattern member 41 uniformly presses the ceramic slab blank. Simultaneously, when the roller-pressed ceramic slab blank is conveyed in translational motion within the embossing channel 3, the roller press pattern member 41 can also uniformly and steadily press against the ceramic slab blank, avoiding the problem of unclear textures caused by partial shape recovery of the ceramic slab blank, which has a certain plasticity, after roller press forming.

**[0033]** Furthermore, the upper forming press roller 12 and the lower forming press roller 22 are arranged op-

posite to each other. Then, when the ceramic powder material 5 passes between the upper forming press roller 12 and the lower forming press roller 22, compression is formed between the ceramic powder material 5 and the roller press pattern member 41. This not only compacts the ceramic powder material 5 into a ceramic slab blank but also embosses relatively clear textures onto the ceramic slab blank.

**[0034]** As a preferred mode of the present embodiment, specifically referring to FIG. 2 and FIG. 5, the aforementioned upper power roller assembly comprises a first driving roller 13, a first driven roller 14, and a first tensioning cylinder 15. The upper forming press roller 12 is disposed between the first driving roller 13 and the first driven roller 14. A movable telescoping end of the first tensioning cylinder 15 is connected to the first driven roller 14. The first tensioning cylinder 15 may be an air cylinder, may also be a hydraulic cylinder, or may also be an electric cylinder.

**[0035]** Thus, assuming the roller press pattern member 41 is assembled on the upper steel belt 11. During the installation and removal of the upper steel belt 11 and the roller press pattern member 41, the first tensioning cylinder 15 may be controlled to be in a compressed state, causing the upper steel belt 11 and the upper power roller assembly, as well as the upper steel belt 11 and the roller press pattern member 41, to be in a slack state. This facilitates assembling the upper steel belt 11 and the roller press pattern member 41 onto the upper power roller assembly, or facilitates removing the upper steel belt 11 and the roller press pattern member 41 from the upper power roller assembly. When the upper steel belt 11 and the roller press pattern member 41 are placed on the upper power roller assembly, the first tensioning cylinder 15 may be controlled to be in an extended state until the upper steel belt 11 and the roller press pattern member 41 are in a tensioned state.

**[0036]** Therefore, with the action of the first tensioning cylinder 15, the installation and removal of the upper steel belt 11 and the roller press pattern member 41 are automated, achieving convenience in handling the upper steel belt 11 and the roller press pattern member 41. Simultaneously, the upper steel belt 11 is maintained at an optimal tension force. Furthermore, the roller press pattern member 41 is ensured to abut against the upper steel belt 11 evenly and stably, preventing slipping between the upper steel belt 11 and the roller press pattern member 41 during the rolling process, thereby effectively ensuring the quality of the finished textured ceramic slab blank.

**[0037]** Additionally, the aforementioned lower power roller assembly comprises a second driving roller 23, a second driven roller 24, and a second tensioning cylinder 25. The lower forming press roller 22 is disposed between the second driving roller 23 and the second driven roller 24. A movable telescoping end of the second tensioning cylinder 25 is connected to the second driven roller 24. The second tensioning cylinder 25 may be an air cylinder,

may also be a hydraulic cylinder, or may also be an electric cylinder.

**[0038]** Thus, assuming the roller press pattern member 41 is assembled on the lower steel belt 21. During the installation and removal of the lower steel belt 21 and the roller press pattern member 41, the second tensioning cylinder 25 may be controlled to be in a compressed state, causing the lower steel belt 21 and the lower power roller assembly, as well as the lower steel belt 21 and the roller press pattern member 41, to be in a slack state. This facilitates assembling the lower steel belt 21 and the roller press pattern member 41 onto the lower power roller assembly, or facilitates removing the lower steel belt 21 and the roller press pattern member 41 from the lower power roller assembly. When the lower steel belt 21 and the roller press pattern member 41 are placed on the lower power roller assembly, the second tensioning cylinder 25 may be controlled to be in an extended state until the lower steel belt 21 and the roller press pattern member 41 are in a tensioned state.

**[0039]** Therefore, with the action of the second tensioning cylinder 25, the installation and removal of the lower steel belt 21 and the roller press pattern member 41 are automated, achieving convenience in handling the lower steel belt 21 and the roller press pattern member 41. Simultaneously, the lower steel belt 21 is maintained at an optimal tension force. Furthermore, the roller press pattern member 41 is ensured to abut against the lower steel belt 21 evenly and stably, preventing slipping between the lower steel belt 21 and the roller press pattern member 41 during the rolling process, thereby effectively ensuring the quality of the finished textured ceramic slab blank.

**[0040]** Of course, in addition to preventing slipping of the roller press pattern member 41 through the first tensioning cylinder 15 and the second tensioning cylinder 25, an anti-slip layer, such as a paint layer or an adhesive coating layer, may be formed on the surfaces of the upper steel belt 11 and the lower steel belt 21. Furthermore, the applicant also provides another preferred solution:

in response to the roller press pattern member 41 being assembled on the upper steel belt 11, a perimeter of the roller press pattern member 41 is shorter than a perimeter of the upper steel belt 11 by 0% to 10%; or,

in response to the roller press pattern member 41 being assembled on the lower steel belt 21, a perimeter of the roller press pattern member 41 is shorter than a perimeter of the lower steel belt 21 by 0% to 10%.

**[0041]** Thus, in response to the perimeter of the roller press pattern member 41 being equal to the perimeter of the upper steel belt 11 or the lower steel belt 21, since the roller press pattern member 41 is wound around the outer side of the upper steel belt 11 and/or the lower steel belt 21, the roller press pattern member 41 will also be in a

stretched and deformed state when the upper steel belt 11 and/or the lower steel belt 21 is in a tensioned state. At this time, the roller press pattern member 41 will abut and tightly adhere to the upper steel belt 11 and/or the lower steel belt 21. That is, cooperating with the first tensioning cylinder 15 and the second tensioning cylinder 25, the frictional force between the roller press pattern member 41 and the upper steel belt 11, and between the roller press pattern member 41 and the lower steel belt 21 is effectively increased, thereby effectively preventing slipping between the upper steel belt 11 and/or the lower steel belt 21 and the roller press pattern member 41 during the rolling process.

**[0042]** Furthermore, in response to the roller press pattern member 41 being assembled on the upper steel belt 11, the perimeter of the roller press pattern member 41 may also be shorter than the perimeter of the upper steel belt 11 by 0% to 10%. Within the range of 0% to 10%, the pressing force between the upper steel belt 11 and the roller press pattern member 41 can be effectively increased, thereby increasing the frictional force between the upper steel belt 11 and the roller press pattern member 41. This can very effectively prevent slipping between the upper steel belt 11 and the roller press pattern member 41 during the rolling process. However, in response to the perimeter of the roller press pattern member 41 being longer than the perimeter of the upper steel belt 11, the frictional force between the upper steel belt 11 and the roller press pattern member 41 is insufficient, and slipping is likely to occur during the rolling process, thereby affecting the pattern effect. In response to the perimeter of the roller press pattern member 41 being shorter than the perimeter of the upper steel belt 11 by a length exceeding 10%, the roller press pattern member 41 is prone to over-stretching, leading to cracking or breaking problems when the upper steel belt 11 is in a tensioned state.

**[0043]** Similarly, in response to the roller press pattern member 41 being assembled on the lower steel belt 21, the perimeter of the roller press pattern member 41 may also be shorter than the perimeter of the lower steel belt 21 by 0% to 10%. Within the range of 0% to 10%, the frictional force between the lower steel belt 21 and the roller press pattern member 41 can be effectively increased, which can very effectively prevent slipping between the lower steel belt 21 and the roller press pattern member 41 during the rolling process. However, in response to the perimeter of the roller press pattern member 41 being longer than the perimeter of the lower steel belt 21, the frictional force between the lower steel belt 21 and the roller press pattern member 41 is insufficient, and slipping is likely to occur during the rolling process, thereby affecting the pattern effect. In response to the perimeter of the roller press pattern member 41 being shorter than the perimeter of the lower steel belt 21 by a length exceeding 10%, the roller press pattern member 41 is prone to over-stretching, leading to cracking or breaking problems when the lower steel belt 21 is in a tensioned

state.

**[0044]** As a preferred implementation of the present embodiment, specifically referring to FIG. 1, FIG. 2, and FIG. 5, the roller press forming apparatus further includes a cleaning device 7, configured to remove ceramic powder material 5 remaining on the surface of the roller press pattern member 41. Specifically, the cleaning device 7 may be a cleaning brush assembly. The cleaning brush assembly is fixed, and the relative movement between the cleaning brush assembly and the roller press pattern member 41 achieves the purpose of cleaning the surface of the roller press pattern member 41. The cleaning device 7 may also be a power motor equipped with a cleaning brush. By providing a power source through the power motor to drive the cleaning brush to perform rotational motion, the purpose of cleaning the surface of the roller press pattern member 41 may also be achieved.

**[0045]** It should be noted that the number of the cleaning device 7 may be one. Of course, the number of the cleaning device 7 may also be two, three, four, five, etc. Furthermore, the installation position of the cleaning device 7 may be adjusted according to the structure of the roller press forming apparatus and the structure of the cleaning device 7, and is not limited to the position shown in the figures.

**[0046]** As a preferred implementation of the present embodiment, specifically referring to FIG. 1, FIG. 2, and FIG. 5, the upper steel belt 11 between the upper forming press roller 12 and the first driven roller 14 forms a feed guiding section, the lower steel belt 21 between the lower forming press roller 22 and the second driven roller 24 forms a feed conveying section, and the feed guiding section is arranged obliquely relative to the feed conveying section.

**[0047]** Thus, during the process where the ceramic powder material 5 is conveyed toward the embossing channel 3 driven by the lower pressing roller assembly 2, since the feed guiding section is inclined, i.e., an angle is formed between the feed guiding section and the feed conveying section, the gap between the feed guiding section and the feed conveying section gradually narrows and the height gradually decreases. Then, when the ceramic powder material 5 enters the gap between the feed guiding section and the feed conveying section, it is squeezed by the feed guiding section. The upper layer of ceramic powder material 5 is gradually pressed into the lower layer of ceramic powder material 5, discharging part of the gas between the ceramic powder material 5, and then the ceramic powder material 5 is pressed over a longer distance with a smaller height difference. Simultaneously, the roller press pattern member 41 will contact and preliminarily press the ceramic powder material 5, which then enters the embossing channel 3. After further compression and crushing by the upper forming press roller 12 and the lower forming press roller 22, it is formed into a textured ceramic slab blank.

## Embodiment 2

**[0048]** The roller press forming apparatus for ceramic textures disclosed in the embodiment 1 achieves the purpose of forming embossment on the ceramic slab blank without changing or only slightly adjusting the process parameters for roller press forming ceramic slab blanks. Moreover, the roller press pattern member 41 may be flexibly and conveniently replaced according to design and requirements, improving production efficiency.

**[0049]** Since ceramic powder material 5 scatters from the device/apparatus during transportation and the rolling process, the applicant adopts an edge baffle assembly in the existing roller press forming device, and utilizes the inclined surface of the edge baffle assembly to abut and fit against the end surface of the compaction section, thereby preventing side leakage of the powder material. During long-term production or testing, it has been found that when the existing edge baffle assembly fits with the compaction section, since the existing edge baffle assembly is stationary, the compaction belt will generate friction and wear with the existing edge baffle assembly during movement. Furthermore, both the existing edge baffle assembly and the compaction belt will generate vibration during the rolling process.

**[0050]** In view of the above problems, the applicant also provides a preferred implementation. Specifically, referring to FIG. 2 and FIG. 4, the roller press pattern member 41 is provided with a side constraint member 6. The side constraint member 6 extends along the length direction of the roller press pattern member 41, and the side constraint member 6 is wound around the upper surface of the roller press pattern member 41. Thus, by utilizing the blocking of the side constraint member 6, the ceramic powder material 5 is prevented from scattering sideways from the roller press pattern member 41 during transportation. The side constraint member 6 is preferably configured as two, and the two side constraint members 6 are arranged opposite to each other. Then, the ceramic powder material 5 is well constrained between the two side constraint members 6, thereby effectively conveying the ceramic powder material 5 into the embossing channel 3 for compaction and embossing treatment.

**[0051]** The core of this embodiment lies in that the side constraint member 6 possesses elastic properties, enabling the side constraint member 6 to be compressed and deformed when passing through the embossing channel 3. Thus, when the side constraint member 6 moves to the embossing channel 3 along with the roller press pattern member 41, the upper steel belt 11 of the upper pressing roller assembly 1 abuts and fits against the side constraint member 6. When the upper steel belt 11 compresses the side constraint member 6, the side constraint member 6 will deform for self-adjustment, thereby avoiding damage to the side constraint member 6. Its unexpected effects include the following:

1. Since the ceramic powder is compacted and embossed when passing through the embossing channel 3, the upper steel belt 11, the roller press pattern member 41, and the side constraint member 6 are relatively stationary to each other. In this way, friction or wear will not occur between the side constraint member 6 and the upper steel belt 11, and the problem of vibration between the side constraint member 6 and the upper steel belt 11 is also avoided.

2. Under the action of the side constraint member 6, the ceramic powder may generate a lateral constraint force on the ceramic slab blank during the forming process of the ceramic slab blank, resulting in better forming quality of the ceramic slab blank. That is, the ceramic powder expands toward both sides of the roller press pattern member 41 during the compression process by the upper pressing roller assembly 1 and the lower pressing roller assembly 2. At this time, constrained by the side constraint member 6, collapse will not occur, and uncompact powder will not scatter from the ceramic powder.

3. Since the lateral constraint member 6 passes through the embossing channel 3 along with the roller press pattern member 41, the ceramic slab blank still receives the lateral constraint force from the lateral constraint member 6 when passing through the embossing channel 3. In this way, the lateral constraint member 6 and the roller press pattern member 41 cooperate with each other, effectively ensuring that the ceramic slab blank is shaped and stabilized within the embossing channel 3, thereby further improving the quality of the ceramic slab blank. Simultaneously, it also prevents uncompact ceramic powder from scattering out of the embossing channel 3, polluting the roller press forming apparatus.

4. The tension force provided by the lower pressing roller assembly 2 is cleverly utilized, enabling the lateral constraint member 6 to be stably fixed onto the roller press pattern member 41. Compared to the existing edge baffle assembly, this is simpler, more convenient for production, manufacturing, and assembly, and effectively reduces production costs.

**[0052]** As a preferred implementation of the present embodiment, the roller press pattern member 41 is provided with the lateral constraint member 6 on both opposite sides in the conveying direction. The roller press pattern member 41 is provided with a positioning protrusion, and the lateral constraint member 6 is provided with an adjustment slot configured to engage the positioning protrusion. In this way, the cooperation between the positioning protrusion and the adjustment slot may enhance the lateral load-bearing capacity of the lateral constraint member 6.

**[0053]** It is configured with a plurality of adjustment slots. The plurality of adjustment slots are spaced apart along the width direction of the lateral constraint member

6. Then, by engaging the positioning protrusion with different adjustment slots, the purpose of adjusting the spacing between the two lateral constraint members 6 may be achieved through the cooperation of the positioning protrusion and the adjustment slots.

**[0054]** It should be noted that the aforementioned positioning protrusion may be disposed on the lateral constraint member 6, and the adjustment slot can be correspondingly disposed on the roller press pattern member 41. This may also achieve the purpose of enhancing the lateral load-bearing capacity of the lateral constraint member 6.

**[0055]** As another preferred implementation of the present embodiment, the roller press pattern member 41 and the lateral constraint member 6 are formed in a single piece. In this way, the connection strength between the roller press pattern member 41 and the lateral constraint member 6 may be ensured, thereby providing optimal lateral constraint force on the ceramic slab blank. Furthermore, there is no need for additional assembly of the lateral constraint member 6, thus simplifying the assembly process of the roller press forming apparatus. When it is necessary to change the spacing between the two lateral constraint members 6, it is only required to disassemble the roller press pattern member 41 and then assemble a roller press pattern member 41 that meets the spacing requirement between the two lateral constraint members 6. The replacement is also quite simple and efficient, effectively ensuring production efficiency.

### Embodiment 3

**[0056]** Based on the roller press forming apparatus for ceramic textures disclosed in the embodiment 1 and the embodiment 2, the applicant also discloses a roller press forming method. Before the roller press process, the roller press pattern member 41 should be assembled onto the upper steel belt 11 of the upper pressing roller assembly 1 and/or the lower steel belt 21 of the lower pressing roller assembly 2. As shown in FIG. 1, taking the assembly of the roller press pattern member 41 onto the lower steel belt 21 of the lower pressing roller assembly 2 as an example, control the second tensioning cylinder 25 to contract, so that the lower steel belt 21 of the lower pressing roller assembly 2 is in a relaxed state. Then, sleeve the roller press pattern member 41 with a selected interval specification (the spacing dimension between the two lateral constraint members 6) onto the lower steel belt 21 of the lower pressing roller assembly 2. Next, control the second tensioning cylinder 25 to push until the lower steel belt 21 is in a tensioned state, and the roller press pattern member 41 abuts tightly against the lower steel belt 21. Subsequently, the roller press process begins, including the following steps:

Step 1: Convey the ceramic powder material 5 to the lower pressing roller assembly 2 quantitatively. Specifically, a hopper may be used for quantitative feed-

ing. That is, fill the hopper with powder material, adjust the hopper according to the thickness of the brick blank to be formed, and control the hopper to allow the powder material to fall onto the roller press pattern member 41 on the lower pressing roller assembly 2.

Step 2: Convey the ceramic powder material 5 along the conveying direction to the embossing channel 3. Specifically, the ceramic powder material 5 is transported together with the roller press pattern member 41 toward the direction of the embossing channel 3. When the ceramic powder material 5 enters the gap between the feed guiding section and the feed conveying section, part of the gas inside the ceramic powder material 5 is discharged, and the roller press pattern member 41 will contact and preliminarily press the ceramic powder material 5.

Step 3: Compact and emboss the ceramic powder material 5 into a textured ceramic slab blank through a combined action of the upper pressing roller assembly 1, the lower pressing roller assembly 2, and the roller press pattern member 41, .

**[0057]** In this step 3, through the force jointly applied by the upper forming press roller 12 of the upper pressing roller assembly 1 and the lower forming press roller 22 of the lower pressing roller assembly 2, not only is the effect of crushing and press-forming the ceramic slab blank achieved, but also the roller press pattern member 41 embosses textures on the surface of the ceramic slab blank. Moreover, during the process where the ceramic slab blank passes through the embossing channel 3, with the cooperation of the roller press pattern member 41 and the lateral constraint member 6, the ceramic slab blank is shaped and stabilized, allowing the internal gas and internal stress of the ceramic slab blank to gradually release, thereby improving the quality of the ceramic slab blank.

**[0058]** The technical means disclosed in the solution of the present application are not limited to those disclosed in the embodiments mentioned above but also include technical solutions consisting of any combination of the above technical features. It should be noted that for those skilled in the art, multiple improvements and modifications may be made without departing from the principles of the present application. These improvements and modifications are also considered to be within the scope of protection of the present application.

## Claims

1. A roller press forming apparatus for ceramic textures, comprising:

an upper pressing roller assembly (1);  
a lower pressing roller assembly (2), the upper pressing roller assembly (1) and the lower

pressing roller assembly (2) being arranged opposite to each other, and an embossing channel (3) being formed at an interval between the upper pressing roller assembly (1) and the lower pressing roller assembly (2), an upper steel belt (11) of the upper pressing roller assembly (1) and/or a lower steel belt (21) of the lower pressing roller assembly (2) being wound with a roller press pattern member (41) having elastic properties, a surface of the roller press pattern member (41) being provided with embossing protrusions;

the roller press pattern member (41) being configured for roller press forming a textured ceramic slab blank from ceramic powder material (5) during a process of the ceramic powder material (5) passing through the embossing channel (3) along a conveying direction.

2. The roller press forming apparatus for ceramic textures according to claim 1, wherein a perimeter of the roller press pattern member (41) is shorter than a perimeter of the upper steel belt (11) by 0% to 10%, or, a perimeter of the roller press pattern member (41) is shorter than a perimeter of the lower steel belt (21) by 0% to 10%.
3. The roller press forming apparatus for ceramic textures according to claim 1 or 2, wherein the upper pressing roller assembly (1) comprises an upper forming press roller (12) and an upper power roller assembly, the upper forming press roller (12) cooperating with the upper power roller assembly to tension the upper steel belt (11); the lower pressing roller assembly (2) comprises a lower forming press roller (22) and a lower power roller assembly, the lower forming press roller (22) cooperating with the lower power roller assembly to tension the lower steel belt (21), the upper forming press roller (12) and the lower forming press roller (22) being arranged opposite to each other.
4. The roller press forming apparatus for ceramic textures according to claim 3, wherein the upper power roller assembly comprises a first driving roller (13), a first driven roller (14) and a first tensioning cylinder (15), the upper forming press roller (12) is disposed between the first driving roller (13) and the first driven roller (14), a movable telescoping end of the first tensioning cylinder (15) is connected to the first driven roller (14); the lower power roller assembly comprises a second driving roller (23), a second driven roller (24) and a second tensioning cylinder (25), the lower forming press roller (22) is disposed between the second driving roller (23) and the second driven roller (24), a movable telescoping end of the second tensioning cylinder (25) is connected to the second driven roller

(24).

5. The roller press forming apparatus for ceramic textures according to claim 1 or 2, wherein a lateral constraint member (6) is disposed on the roller press pattern member (41), the lateral constraint member (6) extends along a length direction of the roller press pattern member (41), the lateral constraint member (6) has elastic properties, enabling the lateral constraint member (6) to be compressed and deformed when passing through the embossing channel (3). 5 10
6. The roller press forming apparatus for ceramic textures according to claim 5, wherein the roller press pattern member (41) is provided with the lateral constraint member (6) on both opposite sides in the conveying direction, one of the roller press pattern member (41) and the lateral constraint member (6) is provided with a positioning protrusion, the other of the roller press pattern member (41) and the lateral constraint member (6) is provided with an adjustment slot configured to engage the positioning protrusion, the positioning protrusion and the adjustment slot cooperate to adjust a spacing between the two lateral constraint members (6). 15 20 25
7. The roller press forming apparatus for ceramic textures according to claim 5, wherein the roller press pattern member (41) and the lateral constraint member (6) are formed in a single piece. 30
8. The roller press forming apparatus for ceramic textures according to claim 1 or 2 or 6 or 7, further comprising a cleaning device (7), configured to remove ceramic powder material (5) remaining on a surface of the roller press pattern member (41). 35
9. The roller press forming apparatus for ceramic textures according to claim 4, wherein the upper steel belt (11) between the upper forming press roller (12) and the first driven roller (14) forms a feed guiding section, the lower steel belt (21) between the lower forming press roller (22) and the second driven roller (24) forms a feed conveying section, and the feed guiding section is arranged obliquely relative to the feed conveying section. 40 45
10. A roller press forming method, applied to the roller press forming apparatus according to any one of claims 1 to 9, comprising the following steps: 50
  - step1, conveying ceramic powder material (5) to the lower pressing roller assembly (2) quantitatively;
  - step2, conveying the ceramic powder material (5) along a conveying direction to the embossing channel (3); and
  - step3, compacting and embossing the ceramic

powder material (5) into a textured ceramic slab blank through a combined action of the upper pressing roller assembly (1), the lower pressing roller assembly (2), and the roller press pattern member (41).

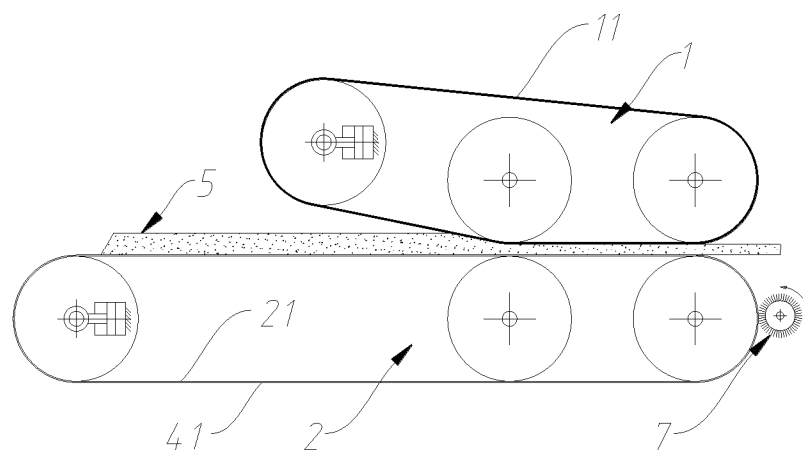


FIG. 1

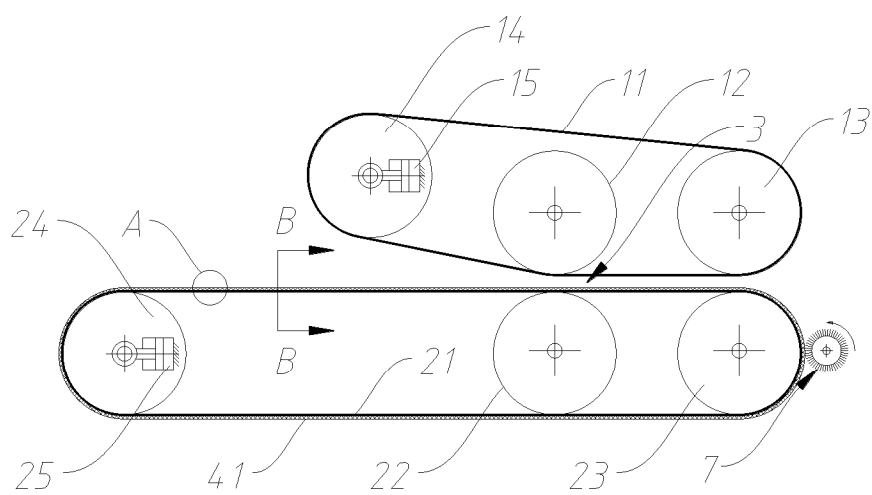


FIG. 2

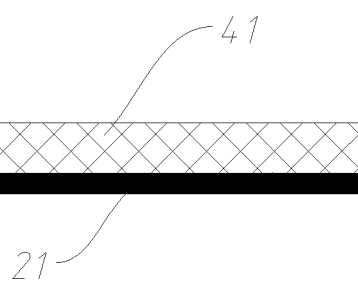


FIG. 3

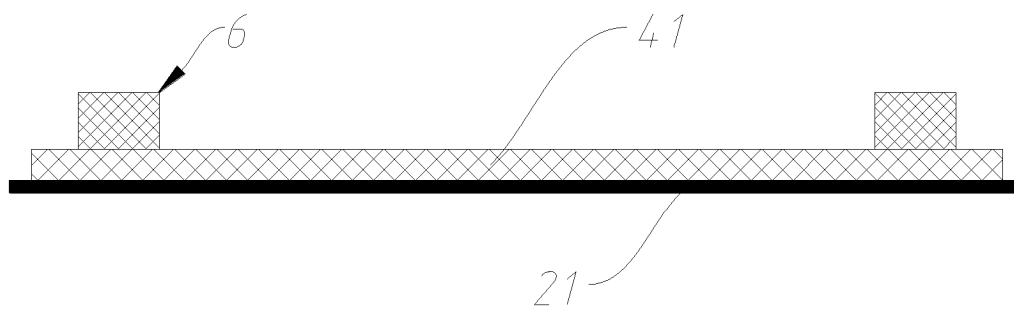


FIG. 4

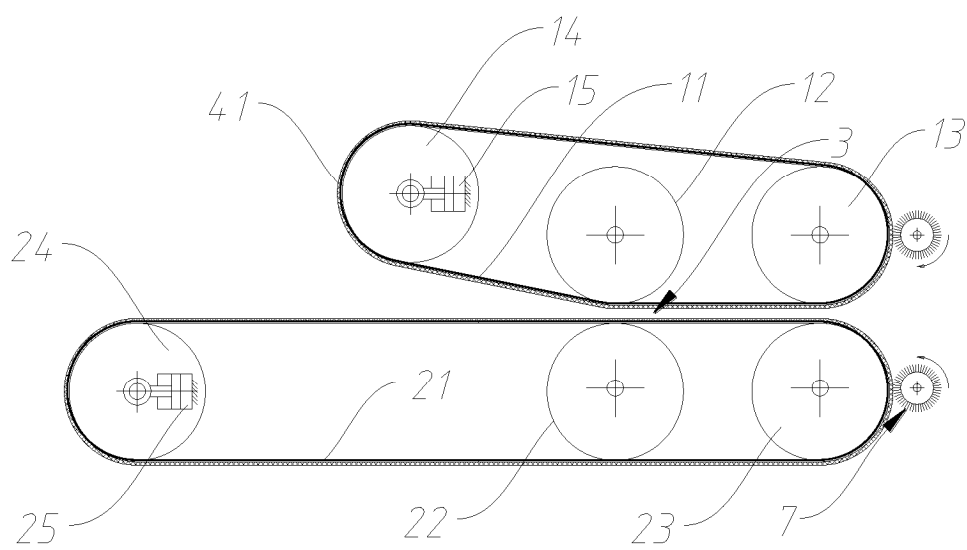


FIG. 5

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/071519

## A. CLASSIFICATION OF SUBJECT MATTER

B28B3/12(2006.01)i; B28B7/00(2006.01)i; B28B7/38(2006.01)i; B28B17/00(2006.01)i

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)

B28B

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)

CNTXT: CNKI; ENTXT; ENTXTC; VEN: 挡边, 约束, 皮带, 钢带, 传送带, 传输带, 压花, 纹理, 纹路, 凸起, 花纹, line?, emboss+, textur+, bulg+, sip+, retaining w side, barrier w strip?

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                     | Relevant to claim No. |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| PX        | CN 117103426 A (FOSHAN HENGLITAI MACHINERY CO., LTD.) 24 November 2023 (2023-11-24)<br>claims 1-10                                     | 1-10                  |
| X         | CN 109227891 A (KEDA CLEAN ENERGY CO., LTD.) 18 January 2019 (2019-01-18)<br>description, pages 3-4, and figures 1-2                   | 1-4, 9, 10            |
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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| "P" document published prior to the international filing date but later than the priority date claimed                                                                  |                                                                                                                                                                                                                                                  |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Date of the actual completion of the international search<br><b>23 May 2024</b>                                                                                                                | Date of mailing of the international search report<br><b>12 June 2024</b> |
| Name and mailing address of the ISA/CN<br><b>China National Intellectual Property Administration (ISA/CN)<br/>China No. 6, Xitucheng Road, Jimenqiao, Haidian District,<br/>Beijing 100088</b> | Authorized officer<br><br><br>Telephone No.                               |

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/CN2024/071519**

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| 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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| A                                      | CN 202156721 U (DALIAN TIANLU MECHANICAL AND ELECTRICAL<br>EQUIPMENTMANUFACTURING CO., LTD.) 07 March 2012 (2012-03-07)<br>entire document | 1-10                  |
| A                                      | KR 19980052350 A (우덕창) 25 September 1998 (1998-09-25)<br>entire document                                                                   | 1-10                  |

## INTERNATIONAL SEARCH REPORT

### Information on patent family members

International application No.

**PCT/CN2024/071519**

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|----------------------------------------|--------------|----|-----------------------------------|-------------------------|--------------|----|-----------------------------------|
| CN                                     | 117103426    | A  | 24 November 2023                  | None                    |              |    |                                   |
| CN                                     | 109227891    | A  | 18 January 2019                   | WO                      | 2020082836   | A1 | 30 April 2020                     |
|                                        |              |    |                                   | CN                      | 209812642    | U  | 20 December 2019                  |
| CN                                     | 204450807    | U  | 08 July 2015                      | None                    |              |    |                                   |
| CN                                     | 113634313    | A  | 12 November 2021                  | WO                      | 2023019938   | A1 | 23 February 2023                  |
|                                        |              |    |                                   | IN                      | 202317023185 | A  | 24 November 2023                  |
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| DE                                     | 102016114933 | A1 | 15 February 2018                  | None                    |              |    |                                   |
| CN                                     | 202156721    | U  | 07 March 2012                     | None                    |              |    |                                   |
| KR                                     | 19980052350  | A  | 25 September 1998                 | None                    |              |    |                                   |

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- CN 115922879 A [0003]