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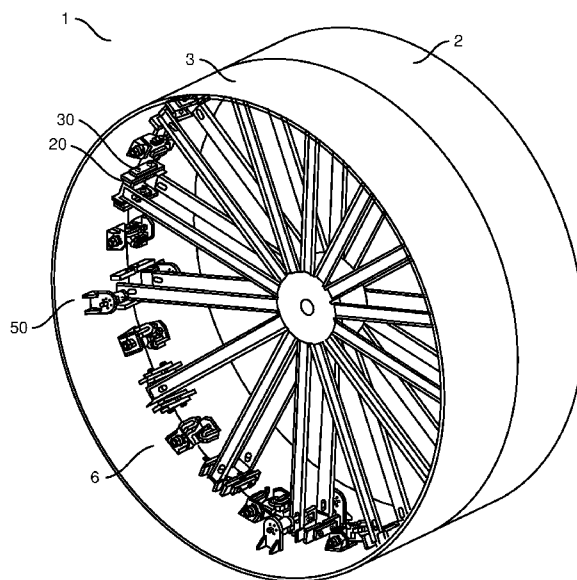


FIG. 8

(57) Abstract: A system for radially and axially aligning a new kiln shell section with an existing kiln shell section during a kiln shell section replacement or kiln erection process comprising: a tensioning device comprising a first alignment bracket on the new kiln shell section and a second alignment bracket on the existing kiln shell section, the alignment brackets being between stiffener braces on the kiln shell sections; a radial adjustment lug disposed on the first or second alignment brackets; and an axial stud connected to the first and second alignment brackets. Also provided is a method for radially and axially aligning a new kiln shell section with an existing kiln shell section during the kiln shell section replacement or kiln erection process.

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SYSTEM AND METHOD FOR ALIGNING KILN SHELL SECTIONS

FIELD OF THE INVENTION

- 5 The present invention generally relates to a system and a method for replacing kiln shell sections used in e.g. rotary kilns in the cement and minerals industries, and more particularly to a system and a method for radially and axially aligning kiln shell sections during the kiln shell section replacement process or during kiln erection.

10 BACKGROUND OF THE INVENTION

- Rotary kilns are mainly used in the cement and mineral processing industries. During use and over time kilns shells are prone to e.g. heavy wear, damage and corrosion. Continuing to operate a rotary kiln with a worn, damaged or corroded kiln shell may result in e.g.
- 15 excessive unscheduled downtimes, increased refractory costs, or catastrophic kiln shell failure causing site personnel injury or collateral damage to surrounding equipment. Therefore, when kiln shell sections become worn, damaged or corroded they are required to be replaced. The process of replacing a worn kiln shell section with a new kiln shell section is generally referred to as "kiln shell section replacement."

- 20 It is critical during kiln shell section replacement that the new kiln shell section be both radially and axially aligned with the existing kiln shell section. In order to perform the kiln shell section replacement, the kiln is required to be shut down. Existing kiln shell section replacement (and kiln erection) processes involve substantial planning, complicated
- 25 alignment procedures and substantial welding work resulting in e.g. increased kiln down time, alignment errors and decreased productivity and throughput.

OBJECT OF THE INVENTION

- 30 It is an object of the invention to overcome or at least alleviate one or more of the above problems and/or provide the consumer with a useful or commercial choice.

SUMMARY OF THE INVENTION

A system is provided for radially and axially aligning a new kiln shell section with an existing kiln shell section during a kiln shell section replacement or kiln erection process.

- 5 The system may include a tensioning device comprising: a first alignment bracket disposed on an inner surface of the new kiln shell section between stiffener braces on the new kiln shell section and a second alignment bracket disposed on an inner surface of the existing kiln shell section between stiffener braces on the existing kiln shell section such that the first and second alignment brackets are substantially aligned; a radial adjustment lug
10 disposed on the first or second alignment brackets for performing radial alignment of the new and existing kiln shell sections; and an axial stud connected to the first and second alignment brackets for performing axial alignment of the new and existing kiln shell sections. In some embodiments, the system may further comprise: a first strong back plate disposed on the stiffener brace on the new kiln shell section; a second strong back plate
15 connected to the first strong back plate for enabling torque transfer during rotation of the kiln shell sections for welding; wherein the second strong back plate extends from the inner surface of the new kiln shell section to the inner surface of the existing kiln shell section. In some embodiments, the system may further comprise further comprising a first strong back plate disposed on the stiffener brace on the existing kiln shell section and a radial
20 adjustment lug disposed on the first strong back plate disposed on the stiffener brace on the existing kiln shell section for further assisting with performing radial alignment of the new and existing kiln shell sections. In some embodiments, the second strong back plate may be indirectly connected to the first strong back plate disposed on the stiffener brace on the new kiln shell section. In some embodiments, the system may further comprise a wedge
25 plate sandwiched between the first strong back plate and the second strong back plate. In some embodiments, the system may further comprise a hydraulic fastening device for further axially aligning the new kiln shell section with the existing kiln shell section comprising: a hydraulic cylinder mounting bracket disposed on the inner surface of the existing kiln shell section and a stud mounting bracket disposed on the inner surface of the
30 new kiln shell section such that the mounting brackets are substantially aligned; a hydraulic cylinder disposed on the hydraulic cylinder mounting bracket; and a stud disposed on or through the stud mounting bracket; wherein the stud extends through bores in the stiffener braces of the existing and new kiln shell sections and wherein the stud is integrally

connected to the hydraulic cylinder. In some embodiments, the hydraulic cylinder may be a push-pull hydraulic cylinder. In some embodiments, the tensioning device may be disposed between each of the stiffener braces. In some embodiments, the hydraulic fastening device may be disposed on the stiffener braces, which approximately correspond to the 2, 6 and 12 positions. In some embodiments, the first or second alignment brackets may be comprised of: a first bottom plate laterally disposed on the inner surface of the new kiln shell; a second bottom plate laterally disposed on the inner surface of the existing kiln shell; a first back plate disposed on the first bottom plate, the first back plate being located substantially perpendicular to the first bottom plate; a second back plate disposed on the second bottom plate, the second back plate being located substantially perpendicular to the second bottom plate; one or more side members disposed on the first or second bottom plates, the one or more side members being located at approximately 90 degree angles from the first or second back plates; wherein one or more of the radial adjustment lugs are disposed on the one or more side members; and wherein the axial stud is connected to or through the first back plate and the second back plate. In some embodiments, the radial adjustment lugs may be connected to the one or more side members via pins or rods. In some embodiments, the radial adjustment lugs may further comprise a locking means for locking the radial adjustment lugs into place on the first or second bottom plates inside the one or more side members.

In some embodiments of the system, the system may further comprise a first strong back plate disposed on the new kiln shell section; a first strong back plate disposed on the existing kiln shell section; a second strong back plate connected to the first strong back plate on the new and existing kiln shell sections for enabling torque transfer during rotation of the kiln shell sections for welding; wherein the second strong back plate extends from the inner surface of the new kiln shell section to the inner surface of the existing kiln shell section. In some embodiments, the system may further comprise a hydraulic cylinder mounting bracket disposed on the inner surface of the existing kiln shell section and a stud mounting bracket disposed on the inner surface of the new kiln shell section such that the mounting brackets are substantially aligned; a hydraulic cylinder disposed on the hydraulic cylinder mounting bracket; and a stud disposed on or through the stud mounting bracket; wherein the stud extends through bores in the stiffener braces of the existing and new kiln shell sections and wherein the stud is integrally connected to the hydraulic cylinder. In

some embodiments, the hydraulic cylinder may be a push-pull hydraulic cylinder. In some embodiments, the tensioning device may be disposed between each of the stiffener braces. In some embodiments, the hydraulic fastening device may be disposed on the stiffener braces which approximately correspond to the 2, 6 and 12 positions. In some embodiments, the first or second alignment brackets may be comprised of: a first bottom plate laterally disposed on the inner surface of the new kiln shell; a second bottom plate laterally disposed on the inner surface of the existing kiln shell; a first back plate disposed on the first bottom plate, the first back plate being located substantially perpendicular to the first bottom plate; a second back plate disposed on the second bottom plate, the second back plate being located substantially perpendicular to the second bottom plate; one or more side members disposed on the first or second bottom plates, the one or more side members being located at approximately 90 degree angles from the first or second back plates; wherein one or more of the radial adjustment lugs are disposed on the one or more side members; and wherein the axial stud is connected to or through the first back plate and the second back plate. In some embodiments, the radial adjustment lugs may be connected to the one or more side members via pins or rods. In some embodiments, the radial adjustment lugs may further comprise a locking means for locking the radial adjustment lugs into place on the first or second bottom plates inside the one or more side members.

A method is also provided for radially and axially aligning a new kiln shell section with an existing kiln shell section during a kiln shell section replacement or kiln erection process. The method may include, providing the tensioning device described herein and adjusting the radial adjustment lug such that the new kiln shell section is substantially radially aligned with the existing kiln shell section and adjusting the axial stud such that the new kiln shell section is substantially axially aligned with the existing kiln shell section. The method may further include welding the new kiln shell section to the existing kiln shell section along the intersection of the new and existing kiln shell sections.

The method may further include attaching a first strong back plate on the stiffener brace on the new kiln shell section and attaching a second strong back plate to the first strong back plate such that the second strong back plate extends from the inner surface of the new kiln shell section to the inner surface of the existing kiln shell section. The method may further include welding the second strong back plate to the inner surface of the new and existing

kiln shell sections. The method may further include attaching a first strong back plate on the stiffener brace on the existing kiln shell section and attaching a radial adjustment lug on the first strong back plate for further assisting with performing radial alignment of the new and existing kiln shell sections and adjusting the radial adjustment lug such that the new kiln shell section is substantially radially aligned with the existing kiln shell section. The method may further include providing a hydraulic fastening device, as further described herein, and adjusting the hydraulic fastening device such that that the new kiln shell section is further substantially axially aligned with the existing kiln shell section.

The method may further include attaching a first strong back plate on or near the stiffener brace on the new kiln shell section; attaching a first strong back plate on or near the stiffener brace on the existing kiln shell section; and attaching a second strong back plate to the first strong back plates such that the second strong back plate extends from the inner surface of the new kiln shell section to the inner surface of the existing kiln shell section. The method may further include welding the second strong back plate to the inner surface of the new and existing kiln shell sections. The method may further include providing a hydraulic fastening device, as further described herein, and adjusting the hydraulic fastening device such that that the new kiln shell section is further substantially axially aligned with the existing kiln shell section.

Other details, objects, and advantages of the invention will become apparent as the following description of certain present exemplary embodiments thereof and certain present exemplary methods of practicing the same proceeds.

BRIEF DESCRIPTION OF THE FIGURES

Embodiments of the invention, by way of example only, will be described with reference to the accompanying drawings in which:

Figure 1 shows an overview of an exemplary embodiment of the new kiln shell section with the first alignment bracket and first strong back plate.

Figure 2 shows a close-up view of an exemplary embodiment of the new kiln shell section with the first alignment bracket and first strong back plate.

Figure 3 shows an overview of an exemplary embodiment of the new kiln shell section with the first alignment bracket, radial adjustment lug and first strong back plate.

Figure 4 shows a close-up view of an exemplary embodiment of the new kiln shell section with the first alignment bracket, radial adjustment lug and first strong back plate.

5 Figure 5 shows an overview of an exemplary embodiment of the system for radially and axially aligning a new kiln shell section with an existing kiln shell section during a kiln shell section replacement or kiln erection process.

Figures 6A-6C shows close-up views of an exemplary embodiment of the tensioning device.

10 Figure 7 shows a close-up view of exemplary embodiments of e.g. the tensioning device, the first and second strong back plates, the wedge plate and the hydraulic fastening device.

Figure 8 shows an overview of an exemplary embodiment of the system for radially and axially aligning a new kiln shell section with an existing kiln shell section during a kiln
15 shell section replacement or kiln erection process.

Figure 9 shows a close-up view of another exemplary embodiment of e.g. the tensioning device, the first and second strong back plates and the hydraulic fastening device.

20 DETAILED DESCRIPTION OF THE INVENTION

Figures 1-4 depict an exemplary embodiment of a new kiln shell section 2 with stiffeners or stiffener braces 4. It is to be understood herein that the term "new kiln shell section" could also refer to a first kiln shell section 2 during the kiln erection process. Figure 1
25 depicts a first mounting bracket 10a which can be disposed on the internal surface of the new kiln shell section 2, typically between stiffener braces 4. As shown in Figures 3-4 a radial adjustment lug 11 may be disposed on the first mounting bracket 10a. In some embodiments, there can be first back plates 20 connected to the base of the stiffeners 4 on the internal surface of the new kiln shell section. Typically, the first back plates 20 are pre-
30 welded at e.g. a manufacturing shop onto the stiffener braces 4. Like the new kiln shell section 2, the existing kiln shell section 3 also contains stiffeners 4 and second mounting brackets 10b which can be disposed on the internal surface of the existing kiln shell section 2, as shown in e.g. Figures 5 and 6 A-C. It is to be understood herein that the term "existing

kiln shell section" could also refer to a second kiln shell section 2 during the kiln erection process. Disposed on the second mounting bracket 10b is also a radial adjustment lug 11. The first mounting bracket 10a on the new kiln shell section 2 can be substantially aligned, both vertically and horizontally, with the second mounting bracket 10b on the existing kiln shell section 3.

Figures 6A-6C depict an exemplary embodiment of the tensioning device 6. In an exemplary embodiment, the tensioning device 6 includes the mounting brackets 10a, 10b described above, a radial adjustment lug 11 and an axial stud 12. The radial adjustment lug 11 can be disposed on one of the first or second alignment brackets 10a, 10b or both for performing radial alignment of the new and existing kiln shell sections 2, 3. The axial stud 12 may be connected to the first and second alignment brackets 10a, 10b for performing axial alignment of the new and existing kiln shell sections 2, 3. In some embodiments, the tensioning device 6 optionally includes a hydraulic tensioner device 85 for hydraulically tightening or loosening the axial stud 12 in order to perform axial alignment of the new and existing kiln shell sections 2, 3. The axial stud 12 may be disposed through bores in back members 83 of the first and second alignment brackets 10a, 10b and fastened with e.g. nuts and/or washers or the like. The radial adjustment lug 11 may be comprised of a first and second arm 70, 71 and a connection member 72, which connects the first arm 70 to the second arm 71. In some embodiments, the first and second arm 70, 71 and the connection member 72 are integrally formed as one-piece, e.g. by moulding. The radial adjustment lug 11 may contain a locking means 75 on the underside of the connection member 72 e.g. a nub, a projection or a screw, bolt or the like for locking the radial adjustment 11 into place on the first and second alignment brackets 10a, 10b. Each of the alignment brackets 10a, 10b can contain a radial adjustment lug 11 or only one of the alignment brackets 10a, 10b may contain such a lug 11. The radial adjustment lugs are generally connected to the first and/or second alignment brackets 10a, 10b using e.g. a pin or a rod 73 which is disposed through bores in the first and second arms 70, 71 and bores in the alignment brackets 10a, 10b, e.g. in the one or more side members 81, 82. As the axial stud 12 is tightened, the radial adjustment lugs 11 are able to radially align the new and existing kiln shell sections 2, 3. For example, the locking means 75 on the radial adjustment lugs 11 can be disposed in indents on the first or second bottom plates 80 of the first or second alignment brackets 10a, 10b. By way of further example, the radial

adjustment lugs 11 can be radially locked into place between one or more side members 81, 82 of the first and/or second alignment brackets 81, 82.

5 Figures 6A-6C also depict an exemplary embodiment of the first and/or second alignment brackets 10a, 10b. In an exemplary embodiment, the first or second alignment brackets 10a, 10b may have a first bottom plate 80 laterally disposed on the inner surface of the new kiln shell 2 and/or a second bottom plate 80 laterally disposed on the inner surface of the existing kiln shell 3. A first back plate 83 may be disposed on the first bottom plate 80, the first back plate being located substantially perpendicular to the first bottom plate 80. A
10 second back plate 83 may be disposed on the second bottom plate 80, the second back plate being located substantially perpendicular to the second bottom plate 80. One or more side members 81, 82 may be disposed on the first or second bottom plates 80 and the one or more side members 81, 82 may be located at approximately 90 degree angles from the first or second back plates 83. In some embodiments, there are support members 84 which
15 project from the first or second back plates 83 to provide structural support for the back plates 83 disposed on the first or second bottom plates 80.

Figure 7 depicts an exemplary embodiment of the system 1, where the system 1 has a combination of one or more tensioning devices 6, a first strong back plate 20, a second
20 strong back plate 30 or a combination thereof. In an exemplary embodiment, there is a first strong back plate 20 disposed on the stiffener brace 4 on the new kiln shell section 2 and/or a second strong back plate 30 connected to the first strong back plate 20 for enabling torque transfer during rotation of the kiln shell sections for welding. In an exemplary embodiment, the second strong back plate 30 may extend from the inner surface of the new
25 kiln shell section 2 to the inner surface of the existing kiln shell section 3. The second strong back plate 30 may be directly connected to the first strong back plate 20 via e.g. welding or fastening. In other embodiments, the second strong back plate 30 is indirectly connected to the first strong back plate 20 e.g. using a wedge plate 35 sandwiched between the first strong back plate 20 and the second strong back plate 30. Typically, the second
30 strong back plate 30 is welded into place on site by maintenance personnel.

Figure 9 depicts an exemplary embodiment of the system 1, where the system 1 has a combination of one or more tensioning devices 6, first strong back plates 20, a second

strong back plate 30 or a combination thereof. In an exemplary embodiment, there is a first strong back plate 20 disposed on the stiffener brace 4 on the new kiln shell section 2 and another first strong back plate disposed on the stiffener brace 4 on the existing kiln shell section 3 and/or a second strong back plate 30 connected to the first strong back plates 20 for enabling torque transfer during rotation of the kiln shell sections for welding. In an exemplary embodiment, the second strong back plate 30 may extend from the inner surface of the new kiln shell section 2 to the inner surface of the existing kiln shell section 3. The second strong back plate 30 may be directly connected to the first strong back plates 20 via e.g. welding or fastening. In other embodiments, the second strong back plate 30 is indirectly connected to the first strong back plates 20 e.g. using a wedge plate 35 sandwiched between the first strong back plate 20 and the second strong back plate 30. Typically, the second strong back plate 30 is welded into place on site by maintenance personnel.

In some embodiments, as further shown in Figure 7, the system 1, may have another first strong back plate 20 disposed on the stiffener brace 4 on the existing kiln shell section 3 and one or more radial adjustment lugs 11 disposed on the first strong back plate 20 for further assisting with performing radial alignment of the new and existing kiln shell sections 2, 3.

In some embodiments, as further shown in Figures 7 and 9, the system 1, may have a hydraulic fastening device 50 for assisting with axially aligning the new kiln shell section 2 with the existing kiln shell section 3. In one embodiment, a hydraulic cylinder mounting bracket 52 may be disposed on the inner surface of the existing kiln shell section 3 and a stud mounting bracket 54 may be disposed on the inner surface of the new kiln shell section 2 such that the mounting brackets 52, 54 are substantially aligned. The hydraulic cylinder 56 may be disposed on the hydraulic cylinder mounting bracket 52 and a stud 58 may be disposed on or through the stud mounting bracket 54. The stud 58 may extend through bores 60 in the stiffener braces 4 of the existing 3 and new kiln shell sections 2. The stud 58 may be integrally connected to the hydraulic cylinder 56. The hydraulic cylinder 56 may be a push-pull hydraulic cylinder.

As depicted in Figures 5 and 8, in an exemplary embodiment of the system 1, there may be tensioning devices 6 disposed between each and every one of the stiffener braces 4. In another exemplary embodiment of the system 1, there may be hydraulic fastening devices 50 disposed on the stiffener braces 4 which approximately correspond to the 2, 6 and 12 positions, the "positions" corresponding to an hourly clock.

In use, the system 1 integrates both axial and radial alignment into a single device which reduces the time spent on alignment of the new and existing kiln shell sections. When the tensioning device 6 is in use the radial adjustment lug 11 assists with radially aligning the new and existing kiln shells 2, 3 and at the same time the axial stud 12 performs axial alignment of the new and existing kiln shells 2, 3. When the system is in use it makes it much easier for maintenance personnel to apply a weld to the intersection between the new and existing kiln shells 2, 3. By attaching the second strong back plate 30 to the first strong back plate or plates 20 whereby the second strong back plate extends across the intersection from the inner surface of the new kiln shell section 2 to the existing kiln shell section 3, the second strong back plate enables torque transfer during rotation of the kiln shell sections 2, 3 for welding the intersection 90. To further assist with performing radial alignment, radial adjustment lugs 11 can also be used on first strong back plates 20 on the stiffener braces 4 on the existing kiln shell section 3. To further assist with performing axial alignment, the hydraulic fastening device can also be used and connected through bores 60 in the stiffener braces 4.

It is to be understood that the form of this invention as shown is merely a preferred embodiment. Various changes may be made in the function and arrangement of parts; equivalent means may be substituted for those illustrated and described; and certain features may be used independently from others without departing from the spirit and scope of the invention as defined in the following claims.

LIST OF COMPONENTS

- 1 - system
- 2 - new kiln shell section
- 5 3 - existing kiln shell section
- 4 - stiffener brace
- 6- tensioning device
- 10a - first alignment bracket
- 10b - second alignment bracket
- 10 11- radial adjustment lug
- 12 - axial stud
- 20 - first strong back plate
- 30 - second strong back plate
- 35 - wedge plate
- 15 50 - hydraulic fastening device
- 52 - hydraulic cylinder mounting bracket
- 54 - stud mounting bracket
- 56 - hydraulic cylinder
- 58 - stud
- 20 60 - bore
- 70 - first arm
- 71 - second arm
- 72 - connection member
- 73 - pin or rod
- 25 75 - locking means
- 80 - bottom plate
- 81, 82 - side member
- 83 - back member
- 84 - support member
- 30 85 - hydraulic tensioner device
- 90 - intersection

CLAIMS

1. A system (1) for radially and axially aligning a new kiln shell section (2) with an existing kiln shell section (3) during a kiln shell section replacement or kiln erection
5 process comprising:

a tensioning device (6), the tensioning device (6) comprising:

a first alignment bracket (10a) disposed on an inner surface of the new kiln shell section (2) between stiffener braces (4) on the new kiln shell section (2) and a second alignment bracket (10b) disposed on an inner surface of the existing kiln shell section (3)
10 between stiffener braces (4) on the existing kiln shell section (3) such that the first and second alignment brackets (10a, 10b) are substantially aligned;

a radial adjustment lug (11) disposed on the first or second alignment brackets (10a, 10b) for performing radial alignment of the new and existing kiln shell sections (2, 3); and

15 an axial stud (12) connected to the first and second alignment brackets (10a, 10b) for performing axial alignment of the new and existing kiln shell sections (2, 3).

2. The system (1) of claim 1, further comprising:

a first strong back plate (20) disposed on the stiffener brace (4) on the new kiln shell
20 section (2);

a second strong back plate (30) connected to the first strong back plate (20) for enabling torque transfer during rotation of the kiln shell sections for welding;

wherein the second strong back plate (30) extends from the inner surface of the new kiln shell section (2) to the inner surface of the existing kiln shell section (3).

25 3. The system (1) of claim 2, further comprising a first strong back plate (20) disposed on the stiffener brace (4) on the existing kiln shell section (3) and a radial adjustment lug (11) disposed on the first strong back plate (20) disposed on the stiffener brace (4) on the existing kiln shell section (3) for further assisting with performing radial alignment of the
30 new and existing kiln shell sections (2, 3).

4. The system (1) of any one of claims 1-3, further comprising a hydraulic fastening device (50) for further axially aligning the new kiln shell section (2) with the existing kiln shell section (3) comprising:

5 a hydraulic cylinder mounting bracket (52) disposed on the inner surface of the existing kiln shell section (3) and a stud mounting bracket (54) disposed on the inner surface of the new kiln shell section (2) such that the mounting brackets (52, 54) are substantially aligned;

a hydraulic cylinder (56) disposed on the hydraulic cylinder mounting bracket (52);
and

10 a stud (58) disposed on or through the stud mounting bracket (54);

wherein the stud (58) extends through bores (60) in the stiffener braces (4) of the existing (3) and new kiln shell sections (2) and wherein the stud (58) is integrally connected to the hydraulic cylinder (56).

15 5. The system (1) of any one of claims 1-4, wherein the tensioning device (6) is disposed between each of the stiffener braces (4).

6. The system (1) of any one of claims 4-5, wherein the hydraulic fastening device (50) is disposed on the stiffener braces (4) which approximately correspond to the 2, 6 and
20 12 positions.

7. The system (1) of any one of the preceding claims,

wherein the first or second alignment brackets (10, 10b) are comprised of:

25 a first bottom plate (80) laterally disposed on the inner surface of the new kiln shell (2);

a second bottom plate (80) laterally disposed on the inner surface of the existing kiln shell (3);

a first back plate (83) disposed on the first bottom plate (80), the first back plate being located substantially perpendicular to the first bottom plate (80);

30 a second back plate (83) disposed on the second bottom plate (80), the second back plate being located substantially perpendicular to the second bottom plate (80);

one or more side members (81, 82) disposed on the first or second bottom plates (80), the one or more side members being located at approximately 90 degree angles from the first or second back plates (83);

wherein one or more of the radial adjustment lugs (11) are disposed on the one or
5 more side members (81, 82); and

wherein the axial stud (12) is connected to or through the first back plate (83) and the second back plate (83).

8. The system of claim 7, wherein the radial adjustment lugs (11) further comprise a
10 locking means (75) for locking the radial adjustment lugs (11) into place on the first or second bottom plates (80) inside the one or more side members (81, 82).

9. A method for radially and axially aligning a new kiln shell section (2) with an existing kiln shell section (3) during a kiln shell section replacement or kiln erection
15 process comprising:

providing a tensioning device (6), the tensioning device (6) comprising a first alignment bracket (10a) disposed on an inner surface of the new kiln shell section (2) between stiffener braces (4) on the new kiln shell section (2) and a second alignment bracket (10b) disposed on an inner surface of the existing kiln shell section (3) between
20 stiffener braces (4) on the existing kiln shell section (3) such that the first and second alignment brackets (10a, 10b) are substantially aligned; a radial adjustment lug (11) disposed on the first or second alignment brackets (10a, 10b) for performing radial alignment of the new and existing kiln shell sections (2, 3); and an axial stud (12) connected to the first and second alignment brackets (10a, 10b) for performing axial alignment of the
25 new and existing kiln shell sections (2, 3);

adjusting the radial adjustment lug (11) such that the new kiln shell section (2) is substantially radially aligned with the existing kiln shell section (3); and

adjusting the axial stud (12) such that the new kiln shell section (2) is substantially axially aligned with the existing kiln shell section (3).

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10. The method of claim 9, further comprising welding the new kiln shell section (2) to the existing kiln shell section (3) along the intersection (90).

11. The method of any one of claims 9-10, further comprising:

attaching a first strong back plate (20) on the stiffener brace (4) on the new kiln shell section (2);

attaching a second strong back plate (30) to the first strong back plate (20) such that the second strong back plate (30) extends from the inner surface of the new kiln shell section (2) to the inner surface of the existing kiln shell section (3).

12. The method of claim 11, further comprising welding the second strong back plate (30) to the inner surface of the new and existing kiln shell sections (2, 3).

10 13. The method of any of claims 11-12, further comprising:

attaching a first strong back plate (20) on the stiffener brace (4) on the existing kiln shell section (3); and

attaching a radial adjustment lug (11) on the first strong back plate (20) on the stiffener brace (4) on the existing kiln shell section (3) for further assisting with performing radial alignment of the new and existing kiln shell sections (2, 3);

adjusting the radial adjustment lug (11) such that the new kiln shell section (2) is substantially radially aligned with the existing kiln shell section (3).

14. The method of any one of claims 9-13, further comprising:

providing a hydraulic fastening device (50) for axially aligning the new kiln shell section (2) with the existing kiln shell section (3), the hydraulic fastening device comprising a hydraulic cylinder mounting bracket (52) disposed on the inner surface of the existing kiln shell section (3) and a stud mounting bracket (54) disposed on the inner surface of the new kiln shell section (2) such that the mounting brackets (52, 54) are substantially aligned; a hydraulic cylinder (56) disposed on the hydraulic cylinder mounting bracket (52); and a stud (58) disposed on or through the stud mounting bracket (54) wherein the stud (58) extends through bores (60) in the stiffener braces (4) of the existing (3) and new kiln shell sections (2) and wherein the stud (58) is integrally connected to the hydraulic cylinder (56);

adjusting the hydraulic fastening device (50) such that that the new kiln shell section (2) is substantially axially aligned with the existing kiln shell section (3).

15. The system (1) of claim 1, further comprising:

a first strong back plate (20) disposed on the new kiln shell section (2);
a first strong back plate (20) disposed on the existing kiln shell section (3);
a second strong back plate (30) connected to the first strong back plate (20) on the
new and existing kiln shell sections (2, 3) for enabling torque transfer during rotation of
5 the kiln shell sections for welding;
wherein the second strong back plate (30) extends from the inner surface of the new
kiln shell section (2) to the inner surface of the existing kiln shell section (3).

16. The system (1) of claim 15, further comprising a hydraulic fastening device (50)
10 for further axially aligning the new kiln shell section (2) with the existing kiln shell section
(3) comprising:

a hydraulic cylinder mounting bracket (52) disposed on the inner surface of the
existing kiln shell section (3) and a stud mounting bracket (54) disposed on the inner
surface of the new kiln shell section (2) such that the mounting brackets (52, 54) are
15 substantially aligned;

a hydraulic cylinder (56) disposed on the hydraulic cylinder mounting bracket (52);
and

a stud (58) disposed on or through the stud mounting bracket (54);
wherein the stud (58) extends through bores (60) in the stiffener braces (4) of the
20 existing (3) and new kiln shell sections (2) and wherein the stud (58) is integrally connected
to the hydraulic cylinder (56).

17. The system (1) of any one of claims 15-16, wherein the tensioning device (6) is
disposed between each of the stiffener braces (4).

25

18. The system (1) of any one of claims 16-17, wherein the hydraulic fastening device
(50) is disposed on the stiffener braces (4) which approximately correspond to the 2, 6 and
12 positions.

30 19. The system (1) of any one of claims 15-18,

wherein the first or second alignment brackets (10, 10b) are comprised of:

a first bottom plate (80) laterally disposed on the inner surface of the new
kiln shell (2);

a second bottom plate (80) laterally disposed on the inner surface of the existing kiln shell (3);

a first back plate (83) disposed on the first bottom plate (80), the first back plate being located substantially perpendicular to the first bottom plate (80);

5 a second back plate (83) disposed on the second bottom plate (80), the second back plate being located substantially perpendicular to the second bottom plate (80);

one or more side members (81, 82) disposed on the first or second bottom plates (80), the one or more side members being located at approximately 90 degree angles from the first or second back plates (83);

10 wherein one or more of the radial adjustment lugs (11) are disposed on the one or more side members (81, 82); and

wherein the axial stud (12) is connected to or through the first back plate (83) and the second back plate (83).

15 20 The system of claim 19, wherein the radial adjustment lugs (11) further comprise a locking means (75) for locking the radial adjustment lugs (11) into place on the first or second bottom plates (80) inside the one or more side members (81, 82).

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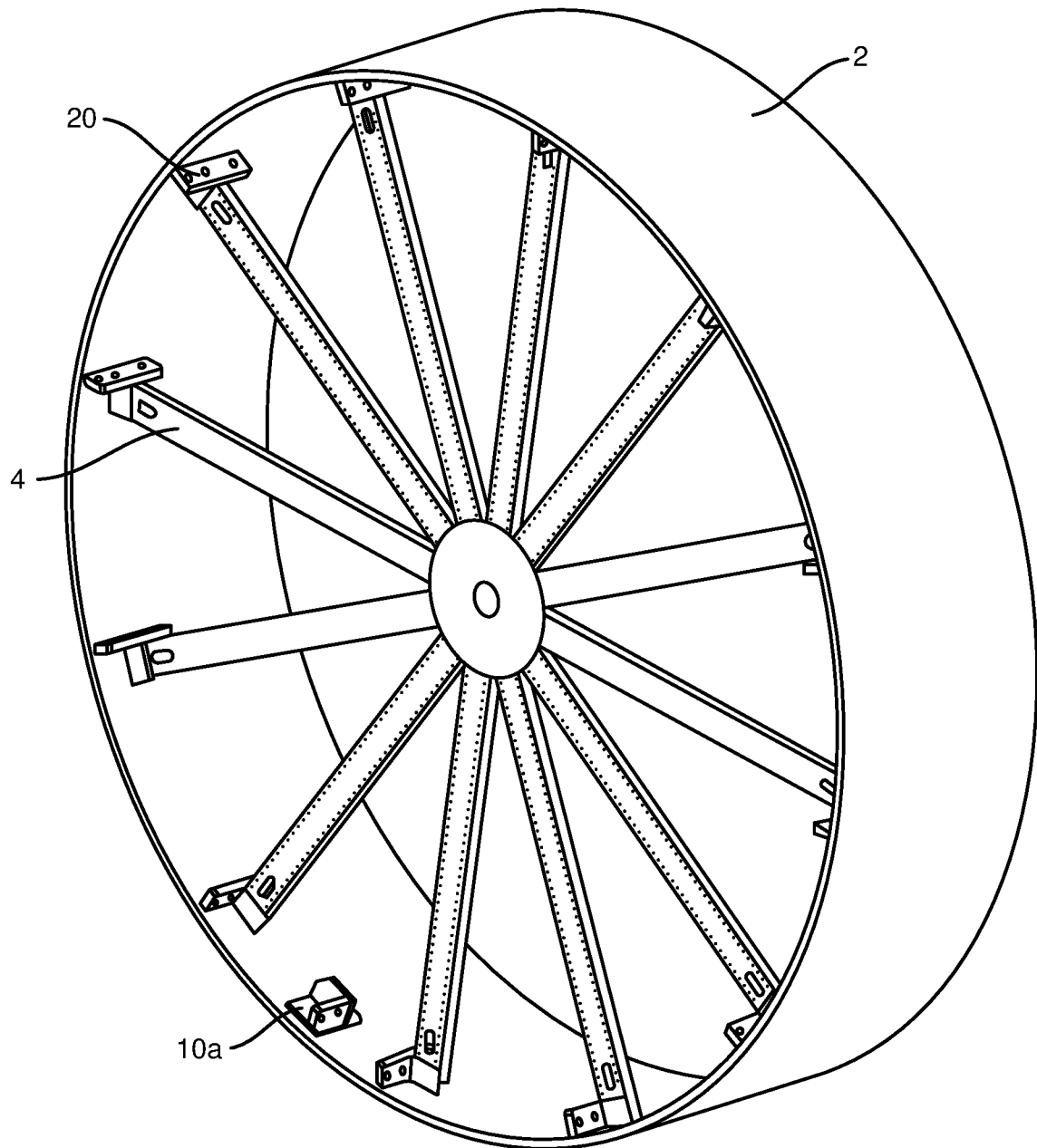


FIG. 1

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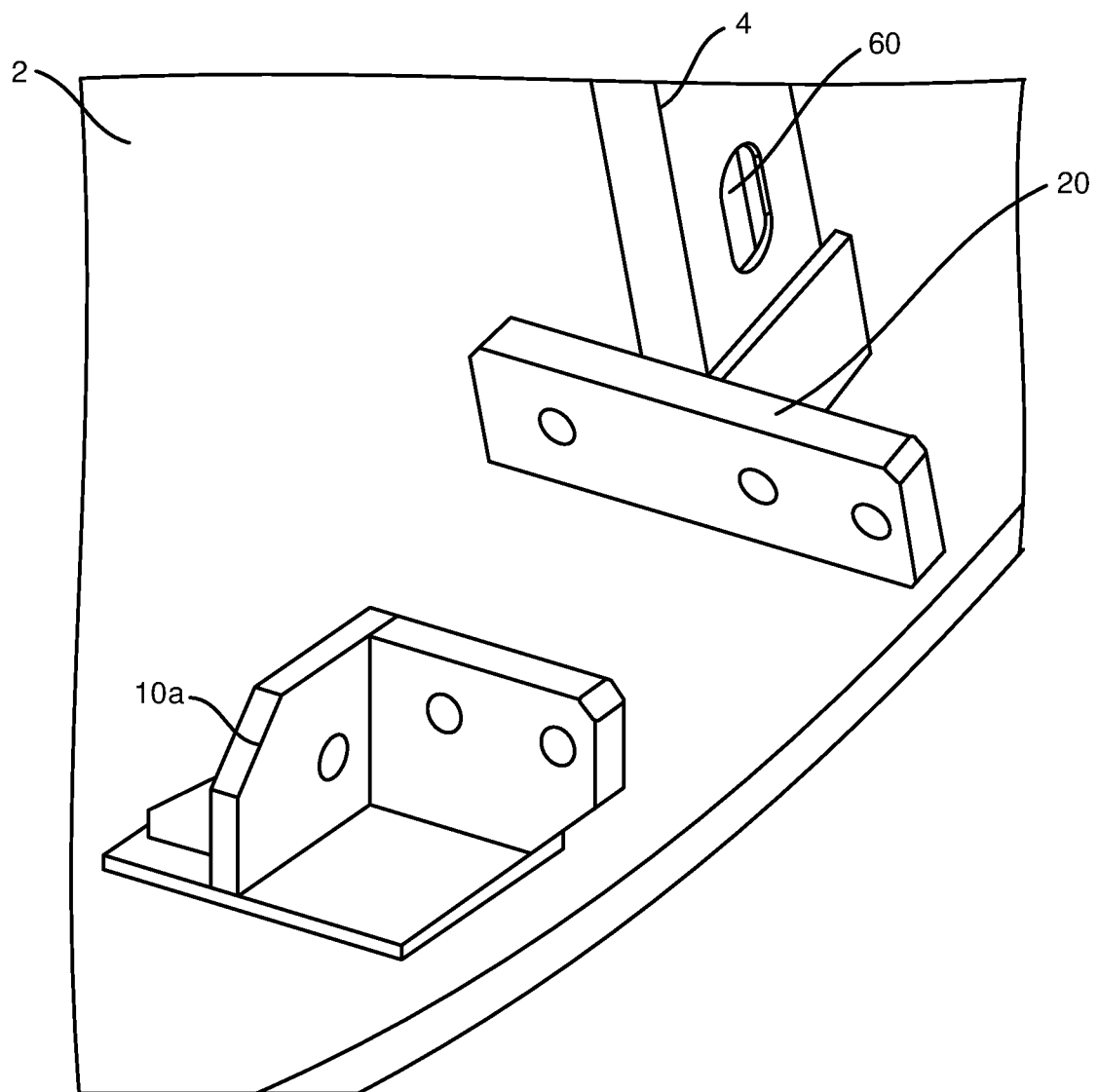


FIG. 2

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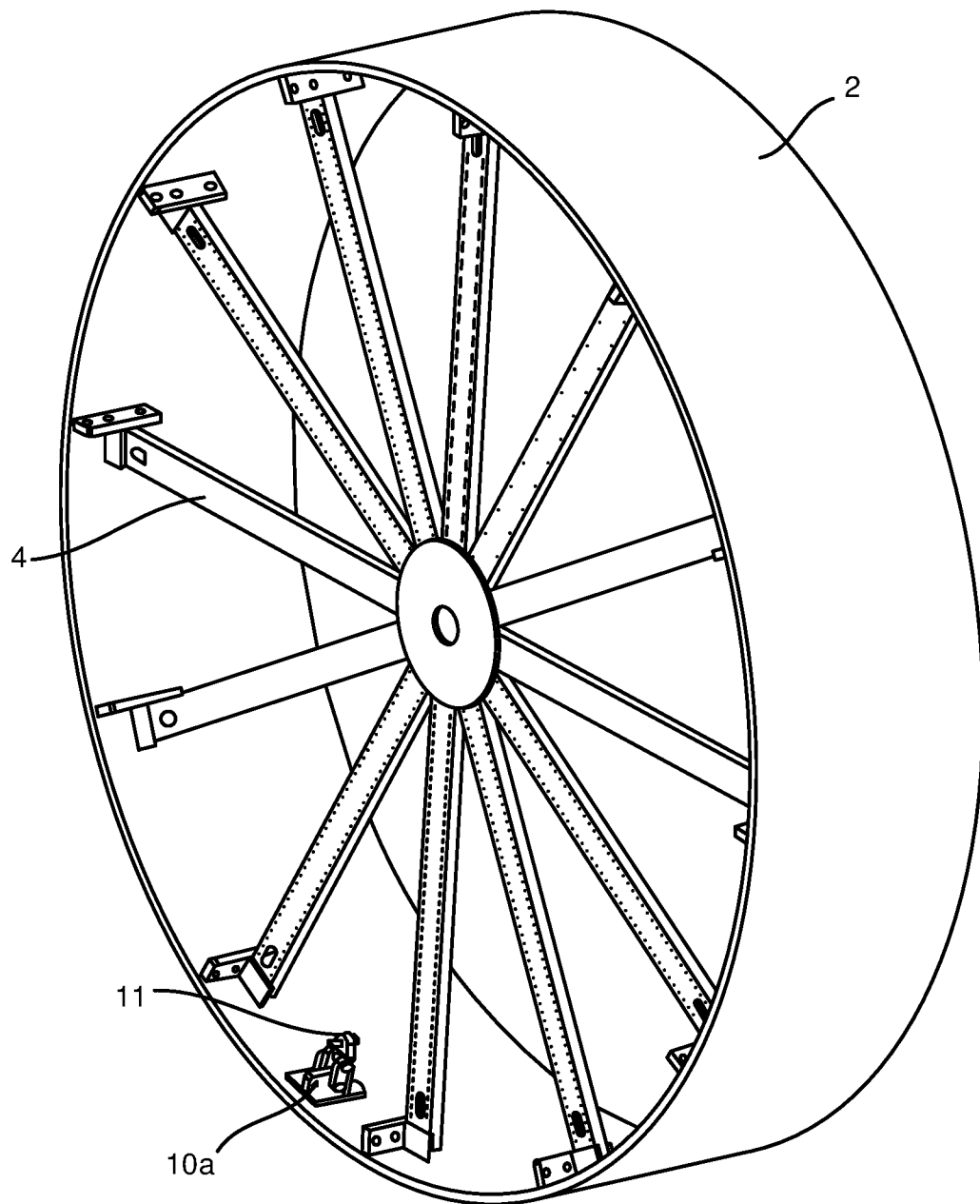


FIG. 3

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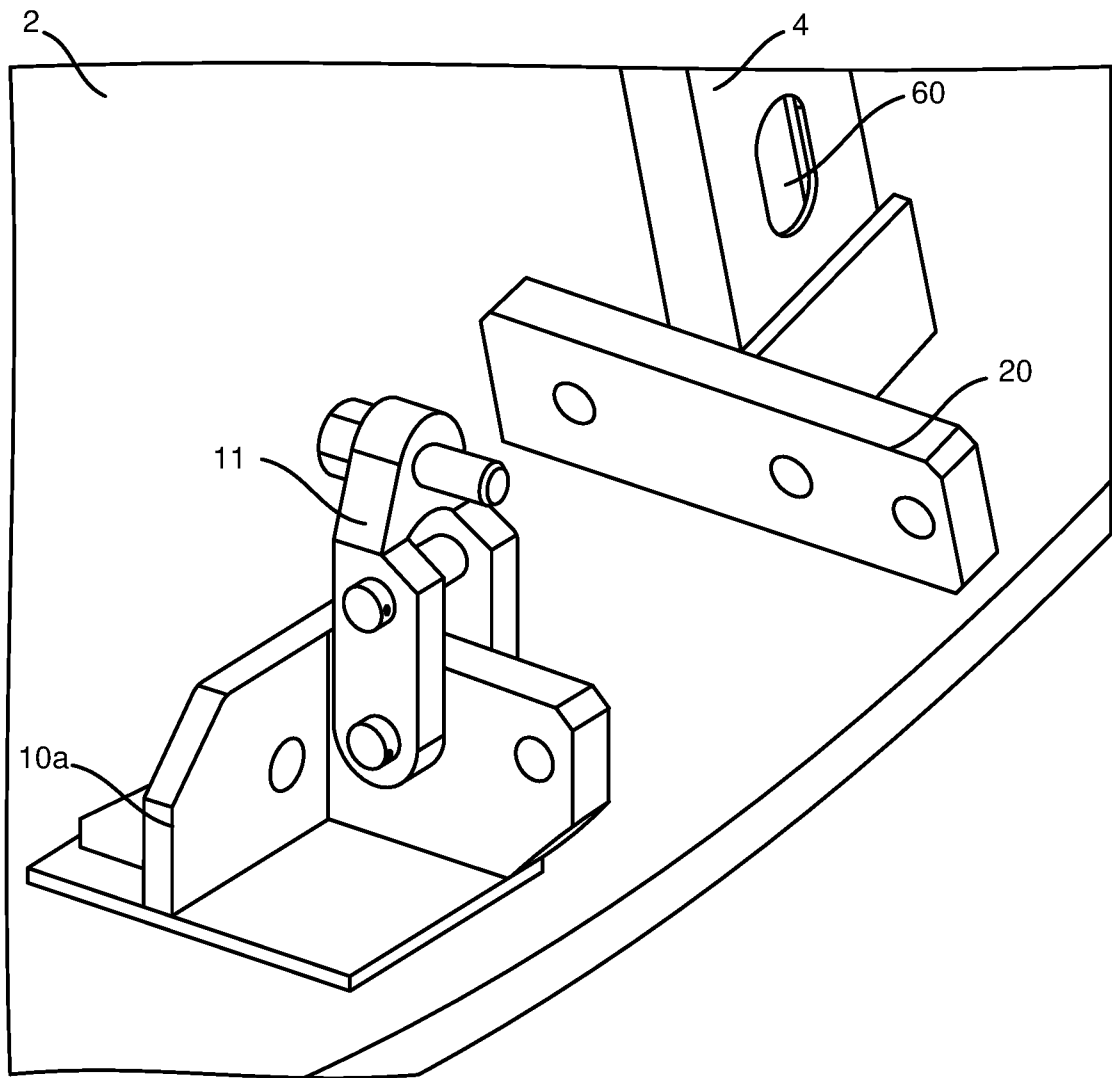


FIG. 4

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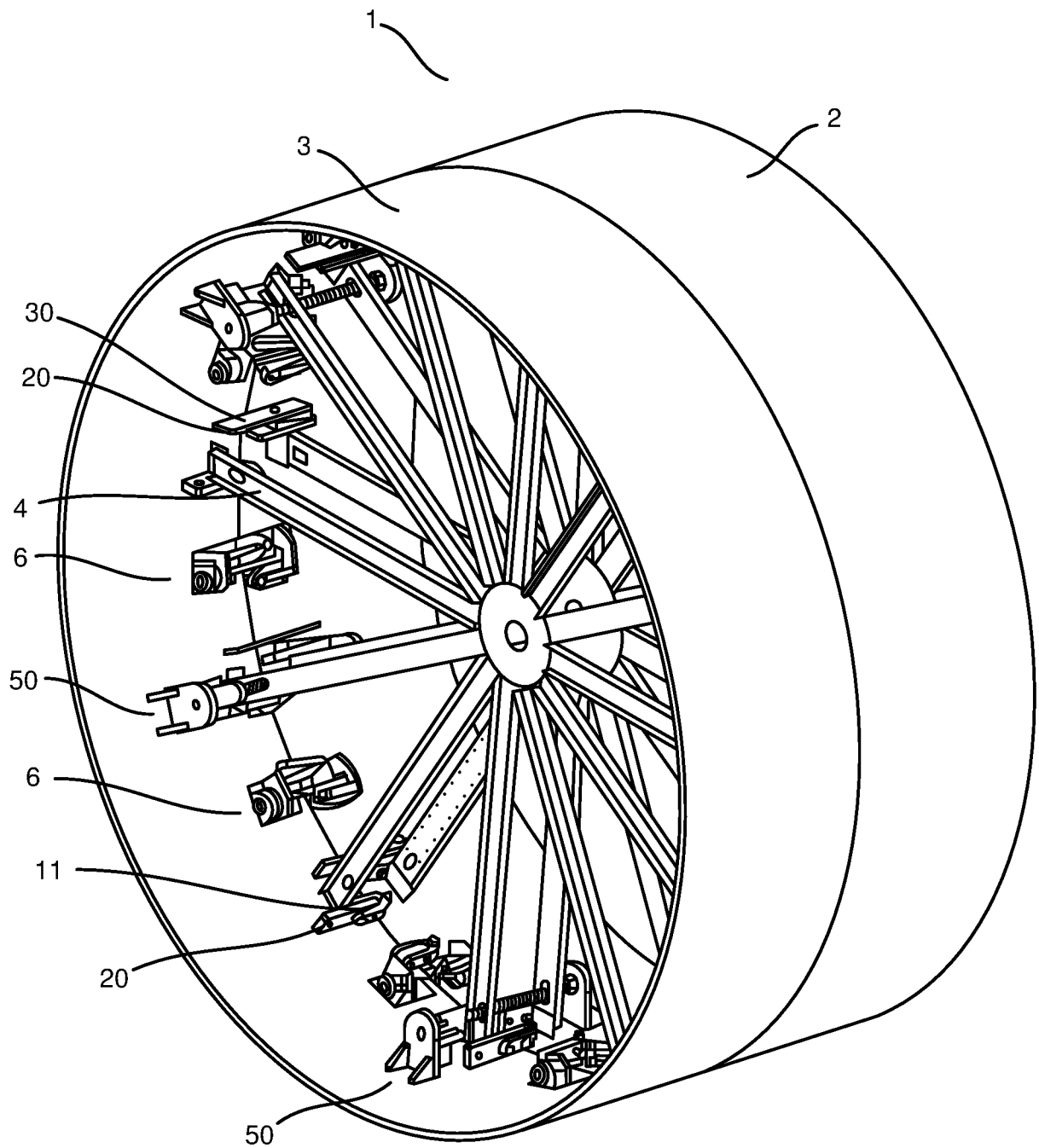


FIG. 5

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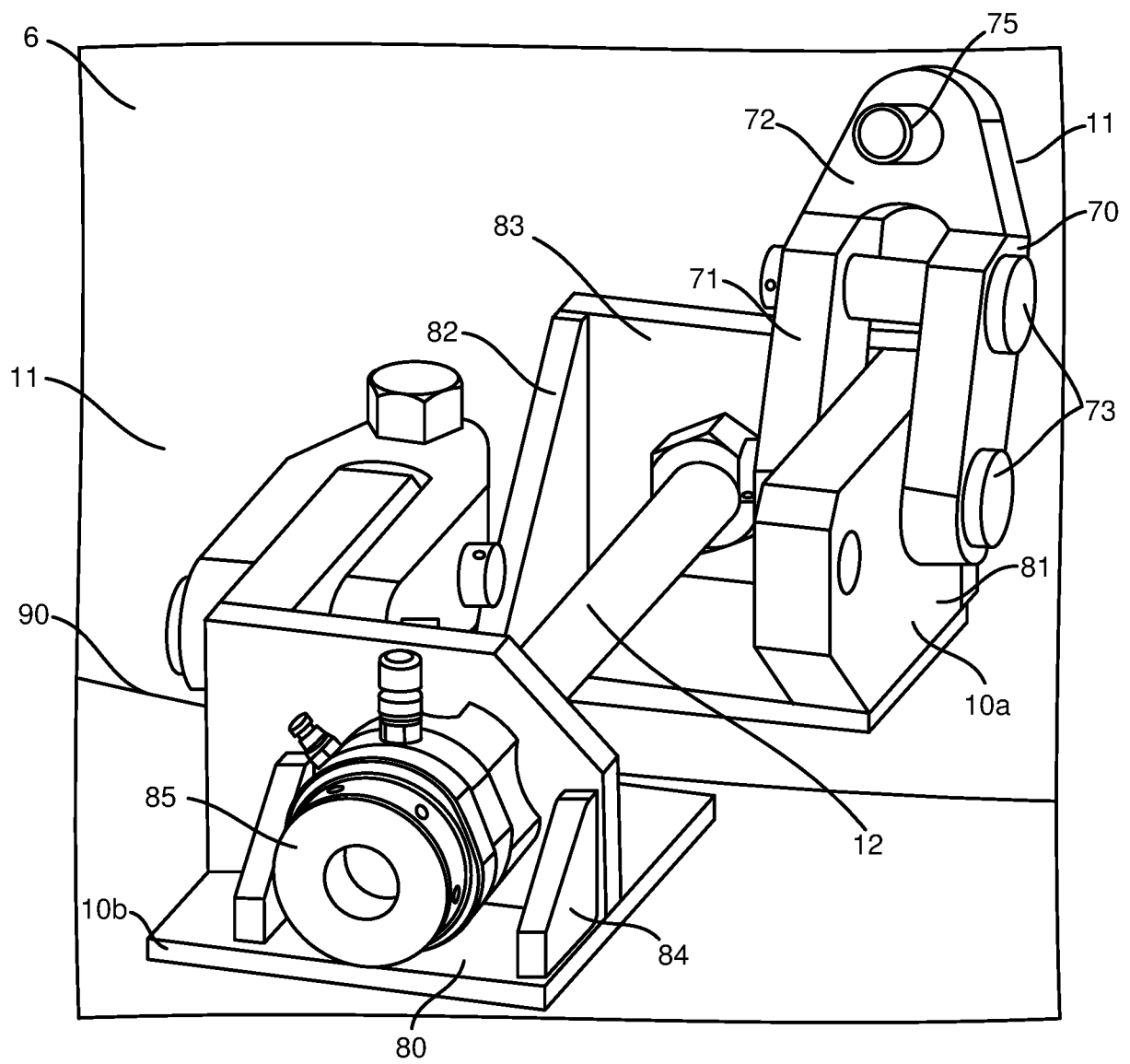


FIG. 6A

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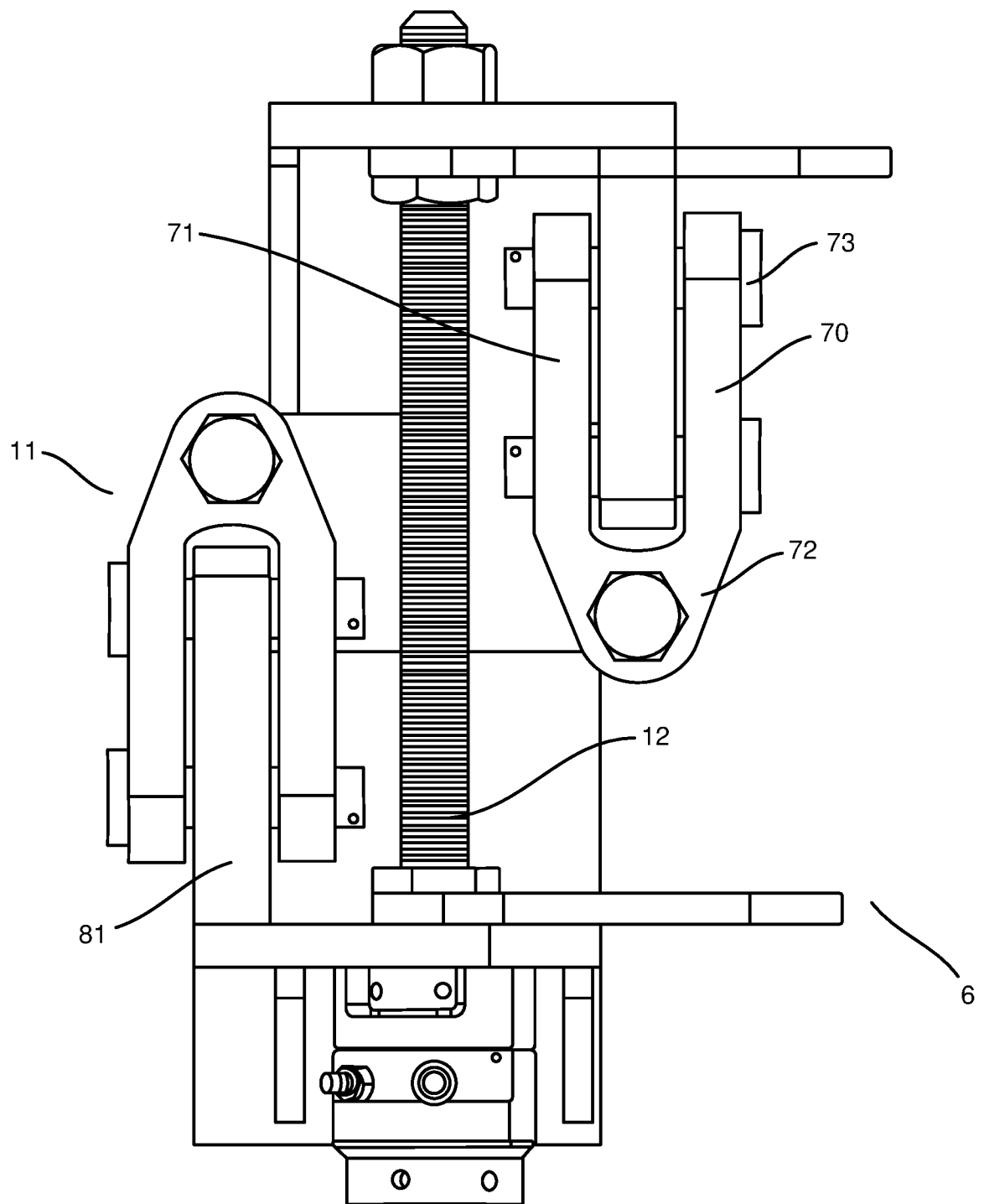


FIG. 6B

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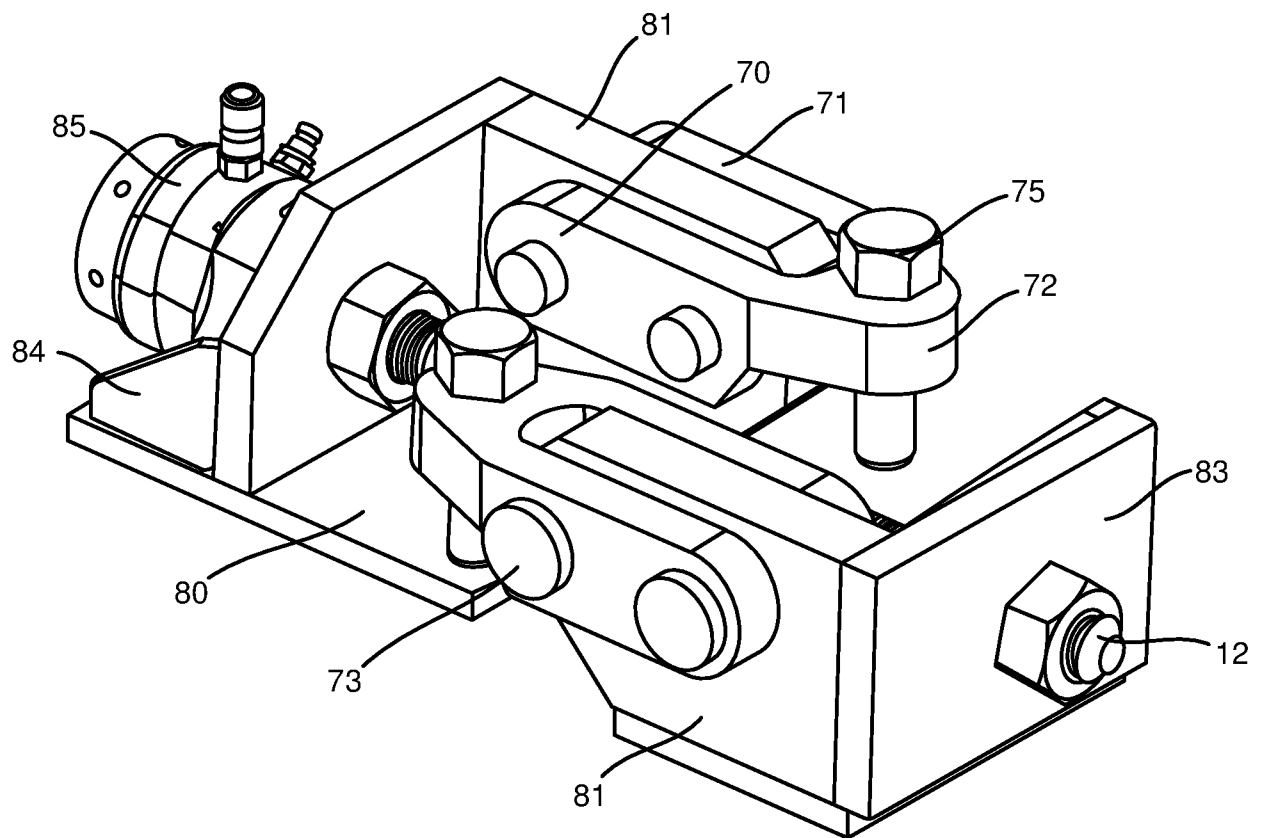


FIG. 6C

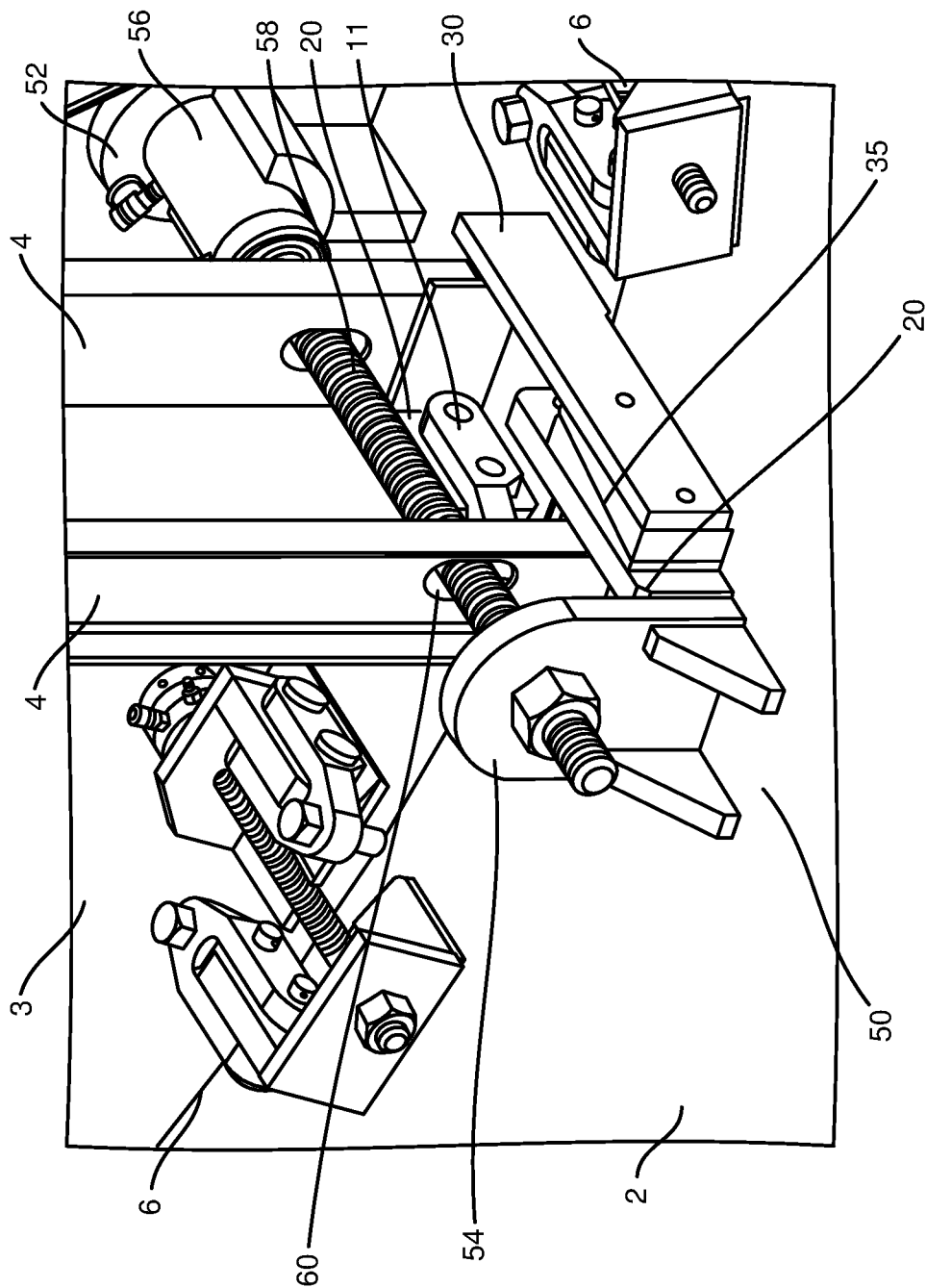


FIG. 7

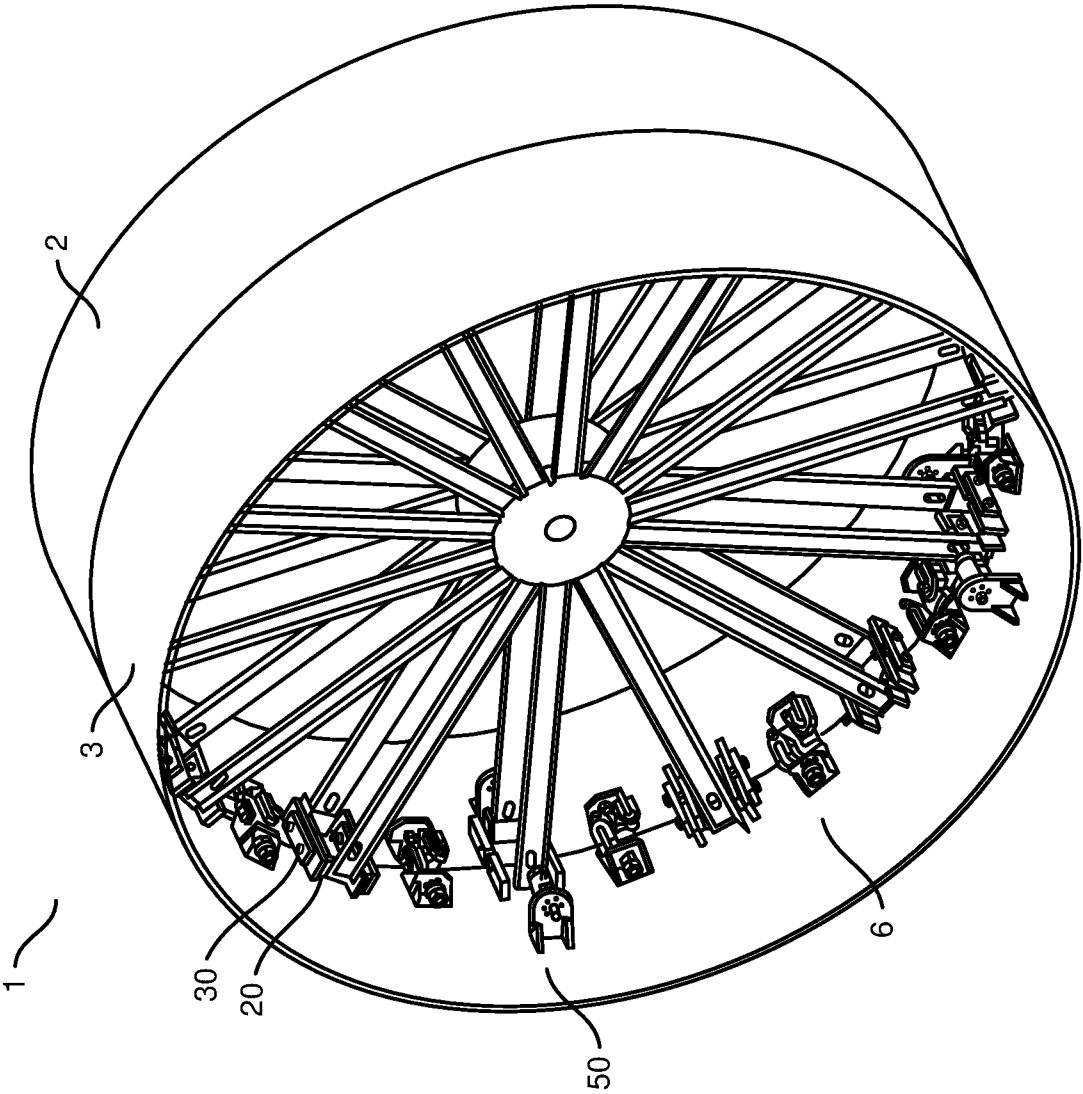


FIG. 8

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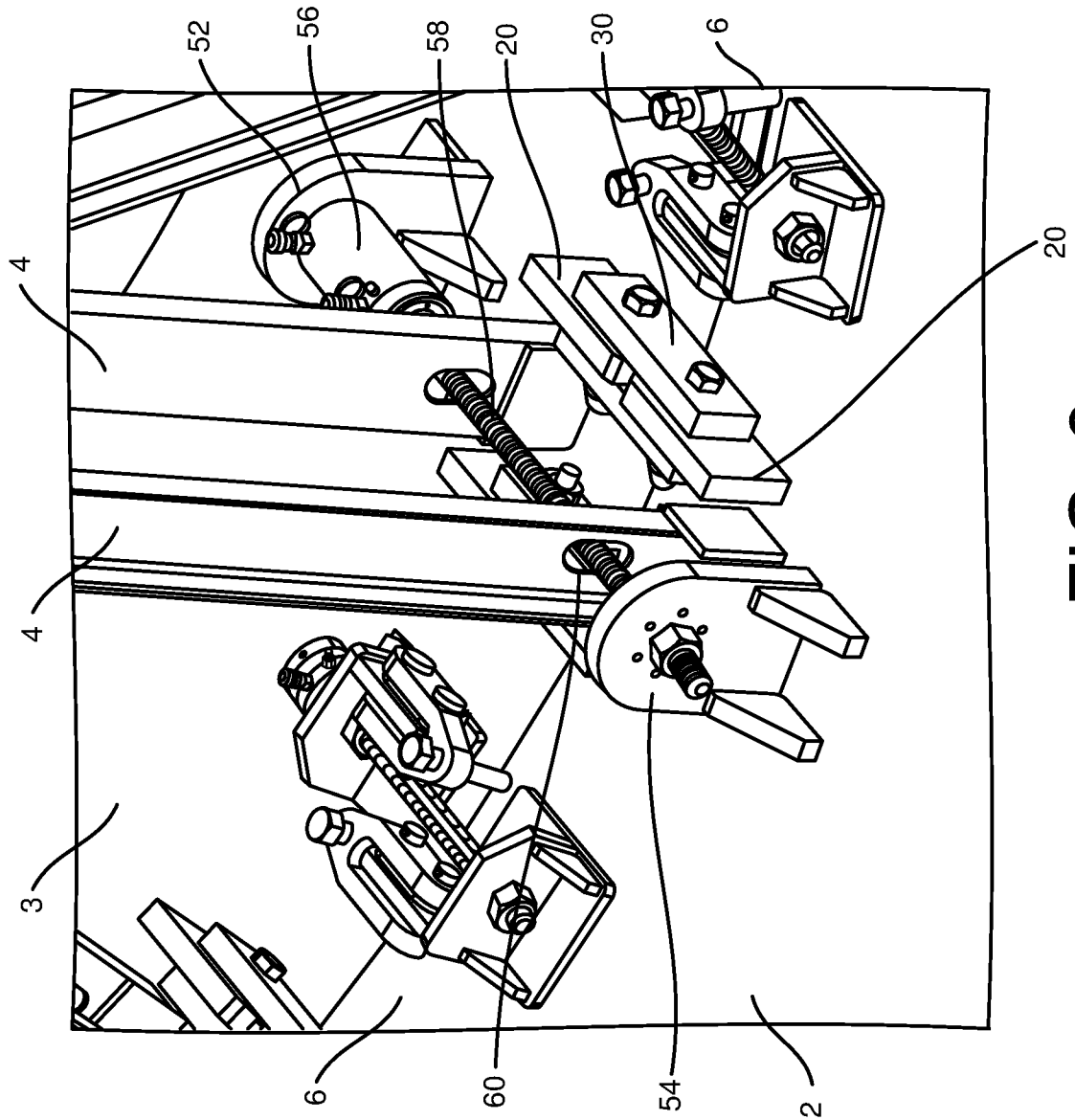


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2017/055315

A. CLASSIFICATION OF SUBJECT MATTER
INV. F27B7/20
ADD.

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)
F27B F27D

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 105 758 171 A (MCC BAOSTEEL TECH SERV CO LTD) 13 July 2016 (2016-07-13) abstract; figures 5,6,7,9,11,12 -----	1-20
A	JP H09 141495 A (ISHIKAWAJIMA HARIMA HEAVY IND) 3 June 1997 (1997-06-03) abstract; figures 1,3,5 -----	1,9
A	JP 2001 108374 A (ISHIKAWAJIMA HARIMA HEAVY IND) 20 April 2001 (2001-04-20) abstract; figures 1,2,5 -----	1,9
A	US 3 869 784 A (SIMPSON RICHARD R) 11 March 1975 (1975-03-11) the whole document -----	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

18 January 2018

Date of mailing of the international search report

25/01/2018

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2017/055315

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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