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(54) **TOWABLE STRUCTURE FOR THE TREATMENT OF ROAD SURFACES**

SCHLEPPBARE STRUKTUR ZUR BEHANDLUNG VON STRASSEN OBERFLÄCHEN

STRUCTURE REMORQUABLE DESTINÉE AU TRAITEMENT DE SURFACES DE ROUTE

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(56) References cited:
EP-B1- 0 529 544 US-B2- 10 155 529

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Description

[0001] The present invention refers to a towable structure, in particular a trailer, for the treatment of road surfaces, in particular asphalted surfaces.

Background

[0002] The present invention finds application within the sector of the construction and maintenance of tyre test tracks.

[0003] It is well known that, due to operational wear, such tracks must be periodically maintained, and often resurfaced.

[0004] However, following a resurfacing process, the roughness characteristics of the surface are evidently altered, often to the point that these are no longer such as to guarantee compliance with the regulations for the sector, and at the same time, no longer such as to ensure an adequate level of adherence.

[0005] In fact, it is known, that tests performed on tyres must be carried out under standardized conditions with respect to many parameters, including the coefficients of adhesion and surface roughness. This is in order to render all of the tests performed comparable and similar therebetween, even if performed at different times and/or in different places.

[0006] The problem of maintaining test tracks in such a way that they are constantly compliant with the regulations is therefore strong felt.

[0007] At present, one solution that has been adopted to alleviate the problem in relation to the periodic resurfacing of tracks, is to use a trolley, pulled by a vehicle (for example, a tractor), and equipped with a plurality of locked tyres, i.e., not free to rotate around the axis thereof.

[0008] The sliding of these tyres upon the road surface, typically asphalted, leads to wear, and the rubber that detaches therefrom adheres to the road surface thereby improving the characteristics thereof in terms of grip and roughness, thus preserving a condition of compliance with the test regulations for longer.

[0009] Such a system has the obvious drawback however that the tyres, in the area of contact with the asphalt, undergo severe wear, until reaching the point wherein a flat-spot is formed on the tread.

[0010] The trolley is therefore equipped with a mechanism that makes it possible for the tyres to be rotated at such an angle that a new portion of tread faces the asphalted surface. Such a rotation operation must however be performed manually, wheel by wheel. This involves a series of manual processes that slow down the surface maintenance operation and therefore the productivity and efficiency of the treatment process. In particular, in order to be able to adjust the position of the wheels every time, it is necessary to:

- manually lift the trolley;
- remove the tyre carrier axles;
- rotate the same by one step, and
- refit.

[0011] These operations are then repeated for each tyre or tyre carrier axle of the trolley.

[0012] EP 0 529 544 B1 discloses a wheeled towable structure comprising the features of the preamble of independent claim 1.

[0013] The purpose of the present invention is, therefore, to solve those problems left unresolved by the prior art, by providing a towable structure as defined in claim 1. Further characteristics of the present invention are defined in the corresponding dependent claims.

[0014] In particular, one object of the present invention is to speed up those operations necessary for the rotation and locking of the tyres so as to render the entire treatment process more continuous, faster, and therefore more efficient.

[0015] Other clear advantages over the prior art, together with the characteristics and usages of the present invention, will become clear from the following detailed description of the preferred embodiments thereof, given purely by way of a non-limiting example.

Brief description of the figures

[0016] Reference will be made to the drawings in the attached figures, wherein:

- Figure 1 is a perspective view of a towable structure according to a first embodiment of the present invention;
- Figure 2 is a top view of the towable structure of figure 1;
- Figure 3 is a perspective view of a towable structure according to a second embodiment of the present invention;
- Figure 4 is a top view of the towable structure of figure 3;
- Figures 5A and 5B show a structure according to the invention in two different possible configurations;
- Figure 6 is a side view of a structure according to the invention, that shows the presence of lifting jacks;
- Figures 7A and 7B show the extent of the road surface treatment action;
- Figure 8 is a perspective view of one of the groups of wheel;
- Figure 9 is an exploded view of the group of wheels of

figure 5;

- Figure 10 is a perspective view of a group of wheels, wherein, by way of example, the subdivision of the tyre into sectors is indicated;
- Figure 11 is a front view of a tyre wherein, by way of example, the subdivision into sectors is indicated;
- Figures 12A to 12B show the two flanges of a group of wheels according to the invention;
- Figure 12C shows the two flanges of a superimposed group of wheels, in partial transparency;
- Figure 13 shows the means for locking the rubber wheels of a group of wheels; and
- Figures 14A to 14C show the modality according to which the controlled rotation from one sector to an adjacent sector takes place.

Detailed description of possible embodiments of the invention

[0017] The present invention will be described below with reference to the above figures. Referring first to figures 1 and 2, a possible embodiment of a towable wheeled structure 1, according to the present invention, comprises a frame 2 on which a plurality of groups of wheels 3 are mounted.

[0018] In the following part of the present description, and for all of the embodiments described, the same numerical references will be attributed to the parts of each group of wheels.

[0019] Each group 3, in turn, comprises one or more rubber wheels 4, equipped with tyres, and mounted so as to rotate at a respective wheel axis A.

[0020] Preferably, each group of wheels 3 comprises two coaxial, paired rubber wheels 4. Furthermore, the towable structure 1 comprises means 5, 5', 6, 6', 7 for locking the rotation of the wheels 4 of each group of wheels 3 at a plurality of predetermined angular locking positions.

[0021] The structure provides means for actuating the means for locking the rotation of the rubber wheels 4, configured in such a way as to allow the wheels 4 of each group to rotate from one locking position to another, during the operation of said towable structure.

[0022] The following figures 3 and 4 refer to a second possible embodiment of the present invention, according to which a towable structure 11 further comprises a pair of maneuvering wheels 14, connected to the frame 2 by means of an articulated mechanism 20 which, when operated, allows for the positioning of the maneuvering wheels 14 in at least two positions.

[0023] The two positions are respectively illustrated in the following figures 5A and 5B.

[0024] In a first treatment position (FIG. 5A) the maneuvering wheels 14 are raised from the ground, and the rubber wheels 4 are therefore in contact with the ground.

[0025] In a second maneuvering position (FIG. 5B), the maneuvering wheels are in contact with the ground, whilst the rubber wheels 4 are raised from the ground. The maneuvering wheels 14 are mounted idling upon the respective axes thereof. In this second maneuvering position, therefore, the structure 11 can be more easily towed and maneuvered upon the maneuvering wheels 14, without the rubber wheels 4, which are usually locked in rotation, offering resistance to towing.

[0026] According to both embodiments described up to now, the structure 1, 11 can advantageously comprise - as shown in figure 6 - a plurality of hydraulic jacks 30 for lifting the structure itself, so that the rubber wheels 4 are detached from the ground. This is particularly useful and advantageous, for example, in order to be able to easily replace the tyres of the rubber wheels 4, and/or in order to perform other maintenance operations upon the structure and/or upon the group of wheels 3.

[0027] In each of the possible embodiments, the number and arrangement of the group of wheels 3 can be chosen on the basis of the sizing of the structure and on the basis of the treatment coverage to be obtained.

[0028] For example, in the embodiments described, the groups of wheels 3 are arranged upon six axes A, parallel to each other and orthogonal to a towing direction T of the structure 1, 11.

[0029] According to a preferred embodiment, the group of wheels 3 are distributed on each of said six parallel axes A, such that the footprint of the rubber wheels 4 of groups on different axes partially overlaps to fully cover the overall gauge S of the towable structure 1, 11. The term overall gauge S refers to the distance S between the outer faces of the two outermost rubber wheels 4, along a direction orthogonal to the towing direction T. This arrangement is exemplified in figures 7A and 7B.

[0030] According to a possible embodiment, eight groups of wheels 3 are envisaged, arranged staggered as described above, thus making it possible to cover an overall gauge of about 3 meters.

[0031] The following figures 8 and 9 show a group of wheels 3, respectively in perspective and exploded view.

[0032] According to a preferred embodiment of the present invention, the rubber wheels 4 of each group of wheels 3 are rotationally integral therebetween, mounted on the common wheel axis A.

[0033] The group of wheels 3 is mounted on a small frame 8 that is rendered integral to the frame 2 of the towable structure 1, 11.

[0034] The means for locking the rotation of the wheels 4 comprise a pair of flanges 5, 5', coaxially therebetween, and mounted in such a way as to rotate integrally around a flange axis F.

[0035] The flanges 5, 5' are equipped with a plurality of slots that are denoted respectively by the numbers 9 and

9' in the figures.

[0036] Furthermore, the locking means also comprise a pair of pins 6, 6', integral with the frame 8, and adapted to interfere, when operated, each with the slots 9, 9' of one of the flanges 5, 5'.

[0037] Furthermore, the locking means comprise a transmission system 7, for example a crown and chain mechanism, that connects the flange axis F to the wheel axis A, thereby rendering them integral in rotation.

[0038] The mechanism for locking the rotation of the wheels 4, the operation thereof will be described in greater detail below, has the already anticipated function of making it possible to lock the rotation of the wheels 4 of each group of wheels 3 at a plurality of predetermined angular locking positions.

[0039] Advantageously, the locking means can be operated in such a way as to allow for the rotation of the wheels 4 of each group from one locking position to another, during the operation of said towable structure, without interrupting the road surface treatment operations.

[0040] The following figures 10 and 11 show a tyre of the group of wheels 3, whereupon, purely by way of example and for the sole purposes of this description, indications are given in relation to possible sectors of a tyre and corresponding to as many predetermined positions. In the example, there are twelve positions, numbered from '1' to '12', each therefore corresponding to twelve angular sectors 40, each of 30°.

[0041] As illustrated in the subsequent figures 12A and 12B, the slots 9, 9' are made at the peripheral circumference of each flange 5, 5', equally distributed along such a circumference.

[0042] Preferably, the slots 9, 9' all have the same length P along the circumference.

[0043] Furthermore, the flanges 5, 5' of the same pair of flanges of the same group of wheels 3 are mounted out of phase with respect to one another such that the beginning of each slot 9 on a first flange 5 corresponds to the end of a slot 9' on a second flange 5'. In this way each point of correspondence between the slots 9, 9' defines a corresponding predetermined position. According to the example described above, figures 12A and 12B show the two flanges 5, 5', each thereof envisages six only (respectively indicated by 9 and 9') equally angularly spaced therebetween by 60°.

[0044] The two flanges 5, 5' are mounted out of phase as shown in the figure, in such a way that the points of correspondence of the respective slots determine the twelve predetermined positions (again numbered from '1' to '12') corresponding to the twelve tyres sectors.

[0045] Figure 12C shows the two flanges 5, 5' superimposed, in partial transparency, in order to clearly show the points of correspondence of the slots 9, 9' and therefore the twelve predetermined positions.

[0046] The rotational blocking, as already clarified, occurs by means of two pins 6, 6' which, when actuated, interfere respectively with one of the slots 9, 9' of the

flanges 5, 5', thereby causing it to be blocked in rotation. The actuation of the pins is preferably performed by the actuation means which comprise a hydraulic actuation mechanism for the pins. Here it can be assumed that the hydraulic actuation component of the pins is within the reach of a person skilled in the art who will be able to choose the correct hydraulic actuators and size the circuit appropriately, without having to provide the details thereof herein. The hydraulic force for supplying these components can, for example, be taken from a tractor that pulls the structure, by means of a power take-off shaft thereof.

[0047] In order to illustrate in more detail what has just been described, the following figure 13 shows some components in partial transparency.

[0048] The following figures from 14A to 14C illustrate the passage from one predetermined position to another predetermined position.

[0049] The two pins 6, 6' operate alternately. Figure 14A shows the pin 6' which interferes, considering the direction of rotation R of the parts indicated in the figure, with one end of a slot 9' of the flange 5'. This interference evidently blocks the flange 5' in rotation. Insofar as the flange 5' is integral in rotation with the wheels 4, the wheels 4 are also blocked due to such interference at the predetermined position corresponding to the sector 40 denoted by '12' on the tyre.

[0050] During this step, the pin 6 is not operational and does not perform any function and therefore can - as in the figure - be retracted without interfering with the corresponding slot 9 of the flange 5.

[0051] The following figure 14B shows a transition step, between one position and another.

[0052] During this step, the two pins 6 and 6' reverse the function and position thereof. The pin 6' retracts and relinquishes the interference and locking function, whilst the pin 6 extends and interferes with the slot 9 of the flange 5.

[0053] In this position, obviously, the flanges 5, 5', and therefore the wheels 4, can rotate according to the direction of rotation R indicated in the figure.

[0054] Such a rotation can persist for the entire length of the slot 9, until, as illustrated in the following figure 14C, the pin 6 comes to rest at one end of the same slot 9, thereby locking the rotation of the flange 5. Consequently, the wheels 4 will have rotated by a corresponding angle (30°) in the direction of rotation R indicated in the figure and will then be blocked at a different sector 40, denoted in the figure by the number '11'.

Claims

1. Wheeled towable structure (1, 11), comprising:

- a frame (2) on which a plurality of groups of wheels assemblies (3) are mounted, each group (3) comprising one or more rubber wheels (4),

equipped with tyres and mounted so as to rotate at a respective wheel axis (A);

• means (5, 5', 6, 6', 7) for locking the rotation of the wheels of each group of wheels (3) in predetermined locking positions;

• means for actuating said means (5, 5', 6, 6', 7) for locking the rotation of the rubber wheels (4), configured to move the wheels of each group (3) from a locking position to another during the movement of said towable structure (1, 11),

characterized in that said means (5, 5', 6, 6', 7) for locking the rotation comprises a pair of flanges (5, 5') coaxially mounted so as to rotate integrally around a flange axis (F) and respectively equipped with a plurality of slots (9, 9'), and a pair of pins (6, 6') integral with a frame (8) of said group of wheels (3) and adapted to interfere, when operated, each with the slots (9, 9') of one of said flanges (5, 5'), said means (5, 5', 6, 6', 7) further comprising a transmission system (7) which connects said flange axis (F) to said wheel axis (A).

2. Towable structure (1, 11) according to claim 1, wherein each group of wheels (3) comprises two coaxial rubber wheels (4).
3. Towable structure (1, 11) according to claim 1 or 2, wherein the rubber wheels (4) of each wheel group (3) are rotationally integral with each other.
4. Towable structure (1, 11) according to one of the claims 1 to 3, wherein said slots (9, 9') are made at a peripheral circumference of each flange (5, 5'), equally distributed along said circumference.
5. Towable structure (1, 11) according to one of the claims 1 to 4, in which said slots (9, 9') all have the same width along said circumference.
6. Towable structure (1, 11) according to one of the claims 1 to 5, wherein said flanges (5, 5') of a pair of flanges are out of phase with respect to each other so that the beginning of each one slot (9) on a first flange (5) corresponds to the end of a slot (9') on a second flange (5'), each correspondence point between the slots (9, 9') defining a corresponding predetermined position.
7. Towable structure (1, 11) according to one of claims 1 to 6, wherein said means for actuating comprises a mechanism for hydraulic actuation of said pins (6, 6').
8. Towable structure (1, 11) according to one of claims 1 to 7, wherein said groups of wheels (3) are arranged on six axes (A) parallel to each other and orthogonal to a towing direction (T) of the structure (1, 11).

9. Towable structure (1, 11) according to claim 8, in which said groups of wheels (3) are distributed on each of said six parallel axes (A), such that the footprint of the rubber wheels (4) of groups on different axes partially overlap, to fully cover the overall gauge (S) of the towable structure (1, 11).

10. Towable structure (11) according to one of claims 1 to 9, further comprising a pair of maneuvering wheels (14) mounted on an articulated mechanism (20), such that the maneuvering wheels (14) can be positioned in a first treatment position in which they are raised from the ground, the rubber wheels (4) being in contact with the ground, and a second maneuvering position in which they are in contact with the ground, the rubber wheels (4) being raised by the soil.

11. Towable structure (1, 11) according to one of claims 1 to 10, further comprising a plurality of hydraulic jacks (30) for lifting it, so that the rubber wheels (4) are detached from the ground.

Patentansprüche

1. Schleppbare Struktur (1, 11) mit Rädern, umfassend:

• einen Rahmen (2), an dem eine Vielzahl von Gruppen von Räderanordnungen (3) montiert sind, jede Gruppe (3) umfassend ein oder mehrere Gummiräder (4), die mit Reifen ausgestattet und montiert sind, um sich an einer jeweiligen Radachse (A) zu drehen;

• Mittel (5, 5', 6, 6', 7) zum Blockieren der Drehung der Räder jeder Gruppe von Rädern (3) in zuvor bestimmten Blockierpositionen;

• Mittel zum Betätigen der Mittel (5, 5', 6, 6', 7) zum Blockieren der Drehung der Gummiräder (4), die konfiguriert sind, um die Räder jeder Gruppe (3) während der Bewegung der schleppbaren Struktur (1, 11) von einer Blockierposition in eine andere zu bewegen,

dadurch gekennzeichnet, dass die Mittel (5, 5', 6, 6', 7) zum Blockieren der Drehung ein Paar Flansche (5, 5'), die koaxial montiert sind, um sich integral um eine Flanschachse (F) herum zu drehen, und jeweils mit einer Vielzahl von Schlitzen (9, 9') ausgestattet sind, und ein Paar Stifte (6, 6') umfassen, die mit einem Rahmen (8) der Gruppe von Rädern (3) integral und angepasst sind, um, wenn sie betrieben werden, mit jedem der Schlitze (9, 9') eines der Flansche (5, 5') zu interferieren, die Mittel (5, 5', 6, 6', 7) ferner umfassend ein Getriebesystem (7), das die Flanschachse (F) mit der Radachse (A) verbindet.

2. Schleppbare Struktur (1, 11) nach Anspruch 1, wobei jede Gruppe von Rädern (3) zwei koaxiale Gummiräder (4) umfasst.
3. Schleppbare Struktur (1, 11) nach Anspruch 1 oder 2, wobei die Gummiräder (4) jeder Radgruppe (3) drehintegral miteinander sind.
4. Schleppbare Struktur (1, 11) nach einem der Ansprüche 1 bis 3, wobei die Schlitzte (9, 9') an einem äußeren Umfang jedes Flanschs (5, 5') angefertigt werden, gleichmäßig verteilt entlang des Umfangs.
5. Schleppbare Struktur (1, 11) nach einem der Ansprüche 1 bis 4, in der die Schlitzte (9, 9') entlang des Umfangs alle die gleiche Breite aufweisen.
6. Schleppbare Struktur (1, 11) nach einem der Ansprüche 1 bis 5, wobei die Flansche (5, 5') eines Paares Flansche in Bezug aufeinander phasenverschoben sind, sodass der Anfang jedes Schlitzes (9) an einem ersten Flansch (5) dem Ende eines Schlitzes (9') an einem zweiten Flansch (5') entspricht, wobei jeder Entsprechungspunkt zwischen den Schlitzten (9, 9') eine entsprechende zuvor bestimmte Position definiert.
7. Schleppbare Struktur (1, 11) nach einem der Ansprüche 1 bis 6, wobei die Mittel zum Betätigen einen Mechanismus für eine hydraulischen Betätigung der Stifte (6, 6') umfassen.
8. Schleppbare Struktur (1, 11) nach einem der Ansprüche 1 bis 7, wobei die Gruppen von Rädern (3) an sechs Achsen (A), die parallel zueinander und orthogonal zu einer Schlepprichtung (T) der Struktur (1, 11) sind, angeordnet sind.
9. Schleppbare Struktur (1, 11) nach Anspruch 8, in der die Gruppen von Rädern (3) an jeder der sechs parallelen Achsen (A) derart verteilt sind, dass sich die Aufstandsfläche der Gummiräder (4) von Gruppen auf unterschiedlichen Achsen teilweise überlappen, um die Gesamtpurweite (S) der schleppbaren Struktur (1, 11) vollständig abzudecken.
10. Schleppbare Struktur (11) nach einem der Ansprüche 1 bis 9, ferner umfassend ein Paar Manövrierräder (14), die an einem Gelenkmechanismus (20) derart montiert sind, dass die Manövrierräder (14) in einer ersten Bearbeitungsposition, in der sie von dem Boden angehoben sind, wobei die Gummiräder (4) den Boden berühren, und in einer zweiten Manövrierposition positioniert werden können, in der sie den Boden berühren, wobei die Gummiräder (4) durch die Erde angehoben werden.
11. Schleppbare Struktur (1, 11) nach einem der An-

sprüche 1 bis 10, ferner umfassend eine Vielzahl von Hydraulikhebern (30) zum Hochheben dieser, sodass die Gummiräder (4) von dem Boden gelöst werden.

Revendications

1. Structure pouvant être remorquée (1, 11) à roues, comprenant :

- un châssis (2) sur lequel sont montés une pluralité de groupes d'ensembles roues (3), chaque groupe (3) comprenant une ou plusieurs roues en caoutchouc (4), équipées de pneus et montées de manière à entrer en rotation autour d'un axe de roue (A) respectif ;
- des moyens (5, 5', 6, 6', 7) pour le blocage de la rotation des roues de chaque groupe de roues (3) dans des positions de blocage prédéterminées ;
- des moyens d'actionnement desdits moyens (5, 5', 6, 6', 7) pour le blocage de la rotation des roues en caoutchouc (4), conçus pour déplacer les roues de chaque groupe (3) d'une position de blocage à une autre pendant le déplacement de ladite structure pouvant être remorquée (1, 11),

caractérisée en ce que lesdits moyens (5, 5', 6, 6', 7) pour le blocage de la rotation comprend une paire de flasques (5, 5') montés coaxialement de manière à entrer en rotation solidairement autour d'un axe de flasque (F) et équipés respectivement d'une pluralité de fentes (9, 9'), et une paire de goupilles (6, 6') solidaires d'un châssis (8) dudit groupe de roues (3) et aptes à interférer, lorsqu'elles sont actionnées, chacune avec les fentes (9, 9') de l'un desdits flasques (5, 5'), lesdits moyens (5, 5', 6, 6', 7) comprenant en outre un système de transmission (7) qui relie ledit axe de flasque (F) audit axe de roue (A).

2. Structure pouvant être remorquée (1, 11) selon la revendication 1, dans laquelle chaque groupe de roues (3) comprend deux roues coaxiales en caoutchouc (4).
3. Structure pouvant être remorquée (1, 11) selon la revendication 1 ou 2, dans laquelle les roues en caoutchouc (4) de chaque groupe de roues (3) sont solidaires en rotation les unes des autres.
4. Structure pouvant être remorquée (1, 11) selon l'une des revendications 1 à 3, dans laquelle lesdites fentes (9, 9') sont réalisées au niveau d'une circonférence périphérique de chaque flasque (5, 5'), également réparties le long de ladite circonférence.

5. Structure pouvant être remorquée (1, 11) selon l'une des revendications 1 à 4, où lesdites fentes (9, 9') ont toutes la même largeur le long de ladite circonférence. 5
6. Structure pouvant être remorquée (1, 11) selon l'une des revendications 1 à 5, dans laquelle lesdits flasques (5, 5') d'une paire de flasques sont déphasés l'un par rapport à l'autre de sorte que le début de chaque fente (9) sur un premier flasque (5) correspond à la fin d'une fente (9') sur un second flasque (5'), chaque point de correspondance entre les fentes (9, 9') définissant une position prédéterminée correspondante. 10
7. Structure pouvant être remorquée (1, 11) selon l'une des revendications 1 à 6, dans laquelle lesdits moyens d'actionnement comprennent un mécanisme pour l'actionnement hydraulique desdites goupilles (6, 6'). 15
8. Structure pouvant être remorquée (1, 11) selon l'une des revendications 1 à 7, dans laquelle lesdits groupes de roues (3) sont agencés sur six axes (A) parallèles les uns aux autres et orthogonaux à une direction de remorquage (T) de la structure (1, 11). 20
9. Structure pouvant être remorquée (1, 11) selon la revendication 8, où lesdits groupes de roues (3) sont répartis sur chacun desdits six axes parallèles (A), de telle sorte que l'empreinte des roues en caoutchouc (4) de groupes sur des axes différents se chevauche partiellement, pour couvrir entièrement le gabarit global (S) de la structure pouvant être remorquée (1, 11). 25
10. Structure pouvant être remorquée (11) selon l'une des revendications 1 à 9, comprenant en outre une paire de roues de manoeuvre (14) montées sur un mécanisme articulé (20), de telle sorte que les roues de manoeuvre (14) peuvent être positionnées dans une première position de traitement où elles sont soulevées du sol, les roues en caoutchouc (4) étant en contact avec le sol, et une seconde position de manoeuvre où elles sont en contact avec le sol, les roues en caoutchouc (4) étant soulevées par le sol. 30
11. Structure pouvant être remorquée (1, 11) selon l'une des revendications 1 à 10, comprenant en outre une pluralité de vérins hydrauliques (30) pour la soulever, de sorte que les roues en caoutchouc (4) sont détachées du sol. 35

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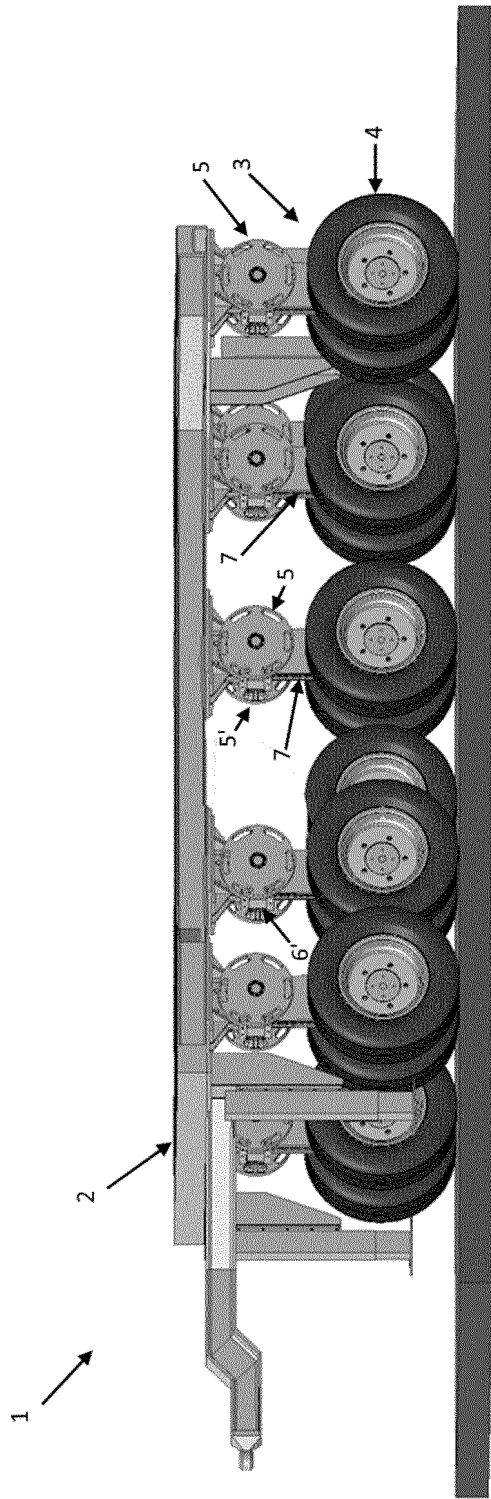


FIG. 1

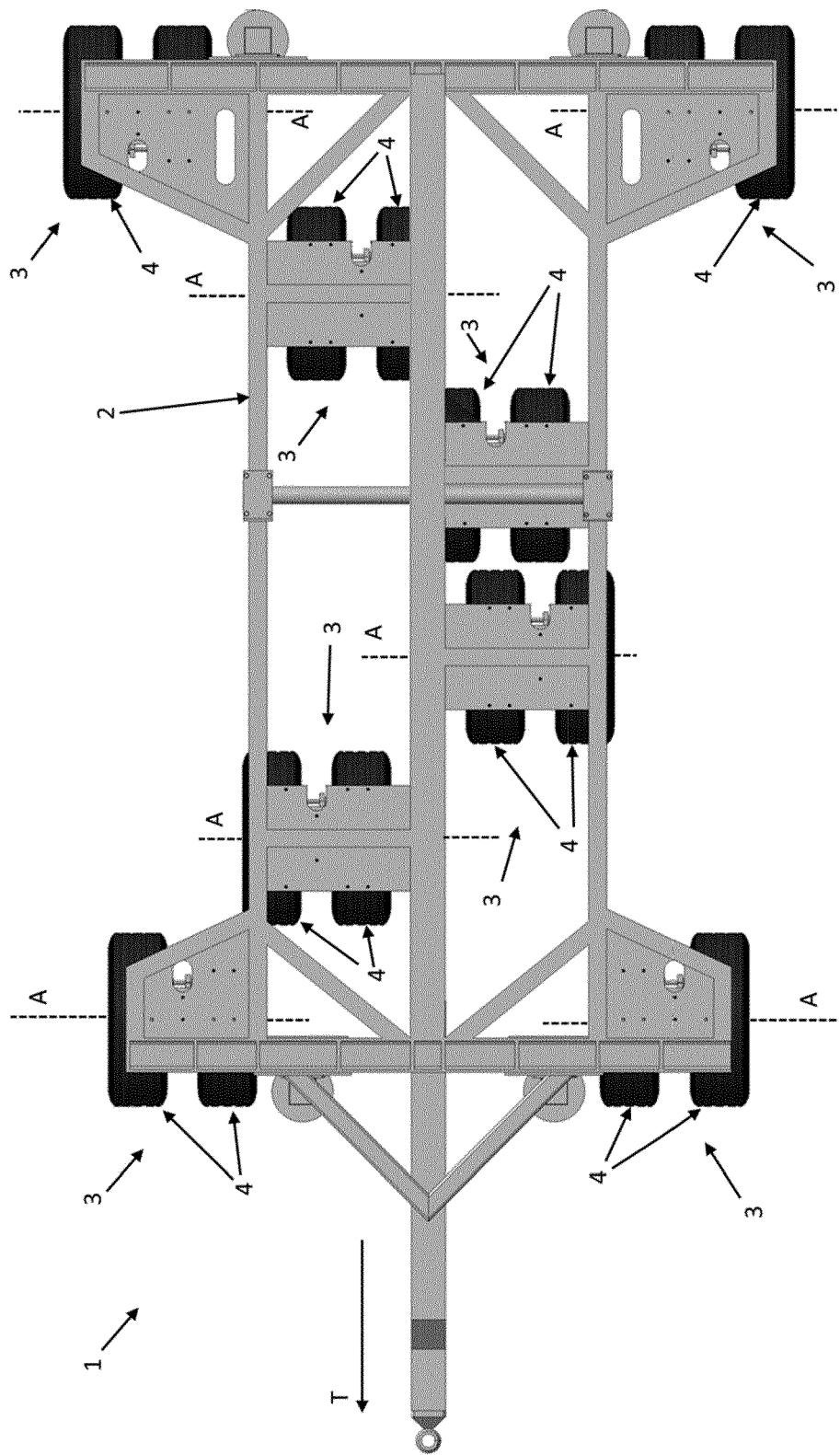


FIG. 2

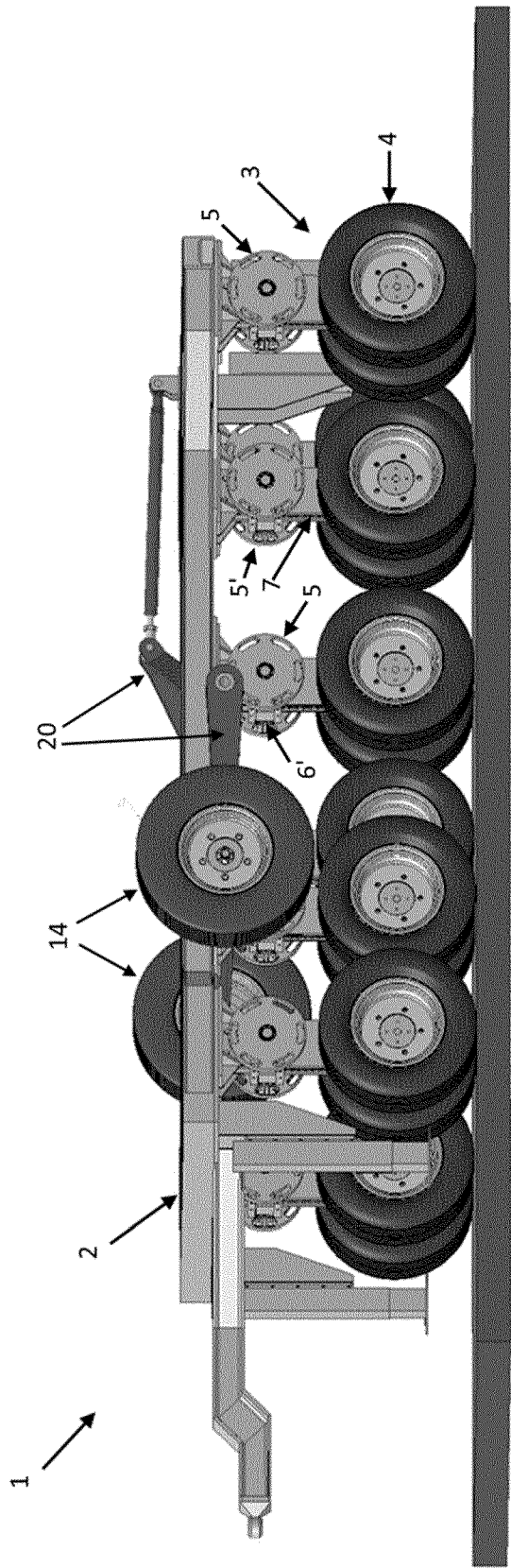


FIG. 3

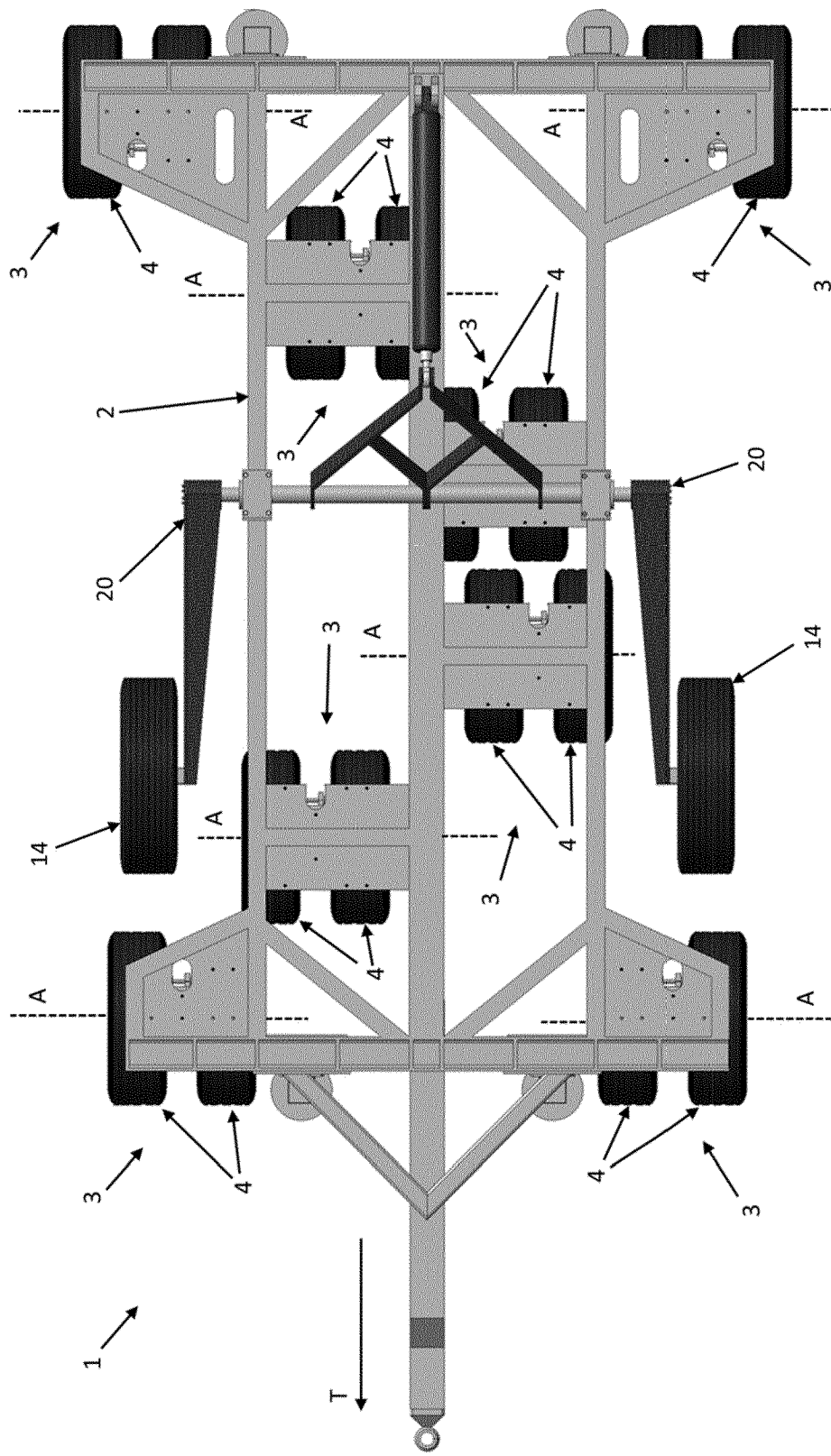


FIG. 4

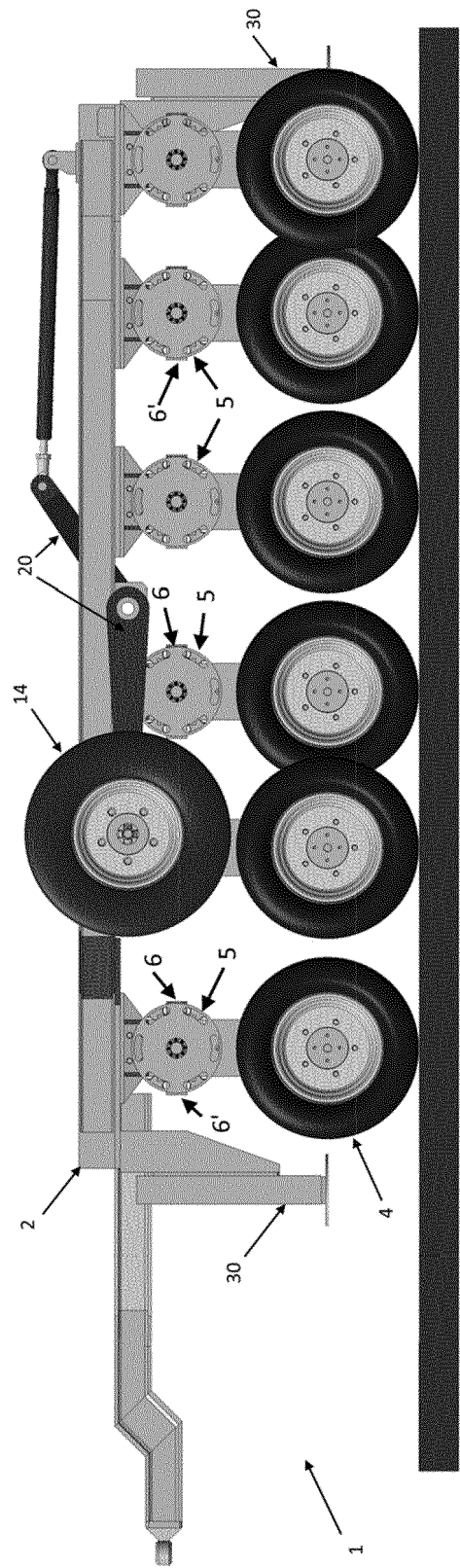


FIG. 5A

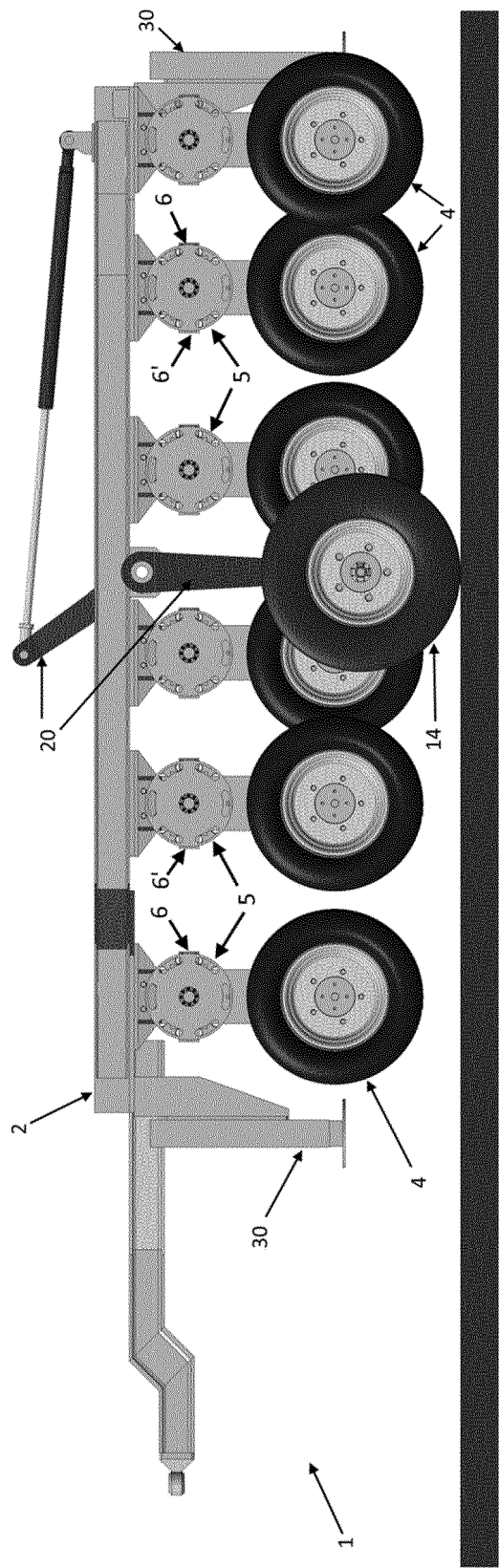


FIG. 5B

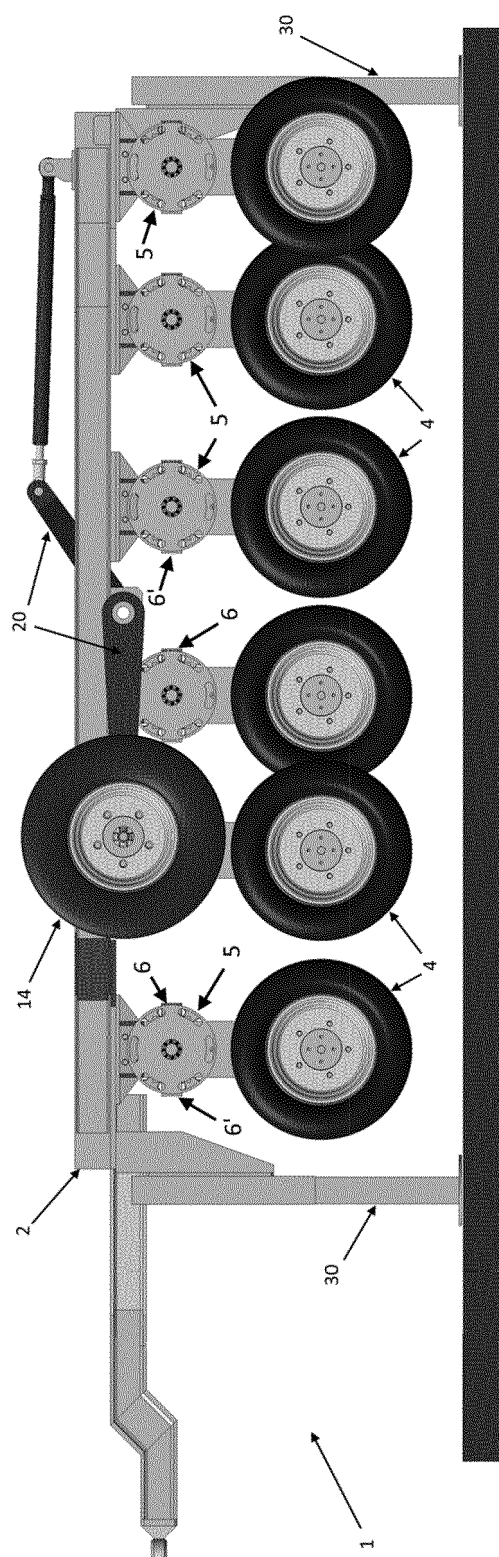


FIG. 6

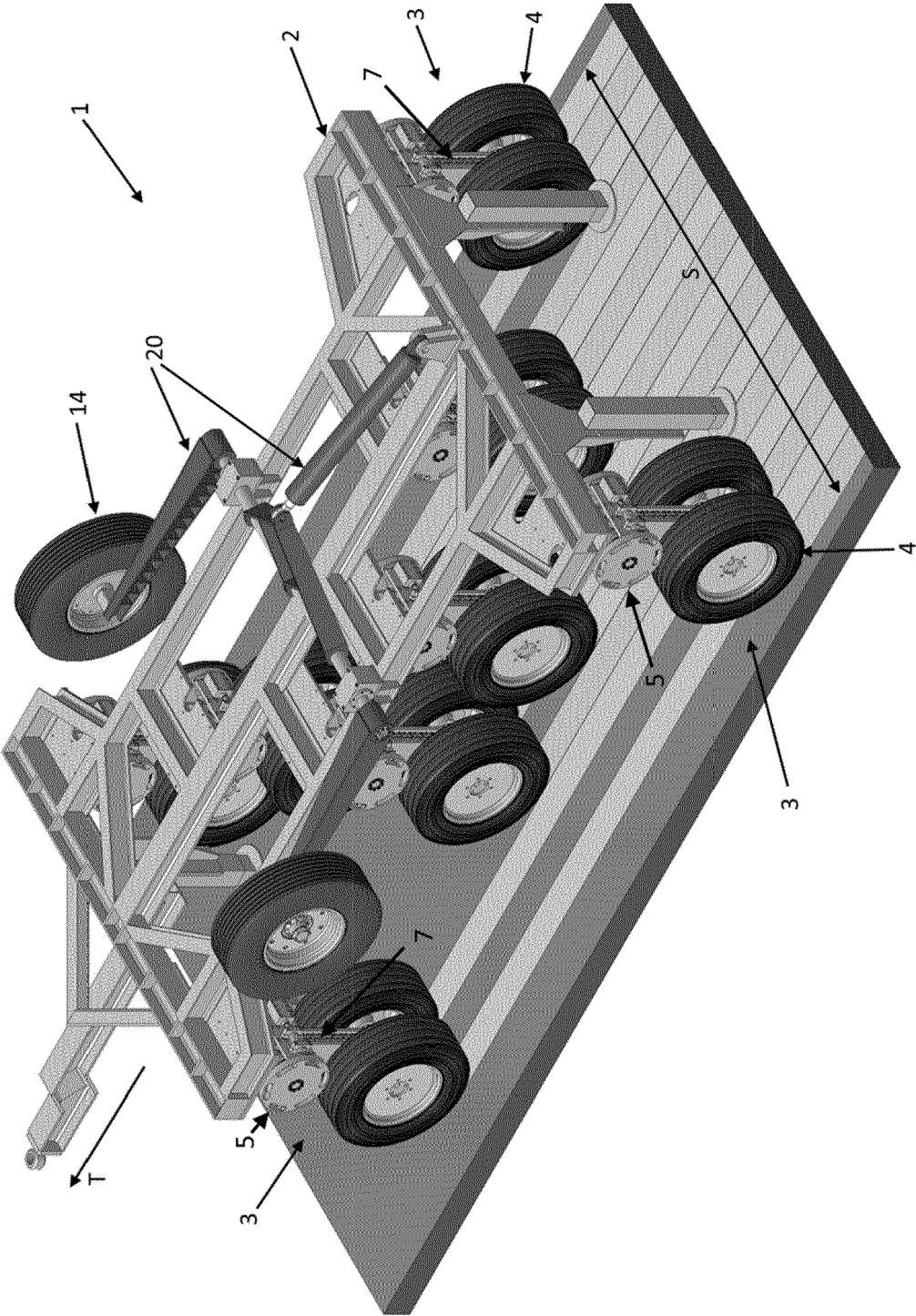


FIG. 7A

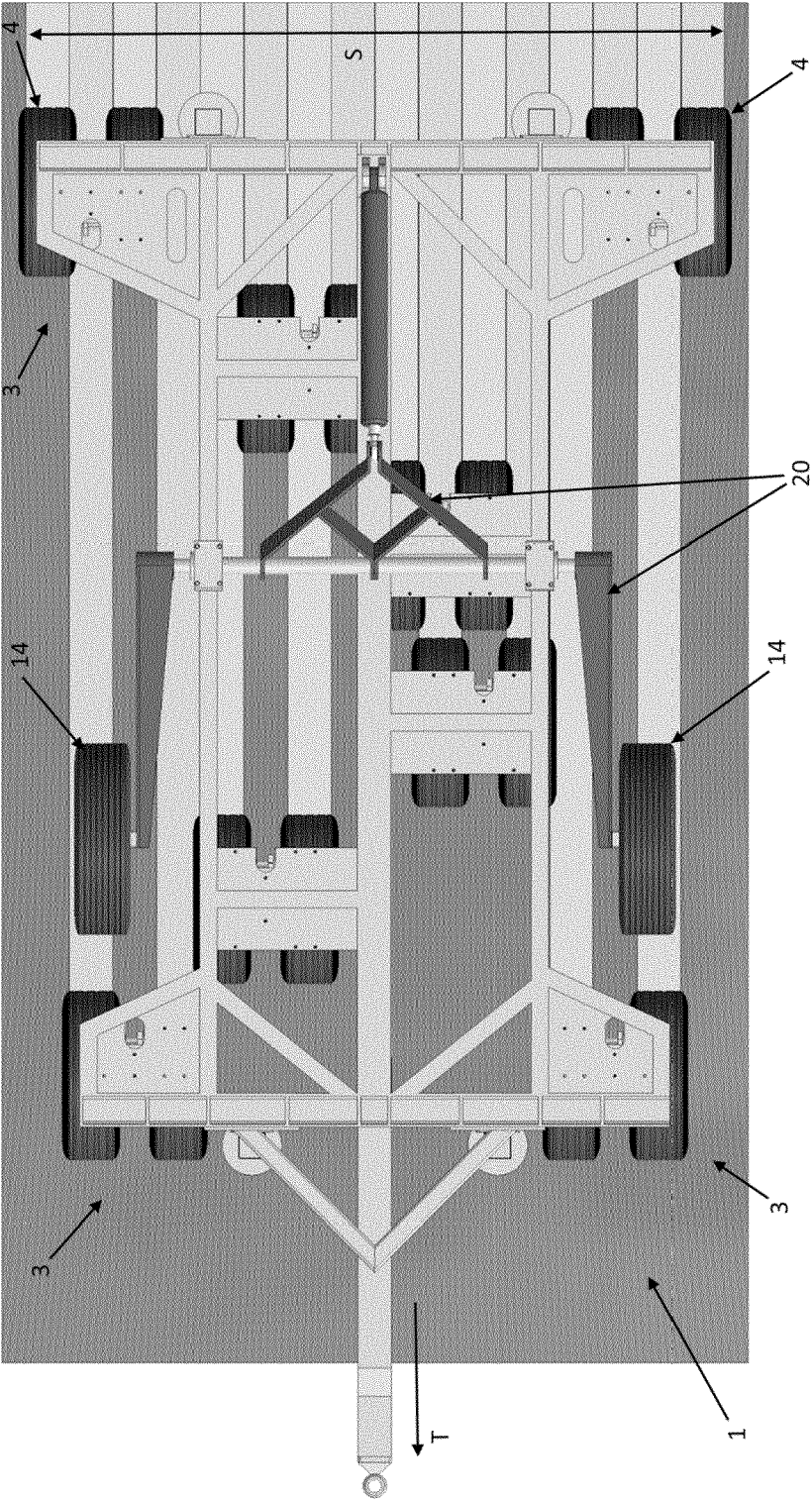


FIG. 7B

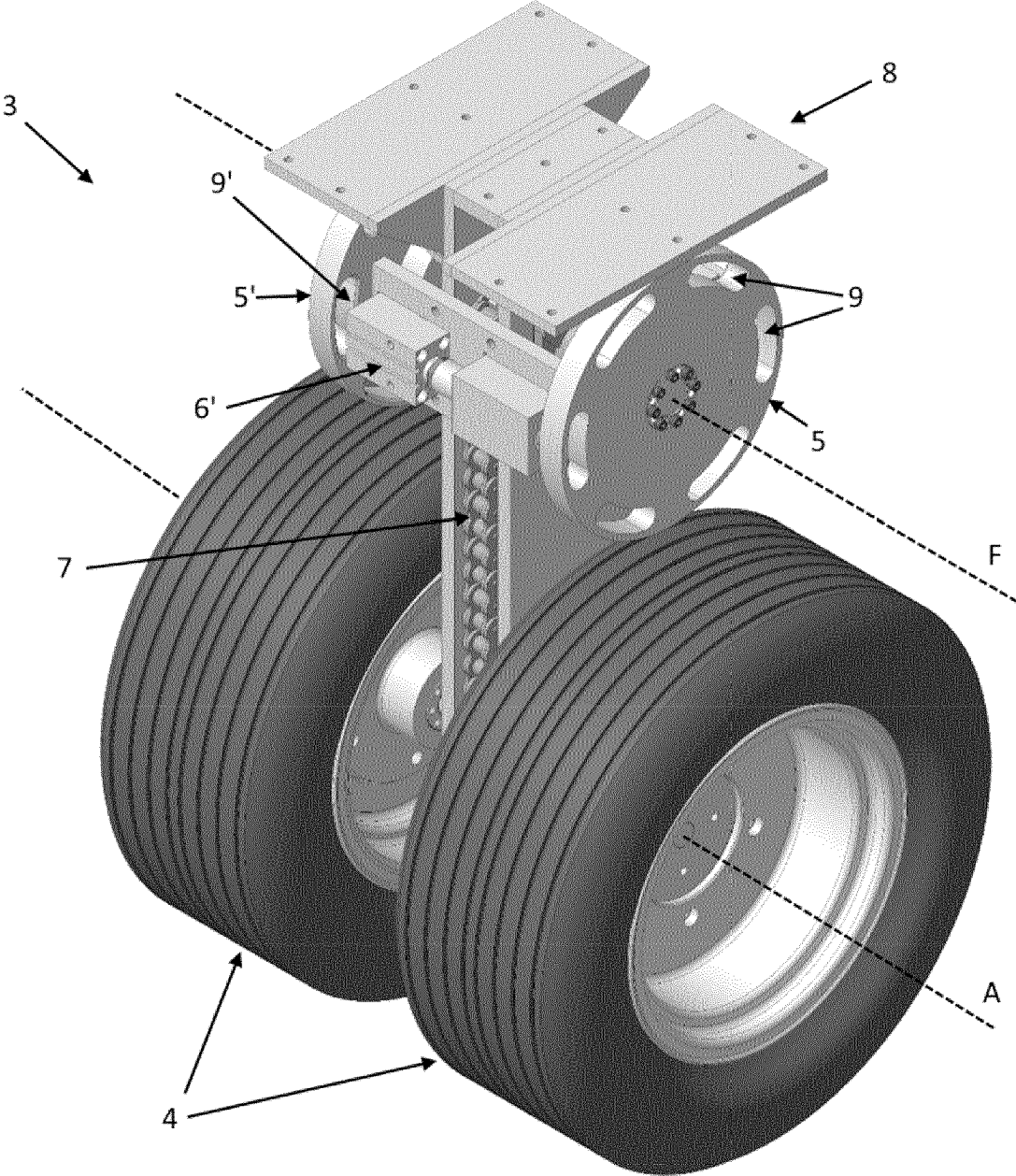


FIG. 8

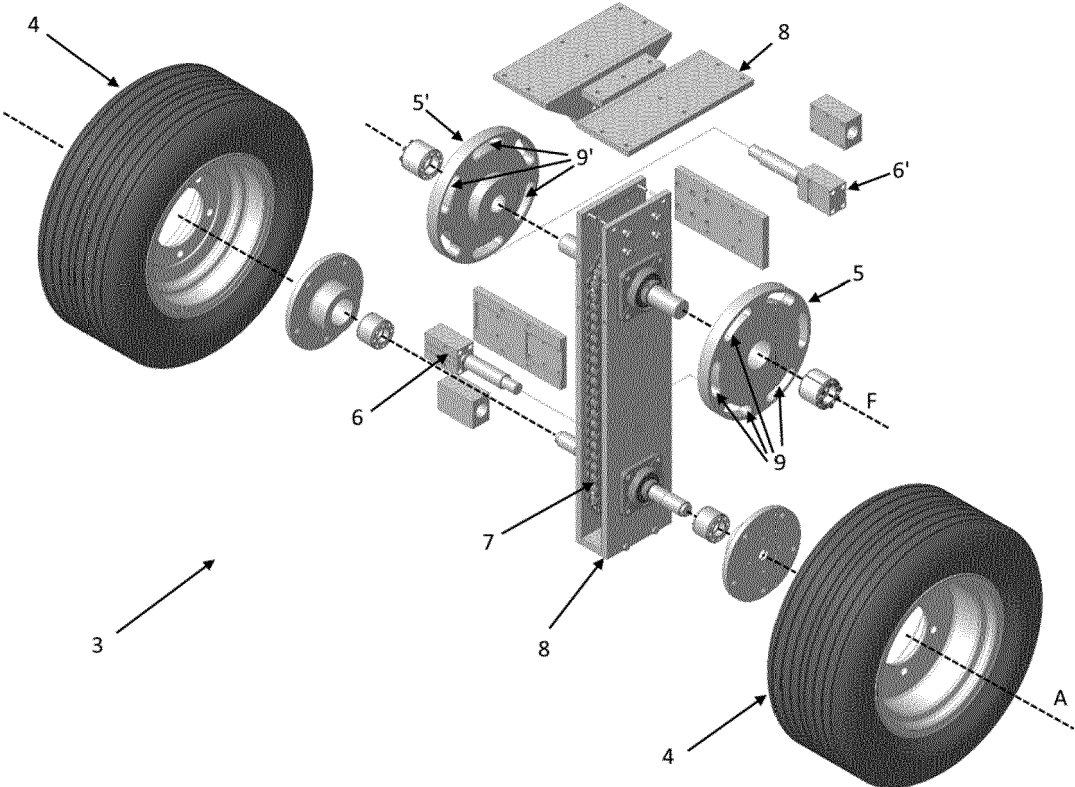


FIG. 9

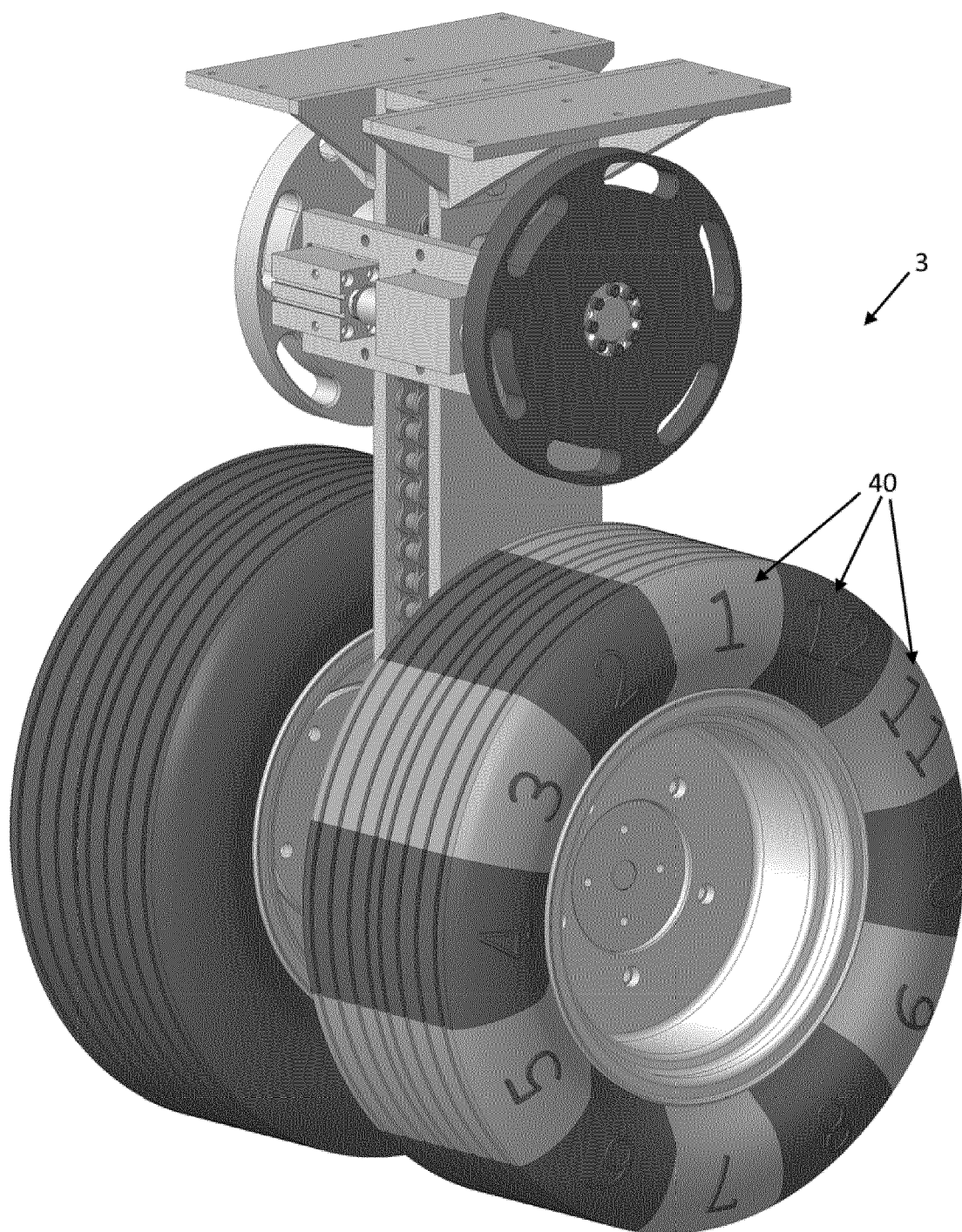


FIG. 10

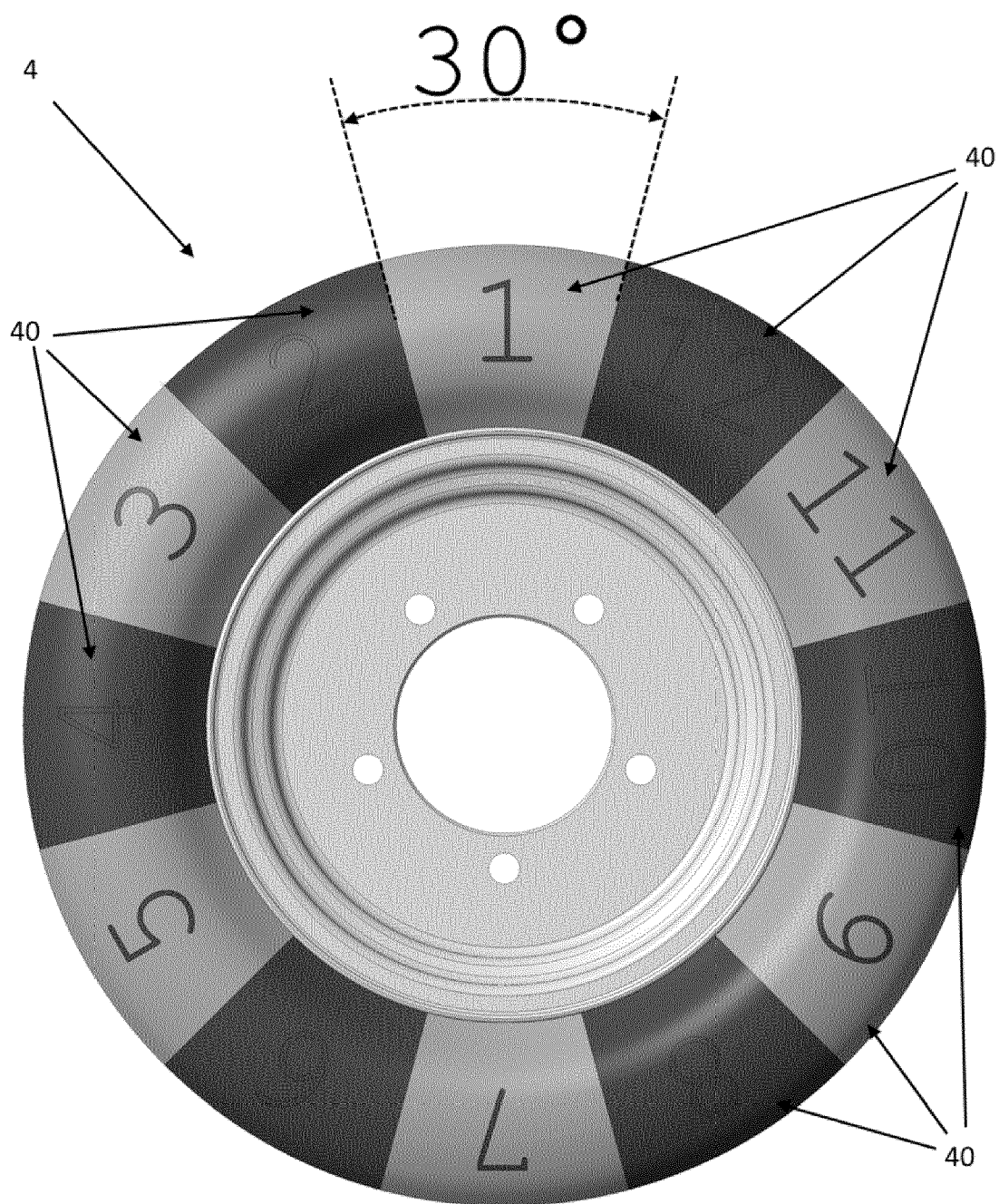


FIG. 11

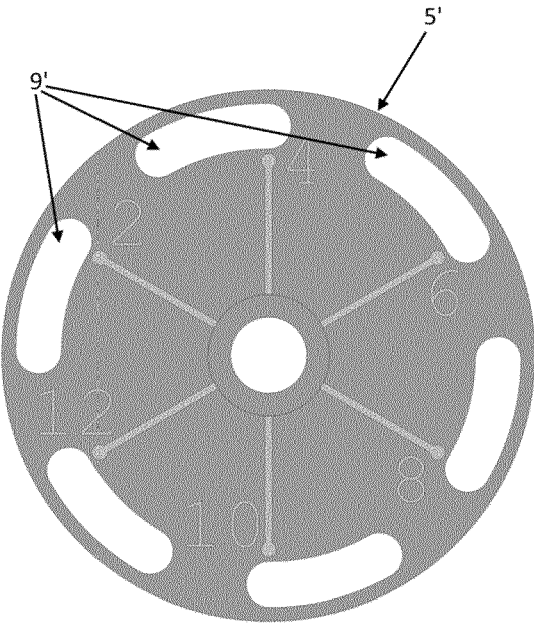


FIG. 12A

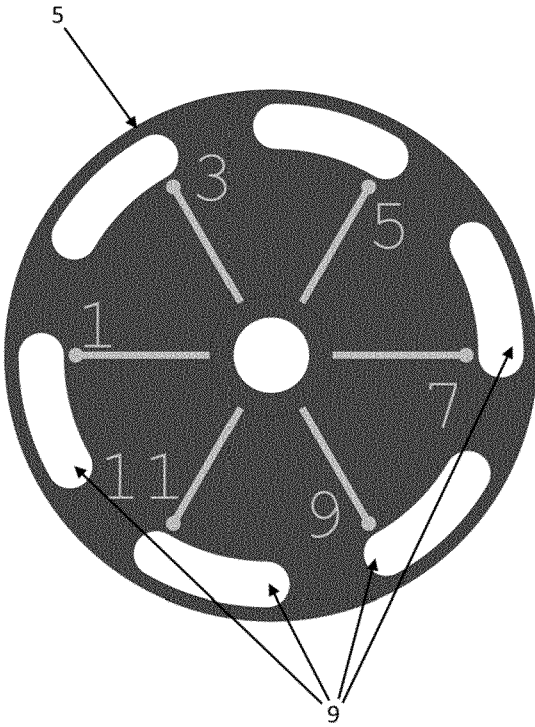


FIG. 12B

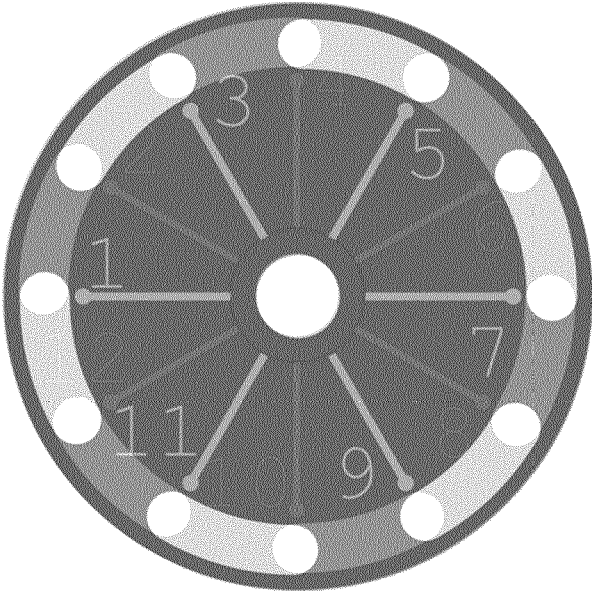


FIG. 12C

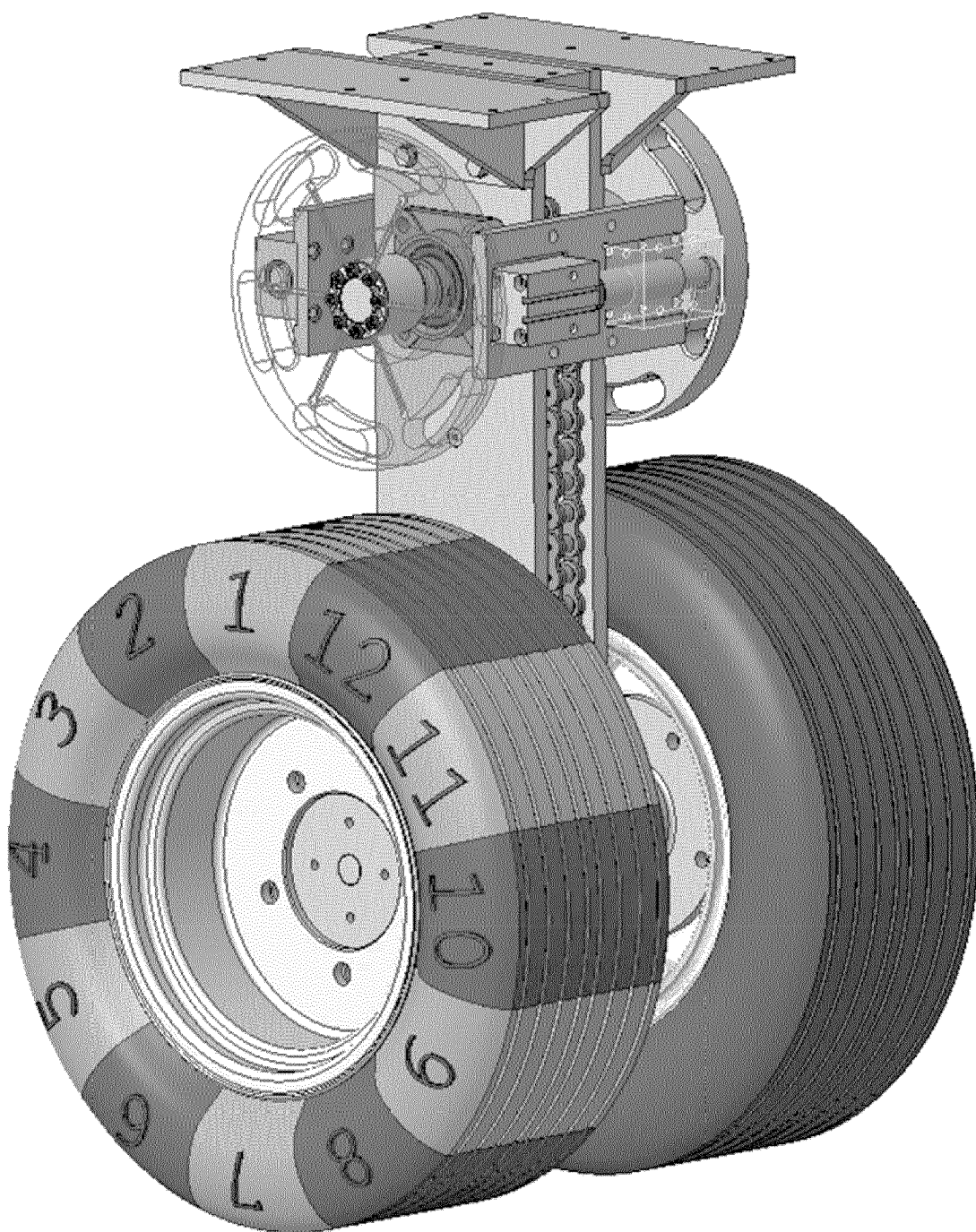


FIG. 13

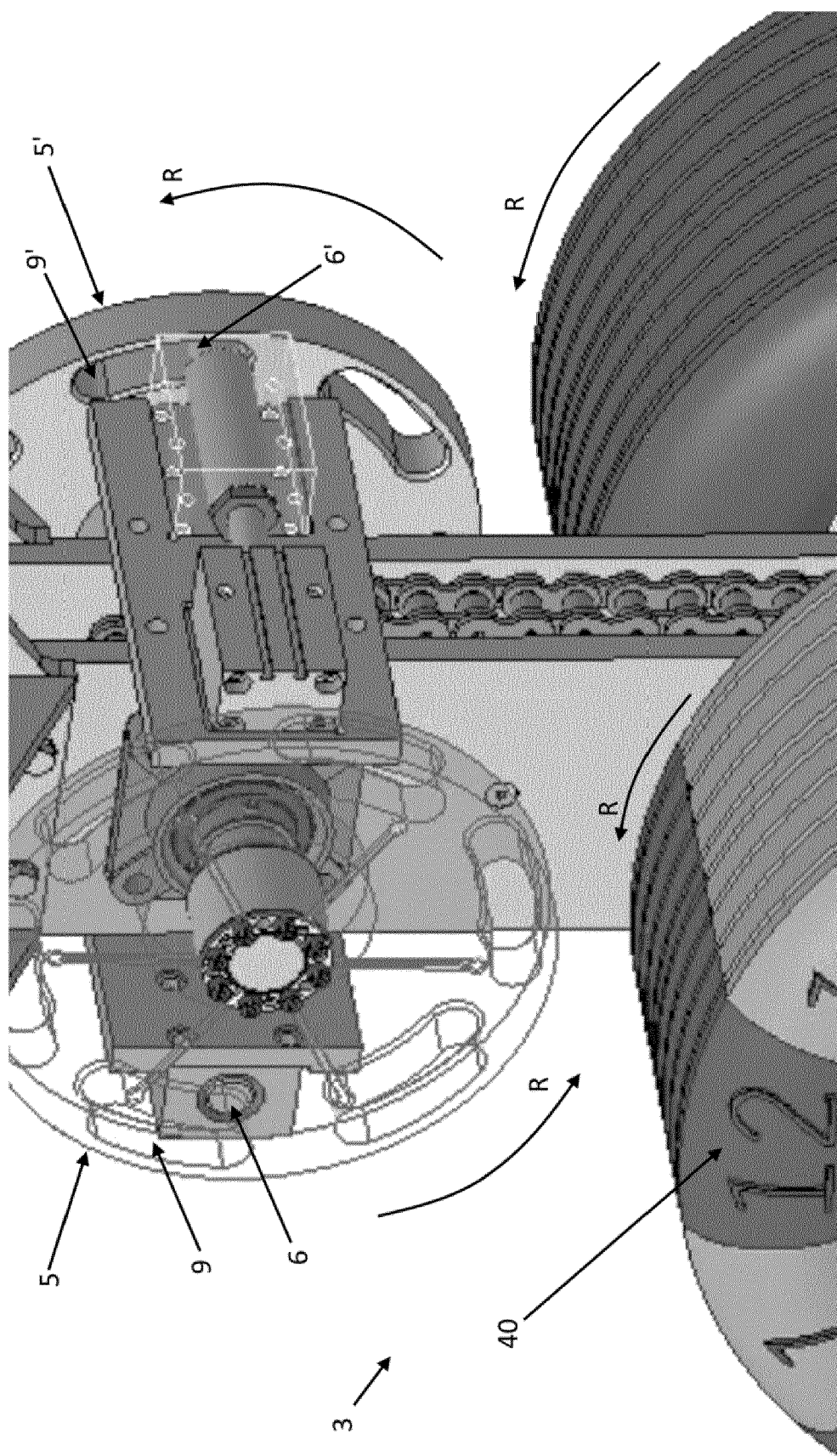


FIG. 14A

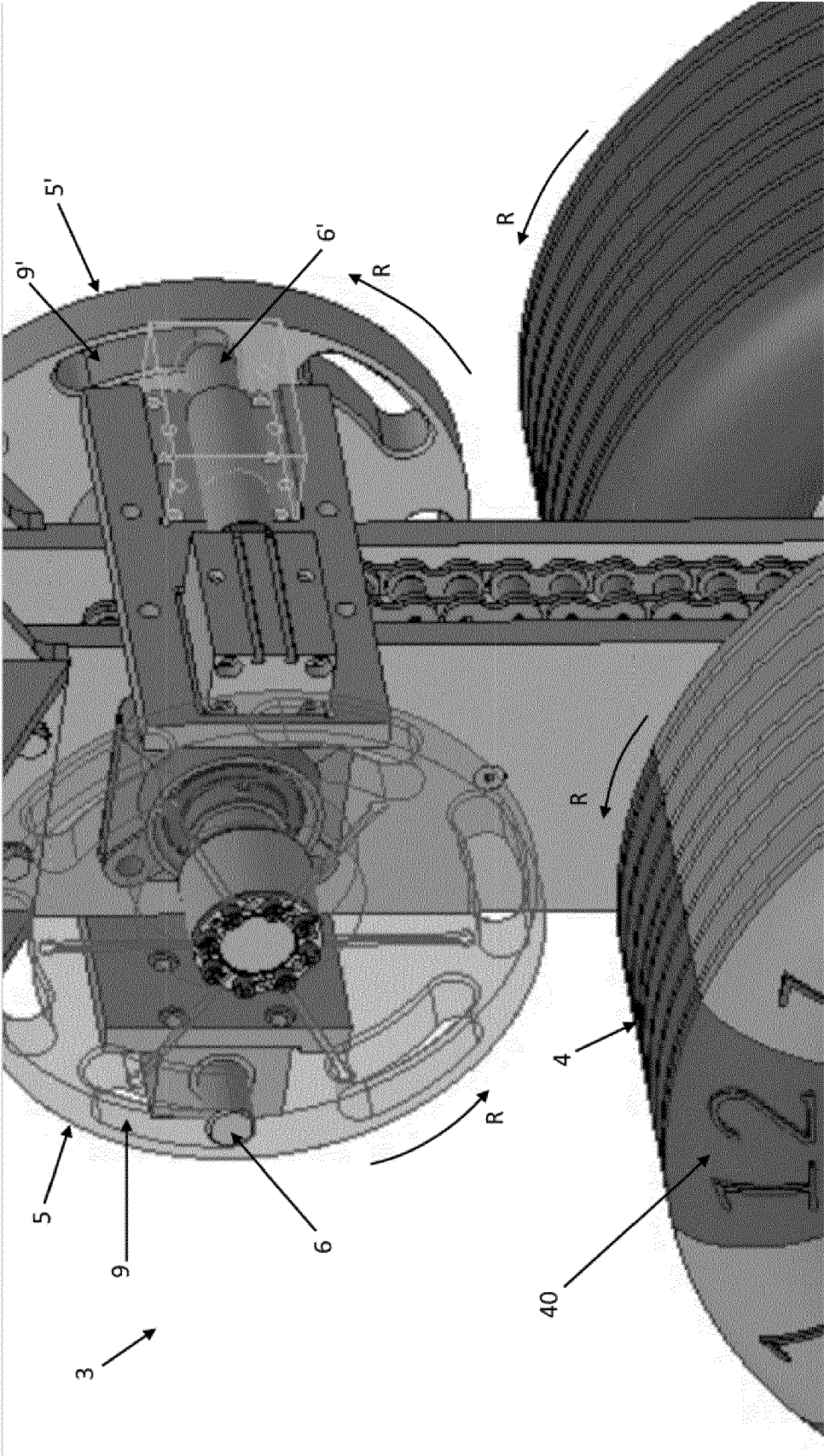


FIG. 14B

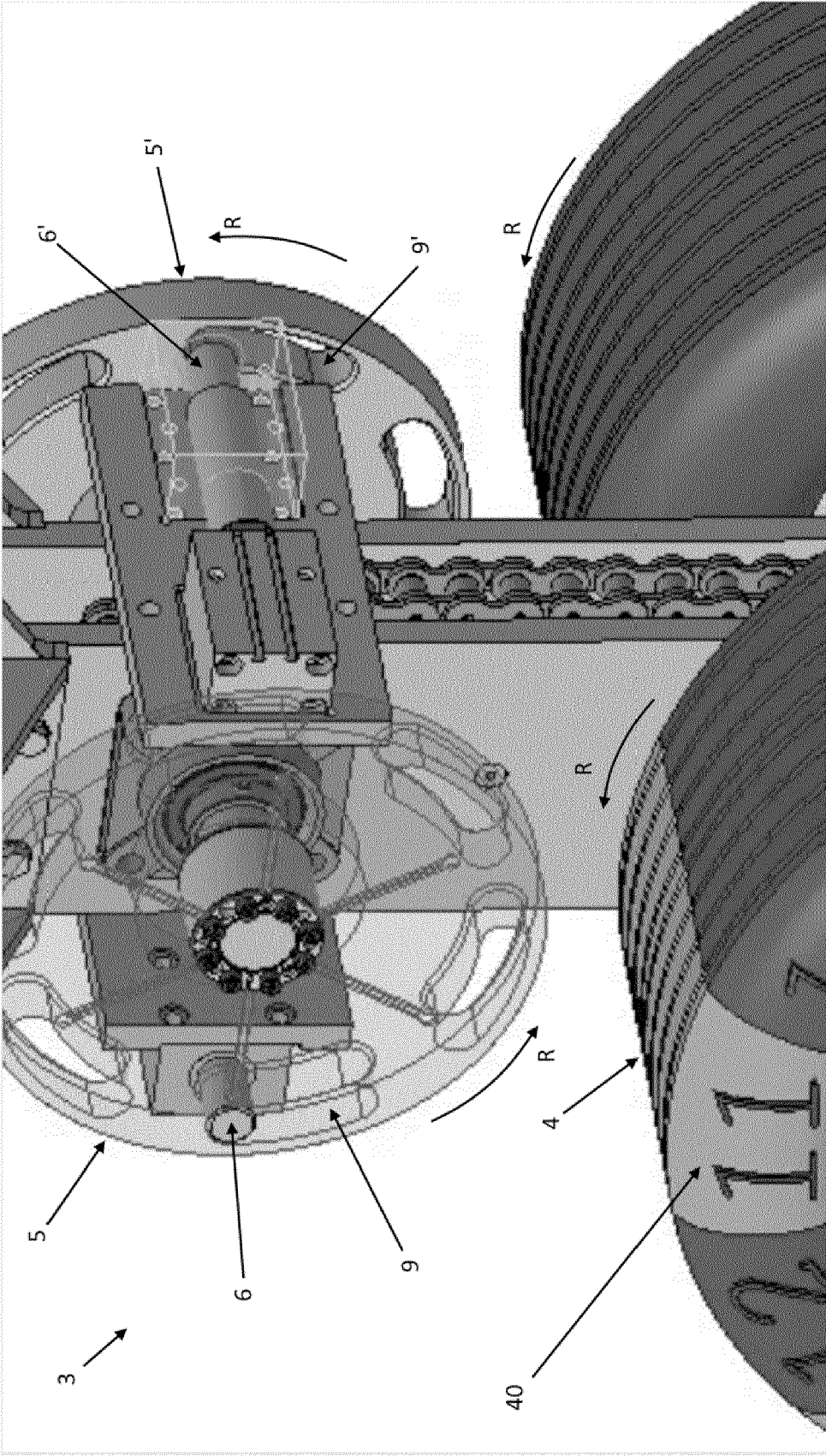


FIG. 14C

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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