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(54) **GAUGE-CHANGING SYSTEM FOR NARROW GAUGE**

(57) The system is devised for adapting the bogies of a train to different railway track gauges, including a plurality of bogies made by two half-bogies (1 or 1') which are displaceable by means of lateral sleepers (2 or 2') and a central sleeper (3 or 3'), said displacement being locked by means of locking mechanisms (4 or 4') provided on the lateral sleepers (2') and central sleeper (3'), where the half-axles (5') of the respective half-bogies (1 or 1') are independent. The system further includes a gauge changing platform having lateral displacement bedplates (14 or 14') provided with bogie gauge opening means (9 or 9') and closing means (16 or 16') actuated by means of reversible screws. The system further includes bogie-carrying carriages (10 or 10') which are displaceable along a ditch (13 or 13'), each of said bogie-carrying carriages (10 or 10') being provided with a counterpivot (12) for elevating the transported load during the adaptation maneuvers, such that the gauge opening and closing means do not have to carry out great efforts, and providing also traction to said bogie until the next bogie arrives at the gauge changing platform.

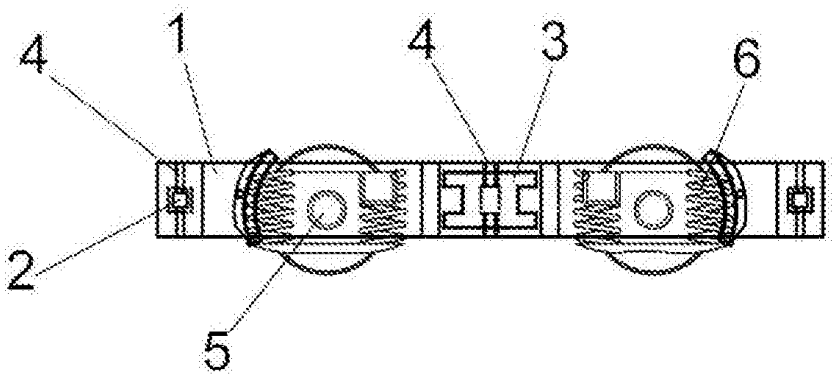

FIG. 1a

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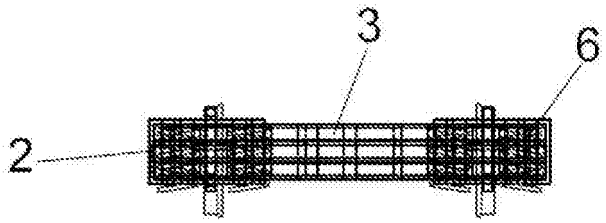

FIG. 1b

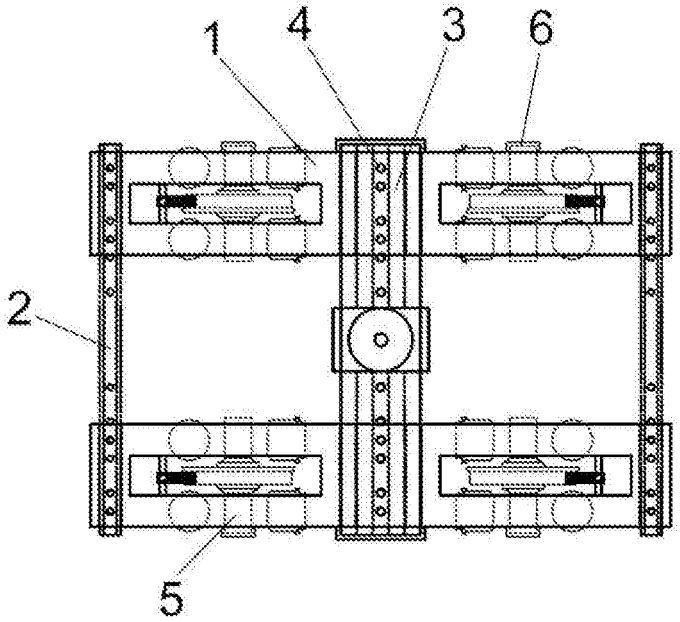

FIG. 1c

Description

Object of the invention

[0001] The present invention refers to a railway track gauge changing system to metric gauge where the change takes place automatically; it is therefore not necessary to transfer the load from the train with the original railway track gauge to a new train with a new railway track gauge anymore, or to replace the train axles.

[0002] The object of the invention is to eliminate the currently existing physical barrier in connection with the gauge change to metric gauge.

[0003] The invention thus pertains to the railway field.

Prior art

[0004] A gauge changing installation refers to a place where trains are adapted to a railway track of a different width. There are specific solutions for passenger trains, but the operating principle of these solutions cannot not be used in any train not pertaining to the original train family of each corresponding manufacturer.

[0005] Nowadays, known changing system TCRS 4 allows the change of different types of trains to take place in a single platform, although icing problems arise in some of the compatible systems.

[0006] A variable gauge bogie system with a changer where the gauge change does not take place actively or automatically on the corresponding bogie is also known.

[0007] A system using a fixed frame bogie where the gauge change takes places by means of a wheel displacement complemented by means of a fixed changing platform is also known.

[0008] However, both solutions have in common their inability to adapt to any gauge, as well as their exclusive use in passenger trains, since they cannot be employed in freight trains.

[0009] Specifically, in connection with freight transport by train, there is no fluid solution allowing the change from one gauge to another, and therefore the gauge change takes place by means of slow and difficult cargo transfers or by replacing the train axles; accordingly, there is currently no generally used system allowing the gauge change to take place in a fluid, continuous way.

Description of the invention

[0010] The system of the invention is devised for satisfactorily solving the abovementioned drawbacks thanks to performing the gauge change automatically.

[0011] The system is mainly based on a bogie having a special configuration where the classic axle is eliminated and replaced with two half-axles for each wheel.

[0012] Therefore, the structure of the bogie is divided in two parts, that is, each bogie is formed by two half-bogies, in combination with the respective connection elements corresponding to a central sleeper and two lateral sleepers.

[0013] There are locks housed inside these sleepers, both central and lateral, the locks being different for the central and the lateral sleepers, and the locking of the bogie takes places based on these locks, where the unlocking takes place by means of the action of electromechanically actuated eccentric axles on the bolts that constitute the lock, thus allowing the bogie to adapt to different gauges.

[0014] The movement allowing the gauge change takes place when the half-bogies displace on the central and lateral sleepers; during such displacement it is necessary to control that the sleepers do not move laterally when the gauge change takes place; in order to do that, control means are installed in the changer unit.

[0015] On the other hand, the bogie includes a telescopic guiding system for allowing the two wheels to turn at the same speed.

[0016] Additionally, the bogie includes a braking system based on four pneumatic actuators connected to the TFA pipe by means of flexible connections; this provides for the possibility of manually actuating the parking brakes of the bogie by means of actuators.

[0017] With respect to the changer itself, it includes a set of bogie-carrying carriages which move inside a ditch by means of a rack system with metallic wheels displaceable on tracks; this is complemented by lateral displacement bedplates designed for carrying out the gauge change in such a way that the movement of the bogie-carrying carriages may be oscillating, carousel-type continuous or by transfer. In any case, the bogie-carrying carriages pull the coach in the train movement direction and leave it on the zone where the lateral displacement bedplates are located, where the gauge change takes places, said pulling taking place by means of the central counter-pivot which forms part of the bogie-carrying carriage itself and which is able to move upwards by means of the action of a reversible electric screw.

[0018] In the gauge changing process, the use of the abovementioned counter-pivot takes place by means of elevating the load supported by the bogie during a short period of time, the height of such elevation being just some centimeters, in such a way that during that period of time the load is released from the half-bogies, this in turn allowing that upon the action of the lateral displacement bedplates on the half-bogies, locks and central and lateral sleepers, where the lateral displacement bedplates are responsible for the displacement of the tracks which move during the gauge change operation, the bogie gauge change takes place simply and with a lower friction.

[0019] When the half-bogies move laterally during the gauge change, the turning of the wheels is impeded by means of a locking system, which can be actuated manually if necessary.

[0020] Therefore, the elevation movement of the counter-pivot pertaining to the bogie-carrying carriages takes places in two phases, one corresponding to the lower

position for pulling the coach, and another corresponding to a higher position where the load is elevated some centimeters for a short period of time for performing the gauge change operation. The same gauge change system could be applied in case the coach comprised a rolling system formed by half-bogies of a single axle.

[0021] In an alternative embodiment of the changer, the unlocking is pneumatically actuated by means of suitable actuators, which are actuated by means of suitable reversible screws.

[0022] Also, another novel feature of the bogie consists in that the central and lateral sleepers are interconnected by means of stiffeners for maintaining the relative position between the sleepers during the gauge change operation.

[0023] In connection with the stiffeners connecting the central and lateral sleepers, they can include ducts for the passage of pressurized air from the central sleeper to the lateral sleepers during the unlocking process, thus allowing for a reduction in the unlocking mechanisms of the changer, that is, allowing for the elimination of the actuators of the lateral sleepers, thereby saving costs.

[0024] In addition, the bogie may be provided on a single central sleeper, without lateral sleepers. In this case, the displacement of the half-bogies would take place on a single central sleeper with a cylindrical shape, the half-bogies including prismatic pieces housed in respective recesses provided in the half-bogies for supporting the ends of said central sleeper, with a high resistance elastomeric material provided therebetween.

[0025] In this embodiment of the invention where only a single central sleeper is employed, the latching locks would enter in the prismatic support pieces for said central sleeper, allowing it to turn slightly.

[0026] It is also worth mentioning that the telescopic guiding system of the half-axles of the bogies may be complemented by means of a cardan transmission system, or else by means of a torque transmitting flexible coupling system.

[0027] All the movements will be controlled by means of a programmable computer (central PLC), and the system will additionally be controlled by means of artificial vision equipment which will supervise structural defects, temperatures and geometric shapes, thereby allowing the motorization of the bogie formed by two half-bogies, that is, with four half-axles, by means of geared motors for speeds under 90 km/h, thereby allowing for a high traction capability.

[0028] The advantages of the described system are now summarized:

- Solution to the icing problem arising in the several conventional gauge change systems.
- Solution to the problem of supervising the change process in conventional systems.
- Automatic system assisted from the changer, thereby reducing the cost of the bogie set.
- Reduced maintenance system, limited to the usual wearing.
- The system is valid for several types of gauges.
- The system is highly robust and therefore it has a long life.

Description of the drawings

[0029] In order to complement the following description and with the object of achieving a better understanding of the features of the invention, according to a preferred embodiment of the same, a set of drawings are attached as an integral part of said description, the drawings being merely illustrative, not limiting, which represent:

Figures 1a, 1b and 1c.- Show respective schematic front, side and top views of the bogie, the first component part of the device of the invention, where the elements forming it are disclosed in a position corresponding to a gauge greater than metric.

Figures 2a, 2b and 2c.- Show respective schematic front, side and top views of the bogie, the first component part of the device of the invention, where the elements forming it are disclosed in a position corresponding to the metric gauge.

Figures 3a, 3b and 3c.- Show respective schematic front, side and top views of the changer, the second component part of the device of the invention, where the elements forming it are disclosed in a position corresponding to the moment when the change to metric begins.

Figures 4a, 4b and 4c.- Show respective schematic front, side and top views of the changer, the second component part of the device of the invention, where the elements forming it are disclosed in a position corresponding to the moment when the change from metric begins.

Figures 5a, 5b.- Show respective schematic top views of the bogie in the changer where the interaction between the different elements in positions corresponding to the beginning of the change from metric gauge and to metric gauge, respectively, can be seen.

Figure 5c.- Shows a front view of the unit of figure 5a.

Figures 6a, 6b and 6c.- Show respective schematic front, side and top views of the rolling system having a single axle formed by half-bogies in a position corresponding to the beginning of the change from met-

ric gauge.

Figures 7a, 7b and 7c.- Show respective schematic front, side and top views of the bogie, the first component part of the device of the invention, where the elements forming it are disclosed in a position corresponding to the gauge greater than metric, in case it includes the telescopic guiding system between both wheels.

Figures 8a, 8b and 8c.- Show respective schematic front, side and top views of the bogie, the first component part of the device of the invention, where the elements forming it are disclosed in a position corresponding to metric gauge, in case it includes the telescopic guiding system between both wheels.

Figures 9a and 9b.- Show respective schematic plant views of the bogie in the changer where the interaction between the different elements, in case it includes the telescopic guiding system between both wheels, in the positions corresponding to the beginning of the change from metric gauge and to metric gauge, respectively, can be seen.

Figure 9c.- Shows a front view of the unit of figure 9a.

Figures 10a, 10b and 10c.- Show respective schematic front, side and top views of the single axle rolling system formed by half-bogies, in case it includes the telescopic guiding system between both wheels, in a position corresponding to the moment when the change from metric begins.

Figures 11a, 11b and 11c.- Show respective schematic front, side and top views of the bogie, the first component part of the device object of the invention, where the elements forming it are disclosed in a position corresponding to the gauge greater than metric.

Figures 12a, 12b and 12c.- Show respective schematic front, side and top views of the bogie, the first component part of the device object of the invention, where the elements forming it are disclosed in a position corresponding to metric gauge.

Figures 13a, 13b and 13c.- Show respective schematic front, side and top views of the changer, the second component part of the device object of the invention, where the elements forming it are disclosed in a position corresponding to the moment when the change to metric gauge begins.

Figures 14a, 14b and 14c.- Show respective schematic front, side and top views of the changer, the second component part of the device object of the invention, where the elements forming it are disclosed in a position corresponding to the moment when the change from metric gauge begins.

Figures 15a and 15b.- Show respective schematic plant views of the bogie in the changer where the interaction between the different elements in the positions corresponding to the beginning of the change from metric gauge and to metric gauge, respectively, can be seen.

Figure 15c.- Shows a front view of the unit of figure 5a.

Figures 16a, 16b and 16c.- Show respective schematic front, side and top views of the single axle rolling system formed by half-bogies in a position corresponding to the beginning of the change from metric gauge.

Figures 17a, 17b and 17c.- Show respective schematic front, side and top views of the bogie, the first component part of the device object of the invention, where the elements forming it are disclosed in a position corresponding to the gauge greater than metric, in case it includes the telescopic guiding system between both wheels.

Figures 18a, 18b and 18c.- Show respective schematic front, side and top views of the bogie, the first component part of the device object of the invention, where the elements forming it are disclosed in a position corresponding to metric gauge, in case it includes the telescopic guiding system between both wheels.

Figures 19a and 19b.- Show respective schematic plant views of the bogie in the changer where the interaction between the different elements, in the case it includes the telescopic guiding system between both wheels, in the positions corresponding to the beginning of the change from metric gauge and to metric gauge, respectively, can be seen.

Figure 19c.- Show a front view of the unit of figure 9a.

Figures 20a, 20b and 20c.- Show respective schematic front, side and top views of the single axle rolling system formed by half-bogies, in case it includes the telescopic guiding system between both wheels, in a position corresponding to the beginning of the change from metric gauge.

Figures 21a, 21b and 21c.- Show respective schematic front, side and top views of the bogie, in the configuration without lateral sleepers and central cylindrical sleeper on a prismatic fixture supported on high resistance elastomeric pieces, in a position corresponding to the gauge greater than metric.

Figures 22a, 22b and 22c.- Show respective schematic front, side and top views of the bogie, in the configuration without lateral sleepers and central cylindrical sleeper on a prismatic fixture supported on high resistance elastomeric pieces, in a position corresponding to metric gauge.

Figures 23a, 23b and 23c.- Show respective schematic front, side and top views of the bogie, in the configuration without lateral sleepers and central cylindrical sleeper on a prismatic fixture supported on high resistance elastomeric pieces, in a position corresponding to the gauge greater than metric, in case it includes the telescopic guiding system between both wheels.

Figures 24a, 24b and 24c.- Show respective schematic front, side and top views of the bogie, in the configuration without lateral sleepers and central cylindrical sleeper on a prismatic fixture supported on high resistance elastomeric pieces, in a position corresponding to the metric gauge, in case it includes the telescopic guiding system between both wheels.

Preferred embodiment of the invention

[0030] In view of the abovementioned figures, and referring specifically to figures 1 to 10, each bogie includes two half-bogies (1) having guides for the bolts used for the locking systems (4), the half-bogies (1) also having recesses or cavities which the lateral sleepers (2) and a central sleeper (3) pass through, and where the locking mechanisms (4) are located.

[0031] Since the half-bogies (1) include half-axles (5) instead of the conventional axles, there are two grease and suspension boxes on either side of the half-axles (5), as shown in the figures.

[0032] In connection with the electro-mechanic gauge opening and closure mechanism, it includes an opening mechanism (9) for the bogie gauge and a closing mechanism (16) for the bogie gauge which are actuated by means of reversible electric screws (15 and 7), respectively, these mechanisms actuating on the half-bogies (1), on the locking mechanisms (4), lateral sleepers (2) and central sleeper (3), the object of said mechanism being, in case of the sleepers, only to hold them so that they don't slide during the gauge change displacement.

[0033] The system includes lateral displacement bedplates (14) for displacing the respective tracks (8) on which the bogie moves, as well as for carrying out the bogie gauge opening and closing movement.

[0034] On the other hand, the system also includes bogie carrying carriages (10) which pull the coach towards the area of action of the lateral displacement bedplates, where the gauge change takes place by means of the displacement of the bogie-carrying carriages (10) along a ditch (13), where the driving force for said displacement is transmitted by a pinion which is independent from the wheels of the bogie-carrying carriage (10), the pinion engaging a rack (11) and being guided through metallic tracks.

[0035] A counter-pivot (12) provided in the bogie-carrying (10) carriages allows for pulling the bogie, by means of its central sleeper, for elevating the load for carrying out the gauge change.

[0036] Figure 6 shows the same system applied to half-bogies (1) of a single axle, where the lateral sleepers (2) operate as disclosed above, although in this case the central body where the counter-pivot lies moves together with the lateral sleepers (2), forming a single body.

[0037] Figures 7, 8, 9 and 10 show the same scheme as figures 1, 2, 5 and 6, respectively, with the difference that the former figures include a telescopic guiding system between both wheels for guaranteeing the same rotation speed in both.

[0038] As to the electronic installation, it includes a programmable computer (central PLC) provided in a prefabricated module outside the ditch and adjacent to the hydraulic centrals, for managing the controls, the orders, as well as the changer information, the restrictions imposed on the changer itself and the communication between the components, including also the end limit switches that provide information regarding the relative positions during the maneuvers, as well as analogical displacement transducers, anti-entrance barriers and photoelectric cells which stop all displacements in case of intrusion while operating.

[0039] The electrical installation also comprises light and sound warning indicators for indicating that displacements are taking place.

[0040] Figures 11 to 24 show an embodiment improving the embodiment disclosed in figures 1 to 10, said second embodiment comprising half-bogies (1') having recesses or cavities crossed by the lateral sleepers (2') and the central sleeper (3'), where the locking mechanisms (4') are located which use bolts located in guides provided for that purpose in the half-bogies (1').

[0041] As in the previous embodiment, the half-bogies (1') have respective half-axles (5'), besides which the respective independent grease and suspension boxes (6') are provided.

[0042] In this embodiment, the lateral sleepers (2') and the central sleeper (3') are connected by means of prismatic stiffeners (18) allowing for maintaining the same relative position between said sleepers during the gauge change process, where said stiffeners (18) can include ducts for the passage of pressurized air from the central sleeper (3') to the lateral sleepers (2') during the unlocking process, thus reducing the unlocking mechanisms and eliminating the lateral sleeper actuators located in the changer.

[0043] Figures 13, 14 and 15 disclose the gauge opening and closing electro-mechanic mechanism, including internal operation means (9') and external operation means (16') which, together with the displacement of the corresponding tracks (8'), allow for the gauge change.

Both the tracks (8') and the internal operation means (9') are displaceable together by means of the lateral displacement bedplates (14'), which in turn are actuated by reversible screws (15'), while the external operation means (16') are actuated by means of other reversible electric screws (20).

[0044] In other words, the displacement of the half-bogies (1') allowing for the gauge opening and closing takes place by means of the internal operation means (9'), moving together with the tracks (8'), since they are both connected and form part of the lateral displacement bedplates (14'), and whose movement is possible thanks to the reversible screws (15').

[0045] In connection with the external operation means (16') initially provided as pushing elements for carrying out the closing, which are actuated by means of the reversible screws (20), they can also be employed as traction elements, as well as the internal operation means (9'), and therefore the latter can be discarded, since in this case they will carry out the gauge change opening.

[0046] The unlocking of the half-bogies (1') is possible thanks to unlocking actuators (19) which, actuated by the reversible screws (7), actuate on the lateral sleepers (2') and on the central sleeper (3'), by means of an eccentric cam or a pneumatic system, depending on the locking system (4') installed.

[0047] The internal operation means (9') are retractable by means of the corresponding reversible screw for avoiding any interference with the bogie during the maneuver for exiting from the changer.

[0048] In the embodiment described in figures 11 to 24, the system includes bogie-carrying carriages (10') which pull the bogie towards the zone of action of the lateral displacement bedplates (14') where the gauge change takes place, in such a way that the displacement of the bogie-carrying carriage (10') along the ditch (13') takes place by means of the traction force created by a pinion that is independent from the wheels of the bogie-carrying carriage (10') itself, by means of a rack system (11') and guided by means of metallic tracks or on a ground made of resistant reinforced pavement, with the help of the counterpivot (12') which allows for elevating the bogie by means of the central sleeper (3') and elevating the load for carrying out the gauge change, where the bogie-carrying carriage (10') is provided with disc brakes.

[0049] Figure 16 shows the system applied to single axle half-bogies (1'), where the lateral sleepers (2') operate in the same way as before, although in this case the central body where the counterpivot (12') is located forms a single body with the lateral sleepers (2').

[0050] Figures 17, 18, 19 and 20 show the same scheme as figures 11, 12, 15 and 16 respectively, with the difference that the first figures include a telescopic guiding system (17') between both wheels for guaranteeing the same rotation speed in both, where said telescopic guiding system (17') can be complemented by cardan joints or by a torque transmitting flexible connection.

[0051] Figures 21 and 22 show an embodiment where the system does not include lateral sleepers, and where there is a single central sleeper (3') having a cylindrical configuration mounted on a prismatic piece (21) introduced in each half-bogie (1'), said central sleeper (3') being locked to said prismatic piece (21) by means of bolts provided for that purpose, where said prismatic piece (21) is supported on high resistance elastomeric pieces (22).

[0052] Figures 23 and 24 show the same half-bogies (1') corresponding to figures 21 and 22, with the difference that figures 23 and 24 include the telescopic guiding system (17') complemented by cardan joints or a torque transmitting flexible connection provided between both wheels for guaranteeing the same rotation speed in the same.

Claims

1. Gauge changing system for narrow gauge railway track designed for adapting the bogies of a train to different railway track gauges, **characterized by** comprising a gauge change installation and a plurality of bogies installed in the train itself, where said bogies have a special configuration and where said bogie is formed by two half-bogies (1 or 1') which are displaceable therebetween by means of lateral sleepers (2 or 2') and a central sleeper (3 or 3'), and where said half-bogies (1 or 1') comprise locking mechanisms (4 or 4') for locking the half-bogies (1 or 1') on said lateral sleepers (2 or 2') and central sleeper (3 or 3'); where each half-bogie (1 or 1') comprises half-axles (5 or 5'), and where the gauge change installation comprises lateral displacement bedplates (14 or 14') comprising bogie gauge opening (9 or 9') or closing (16 or 16') means, said means being actuated by means of reversible electric screws (15 or 15') and (7 or 20), respectively; said lateral displacement bedplates (14 or 14') being complemented by bogie-carrying carriages (10 or 10') which are displaceable along a lower ditch (13 or 13'), said bogie-carrying carriages (10 or 10') having elevation means for the load of the bogie as well as latching/unlatching means with respect to the central sleeper (3 or 3'), said elevation means being a counterpivot (12 or 12').

2. Gauge changing system for narrow gauge railway track according to claim 1, **characterized by** the half-axles (5) being assisted by a telescopic guiding system (17) for synchronizing the rotation speed of the wheels.

3. Gauge changing system for narrow gauge railway track according to claim 1, **characterized in that** the moving elements participating in the change com-

prise a redundant mechanical latching system guaranteeing the latching of all mechanisms in the rest position.

4. Gauge changing system for narrow gauge railway track according to claim 1, **characterized in that** the bogies include a braking mechanism based on pneumatic actuators connectable to the TFA duct by means of flexible connections, allowing for the manual actuation of the bogie parking brakes by means of actuators.

5. Gauge changing system for narrow gauge railway track according to claim 1, **characterized in that** the lateral sleepers (2') and the central sleeper (3') are interconnected by means of stiffeners (18).

6. Gauge changing system for narrow gauge railway track according to claims 1 and 5, **characterized in that** the opening means (9') are internal operation means which are displaceable together with the corresponding tracks (8') on which the train moves for carrying out the track gauge opening and/or change in a combined way, where the internal opening means (9') are operated by means of reversible electric screws (15'), while the closing means (16') are external operation means actuated by respective reversible screws (20).

7. Gauge changing system for narrow gauge railway track according to claims 1, 5 and 6, **characterized by** including a pneumatically actuated unlocking mechanism (19) by means of unlocking actuators.

8. Gauge changing system for narrow gauge railway track according to claims 1, 5, 6 and 7, **characterized in that** the external operation means (16) can operate by pulling towards the outside for carrying out the opening for changing the track gauge.

9. Gauge changing system for narrow gauge railway track according to claim 5, **characterized in that** the stiffeners (18) are preferably made by prismatic bars having ducts for the passage of pressurized air, from the central sleeper (3') towards the lateral sleepers (2'), during the unlocking period.

10. Gauge changing system for narrow gauge railway track according to claims 1 and 5 to 8, **characterized in that** the displacement of the half-bogies (1') is carried out on a single central (3') sleeper of cylindrical configuration, where the half-bogies (1') include respective prismatic pieces (21) for supporting the ends of said central sleeper (3') using a high resistance elastomeric material (22); where the locks (4') of said central sleeper (3') enter into the prismatic pieces (21), allowing a slight turn of the central sleeper (3').

11. Gauge changing system for narrow gauge railway track according to previous claims, **characterized by** including a programmable computer (central PLC) for managing all elements the elements of the changing system and for communicating with the railway traffic and security systems.

12. Gauge changing system for narrow gauge railway track according to previous claims, **characterized in that** the bogies comprise geared motors for speeds of up to 90 km/h with a high traction capacity.

13. Gauge changing system for narrow gauge railway track according to previous claims, **characterized by** including an artificial vision system for supervision structural defects, temperatures, geometrical shapes and track change irregularities, as well as for recognizing the train type.

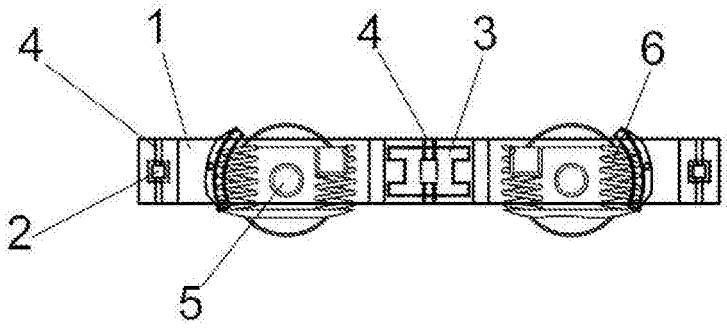

FIG. 1a

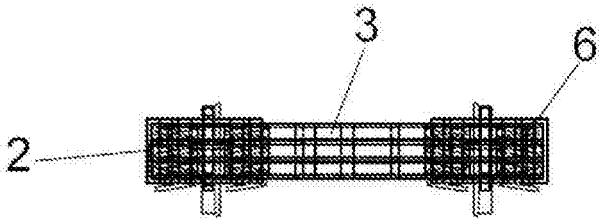

FIG. 1b

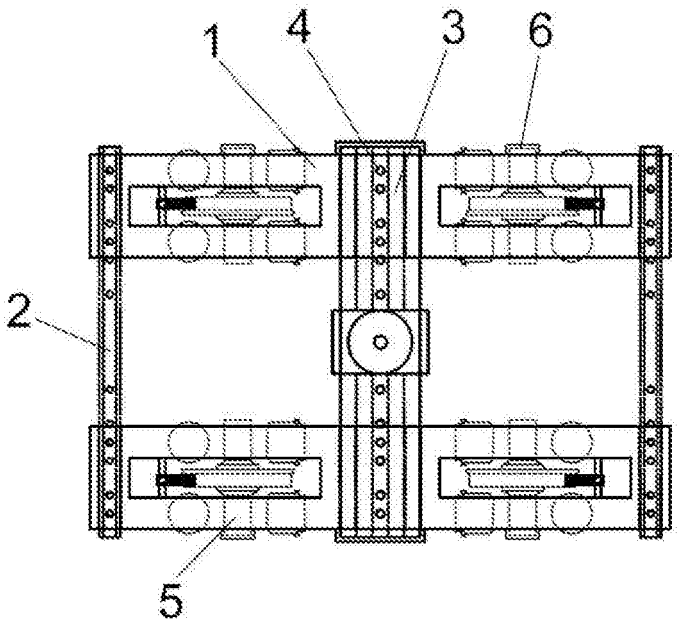

FIG. 1c

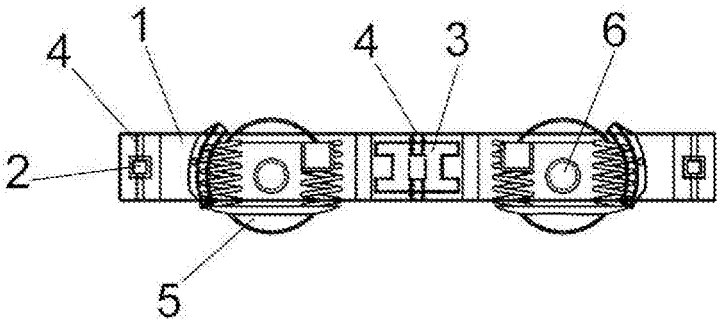

FIG. 2a

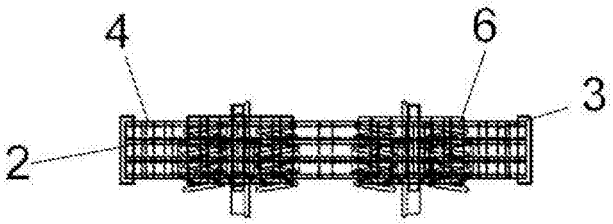

FIG. 2b

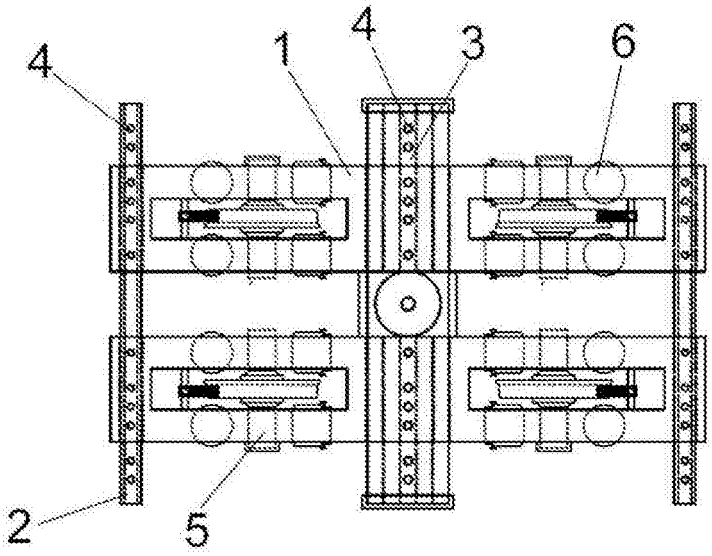

FIG. 2c

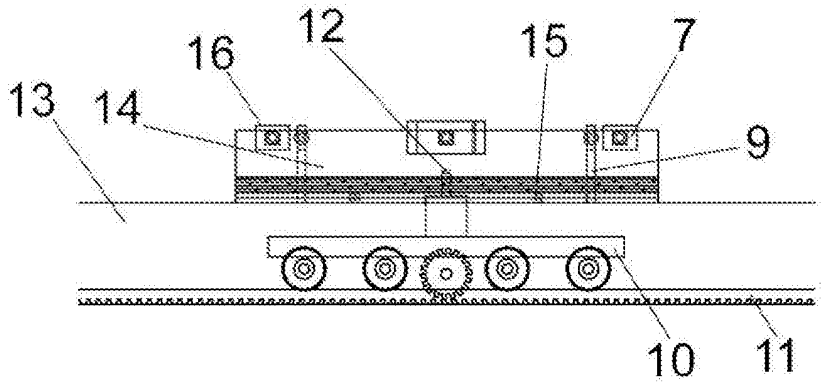

FIG. 3a

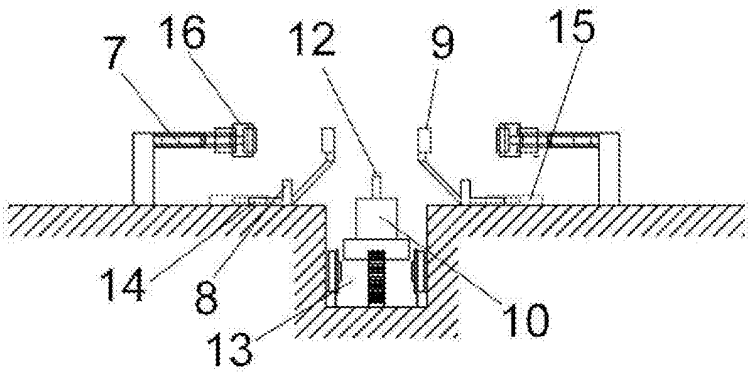

FIG. 3b

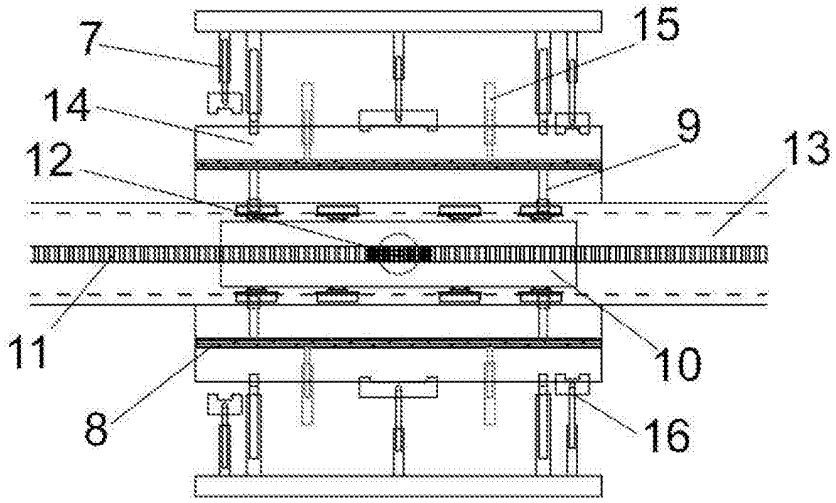

FIG. 3c

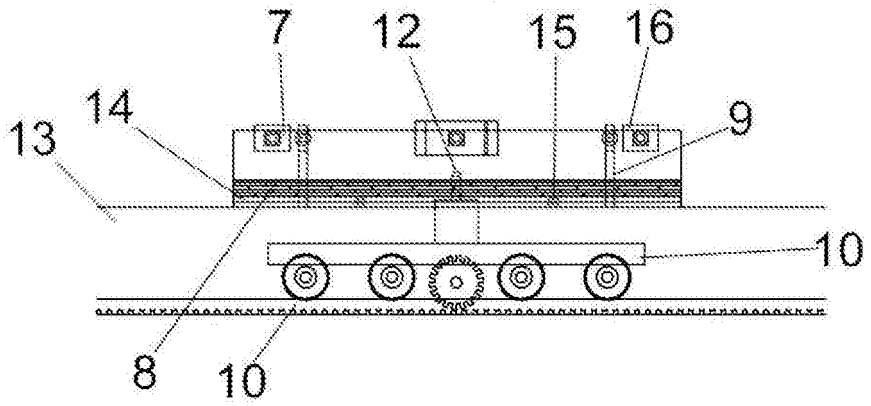

FIG. 4a

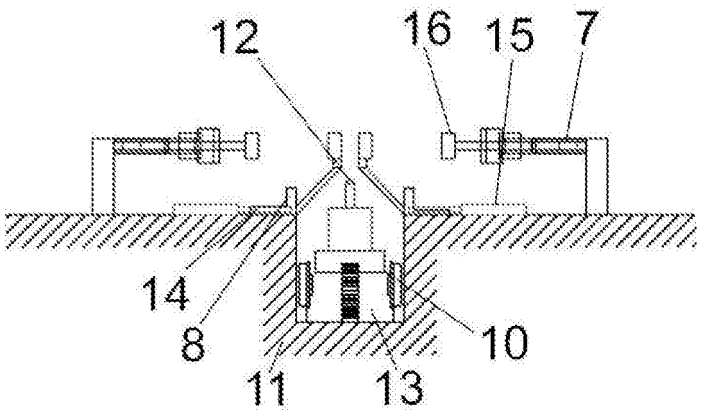

FIG. 4b

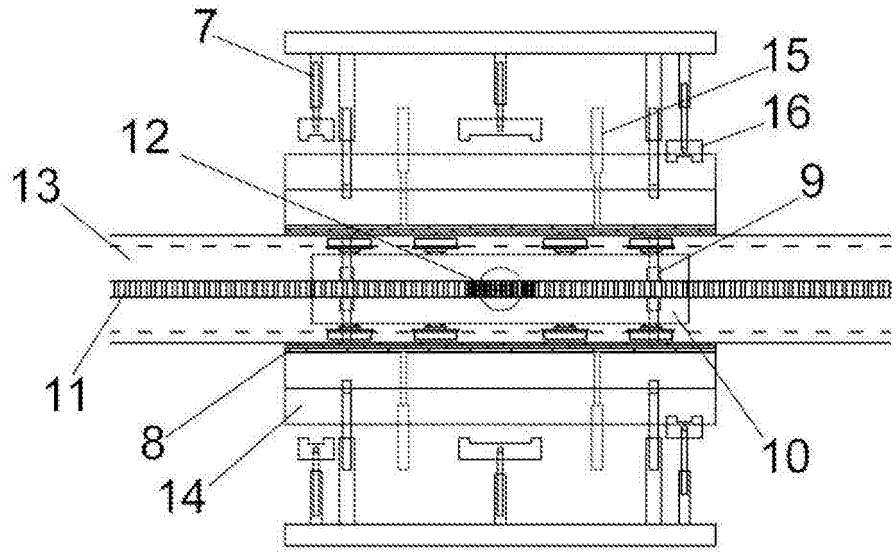

FIG. 4c

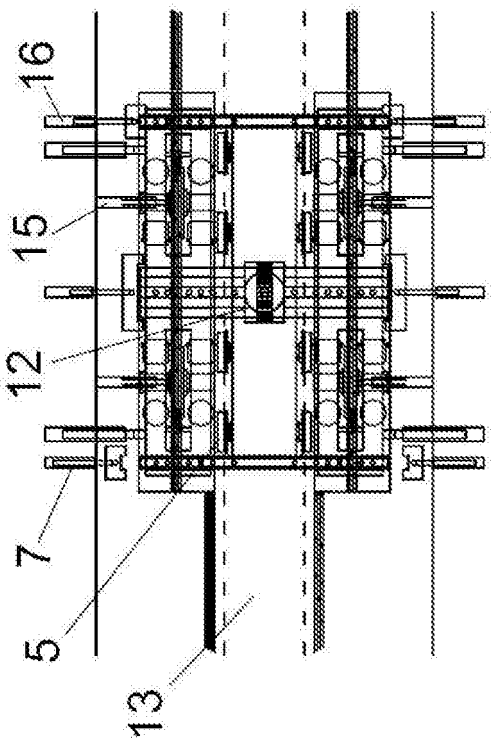

FIG. 5b

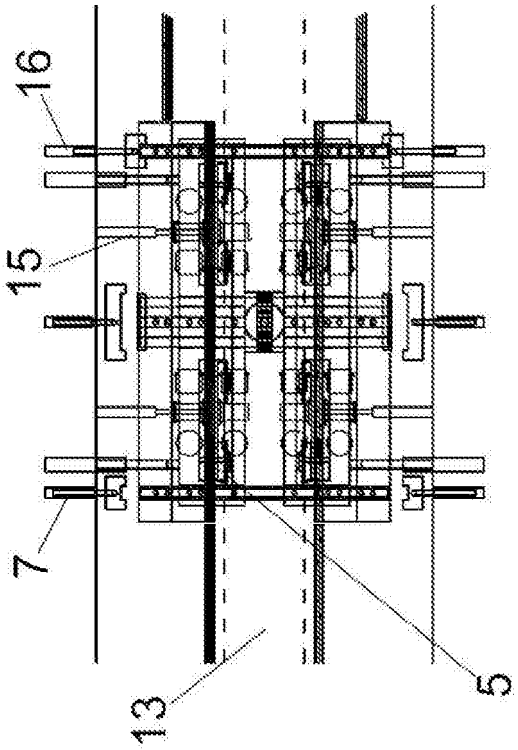

FIG. 5a

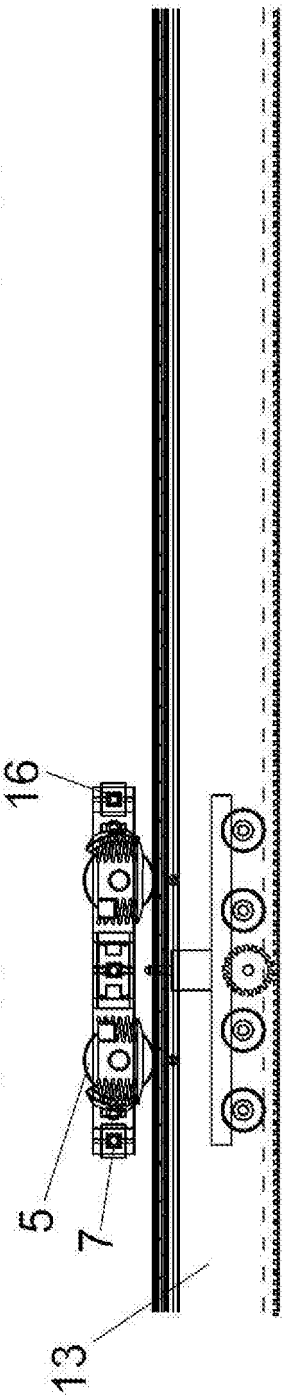

FIG. 5c

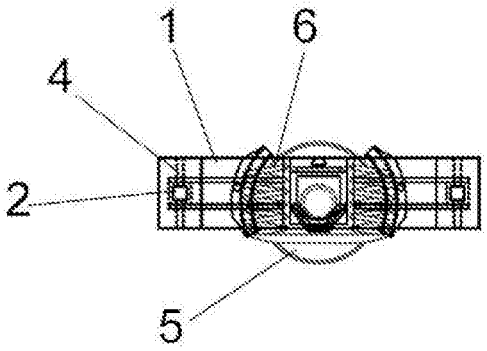

FIG. 6a

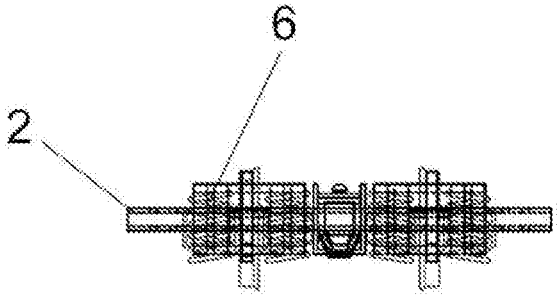

FIG. 6b

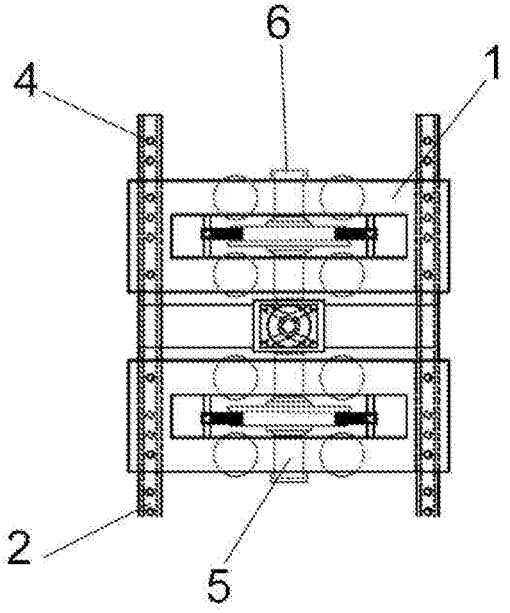

FIG. 6c

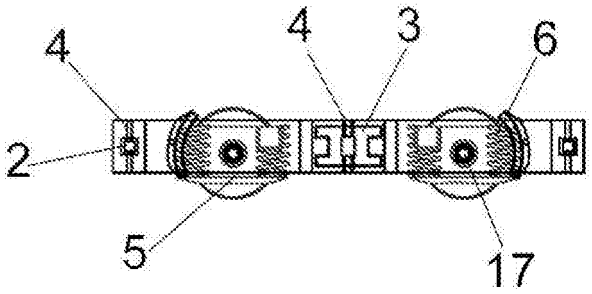

FIG. 7a

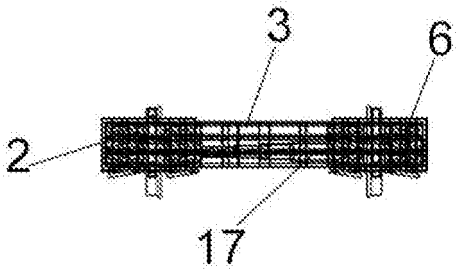

FIG. 7b

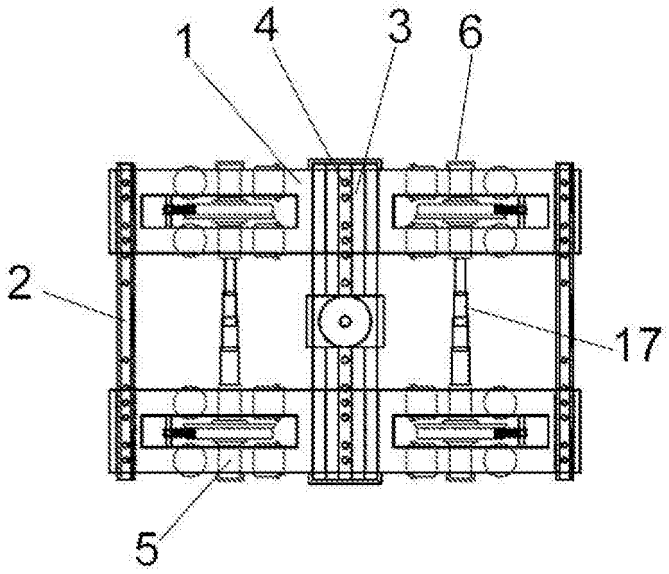

FIG. 7c

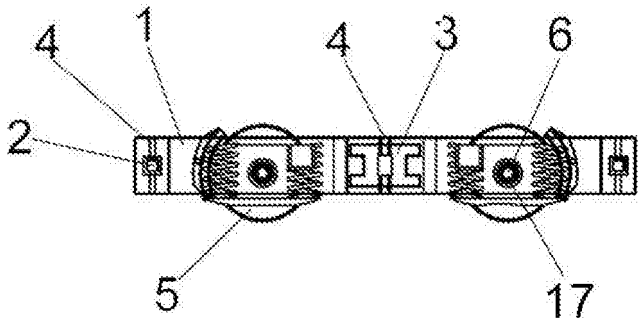

FIG. 8a

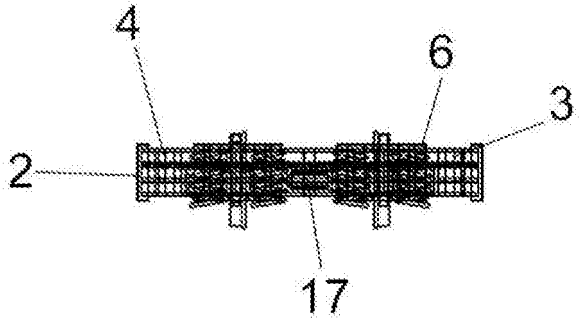

FIG. 8b

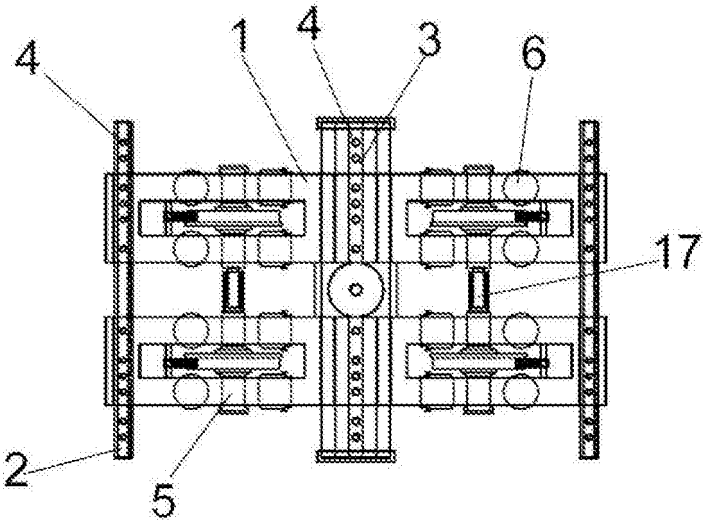

FIG. 8c

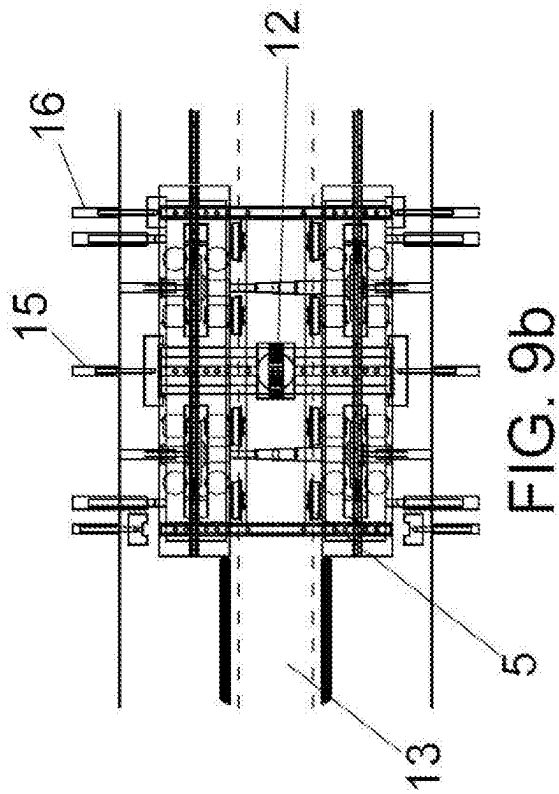

FIG. 9b

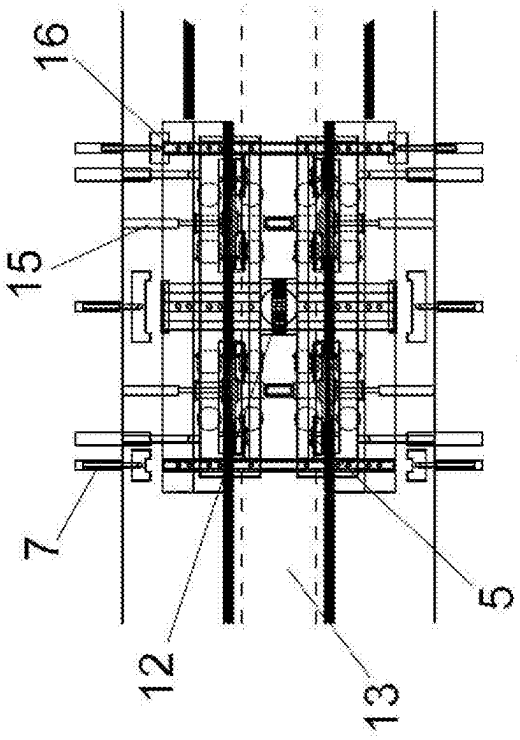

FIG. 9a

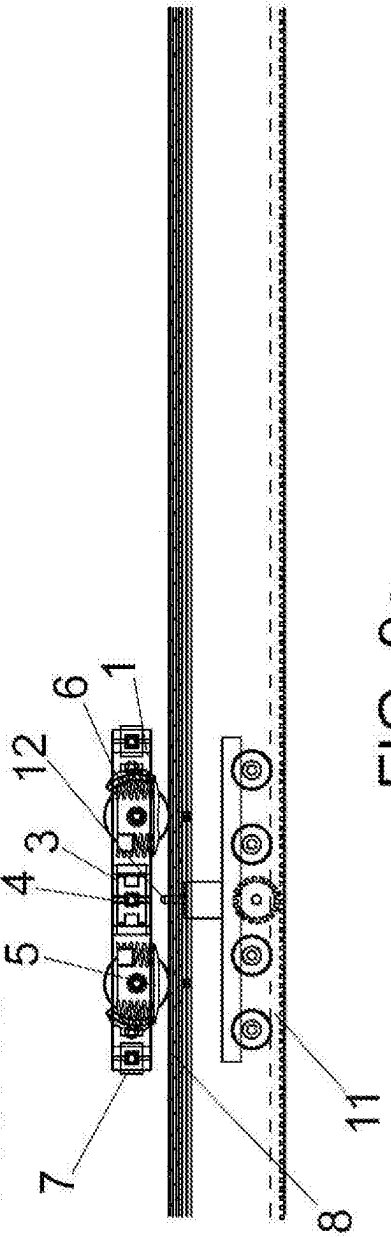

FIG. 9c

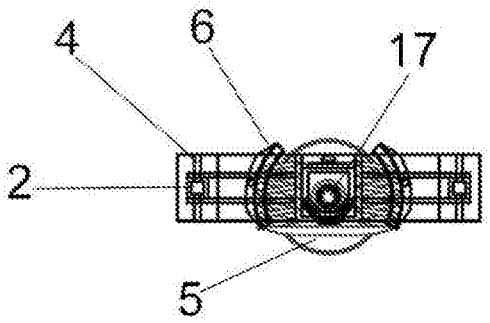

FIG. 10a

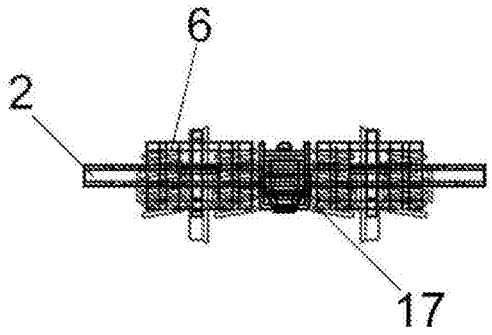

FIG. 10b

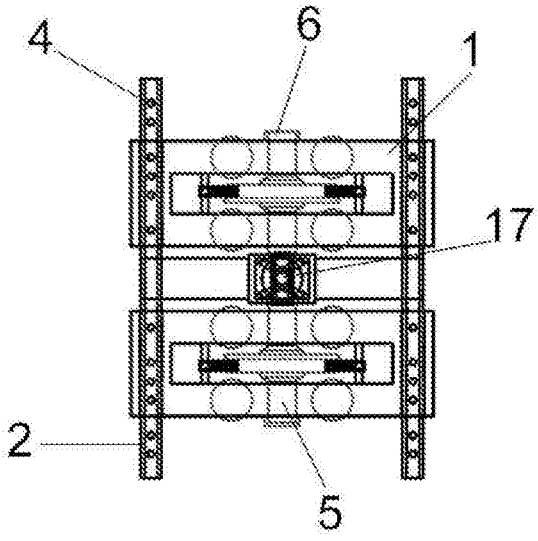

FIG. 10c

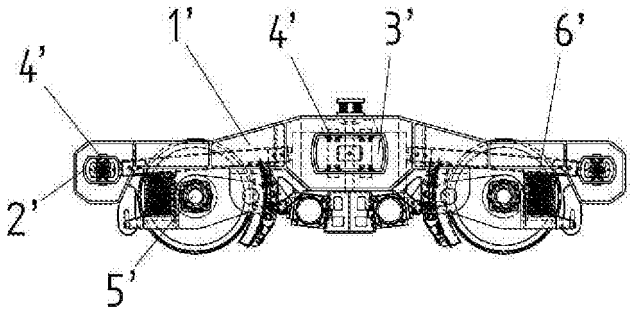

FIG. 11a

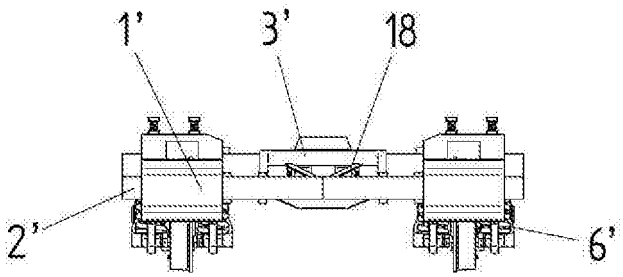

FIG. 11b

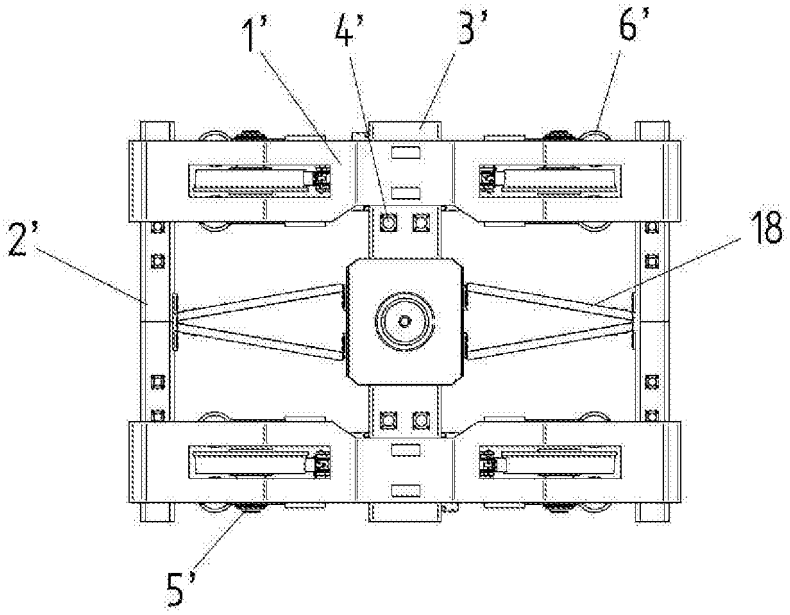

FIG. 11c

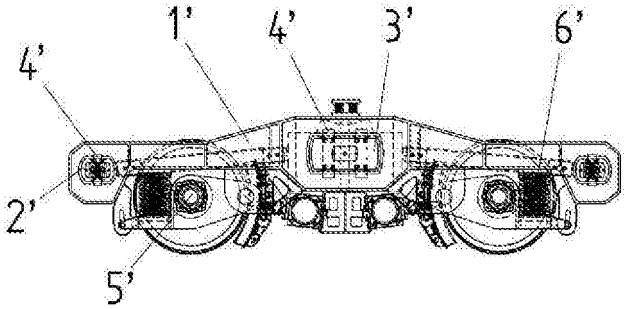

FIG. 12a

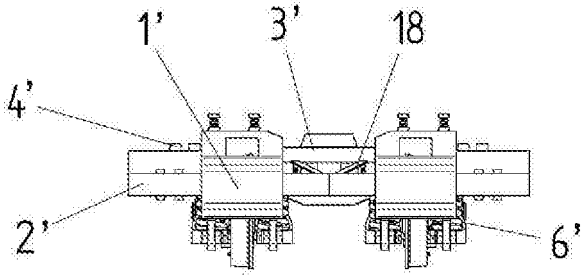

FIG. 12b

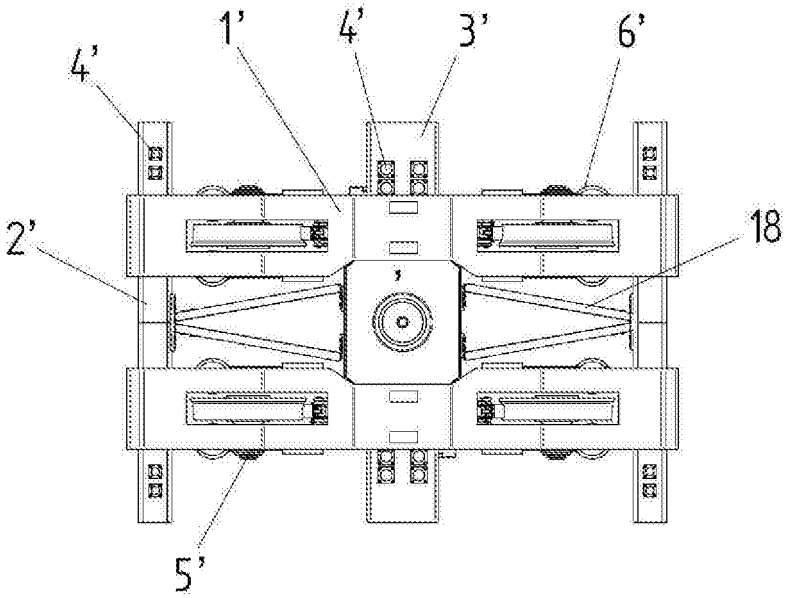

FIG. 12c

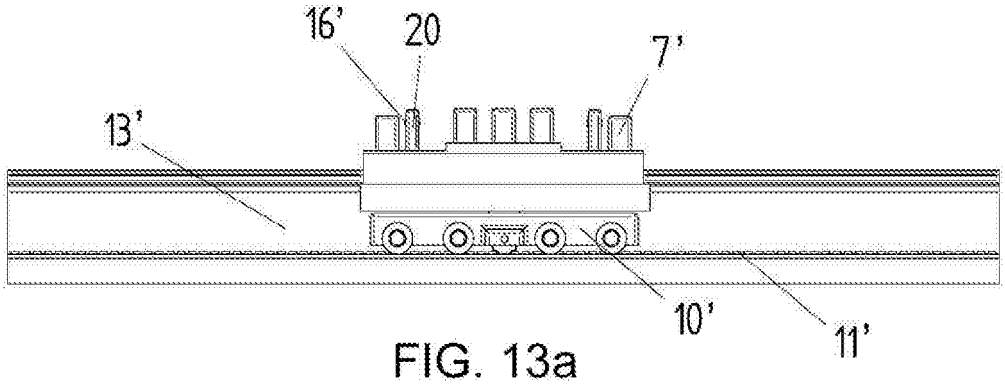

FIG. 13a

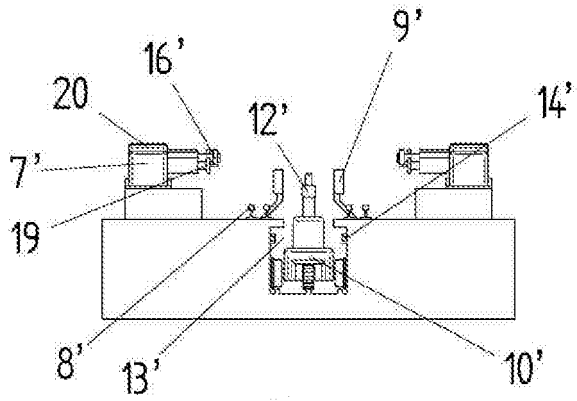

FIG. 13b

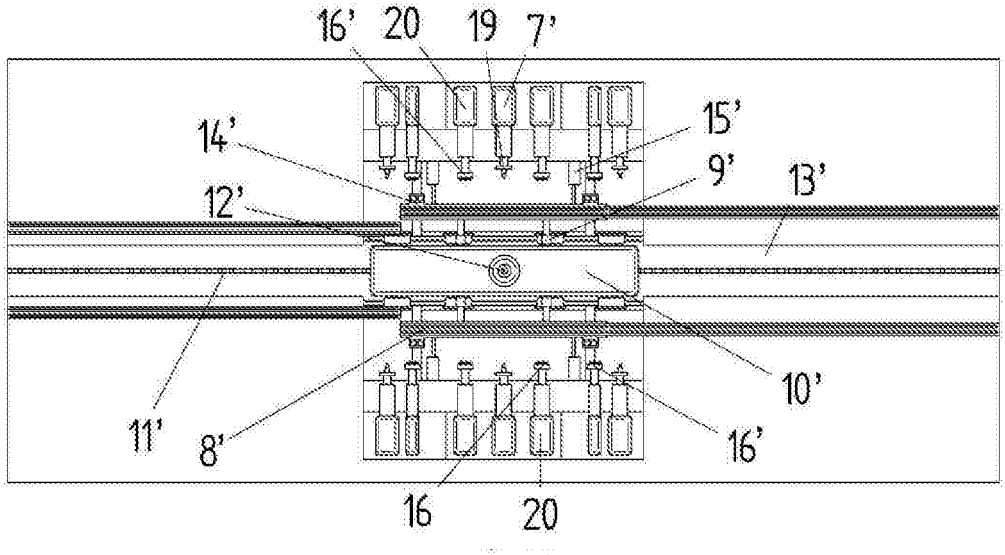

FIG. 13c

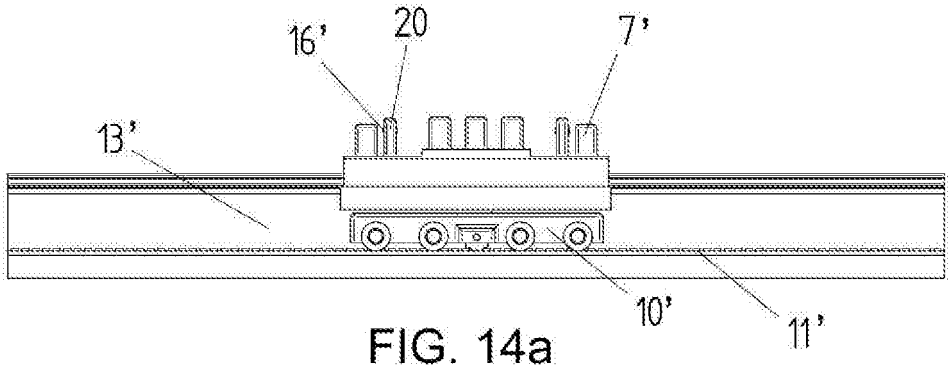

FIG. 14a

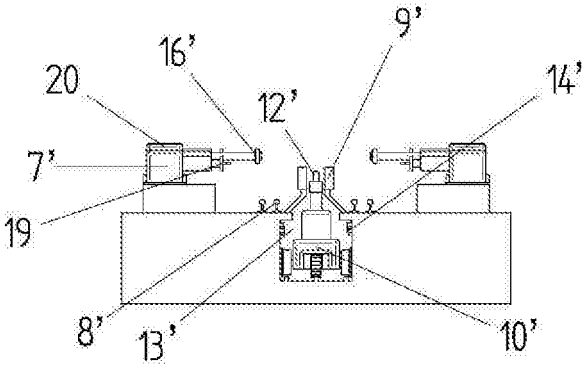

FIG. 14b

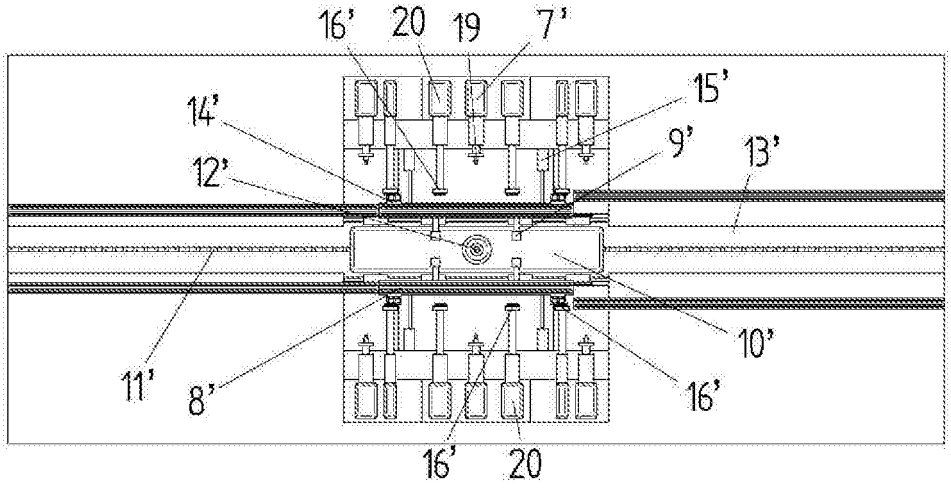

FIG. 14c

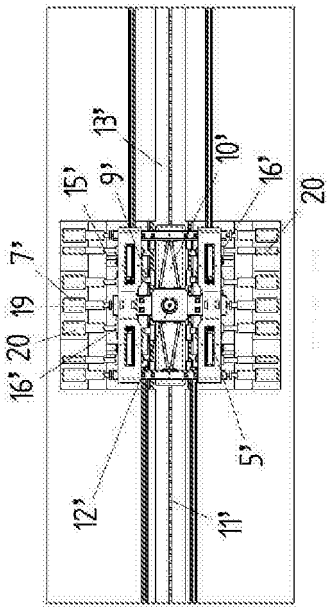

FIG. 15b

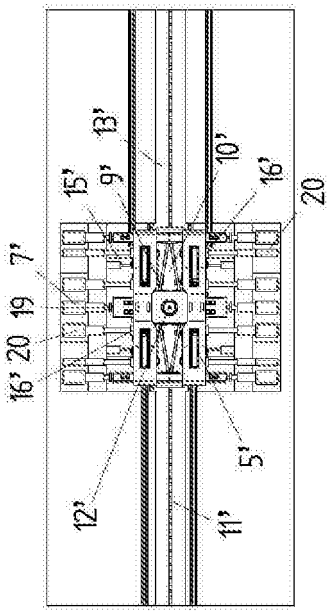

FIG. 15a

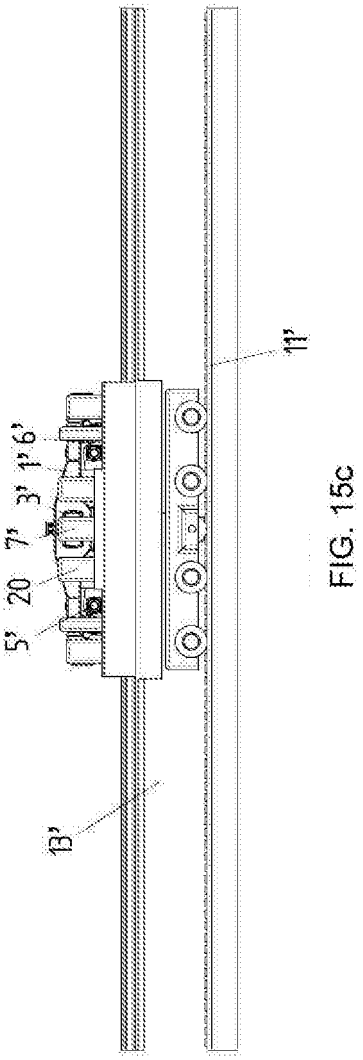

FIG. 15c

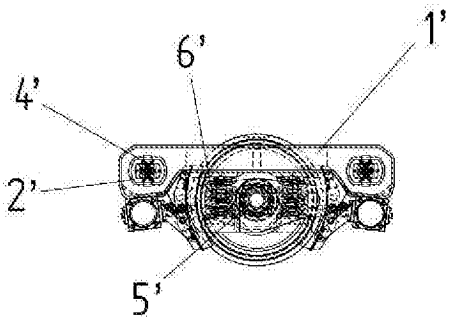

FIG. 16a

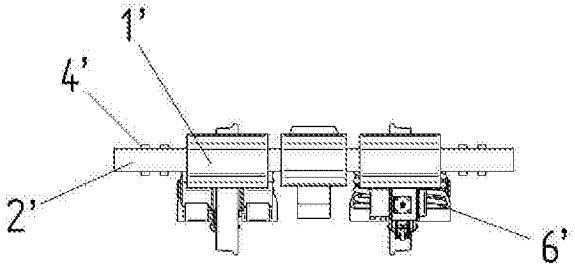

FIG. 16b

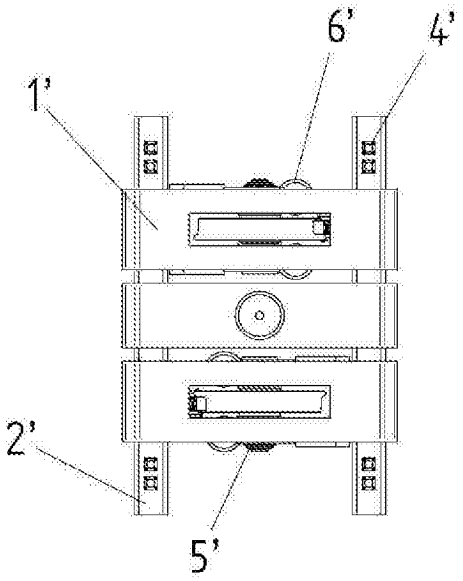

FIG. 16c

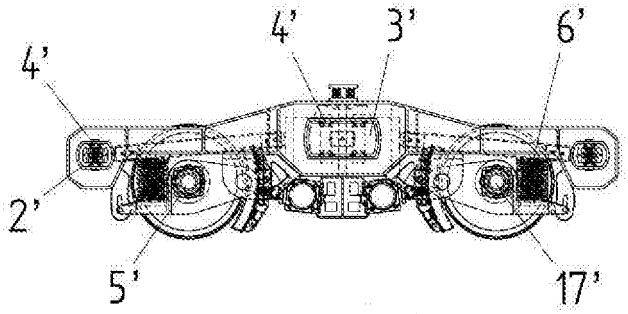

FIG. 17a

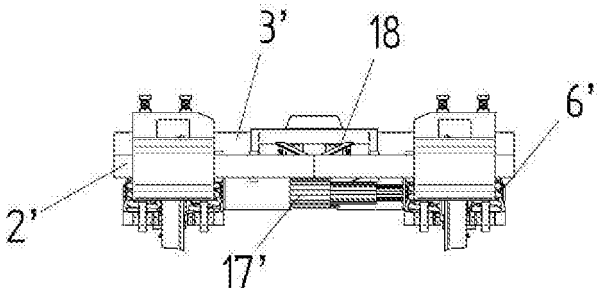

FIG. 17b

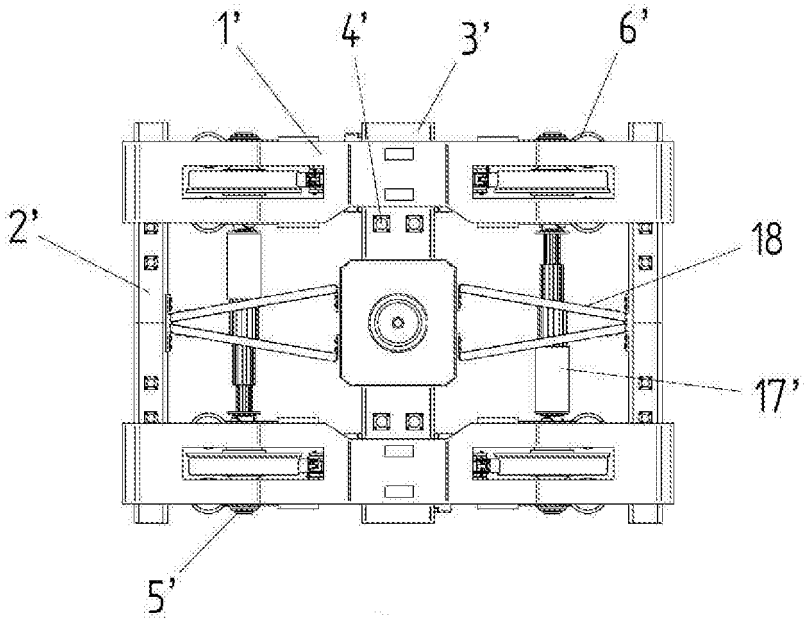

FIG. 17c

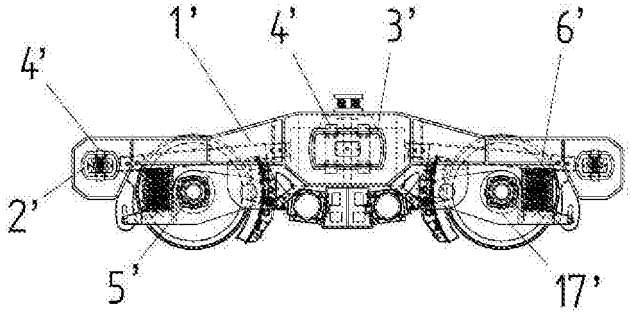

FIG. 18a

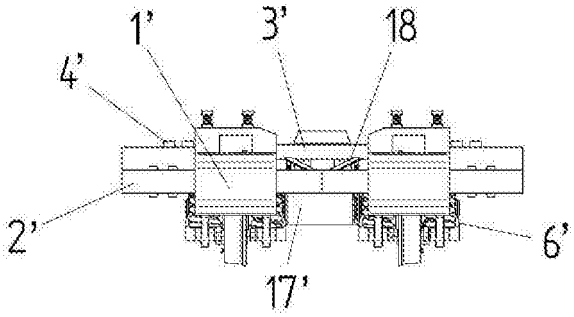

FIG. 18b

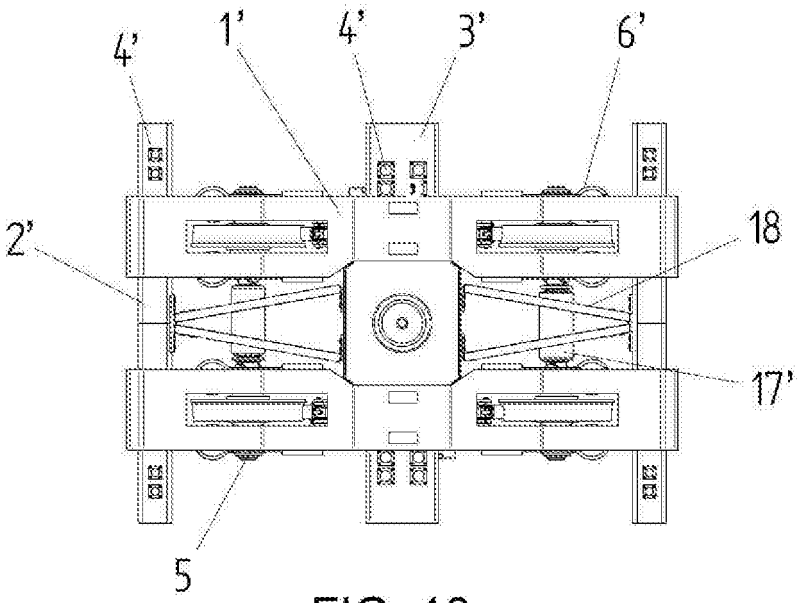

FIG. 18c

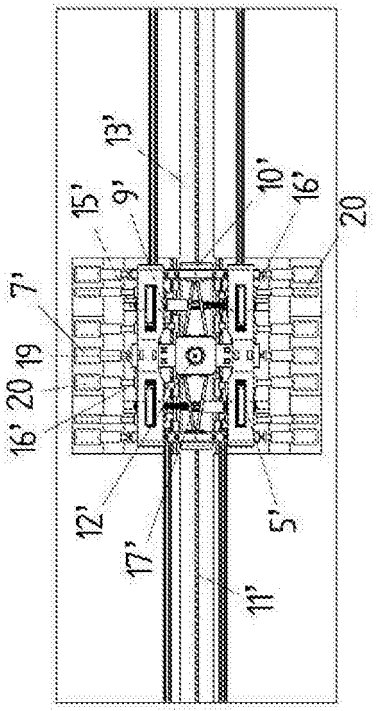

FIG. 19b

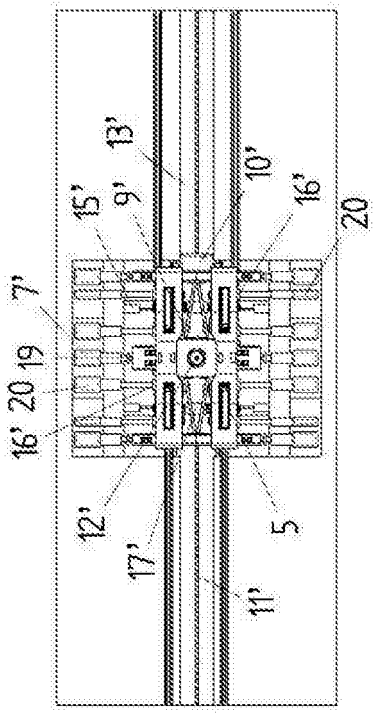

FIG. 19a

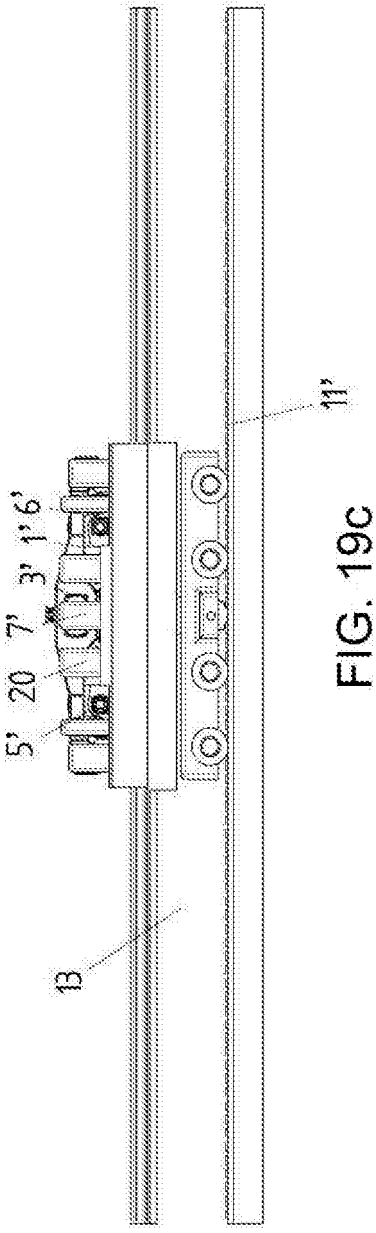

FIG. 19c

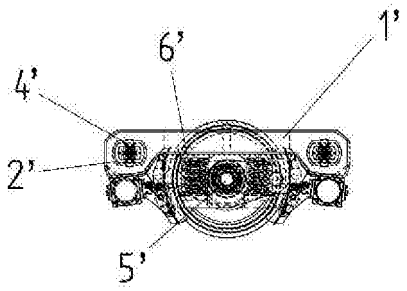

FIG. 20a

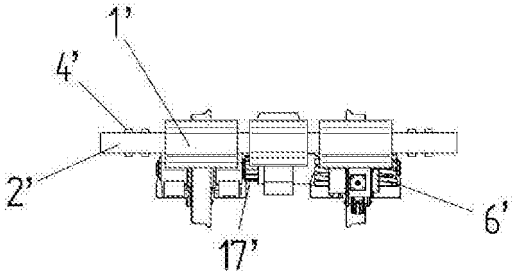

FIG. 20b

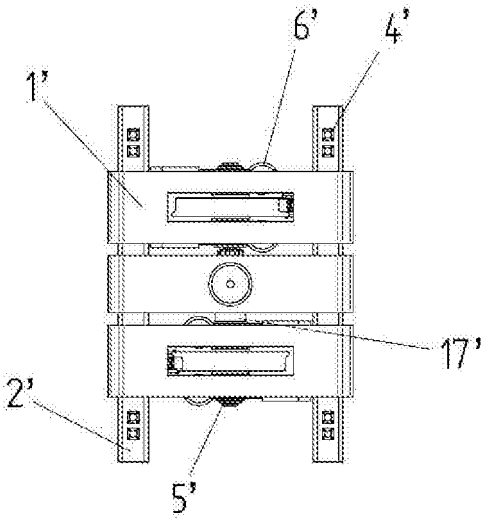

FIG. 20c

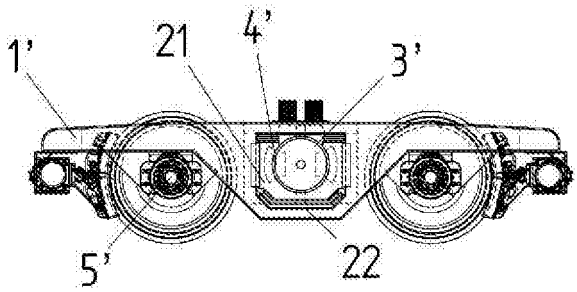

FIG. 21a

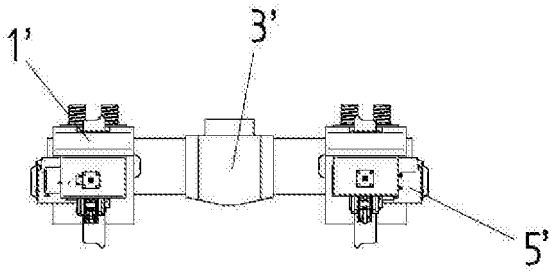

FIG. 21b

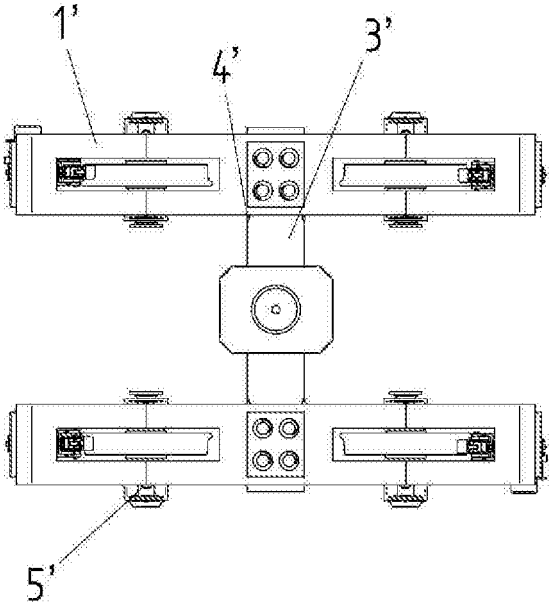

FIG. 21c

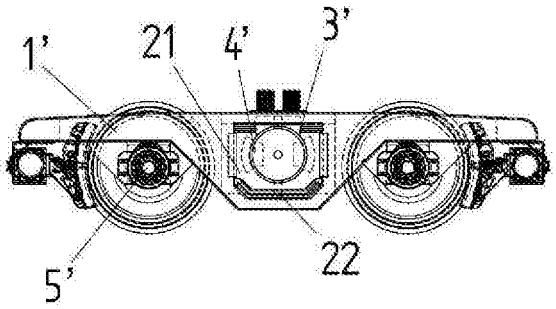

FIG. 22a

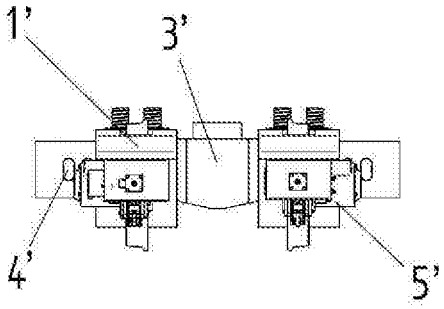

FIG. 22b

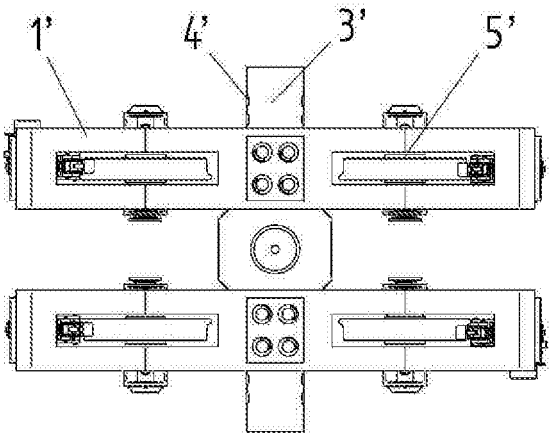

FIG. 22c

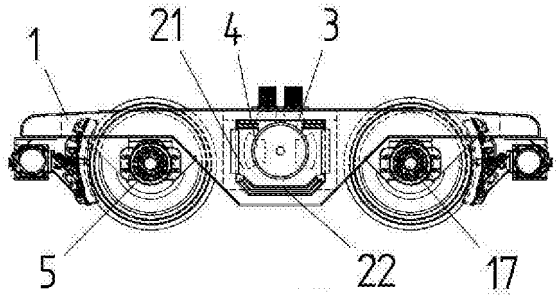

FIG. 23a

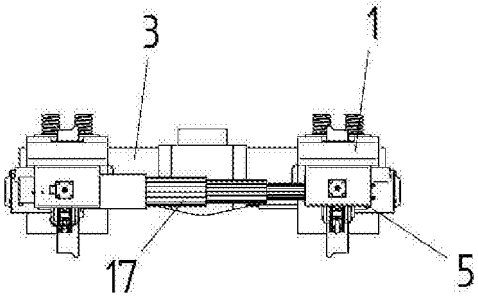

FIG. 23b

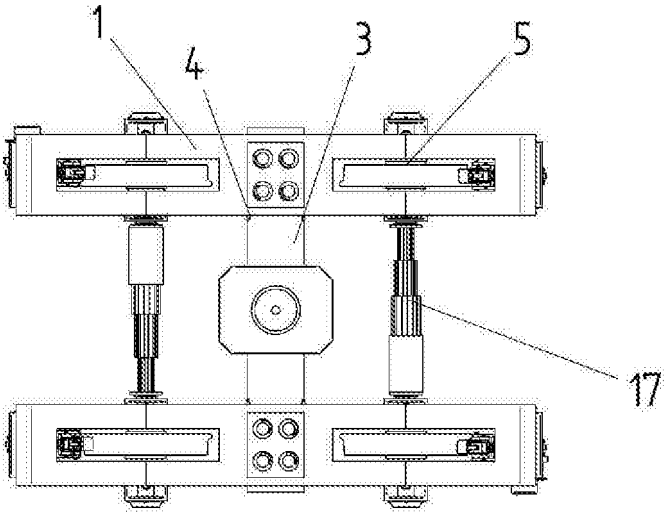

FIG. 23c

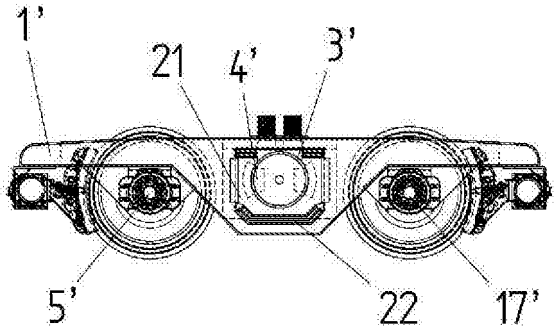

FIG. 24a

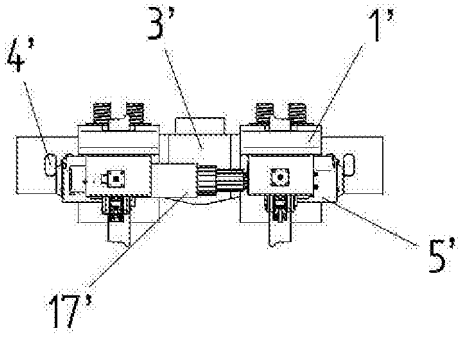

FIG. 24b

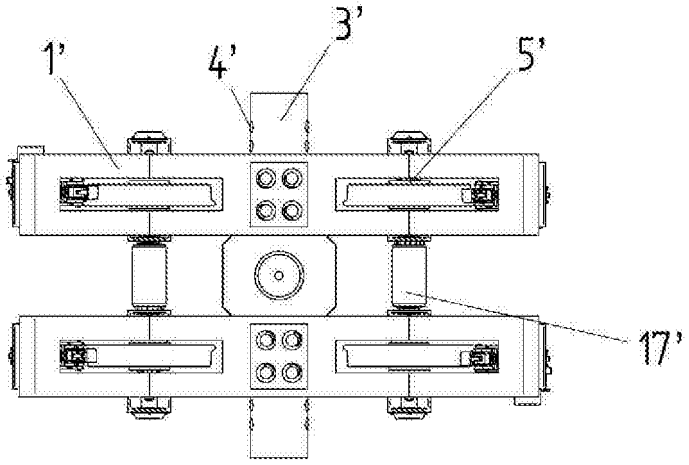

FIG. 24c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2012/070813

A. CLASSIFICATION OF SUBJECT MATTER

B61F7/00 (2006.01)

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)
B61F

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)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 9048346 A (KAWASAKI HEAVY IND LTD) 18/02/1997, the whole document.	1-13
A	FR 403668 A (ADRIEN MILLORAT) 11/11/1909, page 1, line 38 - page 3, line 44; figures.	1-3
A	ES 2224080T T3 (SIEMENS AG) 01/03/2005, page 1, line 5 - page 2, line 5; figures.	1,2,5,9,12
A	FR 2402566 A1 (BULGARSKI DARJAVNI JELESNIZI) 06/04/1979, page 4, line 39 - page 5, line 39; figures.	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure use, exhibition, or other means.
"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 documents , such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01/02/2013	**(08/02/2013)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer V. Población Bolaño Telephone No. 91 3498493

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
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