(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 024 983 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
01.07.2020 Bulletin 2020/27

(21) Application number: **14758667.1**

(22) Date of filing: **24.07.2014**

(51) Int Cl.:
E01B 35/04 *(2006.01)* ***B61K 9/08*** *(2006.01)*

(86) International application number:
PCT/IB2014/063392

(87) International publication number:
WO 2015/011671 (29.01.2015 Gazette 2015/04)

(54) SELF-PROPELLED APPARATUS FOR MEASURING GEOMETRIC AND/OR STRUCTURAL PARAMETERS OF A RAILWAY TRACK AND/OR SWITCH

SELBSTFAHRENDE VORRICHTUNG ZUM MESSEN GEOMETRISCHER UND/ODER STRUKTURELLER PARAMETER EINES GLEISES UND/ODER SCHALTERS

APPAREIL AUTO-PROPULSÉ PERMETTANT DE MESURER DES PARAMÈTRES GÉOMÉTRIQUES ET/OU STRUCTURAUX D'UN VOIE FERRÉE ET/OU D'UN AIGUILLAGE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **24.07.2013 IT BO20130397**
24.07.2013 IT BO20130398

(43) Date of publication of application:
01.06.2016 Bulletin 2016/22

(73) Proprietor: **General Impianti S.r.l.**
Maiolati Spontini (IT)

(72) Inventors:
- **BRUNI, Andrea**
  I-60025 Loreto (IT)
- **CONCETTONI, Enrico**
  I-63834 Massa Fermana (IT)
- **CRISTALLI, Cristina**
  I-60035 Jesi (IT)
- **MATTIOLI, Graziano**
  I-60019 Senigallia (IT)
- **SALVUCCI, Alessandro**
  I-60035 Jesi (IT)

(74) Representative: **Manconi, Stefano et al**
Studio Torta S.p.A.
Via Viotti, 9
10121 Torino (IT)

(56) References cited:
DE-A1- 2 130 385
DE-A1-102006 027 852
FR-A- 1 418 432
GB-A- 272 070
JP-A- H07 223 539
US-A- 3 405 449
US-A- 3 405 449
US-A- 4 534 296
US-A- 5 094 004
US-A1- 2009 073 428
US-A1- 2012 192 756

EP 3 024 983 B1

Description

TECHNICAL FIELD

[0001] The present invention relates to a self-propelled apparatus for measuring geometric and/or structural parameters of a railway track and/or switch.

BACKGROUND ART

[0002] In the field of self-propelled apparatuses for the measuring of geometric and/or structural parameters of a railway track and/or switch, it is known to provide a motor-driven railway carriage provided with a measuring device to measure at least one geometric and/or structural parameter of the railway track and/or switch.

[0003] Known self-propelled apparatuses to measure geometric and/or structural parameters of a railway track and/or switch of the type described above present some drawbacks mainly deriving from the fact that the aforesaid railway bogies are relatively cumbersome, heavy, and costly, entail serious operating difficulties for their transfer from one railway line to another, and are then not suited to being used in a simple and flexible way. In fact, use of the aforesaid railway bogies calls for relatively long manoeuvring times and the availability of relatively long stretches of railway track and/or the presence of corresponding switches, and then involves prolonged interruptions of normal circulation of trains. Furthermore, the relatively heavy weight of railway bogies may lead to deformation of the corresponding rolling structures that come into contact with the railway track and/or switch, jeopardizing proper measurement of the geometric and/or structural parameters of the railway track and/or switch itself.

[0004] Finally, known self-propelled apparatuses are unable to make measurements with high precision, above all where the switches are located, on account of their poor capacity for adaptation to the inevitable variability of the distance between the rails of the track.

[0005] German Patent Application DE-OS- 21 30 385 discloses a mobile track survey apparatus for measuring the gauge of a track. The apparatus is provided with a carriage for being movable on the rails in the direction of track elongation. The track gauge is measured by two rail sensing elements which are biased in opposite directions against the respective track rails. The lateral movement of the sensing elements in respect of each other is converted into electrical signal proportional to this movement, and this signal is transmitted to a signal indicator or recorder.

DISCLOSURE OF INVENTION

[0006] The aim of the present invention is to provide a self-propelled apparatus to measure geometric and/or structural parameters of a railway track and/or switch that will be free from the drawbacks described above and that will be simple and economically advantageous to produce.

[0007] According to the present invention, a self-propelled apparatus to measure geometric and/or structural parameters of a railway track and/or switch is provided as specified in the annexed claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The present invention will now be described with reference to the annexed drawings, which illustrate a non-limiting example of embodiment thereof and in which:

- Figure 1 is a schematic perspective view of a preferred embodiment of the apparatus according to the present invention;
- Figures 2 and 3 are two schematic perspective views of a detail of the apparatus of Figure 1;
- Figure 4 is an exploded perspective view of the detail of Figures 2 and 3;
- Figures 5 and 6 are two schematic side views, with parts in cross section and parts removed for reasons of clarity, of a detail of Figures 2 and 3 illustrated in two different operative positions;
- Figures 7 and 8 are two schematic side views, with parts in cross section and parts removed for reasons of clarity, of a detail of Figures 5 and 6;
- Figure 9 is similar to Figure 3 and is a schematic perspective view of a variant of the detail of Figures 2 and 3; and
- Figure 10 is a schematic side view, with parts in cross section and parts removed for reasons of clarity, of a detail of Figure 9.

BEST MODE FOR CARRYING OUT THE INVENTION

[0009] With reference to Figure 1, designated as a whole by 1 is a self-propelled apparatus for the measuring of geometric and/or structural parameters of a railway track and/or switch, designated by 80 and referred to hereinafter as "track" for simplicity.

[0010] The apparatus 1 comprises a motor-driven carriage 2 designed to be coupled, in use, with the track 80, and an electronic measuring module 3 mounted on the carriage 2 to measure at least one geometric and/or structural parameter of the track 80 while the carriage 2 is moving, in use, along the track 80.

[0011] According to what is illustrated in Figures 2 and 3, the carriage 2 is shaped like an H, and comprises two mutually parallel trains 4 of wheels, which have an elongated shape, extend in a substantially horizontal direction 5, and are each designed to be coupled to a respective rail 81 of the track 80. The two trains 4 of wheels are connected to one another by a central supporting frame 6, which has an elongated shape, and extends in a substantially horizontal direction 7 transverse to the direction 5. The trains of wheels 4 are designed to couple to the

rails 81 in a direction 7 transverse, and in particular perpendicular, to the rails 81.

[0012] The carriage 2 further has two mutually parallel protection buffers 8 (Figure 1), each of which extends in the direction 7 and is engaged at the free ends of the two trains 4 of wheels to guarantee safety for the operators.

[0013] With reference to Figures 3, 4, 7, and 8, the frame 6 comprises a central body 9 having a rectangular shape, and two side appendages 10, which are shaped like a rectangular annulus and are arranged on opposite sides of the body 9 in the direction 7 so as to arrange themselves, in use, above a corresponding rail 81.

[0014] Each appendage 10 is slidably coupled to the body 9 via a bar 10a engaged in a pair of guides 10b (Figure 7) and a coupling roller 11 (Figure 8) rotatably mounted on a respective supporting bracket 12 projecting from the appendage 10 within the body 9 in the direction 7.

[0015] The roller 11 is mounted to turn about an axis 13 of rotation parallel to the direction 5 and is slidably engaged in a respective eyelet 14 made through the body 9 in the direction 7.

[0016] In this connection, it should be pointed out that the roller 11 of one appendage 10 has a diameter substantially equal to a height of the corresponding eyelet 14, whereas the roller 11 of the other appendage 10 has a diameter approximating by defect the height of the corresponding eyelet 14 so as to enable the appendage 10 itself to oscillate, with respect to the body 9, about a longitudinal axis 15 (Figure 7) parallel to the direction 7 and to the trains 4 of wheels to adapt to those stretches of the track 80 in which the rails 81 are not perfectly flat.

[0017] The distance of each appendage 10 from the body 9 in the direction 7 is adjustable via a respective screw/female-screw coupling (Figure 7) constituted by a screw 16 mounted on the body 9 and a corresponding female screw 17 (Figure 7) mounted at one end of the bar 10a of the appendage 10. The two screw/female-screw couplings 16, 17 have respective directions of thread opposite to one another.

[0018] The screws 16 and the respective female screws 17 define part of an actuation device 18, further comprising a pulley 19 rigidly coupled to the two screws 16 and an electric motor 45 (Figure 3), which is connected to the pulley 19 via a belt transmission 46 (Figure 3) to set the screws 16 in rotation so as to impart on the appendages 10 rectilinear displacements in opposite senses in the direction 7.

[0019] The position of the appendages 10 with respect to the central body 9 in the direction 7 is detected via a position sensor 20. The latter is constituted by a linear-sliding potentiometer having a resistive bar 20a fixed on the body 9, parallel to the direction 7, and a slider 20b fixed to the internal screw 17 of one of the two appendages 10 by means of a bracket 17a so as to slide, in use, along the resistive bar 20b following upon displacement of the appendage 10 with respect to the body 9. Since the dimensions of the appendages 10 and of the lateral supporting frames 31 in the direction 7 are known beforehand, the signal supplied by the position sensor 20 indicates the distance between the two trains of wheels 4 in the direction 7, i.e., the wheel gauge of the carriage 2.

[0020] According to a variant (not illustrated) of the present invention, the position of the appendages 10 with respect to the central body 9 in the direction 7 is detected via a rotation sensor designed to detect rotation of the screws.

[0021] Each appendage 10 is further provided with a pair of supporting feet 21, which are mounted on opposite sides of the appendage 10 in the direction 5, and are hinged to the appendage 10 to turn about an axis of fulcrum 22 parallel to the direction 5 itself between an operating position, where the feet 21 project downwards from the appendage 10, and a resting position, where the feet 21 are substantially contained within the appendage 10 itself.

[0022] The feet 21 of each appendage 10 are displaced between the corresponding operative positions and the corresponding resting positions via a crank mechanism 23 comprising a crank 24 hinged to the appendage 10 so as to turn about an axis of fulcrum 25 parallel to the direction 5, and two rockers 26 coupled in an angularly fixed way to the crank 24.

[0023] Each rocker 26 is displaced by the crank 24 about the axis 25, and is connected to a corresponding connecting rod 27, which extends between two axes 28, 29 of rotation parallel to one another and to the direction 5, and where the axis 28 is the axis of rotation of the connecting rod 27 with respect to a first arm 26a of the rocker 26 and the axis 29 is the axis of rotation of the connecting rod 27 with respect to the corresponding foot 21.

[0024] The position of the axes 22, 25, 28, and 29 is such as to define a toggle mechanism, which is stabilized in the operative positions of the feet 21 by a pair of springs 30 interposed between the appendage 10 and the corresponding feet 21 so as to enable the feet 21 to displace into their resting positions only following upon actuation of the crank 24.

[0025] According to what is illustrated in Figure 3, each train 4 of wheels comprises a lateral supporting frame 31, which extends in the direction 5 and supports a plurality of wheels 32 for advance of the carriage, in the case in point two pairs of wheels 32 arranged on opposite sides of the frame 6, and in particular on opposite sides, in the direction 5, of the corresponding appendage 10. The wheels 32 of each pair of wheels 32 are coupled to one another via a belt transmission 33, and are arranged, in use, in contact with a top surface of the corresponding rail 81 of the track 80. For each train 4 of wheels, only one pair of wheels 32 is driven by a motor 32a and the other pair of wheels 32 is provided with an encoder (not illustrated).

[0026] The frame 31 further supports a plurality of guide rollers 34 (in the case in point four rollers 34), which project downwards from the frame 31, are rotatably cou-

pled to the frame 31 so as to turn idle, with respect to the frame 31, about respective longitudinal axes 35 parallel to a vertical direction 36 orthogonal to the directions 5 and 7, and are arranged, in use, in contact with or in the proximity of an internal surface of the corresponding rail 81 of the track 80.

[0027] With reference to Figures 2, 4, 5, and 6, the supporting frame 31 comprises a central rectangular edge or frame 37, which projects from the supporting frame 31 in the direction 7, is arranged on a corresponding appendage 10, and extends about a corresponding crank 24. As may be appreciated from Figure 2, each frame 37 is substantially aligned with the annular rectangular shape of the corresponding appendage 10 in order to define, together with the latter, an opening 37a from which, in use, the corresponding rail 81 is visible from above.

[0028] The frame 37, and then the train 4 of wheels, is releasably engaged to the supporting frame 6 via an engagement device 38 comprising a pair of vertical-pin elements 39 and a pair of horizontal-pin elements 40.

[0029] The elements 39 project downwards from the frame 37 in the direction 36, are substantially U-shaped, and are slidably coupled to respective slits 41 made through the corresponding appendage 10 in the direction 7 so as to co-operate with respective engagement pins 41a mounted within the slits 41 themselves.

[0030] The elements 40 project from the frame 37 in the direction 7 and slidably engage respective holes 42 made through the corresponding appendage 10 in the direction 7 itself.

[0031] The frame 37 and, then, the supporting frame 31 are mobile between a position of engagement of the train 4 of wheels to the supporting frame 6 and a position of release of the train 4 of wheels from the supporting frame 6 under the thrust of the crank 24.

[0032] Rotation of the crank 24, obtained by displacing the feet 21 from the operative positions into the resting positions, leads to rotation of the rockers 26 about the axis 25 and engagement of a second arm 26b of each rocker 26 in a corresponding slot 43 made through the frame 37 in the direction 7.

[0033] The arms 26b co-operate with the corresponding slots 43 so as to move the frame 31 closer to the body 9, engage the elements 39 in the corresponding pins 41a and the elements 40 in the corresponding holes 42, and then engage the train 4 of wheels to the frame 6.

[0034] The opposite rotation of the crank 24, obtained by displacing the feet 21 from the resting positions into the operative positions, leads to rotation of the rockers 26 about the axis 25 and disengagement of the second arm 26b of each rocker 26 from the corresponding slot 43.

[0035] In this case, the arms 26b co-operate with the corresponding slots 43 so as to move the frame 31 away from the frame 6, disengage the elements 40 from the corresponding holes 42, and then release the train 4 of wheels from the frame 6.

[0036] In this connection, it should be pointed out that, when the feet 21 are arranged in their operating position, they project downwards from the wheels 32.

[0037] From what has been set forth above, it thus follows that assembly of the apparatus 1 is carried out by displacing the feet 21 into their operative positions, leaning the feet 21 on the track 80, engaging the two trains 4 of wheels to the frame 6, moving again the feet 21 into their resting positions so as to couple the wheels 32 to the track 80, and mounting the measuring module 3 on four supporting pins 44 projecting upwards from the body 9 in the direction 36. It should be noted that the conformation of the engagement devices 38 enables a unique assembly of each train 4 of wheels on the frame 6.

[0038] Dismantling of the apparatus 1 is obviously carried out following an operating sequence opposite to the one described above.

[0039] Finally, it should be pointed out that the carriage 2 and the measuring device 3 are supplied electrically via one or more batteries (not illustrated).

[0040] Since the two trains 4 of wheels are releasably engaged to the central supporting frame 6, the carriage 2 may be easily dismantled and assembled, has relatively low weights and small overall dimensions, and enables a simple and convenient transfer, for example a manual transfer, of the apparatus 1 from one railway line to another.

[0041] Furthermore, the possibility of adjusting the distance of the appendages 10 and, then, of the trains 4 of wheels, with respect to the central body 9 in the direction 7 enables real-time control of the distance between the two trains 4 of wheels as a function the width of the track 80.

[0042] In this connection, with reference once again to Figure 1, the measuring module 3 comprises an outer shell 47, which is substantially parallelepipedal in shape and is mounted on the pins 44, and two laser profilometers 48, one for each train of wheels 4, which are arranged within the shell 47 and are designed to acquire video images of the top part of the corresponding rail 81.

[0043] Each laser profilometer 48 comprises a laser source 49, which is designed to project, through a respective opening (not illustrated) made in the bottom of the shell 47, a laser curtain 50 transverse to the direction 5 so as to be oriented, in use, onto the corresponding rail 81, and a video camera 51, which is oriented so as to frame the aforesaid opening of the bottom of the shell 47 with its own optical axis 52 oblique with respect to the plane in which the laser curtain 50 lies for acquiring video images of the light contour generated by the laser curtain 50 on the top surface of the corresponding rail 81.

[0044] In the example illustrated in Figure 1, the laser curtain 50 is perpendicular to the direction 5. According to a variant not illustrated of the present invention, it is the optical axis 52, and not the laser curtain 50, that is perpendicular to the direction 5.

[0045] Each of said openings on the bottom of the shell 47 is aligned with a corresponding opening 37a (Figure 2). In this way, each laser curtain 50, after exiting from

the corresponding bottom opening of the shell 47, traverses the access opening 37a and impinges upon the surface of the rail 81, and the corresponding video camera 51 is able to frame, through the access opening 37a, the rail 81 at the light contour generated by the laser curtain 50 on the rail 81.

[0046] The two laser profilometers 48 are fixed with respect to the shell 47, and then with respect to the central supporting frame 6, with their optical axes 52 parallel to a plane that is transverse to the direction 7 and parallel to the direction 5. In Figure 1, the distance between the axes 52 is designated by DL.

[0047] The measuring module 3 further comprises a processing and control unit 53, which is provided in the form of one or more electronic boards, is also arranged within the shell 47, and is configured for processing the video images acquired by the two laser profilometers 48 in order to measure the structural parameters of the track 80 and to control the actuation device 18 as a function the video images acquired and of the signal supplied by the position sensor 20 in order to adapt the wheel gauge of the carriage 2 to the variations of gauge of the track 80.

[0048] In particular, the processing and control unit 53 is configured for determining, in real time, the top profile of each rail 81 from the video images acquired by the corresponding laser profilometer 48, the current gauge of the track 80 as a function of the top profiles of the two rails 81 and the distance DL, and the current wheel gauge of the carriage 2 as a function of the signal supplied by the position sensor 20, and for controlling the motor 45 of the actuation device 18 so as to reduce the difference between the current wheel gauge of the carriage 2 and the current gauge of the track 80. In other words, the processing and control unit 53 controls in real time adjustment of the wheel gauge of the carriage 2 for tracking and compensating the variations in gauge of the track 80.

[0049] Real-time adjustment of the wheel gauge of the carriage 2 enables increase in the precision of measurement of the structural parameters of the track 80.

[0050] According to a further embodiment (not illustrated) of the present invention, only one of the two appendages 10 is slidably coupled to the central body 9, and the actuation device 18 comprises a single external-screw/internal-screw coupling, said internal screw 17 being mounted on the slidable appendage 10. The apparatus 1 according to this embodiment is simpler to produce and is a bit lighter, but has a lower measuring capacity, in the sense that it is more likely for some parts of the rail 81 under the mobile appendage 10 to exit from the field of view of the video camera 51 that is arranged in a position corresponding to the mobile appendage 10. In fact, the rail 81 under the fixed appendage 10 is always well framed by the corresponding video camera 51, whereas the other rail 81 has a greater likelihood of ending up, at least partially, out of the field of view of the other video camera 51 when the gauge of the track 80 increases.

[0051] According to a further embodiment (not illustrated) of the present invention, the appendages 10 are coupled in a fixed way to the central body 9, and the guide rollers 34 are mounted on the corresponding supporting frames 31, not only in a rotatable way about the axes 35, but also slidably in the direction 7. In this way, it is possible to adjust the distance between the guide rollers 34 of one train of wheels 4 with the guide rollers 34 of the other train of wheels 4 and then, in practice, adjust the effective wheel gauge of the carriage 2. In order to prevent the carriage 2 from derailing from the track 80, the wheels 32 must being oversized in width with respect to the embodiment illustrated.

[0052] According to the latter embodiment, the carriage 2 comprises, instead of the actuation device 18, an actuation system having one or more electric motors for imparting on the guide rollers 34 rectilinear displacements in the direction 7 and, instead of the position sensor 20, one or more position sensors connected between the guide rollers 34 and the corresponding supporting frame 31 to detect the position of the guide rollers 34 in the direction 7. The processing and control unit 53 is configured for controlling the actuation system as a function of the video images acquired and of the signals supplied by the position sensors in order to adapt the wheel gauge of the carriage 2 to the variations of gauge of the track 80. Furthermore, the actuation system imparts on the guide rollers 34 of a train of wheels 4 displacements that are symmetrical, i.e., of the same amount and opposite, to the ones imparted on the guide rollers 34 of the other train of wheels 4.

[0053] According to a variant of the latter embodiment described above, the actuation system comprises at least two motors for imparting on the two series of guide rollers 34 of the two trains of wheels 4 mutually independent displacements. The processing and control unit 53 is configured for controlling independently the two motors of the actuation system so as to allow the possibility of adapting the field of view of just one video camera 51, and then the range of measurement of the corresponding laser profilometer 48, in particular situations of use, for example along asymmetric stretches of the railway track (with or without switches). For example, measurements along a stretch of the track 80 may be made by making two passes to and from along the stretch of the track 80 and controlling the guide rollers 34 of the two trains of wheels 4 in a symmetrical way in the forward movement and in an asymmetrical way in the backward movement in order to vary the field of view of at least one video camera 51 for said stretch and thus increase the measuring capacity of the measuring module 3.

[0054] Figures 9 and 10 illustrate a carriage 54, which differs from the carriage 2 illustrated in Figures 2 and 3 substantially in that the four guide rollers 34 of each frame 31 are replaced with two guide assemblies 55, each of which is mounted between two respective wheels 32.

[0055] With particular reference to Figure 10, each guide assembly 55 comprises a rocker 56, which is pivoted on the frame 31 so as to oscillate, with respect to

the frame 31 itself, about an axis of fulcrum 57 parallel to the direction 5, and has a first arm 58 projecting downwards in the direction 36 and a second arm 59 extending in the direction 7.

[0056] The arm 58 is traversed by a threaded pin 60, which has a longitudinal axis 61 substantially parallel to the direction 7, and is rotatably engaged, via interposition of a pair of rolling bearings 62, through a driving roller 63.

[0057] The roller 63 faces the other frame 31, has a substantially frustoconical shape, and is mounted idle on the pin 60 so as to turn about the axis 61. In particular, the roller 63 has a lateral surface 64 that has a crowned profile and faces the arm 58 for coupling, in use, with an inner side 82 of the top profile of a corresponding rail 81.

[0058] The pin 60 projects from the roller 63 in the direction 7, and carries connected thereto a guide bar 65, which extends in the direction 5, is mounted on a supporting bracket 66 fixed to a free end of the pin 60, and is shaped in such a way as to facilitate coupling of the roller 63 with the corresponding rail 81 and favour entry of the roller 63 into the railway switches that it may encounter along the track 80.

[0059] The arm 59 extends within the frame 31, and supports an end-of-stroke block 67, which is made, in the case in point, of plastic material, and is rotatably coupled to the free end of the arm 59 so as to oscillate, with respect to the arm 59 itself, about an axis of fulcrum 68 parallel to the direction 5.

[0060] The end-of-stroke block 67 is provided with a screw 69 made of metal material, which is screwed in the end-of-stroke block 67 itself parallel to the direction 36, and gives out towards the outside of the frame 31 through an opening 70 made in the frame 31 itself.

[0061] The screw 69 defines part of a detection device 71, which is designed to detect the position of the rocker 56 about the axis 57 and further comprises an end-of-stroke sensor 72 fixed to the frame 31 parallel to the direction 36.

[0062] The rocker 56 is mobile about the axis 57 between a first position, where the end-of-stroke block 67 comes to bear upon a surface portion 70a of the frame 31 around the opening 70 and the screw 69 comes into contact with the sensor 72, and a second position, where the end-of-stroke block 67 is arranged at a certain distance from the surface portion 70a and the screw 69 is arranged at a certain distance from the sensor 72 itself. Then, the sensor 72 has the purpose of detecting contact with the screw 69, i.e., of detecting when the screw 69 goes into the end-of-stroke position. Obviously, the screw 69 may be replaced with a different metal element that may be detected by the sensor 62.

[0063] When the rocker 56 is in its first position, the corresponding guide bar 65 is set at the maximum distance from the opposite frame 31. When, instead, the rocker 56 is in its second position, the corresponding guide bar 65 approaches the opposite frame 31, i.e., is set at a distance from the opposite frame 31 shorter than said maximum distance.

[0064] The rocker 56 is displaced into, and normally kept in, its first position by a spring 73, which extends in the direction 36, is mounted on the opposite side of the screw 69 with respect to the axis 68, and is interposed between the frame 31 and the arm 59.

[0065] When, in use, the gauge of the track 80 narrows excessively with respect to the wheel gauge of the carriage 54, the rocker 56 of one or more guide assemblies 55 shifts into its second position against the action of the spring 73, and the corresponding sensor 72 signals the absence of end-of-stroke.

[0066] The processing and control unit 53 is configured for processing signals supplied by the end-of-stroke sensors 72 in order to detect and warn of anomalous situations during advance of the carriage 54 on the track 80 or else during adjustment of the wheel gauge of the carriage 54.

[0067] For example, some anomalous situations that may be detected are the following:

- yaw of the carriage 54 during advance on the track 80, when the sensors 72 corresponding to just two diagonally opposite guide assemblies 55 (for example, the front right one and the rear left one) detect the end-of-stroke;
- impact of the carriage 54 with an obstacle on a rail 81, when only one sensor 72 does not detect the end-of-stroke, i.e., the sensor 72 of the guide assembly 55 the roller 63 of which undergoes impact;
- anomalous narrowing of the track 80, when the sensors 72 of two or three guide assemblies 55 do not detect the end-of-stroke; and
- excessive widening of the wheel gauge of the carriage 54 controlled by the wheel-gauge adjustment system, when the sensors 72 of at least two transversely opposite guide assemblies 55 (i.e., the front ones and/or the rear ones) do not detect the end-of-stroke.

Claims

1. A self-propelled apparatus for measuring geometric and/or structural parameters of a railway track and/or switch (80), the apparatus comprising a motor-driven carriage (2; 54) designed to be coupled, in use, to the railway track and/or switch, and a measuring module (3) mounted on the carriage (2; 54) to measure at least one of said geometric and/or structural parameters of the railway track and/or switch (80); the carriage (2; 54) comprising a central supporting frame or structure (6) extending in a substantially horizontal direction transverse to the direction of the track and two trains of wheels (4), which are carried by the central supporting frame (6) and are each coupleable to a respective rail (81) of the railway track and/or switch (80); the apparatus **being characterized in that** each train of wheels (4) comprises a

lateral supporting frame or structure (31) and a plurality of wheels (32) for advance of the carriage, which are rotatably mounted on the lateral supporting frame (31), and an engagement device (38) for releasably engaging the lateral supporting frame (31) to the central supporting frame (6).

2. The apparatus according to Claim 1, wherein each of said central and lateral supporting frames (6, 31) has an elongated shape; the central supporting frame (6) extending transverse to said lateral supporting frames (31).

3. The apparatus according to Claim 1 or Claim 2, wherein each engagement device (38) comprises coupling means (39, 40) between the central supporting frame (6) and the corresponding lateral supporting frame (31) and actuation means (23) for displacing the coupling means (39, 40) between a position of engagement of the corresponding lateral supporting frame (31) to the central supporting frame (6) and a position of release.

4. The apparatus according to Claim 3, wherein the central supporting frame (6) extends in a first direction (7) and wherein said lateral supporting frames (31) extend in a second direction (5) transverse to the first direction (7); said coupling means (39, 40) being mobile in the first direction (7) between said positions of engagement and release.

5. The apparatus according to Claim 4, wherein each lateral supporting frame (31) is mobile in the first direction (7) for displacing the corresponding coupling means (39, 40) between said positions of engagement and release.

6. The apparatus according to Claim 4 or Claim 5, wherein the coupling means (39, 40) comprise first pin means (40) parallel to the first direction (7) and second pin means (39) parallel to a third direction (36) substantially orthogonal to said first and second directions (7, 5); the second pin means (39) being mobile between said positions of engagement and release along at least one channel of advance (41) substantially parallel to the first direction (7).

7. The apparatus according to any one of Claims 3 to 6, wherein the actuation means (23) comprise at least one drawing member (26b), which is mounted on the central supporting frame (6) and is designed to engage a seat (43) made in the corresponding lateral supporting frame (31) for displacing the corresponding lateral supporting frame (31) between said positions of engagement and release.

8. The apparatus according to any one of the preceding claims, wherein the central supporting frame (6) is provided with at least one pair of supporting feet (21), each of which is mobile between a corresponding operating position, where the supporting foot (21) projects downwards from the central supporting frame (6), in particular downwards from the advancing wheels (32), to lean on the corresponding rail (81), and a corresponding resting position, where the supporting foot (21) is substantially contained within the central supporting frame (6).

9. The apparatus according to Claim 8 when it depends upon any one of Claims 3 to 7, wherein each supporting foot (21) is connected to said actuation means (23) to be displaced by the actuation means (23) themselves between the corresponding operating position and the corresponding resting position.

10. The apparatus according to any one of the preceding claims, wherein the central supporting frame (6) comprises a central body (9) and two lateral appendages (10), which are engaged, in use, to the corresponding lateral supporting frames (31) and are mobile with respect to the central body (9) for controlling selectively the distance between the two trains of wheels (4).

11. The apparatus according to claim 1, wherein the central supporting frame (6) comprises a central body (9) and two lateral appendages (10), at least one first of which is coupled in a mobile way to the central body (9) to slide in a first rectilinear direction (7) transverse to the railway track and/or switch (80); the lateral supporting frame (31) being engaged to a respective lateral appendage (10); the carriage (2; 54) comprising motor-driven actuation means (18) for moving the first lateral appendage (10) in the first direction (7) in order to adjust the wheel gauge of the carriage (2; 54); the measuring module (3)being an electronic measuring module and comprising at least two laser profilometers (48) for acquiring, each, video images of the top part of a respective rail (81) and processing and control means (53) configured for controlling the actuation means (18) as a function of said video images so as to adapt the wheel gauge in real time to the variations of gauge of the railway track and/or switch (80), and preferably configured to measure said geometric and/or structural parameters of the railway track and/or switch (80) on the basis of processing of said video images.

12. The apparatus according to Claim 11, wherein the carriage (2; 54) comprises position sensor means (20) for supplying a signal indicating the current position of the first lateral appendage (10) in the first direction (7), preferably the position sensor means comprising a linear-sliding potentiometer (20) having a resistive bar (20a) fixed on the central body (9), parallel to the first direction (7), and a slider (20b)

fixed with respect to the first lateral appendage (10); the processing and control means (53) being configured for controlling the actuation means (18) as a function of said video images and of said signal so as to adapt the wheel gauge to the variations of gauge of the railway track and/or switch (80) .

13. The apparatus according to Claim 11 or Claim 12, wherein said two laser profilometers (48) are arranged fixed with respect to the central supporting frame (6) with respective optical axes of acquisition (52) spaced apart, in a direction parallel to said first direction (7), by a pre-set distance (DL), and are each arranged in a position corresponding to a respective train of wheels (4) for acquiring video images of the corresponding rail (81).

14. The apparatus according to Claim 13, wherein said processing and control means (53) are configured for controlling the actuation means (18) as a function of said video images and of said pre-set distance (DL) so as to adapt the wheel gauge to the variations of gauge of the railway track and/or switch (80).

15. The apparatus according to Claim 13 or Claim 14, wherein each lateral appendage (10) is shaped like a rectangular annulus and is arranged, in use, above a corresponding rail (81), and each lateral supporting frame (31) comprises an outer edge or frame (37), which is arranged on top of, and substantially aligned with, a corresponding lateral appendage (10) so as to define, together with the latter, an opening (37a) from which a corresponding rail (81) is visible from above; each laser profilometer (48) being arranged on the corresponding frame (37) in such a way as to acquire video images of the corresponding rail (81) through said opening (37a) .

16. The apparatus according to Claim 15, wherein each train of wheels (4) extends in a second direction (5) transverse to the first direction (7) and comprises two pairs of wheels (32), at least one pair of which is motor-driven and which are rotatably mounted on the corresponding lateral supporting frame (31) and are arranged on opposite sides, in the second direction (5), of the corresponding lateral appendage (10).

17. The apparatus according to any one of Claims 11 to 16, wherein both of the lateral appendages (10) are coupled in a mobile way to the central body (9) so as to slide in the first direction (7); said actuation means (18) comprising a double screw/female-screw coupling (16, 17) that connects the central body (9) to the two lateral appendages (10), and an electric motor (45) for driving in rotation the double screw/female-screw coupling (16, 17) so as to impart on the lateral appendages (10) displacements in opposite senses in the first direction (7).

18. The apparatus according to any one of Claims 11 to 17, wherein each train of wheels (4) extends in a second direction (5) transverse to the first direction (7) and comprises at least one guide assembly (55), which comprises: a respective rocker (56) pivoted on the corresponding lateral supporting frame (31) so as to oscillate about a first axis (57) parallel to the second direction (5); a guide roller (63), which is mounted idle on a first arm (59) of the rocker (56) to turn about a second axis (61) substantially parallel to the first direction (7) and is designed to couple with a corresponding rail (81) of said railway track and/or switch (80); a position-detecting device (71) coupled to a second arm (59) of the rocker (56) in such a way as to detect the position of the rocker (56) about the first axis (57); and elastic-return means (73) for displacing the rocker (56) into a pre-set position and normally keeping it there; said processing and control means (53) being configured for processing signals supplied by the position-detecting devices (71) in order to warn of anomalous situations regarding advance of the carriage (54) along the railway track and/or switch (80) and/or regarding control of said actuation means (18).

19. The apparatus according to Claim 18, wherein said guide assembly (55) comprises an end-of-stroke block (67) designed to bear upon a surface portion (70a) of the corresponding lateral supporting frame (31) when said rocker (56) is in said pre-set position, and said position-detecting device (71) comprises an end-of-stroke sensor (72) fixed to the lateral supporting frame (31) in such a way as to detect said condition where said end-of-stroke block (57) bears upon said surface portion (70a).

20. The apparatus according to claim 1, wherein, the lateral supporting frame (31) is engaged to the central supporting frame (6), the plurality of wheels (32) are motor-driven, and each train of wheels (32) comprises a series of guide rollers (34), which are mounted on the lateral supporting frame (31) so as to project downwards to come, in use, into contact with an internal surface of the corresponding rail (81) and are rotatably coupled to the supporting frame (31) to turn idle about respective vertical axes (35) and are slidably coupled in a rectilinear direction (7) transverse to the railway track and/or switch (80); the carriage (2; 54) comprising motor-driven actuation means for moving the guide rollers (34) in said direction (7) so as to adjust the distance between the two series of guide rollers (34); the measuring module (3)being an electronic measuring module and comprising at least two laser profilometers (48) for acquiring, each, video images of the top part of a respective rail (81), and processing and control means (53) configured for controlling the actuation means as a function of said video images so as to

adapt in real time the distance between the two series of guide rollers (34) to the gauge of the railway track and/or switch (80); preferably the actuation means comprising at least two motors for imparting on said two series of guide rollers (34) mutually independent displacements and said processing and control means (53) being configured for controlling said two motors independently.

Patentansprüche

1. Selbstfahrende Einrichtung zum Messen geometrischer und/oder struktureller Parameter eines Eisenbahngleises und/oder einer Eisenbahnweiche (80), wobei die Einrichtung ein motorgetriebenes Fahrgestell (2; 54), das dafür ausgelegt ist, im Einsatz mit dem Eisenbahngleis und/oder der Eisenbahnweiche gekoppelt zu werden, und ein Messmodul (3) aufweist, das auf dem Fahrgestell (2; 54) montiert ist, um zumindest einen der geometrischen und/oder strukturellen Parameter des Eisenbahngleises und/oder der Eisenbahnweiche (80) zu messen; wobei das Fahrgestell (2; 54) einen zentralen Tragrahmen oder eine zentrale Tragstruktur (6), die sich in einer im Wesentlichen horizontalen Richtung quer zur Richtung des Gleises erstreckt, und zwei Räderzüge (4) aufweist, die vom zentralen Tragrahmen (6) getragen werden und mit einer jeweiligen Schiene (81) des Eisenbahngleises und/oder der Eisenbahnweiche (80) jeweils koppelbar sind; wobei die Einrichtung **dadurch gekennzeichnet ist, dass** jeder Räderzug (4) einen lateralen Tragrahmen oder eine laterale Tragstruktur (31) und eine Vielzahl von Rädern (32) zum Vorrücken des Fahrgestells, welche auf dem lateralen Tragrahmen (31) drehbar montiert sind, und eine Eingriffsvorrichtung (38) aufweist, um den lateralen Tragrahmen (31) mit dem zentralen Tragrahmen (6) lösbar in Eingriff zu bringen.

2. Einrichtung nach Anspruch 1, wobei jeder der zentralen und lateralen Tragrahmen (6, 31) eine langgestreckte Form hat; wobei sich der zentrale Tragrahmen (6) quer zu den lateralen Tragrahmen (31) erstreckt.

3. Einrichtung nach Anspruch 1 oder Anspruch 2, wobei jede Eingriffsvorrichtung (38) Kopplungsmittel (39, 40) zwischen dem zentralen Tragrahmen (6) und dem entsprechenden lateralen Tragrahmen (31) und Betätigungsmittel (23) zum Verschieben der Kopplungsmittel (39, 40) zwischen einer Position eines Eingriffs des entsprechenden lateralen Tragrahmens (31) mit dem zentralen Tragrahmen (6) und einer Löseposition aufweist.

4. Einrichtung nach Anspruch 3, wobei sich der zentrale Tragrahmen (6) in einer ersten Richtung (7) erstreckt und wobei sich die lateralen Tragrahmen (31) in einer zweiten Richtung (5) quer zur ersten Richtung (7) erstrecken; wobei die Kopplungsmittel (39, 40) in der ersten Richtung (7) zwischen den Eingriffs- und Lösepositionen beweglich sind.

5. Einrichtung nach Anspruch 4, wobei jeder laterale Tragrahmen (31) in der ersten Richtung (7) beweglich ist, um die entsprechenden Kopplungsmittel (39, 40) zwischen den Eingriffs- und Lösepositionen zu verschieben.

6. Einrichtung nach Anspruch 4 oder Anspruch 5, wobei die Kopplungsmittel (39, 40) erste Stiftmittel (40) parallel zur ersten Richtung (7) und zweite Stiftmittel (39) parallel zu einer dritten Richtung (36), die im Wesentlichen orthogonal zu den ersten und zweiten Richtungen (7, 5) ist, aufweisen; wobei die zweiten Stiftmittel (39) zwischen den Eingriffs- und Lösepositionen entlang zumindest einem Vorrückkanal (41), der im Wesentlichen parallel zur ersten Richtung (7) ist, beweglich sind.

7. Einrichtung nach einem der Ansprüche 3 bis 6, wobei die Betätigungsmittel (23) zumindest ein Ziehglied (26b) aufweisen, das auf dem zentralen Tragrahmen (6) montiert und dafür ausgelegt ist, mit einem Sitz (43) in Eingriff zu gelangen, der im entsprechenden lateralen Tragrahmen (31) ausgebildet ist, um den entsprechenden lateralen Tragrahmen (31) zwischen den Eingriffs- und Lösepositionen zu verschieben.

8. Einrichtung nach einem der vorhergehenden Ansprüche, wobei der zentrale Tragrahmen (6) mit zumindest einem Paar tragende Füße (21) versehen ist, von denen jeder zwischen einer entsprechenden Arbeitsposition, in der der tragende Fuß (21) aus dem zentralen Tragrahmen (6) nach unten, insbesondere von den vorrückenden Rädern (32) nach unten, vorsteht, so dass er auf der entsprechenden Schiene (81) anliegt, und einer entsprechenden Ruheposition beweglich ist, in der der tragende Fuß (21) im Wesentlichen innerhalb des zentralen Tragrahmens (6) enthalten ist.

9. Einrichtung nach Anspruch 8, wenn sie von einem der Ansprüche 3 bis 7 abhängt, wobei jeder tragende Fuß (21) mit den Betätigungsmitteln (23) verbunden ist, um durch die Betätigungsmittel (23) selbst zwischen der entsprechenden Arbeitsposition und der entsprechenden Ruheposition verschoben zu werden.

10. Einrichtung nach einem der vorhergehenden Ansprüche, wobei der zentrale Tragrahmen (6) einen zentralen Körper (9) und zwei laterale Fortsätze (10) aufweist, die im Einsatz mit den entsprechenden la-

teralen Tragrahmen (31) in Eingriff stehen und in Bezug auf den zentralen Körper (9) beweglich sind, um den Abstand zwischen den beiden Räderzügen (4) selektiv zu steuern.

11. Einrichtung nach Anspruch 1, wobei der zentrale Tragrahmen (6) einen zentralen Körper (9) und zwei laterale Fortsätze (10) aufweist, von denen zumindest ein erster mit dem zentralen Körper (9) beweglich gekoppelt ist, um in einer ersten geradlinigen Richtung (7) quer zu dem Eisenbahngleis und/oder der Eisenbahnweiche (80) zu gleiten; wobei der laterale Tragrahmen (31) mit einem jeweiligen lateralen Fortsatz (10) in Eingriff steht; wobei das Fahrgestell (2; 54) ein motorgetriebenes Betätigungsmittel (18) zum Bewegen des ersten lateralen Fortsatzes (10) in der ersten Richtung (7) aufweist, um die Radspurweite des Fahrgestells (2; 54) einzustellen; wobei das Messmodul (3) ein elektronisches Messmodul ist und zumindest zwei Laser-Profilometer (48), um jeweils Videobilder des oberen Teils einer jeweiligen Schiene (81) aufzunehmen, und Verarbeitungs- und Steuerungsmittel (53) aufweist, die dafür konfiguriert sind, das Betätigungsmittel (18) als Funktion der Videobilder zu steuern, um so die Radspurweite in Echtzeit auf die Variationen der Spurweite des Eisenbahngleises und/oder der Eisenbahnweiche (80) anzupassen, und vorzugsweise dafür konfiguriert sind, die geometrischen und/oder strukturellen Parameter des Eisenbahngleises und/oder der Eisenbahnweiche (80) auf der Basis einer Verarbeitung der Videobilder zu messen.

12. Einrichtung nach Anspruch 11, wobei das Fahrgestell (2; 54) ein Positionssensormittel (20) aufweist, um ein Signal bereitzustellen, das die aktuelle Position des ersten lateralen Fortsatzes (10) in der ersten Richtung (7) angibt, wobei das Positionssensormittel vorzugsweise ein lineares SchiebePotentiometer (20) mit einem parallel zur ersten Richtung (7) auf dem zentralen Körper (9) fixierten Widerstandsstab (20a) und einem in Bezug auf den ersten lateralen Fortsatz (10) fixierten Schieber (20b) aufweist; wobei die Verarbeitungs- und Steuerungsmittel (53) dafür konfiguriert sind, das Betätigungsmittel (18) als Funktion der Videobilder und des Signals zu steuern, um die Radspurweite an die Variationen der Spurweite des Eisenbahngleises und/oder der Eisenbahnweiche (80) anzupassen.

13. Einrichtung nach Anspruch 11 oder Anspruch 12, wobei die beiden Laser-Profilometer (48) in Bezug auf den zentralen Tragrahmen (6) fixiert angeordnet sind, wobei jeweilige optische Aufnahmeachsen (52) um einen voreingestellten Abstand (DL) in einer Richtung parallel zur ersten Richtung (7) beabstandet sind, und jeweils an einer Position entsprechend einem jeweiligen Räderzug (4) angeordnet sind, um Videobilder der entsprechenden Schiene (81) aufzunehmen.

14. Einrichtung nach Anspruch 13, wobei die Verarbeitungs- und Steuerungsmittel (53) dafür konfiguriert sind, das Betätigungsmittel (18) als Funktion der Videobilder und des voreingestellten Abstands (DL) zu steuern, um die Radspurweite an die Variationen der Spurweite des Eisenbahngleises und/oder der Eisenbahnweiche (80) anzupassen.

15. Einrichtung nach Anspruch 13 oder Anspruch 14, wobei jeder laterale Fortsatz (10) wie ein rechtwinkliger Ringraum geformt und im Einsatz über einer entsprechenden Schiene (81) angeordnet ist und jeder laterale Tragrahmen (31) einen äußeren Rand oder Rahmen (37) aufweist, der auf, und im Wesentlichen ausgerichtet mit, einem entsprechenden lateralen Fortsatz (10) angeordnet ist, um zusammen mit letztgenanntem eine Öffnung (37a) zu definieren, von der aus eine entsprechende Schiene (81) von oben sichtbar ist; wobei jedes Laser-Profilometer (48) auf dem entsprechenden Rahmen (37) auf solch eine Weise angeordnet ist, um Videobilder der entsprechenden Schiene (81) durch die Öffnung (37a) aufzunehmen.

16. Einrichtung nach Anspruch 15, wobei sich jeder Räderzug (4) in einer zweiten Richtung (5) quer zur ersten Richtung (7) erstreckt und zwei Paare Räder (32) aufweist, von denen zumindest ein Paar motorgetrieben ist und welche auf dem entsprechenden Tragrahmen (31) drehbar montiert und in der zweiten Richtung (5) an entgegengesetzten Seiten des entsprechenden lateralen Fortsatzes (10) angeordnet sind.

17. Einrichtung nach einem der Ansprüche 11 bis 16, wobei beide der lateralen Fortsätze (10) mit dem zentralen Körper (9) beweglich gekoppelt sind, um in der ersten Richtung (7) zu gleiten; wobei das Betätigungsmittel (18) eine Doppel-Schrauben/Schraubenmutterkopplung (16, 17), die den zentralen Körper (9) mit den beiden lateralen Fortsätzen (10) verbindet, und einen Elektromotor (45) aufweist, um die Doppel-Schrauben/Schraubenmutterkopplung (16, 17) drehend anzutreiben, um den lateralen Fortsätzen (10) Verschiebungen im entgegengesetzten Sinn in der ersten Richtung (7) zu vermitteln.

18. Einrichtung nach einem der Ansprüche 11 bis 17, wobei sich jeder Räderzug (4) in einer zweiten Richtung (5) quer zur ersten Richtung (7) erstreckt und zumindest eine Führungsanordnung (55) aufweist, welche aufweist: einen jeweiligen Kipphebel (56), der auf dem entsprechenden lateralen Tragrahmen (31) schwenkbar gelagert ist, um um eine zur zwei-

ten Richtung (5) parallele erste Achse (57) zu oszillieren; eine Führungsrolle (63), welche freilaufend auf einem ersten Arm (59) des Kipphebels (56) montiert ist, um um eine zweite Achse (61) zu drehen, die im Wesentlichen parallel zur ersten Richtung (7) ist, und dafür ausgelegt ist, mit einer entsprechenden Schiene (81) des Eisenbahngleises und/oder der Eisenbahnweiche (80) zu koppeln; eine Positionsdetektionsvorrichtung (71), die mit einem zweiten Arm (59) des Kipphebels (56) auf solch eine Weise gekoppelt ist, um die Position des Kipphebels (56) um die erste Achse (57) zu detektieren; und ein elastisches Rückholmittel (73), um den Kipphebel (56) in eine voreingestellte Position zu verschieben und ihn dort normalerweise zu halten; wobei die Verarbeitungs- und Steuerungsmittel (53) dafür konfiguriert sind, von den Positionsdetektionsvorrichtungen (71) bereitgestellte Signale zu verarbeiten, um vor anomalen Situationen in Bezug auf ein Vorrücken des Fahrgestells (54) entlang dem Eisenbahngleis und/oder der Eisenbahnweiche (80) und/oder in Bezug auf eine Steuerung des Betätigungsmittels (18) zu warnen.

19. Einrichtung nach Anspruch 18, wobei die Führungsanordnung (55) einen Endlage-Block (67) aufweist, der dafür ausgelegt ist, auf einem Oberflächenbereich (70a) des entsprechenden lateralen Tragrahmens (31) aufzuliegen, wenn der Kipphebel (56) in der voreingestellten Position ist, und die Positionsdetektionsvorrichtung (71) einen Endlage-Sensor (72) aufweist, der an dem lateralen Tragrahmen (31) auf solche eine Weise fixiert ist, um den Zustand zu detektieren, in dem der Endlage-Block (57) auf dem Oberflächenbereich (70a) aufliegt.

20. Einrichtung nach Anspruch 1, wobei der laterale Tragrahmen (31) mit dem zentralen Tragrahmen (6) in Eingriff steht, die Vielzahl von Rädern (32) motorgetrieben ist und jeder Zug Räder (32) eine Reihe von Führungsrollen (34) aufweist, die an dem lateralen Tragrahmen (31) montiert sind, so dass sie nach unten vorstehen, um im Einsatz mit einer Innenfläche der entsprechenden Schiene (81) in Kontakt zu kommen, und mit dem Tragrahmen (31) drehbar gekoppelt sind, um freilaufend um jeweilige vertikale Achsen (35) zu drehen, und in einer geradlinigen Richtung (7) quer zu dem Eisenbahngleis und/oder der Eisenbahnweiche (80) gleitfähig gekoppelt sind; wobei das Fahrgestell (2; 54) ein motorgetriebenes Betätigungsmittel aufweist, um die Führungsrollen (34) in der Richtung (7) zu bewegen, um den Abstand zwischen den beiden Reihen Führungsrollen (34) einzustellen; wobei das Messmodul (3) ein elektronisches Messmodul ist und zumindest zwei Laser-Profilometer (48) aufweist, um jeweils Videobilder des oberen Teils einer jeweiligen Schiene (81) aufzunehmen, und die Verarbeitungs- und Steuerungsmittel (53) dafür konfiguriert sind, das Betätigungsmittel als Funktion der Videobilder zu steuern, um in Echtzeit den Abstand zwischen den beiden Reihen Führungsrollen (34) an die Spurweite des Eisenbahngleises und/oder der Eisenbahnweiche (80) anzupassen; wobei das Betätigungsmittel vorzugsweise zumindest zwei Motoren aufweist, um den beiden Reihen Führungsrollen (34) wechselseitig unabhängige Verschiebungen zu vermitteln, und die Verarbeitungs- und Steuerungsmittel (53) dafür konfiguriert sind, die beiden Motoren unabhängig zu steuern.

Revendications

1. Appareil automoteur pour mesurer les paramètres géométriques et/ou structurels d'une voie ferrée et/ou d'un aiguillage ferroviaire (80), l'appareil comprenant un wagon motorisé (2; 54) conçu pour être couplé, en utilisation, à la voie ferrée et/ou à l'aiguillage ferroviaire, et un module de mesure (3) monté sur le wagon (2; 54) pour mesurer au moins l'un desdits paramètres géométriques et/ou structurels de la voie ferrée et/ou de l'aiguillage ferroviaire (80); le wagon (2; 54) comprenant un châssis ou une structure de support central (6) s'étendant dans une direction sensiblement horizontale transversale à la direction du rail et deux trains de roues (4), qui sont portés par le châssis de support central (6) et peuvent chacun être couplés à un rail respectif (81) de la voie ferrée et/ou de l'aiguillage (80); l'appareil étant **caractérisé en ce que** chaque train de roues (4) comprend un châssis ou une structure de support latéral (31) et une pluralité de roues (32) pour l'avance du wagon, qui sont montées de manière rotative sur le châssis de support latéral (31), et un dispositif d'engagement (38) pour engager de manière amovible le châssis de support latéral (31) sur le châssis de support central (6).

2. Appareil selon la revendication 1, dans lequel chacun desdits châssis de support centraux et latéraux (6, 31) a une forme allongée ; le châssis de support central (6) s'étendant transversalement vers lesdits châssis de support latéraux (31).

3. Appareil selon la revendication 1 ou la revendication 2, dans lequel chaque dispositif d'engagement (38) comprend des moyens de couplage (39, 40) entre le châssis de support central (6) et le châssis de support latéral correspondant (31) et des moyens d'actionnement (23) pour déplacer les moyens de couplage (39, 40) entre une position d'engagement du châssis de support latéral correspondant (31) au châssis de support central (6) et une position de relâche.

4. Appareil selon la revendication 3, dans lequel le châssis de support central (6) s'étend dans une première direction (7) et dans lequel lesdits châssis de support latéraux (31) s'étendent dans une deuxième direction (5) transversale à la première direction (7) ; lesdits moyens de couplage (39, 40) étant mobiles dans la première direction (7) entre lesdites positions d'engagements et de relâche.

5. Appareil selon la revendication 4, dans lequel chaque châssis de support latéral (31) est mobile dans la première direction (7) pour déplacer les moyens de couplage correspondants (39, 40) entre lesdites positions d'engagement et de relâche.

6. Appareil selon la revendication 4 ou la revendication 5, dans lequel les moyens de couplage (39, 40) comprennent un premier moyen à broches (40) parallèle à la première direction (7) et un second moyen à broches (39) parallèle à une troisième direction (36) sensiblement orthogonal auxdites première et deuxième directions (7, 5); le second moyen à broche (39) étant mobile entre lesdites positions d'engagement et de relâche le long d'au moins un canal d'avance (41) sensiblement parallèle à la première direction (7).

7. Appareil selon l'une des revendications 3 à 6, dans lequel les moyens d'actionnement (23) comprennent au moins un élément d'étirage (26b), qui est monté sur le châssis de support central (6) et est conçu pour engager un siège (43) réalisé dans le châssis de support latéral correspondant (31) pour déplacer le châssis de support latéral correspondant (31) entre lesdites positions d'engagement et de relâche.

8. Appareil selon l'une des revendications précédentes, dans lequel le châssis de support central (6) est pourvu d'au moins une paire de pieds de support (21), dont chacun est mobile entre une position de fonctionnement correspondante, où le pied de support (21) fait saillie vers le bas à partir du châssis de support central (6), en particulier vers le bas à partir des roues d'avancement (32), pour s'appuyer sur le rail correspondant (81), et une position de repos correspondante, où le pied de support (21) est sensiblement contenu dans le châssis de support central (6).

9. Appareil selon la revendication 8 lorsqu'elle dépend de l'une des revendications 3 à 7, dans lequel chaque pied de support (21) est connecté auxdits moyens d'actionnement (23) pour être déplacé par les moyens d'actionnement (23) eux-mêmes entre la position de fonctionnement correspondante et la position de repos correspondante.

10. Appareil selon l'une des revendications précédentes, dans lequel le châssis de support central (6) comprend un corps central (9) et deux appendices latéraux (10), qui sont engagés, en utilisation, sur les châssis de support latéraux correspondants (31) et sont mobiles par rapport au corps central (9) pour contrôler sélectivement la distance entre les deux trains de roues (4).

11. Appareil selon la revendication 1, dans lequel le châssis de support central (6) comprend un corps central (9) et deux appendices latéraux (10), dont au moins un premier est couplé de manière mobile au corps central (9) de manière à coulisser dans une première direction rectiligne (7) transversale à la voie ferrée et/ou à l'aiguillage (80); le châssis de support latéral (31) étant engagé dans un appendice latéral respectif (10); le wagon (2; 54) comprenant des moyens d'actionnement motorisés (18) pour déplacer le premier appendice latéral (10) dans la première direction (7) afin d'ajuster l'écartement des roues du wagon (2; 54); le module de mesure (3) étant un module de mesure électronique et comprenant au moins deux profilomètres laser (48) pour acquérir, chacun, des images vidéo de la partie supérieure d'un rail respectif (81) et des moyens de traitement et de commande (53) configurés pour contrôler les moyens d'actionnement (18) en fonction desdites images vidéo de manière à adapter l'écartement des roues en temps réel aux variations d'écartement de la voie ferrée et/ou d'aiguillage (80), et de préférence configurés pour mesurer lesdits paramètres géométriques et/ou structurels de la voie ferrée et/ou d'aiguillage (80) sur la base du traitement desdites images vidéo.

12. Appareil selon la revendication 11, dans lequel le wagon (2; 54) comprend des moyens de capteurs de position (20) pour fournir un signal indiquant la position actuelle du premier appendice latéral (10) dans la première direction (7), de préférence un capteur de position comprenant un potentiomètre à glissement linéaire (20) ayant une barre résistive (20a) fixée sur le corps central (9), parallèle à la première direction (7), et un curseur (20b) fixé par rapport au premier appendice latéral (10); les moyens de traitement et de commande (53) étant configurés pour commander les moyens d'actionnement (18) en fonction desdites images vidéo et dudit signal de manière à adapter l'écartement des roues aux variations d'écartement de la voie ferrée et/ou de l'aiguillage (80).

13. Appareil selon la revendication 11 ou la revendication 12, dans lequel lesdits deux profilomètres laser (48) sont disposés de manière fixe par rapport au châssis de support central (6) avec des axes optiques d'acquisition respectifs (52) espacés, dans une direction parallèle à ladite première direction (7),

d'une distance prédéfinie (DL), et sont chacun disposés dans une position correspondant à un train de roues respectif (4) pour acquérir des images vidéo du rail correspondant (81).

14. Appareil selon la revendication 13, dans lequel lesdits moyens de traitement et de commande (53) sont configurés pour commander les moyens d'actionnement (18) en fonction desdites images vidéo et de ladite distance prédéfinie (DL) de manière à adapter l'écartement des roues aux variations d'écartement de la voie ferrée et/ou de l'aiguillage (80).

15. Appareil selon la revendication 13 ou la revendication 14, dans lequel chaque appendice latéral (10) a la forme d'un anneau rectangulaire et est disposé, en utilisation, au-dessus d'un rail correspondant (81), et chaque châssis de support latéral (31) comprend un bord ou châssis extérieur (37), qui est disposé au-dessus et sensiblement aligné à un appendice latéral correspondant (10) de manière à définir, avec ce dernier, une ouverture (37a) à partir de laquelle un rail correspondant (81) est visible d'en haut; chaque profilomètre laser (48) étant disposé sur le châssis correspondant (37) de manière à acquérir des images vidéo du rail correspondant (81) à travers ladite ouverture (37a).

16. Appareil selon la revendication 15, dans lequel chaque train de roues (4) s'étend dans une deuxième direction (5) transversale à la première direction (7) et comprend deux paires de roues (32), dont au moins une paire est entraînée par un moteur et qui sont montés de manière rotative sur le châssis de support latéral correspondant (31) et sont disposés sur des côtés opposés, dans la deuxième direction (5), de l'appendice latéral correspondant (10).

17. Appareil selon l'une des revendications 11 à 16, dans lequel les deux appendices latéraux (10) sont couplés de manière mobile au corps central (9) de manière à coulisser dans la première direction (7); lesdits moyens d'actionnement (18) comprenant un couplage vis double/vis femelle (16, 17) qui relie le corps central (9) aux deux appendices latéraux (10), et un moteur électrique (45) pour entraîner en rotation le couplage vis double/vis femelle (16, 17) de manière à conférer aux appendices latéraux (10) des déplacements en sens opposés dans la première direction (7).

18. Appareil selon l'une des revendications 11 à 17, dans lequel chaque train de roues (4) s'étend dans une deuxième direction (5) transversale à la première direction (7) et comprenant au moins un ensemble de guidage (55), qui comprend: un basculeur respectif (56) pivotant sur le châssis de support latéral correspondant (31) de manière à osciller autour d'un premier axe (57) parallèle à la deuxième direction (5); un galet de guidage (63), qui est monté à vide sur un premier bras (59) du basculeur (56) pour tourner autour d'un second axe (61) sensiblement parallèle à la première direction (7) et est conçu pour être couplé avec un rail (81) de ladite voie ferrée et/ou de l'aiguillage (80); un dispositif de détection de position (71) couplé à un second bras (59) du basculeur (56) de manière à détecter la position du basculeur (56) autour du premier axe (57); et un moyen de rappel élastique (73) pour déplacer le basculeur (56) dans une position préréglée et la maintenir à cet emplacement de manière normale; lesdits moyens de traitement et de commande (53) étant configurés pour traiter des signaux fournis par les dispositifs de détection de position (71) afin d'avertir en cas de situations anormales concernant l'avance du wagon (54) le long de la voie ferrée et/ou de l'aiguillage (80) et/ou concernant la commande desdits moyens d'actionnement (18).

19. Appareil selon la revendication 18, dans lequel ledit ensemble de guidage (55) comprend un bloc de fin de course (67) conçu pour s'appuyer sur une partie de surface (70a) du châssis de support latéral correspondant (31) lorsque ledit basculeur (56) est dans ladite position prédéfinie, et ledit dispositif de détection de position (71) comprend un capteur de fin de course (72) fixé au châssis de support latéral (31) de manière à détecter ladite condition où ledit le bloc de fin de course (57) prend appui sur ladite partie de surface (70a).

20. Appareil selon la revendication 1, dans lequel, le châssis de support latéral (31) est engagé vers le châssis de support central (6), la pluralité de roues (32) est entraînée par un moteur, et chaque train de roues (32) comprend une série de galets de guidage (34), qui sont montés sur le châssis de support latéral (31) de manière à faire saillie vers le bas pour venir, en utilisation, en contact avec une surface interne du rail correspondant (81) et sont couplés de manière rotative au châssis de support (31) pour tourner au ralenti autour d'axes verticaux respectifs (35) et sont couplés de manière coulissante dans une direction rectiligne (7) transversalement à la voie ferrée et/ou à l'aiguillage (80); le wagon (2; 54) comprenant des moyens d'actionnement entraînés par un moteur pour déplacer les galets de guidage (34) dans ladite direction (7) afin d'ajuster la distance entre les deux séries de galets de guidage (34); le module de mesure (3) étant un module de mesure électronique et comprenant au moins deux profilomètres laser (48) pour acquérir, chacun, des images vidéo de la partie supérieure d'un rail respectif (81), et des moyens de traitement et de commande (53) configurés pour commander les moyens d'actionnement en fonction desdites images vidéo de manière à

adapter en temps réel la distance entre les deux séries de galets de guidage (34) au gabarit de la voie ferrée et/ou de l'aiguillage (80); de préférence, les moyens d'actionnement comprenant au moins deux moteurs pour communiquer auxdites deux séries de galets de guidage (34) des déplacements mutuellement indépendants et lesdits moyens de traitement et de commande (53) étant configurés pour commander indépendamment lesdits deux moteurs.

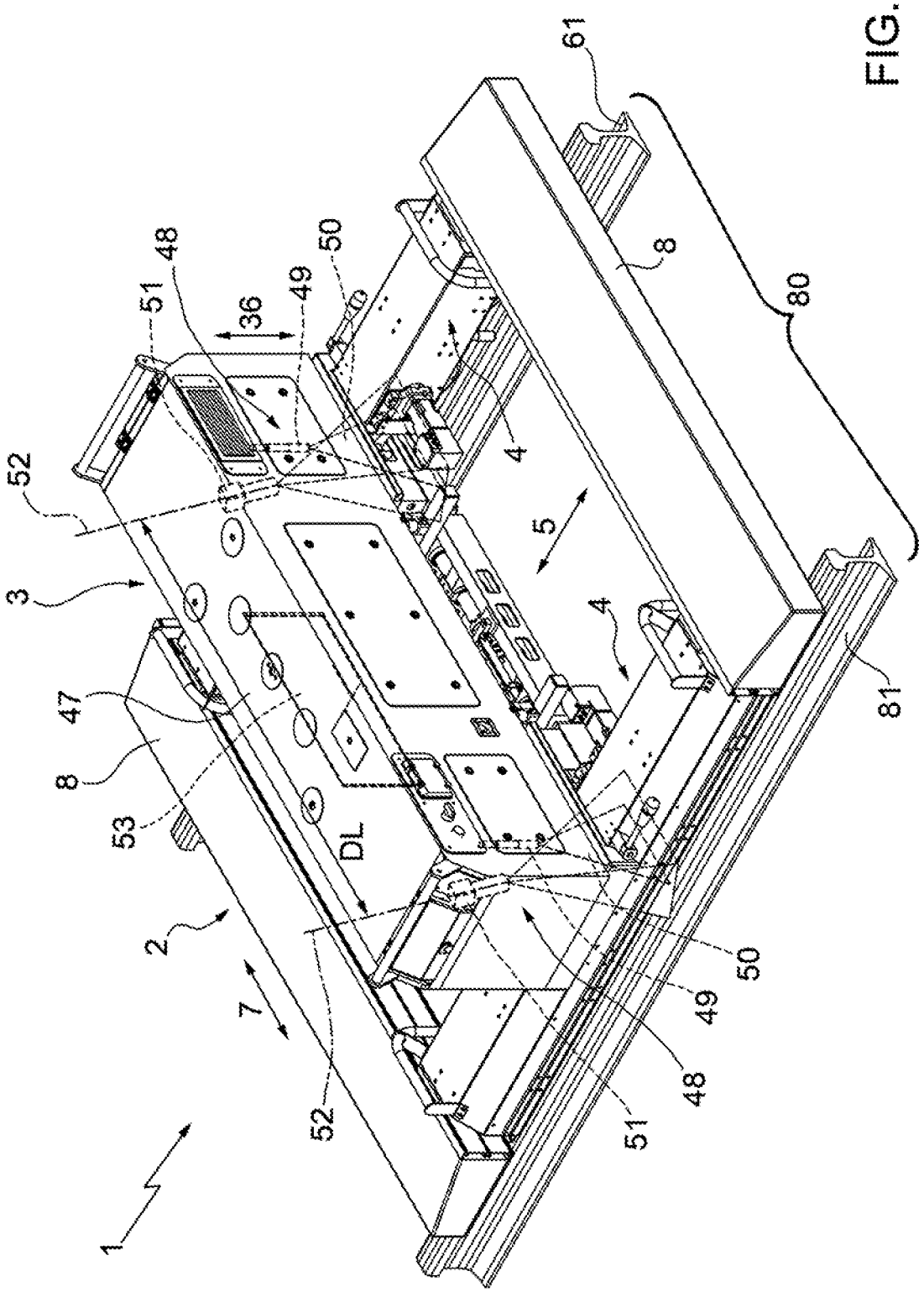

FIG.1

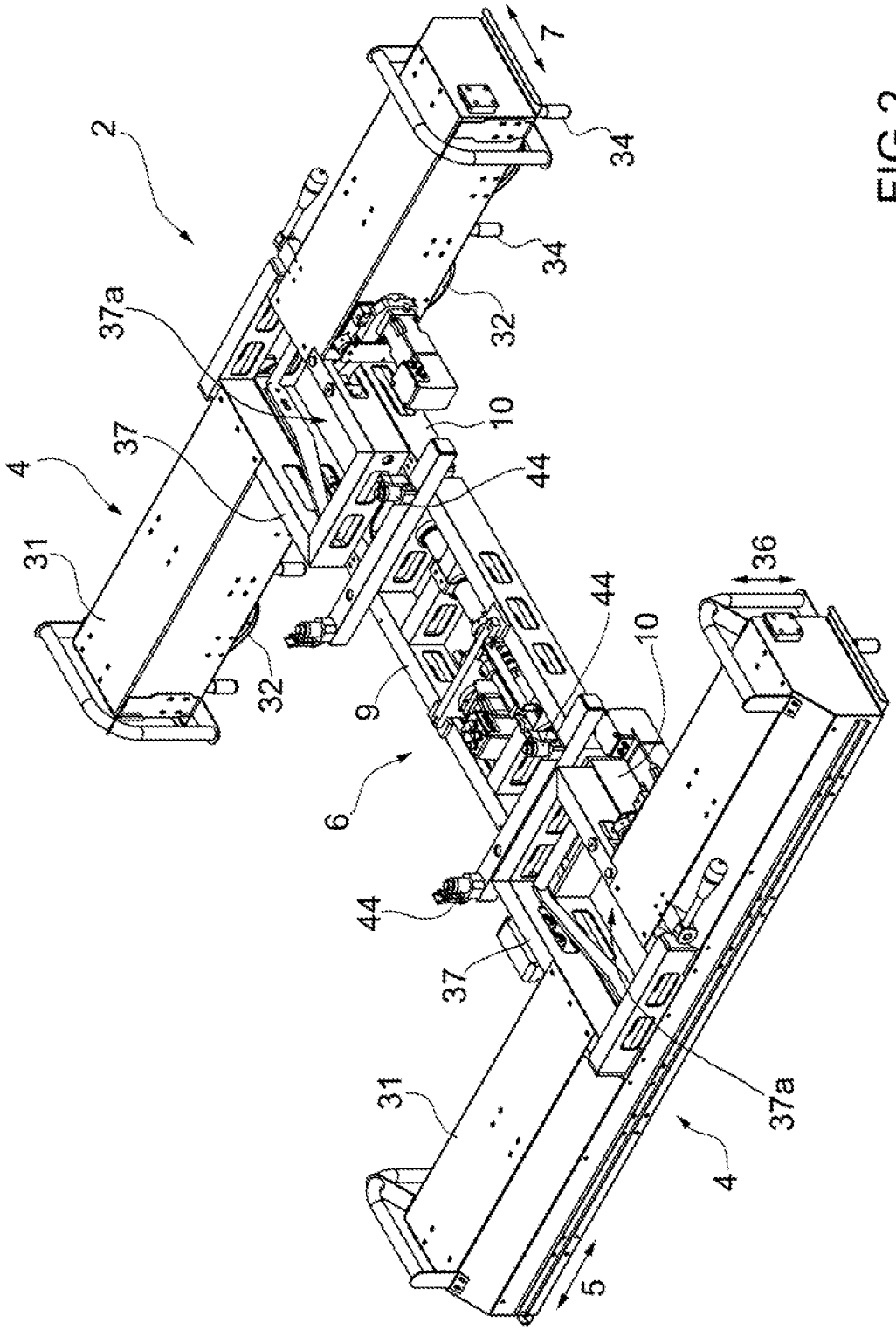

FIG.2

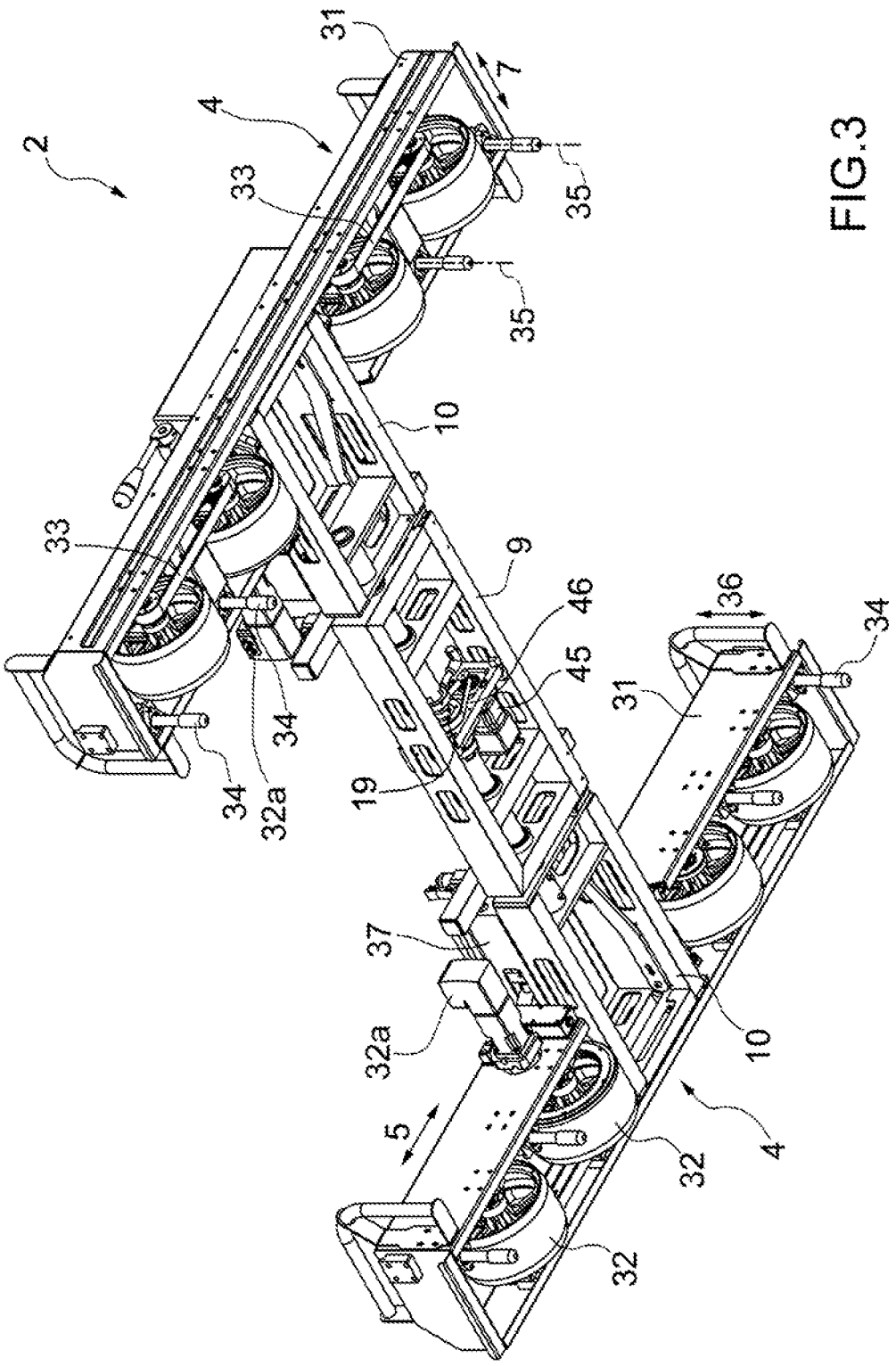

FIG.3

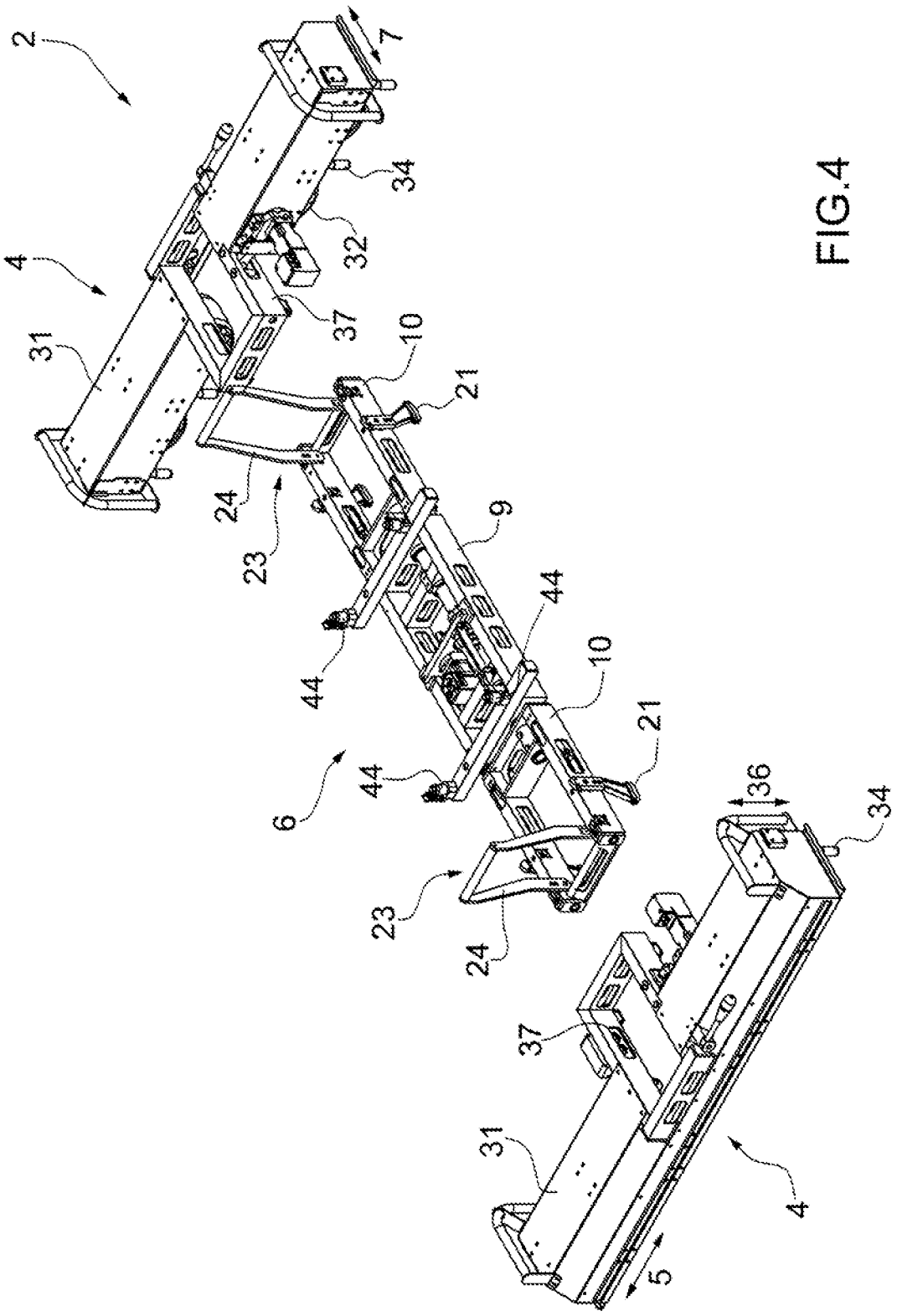

FIG.4

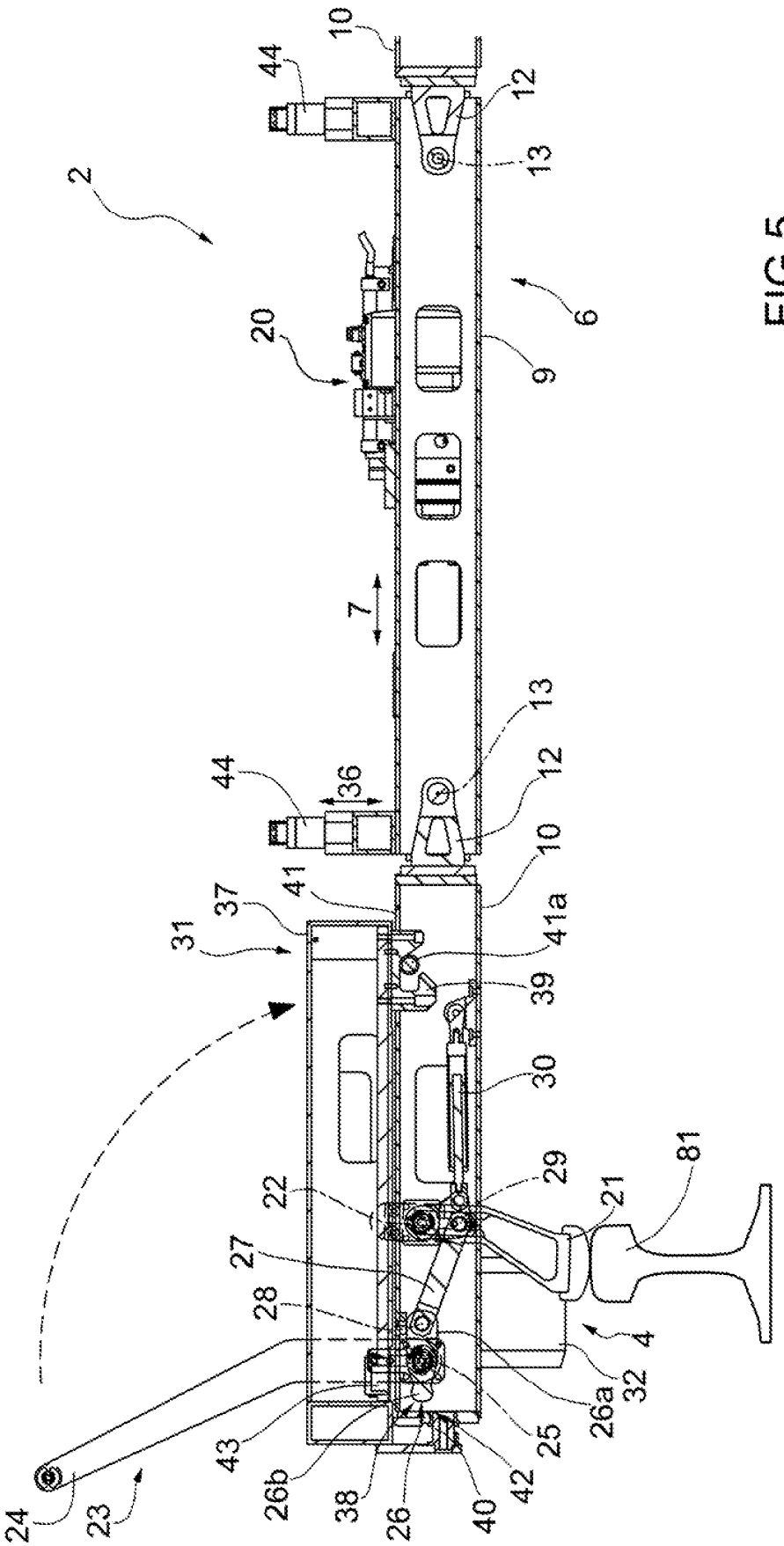
10
44
12
13
2
6
20
9
7
13
44
36
12
10
41
37
41a
31
39
30
29
22
21
81
27
28
4
32
26a
25
43
26b
38
26
40
42
24
23

FIG.5

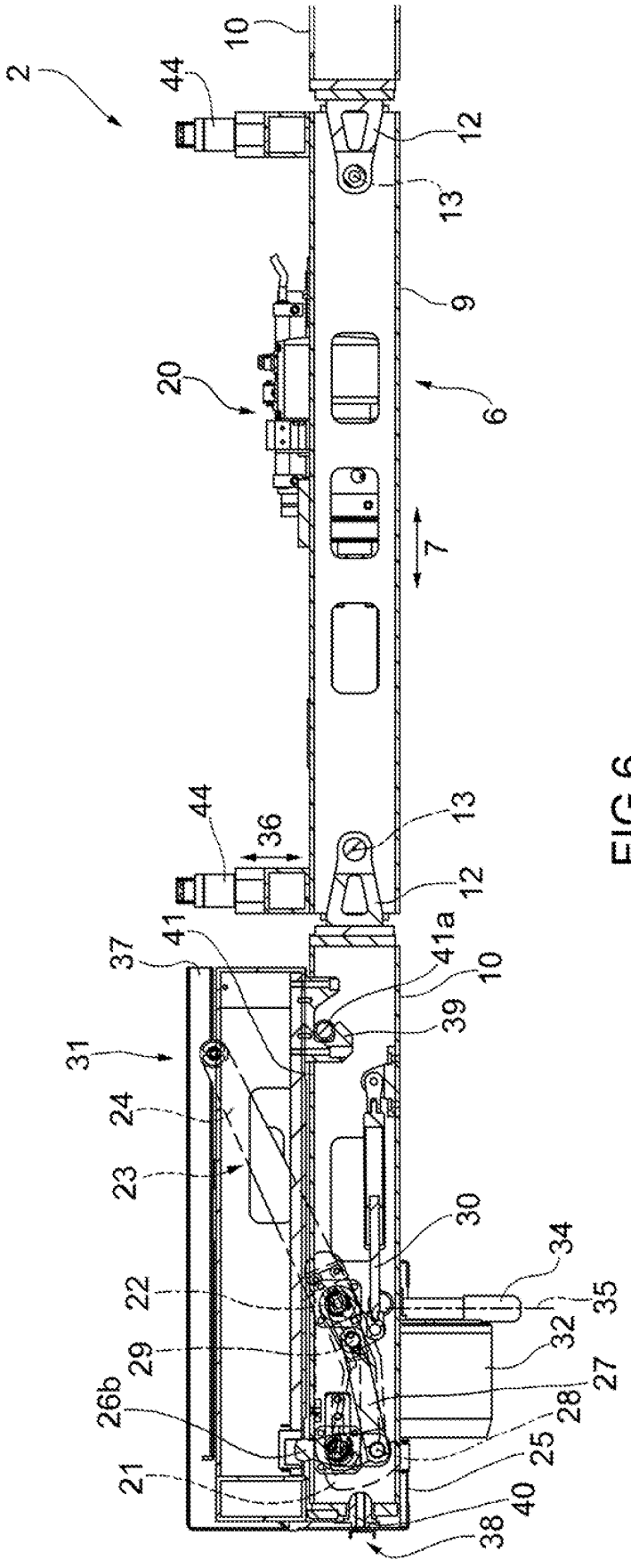
2
10
44
12
13
9
20
6
7
44
36
13
12
37
41
41a
10
39
31
24
23
30
34
22
35
32
29
27
26b
28
25
21
40
38

FIG.6

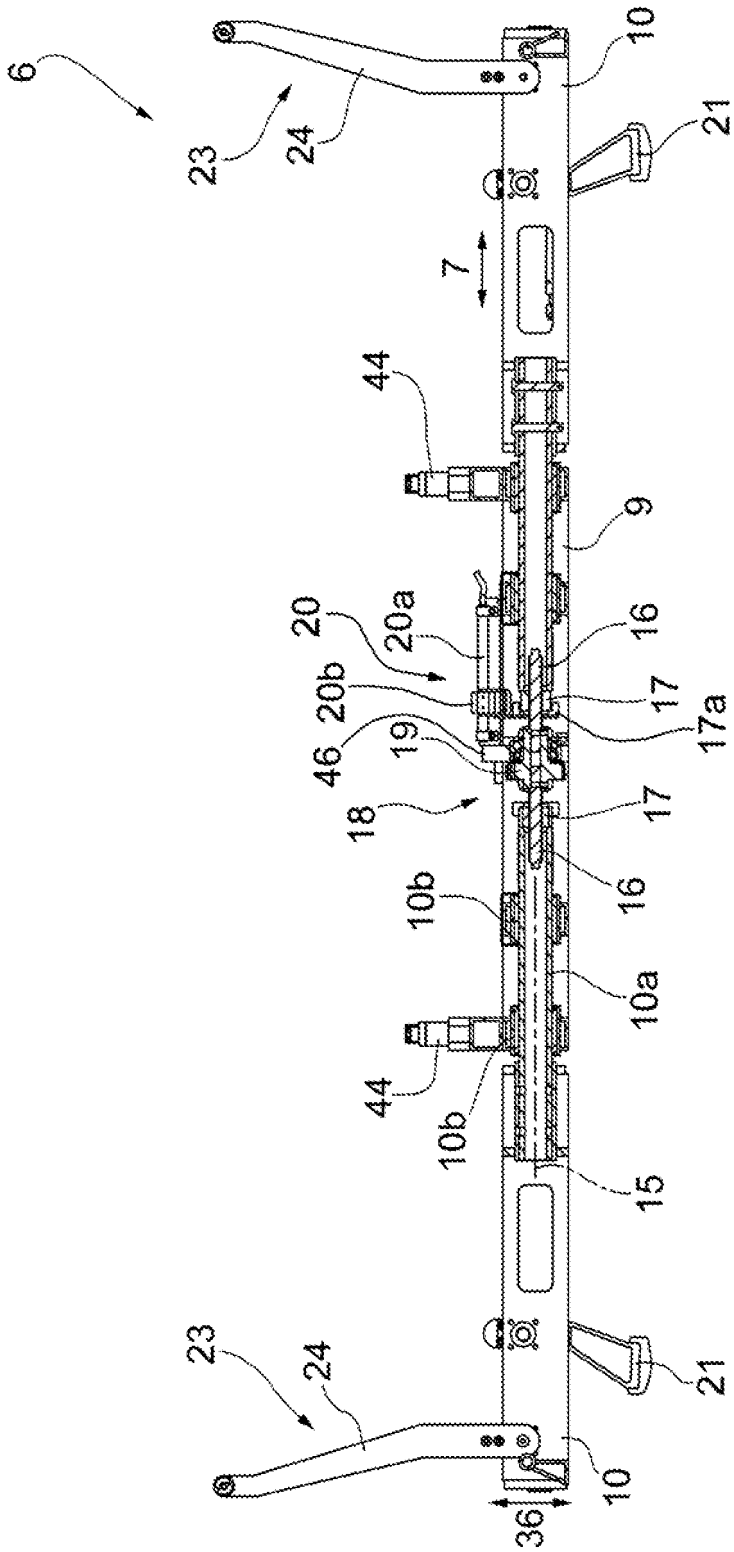

FIG.7

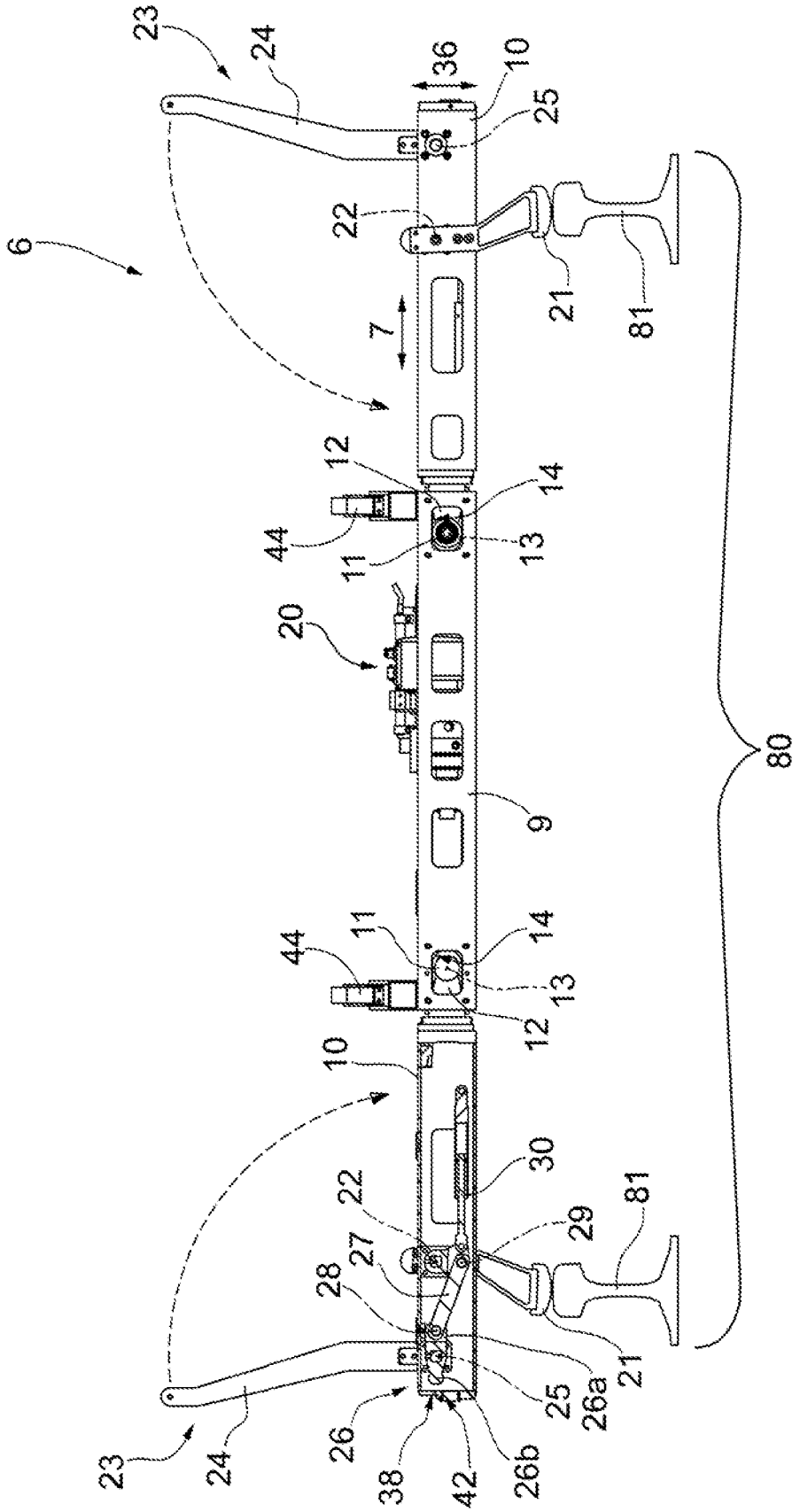
6
23
24
36
10
25
22
21
81
7
12
14
44
11
13
20
80
9
30
29
27
28
26
38
42
26b
26a

FIG.8

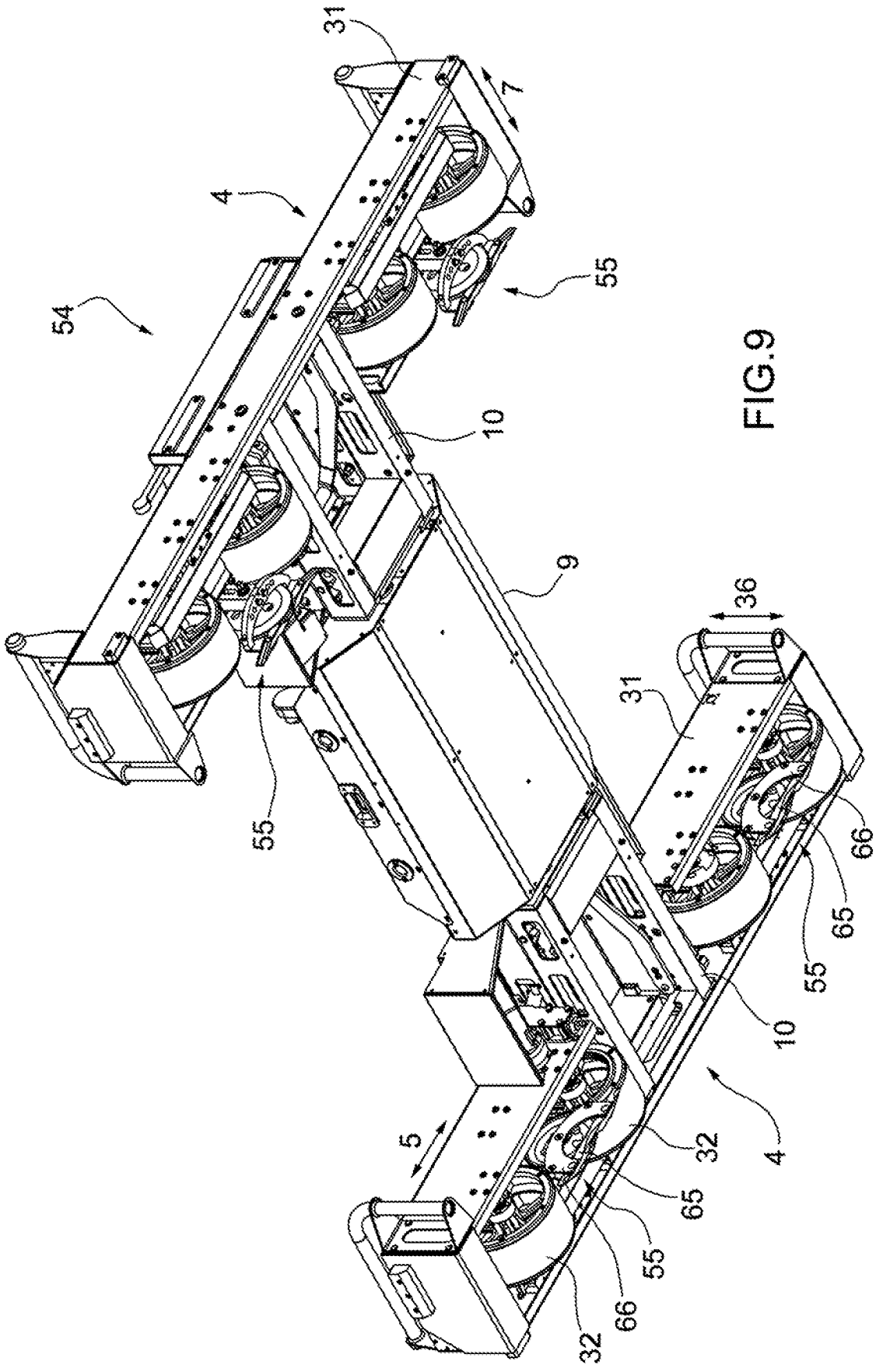

FIG.9

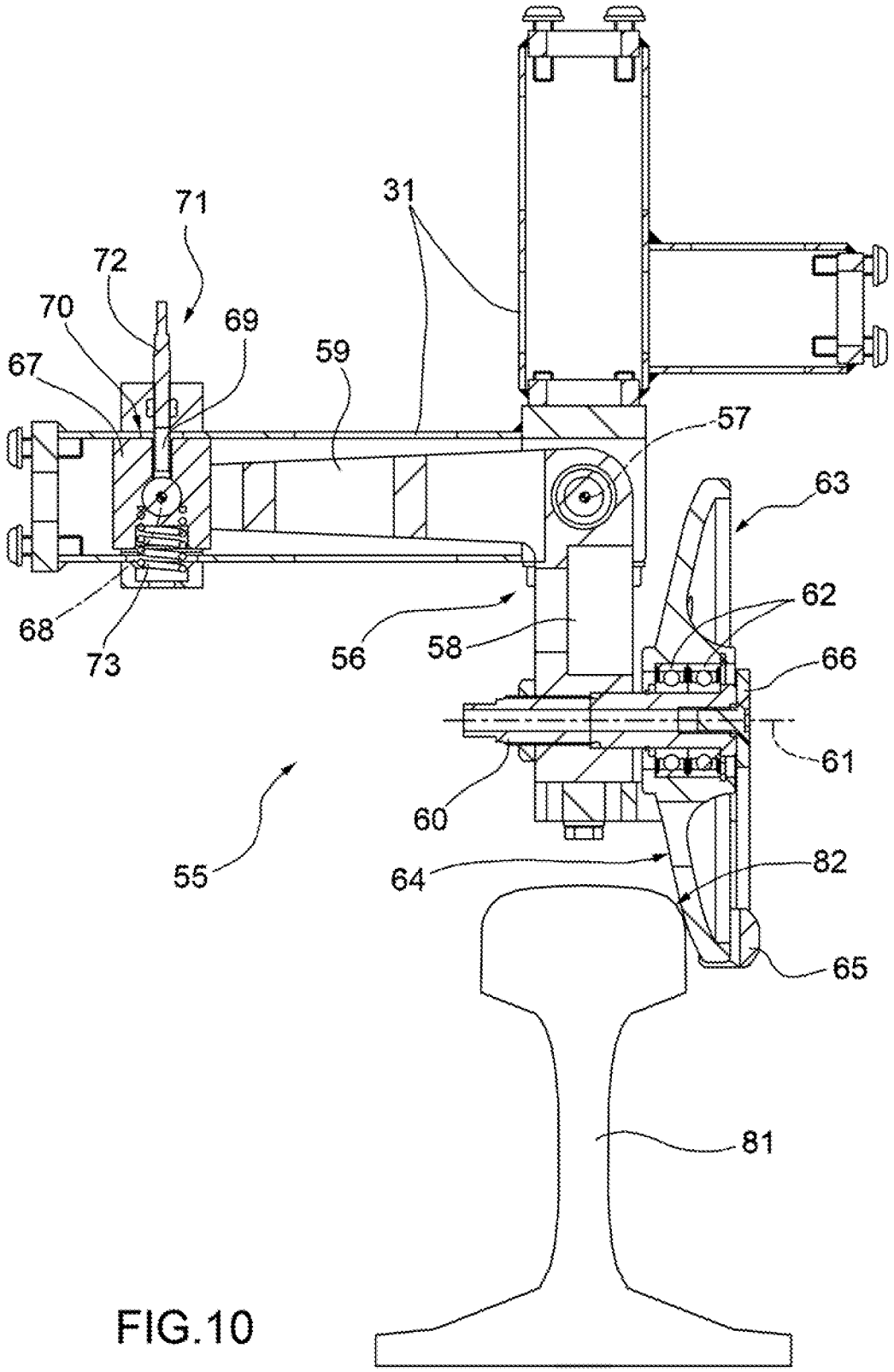

FIG.10

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE OS2130385 **[0005]**