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(54) TERMINAL AND RELATIVE APPARATUS FOR HEATING RAILS

(57) The present invention relates to a terminal (1) for an apparatus (100) for laying rails (R). The apparatus comprises a railway vehicle (V) movable on the railway ballast along an advancement trajectory (A) and configured for positioning said rails on the ballast. The apparatus comprises a generator (2) carried by the railway vehicle. The terminal is connectable to the generator and is integrally movable with the railway vehicle along the advancement trajectory; the terminal is configured for contacting the rail and allowing the passage of current through the latter. The terminal comprises a plurality of conductive elements, which, during the movement of the railway vehicle, contact the rail in order to place the latter in electrical connection with the generator.

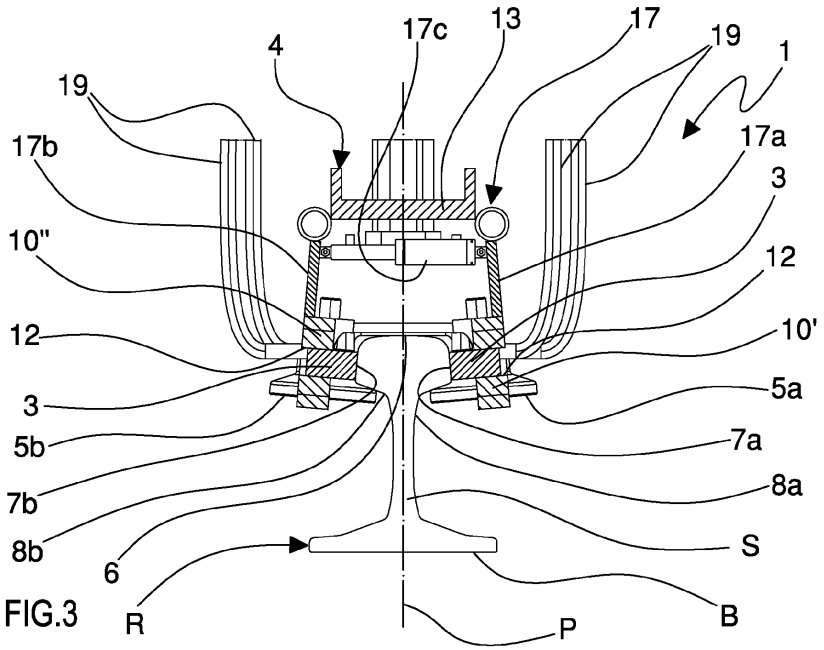

FIG.3

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Description

FIELD OF THE INVENTION

[0001] The object of the present invention is a terminal and a relative apparatus for heating rails. The apparatus is employable for heating rails while laying and constraining them on the railway ballast. In particular, the terminal and the relative apparatus are usable for making and/or renovating railway lines.

STATE OF THE ART

[0002] Apparatuses for making and/or the renewal of railway ballast capable of heating the rails at a desired regulation temperature are known. Such apparatuses allow fixing the rails to the sleepers at a predetermined thermal expansion, condition that allows preventing undesired deformations or breakage of the tracks in a condition of high temperature variations.

[0003] Apparatuses are known that are suitable for continuously heating the rails at a predetermined temperature while laying them and thus during the movement of the apparatus along the railway ballast. One example is described in the English patent application No. GB 1248082 A. Such apparatus comprises a plurality of wagons configured for disengaging the rails to be scrapped from the sleepers, laying the new rails and constraining the new rails to sleepers; the apparatus is provided with a generator connectable to the new rails by means of movable terminals, suitable for sliding along the rails to be laid during the movement of the apparatus along the ballast.

[0004] Even if the solution described in the patent application no. GB 1248082 A allows achieving a continuous heating and laying of the rails, the Applicant has detected that such solution may be improved with regard to several aspects.

OBJECT OF THE INVENTION

[0005] Object of the present invention is therefore that of resolving at least one of the drawbacks and/or limitations of the preceding solutions. A first objective of the present invention is to provide a terminal and a relative apparatus for heating rails suitable for ensuring a quick and correct laying of the rails, in particular allowing savings in terms of electrical energy consumptions. Another object of the present invention is to provide a terminal and a relative apparatus for heating rails having a simple and compact structure, in particular having reduced production and maintenance costs. These and still other objects, which will be clearer from the following description, are substantially reached by a terminal and a relative apparatus for heating rails according to one or more of the accompanying claims and/or with the description reported below.

SUMMARY

[0006] In one aspect, a terminal (1) for an apparatus (100) for laying at least one rail (R) on a railway ballast is provided, said apparatus (100) being of the type comprising:

- at least one railway vehicle (V) movable on the railway ballast along an advancement trajectory (A), said railway vehicle (V) being configured for positioning said at least one rail above the railway ballast,
- at least one generator (2) carried by the railway vehicle (V),

wherein the terminal (1) is connectable to the generator (2) and engageable with the rail (R) in order to allow the passage of current through the latter.

[0007] In one aspect according to the preceding aspect the terminal (1), in an engagement condition with the rail, is movable relative to the latter along the advancement trajectory (A).

[0008] In one aspect according to the preceding aspect the terminal comprises a plurality of conductive elements (3). In one aspect according to any one of the preceding aspects at least one of said conductive elements (3), during the movement of the railway vehicle (V) along the advancement trajectory (A), is configured for contacting the rail (R) in order to place it in electrical connection with the generator (2). In one aspect according to any one of the preceding aspects the terminal (1) is configured for defining, in cooperation with the rail (R) and the generator (2), a closed electric circuit. In one aspect according to any one of the preceding aspects the conductive elements (3), in use, are configured for contacting at least one top surface (6) and/or one flank of the rail (R).

[0009] In one aspect according to any one of the preceding aspects two or more conductive elements (3) of said plurality, in use, are aligned along a direction configured for being substantially parallel to one section of an extension direction (Y) of the rail (R) with which said terminal (1) is engaged. In one aspect according to any one of the preceding aspects the conductive elements (3) are of a number greater than 2, optionally comprised between 3 and 30, still more optionally between 3 and 20. In one aspect according to any one of the preceding aspects the conductive elements (3) are spaced along the alignment direction. In one aspect according to any one of the preceding aspects two conductive elements (3) adjacent to each other along the alignment direction thereof are placed at a minimum distance greater than 3 mm, optionally comprised between 5 mm and 30 mm.

[0010] In one aspect according to any one of the preceding aspects each conductive element (3) is made of at least one of the following materials, hard coal, copper, bronze, brass. In one aspect according to any one of the preceding aspects each conductive element is at least partly made of at least one of the following materials: coal-graphite, electro-graphite, metal-graphite, silver

graphite, Bakelite graphite.

[0011] In one aspect according to any one of the preceding aspects the terminal (1) comprises a frame (4) carrying the plurality of conductive elements (3). In one aspect according to the preceding aspect the frame (4) is extended along a longitudinal extension direction (X) between a first and a second end portion (4a, 4b). In one aspect according to the preceding aspect two or more of said conductive elements (3) are aligned along a direction substantially parallel to the longitudinal extension direction (X) of the frame (4). In one aspect according to any one of the preceding aspects the frame (4) comprises a central body (4c) interposed between the first and the second end portion (4a, 4b), in which the plurality of conductive elements (3) is directly engaged with the central body (4c) of the frame (4). In one aspect according to any one of the preceding aspects the plurality of conductive elements (3) is interposed between the first and the second end portion (4a, 4b) of the frame (4).

[0012] In one aspect according to any one of the preceding aspects the terminal (1) comprises at least one first and a second abutment element (41, 42) which, in use, are configured for allowing the abutment of the terminal (1) on a top surface (6) of the rail (R). In one aspect according to the preceding aspect the first and the second abutment element (41, 42) respectively comprise a wheel which, in use, is configured for rolling on a top surface (6) of the rail (R) in order to allow the terminal (1) to slide along said rail (R). In one aspect according to any one of the preceding aspects the terminal (1), in use, is configured for being abutted and sliding on a top surface (6) of the rail (R). In one aspect according to the three preceding aspects said first and second abutment elements (41, 42) are movable via rotation about an axis orthogonal to the longitudinal extension direction of the frame (4). In one aspect according to the preceding aspect the rotation axis of the first and second abutment elements (41, 42), in a use condition of the terminal during which the terminal (1) is movable together with the railway vehicle (V) along the advancement trajectory (A), is configured for being parallel to an upper abutment plane defined by the rail (R). In one aspect according to any one of the preceding aspects the first abutment element (41) is carried by the first end portion (4a) of the frame (4). In one aspect according to any one of the preceding aspects the second abutment element (42) is carried by the second end portion (4b) of the frame (4).

[0013] In one aspect according to any one of the preceding aspects the frame (4) has a length, defined by the maximum distance between the first and the second end portion (4a, 4b), greater than 400 mm, optionally comprised between 500 mm and 1000 mm. In one aspect according to any one of the preceding aspects the rotation axes of the first and second abutment elements (41, 42) are parallel to each other. In one aspect according to any one of the preceding aspects the rotation axes of the first and of the second abutment element (41, 42) are placed at a distance from each other greater than 300 mm, optionally comprised between 400 mm and 1000 mm.

[0014] In one aspect according to any one of the preceding aspects the terminal (1) comprises at least one guide element (5) carried by the frame (4), said guide element (5), in use conditions of the terminal (1), being configured for contacting the rail (R) and maintaining the longitudinal extension direction (X) of the frame (4) substantially parallel to at least one section of the rail (R) in contact with the terminal (1), optionally with the section of the rail (R) placed, in use, under the terminal (1).

[0015] In one aspect according to the preceding aspect the guide element (5) is interposed between the first and the second end portion (4a, 4b) of the frame (4). In one aspect according to the two preceding aspects the guide element (5) is substantially interposed between the first and the second abutment element (41, 42). In one aspect according to the three preceding aspects the guide element (5) is directly carried by the central body (4c) of the frame (4).

[0016] In one aspect according to the four preceding aspects the at least one guide element (5) comprises at least one first and at least one second guide element (5a, 5b) respectively configured for contacting opposite flanks of the rail (R). In one aspect according to the preceding aspect the first and the second guide element (5a, 5b) lie substantially on a same plane orthogonal to the longitudinal extension direction (X) of the frame (4). In one aspect according to the two preceding aspects the first and the second guide element (5a, 5b) lie substantially on a same plane which, in use conditions of the terminal (1), is configured for being orthogonal to the advancement trajectory (A). In one aspect according to the three preceding aspects the first and the second guide element (5a, 5b) are, in use condition of the terminal, configured for being arranged opposite to each other with respect to a symmetry plane of the transverse section of the rail (R).

[0017] In one aspect according to any one of the preceding aspects the first and the second guide element are arranged in proximity to the first and/or of the second end portion (4a, 4b) of the frame (4). In one aspect according to any one of the preceding aspects the terminal (1) comprises a first and a second guide element (5a, 5b) arranged at the first end portion (4a) of the frame (4) and a first and second guide element (5a, 5b) arranged at the second end portion (4b) of the frame.

[0018] In one aspect according to any one of the preceding aspects each guide element (5a, 5b) comprises a contrast wheel movable via rotation about an axis transversal, optionally substantially orthogonal, to the longitudinal extension direction of the frame (4).

[0019] In one aspect according to any one of the preceding aspects the rail (R) is of the type comprising:

- a base (B) configured for contacting the railway ballast,
- a stem (S) emerging from the base (B),

- a head (H) engaged with the stem (S) on the side opposite the base (B), said head (H) having:
  - at least one top surface (6) suitable for allowing the rolling of a wheel of the railway vehicle (V),
  - a first and a second flank (7a, 7b) connected to the upper surface and arranged opposite each other, said first and second flanks (7a, 7b) emerge from the top surface (6) in the direction of the base (B),
  - a first and a second connector surface (8a, 8b) opposite the top surface (6) with respect to the first and second flanks (7a, 7b), where the first connector surface (8a) connects the first flank (7a) to the stem (S) while the second connector surface (8b) connects the second flank (7b) to the stem (S).

[0020] In one aspect according to the preceding aspect the conductive elements (3), in a use condition of the terminal (1) during which said terminal (1) is movable along the rail, are configured for directly contacting at least one of: the first flank (7a) of the rail, the second flank (7b) of the rail, the top surface (6) of the rail.

[0021] In one aspect according to the two preceding aspects the first and second abutment element (41, 42), in a use condition of the terminal (1) during which said terminal (1) is movable along the rail, are configured for being moved via rolling above the top surface (6) of the rail (R), optionally in order to allow the movement of the terminal (1) above the rail (R). In one aspect according to the three preceding aspects the first guide element (5a) is configured for contacting the first flank (7a) and/or the first connector surface (8a) of the rail. In one aspect according to the four preceding aspects the second guide element (5b) is configured for contacting the second flank (7b) and/or the second connector surface (8b) of the rail.

[0022] In one aspect according to any one of the preceding aspects the terminal (1) comprises at least one sealing element (10) configured for engaging the plurality of conductive elements (3). In one aspect according to the preceding aspect the sealing element (10) comprises at least one seat (12) configured for directly engaging the plurality of conductive elements (3). In one aspect according to any one of the preceding aspects the sealing element (10) is engaged with the central body (4c) of the frame (4). In one aspect according to any one of the preceding aspects the at least one sealing element (10), in use conditions of the terminal during which it is movable along the rail (R), is configured for arranging one or more of said conductive elements (3) in contact with the rail (R), optionally with at least one of: the top surface (6) of the rail, the first flank (7a) of the rail, the second flank (7b) of the rail.

[0023] In one aspect according to any one of the preceding aspects the frame (4) comprises a support plate (13) with which a thrust group (17) is constrained, the thrust group (17) also being engaged with at least one between the sealing element (10) and the plurality of conductive elements (3), said thrust group (17) being configured for acting thrustingly on at least one between the sealing element (10) and the plurality of conductive elements (3), in order to force the contact between one or more of said conductive elements (3) with the rail (R).

[0024] In one aspect according to any one of the preceding aspects the thrust group (17) comprises:

- at least one arm which, on one side, is hinged to the support plate (13) of the frame (4) while on the other side, carries the sealing element (10),
- at least one pusher (17c) active on said arm and configured for maintaining in contact one or more of the conductive elements (3) carried by the sealing element (10) with the rail, optionally with at least one of the first and second flanks of the rail.

[0025] In one aspect according to any one of the preceding aspects the at least one arm comprises at least one first and one second arm (17a, 17b) respectively hinged to the support plate (13) of the frame (4). In one aspect according to any one of the preceding aspects the at least one sealing element (10) comprises a first and a second sealing element (10', 10") each of which carries a plurality of conductive elements (3). In one aspect according to any one of the preceding aspects the pusher (17c) is active on said first and second arm (17a, 17b) which is configured for maintaining in contact one or more of the conductive elements (3) carried by said first and second sealing element (10', 10") respectively with the first and second flanks (7a, 7b) of the rail (R).

[0026] In one aspect according to any one of the preceding aspects the pusher (17c) comprises an actuator. In one aspect according to the preceding aspect the actuator of the pusher (17c) comprises at least one of: a hydraulic cylinder, a pneumatic cylinder.

[0027] In one aspect according to any one of the preceding aspects the support plate (13) of the frame substantially lies on a plane parallel to the longitudinal extension direction (X) of the frame (4), wherein the first and the second arm (17a, 17b) of the thrust group (17) are opposite to each other with respect to a longitudinal center line plane of the terminal (1) which is substantially parallel to the longitudinal extension direction (X) of the frame (4) and orthogonal to the lying plane of the support plate (13). In one aspect according to any one of the preceding aspects the first and the second sealing element (10', 10") are opposite each other with respect to a longitudinal center line plane of the terminal (1) which is substantially parallel to the longitudinal extension direction (X) of the frame (4) and orthogonal to the lying plane of the support plate (13). In one aspect according to any one of the preceding aspects the lying plane of the support plate, in a use condition of the terminal (1) during which the latter is movable along the rail (R), is substantially horizontal.

[0028] In one aspect according to any one of the pre-

ceding aspects the at least one arm of the thrust group (17) is movable via rotation with respect to the support plate (13) about an axis substantially parallel to the longitudinal extension direction (X) of the frame (4). In one aspect according to any one of the preceding aspects the first and the second arm (17a, 17b) of the thrust group (17) are movable via rotation about respective axes, parallel to and spaced from each other. In one aspect according to the preceding aspect the rotation axes of the first and of the second arm (17a, 17b) are substantially parallel to the longitudinal extension direction of the frame (4). In one aspect according to any one of the preceding aspects the rotation axes of the first and second arm (17a, 17b) are opposite to each other with respect to a longitudinal center line plane of the terminal (1) which is substantially parallel to the longitudinal extension direction (X) of the frame (4) and orthogonal to the lying plane of the support plate (13).

[0029] In one aspect according to any one of the preceding aspects the rotation axes of the first and second abutment elements (41, 42) substantially define an ideal abutment plane of the terminal (1). In one aspect according to the preceding aspect the lying plane of the support plate (13) is parallel to the ideal abutment plane of the terminal (1). In one aspect according to the two preceding aspects the support plate (13) is placed, in use, above the first and the second abutment element (41, 42).

[0030] In one aspect according to any one of the preceding aspects the at least one sealing element (10) is interposed between the first and the second guide element (5a, 5b).

[0031] In one aspect according to any one of the preceding aspects the plurality of conductive elements (3) carried by the sealing element (10), in a use condition of the terminal (1) during which it is movable along the rail (R), is slidingly movable relative to the rail (R). In one aspect according to any one of the preceding aspects one or more of the conductive elements (3), in a use condition of the terminal (1), define sliding electrical contacts configured for allowing the electrical connection between the rail (R) and the generator (2).

[0032] In one aspect according to any one of the preceding aspects the at least one sealing element (10) comprises at least one catenary (18) carrying a plurality of conductive elements (3) which are movable in closed loop along said catenary. In one aspect according to the preceding aspect the closed loop of the catenary lies on a plane substantially parallel to the longitudinal extension direction (X) of the frame (4). In one aspect according to the two preceding aspects the closed loop of the catenary lies on a plane substantially parallel to the lying plane of the support plate (13).

[0033] In one aspect according to the three preceding aspects each conductive element (3), in use conditions of the terminal during which it is movable along the rail, is movable along the catenary. In one aspect according to the four preceding aspects the catenary (18) is configured for supporting and moving the plurality of conductive elements (3), at least during a use condition of the terminal, and for arranging:

- a first series (3') of conductive elements in direct contact with the rail (R), optionally with the first and/or second flank (7a, 7b) of the rail,
- a second series (3") of conductive elements spaced from the rail.

[0034] In one aspect according to the preceding aspect the first series (3') comprises a plurality of conductive elements (3). In one aspect according to the two preceding aspects the second series (3") comprises a plurality of conductive elements (3). In one aspect according to any one of the preceding aspects the first and second sealing element (10', 10") comprise respective catenaries.

[0035] In one aspect according to any one of the preceding aspects wherein the thrust group (17) comprises at least one elastic return element (17d) interposed between the support plate (13) and the plurality of conductive elements (3), said elastic return element (17d) being configured for acting thrustingly on at least one conductive element (3) in order to force the contact between the latter and the rail (R). In one aspect according to the preceding aspect the thrust group (17) comprises a plurality of elastic return elements (17d), wherein each elastic return element (17d) is configured for acting thrustingly on at least one conductive element (3) in order to force the contact between the latter and the rail (R). In one aspect according to the two preceding aspects the elastic return element (17d) is configured for pushing at least one conductive element (3) against the top surface (6) of the rail (R). In one aspect according to the three preceding aspects the elastic return element (17d) comprises a spring, optionally a pressure spring.

[0036] In one aspect according to any one of the preceding aspects the rotation axes of the first and second abutment elements (41, 42) substantially define an ideal abutment plane of the terminal (1), wherein each elastic return element (17d) is configured for exerting a thrust force on one or more conductive elements direct along a direction orthogonal to the ideal abutment plane of the terminal (1).

[0037] In one aspect according to any one of the preceding aspects the at least one sealing element (10) comprises at least one catenary (18) carrying a plurality of conductive elements (3) which are movable as a closed loop along said catenary. In one aspect according to the preceding aspect the closed loop of the catenary lies on a plane substantially parallel to the longitudinal extension direction (X) of the frame (4). In one aspect according to the two preceding aspects the closed loop of the catenary (18) lies on a plane transverse, optionally orthogonal, to the lying plane of the support plate (13).

[0038] In one aspect according to the three preceding aspects each conductive element (3), in a use condition of the terminal during which it is movable along the rail,

is movable along the catenary. In one aspect according to the four preceding aspects the catenary (18) is configured for supporting and moving the plurality of conductive elements (3), at least during a use condition of the terminal, and for arranging:

- a first series (3') of conductive elements in direct contact with the rail (R), optionally with the top surface (6) of the rail (R),
- a second series (3") of conductive elements spaced from the rail (R).

[0039] In one aspect according to the preceding aspect the first series (3') comprises a plurality of conductive elements (3). In one aspect according to the two preceding aspects the second series (3") comprises a plurality of conductive elements (3). In one aspect according to the three preceding aspects at least the plurality of conductive elements (3) of the first series (3') is aligned along a direction which, in use conditions of the terminal (1) during which it is movable along the rail, is configured for being substantially parallel to a section of the rail in direct contact with the terminal.

[0040] In one aspect according to any one of the preceding aspects the terminal (1) comprises at least one connector (9) configured for electrically connecting at least one conductive element (3) to the generator (2). In one aspect according to any one of the preceding aspects the terminal (1) comprises a plurality of connectors (9), each of which is configured for electrically connecting at least one conductive element (3) with the generator (2). In one aspect according to the preceding aspect each connector (9) is configured for electrically connecting a number of conductive elements (3) to the generator (2) equal to or lower than 3. In one aspect according to the three preceding aspects each connector (9) comprises one or more cables (19) configured for connecting one or more conductive elements (3) to the generator (2). In one aspect according to any one of the preceding aspects each connector (9) comprises at least four cables (19) configured for connecting two conductive elements (3) adjacent to the generator (2).

[0041] In one aspect according to any one of the preceding aspects the connector (9) is carried by the frame (4). In one aspect according to any one of the preceding aspects the connector (9) is directly engaged with the central body (4c) of the frame (4).

[0042] In one aspect according to any one of the preceding aspects the support plate (13), in use conditions of the terminal (1) during it is movable along the rail, is movable close to and away from the rail (R). In one aspect according to the preceding aspect the support plate (13), in use conditions of the terminal (1) during it is movable along the rail, is movable along a vertical direction.

[0043] In one aspect according to any one of the preceding aspects the frame (4) comprises a base plate (14a) fixed to the frame and extended along the extension direction (X) of the frame interposed between the first and the second end portion (4a, 4b), said base plate being configured for being arranged, in use conditions of the terminal (1) during which it is movable along the rail, above the rail, optionally above the top surface (6) of the head (H) of the rail (R).

[0044] In one aspect according to the preceding aspect the frame (4) comprises an adjustment device (14) configured for moving the support plate (13). In one aspect according to the preceding aspect the adjustment device (14) comprises a regulator (14b) which movably engages the support plate (13) with the base plate (14a), wherein said regulator (14b), in use conditions of the terminal (1) during which it is movable along the rail, is configured for moving the support plate (13) close to and away from the rail (R).

[0045] In one aspect according to the preceding aspect the regulator comprises two or more screws fixed, on one side, to the base plate (14b) and, on the other side, engaged within one or more holes of the support plate (13).

[0046] In one aspect an apparatus (100) for laying rails (R) on a railway ballast is provided, said apparatus comprising:

- at least one railway vehicle (V) movable along an advancement trajectory (A) and configured for positioning at least one rail (R) on a railway ballast,
- at least one generator (2) carried by the railway vehicle (V),
- at least one terminal (1) according to any one of the preceding aspects placed in connection with the generator (2) and configured for contacting the rail (R) in order to allow the passage of current through it.

[0047] In one aspect according to the preceding aspect said at least one terminal (1) is configured for defining, in cooperation with the rail (R) and the generator (2), a closed electric circuit.

[0048] In one aspect according to any one of the preceding apparatus aspects the at least one terminal comprises at least one first and a second terminal (1a, 1b). In one aspect according to the preceding aspect the generator (2) is electrically connected to said first and second terminals (1a, 1b). In one aspect according to the two preceding aspects the first and the second terminal (1a, 1b), in cooperation with the generator (2), are configured for allowing the passage of an electric current through said rail (R) in order to allow the heating thereof.

[0049] In one aspect according to the three preceding aspects the first terminal (1a), the second terminal (1b), the generator (2) are configured for defining, with a same rail (R), a closed electric circuit.

[0050] In one aspect according to any one of the preceding aspects of an apparatus the generator (2) is a voltage generator or a current generator. In one aspect according to any one of the preceding aspects of an apparatus, the generator is configured for electrically power supplying at least one terminal (1). In one aspect according to the preceding aspect the generator (2) is configured

for supplying a direct voltage to the at least one of said terminals (1).

[0051] In one aspect according to any one of the preceding aspects of an apparatus, the generator (2) comprises an endothermic engine configured for generating mechanical energy, said generator also comprising an alternator connected to said endothermic engine and configured for converting the mechanical energy produced by the endothermic engine into electrical energy.

[0052] In one aspect according to any one of the preceding aspects of an apparatus (100) comprises:

- a first and a second terminal (1a, 1b) electrically connected to the generator (2) in order to define a first connection group, said first and second terminals (1a, 1b) of the first connection group being configured for contacting a first rail (23a) of a track, said first and the second terminal (1a, 1b) of the first connection group, in cooperation with the generator (2), are configured for allowing the passage of an electric current through said first rail (23a) in order to allow the heating thereof,
- a first and a second terminal (1a, 1b) electrically connected to the generator (2) in order to define a second connection group, said first and second terminals (1a, 1b) of the second connection group being configured for contacting a second rail (23b) of a track, said first and the second terminal (1a, 1b) of the second connection group, in cooperation with the generator (2), are configured for allowing the passage of an electric current through said second rail (23b) in order to allow the heating thereof.

[0053] In one aspect according to the preceding aspect the first and the second connection group are connected in parallel with the generator (2). In one aspect according to the two preceding aspects said first and second connection group are configured for applying a same voltage respectively to the first and to the second rail (23a, 23b).

[0054] In one aspect according to any one of the preceding aspects of an apparatus (100), the first terminal (1a), in a use condition of the apparatus during it is movable with respect to the ballast, is arranged upstream of the second terminal (1b) with respect to the advancement trajectory (A). In one aspect according to any one of the preceding aspects of an apparatus (100), the first terminal (1a), in a use condition of the apparatus during which it is movable along the ballast, is spaced from the second terminal (1b). In one aspect according to any one of the preceding aspects of an apparatus (100), the first terminal (1a), in a use condition of the apparatus during which it is movable along the ballast, is arranged with respect to the second terminal (1b) at a distance greater than 10 meters, optionally comprised between 50 meters and 300 meters.

[0055] In one aspect according to any one of the preceding aspects of an apparatus, the generator (2) is configurable at least between:

- an active condition where each conductive element (3) is power supplied by the generator (2) and is configured for placing the generator (2) in electrical connection with the rail (R),
- an inactive condition where each conductive element (3) is not power supplied by the generator (2).

[0056] In one aspect according to the preceding aspect each conductive element (3) is configured for contacting the rail (R) during the active condition or the inactive condition of the generator (2).

[0057] In one aspect according to any one of the two preceding aspects the railway vehicle (V) is movable along the railway ballast at an advancement speed, and wherein the terminal (1), in the inactive condition of the generator (2), is movable relative to the rail (R), at a respective speed. In one aspect according to the preceding aspect the ratio between the advancement speed of the railway vehicle and the advancement speed of the terminal, is comprised between 0 and 1, optionally comprised between 0 and 0.2. In one aspect according to any one of the four preceding aspects, two temporally successive active conditions of the generator (2) are interrupted by an inactive condition.

[0058] In one aspect according to any one of the preceding aspects the railway vehicle (V), during a laying condition at least one rail on the ballast, is movable along the advancement trajectory at a predetermined speed. In one aspect according to the preceding aspect the terminal (1) during the laying condition, is:

- movable together with the railway vehicle, relative to the rail, and/or
- fixed with respect to the rail and movable relative to the railway vehicle.

[0059] In one aspect according to the preceding aspect the generator (2) is configured for electrically power supplying the terminal (1) in the laying condition (optionally when the railway vehicle is movable along the advancement trajectory and hence movable relative to the rail) and at least when said terminal (1) is fixed with respect to the rail. In one aspect according to the two preceding aspects the generator (2) is configured for defining the active condition only in the laying condition (optionally when the railway vehicle is movable along the advancement trajectory and hence movable relative to the rail), when said terminal (1) is fixed with respect to the rail. In one aspect according to the three preceding aspects the generator (2) is configured for defining the inactive condition in the laying condition (optionally when the railway vehicle is movable along the advancement trajectory and hence movable relative to the rail), when said terminal (1) is also movable relative to the rail along the advancement trajectory.

[0060] In one aspect according to any one of the preceding aspects the railway vehicle (V), during a condition for laying at least one rail on the ballast, is movable along

the advancement trajectory at a predetermined speed. In one aspect according to the preceding aspect the terminal (1) during the laying condition, is movable together with the railway vehicle, relative to the rail. In one aspect according to any one of the two preceding aspects the generator (2) is configured for electrically power supplying the terminal (1) in the laying condition (optionally when the railway vehicle is movable along the advancement trajectory and hence movable relative to the rail) and when said terminal (1) is movable along the advancement trajectory together with the railway vehicle. In one aspect according to any one of the three preceding aspects the generator (2) is configured for defining the active condition in laying condition (optionally when the railway vehicle is movable along the advancement trajectory and hence movable relative to the rail) and when said terminal (1) is movable along the advancement trajectory together with the railway vehicle. In one aspect according to any one of the four preceding aspects, in the laying condition, terminal (1) and railway vehicle (V) are movable along the advancement trajectory (A) substantially at a same speed. In one aspect according to any one of the five preceding aspects, in the laying condition and in the active condition of the generator, terminal (1) and railway vehicle (V) are movable along the advancement trajectory (A) substantially at a same speed.

[0061] In one aspect according to any one of the preceding aspects the active condition of the generator (2) has a time duration comprised between 2 seconds and 600 seconds, optionally comprised between 3 seconds and 300 seconds. In one aspect according to any one of the preceding aspects of an apparatus (100), the railway vehicle (V) comprises:

- at least one removal device (20) configured for picking up two old rails (21) from the railway ballast and depositing them above the same railway vehicle (V),
- at least one laying device (22) configured for positioning a first and a second rail (23a, 23b) on the railway ballast. In one aspect according to the preceding aspect the removal device (20) and the laying device (22) are configured for operating simultaneously with respect to each other during a movement of the railway vehicle (V) along the advancement trajectory.

[0062] In one aspect according to any one of the preceding aspects the apparatus comprises a plurality of arms carried by the railway vehicle (V), each of which is configured for engaging a respective terminal (1). In one aspect according to the preceding aspect each arm is of extensible type. In one aspect according to the preceding aspect, each arm is extended along an extension direction. In one aspect according to any one of the three preceding aspects each arm is movable via rotation relative to the railway vehicle (V).

[0063] In one aspect according to any one of the four preceding aspects each arm is movable at least between:

- a first end stop position where the arm is configured for positioning the terminal (1) with which it is laterally engaged to the railway vehicle,
- a second end stop position where the arm is configured for positioning the terminal (1) with which it is engaged at the rear or front part to the railway vehicle with respect to the advancement direction (A).

[0064] In one aspect according to any one of the five preceding aspects the apparatus comprises a plurality of actuators carried by the railway vehicle (V), each of said actuators being active on a respective arm in order to move it relative to the railway vehicle (V) between the first and the second end stop position.

[0065] In one aspect according to the preceding aspect each actuator, has a position sensor configured for generating a signal representative of an angular displacement between the extension direction of the arm on which the actuator is active and a rectilinear section of the railway vehicle parallel to the advancement trajectory (A).

[0066] In one aspect according to any one of the preceding aspects the apparatus comprises at least one temperature sensor (24) configured for generating a signal representative of a temperature of a rail in contact with said at least one terminal (1). In one aspect according to the preceding aspect the control unit (50) is connected to the temperature sensor, said control unit (50) being configured for:

- receiving, from the temperature sensor (24), the signal representative of the temperature of the rail in contact with the at least one terminal (1),
- on the basis of said representative signal, estimating an instantaneous temperature value of said rail,
- driving, as a function of the estimated temperature of said rail (R), an advancement speed of the railway vehicle (V) along the ballast and a potential difference at the ends of the generator.

[0067] In one aspect according to the preceding aspect the control unit (50) is configured for driving the active or inactive condition of the generator (2).

[0068] In one aspect according to the preceding aspect the control unit (50) is active in driving the generator (2), said control unit (50) being configured for driving the passage between the active condition and the inactive condition of the generator (2) periodically (optionally at predetermined time intervals) or following the reception of a command signal. In one aspect according to any one of the preceding aspects of an apparatus the control unit (50) is active in driving each actuator of a respective arm, said control unit (50) being configured for driving the rotation of each arm at least during the inactive condition of the generator (2).

[0069] In one aspect according to any one of the preceding aspects of an apparatus the control unit is connected to the position sensor and is configured for receiving the signal representative of the angular displace-

ment of the arm with respect to the railway vehicle (V).

[0070] In one aspect according to any one of the preceding aspects of an apparatus the control unit (50) is configured for driving the passage from the active condition to the inactive condition of the generator (2) as a function of the signal representative of the angular displacement of the arm with respect to the railway vehicle (V) or as a function of the instantaneous temperature value of the rail.

[0071] In one aspect according to any one of the preceding aspects of an apparatus the control unit (50) is configured for driving the passage from the active condition to the inactive condition of the generator (2) when at least one arm is in the second end stop position.

[0072] In one aspect according to any one of the preceding aspects of an apparatus, during the movement of the arms from the first to the second end stop position, each conductive element (3) is configured for being fixed with respect to the rail.

[0073] In one aspect according to any one of the preceding aspects of an apparatus the control unit (50), in the inactive condition of the generator (2) is configured for driving the active actuators in order to rotate the latter relative to the railway vehicle and move them from the second to the first end stop position. In one aspect according to any one of the preceding aspects of an apparatus the control unit (50) is configured for driving the passage from the inactive condition to the active condition of the generator (2) when at least one arm is in the first end stop position. In one aspect according to any one of the preceding aspects of an apparatus, during the movement of each arm from the first to the second end stop position, the generator (2) is in the active condition. In one aspect according to any one of the preceding aspects of an apparatus, during the movement of each arm from the second to the first end stop position, the generator (2) is in the inactive condition.

[0074] In one aspect a use of the terminal (1) for heating rails due to Joule effect is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0075] Several embodiments and several aspects of the finding will be described herein below with reference to the accompanying drawings, provided only as a non-limiting example in which:

- Figure 1 and 1A are respectively top and side views of an apparatus for heating tracks comprising a plurality of railway wagons;
- Figure 2 is a perspective view of a first embodiment of a terminal according to the present invention,
- Figures 3 and 4 are respectively of the transverse and longitudinal section views of the terminal of figure 2,
- Figures 5 and 6 are respectively of the transverse and longitudinal section views of a second embodiment of a terminal according to the present invention,
- Figure 7 is a perspective view of the device of figures 5 and 6,
- Figure 8 is a perspective view of a third embodiment of a terminal according to the present invention,
- Figure 9 is a transverse section view of the device of figure 8,
- Figure 10 is a perspective view of a fourth embodiment of a terminal according to the present invention,
- Figure 11 is a side view of a cross section of the device of figure 10,
- Figures 12 and 13 are respectively of the transverse and longitudinal sectional views of the device of figure 10.

DEFINITIONS AND CONVENTIONS

[0076] Parts illustrated in the figures are indicated with the same reference numbers. The figures could illustrate the object of the invention by means of representations that are not in scale; therefore, parts and components illustrated in the figures relative to the object of the invention might only regard schematic representations.

[0077] The apparatus for heating tracks described and claimed herein below may comprise/use at least one control unit 50 set for controlling operative conditions initiated by the apparatus itself. The control unit 50 may be a single unit or be formed by a plurality of separate control units depending on the design selections and operative requirements.

[0078] With control unit it is intended a component of electronic type which may comprise at least one of: a digital processor (CPU), an analog circuit, or a combination of one or more digital processors with one or more analog circuits. The control unit may be "configured" or "programmed" to perform some steps: this may be done in practice by any means that allows configuring or programming the control unit. For example, in the case of a control unit comprising one or more CPUs and one or more memories, one or more programs may be stored in suitable memory banks connected to the CPU or to the CPUs; the program or programs contain instructions which, when executed by the CPU or by the CPUs, program or configure the control unit to perform the operations described in relation to the control unit. Alternatively, if the control unit is or comprises circuitry of analog type, then the control unit circuit may be designed to include circuitry configured, in use, for processing electrical signals in a manner such to perform the steps relative to the control unit.

[0079] Parts of the process described herein may be attained by means of a data processing unit, or control unit, technically substitutable with one or more electronic processors conceived for executing a program or firmware loaded on a memory storage device. Such software program may be written in any one programming language of known type. The computers, if of a number equal to two or more, may be connected to each other by means of a data connection such that their computing

powers are shared in any manner; the same electronic processors may therefore be installed in positions that are even geographically different, attaining, by means of the aforesaid data connection, a distributed calculation environment.

[0080] The data processing unit, or control unit, may be a processor of general purpose type configured for executing one or more parts of the process identified in the present disclosure through the software or firmware program, or be an ASIC or dedicated processor or a FPGA, specifically programmed for executing at least part of the operations of the process described herein. The memory storage device may be non-transient and be internal or external with respect to the processor, or controller, or data processing unit, and may - specifically - be a memory geographically situated remote from the computer. The memory storage device may also be physically divided into multiple portions, or in Cloud form, and the software or firmware program may physically provide for portions stored on memory portions that are geographically divided from each other.

[0081] With the term *"actuator"* it is intended any one device capable of causing movement on a body, for example on a command of the control unit (reception by the actuator of a command sent by the control unit). The actuator may be of an electric, pneumatic, mechanical (for example with a spring), hydraulic type, or of another type.

[0082] With the term *"use condition"* or *"in use"* it is intended a condition during which the at least one terminal, carried by a railway vehicle, is in contact with a rail. During the use condition, the terminal 1 may be movable relative to at least one between the rail and the railway vehicle.

DETAILED DESCRIPTION

Terminal

[0083] Reference number 1 indicates a terminal employable for heating rails R during laying operations of the same rails R above railway ballast in order to allow laying and fixing in traction rails on the sleepers. In this manner, the rails engaged with the sleepers, when subjected to high temperature variations, are configured for being expanded or contracted by a reduced quantity, in a manner such to prevent possible breakage of the rails such to compromise the circulation of railway vehicles. The rail R is extended along an extension direction Y and has:

- a base B configured for contacting the railway ballast,
- a stem S emerging from the base B,
- a head H engaged with the stem S on the side opposite the base B.

[0084] In particular, the head H of each rail R may have:

- at least one top surface 6 suitable for allowing the rolling of a wheel of the railway vehicle V,
- a first and a second flank 7a, 7b connected to the upper surface and arranged opposite each other, where the first and the second flank 7a, 7b emerge from the top surface 6 in the direction of the base B,
- a first and a second connector surface 8a, 8b opposite the top surface 6 with respect to the first and second flanks 7a, 7b, wherein the first connector surface 8a connects the first flank 7a to the stem S, while the second connector surface 8b connects the second flank 7b to the stem S.

[0085] The terminal 1 allows the heating of the rails R due to Joule effect, serving for example a plurality of electrically power supplying conductive elements 3.

[0086] The terminal 1 comprises a frame 4 carrying the conductive elements 3 and configured for positioning, in use, the conductive elements 3 in contact with the rail. In detail, the terminal 1 is configured for contacting a predetermined rail section, being positioned at least partially above the rail itself. In fact, the frame 4 comprises a base plate 14a extended along a longitudinal extension direction X between a first and a second end portion 4a, 4a to define a maximum extension length of the frame 4 greater than 400 mm, optionally comprised between 500 mm and 1000 mm. In other words, the base plate 14a defines a single rigid body extending in interposed between the first and the second end portion 4a, 4b and configured for being positioned, in use, above the top surface S of the rail. The frame 4 may also comprise a central body 4c defined in interposition between the first and the second end portion 4a, 4a, configured for engaging the conductive elements 3 with the frame 4.

[0087] The frame 4 may also have a first and a second abutment element 41, 42 respectively defined at the first and at the second end portion 4a, 4a, which, in use, are configured for allowing the abutment of the terminal 1 on the top surface 6 of the rail R, as well as the movement of the terminal along the same rail R. In particular, the abutment elements 41, 42, allow the terminal to unload its weight on the rail; in this manner, the abovementioned conductive elements 3 are not thrust against the rail by the weight of the terminal, but are independently placed in contact with the rail by a thrust group 17, detailed below. The abutment elements 41, 42 are also configured for allowing the movement of the terminal along the rail section to be treated. In fact, each abutment element has a respective wheel which, in use, is configured for rolling on the top surface 6 of the rail R, allowing the sliding of the terminal 1 along the rail R. The wheels, respectively of the first and of the second abutment element 41, 42, are configured for rotating about an axis orthogonal to the longitudinal extension direction of the frame, allowing the movement of the frame along the rail. In particular, the rotation axes of the wheels are parallel to each other and arranged at a distance greater than 300 m, optionally comprised between 400 mm and 1000 mm.

[0088] As shown in figures 2, 7 and 8, each wheel of the first and of the second abutment element 41, 42, has an elongated cylindrical shape delimited by an external surface configured for contacting, in use, the top surface S of the rail. Each wheel also has, at end portions opposite each other along the rotation axis of the wheel itself, a flange, each of which configured for contacting the rail respectively at the first and of the second flank 7a, 7b of the same rail R, ensuring the sliding of the terminal along the extension direction Y of the rail section treated by the same terminal. In particular, each flange is extended along a direction radially exiting from the external surface of the same wheel, defining a contact portion with the rail.

[0089] The first and the second abutment element 41, 42 have respective terminal elements integral with the base plate 14a and configured for carrying a wheel. In detail, the terminal elements have a hollow structure shaped as a parallelepiped, configured for housing a wheel at its interior which is free to rotate relative to the terminal element itself and simultaneously configured for protecting the wheel from possible impact with obstacles present on the railway ballast. The terminal 1 may also comprise at least one brush (not illustrated) carried by at least one of the first and the second abutment element 41, 42, configured for contacting the top surface 6 of the head H of the rail R and removing a surface layer of the same top surface 6 of the rail. In other words, the brush is configured for contacting and removing rust residues present on the upper surface 6 of the rail. Each contact element 3 is therefore configured for contacting the rail 6 following the removal of the surface layer of the same rail: the brush is then placed upstream of each conductive element along the advancement direction A of the railway vehicle.

[0090] The removal of the surface layer of the rail prevents the damage of the top surface 6, since the contact between a conductive element 3 properly fed on a surface of the rail, e.g. having rust residues, may lead to the onset of sparks such to ruin the rail and compromise the passage of a railway vehicle. The removal of said surface layer allows the contact of each conductive element 3 on a smoothed surface, preventing the onset of sparks and consequently the damage of the rail.

[0091] The terminal 1 may further comprise at least one guide element 5 carried by the frame 4 and configured, in use conditions of the terminal, for contacting the rail R and maintaining the frame 4 substantially parallel to the section of the rail R in contact with the terminal 1. In other words, the guide element 5 allows maintaining the frame 4, in use, in contact with the rail, allowing the sliding of the terminal parallel to the extension direction Y of the rail R. As shown in the enclosed figures, the guide element 5 is carried by the central body 4c of the frame, interposed between the first and the second end portion 4a, 4b and configured for contacting, in use, a connector surface of the rail R. In particular, the guide element comprises a contrast wheel movable via rotation about an axis substantially orthogonal to the longitudinal extension direction of the frame 4, relative to the central body 4c. The contrast wheel is thus configured for maintaining the terminal, in use, in contact with the rail, preventing possible movements of the terminal itself along a direction orthogonal to the longitudinal extension direction of the frame 4.

[0092] As shown in figures 3, 5, 9 and 12, the terminal comprises at least one first and a second guide element 5a, 5b respectively configured for contacting the first and the second flank 7a, 7b of the rail, for example at the first and second connector surfaces 8a, 8b. Indeed, the first and the second guide element 5a, 5b substantially lie on a same plane orthogonal to the longitudinal extension direction X of the frame 4 and configured for being, in use conditions of the terminal 1, orthogonal to the advancement trajectory A. In other words, the first and the second guide element 5a, 5b, in a use condition of the terminal, are configured for being arranged opposite each other with respect to a plane of symmetry of the transverse section of the rail R. Furthermore, it is known that the terminal 1 has a first and a second guide element 5a, 5b at the first end portion 4a of the terminal and a first and a second guide element at the second end portion 4b of the terminal. The guide elements placed at the first end portion 4a are spaced with respect to the guide elements arranged at the second end portion 4b by a quantity comprised between 400 mm and 1000 mm. The guide elements thus spaced along the longitudinal extension direction X of the frame 4 allow maintaining the entire frame 4 aligned along the extension direction Y of the rail section to be treated.

[0093] The frame 4 may further comprise a support plate 13 relatively movable along a direction, in use, that is vertical close to and away from the base plate 14a. In particular, the support plate 13 carries directly or upon interposition of a thrust group 17 or of a sealing element 10 detailed below, the conductive elements 3. In fact, the support plate 13 allows, in use conditions, sets a distance that lies between each conductive element 3 and the rail R, allowing the same conductive elements to contact the rail R and allow the exchange of energy between the two. Indeed it is known that the conductive elements 3 are subjected to wear and therefore long-term contact between the rail and the same conductive elements 3 leads to a degradation of the latter: the support plate 13, in use, is movable close to and away from the rail, and thus allows overcoming the drawback concerning wear, due to the possibility of setting in place the distance between the conductive elements 3 and the rail R, ensuring the correct contact thereof. As shown in the enclosed figures, the support plate 13 has an elongated body extended along the longitudinal extension direction X between the first and the second end portion 4a, 4b.

[0094] The terminal 1 may further comprise an adjustment device 14 carried by the frame 4 and engaged with the support plate 13, configured for moving the latter close to and away from the base plate 14a. The adjustment device 14 is directly carried by the base plate 14a

and rigidly movable with the latter in use conditions of the terminal during which the latter is movable along the rail R; the adjustment device 14 thus allows the relative movement between the support plate 13 and the base plate 14a.

[0095] The adjustment device 14 comprises at least one regulator 14b engaged with the base plate 14a and extended along a vertical direction away from the same base plate 14a, configured for slidably engaging the support plate 13 and moving it close to and away from the rail. In particular, the regulator 14b has an elongated body configured for being engaged within one or more holes of the support plate 13 and allowing the sliding of the same support plate along the elongated body of the regulator. It is known that the elongated body of the regulator 14b may have a threaded portion configured for being coupled, e.g. with a nut, configured for determining the relative position between the support plate 13 and the base plate 14a. Indeed, the nut of the regulator 14b is placed coaxially with the elongated body of the regulator 14b, interposed between the support plate 13 and the base plate 14a: the relative movement between the nut and the elongated body consequently allows moving the support plate close to and away from the base plate 14a.

[0096] The terminal 1 may have a respective regulator 14b engaged with the base plate 14a at the first and of the second end portion 4a, 4b of the frame 4. The base plate may thus have respective holes defined at opposite ends along the longitudinal extension direction of the frame 4, configured for being engaged with the respective regulators 14b.

[0097] The terminal 1 may further have a top plate 27 carried by the frame 4 and rigidly engaged with the regulator 14b, configured for supporting a plurality of connectors 9 detailed below. In particular, the top plate 27 is extended along the longitudinal extension direction X of the frame, interposed between the first and the second end portion 4a, 4b. The top plate 27 may also have respective holes defined at opposite end portions with respect to the longitudinal extension direction X and configured for insertingly receiving a respective regulator 14b. As is visible from the enclosed figures the top plate faces the support plate 13: the support plate 13 is interposed between the base plate 14a and the top plate 27.

[0098] The terminal may further comprise at least one connector 9 carried by the support plate 27 and configured for transmitting electrical energy to at least one conductive element 3. In particular, the connector 9 has at least one outlet configured for making an electrical connection between the terminal and a generator. As shown in the enclosed figures, the terminal comprises a plurality of connectors 9 arranged in parallel with each other and configured for power supplying a predetermined number of conductive elements equal to or lower than 3. Each connector 9 also comprises at least one cable 19 electrically interposed between the connector 9 and the predetermined number of conductive elements. In particular, each connector 9 comprises one or more cables 19, e.g. four, configured for connecting one or more conductive elements 3 to the generator 2. It is known that the connectors 9 may be placed electrically in parallel with each other, in a manner such to reduce the current transmitted to the single conductive elements. In this manner, it is possible to size the plurality of cables in a manner such that these have limited dimensions, that they are easily movable and not very bulky.

[0099] The plurality of conductive elements 3, in use (in particular during the movement of the terminal 1 along the extension direction Y of the rail R) are configured for contacting the rail R and allowing a transfer of electrical energy between the terminal itself and the rail R. In particular, each conductive element 3 is carried by the frame 4 and configured for contacting the top surface 6 of the rail or at least one between the first and the second flank of the rail R. At least one part of the plurality of the conductive elements 3, in a use condition of the terminal 1 and during the movement of the latter along the extension direction Y of the rail R, is aligned along a direction parallel to the same extension direction Y of the rail R. In other words, the conductive elements 3 are configured for being arranged, in use, along a direction parallel to the extension direction X of the frame 4, contacting the rail on top of or on a flank. It is known that the conductive elements 3 are of a number greater than 2, optionally comprised between 3 and 30. Moreover, two conductive elements 3 adjacent to each other are spaced by a minimum distance greater than 3 mm, optionally comprised between 5 mm and 30 mm, in order to allow the dispersion of the heat and prevent an excessive overheating of the same conductive elements. With regard to the structure, each conductive element has a substantially rectangular parallelepiped conformation having a concave contact surface, which is configured for being arranged, in use, in contact with the rail. In particular, the contact surface is configured for having a conformation at least partly counter-shaped with respect to the top surface 6 or to the first or to the second flank 7a, 7b of the rail, in a manner such to allow a complete adhesion of the conductive element to the rail itself. The conductive elements 3 are made of conductive material, configured for transmitting energy to the rail, in particular, each conductive element 3 may be made of at least one of: graphite, coal-graphite, electro-graphite, metal-graphite, silver graphite, Bakelite graphite. The terminal 1 may further comprise at least one sealing element 10 carried by the frame 4 interposed between the first and the second guide element 5a, 5b and configured for engaging the plurality of conductive elements 3, maintaining them, in use conditions of the terminal, in contact with the rail. The sealing element may have a seat 12 configured for directly engaging the plurality of conductive elements and preventing a relative movement thereof with respect to the same sealing element 10.

[0100] The sealing element 10 may be engaged with the central body 4c of the frame 4, e.g. by means of interposition of a thrust group 17 and is movable via rotation

relative to said thrust group 17, in order to allow the movement of the conductive elements close to and away from the rail R. It is noted that the movement via rotation of the sealing element 10 is only possible during a condition of non-operation of the terminal, in which the latter is not coupled to the rail, while, in use, the sealing element 10 is configured for maintaining the conductive elements 3 in contact with at least one of the first and the second flank 7a, 7b of the head H of the rail R. In figures 3 and 9 the sealing element 10 is constrained to the top plate of the terminal upon interposition of a thrust group and is movable via rotation around an axis parallel to the extension direction X of the frame 4. The sealing element 10 may comprise a first and a second sealing element 10', 10", each of which carrying a plurality of conductive elements 3. The first and the second sealing element 10', 10" are movable via rotation around axes parallel to each other and parallel to the extension direction X of the frame: the first and the second sealing element 10', 10" are therefore movable via rotation close to and away from each other. The first and the second sealing element 10', 10" are configured for being arranged, in use, on the side of the rail in order to allow the respective plurality of conductive elements 3 to contact respectively the first and the second flank 7a, 7b of the rail. In other words, the first and the second sealing element 10', 10" are opposite each other with respect to a longitudinal center line plane of the terminal 1, which is substantially parallel to the longitudinal extension direction X of the frame 4 and orthogonal to the lying plane of the support plate 13. In the above-described embodiment, the conductive elements 3 are integral with the sealing element 10 and are, in use and during the movement of the terminal along the rail, slidingly movable relative to said rail R. In other words, conductive elements 3, in use, define electrical sliding contacts configured for allowing the transfer of energy towards the rail R.

[0101] Each sealing element 10 may have a casing (figures 8 and 9) defining a compartment in which the plurality of conductive elements 3 is housed. With regard to the structure, the casing of the sealing element 10 lies on a plane substantially parallel to the lying plane of the support plate 13. In such embodiment, the first and the second sealing element 10', 10" also comprise at least one respective catenary 18, each of which is configured for supporting and moving the plurality of conductive elements 3 at least during a use condition of the terminal. Each catenary 18 is also configured for arranging a first series 3' of conductive elements in direct contact with the rail R at the first and/or of the second flank 7a, 7b of the rail, as well as a second series 3" of conductive elements spaced from the rail. The first and the second series 3', 3" of conductive elements carry a respective plurality of conductive elements 3, which are movable as a closed loop along the catenary 18. In particular, each conductive element 3 is movable along the catenary, in use conditions of the terminal during which the latter is movable along the rail. Indeed, the conductive elements 3 are thrust along the closed loop trajectory of the catenary 18 following the movement of the terminal along the rail. In other words, the conductive elements 3, are movable along the closed loop of the catenary following the contact between the same conductive elements and the rail, without the aid of a dedicated movement device, active on the catenary 18.

[0102] The sealing element 10 may further comprise a plurality of commutators (not shown in the enclosed figures) housed within the casing of the same sealing element 10, electrically connected on one side to a respective connector 9 by means of the cables 19 and on the other side to a conductive element 3. In particular, in such embodiment, each commutator is configured for contacting a respective conductive element 3, in order to allow the transfer of electrical energy towards the rail R. With regard to structure, each commutator has a cylindrical body externally covered by sheets made of conductive material, configured for transmitting energy to the conductive elements. Each commutator 9 is also carried by the casing of the sealing element and is movable via rotation relative to the latter about a vertical axis. Indeed, each commutator allows contacting the conductive elements 3 during the movement of the latter along the closed loop of the catenary 18, maintaining the position of the cables 19 fixed with respect to the top plate 27. In this manner, the commutators prevent the intertwining of the cables 19, which would be inevitable of integrally connected with a respective conductive element 3.

[0103] In a variant shown in figures 10-13, the terminal 1 has a single sealing element 10 having a single catenary 18 arranged as a closed loop along a plane transverse to the lying plane of the support plate 13. The catenary 18 is configured for arranging a plurality of conductive elements in direct contact with the rail R at the top surface 6 of the head H of the rail R.

[0104] The catenary allows the conductive elements 3 to contact the rail without sliding.

[0105] In figures 5-7, the sealing element 10 is defined by the base plate 14a of the frame 4. In particular, the seat 12 is made directly on the base plate 14a with which the conductive elements 14 are engaged and aligned along the extension direction X of the frame 4. Such sealing element 10 is configured for arranging the plurality of conductive elements in direct contact with the rail R at the top surface 6 of the head H of the rail R. The conductive elements 3 are integral with the sealing element 10 and are, in use and during the movement of the terminal along the rail R, slidingly movable relative to the rail R. In other words, of the conductive elements 3, in use, define electrical sliding contacts configured for allowing the transfer of energy towards the rail R.

[0106] As mentioned above, the terminal may comprise a thrust group 17 configured for moving the sealing element 10 close to and away from the rail. In particular, the thrust group 17 may comprise:

- at least one arm which, on one side, is hinged to the

support plate 13 of the frame 4, while on the other side carries the sealing element 10,

- at least one pusher 17c active on the arm and configured for maintaining in contact the conductive elements 3 carried by the sealing element 10 with the rail.

[0107] The pusher 17c is integrally carried by the support plate 13, configured for acting thrustingly on the arm and consequently on the sealing element 10, in order to move the latter close to and away from the rail. It is noted that the at least one arm may comprise at least one first and one second arm 17a, 17b respectively hinged to the support plate 13 of the frame and opposite each other with respect to a longitudinal center line plane of the terminal which is substantially parallel to the longitudinal extension direction X of the frame 4 and orthogonal to the lying plane of the support plate 13. Each between the first and the second arm 17a, 17b is configured for maintaining in contact the conductive elements 3 carried by each sealing element 10', 10" respectively with the first and second flanks 7a, 7b of the rail R. The first and the second arm 17a, 17b are thus movable via rotation about respective axes that are parallel to each other and substantially parallel to the longitudinal extension direction X of the frame 4.

[0108] As is visible in figures 3 and 9, the pusher 17c may comprise an actuator set for moving the first and the second arm 17a, 17b relative to the rail. It is possible to employ a hydraulic cylinder, or pneumatic cylinder or a helical spring. In figures 5-7, the thrust group 17 comprises at least one elastic return element 17d interposed between the support plate 13 and the plurality of conductive elements 3, configured for acting thrustingly on at least one conductive element 3 in order to force the contact between the latter and the rail R. In particular, the thrust group 17 comprises a plurality of elastic return elements 17d. Each elastic return element 17d is configured for ensuring the contact between a respective conductive element 3 on the upper surface S of the head H of the rail R. Indeed, each elastic return element 17b is extended along a direction orthogonal to the upper surface S of the rail, configured for exerting a force on a respective conductive element directed orthogonally to the same upper surface S of the rail R. The elastic return elements 17d may in fact comprise a spring, e.g. compression spring.

Apparatus 100

[0109] It is also object of the present invention an apparatus 100 for making or renovating railway sections, capable of heating the rails due to Joule effect to a regulation temperature.

[0110] As shown in figures 1 and 2, the apparatus 100 comprises at least one railway vehicle V movable on the railway ballast along an advancement trajectory A and configured for positioning at least one rail R above the same railway ballast. In the enclosed figures, in a non-limiting manner, a railway vehicle is shown that is configured for traveling on rail and therefore usable for renovating pre-existing railway sections. It is possible to make a railway vehicle set for making a new movable railway line directly on the railway ballast, for example by means of the use of a tracked movement system.

[0111] The apparatus 100 further comprises a generator 2 carried by the railway vehicle V and configured for supplying energy to be transmitted to the rail. The generator 2 may for example comprise an endothermic engine configured for generating mechanical energy, to which an alternator is connected that is configured for converting the mechanical energy of the endothermic generator into alternating voltage. The generator 2 may further comprise an electric power converter configured for converting the alternating voltage supplied by the alternator into direct voltage. It is in fact observed that it is preferable to power supply the rails with a direct voltage since this has a higher level of safety than alternating voltage, hence being less dangerous for personnel set for using the apparatus in case of malfunctions or accidents during the placement of the rails.

[0112] Alternatively, the generator 2 may be configured for power supplying the terminal 1 in an intermittent manner. In particular, the generator 2 is configurable between:

- an active condition where each conductive element 3 of a respective terminal is power supplied by the generator 2 and is configured for placing the same generator 2 in electrical connection with the rail R,
- an inactive condition where each conductive element 3 is not power supplied by the generator 2.

[0113] It should be noted that the conductive elements 3 of each terminal are configured for contacting the rail R both during the active condition and during the inactive condition of the generator 2. In particular, in the active condition, each terminal 1 is configured for being fixed with respect to the rail, while in the inactive condition, each terminal is configured for being movable relative to the rail R.

[0114] As mentioned above, the generator 2 is configured for operating in an intermittent manner, in other words, two temporally successive active conditions of the generator, are interrupted by an inactive condition. The active condition of the generator 2 may have a time duration different from the inactive condition; in particular, the active condition may have a time duration comprised between 2s and 600s, optionally comprised between 3s and 300s.

[0115] The apparatus also comprises at least one terminal 1 according to the description above, carried by the railway vehicle and electrically connected to the generator 2, configured for contacting the rail and allowing the passage of current through said rail, allowing heating thereof due to Joule effect. In particular, the apparatus

may comprise a first and a second terminal 1a, 1b carried by the railway vehicle and configured for contacting sections spaced from each other by a same rail. Each terminal 1a, 1b is connected to the generator 2 in order to define, in cooperation with the rail, a closed electric circuit. The first and the second terminal 1a, 1b, in use, are slidingly movable along a same rail R in order to deposit a new rail on the ballast. In particular, the first terminal 1a, in use and during the movement of the apparatus along the ballast, is arranged upstream of the second terminal 1b with respect to the advancement trajectory A. The first terminal 1a, in use, is thus arranged at a distance from the second terminal 1b greater than 10 meters, optionally comprised between 50 meters and 300 meters.

[0116] As shown in figure 1, the first and the second terminal 1a, 1b define a first connection group, configured for contacting a first rail 23a of a track heating thereof. The apparatus may further comprise first and second terminals 1a, 1b electrically connected to the generator 2 in order to define a second connection group, configured for contacting a second rail 23b of the track heating thereof. The first and the second connection group are electrically connected to the generator 2 in parallel, in a manner such to allow the passage, respectively on the first and second rails 23a, 23b, of a current having the same intensity, thus having an equivalent heating due to Joule effect of both the rails.

[0117] The apparatus may also comprise a plurality of arms carried by the railway vehicle and configured for engaging a respective terminal. Each arm may be rigidly connected to the railway vehicle or at least partially movable via rotation relative to the latter. Each arm may also have a rigid or extensible body, e.g. in a telescopic manner. Each arm may in fact have:

- a hollow casing hinged to the railway vehicle V,
- an internal body slidably engaged with the hollow casing at a first end, and at a second end opposite the first end said internal body is engaged with a respective terminal 1.

[0118] The hollow casing and the internal body may be movable relative to each other via sliding along an extension direction along which the same hollow casing and internal body are aligned.

[0119] The apparatus may also comprise a plurality of actuators carried by the railway vehicle V, each of which active on a respective arm in order to move it relative to the railway vehicle V. In particular, each actuator allows the relative rotation of the respective arm with respect to the railway vehicle V, at least between:

- a first end stop position where the arm is configured for being positioned laterally to the railway vehicle,
- a second end stop position where the arm is configured for being positioned on the rear part of the railway vehicle with respect to the advancement direction A.

[0120] Each actuator may further comprise a respective position sensor configured for measuring an angular displacement between the extension direction of the arm on which the actuator is active and a rectilinear section of the railway vehicle parallel to the advancement direction A. The position sensor is configured for generating a signal representative of the angular displacement between the extension direction of the arm and the railway vehicle V and sending it to a control unit 50 detailed below.

[0121] The railway vehicle may comprise a head wagon carrying first terminals 1a of the first and of the second group, an end wagon carrying seconds terminals 1b of the first and of the second group and one or more intermediate wagons for posing new rails and the picking up of old rails as detailed below. It is possible to make a single railway wagon to which the first and the seconds terminals 1a, 1b are connected, both of the first and second groups, at respective end portions. The apparatus may further comprise at least one removal device 20 carried by the railway vehicle V and configured for picking up old rails 21 from the railway ballast and depositing them on top of the railway vehicle, as well as at least one laying device 22 carried by the railway vehicle and configured for positioning a first and a second rail 23a, 23b on the railway ballast. The removal device 20 is arranged on the railway vehicle V upstream of the laying device 22 along the advancement direction A. In fact, the apparatus removes old rails 21, before laying and fixing the new rails 23a, 23b above sleepers. It is further noted that the removal device 20 and the laying device 22 are configured for operating, during the movement of the railway vehicle V along the ballast, both simultaneously with respect to each other and simultaneously with the heating of the rails. In other words, the laying device 22 is configured for laying and fixing the new rails 23a, 23b to the sleepers simultaneously with their heating executed by means of the terminals, attaining the abovementioned continuous laying.

[0122] The apparatus may further comprise at least one temperature sensor 24 carried by the railway vehicle, for example by a support arm of a terminal, and active in proximity to a new rail to be laid. In particular, the temperature sensor 24 is configured for generating a signal representative of a temperature value of a rail in contact with a terminal 1. The apparatus comprises a plurality of temperature sensors 24, each of which active at a first and a second terminal 1a, 1b of the first and of the second group and configured for generating respective temperature signals representative of a heating temperature of the rail R.

[0123] The apparatus may also comprise at least one control unit 50 connected to the railway vehicle V, to the generator 2 and to each temperature sensor 24, configured for:

- receiving, from each temperature sensor 24, the signal representative of the temperature of the rail in contact with a respective terminal,
- on the basis of said representative signal, estimating an instantaneous temperature value of said rail,
- driving, as a function of the estimated temperature of said rail R, an advancement speed of the railway vehicle V along the ballast and a potential difference at the ends of the generator.

[0124] The control unit 50 is also configured for comparing the instantaneous estimated temperature value with a predetermined temperature value to which the rails may be heated and, as a function of said comparison, varying the advancement speed of the railway vehicle and/or varying the field voltages of the terminals. In such a manner, the control unit 50 is configured for continuously laying new rails, heating them at a constant temperature. Alternatively, the temperature sensor 24 is configured for operating at least in the active condition of the generator 2, allowing a uniform heating of the rails during the active condition of the generator 2.

[0125] The control unit 50 may be active on the generator 2 in order to drive the passage thereof between the active condition and the inactive condition periodically, upon verification of an event or following the reception of a command signal. In particular, the control unit 50 is connected to the position sensor of each actuator of the arms and is configured for receiving the signal representative of the angular displacement of the arm with respect to the railway vehicle V. The control unit 50 may hence be configured for driving the passage between the active and inactive condition of the generator as a function of the signal representative of the angular displacement of the arm with respect to the railway vehicle V. In other words, the control unit 50 may be configured for driving the passage from the active condition to the inactive condition following the detection of at least one arm in the second end stop position. As mentioned above, in the active condition of the generator 2, each terminal 1 is integral with the rail R, consequently each arm is rotationally moved with respect to the railway vehicle up to reaching the second end stop position, following the movement of the railway vehicle along the advancement trajectory A. In other words, the active actuators on a respective arm do not set any rotation of the arms themselves. Upon reaching the second end stop position of at least one arm, the control unit 50 is configured for:

- driving the passage from the active condition to the inactive condition of the generator 2,
- driving the active actuators on a respective arm to execute the rotation of the latter relative to the railway vehicle in order to move them from the second to the first end stop position.

[0126] In the inactive condition, each terminal 1, being maintained in contact with the rail R, is movable relative to the railway vehicle V, at a speed measured along the advancement trajectory A, greater than an advancement speed of the same railway vehicle V, which is measured along the advancement trajectory A. In particular, the ratio between the advancement speed of the terminal and the advancement speed of the railway vehicle, is comprised between 0 and 1, optionally comprised between 0 and 0.8.

[0127] The control unit 50, following the movement of each arm and of the relative terminal that took place in the inactive condition, is configured for driving the active condition of the generator 2 upon reaching the first end stop position of the arms themselves, once again allowing the heating of a further rail section R.

Process for laying rails

[0128] It is also object of the present invention a laying process using an apparatus 100 according to the aforementioned description. The process provides for the positioning of one or more terminals 1 above a rail in a manner such that one or more of the conductive elements 3 may contact the rail (e.g. the top surface and/or a flank).

[0129] In particular, the process provides for the positioning of at least two terminals engaged on the same rail. A first terminal is carried by a railway wagon (head engine), while the other of the two terminals is carried by an end wagon; the two terminals are spaced from each other along the railway ballast. The two terminals are electrically connected to respective poles of the generator. Following the positioning of the terminals, the railway vehicle advance along the railway ballast and the terminals engaged with the rail advance integrally with the railway vehicle, during the movement of the latter maintaining the conductive elements in contact with the rail, in a manner such that the latter may continuously transfer electrical energy to the rail.

[0130] Alternatively, following the positioning of the terminals engaged with the rail R, the railway vehicle advances along the ballast and simultaneously the control unit 50 drives the active condition of the generator 2; during the active condition, each terminal is fixed with respect to the rail while each arm in support of a respective terminal is moved from the first to the second end stop position. After reaching the second end stop position, the control unit 50 drives the inactive condition of the generator 2, preventing the transmission of energy towards the rail. Further, the control unit 50 drives each actuator active on a respective arm in order to move said arm from the second to the first end stop position; upon reaching the first end stop position, the control unit 50 is configured for newly driving the active condition of the generator, allowing the heating of a subsequent rail section R.

[0131] During and/or following the heating of the rail, this is laid and immediately fixed to the sleepers. The process may provide for the continuous laying of two rails for making a track. Furthermore, the process may simul-

taneously provide for laying the rails, a step of picking up the old rails and moving same on top of the railway vehicle for subsequent disposal.

ADVANTAGES

[0132] The present invention involves considerable advantages with respect to the solutions of the state of the art. In particular, the structure of the terminal 1 ensures the correct contact of at least one conductive element with the rail, in a manner such that the terminal may - continuously and during the movement of the vehicle along the railway ballast - continuously transfer electrical energy to the rail, for the heating thereof due to Joule effect. In addition, the specific structure of the terminal prevents an excessive wear of the conductive elements, reducing to a minimum the maintenance interventions on the terminal and consequently reducing the times for laying the new railway section.

Claims

1. Terminal (1) for an apparatus (100) for laying at least one rail (R) on a railway ballast, said apparatus (100) being of the type comprising:

- at least one railway vehicle (V) movable on the railway ballast along an advancement trajectory (A), said railway vehicle (V) being configured for positioning said at least one rail above the same railway ballast,
- at least one generator (2) carried by the railway vehicle (V),

wherein said terminal (1) is connectable to the generator (2) and engageable with the rail (R) in order to allow the passage of current through said rail, wherein said terminal (1), in an engagement condition with the rail, is movable with respect to said rail along the advancement trajectory (A),
characterized in that said terminal (1) comprises a frame (4) carrying a plurality of conductive elements (3), wherein the frame (4) is extended along a longitudinal extension direction (X) between a first and a second end portion (4a, 4a), wherein at least one of said conductive elements (3) is configured for contacting the rail (R) in order to place said rail in electrical connection with the generator (2), wherein two or more of said conductive elements (3) are aligned along a direction substantially parallel to the longitudinal extension direction (X) of the frame (4).

2. Terminal according to claim 1, wherein each of said conductive elements (3), in use, is configured for contacting at least one top surface (6) and/or one flank of the rail (R).

3. Terminal according to any one of the preceding claims, wherein two or more conductive elements (3) of said plurality, in use and during a movement of the terminal along a rail, are aligned along a direction configured for being substantially parallel to one section of an extension direction (Y) of the rail (R) above which said terminal (1) is movable.

4. Terminal according to any one of the preceding claims, wherein the conductive elements (3) are of a number greater than 2, still more optionally comprised between 3 and 30.

5. Terminal according to any one of the preceding claims, wherein the conductive elements (3) are spaced along the alignment direction.

6. Terminal according to any one of the preceding claims, wherein two immediately consecutive conductive elements (3) along the alignment direction are placed at a minimum distance greater than 3 mm, optionally comprised between 5 mm and 30 mm.

7. Terminal according to any one of the preceding claims, wherein each conductive element (3) is made of at least one of the following materials: graphite, hard coal, copper, bronze, brass,
optionally each conductive element is at least partly made of at least one of the following materials: coal-graphite, electro-graphite, metal-graphite, silver graphite, Bakelite graphite.

8. Terminal according to any one of the preceding claims, wherein the frame (4) comprises a central body (4c) interposed between the first and the second end portion (4a, 4b), wherein the plurality of conductive elements (3) is directly engaged with the central body (4c) of the frame (4).

9. Terminal according to any one of the preceding claims comprising at least one first and one second abutment element (41, 42) which, in use, are configured for allowing the abutment of the terminal (1) itself against a top surface (6) of the rail (R), wherein said first and second abutment elements (41, 42) respectively comprise a wheel which, in use, is configured for rolling on a top surface (6) of the rail (R) in order to allow the sliding of the terminal (1) along said rail (R).

10. Terminal according to the preceding claim, wherein the first and the second abutment element (41, 42) are placed respectively at the first and second end portion of the frame (4).

11. Terminal according to any one of the preceding claims comprising at least one sealing element (10)

configured for engaging the plurality of conductive elements (3), optionally the sealing element (10) is engaged with the central body (4c) of the frame (4), wherein the frame (4) comprises a support plate (13) to which a thrust group (17) is constrained, the thrust group (17) also being engaged with at least one of the sealing element (10) and the plurality of conductive elements (3), said thrust group (17) being configured for acting thrustingly on at least one of the sealing element (10) and the plurality of conductive elements (3) in order to force the contact between one or more of said conductive elements (3) with the rail (R).

12. Terminal according to the preceding claim, wherein the thrust group (17) comprises:

- at least one arm which, on one side, is hinged to the support plate (13) of the frame (4) while, on the other side, it engages the sealing element (10),
- at least one pusher (17c) active on said arm and configured for maintaining in contact one or more of the conductive elements (3) carried by the sealing element (10) with the rail, optionally with at least one between the first and second flanks of the rail.

13. Apparatus (100) for laying rails (R) on a railway ballast, said apparatus comprising:

- at least one railway vehicle (V) movable on the railway ballast along an advancement trajectory (A), said railway vehicle (V) being configured for positioning at least one rail (R) above the same railway ballast,
- at least one generator (2) carried by the railway vehicle (V),
- at least one terminal (1) according to any one of the preceding claims connected to the generator (2) and configured for contacting the rail (R) in order to allow the passage of current through said rail,

wherein the terminal (1) comprises at least one first and one second terminal (1a, 1b) electrically connected to the generator (2) in order to allow the passage of an electric current through said rail (R) in order to allow the heating thereof, optionally due to Joule effect.

14. Apparatus according to the preceding claim comprising:

- a first and a second terminal (1a, 1b) electrically connected to the generator (2) in order to define a first connection group, said first and second terminals (1a, 1b) of the first connection group being configured for contacting a first rail (23a) of a track, said first and the second terminal (1a, 1b) of the first connection group, in cooperation with the generator (2), are configured for allowing the passage of an electric current through said first rail (23a) in order to allow the heating thereof,
- a first and a second terminal (1a, 1b) electrically connected to the generator (2) in order to define a second connection group, said first and second terminals (1a, 1b) of the second connection group being configured for contacting a second rail (23b) of a track, said first and the second terminal (1a, 1b) of the second connection group, in cooperation with the generator (2), are configured for allowing the passage of an electric current through said second rail (23b) in order to allow the heating thereof.

15. Apparatus according to claim 13 or 14, wherein the generator (2) is configured for defining an active condition during which it electrically power supplies said terminal, wherein the generator (2) is configured for defining said active condition during the movement of the railway vehicle (V) along the advancement trajectory,

wherein the terminal (1), during the active condition of the generator and hence during the movement of the railway vehicle (V), is movable together with said railway vehicle (V),
optionally the railway vehicle and the terminal, during the active condition of the generator, are movable along the advancement trajectory (A) substantially at a same speed.

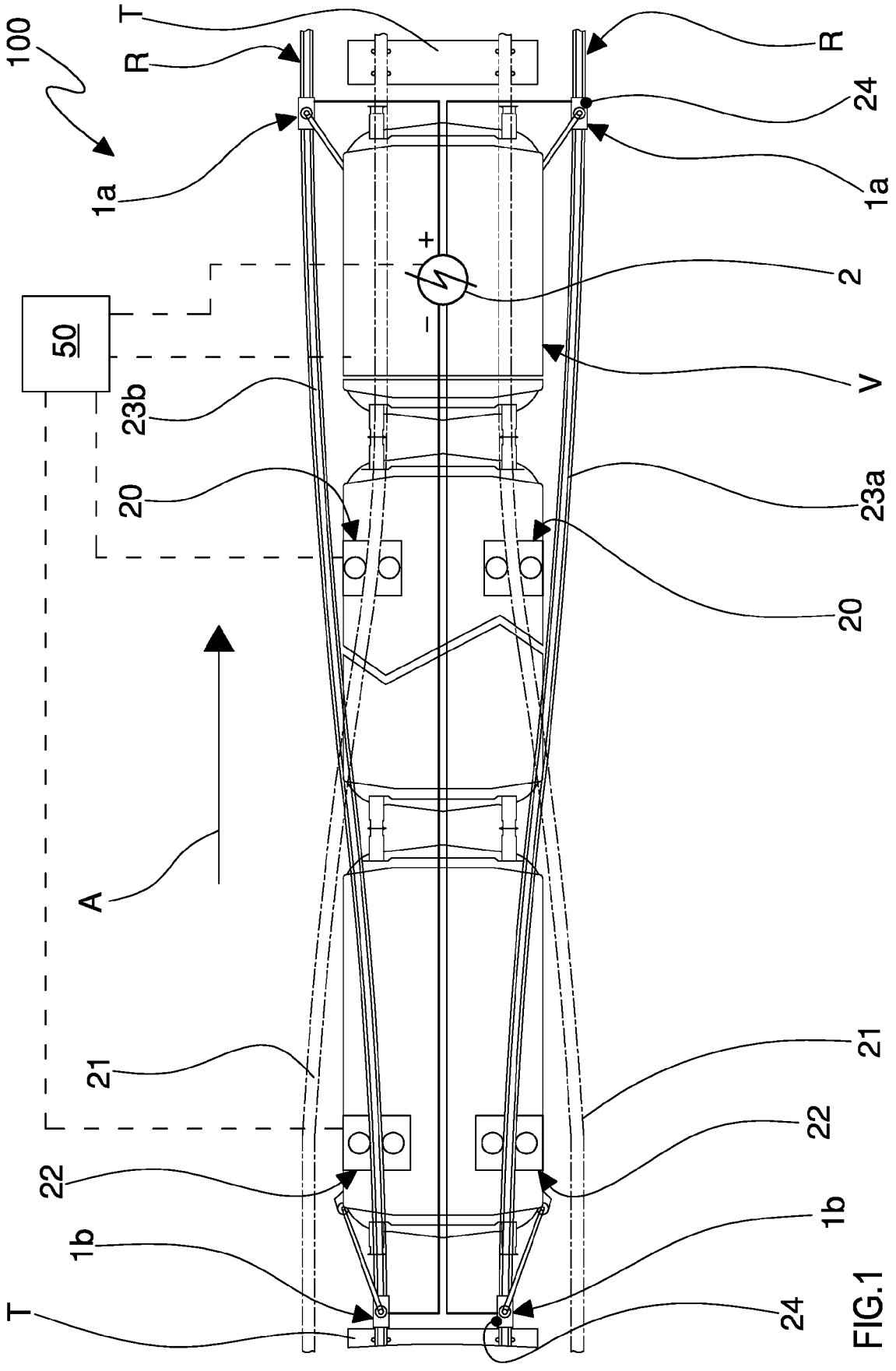


FIG.1

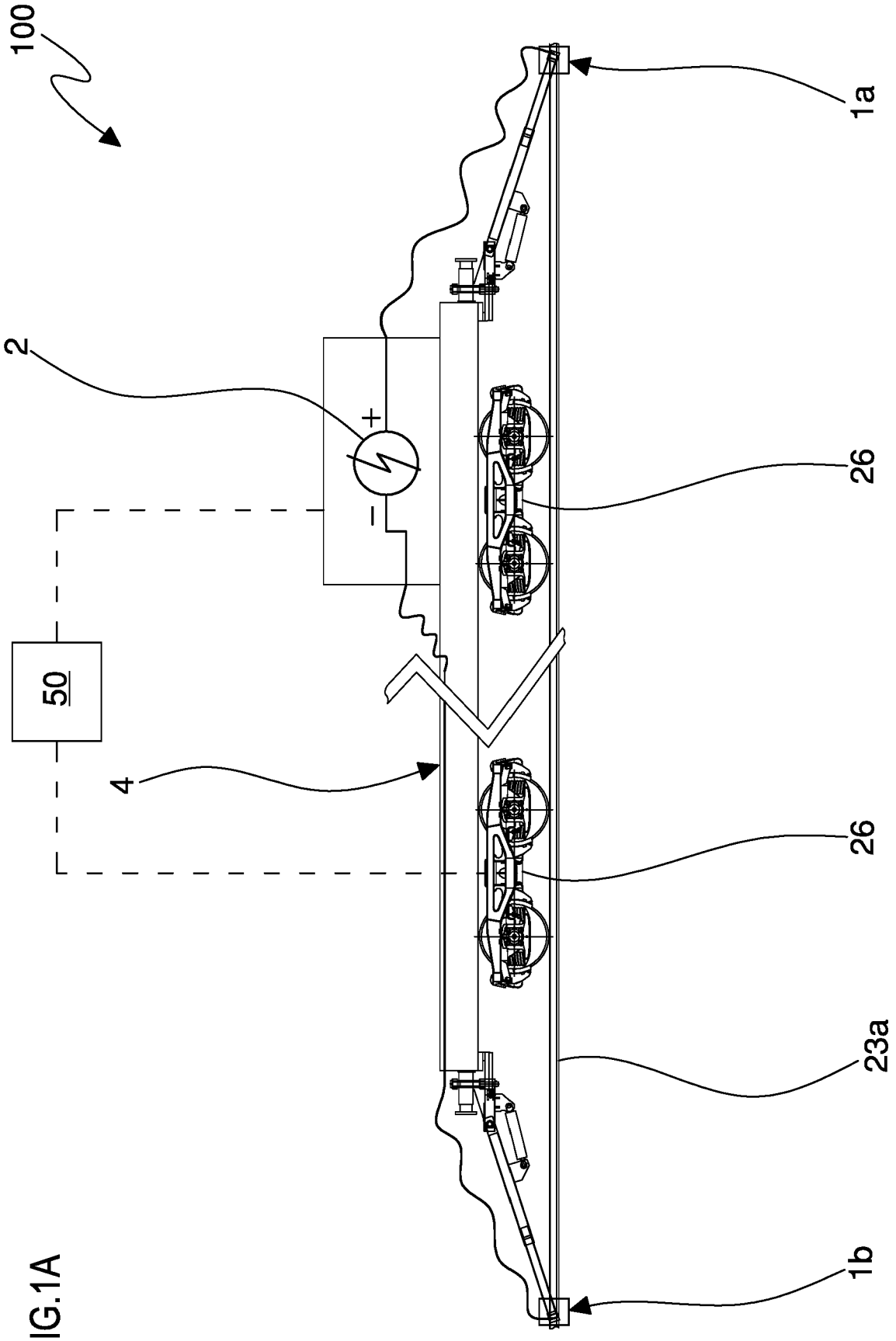
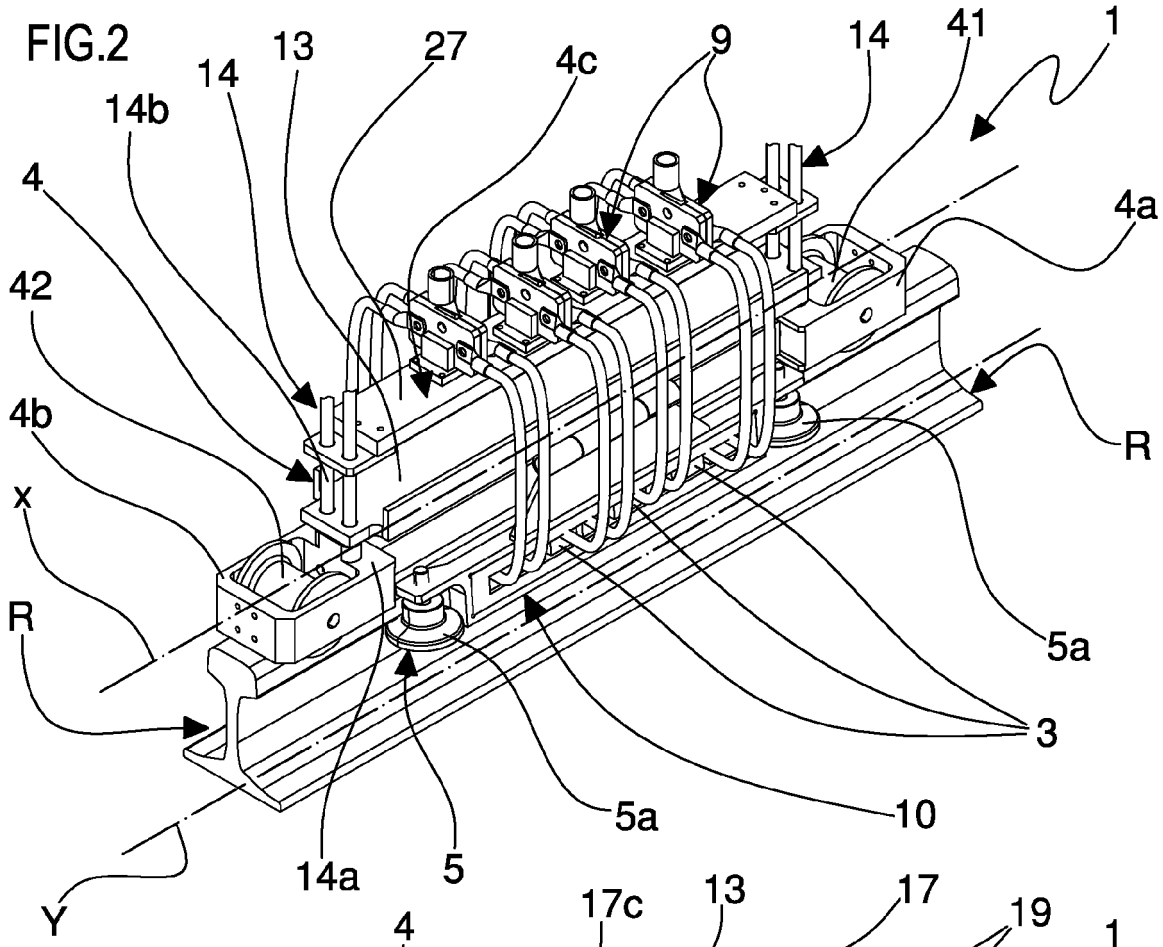


FIG.1A

FIG.2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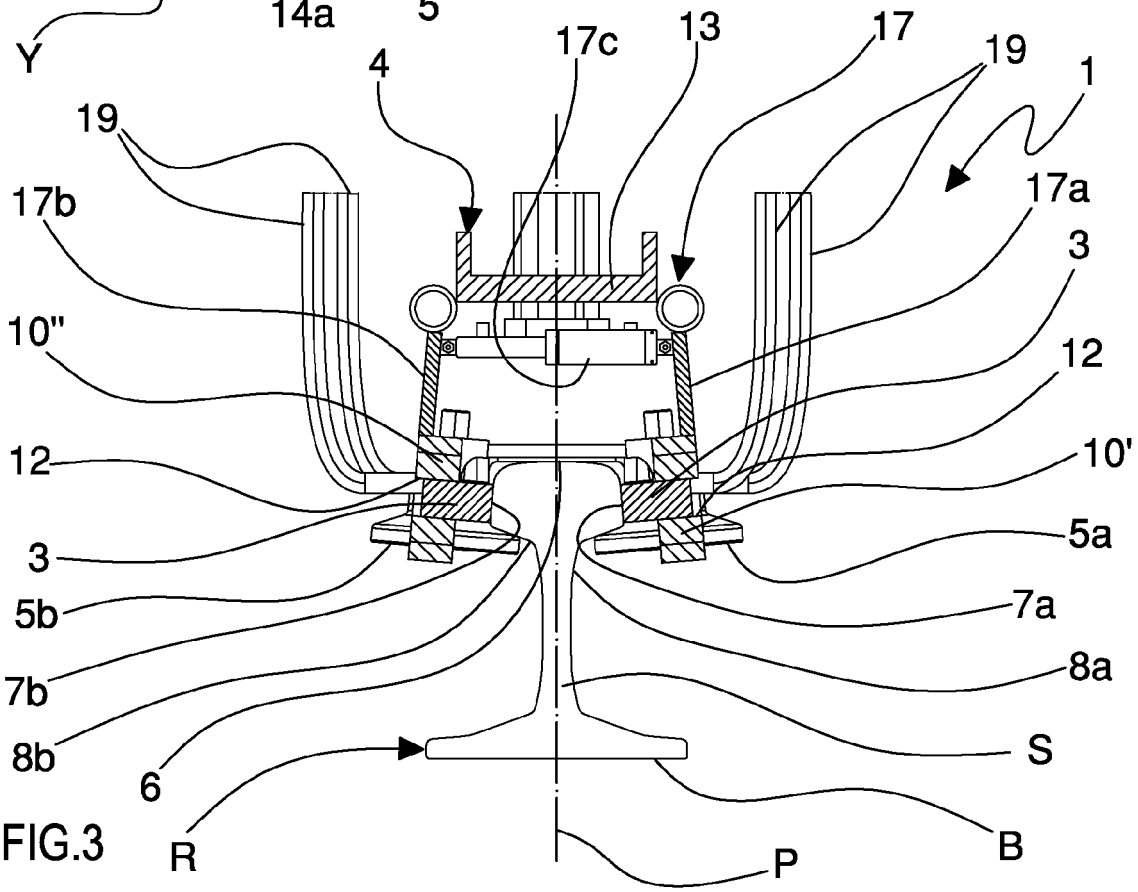
13
27
4c
9
14
41
1
14b
4
4a
42
4b
x
R
R
5a
3
5a
10
14a
5
Y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17c
13
17
19
1
19
17a
17b
3
10"
12
12
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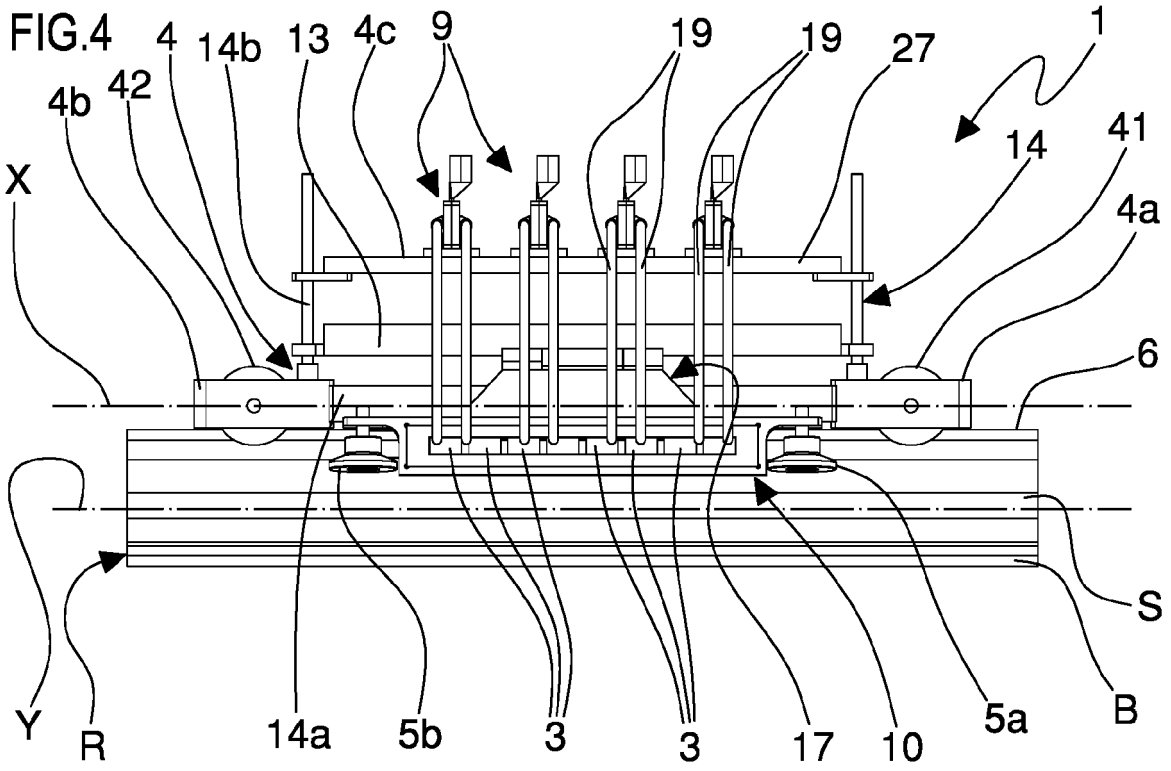
8a
8b
S
6
R
B
P

FIG.3

FIG.4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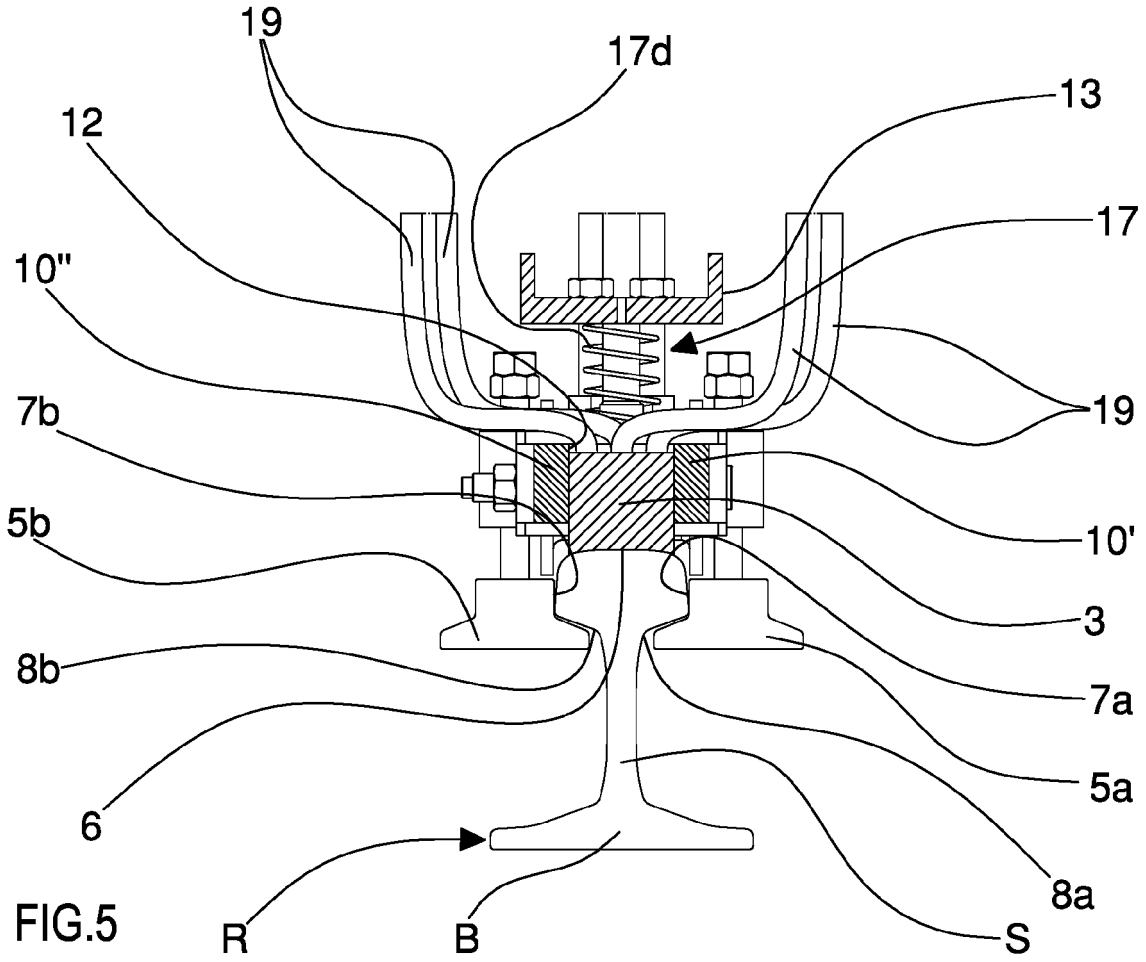
14a
5b
3
3
17
10
5a
B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17d
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12
17
10"
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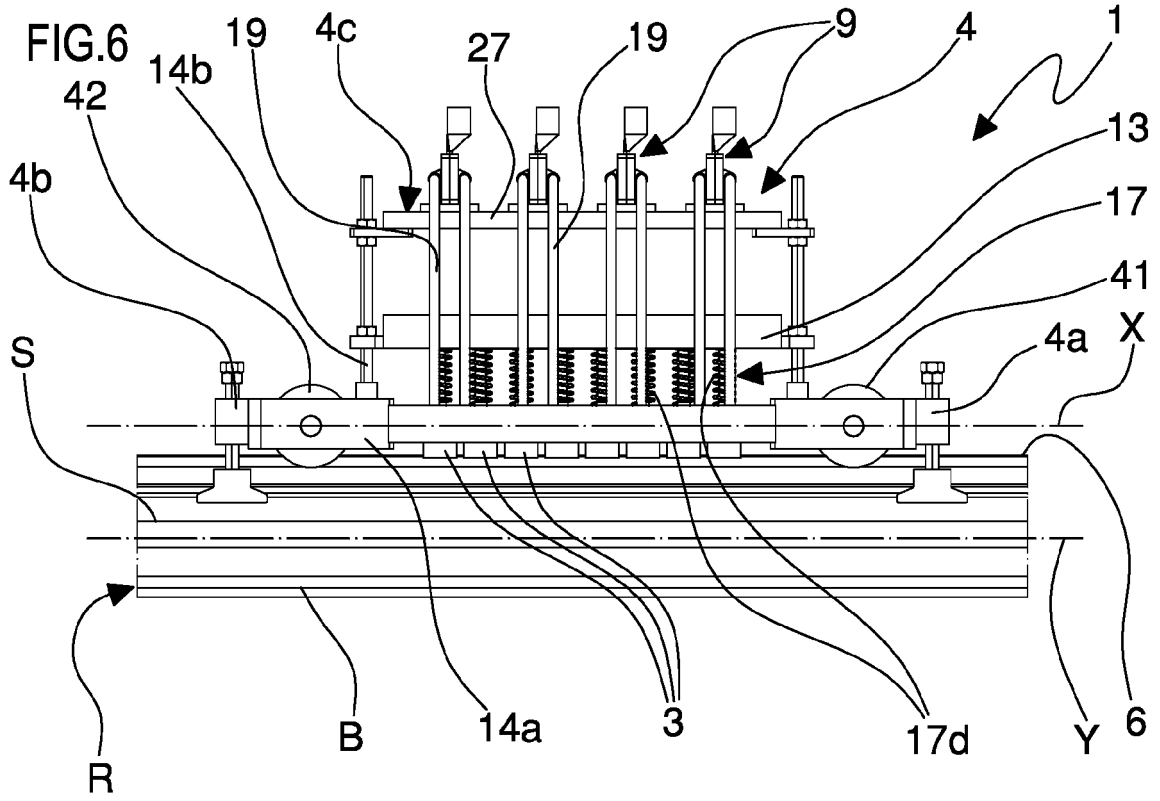
7a
5a
6
8a
R
B
S

FIG.5

FIG.6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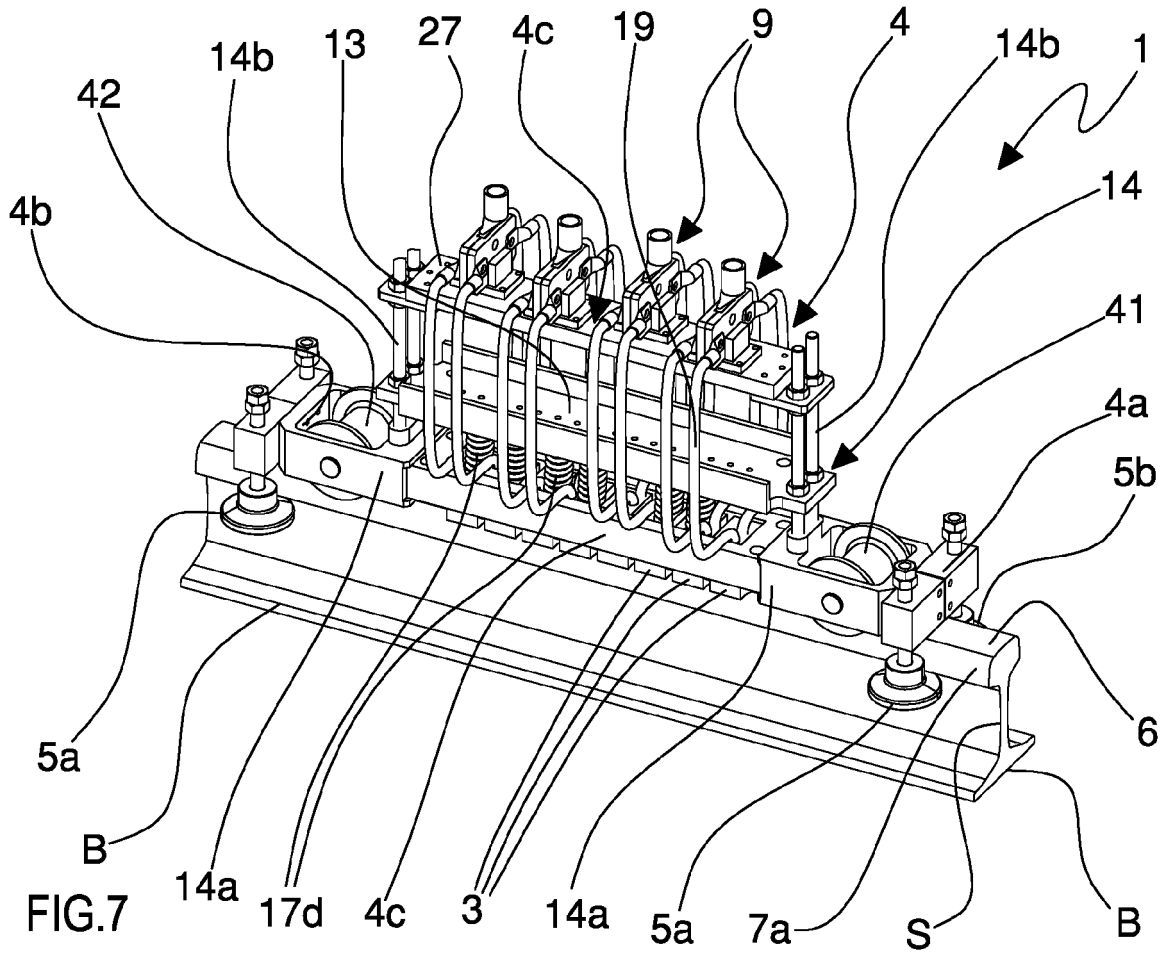
17d
Y
6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4c
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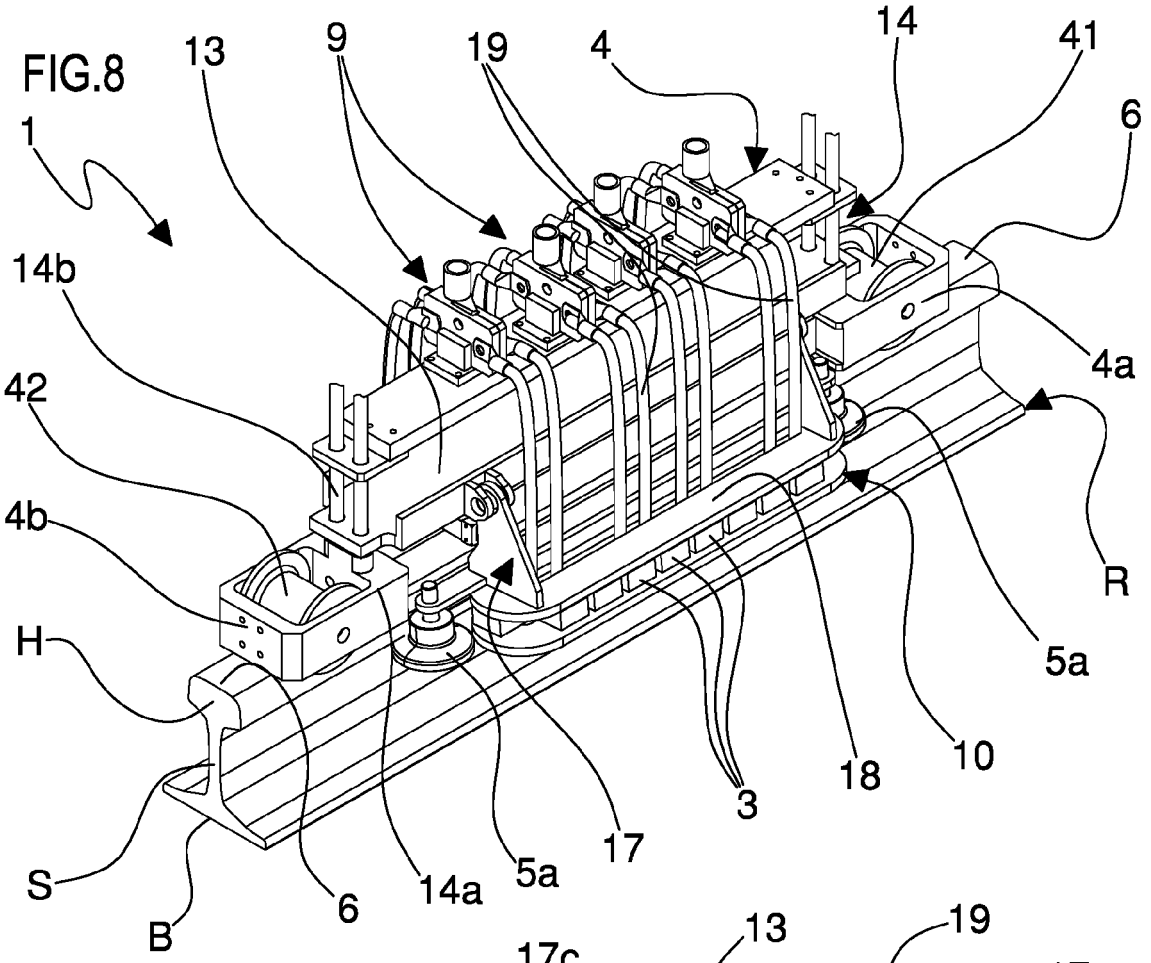
7a
S
B

FIG.7

FIG.8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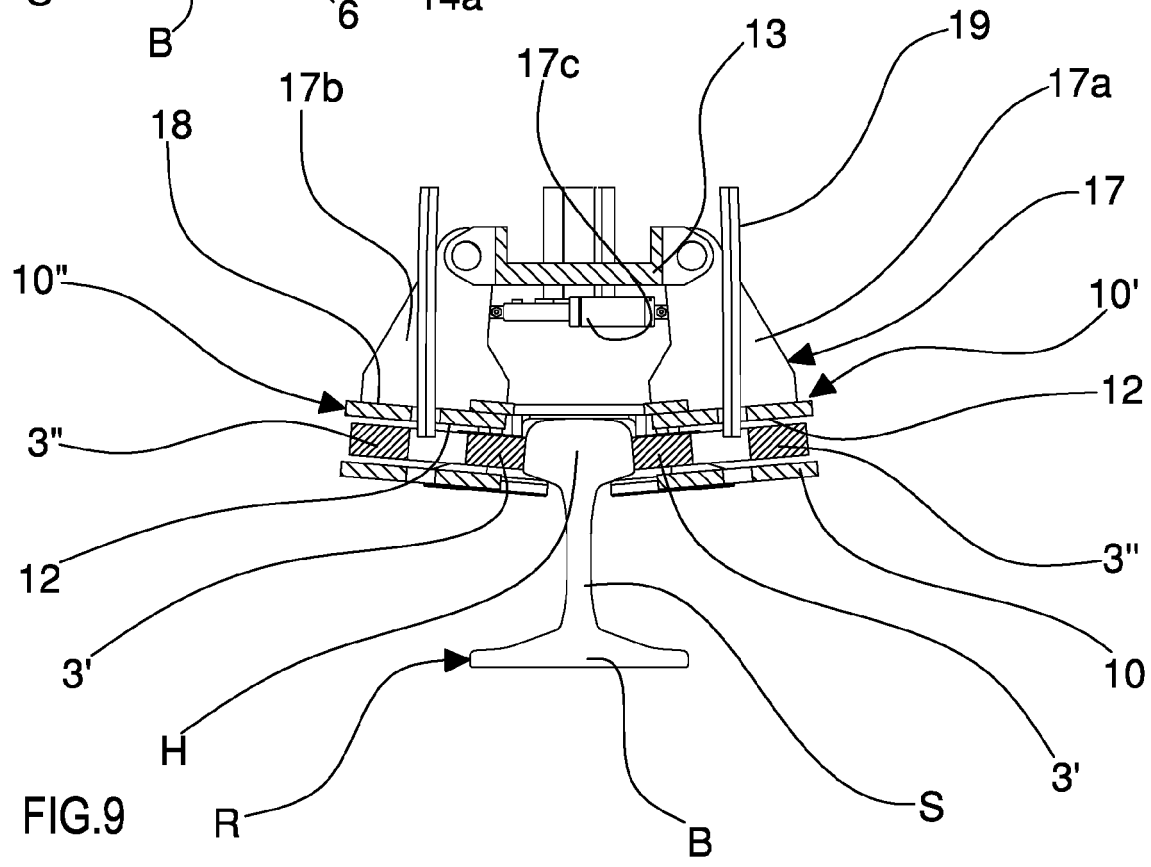
18
10
5a
R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17c
13
19
17a
17
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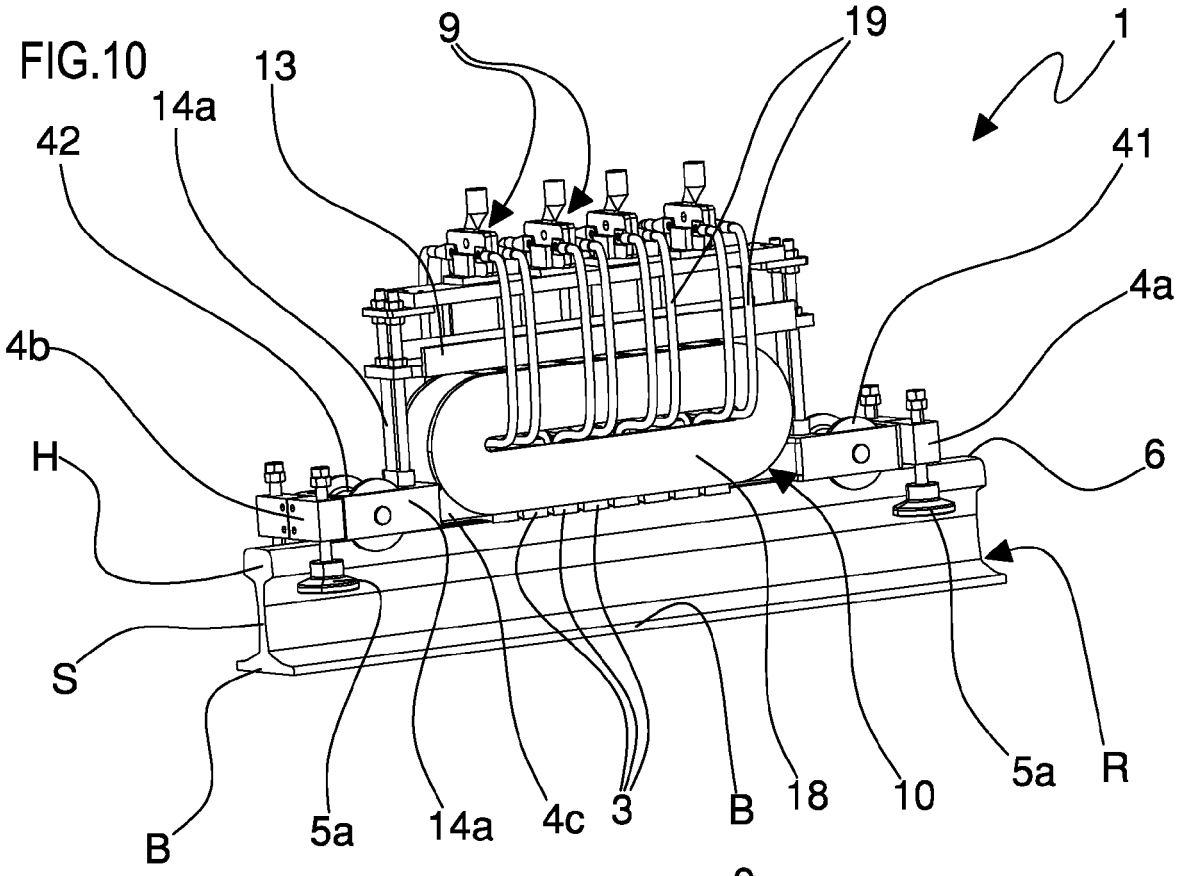
10'
12
3"
12
3'
H
R
B
S
3"
10
3'

FIG.9

FIG.10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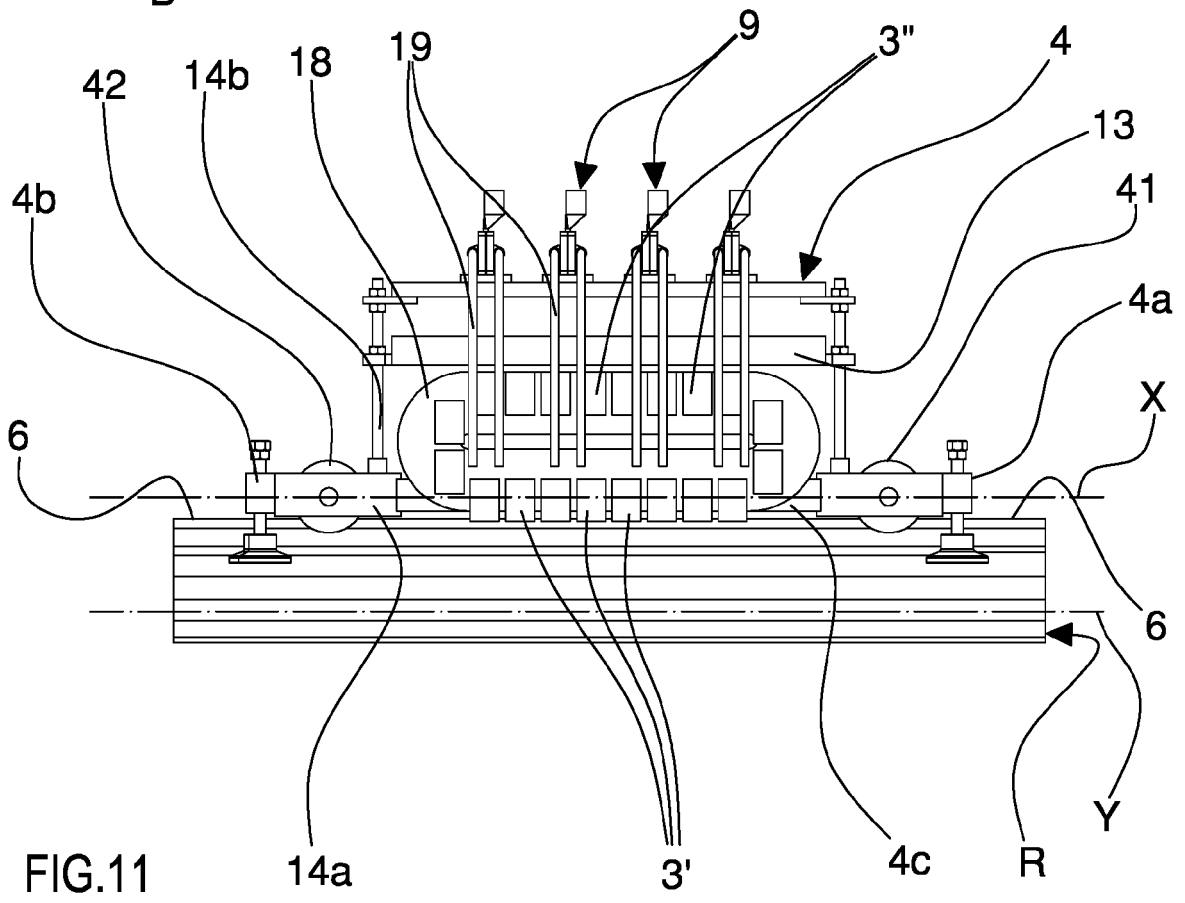
19
1
13
14a
42
41
4a
4b
H
6
S
B
5a
14a
4c
3
B
18
10
5a
R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3"
4
42
14b
18
19
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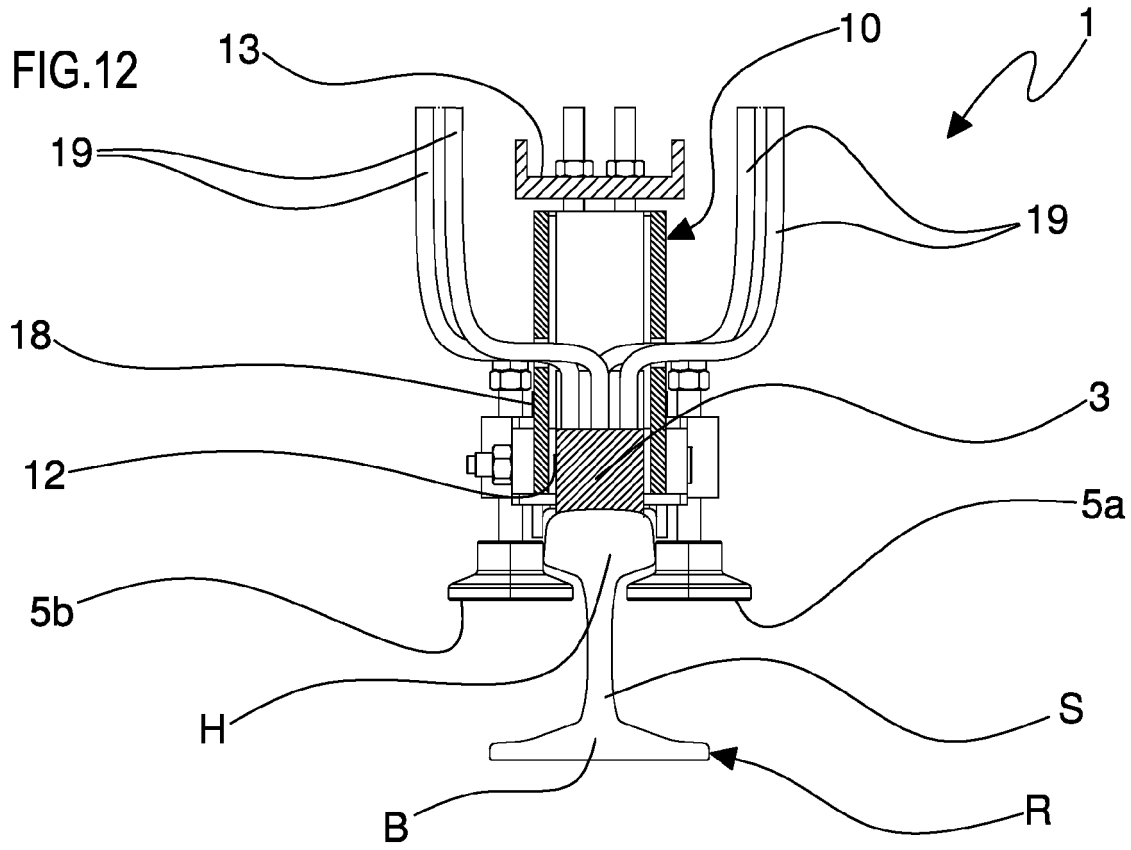
4b
41
4a
X
6
6
14a
3'
4c
R
Y

FIG.11

FIG.12



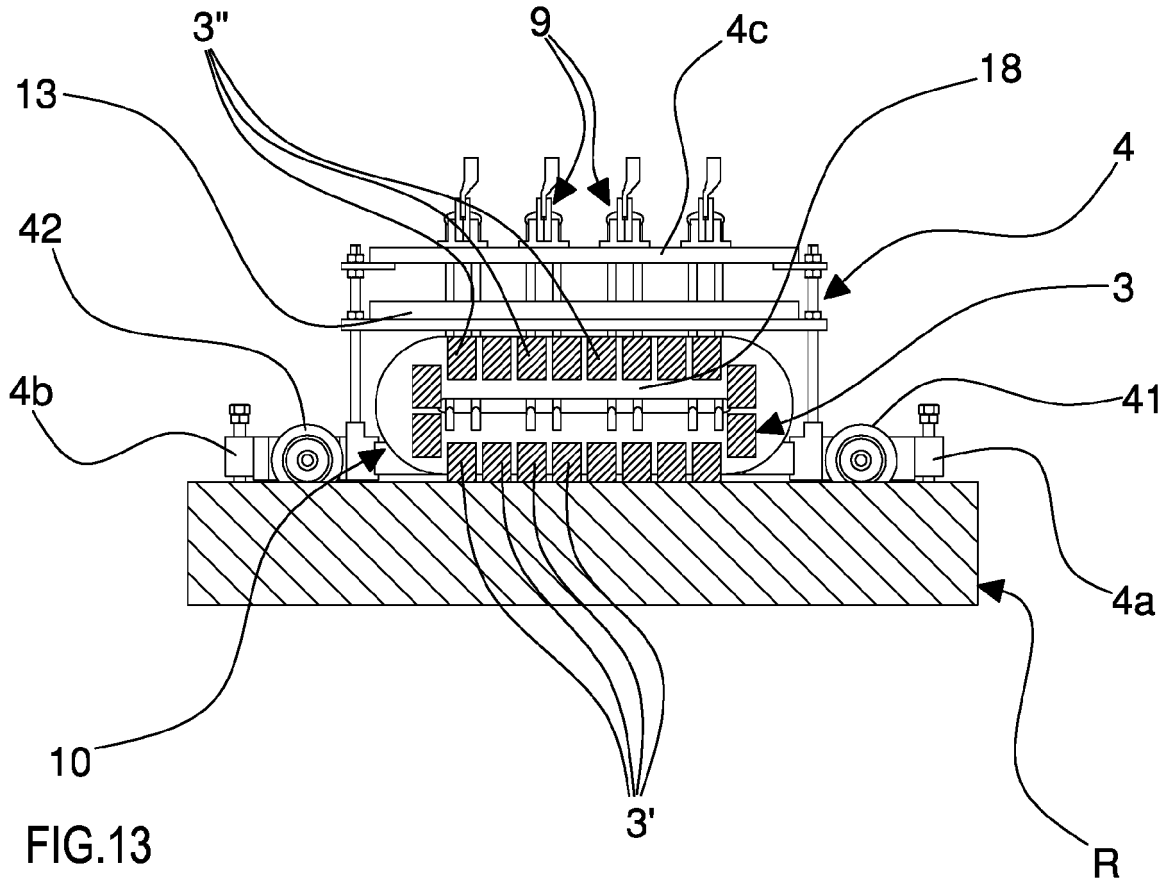


FIG.13

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 19 9437

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	GB 1 248 082 A (PLASSER BAHNBAUMASCH FRANZ [AT]) 29 September 1971 (1971-09-29) * the whole document *	1-15	INV. E01B29/16 E01B31/18
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TECHNICAL FIELDS SEARCHED (IPC)

E01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 January 2023	Movadat, Robin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 19 9437

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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