(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 August 2023 (24.08.2023)

WIPO | PCT

(10) International Publication Number
WO 2023/156166 A1

(51) International Patent Classification:
E01B 31/17 (2006.01)

(21) International Application Number:
PCT/EP2023/051982

(22) International Filing Date:
27 January 2023 (27.01.2023)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
22156807.4 15 February 2022 (15.02.2022) EP

(71) Applicant: **GOLDSCHMIDT HOLDING GMBH** [DE/DE]; Hugo-Licht-Str. 3, 04109 Leipzig (DE).

(72) Inventors: **CESCHIA, Karsten**; Rosa-Luxemburg-Str. 8C, 04683 Naunhof (DE). **KUMMER, Sven**; Am Wäldchen 6, 04509 Wiedemar (DE). **SCHIENBEIN, Richard**; Georg-Schumann-Straße 131, 04155 Leipzig (DE). **STERCL, Johannes**; Am Schenkberg 20, 04349 Leipzig (DE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI,

(54) Title: GRINDING MACHINE AND GRINDING METHOD FOR A RAIL TRACK

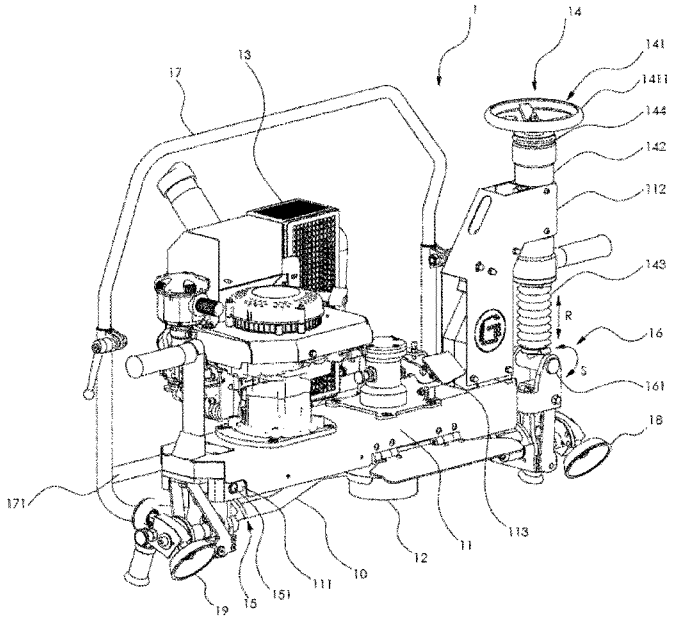

Fig. 2

(57) Abstract: The present invention relates to a grinding machine for a rail track, comprising: a bar (10) arranged in parallel to the rail track (2), a working body (11) attaching to the bar (10) and movable relative to the bar (10), a grinding unit (12) connected to the working body (11) for grinding the rail track (2), a motor (13) for supplying power to the grinding unit (12), and a position adjustment mechanism (14) attached to the working body (11) and to the bar (10) for adjusting the position of the working body (11) so that the working body (11) is movable relative to the bar (10) to change the feed of the grinding unit (12) onto the rail track (2).

WO 2023/156166 A1

[Continued on next page]

SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

Grinding Machine and Grinding Method for a Rail Track

Technical Field

The present invention relates to a grinding machine for a rail track and a grinding method for a rail track.

Background Art

Seamless rail track construction and maintenance require on-site welding of rails. To rework the weld joint and align the railhead contour, an operator needs to grind the top and the side of the rail track. In this way, the reworked rail track prevents traffic accidents.

In 1977, Elektro-Thermit Essen published a grinding machine called "Elemka", as shown in Fig. 1. The grinding stone is fed to contact the rail track through a height adjustment mechanism. When the machine changes the grinding feed with the height adjustment mechanism at one side, the distance between two guidance wheels changes. In addition, the machine is designed only for grinding the running surface and is not suitable not for grinding the running edge of the rail track. The machine also leaves the weight of the machine on the operator. Patent No. WO2018215362A1 shows that an electrical mechanism vertically changes the position of the grinding stone, but such an electrical mechanism is more expensive and heavier.

Technical Problem to be Solved

The objective of the present invention is to provide a grinding machine and a grinding method to change the grinding feed without deforming the machine body and without deviating a guidance wheel out of the rail track and without being inconvenient to operate, to tilt the machine for grinding the whole railhead, and/or to reduce the machine weight.

Summary of the Invention

The following summarizes some aspects of the present invention to provide a basic understanding of the technology discussed. This summary is not an extensive overview of all contemplated features of the invention, and is intended neither to identify key or critical elements of all aspects of the invention nor to delineate the scope of any or all aspects of the invention. Its sole purpose is to present some concepts of one or more aspects of the invention in a summary form as a prelude to the more detailed description that is presented later.

A first aspect of the present invention provides a grinding machine for a rail track, comprising: a bar arranged in parallel to the rail track, a working body attaching to the bar and movable relative to the bar, a grinding unit connected to the working body for grinding the rail track, a motor for supplying power to the grinding unit, and a position adjustment mechanism attached to the working body and to the bar for adjusting the position of the working body so that the working body is movable relative to the bar to change the feed of the grinding unit onto the rail track.

In a second aspect of the present invention according to the first aspect, further comprising: a first rotation means including a first axis and disposed between the working body and the bar, wherein the first rotation means allows the working body to be pivotable around the first axis in the direction T and to be movable relative to the bar in the direction U when the position adjustment mechanism moves the working body.

In a third aspect of the present invention according to the second aspect, further comprising: a second rotation means including a second axis and disposed between the position adjustment mechanism and the bar, wherein the second rotation means allows the position adjustment mechanism to be pivotable around the second axis in direction S when the position adjustment mechanism moves the working body.

In a fourth aspect of the present invention according to the third aspect, the working body includes a hole for accommodating the first axis of the first rotation means when the working body incurs the movement in the direction U relative to the first rotation means during the operation of the position adjustment mechanism.

In a fifth aspect of the present invention according to the fourth aspect, the hole of the working body is shaped to keep the distance between the first axis of the first rotation

means and the second axis of the second rotation means constant during the movement of the working body.

In a sixth aspect of the present invention according to one of the third to fifth aspects, the position adjustment mechanism includes: a driving actuator for an operator to activate the position adjustment mechanism, an adjustment spindle for changing the distance between the driving actuator and the second axis of the second rotation means by rotating the driving actuator, and a bellow covering around the adjustment spindle to protect dust from entering the adjustment spindle.

In a seventh aspect of the present invention according to one of the first to sixth aspects, the working body includes an extending flange for connecting the working body to the position adjustment mechanism.

In an eighth aspect of the present invention according to one of the third to fifth aspects, the first rotation means and the second rotation means are axially rotatable around the bar in the direction W so that the working body is tiltable around the bar to allow the grinding unit to grind the railhead of the rail track.

In a ninth aspect of the present invention according to one of the first to eighth aspects, further comprising a handle fixed on the bar for an operator to hold onto.

In a tenth aspect of the present invention according to the ninth aspect, the handle further comprises a stick in parallel to the bar.

In an eleventh aspect of the present invention according to the tenth aspect, the working body comprising a clip which engages the working body to the stick of the handle or disengages the working body from the stick of the handle.

In a twelfth aspect of the present invention according to one of the first to eleventh aspects, the grinding unit is a grinding stone, a grinding disc, or a grinding belt.

In a thirteen aspect of the present invention according to one of the first to twelfth aspects, further comprising a front guidance wheel and a back guidance wheel for guiding the grinding machine along the rail track.

In a fourteen aspect of the present invention according to the sixth aspect, the driving actuator is driven by an operator, an electric power source, or a hydraulic power source.

In a fifteenth aspect of the present invention according to the fourteenth aspect, the driving actuator is a handwheel.

In a sixteenth aspect of the present invention according to the fifteenth aspect, the position adjustment mechanism includes a locking means for controlling the driving actuator.

A seventeenth aspect of the present invention provides a grinding method for a rail track, comprising: providing a grinding machine according to one of the first to sixteenth aspects, grinding the rail track using the grinding machine, and actuating the position adjustment mechanism for adjusting the position of the working body so that the working body is movable relative to the bar to change the feed of the grinding unit onto the rail track.

Further benefits and advantages of the present invention will become apparent after a careful reading of the detailed description with appropriate reference to the accompanying drawings.

Brief Description of Drawings

Fig. 1 is a perspective view of a conventional grinding machine.

Fig. 2 is a perspective view of a grinding machine for a rail track in accordance with an embodiment of the present invention.

Fig. 3 is another perspective view of the grinding machine of Fig. 2.

Fig. 4a is a front view of the grinding machine of Fig. 2 in the original position.

Fig. 4b is an enlarged view of section A of the grinding machine of Fig. 4a in the original position.

Fig. 5a is a front view of the grinding machine of Fig. 2 in the adjusted position.

Fig. 5b is an enlarged view of section B of the grinding machine of Fig. 5a in the adjusted position.

Fig. 6 is a front view of the grinding machine of Fig. 2 which is applied to a rail track in the original position.

Fig. 7 is a front view of the grinding machine of Fig. 2 which is applied to a rail track in the adjusted position.

Fig. 8 is a perspective view of the grinding machine of Fig. 2 which is applied to a rail track in the tilted position.

Fig. 9 is a side view of the grinding machine of Fig. 2 which is applied to a rail track in the untilted position.

Fig. 10 is a side view of the grinding machine of Fig. 2 which is applied to a rail track in the tilted position.

Detailed Description

Although the invention has been explained in relation to its preferred embodiment(s) as mentioned above, it is to be understood that many other possible modifications and variations can be made without departing from the scope of the present invention. It is, therefore, contemplated that the appended claim or claims will cover such modifications and variations that fall within the true scope of the invention.

Fig. 2 is a perspective view of a grinding machine for a rail track in accordance with the first embodiment of the present invention. Fig. 3 is another perspective view of the grinding machine of Fig. 2. Fig. 4a is a front view of the grinding machine of Fig. 2 in the original position. Fig. 4b is an enlarged view of section A of the grinding machine of Fig. 4a in the original position. Fig. 5a is a front view of the grinding machine of Fig. 2 in the adjusted position. Fig. 5b is an enlarged view of section B of the grinding machine of Fig. 5a in the adjusted position. Fig. 6 is a front view of the grinding machine of Fig. 2 which is applied to a rail track in the original position. Fig. 7 is a front view of the grinding machine of Fig. 2 which is applied to a rail track in the adjusted position. Fig. 8 is a perspective view of the grinding machine of Fig. 2 which is applied to a rail track in the tilted position. Fig. 9 is a side view of the grinding machine of Fig. 2 which is applied to a rail track in the untilted position. Fig. 10 is a side view of the grinding machine of Fig. 2 which is applied to a rail track in the tilted position.

In the following text, please refer to Figs. 2-10 together. A grinding machine 1 for a rail track 2 comprises: a bar 10, a working body 11, a grinding unit 12, a motor 13, a position adjustment mechanism 14, a first rotation means 15, a second rotation means 16, a handle 17, a front guidance wheel 18, and a back guidance wheel 19. Specifically, the bar 10 is arranged in parallel to the rail track 2 and is equipped with the front guidance wheel 18

and the back guidance wheel 19 at the two ends of the bar 10. The front guidance wheel 18 and the back guidance wheel 19 guide the grinding machine 1 along the rail track 2 and avoid the grinding machine 1 falling out of the rail track 2.

The working body 11 is attached to the bar 10 and is horizontally and axially movable relative to the bar 10. The working body 11 is used for holding the grinding unit 12 and the motor 13. In a preferred embodiment, the motor 13 can be provided outside of the grinding machine 1. The working body 11 includes an opening for accommodating the grinding unit 12. The grinding unit 12 is connected to the working body 11 for grinding and perpendicularly passes through the opening of the working body 11. The grinding unit 12 is a grinding stone. In other embodiments, the grinding unit 12 can also be a grinding disc or a grinding belt. In another embodiment, the grinding unit 12 can also be any kind of railway repairing tool, such as a driller unit, a preheater, a welder, or a clamp.

The motor 13 is used for supplying power to the grinding unit 12. The power source of the motor 13 can be electrical power, batteries, gasoline source, diesel source, hydraulic source, or any kind of power source.

The position adjustment mechanism 14 is attached to the working body 11 and is attached to the bar 10 for adjusting the position of the working body 11. Hence, the working body 11 is movable relative to the bar 10 to change the feed of the grinding unit 12 onto the rail track 2. Namely, the position adjustment mechanism 14 can change the grinding machine 1 from the original position (Fig. 4a) to the adjusted position (Fig. 5a). In a preferred embodiment, the working body 11 includes an extending flange 112 for connecting the working body 11 to the position adjustment mechanism 14. The extending flange 112 allows the operator to control the movement of the working body 11 easier.

The handle 17 is fixed on the bar 10 for an operator to hold onto. During operation, the operator can hold the handle 17 to move the grinding machine 1 back and forth along the rail track 2 and tilt the grinding machine 1 around the railhead of the rail track 2.

Please see Figs, 4a, 4b, 5a, and 5b. In a preferred embodiment, the grinding machine 1 includes a first rotation means 15 including a first axis 151 and a second rotation means 16 including a second axis 161 to change the grinding feed without deforming the grinding machine 1 and without deviating the front guidance wheel 18 and the back guidance wheel 19 out of the rail track 2.

The first rotation means 15 includes the first axis 151 and is disposed between the working body 11 and the bar 10. The working body 11 includes a hole 111 for accommodating the first axis 151 of the first rotation means 15 when the working body 11 incurs a movement in the direction U relative to the first rotation means 15 during the operation of the position adjustment mechanism 14 so that the working body 11 is flexibly balanced. Specifically, the hole 111 of the working body 11 is shaped to keep the distance between the first axis 151 of the first rotation means 15 and the second axis 161 of the second rotation means 16 constant during the movement of the working body 11. In addition, the hole 111 of the working body 11 facilitates the rotation of the working body 11 around the first axis 151 of the first rotation means 15. The front guidance wheel 18 and the back guidance wheel 19 do not deviate out of the rail track 2 because the distance therebetween keeps constant.

The first axis 151 of the first rotation means 15 does not move along the direction U. When the position adjustment mechanism 14 moves the working body 11, the first rotation means 15 allows the working body 11 to be pivotable around the first axis 151 in the direction T and to be movable relative to the bar 10 in the direction U, as shown in Figs. 4b and 5b (the adjusted position).

The second rotation means 16 includes the second axis 161 and is disposed between the position adjustment mechanism 14 and the bar 10. When the position adjustment mechanism 14 moves the working body 11 and when the position adjustment mechanism 14 moves down in the direction R, the second rotation means 16 allows the position adjustment mechanism 14 to be pivotable around the second axis 161 in direction S. The movement in the direction S at the second rotation means 16 and the movement in the direction U at the first rotation means 15 keep the length of the working body 11 balanced, as shown in Fig. 5a (the adjusted position). Namely, the working body 11 does not crush or deform from the movements when the grinding machine 1 changes from the original position (Fig. 4a and 4b) to the adjusted position (Fig. 5a and 6b).

In a preferred embodiment, the rotation mechanism of the first rotation means 15 and the second rotation means 16 leads to an angle θ of at least 1.5 degrees between the working body 11 and the bar 10, as shown in Fig. 7. The angle θ can also be 0-20 degrees. Therefore, an angle between the grinding unit 12 and the rail track 2 may exist. The sloped

grinding unit 12 also increases the grinding performance on the rail track 2, as shown in Fig. 7.

Position adjustment mechanism

Please refer to Figs. 2-10. The position adjustment mechanism 14 includes a driving actuator 141, an adjustment spindle 142, a locking means 144, and a bellow 143. The position adjustment activates the movement in the direction R and changes the feed of the grinding unit 12. Specifically, the driving actuator 141 is used for an operator to activate the position adjustment mechanism 14 by rotating or counter-rotating the wheel. By rotating the driving actuator 141, the adjustment spindle 142 changes the distance between the driving actuator 141 and the second axis 161 of the second rotation means 16. The bellow 143 covering around the adjustment spindle 142 protects dust from entering the adjustment spindle 142. The bellow 143 is preferably made of rubber or plastic.

In an embodiment, the driving actuator 141 is driven by an operator and is a handwheel 1411. The operator can operate the handwheel 1411 by hand to control the adjustment spindle 142. The locking means 144 is used for controlling the rotation of the driving actuator 141 to prevent the driving actuator 141 from being automatically rotated. In other words, the locking means 144 prevents the driving actuator 141 from turning independently due to vibrations.

In another preferred embodiment, the driving actuator 141 is driven by an electric power source or a hydraulic power source. For example, the electric power source or the hydraulic power source can be installed on the handle 17 so that the operator can easily control the driving actuator 141 when the operator holds the handle 17. Namely, the operator does not need to turn the driving actuator 141 by hand. This helps the operator to easily use the grinding machine 1.

Tilting function

The tilting function of the grinding machine 1 allows the operator to grind the whole railhead without hugely bending his or her body to operate the grinding machine 1. That is, the grinding machine 1 can be tilted from the untilted position (Fig. 9) to the tilted position (Fig. 10). The grinding machine 1 is convenient for an operator to grind the rail track 2. As shown in Fig. 6, the first rotation means 15 and the second rotation means 16

are axially rotatable around the bar 10 in the direction W so that the working body 11 is tiltable around the bar 10 to allow the grinding unit 12 to grind the railhead of the rail track 2. The tiltable angle Ω of the working body 11 is from 0 to 90 degrees with respect to the handle 17. In a preferable embodiment, the tiltable angle Ω of the working body 11 can also be from 0 to 130 degrees in respect to the handle 17. The handle 17 further comprises a stick 171 parallel to the bar 10. The stick 171 is located nearly adjacent to the working body 11 and is parallel to the working body 11. The working body 11 comprises a clip 113.

When the operator grinds the top of the railhead, the operator can stand and does not need to bend his or her body to operate the grinding machine 1. At this time, the clip 113 engages the working body 11 to the stick 171 of the handle 17. In contrast, if the operator wants to grind the edge of the railhead, the operator just needs to disengage the working body 11 from the stick 171 of the handle 17. Namely, the clip 113 disengages the working body 11 from the stick 171 of the handle 17. In this way, the operator can tilt the working body 11 at a tilted position (Fig. 8) for grinding the side of the rail track 2 (i.e., running edge).

The present invention provides a grinding method for a rail track 2. When an operator wants to rework the weld joint and align the railhead contour, the grinding machine 1 of the present invention is provided. The operator grinds the rail track 2 using the grinding machine 1. When the grinding unit 12 is getting worn out, the operator can actuate the position adjustment mechanism 14 for adjusting the position of the working body 11 so that the working body 11 is movable relative to the bar 10 to change the feed of the grinding unit 12 onto the rail track 2. Namely, the grinding machine 1 is changed from the original position (Fig. 6) to the adjusted position (Fig. 7). When the operator wants to grind the rail track 2 from the top of the rail track 2 (running surface) to the side of the rail track 2 (running edge), the operator can disengage the clip 113 of the working body 11 from the stick 171 of the handle 17 so that the grinding machine 1 is changed from the untilted position (Fig. 9) to the tilted position (Fig. 10).

To sum up, the present invention can change the grinding feed efficiently without deforming the working body 11 and without deviating the front guidance wheel 18 and the back guidance wheel 19 out of the rail track 2, and can tilt the grinding machine 1 for grinding the whole railhead, and can reduce the grinding machine 1 weight.

List of Elements

1	grinding machine
10	bar
11	working body
111	hole
112	extending flange
113	clip
12	grinding unit
13	motor
14	position adjustment mechanism
141	driving actuator
1411	handwheel
142	adjustment spindle
143	bellow
144	locking means
15	first rotation means
151	first axis
16	second rotation means
161	second axis
17	handle
171	stick
18	front guidance wheel
19	back guidance wheel
2	rail track
R, T, U, S, W	direction
θ, Ω	angle

Claims

1. A grinding machine for a rail track, comprising:

a bar (10) arranged in parallel to the rail track (2),

a working body (11) attaching to the bar (10) and movable relative to the bar (10),

a grinding unit (12) connected to the working body (11) for grinding the rail track (2),

a motor (13) for supplying power to the grinding unit (12), and

a position adjustment mechanism (14) attached to the working body (11) and to the bar (10) for adjusting the position of the working body (11) so that the working body (11) is movable relative to the bar (10) to change the feed of the grinding unit (12) onto the rail track (2).

2. The grinding machine of Claim 1, further comprising:

a first rotation means (15) including a first axis (151) and disposed between the working body (11) and the bar (10), wherein the first rotation means (15) allows the working body (11) to be pivotable around the first axis (151) in the direction T and to be movable relative to the bar (10) in the direction U when the position adjustment mechanism (14) moves the working body (11).

3. The grinding machine of Claim 2, further comprising:

a second rotation means (16) including a second axis (161) and disposed between the position adjustment mechanism (14) and the bar (10), wherein the second rotation means (16) allows the position adjustment mechanism (14) to be pivotable around the second axis (161) in direction S when the position adjustment mechanism (14) moves the working body (11).

4. The grinding machine of Claim 3, wherein the working body (11) includes a hole (111) for accommodating the first axis (151) of the first rotation means (15) when the working body (11) incurs the movement in the direction U relative to the first rotation means (15) during the operation of the position adjustment mechanism (14).

5. The grinding machine of Claim 4, wherein the hole (111) of the working body (11) is shaped to keep the distance between the first axis (151) of the first rotation means (15) and the second axis (161) of the second rotation means (16) constant during the movement of the working body (11).

6. The grinding machine of one of Claim 3-5, wherein the position adjustment mechanism (14) includes:

a driving actuator (141) for an operator to activate the position adjustment mechanism (14),

an adjustment spindle (142) for changing the distance between the driving actuator (141) and the second axis (161) of the second rotation means (16) by rotating the driving actuator (141), and

a bellow (143) covering around the adjustment spindle (142) to protect dust from entering the adjustment spindle (142).

7. The grinding machine of one of Claim 1-6, wherein the working body (11) includes an extending flange (112) for connecting the working body (11) to the position adjustment mechanism (14).

8. The grinding machine of one of Claims 3-5, wherein the first rotation means (15) and the second rotation means (16) are axially rotatable around the bar (10) in the direction W so that the working body (11) is tiltable around the bar (10) to allow the grinding unit (12) to grind the railhead of the rail track (2).

9. The grinding machine of one of Claims 1-8, further comprising a handle (17) fixed on the bar (10) for an operator to hold onto.

10. The grinding machine of Claim 9, wherein the handle (17) further comprises a stick (171) in parallel to the bar (10).

11. The grinding machine of Claim 10, wherein the working body (11) comprising a clip (113) which engages the working body (11) to the stick (171) of the handle (17) or disengages the working body (11) from the stick (171) of the handle (17).

12. The grinding machine of one of Claims 1-11, wherein the grinding unit (12) is a grinding stone, a grinding disc, or a grinding belt.

13. The grinding machine of one of Claims 1-12, further comprising a front guidance wheel (18) and a back guidance wheel (19) for guiding the grinding machine (1) along the rail track (2).

14. The grinding machine of Claim 6, wherein the driving actuator (141) is driven by an operator, an electric power source, or a hydraulic power source.

15. The grinding machine of Claim 14, wherein the driving actuator (141) is a handwheel (1411).

16. The grinding machine of Claim 15, wherein the position adjustment mechanism (14) includes a locking means (144) for controlling the driving actuator (141).

17. A grinding method for a rail track, comprising:

providing a grinding machine (1) according to one of Claims 1 to 16,

grinding the rail track (2) using the grinding machine (1), and

actuating the position adjustment mechanism (14) for adjusting the position of the working body (11) so that the working body (11) is movable relative to the bar (10) to change the feed of the grinding unit (12) onto the rail track (2).

Drawings

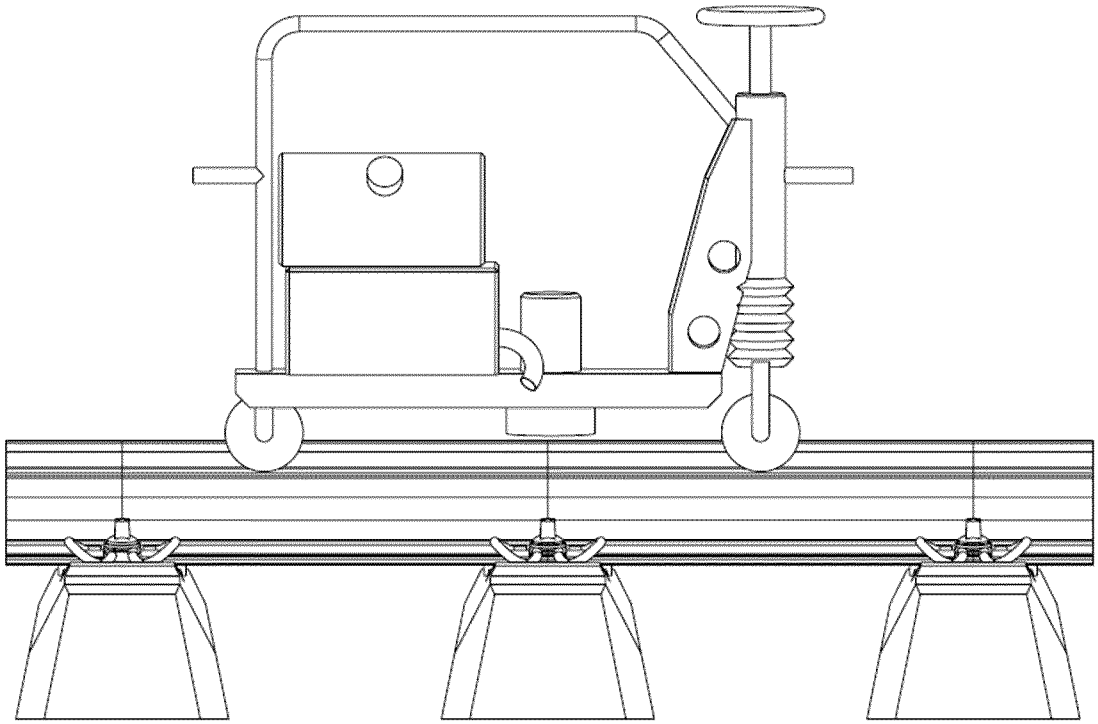

Fig. 1

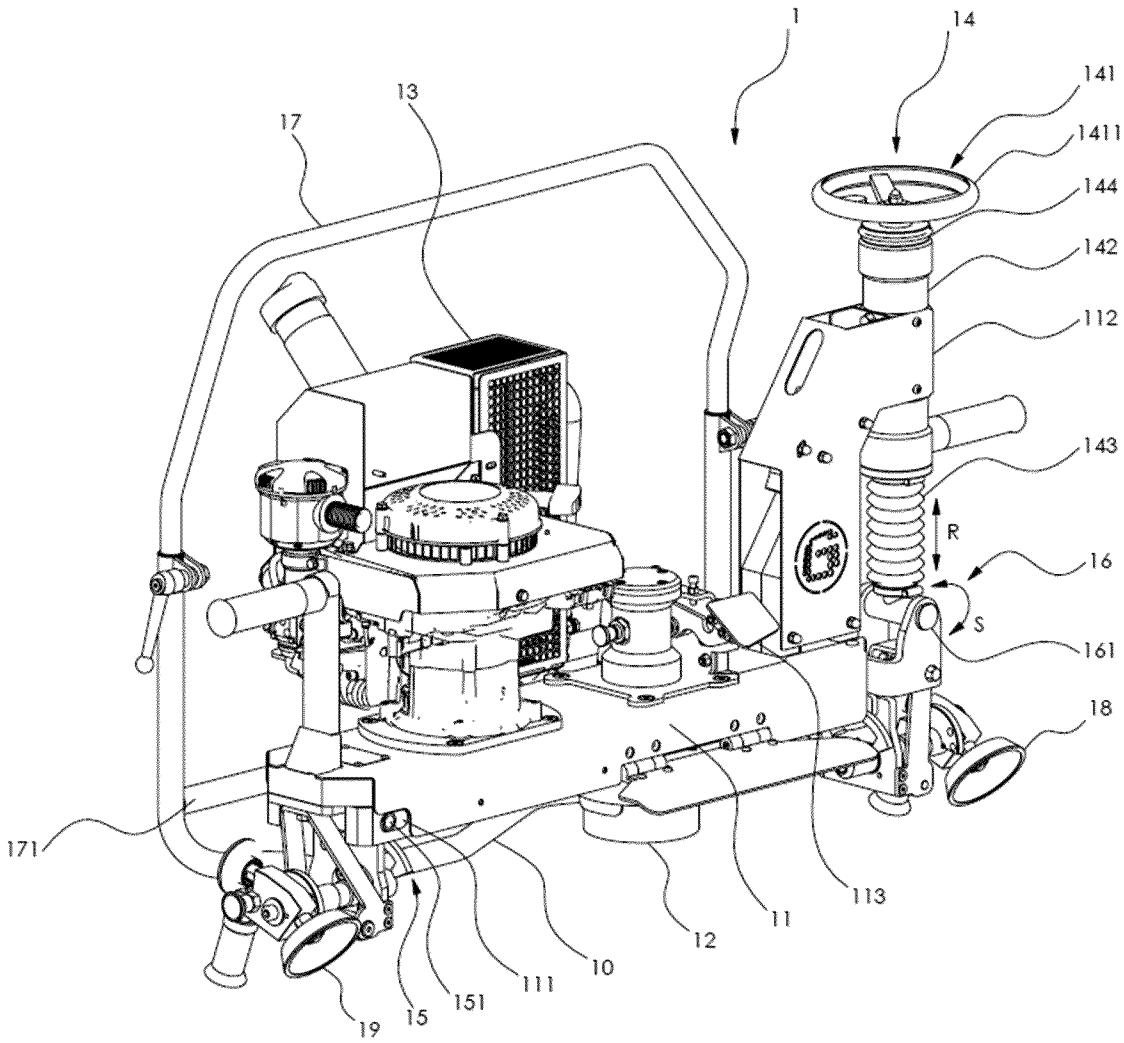
1
14
141
1411
144
142
112
143
R
16
S
161
18
13
17
171
19
15
151
111
10
12
11
113

Fig. 2

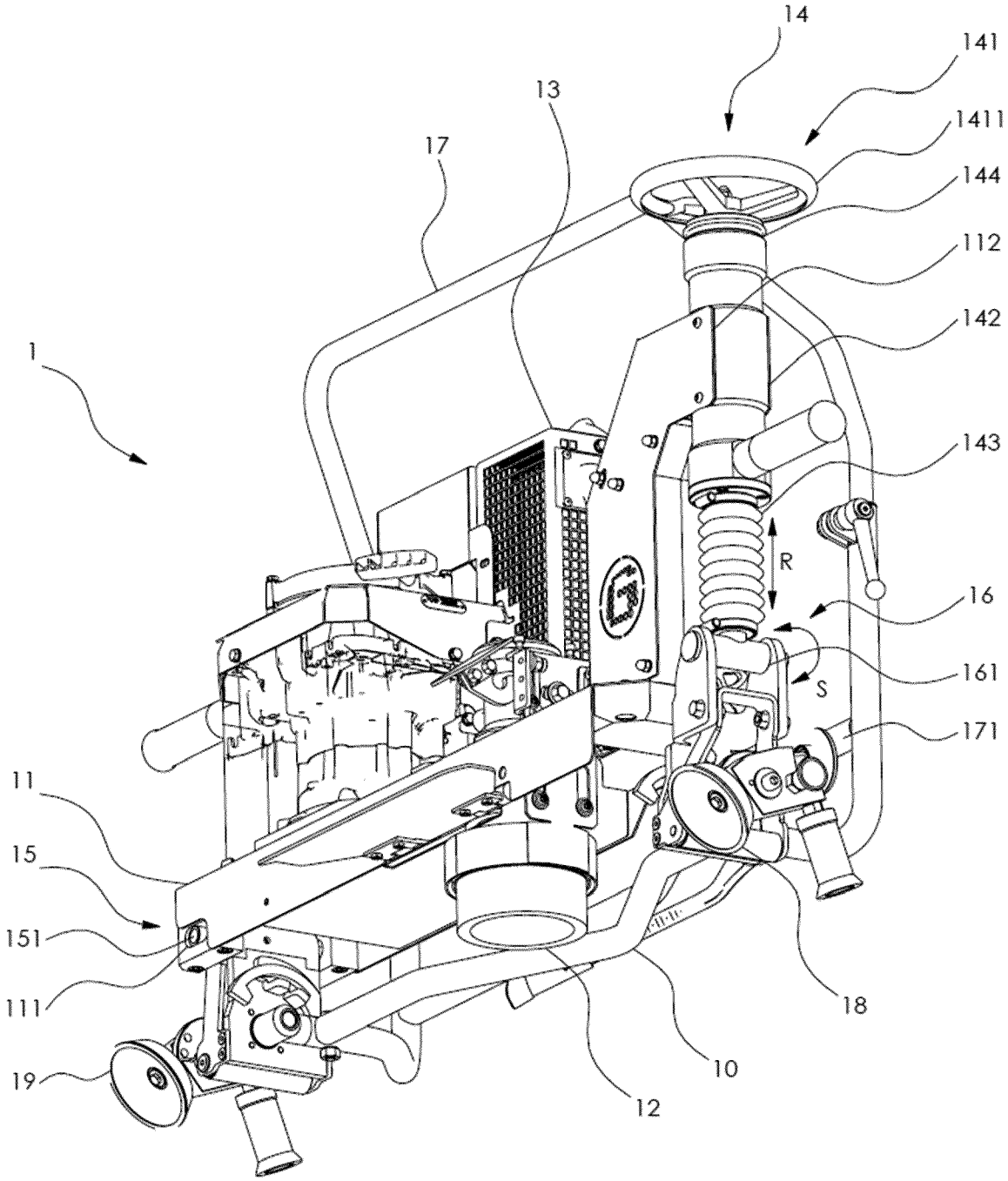
14
141
13
1411
17
144
112
142
1
143
R
16
161
S
171
11
15
151
111
18
19
10
12

Fig. 3

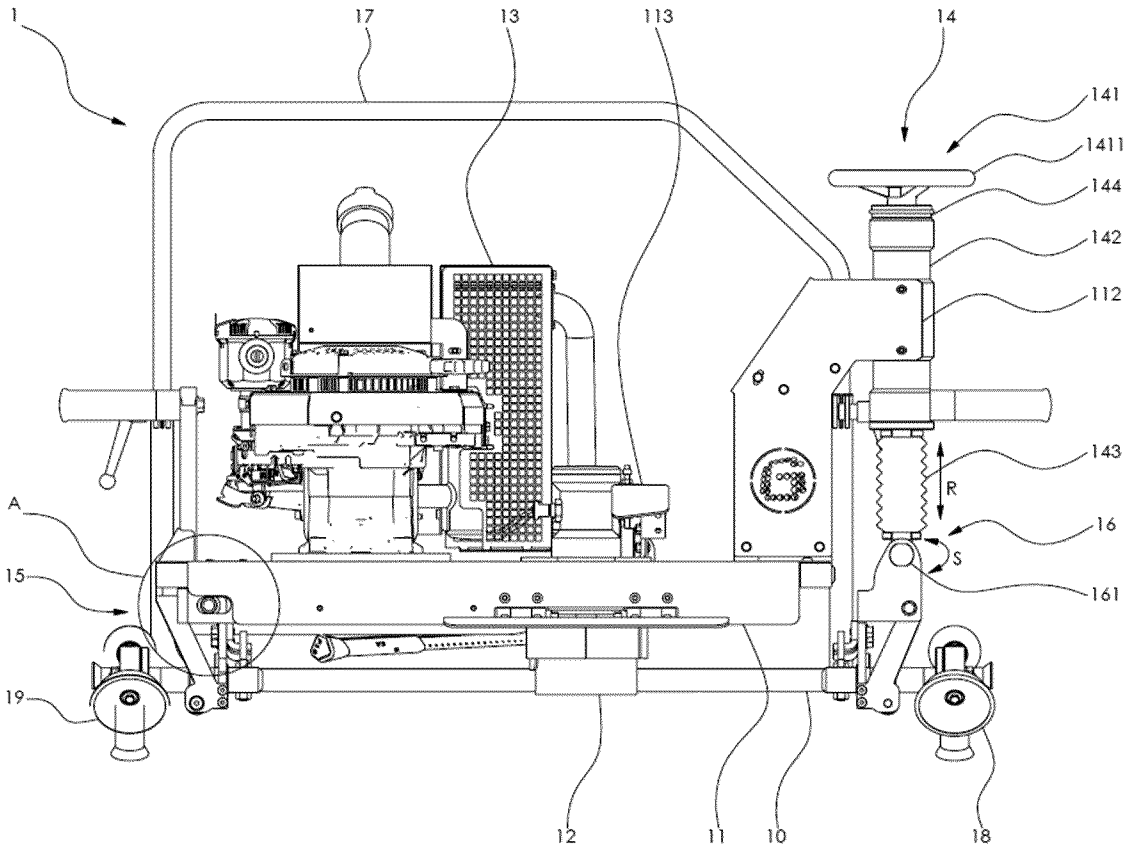

Fig. 4a

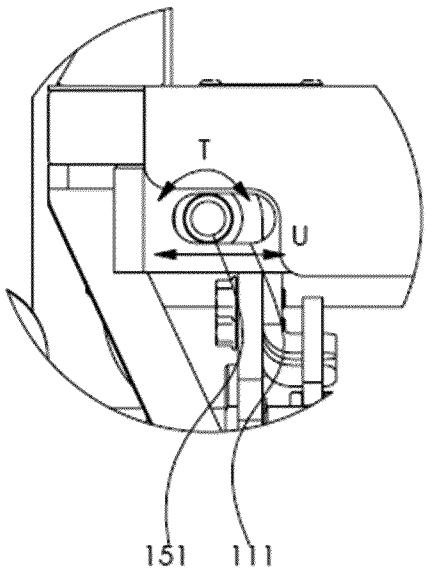

Fig. 4b

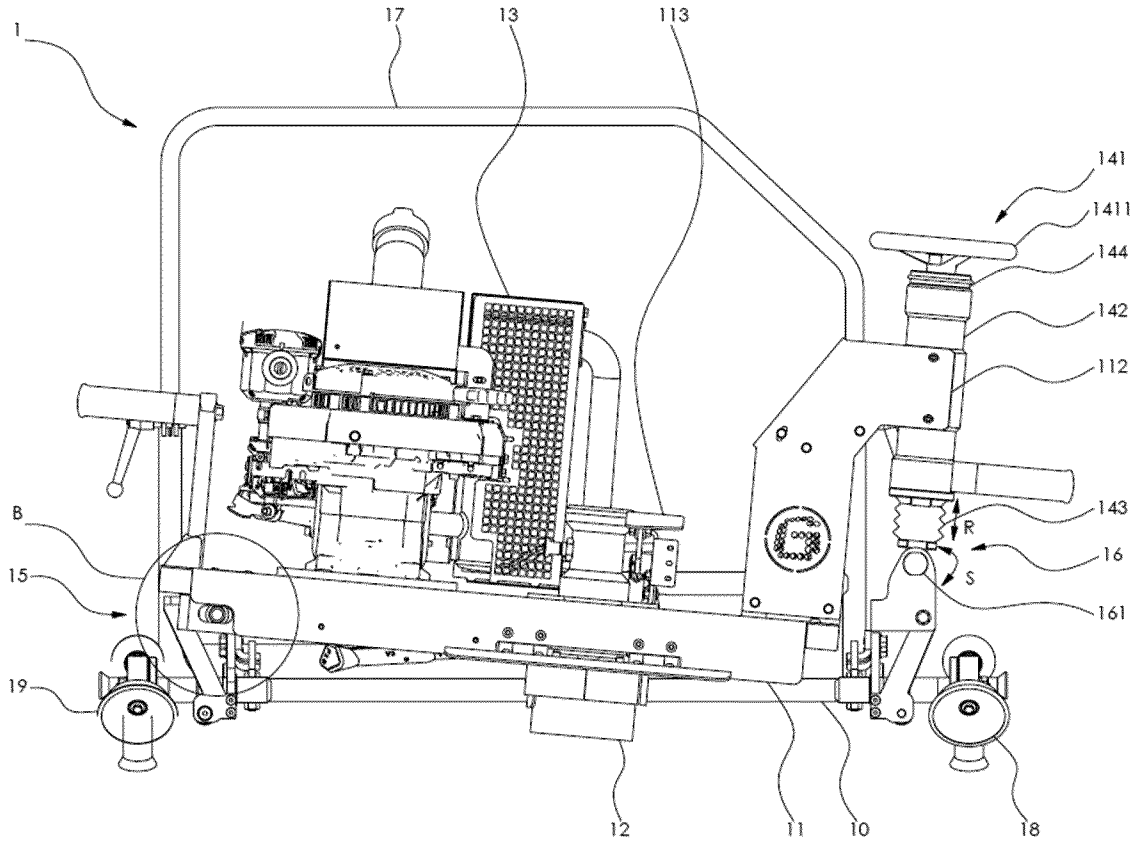

Fig. 5a

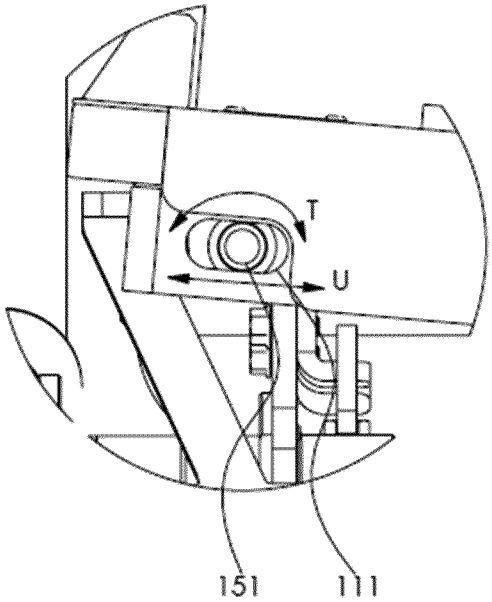

Fig. 5b

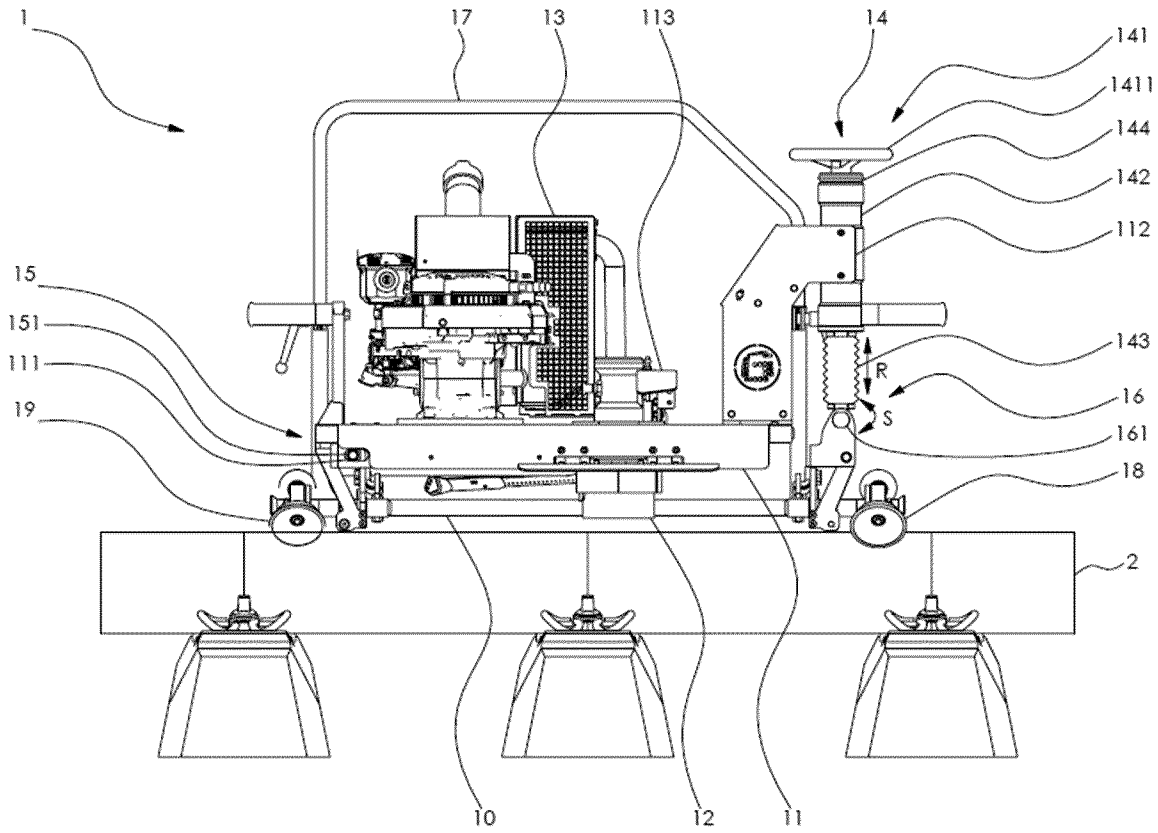
1
17
13
113
14
141
1411
144
142
112
15
151
111
19
143
R
S
16
161
18
2
10
12
11

Fig. 6

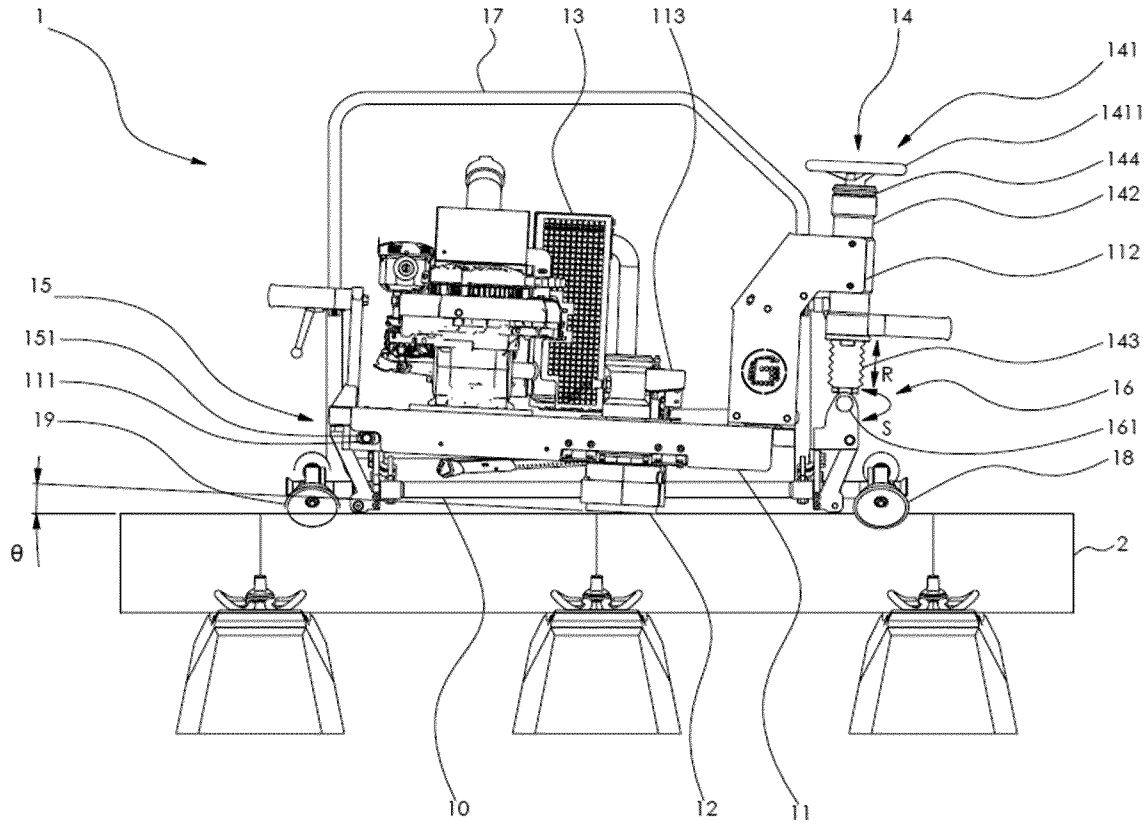
1
17
13
113
14
141
1411
144
142
112
15
151
111
19
143
R
16
S
161
18
θ
2
10
12
11

Fig. 7

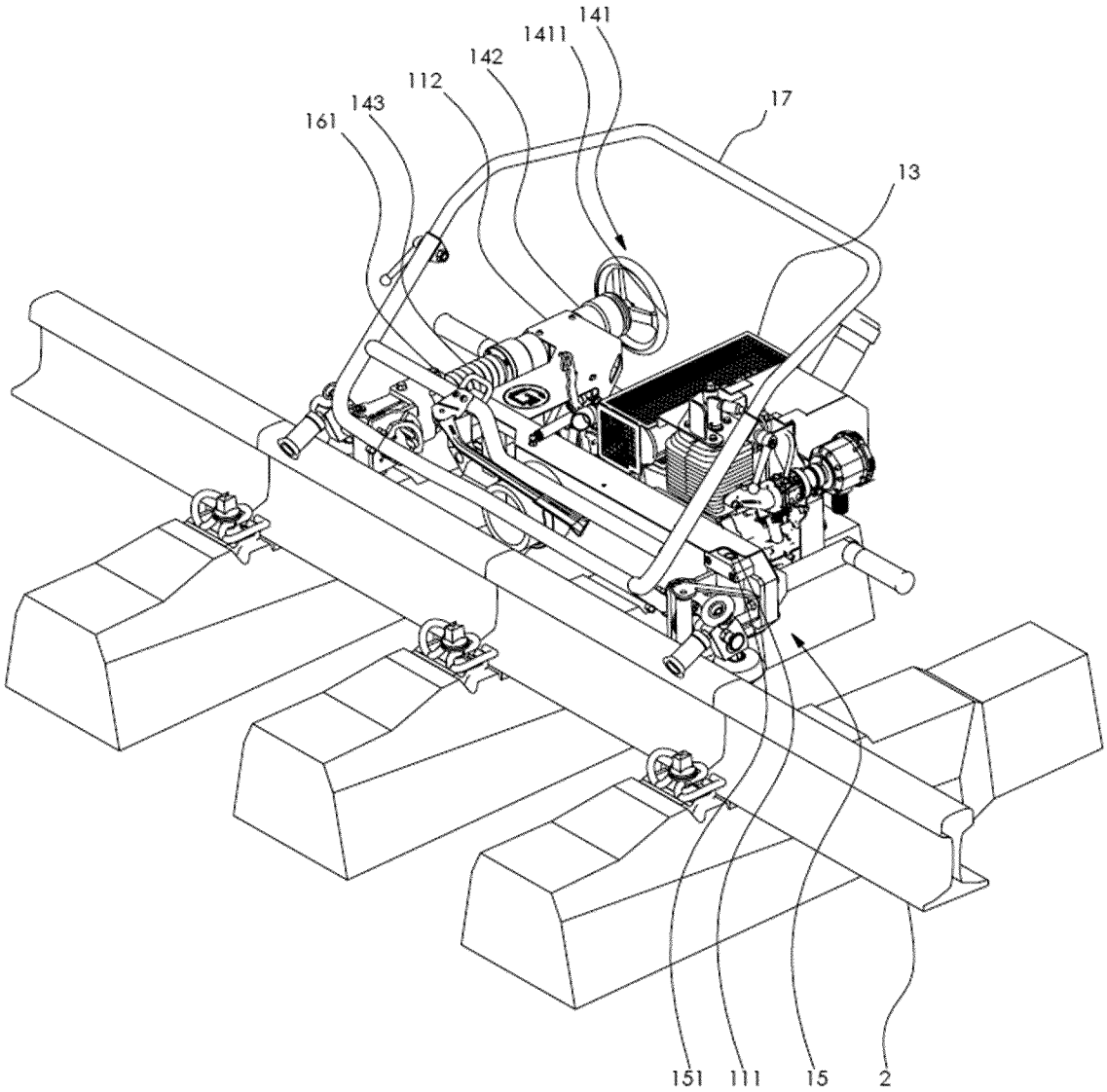

Fig. 8

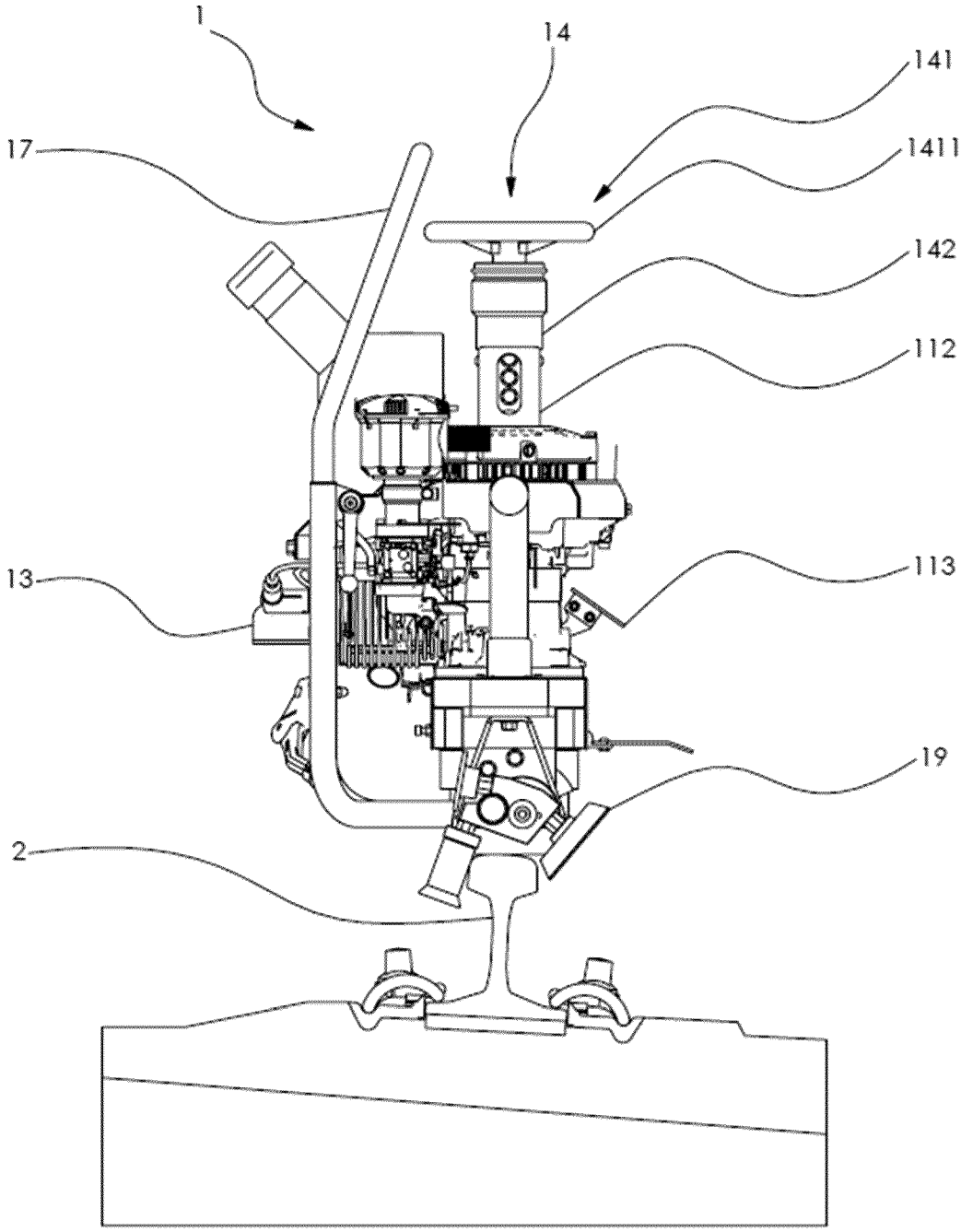

Fig. 9

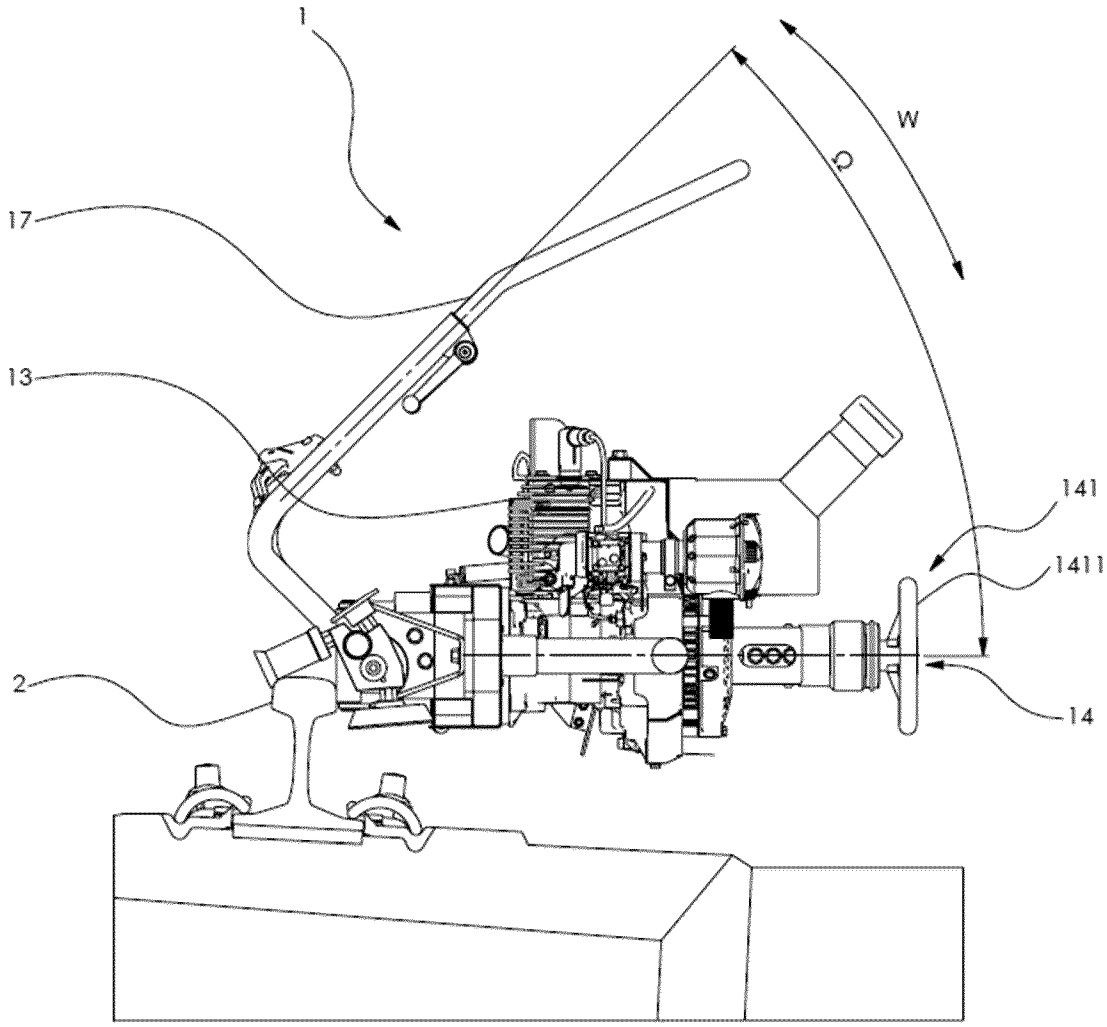

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2023/051982

A. CLASSIFICATION OF SUBJECT MATTER
INV. E01B31/17
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 203 144 852 U (HOHHOT RAILWAY BUREAU WELDING RAIL PLANT) 21 August 2013 (2013-08-21)	1,7, 9-13,17
A	claims; figures	2-6,8, 14-16
A	DE 20 2017 002300 U1 (ROBEL BAHNBAUMASCHINEN GMBH [DE]) 15 January 2018 (2018-01-15) paragraphs [0027] - [0038]; figures	1-17

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

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

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

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 February 2023	27/02/2023

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Movadat, Robin

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2023/051982

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 203144852 U	21-08-2013	NONE	
DE 202017002300 U1	15-01-2018	AU 2018257242 A1	26-09-2019
		CN 110582608 A	17-12-2019
		DE 202017002300 U1	15-01-2018
		EA 201900400 A1	02-03-2020
		EP 3615732 A1	04-03-2020
		JP 2020518739 A	25-06-2020
		WO 2018197115 A1	01-11-2018