FIG. 1

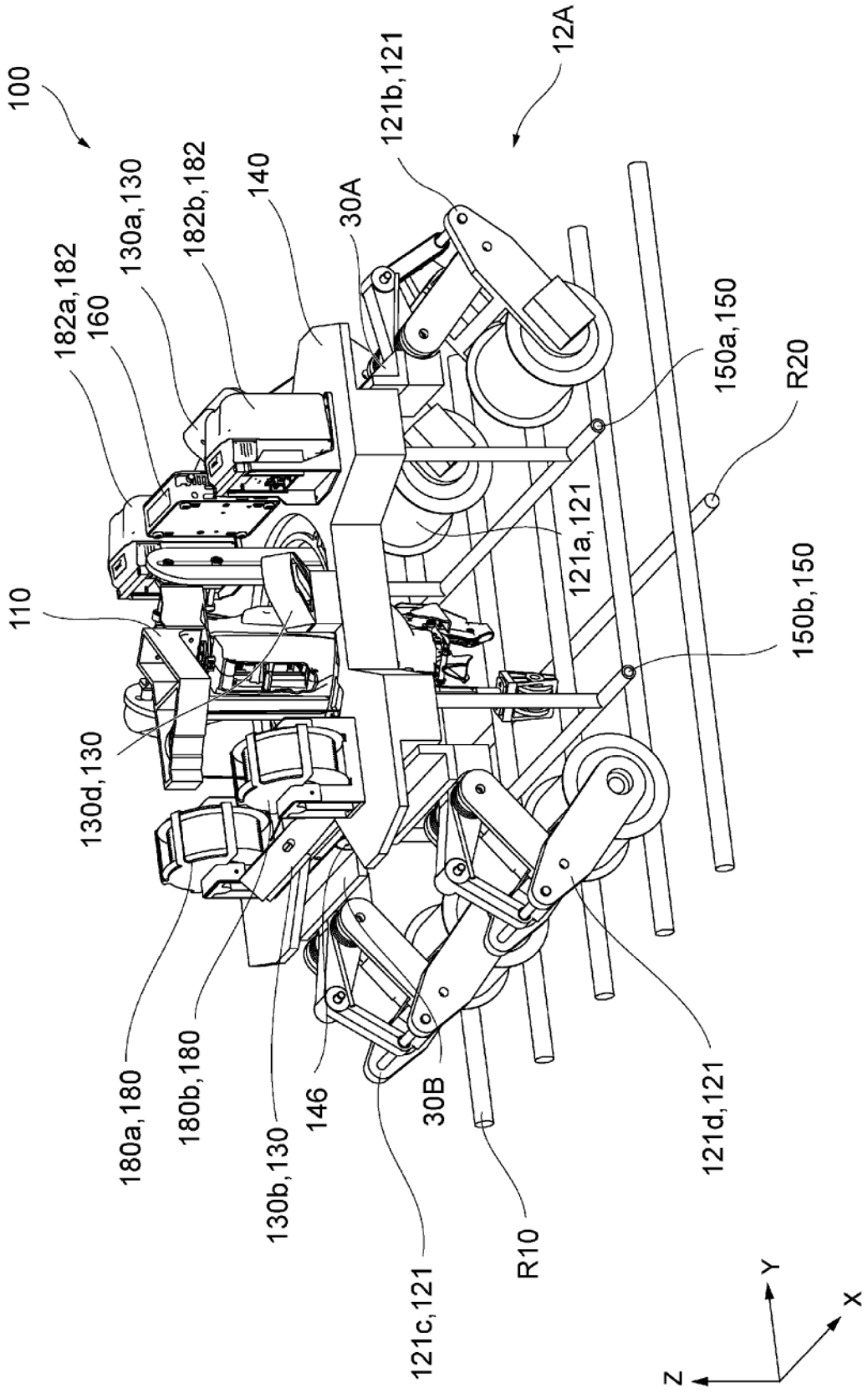

100
12A
121b,121
182a,182
160
130a,130
182b,182
140
30A
150a,150
R20
110
121a,121
150b,150
130d,130
180a,180
180b,180
130b,130
146
30B
121d,121
121c,121
R10
Y
X
Z

FIG. 2

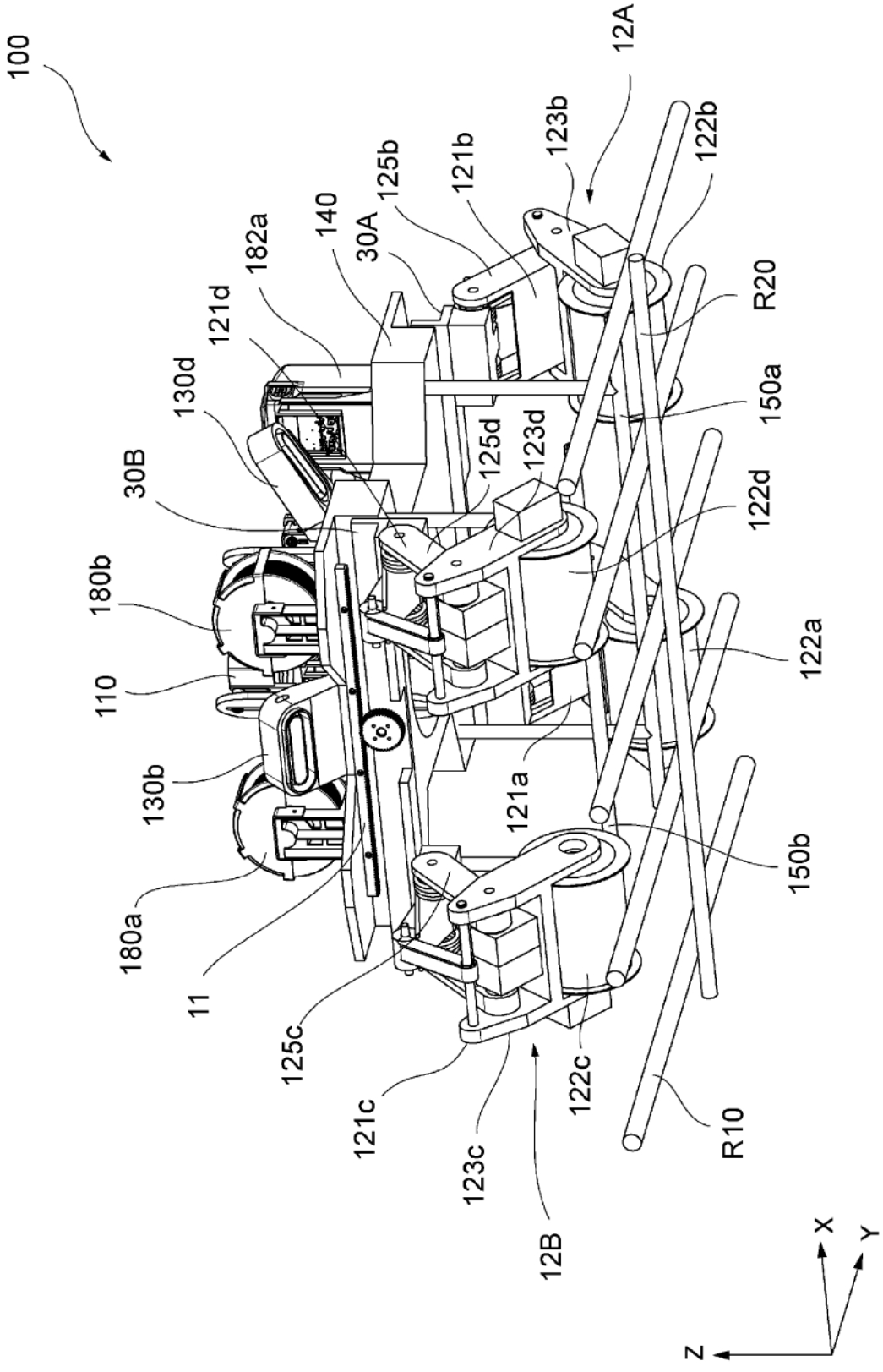

100
12A
123b
122b
121b
125b
140
30A
182a
121d
130d
30B
180b
110
130b
180a
11
125c
121c
123c
12B
122c
R10
R20
150a
122d
125d
123d
122a
121a
150b
X
Y
Z

FIG. 3A

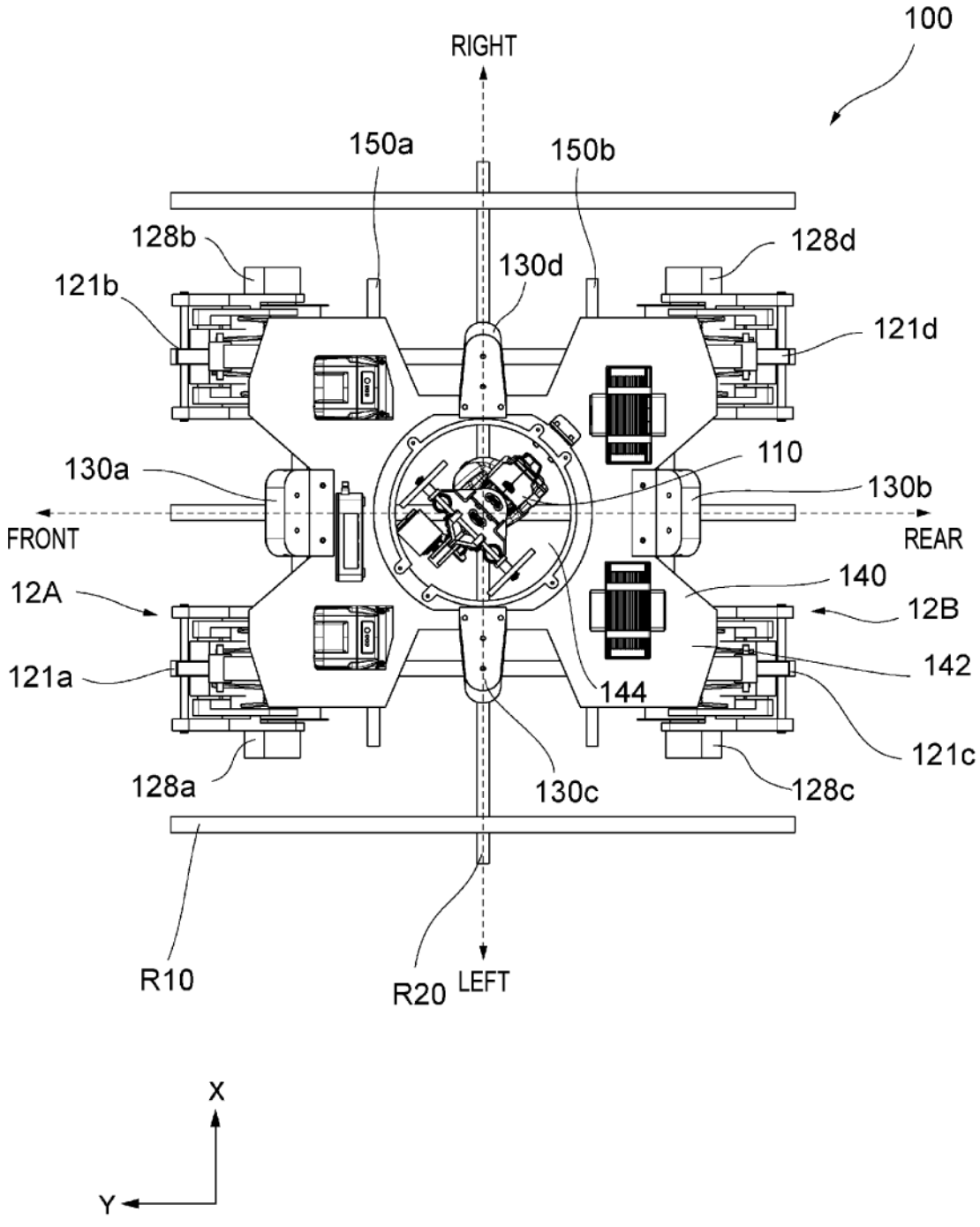

100
RIGHT
150a
150b
128b
128d
130d
121b
121d
110
130a
130b
FRONT
REAR
140
12A
12B
142
121a
144
121c
128a
130c
128c
R10
R20
LEFT
X
Y

FIG. 3B

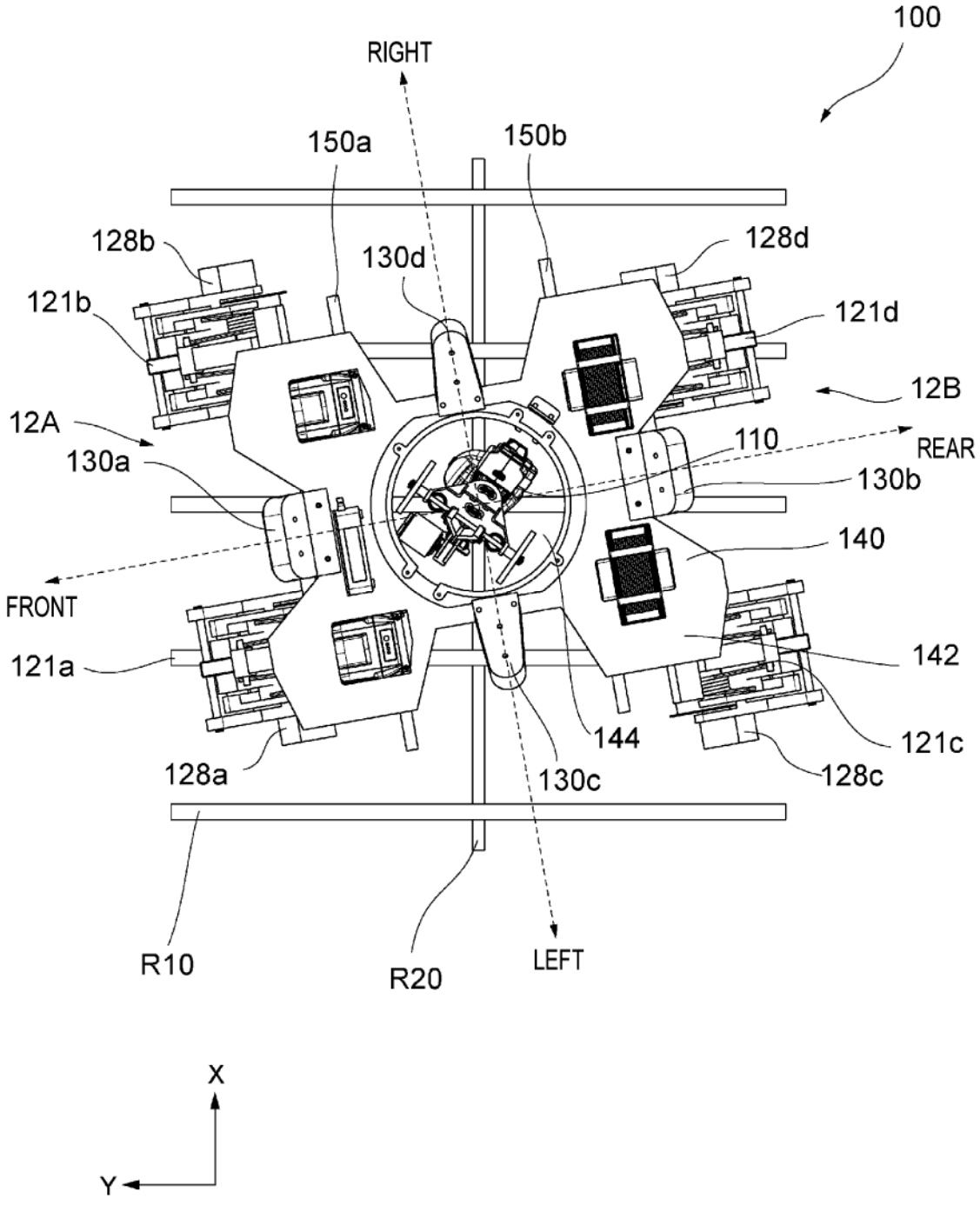

100
RIGHT
150a
150b
128b
130d
128d
121b
121d
12B
12A
110
REAR
130a
130b
140
FRONT
121a
142
144
121c
128a
130c
128c
R10
R20
LEFT
X
Y

FIG. 4A

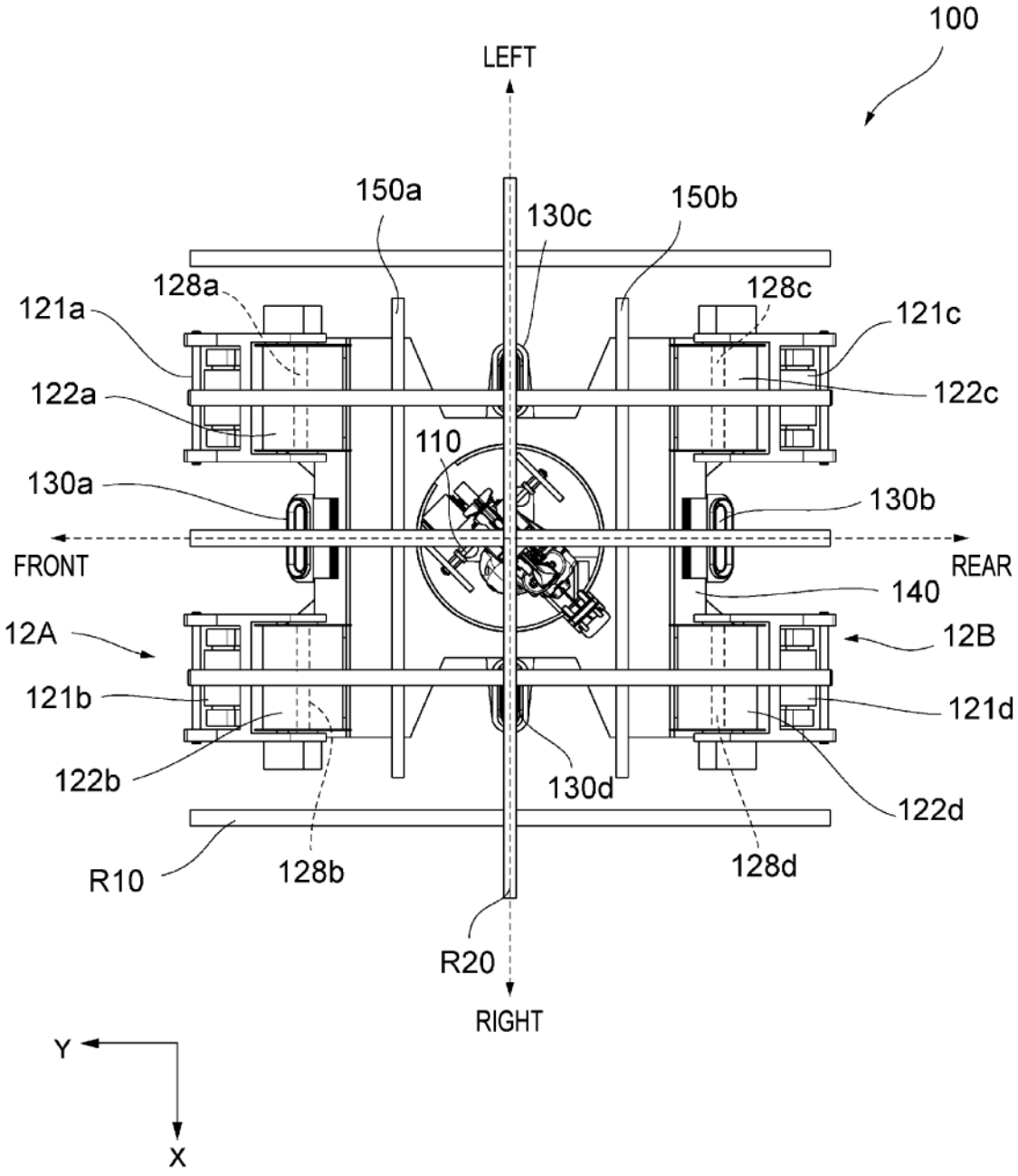

100
LEFT
150a
130c
150b
128a
128c
121a
121c
122a
122c
110
130a
130b
FRONT
REAR
140
12A
12B
121b
121d
122b
130d
122d
R10
128b
128d
R20
RIGHT
Y
X

FIG. 4B

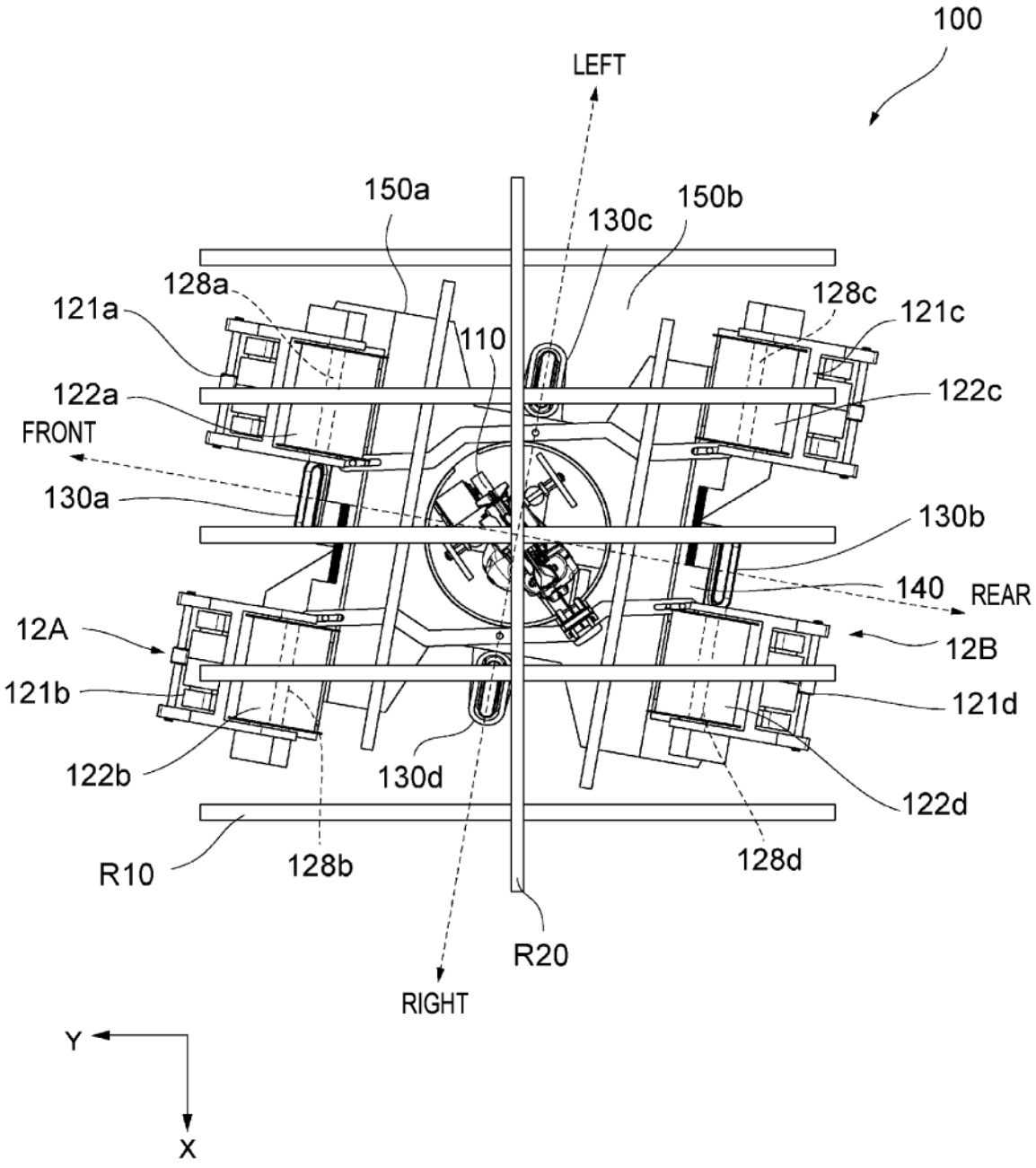

100
LEFT
150a
150b
130c
128a
128c
121a
121c
110
122a
122c
FRONT
130a
130b
140
REAR
12A
12B
121b
121d
122b
130d
122d
R10
128b
128d
R20
RIGHT
Y
X

FIG. 5

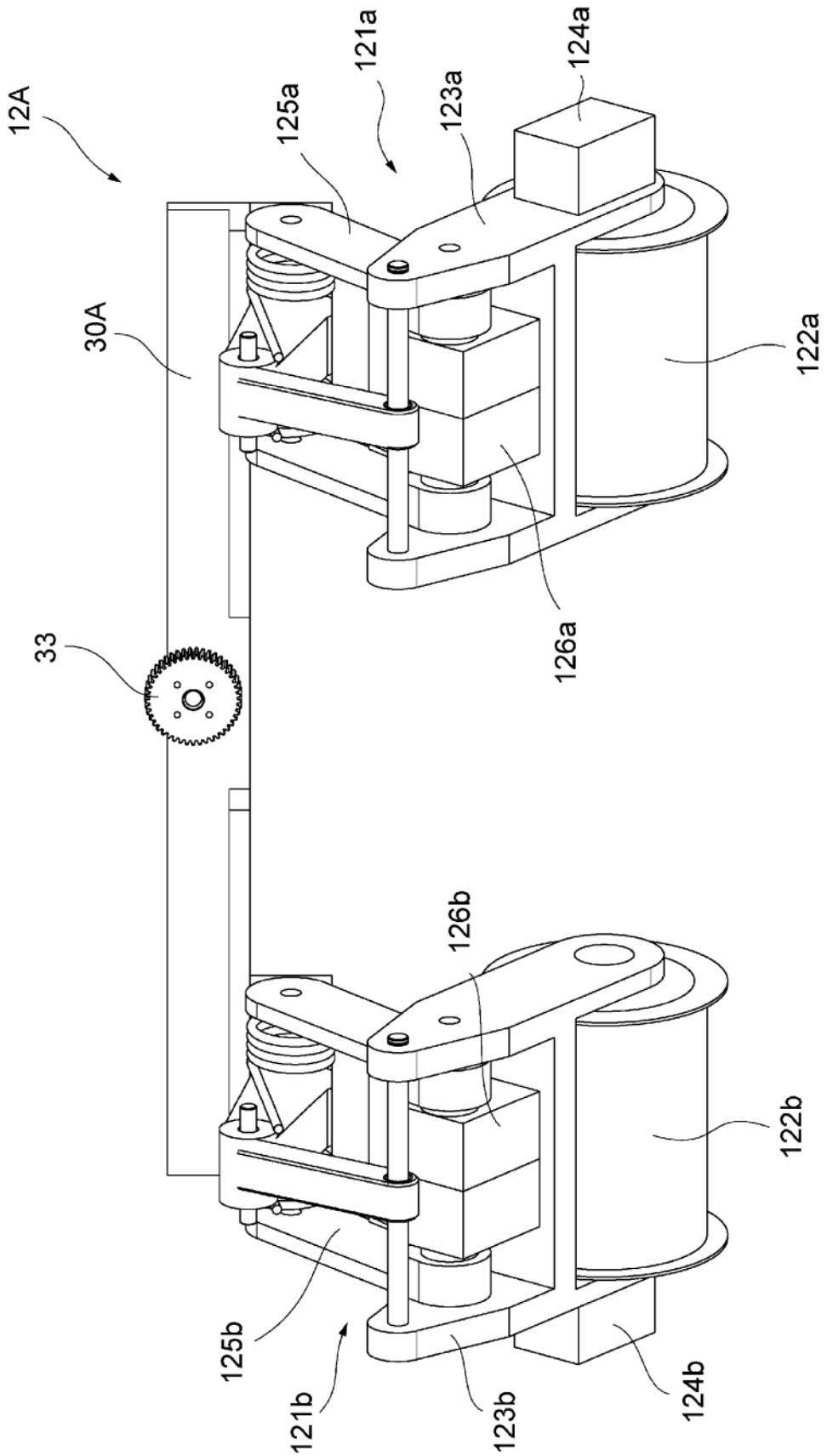

12A
121a
124a
125a
123a
30A
122a
33
126a
126b
122b
125b
121b
123b
124b

FIG. 6

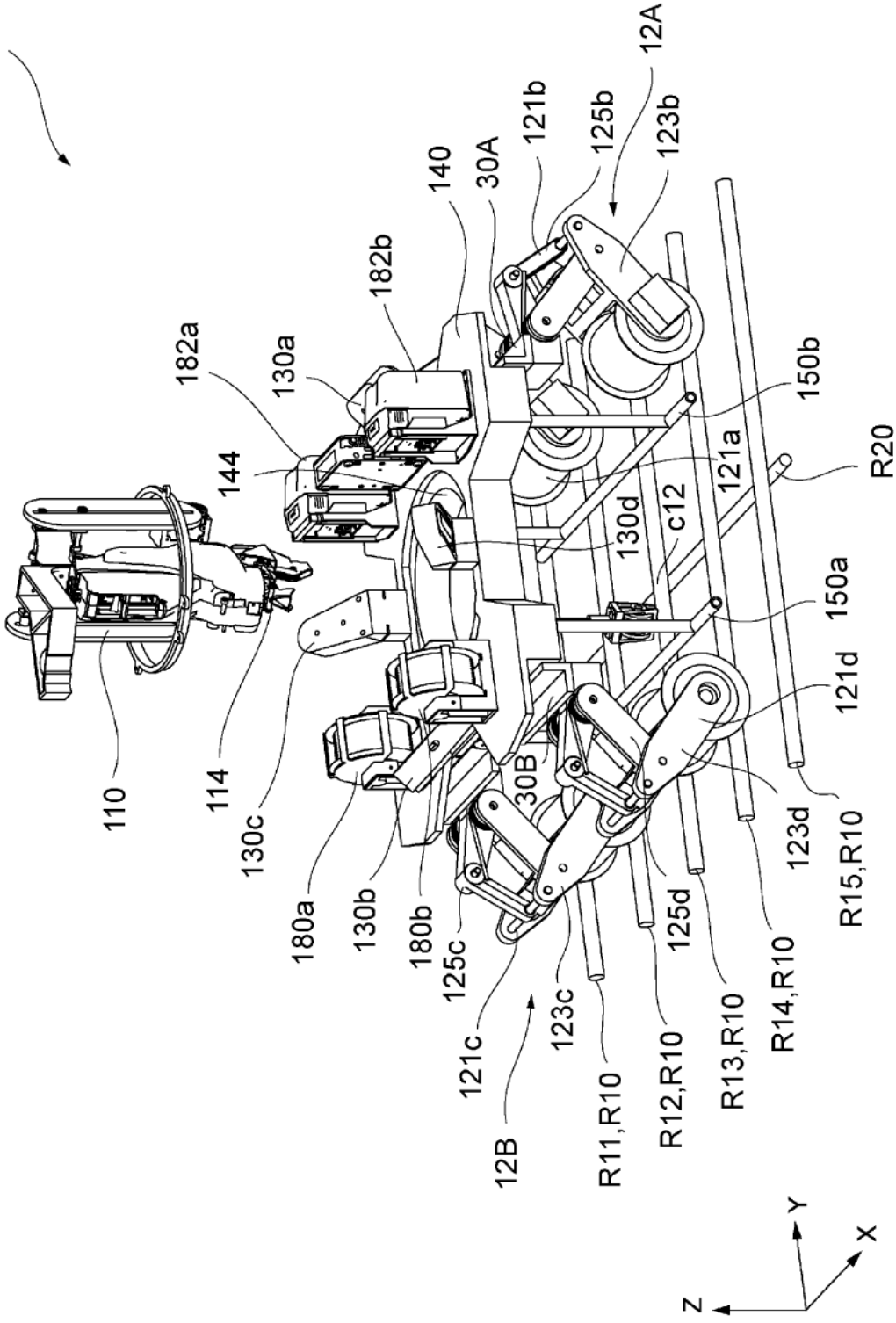

100
110
114
144
182a
130a
182b
140
30A
121b
125b
12A
123b
150b
R20
121a
c12
130d
150a
121d
123d
R15,R10
R14,R10
R13,R10
R12,R10
R11,R10
12B
121c
123c
125c
180b
130b
180a
130c
30B
Y
X
Z

FIG. 7

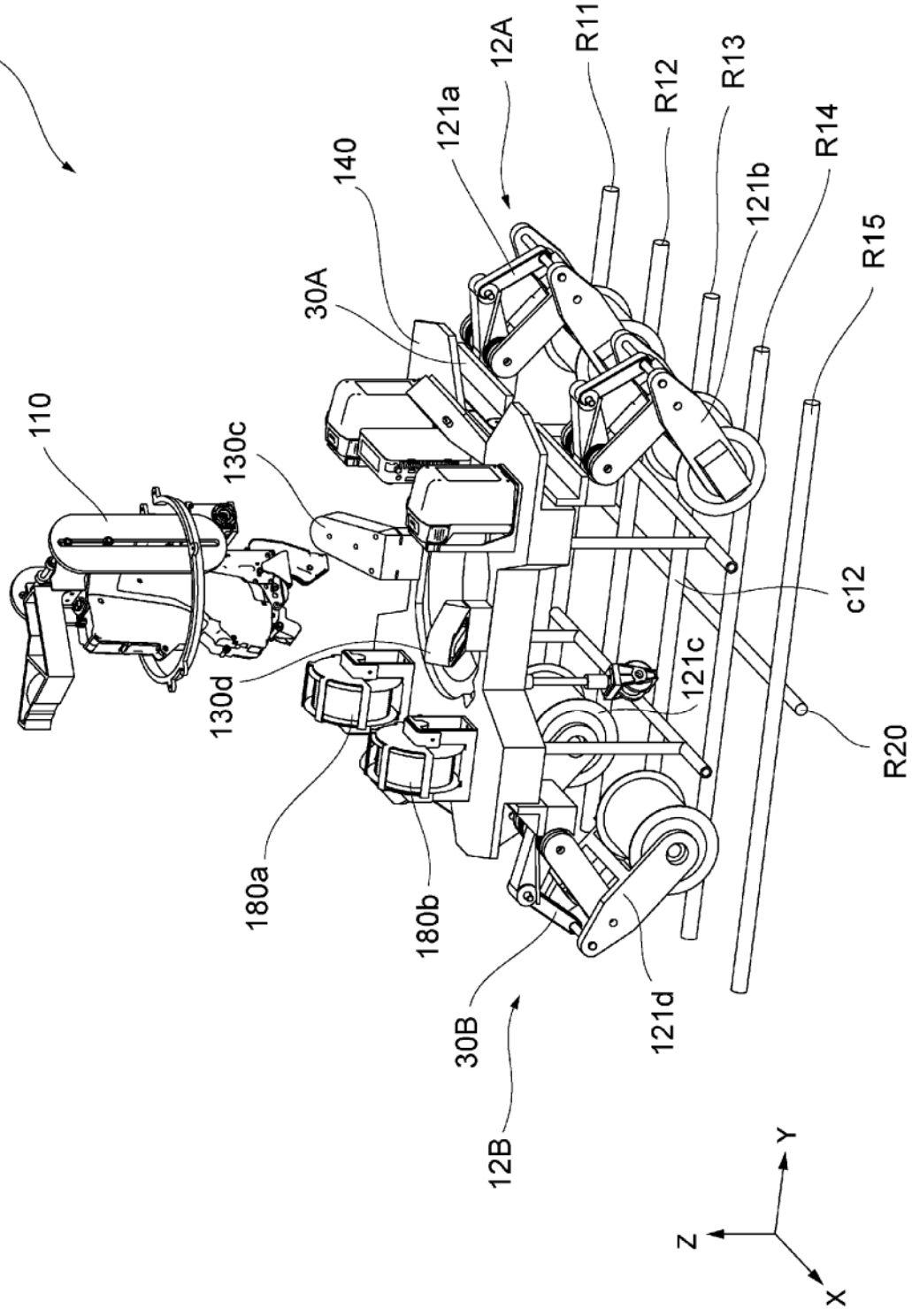
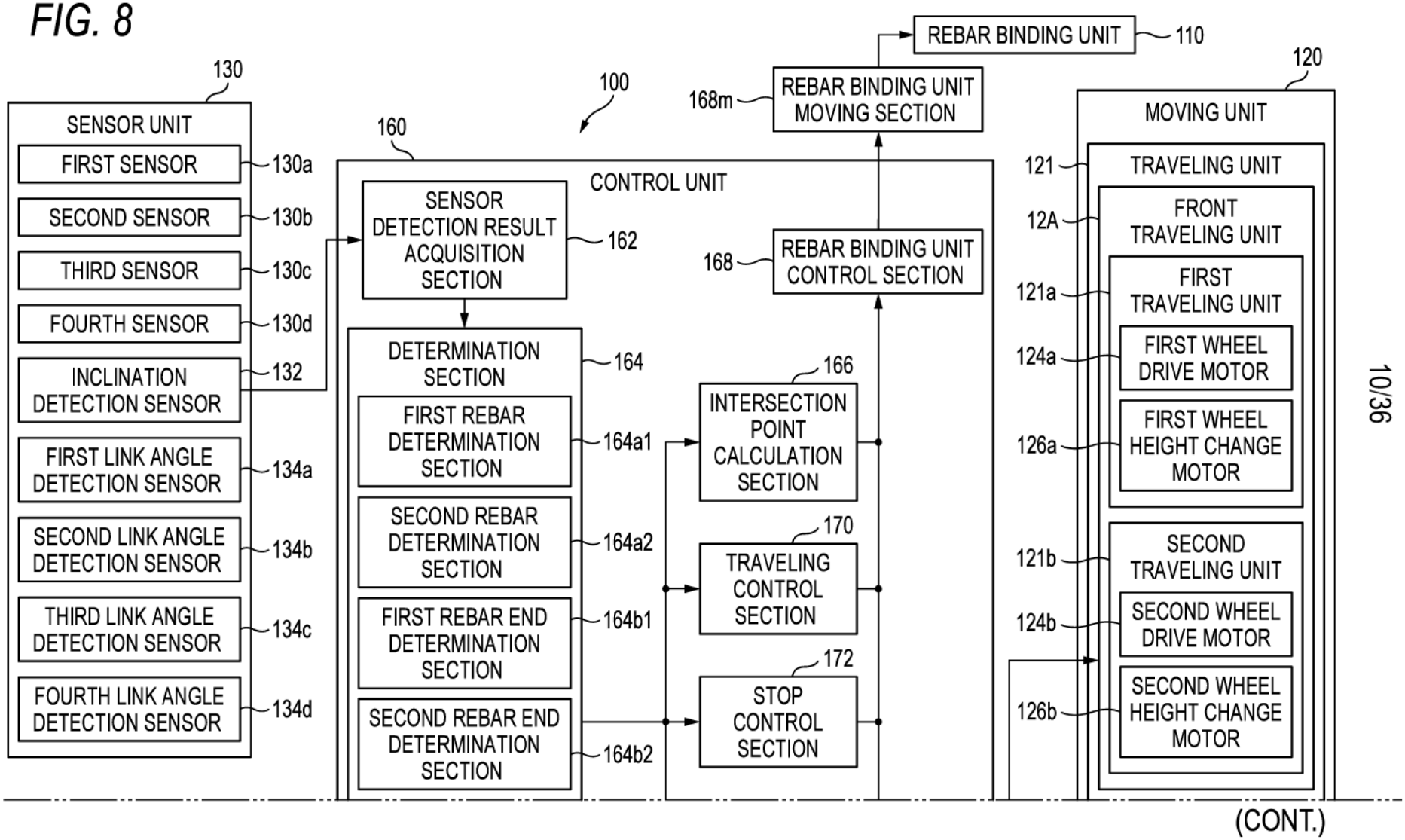
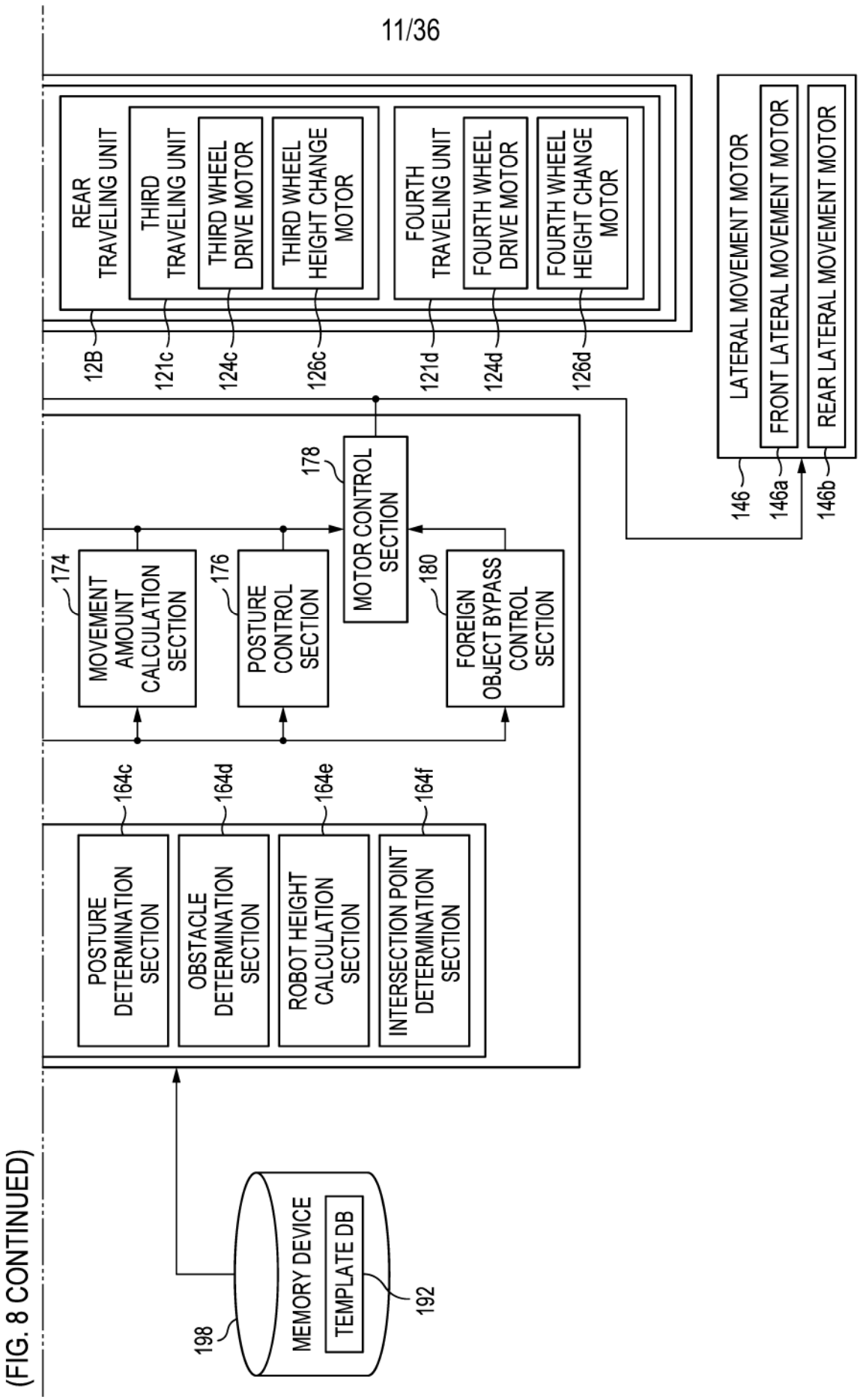

100
110
130c
130d
180a
180b
30A
30B
140
121a
12A
12B
121d
121c
c12
R11
R12
R13
R14
R15
R20
Y
Z
X

FIG. 8


130
SENSOR UNIT
FIRST SENSOR
130a
SECOND SENSOR
130b
THIRD SENSOR
130c
FOURTH SENSOR
130d
INCLINATION DETECTION SENSOR
132
FIRST LINK ANGLE DETECTION SENSOR
134a
SECOND LINK ANGLE DETECTION SENSOR
134b
THIRD LINK ANGLE DETECTION SENSOR
134c
FOURTH LINK ANGLE DETECTION SENSOR
134d
100
160
CONTROL UNIT
SENSOR DETECTION RESULT ACQUISITION SECTION
162
DETERMINATION SECTION
164
FIRST REBAR DETERMINATION SECTION
164a1
SECOND REBAR DETERMINATION SECTION
164a2
FIRST REBAR END DETERMINATION SECTION
164b1
SECOND REBAR END DETERMINATION SECTION
164b2
168m
REBAR BINDING UNIT MOVING SECTION
168
REBAR BINDING UNIT CONTROL SECTION
166
INTERSECTION POINT CALCULATION SECTION
170
TRAVELING CONTROL SECTION
172
STOP CONTROL SECTION
REBAR BINDING UNIT
110
120
MOVING UNIT
121
TRAVELING UNIT
12A
FRONT TRAVELING UNIT
121a
FIRST TRAVELING UNIT
124a
FIRST WHEEL DRIVE MOTOR
126a
FIRST WHEEL HEIGHT CHANGE MOTOR
121b
SECOND TRAVELING UNIT
124b
SECOND WHEEL DRIVE MOTOR
126b
SECOND WHEEL HEIGHT CHANGE MOTOR
(CONT.)

(FIG. 8 CONTINUED)



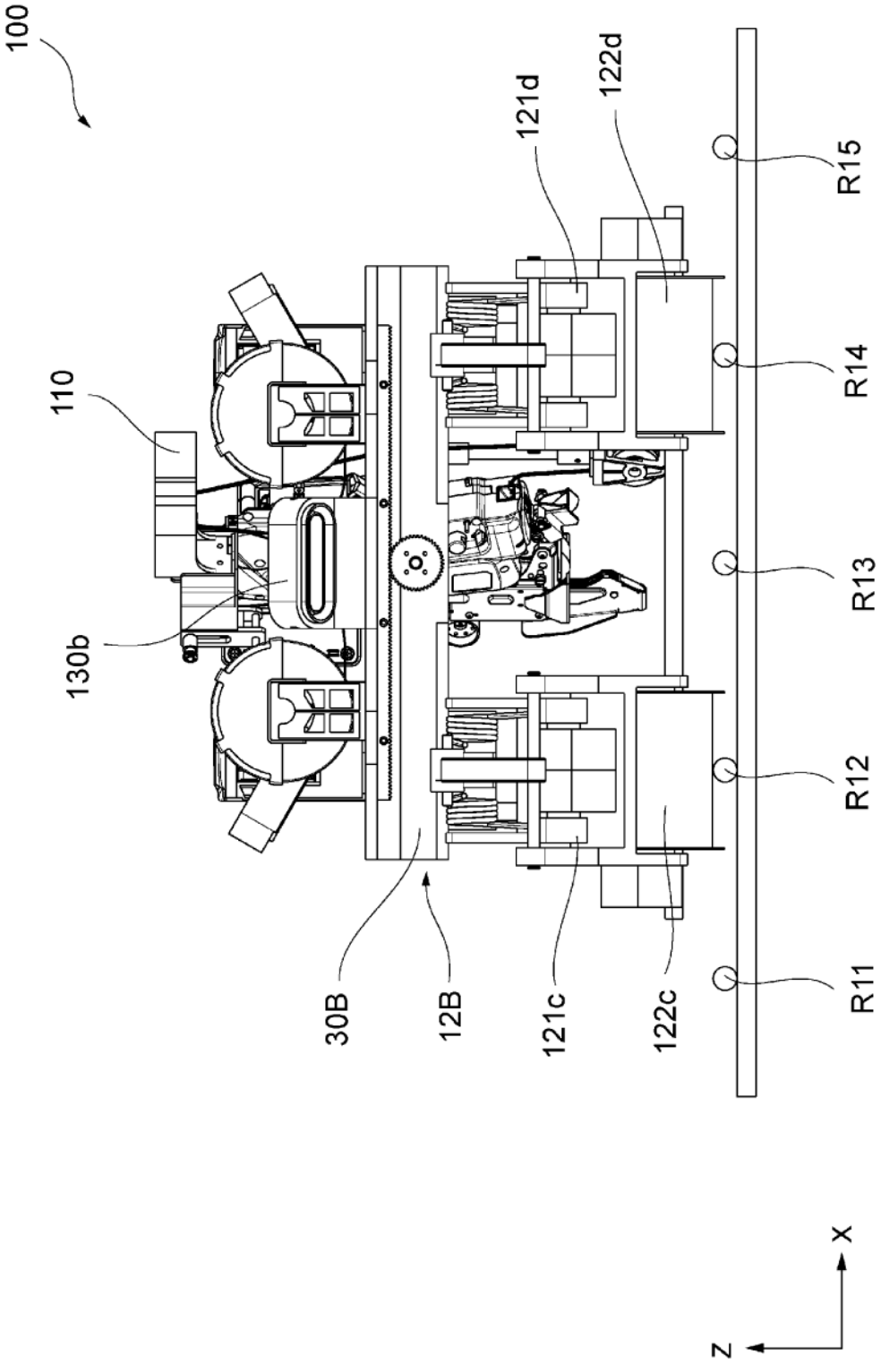


FIG. 9

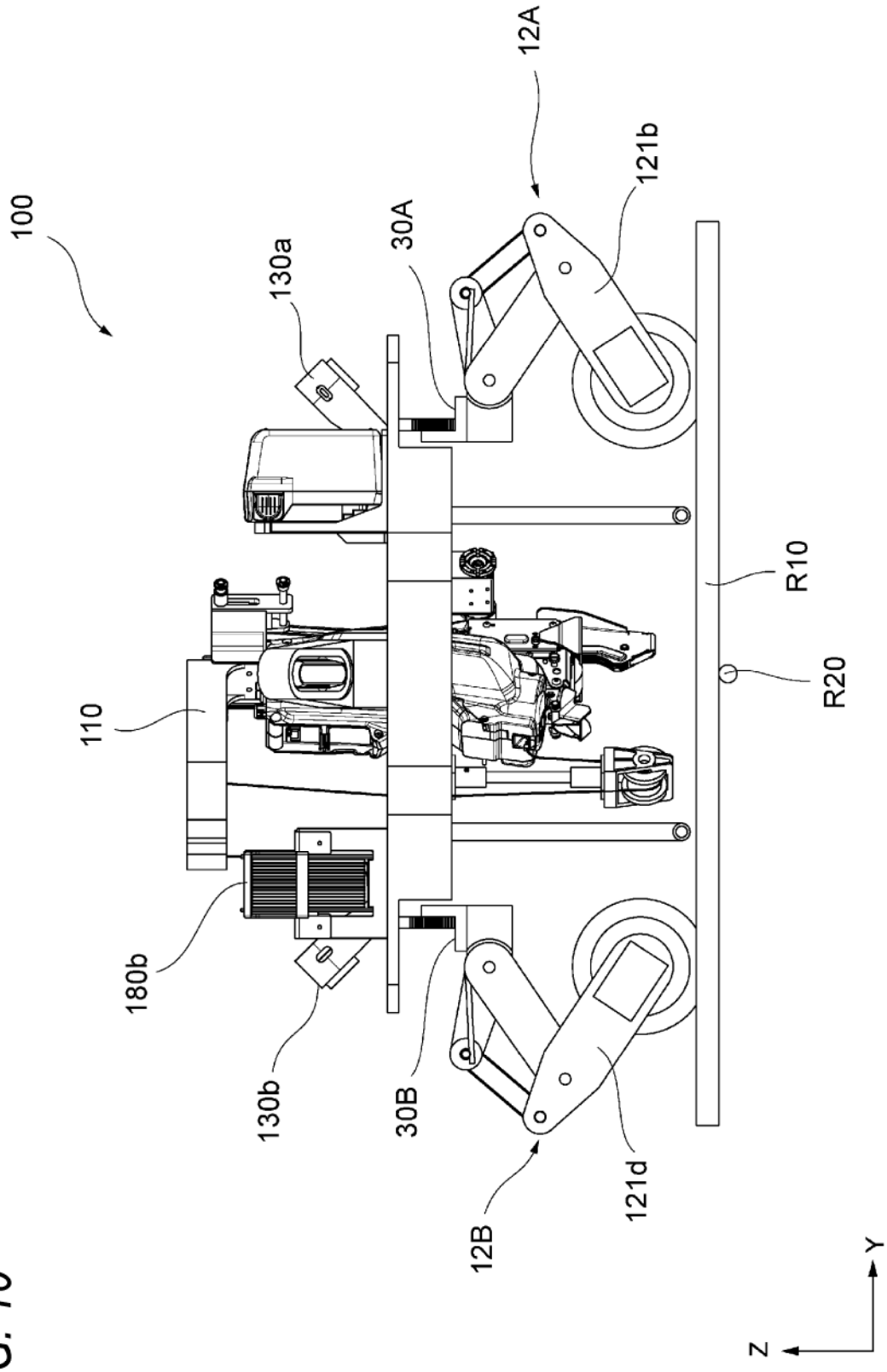


FIG. 10

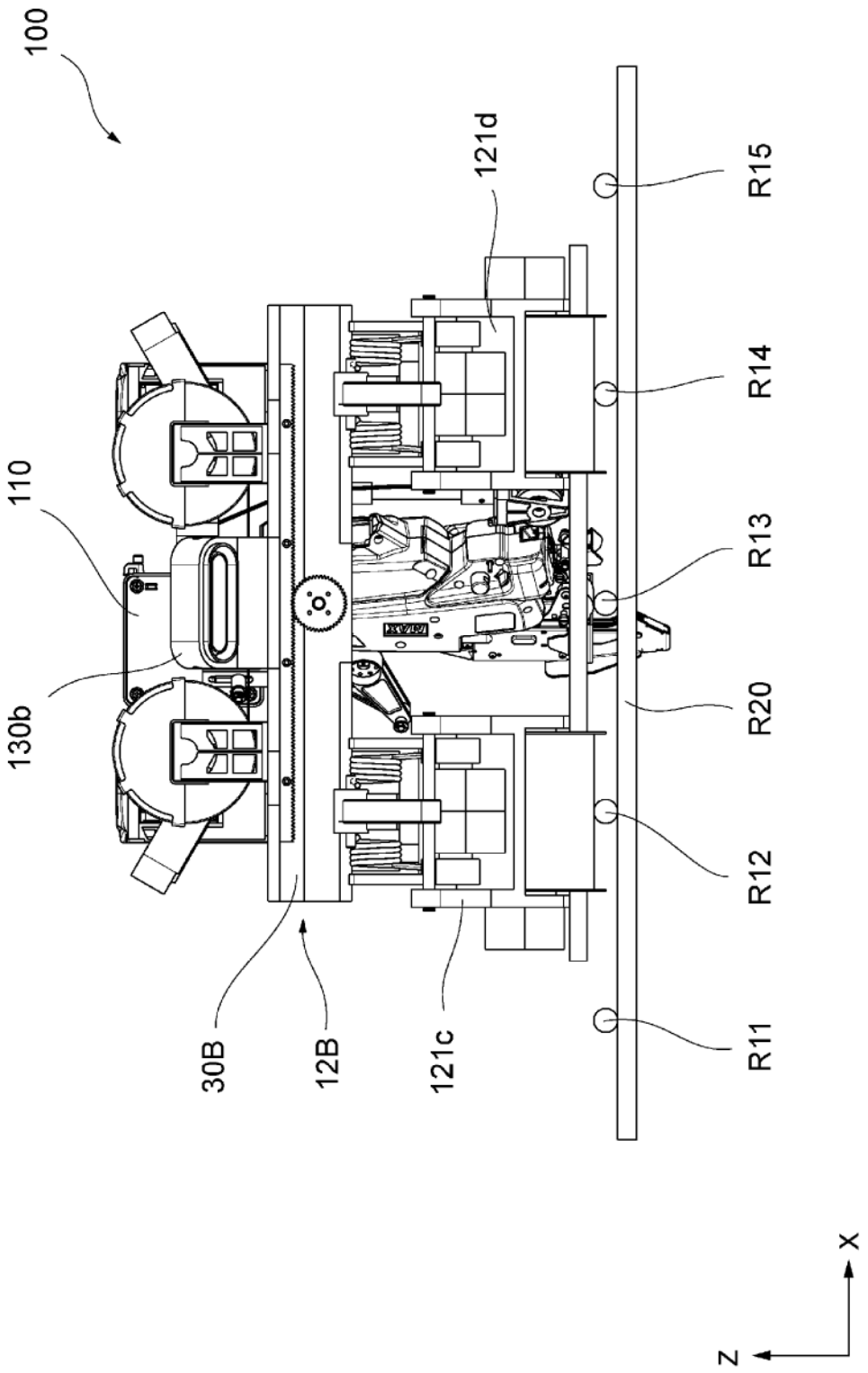


FIG. 11

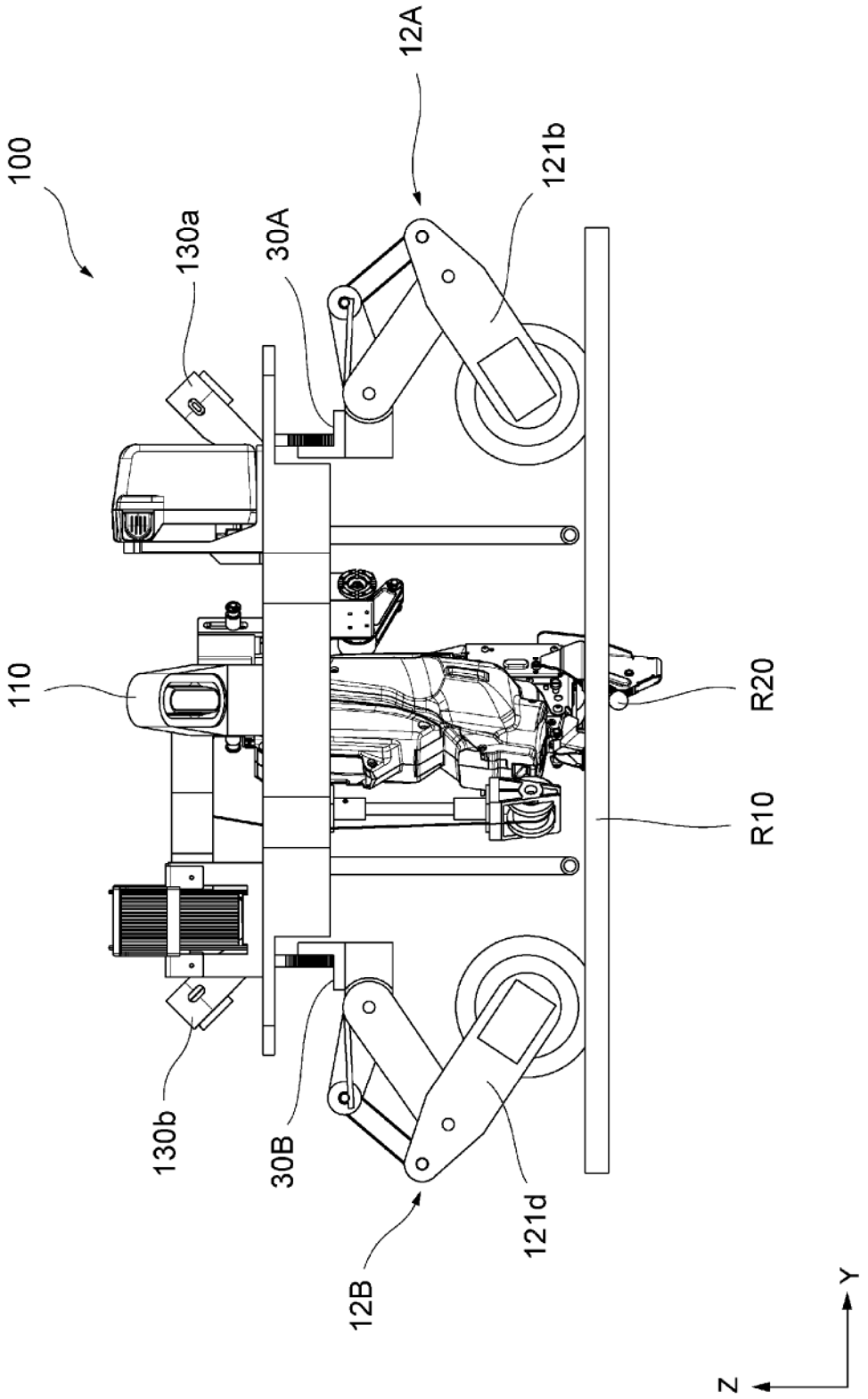


FIG. 12

FIG. 13

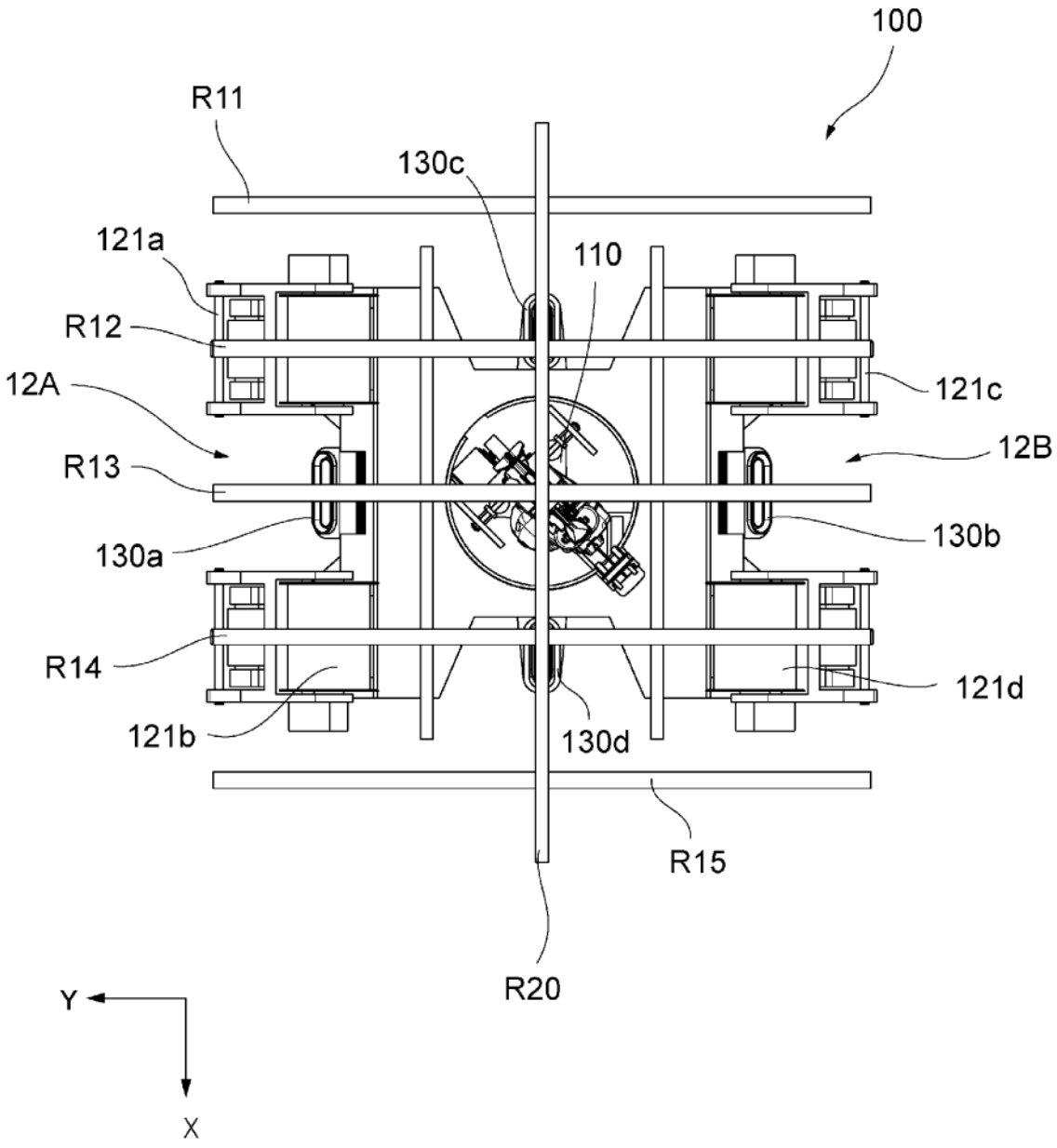

100
R11
130c
121a
110
R12
121c
12A
12B
R13
130b
130a
R14
121d
121b
130d
R15
R20
Y
X

FIG. 14A

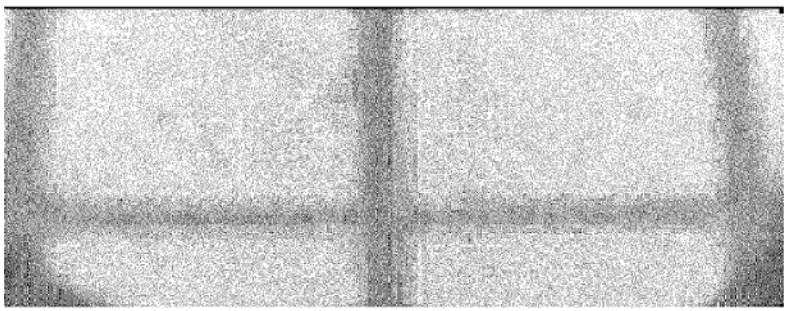


FIG. 14B

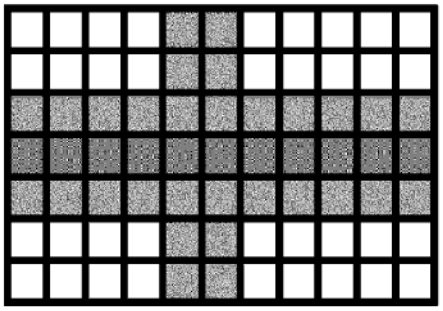


FIG. 15A

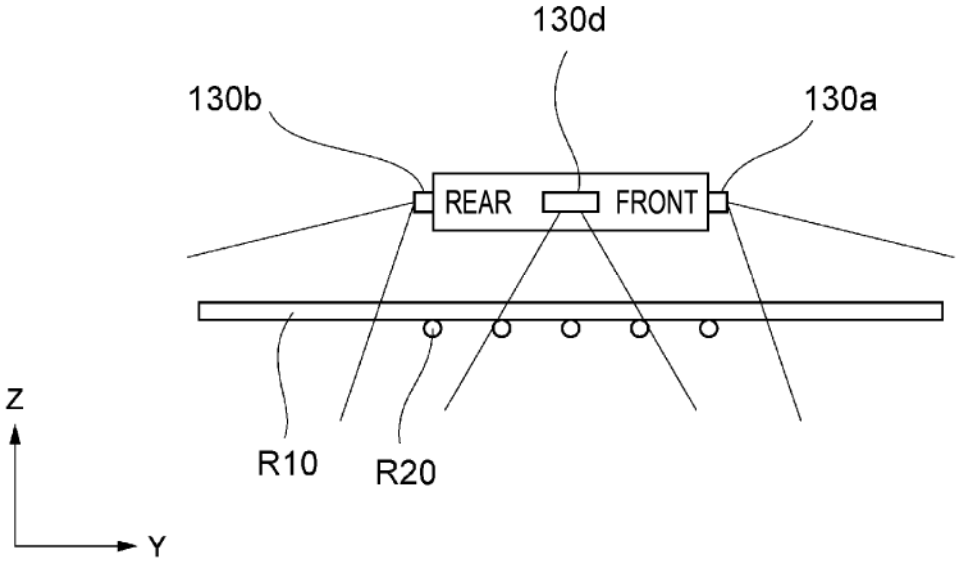


FIG. 15B

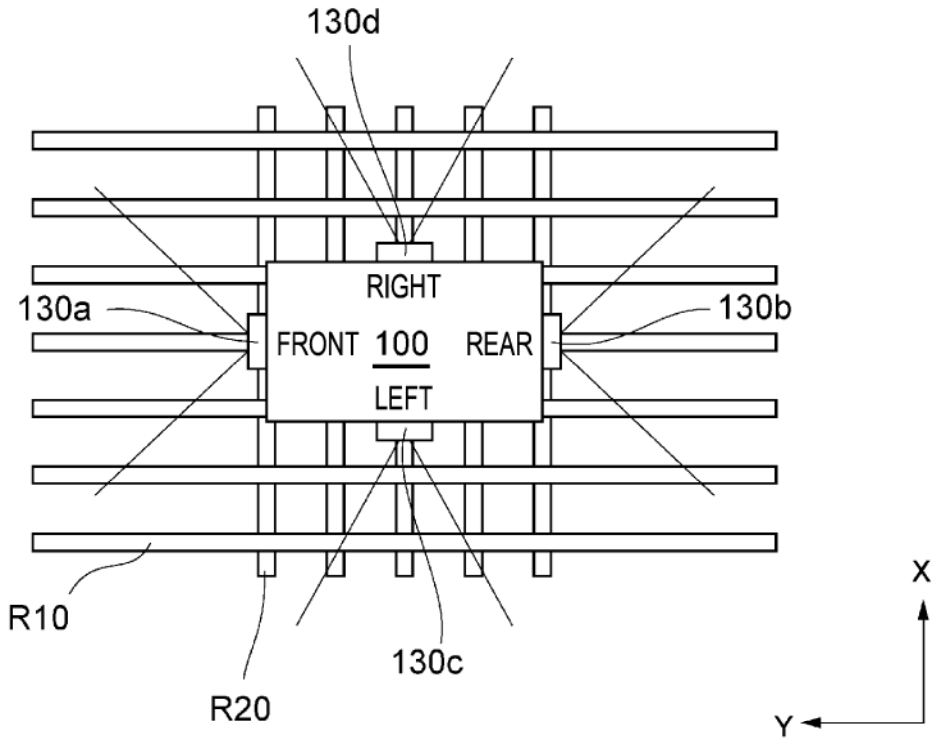


FIG. 16

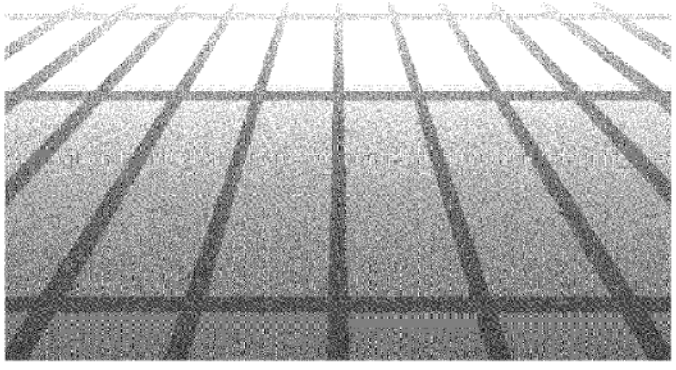


FIG. 17

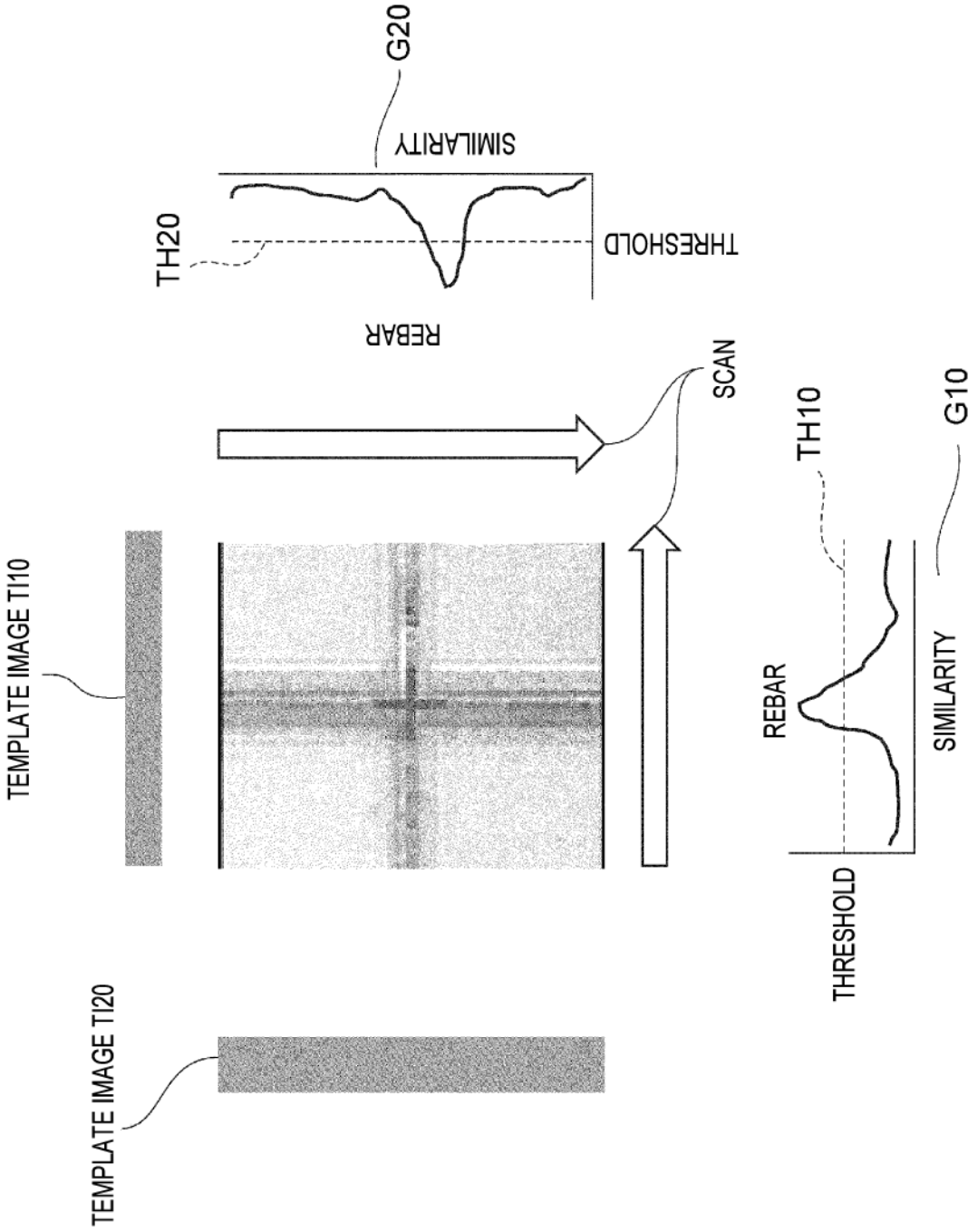

TEMPLATE IMAGE TI20
TEMPLATE IMAGE TI10
SCAN
REBAR
TH10
G10
SIMILARITY
THRESHOLD
REBAR
TH20
G20
SIMILARITY
THRESHOLD

FIG. 18

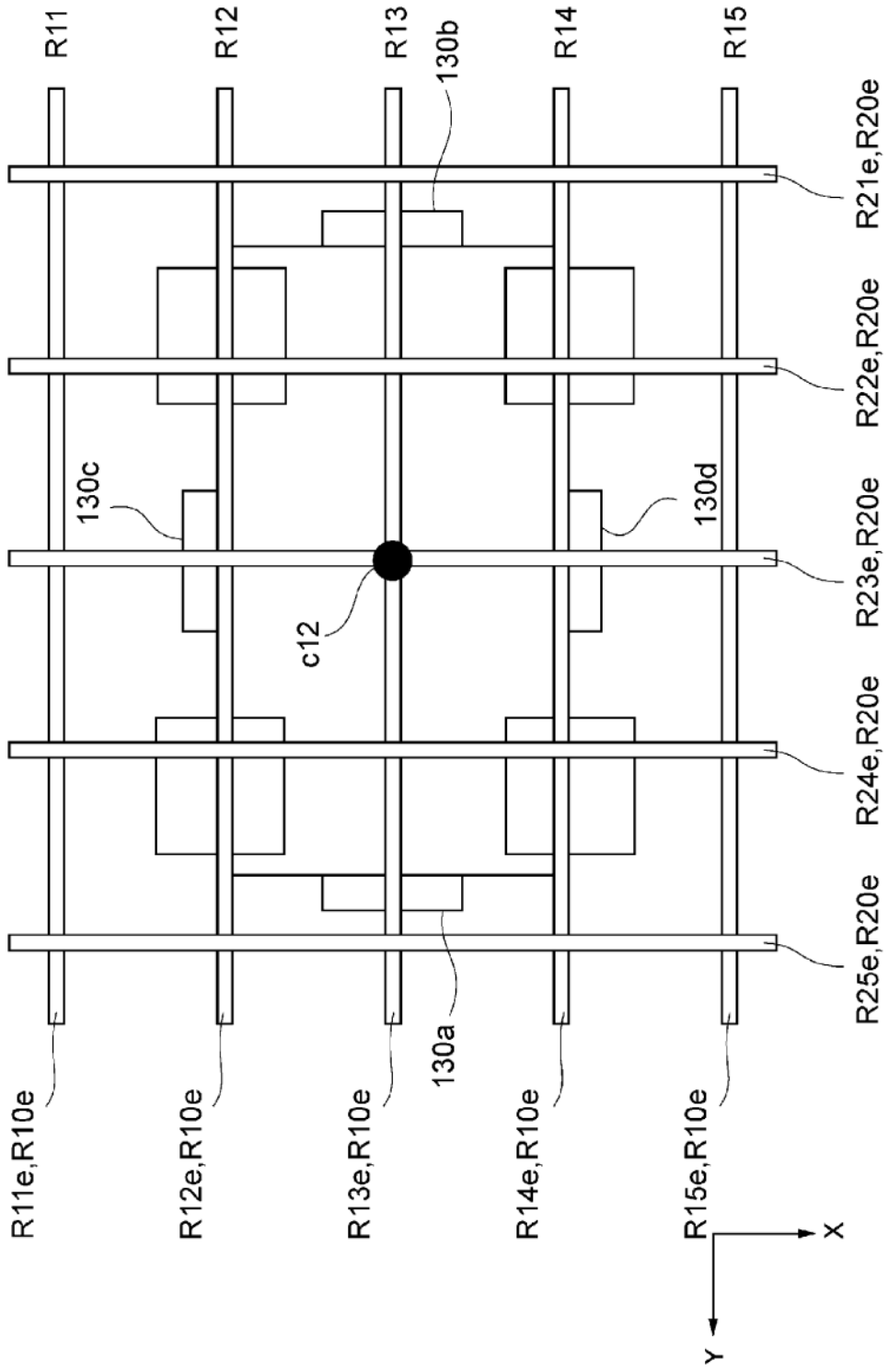

R11
R12
R13
R14
R15
130b
R21
R22
R23
R24
R25
130c
130d
c12
R21e,R20e
R22e,R20e
R23e,R20e
R24e,R20e
R25e,R20e
R11e,R10e
R12e,R10e
R13e,R10e
130a
R14e,R10e
R15e,R10e
X
Y

FIG. 19

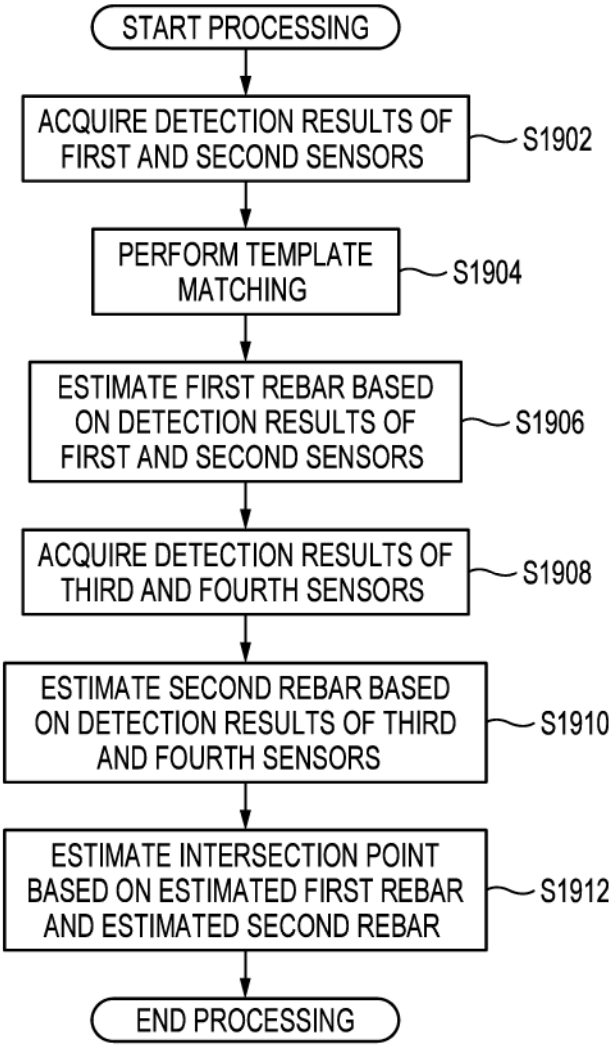

START PROCESSING
ACQUIRE DETECTION RESULTS OF FIRST AND SECOND SENSORS
S1902
PERFORM TEMPLATE MATCHING
S1904
ESTIMATE FIRST REBAR BASED ON DETECTION RESULTS OF FIRST AND SECOND SENSORS
S1906
ACQUIRE DETECTION RESULTS OF THIRD AND FOURTH SENSORS
S1908
ESTIMATE SECOND REBAR BASED ON DETECTION RESULTS OF THIRD AND FOURTH SENSORS
S1910
ESTIMATE INTERSECTION POINT BASED ON ESTIMATED FIRST REBAR AND ESTIMATED SECOND REBAR
S1912
END PROCESSING

FIG. 20

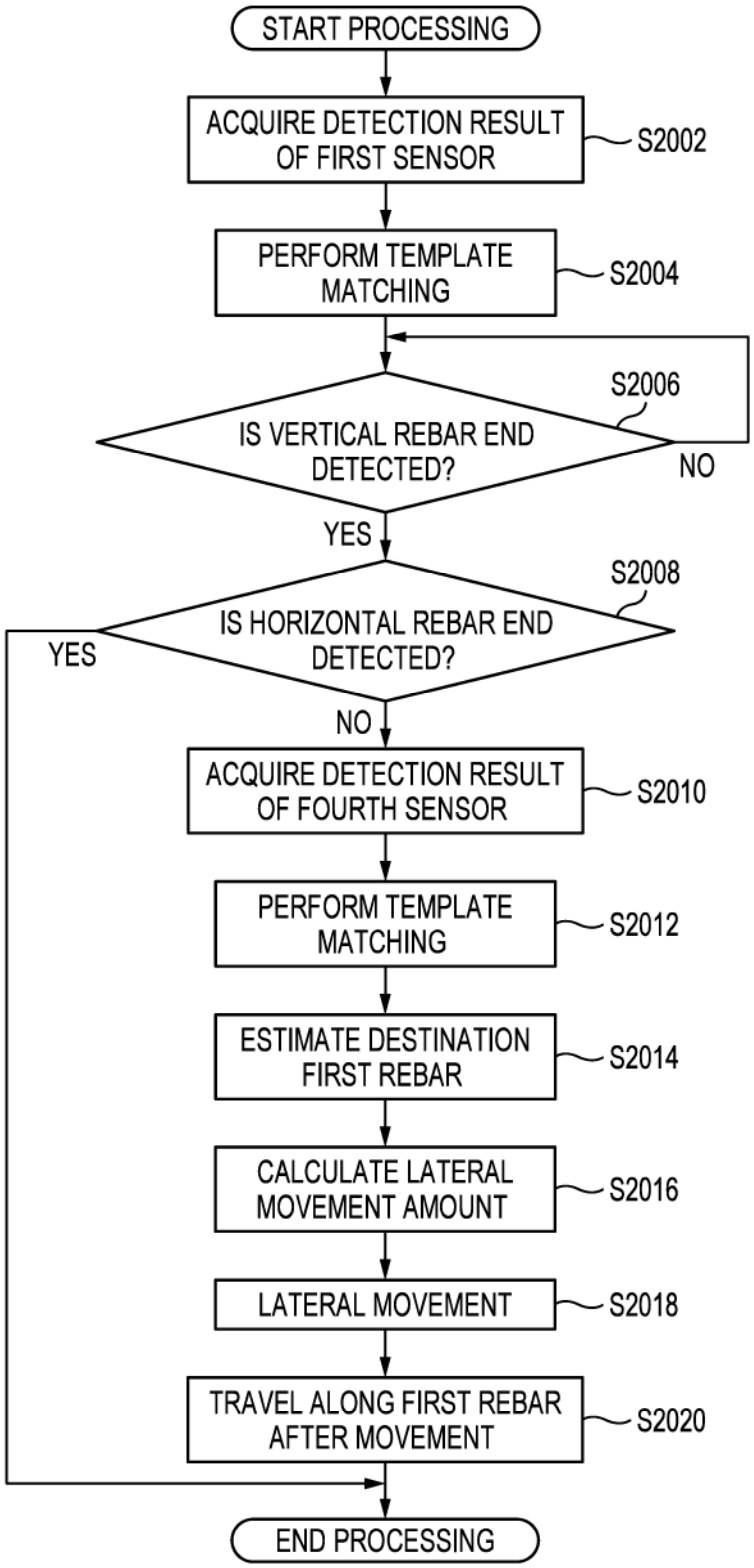
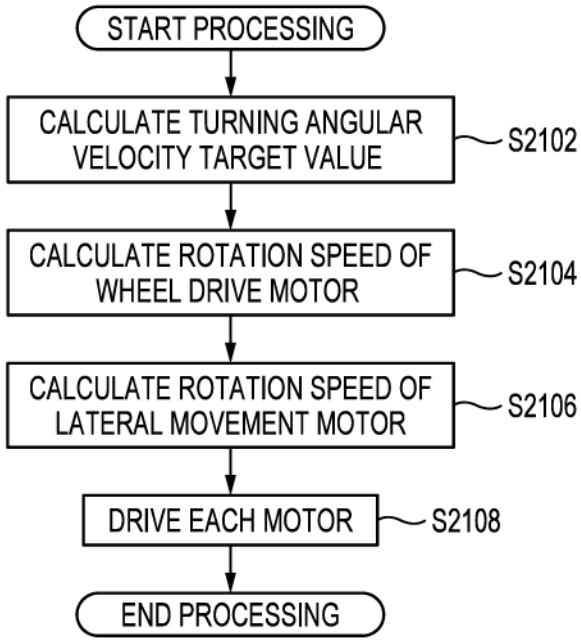

START PROCESSING
ACQUIRE DETECTION RESULT OF FIRST SENSOR
S2002
PERFORM TEMPLATE MATCHING
S2004
S2006
IS VERTICAL REBAR END DETECTED?
NO
YES
S2008
IS HORIZONTAL REBAR END DETECTED?
YES
NO
ACQUIRE DETECTION RESULT OF FOURTH SENSOR
S2010
PERFORM TEMPLATE MATCHING
S2012
ESTIMATE DESTINATION FIRST REBAR
S2014
CALCULATE LATERAL MOVEMENT AMOUNT
S2016
LATERAL MOVEMENT
S2018
TRAVEL ALONG FIRST REBAR AFTER MOVEMENT
S2020
END PROCESSING

FIG. 21


START PROCESSING
CALCULATE TURNING ANGULAR VELOCITY TARGET VALUE
S2102
CALCULATE ROTATION SPEED OF WHEEL DRIVE MOTOR
S2104
CALCULATE ROTATION SPEED OF LATERAL MOVEMENT MOTOR
S2106
DRIVE EACH MOTOR
S2108
END PROCESSING

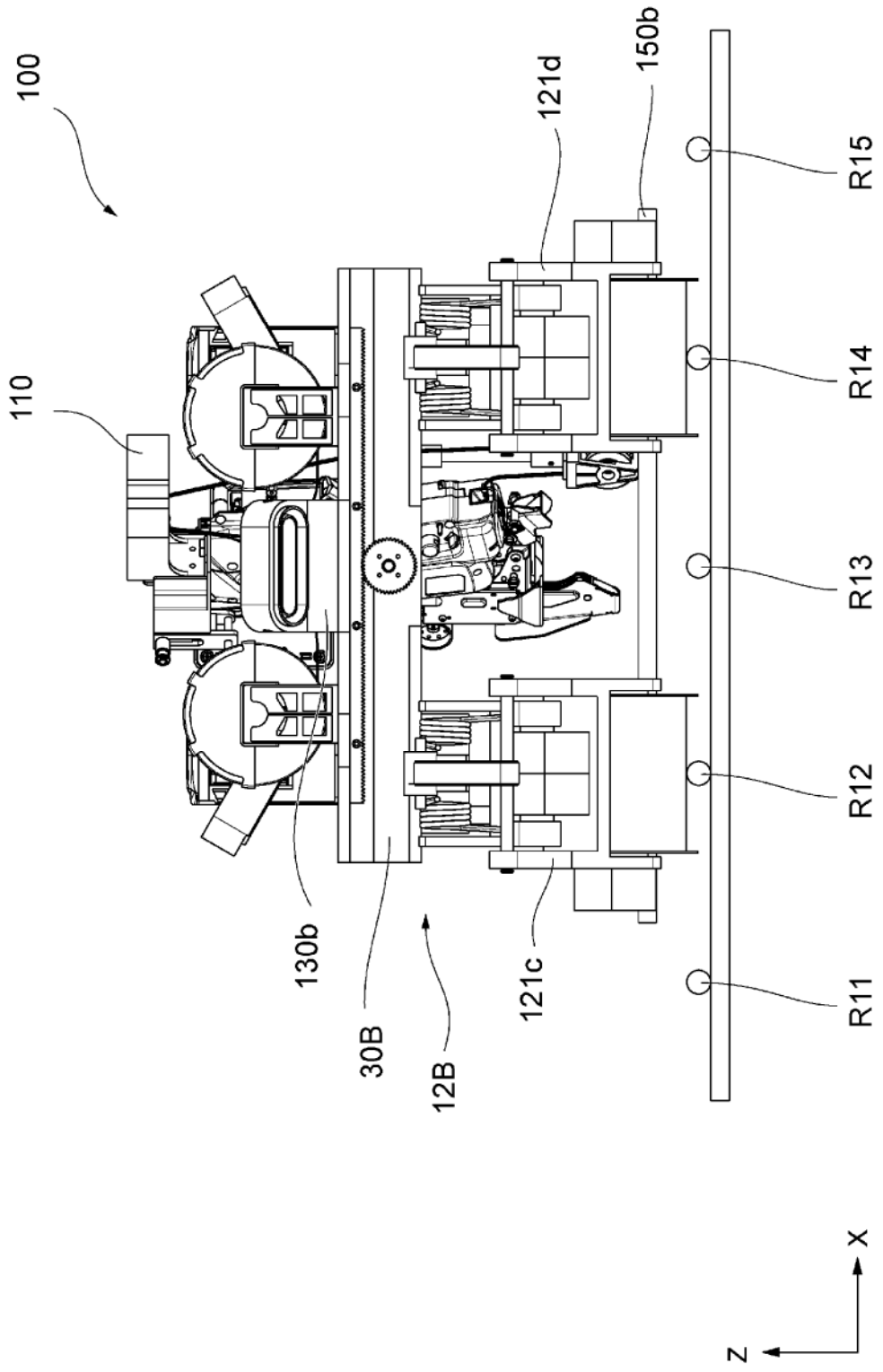


FIG. 22A

FIG. 22B

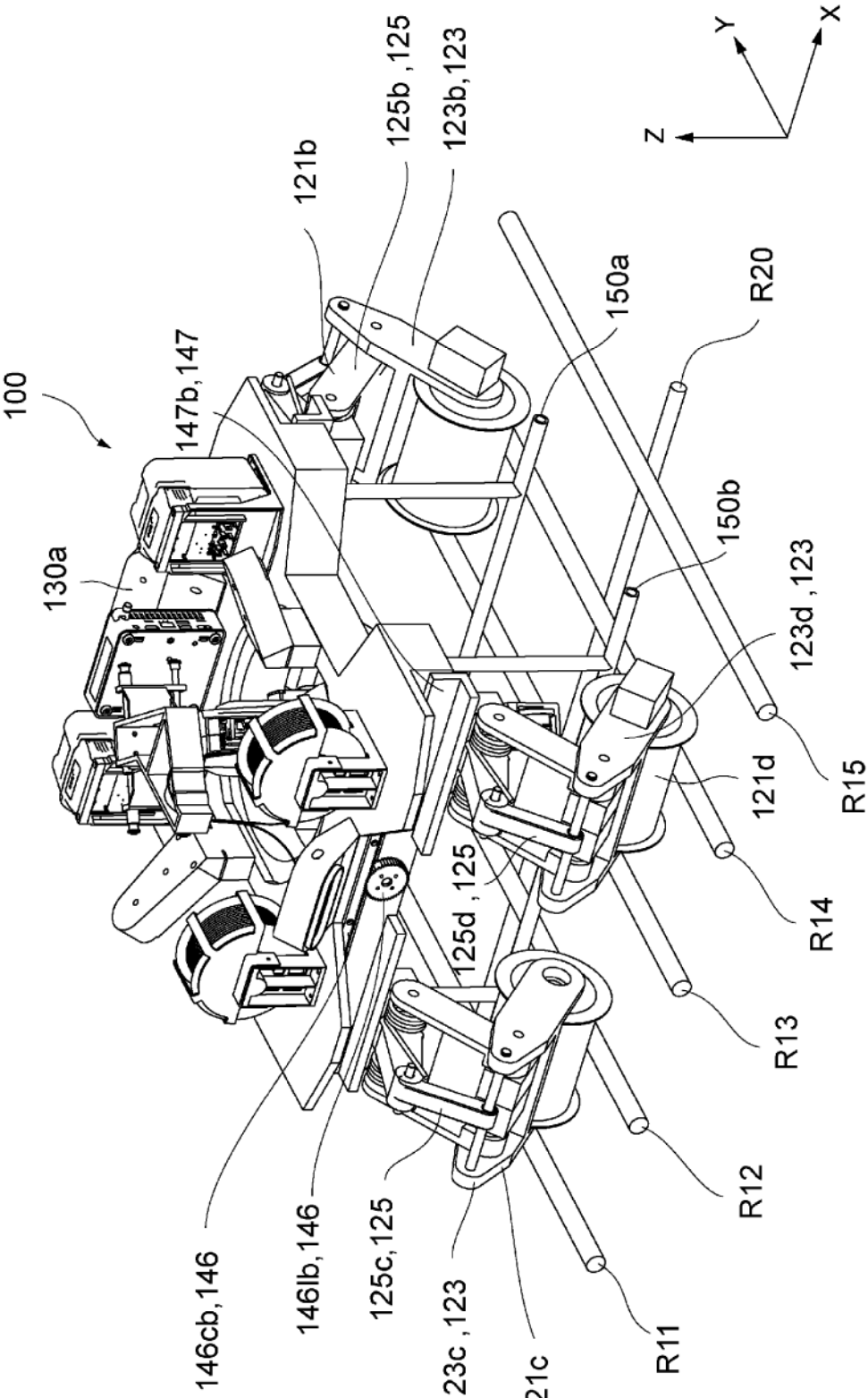

100
130a
147b,147
121b
125b ,125
123b,123
150a
R20
150b
123d ,123
121d
R15
R14
R13
R12
R11
125d ,125
123c ,123
121c
125c,125
146lb,146
146cb,146
Z
Y
X

FIG. 23A

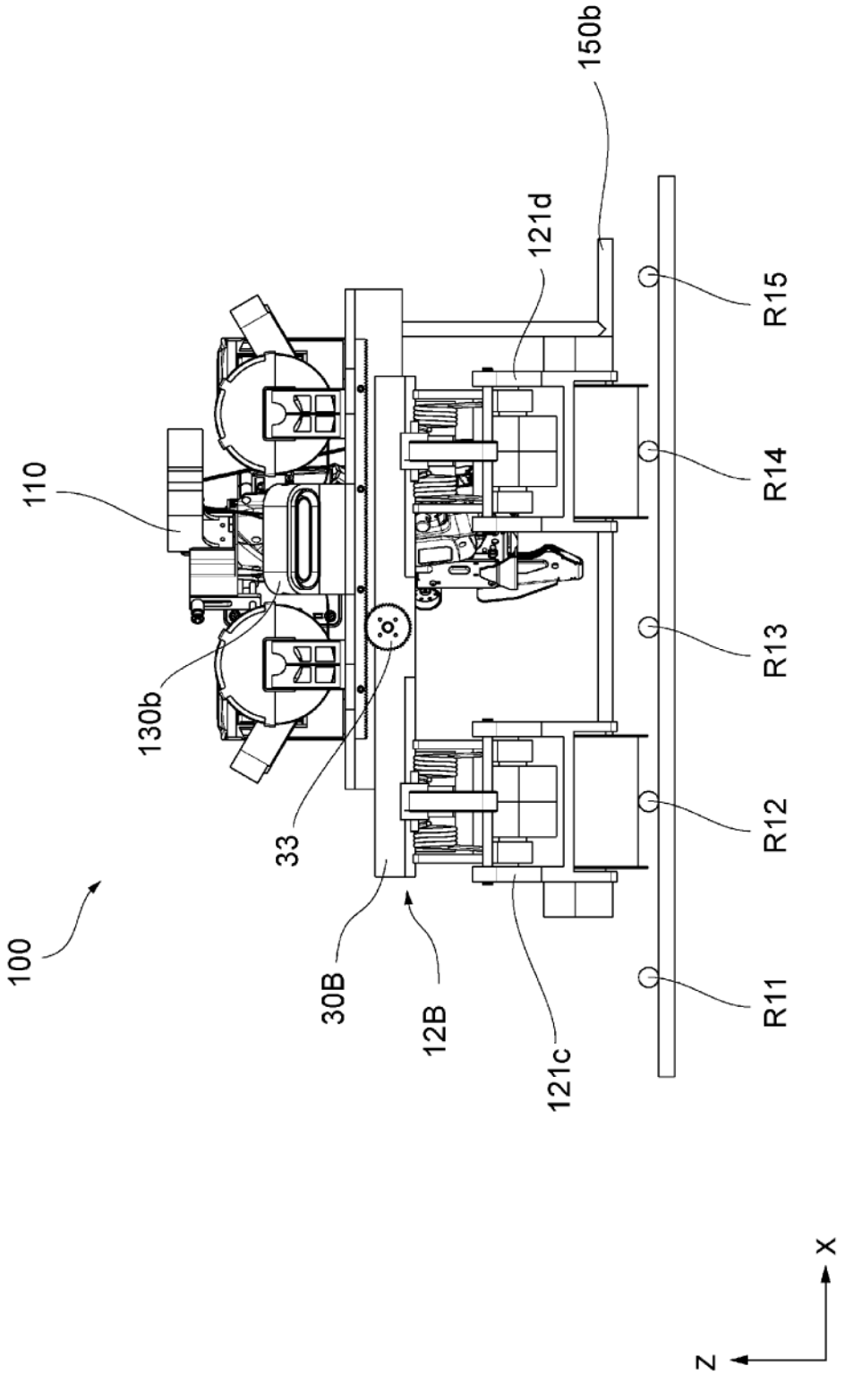
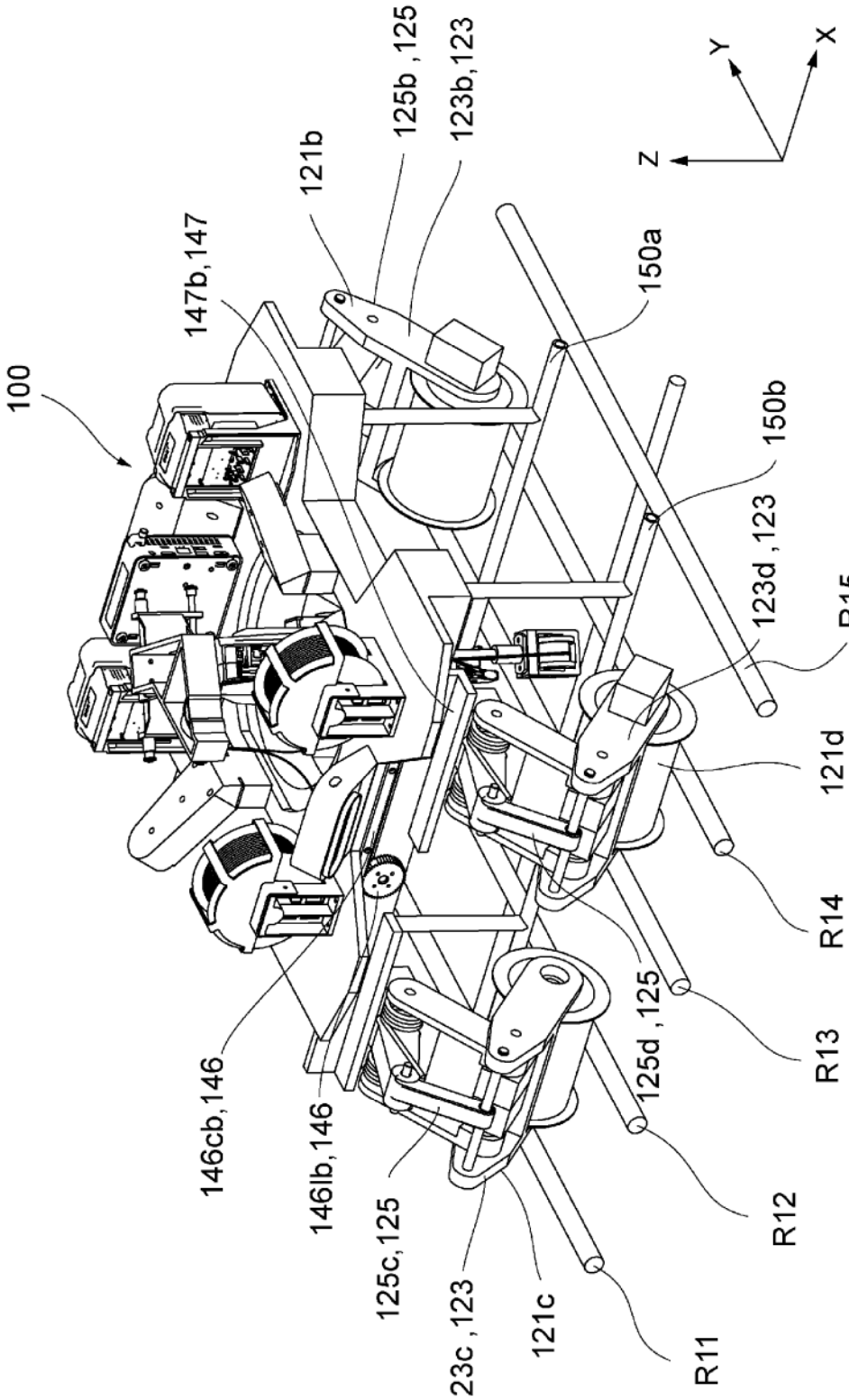


FIG. 23B


100
147b,147
121b
125b ,125
123b,123
150a
150b
123d ,123
R15
121d
R14
R13
125d ,125
R12
R11
121c
123c ,123
125c,125
146lb,146
146cb,146
Z
Y
X

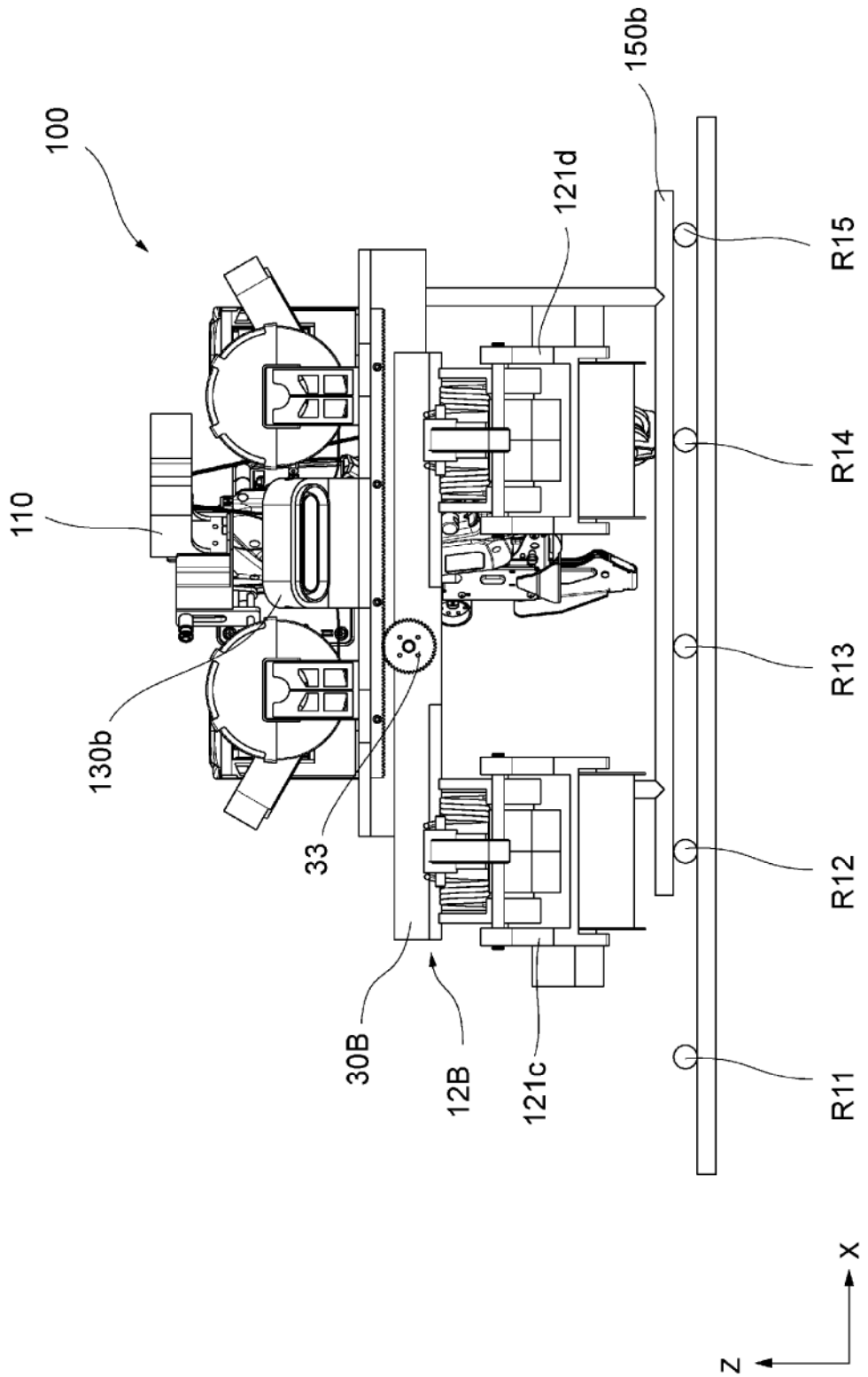
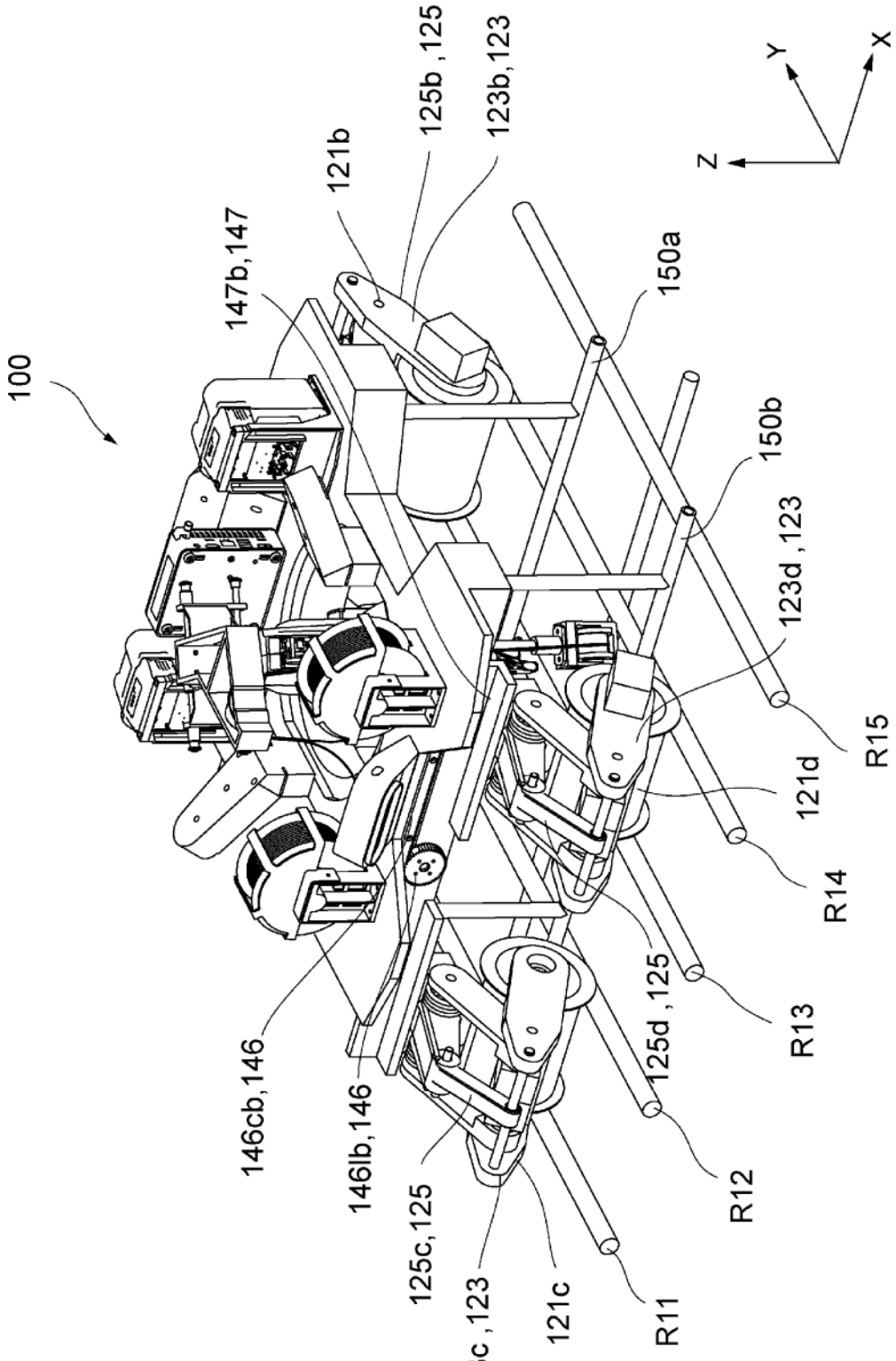


FIG. 24A

FIG. 24B


100
147b,147
121b
125b ,125
123b,123
150a
150b
123d ,123
121d
R15
R14
R13
R12
R11
125d ,125
121c
123c ,123
125c,125
146lb,146
146cb,146
Z
Y
X

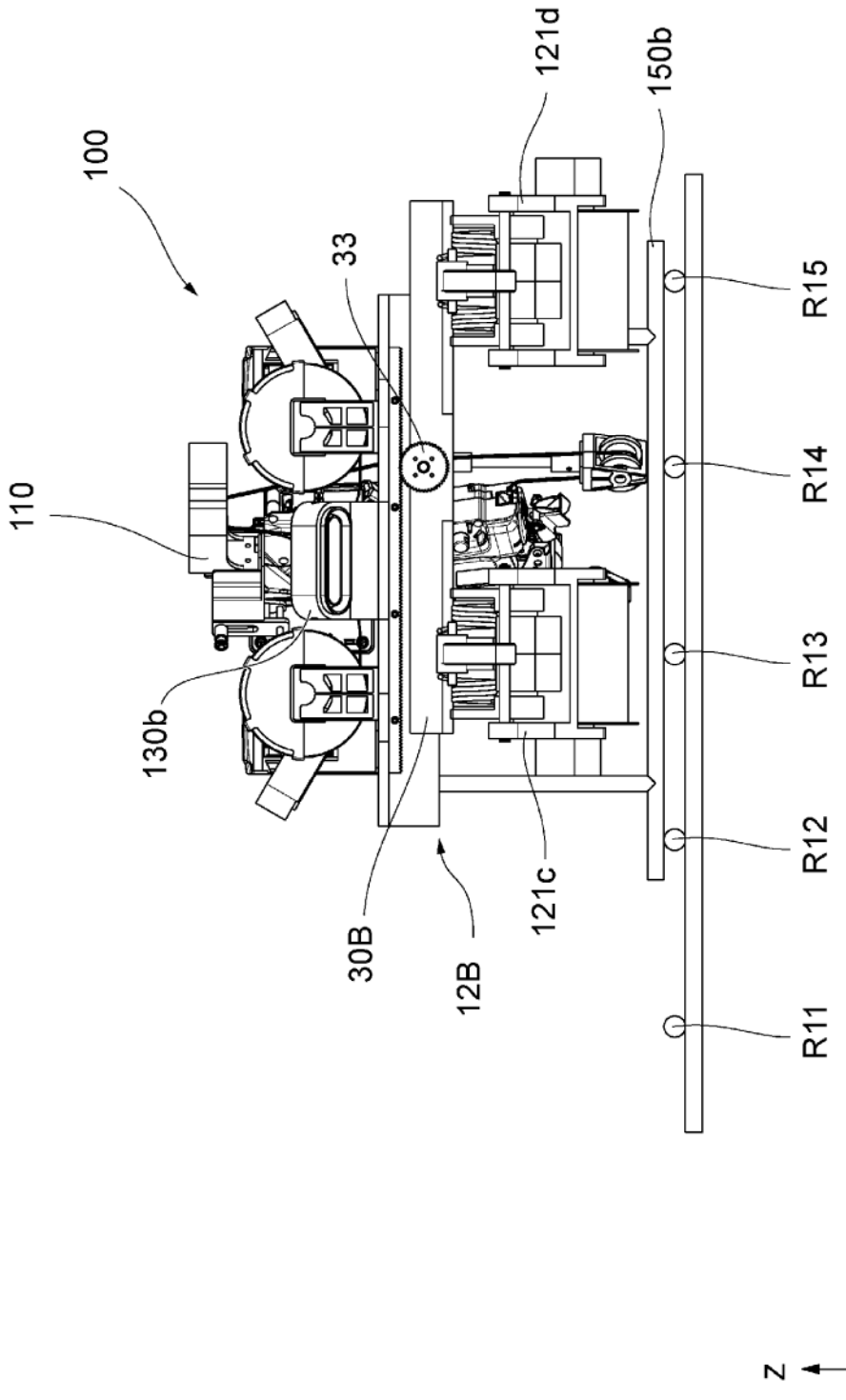
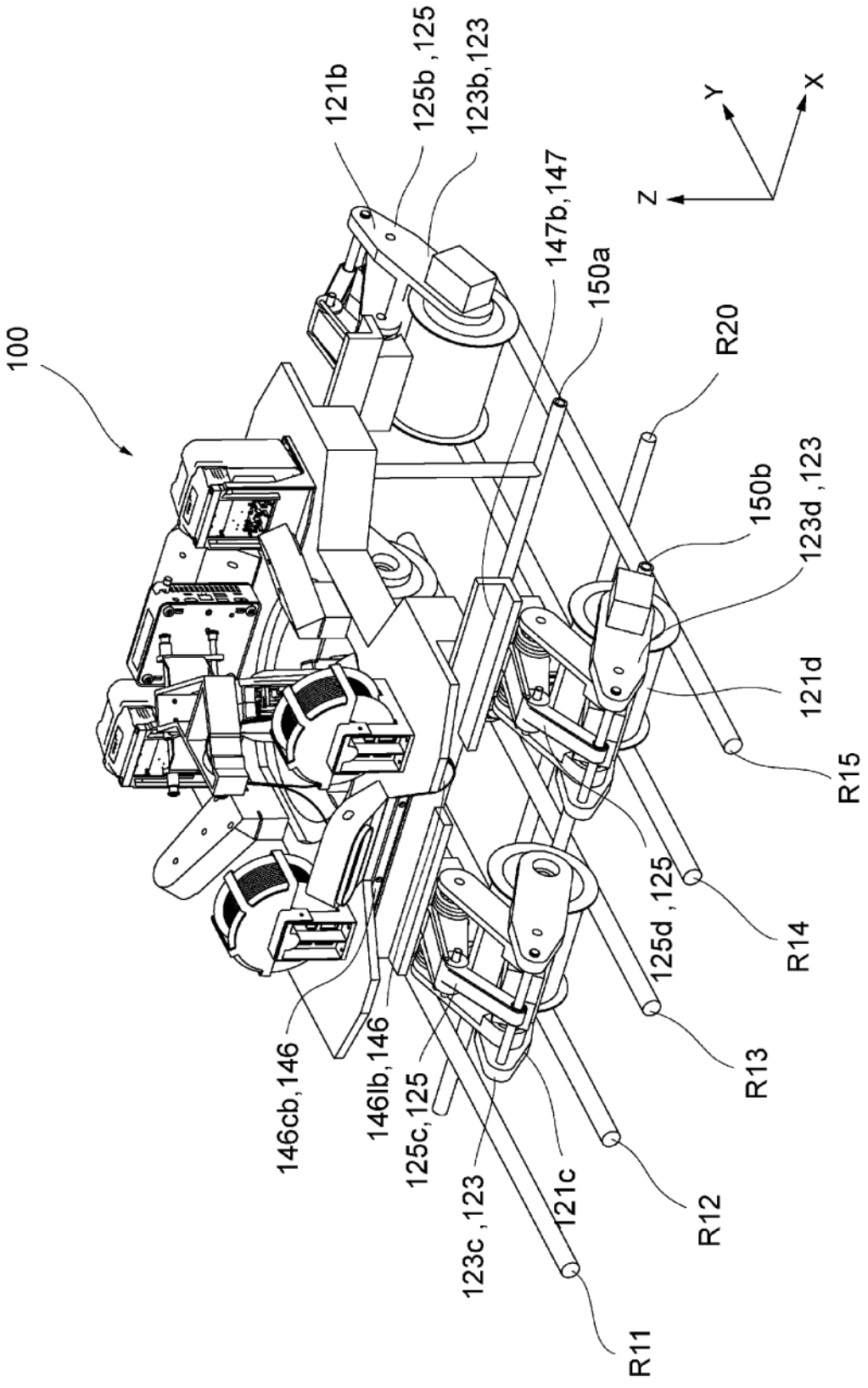


FIG. 25A

FIG. 25B


100
121b
125b ,125
123b,123
147b,147
150a
R20
150b
123d ,123
121d
R15
R14
125d ,125
R13
R12
R11
121c
123c ,123
125c,125
146lb,146
146cb,146
Z
Y
X

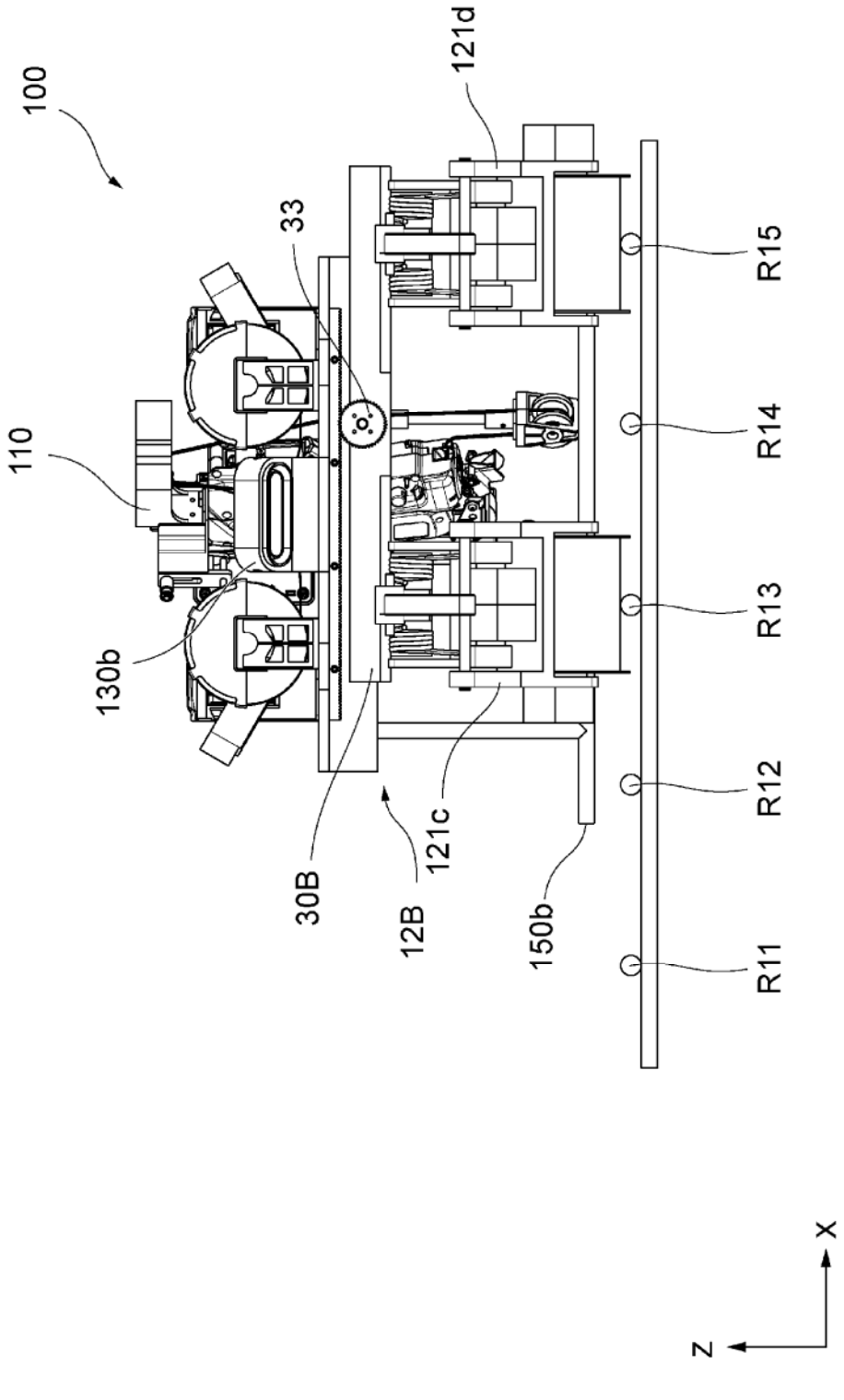
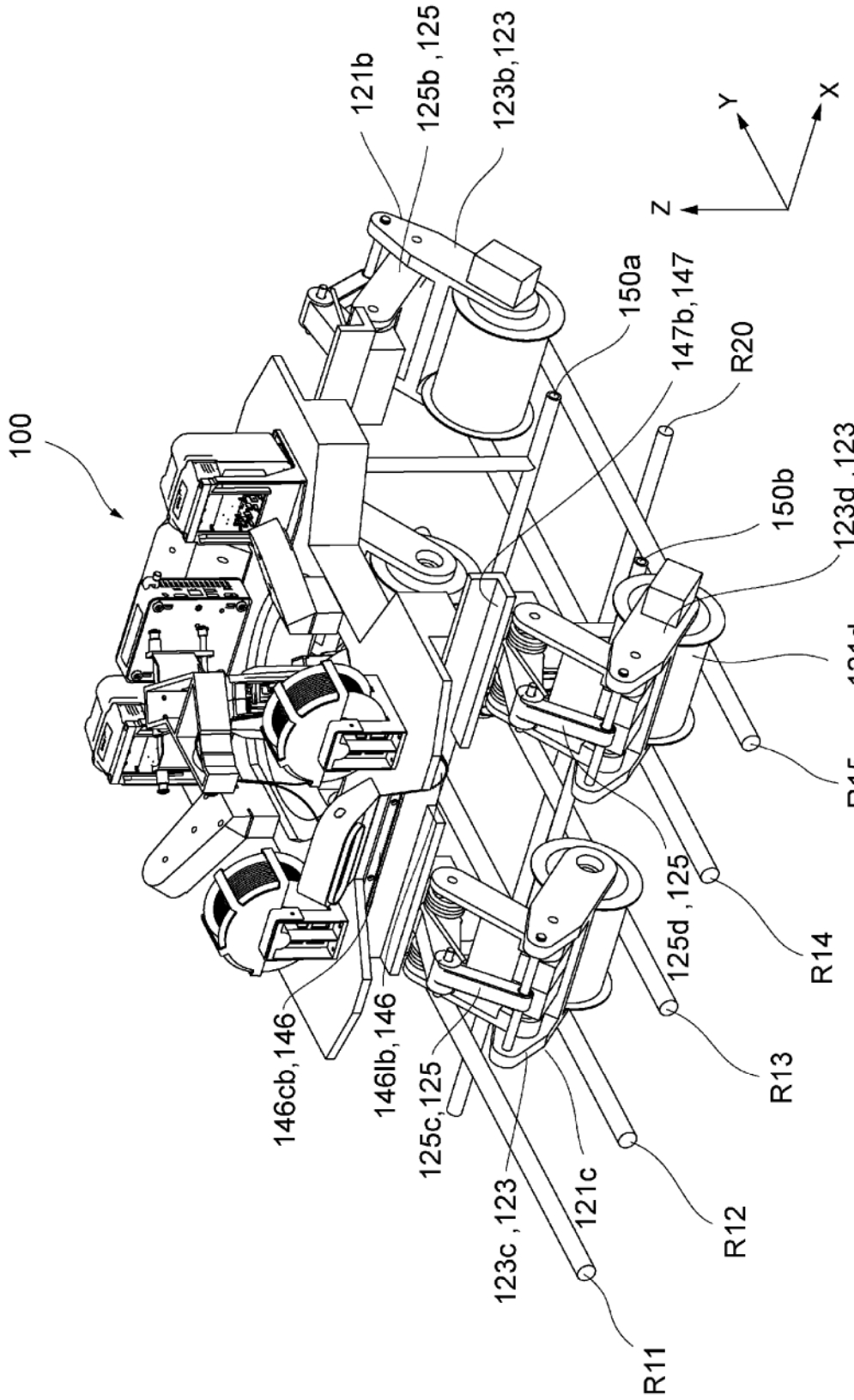


FIG. 26A

FIG. 26B


100
121b
125b ,125
123b,123
150a
147b,147
R20
150b
123d ,123
121d
R15
R14
125d ,125
R13
R12
R11
123c ,123
121c
125c,125
146lb,146
146cb,146
Z
Y
X

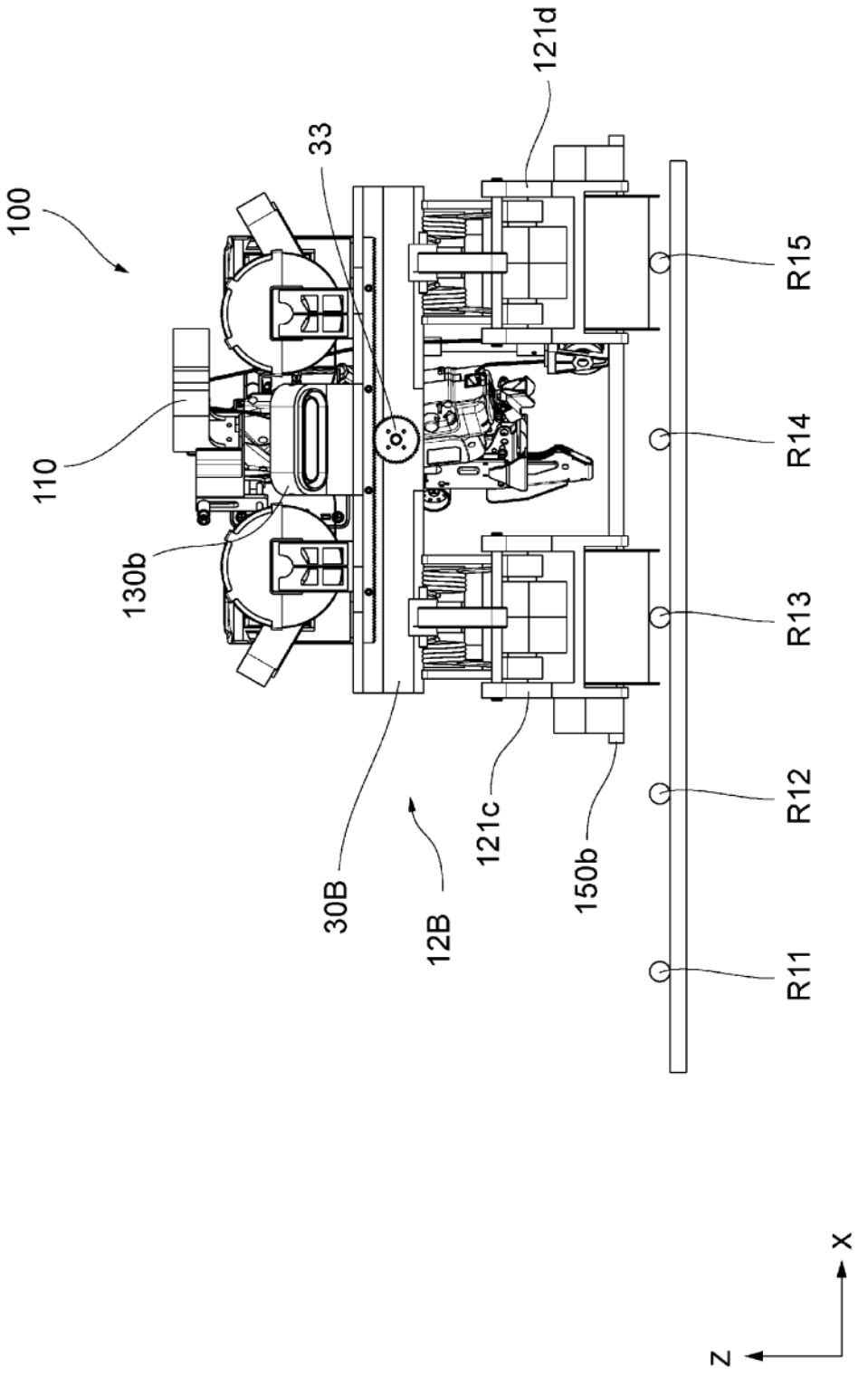


FIG. 27A

FIG. 27B

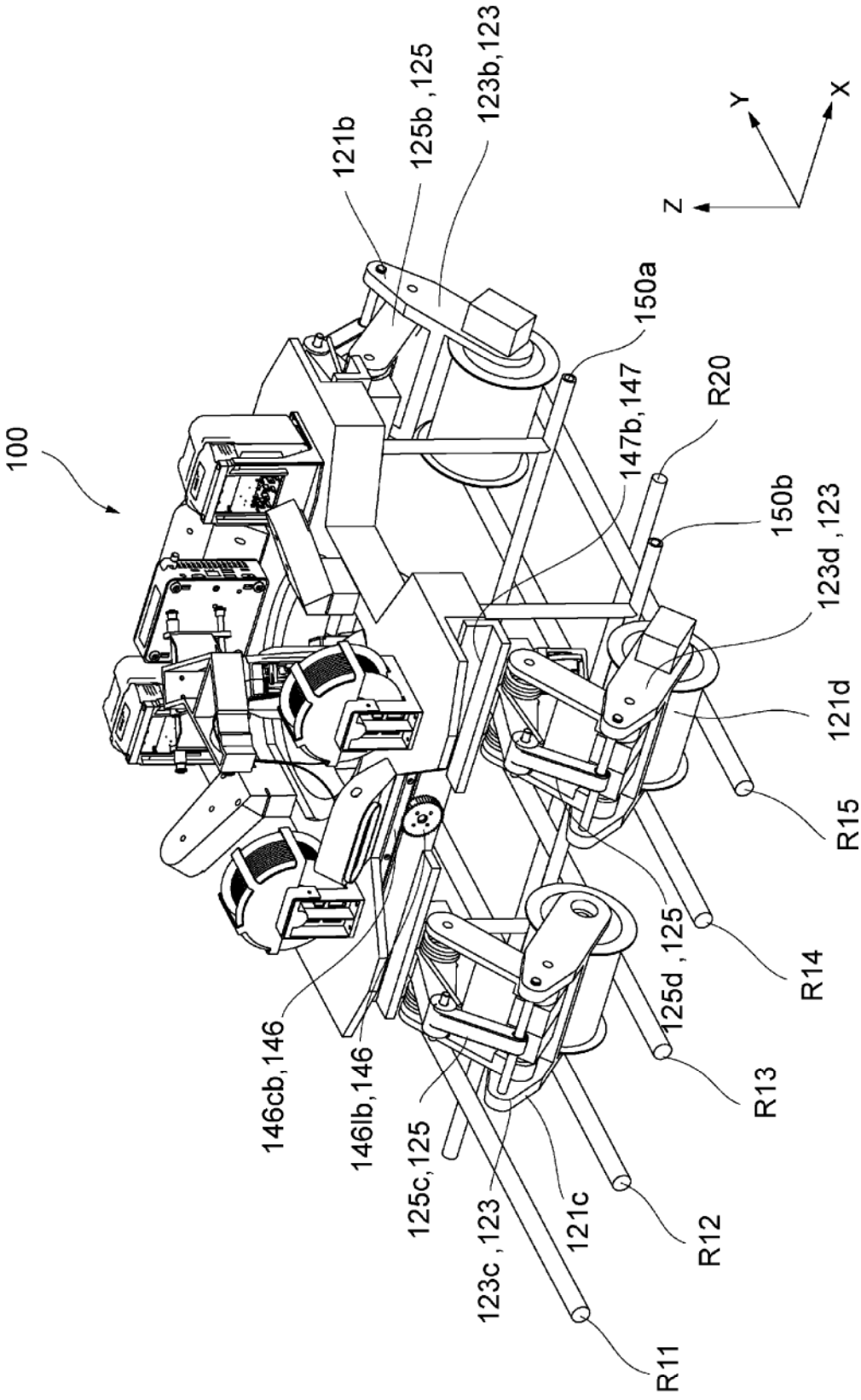

100
121b
125b ,125
123b,123
150a
147b,147
R20
150b
123d ,123
121d
R15
R14
125d ,125
R13
R12
121c
123c ,123
125c,125
146lb,146
146cb,146
Z
Y
X

FIG. 28

