FIG. 1

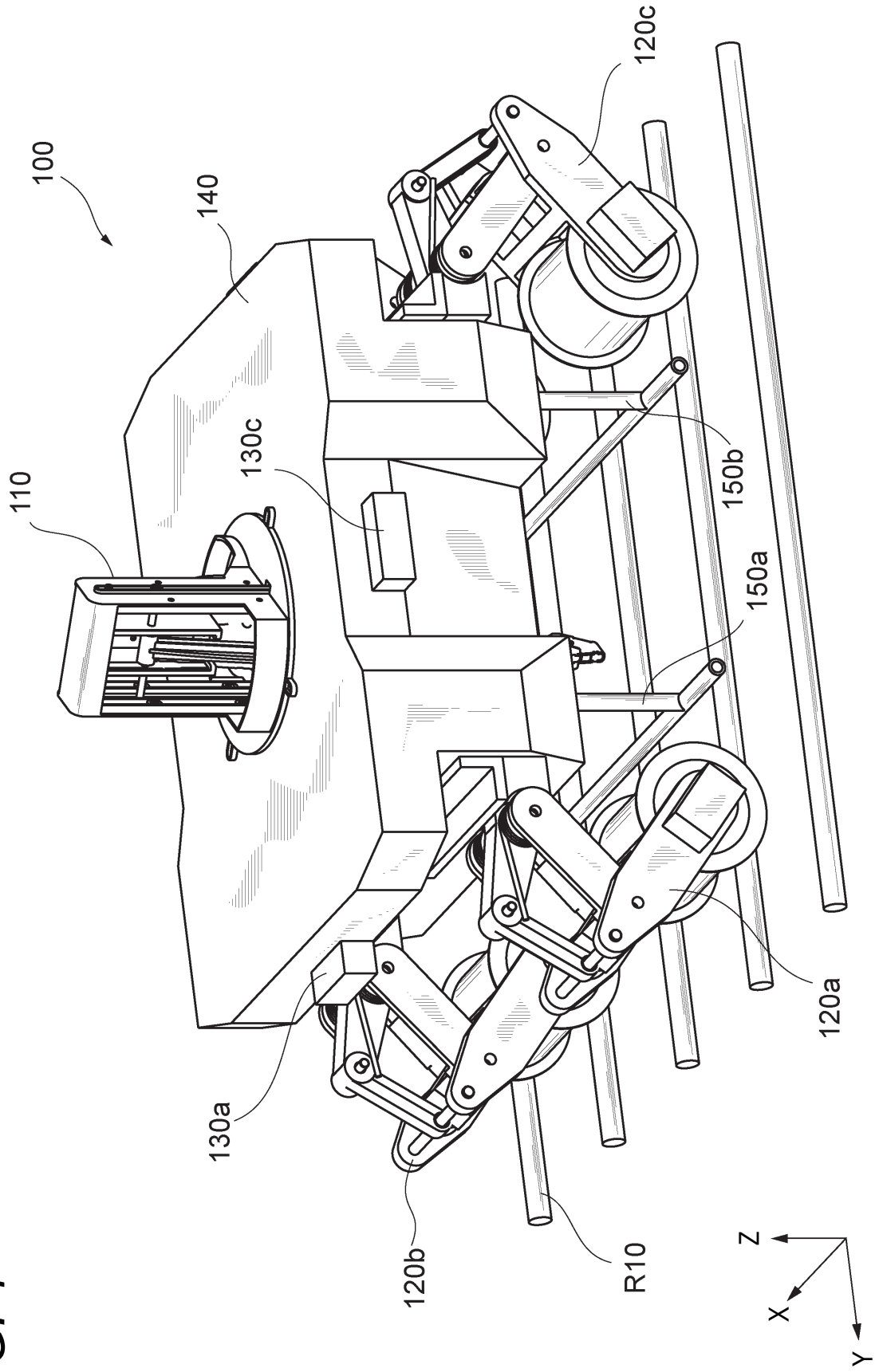


FIG. 2

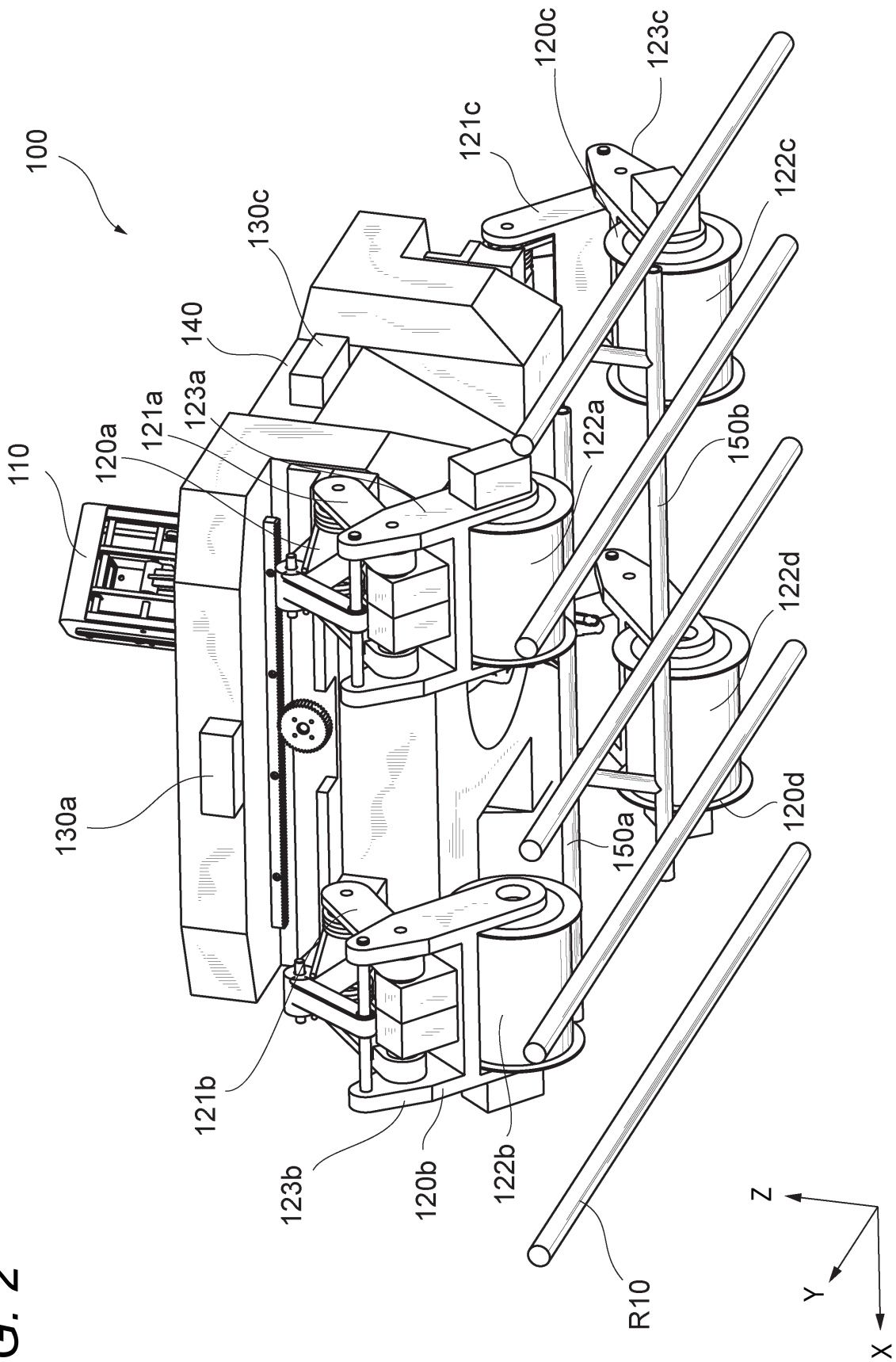
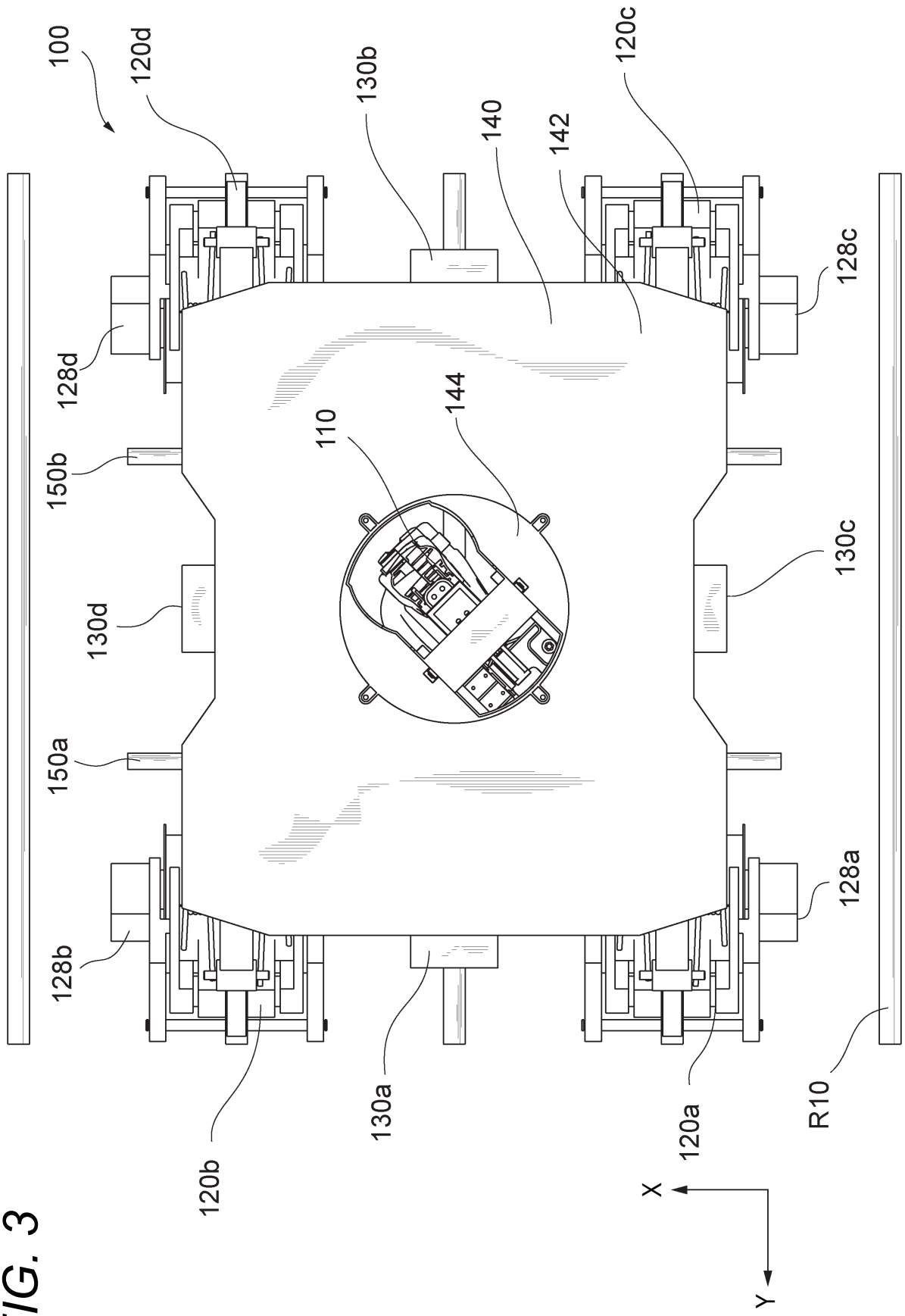

100
110
120a
121a
123a
140
130c
121c
120c
123c
122c
122a
150b
122d
120d
150a
130a
121b
123b
120b
122b
R10
Z
Y
X

FIG. 3


100
120d
130b
140
142
120c
128c
128d
144
110
150b
130c
130d
150a
128a
128b
R10
120b
130a
120a
X
Y

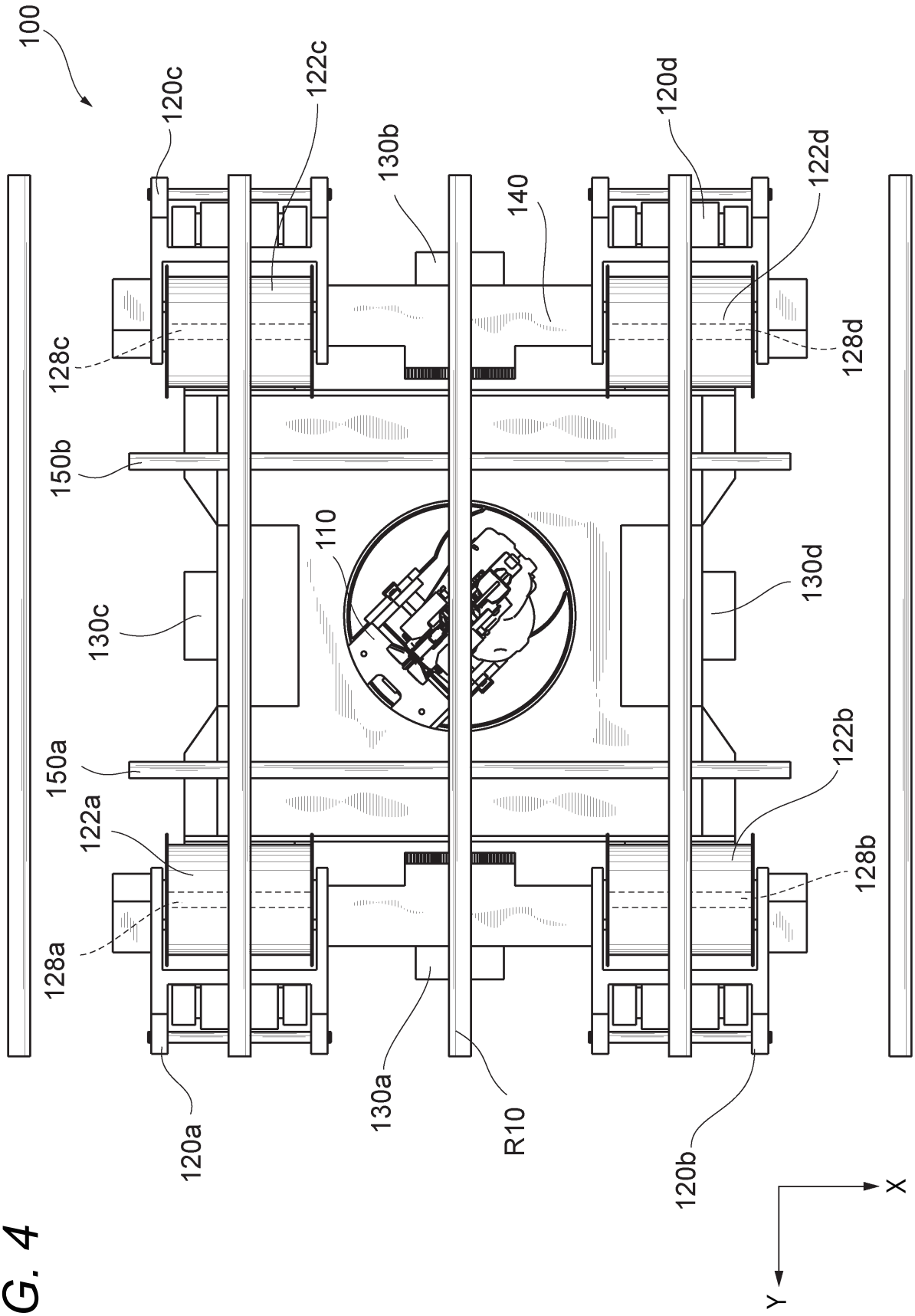

100
120c
122c
130b
140
120d
122d
128c
128d
150b
110
130c
130d
150a
122a
122b
128a
128b
120a
130a
R10
120b
X
Y

FIG. 4

FIG. 5

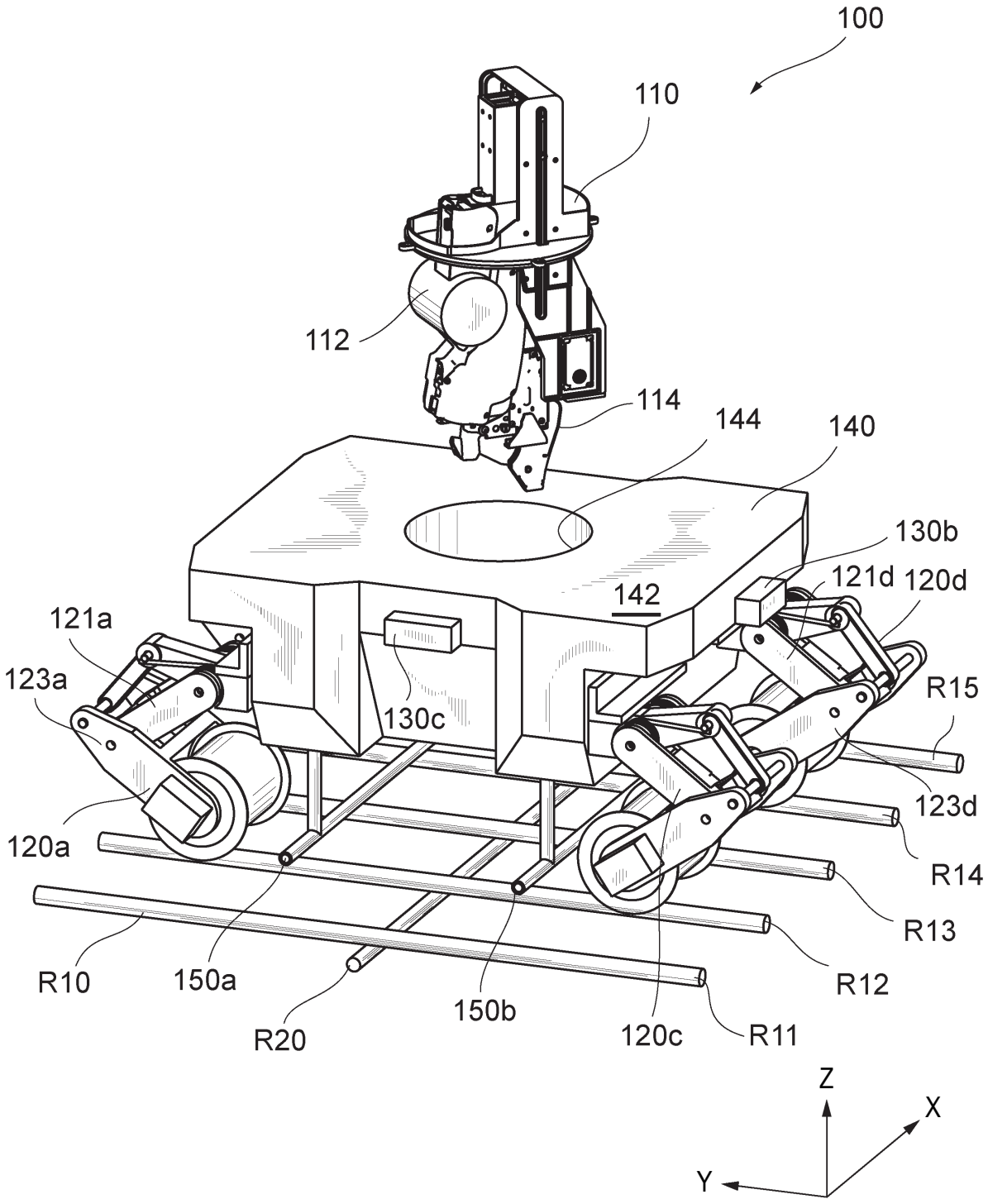

100
110
112
114
144
140
130b
121d
120d
142
121a
123a
130c
R15
123d
120a
R14
R13
R10
150a
R12
R20
150b
120c
R11
Z
X
Y

FIG. 6

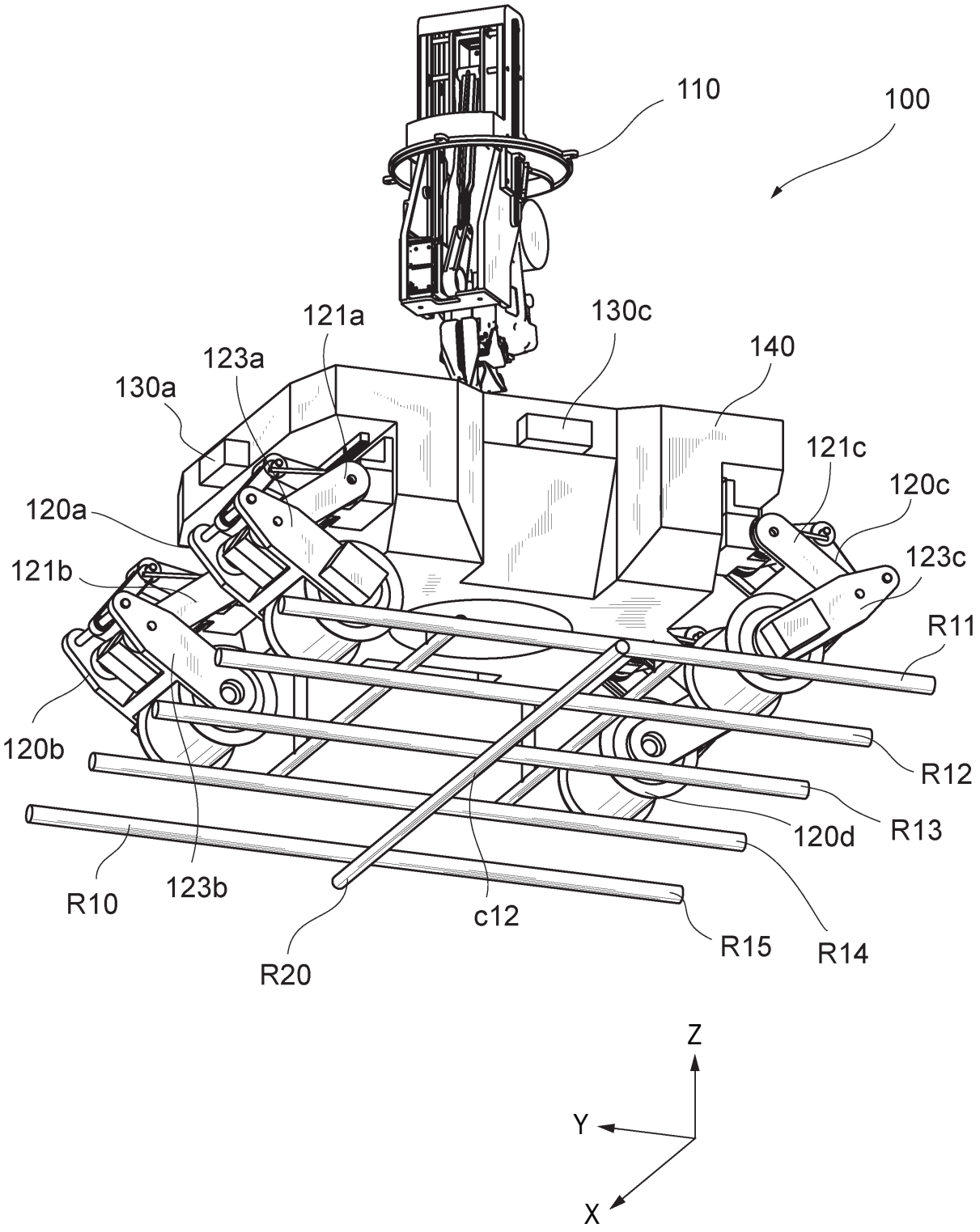
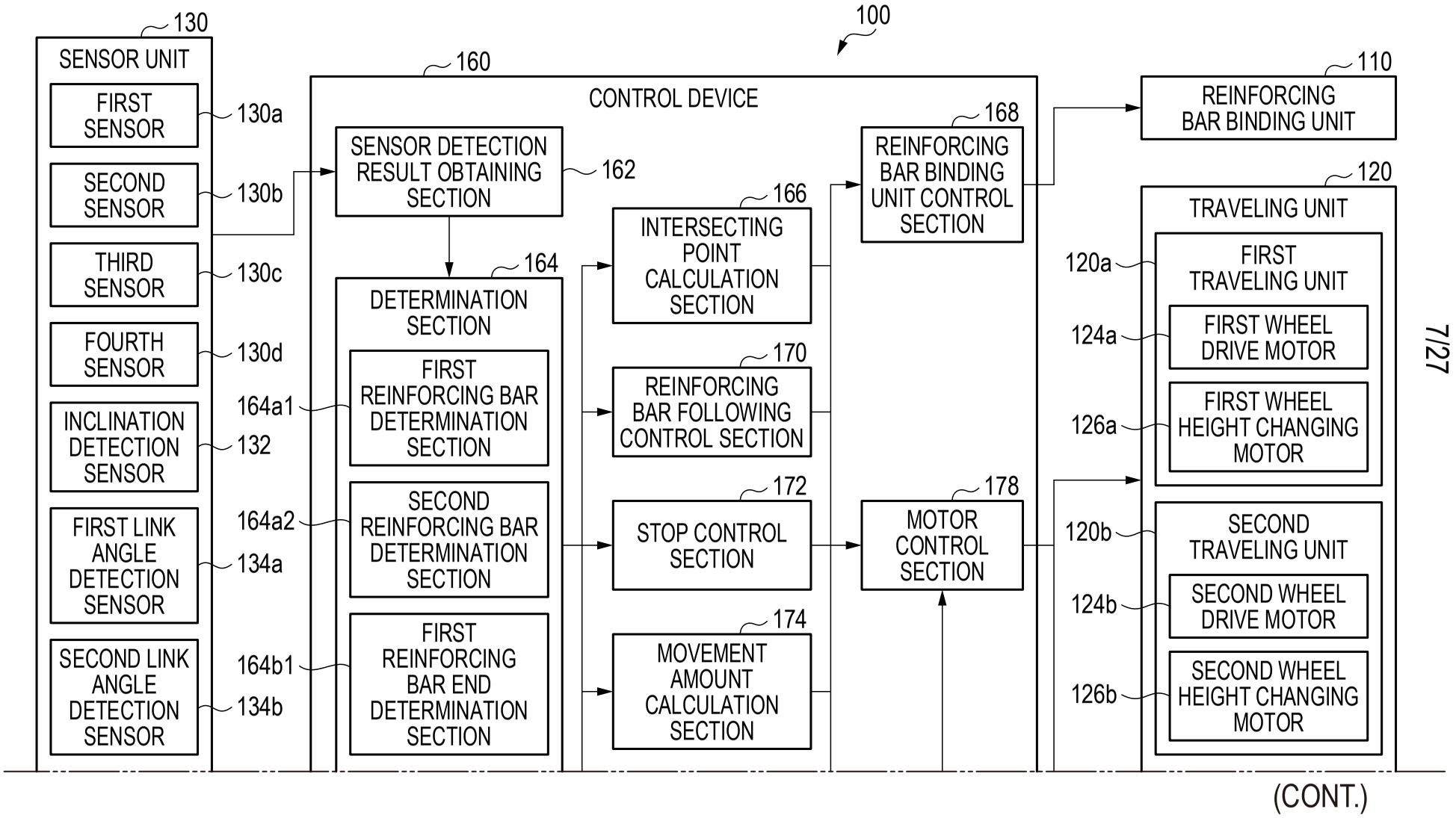
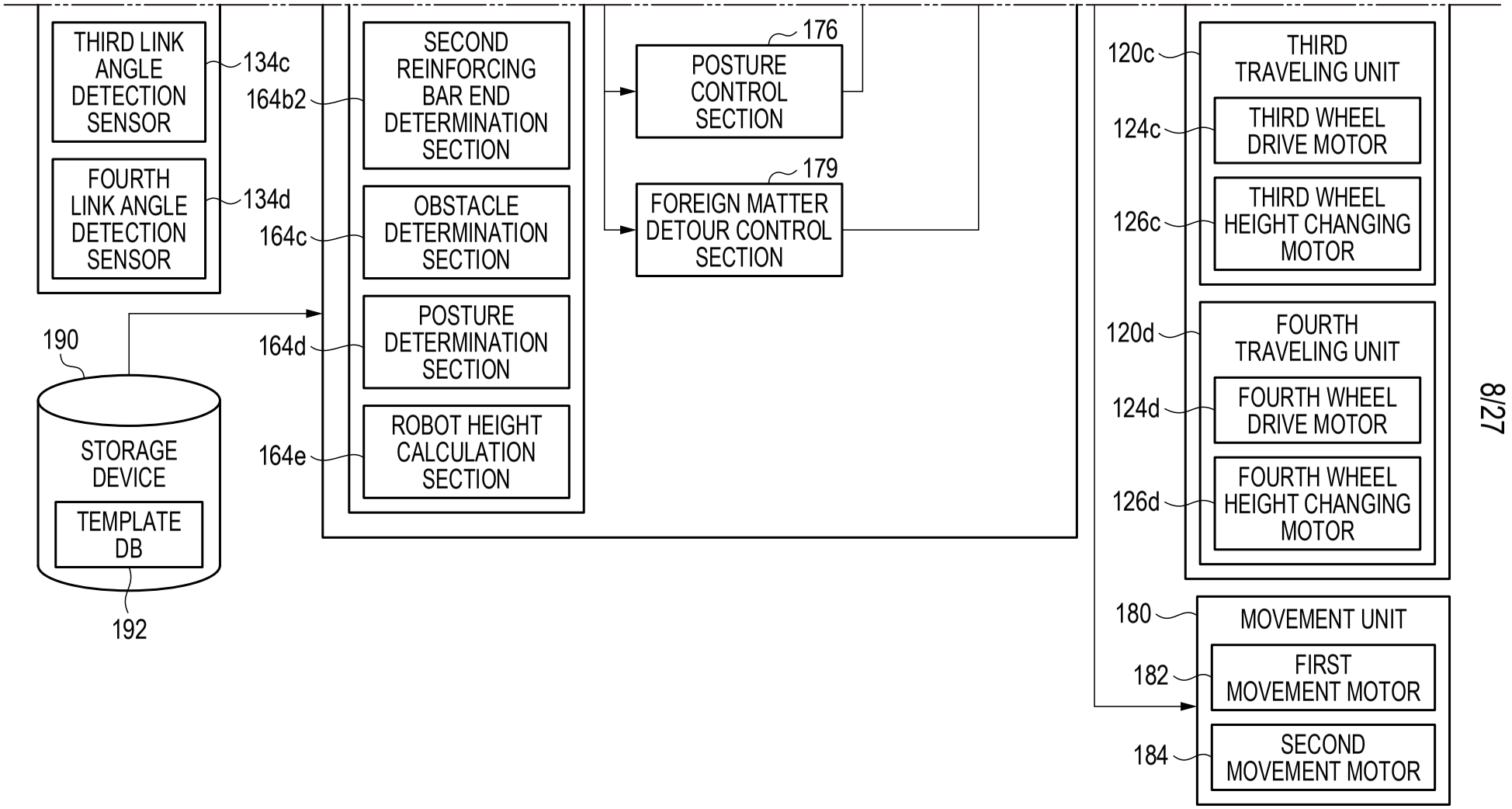

110
100
121a
130c
123a
140
130a
121c
120c
120a
123c
121b
R11
120b
R12
R13
120d
R10
123b
c12
R15
R14
R20
Z
Y
X

FIG. 7


100
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
160
CONTROL DEVICE
SENSOR DETECTION RESULT OBTAINING SECTION
162
164
DETERMINATION SECTION
164a1
FIRST REINFORCING BAR DETERMINATION SECTION
164a2
SECOND REINFORCING BAR DETERMINATION SECTION
164b1
FIRST REINFORCING BAR END DETERMINATION SECTION
166
INTERSECTING POINT CALCULATION SECTION
170
REINFORCING BAR FOLLOWING CONTROL SECTION
172
STOP CONTROL SECTION
174
MOVEMENT AMOUNT CALCULATION SECTION
168
REINFORCING BAR BINDING UNIT CONTROL SECTION
178
MOTOR CONTROL SECTION
110
REINFORCING BAR BINDING UNIT
120
TRAVELING UNIT
120a
FIRST TRAVELING UNIT
124a
FIRST WHEEL DRIVE MOTOR
126a
FIRST WHEEL HEIGHT CHANGING MOTOR
120b
SECOND TRAVELING UNIT
124b
SECOND WHEEL DRIVE MOTOR
126b
SECOND WHEEL HEIGHT CHANGING MOTOR
(CONT.)

(FIG. 7 CONTINUED)



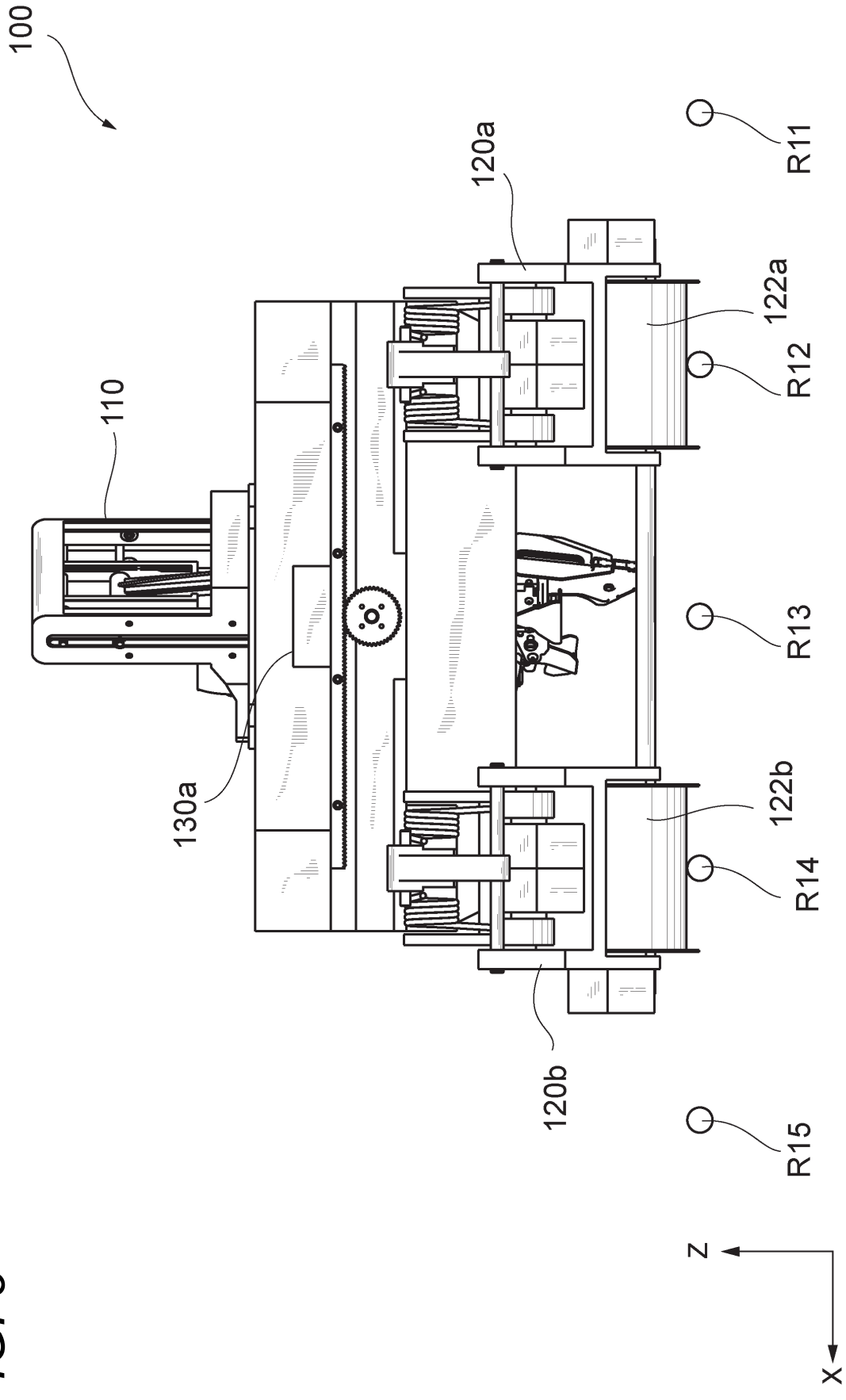


FIG. 8

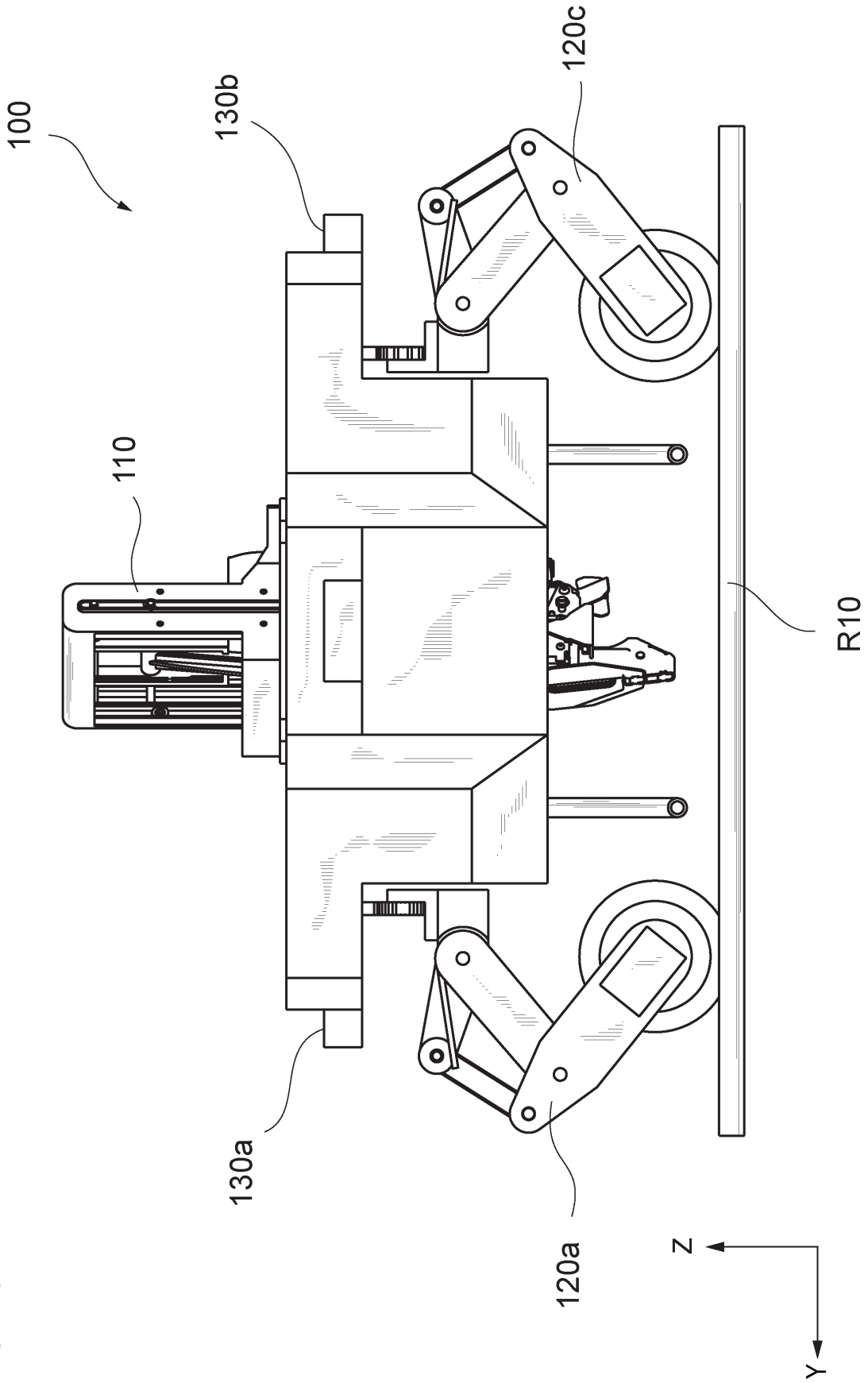


FIG. 9

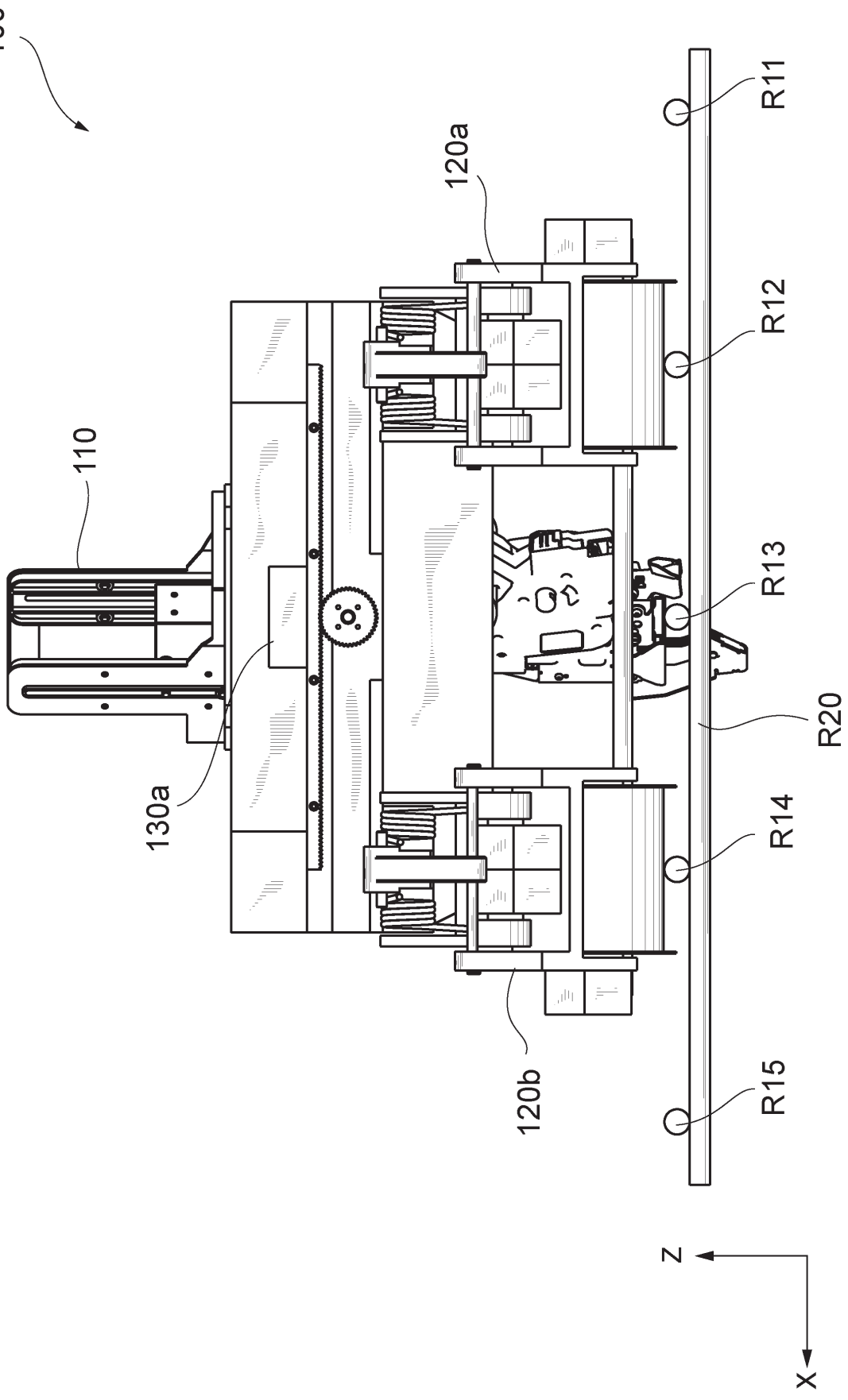


FIG. 10

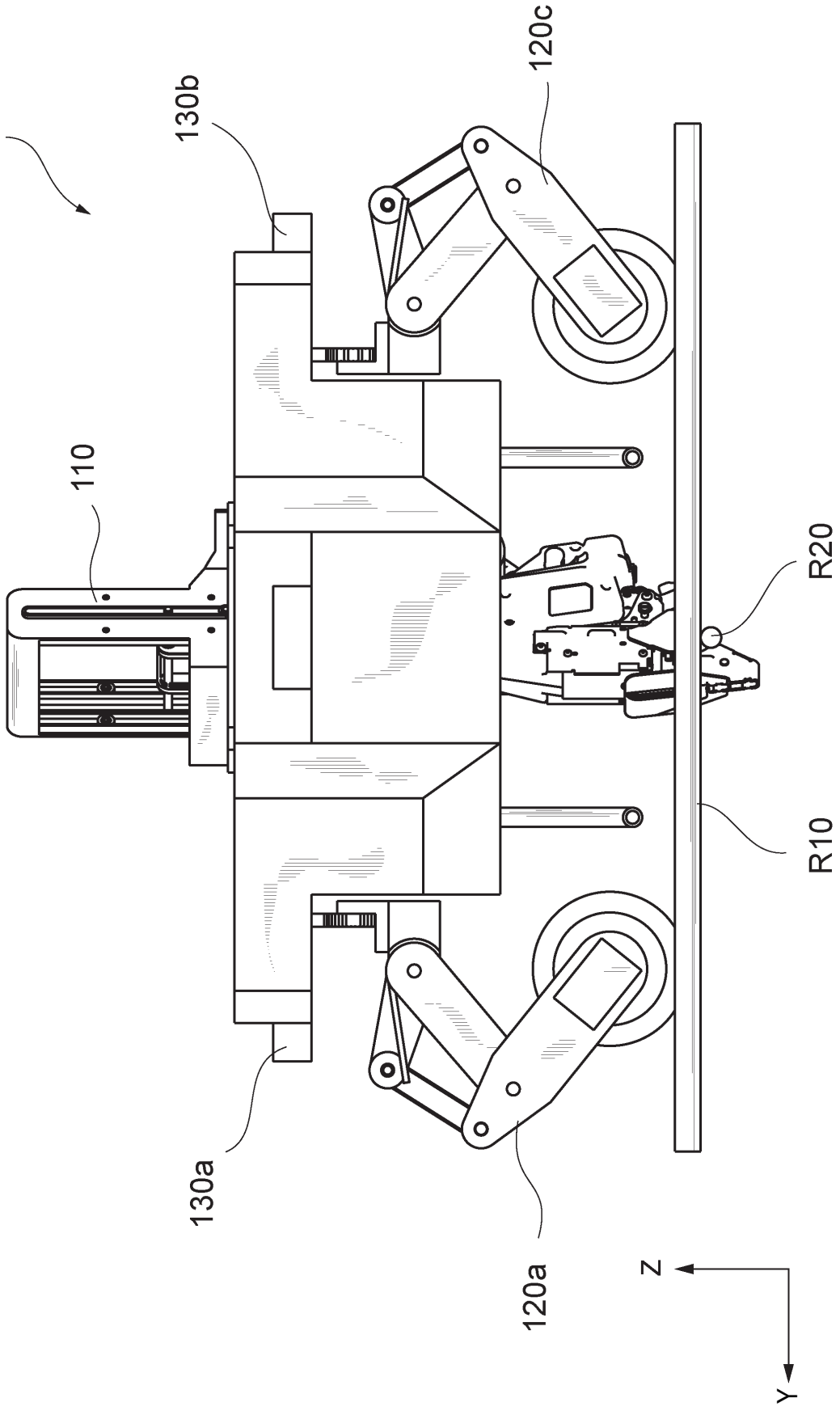


FIG. 11

FIG. 12

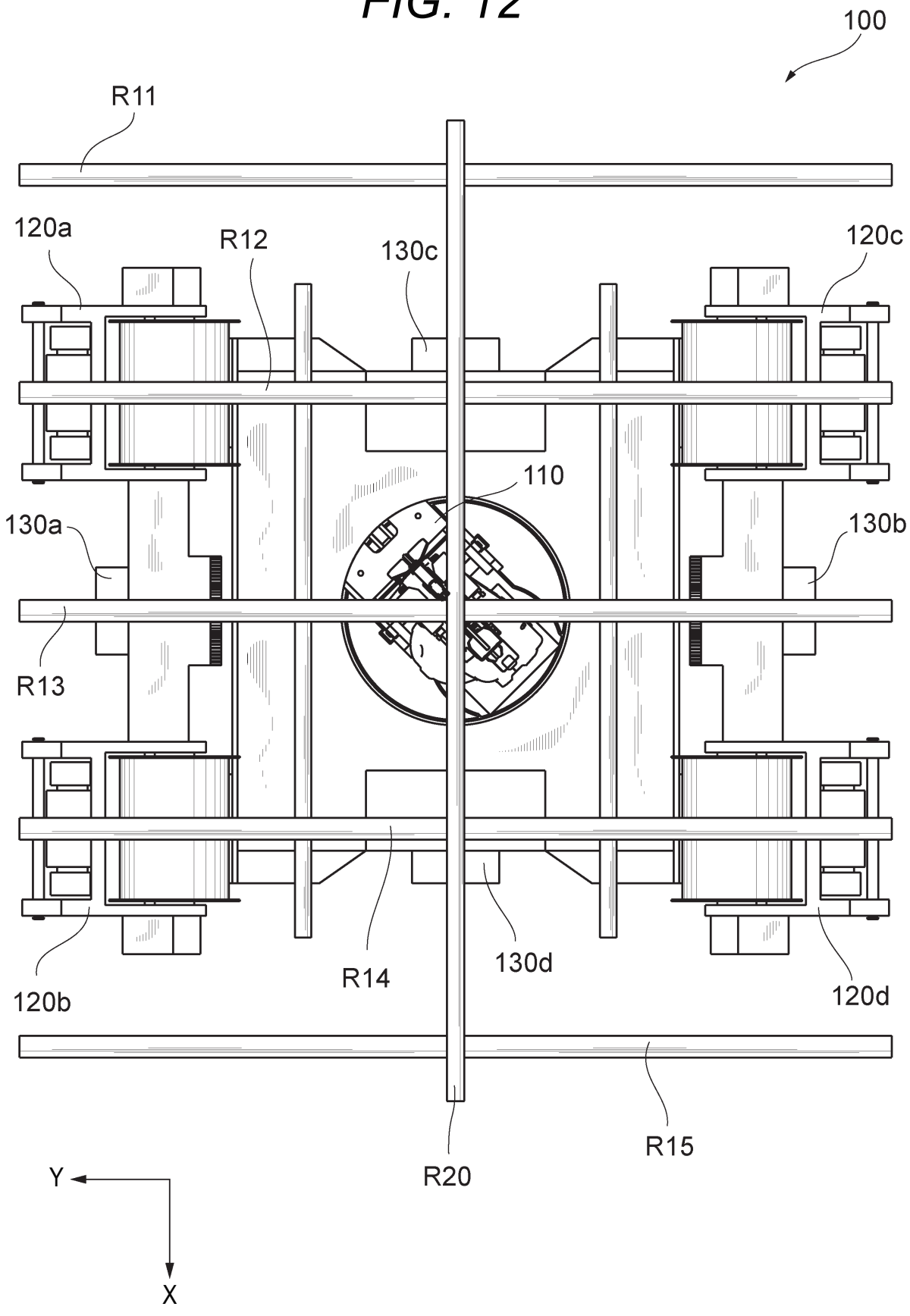
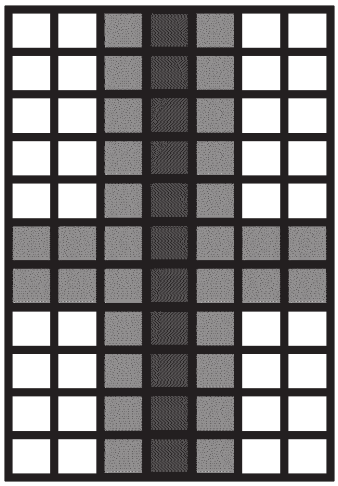
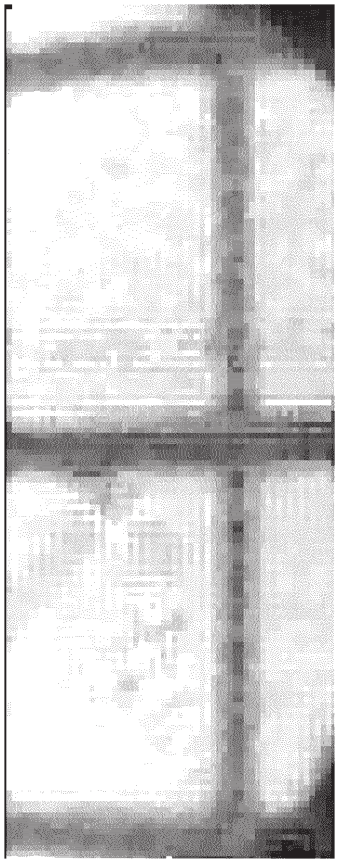

100
R11
120a
R12
130c
120c
110
130a
130b
R13
120b
R14
130d
120d
R15
R20
Y
X

FIG. 13



(b)



(a)

FIG. 14

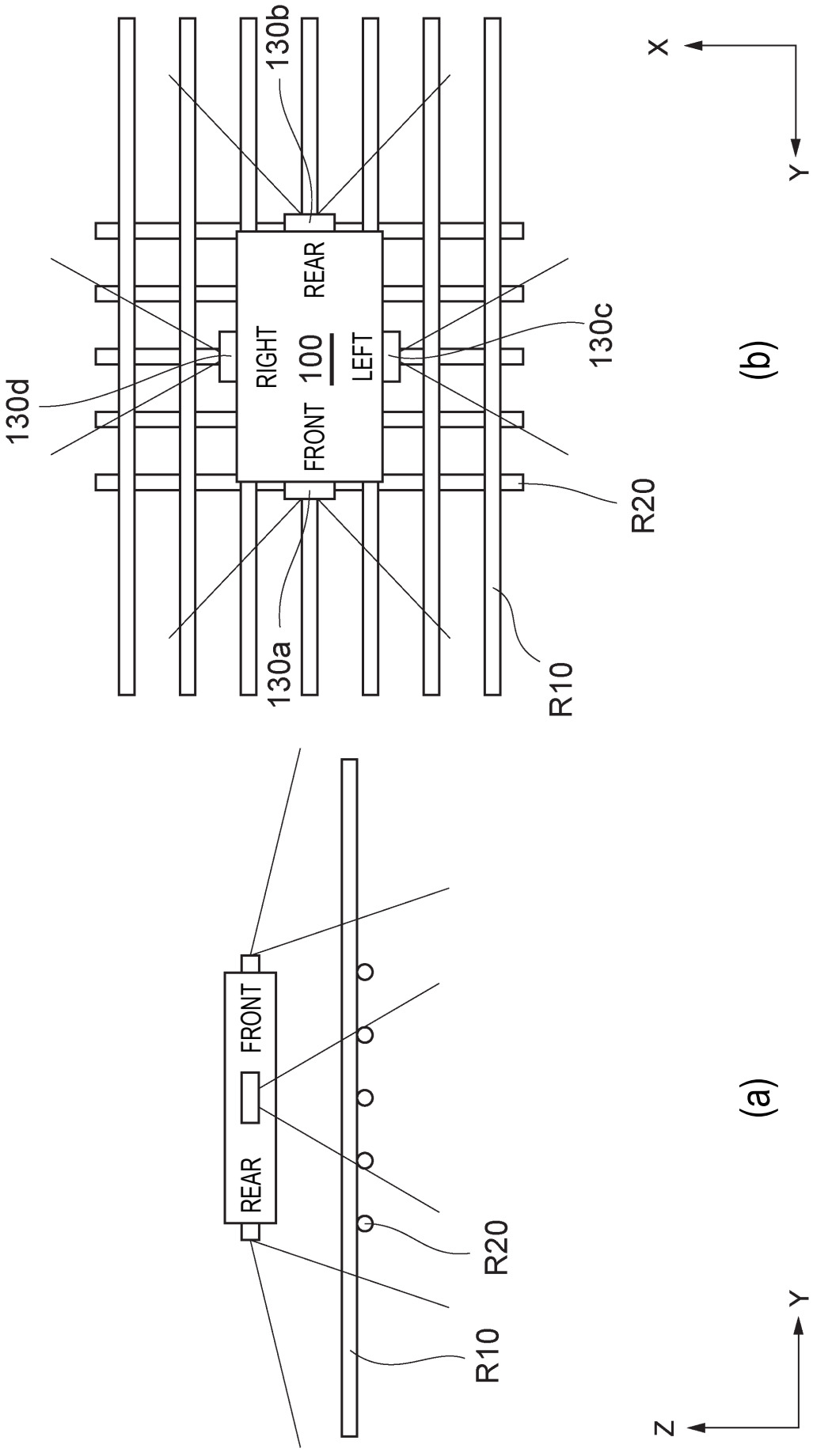

130b
REAR
RIGHT
100
LEFT
FRONT
130d
130c
R20
R10
130a
X
Y
(b)
FRONT
REAR
R20
R10
Y
Z
(a)

FIG. 15



FIG. 16

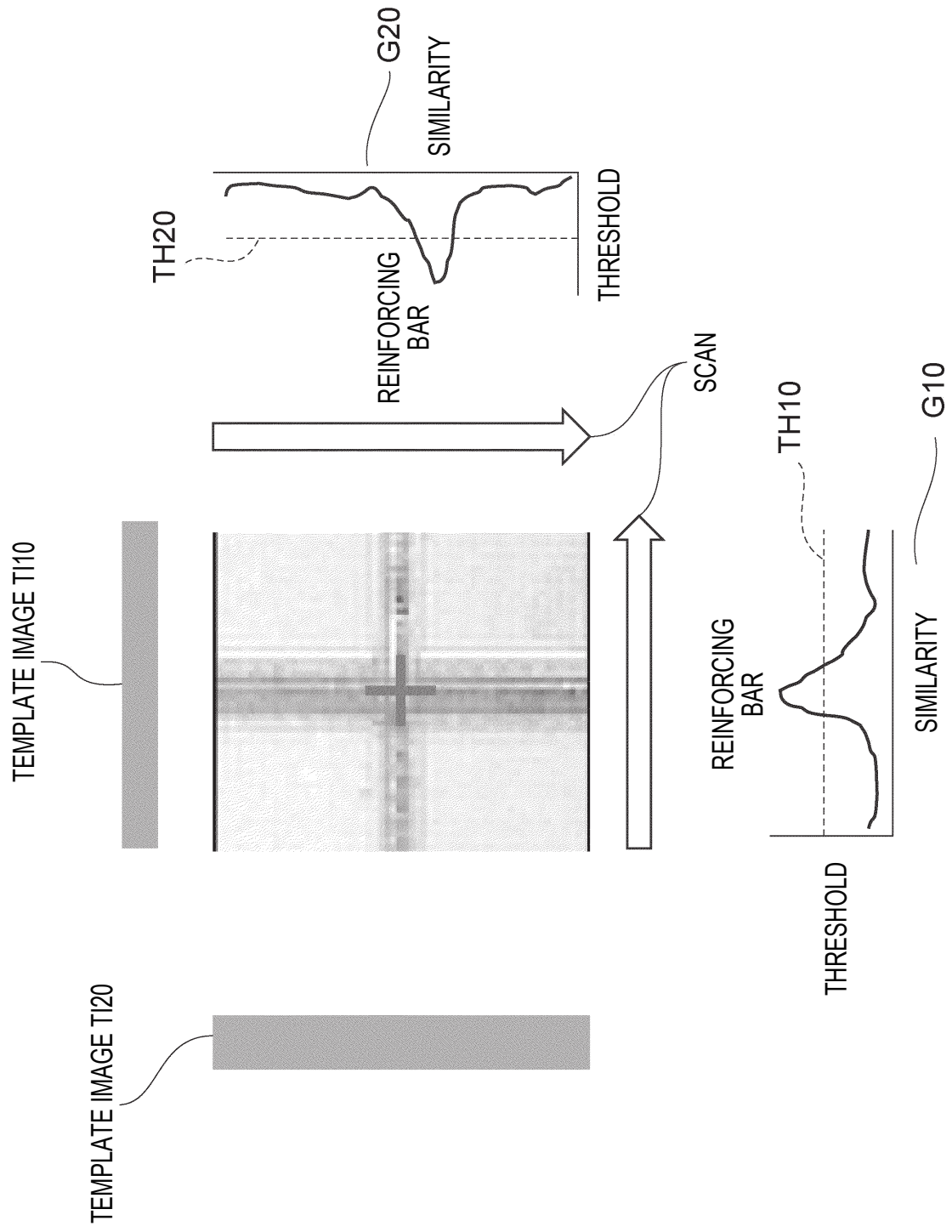

TEMPLATE IMAGE TI10
TEMPLATE IMAGE TI20
SCAN
REINFORCING BAR
TH10
G10
SIMILARITY
THRESHOLD
REINFORCING BAR
TH20
G20
SIMILARITY
THRESHOLD

FIG. 17

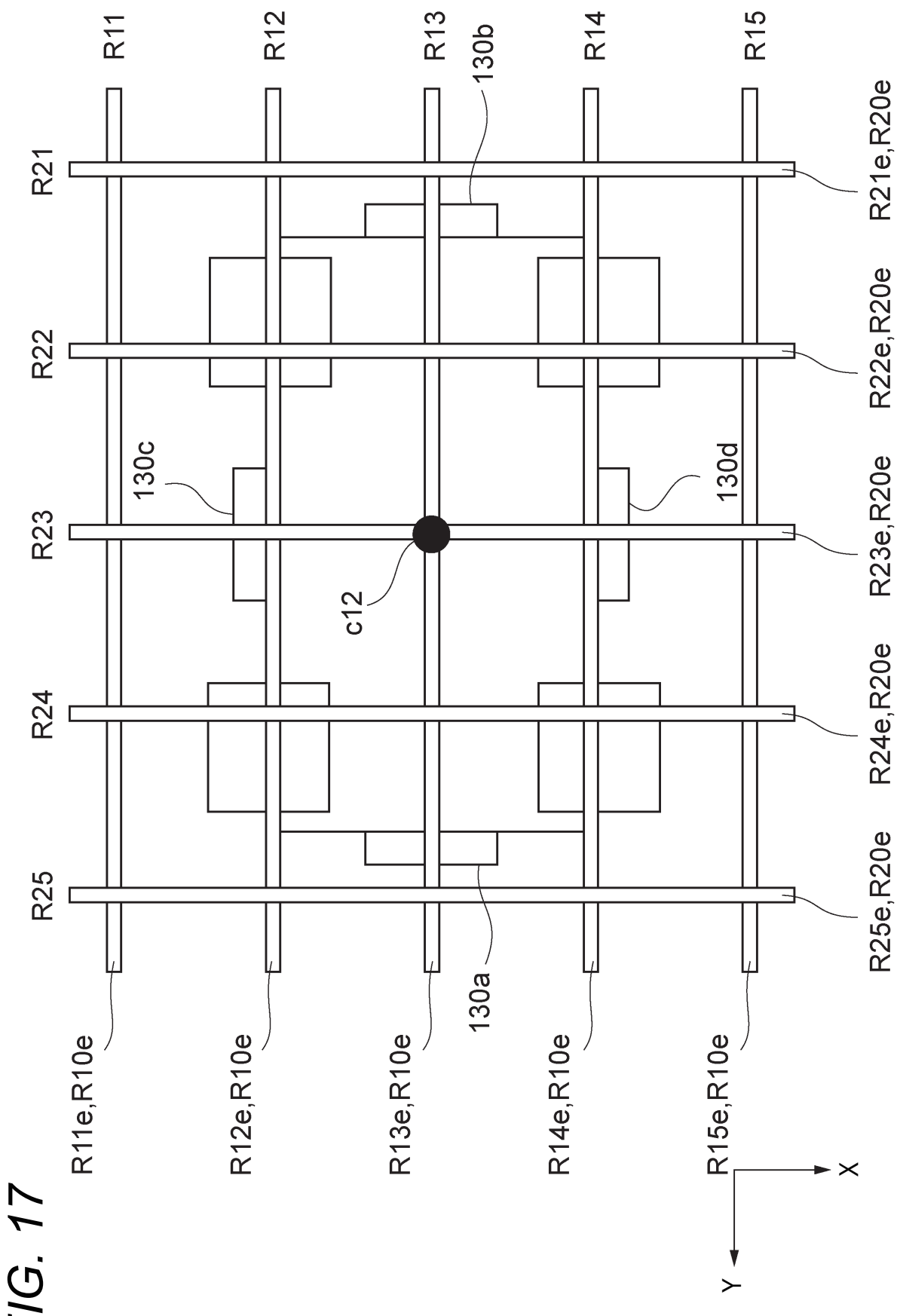

R11
R12
R13
R14
R15
130b
R21
R22
R23
R24
R25
R21e,R20e
R22e,R20e
R23e,R20e
R24e,R20e
R25e,R20e
130c
130d
c12
130a
R11e,R10e
R12e,R10e
R13e,R10e
R14e,R10e
R15e,R10e
X
Y

FIG. 18

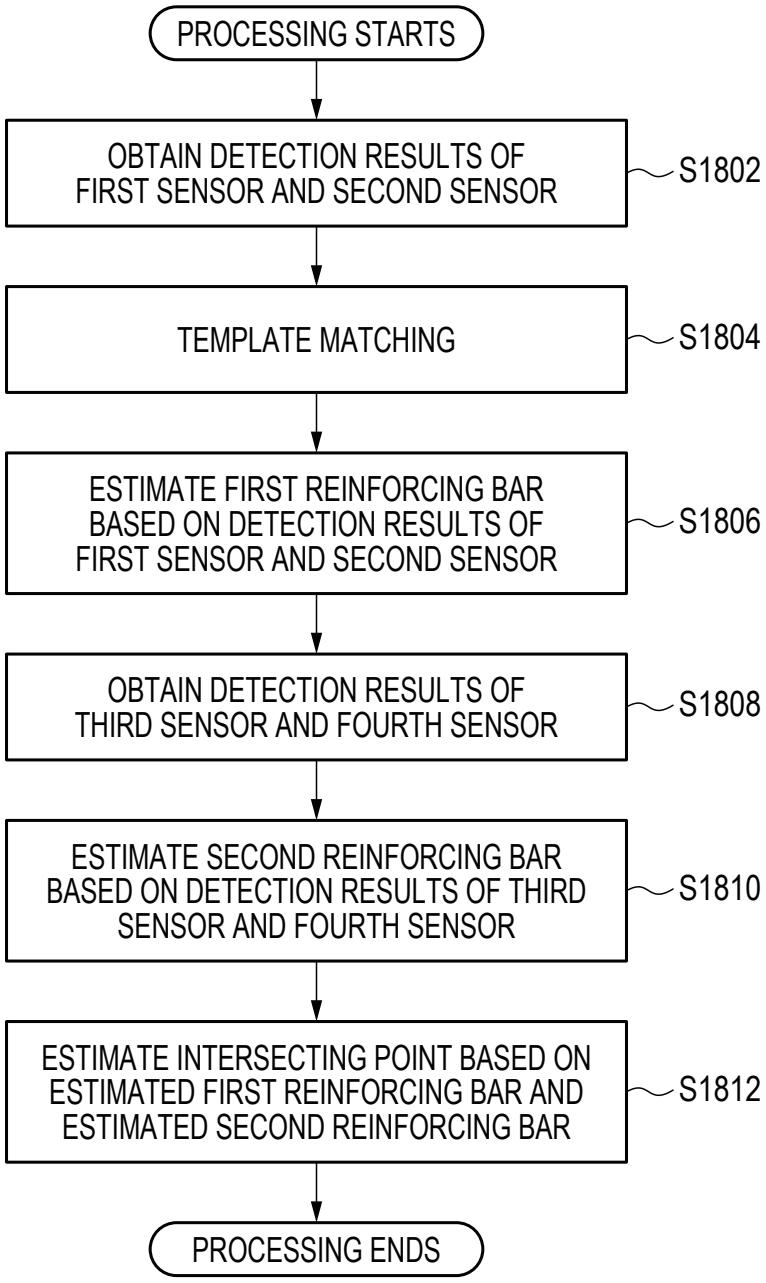

PROCESSING STARTS
OBTAIN DETECTION RESULTS OF FIRST SENSOR AND SECOND SENSOR
S1802
TEMPLATE MATCHING
S1804
ESTIMATE FIRST REINFORCING BAR BASED ON DETECTION RESULTS OF FIRST SENSOR AND SECOND SENSOR
S1806
OBTAIN DETECTION RESULTS OF THIRD SENSOR AND FOURTH SENSOR
S1808
ESTIMATE SECOND REINFORCING BAR BASED ON DETECTION RESULTS OF THIRD SENSOR AND FOURTH SENSOR
S1810
ESTIMATE INTERSECTING POINT BASED ON ESTIMATED FIRST REINFORCING BAR AND ESTIMATED SECOND REINFORCING BAR
S1812
PROCESSING ENDS

FIG. 19

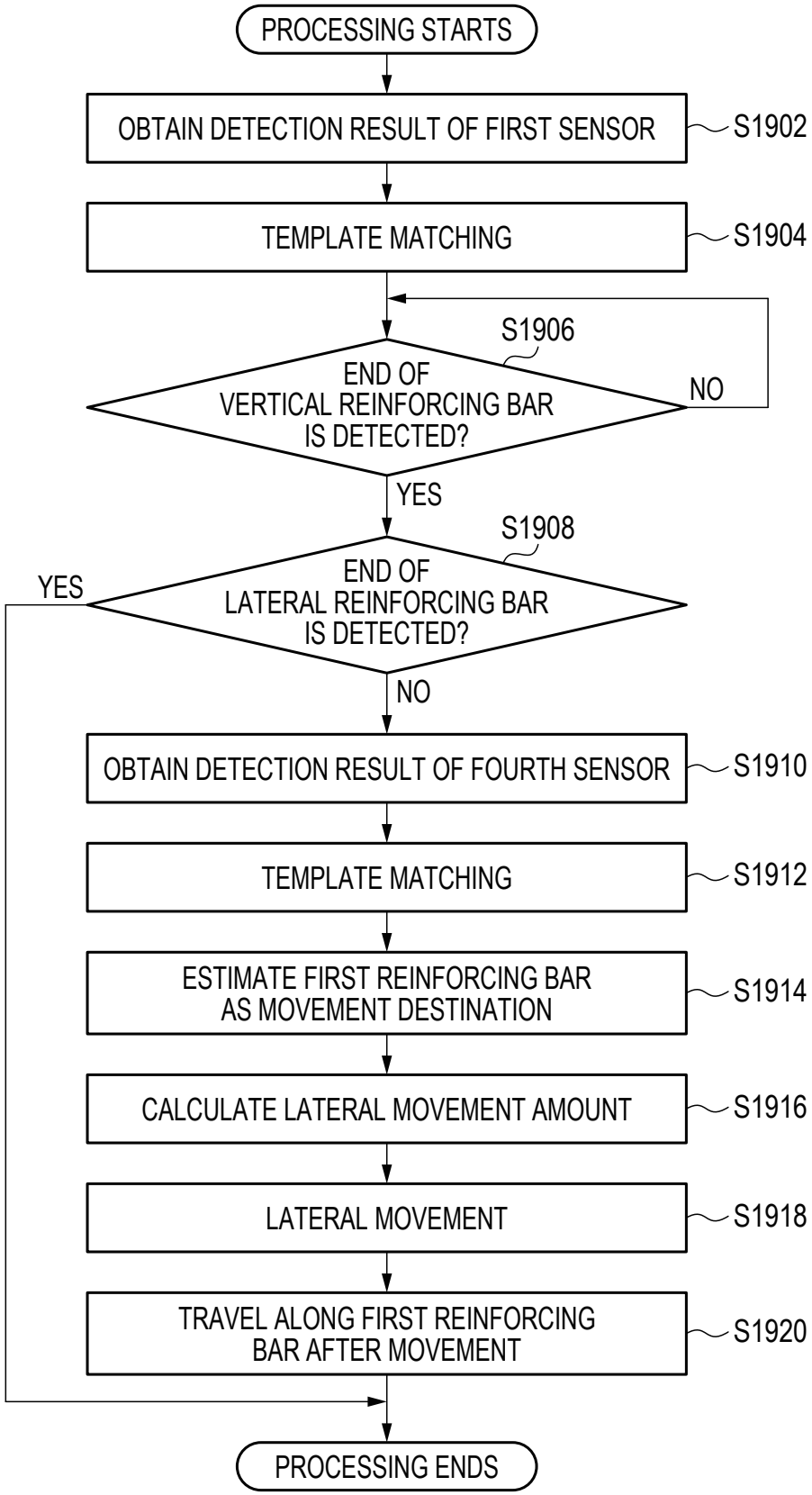

PROCESSING STARTS
OBTAIN DETECTION RESULT OF FIRST SENSOR
S1902
TEMPLATE MATCHING
S1904
S1906
END OF VERTICAL REINFORCING BAR IS DETECTED?
NO
YES
S1908
END OF LATERAL REINFORCING BAR IS DETECTED?
YES
NO
OBTAIN DETECTION RESULT OF FOURTH SENSOR
S1910
TEMPLATE MATCHING
S1912
ESTIMATE FIRST REINFORCING BAR AS MOVEMENT DESTINATION
S1914
CALCULATE LATERAL MOVEMENT AMOUNT
S1916
LATERAL MOVEMENT
S1918
TRAVEL ALONG FIRST REINFORCING BAR AFTER MOVEMENT
S1920
PROCESSING ENDS

FIG. 20

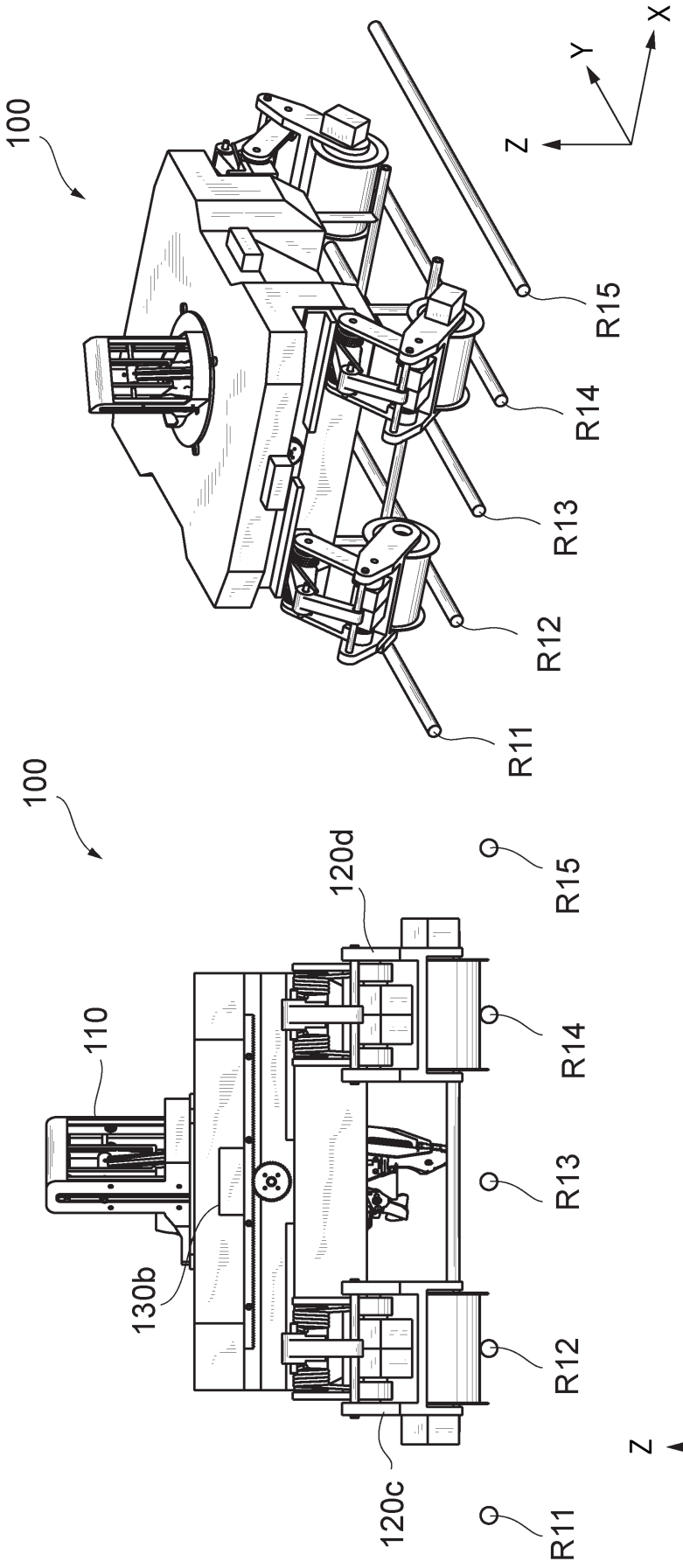

100
Z
Y
X
R15
R14
R13
R12
R11
(b)
100
110
120d
120c
130b
R15
R14
R13
R12
R11
Z
X
(a)

FIG. 21

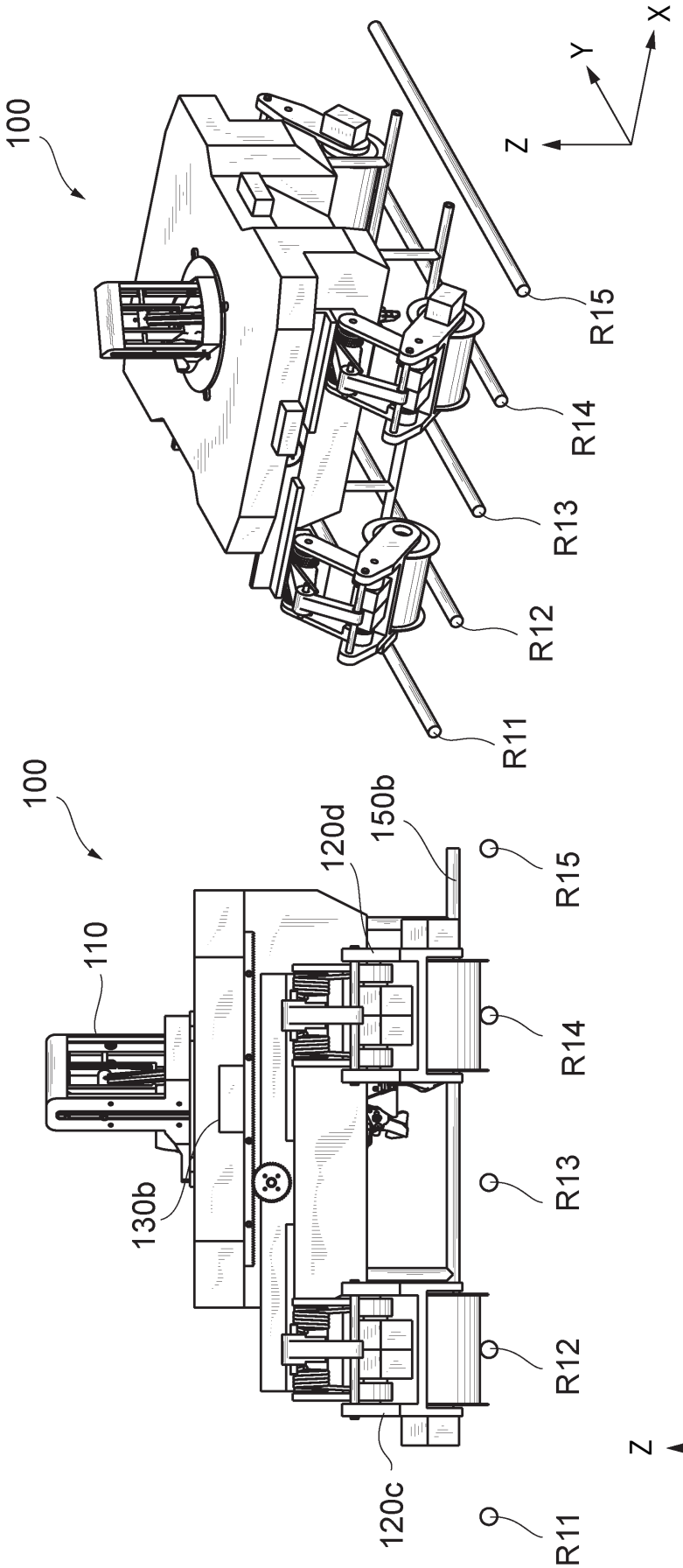

100
110
120d
150b
R15
R14
R13
R12
R11
130b
120c
Z
X
(a)
100
R15
R14
R13
R12
R11
Y
Z
X
(b)

FIG. 22

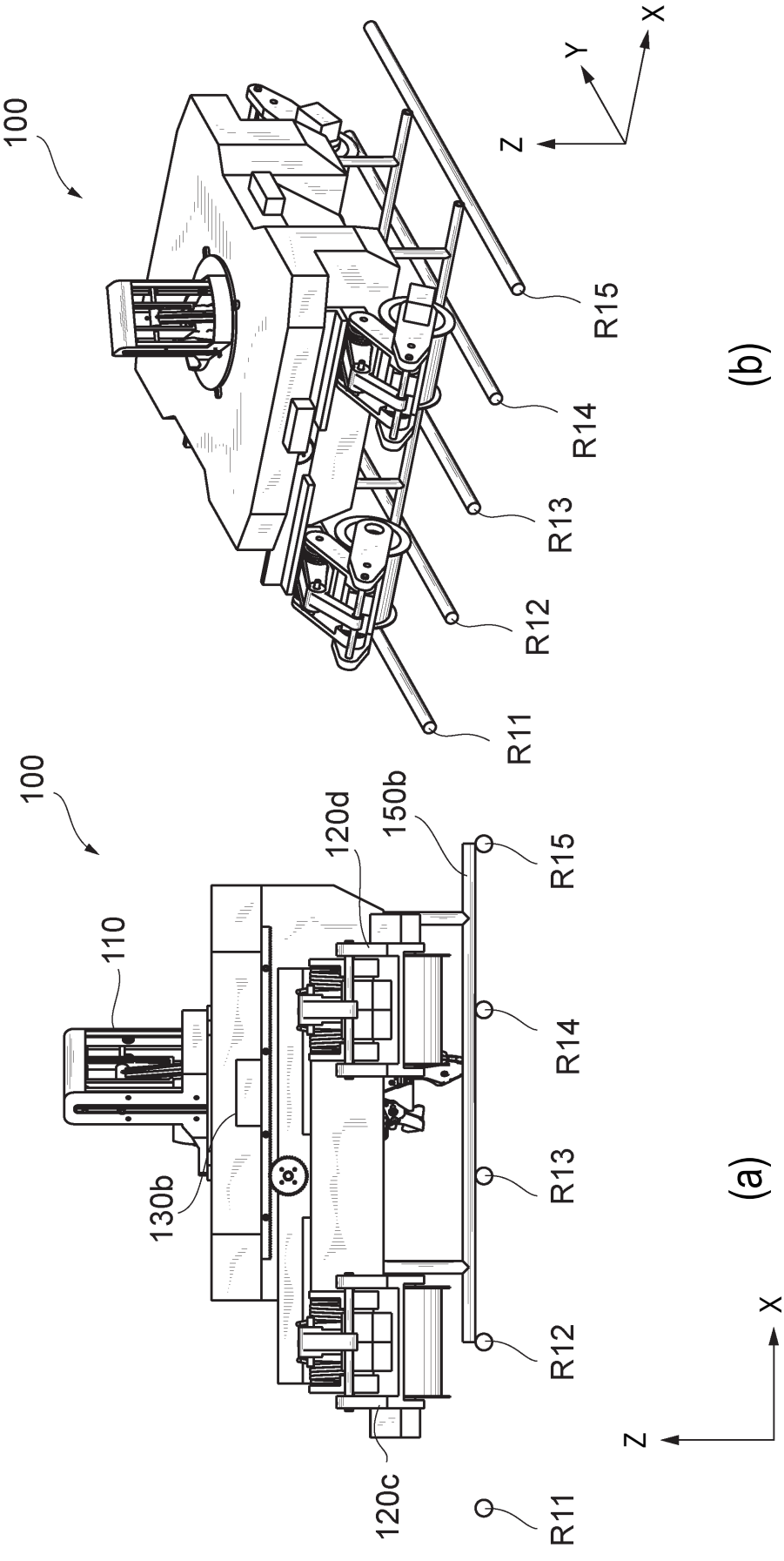

100
R15
R14
R13
R12
R11
Z
Y
X
(b)
100
110
120d
150b
R15
R14
R13
R12
R11
130b
120c
Z
X
(a)

FIG. 23

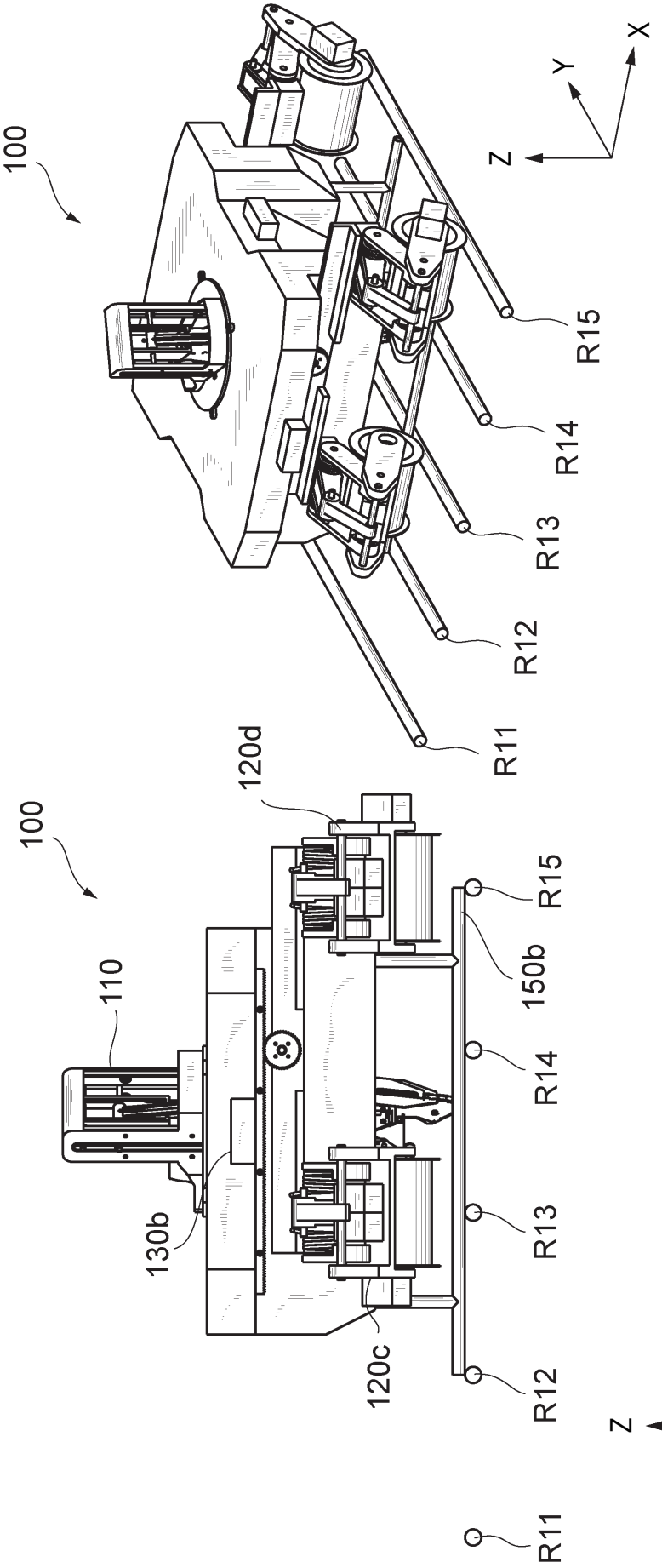

100
R15
R14
R13
R12
R11
Z
Y
X
(b)
100
110
120d
R15
150b
R14
R13
130b
120c
R12
R11
Z
X
(a)

FIG. 24

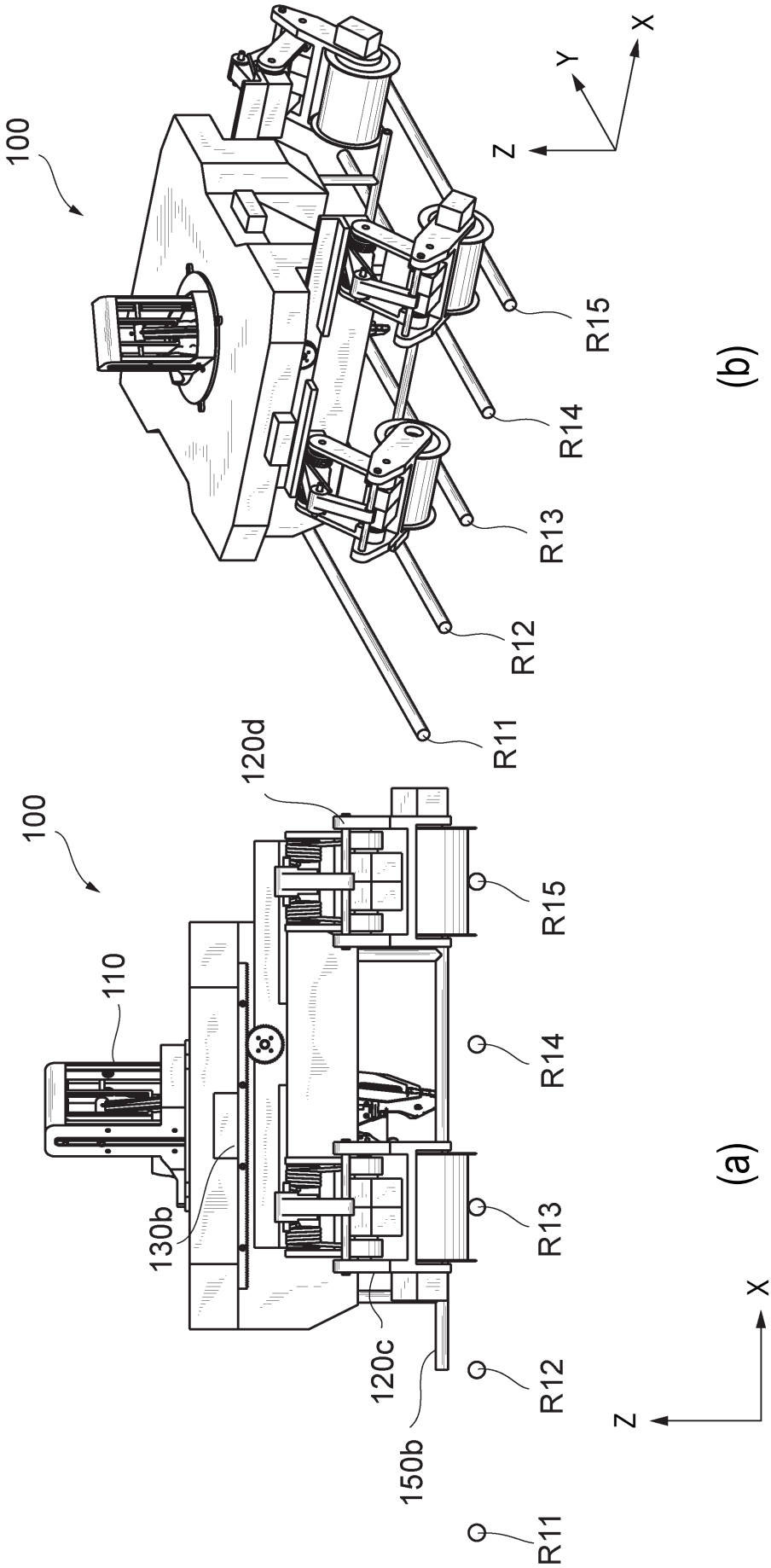

100
110
120d
120c
130b
150b
R11
R12
R13
R14
R15
X
Z
(a)
100
Y
X
Z
R11
R12
R13
R14
R15
(b)

FIG. 25

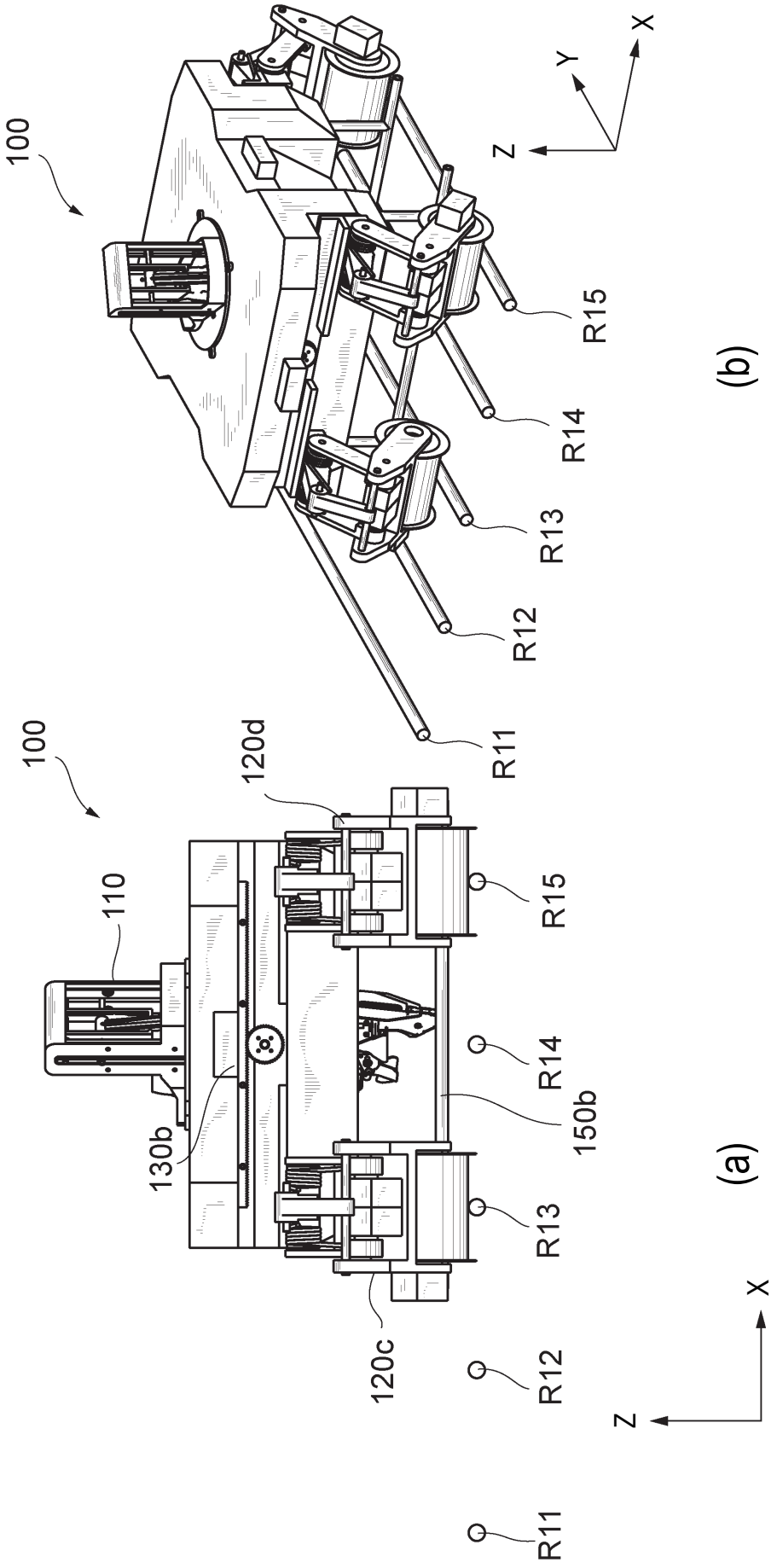

100
Z
Y
X
R15
R14
R13
R12
R11
(b)
100
120d
110
R15
R14
130b
150b
R13
120c
R12
R11
Z
X
(a)

FIG. 26

