FIG. 1

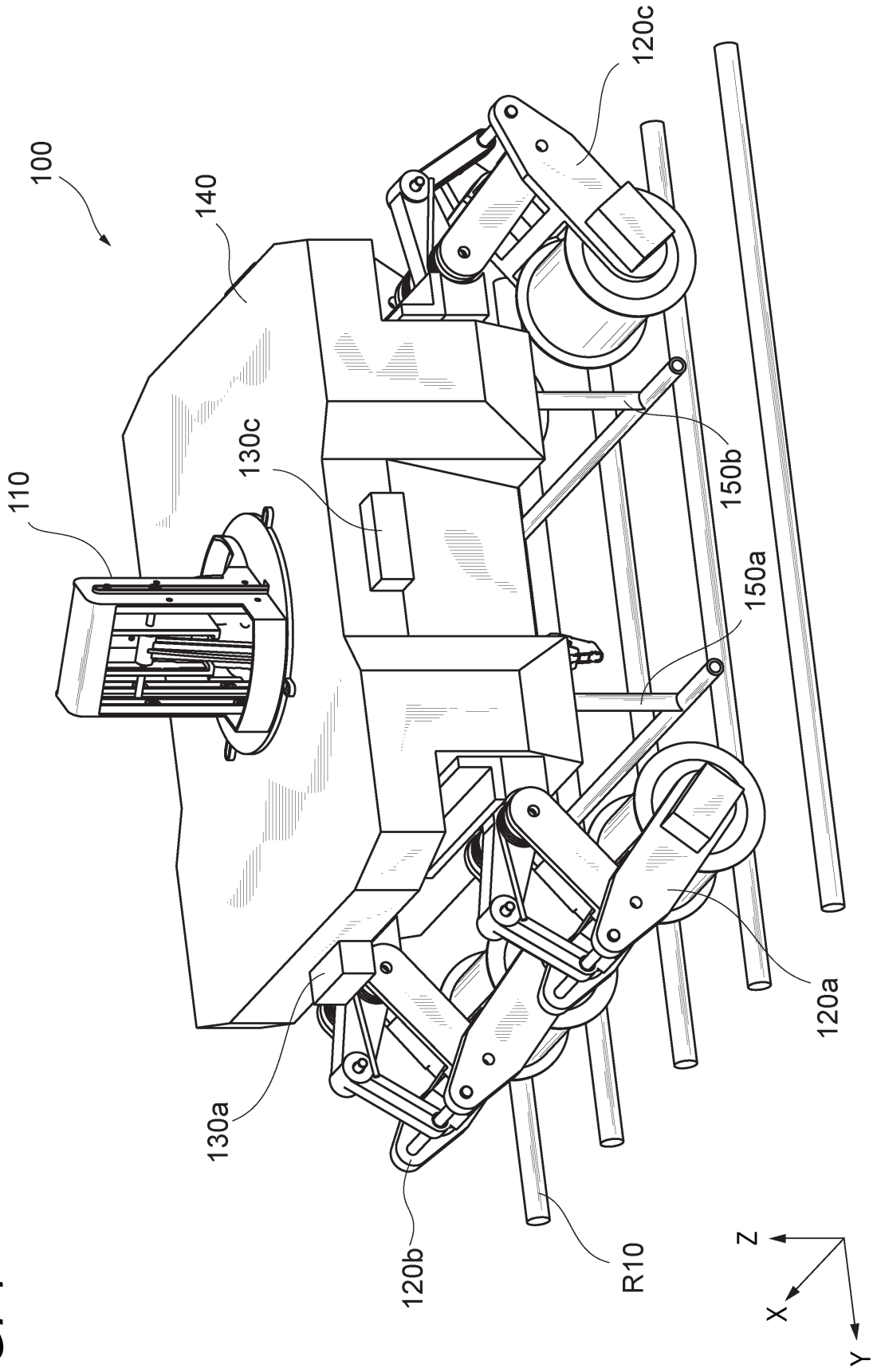


FIG. 2

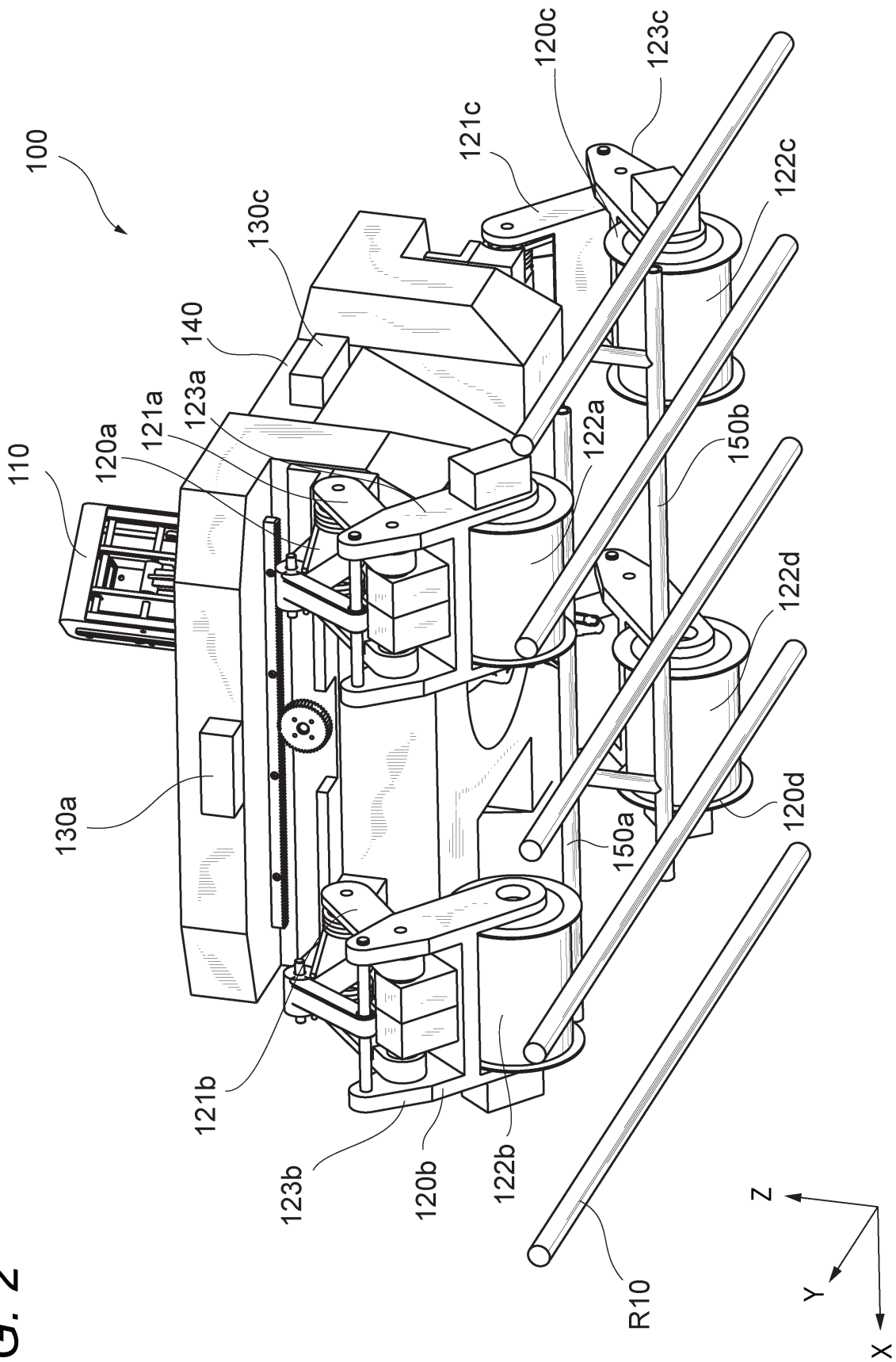
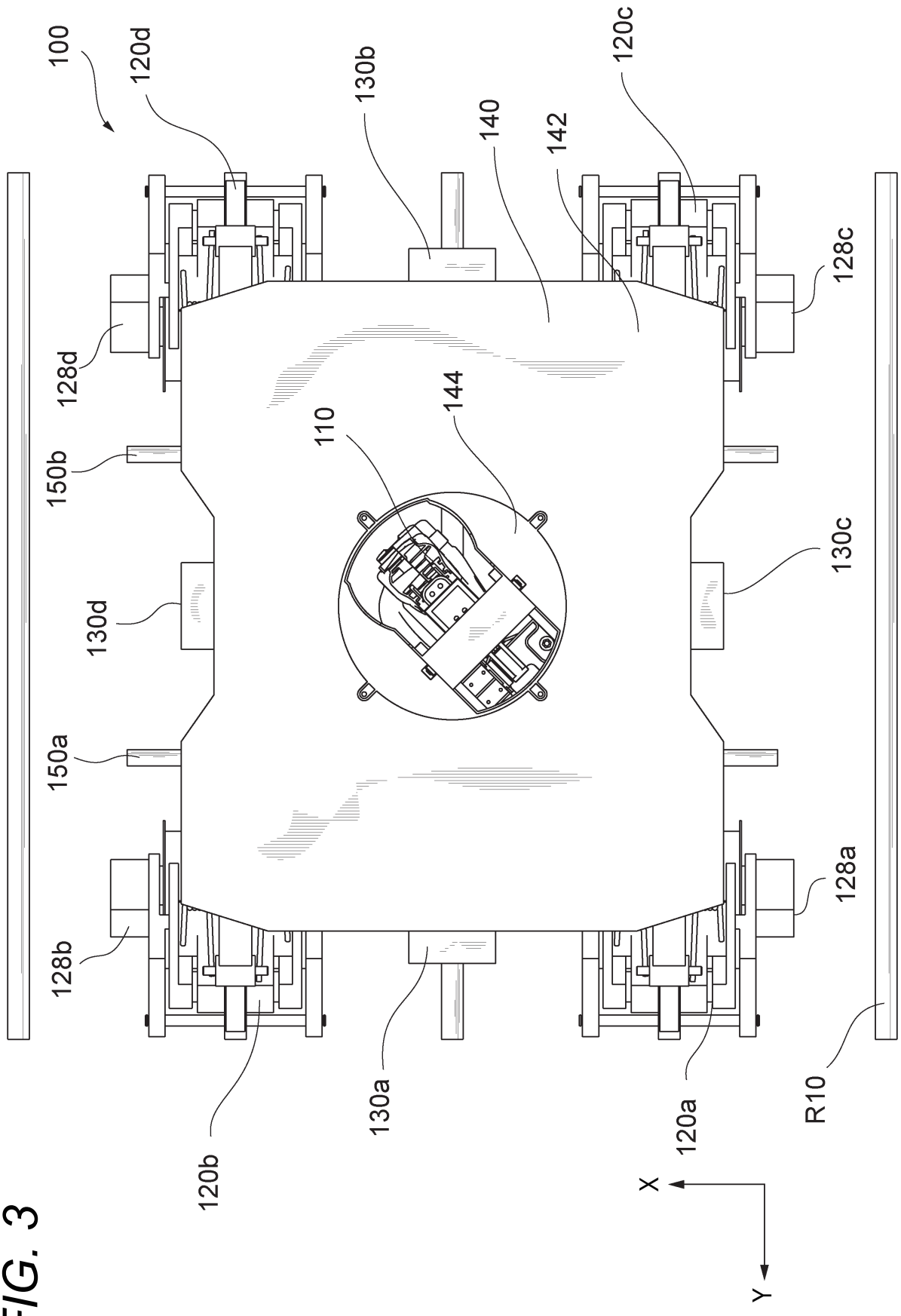

100
110
120a
121a
123a
140
130c
121c
120c
123c
122c
122a
150b
122d
120d
150a
130a
121b
123b
120b
122b
R10
Z
Y
X

FIG. 3


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

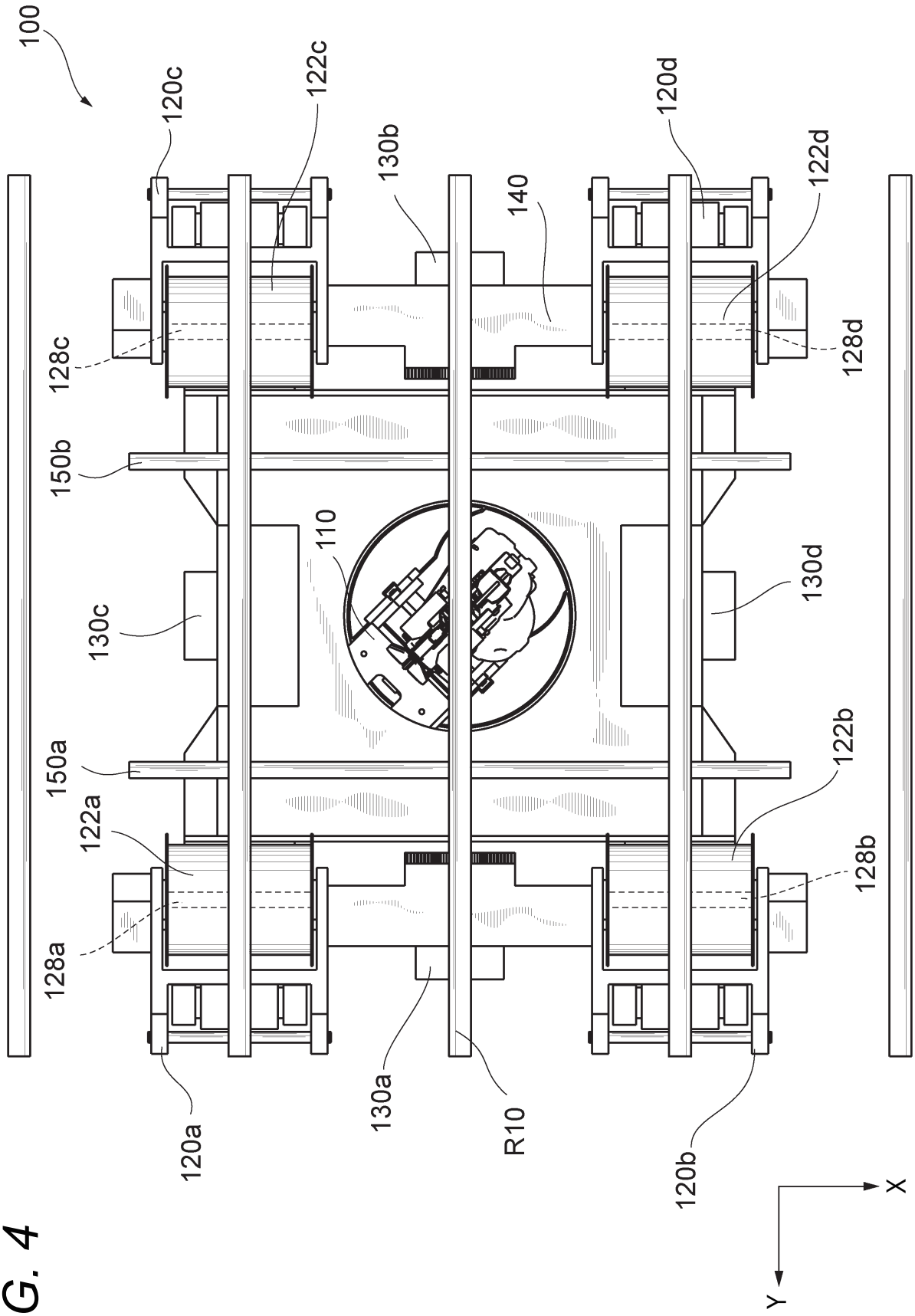

100
120c
122c
130b
140
120d
122d
128c
128d
150b
110
130c
130d
150a
122a
122b
128a
128b
120a
130a
R10
120b
X
Y

FIG. 4

FIG. 5

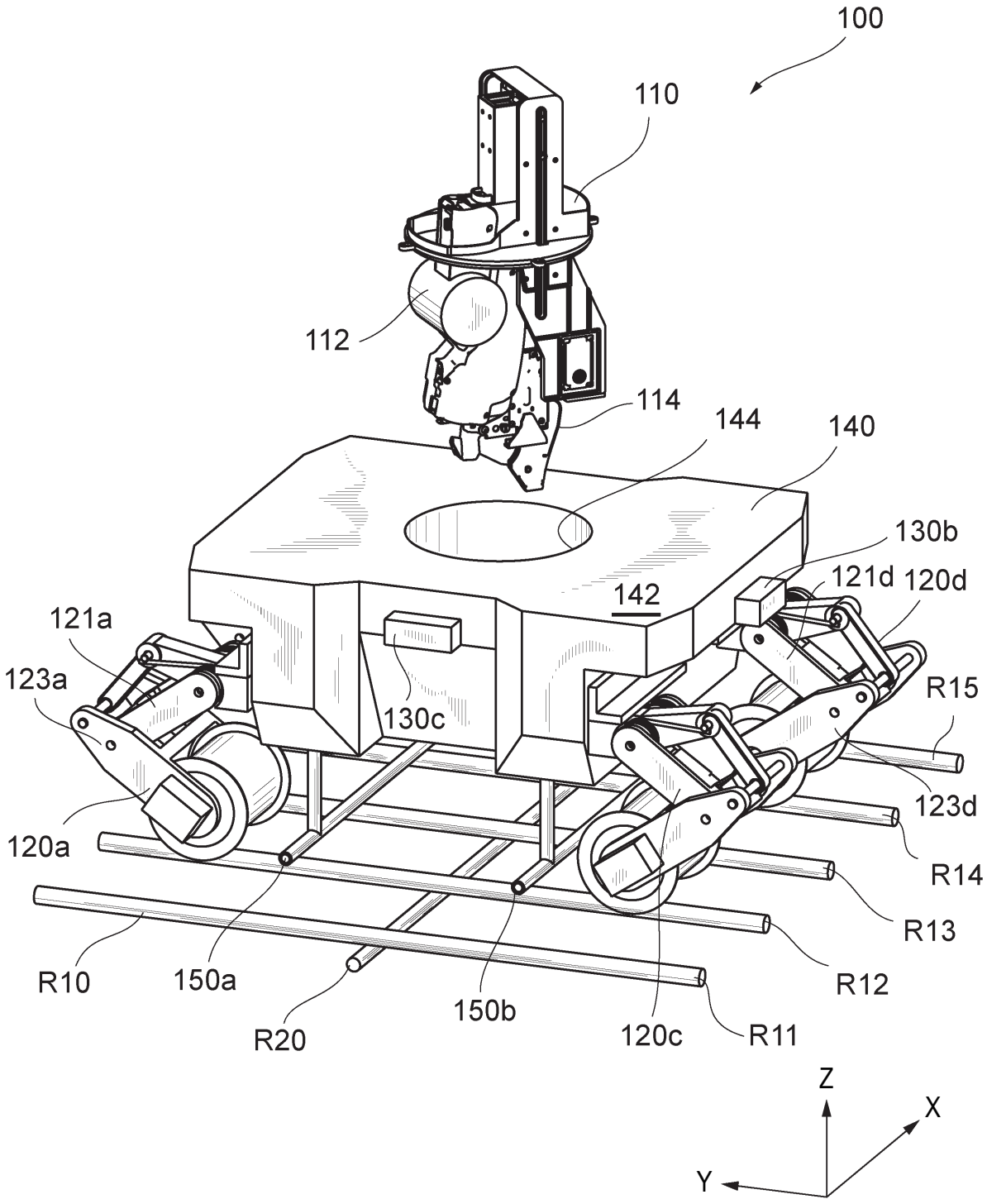

100
110
112
114
144
140
130b
121d
120d
142
121a
123a
130c
R15
123d
120a
R14
R13
R10
150a
R12
R20
150b
120c
R11
Z
X
Y

FIG. 6

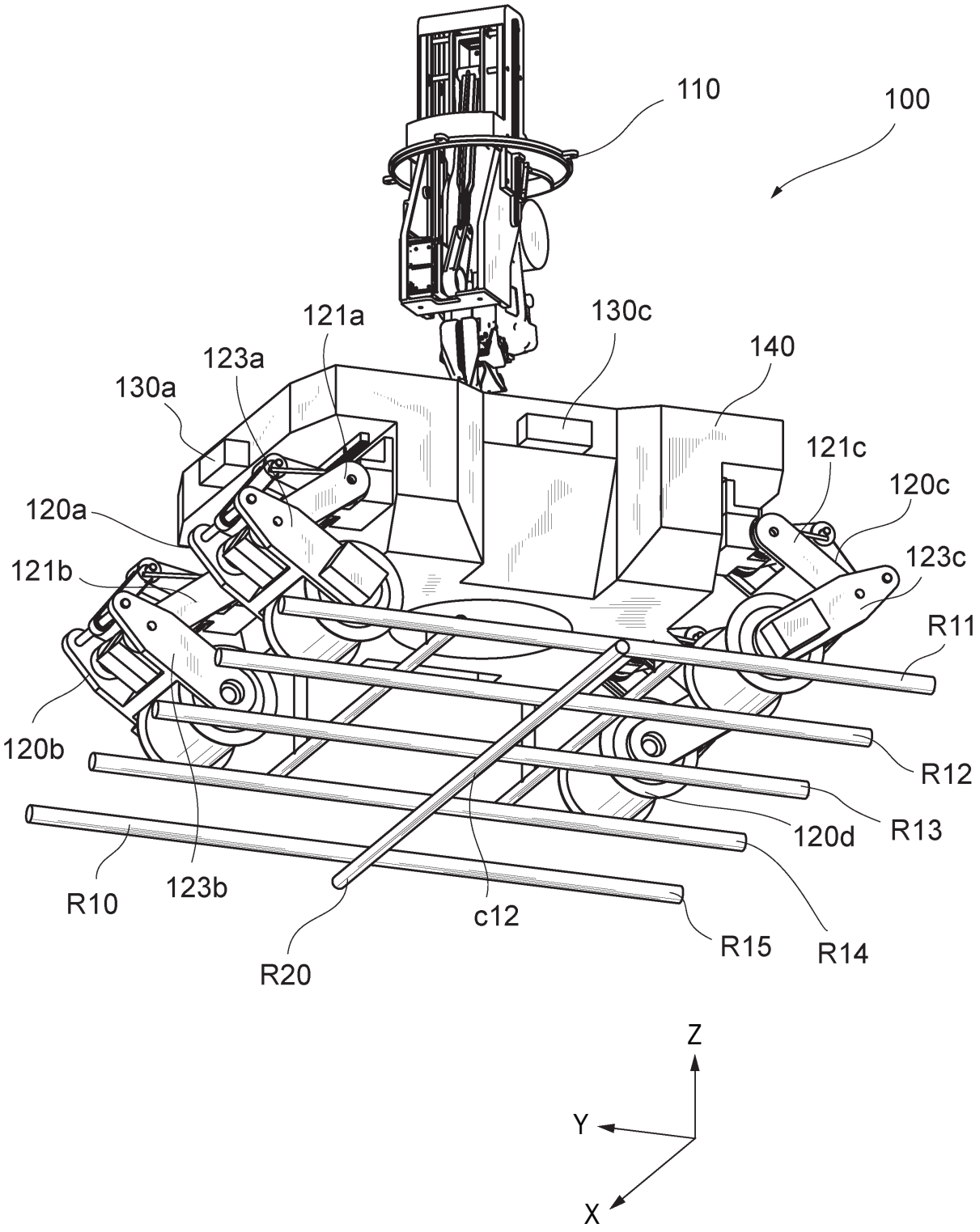

110
100
121a
130c
140
123a
130a
121c
120c
120a
123c
121b
R11
120b
R12
R13
120d
R10
123b
c12
R15
R14
R20
Z
Y
X

FIG. 7A

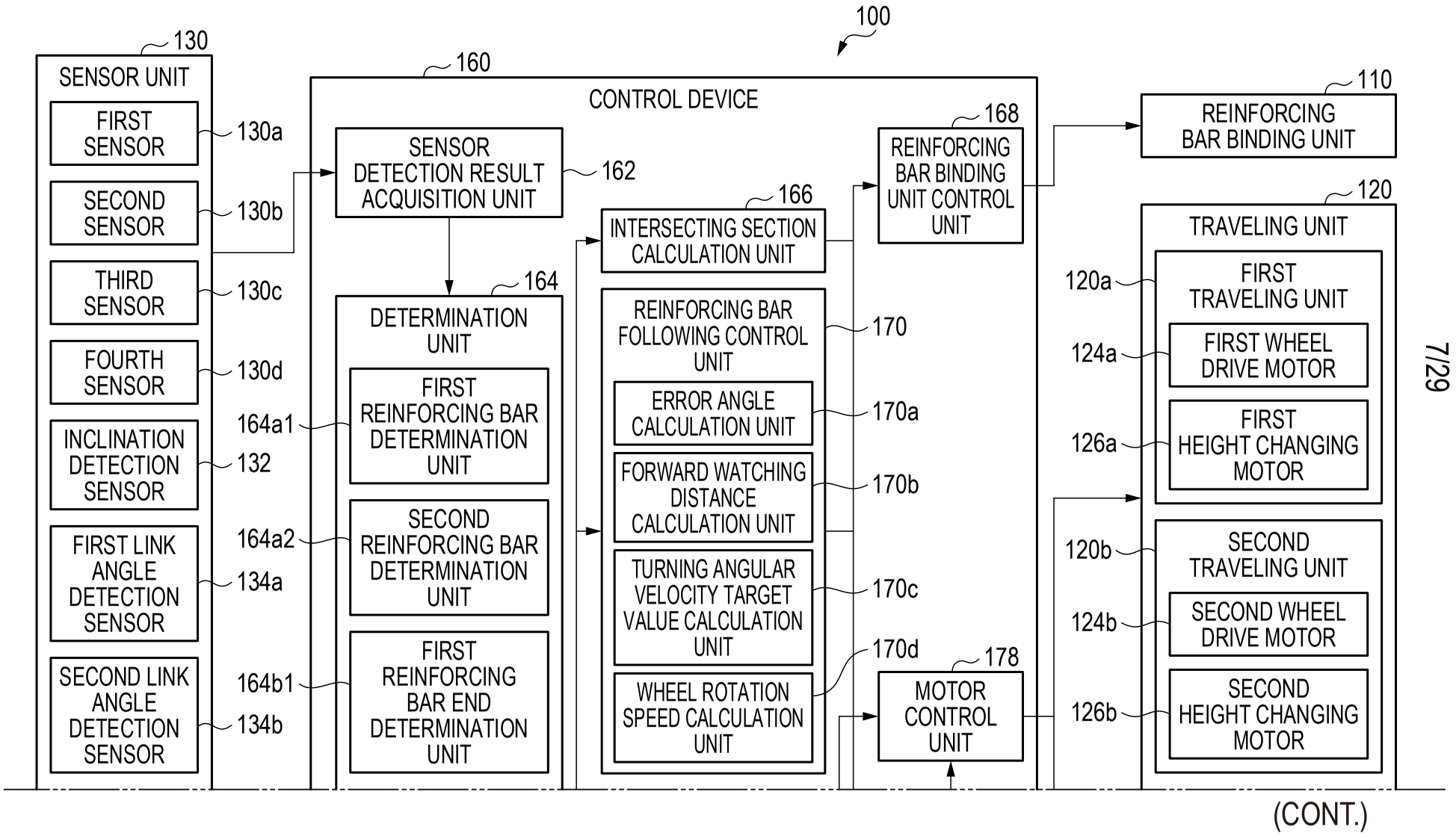
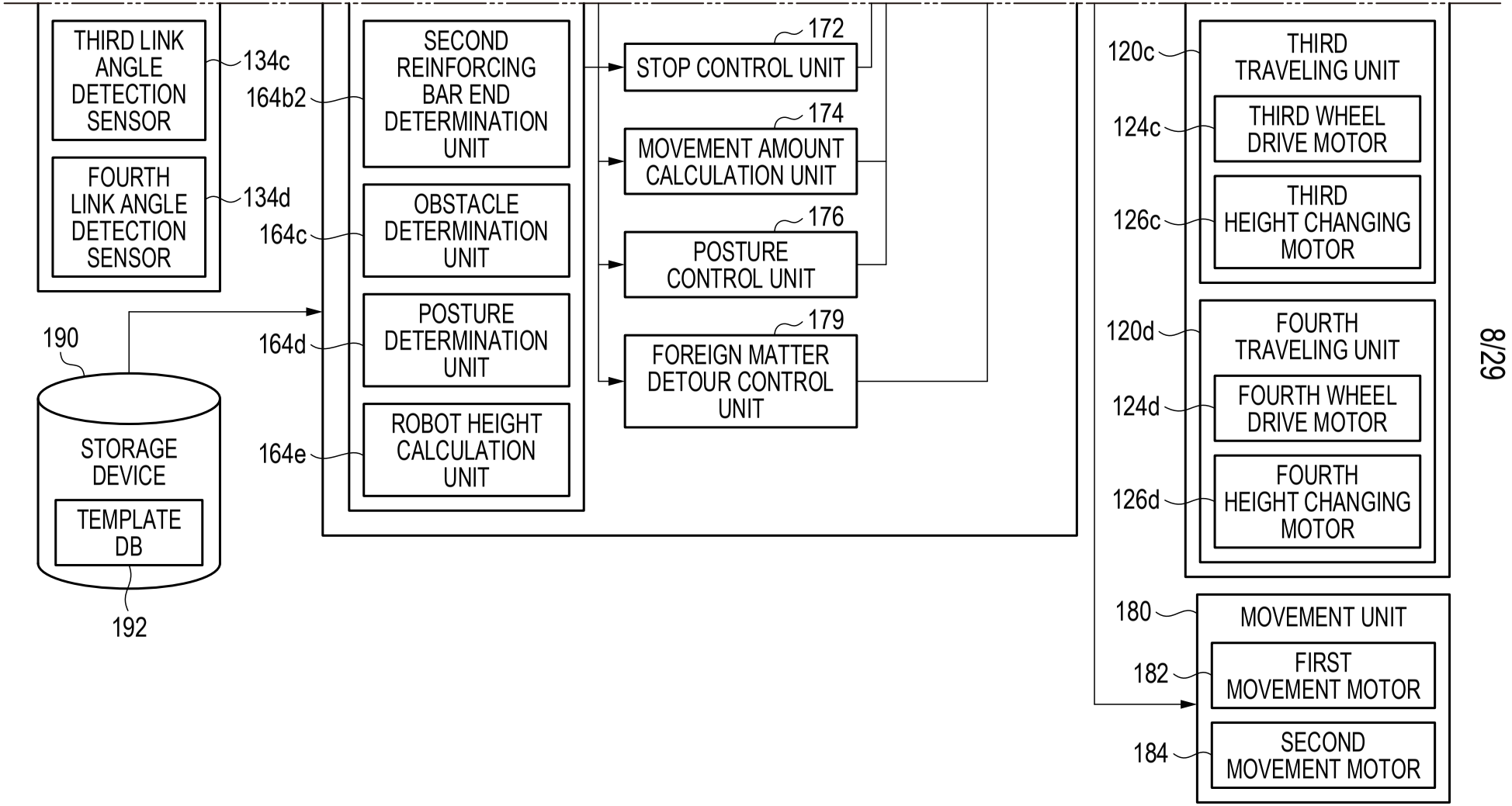

100
130
SENSOR UNIT
FIRST SENSOR
130a
SECOND SENSOR
130b
THIRD SENSOR
130c
FOURTH SENSOR
130d
INCLINATION DETECTION SENSOR
132
FIRST LINK ANGLE DETECTION SENSOR
134a
SECOND LINK ANGLE DETECTION SENSOR
134b
160
CONTROL DEVICE
SENSOR DETECTION RESULT ACQUISITION UNIT
162
164
DETERMINATION UNIT
164a1
FIRST REINFORCING BAR DETERMINATION UNIT
164a2
SECOND REINFORCING BAR DETERMINATION UNIT
164b1
FIRST REINFORCING BAR END DETERMINATION UNIT
166
INTERSECTING SECTION CALCULATION UNIT
170
REINFORCING BAR FOLLOWING CONTROL UNIT
170a
ERROR ANGLE CALCULATION UNIT
170b
FORWARD WATCHING DISTANCE CALCULATION UNIT
170c
TURNING ANGULAR VELOCITY TARGET VALUE CALCULATION UNIT
170d
WHEEL ROTATION SPEED CALCULATION UNIT
168
REINFORCING BAR BINDING UNIT CONTROL UNIT
178
MOTOR CONTROL UNIT
110
REINFORCING BAR BINDING UNIT
120
TRAVELING UNIT
120a
FIRST TRAVELING UNIT
124a
FIRST WHEEL DRIVE MOTOR
126a
FIRST HEIGHT CHANGING MOTOR
120b
SECOND TRAVELING UNIT
124b
SECOND WHEEL DRIVE MOTOR
126b
SECOND HEIGHT CHANGING MOTOR
(CONT.)

FIG. 7B

(CONTINUED FROM FIG. 7A)



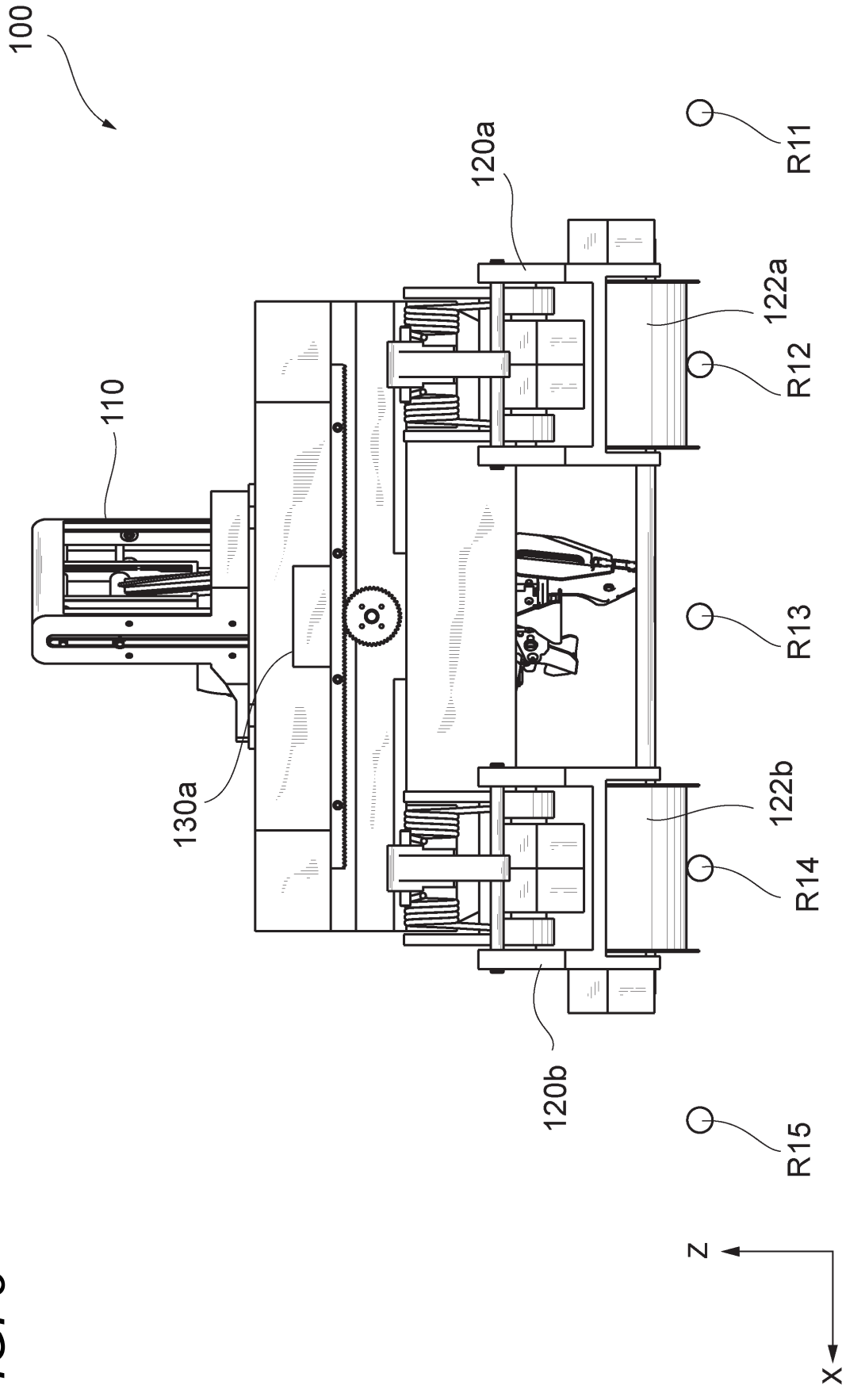
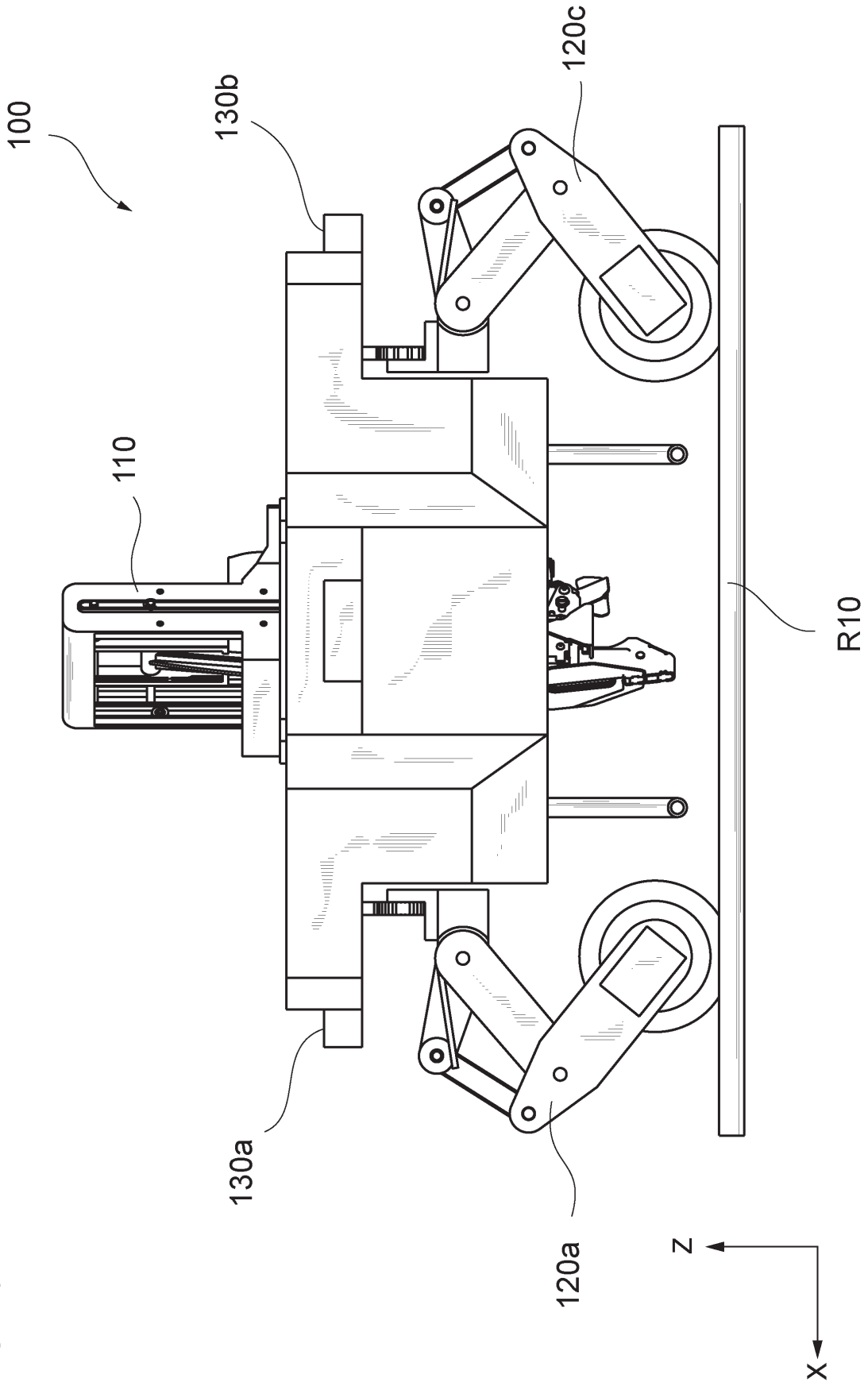


FIG. 8

FIG. 9



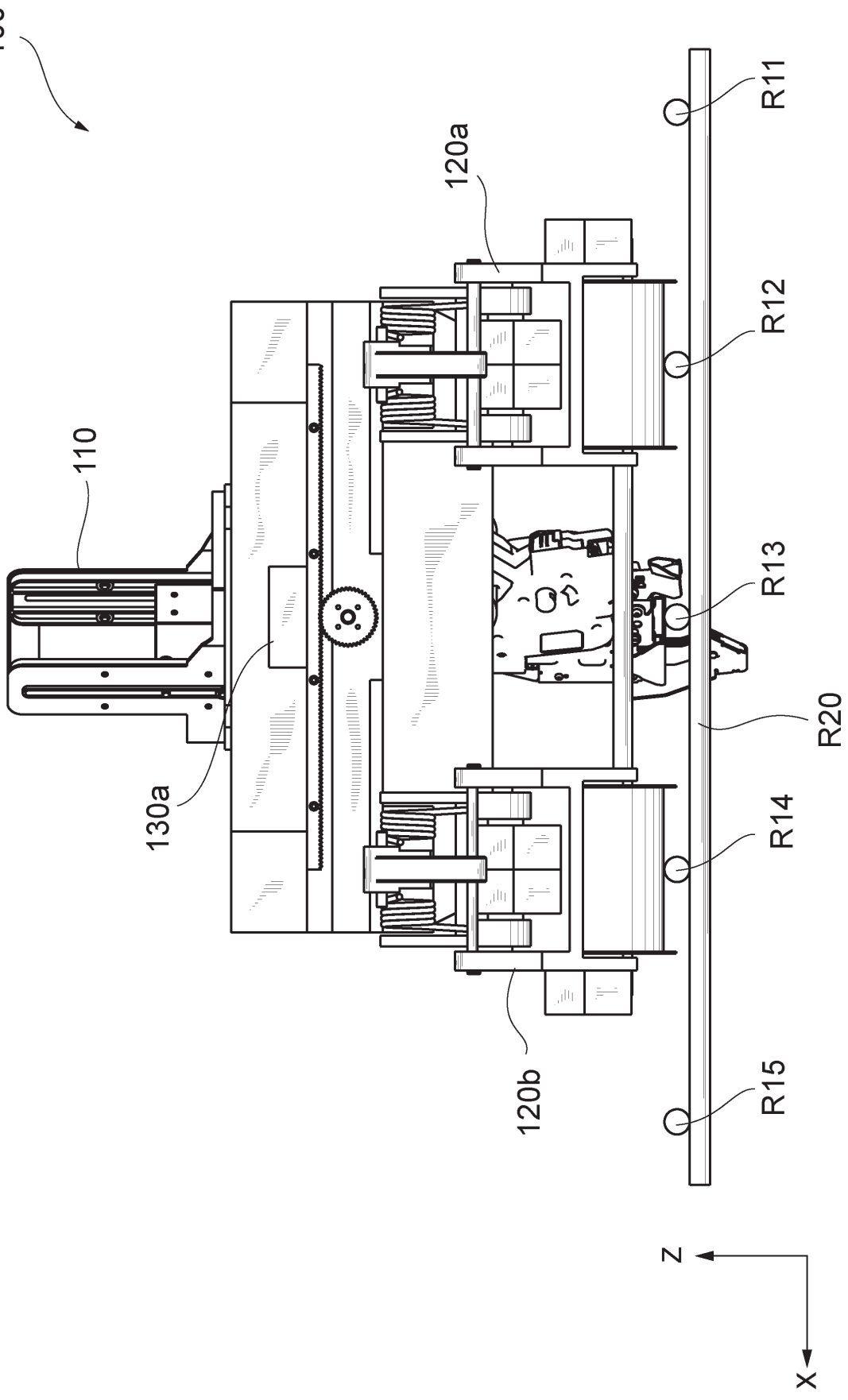


FIG. 10

FIG. 11

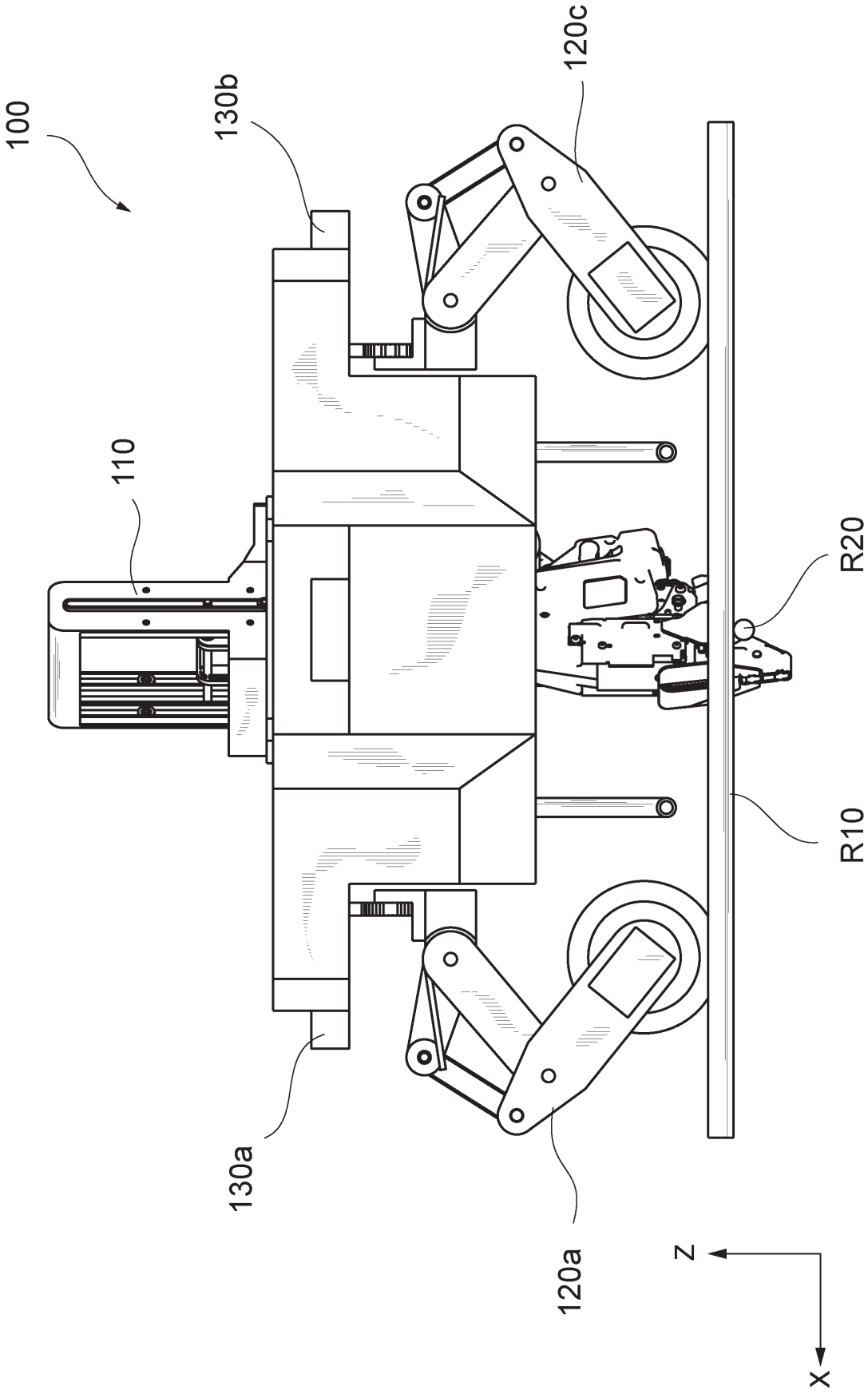


FIG. 12

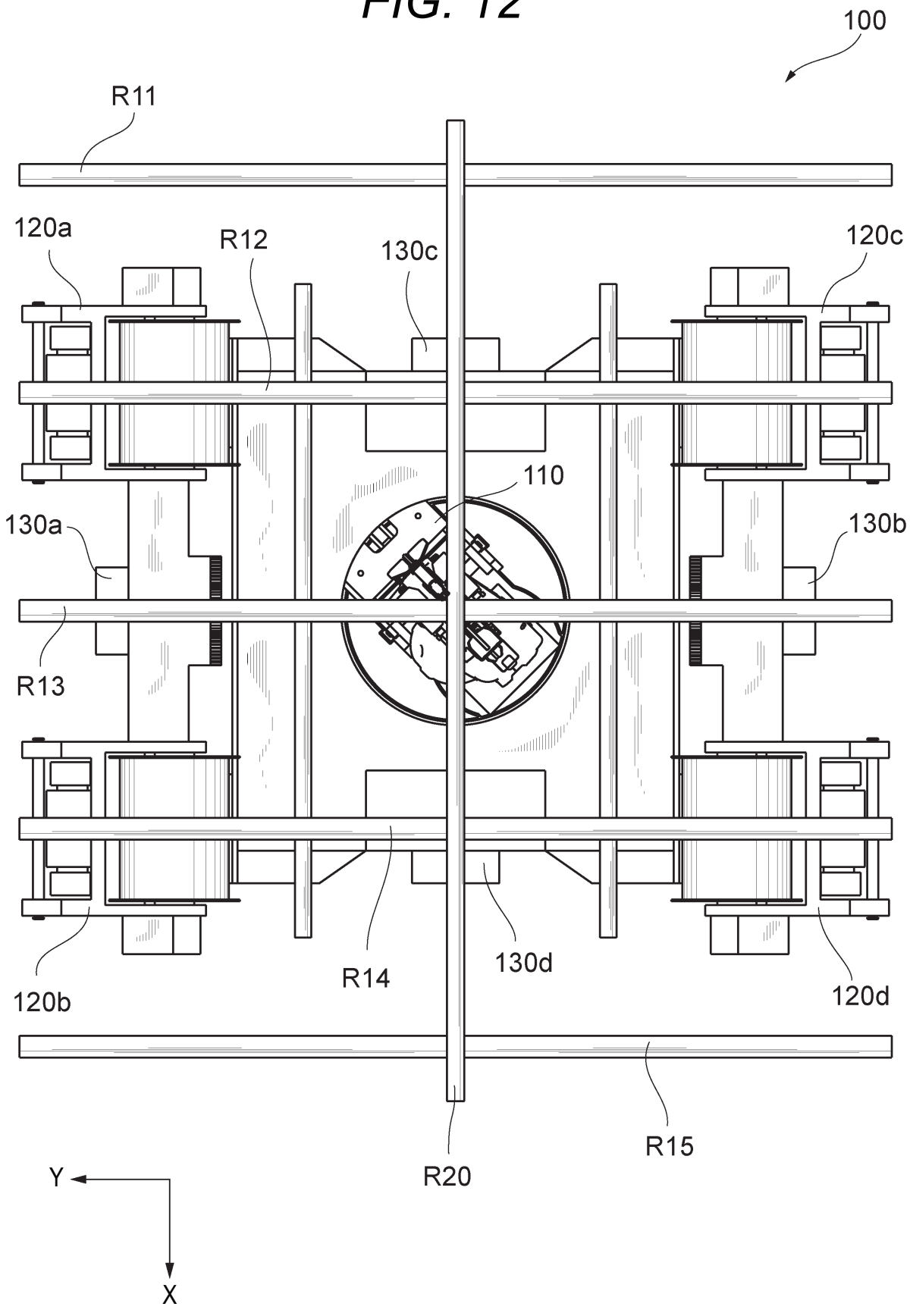

100
R11
120a
R12
130c
120c
110
130a
130b
R13
120b
R14
130d
120d
R15
R20
Y
X

FIG. 13B

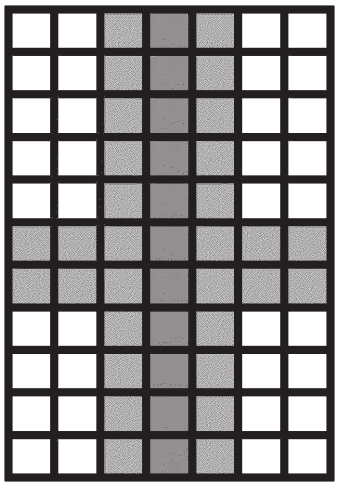


FIG. 13A

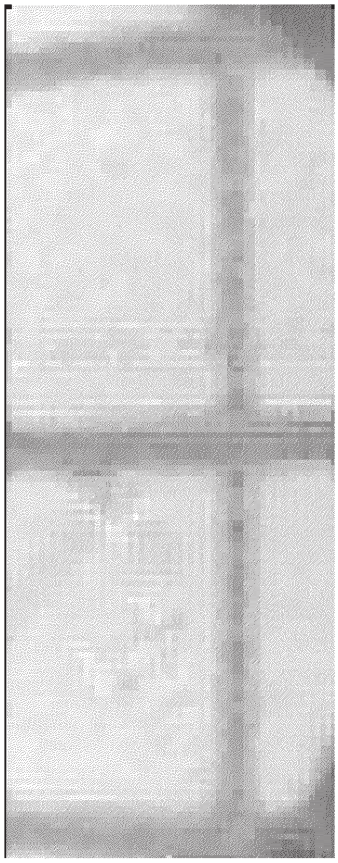


FIG. 14B

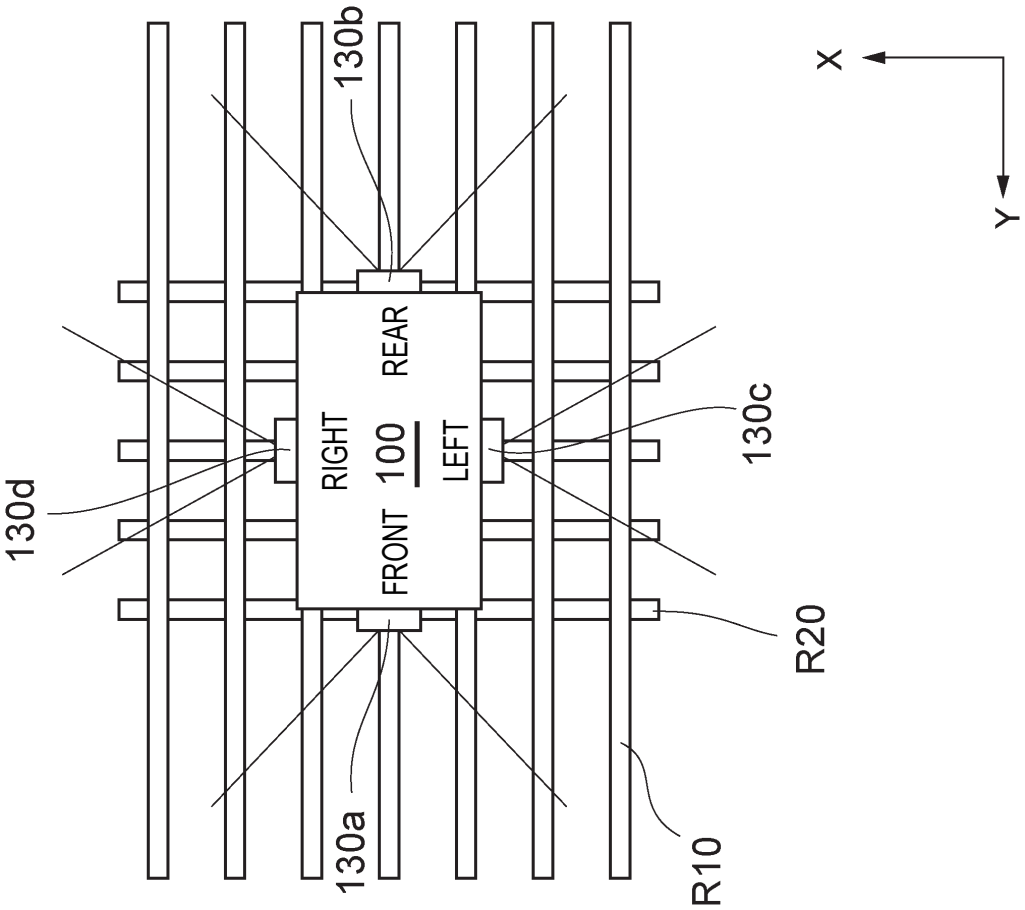


FIG. 14A

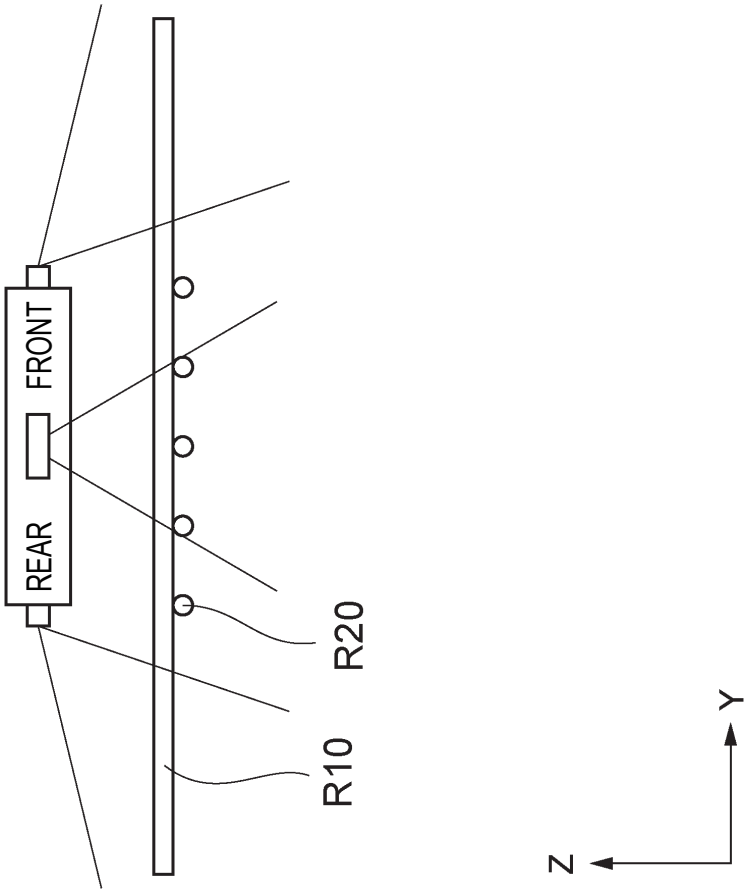


FIG. 15



FIG. 16

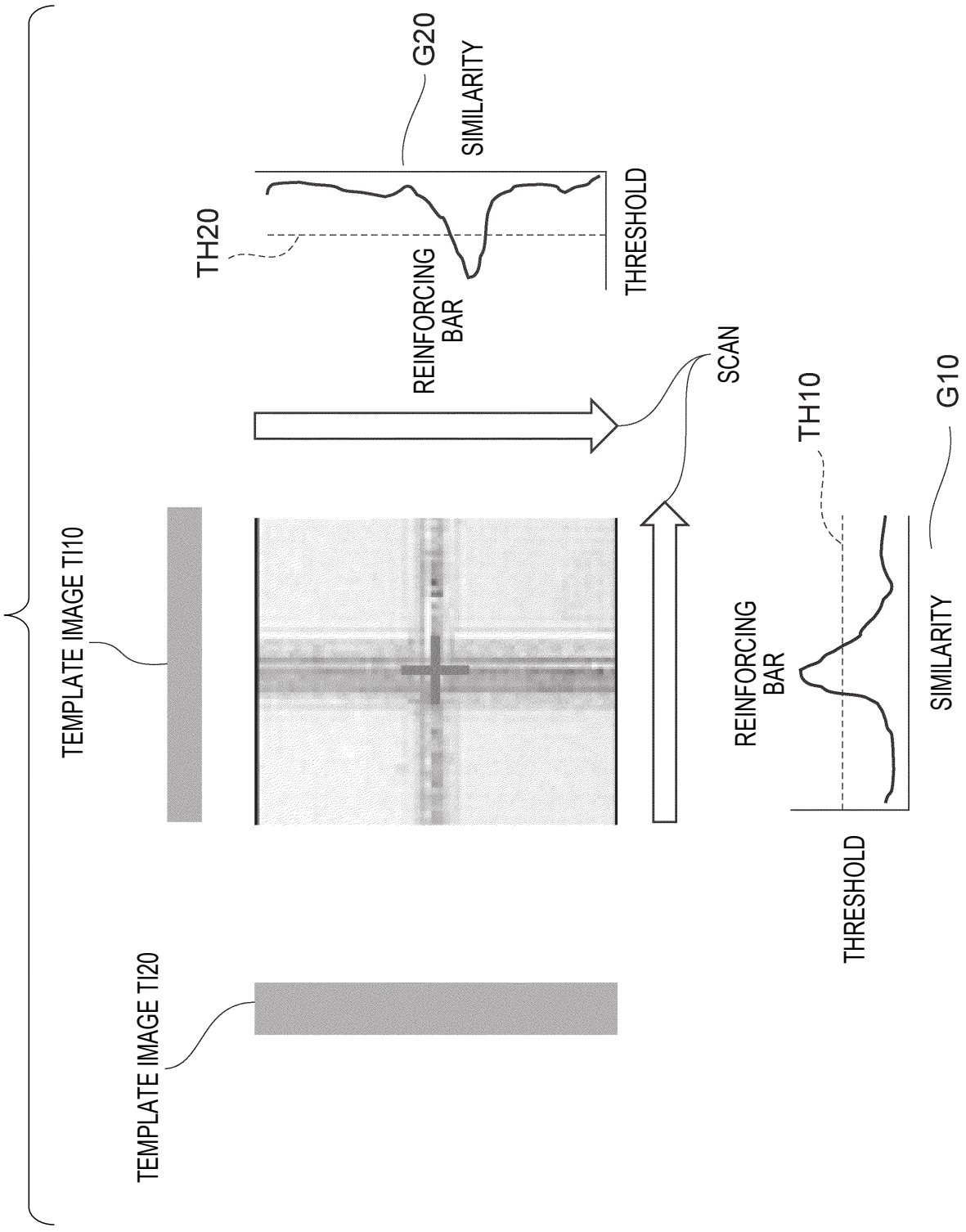

TEMPLATE IMAGE TI10
TEMPLATE IMAGE TI20
SCAN
REINFORCING BAR
TH10
G10
SIMILARITY
THRESHOLD
REINFORCING BAR
TH20
G20
SIMILARITY
THRESHOLD

FIG. 17

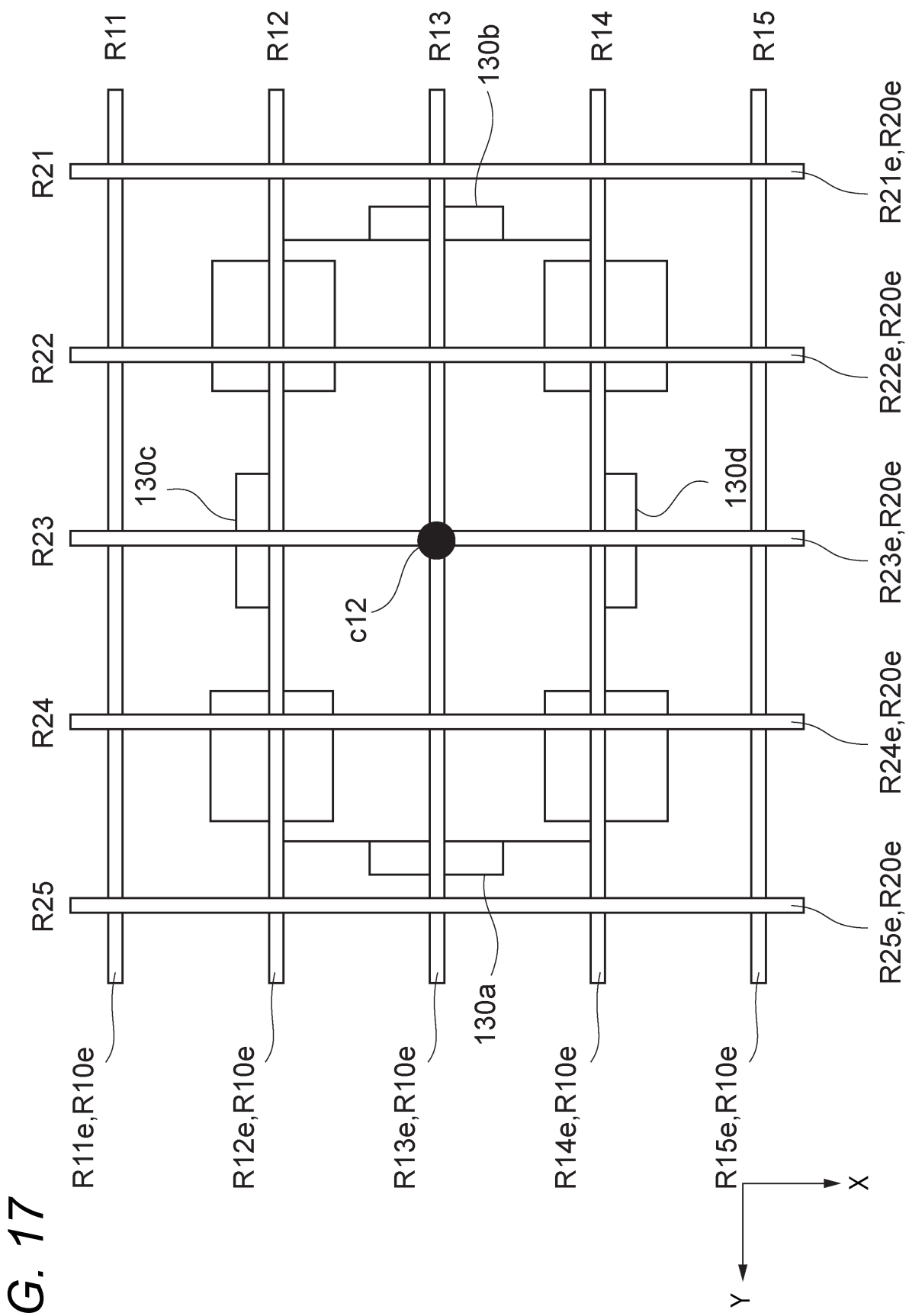

R11
R12
R13
R14
R15
130b
R21
R22
R23
R24
R25
R21e,R20e
R22e,R20e
R23e,R20e
R24e,R20e
R25e,R20e
130c
130d
c12
130a
R11e,R10e
R12e,R10e
R13e,R10e
R14e,R10e
R15e,R10e
X
Y

FIG. 18

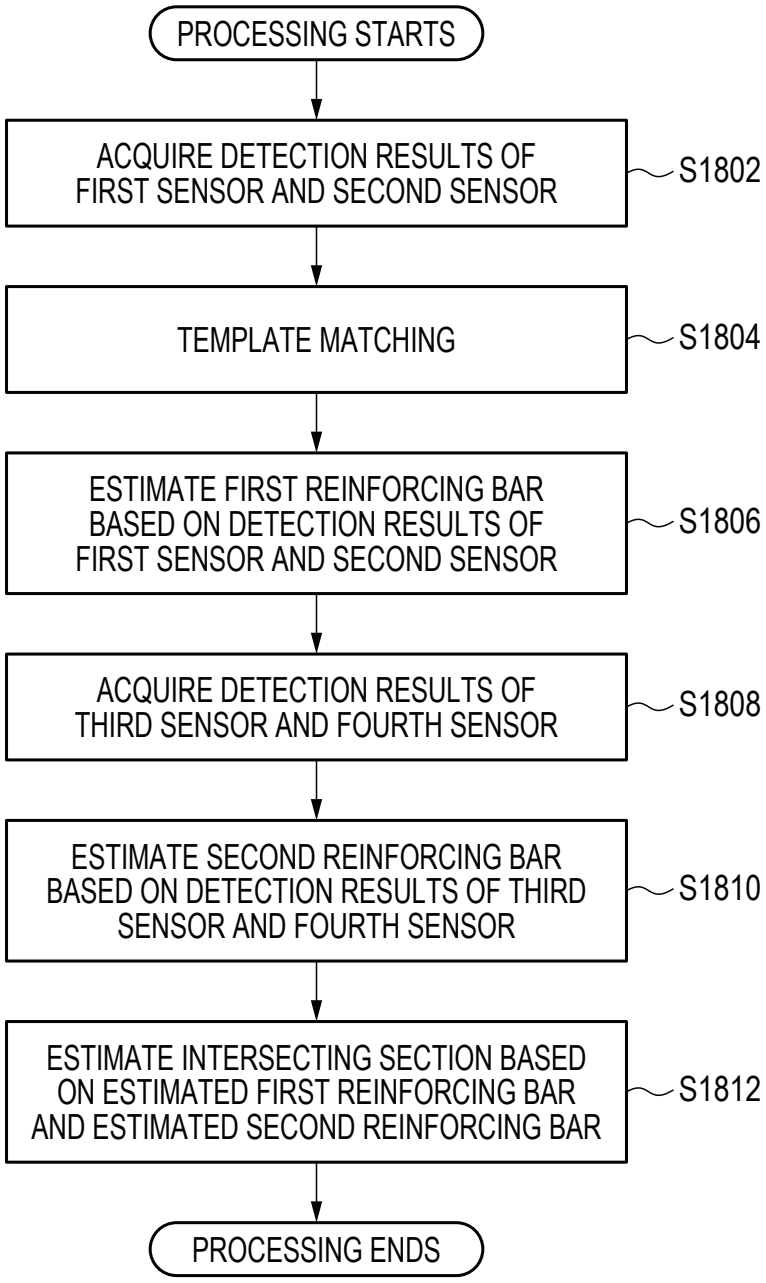

PROCESSING STARTS
ACQUIRE DETECTION RESULTS OF FIRST SENSOR AND SECOND SENSOR
S1802
TEMPLATE MATCHING
S1804
ESTIMATE FIRST REINFORCING BAR BASED ON DETECTION RESULTS OF FIRST SENSOR AND SECOND SENSOR
S1806
ACQUIRE DETECTION RESULTS OF THIRD SENSOR AND FOURTH SENSOR
S1808
ESTIMATE SECOND REINFORCING BAR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

FIG. 19

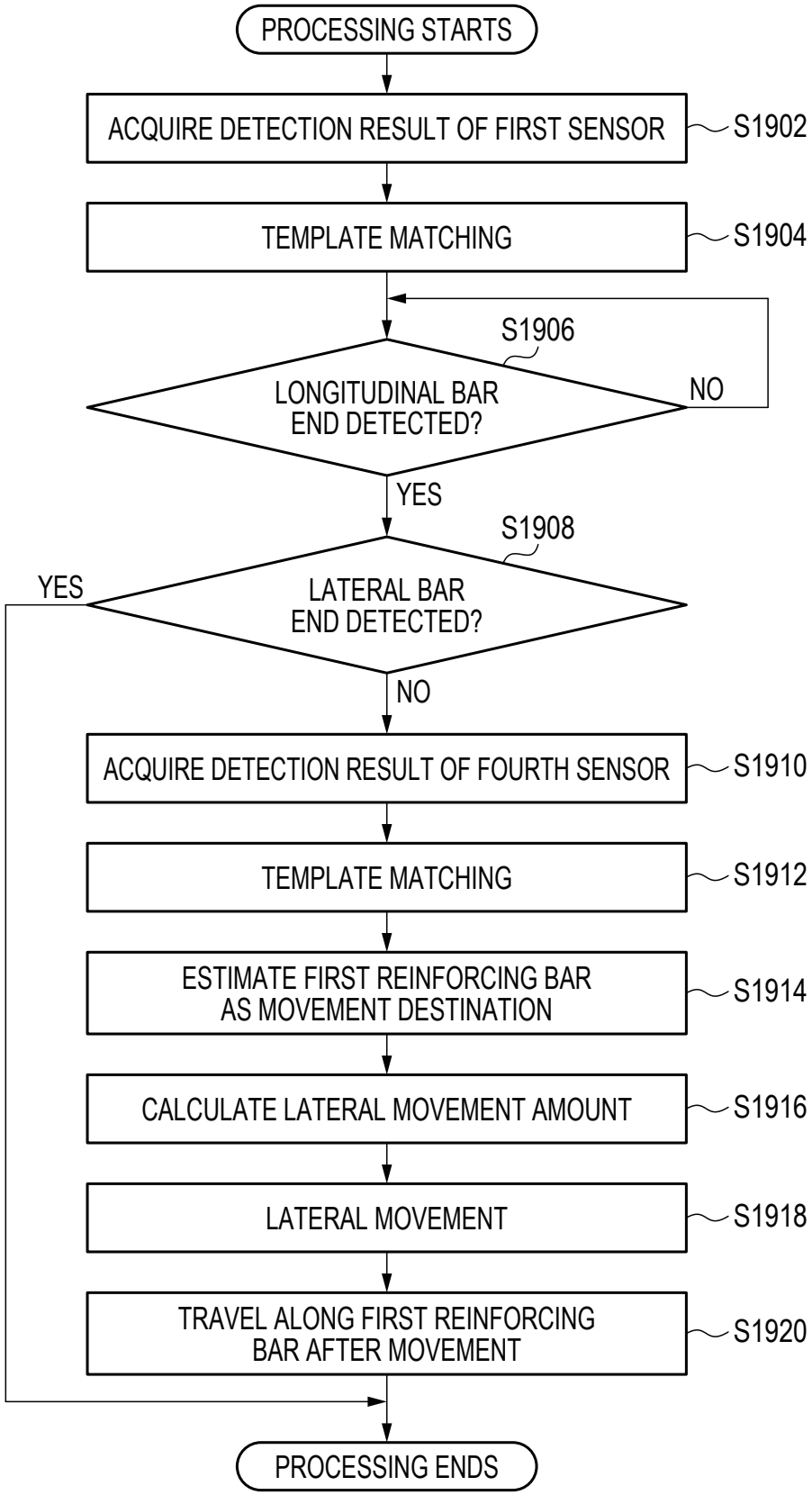

PROCESSING STARTS
ACQUIRE DETECTION RESULT OF FIRST SENSOR
S1902
TEMPLATE MATCHING
S1904
S1906
LONGITUDINAL BAR END DETECTED?
NO
YES
S1908
LATERAL BAR END DETECTED?
YES
NO
ACQUIRE DETECTION RESULT OF FOURTH SENSOR
S1910
TEMPLATE MATCHING
S1912
ESTIMATE FIRST REINFORCING BAR AS MOVEMENT DESTINATION
S1914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

FIG. 20

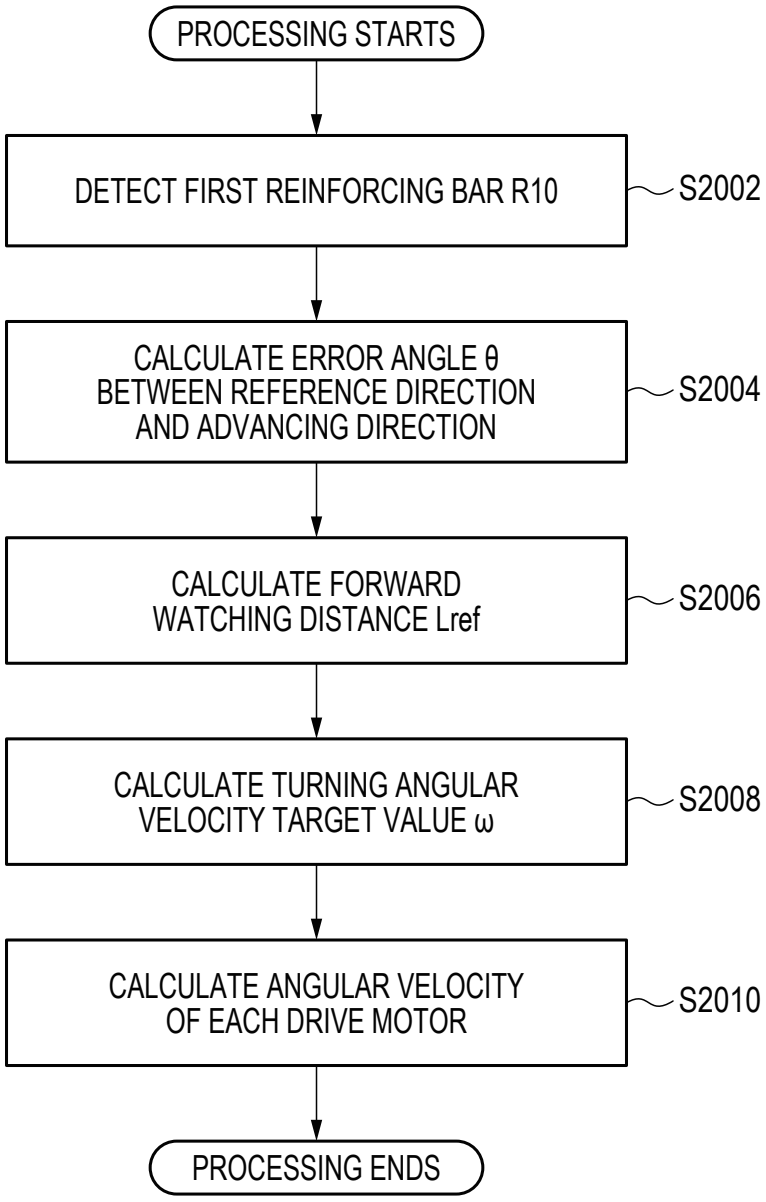

PROCESSING STARTS
DETECT FIRST REINFORCING BAR R10
S2002
CALCULATE ERROR ANGLE θ BETWEEN REFERENCE DIRECTION AND ADVANCING DIRECTION
S2004
CALCULATE FORWARD WATCHING DISTANCE Lref
S2006
CALCULATE TURNING ANGULAR VELOCITY TARGET VALUE ω
S2008
CALCULATE ANGULAR VELOCITY OF EACH DRIVE MOTOR
S2010
PROCESSING ENDS

FIG. 21

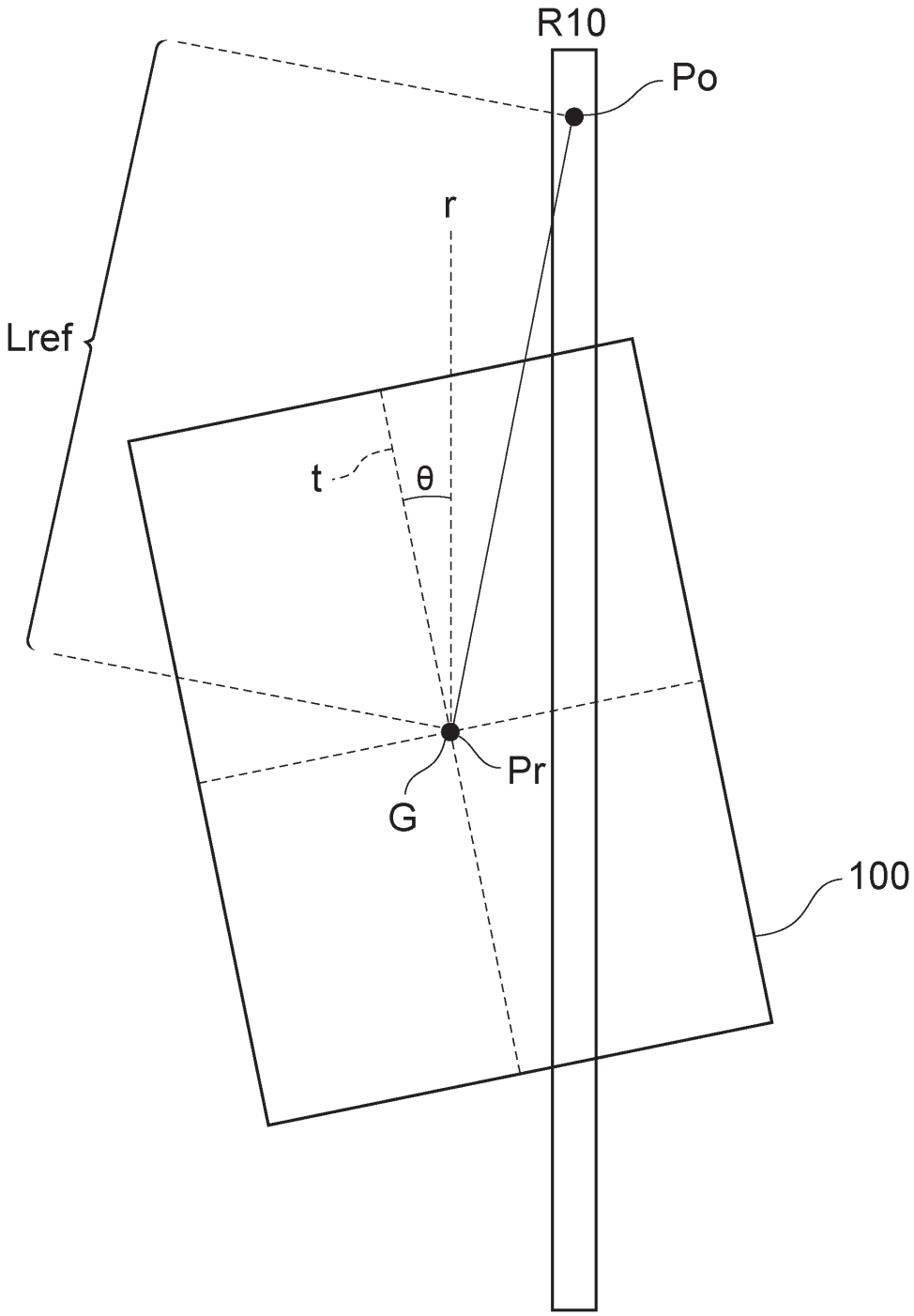


FIG. 22A

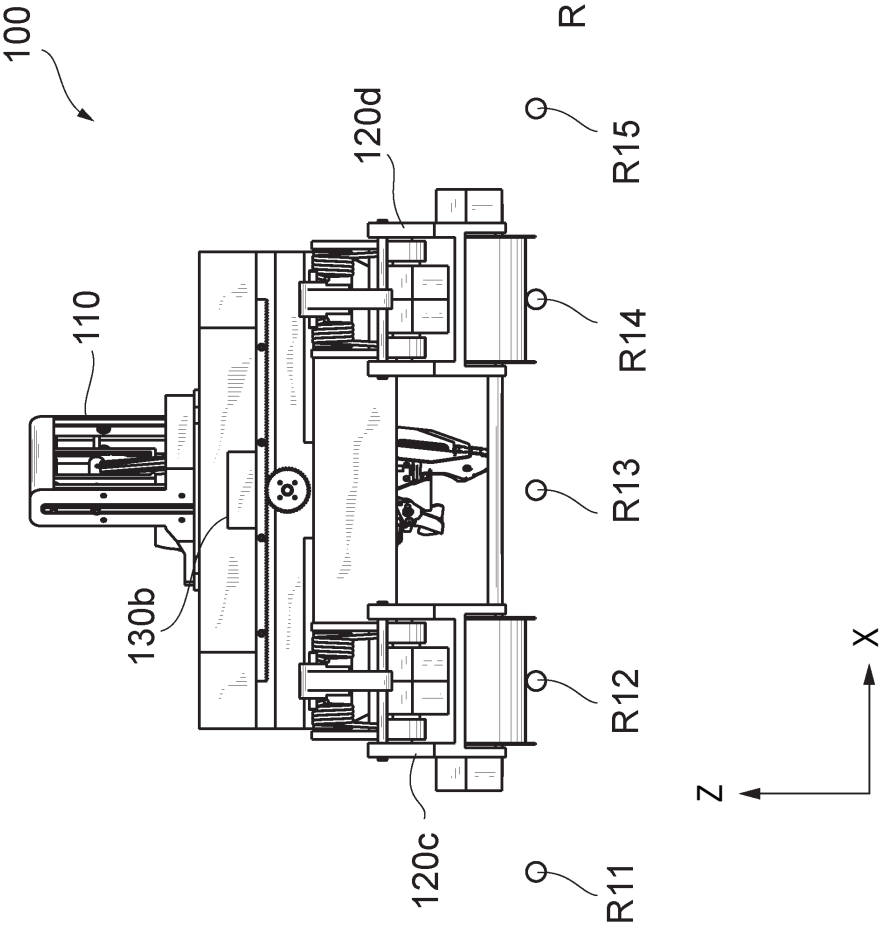


FIG. 22B

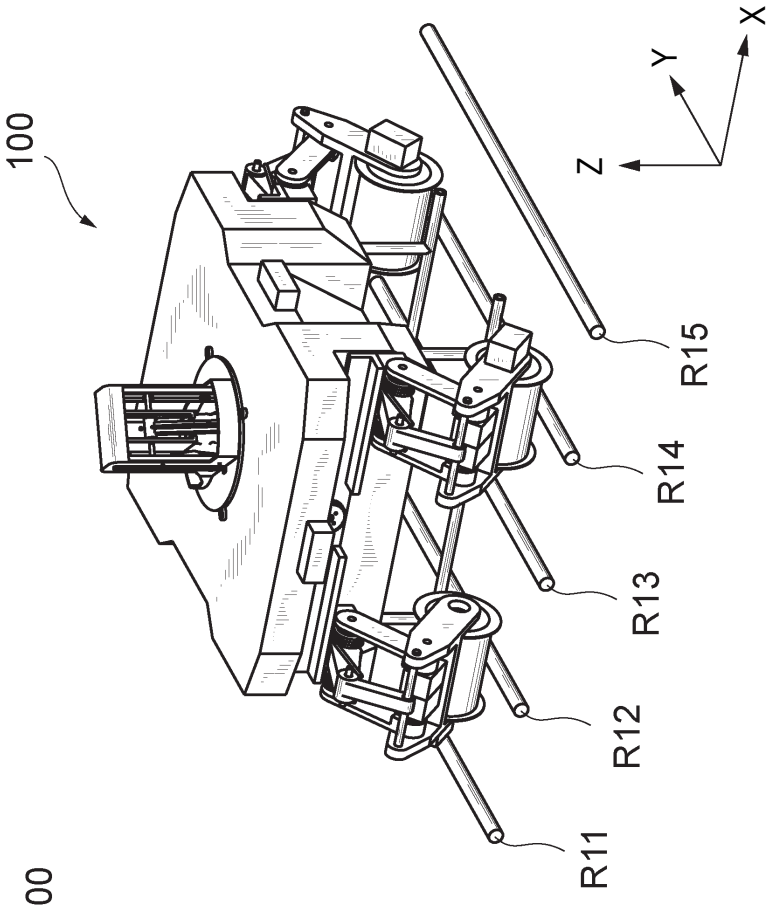


FIG. 23A

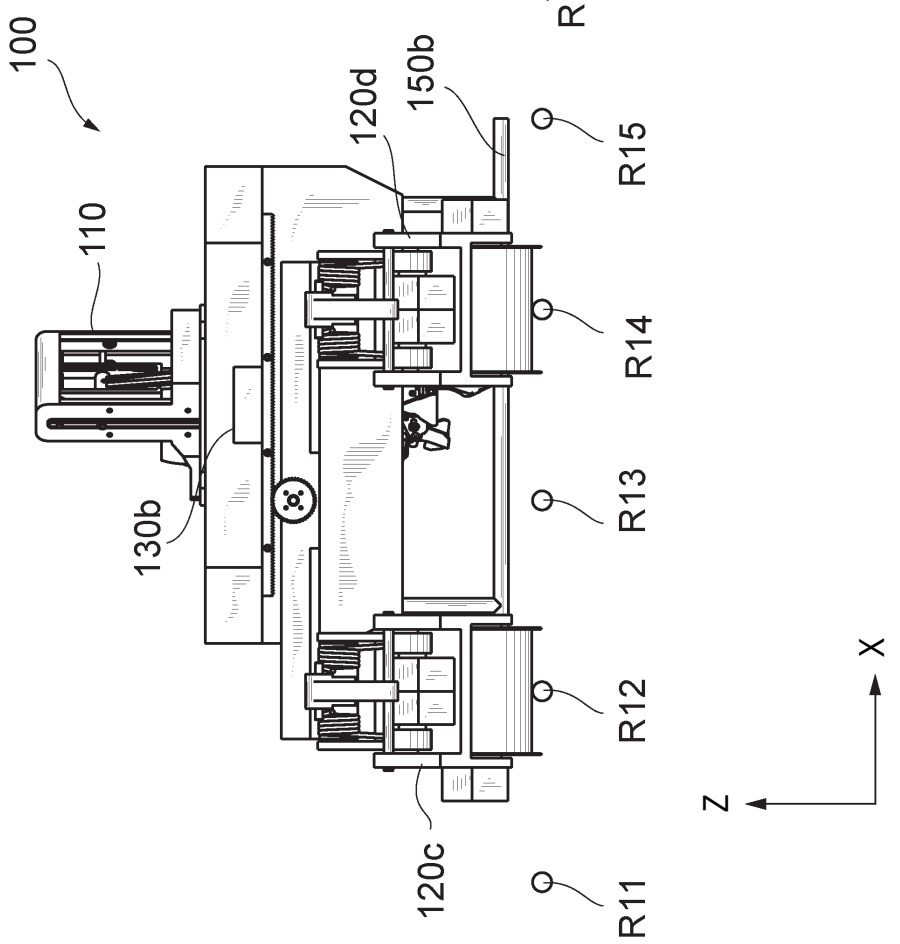


FIG. 23B

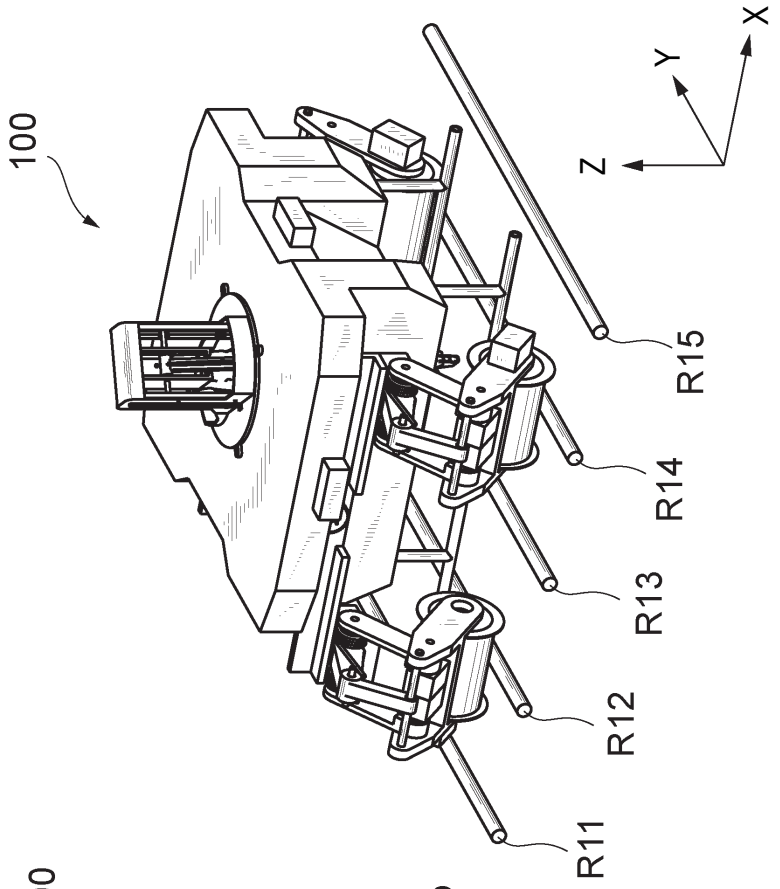


FIG. 24A

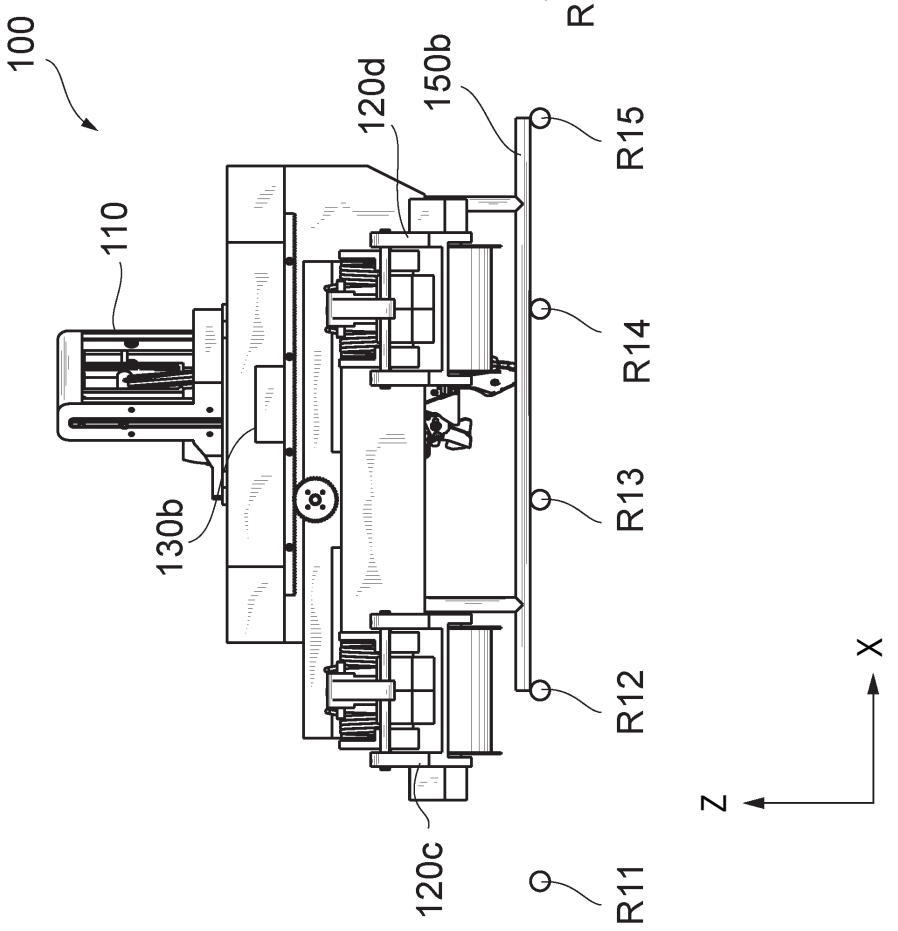


FIG. 24B

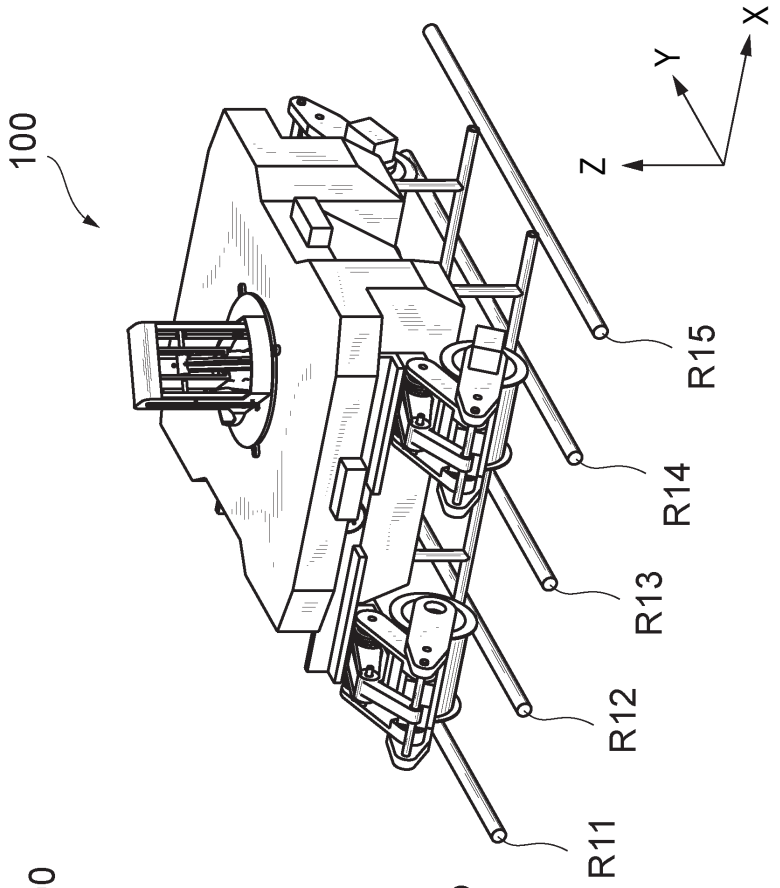


FIG. 25A

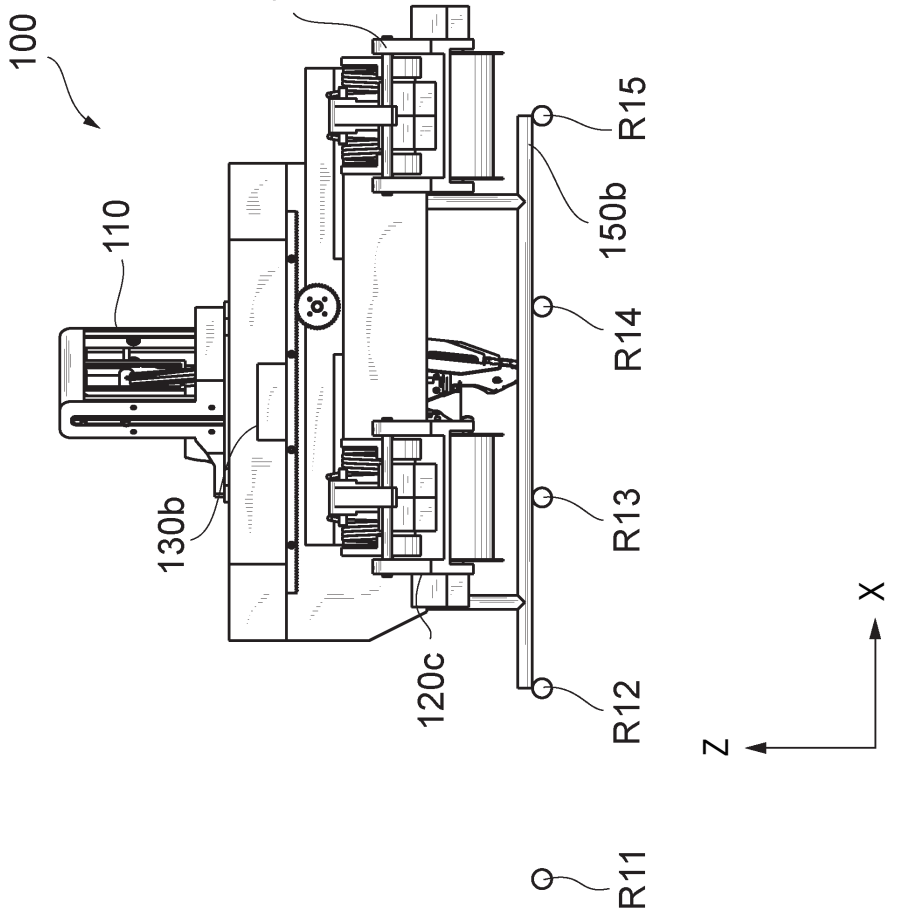


FIG. 25B

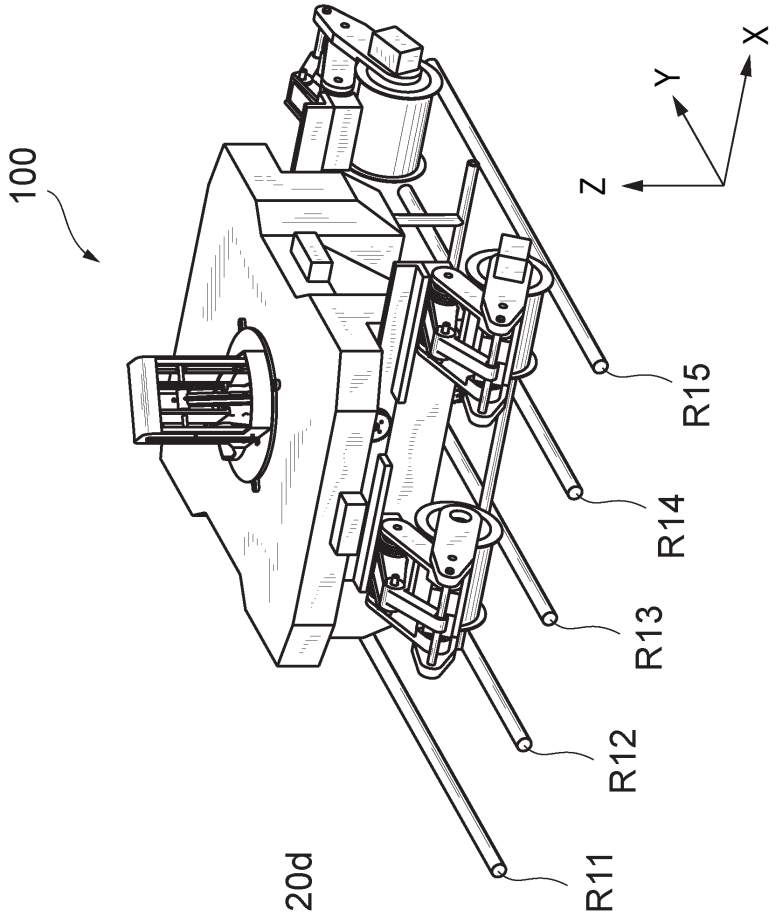


FIG. 26A

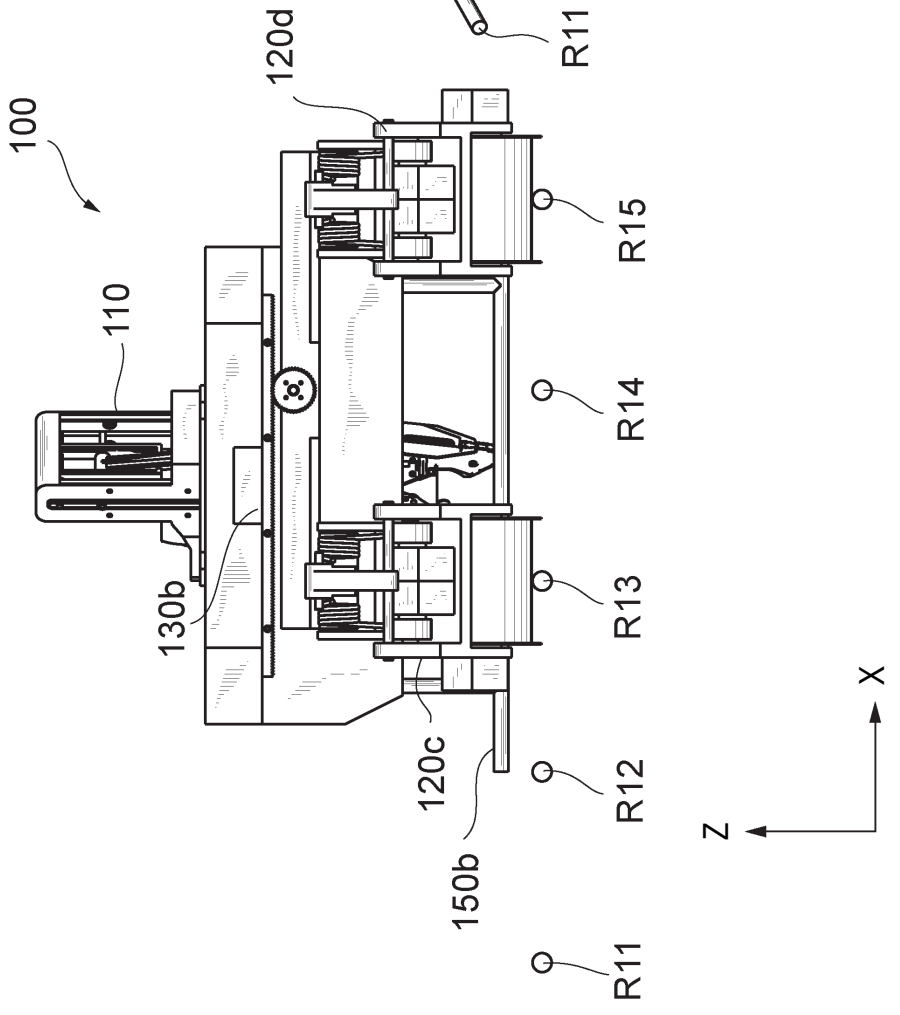


FIG. 26B

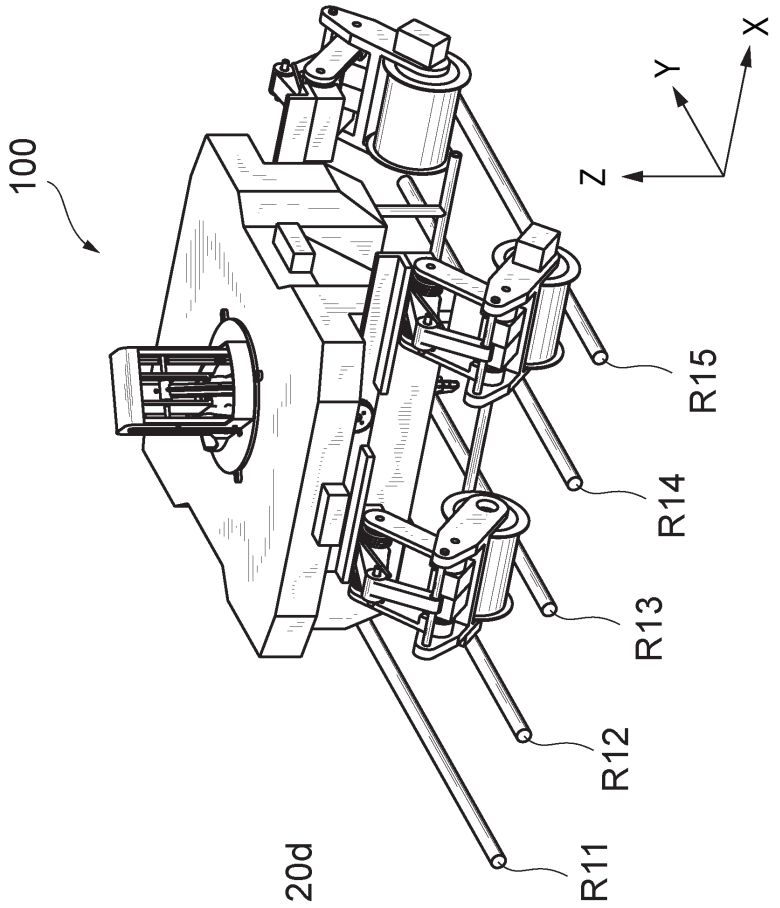


FIG. 27A

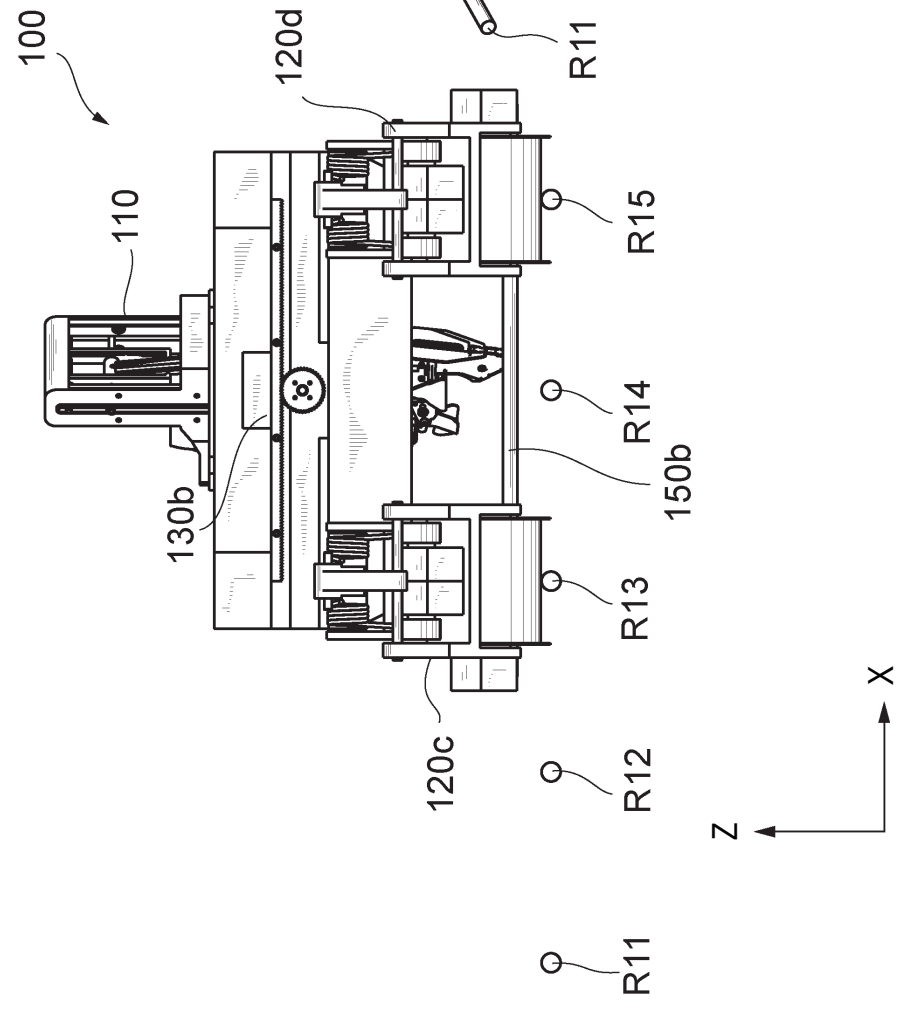


FIG. 27B

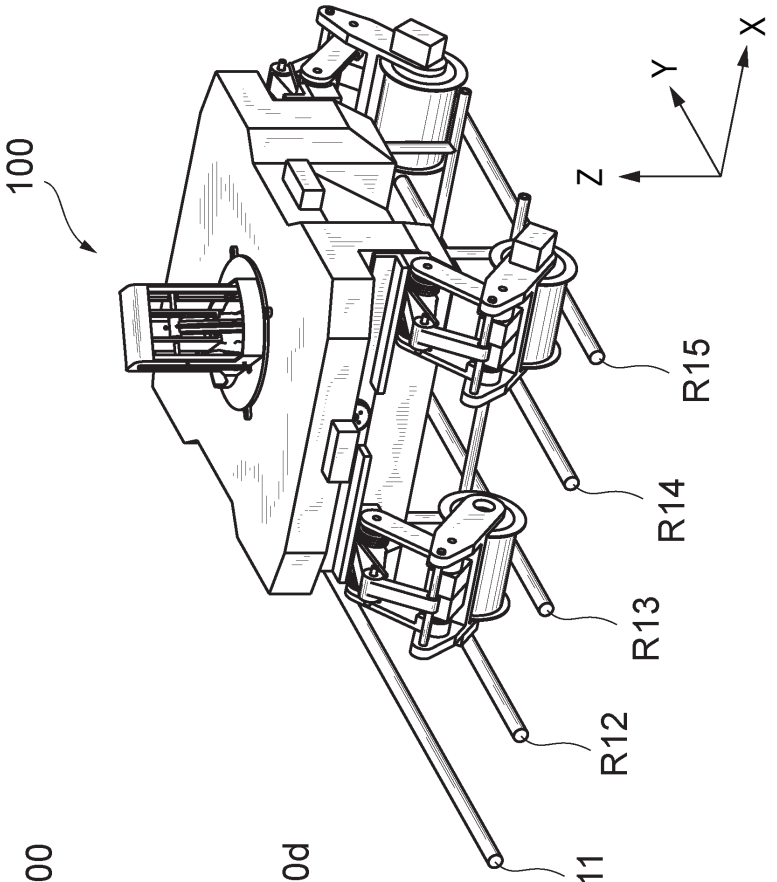


FIG. 28

