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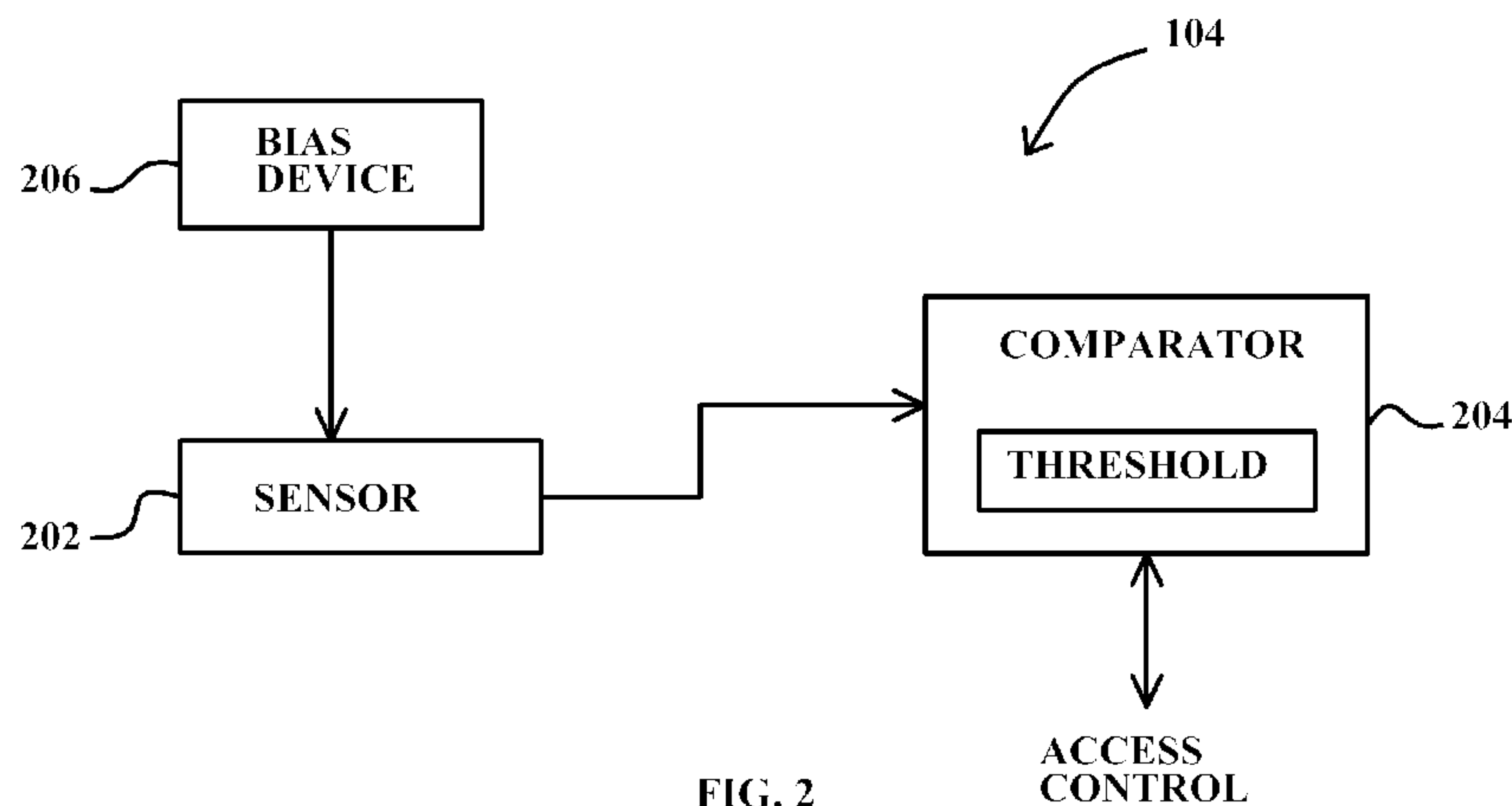


FIG. 2

(57) **Abrégé/Abstract:**

A security device, according to various aspects of the present invention, detects movement of a provided portal cover. The security device includes a sensor, a bias magnet, and a processor. The sensor provides indicia of a magnitude of a magnetic flux through the sensor. The bias magnet provides the magnetic flux through the sensor. The processor detects a change in the magnitude of the magnetic flux outside an upper boundary and a lower boundary of a first threshold and a second threshold respectively. The sensor does not move with respect to the magnet. Movement between the sensor and the portal cover changes the magnitude of the magnetic flux through the sensor. The processor determines an average value of a series of values of the indicia of the magnitude of the magnetic flux that fall within the upper boundary and the lower boundary of the first threshold. The upper boundary and the lower boundary of the first threshold and the second threshold respectively are set in accordance with the average value.

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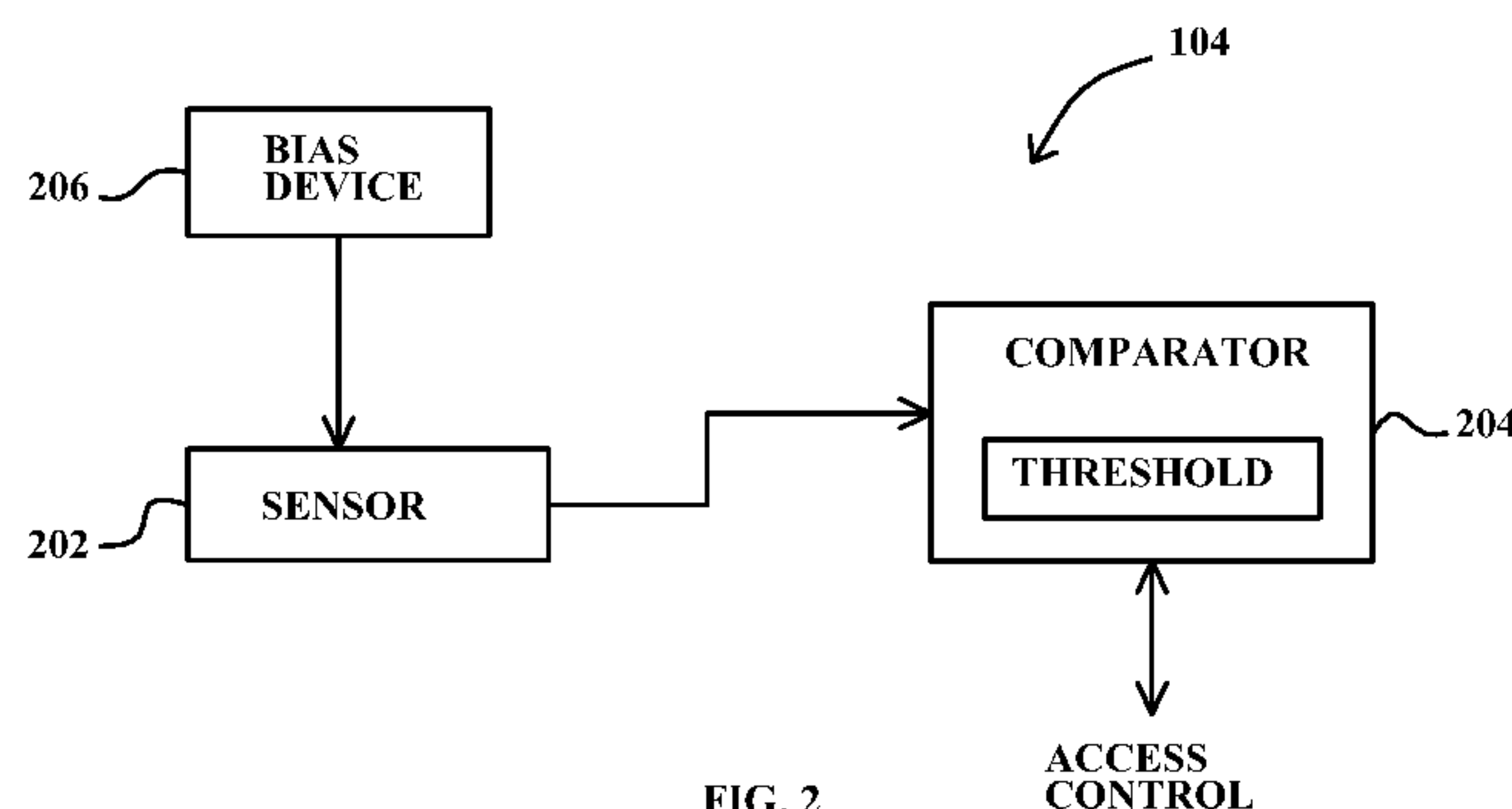


FIG. 2

(57) Abstract: A security device, according to various aspects of the present invention, detects movement of a provided portal cover. The security device includes a sensor, a bias magnet, and a processor. The sensor provides indicia of a magnitude of a magnetic flux through the sensor. The bias magnet provides the magnetic flux through the sensor. The processor detects a change in the magnitude of the magnetic flux outside an upper boundary and a lower boundary of a first threshold and a second threshold respectively. The sensor does not move with respect to the magnet. Movement between the sensor and the portal cover changes the magnitude of the magnetic flux through the sensor. The processor determines an average value of a series of values of the indicia of the magnitude of the magnetic flux that fall within the upper boundary and the lower boundary of the first threshold. The upper boundary and the lower boundary of the first threshold and the second threshold respectively are set in accordance with the average value.

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1 METHODS AND APPARATUS FOR SECURITY DEVICE PORTAL SENSING
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56 CROSS-REFERENCE TO RELATED APPLICATIONS

7 [0001] This application claims benefit under 35 U.S.C. §119(e) of U.S. Provisional
8 Application No. 60/874,996 filed 12/16/2006 herein incorporated by reference and U.S.
9 Provisional Application No. 60/897,785 filed 01/26/2007 herein incorporated by reference.

10
11 FIELD OF THE INVENTION

12 [0002] Embodiments of the present invention relate to apparatus for monitoring access to a
13 secured area through a portal.

14
15 BACKGROUND OF THE INVENTION

16 [0003] Conventional security devices have been used to control access to a secured area.
17 Access control includes detecting unauthorized ingress and/or egress; authenticating
18 authorized users, providing reports of ingress and/or egress; and providing timely notice of
19 unauthorized access. A security device that controls access to an area may benefit from fast,
20 efficient deployment into the area and detection of tampering with the security device by an
21 unauthorized person.

22
23 SUMMARY OF THE INVENTION

24 [0004] A security device, according to various aspects of the present invention, detects
25 movement of a provided portal cover. The security device includes a sensor, a bias magnet,
26 and a processor. The sensor provides indicia of a magnitude of a magnetic flux through the
27 sensor. The bias magnet provides the magnetic flux through the sensor. The processor
28 detects a change in the magnitude of the magnetic flux outside an upper boundary and a
29 lower boundary of a first threshold and a second threshold respectively. The sensor does not
30 move with respect to the magnet. Movement between the sensor and the portal cover
31 changes the magnitude of the magnetic flux through the sensor. The processor determines an
32 average value of a series of values of the indicia of the magnitude of the magnetic flux that
33 fall within the upper boundary and the lower boundary of the first threshold. The upper
34 boundary and the lower boundary of the first threshold and the second threshold respectively
35 are set in accordance with the average value.

1 [0005] A method, according to various aspects of the present invention, detects movement of
2 a portal cover. A security device performs the method. The method includes, in any
3 practical order, (1) averaging a series of values of indicia of a magnitude of a magnetic flux
4 through a sensor that fall within an upper and a lower boundary of a first threshold to provide
5 an average value; (2) detecting indicia the magnitude of the magnetic flux that falls outside
6 an upper and a lower boundary of a second threshold; (3) adjusting the upper and the lower
7 boundary of the first threshold and the second threshold respectively in accordance with the
8 average value; and (4) providing a signal in accordance with detecting. A magnet couples to
9 a body of the security device to provide the magnetic flux through the sensor. The sensor
10 couples to the body. The sensor does not move with respect to the magnet. Movement of the
11 sensor with respect to the portal cover changes the magnitude of the magnetic flux through
12 the sensor.

13 14 BRIEF DESCRIPTION OF THE DRAWING

15 [0006] Embodiments of the present invention will now be further described with reference to
16 the drawing, wherein like designations denote like elements, and:

17 [0007] FIG. 1 is a functional block diagram of a security device according to various aspects
18 of the present invention;

19 [0008] FIG. 2 is a functional block diagram of a removal detector according to various
20 aspects of the present invention;

21 [0009] FIG. 3 a plan view of the security device of FIG. 1 having an implementation of the
22 removal detector of FIG. 2 in a removed position;

23 [0010] FIG. 4 a plan view of the security device of FIG. 1 having an implementation of
24 the removal detector of FIG. 2 in a coupled position;

25 [0011] FIG. 5 a plan view of a bias device and a sensor of the removal detector of FIG. 2
26 in a removed position;

27 [0012] FIG. 6 a plan view of a bias device and a sensor of the removal detector of FIG. 2
28 in a coupled position;

29 [0013] FIG. 7 a plan view of a bias device and a sensor of the removal detector of FIG. 2
30 in a removed position;

31 [0014] FIG. 8 a plan view of the security device of FIG. 1 having an implementation of
32 the removal detector of FIG. 2;

33 [0015] FIG. 9 a plan view a sensing axis of a sensor of the removal detector of FIG. 2;

1 [0016] FIG. 10 a plan view of the security device of FIG. 1 having an implementation of
2 the removal detector of FIG. 2 in a removed position;

3 [0017] FIG. 11 a plan view of the security device of FIG. 1 having an implementation of
4 the removal detector of FIG. 2 in a coupled position;

5 [0018] FIG. 12 is a functional block diagram of a portal sensor according to various
6 aspects of the present invention;

7 [0019] FIG. 13 a plan view of the security device of FIG. 1 having an implementation of
8 the portal sensor of FIG. 12 in a position distal from a portal cover;

9 [0020] FIG. 14 a plan view of the security device of FIG. 1 having an implementation of
10 the portal sensor of FIG. 12 in a position proximate to a portal cover;

11 [0021] FIG. 15 is a data flow diagram of a method performed by security device of FIGs.
12 1, 8, and 12;

13 [0022] FIG. 16 is a diagram of indicia of a magnetic flux, a drift threshold, and an alarm
14 threshold of the portal sensor of FIG. 12 over time;

15 [0023] FIG. 17 is a diagram of an average value of the indicia of magnetic flux of FIG.
16 16;

17 [0024] FIG. 18 is a plan view of the security device of FIG. 1 positioned on a portal cover
18 having a right portal cover and a left portal cover;

19 [0025] FIG. 19 is a plan view of an implementation of the security device of FIG. 1
20 positioned as shown in FIG. 18;

21 [0026] FIG. 20 is a plan view of an implementation of the security device of FIG. 1;

22 [0027] FIG. 21 is a plan view of an implementation of the security device of FIG. 1
23 having a track that permits sensor movement;

24 [0028] FIG. 22 is a plan view of an implementation of the security device of FIG. 1 that
25 provides a signal through a portal cover;

26 [0029] FIG. 23 is a perspective plan view of the security device of FIG. 1 having an
27 implementation of a coupling apparatus according to various aspects of the present invention;

28 [0030] FIG. 24 is a perspective view of the coupling apparatus of FIG. 23;

29 [0031] FIG. 25 is a perspective view of the security device of FIG. 23 having a coupling
30 apparatus;

31 [0032] FIG. 26 is a plan view of the security device of FIG. 1 having an implementation
32 of a coupling apparatus according to various aspects of the present invention;

33
34 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

1 [0033] A security device, according to various aspects of the present invention, secures
2 an area accessible through a portal (e.g., doorway, window opening, hatch, vent) against
3 unreported ingress and/or egress (e.g., access). A security device monitors a portal to provide
4 reports of ingress and egress; a warning of unauthorized access; authentication of authorized
5 users; and status of the security device.

6 [0034] A security device detects physical stimulus (e.g., electrical, magnetic, pressure,
7 movement, temperature, light, electromagnetic radiation), physical quantities, physical
8 characteristics, and/or a change in a physical quantity or characteristic to detect access to the
9 secured area through a portal. For example a security device may detect changes in
10 temperature, magnetic flux, motion, pressure exerted against an object; and light (e.g.,
11 intensity, wavelength), and radio frequency signals. A security device may detect changes
12 (e.g., increase, decrease, average value, rate of change, departure from a quiescent value) in
13 physical stimulus as indicia of access to the secured area. A security device may detect
14 physical quantities of heat, light, vibration, and magnetic flux.

15 [0035] A security device may provide a warning of unauthorized access including a loud
16 noise (e.g., siren, alarm, bell, human operator voice), transmitting a signal, receiving a signal,
17 transmit a message, receive a message, and establishing communication with an authorized
18 user (e.g., monitoring service). The security device may determine a type of warning action
19 in accordance with a policy or a decision by a human operator. Lack of authorization may be
20 detected by a failure to provide user specific information (e.g., pin, access code, employee id
21 number), time of access (e.g., outside of regular working hours), location of access (e.g.,
22 access to a particular site rarely or never authorized); time to respond (e.g., slow response
23 from user, response before required), and type of response (e.g., user enters distress code).

24 [0036] A security device may authenticate users. Authentication may compare user
25 provided information with information maintained by the security device or knowledge of a
26 human operator. User information may include a pin, biometric information (e.g., voice, iris,
27 fingerprint, voice pattern, facial recognition), a password (e.g., a one-touch device, user
28 supplied password, Dallas/Maxium "one-touch"), a phone number, an employee number, a
29 bar code, and an RFID transmission. User information may be authenticated locally or
30 transmitted to a remote location for authentication.

31 [0037] Status of the security device may include an amount of battery charge, a removal
32 event, component health, physical stimulus detected, amounts of physical stimulus detected,
33 and variations of physical stimulus. A removal event may include moving, shaking, or
34 striking the security device without authorization. A security device may provide notice of

1 the status of the security device. Notice may include transmitting a signal (e.g., radio
2 transmission, flashing LED), transmitting a message (e.g., phone message, email, text
3 message), and producing a noise (e.g., siren, alarm, bell, beep). Notice may include status
4 information (e.g., amount of battery charge, receive signal strength, transmit signal strength,
5 occurrence of a removal event, type of removal event).

6 **[0038]** A security device may provide information (e.g., report, summary, statistics)
7 concerning access to the secured area. A report may include time of access, date of access,
8 user information, security device status information, physical stimulus detected, notice
9 provided, warning provided, policy implemented, and actions taken by a human operator. A
10 security device may provide a report according to a policy (e.g., weekly, monthly, concurrent
11 with notice of unauthorized access) or upon request.

12 **[0039]** For example, security device 100 of FIGs. 1 – 26, according to various aspects of
13 the present invention, monitors access to a secured area accessible by a portal by monitoring
14 a portal cover and detecting removal of the security device. Security device 100 may include
15 one or more portal sensors 102, one or more removal detectors 104, zero or more motion
16 sensors, access control 110 and zero or more communication modules 112.

17 **[0040]** A portal sensor detects ingress and egress through a portal to and from a protected
18 area. A portal sensor detects physical stimulus, physical quantities, physical characteristics,
19 and/or a change in a physical quantity or characteristic. A portal sensor may detect
20 movement of a portal cover (e.g., door, window) as an indication of access through a portal.
21 A portal sensor may report an event. Events may include greater than threshold amount of
22 movement of a portal cover (e.g., opening, closing), greater than threshold duration of a
23 portal cover in a particular position (e.g., open, closed, partially open), greater than threshold
24 speed and/or acceleration of portal movement, and greater than threshold amount of force
25 applied to the portal and/or the port cover (e.g., attack, destruction).

26 **[0041]** A removal detector detects removal of the security device from a location. A
27 location includes position and/or orientation of the security device. A removal detector
28 detects physical stimulus, physical quantities, physical characteristics, and/or a change in a
29 physical quantity or characteristic. Physical stimulus used to detect a removal may include
30 movement in a direction, vibration, change of a physical force, a change in orientation, and
31 acceleration of the security device. A removal detector may detect an event (e.g., removal,
32 replacement). A removal detector may report an event.

33 **[0042]** A removal detector may couple a security device to a surface. Coupling includes
34 coupling a removal detector to a surface using a same physical stimulus monitored by the

1 removal detector to detect removal. A surface includes a portal cover, a portal frame, a
2 surface adjacent to a portal, and a surface adjacent to a portal cover.

3 **[0043]** A motion sensor detects movement of the security device. A motion sensor
4 detects physical stimulus, physical quantities, physical characteristics, and/or a change in a
5 physical quantity or characteristic. A motion sensor may detect a physical stimulus that is
6 different from the physical stimulus detected by a removal detector. A motion sensor may
7 detect an event. A motion sensor may report an event. An event may include motion greater
8 than a threshold and vibration within a frequency range. A motion sensor includes any
9 conventional motion and/or vibration sensor. An implementation of security device 100
10 includes a motion sensor that includes a piezo film strip.

11 **[0044]** Access control may receive event notices, apply policy for warning action, apply
12 policy for a response to authorized and/or unauthorized access, and assist in event detection.
13 Event notices may be reported to the access control from any sensor, detector, user (e.g.,
14 panic button), or system operator (e.g., system test). Access control may include any
15 conventional data processing equipment, communication equipment, sensing equipment, and
16 software. Assisting in event detection may include receiving physical stimulus, physical
17 quantities, and/or physical characteristics from a sensor and/or detector to detect a change.
18 Applying policy may include receiving user information, transmitting user information to a
19 central location, receiving stored user information, transmitting stored user information,
20 comparing user information to stored information, reporting authentication status (e.g., failed,
21 successful), and determining a response to unauthorized access.

22 **[0045]** A communication module communicates with other units of a security system.
23 Units of a security system may include security devices as described herein, an aggregator
24 that aggregate information from a plurality of security devices, and a central location (e.g.,
25 manned, unmanned). A communication module communicates using any conventional
26 hardware (e.g., wired, wireless) and any conventional protocol (e.g., TCP/IP, 802.11, Zigbee,
27 cellular telephone). A communication module receives and/or transmits information.
28 Information may include reports, event notices, policy, actions taken according to policy, user
29 information, stored information, physical stimulus detected, physical quantities detected,
30 physical characteristics detected, and/or a change in a physical quantity or characteristic
31 detected.

32 **[0046]** Access control may use information received by the communication module.
33 Access control may transmit information to another unit using the communication module.

1 [0047] An implementation of security device 100 may include portal sensor 102, removal
2 detector 104, motion sensor 106, access control 110, and communication module 112.

3 [0048] Removal detector 104 may include bias device 206, sensor 202, and comparator
4 204.

5 [0049] A sensor detects physical stimulus, physical quantities, physical characteristics,
6 and/or a change in a physical quantity or characteristic. A sensor may detect indicia of
7 removal. A sensor may include any conventional sensing equipment and software. For
8 example, sensor 202 may include a magnetic flux sensor (e.g., Hall effect sensor, a
9 magnetometer, a gaussmeter), vibration sensors, current sensors, voltage sensors, light
10 sensors, location sensors (e.g., GPS), and motion sensor (e.g., field of view differencing
11 detectors, illumination change detectors, change of reflectivity detectors).

12 [0050] A bias device provides a physical stimulus of the type of physical stimulus
13 detected by the sensor. A bias device provides a base quantity (e.g., magnitude) of a physical
14 stimulus. A sensor detects at least a portion of the base quantity. Environmental factors
15 (e.g., proximity to a physical object, human activity, movement) may affect the quantity of
16 the base stimulus detected by the sensor. Environmental factors may increase or decrease the
17 quantity of the physical stimulus detected by the sensor.

18 [0051] A comparator receives information regarding the quantity of the physical stimulus
19 detected by the sensor. A comparator may detect a threshold change in the quantity of the
20 physical stimulus detected by the sensor. A comparator may apply a hysteresis to the
21 information received from the sensor to reduce an effect that noise may have on the quantity
22 of the physical stimulus reported by the sensor. A comparator may provide a notice in
23 accordance with detecting a threshold change in the quality of physical stimulus detected by
24 the sensor. A notice may include a voltage, a current, and a data packet of a communication
25 protocol. A threshold may be adjusted. Adjustment includes increasing, decreasing, and
26 maintaining a value of the threshold. An adjustment may be made in accordance with
27 temperature, age, duty cycle, and environmental conditions.

28 [0052] In one implementation, bias device 206 includes magnets 310 and 312. Sensor
29 202 includes hall switch 314. Hall switch 314 includes a comparator having a threshold.
30 Hall switch 314 provides an electrical signal in accordance with a change in the magnitude of
31 the magnetic flux detected by hall switch 314 greater than the threshold. Hall switch 314 is
32 positioned in such a manner that at least a portion of magnetic flux 308 between a pole of
33 magnet 310 and a pole of opposite polarity of magnet 312 conducts through hall switch 314.

1 Magnetic flux 306 between a pole of magnet 310 and a pole of opposite polarity of magnet
2 312 conducts away from hall switch 314 through metal 304.

3 **[0053]** Movement of removal detector 104 to a position proximate to metal surface 402
4 conducts magnetic flux 404 (e.g., at least a portion of magnetic flux 308) away from Hall
5 switch 314. Hall switch 314 detects a change between the magnitude of the magnetic flux
6 308 and 404 that conducts through hall switch 314. Hall switch 314 provides a signal in
7 accordance with detecting the change. Hall switch 314 may provide the signal to access
8 control 110. The signal provides indicia of a removal of removal sensor 104 from metal
9 surface 402.

10 **[0054]** Removal detector 104 may couple to security device 100 in such a manner that
11 movement of security device 100 results in detectable movement in removal detector 104.
12 The above implementation of removal detector 104 may detect removal of removal device
13 104, and thus security device 100, from surface 402. Coupling removal detector 104 to
14 security device 100 and/or to metal surface 402 may include attaching with glue, securing
15 with a fastener, and coupling with magnetic force.

16 **[0055]** In one implementation, security device 100 includes metal 304 in body 302.
17 Magnets 310 and 312 magnetically couple to metal 304. Magnets 310 and 312 may be
18 further held in a position using structure related to body 302 or metal plate 304. Structure
19 may include walls, supports, and recesses.

20 **[0056]** Hall switch 314 couples to security device 100. The coupling of Hall switch 314
21 to security device 100 includes using a fastener and positioning hall switch 314 in a bore in
22 metal 304. Hall switch 314 couples in such a manner that hall switch 314 does not move
23 (e.g., rotational movement, vertical movement, horizontal movement) with respect to magnet
24 310 and magnet 312 as security device 100 moves. Accordingly, movement of security
25 device 100 from a position away from metal surface 402 to a position proximate (e.g., in
26 contact) to metal surface 402 does not change the position between hall switch 314, magnet
27 310 and/or magnet 312. A spaced between sensor 202 and bias device 206 may be potted to
28 reduce movement between sensor 202 and bias device 206.

29 **[0057]** The physical stimulus provided by bias device 206 may further provide a coupling
30 force. The coupling force may couple removal detector 104 to security device 100 and/or to
31 an object. As mentioned above, in one implementation, magnets 310 and 312 of removal
32 detector 104 magnetically couple to metal 304 of security device 100. Magnets 310 and 312
33 may further magnetically couple security device 100 to metal surface 402. Coupling security
34 device 100 to metal surface 402 conducts magnetic flux 404 away from Hall switch 314.

1 Removal of security device 100 from metal surface 402 permits at least a portion of magnetic
2 flux 308 to conduct through Hall switch 314. Detection of a change in the magnitude of the
3 magnetic flux through Hall switch 314 provides indicia of a removal or an attachment of
4 security device 100 from/to metal surface 402.

5 **[0058]** Metal surface 402 may include a metal door, a door with a metal surface, a door
6 having a metal portion, a metal portal cover, a surface adjacent to a portal.

7 **[0059]** An implementation of removal detector 104 includes u-shaped magnet 502 and
8 hall switch 506 positioned in the cavity of u-shaped magnet 502. At least a portion of
9 magnetic flux 504 from a north pole and a south pole of magnet 502 conducts through hall
10 switch 506. Placement of removal detector 104 proximate to metal surface 602 conducts
11 magnetic flux 604 (e.g., at least a portion of magnetic flux 504) away from Hall switch 506.
12 Hall switch 506 detects a change between the magnitude of the magnetic flux 504 and 604.
13 Hall switch 506 provides a signal in accordance with detecting the change.

14 **[0060]** An implementation of removal detector 104 includes cylindrical magnet 702 and
15 hall switch 706 positioned in a cavity of magnet 702. At least a portion of magnetic flux 704
16 from a north pole and a south pole of magnet 702 conducts through Hall switch 706.
17 Placement of removal detector 104 proximate to a metal surface conducts at least a portion of
18 magnetic flux 704 away from Hall switch 706. Hall switch 706 detects a conducting away of
19 magnetic flux away from Hall switch 706 when removal detector 104 is positioned proximate
20 to a metal surface. Hall switch 706 provides a signal in accordance with detecting a
21 conducting away.

22 **[0061]** An implementation of security device 800 includes at least one of removal
23 detectors 830 and 840. Magnets 806 – 822 provide a magnetic flux that conducts through
24 hall switches 832 and 842. Magnets 810 and 820 may provide a primary magnetic flux that
25 conducts through Hall switch 842. Magnets 806, 808, 812, 814, 816, and 822 may provide a
26 secondary magnetic flux that may increase or decrease the magnitude of the magnetic flux
27 provided by magnets 810 and 820 and that conducts through hall switch 842.

28 **[0062]** The poles of magnets 806 – 822 may be arranged to increase or decrease a
29 magnetic flux that conducts through hall switch 832 and/or 842. For example, magnets 806 –
30 812 may be positioned such that their north poles are oriented in the same direction and the
31 south poles of magnets 814 – 822 are positioned opposite. Such an arrangement may
32 increase a magnetic flux detected by hall switches 832 and 842 when security device 800 is
33 not proximate to a metal surface. The arrangement of magnetic poles shown in FIG. 8 may

1 decrease a magnitude of magnetic flux detected by hall switches 832 and 842 when security
2 device 800 is not proximate to a metal surface.

3 **[0063]** Magnets 806 – 822 may further be used to mount removal detectors 832 and 842
4 to body 802 of security device 800 and/or to a metal surface (not shown). In this
5 implementation, magnets 806 – 822 magnetically couple to metal plate 804 of body 802.
6 Hall switch 832 and 842 also couple to body 802 in such a manner that hall switch 832 and
7 842 do not move with respect to magnets 806 – 822. Placement of security device 800
8 proximate to a metal surface (not shown) magnetically couples security device 800 to the
9 metal surface and further conducts at least a portion of the magnetic flux of magnets 806 –
10 822 away from Hall switch 832 and 842.

11 **[0064]** A sensor may have a sensing axis. A sensing axis includes an axis through a
12 sensor. Providing a physical stimulus along a sensing axis may permit a sensor to have
13 greater sensitivity in detecting a magnitude of a physical stimulus. For example, sensor 902
14 is shown relative to orthogonal x, y, and z axes. A sensing axis of sensor 902 comprises the
15 x-axis. Accordingly, detector 902 may detect a physical stimulus provided along the x-axis
16 while the same magnitude of a physical stimulus provided along any other axis or direction
17 may be detected to a lesser extent or not at all.

18 **[0065]** In the case of a magnetic sensor, positioning the sensing axis relative to a
19 magnetic flux provided by a bias magnet may permit a magnetic sensor to have greater
20 sensitivity in detecting variations in a magnitude of the magnetic flux. Increased sensitivity
21 enables sensor 202 to detect smaller variations in the magnitude of the magnetic flux and/or
22 to be less immune to noise. A magnetic flux includes a flow of magnetic stimulus between
23 poles of opposite polarity. For example, a magnetic flux flows between a north pole and a
24 south pole (or visa versa) of magnets 312 and 310; magnet 502, magnet 702, magnets 810
25 and 820 (not shown), and magnet 1004.

26 **[0066]** Positioning the sensing axis relative to a magnetic flux includes positioning the
27 sensing axis perpendicular, parallel, and at an angle to the magnetic flux. In an
28 implementation, the sensing axis of Hall switch 314 is positioned perpendicular to magnetic
29 flux 308. In another implementation, Hall switch 1006 is positioned perpendicular to
30 magnetic flux 1008. Magnet 1004 of removal detector 104 couples to body 1002 of security
31 device 100. At least a portion of magnetic flux 1008 conducts through Hall switch 1006
32 when security device 100 is positioned away from metal surface 1102. Magnetically
33 coupling security device 100 to metal surface 1102 using magnet 1004 conducts magnetic
34 flux 1104 (at least a portion of magnetic flux 1008) away from Hall switch 1006. Hall switch

1 1006 detects a change between the magnitude of the magnetic flux 1008 and 1104. Hall
2 switch 1006 provides a signal in accordance with detecting the change.

3 [0067] Portal sensor 102 may include sensor 1202, bias device 1204, processor 1206 and
4 memory 1212. Sensor 1202 may include hall sensor 1302. Bias device 1204 may include
5 magnet 1304.

6 [0068] Processor 1206 includes a conventional programmable controller circuit having a
7 microprocessor, memory, timer, and analog to digital converter programmed according to
8 various aspects of the present invention, to perform methods discussed below. The
9 microprocessor executes on a stored program and data. Portal sensor 102 may include
10 process 1206 or methods performed by processor 1206 may be performed by a processor that
11 also performs methods for access control 110.

12 [0069] An implementation of portal sensor 102 includes Hall sensor 1302 and magnet
13 1304. Magnet 1304 provides a magnetic flux. At least a portion of the magnetic flux from
14 magnet 1304 conducts through Hall sensor 1302. Hall sensor 1304 provides indicia of a
15 magnitude of a magnetic flux 1306 that conducts through hall sensor 1302. Indicia of a
16 magnitude of a magnetic flux includes a voltage proportional to a magnetic flux and a current
17 proportional to a magnetic flux.

18 [0070] Hall sensor 1302 and magnet 1304 mount in body 1308 of security device 100 in
19 such a manner that movement of security device 100 and/or a portal does not move sensor
20 1302 with respect to magnet 1304.

21 [0071] Movement of portal sensor towards and/or away from a metal portion of a portal
22 changes a magnitude of the magnetic flux (e.g., 1306, 1402) that conducts through Hall
23 sensor 1302. A magnitude of magnetic flux that conducts through Hall sensor 1302 is
24 proportional to a distance between body 1308 of security device 100 and portal cover 1402.
25 A portal cover includes a metal door, a door having a metal portion, a door having a metal
26 surface, and a window with a metal portion. Hall sensor 1302 detects a magnitude of the
27 magnetic flux through Hall sensor 1302. Hall sensor 1302 provides indicia of the magnitude
28 of the magnetic flux to processor 1206 to perform methods described below.

29 [0072] Methods, discussed herein, performed by security device 100 may be performed
30 by any combination of initializing, reading, calculating, setting, and detecting capabilities of
31 the available components of the security device. Data used by security device 100 to perform
32 methods may be stored, retrieved, converted, averaged, summed, compared, transmitted, and
33 displayed. Security device 100 may perform a function in accordance with a result of
34 performing a method. For example, portal sensor 102 may perform methods 1500 of FIG.

1 15. Some methods of 1500 may be distributed to other components communicated by
2 communication module 112.

3 [0073] A dataflow diagram describes the cooperation of processes that may be
4 implemented by any combination of serial and parallel processing. In a fully parallel
5 implementation, an instance of each required process is instantiated when new or revised data
6 for that process is available; or, a static set of instances share processing resources in a single
7 or multithreaded environment, each process operating when new or revised data is available
8 to that process.

9 [0074] Process 1500 may begin upon reset and/or power up of security device 100.
10 Process 1500 may also begin in accordance with a software command executed by processor
11 1206 or through a process for exception handling.

12 [0075] Initializing process 1502 prepares data and components to perform the other
13 processes of process 1500. Preparing data includes setting a data to an initial value. For
14 example, setting element index to a first element of an array of elements for storing a series
15 of prior sensor values; setting each element of the array of elements to an initial value; and
16 setting sum and average value to zero. Preparing a component includes resetting analog-to-
17 digital converter 1208, setting timer 1210 to an initial value, establishing interrupt intervals
18 for processor 1206, and establishing interrupt vectors for processor 1206.

19 [0076] Initialization process 1502 may further establish a magnitude of a magnetic flux
20 through sensor 1302 that represents a closed position of a portal cover.

21 [0077] Read sensor process 1504 receives data from sensor 1202. Data from sensor 1202
22 includes indicia of a magnitude of a physical stimulus detected by sensor 1202. For example,
23 data from sensor 1202 may include indicia of a magnitude of a magnetic flux conducted
24 through sensor 1302. Data from sensor 1202 may be stored in data store 1512. For example,
25 data read from sensor 1202 may be stored in a data referred to as present sensor value.

26 [0078] Calculate average process 1506 determines and average value of the data received
27 from sensor 1202 with respect to prior data received from sensor 1202. A data structure (e.g.,
28 array, linked list) may store prior sensor values. The data structure may be accessed using an
29 element index. The number of elements in the data structure may be stored as a data referred
30 to as number of elements. The present sensor value may be combined with the prior sensor
31 values in such a manner as to produce a sum of all values read from sensor 1202 up to the
32 number of elements. An average value of prior sensor values may be produced by dividing
33 the sum by the number of valid values present in the prior sensor values structure.

1 [0079] Data and intermediate values may be stored in data store 1512 and accessed by
2 processor 1206. Data store 1512 may be located in memory 1212.

3 [0080] Calculating an average value may compensate for drift in the operation of
4 components of portal sensor 102. For example, averaging a series of values received from
5 sensor 1202 may compensate for a drift in the values received from sensor 1202 over
6 temperature and time (e.g., aging of sensor, bias device).

7 [0081] Set thresholds process 1508 establishes thresholds for use by other processes.
8 Thresholds may be used to determine whether to perform an action. An action may include
9 using data received from sensor 1202 to form an average, discarding data received from
10 sensor 1202, and setting an alarm status (e.g., active, inactive, early warning). A threshold
11 includes any threshold used by process 1500 to perform the processes of security device 100.
12 For example, thresholds set by set threshold process 1508 may include a drift threshold and
13 an alarm threshold. A threshold may include a single value, a series of values, and a value
14 having an upper boundary and a lower boundary.

15 [0082] An implementation of process 1500 uses a drift threshold and an alarm threshold
16 that each has an upper boundary and a lower boundary respectively. An average value of
17 data received from sensor 1202 may be calculated in accordance with the drift threshold. For
18 example, data received from sensor 1202 having a value that falls within the drift threshold
19 (e.g., greater or equal to a lower boundary, less than or equal to an upper boundary) is used to
20 calculate an average value for sensor data as discussed above. Data received from sensor
21 1202 having a value that falls outside the drift threshold (e.g., less than a lower boundary,
22 great than an upper boundary) is not used to calculate an average value.

23 [0083] An alarm status may be set in accordance with the alarm threshold. For example,
24 data received from sensor 1202 having a value that falls within the alarm threshold (e.g.,
25 greater or equal to a lower boundary, less than or equal to an upper boundary) indicates
26 movement of a portal cover within a limit, thus the alarm status may be set to inactive. Data
27 received from sensor 1202 having a value that falls outside the alarm threshold (e.g., less than
28 a lower boundary, great than an upper boundary) indicates movement of a portal cover
29 beyond a limit, thus the alarm status may be set to active. Data received from sensor 1202
30 having a value that falls outside the alarm threshold followed by a subsequent value that falls
31 within the alarm threshold or a pattern that falls within and outside the alarm threshold over a
32 period of time may permit the alarm status to be set to an early warning state.

1 [0084] Set thresholds process 1508 may set a threshold to compensate for drift in the
2 operation of components of portal sensor 102. An implementation of portal sensor 102 sets
3 threshold values in accordance with an average value of the data received from sensor 1202.

4 [0085] An implementation of portal sensor 102 sets a drift threshold to account for noise
5 (e.g., jitter, thermal, electrical, mechanical) that influences detection by sensor 1202. An
6 implementation of portal sensor 102 sets the drift boundary as being equivalent to the six
7 least significant bits of analog-to-digital converter 1208.

8 [0086] An implementation of portal sensor 102 sets an alarm threshold to set a limit on
9 portal movement. The limit is set in accordance with the range of motion detectable by
10 sensor 1202.

11 [0087] Detect door status process 1510 detects a position of a portal cover. Detecting a
12 position of a portal cover includes detecting movement of a portal cover outside of a limit.
13 Detect door status process 1510 sets an alarm status in accordance with detecting as discussed
14 above. For example, as discussed above, a value received from sensor 1202 outside the alarm
15 threshold indicates that the alarm status may be set to active.

16 [0088] Any conventional computational techniques may be used to determine whether a
17 data value received from sensor 1202 falls within or outside a threshold (e.g., comparison to
18 threshold values, rate of change, amount of change from previous value).

19 [0089] FIG. 16 represents an implementation of process 1500 including data values
20 receive from sensor 1202 and values set for the drift and alarm thresholds. In FIG. 16,
21 squiggly line 1602 represents a series of present sensor values received from sensor 1202.
22 Data from sensor 1202 that falls within drift upper boundary 1604 and drift lower boundary
23 1606 are used to calculate the average value of the data received from sensor 1202. Datum
24 1608 from sensor 1202 falls outside of the drift threshold and is not used to calculate an
25 average value. Datum 1608 falls within the alarm threshold. Active alarm status 1614
26 occurs when data from sensor 1202 that falls outside the alarm threshold.

27 [0090] Line 1702 of FIG. 17 represents the average value of the values of squiggly line
28 1602 that falls within the drift threshold. The average value does not change during the alarm
29 active status because no data from sensor 1202, as depicted in FIG. 16, falls within the drift
30 threshold accordingly the average value does not change.

31 [0091] Security device 100 may couple to any object to detect removal. Security device
32 100 may be positioned to detect movement of a portal cover. In one implementation, security
33 device 100 magnetically couples to right portal cover 1804 and detects movement of adjacent
34 left portal cover 1806. Removal detector 104 magnetically couples body 1902 of security

1 device 100 to right portal cover 1804. Portal sensor 102 detects movement of left portal
2 cover 1806 relative to security device 100 and thus right portal cover 1804. Movement of left
3 portal cover 1806 relative to right portal cover 1804 greater than a threshold may result in a
4 warning of unauthorized access. Removal of body 1902 from right portal cover 1804 may
5 result in a warning of unauthorized access.

6 **[0092]** Security device 100 may couple to and monitor a variety of portals. For example,
7 a shape of the body of security device 100 may fit a particular portal construction. In one
8 implementation, body 2002 of security device 100 positions removal detector 104 and portal
9 sensor 100 on each side of seal 2008 between right portal cover 2004 and left portal cover
10 2006.

11 **[0093]** Portal sensor 102 and/or removal detector 104 may be moveably coupled to
12 security device 100. Moveably coupling portal sensor 102 and/or removal detector 104 to the
13 body of security device 100 permits security device 100 to monitor portals having different
14 closure mechanism, portal mounting mechanism, and portal spacing (e.g., gaps,
15 misalignment). A moveable coupling may provide security device 100 greater uniformity in
16 coupling to a portal and detecting portal status. In one implementation, portal sensor 102
17 moves along track 2112. Track 2112 permits portal sensor 102 to retract into body 2102
18 when portal cover 2110 is flush with portal casing 2106. Track 2112 permits portal sensor to
19 extend from body 2102 when portal cover 2110 is not flush with portal casing 2106 as shown
20 in FIG. 21. A moveable coupling may permit greater movement of a portal or security device
21 100 before providing a notice.

22 **[0094]** Security device 100 may couple to a portal cover, a portal casing, and/or a surface
23 adjacent to a portal using a fastener. A fastener may be used in addition to or as a substitute
24 to any couple force provided by removal detector 102. For example, fastener 2104 couples
25 body 2102 of security device 100 to portal casing 2106. In an implementation where removal
26 detector is of the type as removal detector 840, the removal detector provides additional
27 magnetic coupling to a portal casing 2106 that is susceptible to magnetic coupling.

28 **[0095]** A portal that is not susceptible to magnetic coupling may be prepared for
29 magnetic coupling using fasteners that are susceptible to magnetic coupling. For example, a
30 fastener that is susceptible to magnetic coupling may be coupled to a portal cover. Coupling
31 the fastener to the portal cover includes mechanical coupling and chemical coupling (e.g.,
32 glue). A fastener may be positioned on the portal cover to correspond to a position of a
33 magnet in a removal detector. An implementation uses fastener 2206 coupled to right portal
34 cover 2210 and positioned to correspond to the positions of magnets 2214 of removal

1 detector 104. Fasteners 2206 mechanically couple to right portal cover 2210 and magnets
2 2214 magnetically couple to fasteners 2206 thereby coupling body 2202 of security device
3 100 to right portal cover 2210. Fasteners 2206 are positioned in such a manner that coupling
4 body 2202 to the fasteners 206 positions portal sensor 102 proximate to left portal cover
5 2212.

6 **[0096]** Fasteners may also be used as conductors. A conductor may carry an electric
7 potential. An electric potential may be impressed (e.g., provided) on a fastener by a first
8 device and detected by a second device and/or alternately provided and detected by the first
9 and second device. An electrical potential may carry information (e.g., signal). A fastener
10 having an end portion exposed on each side of a portal cover may carry an electrical potential
11 from one side of the portal through to the other side of the portal. An electric potential
12 includes a direct current (e.g., DC) potential and an alternating potential (e.g., changing over
13 time). In one implementation, fasteners 2206 conduct an electrical potential between access
14 control 110 and device 2216 positioned in body 2204. Body 2204 is positioned on a different
15 side of portal 2206 than body 2202. Device 2216 may include a security device, a portion of
16 a security device, a communication module, and a concentrator. A fastener used as a
17 conductor may need to be insulated from the material of the portal cover. For example, metal
18 fasteners need to be insulated from a metal door to permit the fasteners to carry a signal. In
19 one implementation, insulator 2208 insulates fastener 2206 from the material of right portal
20 cover 2210.

21 **[0097]** Security device 100 may cooperate with a fastener to couple security device 100
22 to a portal cover and/or portal frame. Cooperation may include a coupling between the
23 fastener and the portal and a coupling between the fastener and security device 100. A
24 coupling between the fastener and security device 100 may permit portal sensor 102 of
25 security device 100 to move between a sensing position to a non-sensing position without
26 decoupling the fastener from the portal cover and/or frame. A coupling between the fastener
27 and security device 100 may permit removal detector 104 to move between a removed
28 position and a non-removed position without decoupling the fastener from the portal cover
29 and/or frame. Movement from a non-removed position to a removed position magnetically
30 decouples security device 100 from the fastener, but not the fastener from the portal. In one
31 implementation, fastener 2302 includes base 2402 and a first portion 2304 of hinge 2308.
32 Body 2310 of security device 100 includes a second portion 2306 of hinge 2308. Body 2310
33 pivotally moves with respect to fastener 2302 around hinge 2308.

1 [0098] Fastener 2302 includes first portion 2304 of hinge 2308, base 2402, and surface
2 2404. Base 2402 couples to right portal cover 2312. Coupling of base 2402 to right portal
3 cover 2312 includes mechanical (e.g., fastener, welding), magnetic, and chemical (e.g., glue).
4 When body 2310 of security device 100 is positioned in an operable position, surface 2404 is
5 positioned adjacent to removal detector 102. Surface 2404 may be formed of a material that
6 is susceptible to magnetic forces to cooperate with a magnetic implementation of removal
7 detector 102. A magnetic implementation of removal detector 102 may magnetically couple
8 to surface 2404 and detect removal of security device from surface 2404.

9 [0099] A security device 100 that cooperates with fastener 2302 includes second portion
10 2306 of hinge 2308, removal detector 104 that cooperates with surface 2404, and portal
11 sensor 102 that is positioned adjacent to left portal cover 2314 when body 2310 of security
12 device 100 is positioned in an operative position. Portal sensor 102 may include additional
13 magnets 2502 to nominally couple portal sensor 102 to left portal cover 2314. Magnets 2502
14 may increase, decrease, or have no affect on a magnitude of the magnetic flux detected by
15 sensor 1202. Magnets 2502 may increase a amount of force required to move left portal
16 cover 2314 beyond a limit.

17 [0100] A shape of a fastener may cooperate with a portal to attach to any portion of a
18 portal. For example, referring to FIG. 26, fastener 2602 couples to right portal cover 2312
19 over handle 2316. Body 2610 of security device 100 couples to fastener 2602 at hinge 2608
20 in such a manner that removal detector 102 (not shown) of security device 100 is positioned
21 adjacent to surface 2606 and portal sensor 102 (not shown) is positioned adjacent to left
22 portal cover 2314. Base 2604 couples to right portal cover 2312.

23 [0101] The foregoing description discusses preferred embodiments of the present
24 invention which may be changed or modified without departing from the scope of the present
25 invention as defined in the claims. While for the sake of clarity of description, several
26 specific embodiments of the invention have been described, the scope of the invention is
27 intended to be measured by the claims as set forth below.

**AMENDED CLAIMS received by the International Bureau on
24 December 2008 (24.12.2008)**

WO 2008/140609

PCT/US2007/087383

1 Replacement sheets for originally filed sheet no. 18 follow:

2 1. A security device for detecting movement of a provided portal cover, the security
3 device comprising:

4 a sensor that provides indicia of a magnitude of a magnetic flux through the sensor;

5 a bias magnet that provides the magnetic flux through the sensor; and

6 a processor that receives the indicia of the magnitude of the magnetic flux and detects
7 a change in the magnitude of the magnetic flux outside an upper boundary and a lower
8 boundary of a first threshold and an upper boundary and a lower boundary of a second
9 threshold; wherein:

10 the sensor does not move with respect to the magnet;

11 movement of the sensor with respect to at least one of the portal cover and a
12 portal changes the magnitude of the magnetic flux through the sensor;

13 the processor determines an average value of a series of values of the indicia
14 of the magnitude of the magnetic flux that fall within the upper boundary and the lower
15 boundary of the first threshold; and

16 the upper boundary and the lower boundary of the first threshold and the
17 second threshold respectively are set in accordance with the average value.

18
19 2. The security device of claim 1 wherein the processor provides a notice in accordance
20 with the change in the magnitude of the magnetic flux that falls outside the upper boundary
21 and the lower boundary of the second threshold.

22 3. The security device of claim 1 wherein:

23 the sensor comprises a sensing axis; and

24 the bias magnet provides the magnetic flux parallel to the sensing axis.

25 4. The security device of claim 1 wherein the average value comprises only the indicia
26 of the magnitude that fall between the lower boundary and the upper boundary of the first
27 threshold.

28 5. The security device of claim 1 wherein the indicia comprises a voltage.

29 6. The security device of claim 1 wherein the indicia comprises a current.

30 7. The security device of claim 1 wherein the sensor couples to a body of the security
31 device and is positioned adjacent to the portal cover.

32 8. The security device of claim 1 wherein the magnet couples to a body of the security
33 device distal from the portal cover along an axis between the sensor and the magnet.

AMENDED SHEET (ARTICLE 19)

1 Replacement sheets for originally filed sheet no. 19 follow:

2 9. The security device of claim 1 wherein the absolute value of the upper boundary and
3 the lower boundary of the first threshold and the second threshold respectively are different.

4 10. The security device of claim 1 wherein the absolute value of the upper boundary and
5 the lower boundary of the first threshold are less than the absolute value of the upper
6 boundary and the lower boundary of the second threshold.

7 11. The security device of claim 1 wherein the series of values comprises at least one
8 thousand values.

9 12. The security device of claim 1 wherein the processor receives indicia of the
10 magnitude at least every 0.5 seconds.

11 13. The security device of claim 1 wherein the processor comprises an analog-to-digital
12 converter that converts a voltage.

13
14 14. A method performed by a security device for detecting movement of a portal cover,
15 the method comprising:

16 averaging a series of values of indicia of a magnitude of a magnetic flux through a
17 sensor that fall within an upper and a lower boundary of a first threshold to provide an
18 average value;

19 detecting indicia of the magnitude of the magnetic flux that falls outside an upper and
20 a lower boundary of a second threshold; and

21 adjusting the upper and the lower boundary of the first threshold and the second
22 threshold respectively in accordance with the average value; wherein:

23 a magnet couples to a body of the security device to provide the magnetic flux
24 through the sensor;

25 the sensor couples to the body;

26 the sensor does not move with respect to the magnet;

27 movement of the sensor with respect to at least one of the portal cover and the
28 portal changes the magnitude of the magnetic flux through the sensor.

29
30 15. (Original) The method of claim 14 wherein averaging comprises detecting whether a
31 current indicia of the magnitude of the magnetic flux is less than the upper boundary and
32 greater than the lower boundary of the first threshold.

33 16. (Original) The method of claim 14 wherein averaging comprises eliminating each
34 indicia that falls outside the upper boundary and the lower boundary of the first threshold.

1 Replacement sheets for originally filed sheet no. 20 follow:

2 17. The method of claim 14 wherein averaging comprises eliminating each indicia that
3 falls outside the upper boundary and the lower boundary of the second threshold.

4 18. The method of claim 14 wherein adjusting comprises changing a value of the upper
5 boundary and the lower boundary of the first threshold in accordance with a change in the
6 average value.

7 19. The method of claim 14 wherein adjusting comprises changing a value of the upper
8 boundary and the lower boundary of the second threshold in accordance with a change in the
9 average value.

10 20. The method of claim 14 wherein the absolute value of the upper boundary and the
11 lower boundary of the first threshold are less than the absolute value of the upper boundary
12 and the lower boundary of the second threshold.

13
14 21. A security device for detecting movement of a provided portal cover, the security
15 device comprising:

16 a sensor that provides indicia of a magnitude of a magnetic flux through the sensor;

17 a bias magnet that provides the magnetic flux through the sensor; and

18 a processor that receives the indicia of the magnitude of the magnetic flux and detects
19 a change in the magnitude of the magnetic flux outside an upper boundary and a lower
20 boundary of a first threshold and an upper boundary and a lower boundary of a second
21 threshold; wherein:

22 the sensor does not move with respect to the magnet; and

23 movement of the sensor with respect to at least one of the portal cover and a
24 portal changes the magnitude of the magnetic flux through the sensor.

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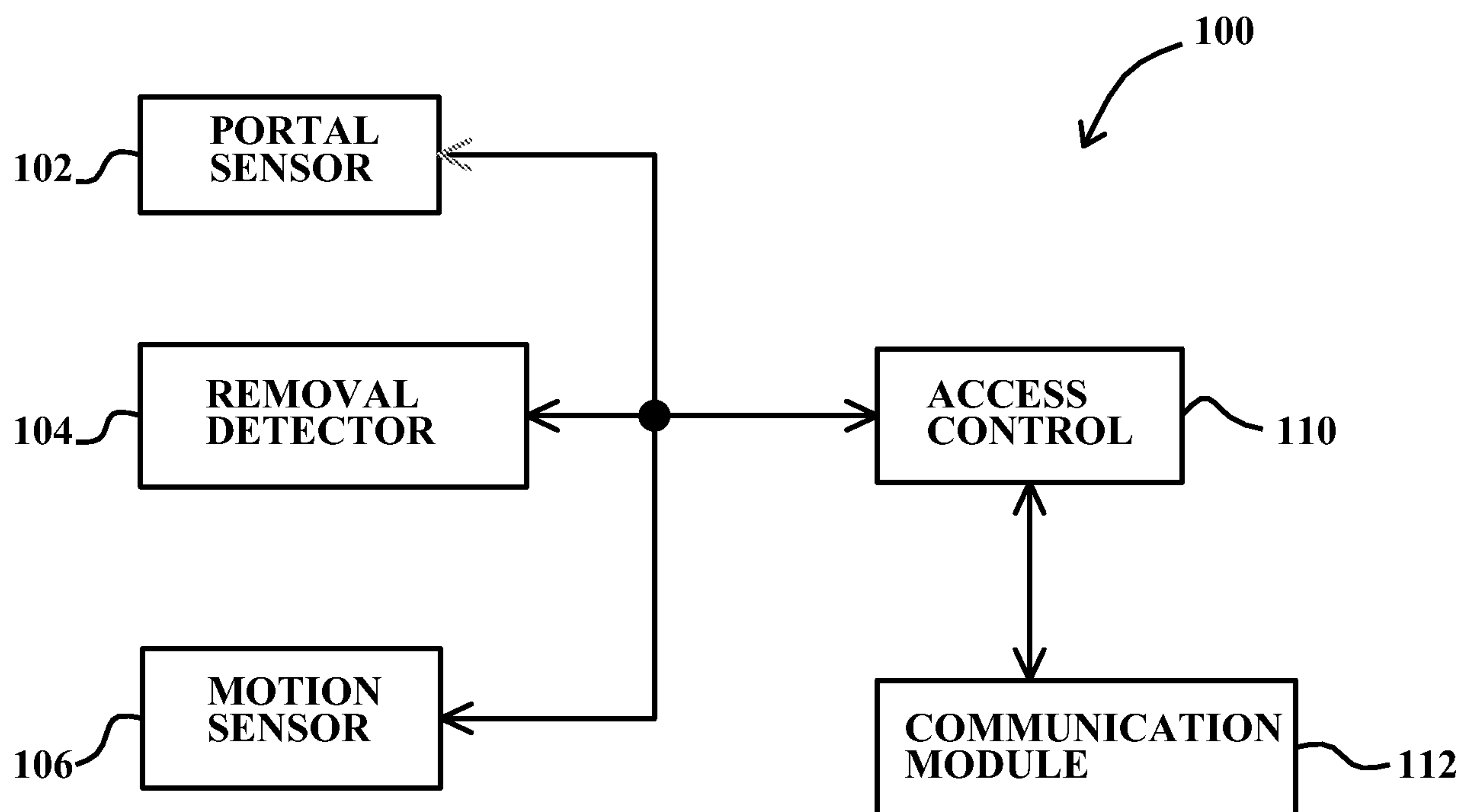


FIG. 1

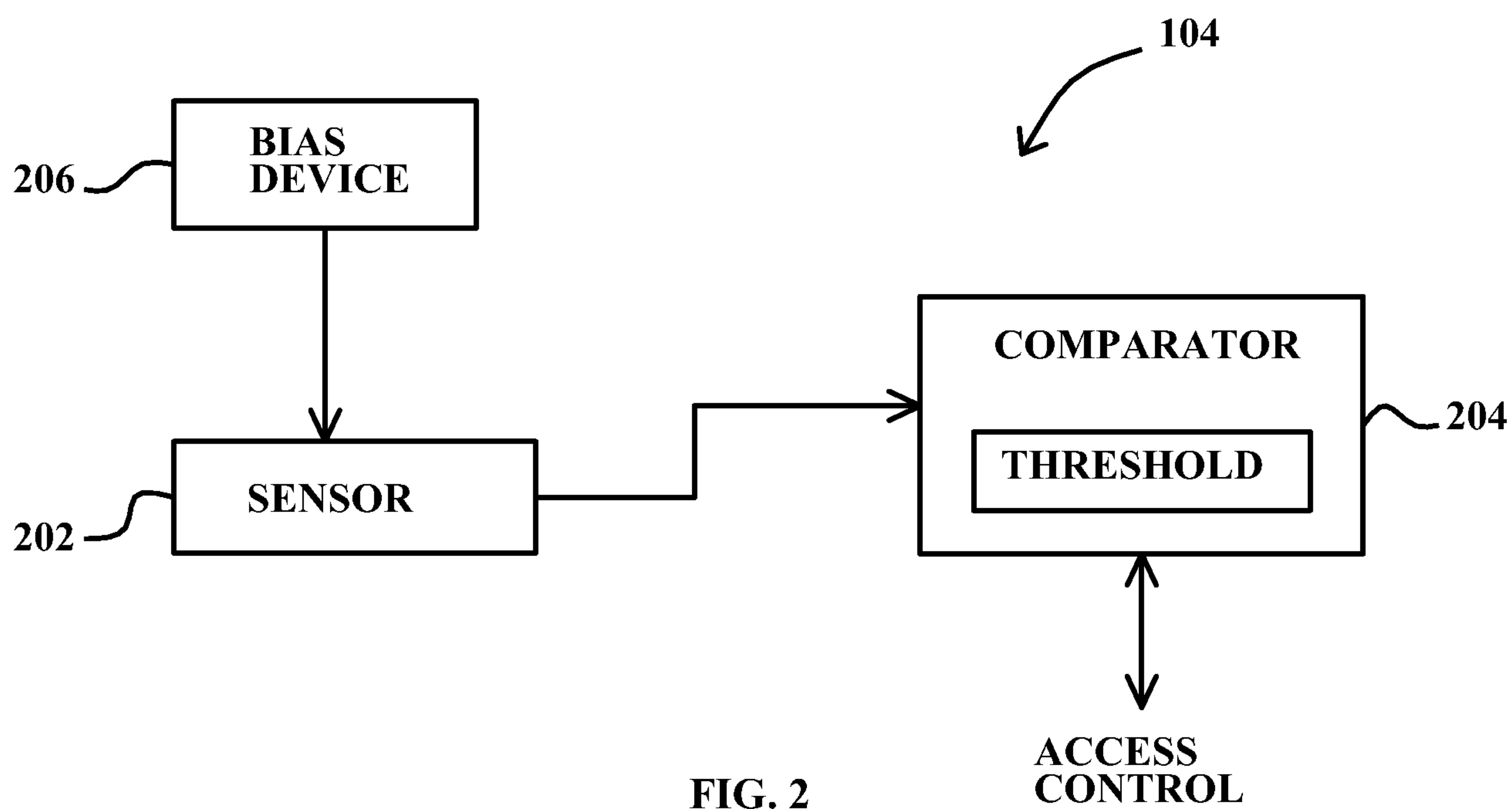
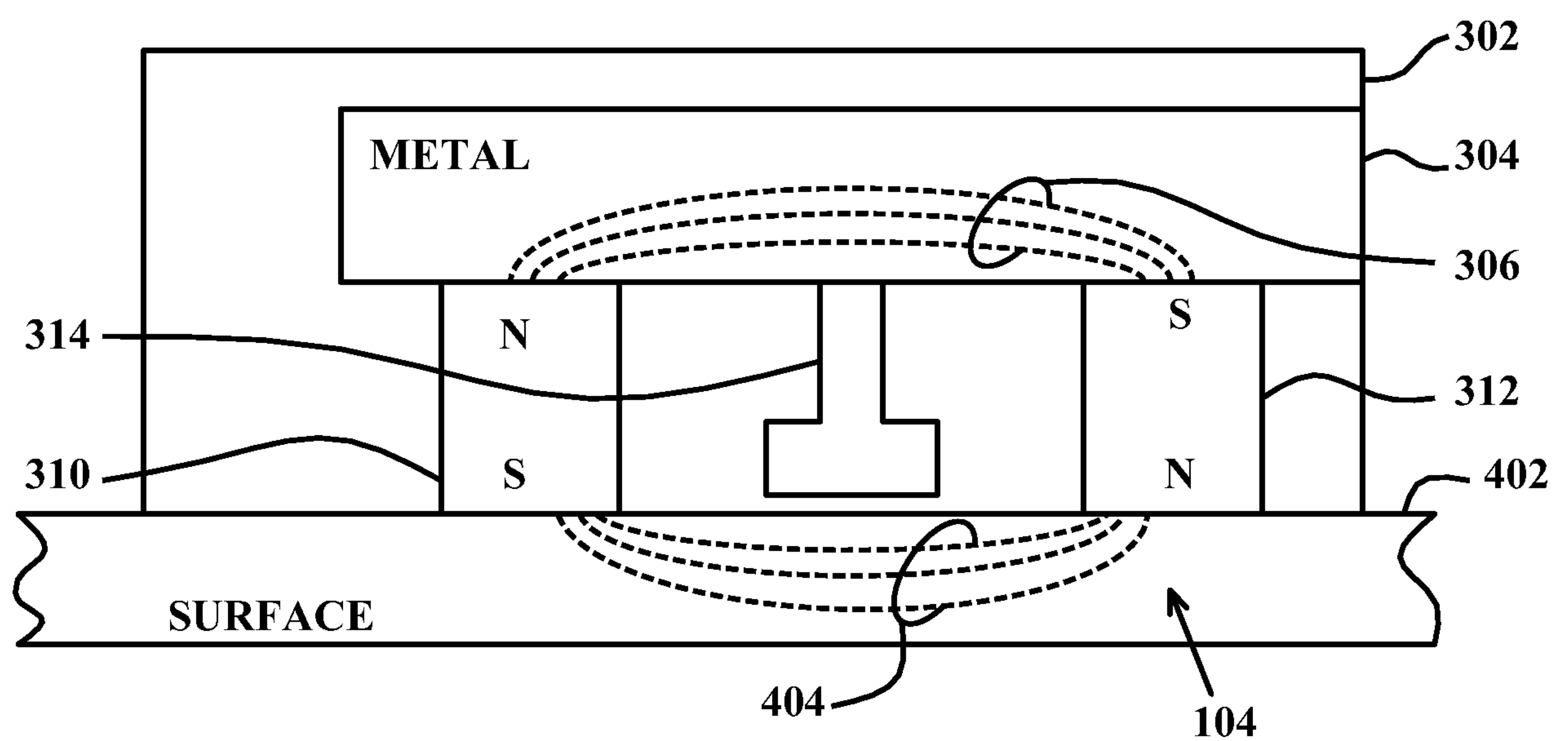
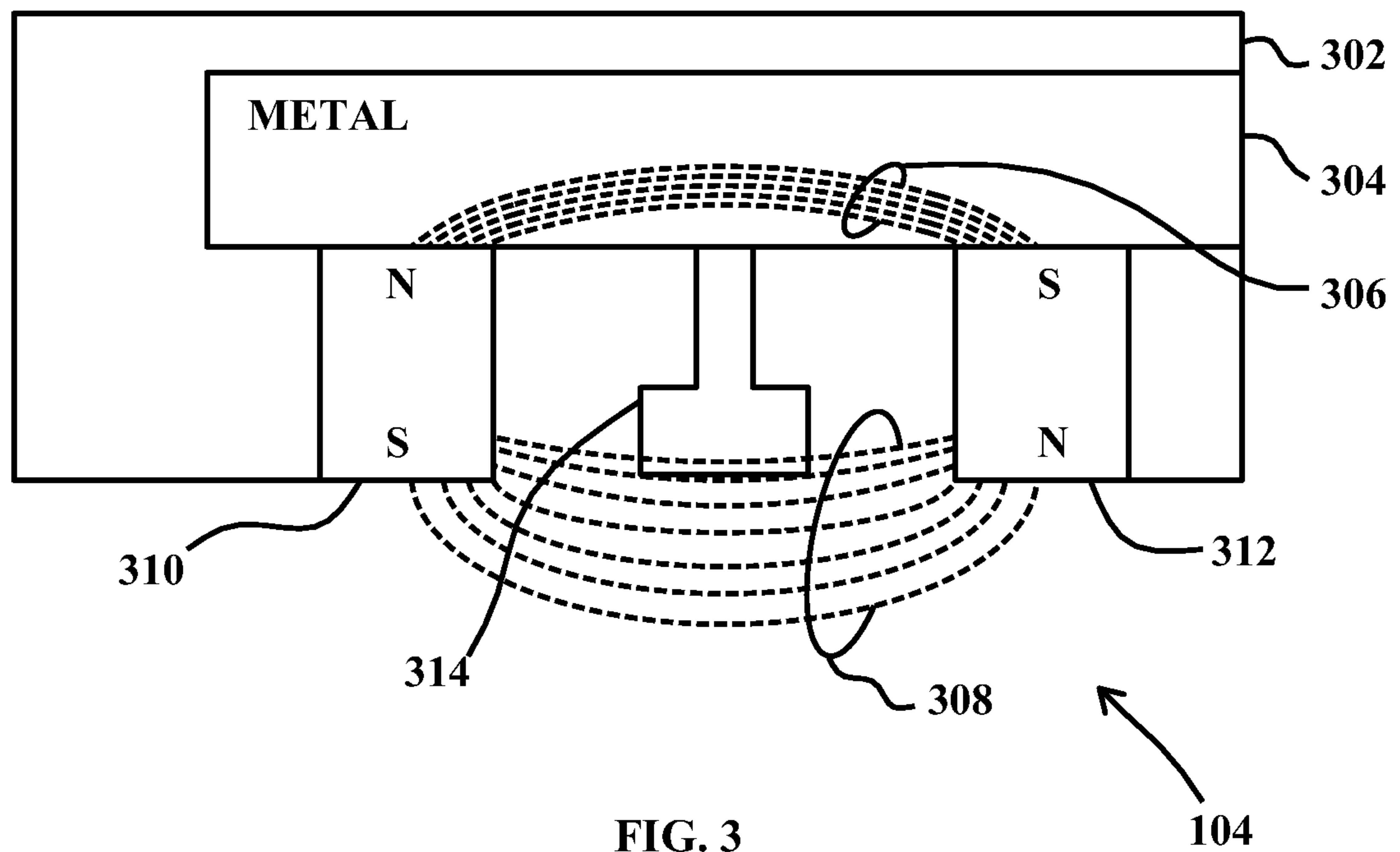


FIG. 2

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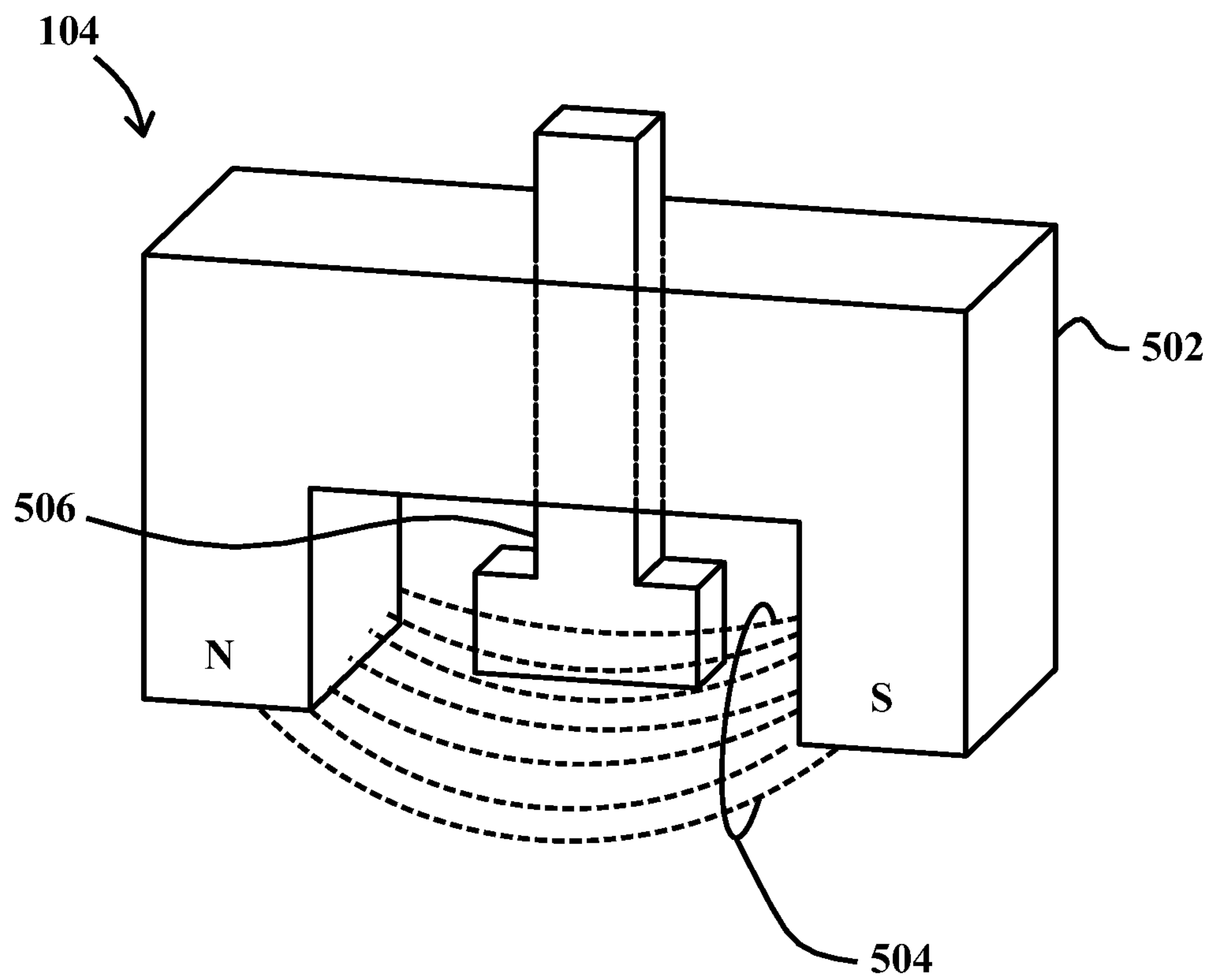


FIG. 5

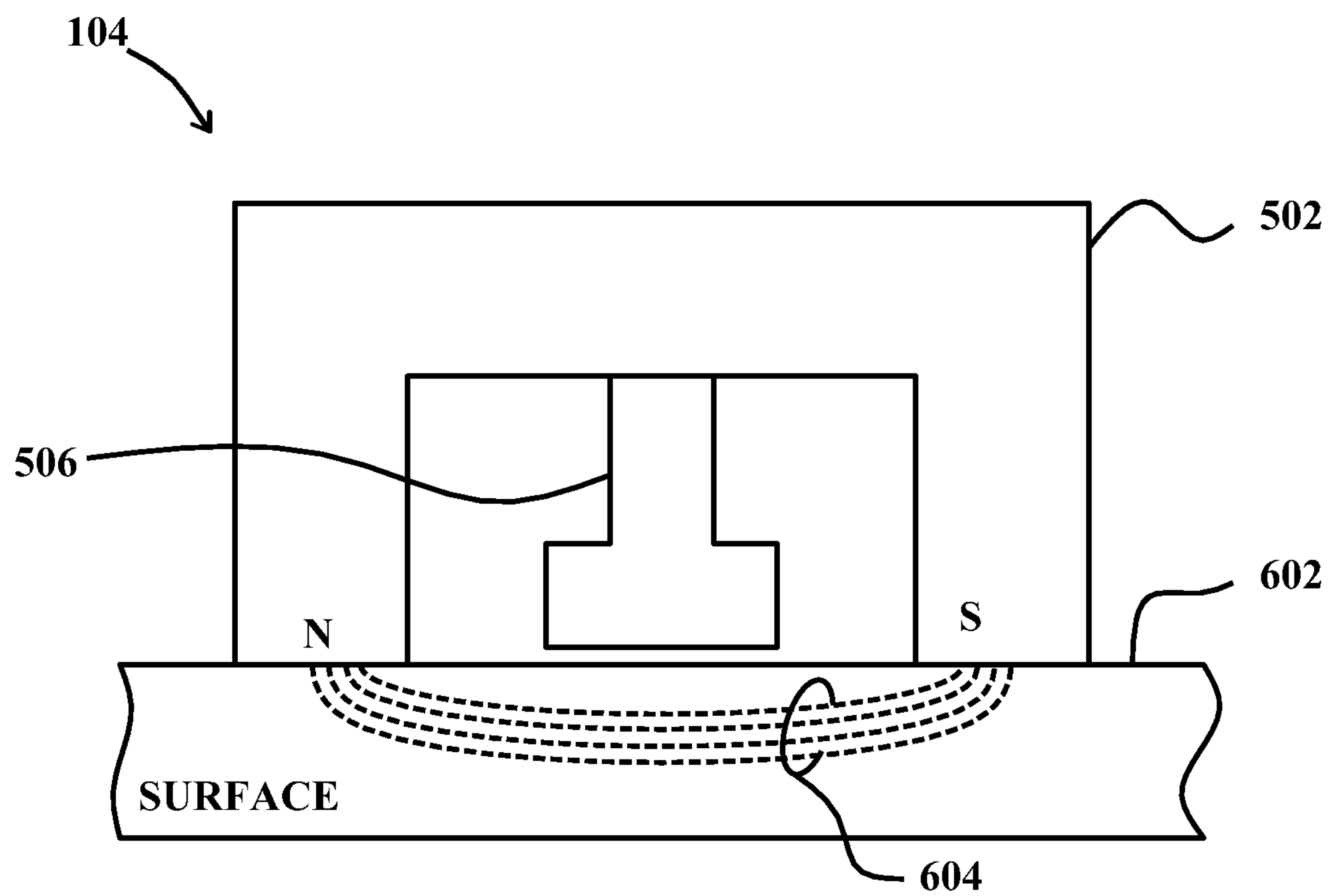


FIG. 6

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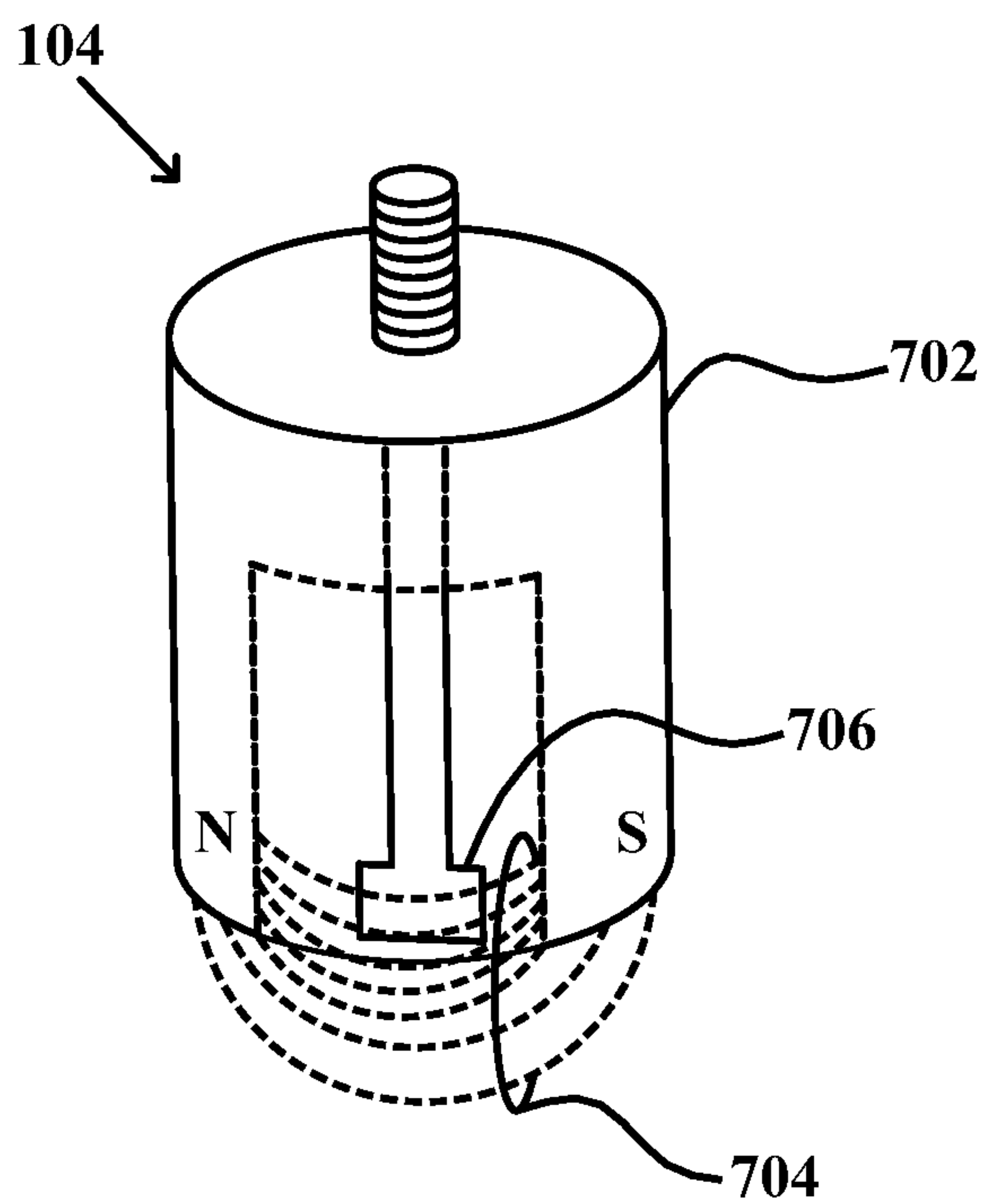


FIG. 7

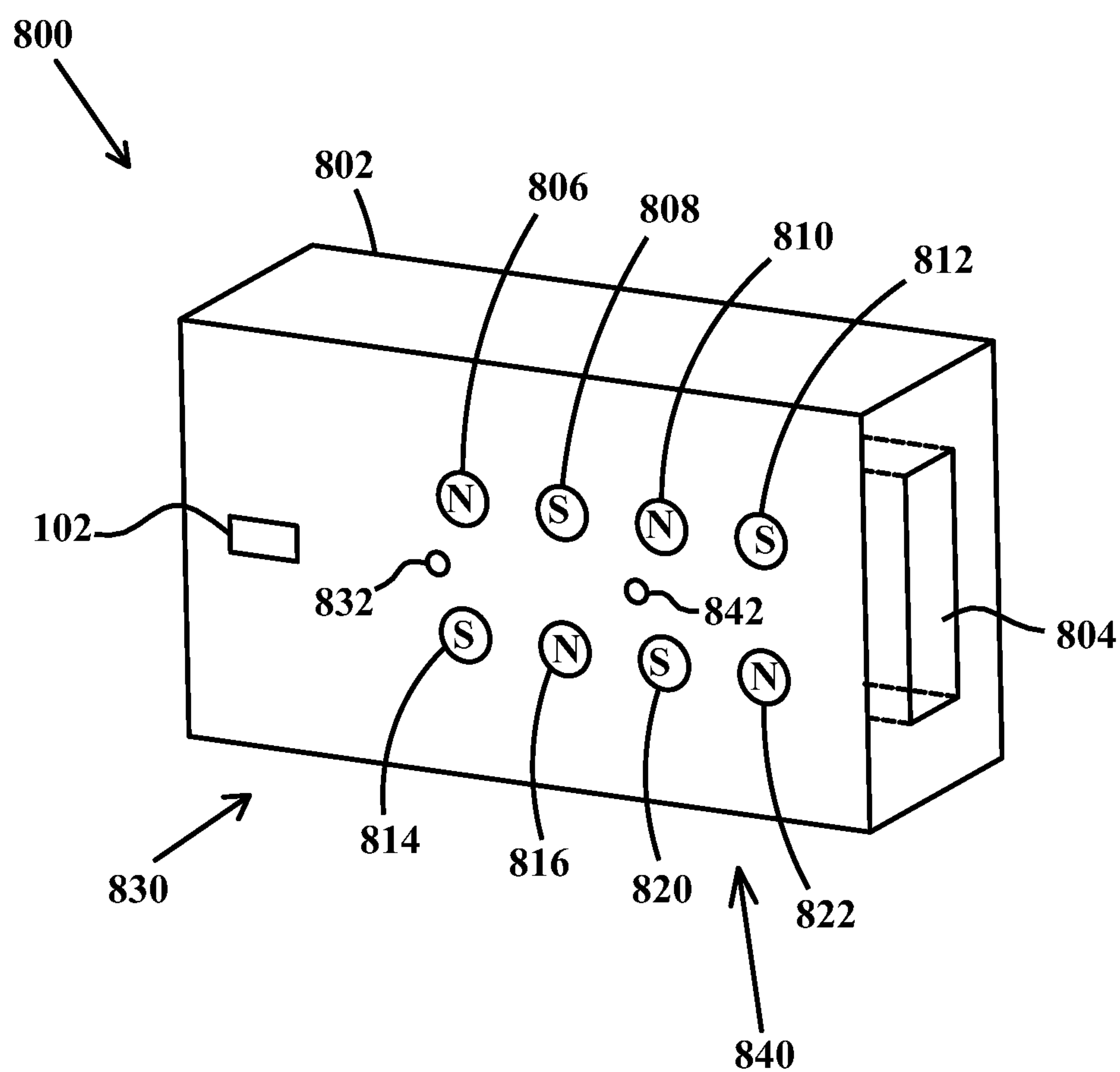


FIG. 8

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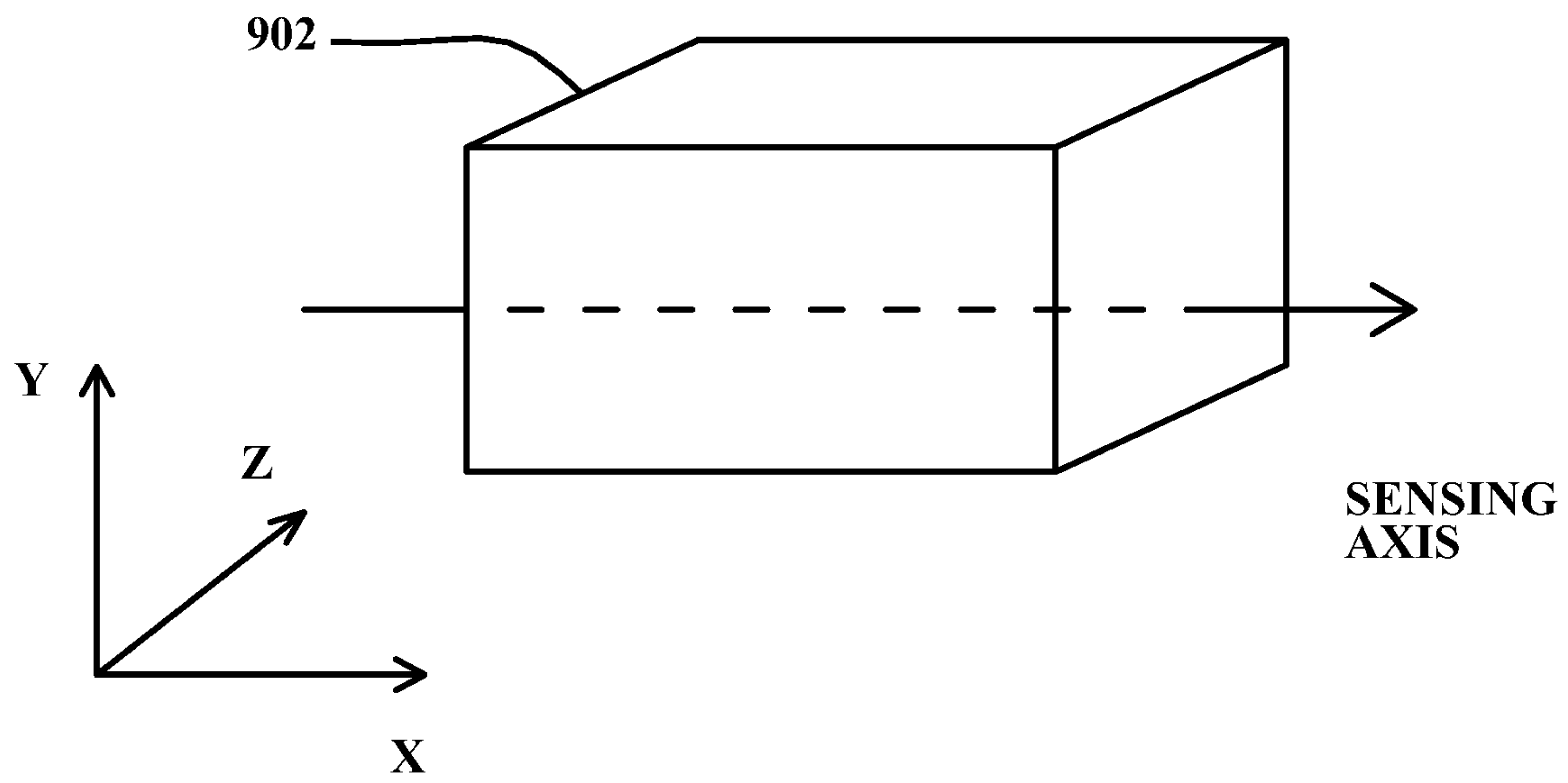


FIG. 9

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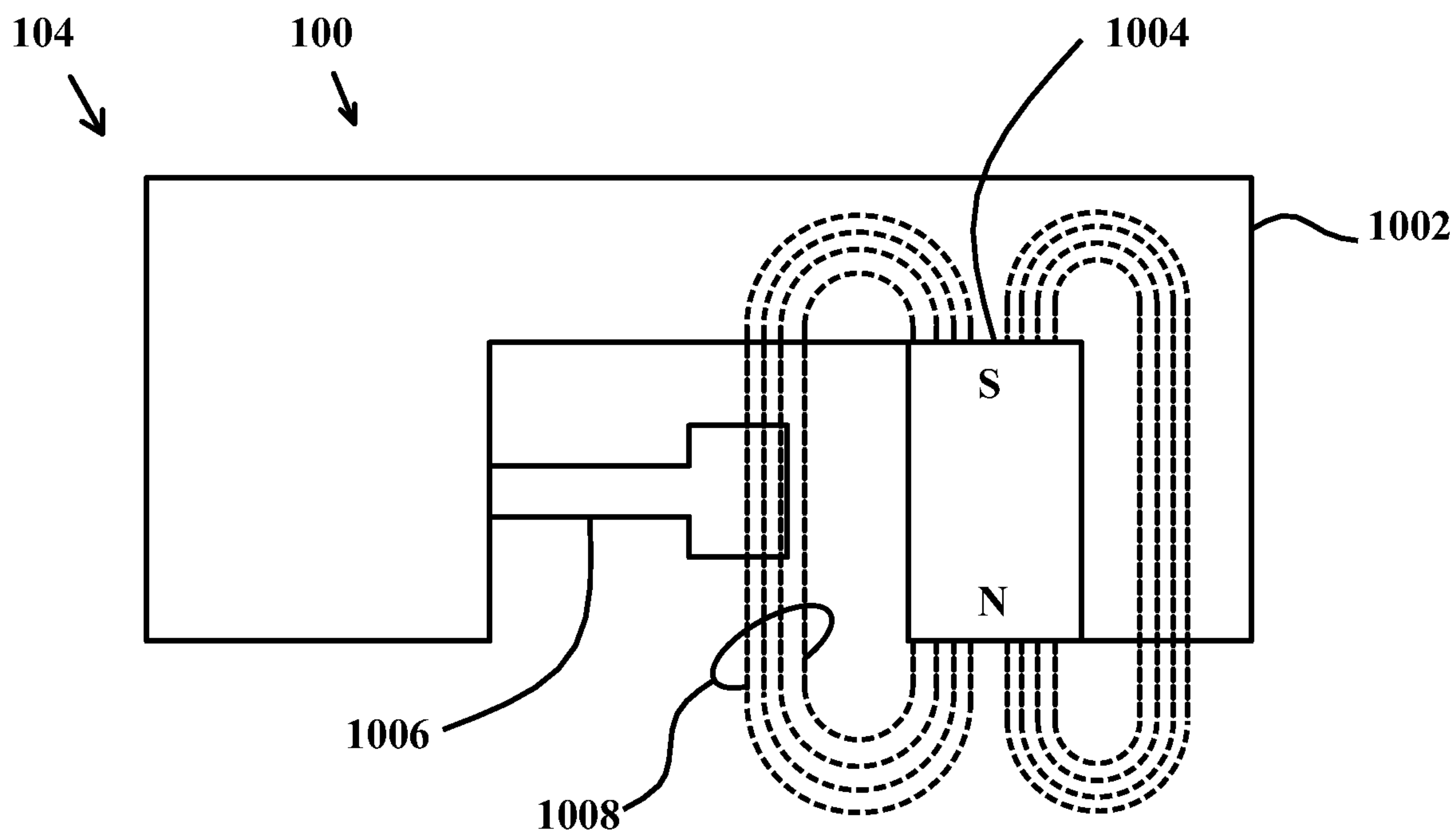


FIG. 10

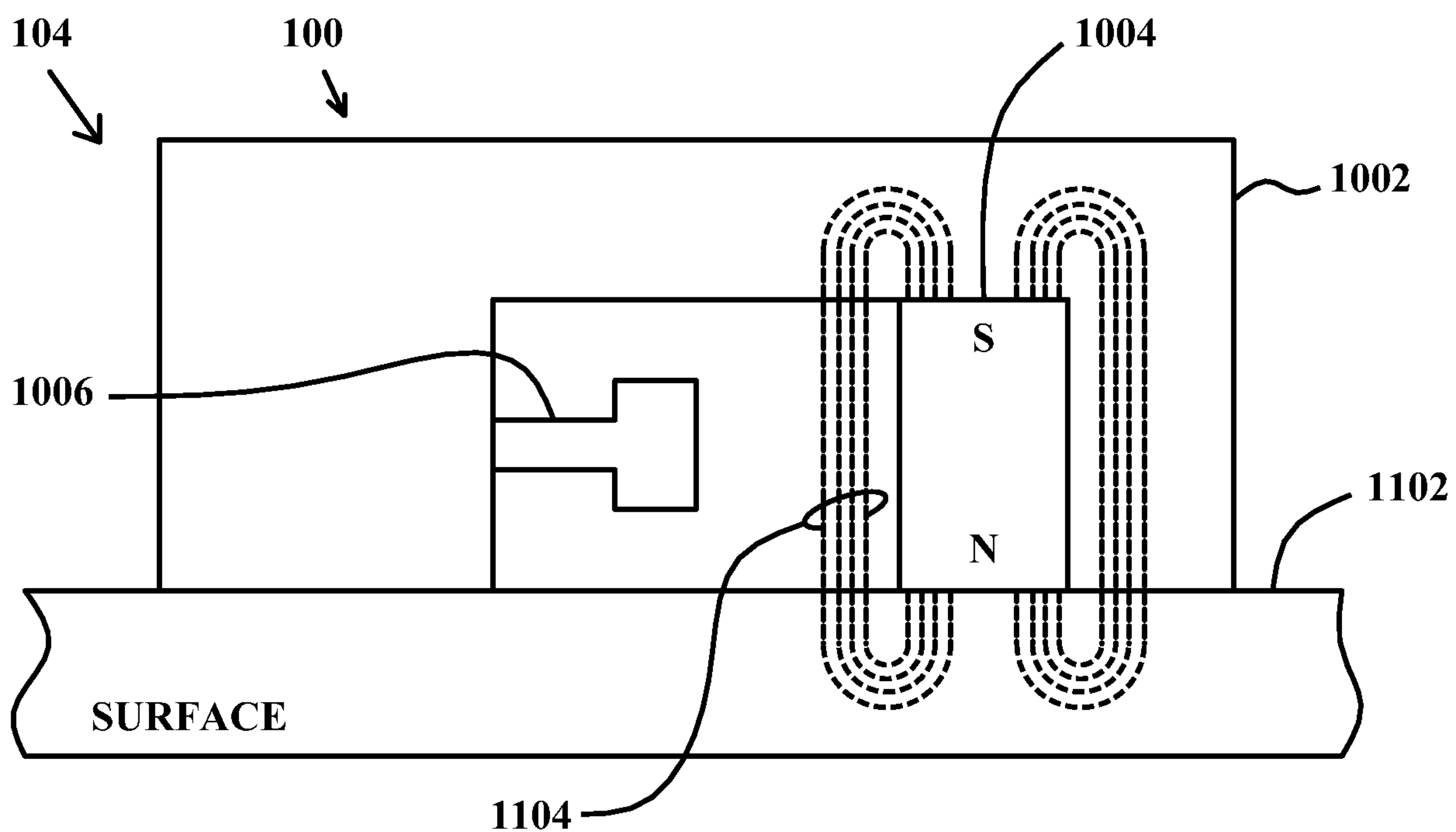


FIG. 11

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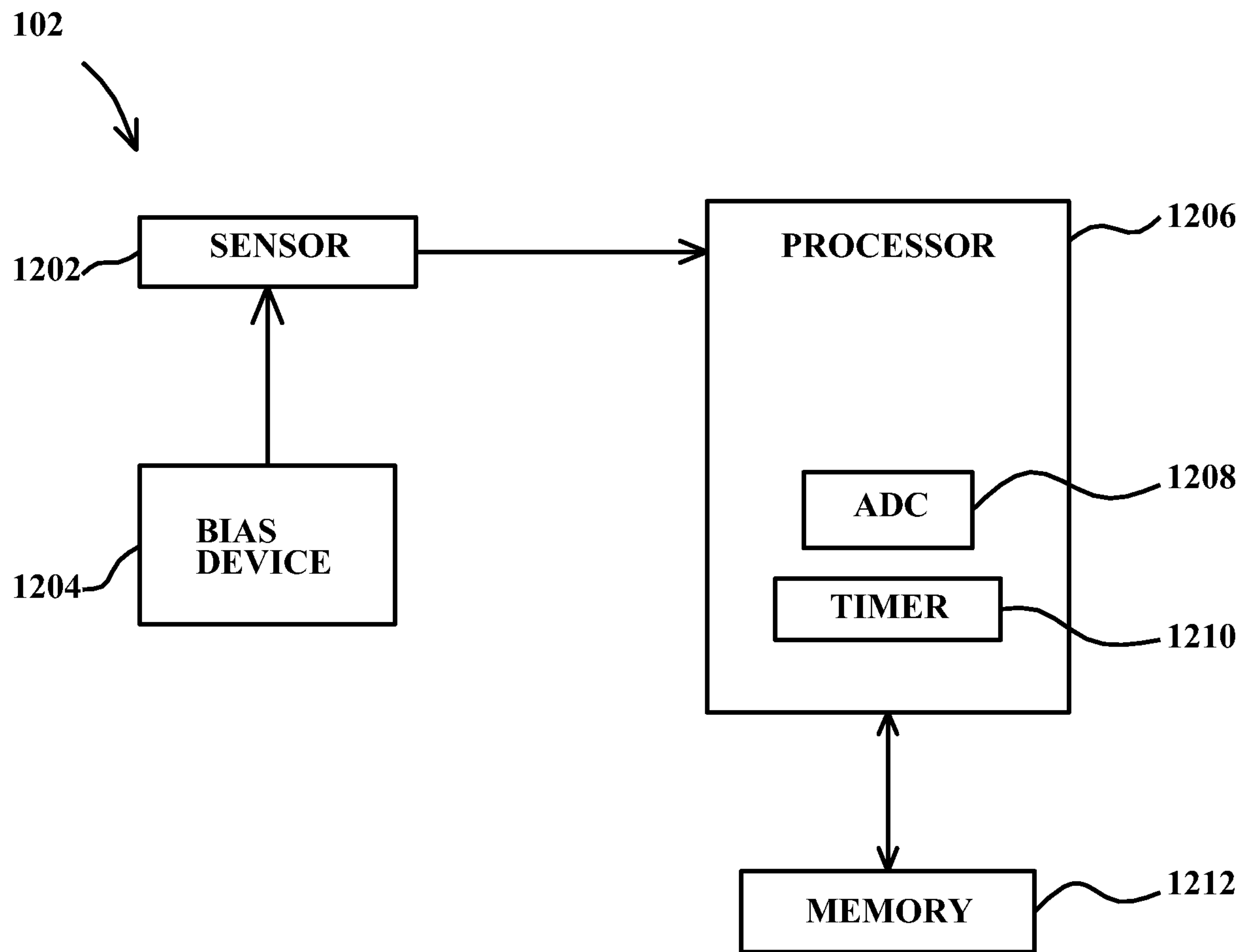


FIG. 12

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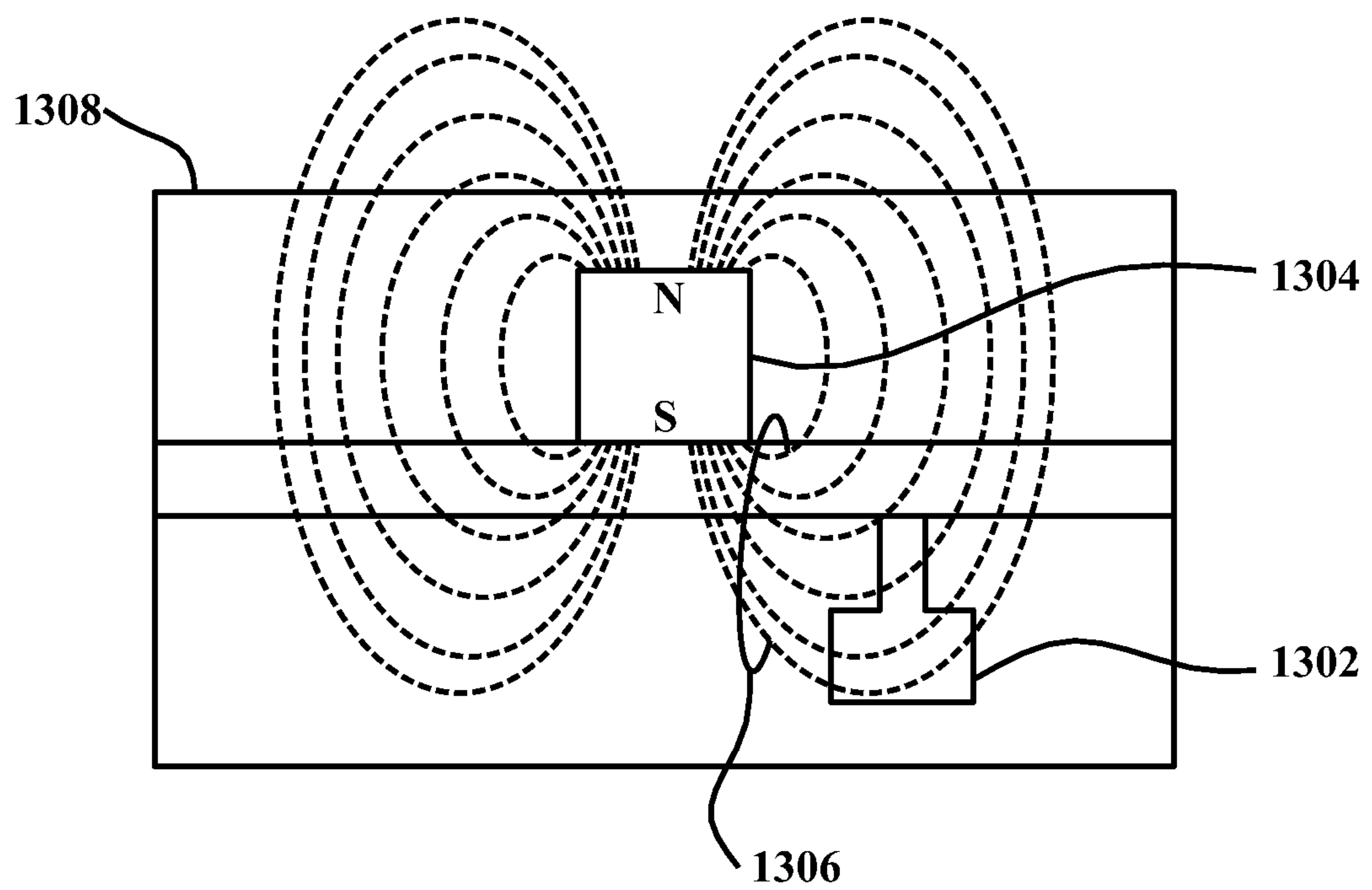


FIG. 13

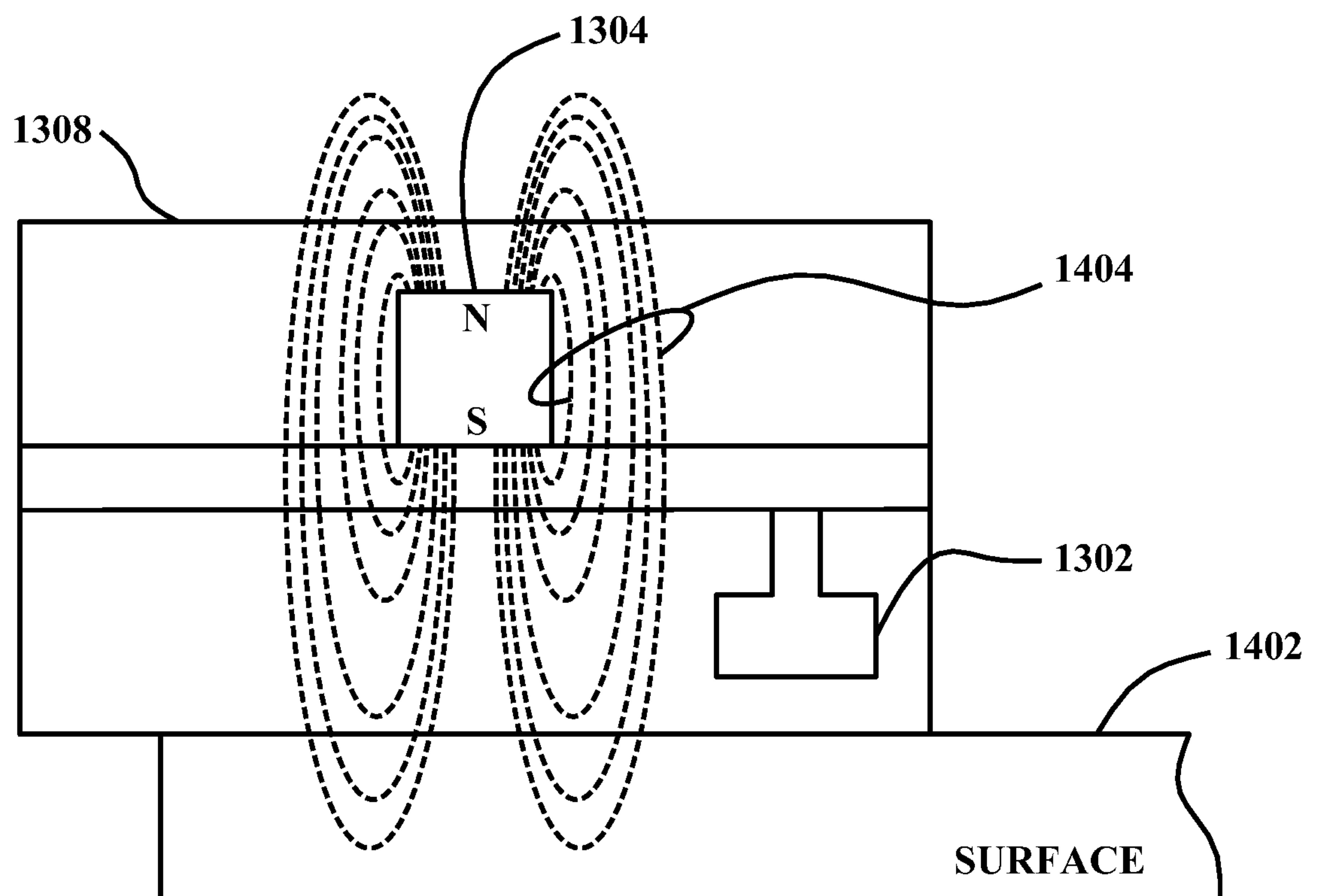


FIG. 14

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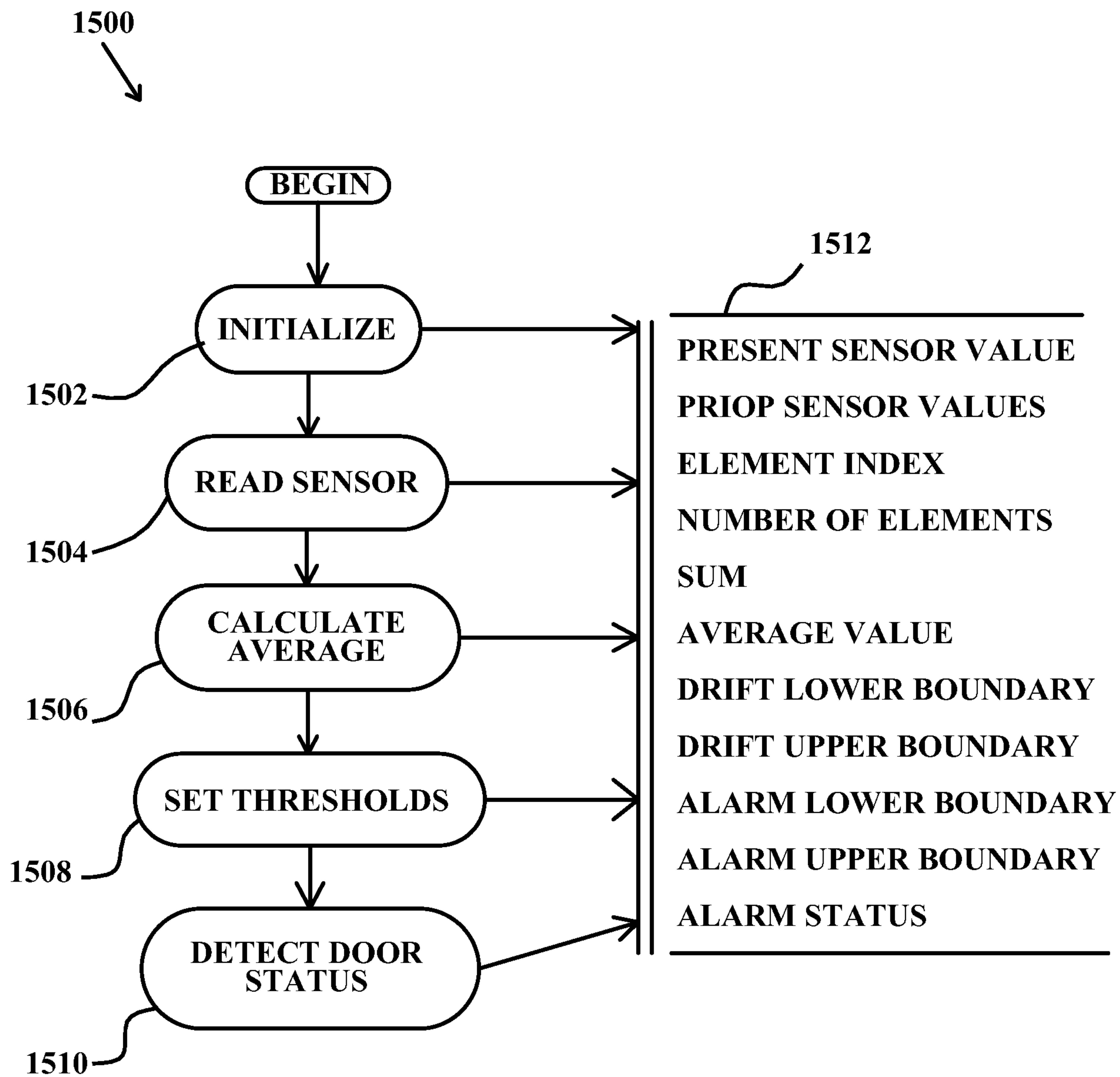


FIG. 15

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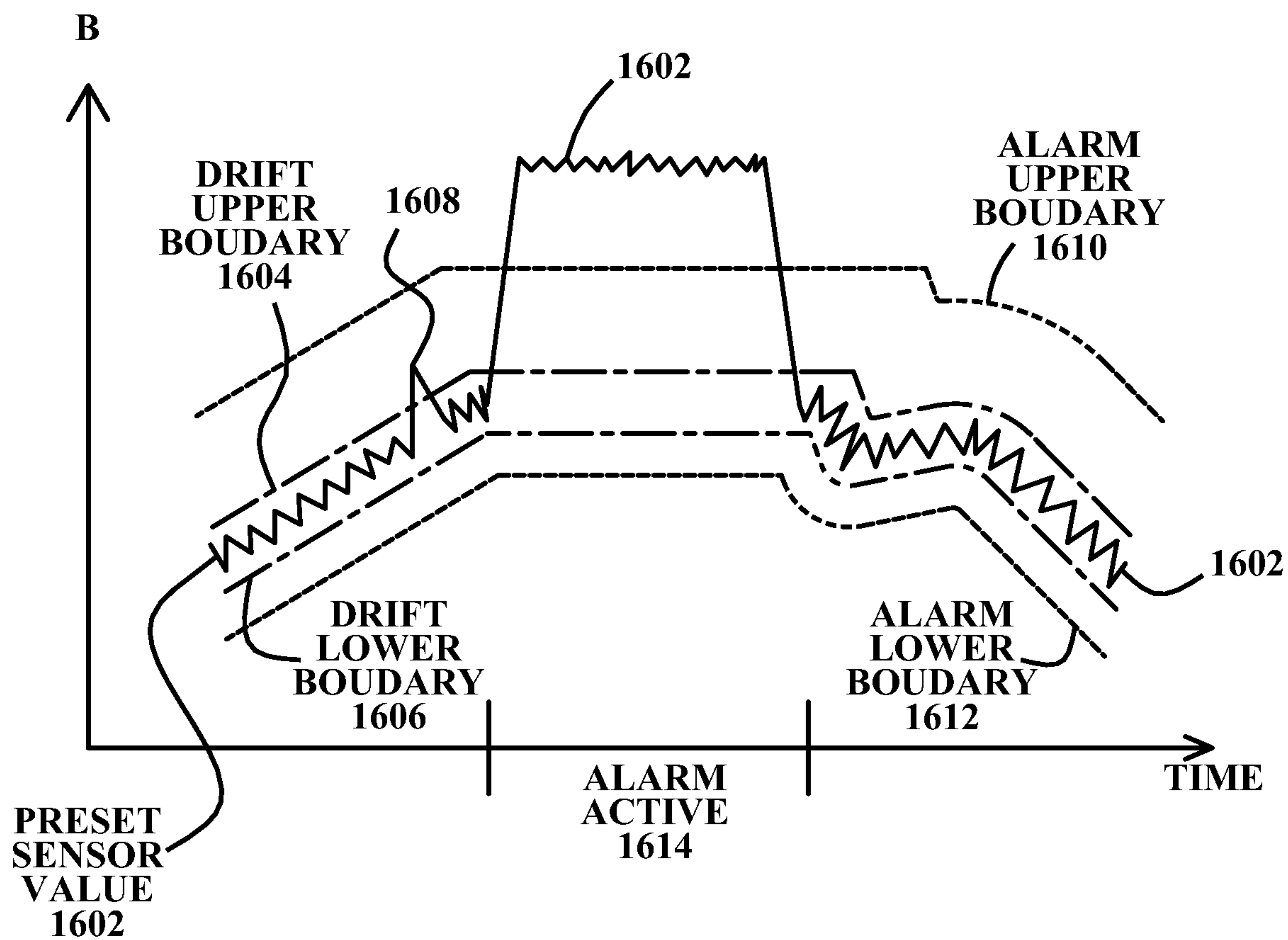


FIG. 16

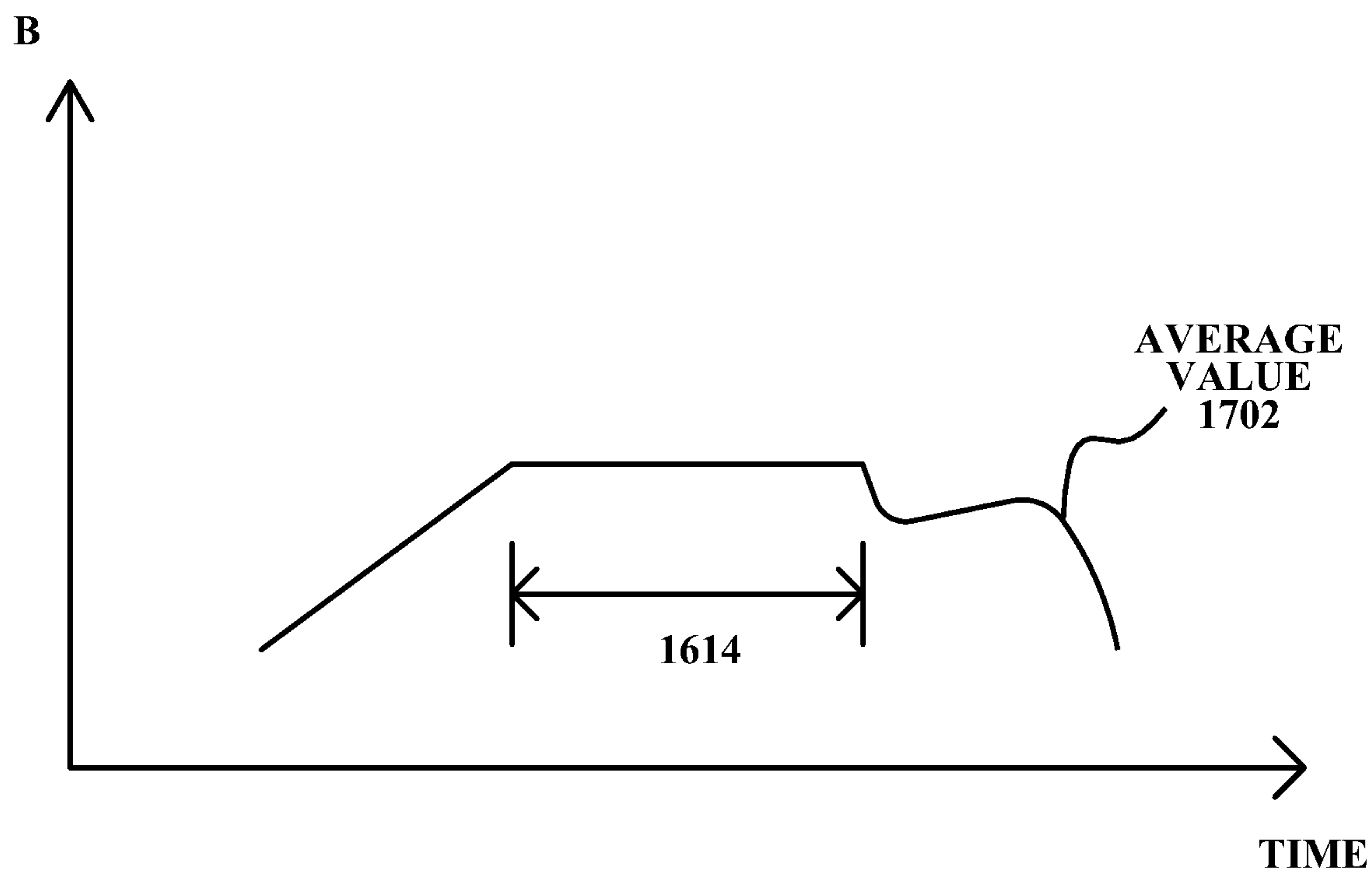


FIG. 17

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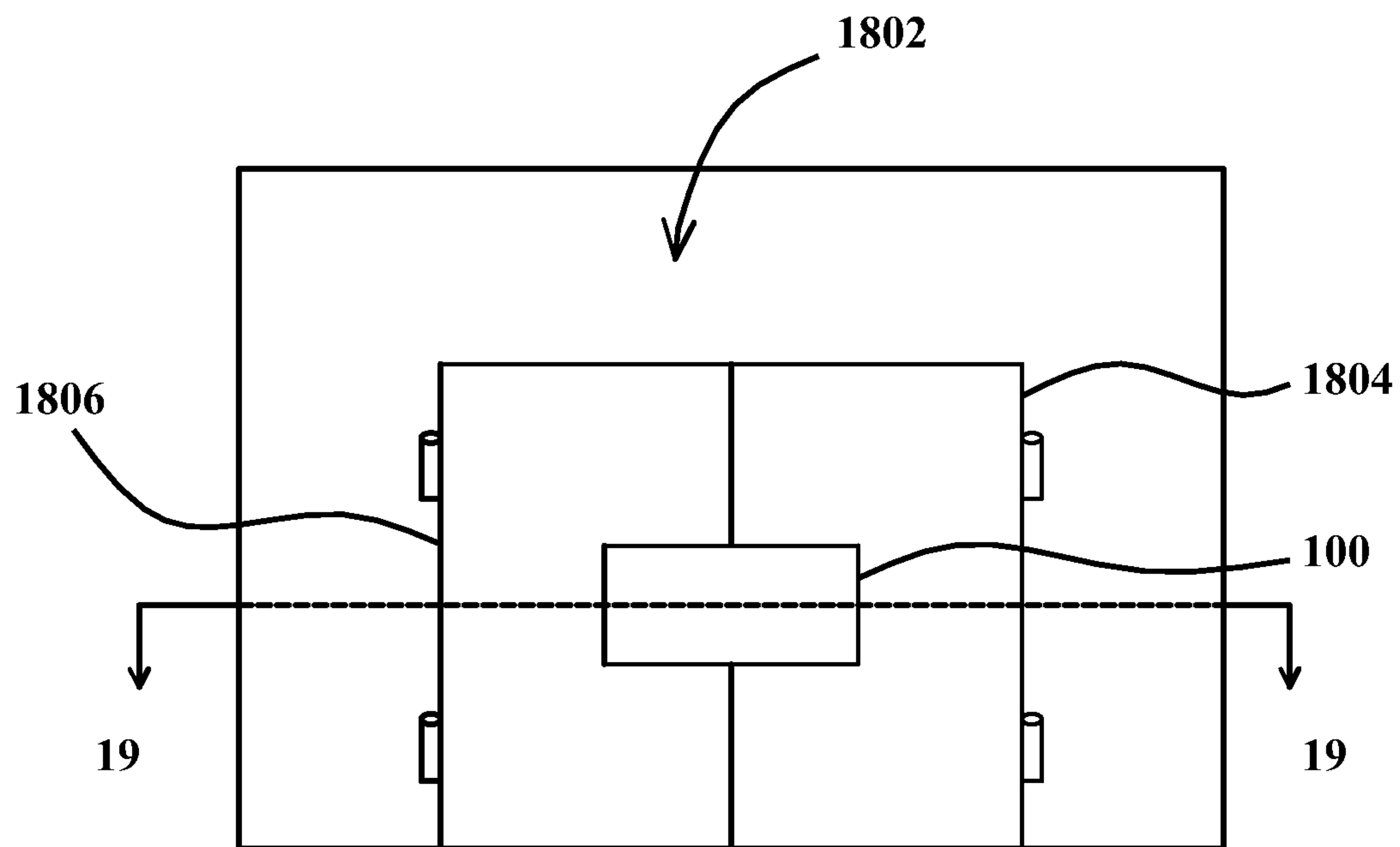


FIG. 18

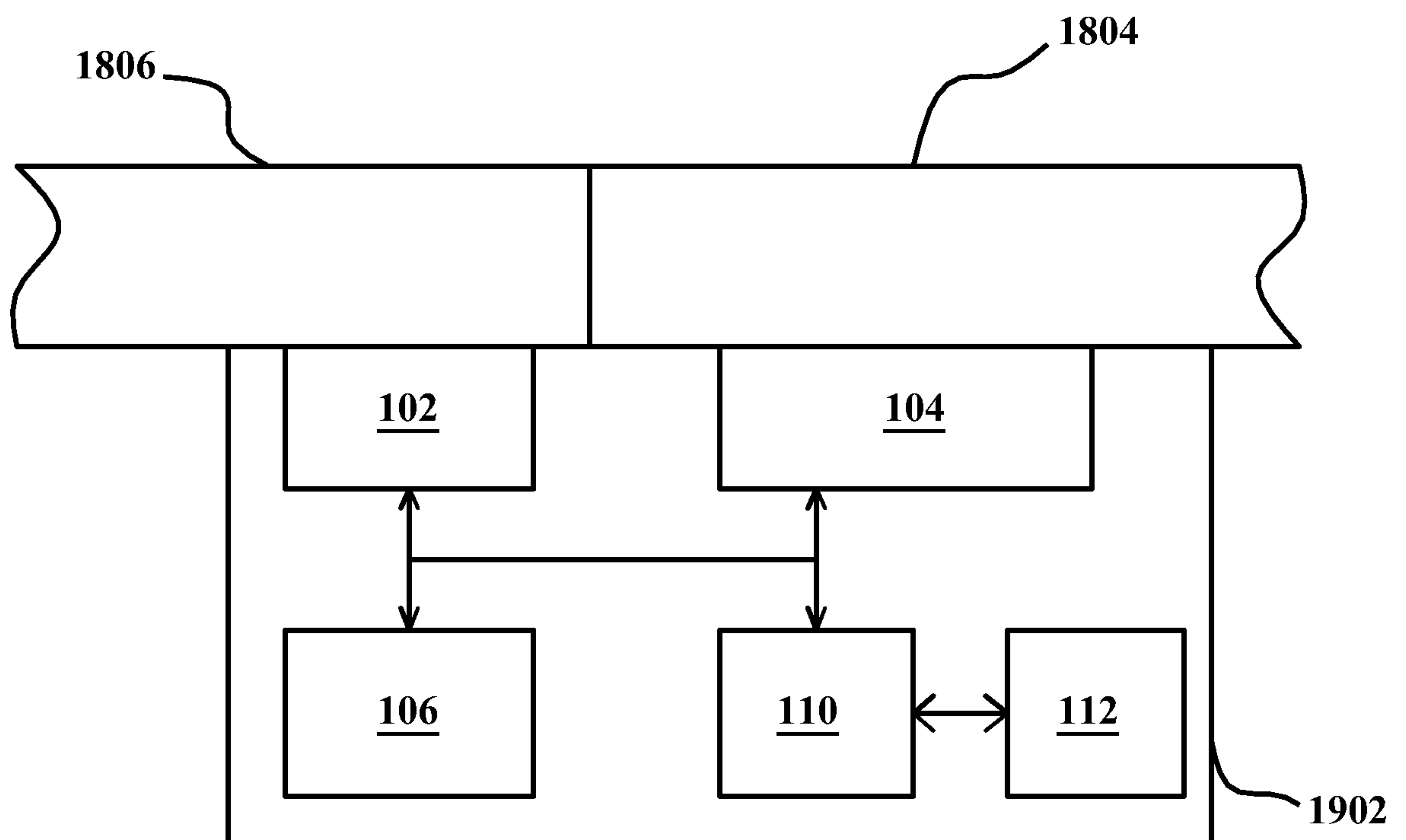


FIG. 19

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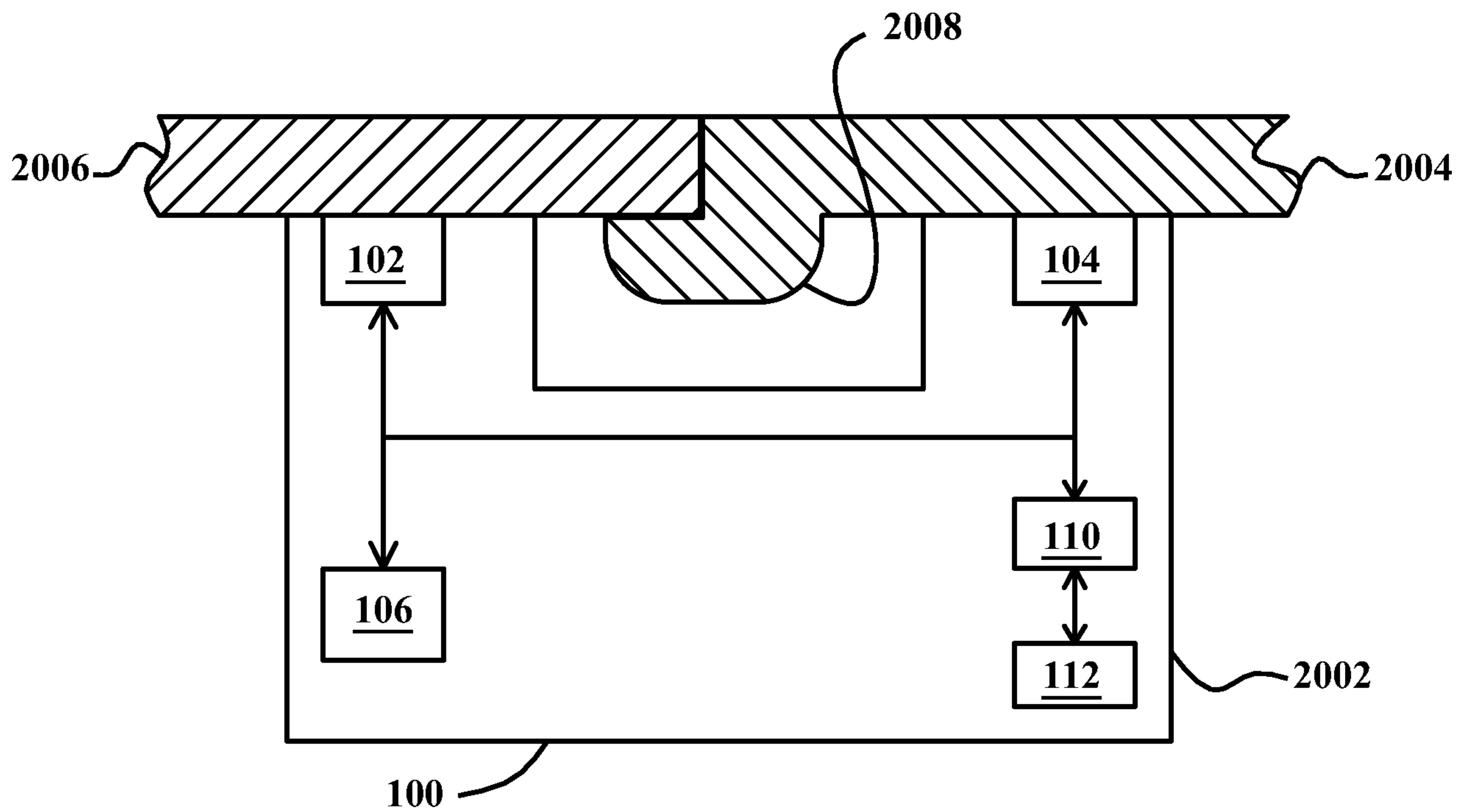


FIG. 20

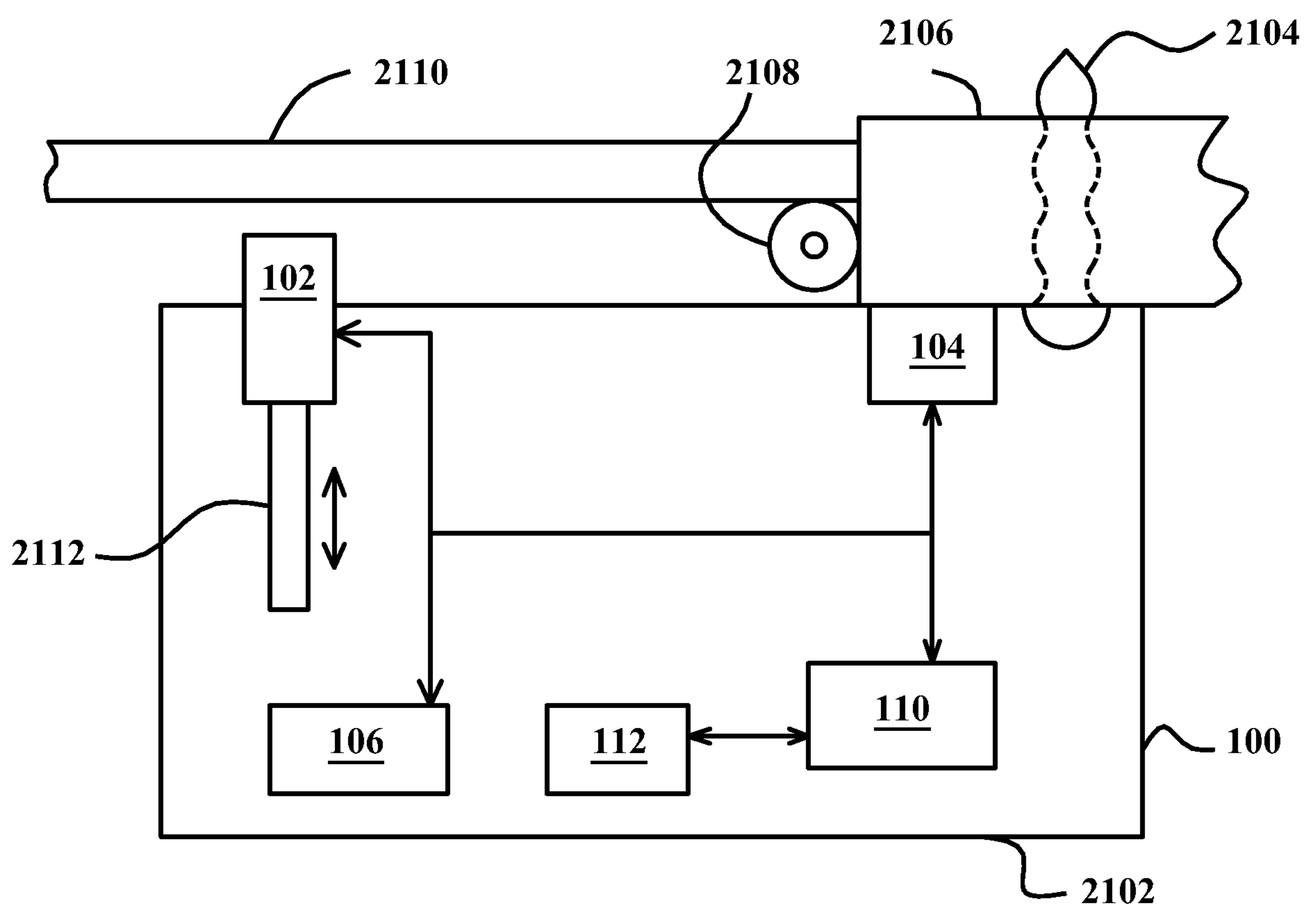


FIG. 21

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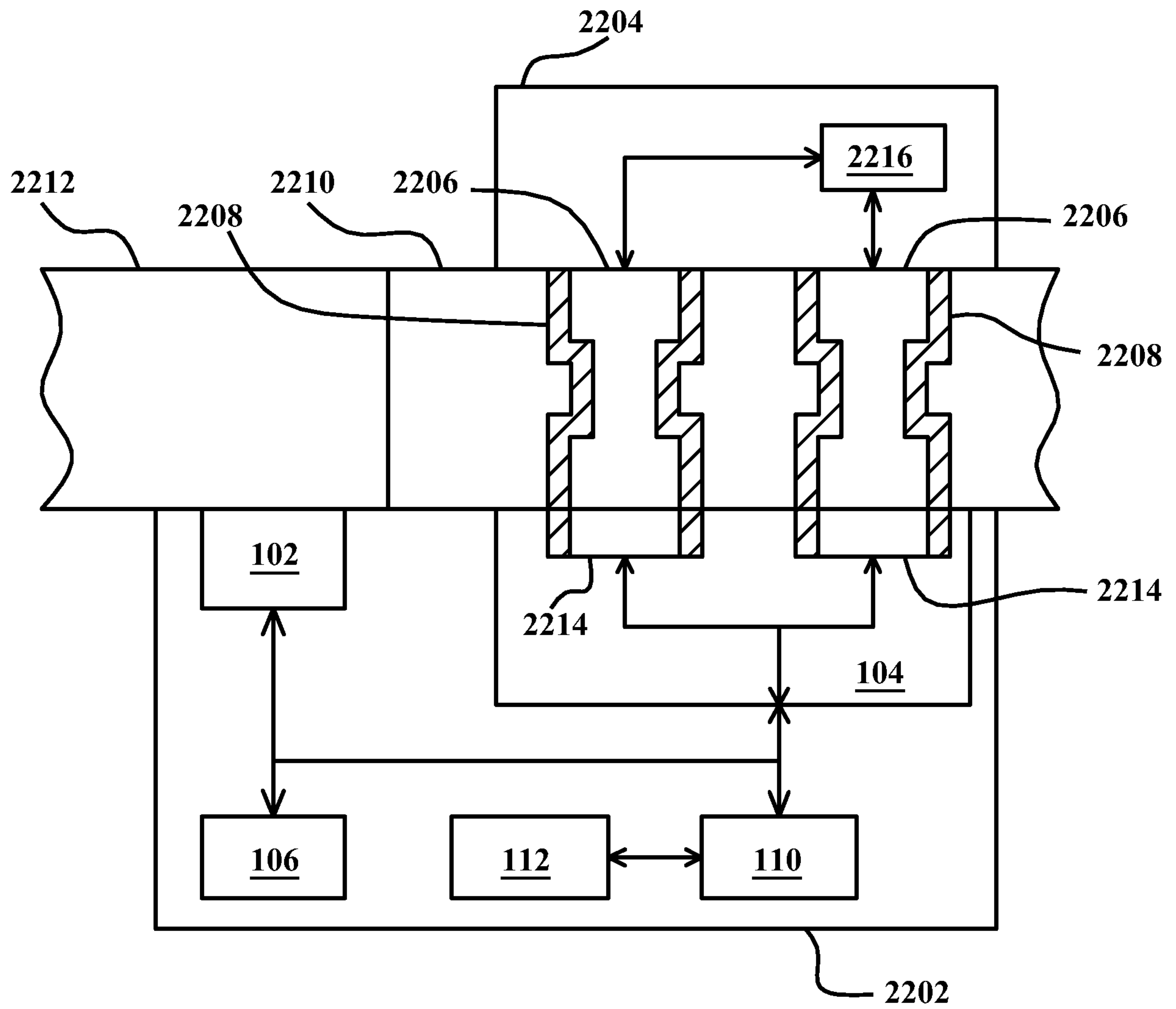


FIG. 22

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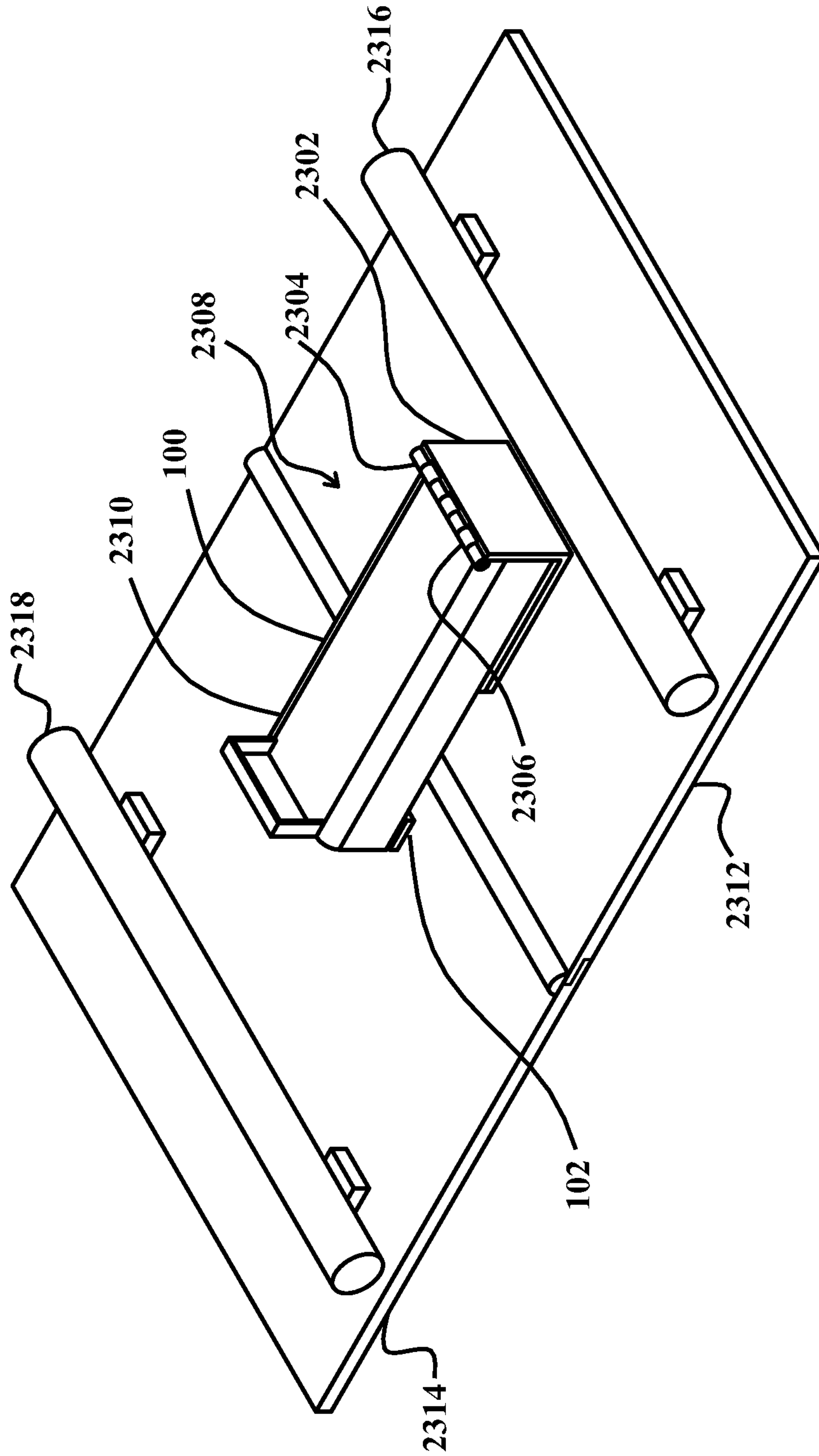


FIG. 23

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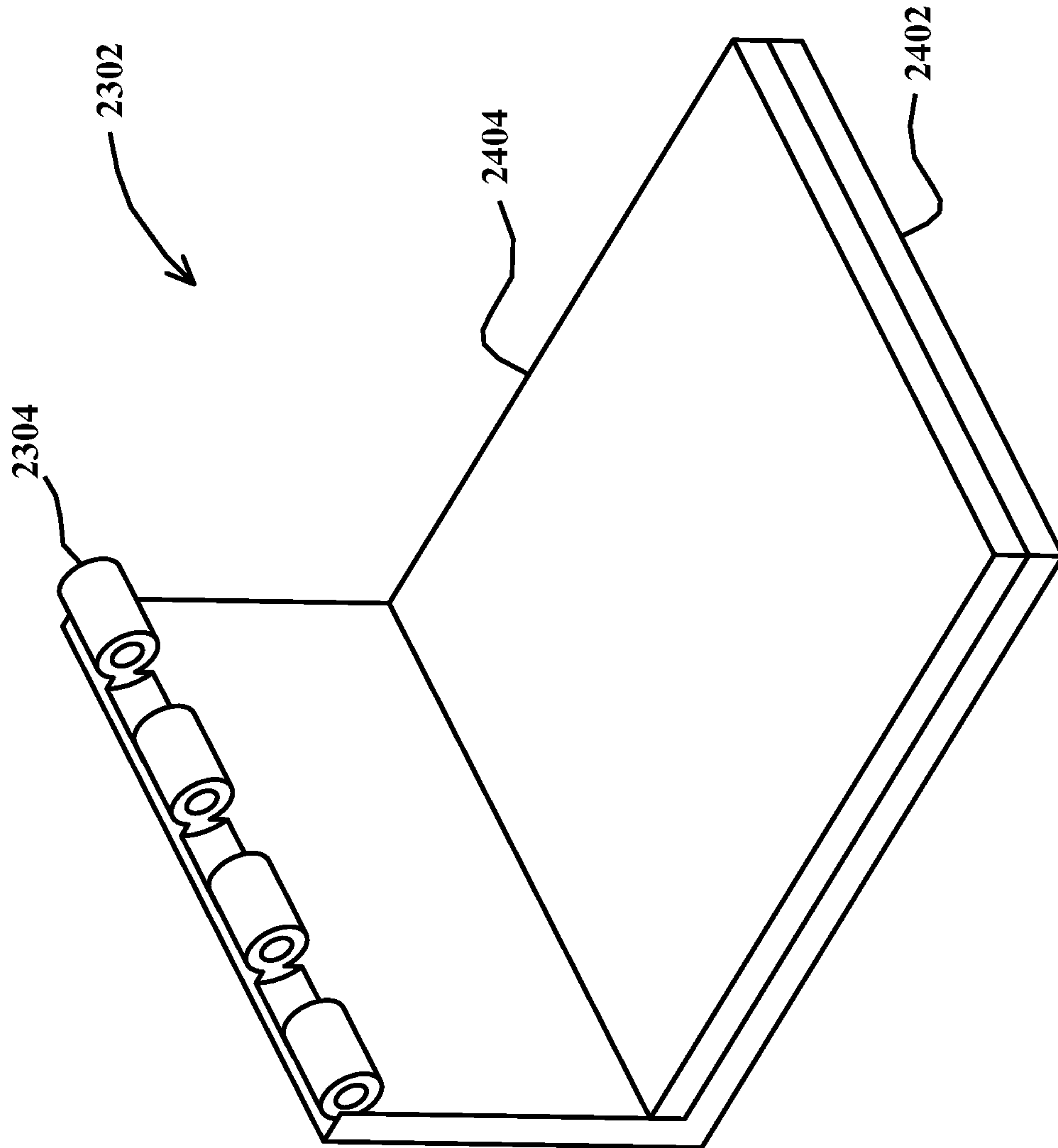


FIG. 24

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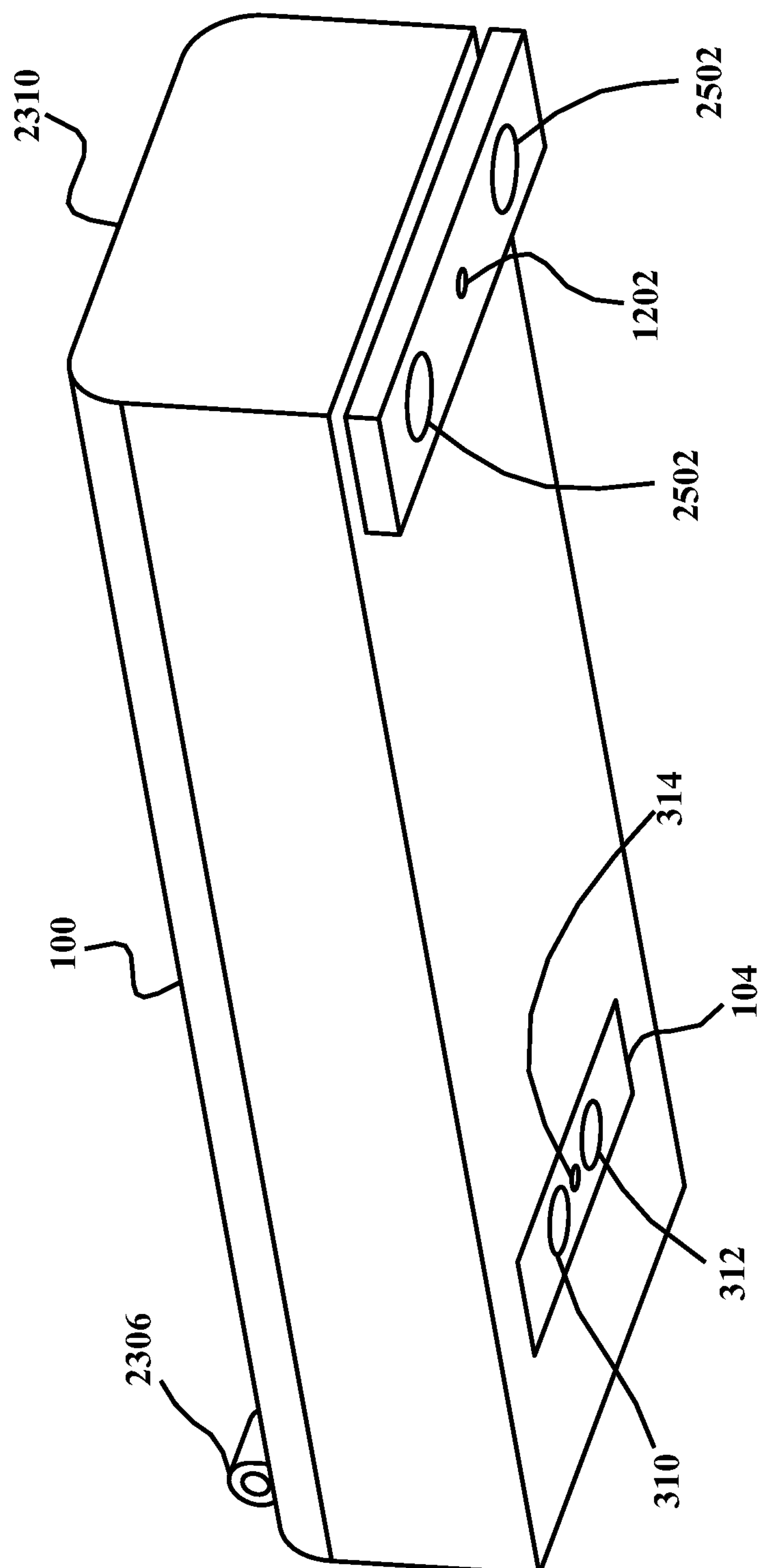
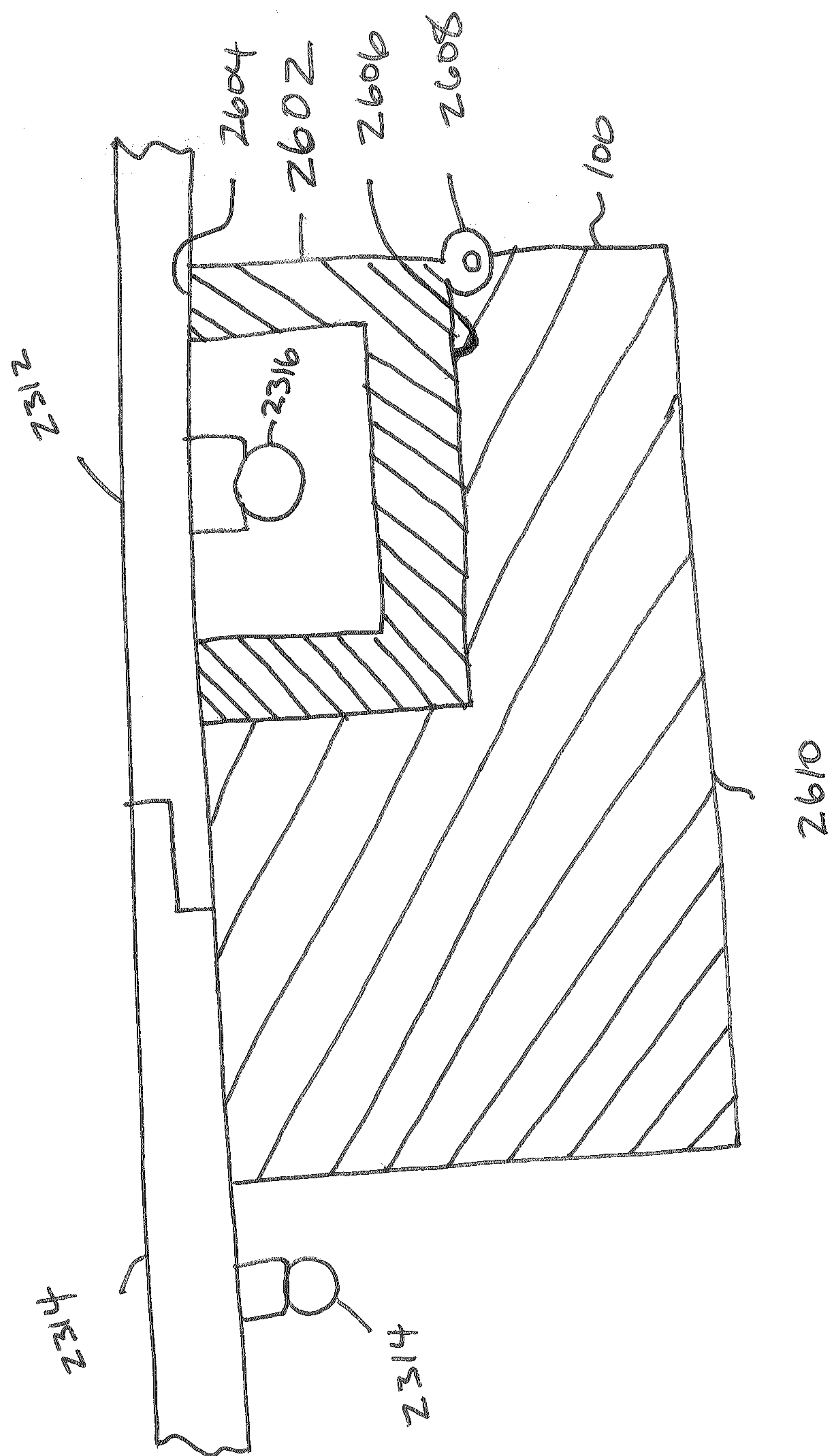


FIG. 25



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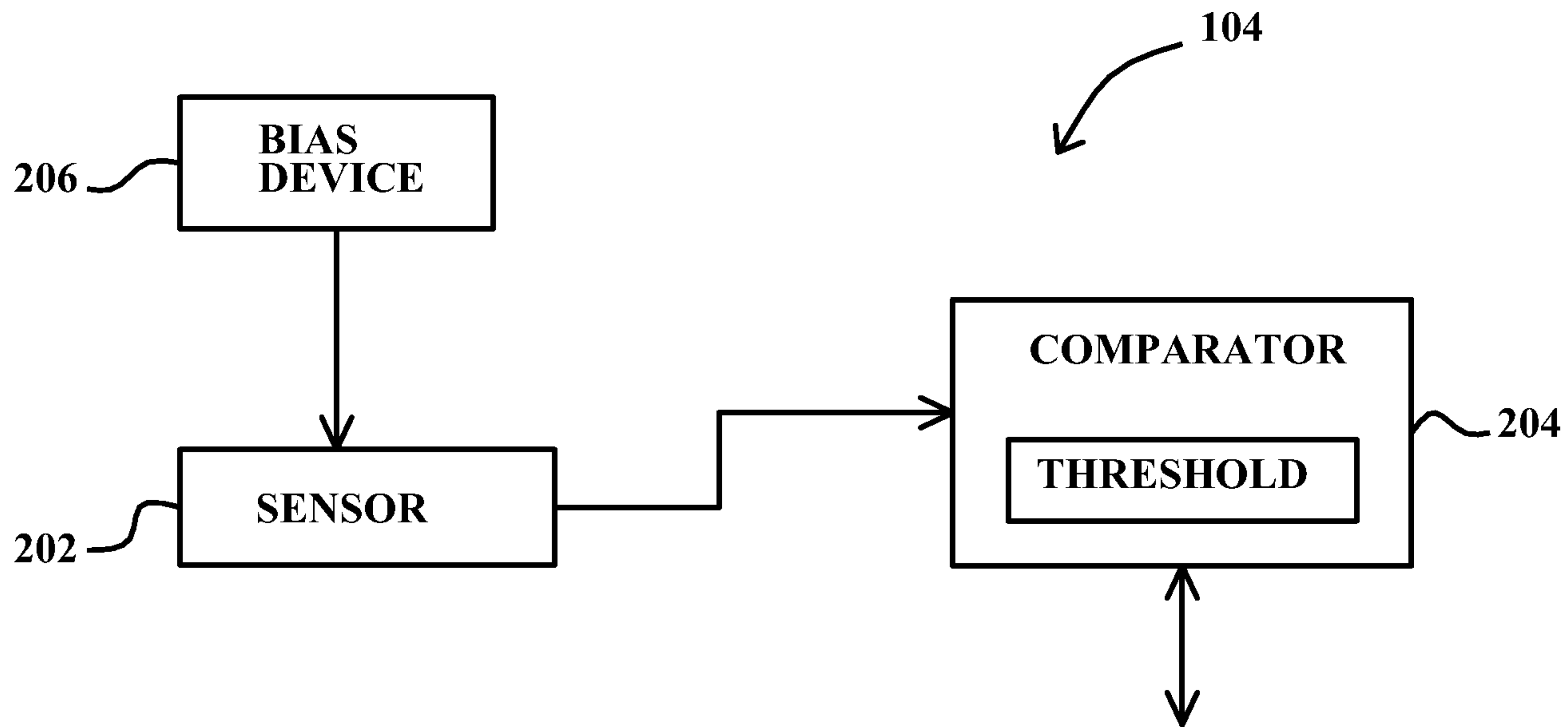


FIG. 2