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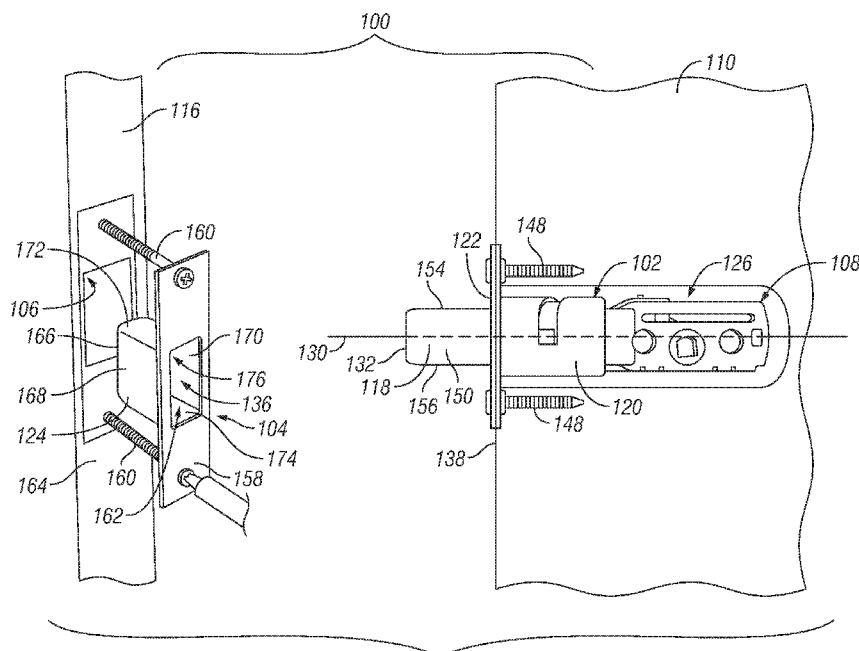


FIG. 1

(57) Abstract: A sensor assembly includes a sensor located within an opening formed in a strike box of the strike assembly. The sensor, which could be an optical, mechanical, continuity, inductive, ultrasonic, and/or mechanical sensor, is configured to detect whether the bolt of the bolt assembly is encompassed by the strike box. The sensor assembly is configured to interact with a surface of the bolt when the bolt is located within the opening.



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STRIKE PLATE WITH BOLT SENSING FEATURERelated Application

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 62/350,774 filed June 16, 2016 for a “Strike Plate with Bolt Sensing Feature,” which is hereby incorporated by reference in its entirety.

Technical Field

[0002] The present disclosure relates generally to sensors for doors; in particular, this disclosure relates to sensors for detecting whether a door is fully latched.

Background and Summary

[0003] Security systems are in widespread use in residential and commercial markets. These devices control ingress through doors to secured areas, such as a building or other secured space, by requiring certain authorized credentials. Existing security systems may include a sensor for determining whether a door is open or closed. In various embodiments of such systems, such a sensor may be located within the electronic latch mechanism in the door to determine if the bolt of the latch mechanism is retracted or extended. However, existing sensors are not able to provide exact location information regarding the bolt to determine whether the bolt is secured within a strike box of the door frame to ensure the door is closed. Further, existing sensors cannot determine whether a door is merely slightly ajar with the bolt extended or closed with the bolt secured within the strike box. Moreover, installation of existing sensors can be time consuming and aesthetically unpleasing. As one example, installers may be forced to separately install a magnet to a door and a magnetic sensor to molding surrounding the door (or vice versa) to determine orientation of the door to the door frame. Although such sensors are available in different colors to try to blend in with the door and molding colors, it can still have an unsightly appearance.

[0004] According to one aspect, this disclosure provides a sensor assembly that includes a sensor located within an opening formed in a strike box of the strike assembly. The sensor, which could be an optical, mechanical, continuity, inductive, ultrasonic, and/or mechanical sensor, is configured to detect whether the bolt of the bolt assembly is encompassed by the strike box. The sensor assembly is configured to interact with a surface of the bolt when the bolt is located within the opening.

Brief Description of the Figures

[0005] The detailed description makes references to the accompanying figures in which:

[0006] Figure 1 is a side view of a latch assembly in accordance with an embodiment of the present invention to be installed in a door and door jamb;

[0007] Figure 2 is a cross-sectional view of a lock assembly in accordance with an embodiment of the present disclosure, illustrating the latch assembly of Figure 1 installed in a door and a door jamb; and

[0008] Figures 3-17 are cross-sectional views of various embodiments of a sensor assembly to be used with the latch assembly of Figure 1.

[0009] Corresponding reference characters indicate corresponding parts throughout the several views. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principals and functions of the invention. The exemplification set out herein illustrates embodiments of the invention, and such exemplification is not to be construed as limiting the scope of the invention in any manner.

Detailed Description

[00010] While the concepts of the present disclosure are susceptible to various modifications and alternative forms, specific exemplary embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be

understood, however, that there is no intent to limit the concepts of the present disclosure to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure. Those of ordinary skill may recognize that other elements and/or operations may be desirable and/or necessary to implement the devices, systems, and methods described herein. Because such elements and operations are well known in the art, and because they do not facilitate a better understanding of the present disclosure, a discussion of such elements and operations may not be provided herein.

[00011] In the drawings, some structural features may be shown in specific arrangements and/or orderings. However, it should be appreciated that such specific arrangements and/or orderings may not be required. Rather, in some embodiments, such features may be arranged in a different manner and/or order than shown in the illustrative figures. Additionally, the inclusion of a structural or method feature in a particular figure is not meant to imply that such feature is required in all embodiments and, in some embodiments, may not be included or may be combined with other features.

[00012] Figures 1 and 2 illustrate various views of a latch assembly 100 according to one embodiment of the disclosure. The term “latch assembly” is broadly intended to encompass a latch mechanism of any electronic, electro-mechanical, or mechanical lock assemblies that utilize a bolt that is movable between a locked engaged with a strike box (or strike plate) and an unlocked position outside of the strike box (or strike plate) via electronical and/or mechanical force. It should be appreciated, however, that the present disclosure applies to any type of lock assembly that utilizes a bolt received within a strike box (or strike plate) and is not restricted to the specific embodiments described herein.

[00013] As illustrated in Figures 1 and 2, in a typical lock assembly 200, the lock assembly 200 may include an exterior assembly 112, the latch assembly 100, and an interior

assembly 114. Typically, the exterior assembly 112 is mounted on the outside of a door 110, while the interior assembly 114 is mounted inside the door 110. The latch assembly 100 is configured to be located between the exterior and interior assemblies 112 and 114 and may be partially mounted in a bore 108 formed in the door 110. The term “outside” is broadly used to mean an area outside a door and “inside” is also broadly used to denote an area inside a door. With an exterior entry door, for example, the exterior assembly may be mounted outside a building, while the interior assembly may be mounted inside the building. With an interior door, the exterior assembly may be mounted inside a building, but outside a room secured by the lock assembly, while the interior assembly may be mounted in the secured room.

[00014] In illustrative embodiments, the latch assembly 100 is configured to be operated by the interior and/or exterior assemblies 112 and 114 to latch or unlatch the door from a surrounding door frame/jamb 116 to restrict or permit access through the door frame 116. In various embodiments, for example, the interior assembly 114 includes an interior cover 144 that houses internal components (not shown) of the internal assembly 114 which interact with the latch assembly 100 to operate the latch assembly 100. Alternatively, the exterior assembly 112 may include components (not shown) which interact with the latch assembly 100 to operate the latch assembly 100. As another embodiment, both the internal and external assemblies 112 and 114 can be configured with components to operate the latch assembly 100.

[00015] As illustrated in Figure 1, the latch assembly 100 generally comprises a bolt assembly 102 and a strike assembly 104. The bolt assembly 102 is disposed substantially in the core 108 in the door 110, and may be actuated manually via the internal or external assemblies 112 and 114 by a mechanical lock assembly, or electronically using, for example, a keypad, to extend and retract a bolt 118 of the bolt assembly 102. In illustrative

embodiments, for example, a turnpiece 146 of the interior assembly 114 may be rotated by a user to manually extend and retract the bolt 118. The strike assembly 104 is disposed substantially in a core 106 in the door frame 116 of the door and is configured to receive the bolt 118 of the bolt assembly 102 within a strike box 124 of the strike assembly 104 when the door 110 is aligned with the door frame 116. By containing the bolt 118 within the strike box 124, the door 110 may be blocked or prevented from moving out of alignment with the door frame 116, effectively latching the door 110 in a closed position.

[00016] In illustrative embodiments, the bolt assembly 102 comprises the bolt 118, a sleeve 120, a base plate 122, and a bolt-driving mechanism 126. The bolt 118 may be connected to the sleeve 120 and the bolt-driving mechanism 126 such that the bolt-retracting mechanism 126 can operate to extend or retract the bolt 118 within the sleeve 120. For example, the bolt 118 may be configured to move linearly in and out of the sleeve 120 of the bolt assembly 102 along an extension axis 130 when the bolt-driving mechanism 126 is actuated (via the interior or exterior assemblies 112 and 114, for example) to retract the bolt 118. Various forms of bolt-retracting mechanisms are known in the art and considered within the scope of this disclosure. The sleeve 120 may be fixedly coupled to the base plate 122 to permit the bolt assembly 102 to be secured to the door 110. For example, as is typical, the bolt assembly 102 may be located within the core 108 of the door 110 and further attached to at least a connecting edge 138 of the door 110 that extends between an exterior edge 140 (Figure 2) of the door 110 and an interior edge 142 (Figure 2) of the door 110. The base plate 122 may be secured to be flush against the connecting edge 138 of the door 110 (via, for example, connecting screws 148) so that the sleeve 120 and bolt-retracting mechanism 126 are contained within the core 108 of the door 110.

[00017] The bolt 118 may be configured of various dimensions that can be received within the strike box 124. In illustrative embodiments, the bolt 118 could generally be

rectangular in cross-section and includes at least a first end 132, a first side 150, a second side 152, a top surface 154, and a bottom surface 156. When the bolt 118 is retracted within the sleeve 120, the first end 132 of the bolt 118 is generally flush with the base plate 122. When the bolt 118 is extended, the bolt 118 protrudes through an edge bore 134 in the door 110 into the strike box 124, which is positioned in the jamb 116 adjacent the door 110, in order to secure the door 110 to the jamb 116.

[00018] As illustrated in Figures 1 and 2, the strike assembly 104 may comprise the strike box 124, an opening 136 formed by the strike box 124, and a base plate 158. The strike box 124 may be fixedly connected to the base plate 158, and the base plate 158 is formed to include an aperture 162 that permits access to the opening 136 of the strike box 124 from an exterior of the strike assembly 104. As is typical, the strike assembly 104 is attached to the jamb 116 using fasteners 160 that extend through the base plate 158 so that the base plate 158 is flush with a surface 164 of the jamb 116. When the base plate 158 is connected to the jamb 116, the strike box 124 is configured to be contained within the core 106 formed in the jamb 116.

[00019] The strike box 124 may be configured of various dimensions such that the opening 136 can receive the bolt 118 of the bolt assembly 102. In illustrative embodiments, the strike box 124 is generally rectangular in cross-section and includes a back panel 166, a first side panel 168, a second side panel 170, a top panel 172, and a bottom panel 174, and is formed to include an aperture 176 that is positioned opposite the back panel 166 and configured to align with the aperture 162 of the base plate 158 to permit access to the opening 136 of the strike box 124. The opening 136 is defined by the connection of the back panel 166, first side panel 168, second side panel 170, top panel 172 and bottom panel 174. Under desired conditions, when the bolt 118 is extended into the strike box 124, the bolt 118 is surrounded by the panels 166, 168, 170, 172 and 174, and at least the first and second side

panels 168 and 170 block movement of the bolt 118 out of the strike box 124 in order to secure the door 110 to the jamb 116. In various embodiments, as illustrated in Figures 3-17, the top surface 154 of the bolt 118 may be slightly spaced apart from the top panel 172 of the strike box, and the bottom surface 156 of the bolt 118 may be slightly spaced apart from the bottom panel 174 of the strike box 124, when the bolt 118 is received within the opening 136 of the strike box 124. Similarly, the back panel 166 of strike box 124 may be slightly spaced apart from the first end 132 of the bolt 118 when the bolt 118 is received within the opening 136.

[00020] In illustrative embodiments, the latch assembly 100 includes a sensor assembly 180 that is configured to detect whether the bolt 118 is located in the opening 136 of the strike box 124 a sufficient distance as to securely latch the door 110 to the jamb 116 in a closed position. In various embodiments, the sensor assembly 180 may be at least partially coupled to the strike assembly 104 to interact with the bolt 118 as it is received within the opening 136. The sensor assembly 180 may alternatively be coupled to another part of the latch assembly 100 to detect if the bolt 118 has entered the opening 136 of the strike box 124.

[00021] Various embodiments of the sensor assembly 180 will now be described herein. The various embodiments are provided to illustrate how the sensor assembly 180 can work in conjunction with the strike assembly 104 and/or bolt 118 to detect that the bolt 118 is adequately contained within the strike box 124 of the strike assembly 104 or not, and are not intended to limit the scope of the sensor assembly 180. It is within the scope of this disclosure for the determination of the amount of the bolt 118 that is required to be considered adequately secured may be performed during set up or installation, or may be mechanically configured by other factors. It is also within the scope of this disclosure that the sensor assembly 180 may be configured to have multiple sensing components that can determine the depth of the bolt 118 within the strike box 104, and also determine travel

direction of the bolt 118. Other measurements and determinable characteristics of the bolt 118 as it travels into the strike box 104 will be understood to one of ordinary skill in the art.

[00022] In a first illustrative embodiment of the sensor assembly 180, an optical sensor 210 may be located along an inside surface 182 of the back panel 166 of the strike box 124, as illustrated in Figure 3. The optical sensor 210 includes a transmission (TX) portion 212 and a receiver (RX) portion 214, with the TX portion 212 configured to transmit or send an optical signal 215 along a TX axis 216 that is substantially parallel with the extension axis 130 of the bolt 118, the TX axis 216 configured to intersect a portion of the first end 132 of the bolt 118 when the bolt 118 enters the strike box 124. The signal 215 is configured to be reflected off of the first end 132 of the bolt 118 when the bolt 118 is received within the strike box 124 such that the signal will reflect off of the bolt 118 and back toward the back panel 166 of the strike box 124 along a RX axis 218. In such an embodiment, the RX portion 214 is configured to be aligned with the RX axis 218 to receive the signal 215 after it has bounced off of the first end 132 of the bolt 118. The RX portion 214 of the optical sensor 210 is configured to detect the strength of the reflection of the signal 215 after it has bounced off of the first end 132. When the bolt 118 is located at a predetermined distance from the sensor 210 that corresponds with the bolt 118 being secured within the strike box 124, the signal 215 will have a determinable reflection strength. The sensor assembly 180 can accordingly detect when the bolt 118 is located within the strike box 124 by analyzing the reflection strength of the signal 215 via the RX portion 214 of the sensor. If the bolt 118 is not located within the strike box 124 or located within a predetermined distance of the TX portion 212 that can receive/deflect the signal 215, then the signal 215 will not be returned to the RX portion 214 and the sensor assembly 180 will then indicate that the bolt 118 is not located within the strike box 124, *i.e.*, the door 110 is not completely latched closed.

[00023] In a second illustrative embodiment of the sensor assembly 180, the optical sensor 210 may operate in a similar manner as the first illustrative embodiment and as illustrated in Figure 3, except the sensor assembly 180 has the ability to track the time from transmission of the signal 215 by the TX portion 212 to receipt of the signal 215 by the RX portion 214. In this manner, when the bolt 118 is located at a predetermined distance from the sensor 210 that corresponds with the bolt 118 being secured within the strike box 124, there will be a predetermined length of time for the signal to travel from the TX portion 212 to the RX portion 214. The sensor assembly 180 can accordingly detect when the bolt 118 is located within the strike box 124 by analyzing whether the time between sending signal 215 from the TX portion 212 to the RX portion 214 meets the predetermined length of time. If the bolt 118 is not located within the strike box 124 or located within a predetermined distance of the TX portion 212 that can receive/deflect the signal 215, then the signal 215 will not be returned to the RX portion 214 and there will be no end time registered by the RX portion 214. Accordingly, the sensor assembly 180 will then indicate that the bolt 118 is not located within the strike box 124, *i.e.*, the door 110 is not completely latched closed.

[00024] In a third illustrative embodiment of the sensor assembly 180, the optical sensor 210 may operate in a similar manner as the first embodiment, except that the sensor assembly 180 may be located along an inside surface 184 of the top panel 172, as illustrated in Figure 4. The TX portion 212 of the optical sensor 210 is configured to transmit or send the optical signal 215 along a TX axis 217 that is substantially perpendicular to the extension axis 130 of the bolt 118, the TX axis 217 configured to intersect the top surface 154 of the bolt 118 when the bolt 118 extends a predetermined distance D into the strike box 124 from the surface 164 of the jamb 116, wherein the distance D can represent the amount of distance that the bolt 118 must travel past the surface 164 and into the opening 136 of the strike box 124 to be securely retained within the strike box 124. The signal 215 is configured to be

reflected off of the top surface 154 of the bolt 118 when the bolt 118 is received within the strike box 124 such that the signal will reflect off of the bolt 118 and back toward the top panel 172 of the strike box 124 along an RX axis 219. In such an embodiment, the RX portion 214 is configured to be aligned with the RX axis 219 to receive the signal 215 after it has bounced off of the top surface 154 of the bolt 118. If the sensor assembly 180 detects the bolt 118 is located within the strike box 124 by analyzing whether the RX portion 214 has received the signal 215, then the sensor assembly 180 can indicate that the door 110 is adequately latched closed. In an alternative to this embodiment, an optical sensor 210a may be alternatively positioned along an inside surface 186 of the bottom panel 174 of the strike box 124 that can send a signal 215 to deflect off the bottom surface 156 of the bolt 118. Alternatively, the sensor assembly 180 may include both a first optical sensor 210 and a second optical sensor 210a.

[00025] In a fourth illustrative embodiment of the sensor assembly 180, the optical sensor 210 may operate in a similar manner as the third illustrative embodiment and as illustrated in Figure 4, except the sensor assembly 180 has the ability to track the time from transmission of the signal 215 by the TX portion 212 to receipt of the signal 215 by the RX portion 214, similar to the second illustrative embodiment. In this manner, when the bolt 118 is located in the strike box 124 and intersects TX axis 216, there will be a predetermined length of time for the signal to travel from the TX portion 212 to the RX portion 214. The sensor assembly 180 can accordingly detect when the bolt 118 is secured within the strike box 124 by analyzing whether the time between sending signal 215 from the TX portion 212 to the RX portion 214 the reflection strength of the signal 215 via the RX portion 214 of the sensor. If the bolt 118 is not secured within the strike box 124 or located within a predetermined distance of the TX portion 212 that can receive/deflect the signal 215, then the

signal 215 will not be returned to the RX portion 214 and there will be no end time registered by the RX portion 214.

[00026] In a fifth illustrative embodiment of the sensor assembly 180, an optical sensor 220 may be located along both an inside surface 184 of the top panel 172 and an inside surface 186 of the bottom panel 174 of the strike box 124, as illustrated in Figure 5. The optical sensor 220 includes a transmission (TX) portion 222 and a receiver (RX) portion 224, with the TX portion 222 configured to transmit or send an optical signal 225 along a beam axis 226 that intersects the RX portion 224. The TX portion 222 may be configured to transmit the optical signal 225 continuously, or at predetermined time intervals, to the RX portion 224. As illustrated in Figure 5, the beam axis 226 may be substantially perpendicular to the extension axis 130 of the bolt 118, although other alignments of the beam axis 226 and the extension axis 130 are envisioned herein. The beam axis 226 is configured to be at least a predetermined distance D from the surface 164 of the jamb 116, wherein the distance D can represent the amount of distance that the bolt 118 must travel past the surface 164 and into the opening 136 of the strike box 124 to be securely retained within the strike box 124. As the bolt 118 is received within the strike box 124, the top surface 154 and/or the bottom surface 156 of the bolt 118 will intersect the beam axis 226, breaking the signal 225 from the TX portion 222 to the RX portion 224. Accordingly, when the RX portion 224 of the optical sensor 210 fails to detect the signal 225, the sensor assembly 180 can identify that the bolt 118 is located within the strike box 124, *i.e.*, the door is latched closed. Otherwise, the sensor assembly 180 detects that the door is not fully latched closed.

[00027] In a sixth illustrative embodiment of the sensor assembly 180, a mechanical sensor 230 may be located along an inside surface 182 of the back panel 166 of the strike box 124, as illustrated in Figure 6. The mechanical sensor 230 may be comprised of a movable switch 232, a biasing member 234, and an optional base 236 upon which the switch 232 is

hinged or pivoted for movement. The mechanical sensor 230 is mounted upon the back panel 166 in such a way that the switch 232 extends within the opening 136 such that a portion (such as an end 233) of the switch 232 intersects with the extension axis 130 of the bolt 118. The switch 232 is biased away from the back panel 166 by the biasing member 234 toward the aperture 162 of the strike box 124. The switch 232 is configured to be pushed toward the back panel 166 when the first end 132 of the bolt 118 abuts against the switch 232 as the bolt enters the strike box 124. The switch 232 may be located along an actuation axis 238 that is generally perpendicular to the extension axis 130, and the actuation axis 238 may be located a predetermined distance D from the surface 164 of the jamb 116 that corresponds with the bolt 118 being secured within the strike box 124. When the first end 132 of the bolt 118 is located at the predetermined distance D from the surface 164, it will bias the switch 232 toward the back panel 166 against the biasing member 234. The sensor assembly 180 then detects that the bolt 118 is located within the strike box 124 and the door 110 is latched. If the bolt 118 is not located within the strike box 124 or located within the predetermined distance D of the switch 232 to bias the switch 232 toward the back panel 166, then the sensor assembly 180 will then indicate that the bolt 118 is not located within the strike box 124, *i.e.*, the door 110 is not completely latched closed.

[00028] In a seventh illustrative embodiment of the sensor assembly 180, the sensor assembly 180 may operate in a similar manner as the sixth embodiment, except that the sensor assembly 180 may be located along an inside surface 184 of the top panel 172, as illustrated in Figure 7. The switch 232 is biased away from the top panel 172 by the biasing member 234 toward the bottom panel 174 of the strike box 124. The mechanical sensor 230 is mounted upon the back panel 166 in such a way that the switch 232 extends within the opening 136 such that the end 233 of the switch 232 is positioned along an intersection axis 239 of the top surface 154 bolt 118 when switch 232 is in a natural state that is biased way

from the top panel 172 by the biasing member 234. The intersection axis 239 is generally parallel to the extension axis 130. The end 233 of the switch 232 is also positioned a predetermined distance D from the surface 164 of the jamb 116 that corresponds with the bolt 118 being secured within the strike box 124. When the bolt 118 is moved within the strike box 124 the predetermined distance D, the top surface 154 of the bolt 118 will abut against the end 233 of the switch 232 and move the switch upward toward the top panel 172. The sensor assembly 180 then detects that the bolt 118 is located within the strike box 124 and the door 110 is latched. If the bolt 118 is not located within the strike box 124 or located within the predetermined distance D of the switch 232 to bias the switch 232 toward the top panel 172, then the sensor assembly 180 will then indicate that the bolt 118 is not located within the strike box 124, *i.e.*, the door 110 is not completely latched closed. As an alternative or in conjunction with this illustrative embodiment, the sensor assembly 180 may comprise a mechanical sensor positioned along the inside surface 186 of the bottom panel 174 of the strike box 124 in order to intersect the bottom surface 156 of the bolt 118.

[00029] In an eighth illustrative embodiment of the sensor assembly 180, a capacitive sensor 240 may be located along an inside surface 182 of the back panel 166 of the strike box 124, as illustrated in Figure 8. The capacitive sensor 240 includes one or more capacitive sensor elements 242 that are configured to emit an electrical field 244 within the opening 136 of the strike box 124. The sensor assembly 180 is configured to detect changes in the electrical field 244 generated by the capacitive sensor 240. The capacitive sensor element 242 is located to be substantially aligned with the extension axis 130 of the bolt 118 when the bolt 118 enters the strike box 124. As the first end 132 of the bolt 118 extends within the opening 136, it will replace the dielectric constant of air, as is generally known. The capacitive sensor element 242 can be configured to create an electrical field 244 that generally extends to an actuation axis 246, the actuation axis generally extending a

predetermined distance D from the surface 164 of the jamb 116 that corresponds with the bolt 118 being secured within the strike box 124. When the bolt 118 is moved within the strike box 124 the predetermined distance D, the electrical field 244 is changed and the capacitive sensor 240 can detect the change, for instance, an increase in the capacitance sensed. When a pre-determined capacitive threshold is reached within the electrical field 244, the sensor assembly 180 will register that the bolt 118 is secured within the strike box 124. If the bolt 118 is not located within the strike box 124 or located within a predetermined distance D to alter the electrical field 244, then the sensor assembly 180 will then indicate that the bolt 118 is not located within the strike box 124, *i.e.*, the door 110 is not completely latched closed.

[00030] In a ninth illustrative embodiment of the sensor assembly 180, the sensor assembly 180 may operate in a similar manner as the seventh embodiment, except that the sensor assembly 180 may be located along an inside surface 188 of the first side panel 168 of the strike box 124, as illustrated in Figure 9. The capacitive sensor 240 includes one or more capacitive sensor elements 242 that are configured to emit an electrical field 244 within the opening 136 of the strike box 124. The capacitive sensor elements 242 are aligned along a measurement plane/axis 248 that is generally perpendicular to the extension axis 130 of the bolt 118 when it is received within the strike box 124. As in the previous embodiment, the bolt 118 will saturate or change the electrical field 244 as it comes within a predetermined distance of the field 244, and the capacitive sensor element 242 generating the electrical field 244 will be able to detect such change. In various embodiments, the capacitive sensor elements 242 may be positioned to be a predetermined distance D from the surface 164 of the jamb 116 that corresponds with the bolt 118 being secured within the strike box 124. Alternatively, the capacitive sensor elements 242 may be positioned along length of the first side panel 168 to detect as the bolt 118 is inserted into the opening 136, and the sensor assembly 180 may have a pre-determined threshold of saturation across all of the capacitive

sensor elements 242 (or a pre-determined order of saturating each of the individual sensor elements 242) that determines whether the bolt 118 is located sufficiently within the opening 136 of the strike box 124 to secure the bolt 118 and ensure the door 110 is latched sufficiently. It is further envisioned that the capacitive sensor 240 may be positioned along the second side panel 170, the top panel 172, or the bottom panel 174 of the strike box 124, or multiple capacitive sensors 240 may be positioned on one or more of these panels, within the scope of this disclosure.

[00031] In a tenth illustrative embodiment of the sensor assembly 180, an inductive sensor 250 may be located along an inside surface 182 of the back panel 166 of the strike box 124, as illustrated in Figure 10. The inductive sensor 250 includes one or more inductive coil elements 252 that are configured to emit an electrical field 254 within the opening 136 of the strike box 124. The sensor assembly 180 is configured to detect the frequency in the electrical field 254 generated by the inductive sensor 250. The inductive coil element 252 is located to be substantially aligned with the extension axis 130 of the bolt 118 when the bolt 118 enters the strike box 124. As the first end 132 of the bolt 118 extends within the opening 136, it will replace the dielectric constant of air, which, in turn will change the frequency measured by the inductive sensor 250, as is generally known. The inductive coil element 252 can be configured to create an electrical field 254 that generally extends to an actuation axis 256, the actuation axis 256 generally being perpendicular to the extension axis 130 and extending a predetermined distance D from the surface 164 of the jamb 116 that corresponds with the bolt 118 being secured within the strike box 124. When the bolt 118 is moved within the strike box 124 the predetermined distance D, the electrical field 254 is changed and the inductive sensor 250 can detect the change in frequency. When a pre-determined frequency threshold is reached within the electrical field 254, the sensor assembly 180 will register that the bolt 118 is secured within the strike box 124. If the bolt 118 is not located

within the strike box 124 or located within a predetermined distance D to alter the electrical field 254, then the sensor assembly 180 will then indicate that the bolt 118 is not located within the strike box 124, *i.e.*, the door 110 is not completely latched closed.

[00032] In an eleventh illustrative embodiment of the sensor assembly 180, the sensor assembly 180 may operate in a similar manner as the tenth embodiment, except that the sensor assembly 180 may be positioned around an exterior circumference 190 of the strike box 124, as illustrated in Figure 11. The exterior circumference 190 of the strike box 124 may be defined by the back panel 166, first side panel 168, second side panel 170, top panel 172, and bottom panel 174. Specifically, the inductive sensor 250 may be configured such that the inductive coil element 252 is wrapped around an outside of the exterior circumference 190 of the strike box 124, or the inductive coil element 252 may be wrapped around an inside of the exterior circumference 190 and contained within the opening 136. The inductive coil element 252 is configured to create the electrical field 254 within the opening 136, and the inductive sensor 250 is configured to measure the frequency of the electrical field 254. As the first end 132 of the bolt 118 extends within the opening 136, the bolt 118 will replace the dielectric constant of air, which, in turn will change the frequency measured by the inductive sensor 250, as is generally known. An actuation axis 256 is perpendicular to the extension axis 130 of the bolt 118 and is defined by being a predetermined distance D from the surface 164 of the jamb 116 that corresponds with the bolt 118 being secured within the strike box 124. When the bolt 118 is moved within the strike box 124 the predetermined distance D, the inductive sensor 250 registers the change in frequency in the electrical field 254, the predetermined distance D corresponding with a when a pre-determined frequency threshold. If the pre-determined frequency threshold is reached within the electrical field 254, the sensor assembly 180 will register that the bolt 118 is

secured within the strike box 124. Otherwise, the sensor assembly 180 will register that the door is not securely latched (*e.g.* closed).

[00033] As an alternative embodiment to the eleventh embodiment described above, the bolt 118 may include an optional RFID chip 292 that is in communication with the inductive sensor 250. The RFID chip 292 within the bolt 118 may be configured to be activated when the bolt 118 reaches a predetermined distance within the electrical field 254 created by the inductive coil element 252, as illustrated in Figure 11A. When the bolt 118 is moved within the strike box 124 a predetermined distance that actuates the permits the electrical field 254 to actuate the RFID chip 292, and the RFID chip 292 will send a signal to the inductive sensor 250 that registers the bolt is securely retained within the strike box 124.

[00034] In a twelfth illustrative embodiment of the sensor assembly 180, an ultrasonic sensor 260 may be located along an inside surface 182 of the back panel 166 of the strike box 124, as illustrated in Figure 12. The ultrasonic sensor 260 includes a transmission (TX) portion 262 and a receiver (RX) portion 264, with the TX portion 212 configured to transmit or send an ultrasonic signal 265 in a transmission field 266 that substantially intersects with the extension axis 130 of the bolt 118. The transmission field 266 is configured to permit the ultrasonic signal 265 to interact with a portion of the first end 132 of the bolt 118 when the bolt 118 enters the strike box 124. The signal 265 is configured to be reflected off of the first end 132 of the bolt 118 when the bolt 118 is received within the strike box 124 such that the signal 265 will reflect off of the bolt 118 and back toward the back panel 166 of the strike box 124 through the transmission field 266. In such an embodiment, the RX portion 264 is configured to be aligned with the transmission field 266 to receive the signal 265 after it has bounced off of the first end 132 of the bolt 118. The RX portion 264 of the ultrasonic sensor 260 is configured to detect the strength of the reflection of the signal 265 after it has bounced off of the first end 132. When the bolt 118 is located at a predetermined distance from the

sensor 260 that corresponds with the bolt 118 being secured within the strike box 124, the signal 265 will have a determinable reflection strength. The sensor assembly 180 can accordingly detect when the bolt 118 is located within the strike box 124 by analyzing the reflection strength of the signal 265 via the RX portion 214 of the sensor 260. If the bolt 118 is not located within the strike box 124 or located within a predetermined distance of the TX portion 262 that the bolt 118 can receive/deflect the signal 265, then the signal 265 will not be returned to the RX portion 264 and the sensor assembly 180 will then indicate that the bolt 118 is not located within the strike box 124, *i.e.*, the door 110 is not completely latched closed.

[00035] In a thirteenth illustrative embodiment of the sensor assembly 180, an ultrasonic sensor 260 may be located along both an inside surface 184 of the top panel 172 and an inside surface 186 of the bottom panel 174 of the strike box 124, as illustrated in Figure 13. The ultrasonic sensor 260 includes a transmission (TX) portion 262 and a receiver (RX) portion 264, with the TX portion 262 configured to transmit or send an ultrasonic signal 265 along a beam axis 268 that intersects the RX portion 264. The TX portion 262 may be configured to transmit the ultrasonic signal 265 continuously, or a predetermined time intervals, to the RX portion 264, and the RX portion 264 is configured to detect a signal 265 from the TX portion 262 when there are no interruptions along the beam axis 268. As illustrated in Figure 13, the beam axis 268 may be substantially perpendicular to the extension axis 130 of the bolt 118, although other alignments of the beam axis 268 and the extension axis 130 are envisioned herein. The beam axis 268 is configured to be at least a predetermined distance D from the surface 164 of the jamb 116, wherein the distance D can represent the amount of distance that the bolt 118 must travel past the surface 164 and into the opening 136 of the strike box 124 to be securely retained within the strike box 124. As the bolt 118 is received within the strike box 124, the top surface 154 and/or the bottom

surface 156 of the bolt 118 will intersect the beam axis 268, breaking the signal 265 from the TX portion 262 to the RX portion 264. Accordingly, when the RX portion 264 of the ultrasonic sensor 260 fails to detect the signal 265, the sensor assembly 180 can identify that the bolt 118 is located within the strike box 124, *i.e.*, the door is latched closed. Otherwise, the sensor assembly 180 detects that the door is not fully latched closed.

[00036] In a fourteenth illustrative embodiment of the sensor assembly 180, a continuity sensor 270 may be located along an inside surface 182 of the back panel 166 of the strike box 124, as illustrated in Figure 14. The continuity sensor 270 may be comprised of a first leaf spring 272 and a second leaf spring 274, which each of the leaf springs 272 and 274 having a normal state (biased open or biased closed). The continuity sensor 270 is mounted upon the back panel 166 in such a way that the leaf springs 272 can extend within the opening 136 such that a portion (such as ends 273 and 275) of the leaf springs 272 and 274, the leaf springs being aligned to be engaged by the bolt 118 (*e.g.* the first end 132 of the bolt 118) when the bolt 118 extends a predetermined distance D within the strike plate 124 and the leaf springs 272 and 274 are in their normal state. As the bolt reaches the first and/or second leaf springs 272 and/or 274, the normal stage of the leaf springs 272 and 274 will be changed. The continuity sensor 270 is configured to detect a change in the state of the leaf springs 272 and 274, and will register that the bolt has entered the strike box 124. In various embodiments, the predetermined distance D is the distance between the first edge 132 of the bolt 118 and the surface 164 of the jamb 116 when the bolt 118 is securely retained within the strike box 124. Accordingly, the continuity sensor 270 can indicate that the door is securely closed if the continuity sensor 270 is configured such that the leaf springs 272 and 274 cannot be changed out of their normal state unless the bolt 118 has reached or exceeded the predetermined distance D.

[00037] In a fifteenth illustrative embodiment of the sensor assembly 180, a continuity sensor 280 may be located along both an inside surface 184 of the top panel 172 and an inside surface 186 of the bottom panel 174 of the strike box 124, as illustrated in Figure 15. The continuity sensor 280 may be comprised of a first moveable feature 282 and a second movable feature 284. In various embodiments, the moveable features 282 and 284 are any components that can be moved by a bolt 118 when a bolt 118 comes into contact with the features 282 and 284, and that such movement is capable of being detected by a sensor mechanism. For instance, the moveable features 282 and 284 may be comprised of brushes that extend into the opening 136 from the top panel 172 and bottom panel 174, the brushes having free ends 283 and 285, respectively, that may abut against the top surface 154 and bottom surface 156 of the bolt 118 and be deflected where such deflection can be sensed by the a sensor. Alternatively, each of the movable features 282 and 284 may be comprised of one or more leave springs biased into the opening 136 with free ends 283 and 285. The ends 283 and 285 extend at least a distance X into the opening 136 such that the ends 283 and 285 will engage with the bolt 118 when the bolt 118 is secured within the strike box 124. Other forms of moveable features are known in the art. As illustrated in Figure 15, the movable features 282 and 284 are positioned along an actuation axis 286 that may be substantially perpendicular to the extension axis 130 of the bolt 118, although other alignments of the actuation axis 286 and the extension axis 130 are envisioned herein. The actuation axis 286 is configured to be at least a predetermined distance D from the surface 164 of the jamb 116, wherein the distance D can represent the amount of distance that the bolt 118 must travel past the surface 164 and into the opening 136 of the strike box 124 to be securely retained within the strike box 124. When the bolt 118 engages with the movable features 282 and 284 within the opening 136, the normal state of the movable features 282 and 284 will be changed and the sensor assembly 180 will register that the bolt has entered the strike box 124.

[00038] In a sixteenth illustrative embodiment of the sensor assembly 180, a magnet/hall sensor 290 may be located along an inside surface 182 of the back panel 166 of the strike box 124, as illustrated in Figure 16. The hall sensor 290 includes a hall-effect sensing mechanism 298 that measures the local magnetic field strength of the surrounding area 294 within the opening 136 of the strike box 124. The sensor assembly 180 further includes a magnet or other similar magnet component 296 that is carried by the bolt 118 adjacent the first end 132 of the bolt 118. In illustrative embodiments, the magnet 296 may be located inside the bolt 118. As the bolt 118 travels into the opening 136 and the surrounding area 294 around the hall sensor 290, the magnetic field strength is increased. The sensor 290 can be configured with a predetermined threshold magnetic field strength such that, if the threshold is reached, the sensor 290 will register that the bolt 118 is within the strike box 124 a predetermined distance. The predetermined distance can represent the amount of distance that the bolt 118 must travel past the surface 164 and into the opening 136 of the strike box 124 to be securely retained within the strike box 124. When the hall sensor 290 registers this predetermined distance, the sensor assembly 180 will register that the bolt has entered and is retained within the strike box 124. The amount of predetermined magnetic flux can optionally be calibrated during set-up to account for different door preparation and system configurations.

[00039] In a seventeenth illustrative embodiment of the sensor assembly 180, the sensor assembly 180 may operate in a similar manner as the sixteenth embodiment, except that the sensor assembly 180 may be located along an inside surface 184 of the top panel 172, as illustrated in Figure 17. The magnet or other similar magnet component 296 that is carried by the bolt 118 may be positioned adjacent the first end 132 of the bolt 118 or adjacent the top surface 154 of the bolt 118. In illustrative embodiments, the magnet 296 may be located inside the bolt 118. As with the previous embodiment, the sensor assembly

180 includes a hall-effect sensor 290 that can detect and determine the strength of a magnetic field in a surrounding area 294. Accordingly, the sensor assembly 180 can register if the bolt has entered the strike box 124, and further if the bolt has traveled far enough into the strike box 124 to be securely retained within the strike box 124.

[00040] A method of using the sensor assembly 180 will now be described. The sensor assembly 180 is coupled to or incorporated in a latch assembly 100 to determine whether a bolt assembly 102 of the latch assembly 100 is engaged with a strike assembly 104 of the latch assembly, and in particular, whether a bolt 118 of the bolt assembly 102 is securely retained within a strike box 124 of the strike assembly 104. The bolt 118 may be positioned, in a first instance, outside of the strike box 124 such that a door 110 in which the bolt assembly 102 is retained is not securely latched. The sensor assembly 180 is at least partially coupled to or retained by the strike assembly 104 and operates to sense whether an interior cavity or opening 136 of the strike box 124 configured to receive the bolt 118 has an object (such as the bolt 118) retained therein. The sensor assembly 180 detects whether the bolt 118 is positioned within the strike box 124 by including at least one sensor retained by the strike box 124. In a first step of the method, the bolt 118 is positioned outside of the strike box 124 and the sensor of the sensor assembly 180 detects that the opening 136 of the strike box 124 does not contain the bolt 118. When the bolt 118 is moved into the opening 136 of the strike box 124, the sensor of the strike box 124 detects a change within the opening 136 and indicates that the bolt 118 has been positioned therein. In various embodiments, the sensor of the strike box 124 can detect how far away an end surface 132 of the bolt 118 is positioned from a back panel 166 of the strike box 124, and accordingly can detect whether the end surface 132 of the bolt 118 is adequately within the strike box 124 such that it is retained therein and will not exit the strike box 124 if a force is applied to the door 110 to which the bolt 118 is attached to disengage the door from its door jamb 116.

EXAMPLES

[00041] Example 1 provides a sensor assembly for a lock assembly of a door. The sensor assembly includes a sensor located within an opening formed in a strike box of the lock assembly. The sensor is configured to detect whether a bolt of the lock assembly has entered the opening a sufficient distance so as to prevent removal of the bolt from the opening when an opening force is applied to the door.

[00042] In Example 2, the subject matter of Example 1 is further configured such that the sensor is an optical sensor that transmits an optical signal that interacts with the bolt when the bolt is within the opening.

[00043] In Example 3, the subject matter of Example 2 is further configured such that the optical sensor includes a transmission portion and a receiver portion.

[00044] In Example 4, the subject matter of Example 2 is further configured such that the sensor is located along a back panel of the strike box.

[00045] In Example 5, the subject matter of Example 4 is further configured such that the bolt is located within the opening, the optical signal is transmitted from the optical sensor, bounces off of an end of the bolt, and is transmitted back to the optical sensor.

[00046] In Example 6, the subject matter of Example 2 is further configured such that the sensor is located along a top panel of the strike box.

[00047] In Example 7, the subject matter of Example 1 is further configured such that the sensor assembly includes two or more optical sensors.

[00048] In Example 8, the subject matter of Example 1 is further configured such that the optical sensor transmits the optical signal along a transmission axis that is parallel to an extension axis upon which the bolt extends within the opening.

[00049] In Example 9, the subject matter of Example 1 is further configured such that the sensor is a mechanical sensor.

[00050] In Example 10, the subject matter of Example 9 is further configured such that the mechanical sensor comprises a moveable switch that is biased to an open position by a biasing member.

[00051] In Example 11, the subject matter of Example 10 is further configured such that the mechanical sensor is positioned along a back panel of the strike box, and wherein the moveable switch extends toward an opening of the strike box in the open position.

[00052] In Example 12, the subject matter of Example 11 is further configured such that the movable switch is positioned in the path of movement of the bolt as the bolt is moved along an extension axis into the opening such that the moveable switch is capable of being engaged by an end of the bolt.

[00053] In Example 13, the subject matter of Example 9 is further configured such that the mechanical sensor is positioned along a top pane of the strike box.

[00054] In Example 14, the subject matter of Example 1 is further configured such that the sensor is a capacitive sensor that emits an electrical field within the opening.

[00055] In Example 15, the subject matter of Example 14 is further configured such that the capacitive sensor includes a sensor element that detects changes in the electrical field.

[00056] In Example 16, the subject matter of Example 14 is further configured such that the electrical field extends at least to an actuation axis, the actuation axis defined by being a predetermined distance into the opening of the strike box from an aperture providing access to the opening.

[00057] In Example 17, the subject matter of Example 14 is further configured such that the sensor is located along a back panel of the strike box.

[00058] In Example 18, the subject matter of Example 14 is further configured such that the sensor is located along a side panel of the strike box.

[00059] In Example 19, the subject matter of Example 18 is further configured such that the sensor element includes a plurality of sensing elements that detect changes in the electrical field, the plurality of sensing elements positioned in a linear arrangement that is substantially parallel with an extension axis of the bolt as it extends within the opening.

[00060] In Example 20, the subject matter of Example 1 is further configured such that the sensor is an inductive sensor.

[00061] In Example 21, the subject matter of Example 20 is further configured such that the inductive sensor is located along a back panel of the strike box.

[00062] In Example 22, the subject matter of Example 1 is further configured such that the inductive sensor is located along an exterior circumference of the strike box.

[00063] In Example 23, the subject matter of Example 20 is further configured such that the sensor includes one or more inductive coil elements that emit an electrical field within the opening, the sensor configured to detect the frequency of the electrical field.

[00064] In Example 24, the subject matter of Example 23 is further configured such that the bolt is configured to change the dielectric constant of air within the opening.

[00065] In Example 25, the subject matter of Example 24 is further configured such that the dielectric constant of air within the opening will reach a predetermined level when the bolt is located the predetermined distance within the strike box.

[00066] In Example 26, the subject matter of Example 25 is further configured such that the predetermined distance corresponds with an actuation axis of the bolt, and the electrical field extends to at least the actuation axis.

[00067] In Example 27, the subject matter of Example 27 is further configured such that the sensor is an ultrasonic sensor.

[00068] In Example 28, the subject matter of Example 27 is further configured such that the sensor includes a transmission portion and a receiver portion.

[00069] In Example 29, the subject matter of Example 28 is further configured such that the transmission portion transmits an ultrasonic signal into a transmission field within the opening.

[00070] In Example 30, the subject matter of Example 29 is further configured such that the transmission field extends to at least an actuation axis of the bolt, wherein the actuation axis of located at the predetermined distance within the strike box.

[00071] In Example 31, the subject matter of Example 29 is further configured such that the sensor is located along a back panel of the strike box.

[00072] In Example 32, the subject matter of Example 31 is further configured such that the ultrasonic signal is transmitted along a transmission axis, the transmission axis being substantially parallel to an extension axis of the bolt.

[00073] In Example 33, the subject matter of Example 27 is further configured such that the sensor is located along top and bottom panels of the strike box.

[00074] In Example 34, the subject matter of Example 1 is further configured such that the sensor is a continuity sensor.

[00075] In Example 35, the subject matter of Example 34 is further configured such that the sensor includes a plurality of moveable features that extend from either a back panel, top panel, or bottom panel of the strike box into the opening.

[00076] In Example 36, the subject matter of Example 35 is further configured such that the plurality of moveable features include a free end that may be abutted by the bolt when the bolt is inserted into the opening.

[00077] In Example 37, the subject matter of Example 35 is further configured such that the plurality of moveable features are comprised of brushes.

[00078] In Example 38, the subject matter of Example 34 is further configured such that the sensor is comprises of one or more leaf springs.

[00079] Example 39 provides a lock assembly for a door with a latch assembly coupled to the door and including an extendable bolt. The lock assembly includes a strike assembly coupled to a jamb corresponding to the door. The strike assembly is configured to receive the bolt of the bolt assembly to secure the door to the jamb. A sensor assembly includes a sensor located within an opening formed in a strike box of the strike assembly. The sensor is configured to detect whether the bolt of the bolt assembly is encompassed by the strike box. The sensor assembly is configured to interact with a surface of the bolt when the bolt is located within the opening.

WHAT IS CLAIMED IS:

1. A sensor assembly for a lock assembly of a door, the sensor assembly comprising:
a sensor located within an opening formed in a strike box of the lock assembly, the sensor configured to detect whether a bolt of the lock assembly has entered the opening a sufficient distance so as to prevent removal of the bolt from the opening when an opening force is applied to the door.
2. The sensor assembly of claim 1, wherein the sensor is an optical sensor that transmits an optical signal that interacts with the bolt when the bolt is within the opening.
3. The sensor assembly of claim 2, wherein, when the bolt is located within the opening, the optical signal is transmitted from the optical sensor, bounces off of an end of the bolt, and is transmitted back to the optical sensor.
4. The sensor assembly of claim 2, wherein the optical sensor transmits the optical signal along a transmission axis that is parallel to an extension axis upon which the bolt extends within the opening.
5. The sensor assembly of claim 1, wherein the sensor is a mechanical sensor comprising a moveable switch that is biased to an open position by a biasing member, wherein the movable switch is positioned in the path of movement of the bolt as the bolt is moved along an extension axis into the opening such that the moveable switch is capable of being engaged by an end of the bolt.
6. The sensor assembly of claim 1, where in the sensor is a capacitive sensor that emits an electrical field within the opening and includes a sensor element that detects changes in the electrical field, wherein the electrical field extends at least to an actuation axis defined by being a predetermined distance into the opening of the strike box from an aperture providing access to the opening.

7. The sensor assembly of claim 1, wherein the sensor element includes a plurality of sensing elements that detect changes in the electrical field, the plurality of sensing elements positioned in a linear arrangement that is substantially parallel with an extension axis of the bolt as it extends within the opening.
8. The sensor assembly of claim 1, wherein the sensor is an inductive sensor located in a back panel of the strike box and/or along an exterior circumference of the strike box.
9. The sensor assembly of claim 8, wherein the sensor includes one or more inductive coil elements that emit an electrical field within the opening, the sensor configured to detect the frequency of the electrical field.
10. The sensor assembly of claim 9, wherein the bolt is configured to change the dielectric constant of air within the opening, wherein the dielectric constant of air within the opening will reach a predetermined level when the bolt is located the predetermined distance within the strike box.
11. The sensor assembly of claim 10, wherein the predetermined distance corresponds with an actuation axis of the bolt, and the electrical field extends to at least the actuation axis.
12. The sensor assembly of claim 1, wherein the sensor is an ultrasonic sensor configured to transmit an ultrasonic signal into a transmission field within the opening, wherein the transmission field extends to at least an actuation axis of the bolt, wherein the actuation axis of is located at the predetermined distance within the strike box.
13. The sensor assembly of claim 12, wherein the ultrasonic signal is transmitted along a transmission axis, the transmission axis being substantially parallel to an extension axis of the bolt.
14. The sensor assembly of claim 1, wherein the sensor includes a plurality of moveable features that extend from either a back panel, top panel, or bottom panel of the strike box into

the opening, wherein the plurality of moveable features include a free end that may be abutted by the bolt when the bolt is inserted into the opening.

15. The sensor assembly of claim 14, wherein the plurality of moveable features are comprised of brushes.

16. The sensor assembly of claim 15, wherein the sensor is comprises of one or more leaf springs.

17. A lock assembly for a door, the lock assembly comprising:

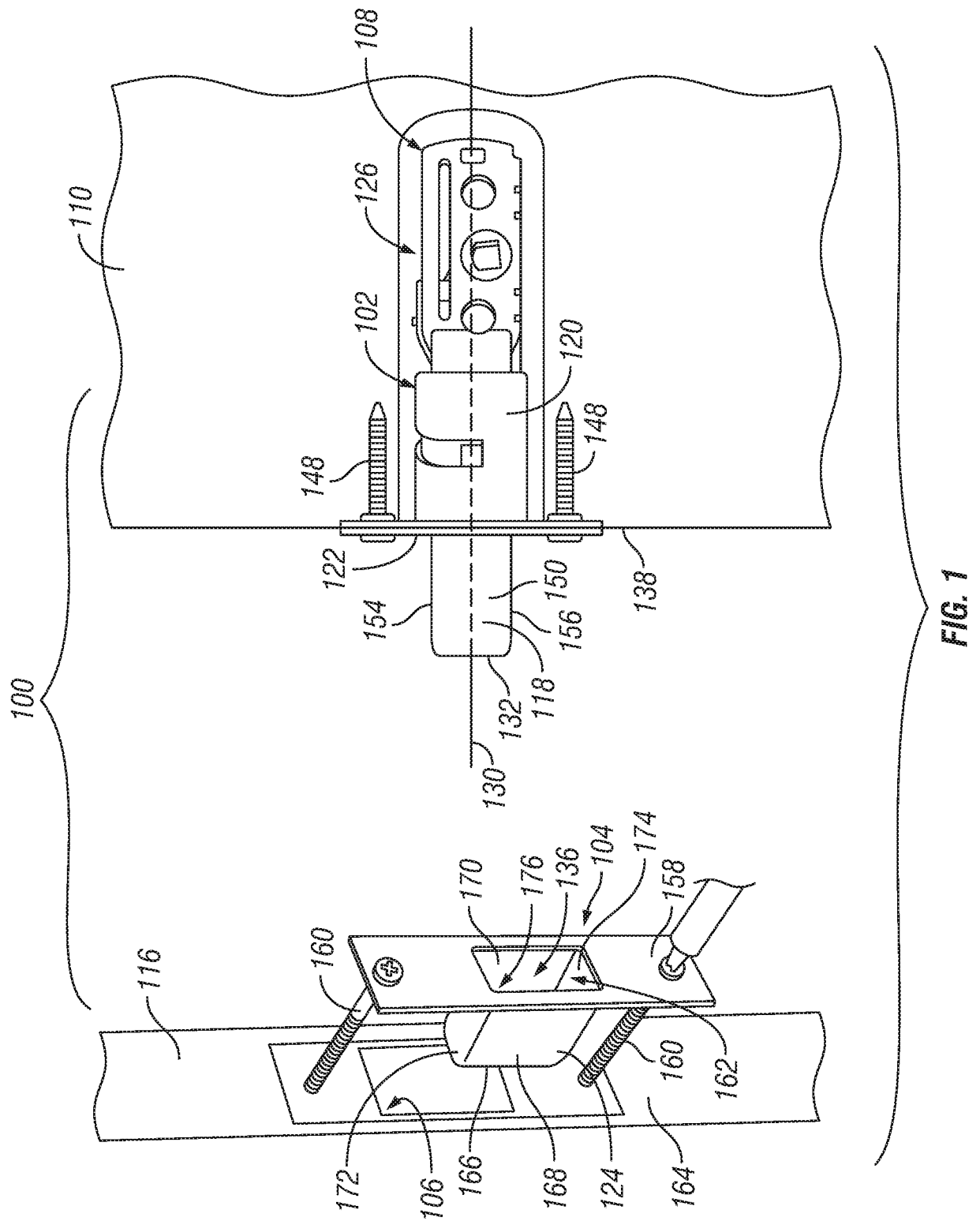
a latch assembly coupled to the door and including an extendable bolt;

a strike assembly coupled to a jamb corresponding to the door, the strike assembly configured to receive the bolt of the bolt assembly to secure the door to the jamb; and

a sensor assembly comprising a sensor located within an opening formed in a strike box of the strike assembly, the sensor configured to detect whether the bolt of the latch assembly is encompassed by the strike box, the sensor assembly configured to interact with a surface of the bolt when the bolt is located within the opening.

18. The lock assembly of claim 17, wherein the sensor assembly is one or more of an optical, mechanical, continuity, inductive, ultrasonic, and/or mechanical sensor configured to detect whether the bolt of the bolt assembly is encompassed by the strike box.

19. The lock assembly claim 17, wherein the sensor is located on a back panel of the strike box and/or a circumferential wall of the strike box.



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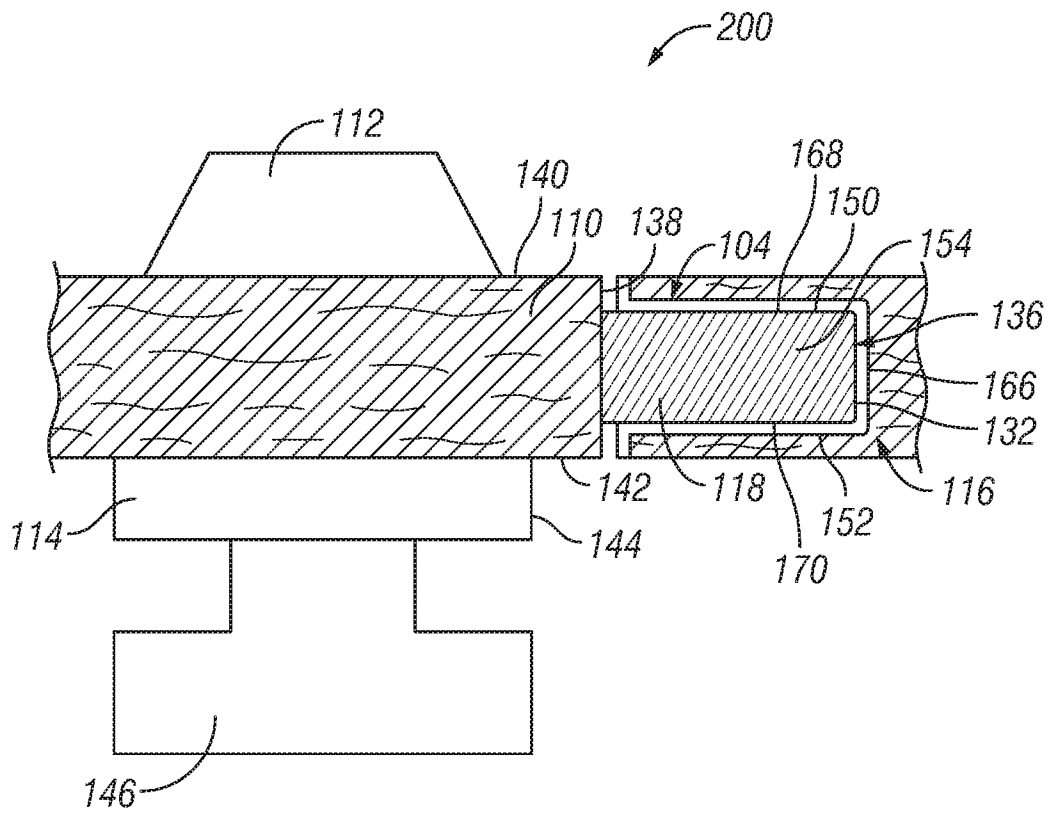
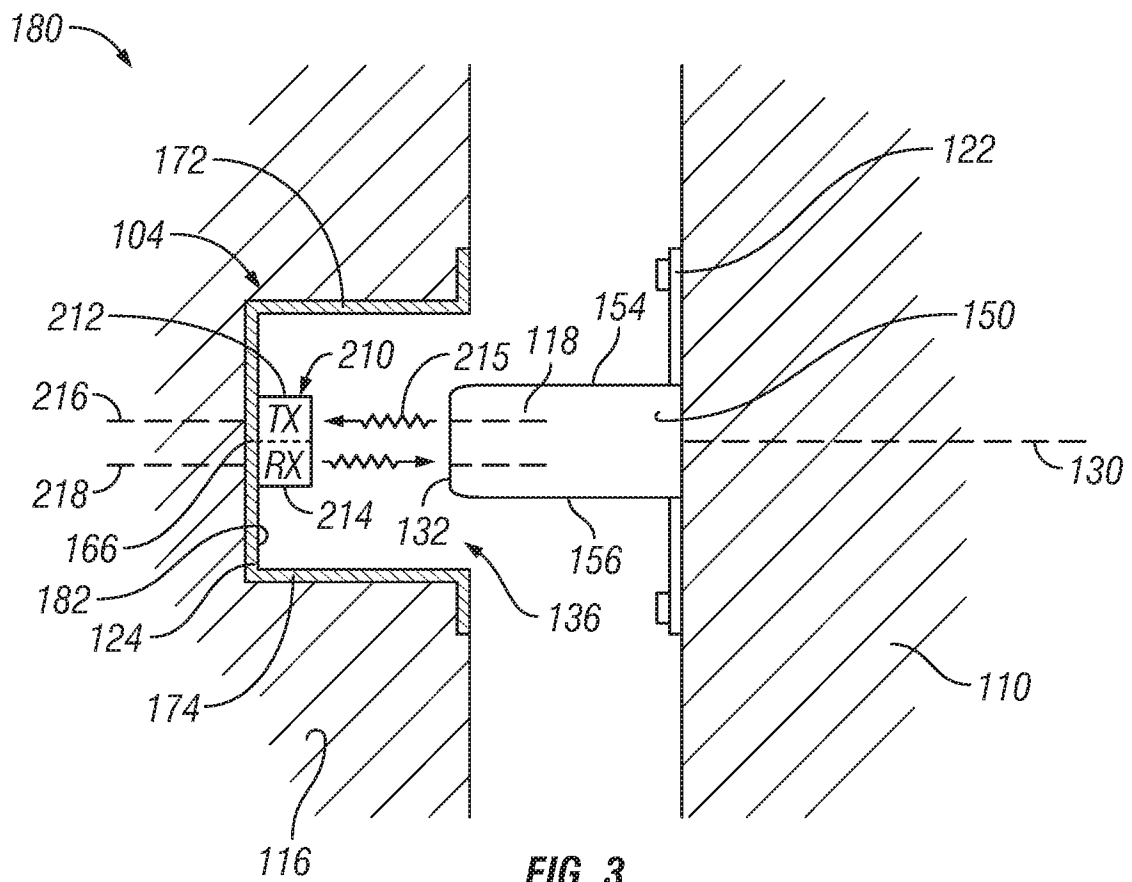


FIG. 2



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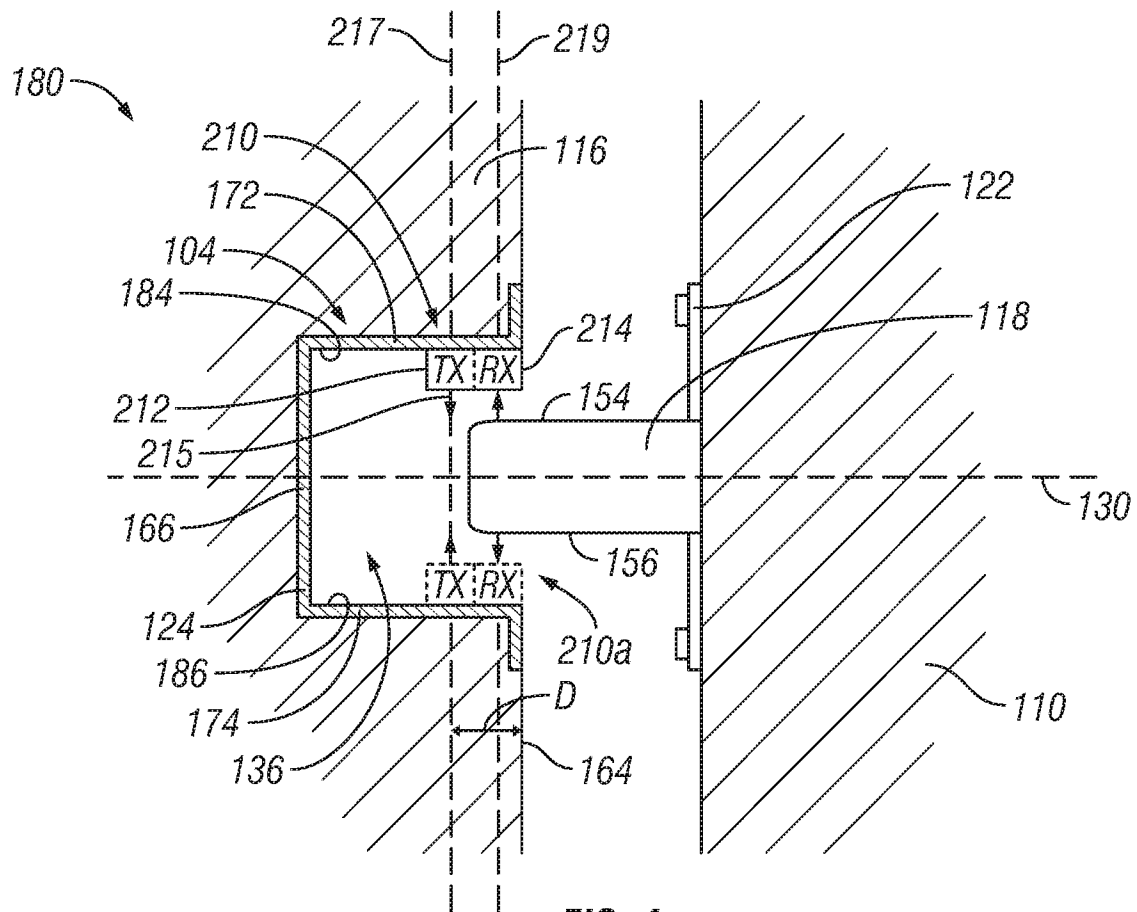
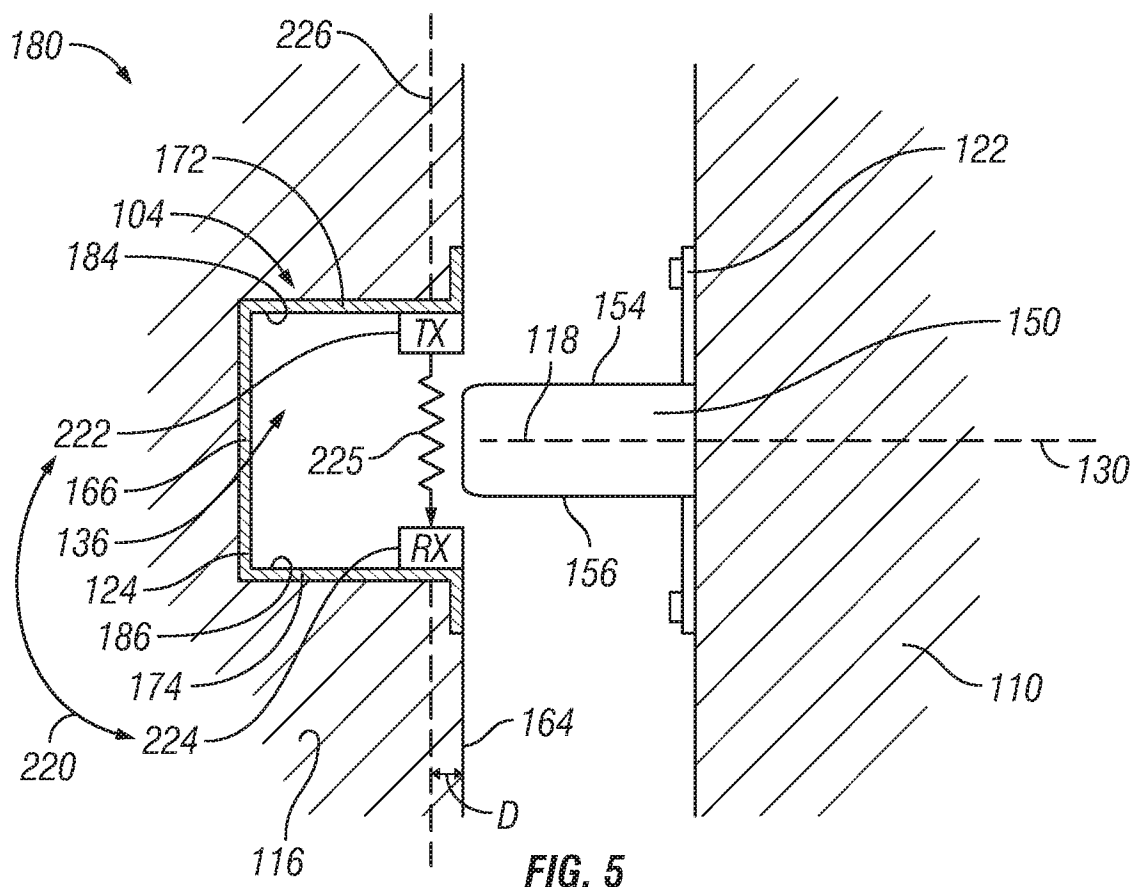


FIG. 4



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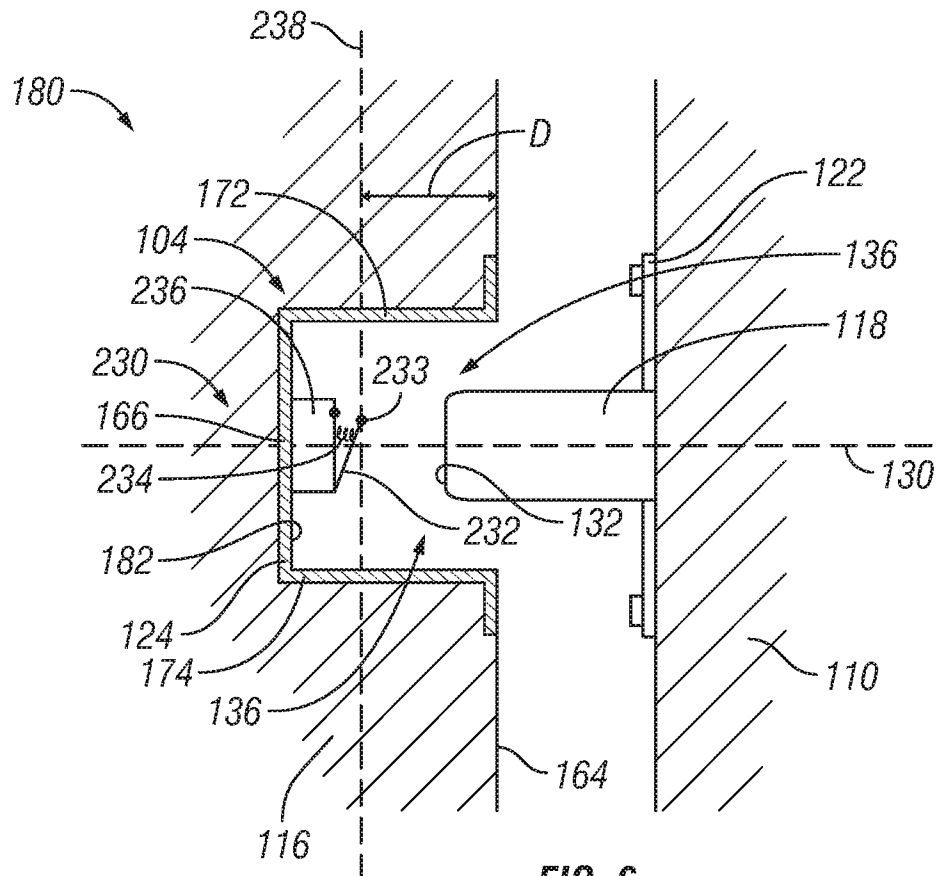


FIG. 6

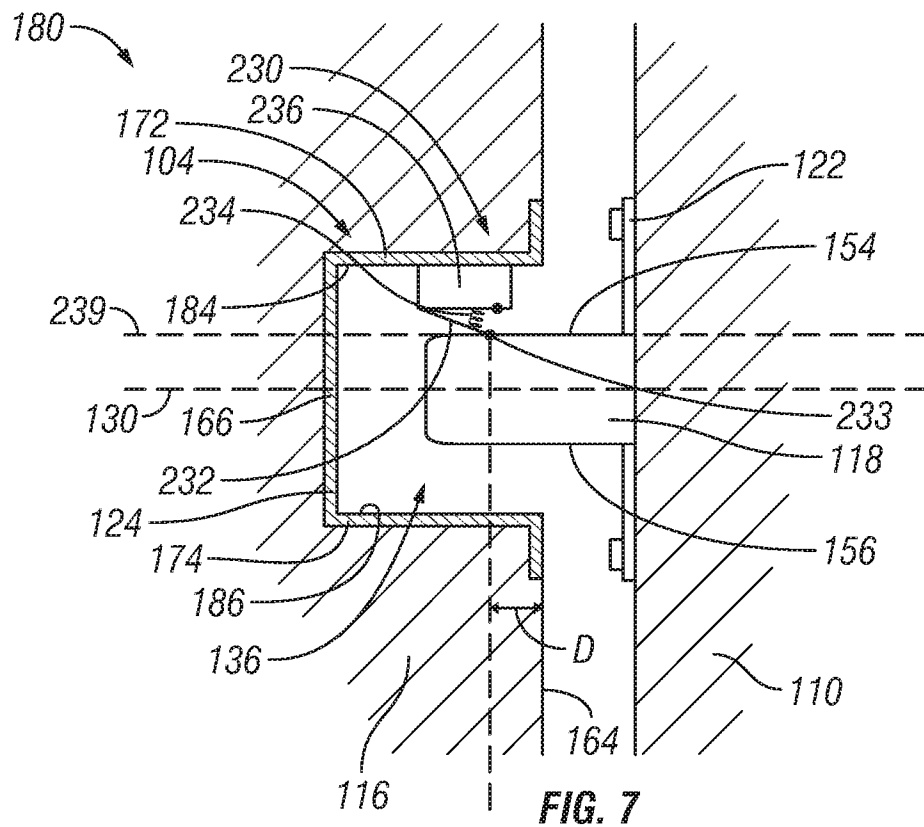


FIG. 7

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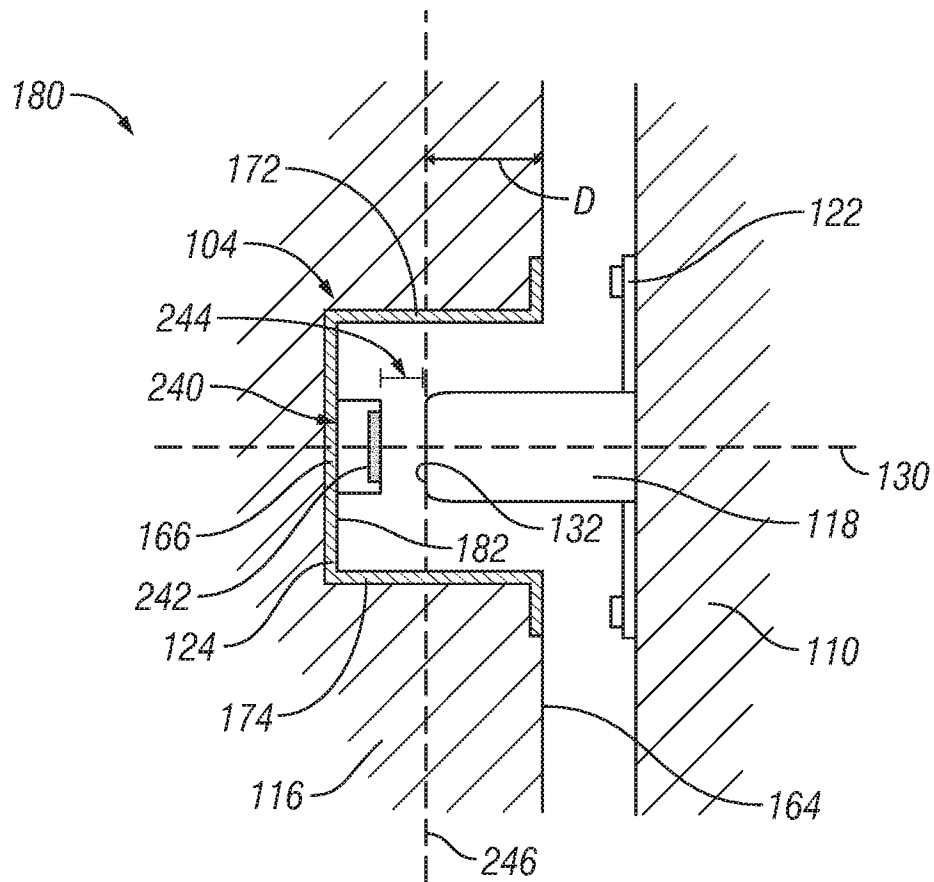


FIG. 8

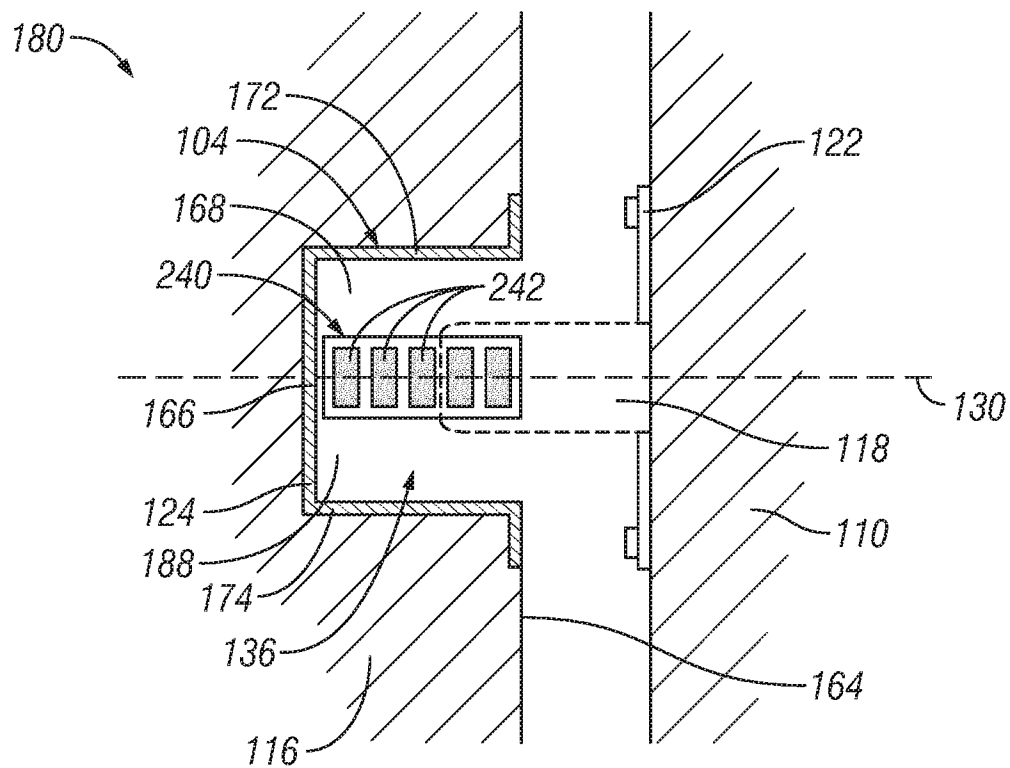


FIG. 9

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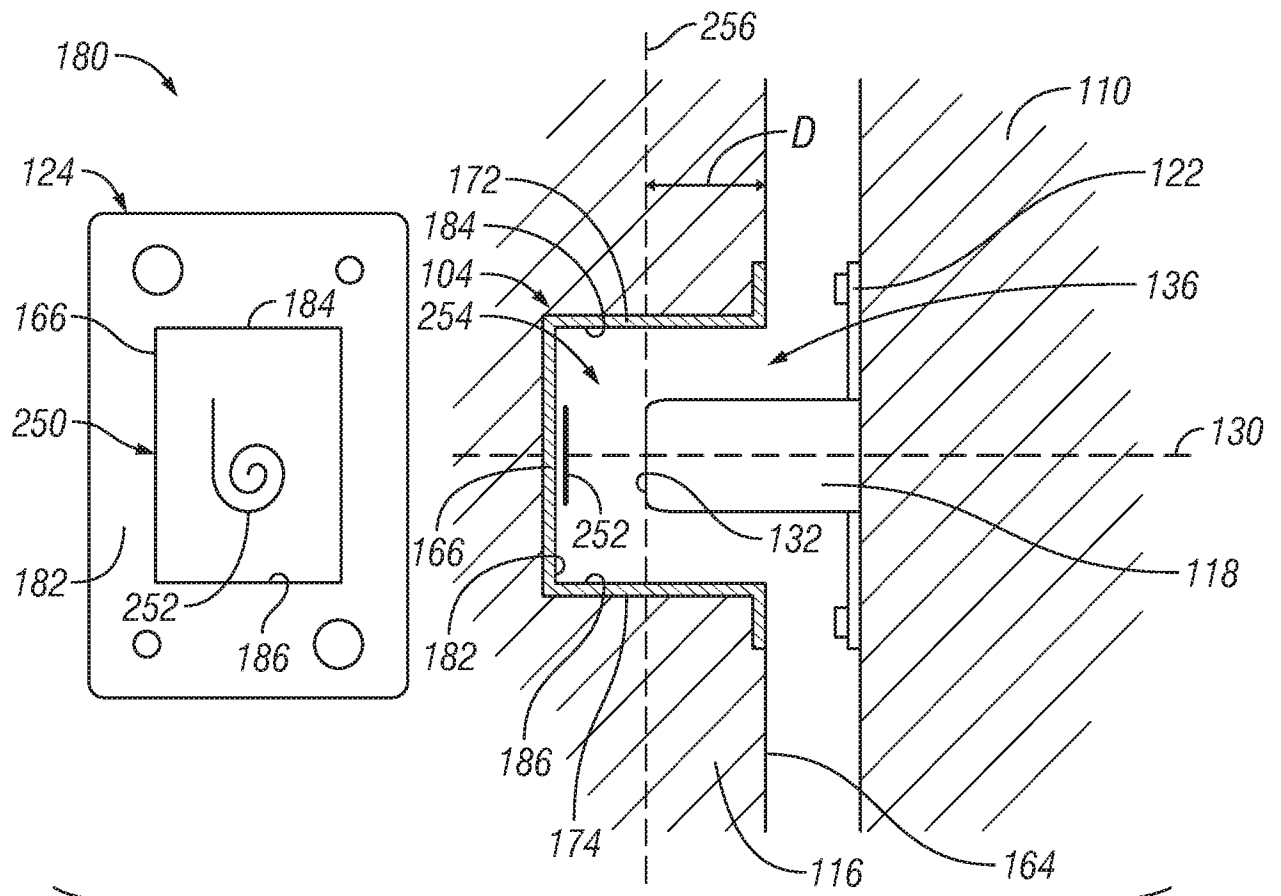


FIG. 10

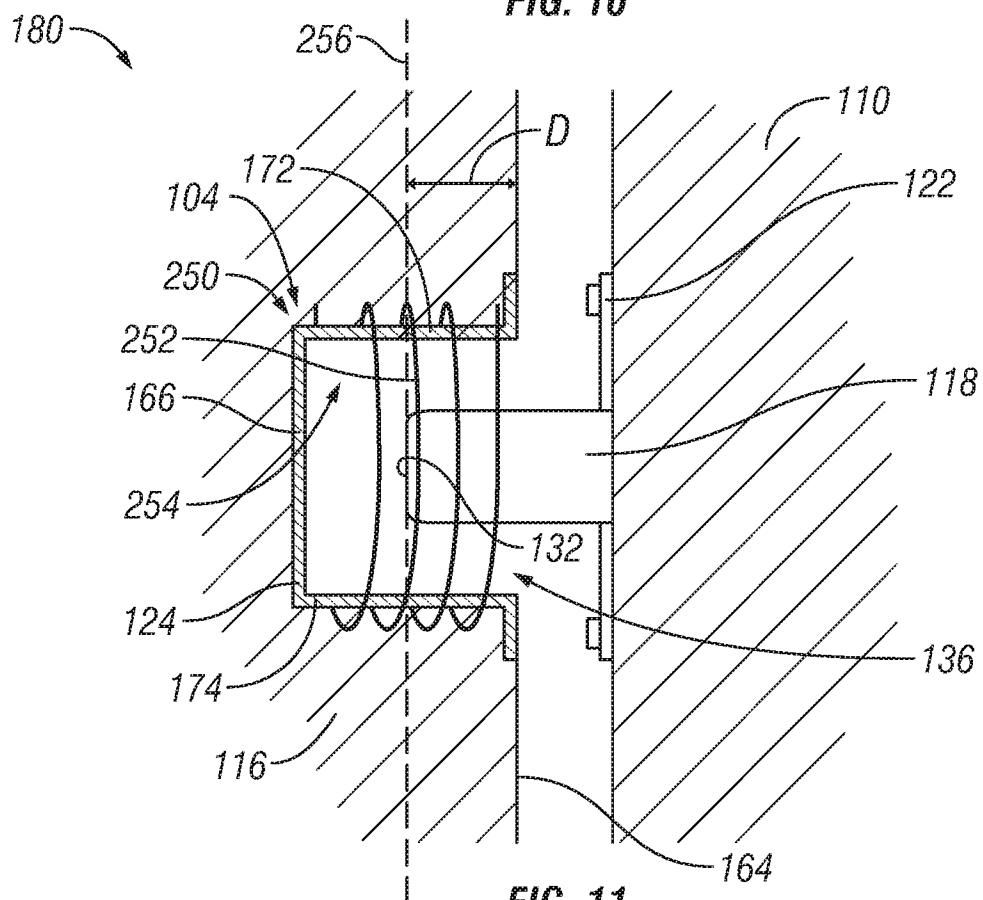


FIG. 11

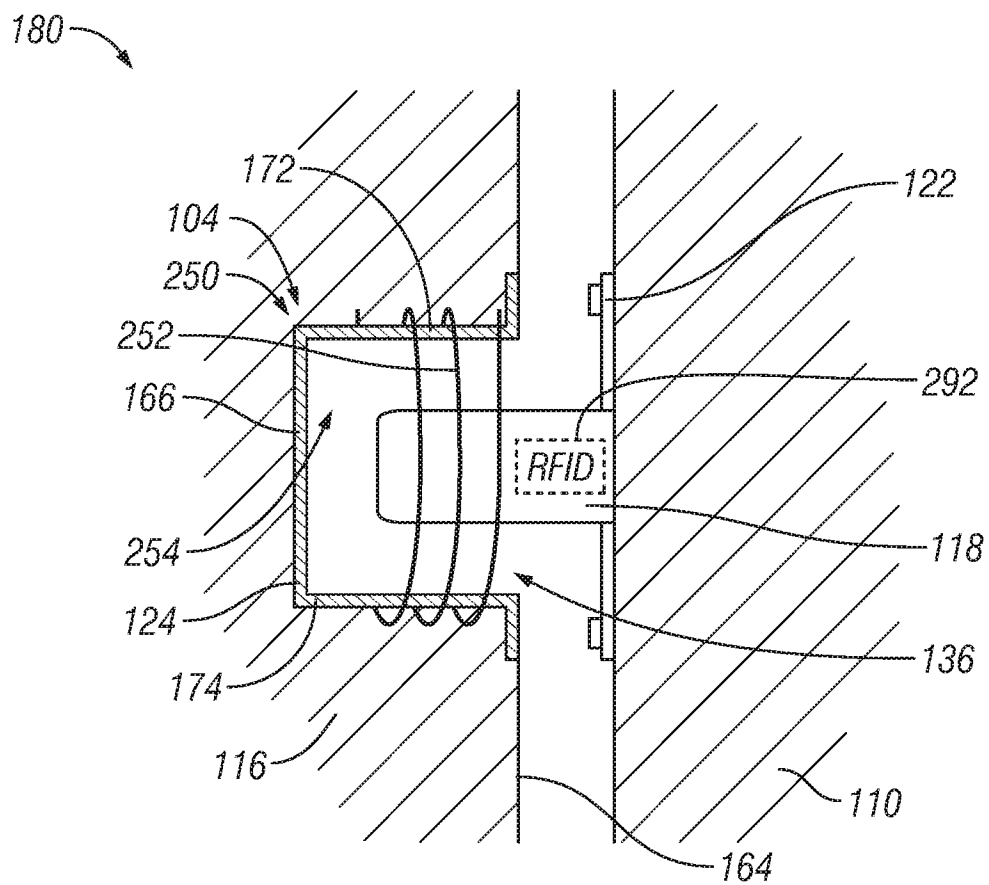


FIG. 11A

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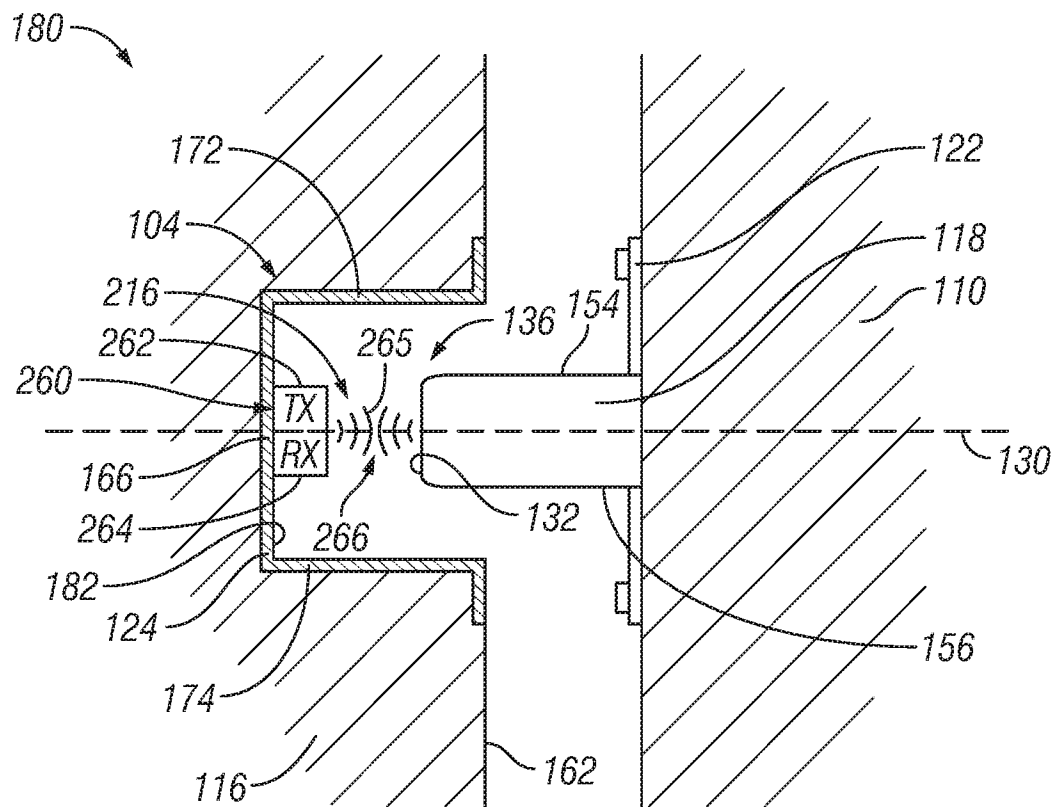


FIG. 12

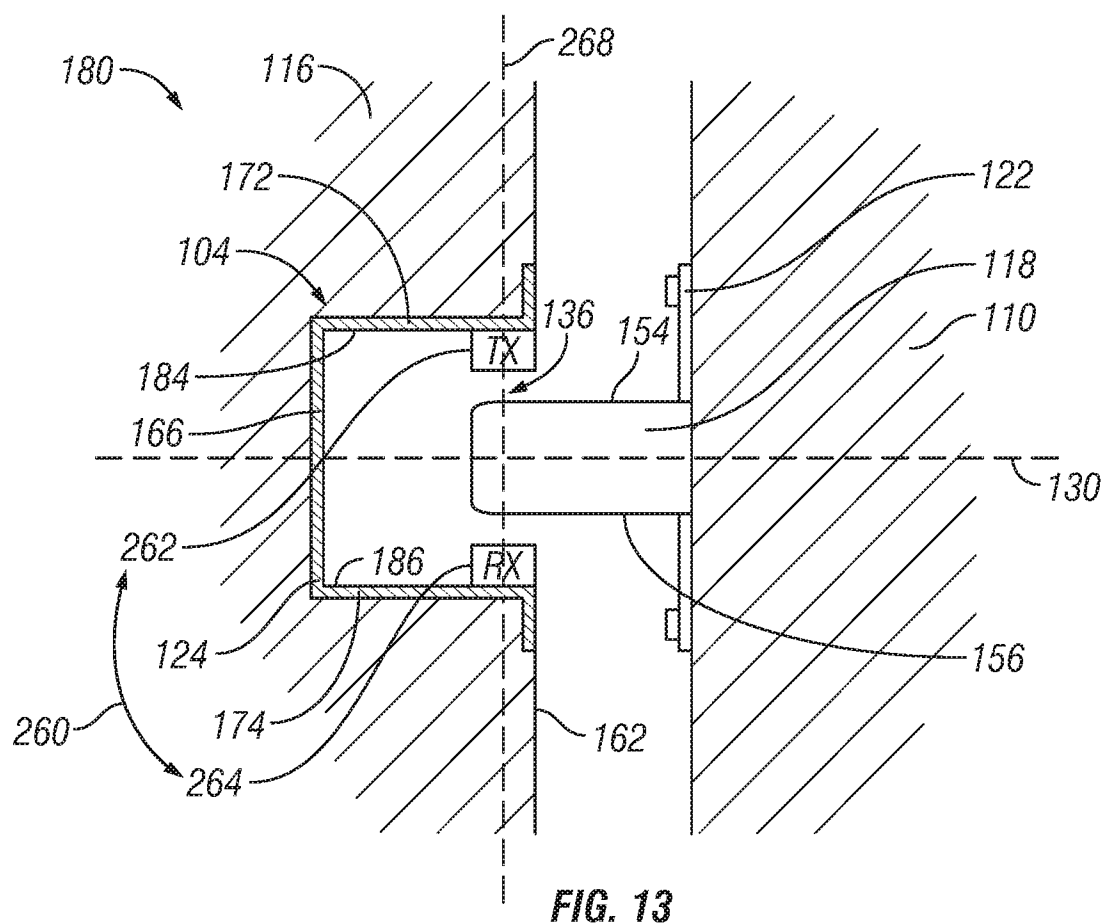


FIG. 13

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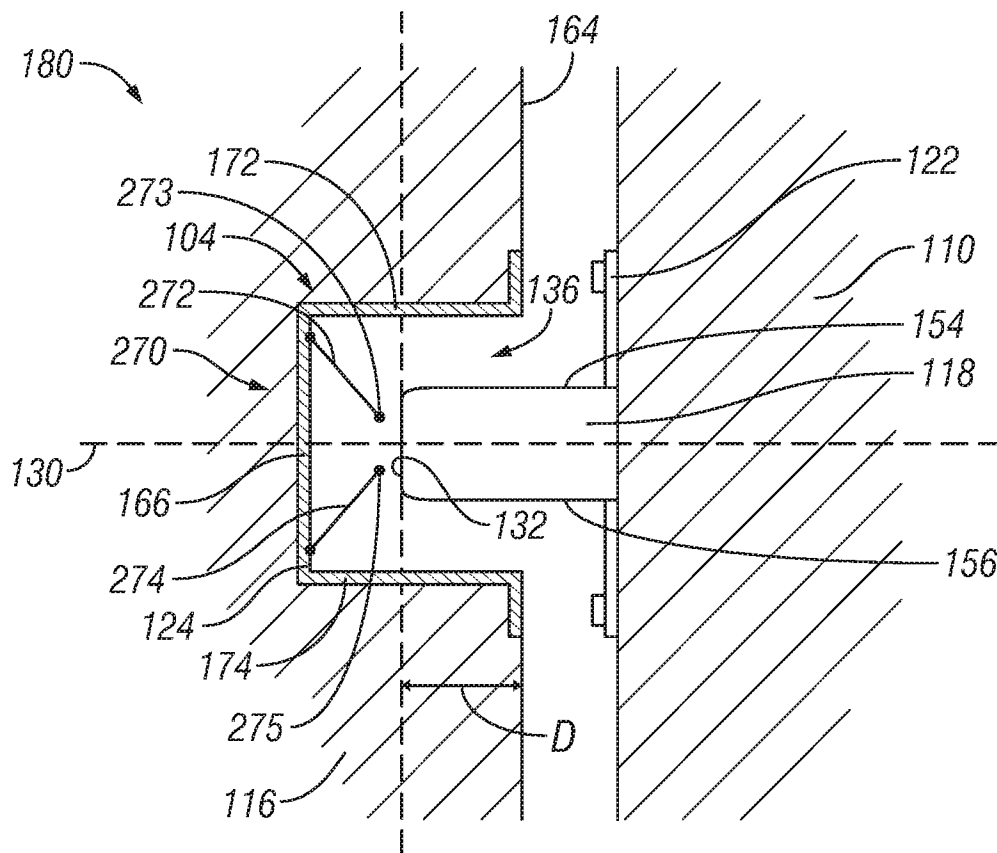


FIG. 14

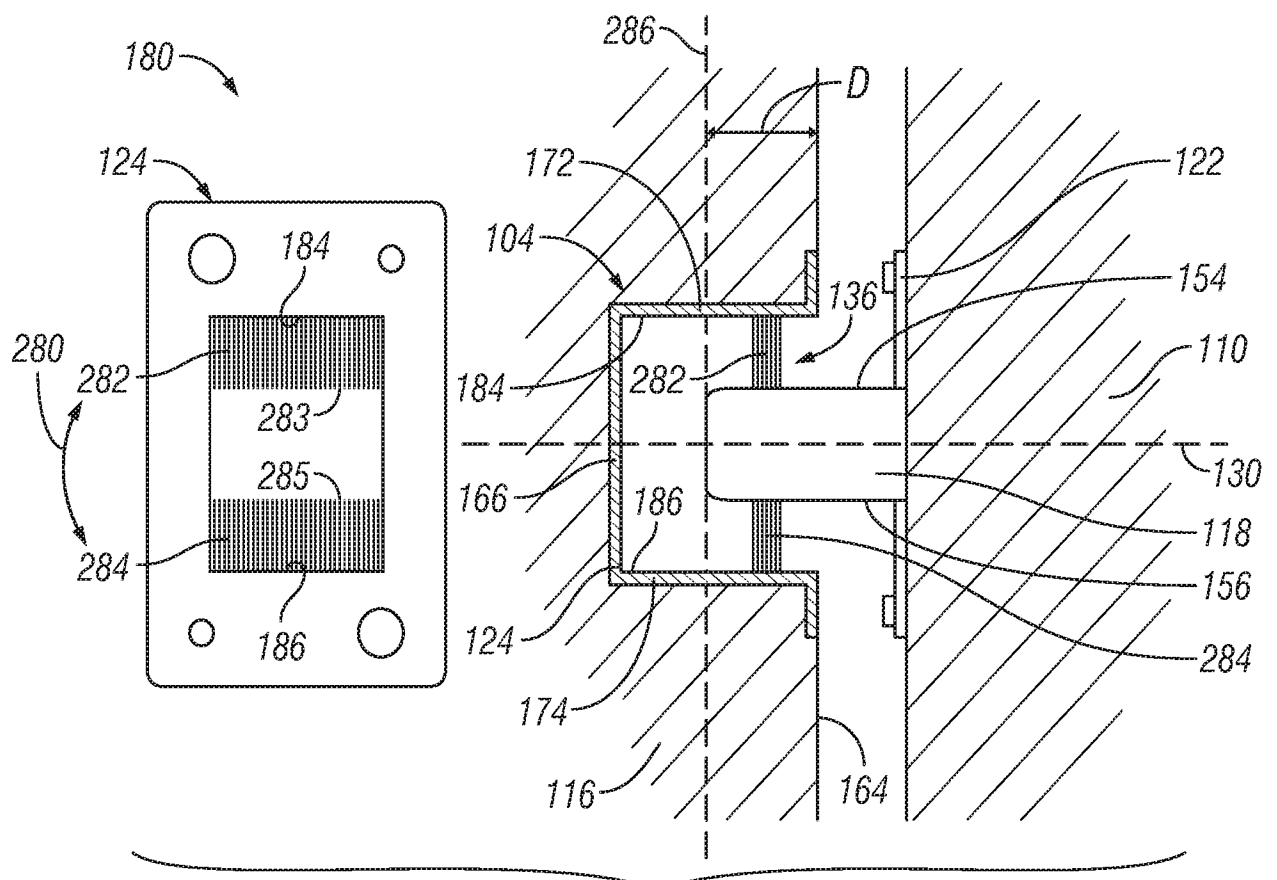


FIG. 15

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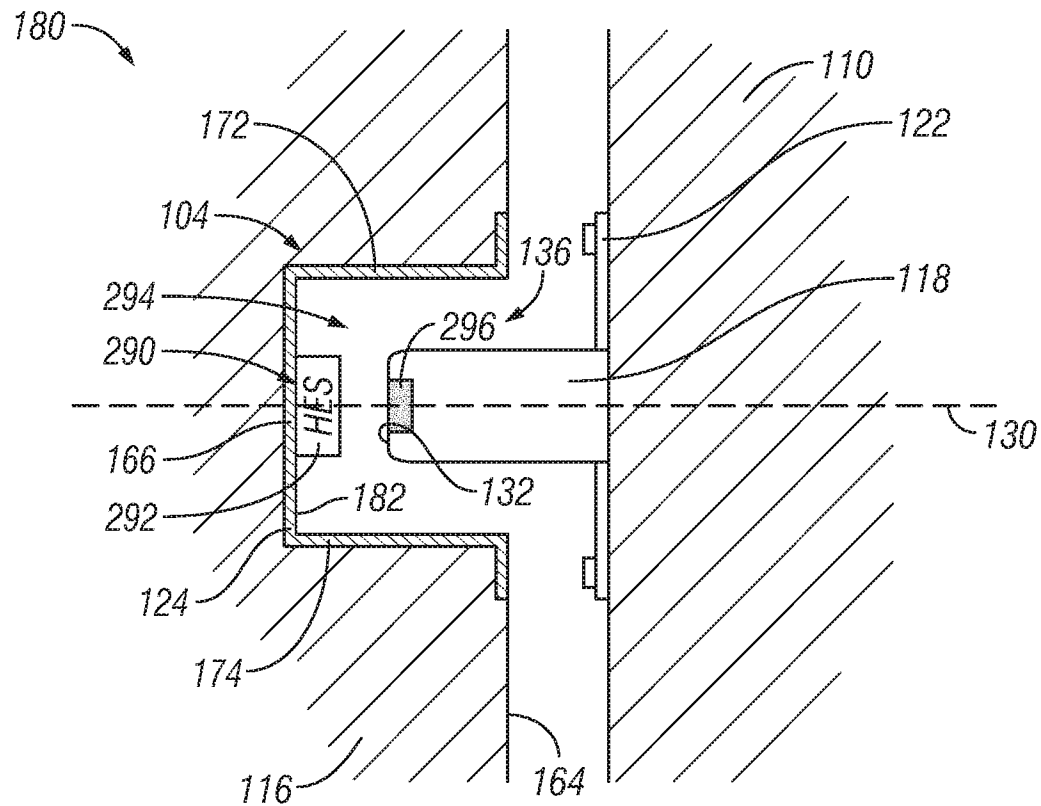


FIG. 16

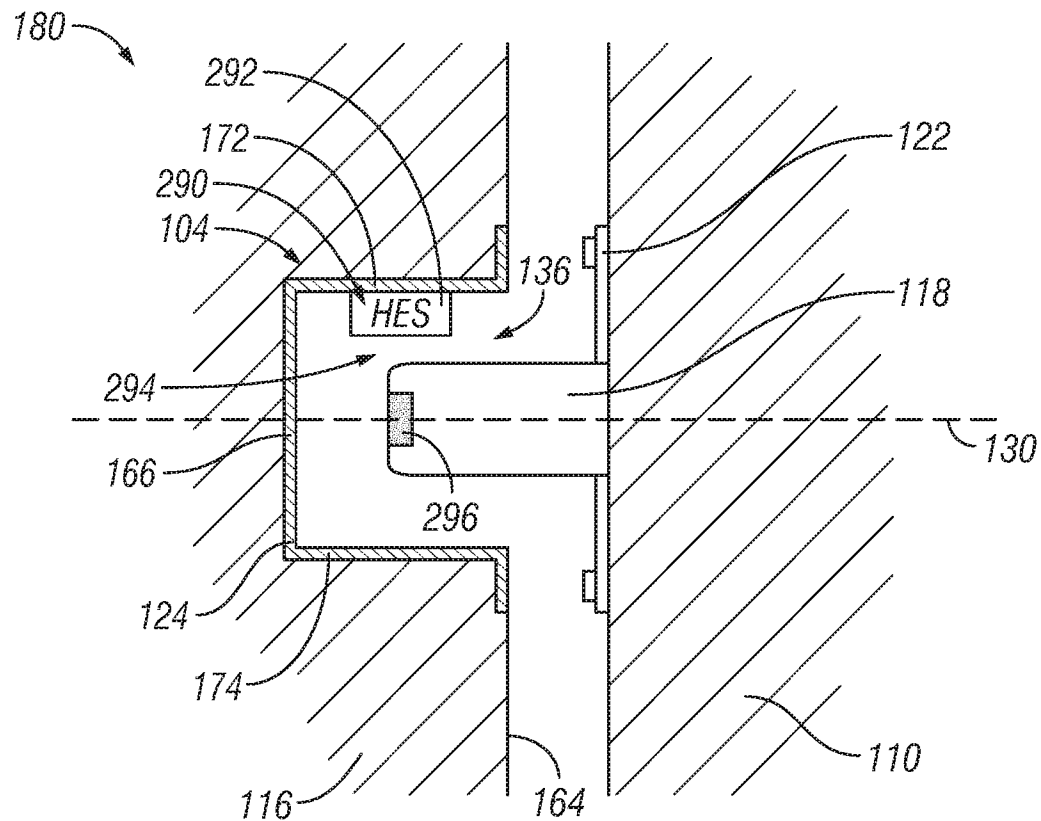


FIG. 17

A. CLASSIFICATION OF SUBJECT MATTER**E05B 17/22(2006.01)i, E05B 15/02(2006.01)i, E05B 17/00(2006.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E05B 17/22; E05B 47/02; G01R 33/00; H01F 7/02; E05B 47/00; G08B 13/08; E05B 41/00; E05B 45/00; E05B 15/02; E05B 17/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: sensor assembly, strike box, lock assembly, opening force, door

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012-0167646 A1 (SHARMA et al.) 05 July 2012 See paragraphs [0042]-[0055], [0083]-[0100]; and figures 1-3, 7, 9-11, 18-19.	1-13, 17-19
Y		14-16
Y	US 2009-0066320 A1 (POSEY, DAVID T.) 12 March 2009 See paragraphs [0016]-[0021]; and figures 2-6.	14-16
A	US 2005-0044908 A1 (MIN, BYONG DO) 03 March 2005 See paragraphs [0027]-[0058]; and figures 1-4.	1-19
A	WO 2013-067091 A1 (SARGENT MANUFACTURING COMPANY) 10 May 2013 See page 8, line 12 - page 11, line 14; and figures 1-11.	1-19
A	US 2008-0012705 A1 (OUTZS, ALLAN H.) 17 January 2008 See paragraphs [0026]-[0028]; and figures 1-7.	1-19



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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