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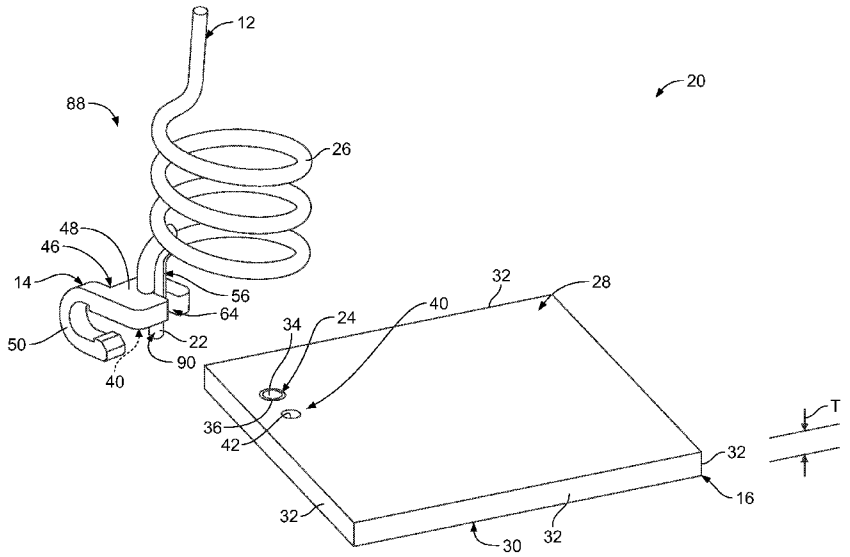

FIG. 2

(57) **Abstract**: A holder (14) is provided for holding an electrical component (12) on a circuit board (16) having a lead hole (24). The holder includes a body (46) having a base (48) for holding the electrical component and a connection member (50) for mounting the body to the circuit board. The base includes a lead opening (56) that is configured to hold a solder lead (22) of the electrical component therein. The connection member extends from the base and is configured to mechanically connect to the circuit board such that the base holds an end (90) of the solder lead of the electrical component within the lead hole of the circuit board.

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ELECTRICAL COMPONENT HOLDER

[0001] The subject matter described and/or illustrated herein relates generally to a holder for an electrical component, and more particularly to a holder for holding an electrical component to a circuit board during a soldering operation.

[0002] Antennas are electrical devices that convert electrical power into radio frequency (RF) waves, and vice versa. Antennas are used with RF transmitters and RF receivers for respectively transmitting and receiving RF waves. In transmission, the RF transmitter supplies an oscillating RF electric current to the terminals of the antenna, and the antenna radiates the energy from the current as RF waves. In reception, the antenna intercepts some of the power of an RF wave in order to produce a tiny voltage at the terminals of the antenna, which is applied to the RF receiver.

[0003] Some known antennas are mounted to circuit boards. For example, some known antennas include a lead that is received within a hole (e.g., an electrical via and/or thru hole) of the circuit board. The lead is then soldered to the circuit board to electrically connect the antenna to the circuit board. For example, the lead may be soldered to a contact pad positioned on a surface of the circuit board adjacent the hole and/or may be soldered to electrically conductive material of the hole.

[0004] It may be difficult to solder the leads of at least some known antennas to the circuit board. For example, an operator may need to hold the antenna during the soldering operation to support the antenna and prevent the lead from falling out of, and/or becoming misaligned within, the hole of the circuit board. But, holding the antenna while the lead is being soldered to the circuit board may make it more difficult for a single operator to complete the soldering operation. For example, the single operator may be required to perform the soldering operation with one hand while holding the antenna with the other hand, which may increase the difficulty and/or time required to mount the antenna to the circuit board and thereby increase manufacturing costs and/or reduce production numbers. Moreover, and for example, soldering the leads of at least some known antennas to circuit boards may require two operators, for example one operator to hold the antenna and another operator to solder the antenna to the circuit board. The use of such a second operator to

complete the soldering operation may increase manufacturing costs and/or reduce production numbers.

[0005] The solution to the problem is provided by a holder for holding an electrical component on a circuit board having a lead hole. The holder includes a body having a base for holding the electrical component and a connection member for mounting the body to the circuit board. The base includes a lead opening that is configured to hold a solder lead of the electrical component therein. The connection member extends from the base and is configured to mechanically connect to the circuit board such that the base holds an end of the solder lead of the electrical component within the lead hole of the circuit board.

[0006] The invention will now be described by way of example with reference to the accompanying drawings in which:

[0007] Figure 1 is a perspective view of an embodiment of an electrical device.

[0008] Figure 2 is a partially exploded perspective view of a circuit board assembly of the electrical device shown in Figure 1.

[0009] Figure 3 is a perspective view of an embodiment of an antenna holder of the circuit board assembly shown in Figure 2.

[0010] Figure 4 is another perspective view of the antenna holder shown in Figure 3 illustrating a different orientation of the antenna holder as compared to Figure 3.

[0011] Figure 5 is an exploded perspective view of an embodiment of an assembly of an embodiment of an antenna and the antenna holder shown in Figures 3 and 4.

[0012] Figure 6 is an unexploded perspective view of the assembly shown in Figure 5.

[0013] Figure 7 is a perspective view of a portion of the assembly shown in Figures 5 and 6 illustrating a cross section of the assembly.

[0014] Figure 8 is another perspective view of the circuit board assembly shown in Figure 2.

[0015] Figure 9 is a perspective view of a portion of the circuit board assembly shown in Figures 2 and 8 illustrating a cross section of the assembly.

[0016] Figure 10 is an elevational view of the circuit board assembly shown in Figures 2, 8, and 9 illustrating the assembly shown in Figures 5-7 mounted to an embodiment of a circuit board of the circuit board assembly.

[0017] Figure 11 is a perspective view of another embodiment of an assembly of another embodiment of a holder and another embodiment of an electrical component.

[0018] Figure 12 is a perspective view of a portion of the assembly shown in Figure 11 illustrating a cross section of the assembly.

[0001] In an embodiment, a holder is provided for holding an electrical component on a circuit board having a lead hole. The holder includes a body having a base for holding the electrical component and a connection member for mounting the body to the circuit board. The base includes a lead opening that is configured to hold a solder lead of the electrical component therein. The connection member extends from the base and is configured to mechanically connect to the circuit board such that the base holds an end of the solder lead of the electrical component within the lead hole of the circuit board.

[0002] In an embodiment, an antenna assembly includes an antenna that includes a solder lead having an end. The antenna assembly also includes an antenna holder for holding the antenna on a circuit board. The antenna holder includes a body having a base for holding the antenna and a connection member for mounting the body to the circuit board. The base includes a lead opening. The solder lead of the antenna is received within the lead opening such that the end of the solder lead is exposed from the body for being received within a lead hole of the circuit board. The connection member extends from the base and is configured to mechanically connect to the circuit board such that the base holds the end of the solder lead of the antenna within the lead hole of the circuit board.

[0003] In an embodiment, a circuit board assembly includes a circuit board having a lead hole, and an antenna that includes a solder lead having an end. The circuit board assembly also includes an antenna holder for holding the antenna on the circuit board. The antenna holder includes a body having a base for holding the antenna and a connection member for mounting the body to the circuit board. The base includes a lead opening. The solder lead of the antenna is received within the lead opening such that the end of the solder lead is exposed from the body. The connection member extends from the base and is mechanically connected to the circuit board such that the base holds the end of the solder lead of the antenna within the lead hole of the circuit board.

[0004] Figure 1 is a perspective view of an embodiment of an electrical device 10. The electrical device 10 includes an electrical component 12, a holder 14, and a circuit board 16. In the illustrated embodiment, the electrical component 12 is an antenna. The electrical component 12 will be referred to herein as the "antenna 12", while the holder 14 will be referred to herein as the "antenna holder 14". As will be described in more detail below, the antenna 12 and the antenna holder 14 are mounted to the circuit board 16. As can be seen in Figure 1, the circuit board 16 is mounted to a substrate 18 of the electrical device 10. The substrate 18 may be a host circuit board that provides electrical pathways between the circuit board 16 and one or more various other components of the electrical device 10. Alternatively, the substrate 18 may be a structure that mechanically supports the circuit board 16 within the electrical device 10 without providing any electrical pathways between the circuit board 16 and one or more various other components of the electrical device 10. The electrical device 10 may be any type of electrical device that includes an electrical component 12 that is mounted to a circuit board. A combination of the antenna 12 and the antenna holder 14 may be referred to herein as an "antenna assembly".

[0005] The circuit board 16, the antenna holder 14, and the antenna define a circuit board assembly 20, which is an antenna system that is configured to transmit and/or receive radio frequency (RF) waves. For example, the circuit board 16 may be, or include, an RF transmitter that transmits RF waves into the environment (e.g., the atmosphere) of the electrical device 10 using the antenna 12. Moreover, the circuit board 16 may be, or include, an RF receiver that receives RF waves from the environment of the electrical device 10 using the antenna 12. In some embodiments, the circuit board 16 is, or includes, both an RF

transmitter and an RF receiver for both transmitting RF waves into the environment using the antenna 12 and receiving RF waves from the environment using the antenna 12.

[0006] As will be described in more detail below, the antenna holder 14 is configured to hold the antenna 12 to the circuit board 16 during a soldering operation. Specifically, the antenna holder 14 holds a solder lead 22 of the antenna 12 within a lead hole 24 (Figures 2, 8, and 10) of the circuit board 16 while the solder lead 22 is soldered to the circuit board 16. As described above, the electrical component 12 is an antenna in the illustrated embodiment. But, the electrical component 12 is not limited to being or including an antenna. Rather, in addition or alternatively to an antenna, the electrical component 12 may be, or include, any other type of electrical component that includes a solder lead (e.g., the solder lead 22) for soldering the electrical component 12 to a circuit board. Examples of other types of electrical components of the electrical component 12 include, but are not limited to, electrical connectors, electrical contacts, capacitors, memories, integrated circuits, processors, controllers, chips, single leaded connector pins, combined thru hole and surface mount components, and/or the like.

[0007] Figure 2 is a partially exploded perspective view of the circuit board assembly 20. The solder lead 22 of the antenna 12 is shown in Figure 2 as being held by the antenna holder 14, while the antenna 12 and the antenna holder 14 are shown as exploded from the circuit board 16. In the illustrated embodiment, the antenna 12 includes the solder lead 22 and a coil 26 that extends from the solder lead 22. But, the coil 26 is meant only as one example of the shape of the antenna 12. The antenna 12 is not limited to having a coil. Rather, the antenna 12 may be any other type of antenna having any other shape in addition or alternative to the coil 26, such as, but not limited to, fractal shapes, loops, beams, and/or the like.

[0008] The circuit board 16 extends a thickness T from an antenna side 28 to an opposite side 30 that is opposite the antenna side 28. The circuit board 16 includes one or more edges 32 that extend from the antenna side 28 to the opposite side 30. The circuit board 16 includes the lead hole 24, which as will be described below is configured to receive the solder lead 22 of the antenna 12 therein. In the illustrated embodiment, the lead hole 24 is a thru hole that extends completely through the thickness T of the circuit board 16. But, the

lead hole 24 may extend only partially through the thickness T of the circuit board 16. Moreover, in the illustrated embodiment, the lead hole 24 is an electrical via that includes electrically conductive material 34 that extends on the interior wall(s) of the circuit board 16 that define the lead hole 24. Optionally, the lead hole 24 includes an electrically conductive contact pad 36 that extends on the antenna side 28 and/or includes an electrically conductive contact pad 38 (Figure 10) that extends on the opposite side 30. As will be described below, the solder lead 22 of the antenna 12 is soldered to the material 34, the contact pad 36, and/or the contact pad 38. The antenna side 28 of the circuit board 16 may be referred to herein as an "electrical component side" of the circuit board 16. The opposite side 30 of the circuit board 16 may be referred to herein as a "side" of the circuit board 16.

[0009] In some alternative embodiments, the lead hole 24 is not an electrical via (whether or not the lead hole 24 is a thru hole) such that the lead hole 24 does not include the electrically conductive material 34. In embodiments wherein the lead hole 24 is not an electrical via, the solder lead 22 may be soldered to one or more contact pads and/or other electrical contacts (not shown) that extend on the opposite side 30 of the circuit board 16 adjacent the lead hole 24, and/or the solder lead 22 may be soldered to one or more contact pads and/or other electrical contacts (not shown) that extend on the antenna side 28 adjacent the lead hole 24.

[0010] In the illustrated embodiment, the lead hole 24 has a cylindrical (i.e., circular cross-sectional) shape, as is shown in Figure 2. But, the lead hole 24 may additionally or alternatively include any other shape, such as, but not limited to, a parallelepiped, a rectangular cross-sectional shape, an oval cross-sectional shape, a triangular cross-sectional shape, a cross-sectional shape having more than four sides, and/or the like.

[0011] The antenna holder 14 and the circuit board 16 include a detent 40. Specifically, and as will be described in more detail below, the circuit board 16 includes an opening 42 that receives a protrusion 44 (Figures 4 and 9) of the antenna holder 14 therein to resist rotation of the antenna holder 14 relative to the circuit board 16. In the illustrated embodiment, opening 42 is a thru hole that extends completely through the thickness T of the circuit board 16. But, the opening 42 may extend only partially through the thickness T of the circuit board 16. For example, the opening 42 may be a depression within the antenna

side 28 or the opposite side 30 of the circuit board 16. Moreover, in the illustrated embodiment, the opening 42 has a cylindrical (i.e., circular cross-sectional) shape. But, the opening 42 may additionally or alternatively include any other shape, such as, but not limited to, a parallelepiped, a rectangular cross-sectional shape, an oval cross-sectional shape, a triangular cross-sectional shape, a cross-sectional shape having more than four sides, and/or the like. Examples of shapes of the opening 42 when the opening 42 is a depression include, but are not limited to, a partially spherical (e.g., a half sphere, a 1/3 sphere, a 1/4 sphere, and/or the like) depression, a triangular depression, an oval shaped depression, a rectangular depression, a depression having more than four sides, and/or the like.

[0012] Although shown as having a rectangular shape that includes four edges 32, the circuit board 16 may additionally or alternatively include any other shape, such as, but not limited to, a circular shape, an oval shape, a triangular shape, a shape having more than four edges 32, and/or the like.

[0013] Figure 3 is a perspective view of an embodiment of the antenna holder 14. Figure 4 is another perspective view of the antenna holder 14 illustrating a different orientation of the antenna holder 14 as compared to Figure 3. Referring now to Figures 2-4, the antenna holder 14 includes a body 46 having a base 48 and a connection member 50 that extends from the base 48. As will be described below, the base 48 is configured to hold the antenna 12 (not shown in Figures 3 and 4), and the connection member 50 is configured to mount the body 46 to the circuit board 12 (not shown in Figures 3 and 4). The body 46 of the antenna holder 14 is fabricated from one or more dielectric materials such that at least a portion of the body 46 is dielectric (i.e., electrically insulative). The dielectric properties of the body 46 enables the body 46 to hold the antenna 12 without electrically shorting the antenna 12. In some embodiments, one or more portions of the body 46 may be metallized and/or electrically conductive, so long as the body 46 does not provide an electrical short between the antenna 12 and the circuit board 16.

[0014] Referring now solely to Figure 3, the base 48 extends a thickness T_1 from a side 52 to an opposite side 54. The base 48 includes a lead opening 56 that extends through the thickness T_1 of the base 48. The lead opening 56 is configured to hold the solder lead 22 (Figures 1, 2, 5-8, and 10) of the antenna 12 (Figures 1, 2, and 5-10) therein, as will

be described below. Optionally, the base 48 includes a tower 58 that extends outward from the side 52 of the base 48. As can be seen in Figure 3, the lead opening 56 extends through the tower 58 of the base 48. When included, the tower 58 provides additional support for the antenna 12 along an axis 60 of the base 48 that extends approximately perpendicular to the sides 52 and 54 of the base 48.

[0015] The lead opening 56 extends a length through the base 48 from an end 62 to an opposite end 64. As can be seen in Figure 3, the length of the lead opening 56 extends through the tower 58 of the base 48. The lead opening 56 includes a side entrance 66 that extends along the length of the lead opening 56 from the end 62 to the end 64. As will be described below, the lead opening 56 is configured to receive the solder lead 22 of the antenna 12 therein through the side entrance 66. In other words, the solder lead 22 is configured to be inserted into the lead opening 56 through the side entrance 66. The base 48 includes an optional lead-in feature 68 for guiding the solder lead 22 into the lead opening 56 through the side entrance 66. In the illustrated embodiment, the lead-in feature 68 includes opposing ramps 68a and 68b, but other structures may be additionally or alternatively used as the lead-in feature 68.

[0016] In the illustrated embodiment, the lead opening 56 of the base 48 is configured to receive the solder lead 22 of the antenna 12 with a snap-fit connection to hold the solder lead 22 within the lead opening 56. But, the lead opening 56 may be additionally or alternatively configured to receive the solder lead 22 of the antenna 12 with an interference-fit connection to hold the solder lead 22 within the lead opening 56. In the illustrated embodiment, the snap-fit connection between the lead opening 56 and the solder lead 22 is provided by one or more snap ribs 70 that extend along at least a portion of the length of the lead opening 56. The snap ribs 70 are configured to deflect and/or deform as the solder lead 22 is inserted into the lead opening 56 through the side entrance 66. Once the solder lead 22 has cleared the snap ribs 70, the snap ribs 70 snap back to the undeflected and/or undeformed positions to hold the solder lead 22 within the lead opening 56. Although two are shown, the lead opening 56 may include any number of the snap ribs 70.

[0017] Optionally, the lead opening 56 of the base 48 is bent along the length of the lead opening 56, as is shown in the illustrated embodiment. Specifically, the

path of the lead opening 56 through the base 48 includes segments 72 and 74 that are interconnected at a bend 76 of the lead opening 56. The segment 72 includes the end 64 of the lead opening 56, while the segment 74 includes the end 62. As will be described below, the segment 74 of the lead opening 56 is configured to receive a segment 89 (Figures 5-7) of the coil 26 (Figures 2 and 5-7) of the antenna 12 therein. The bend 76 may have any angle that enables the segment 74 of the lead opening 56 to hold a structure (e.g., the coil 26) of the antenna 12 that extends from the solder lead 22.

[0018] The lead opening 56 may have any shape that enables the antenna holder 14 to hold the solder lead 22 of the antenna 12 as described and/or illustrated herein. Optionally, the lead opening 56 includes a shape that is complementary with the shape of the solder lead 22 and/or another structure (e.g., the coil 56) of the antenna 12.

[0019] Referring now to Figure 4, the antenna holder 14 includes the protrusion 44 that defines a portion of the detent 40 of the antenna holder 14 and the circuit board 16 (Figures 1, 2, and 8-10). Specifically, the protrusion 44 extends outward on the side 54 of the base 48 of the body 46. In the illustrated embodiment, the protrusion 44 has a partially spherical shape. But, the protrusion 44 may additionally or alternatively include any other shape, such as, but not limited to, a parallelepiped, a rectangular cross-sectional shape, an oval cross-sectional shape, a cylindrical (i.e., circular cross-sectional) shape, a triangular cross-sectional shape, a cross-sectional shape having more than four sides, and/or the like.

[0020] The body 46 of the antenna holder 14 includes the connection member 50. The connection member 50 extends from the base 48 and is configured to mechanically connect to the circuit board 16 to thereby mount the body 46 to the circuit board 16. In the illustrated embodiment, the connection member 50 is a spring clip. Specifically, the connection member 50 includes a spring arm 78 that extends outward from an edge 80 of the base 48. The spring arm 78 extends a length from the edge 80 of the base 48 to an end 82 of the spring arm 78. As can be seen in Figure 4, the length of the spring arm 78 is curved such that the length of the spring arm 78 curves back toward the base 48 as the spring arm 78 extends from the edge 80 to the end 82. In other words, the spring arm 78 has a "U" shape in the illustrated embodiment.

[0021] The spring arm 78 is shown in Figure 4 in the natural resting position of the spring arm 78. The end 82 of the spring arm 78 is resiliently deflectable in the direction of the arrow A from the natural resting position of the spring arm 78. The spring arm 78 defines a spring clip that is configured to clip to the circuit board 16 such that the spring arm 78 straddles an edge 32 (Figures 2 and 9) of the circuit board 16. The spring arm 78 includes an optional engagement platform 84 at which the spring arm 78 is configured to engage in physical contact with the circuit board 16 to mechanically connect the connection member 50 to the circuit board 16. Specifically, the spring arm 78 is configured to mechanically connect to the circuit board 16 by engaging in physical contact with the opposite side 30 (Figures 2 and 8-10) of the circuit board 16 such that the circuit board 16 is engaged in physical contact between the engagement platform 84 of the spring arm 78 and the side 54 of the base 48.

[0022] Although shown as being located at the end 82 of the spring arm 78, the engagement platform 84 may be additionally or alternatively be located at any other location along the length of the spring arm 78. In some embodiments, the spring arm 78 may include two or more engagement platforms 84 located at different locations along the length of the spring arm 78, or may include a single engagement platform 84 that extends along a greater portion of the length of the spring arm 78 as compared to the exemplary engagement platform 84 shown and described herein.

[0023] The connection member 50 is not limited to the illustrated embodiment of the spring arm 78. Rather, other arrangements, structures, geometry, and/or the like of connection member 50 that enable the connection member 50 to mount the body 46 to the circuit board 50 as shown and/or described herein (e.g., such that the base 48 holds the solder lead 22 within the lead hole 24 during a soldering operation) may be used in addition or alternative to the spring arm 78. Moreover, the spring arm 78 may have any other geometry that enable the connection member 50 to mount the body 46 to the circuit board 50 as shown and/or described herein.

[0024] Figure 5 is an exploded perspective view of an assembly 88 of the antenna 12 and the antenna holder 14. The solder lead 22 of the antenna 12 is configured to be inserted into the lead opening 56 of the antenna holder 14 through the side entrance 66.

Specifically, from the position relative to the antenna holder 14 shown in Figure 5, the antenna 12 is configured to be moved relative to the antenna holder 14 in the direction of the arrow B such that the solder lead 22 of the antenna 12 is received into the segment 72 of the lead opening 56 of the antenna holder 14 through the side entrance 66 of the lead opening 56. In the illustrated embodiment, as the solder lead 22 is inserted into the lead opening 56 through the side entrance 66, the segment 89 of the coil 26 is received into the segment 74 of the lead opening 56 through the side entrance 66, as should be apparent from Figure 5. The assembly 88 may be referred to herein as an "antenna assembly".

[0025] Figure 6 is an unexploded perspective view of the assembly 88 illustrating the antenna 12 as held by the antenna holder 14. As shown in Figure 6, the solder lead 22 of the antenna 12 is held within the segment 72 of the lead opening 56 of the antenna holder 14. Optionally, the segment 89 of the coil 26 of the antenna 12 is held by the lead opening 56 of the antenna holder 14. Specifically, in the illustrated embodiment, the segment 89 of the coil 26 is held within the segment 74 of the lead opening 56. As should be apparent from Figure 6, the portions of the body 46 of the antenna holder 14 through which the lead opening 56 extends supports the solder lead 22 of the antenna 12 along the axis 60. When included, a portion of the solder lead 22 extends within the tower 58 of the base 48 such that the tower 58 provides additional (i.e., in addition to the portion of the lead opening 56 that extends through the thickness T_1, shown in Figure 3, of the base 48) support for the antenna 12 along the axis 60. In the illustrated embodiment, the portion of the body 46 that defines the segment 74 of the lead opening 56 supports the segment 89 of the coil 26 of the antenna 12. As can be seen in Figure 6, an end 90 of the solder lead 22 is exposed from the body 46 of the antenna holder 14 along the side 54 of the base 48 when the solder lead 22 is held within the lead opening 56.

[0026] The solder lead 22 and the segment 89 of the antenna 12 are securely held by the base 48 within the lead opening 56 via the snap-fit connection between the segment 72 of the lead opening 56 and the solder lead 22 and between the segment 74 of the lead opening 56 and the segment 89 of the antenna coil 26. Specifically, and referring now to Figure 7, the solder lead 22 of the antenna 12 is received into the segment 72 of the lead opening 56 such that the snap ribs 70 have snapped around the solder lead 22, as shown in Figure 7. Similarly, the segment 89 of the coil 26 of the antenna 12 is received into the

segment 74 of the lead opening 56 such that the snap ribs 70 have snapped around the segment 89. The solder lead 22 and the segment 89 of the antenna 12 are thereby securely held within the lead opening 56 of the antenna holder 14.

[0027] Referring again to Figure 2, the antenna holder 14 is configured to hold the end 90 of the solder lead 22 of the antenna 12 within the lead hole 24 of the circuit board 16 during a soldering that is operation performed on the solder lead 22 (i.e., while the solder lead 22 is soldered to the circuit board 16). To solder the antenna 12 to the circuit board 16, the assembly 88 of the antenna 12 and the antenna holder 14 is mounted to the circuit board 16 by inserting the end 90 of the solder lead 22 into the lead hole 24 of the circuit board 16, for example by aligning the end 64 (Figures 2 and 3) of the lead opening 56 with the lead hole 24 of the circuit board 16. The end 90 of the solder lead 22 is inserted into the lead hole 24 with the assembly 88 in an orientation wherein the connection member 50 does not engage the circuit board 16, for example the orientation shown in Figure 2.

[0028] Figure 8 is a perspective view of the circuit board assembly 20 illustrating the assembly 88 of the antenna 12 and the antenna holder 14 after the end 90 of the solder lead 22 has been received into the lead hole 24 of the circuit board 16. To mechanically connect the connection member 50 to the circuit board 16 and thereby mount the assembly 88 to the circuit board 16, the base 48 of the body 46 of the antenna holder 14 is rotated about the solder lead 22, and relative to the circuit board 16, in the direction of the arrow C. As the base 48 of the body 46 rotates relative to the circuit board 16 in the direction C, the engagement platform 84 of the spring arm 78 of the connection member 50 engages in physical contact with the opposite side 30 of the circuit board 16. The engagement between the spring arm 78 and the opposite side 30 of the circuit board 16 deflects the end 82 of the spring arm 78 in the direction A.

[0029] The base 48 of the antenna holder 14 is rotated in the direction C until the spring arm 78 of the connection member 50 is in the orientation relative to the circuit board 16 that is shown in Figures 1 and 9. The connection member 50 of the antenna holder 14 is mechanically connected to the circuit board 16 in the orientation shown in Figures 1 and 9. Specifically, and referring now solely to Figure 9, the spring arm 78 of the connection member 50 is clipped to the circuit board 16 over the edge 32 of the circuit board

16. When clipped over the edge 32 of the circuit board 16 as shown in Figure 9, the spring arm 78 straddles the edge 32 of the circuit board 16. As can be seen in Figure 9, the engagement platform 84 of the spring arm 78 is engaged in physical contact with the opposite side 30 of the circuit board 16, and the side 54 of the base 48 is engaged in physical contact with the antenna side 28 of the circuit board 16. The resilience of the spring arm 78 that biases the spring arm 78 to the natural resting position shown in Figure 4 exerts a force on the opposite side 30 of the circuit board 16 that presses the circuit board 16 against both the base 48 and the spring arm 78 of the antenna holder 14. The circuit board 16 is thus engaged in physical contact between the engagement platform 84 of the spring arm 78 and the side 54 of the base 48, which mechanically connects the connection member 50 to the circuit board 16 such that the assembly 88 of the antenna 12 and the antenna holder 14 is mounted to the circuit board 16.

[0030] As can be seen in Figure 9, as the base 48 of the antenna holder 14 is rotated in the direction C, the protrusion 44 of the antenna holder 14 is received within the opening 42 of the circuit board 16. The detent 40 formed by the cooperation between the protrusion 44 and the opening 42 resists rotation of the antenna holder 14 relative to the circuit board 14. For example, reception of the protrusion 44 within the opening 42 resists rotation of the antenna holder 14 in the direction of the arrow D. The detent 40 may facilitate holding the antenna holder 14 in the orientation relative to the circuit board 16 that is shown in Figures 1 and 9.

[0031] When the assembly 88 of the antenna holder 14 and the antenna 12 is mounted to the circuit board 16 as shown in Figures 1 and 9, the mechanical connection between the connection member 50 and the circuit board 16 enables the base 48 of the antenna holder 14 to hold the end 90 (Figures 2, 8, and 10) of the solder lead 22 (Figures 1, 2, 5-8, and 10) of the antenna 12 within the lead hole 24 (Figures 2, 8, and 10) of the circuit board 16. For example, Figure 10 is an elevational view of the circuit board assembly 20 illustrating the assembly 88 of the antenna holder 14 and the antenna 12 mounted to the circuit board 16. As shown in Figure 10, the base 48 of the antenna holder 14 holds the end 90 of the solder lead 22 of the antenna 12 within the lead hole 24 of the circuit board 16 via the mechanical connection between the connection member 50 and the circuit board 16. The solder lead 22 can then be soldered to the circuit board 16 while the base 48 of the antenna

holder 14 holds the end 90 of the solder lead 22 within the lead hole 24 of the circuit board 16.

[0032] For example, in the illustrated embodiment, the base 48 of the body 46 of the antenna holder 14 extends along the antenna side 28 of the circuit board 16, while the end 90 of the solder lead 22 is exposed along the opposite side 30 of the circuit board 16. Accordingly, the end 90 of the solder lead 22 is configured to be soldered to the circuit board 16 along the opposite side 30 of the circuit board 16 in the illustrated embodiment. If the electrically conductive material 34 is included, the end 90 of the solder lead 22 may be soldered to the electrically conductive material 34 of the lead hole 24 along the opposite side 30 of the circuit board 16. In addition or alternatively to being soldered to the electrically conductive material 34 along the opposite side 30 of the circuit board 16, the end 90 of the solder lead 22 may be soldered to the contact pad 38 that extends on the opposite side 30 of the circuit board 16 and/or to one or more other contact pads and/or other electrical contacts that extend on the opposite side 30. In some alternative embodiments, and in addition or alternatively to being soldered to the contact pad 38, to being soldered to one or more other contact pads and/or other electrical contacts that extend on the opposite side 30, and/or to being soldered along the opposite side 30 to the electrically conductive material 34, the end 90 of the solder lead 22 may soldered along the antenna side 28 to the electrically conductive material 34, may be soldered to one or more other contact pads and/or other electrical contacts that extend on the antenna side 28, and/or may be soldered to the contact pad 36 that extends on the antenna side 28 of the circuit board 16.

[0033] By holding the end 90 of the solder lead 22 within the lead hole 24 of the circuit board 16 while the end 90 is being soldered to the circuit board 16, the antenna holder 14 enables the soldering operation to be performed on the antenna 12 without requiring that an operator hold the solder lead 22 of the antenna within the lead hole 24 while the soldering operation is being performed. Specifically, the antenna holder 14 supports the antenna 12 and prevents the solder lead 22 of the antenna 12 from falling out of, and/or becoming misaligned within, the lead hole 24 of the circuit board. Accordingly, it may be less difficult and/or less time consuming to solder the antenna 12 to the circuit board 16 using the antenna holder 14, for example as compared to an operator holding the antenna 12 while the soldering operation is performed on the antenna 12. For example, the antenna holder 14

may enable a single operator to complete the soldering operation on the antenna 12. By lessening the difficulty and/or shortening the time required to solder the antenna 12 to the circuit board 12, the antenna holder 14 may reduce the manufacturing costs associated with the electrical device 10 (Figure 1) and/or the circuit board assembly 20. Moreover, the reduced difficulty and/or production time provided by the antenna holder 14 may increase the number of electrical devices 10 and/or circuit board assemblies 20 that can be produced in a given amount of time.

[0034] Figure 11 is a perspective view of another embodiment of an assembly 188 of another embodiment of a holder 114 and another embodiment of an electrical component 112. In the illustrated embodiment, the electrical component 112 is an antenna. The electrical component 112 will be referred to herein as the "antenna 112", while the holder 114 will be referred to herein as the "antenna holder 114". The antenna holder 114 includes a body 146 having a base 148 and a connection member 150 that extends from the base 148. The base 148 is configured to hold the antenna 112, and the connection member 150 is configured to mount the body 146 to the circuit board 12 (Figures 1, 2, and 8-10). The geometry, structure, and operation of the connection member 150 is substantially similar to the connection member 50 (Figures 1-4 and 8-10) and therefore the geometry, structure, and operation of the connection member 150 will not be described herein.

[0035] The base 148 includes a lead opening 156 that extends through the base 148. The lead opening 156 is configured to hold a solder lead 122 of the antenna 112 therein. Optionally, the base 148 includes a tower 158 that extends outward from a side 152 of the base 148. The lead opening 156 extends through the tower 158 of the base 148. The lead opening 156 extends a length through the base 148 from an end 162 to an opposite end 164. The lead opening 156 is configured to receive the solder lead 122 of the antenna 112 therein through the end 162. The length of the lead opening 156 extends through the tower 158 of the base 148. In the illustrated embodiment, the lead opening 156 of the base 148 of the body 146 follows an approximately straight path through the body 146.

[0036] In the illustrated embodiment, the lead opening 156 of the base 148 is configured to receive the solder lead 122 of the antenna 112 with an interference-fit connection to hold the solder lead 122 within the lead opening 156. But, the lead opening

156 may be additionally or alternatively configured to receive the solder lead 122 of the antenna 112 with a snap-fit connection to hold the solder lead 122 within the lead opening 156. Figure 12 is a perspective view of a portion of the assembly 188 illustrating a cross section of the assembly 188 that illustrates an exemplary interference-fit between the solder lead 122 and the lead opening 156. In the illustrated embodiment, the interference-fit connection between the lead opening 156 and the solder lead 122 is provided by one or more protrusions 170 that extend outward on the solder lead 122. The protrusion 170 interferes with the interior wall(s) of the base 148 that defines the lead opening 156 to provide the interference-fit between the solder lead 122 and the lead opening 156. In addition or alternatively to the protrusion(s) 170 on the solder lead 122, the interior wall(s) of the base 148 that define the lead opening 156 may include one or more protrusions (not shown) that interfere with the solder lead 122 to provide the interference-fit. Although one is shown, the solder lead 122 may include any number of the protrusions 170.

[0037] Although shown and described as being an antenna, the electrical component 112 is not limited to being or including an antenna. Rather, in addition or alternatively to an antenna, the electrical component 112 may be, or include, any other type of electrical component that includes a solder lead (e.g., the solder lead 122) for soldering the electrical component 112 to a circuit board. Examples of other types of electrical components of the electrical component 112 include, but are not limited to, electrical connectors, electrical contacts, capacitors, memories, integrated circuits, processors, controllers, chips, single leaded connector pins, combined thru hole and surface mount components, and/or the like.

[0038] The embodiments described and/or illustrated herein provide a holder that may enable an electrical component to be soldered to a circuit board with less difficulty, for example as compared to at least some known electrical components and circuit boards. The embodiments described and/or illustrated herein provide a holder that may decrease manufacturing costs and/or increase production numbers.

WHAT IS CLAIMED IS:

1. A holder (14) for holding an electrical component (12) on a circuit board (16) having a lead hole (24), the holder comprising a body (46) having a base (48) for holding the electrical component and a connection member (50) for mounting the body to the circuit board, the base comprising a lead opening (56) that is configured to hold a solder lead (22) of the electrical component therein, the connection member extending from the base and being configured to mechanically connect to the circuit board such that the base holds an end (90) of the solder lead of the electrical component within the lead hole of the circuit board.

2. The holder (14) of claim 1, wherein the base (48) of the body (46) is configured to hold the end (90) of the solder lead (22) of the electrical component (12) within the lead hole (24) of the circuit board (16) during a soldering operation that solders the solder lead of the electrical component to the circuit board.

3. The holder (14) of claim 1, wherein the base (48) of the body (46) comprises a tower (58) that extends outward from the base, the lead opening (56) of the base extending through the tower such that a portion of the solder lead (22) extends within the tower.

4. The holder (114) of claim 1, wherein the lead opening (156) of the base (148) of the body (146) follows an approximately straight path through the body.

5. The holder (14) of claim 1, wherein the lead opening (56) of the base (48) of the body (46) extends a length through the base, the lead opening comprising a side entrance (66) that extends along the length of the lead opening, the lead opening being configured to receive the solder lead (22) of the electrical component (12) therein through the side entrance.

6. The holder (14) of claim 1, wherein the electrical component (12) is an antenna that includes a coil (26), the lead opening (56) of the base (48) of the body (46) extending a length through the base, the lead opening being bent along the length of the lead opening, the lead opening being configured to hold a segment (89) of the coil of the antenna.

7. The holder (14, 114) of claim 1, wherein the lead opening (56, 156) of the base (48, 148) of the body (46, 146) is configured to receive the solder lead (22) of the electrical component (12) with at least one of a snap-fit connection or an interference-fit connection to hold the solder lead within the lead opening.

8. The holder (14) of claim 1, wherein the base (48) of the body (46) is configured to be rotated relative to the circuit board (16) when the end (90) of the solder lead (22) is received within the lead hole (56) of the circuit board to mechanically connect the connection member (50) to the circuit board.

9. The holder (14) of claim 1, wherein the connection member (50) comprises a u-shaped spring arm (78) that is configured to straddle an edge (32) of the circuit board (16).

10. The holder (14) of claim 1, wherein the body (46) is configured to be rotated relative to the circuit board (16) when the end (90) of the solder lead (22) is received within the lead hole (56) of the circuit board to mechanically connect the connection member (50) to the circuit board, the connection member and the circuit board comprising a detent (40) that is configured to resist rotation of the body relative to the circuit board when the connection member is mechanically connected to the circuit board.

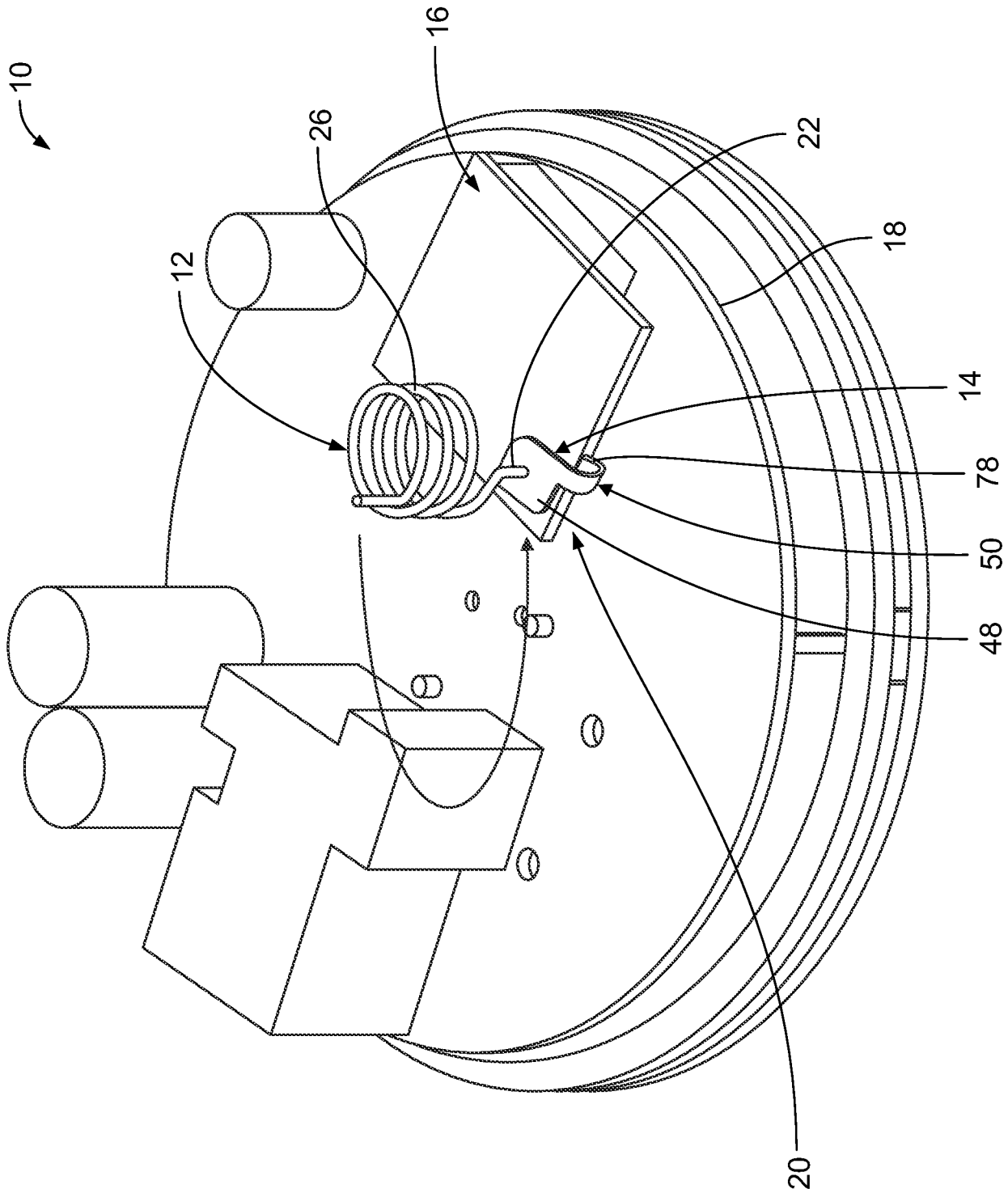

FIG. 1

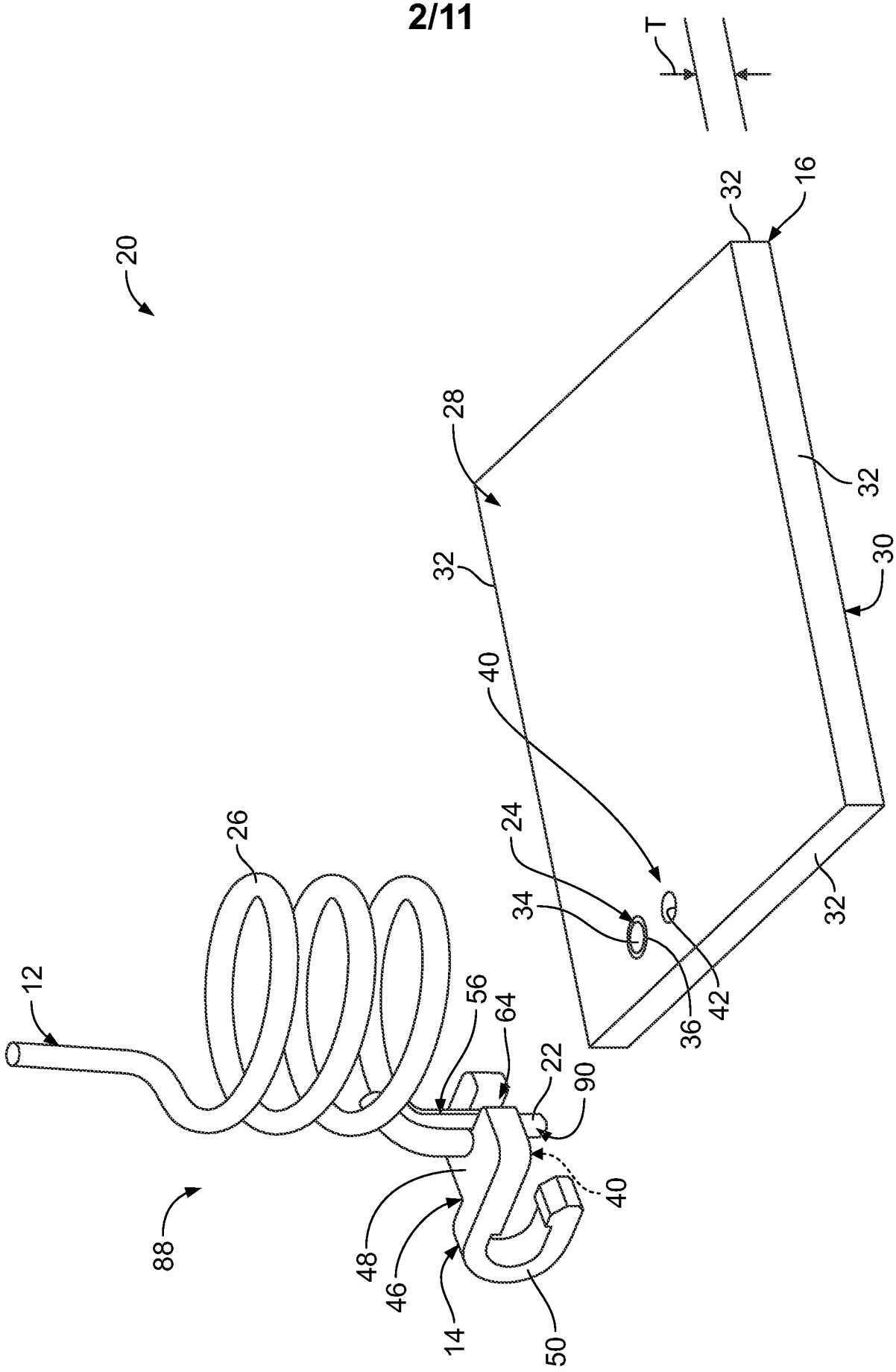
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FIG. 2

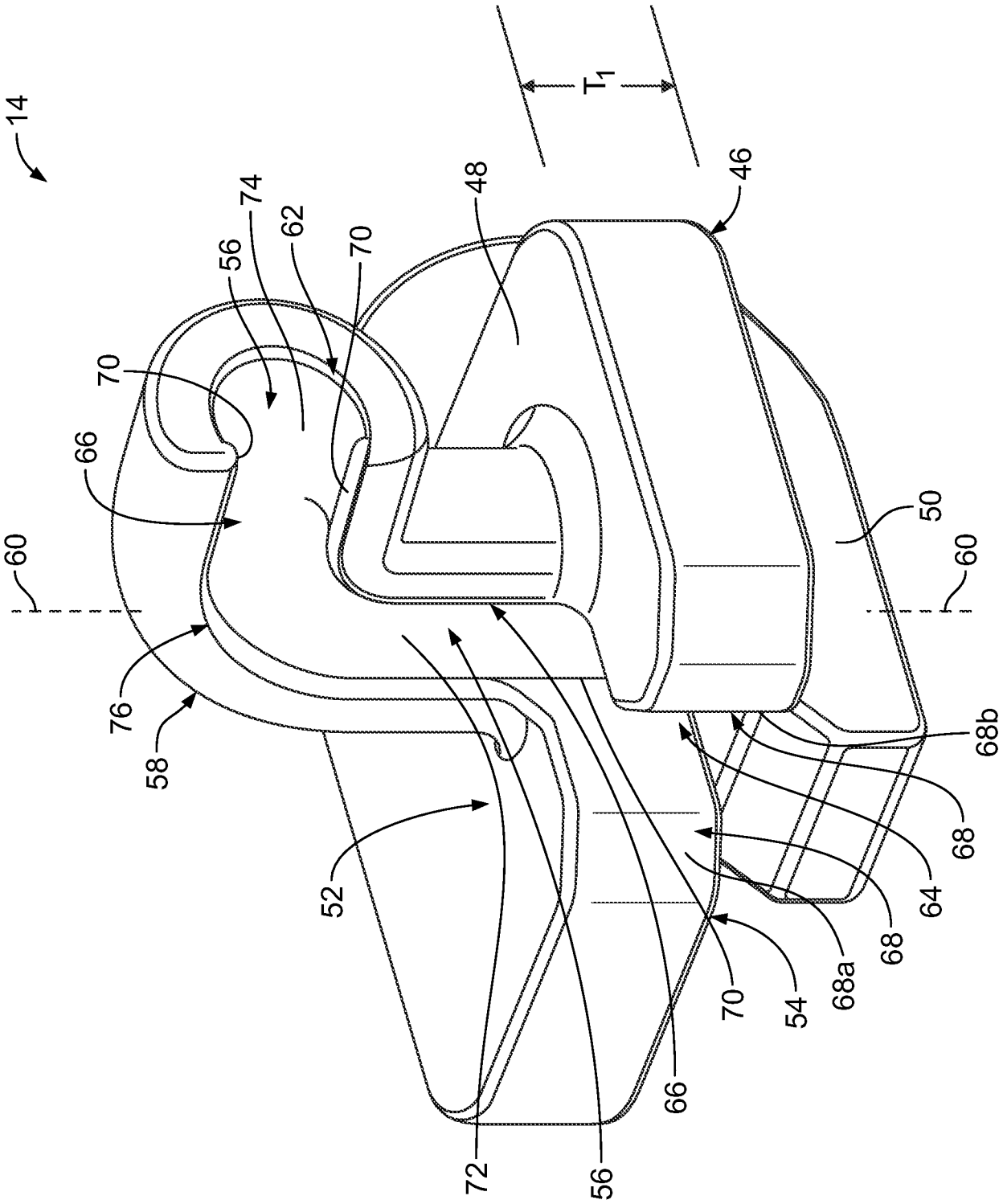
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FIG. 3

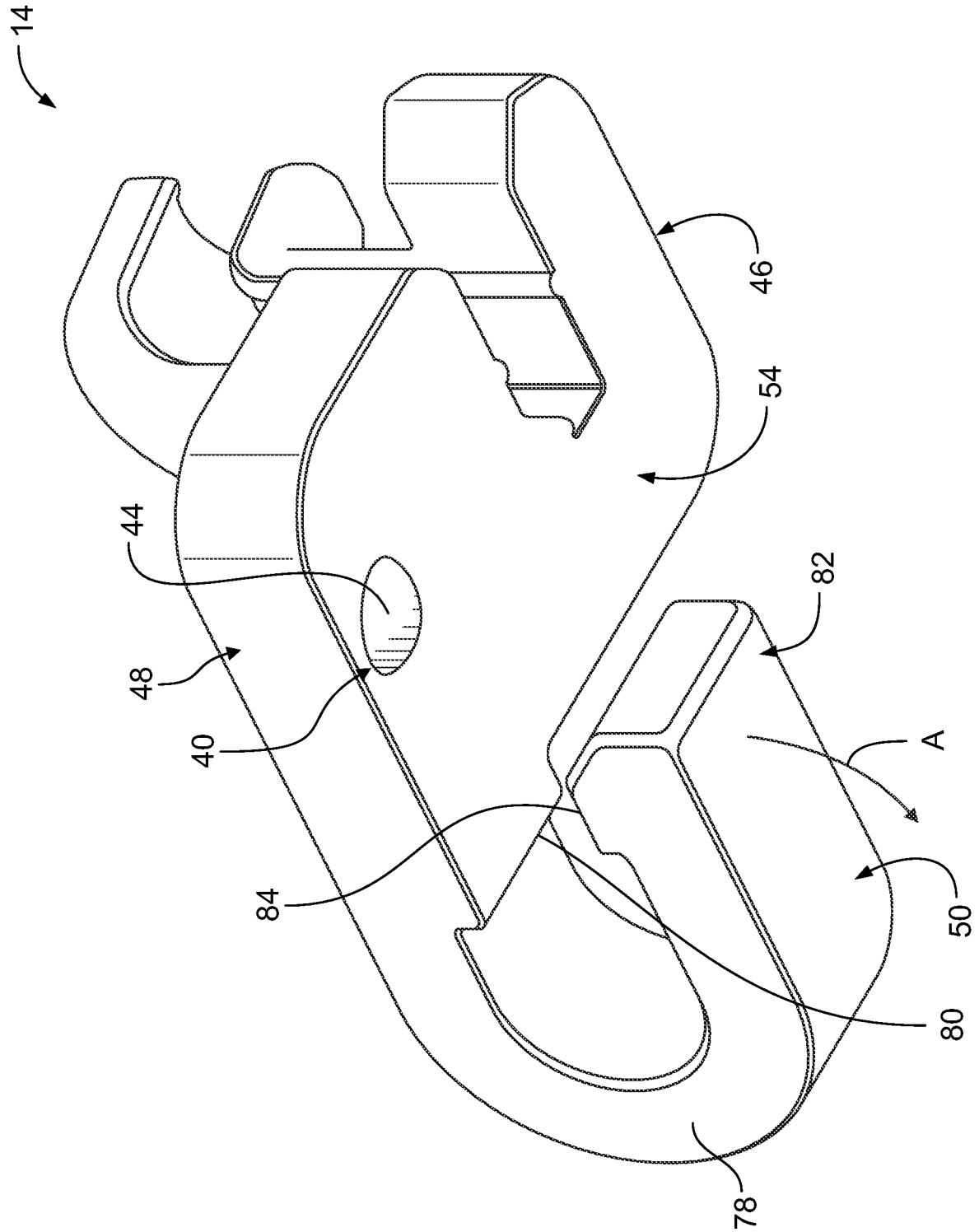

FIG. 4

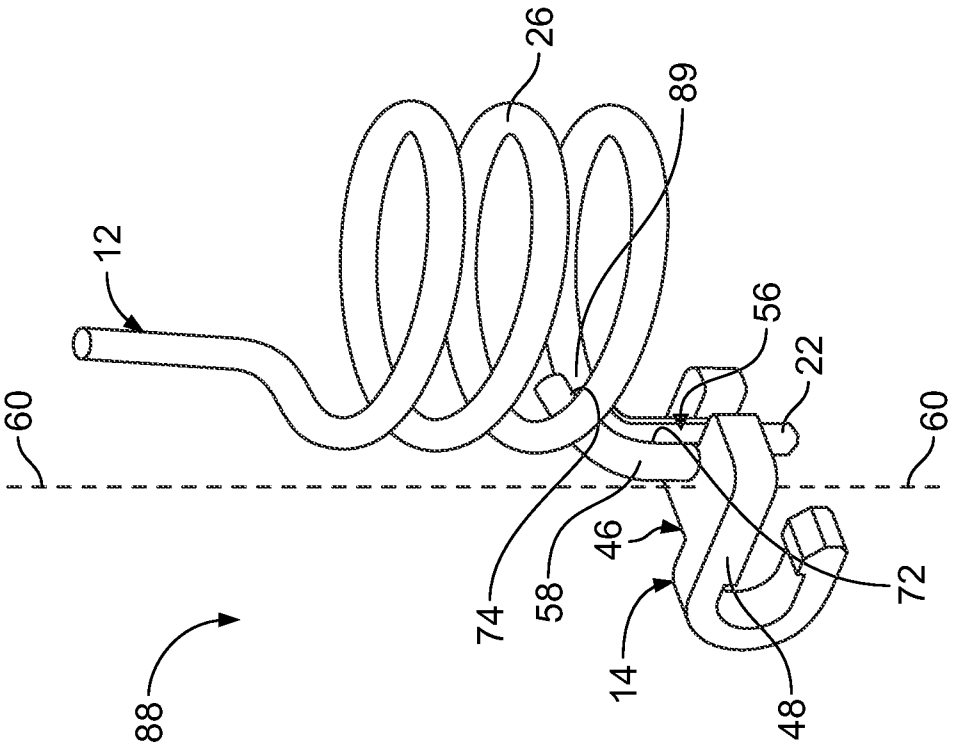

FIG. 6

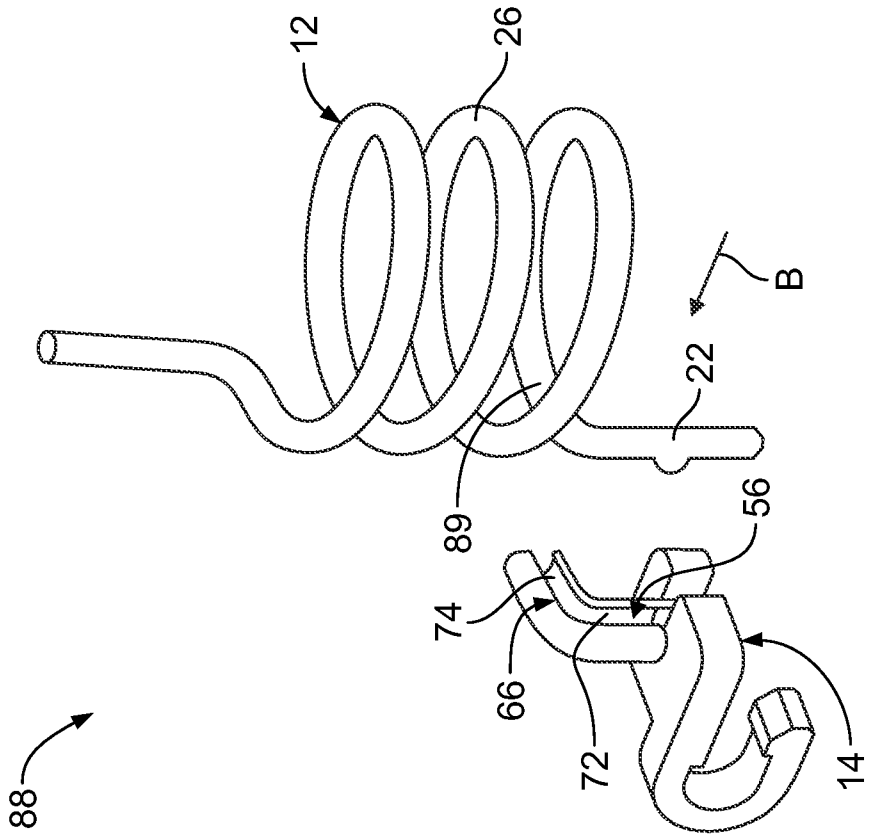

FIG. 5

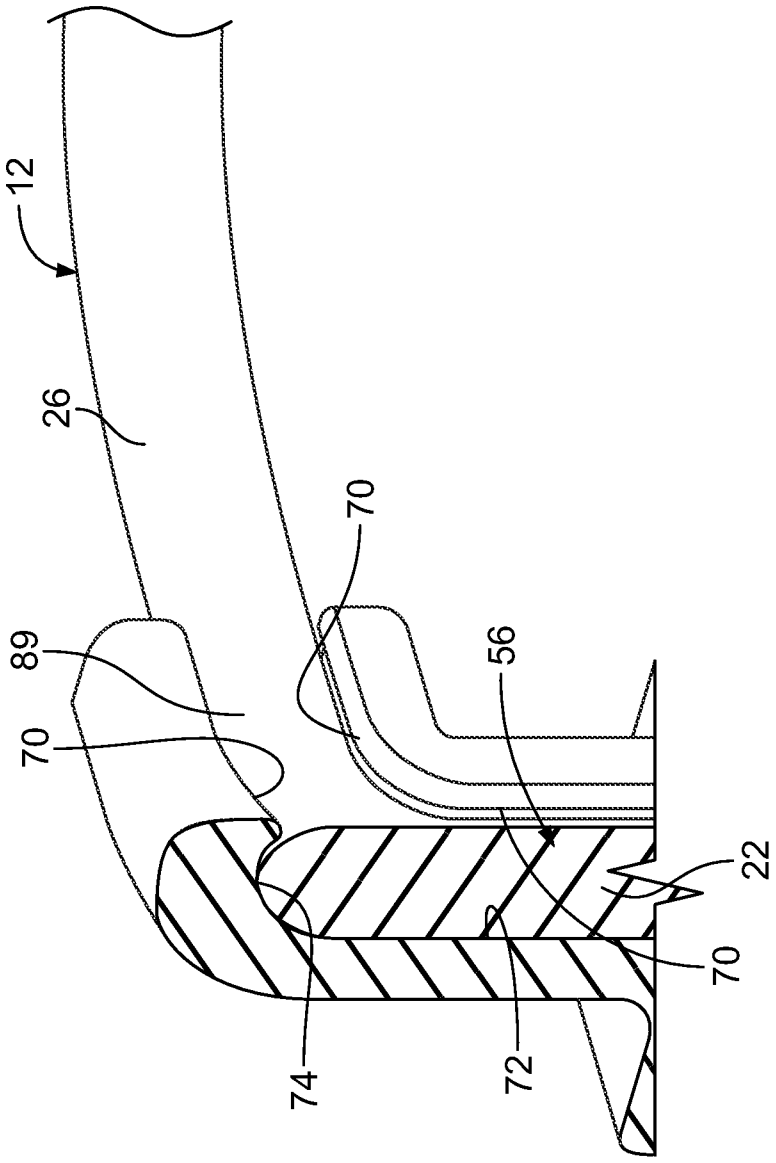

FIG. 7

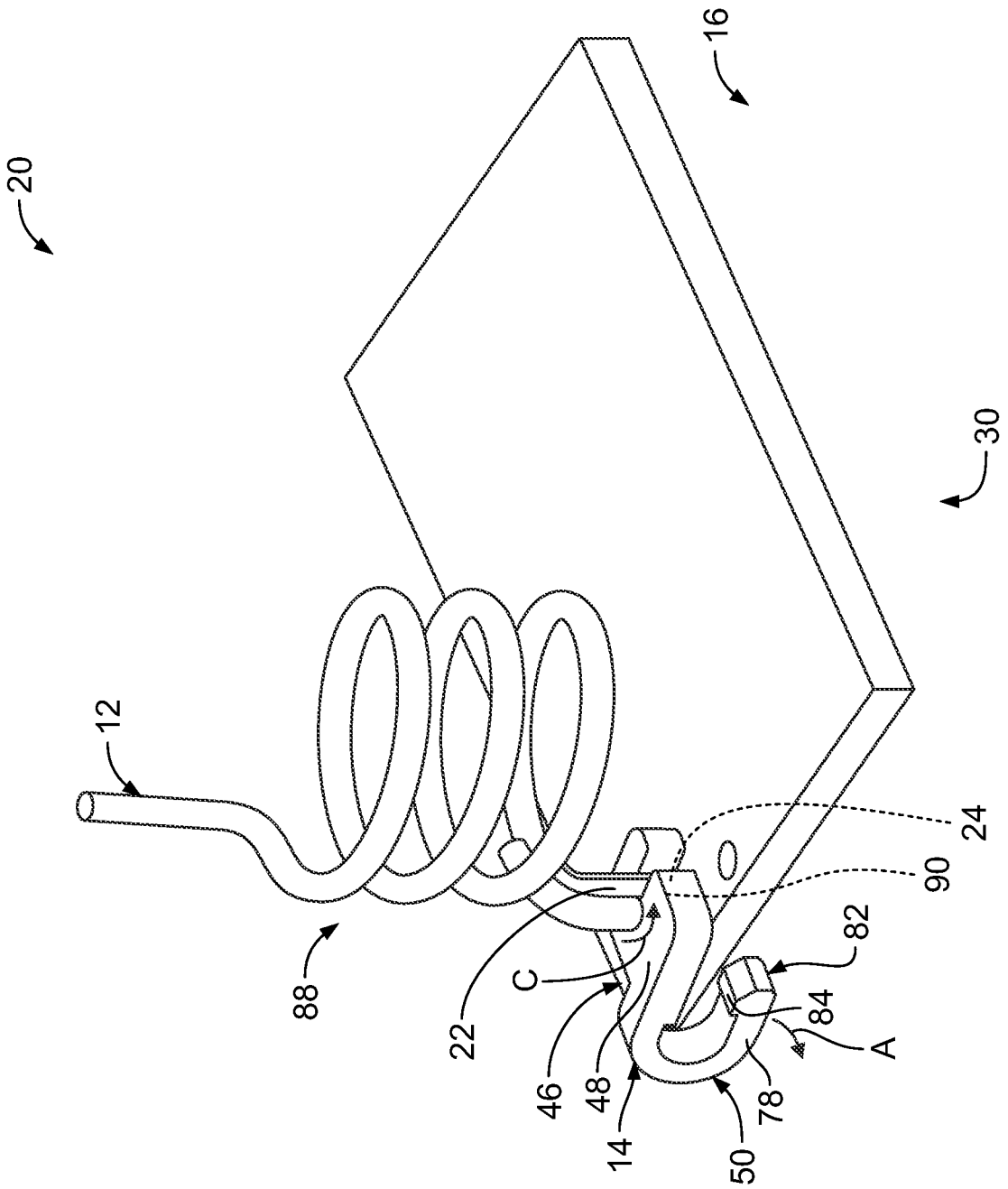

FIG. 8

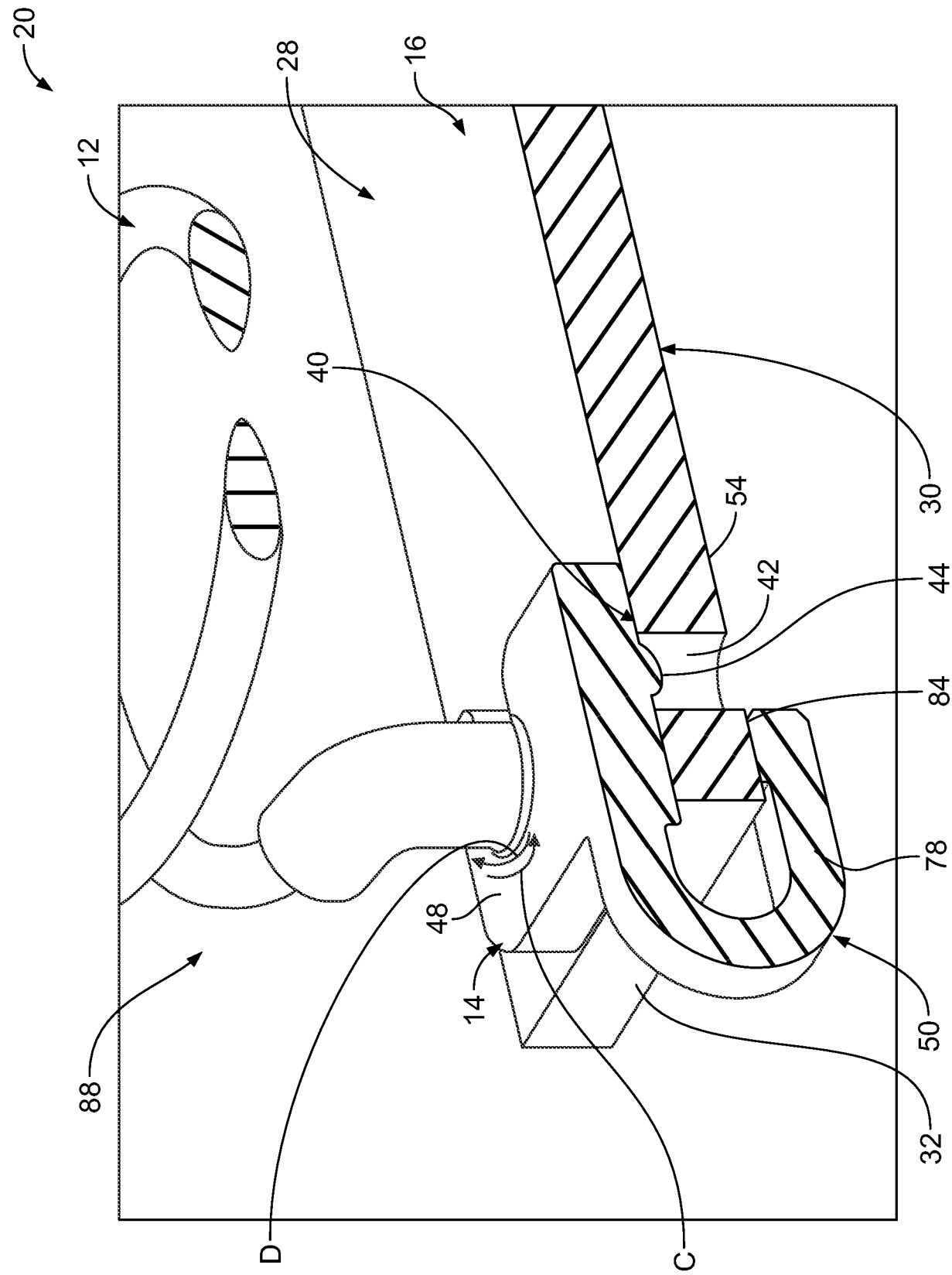

FIG. 9

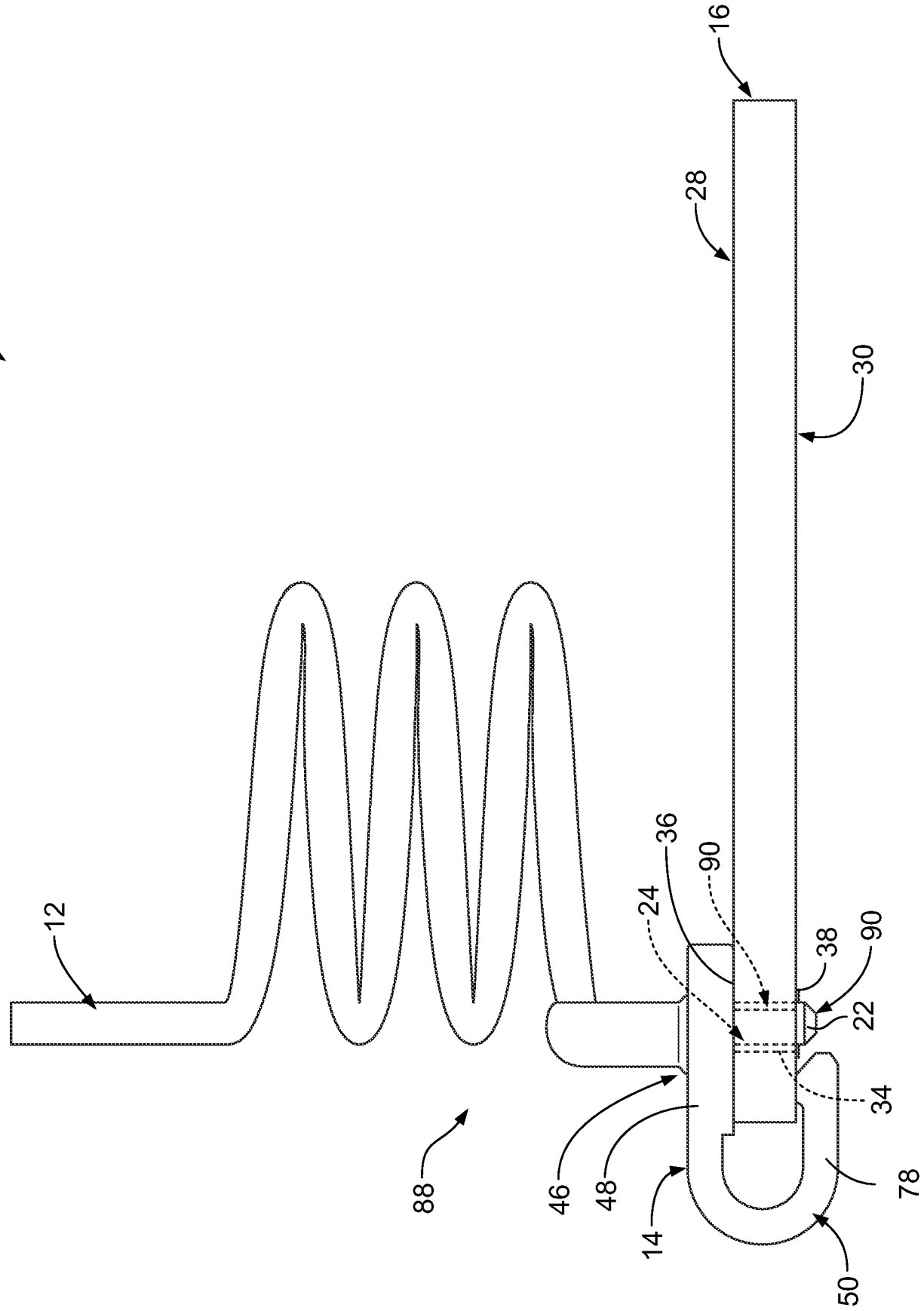

FIG. 10

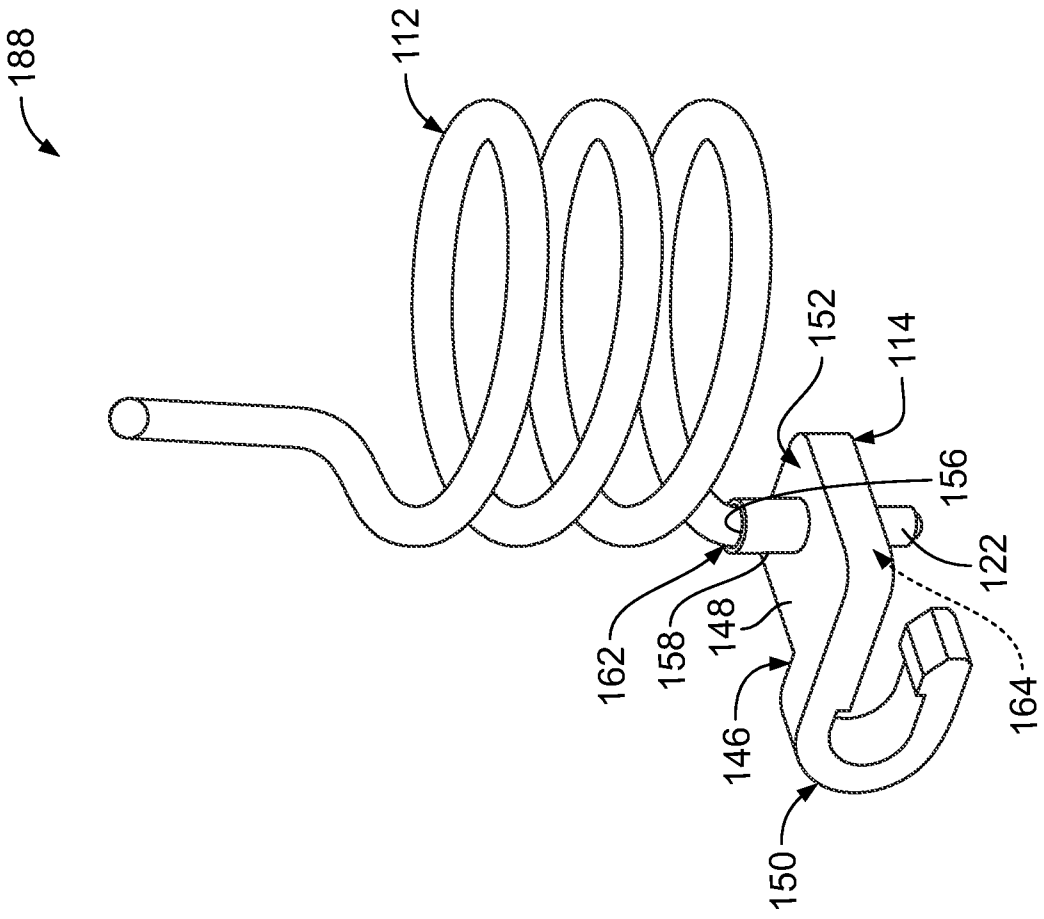

FIG. 11

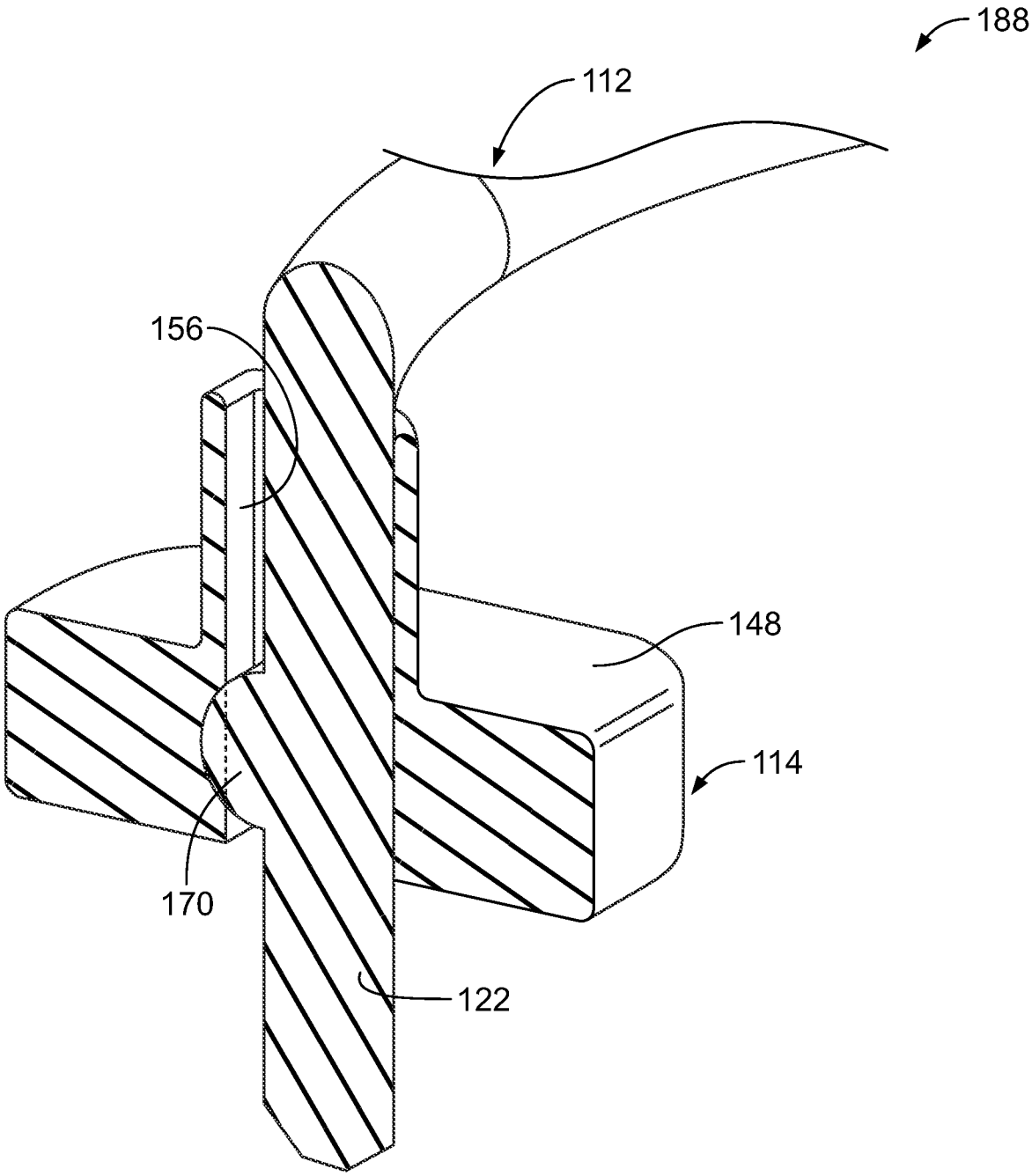

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/043819

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05K3/30 H05K7/00
ADD. H01R13/00 H05K3/34

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)
H05K H01R

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/328918 A1 (YANG MING-TANG [TW] ET AL) 30 December 2010 (2010-12-30) paragraph [0018] - paragraph [0028]; figures 2A-2D	1,3-5,9, 10
X	US 2006/258190 A1 (CHEN WAN-TIEN [TW]) 16 November 2006 (2006-11-16) abstract; figure 1	1,4,7,9
Y	US 2012/315799 A1 (SZCZESNY DAVID S [US]) 13 December 2012 (2012-12-13) figures 1,3	9
Y	US 2010/248502 A1 (MIKI YASUYUKI [JP] ET AL) 30 September 2010 (2010-09-30) figures 2,3A,3B,4A,4B	9,10

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[X] Further documents are listed in the continuation of Box C.

[X] 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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 December 2014	11/12/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Zimmer, René

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/043819

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	EP 2 688 150 A1 (TYCO ELECTRONICS CORP [US]) 22 January 2014 (2014-01-22)	1,3-5,7
Y,P	figure 4	9,10

X	3 Ausgabe November ET AL: "Ersatzteile-Liste List of spare parts Liste des pièces détachées Catalogo pezzi staccati Lista de piezas de repuesto", , 7 February 2003 (2003-02-07), XP055156810, Retrieved from the Internet: URL:http://www.brewersewing.com/StockImages/Parts_manuals/special/sewing_parts_manuals/TL_1520-40_eng-dt.pdf [retrieved on 2014-12-04] part 93-035 067-15/000; page 3	1,4,9

1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/043819

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 2, 6, 8(completely); 10(partially)
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 2, 6, 8(completely); 10(partially)

Claim 2, 6 and 8 relate to using the apparatus of claim 1 without clearly indicating what features are necessary to perform the claimed use. The claims are therefore not in compliance with the provisions of clarity of Article 6 PCT, as it is particularly burdensome for a skilled person to establish the subject-matter for which protection is sought. The non-compliance with the substantive provisions is to such an extent, that the search was performed taking into consideration the non-compliance in determining the extent of the search (PCT Guidelines 9.19 and 9.25).

As claim 10 comprises in its first part the features of claim 8, only the second part of claim 10, namely: "the connection member and the circuit board comprising a detent (40) that is configured to resist rotation of the body relative to the circuit board when the connection member is mechanically connected to the circuit board." has been searched.

The search was based on the subject-matter that, as far as can be understood, could reasonably be expected to be claimed later in the procedure.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2014/043819

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010328918 A1	30-12-2010	TW 201100702 A	01-01-2011
		US 2010328918 A1	30-12-2010
US 2006258190 A1	16-11-2006	NONE	
US 2012315799 A1	13-12-2012	TW 201310802 A	01-03-2013
		US 2012315799 A1	13-12-2012
		WO 2012170374 A1	13-12-2012
US 2010248502 A1	30-09-2010	JP 2010225466 A	07-10-2010
		US 2010248502 A1	30-09-2010
EP 2688150 A1	22-01-2014	CN 103633461 A	12-03-2014
		EP 2688150 A1	22-01-2014
		JP 2014022370 A	03-02-2014
		KR 20140010903 A	27-01-2014
		US 2014024230 A1	23-01-2014