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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

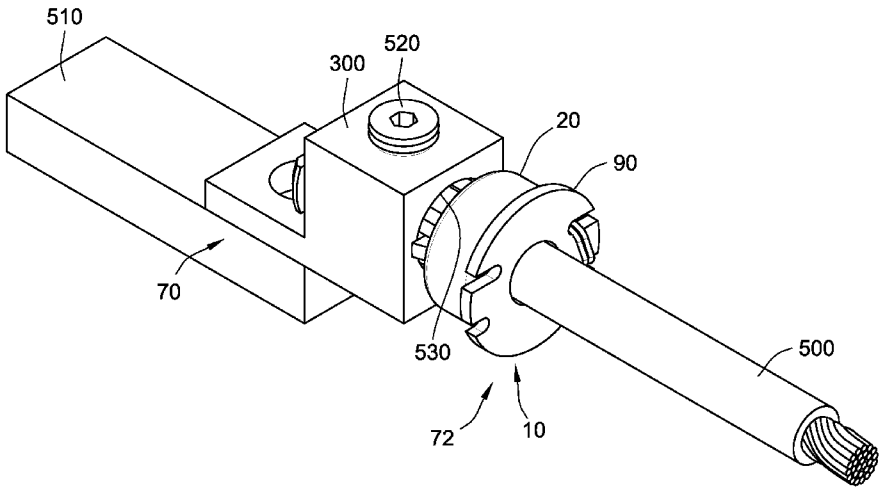
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(54) Title: CURRENT TRANSFORMER RETAINER FOR A CONDUCTOR APERTURE



(57) Abstract: A retainer 10 is configured to securely mount a toroidally shaped current transformer sensor 20 on the wall of an electrical cabinet 550 or on a mounting lug 300, for passage of a current conducting wire 500 through a central channel 50 of the retainer 10. The retainer 10 is generally tubular in shape 30 to fit through the hole 25 in the toroidal current transformer sensor 20, with a flange 90 on one end 72 and two opposed, resilient arms 80, 82 extending from near the flange 90, toward the opposite end 70. The retainer 10, with the current transformer sensor 20 seated on it near the flange 90, may then be inserted by hand into an aperture, such as a knockout hole 560, in an electrical cabinet 550 or a conductor bore 530 in a mounting lug 300, by squeezing the arms together to fit through the aperture.

CURRENT TRANSFORMER RETAINER FOR A CONDUCTOR APERTURE

Inventors: Gerardo Rodriguez Najera and Vladimir Cano

FIELD OF THE INVENTION

[0001] The invention is generally directed to a retainer device for installation of a current transformer sensor on a mounting body such as at a conductor aperture of an electrical cabinet or mounting lug.

BACKGROUND OF THE INVENTION

[0002] The sensing of current in a wire conducting alternating current is generally accomplished by threading the wire through a toroidally shaped coil that senses the magnetic field produced by the current. It has been the general practice to allow the current transformer sensor to hang loosely on the wire. There have been efforts in the past to fasten the current transformer to a chassis or the wall of an electrical cabinet, but past mounting mechanisms required tools and special mounting lugs for installation and typically could only be installed at the time of the original assembly of the electrical components in the chassis or cabinet.

SUMMARY OF THE INVENTION

[0003] In an example embodiment of the invention, a retainer device is configured to fit through the hole in a toroidally shaped coil of the current transformer. The retainer is generally tubular in shape and has a flange on one end against which the coil may be positioned. The retainer has two opposed, resilient arms extending from near the flange, toward the end opposite to the flange. The retainer, with the current transformer seated on it, may then be inserted by hand into an aperture, such as a knockout hole, in an electrical cabinet or a conductor bore in a mounting lug, by squeezing the arms together to fit through the aperture. The retainer has a central channel through the flange and between the arms, through which the wire may then be threaded. The end of the arms may include a fastener, such as outwardly shaped flanges or fingers, which snap into place on the far side of the cabinet wall or mounting lug. The presence of the wire within

the channel between the two arms may prevent the arms from being squeezed back together, thereby locking the retainer into place on the mounting body, e.g., a cabinet wall or mounting lug.

[0004] In this manner, no tools or special mounting lugs are required for installation of the current transformer in a securely fixed location on electrical cabinets in a wide variety of applications. Moreover, the retainer with the current transformer may be retrofitted at any time on an electrical cabinet or mounting lug.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Example embodiments of the invention are depicted in the accompanying drawings that are briefly described as follows:

[0006] Figure 1 is a perspective view of the retainer, with the current transformer sensor seated on the retainer, the arms of the retainer inserted into the conductor bore of a mounting lug, and a current conducting wire threaded through the central channel of the retainer, in accordance with an example embodiment of the invention.

[0007] Figure 2 is a perspective view of the retainer, showing various features of the retainer in greater detail, in accordance with an example embodiment of the invention.

[0008] Figure 3 is a perspective view of the retainer, with the current transformer sensor seated on the retainer, in accordance with an example embodiment of the invention.

[0009] Figure 4 is a top cross-sectional view of the retainer along its cylindrical axis, with the current transformer sensor seated on the retainer, the arms of the retainer inserted into the conductor bore of the mounting lug, and the current conducting wire threaded through the central channel of the retainer, in accordance with an example embodiment of the invention.

[0010] Figure 5 is a perspective view of another example embodiment of the retainer positioned above a knockout hole of an electrical cabinet, with the current transformer sensor seated on the retainer, and the arms of the retainer positioned above the knockout hole before its insertion, in accordance with an example embodiment of the invention.

[0011] Figure 6 is a perspective view of the example embodiment of the retainer of Figure 5, after the arms have been inserted through the knockout hole of the electrical

cabinet, with the current transformer sensor seated on the retainer, and the current conducting wire threaded through the central channel of the retainer, in accordance with an example embodiment of the invention.

DETAILED DESCRIPTION OF THE EXAMPLE EMBODIMENTS

[0012] Figure 1 is a perspective view of the retainer 10, with the current transformer sensor 20 seated on the retainer 10. The retainer 10 is configured to securely mount the toroidally shaped current transformer sensor 20 on the mounting lug 300 or on the wall of an electrical cabinet, for passage of the current conducting wire 500 through the central channel 50 of the retainer 10, as shown in Figure 2.

[0013] The retainer 10 is configured to fit through the hole 25 in the toroidally shaped coil of the current transformer sensor 20, as shown in Figure 3. The retainer 10 is generally tubular in shape and has a flange 90 on one end 72 against which the transformer coil 20 may be positioned. The retainer 10 has two opposed, resilient arms 80 and 82, extending from near the flange 90, toward the end 70 opposite to the flange 90. The retainer 10, with the current transformer sensor 20 seated on it, may then have its first end 70 inserted by hand into an aperture, such as the conductor bore 530 in the mounting lug 300 or through a knockout hole in an electrical cabinet, by squeezing the arms 80 and 82 together to fit through the aperture.

[0014] The central channel 50 passes through the flange 90 and between the arms 80 and 82 of the retainer 10, as shown in Figure 2, through which the current conducting wire 500 may then be threaded. The ends of the arms 80 and 82 may include fasteners 310 and 312, such as outwardly shaped flanges or fingers, as shown in Figure 2, which snap into place on the far side of the mounting lug 300 or cabinet wall. The presence of the current conducting wire 500 within the central channel 50 between the two arms 80 and 82 prevents the arms from being squeezed back together, thereby locking the retainer 10 into place on the mounting lug 300 or cabinet wall. In another example embodiment, the fasteners 310 and 312 may be a knurled or barbed pattern on the outer cylindrical surface 400 of the retainer 10 shown in Figure 2, which may frictionally engage the inside surface of the conductor bore 530. The current conducting wire 500 may optionally be fastened in place with the binding screw 520 in the mounting lug 300.

[0015] No tools or special mounting lugs are required to install the retainer 10 and current transformer sensor 20 in a securely fixed location on the mounting lug 300 or on the wall of an electrical cabinet. The retainer 10 with the current transformer sensor 20 may be retrofitted on the mounting lug or electrical cabinet at any time. The retainer 10 with the current transformer sensor 20 may be used for current sensing in a variety of applications for residential use, commercial use, or industrial use. The retainer 10 with the current transformer sensor 20 may be conveniently mounted on mounting lugs or electrical cabinets used, for example, in load centers, panel boards, switch boards, safety switches, transfer switches, circuit breakers, combination service entrance device, metering equipment, contactors, relays, electric motors, motor center controllers, power usage meters, and charging stations. One example location for the mounting lug 300 may be as mounted on an equipment terminal 510, as shown in Figure 1.

[0016] Figure 2 is a perspective view of the retainer 10, showing it in greater detail, in accordance with an example embodiment of the invention. The hollow tubular body of the retainer 10 has an outer cylindrical surface 400 and an inner cylindrical surface 402 coaxial with a cylindrical axis 40. The inner cylindrical surface 402 forms the central channel 50 open at both ends 70 and 72 for passage of the current conducting wire 500. The hollow tubular body of the retainer 10 has a transverse slot 60 therein beginning at the first end 70, which is substantially coincident with the cylindrical axis 40. The transverse slot 60 forms the two opposed arms 80 and 82 that are capable of being resiliently compressed toward each other to enable insertion of the first end 70 through the aperture, such as the conductor bore 530 in the mounting lug 300 or through a knockout hole in an electrical cabinet. The retainer may be composed of a resilient material, such as a suitable plastic, to enable the arms 80 and 82 to be compressed upon insertion in to the aperture and to snap back when reaching the far side of the mounting lug 300 or cabinet wall. The transverse slot 60 forms a gap between the two opposed arms 80 and 82, which is sufficiently wide to enable the binding screw 520 of the mounting lug 300, to pass between the arms 80 and 82 to contact and bind the current conducting wire 500 in the central channel 50, as shown in Figure 1.

[0017] The flange 90 formed at the second end 72 of the retainer 10, is substantially perpendicular to the cylindrical axis 40, having a surface facing toward the

first end 70, for seating the substantially toroidal current transformer sensor 20 positioned on the outer cylindrical surface 400 and adjacent to the flange 90.

[0018] Figure 3 is a perspective view of the retainer 10, with the current transformer sensor 20 seated on the retainer 10 near the flange 90, in accordance with an example embodiment of the invention. Resilient detents 320 and 322 on each arm 80 and 82, as shown in Figure 2, project from the outer cylindrical surface 400 of the hollow tubular body 30 near the second end 72 of the retainer 10, to hold the current transformer sensor 20 in its seated position adjacent to the flange 90. The resilient detents 320 and 322 also maintain a space between the current transformer sensor 20 and the mounting lug 300 when the arms 80 and 82 have been inserted through the conductor bore 530.

[0019] Figure 4 is a top cross-sectional view of the retainer 10 along its cylindrical axis 40, with the current transformer sensor 20 seated on the retainer 10, the arms 80 and 82 of the retainer 10 inserted into the conductor bore 530 of the mounting lug 300, and the current conducting wire 500 threaded through the central channel 50 of the retainer 10, in accordance with an example embodiment of the invention. The sensor wire 212 for the current transformer sensor 20, may be wrapped around the wire restrain feature 210 of Figure 2, to prevent inadvertent pulling on the sensor wire 212 while the arms 80 and 82 of the retainer 10 are being inserted into the conductor bore 530 of the mounting lug 300. The figure shows that the ends of the arms 80 and 82 have passed completely through the conductor bore 530 of the mounting lug 300 and the fasteners 310 and 312, have snapped into place on the far side of the mounting lug 300, thereby locking the retainer 10 into place on the mounting lug 300. Thereafter, when the current conducting wire 500 is threaded within the central channel 50 between the two arms 80 and 82, its presence prevents the arms from being squeezed back together.

[0020] Resilient detents 320 and 322 on each arm 80 and 82, are located between the seated position of the current transformer sensor 20 and the mounting lug 300 when the arms 80 and 82 have been inserted through the conductor bore 530, for maintaining a space between the current transformer sensor 20 and the mounting lug 300. In this manner, any magnetic properties of the mounting lug 300, such as being composed of a

ferromagnetic material, will have a minimized effect on the magnetic field produced by the current in the wire 500, which is to be sensed by the current transformer sensor 20.

[0021] The retainer 20 may be composed of a resilient material whose magnetic properties have a minimal effect on the magnetic field coupling the current transformer sensor 20 and the wire 500 when carrying a current. For example, the retainer 20 may be composed of a thermoplastic, a thermoset plastic, rubber, a rubber-derivative, wood, or a wood-derivative material.

[0022] Figure 5 is a perspective view of another example embodiment of the retainer 10 positioned above a knockout hole 560 of an electrical cabinet 550. The current transformer sensor 20 is shown seated on the retainer 10 and the arms 80 and 82 of the retainer are positioned above the knockout hole 560 before their insertion into the hole, in accordance with an example embodiment of the invention. If the diameter of the current conducting wire 500 is approximately the same as the inner diameter of the inner cylindrical surface 402 of the retainer 10, then the arms 80 and 82 of the retainer 10 are inserted through the knockout hole 560 before the wire 500 is threaded through the retainer 10.

[0023] Figure 6 is a perspective view of the example embodiment of the retainer 10 of Figure 5, after its arms 80 and 82 have been inserted into the knockout hole 560 of the electrical cabinet 550. The current transformer sensor 20 is shown seated on the retainer 10 and the detents 320 and 322 on the arms 80 and 82 are in contact with the surface of the electrical cabinet 550, for maintaining a space between the current transformer sensor 20 and the electrical cabinet 550. In this manner, any magnetic properties of the electrical cabinet 550, such as being composed of a ferromagnetic material, will have a minimized effect on the magnetic field produced by the current in the wire 500, which is to be sensed by the current transformer sensor 20, in accordance with an example embodiment of the invention.

[0024] Although specific example embodiments of the invention have been disclosed, persons of skill in the art will appreciate that changes may be made to the details described for the specific example embodiments, without departing from the spirit and the scope of the invention.

What is claimed is:

1. A retainer for a current transformer sensor, comprising:

a hollow tubular body having an outer surface and an inner surface coaxial with a cylindrical axis and forming a central channel open at both ends for passage of a wire capable of conducting an electrical current, the hollow tubular body having a transverse slot therein beginning at a first end and being substantially coincident with the cylindrical axis, forming two opposed arms capable of being resiliently compressed toward each other to enable insertion of the first end through an aperture of a mounting body; and

a flange formed at a second end of the tubular body opposite the first end, and substantially perpendicular to the cylindrical axis, with an aperture coincident with the central channel, having a surface facing toward the first end, for seating a substantially toroidal current transformer sensor positioned on the outer cylindrical surface and adjacent to the flange.

2. The retainer for a current transformer sensor of claim 1, wherein the transverse slot forms a gap between the two opposed arms, which is sufficiently wide to enable a binding screw of the mounting body, to pass between the arms to contact and bind the wire in the central channel.

3. The retainer for a current transformer sensor of claim 1, further comprising:

a fastener on each arm at the first end of the tubular body, for engaging the mounting body after insertion of the arms through the aperture of the mounting body.

4. The retainer for a current transformer sensor of claim 3, wherein after the arms have been inserted through the aperture of the mounting body, the passage of the wire through the central channel prevents the arms from being compressed toward each other sufficiently to prevent the fastener on each arm from disengaging the mounting body.

5. The retainer for a current transformer sensor of claim 1, further comprising:

a resilient detent on each arm, on the outer cylindrical surface near the second end of the tubular body, for holding the substantially toroidal current transformer sensor in its seated position adjacent to the flange.

6. The retainer for a current transformer sensor of claim 1, further comprising:

a resilient detent on each arm, on the outer cylindrical surface of the tubular body and located between the seated position of the current transformer sensor and the mounting body when the arms of the retainer have been inserted into the mounting body, for maintaining a space between the current transformer sensor and the mounting body.

7. The retainer for a current transformer sensor of claim 1, wherein the retainer is composed of a resilient material whose magnetic properties have minimal effect on a magnetic field coupling the current transformer sensor and the wire when carrying a current.

8. The retainer for a current transformer sensor of claim 1, wherein the retainer is composed of a material selected from the group consisting of a thermoplastic, a thermoset plastic, rubber, a rubber-derivative, wood, or a wood-derivative.

9. The retainer for a current transformer sensor of claim 1, further comprising:

a wire restraint projection in the flange of the retainer, for restraining a sensor wire of the current transformer sensor by wrapping the sensor wire around the wire restrain projection.

10. The retainer for a current transformer sensor of claim 1, wherein the mounting body is a mounting lug having a conductor bore as the aperture for receiving insertion of the arms of the tubular body and a binding screw to pass between the arms of the tubular body to contact and bind the wire in the central channel.

11. The retainer for a current transformer sensor of claim 1, wherein the mounting body is an electrical cabinet having a knockout hole as the aperture for receiving insertion of the arms of the tubular body.

12. The retainer for a current transformer sensor of claim 1, wherein the outer surface is cylindrical.

13. The retainer for a current transformer sensor of claim 1, wherein the inner surface is cylindrical.

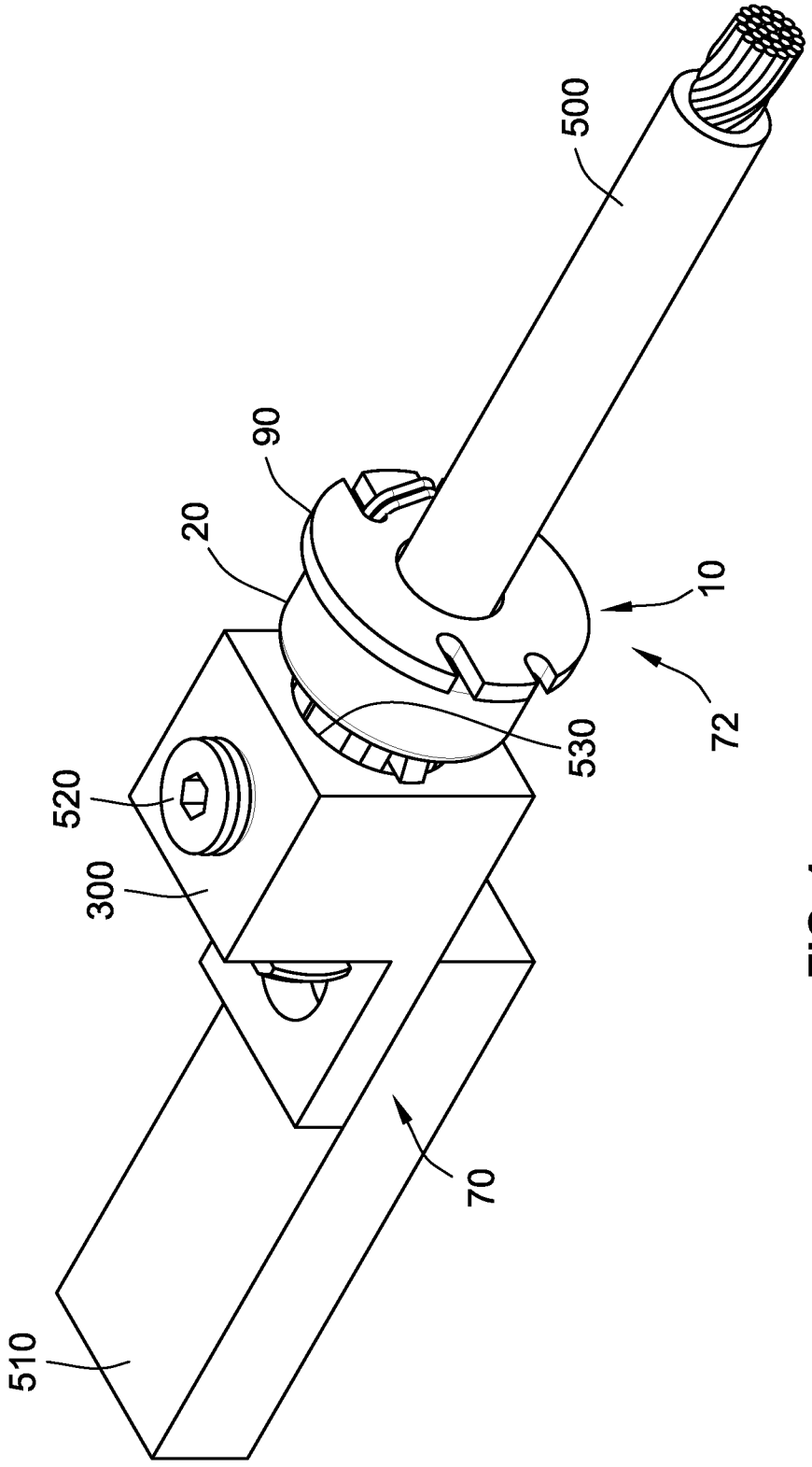


FIG. 1

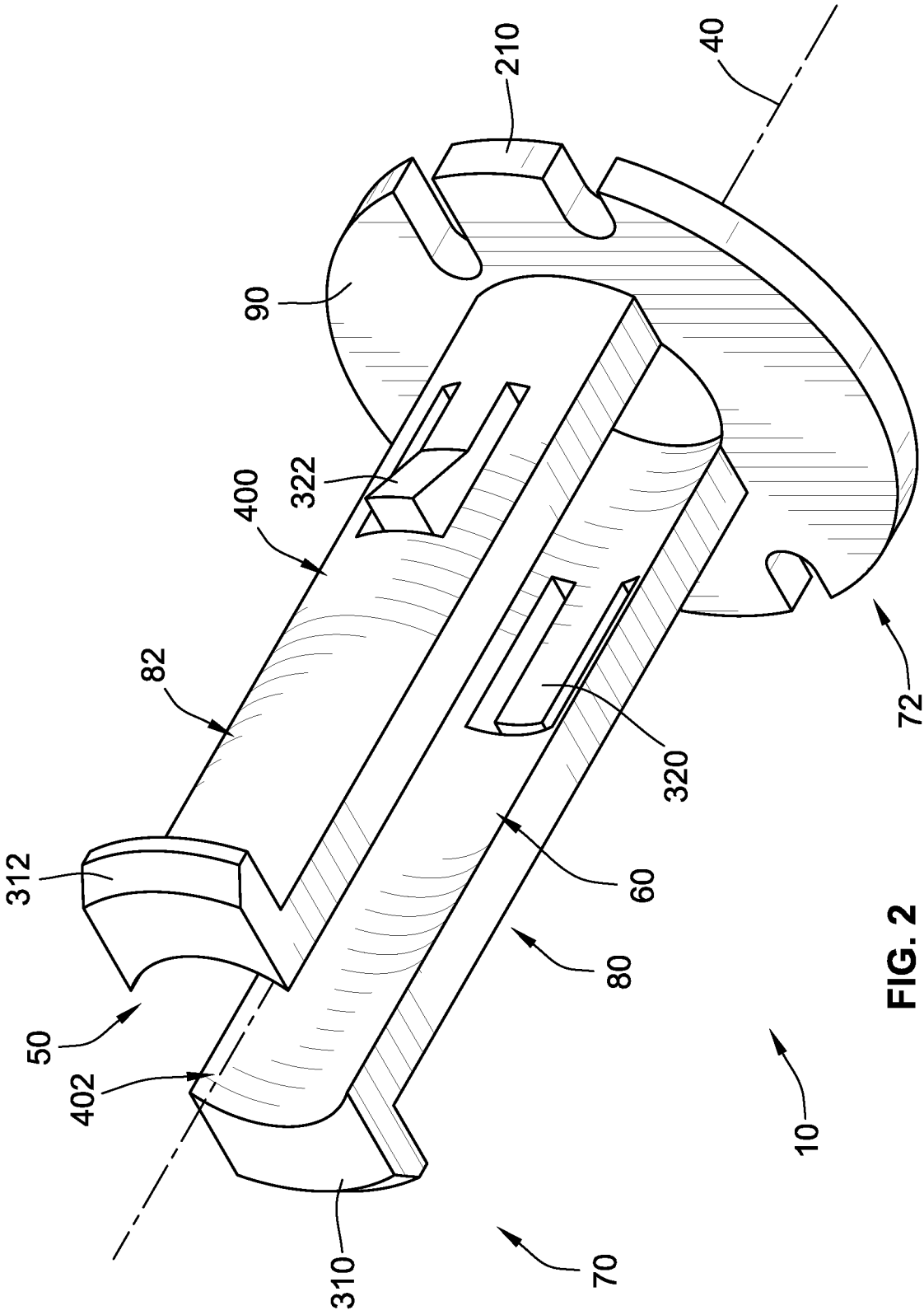


FIG. 2

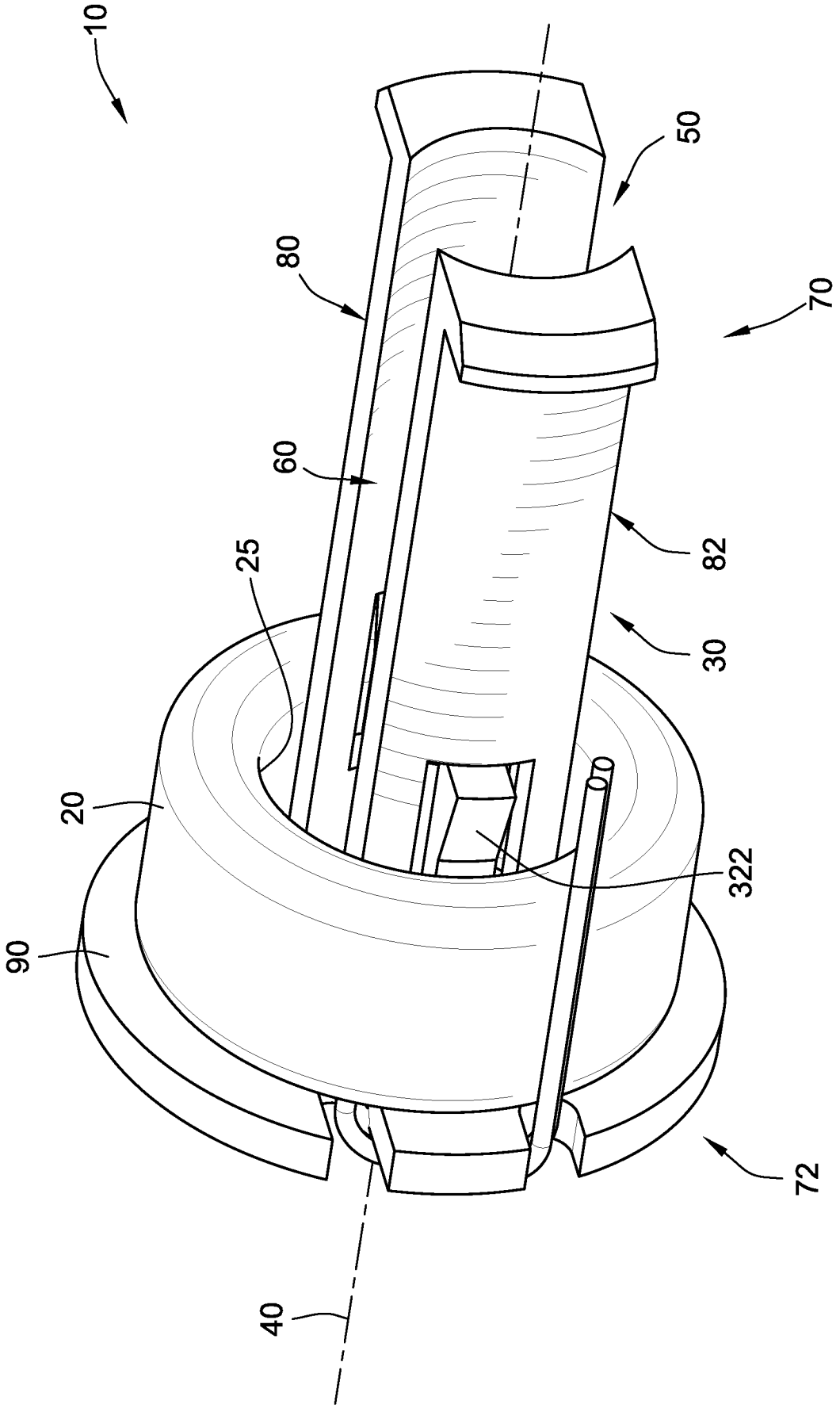


FIG. 3

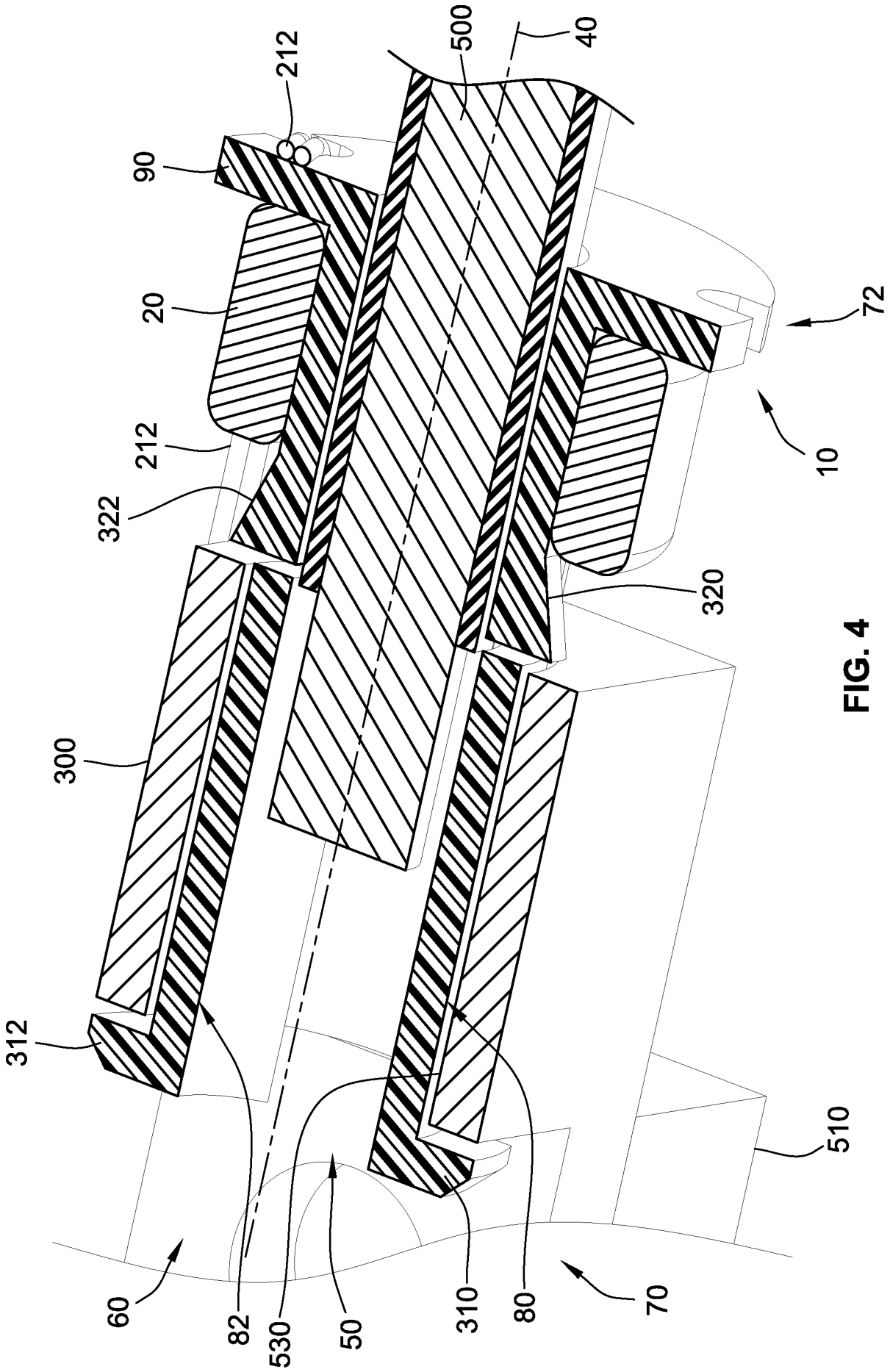

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FIG. 4

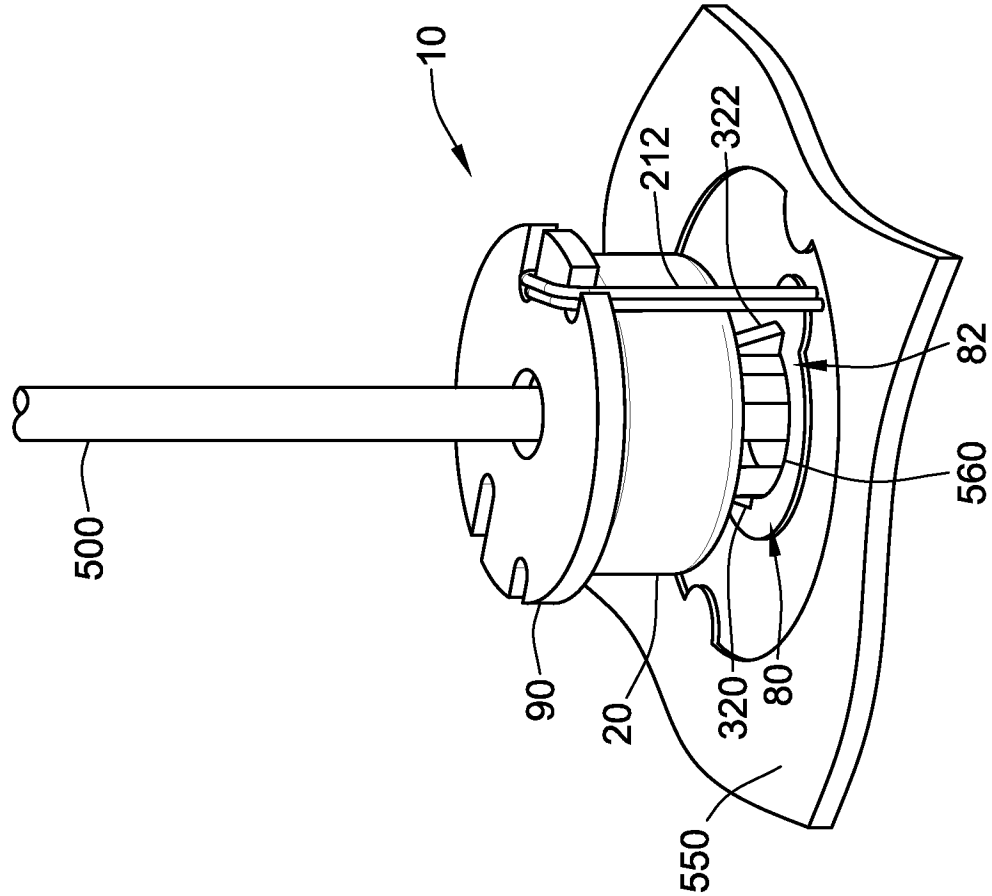

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FIG. 6

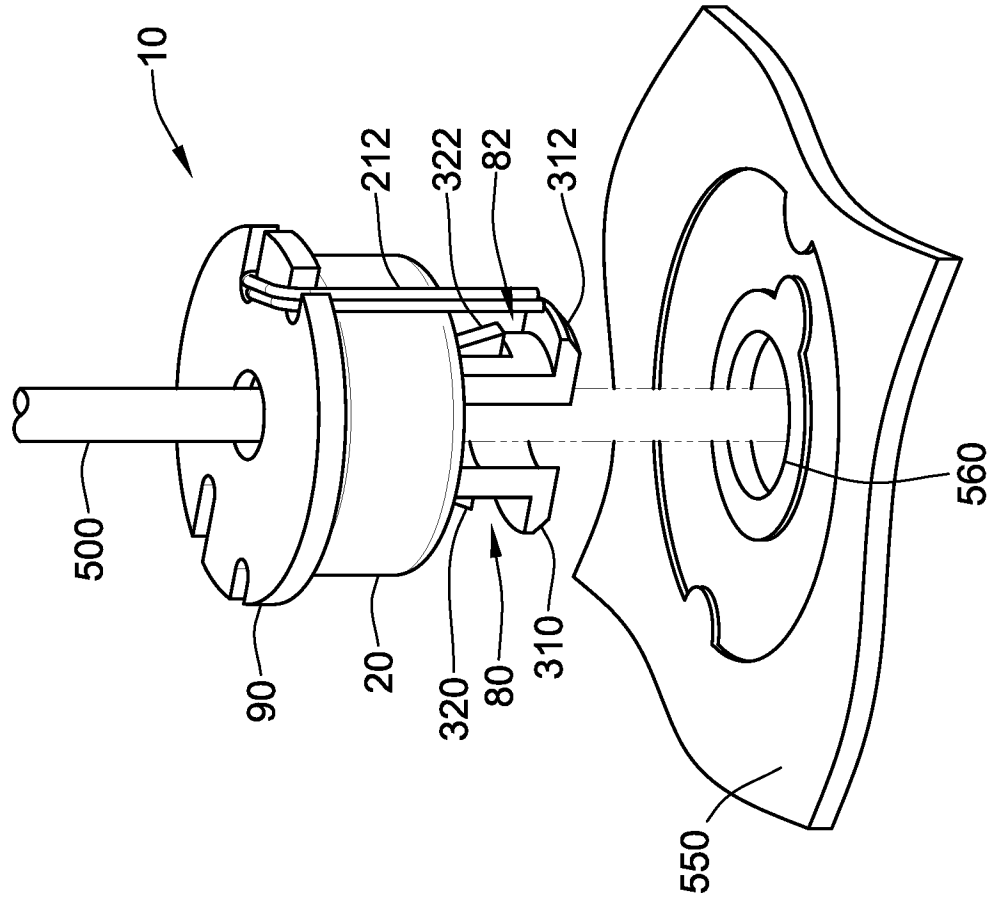

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FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US13/47290

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G01R 15/18 (2013.01)
USPC - 361/652
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)
IPC(8) Classification(s): G01R 15/18; H01F 5/02, 27/29; H02B1/20 (2013.01)
USPC Classification(s): 248/230.7; 264/272.19; 324/547; 336/65, 192, 229; 361/42, 623, 652

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)
MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C,B, DE-A, DE-T, DE-U, GB-A, FR-A); DialogPRO (Derwent, INSPEC, NTIS, PASCAL, Current Contents Search, Dissertation Abstract Online, Inside Conference); IEEE/IEEEXplore; Google/Google Scholar; Keywords: Tubular*, Cylindrical*, Transformer*, Sensor*, Transformer*1sensor*, Retainer*, Transverse*1Slot*, Channel*, Central*1channel*, Aperture*, Resilient*1flange*, Resilient*1arm*, Flange*, Arm*, Compress*1flange*, Compress*1arm*, Cylindrical*1axis

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,090,644 A (LENKER, SJ) February 25, 1992; figure 8; column 3, lines 50-60; column 4, lines 10-20	1-4, 11-13 --- 5-8
Y	WO 2011/095904 A1 (ABOULNAGA, A et al.) August 11, 2011; figure 1; paragraph [0029]	5-8
A	US 4,571,569 A (SCHARL) February 18, 1986; entire document	1-13

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"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
1 November 2013 (01.11.2013)	08 NOV 2013

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774