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(71) Applicant: **HYDE TOOLS, INC.** [US/US]; 54 Eastford Road, Southbridge, MA 01550 (US).

(72) Inventors; and
(71) Applicants : **FARLAND, Richard, M.** [US/US]; 166 Lake Road, Fiskdale, MA 01518 (US). **TALBOT, Corey** [US/US]; 310 West Street, Hebron, CT 06248 (US).

(74) Agent: **FRANCO, Louis, J.**; Law Office of Louis J. Franco, 250 Arbor Street, Lunenburg, MA 01462 (US).

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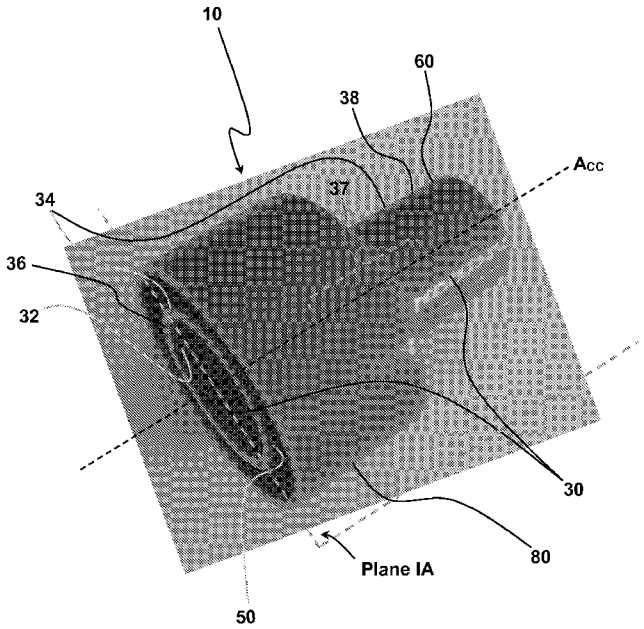

FIG. 1

(57) Abstract: A conduit-coupling adaptor configured for mutually joining conduits of disparate diameters includes a central conduit with interior and exterior surfaces extending longitudinally between central- conduit first and second ends. The central-conduit first and second ends define, respectively, first-end and second-end coupling sleeves that extend longitudinally in opposite directions and terminate at, respectively, first and second openings. The coupling sleeves can be implemented, alternatively, as male or female coupling members relative to other conduits. A first-end skirt includes a skirt wall concentrically disposed about at least a lengthwise portion of the central-conduit first end. The skirt wall has skirt-wall inside and outside surfaces that longitudinally co-extend with at least a portion of the first- end coupling sleeve and are joined to the central-conduit wall by a shoulder. The skirt-wall inside surface defines a socket that is configured as a female connector for insertably receiving a male coupling member of another conduit.

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CONDUIT-COUPLING ADAPTOR FOR COUPLING FLUID CONDUITS OF DISPARATE DIAMETERS

BACKGROUND

Hoses for central and portable vacuum cleaning systems (e.g. shop or garage vacuums) are available in several different standard diameters. When coupling two hoses of disparate diameters, a coupling adaptor is required. Presently available coupling adaptors include, for example, a first end configured to receive, or be received by, a first hose of a first diameter and a second end, opposite the first end, configured to receive, or be received by, a second hose of a second diameter different from the first diameter. Since each coupling adaptor is configured to cooperatively couple only two hoses of specific diameters, a garage or shop, for example, having vacuum hoses of several different sizes requires an array of hose adaptors to facilitate the selective coupling of different hose-size combinations.

Accordingly, a need exists for a single conduit-coupling adaptor that facilitates the coupling of conduits (e.g., vacuum hoses) of various diameters in order to reduce the number of coupling adapters required to couple various combinations of conduits.

SUMMARY

In each of various alternative embodiments, a conduit-coupling adaptor is configured for mutually coupling fluid (e.g., "air" in a vacuum system) conduits of various disparate diameters. The adaptor overall has a predefined default configuration and is sufficiently rigid to be self-supporting. However, in various versions, the adaptor can be flexed to deviate from its predefined configuration when subjected to an applied distorting force, and exhibits a restorative "memory" property such that, when the applied distorting force is removed, the adaptor returns to its predefined (default) configuration. Accordingly, the adaptor can be fabricated from any one or more of numerous materials such as, by way of non-limiting example, rubber and/or a polymeric material such as plastic. The ability of the adaptor to flex or "distort" increases its durability and facilitates both fluid-tight coupling and frictional engagement with other conduits.

At its center, the conduit-coupling adaptor includes a central conduit having a central-conduit wall with interior and exterior surfaces. The interior and exterior surfaces extend longitudinally along a central-conduit axis between central-conduit first and second ends, which ends are integrally joined to one another through a conduit center portion situated between the first and second ends.

The central-conduit first end defines a first-end coupling sleeve that extends longitudinally away from the conduit center portion toward a first opening defined by the central-conduit first end. The first-end coupling sleeve has first-sleeve inner and outer surfaces defined by, respectively, co-extensive portions of the interior and exterior surfaces of the central-conduit wall. Correspondingly, the central-conduit second end defines a second-end coupling sleeve that extends longitudinally away from the conduit center portion, in a direction opposite the extension of the first-end coupling sleeve, toward a second opening defined by the central-conduit second end. The second-end coupling sleeve has second-sleeve inner and outer surfaces defined by, respectively, co-extensive portions of the interior and exterior surfaces of the central-conduit wall.

Concentrically disposed about at least a lengthwise portion of the central-conduit first end is a self-supporting first-end skirt defined by a skirt wall. The skirt wall has skirt-wall inside and outside surfaces that longitudinally co-extend with at least a portion of the first-end coupling sleeve. Additionally, the skirt is joined to the central conduit by a shoulder that transitions the skirt-wall inside and outside surfaces to the exterior surface of the central-conduit wall.

The first-end coupling sleeve has first-sleeve inner and outer diameters, while the second-end coupling sleeve has second-sleeve inner and outer diameters. In alternative configurations, at least one of (i) the first-sleeve inner diameter, (ii) the first-sleeve outer diameter, (iii) the second-sleeve inner

diameter and (iv) the second-sleeve outer diameter varies as a function of axial displacement along the central-conduit axis. Diameters that vary as a function of axial displacement alternatively facilitate a coupling sleeve's implementation as a male or female coupling member, an aspect that it more thoroughly described in the detailed description in conjunction with the drawings. Additionally, the skirt-wall inside surface defines a skirt-wall inside diameter larger than the first-sleeve outer diameter such that there exists an annular gap between the first sleeve and the skirt, and the skirt defines a socket that is configured as a female connector (or "coupling member") for insertably receiving a male coupling member of another conduit.

Representative embodiments are more completely described and depicted in the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side perspective view of a conduit-coupling adaptor configured for mutually coupling fluid conduits of disparate diameters;

FIG. 1A is a cross-sectional view into the plane IA of FIG. 1;

FIG. 2 is a side perspective view in which a first sleeve defined by the adaptor of FIG. 1 defines a female coupling member into which has been inserted a male coupling member of a first conduit;

FIG. 3 is a side view in which a second sleeve of the adaptor shown in FIG. 2 defines a male coupling member that has been inserted into a female coupling member of a second conduit; and

FIG. 4 is a side view of an illustrative conduit-coupling adaptor like that of FIGS. 1-3 in which a skirt co-axially disposed about the first sleeve (visible in FIGS. 1, 1A and 2) defines a female coupling member into which has been inserted a male coupling member defined at an end of a third conduit.

DETAILED DESCRIPTION

The following description of variously configured conduit-coupling adapters is demonstrative in nature and is not intended to limit the invention or its application of uses. Accordingly, the various implementations, aspects, versions and embodiments described in the summary and detailed description are in the nature of non-limiting examples falling within the scope of the appended claims and do not serve to define the maximum scope of the claims.

Referring initially to FIG. 1 and FIG. 1A, the latter being a cross-sectional view into the plane IA of FIG. 1, an illustrative conduit-coupling adapter **10** is configured for mutually coupling, in series, fluid conduits of disparate inner and/or outer diameters. In various embodiments, an adapter **10** is configured for coupling vacuum hoses such as those used in conjunction with household vacuum cleaners, garage and shop vacuums, and dust-creating power tools such as saws, sanders and routers, by way of non-limiting example. Moreover, the conduits can be flexible, rigid or partially flexible and partially rigid.

The example of FIGS. 1 and 1A includes a self-supporting, tubular central conduit **20** having a central-conduit wall **30** with interior and exterior surfaces **32** and **34**. The interior and exterior surfaces **32** and **34** extend longitudinally along a central-conduit axis $\mathbf{A_{CC}}$ between, and co-extensively with, central-conduit first and second ends **36** and **38**. The first and second ends **36** and **38** are integrally joined to one another through a conduit center portion **37** situated between the first and second ends **36** and **38**.

The central-conduit first end **36** defines a first-end coupling sleeve **50**, which may be alternatively and interchangeably referred to as "first coupling sleeve **50**" or "first sleeve **50**." The first sleeve **50** extends longitudinally away from the center portion **37** toward a first opening $\mathbf{36_O}$ defined by the central-conduit first end **36**. The first sleeve **50** has first-sleeve inner and outer surfaces **52** and **54** defined by, respectively, co-extensive portions of the interior and exterior surfaces **32** and **34** of the central-conduit wall **30**.

With continued reference to FIGS. 1 and 1A, the central-conduit second end **38** defines a second-end coupling sleeve **60**, which may be alternatively and interchangeably referred to as "second coupling sleeve **60**" or "second sleeve **60**." The second sleeve **60** extends longitudinally away from the center portion **37**, in a direction opposite the extension of the first sleeve **50**, toward a second opening $\mathbf{38_O}$ defined by the central-conduit second end **38**. The second sleeve **60** has second-sleeve inner and outer surfaces **62** and **64** defined by, respectively, co-extensive portions of the interior and exterior surfaces **32** and **34** of the central-conduit wall **30**.

Disposed concentrically (i.e., co-axially about the central-conduit axis $\mathbf{A_{CC}}$) about at least a lengthwise portion of the central-conduit first end **36** is a self-supporting first-end skirt **80**. The skirt **80** is

defined by a skirt wall **82** having skirt-wall inside and outside surfaces **84** and **86** that longitudinally co-extend with at least a portion of the first sleeve **50**. The skirt **80** is structurally joined to the central conduit **20** by a shoulder **90** through which, as shown most clearly in FIG. 1A, the skirt-wall inside and outside surfaces **84** and **86** are transitioned to the exterior surface **34** of the central-conduit wall **30**. More specifically, in an embodiment that is integrally molded as a single piece, such as the illustrative example of FIGS. 1 through 4, a shoulder inside surface **92** transitionally joins the skirt-wall inside surface **84** to that portion of the central-conduit wall **30** that ultimately defines the first-sleeve outer surface **54**, while the skirt-wall outside surface **86** transitions to the portion of central-conduit wall **30** defining the second-sleeve outer surface **64** through a shoulder outer surface **96**.

Referring still to FIG. 1A, the first sleeve **50** has first-sleeve inner and outer diameters $\mathbf{D_{iS1}}$ and $\mathbf{D_{oS1}}$. In alternative embodiments, either or both of these diameters $\mathbf{D_{iS1}}$ and $\mathbf{D_{oS1}}$ can vary as a function of axial displacement along the central-conduit axis $\mathbf{A_{CC}}$. Whether and how either diameter $\mathbf{D_{iS1}}$ and $\mathbf{D_{oS1}}$ varies can define whether the first sleeve **50** serves as a male or female connector, or both. In the particular example of FIG. 1A, the first-sleeve inner diameter $\mathbf{D_{iS1}}$ remains constant as a function of displacement along the central-conduit axis $\mathbf{A_{CC}}$; hence, in this cross-sectional view, the opposite sides of the first-sleeve inner surface **52** depicted are mutually parallel. However, the first-sleeve outer diameter $\mathbf{D_{oS1}}$ reduces as a function of displacement along the central-conduit axis $\mathbf{A_{CC}}$ in a direction away from the conduit center portion **37**. That is, the first-sleeve outer surface **54** tapers toward a focal point (not shown) that would be distally located beyond the bottom edge of the drawing sheet. The tapering of the first-sleeve outer surface **54** in this manner facilitates the use of the first sleeve **50** as a male connector, a coupling combination not shown in any of the drawings, but which can nevertheless be appreciated.

Despite the lack of taper in the first-sleeve inner surface **52** in the example of FIGS. 1 and 1A, the first sleeve **50** can nonetheless serve as a female coupling member (i.e., connector) relative to a first conduit **100** having a first-conduit first end **110** tapered so as to define a male connector. Such a coupling combination is shown in FIG. 2. More specifically, in FIG. 2, the tapered first-conduit first end **110** of a first conduit **100** defines a male coupling member **120** that has been inserted (axially along the central-conduit axis $\mathbf{A_{CC}}$) into the first opening $\mathbf{36_O}$ of the first sleeve **50** defined by the central-conduit first end **36**. The materials from which the first-conduit first end **110** and the first sleeve **50** of the conduit-coupling adaptor **10** are fabricated, as well as the respective dimensions of the first-conduit first end **110** and the first sleeve **50**, are predetermined such that the first conduit **100** and the conduit-coupling adaptor **10** are coupled through frictional engagement between a male-coupling outer surface **125** and the first-sleeve inner surface **52**.

Returning to FIG. 1A, the second sleeve **60** has second-sleeve inner and outer diameters $\mathbf{D_{iS2}}$

and D_{oS2}. As with the first-sleeve inner and outer diameters D_{iS1} and D_{oS1}, either or both of the second-sleeve inner and outer diameters D_{iS2} and D_{oS2} can vary as a function of axial displacement along the central-conduit axis A_{CC}, which can similarly define whether the second sleeve **60** serves as a male or female connector, or both. In the particular example of FIG. 1A, the second-sleeve outer diameter D_{oS2} reduces as a function of displacement along the central-conduit axis A_{CC} in a direction away from the conduit center portion **37**. That is, like the first-sleeve outer surface **54**, the second-sleeve outer surface **64** tapers toward a distant focal point (not shown), but in this case the focal point would be located beyond the top edge of the drawing sheet. The tapering of the second-sleeve outer surface **64** in this manner facilitates the use of the second sleeve **60** as a male connector, as shown, for example, in FIG. 3, in which the second sleeve **60** is coupled to a second conduit **200**. More specifically, in FIG. 3, a second conduit **200** has a second-conduit first end **210** with a female-coupling inner surface **215** defining a female coupling member **220**. The second sleeve **60** is shown received (by axial insertion) within the female coupling member **220** such that the second-sleeve outer surface **64** frictionally engages the female-coupling inner surface **215**. As with the example of the first sleeve **50** described with reference to FIG. 2, the materials from which the second sleeve **60** and female coupling member **220** are fabricated cooperatively define a sufficiently high coefficient of friction for the second sleeve **60** to be retained by friction within the female coupling connector **220** under normal use.

Referring now to FIGS. 1A and 4, the inside surface **84** of the skirt wall **82** (alternatively, "skirt-wall inside surface **84**") defines a "socket" that is configured for use as a female connector (alternatively, "female coupling member"). More specifically, the skirt-wall inside surface **84** defines a skirt-wall inside diameter D_{iSW} that is larger than the first-sleeve outer diameter D_{oS1} and, thereby, defines a socket that is configured for insertably receiving a male coupling member of another conduit. In FIG. 4, a third conduit **300** has a third-conduit first end **310** configured as a male coupling member **320** insertably received into the skirt **80**. In the particular example of FIG. 4, the third conduit **300** happens to be an adaptor itself, but it will be appreciated that the third conduit **300** could be a vacuum system hose as in the cases of the illustrative first and second conduits **100** and **200**. As with the previous examples, the selectively separable coupling between the third conduit **300** and the shirt **80** is maintained by friction. More specifically, the inside surface **84** of the skirt wall **82** frictionally engages a male-coupling outer surface **325** of the male coupling member **320**.

The foregoing is considered to be illustrative of the principles of the invention. Furthermore, since modifications and changes to various aspects and implementations will occur to those skilled in the art without departing from the scope and spirit of the invention, it is to be understood that the foregoing does not limit the invention as expressed in the appended claims to the exact constructions, implementations

and versions shown and described.

What is claimed is:

1. A conduit-coupling adaptor configured for mutually coupling fluid conduits of disparate diameters, the adaptor comprising:

a self-supporting central conduit having a central-conduit wall with interior and exterior surfaces extending longitudinally along a central-conduit axis between central-conduit first and second ends integrally joined to one another through a conduit center portion situated between the first and second ends;

a first-end coupling sleeve defined by the central-conduit first end and extending longitudinally away from the conduit center portion toward a first opening defined by the central-conduit first end, the first-end coupling sleeve having first-sleeve inner and outer surfaces defined by, respectively, co-extensive portions of the interior and exterior surfaces of the central-conduit wall;

a second-end coupling sleeve defined by the central-conduit second end and extending longitudinally away from the conduit center portion, in a direction opposite the extension of the first-end coupling sleeve, toward a second opening defined by the central-conduit second end, the second-end coupling sleeve having second-sleeve inner and outer surfaces defined by, respectively, co-extensive portions of the interior and exterior surfaces of the central-conduit wall; and

a self-supporting first-end skirt concentrically disposed about at least a lengthwise portion of the central-conduit first end, the skirt being (i) defined by a skirt wall having skirt-wall inside and outside surfaces that longitudinally co-extend with at least a portion of the first-end coupling sleeve and (ii) joined to the central conduit by a shoulder that transitions the skirt-wall inside and outside surfaces to the exterior surface of the central conduit wall.

2. The conduit-coupling adaptor of claim 1 wherein

(i) the first-end coupling sleeve has first-sleeve inner and outer diameters and the second-end coupling sleeve has second-sleeve inner and outer diameters; and

(ii) at least one of the first-sleeve inner diameter, the first-sleeve outer diameter, the second-sleeve inner diameter and the second-sleeve outer diameter varies as a function of axial displacement along the central-conduit axis.

3. The conduit-coupling adaptor of claim 2 wherein at least one of the first-sleeve outer diameter and the second-sleeve outer diameter reduces as a function of displacement along the central-conduit axis in a direction away from the conduit center portion in order to facilitate the implementation of, respectively, the first-end coupling sleeve and the second-end coupling sleeve as a male coupling member.

4. The conduit-coupling adaptor of claim 3 wherein the skirt-wall inside surface defines a skirt-wall inside diameter larger than the first-sleeve outer diameter and defines a socket that is configured as a female connector for insertably receiving a male coupling member of another conduit.

5. The conduit-coupling adaptor of claim 2 wherein the skirt-wall inside surface defines a skirt-wall inside diameter larger than the first-sleeve outer diameter and defines a socket that is configured as a female connector for insertably receiving a male coupling member of another conduit.

6. The conduit-coupling adaptor of claim 5 wherein, in addition to being self-supporting, the adaptor (i) has a predefined default configuration from which it can be flexed when subjected to an applied distorting force and (ii) exhibits a restorative memory property such that, when the distorting force is removed, the adaptor returns to its predefined configuration.

7. The conduit-coupling adaptor of claim 6 fabricated from at least one of rubber and a polymeric material.

8. The conduit-coupling adaptor of claim 4 wherein, in addition to being self-supporting, the adaptor (i) has a predefined default configuration from which it can be flexed when subjected to an applied distorting force and (ii) exhibits a restorative memory property such that, when the distorting force is removed, the adaptor returns to its predefined configuration.

9. The conduit-coupling adaptor of claim 2 wherein, in addition to being self-supporting, the adaptor (i) has a predefined default configuration from which it can be flexed when subjected to an applied distorting force and (ii) exhibits a restorative memory property such that, when the distorting force is removed, the adaptor returns to its predefined configuration.

10. The conduit-coupling adaptor of claim 1 wherein, in addition to being self-supporting, the adaptor (i) has a predefined default configuration from which it can be flexed when subjected to an applied distorting force and (ii) exhibits a restorative memory property such that, when the distorting force is removed, the adaptor returns to its predefined configuration.

11. A conduit-coupling adaptor for mutually coupling fluid conduits of disparate diameters, the adaptor having a predefined default configuration and comprising:

a self-supporting central conduit having a central-conduit wall with interior and exterior surfaces extending longitudinally along a central-conduit axis between central-conduit first and second ends integrally joined to one another through a conduit center portion situated between the central-conduit first and second ends;

a first-end coupling sleeve defined by the central-conduit first end and extending longitudinally away from the conduit center portion toward a first opening defined by the central-conduit first end, the first-end coupling sleeve having first-sleeve inner and outer surfaces defined by, respectively, co-extensive portions of the interior and exterior surfaces of the central-conduit wall;

a second-end coupling sleeve defined by the central-conduit second end and extending longitudinally away from the conduit center portion, in a direction opposite the extension of the first-end coupling sleeve, toward a second opening defined by the central-conduit second end, the second-end coupling sleeve having second-sleeve inner and outer surfaces defined by, respectively, co-extensive portions of the interior and exterior surfaces of the central-conduit wall; and

a self-supporting first-end skirt concentrically disposed about at least a lengthwise portion of the central-conduit first end, the skirt being (i) defined by a skirt wall having skirt-wall inside and outside surfaces that longitudinally co-extend with at least a portion of the first-end coupling sleeve and (ii) joined to the central conduit by a shoulder that transitions the skirt-wall inside and outside surfaces to the exterior surface of the central conduit wall, wherein

(a) the adaptor is fabricated from a material exhibiting a restorative memory property such that, when subjected to a distorting force, the adaptor can be flexed from the default configuration and, when the distorting force is removed, the adaptor returns to its default configuration;

(b) the first-end coupling sleeve has first-sleeve inner and outer diameters and the

second-end coupling sleeve has second-sleeve inner and outer diameters; and

(c) the skirt-wall inside surface defines a skirt-wall inside diameter larger than the first-sleeve outer diameter, and defines a socket that is configured as a female connector for insertably receiving a male coupling member of another conduit.

12. The conduit-coupling adaptor of claim 11 wherein at least one of the first-sleeve outer diameter and the second-sleeve outer diameter reduces as a function of displacement along the central-conduit axis in a direction away from the conduit center portion in order to facilitate the implementation of, respectively, the first-end coupling sleeve and the second-end coupling sleeve as a male coupling member.

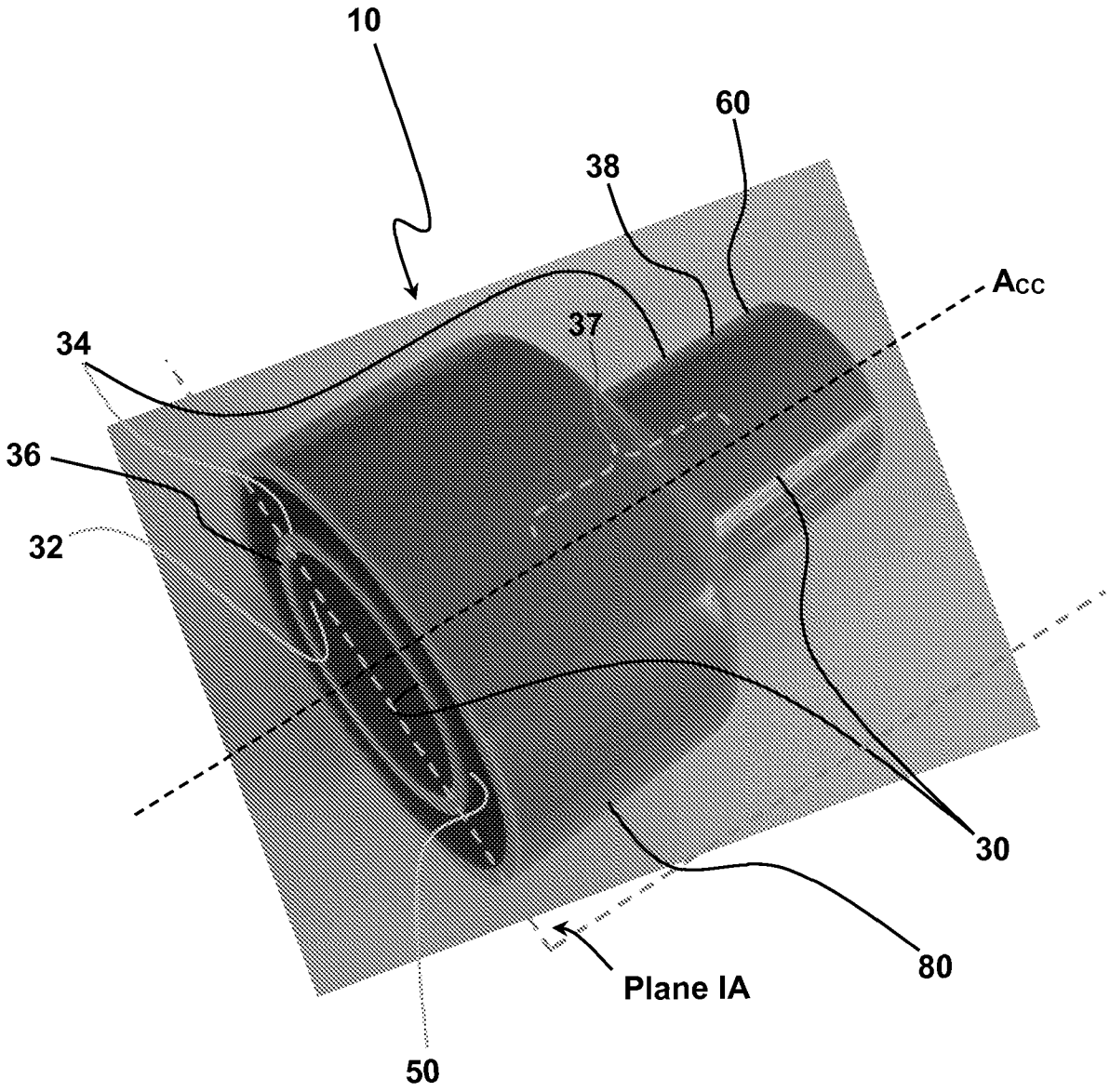

FIG. 1

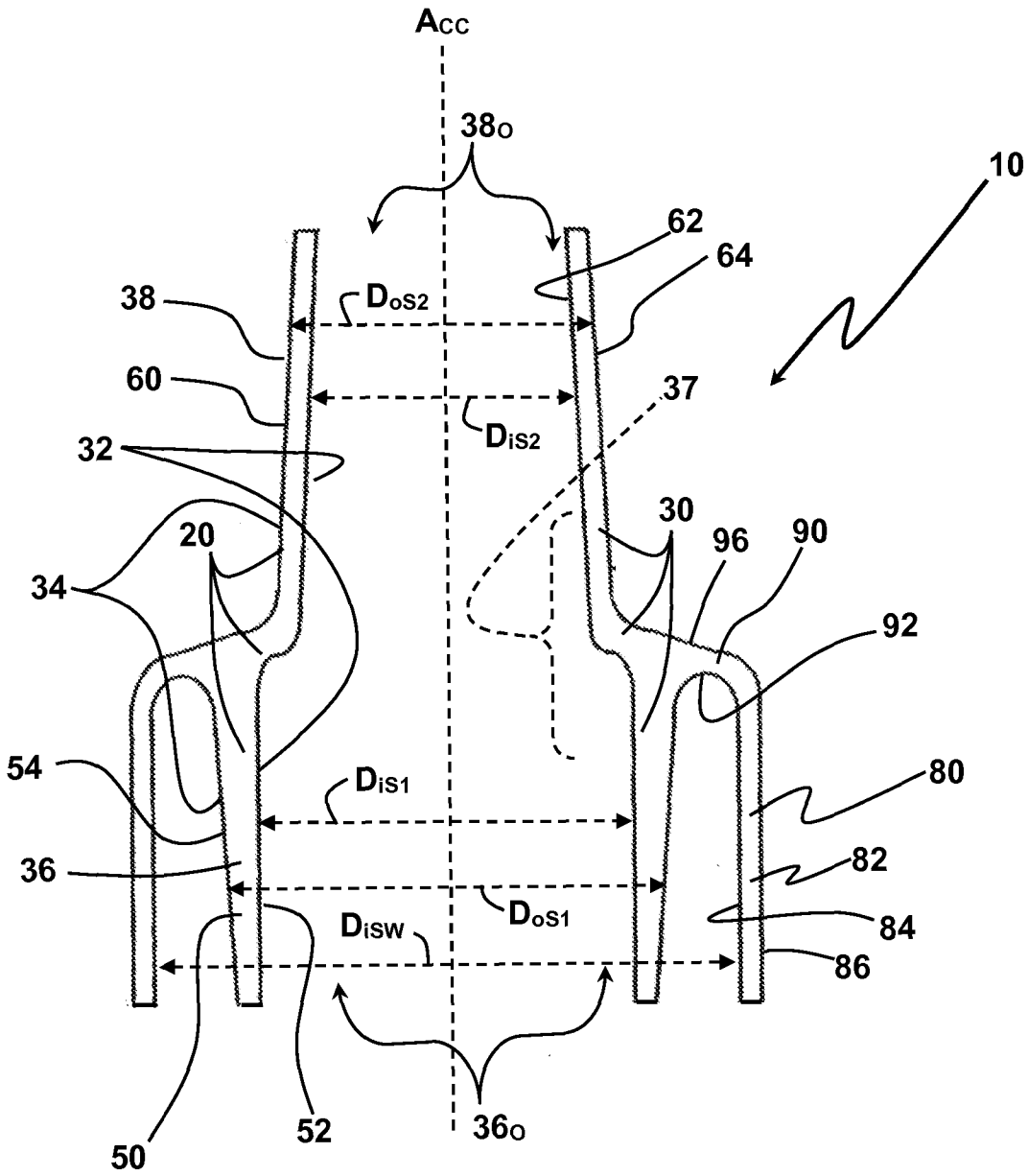
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FIG. 1A

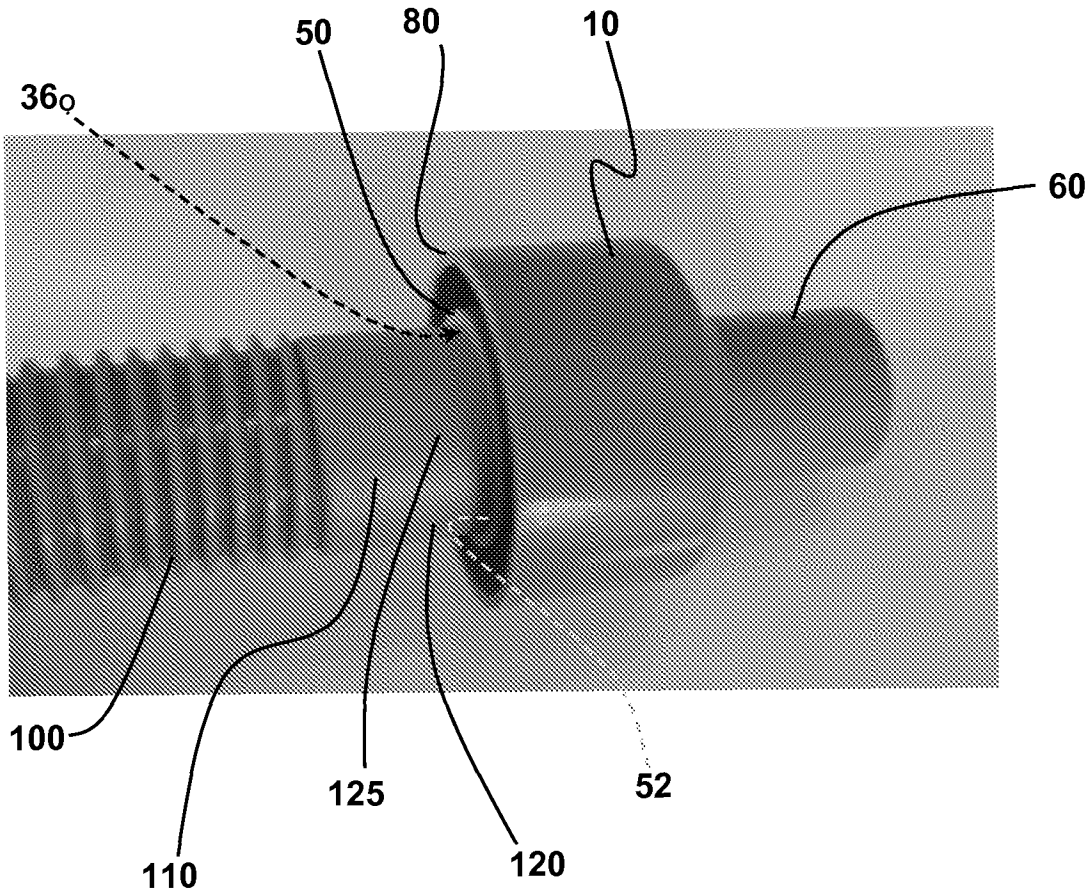

FIG. 2

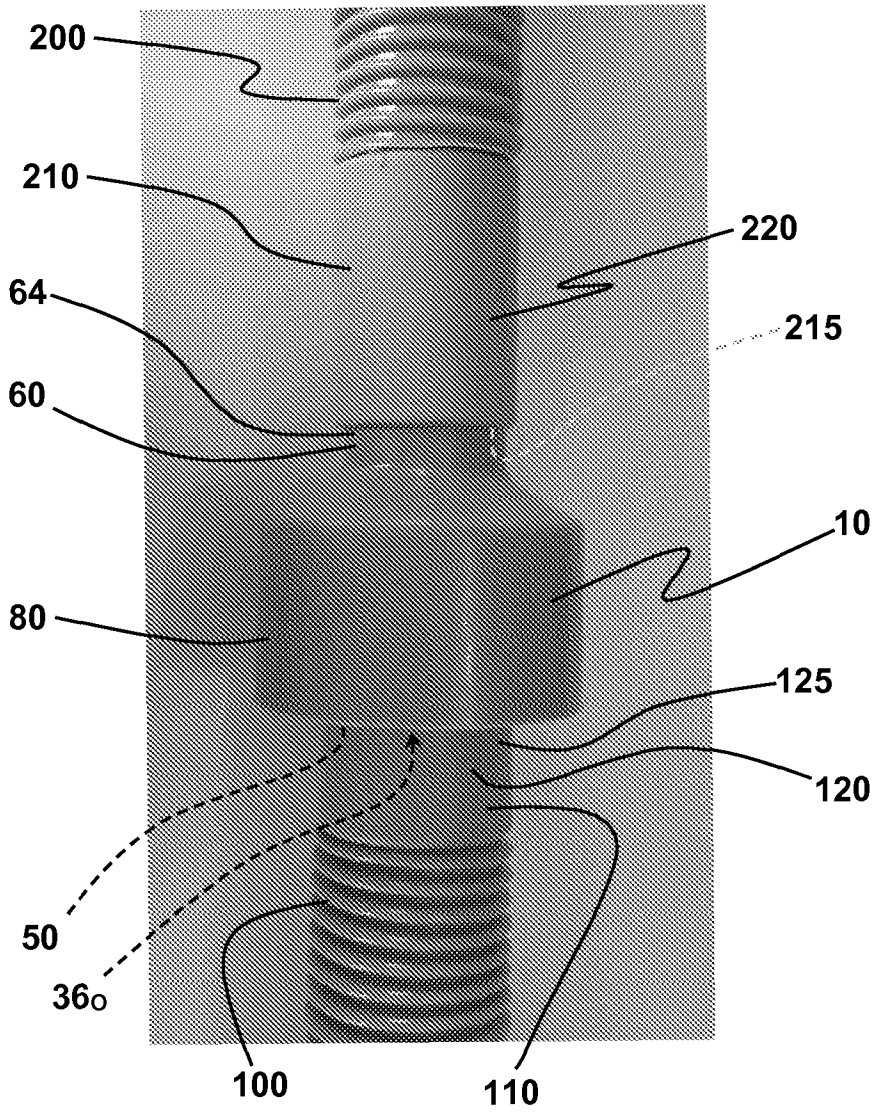

FIG. 3

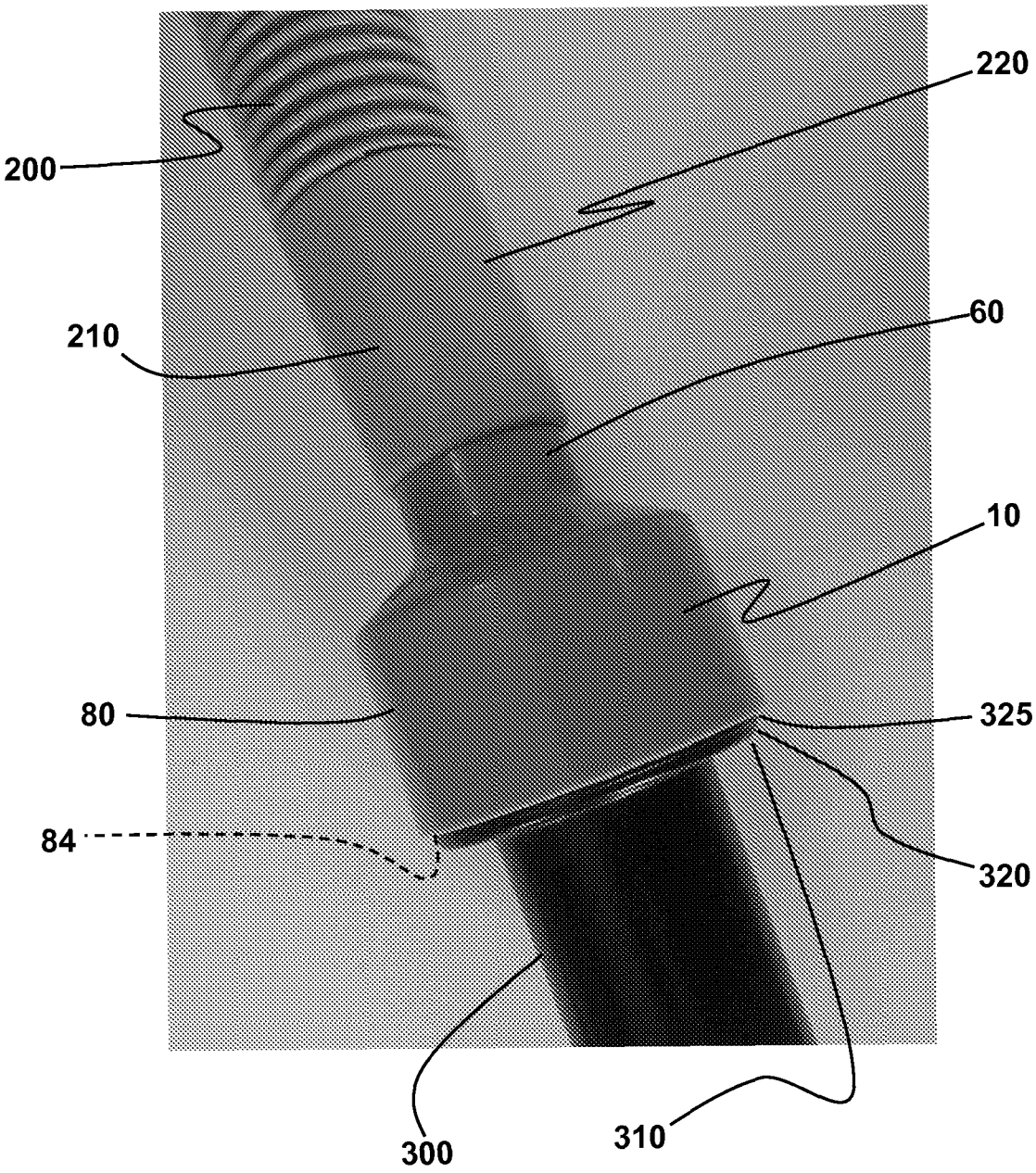

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 15/11128

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A47L 9/24 (2015.01)
CPC - A47L 9/242
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) - A47L 9/24 (2015.01)
CPC - A47L 9/242

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC(8) - F16L 37/00, F16L 27/00, F16L 25/14, A47L 9/24 (2015.01)
CPC - A47L 9/242, A47L 9/244, A47L 9/1427, A47L 9/06, A47L 13/42, A61F 2/76 (Search Terms Limited, See Below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google Patents, Google Scholar. Search Terms Used: vacuum hose couplings; conduit-coupling adaptor; vacuum hose conduit-coupling adaptor, vacuum hose coupling having a skirt; vacuum hose coupling having coupling sleeves; vacuum hose adapter; conduit% OR passage% OR channel% OR tube% OR pipe% OR canal% OR duct% OR main% coupling

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 8,113,543 B1 (Romani et al.) 14 February 2012 (14.02.2012), entire document, especially Fig 1-4; Col 3, ln 38-41	1-5 ----- 6-12
Y	US 2005/0082828 A1 (Wicks et al.) 21 April 2005 (21.04.2005), entire document, especially Fig 2-5; para [0059]	6-12
A	US 2012/0175868 A1 (Welchert) 12 July 2012 (12.07.2012), entire document	1, 11
A	US 4,941,689 A (Sjoberg) 17 July 1990 (17.07.1990), entire document	1, 11

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

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Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-8300

Authorized officer:
Lee W. Young
PCT Helpdesk: 571-272-4300
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