



- (51) International Patent Classification:
F16L 5/12 (2006.01) *B60H 1/00* (2006.01)
- (21) International Application Number:
PCT/US2014/017860
- (22) International Filing Date:
22 February 2014 (22.02.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/812,793 17 April 2013 (17.04.2013) US
- (71) Applicant: **ILLINOIS TOOL WORKS INC.** [US/US];
155 Harlem Avenue, Glenview, Illinois 60025 (US).
- (72) Inventors: **BENOIT, Thomas A.**; c/o Illinois Tool Works
Inc., 155 Harlem Avenue, Glenview, Illinois 60025 (US).
KATO, Eric J.; c/o Illinois Tool Works Inc., 155 Harlem
Avenue, Glenview, Illinois 60025 (US).
- (74) Agent: **HAUPTMAN, Benjamin J.**; LOWE HAPTMAN
& HAM LLP, 2318 Mill Rd, Suite 1400, Alexandria, Vir-
ginia 22314 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

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

[Continued on next page]

(54) Title: TUBE-HOLDING ASSEMBLY

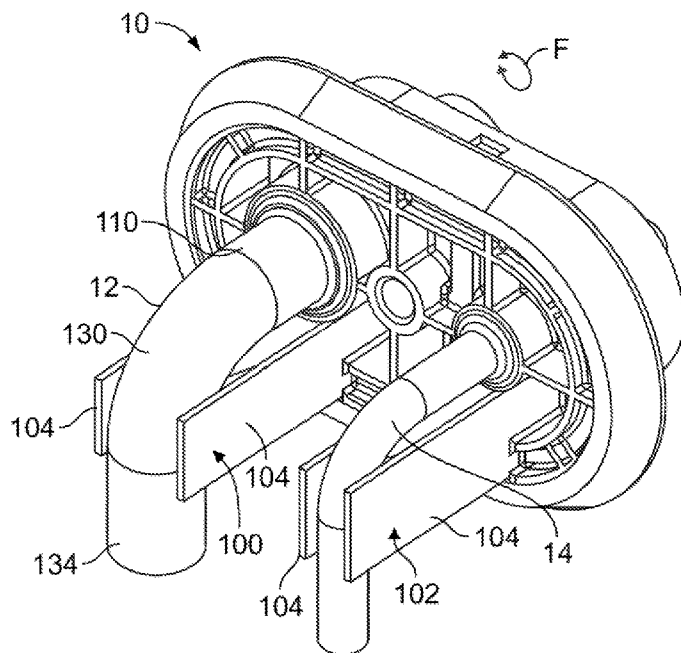


FIG. 6

(57) Abstract: A tube-holding assembly may be configured to securely route at least one tube member from an engine compartment across a structural firewall to a passenger compartment of a vehicle. The assembly may include a tube support body and at least one rotation-preventing extension. The tube support body is configured to securely hold the tube member(s). At least one tube support passageway is formed through the support body. At least a portion of the tube member(s) is configured to be securely retained within the tube support passageway(s). The rotation-preventing extension(s) outwardly extending from the tube support body proximate to the tube support passageway(s). The rotation-preventing extension(s) is configured to prevent the tube member(s) from rotating with respect to the tube support body.



— *as to the applicant's entitlement to claim the priority of
the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

TUBE-HOLDING ASSEMBLY**RELATED APPLICATIONS**

[0001] This application relates to and claims priority benefits from U.S. Provisional Patent Application No. 61/812,793 filed April 17, 2013, which is hereby incorporated by reference in its entirety.

FIELD OF EMBODIMENTS OF THE DISCLOSURE

[0002] Embodiments of the present disclosure generally relate to tube-holding assemblies that are configured to securely hold and retain tube elements, and, more particularly, to tube-holding assemblies that may be used to support air conditioning or other lines at a transition across a firewall or other dividing wall structure within a vehicle.

BACKGROUND

[0003] In various settings, tubes carrying gases or liquids may be routed across a dividing wall structure. For example, in vehicles such as automobiles, aircraft, or the like, air conditioning lines may be routed from an engine compartment across a structural firewall to provide access to a passenger compartment ventilation system. The air conditioning lines are typically supported by holding blocks located at the firewall. As an example, a metal block may include two holes that are configured to accommodate tubes passing therethrough and a third hole that is configured to accommodate a fastener, such as a screw, bolt, or the like. The fastener secures the block to the firewall. The block, in turn, secures the tubes in place as they transition between the engine compartment and the passenger compartment. The tubes may be held in place within the block by soldering the metal tubes to the metal block.

[0004] While the practice of using a metal support block with soldered connections is believed to provide a secure transition, the use of solder to hold the tubes

in place may require a substantial level of skill, time, and effort. Further, the use of metal holding blocks may give rise to a relatively high expense as well as to increased weight.

[0005] United States Patent No. 8,430,365, entitled "Tube Holding Block Assembly," which is hereby incorporated by reference in its entirety, provides a tube retention block assembly having a support body that incorporates one or more tube support passageways of discontinuous character extending across the support body. A displaceable retaining yoke is configured to be inserted into a slot disposed transverse to the tube support passageways. The retaining yoke may include one or more engagement cradles that are configured to at least partially surround and lock in place tubes that extending through the tube support body.

[0006] It has been found that tubes positioned within a tube holding block assembly may undesirably rotate. For example, while the tubes may be secured within passageways formed through an assembly, the tubes may rotate therein. In some known assemblies, portions of the tube members themselves may be flattened, for example. The flattened surfaces of the tube members may interface with reciprocal features of a tube support body to reduce the risk of rotation. However, the tubes themselves may need to be specially formed and manufactured in order to provide the flattened surfaces. As such, standard tube members may not be compatible with such assemblies, or, if used, may undesirably rotate within the assemblies.

SUMMARY OF EMBODIMENTS OF THE DISCLOSURE

[0007] Certain embodiments of the present disclosure provide a tube-holding assembly configured to securely route at least one tube member from an engine compartment across a structural firewall to a passenger compartment of a vehicle. The assembly may include a tube support body configured to securely hold the tube member(s). At least one tube support passageway may be formed through the support body. At least a portion of the tube member(s) is configured to be securely retained within the tube support passageway(s). The assembly may also include at least one rotation-preventing extension outwardly extending from the tube support body proximate

to the tube support passageway(s). The rotation-preventing extension(s) is configured to prevent the tube member(s) from rotating with respect to the tube support body.

[0008] The rotation-preventing extension(s) may include opposed lateral walls. At least a portion of the tube member(s) is configured to be positioned between the opposed lateral walls. The rotation-preventing extension(s) may also include a tube-supporting base spanning between the opposed lateral walls. The opposed lateral walls may be configured to exert an inwardly-directed compressive force into the tube member(s) to prevent the tube member(s) from rotating with respect to the support body. In at least one embodiment, the rotation-preventing extension(s) may also include one or more flexible-retaining protuberances that are configured to one or both of snapably secure to, or be retained by, at least a portion of the tube member(s). The rotation-preventing extension(s) may also include an angled or curved transition wall extending from the tube-supporting base. The rotation-preventing extension(s) may also include a guide beam extending from the transition wall. The guide beam may be orthogonal to the tube-supporting base.

[0009] Certain embodiments of the present disclosure provide a system that may include first and second tube members configured to be routed from an engine compartment across a structural firewall to a passenger compartment of a vehicle, and a tube-holding assembly configured to securely hold the first and second tube members. The tube-holding assembly may include a tube support body securely holding the first and second tube members. First and second tube support passageway may be formed through the support body. At least portions of the first and second tube members are securely retained within the first and second tube support passageways, respectively. The tube-holding assembly may also include first and second rotation-preventing extensions outwardly extending from the tube support body proximate to the first and second tube support passageways, respectively. The first and second rotation-preventing extensions prevent the first and second tube members from rotating with respect to the tube support body.

[0001] Each of the first and second rotation-preventing extensions may include opposed lateral walls. At least a portion of the first and second tube members is configured to be positioned between the opposed lateral walls. Each of the first and second rotation-preventing extensions may also include a tube-supporting base spanning between the opposed lateral walls. The opposed lateral walls may be configured to exert an inwardly-directed compressive force into one of the first or second tube members to prevent the first or second tube members from rotating with respect to the support body. Each of the first and second rotation-preventing extensions may also include one or more flexible-retaining protuberances that are configured to one or both of snapably secure to, or be retained by, at least a portion of one of the first or second tube members. Each of the first and second rotation-preventing extensions may also include an angled or curved transition wall extending from the tube-supporting base. Each of the first and second rotation-preventing extensions may also include a guide beam extending from the transition wall. The guide beam may be orthogonal to the tube-supporting base.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

[0002] Figure 1 illustrates a perspective exploded view of a tube-holding assembly, according to an embodiment of the present disclosure.

[0003] Figure 2 illustrates a front view of a rotation-preventing extension, according to an embodiment of the present disclosure.

[0004] Figure 3 illustrates a front view of a rotation-preventing extension, according to an embodiment of the present disclosure.

[0005] Figure 4 illustrates a front view of a rotation-preventing extension, according to an embodiment of the present disclosure.

[0006] Figure 5 illustrates a front view of a rotation-preventing extension, according to an embodiment of the present disclosure.

[0007] Figure 6 illustrates a perspective front view of a tube-holding assembly, according to an embodiment of the present disclosure.

[0008] Figure 7 illustrates a lateral view of a tube-holding assembly, according to an embodiment of the present disclosure.

[0009] Before the embodiments of the disclosure are explained in detail, it is to be understood that the disclosure is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The disclosure is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use of "including" and "comprising" and variations thereof is meant to encompass the items listed thereafter and equivalents thereof as well as additional items and equivalents thereof.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE DISCLOSURE

[0010] Figure 1 illustrates a perspective exploded view of a tube-holding or retention assembly 10, according to an embodiment of the present disclosure. The tube-holding assembly 10 is configured to support and retain a first tube member 12, such as a tubular conduit, cylinder, rod, or the like and a second tube member 14, such as a tubular conduit, cylinder, rod, or the like. The assembly 10 and the tube members 12 and 14 may form a system. As shown, the first and second tube members 12 and 14 may be different shapes and/or sizes. Alternatively, the tube-holding assembly 10 may be configured to support and retain more or less tube members than shown.

[0011] The tube-holding assembly 10 may include a tube support body 16 and a retaining yoke 18. The tube support body 16 may include a circumferential flexible sealing member 20, such as a gasket, formed of rubber or another flexible material disposed about the perimeter of a face 21 or outer interface surface of the support body 16. The sealing member 20 is configured to sealingly engage a component, such as a firewall (not shown) or other structure, in and/or on which the tube-holding assembly 10 may be mounted.

[0012] The tube support body 16 may include a first tube support passageway 22 configured to receive the first tube member 12. The tube support body 16 may also include a second tube support passageway 24 configured to receive the second tube member 14. The first tube support passageway 22 may include a raised annular shoulder surface 26 inwardly extending from an interior surface of the passageway 22. The first raised annular shoulder surface 26 defines a reduced diameter opening within the first tube support passageway 22. The reduced diameter opening is sized to permit passage of a segment of the first tube member 12, but to block passage of a first flange 28. Thus, the first raised annular shoulder surface 26 defines a stop that limits the insertion of the first tube member 12 by abutting against the first flange 28. Similarly, the second tube support passageway 24 includes a second raised annular shoulder surface 30 that limits the extent of insertion of the second tube member 14 by engaging a second flange 32. Accordingly, by setting the positions of the first raised annular shoulder surface 26 and the second raised annular shoulder surface 30 along with the positions of the first flange 28 and the second flange 32, a well-defined degree of insertion depth by the first and second tube members 12 and 14, respectively, may be achieved. While the first and second raised annular shoulder surfaces 26, 30, respectively, and the first and second flanges 28, 32, respectively, are illustrated as substantially continuous annular structures, it is likewise contemplated that other continuous or discontinuous configurations providing raised profiled surfaces may be used. Alternatively, the assembly may be devoid of the first and second raised annular shoulder surfaces 26 and 30.

[0013] The first tube member 12 may include a first enhanced diameter annular ring 36 defining a first distal enhanced diameter tube surface disposed in axially spaced relation from the first flange 28. A reduced diameter neck may be located between the first flange 28 and the first enhanced diameter annular ring 36. Additionally, one or more flats (not shown) may be disposed along the length of the first reduced diameter neck. The orientation of the flats may be used to control and maintain the relative rotational orientation of the first tube member 12 within the tube support body 16. Likewise, the second tube member 14 may include a second enhanced diameter

annular ring 42 defining a second distal enhanced diameter tube surface disposed in axially spaced relation from the second flange 32. One or more flats may be formed along the length of a second reduced diameter neck to aid in rotational positioning of the second tube member 14. Alternatively, the tube members 12 and 14 may not include the flats.

[0014] The tube support body 16 may also include a fastener acceptance passageway 48 that extends axially through the tube support body 16 in generally parallel relation to the first and second tube support passageways 22 and 24, respectively. The fastener acceptance passageway 48 is configured to receive a fastener, such as a screw, bolt or other such attachment device (not shown) that may be used to connect the tube-holding assembly 10 to the firewall (not shown) or other such support structure. While a single fastener acceptance passageway 48 is shown, additional attachment passageways may be utilized if desired.

[0015] The tube support body 16 may also include a slot opening 50 that is generally transverse to the first tube support passageway 22 and the second tube support passageway 24. The slot opening 50 extends to a depth to intersect with the first and second tube support passageways 22 and 24 such that the tube support passageways 22 and 24 may be discontinuous along their length. As shown, the slot opening 50 is configured to accept the retaining yoke 18 in a wedge-fitting relation.

[0016] The slot opening 50 may include one or more positioning grooves extending along the slot opening 50. The positioning grooves may extend generally in a direction corresponding to the path of insertion of the retaining yoke 18. The retaining yoke 18 may include one or more positioning ribs 54 that are configured to engage and ride within the reciprocal positioning grooves as the retaining yoke 18 is inserted into the slot opening 50 in the direction of arrows A. Thus, the engagement between the positioning groove(s) and the positioning rib(s) 54 may be used to achieve a desired orientation of the retaining yoke 18 within the tube support body 16.

[0017] The retaining yoke 18 may include a first tube engagement cradle 60 and a second tube engagement cradle 62. The first tube engagement cradle 60 is configured to fit about a first reduced diameter neck 38 of the first tube member 12. The second tube engagement cradle 62 is configured to fit about a second reduced diameter neck 44 of the second tube member 14. The first tube engagement cradle 60 may be of a generally "U" shaped configuration including downwardly extending opposing legs having generally planar interior surfaces adapted to engage flats of the first reduced diameter neck 38. Likewise, the second tube engagement cradle 62 may be of a generally "U" shaped configuration including downwardly extending opposing legs having generally planar interior surfaces adapted to engage flats on opposing sides of the second reduced diameter neck 44. Thus, the first tube member 12 and the second tube member 14 may be oriented at a defined angular position and may be blocked from rotational movement by the legs of the first and second tube engagement cradles 60, 62 respectively.

[0018] Alternatively, the first tube engagement cradle 60 and/or the second tube engagement cradle 62 may have virtually any other configuration adapted to at least partially surround a corresponding reduced diameter portion of the tube members 12 and 14, respectively. By way of example only, and not limitation, the first tube engagement cradle 60 and/or the second tube engagement cradle 62 may have a generally semi-circular or other curved surface configuration that would otherwise permit rotation of the corresponding tube members 12 and 14.

[0019] In general, the tube engagement cradles 60, 62 fit about the corresponding portions of the first tube member 12 and the second tube member 14 in a nested relation. The effective internal diameter of the tube engagement cradles 60, 62 may be less than the outer diameter of the corresponding enhanced diameter annular rings 36, 42. Accordingly, when the retaining yoke 18 is inserted into the slot opening 50 in the direction of arrows A, the first and second tube engagement cradles 60 and 62, respectively, block withdrawal of the first and second tube members 12 and 14, respectively, from the first and second tube support passageways 22 and 24, respectively.

Accordingly, the first tube member 12 and the second tube member 14 may be held at a defined axial position within the tube support body 16.

[0020] The retaining yoke 18 may also include an eyelet 64 that is configured to align with the fastener acceptance passageway 48 upon full insertion of the retaining yoke 18 into the slot opening 50. Thus, a fastener such as an elongated bolt, screw or the like, may pass through the eyelet 64 in aligned relation with the fastener acceptance passageway 48.

[0021] The retaining yoke 18 may also include a snap latch 70 that holds the retaining yoke 18 in place within the tube support body 16. The snap latch 70 may include a resilient post having an outwardly projecting chamfered detent. During insertion of the retaining yoke 18, the chamfered detent may ride within a camming groove extending along a wall of the slot opening 50 in generally opposing relation to the positioning grooves. Upon full insertion, the chamfered detent snaps in place beneath a ledge formed at the interior of the camming groove. In this position, the retaining yoke 18 is blocked against withdrawal. In the event that withdrawal of the retaining yoke 18 is desired, a tool such as a screwdriver or the like may be inserted into an access window to push the resilient post and the chamfered detent inwardly towards the positioning grooves thereby allowing the retaining yoke to be pulled out of position. Alternatively, the retaining yoke 18 may not include the snap latch 70.

[0022] When the retaining yoke 18 is fully inserted into the slot opening 50, the first tube member 12 and the second tube member 14 are held in a defined axial position relative to the tube support body 16, thereby facilitating secure attachment of feed lines to either end of the tube members 12 and 14. Such connections may be made by so-called "quick connect" or other connection techniques.

[0023] The tube support body 16 and/or the retaining yoke 18 may be formed from metal, plastic, or other materials. Various other arrangements, shapes, sizes, orientations, and the like may be used to securely support tube members within a support

body. For example, United States Patent No. 8,430,365 illustrates and describes other such arrangements.

[0024] As shown in Figure 1, a rotation-preventing extension 100 may outwardly extend from the front face 21 of the support body 16 proximate to the first tube support passageway 22. Similarly, a rotation-preventing extension 102 may outwardly extend from the first face 21 of the support body 16 proximate to the second tube support passageway 24. As shown, the rotation-preventing extensions 100 and 102 extend from the front face 21 below the first and second tube support passageways 22 and 24, respectively. Alternatively, the rotation-preventing extensions 100 and 102 may extend from the front face 21 above and/or to one or more sides of the first and second tube support passageways 22 and 24, respectively. For example, the rotation-preventing extensions 100 and 102 may be tubular sleeves that outwardly extend from the front face 21 and radially about central axes.

[0025] While the sizes of the rotation-preventing extensions 100 and 102 shown in Figure 1 are different, it is understood that the rotation-preventing extensions 100 and 102 may be any shape and size that is configured to accommodate a tube member of a desired shape and size. Further, while only two rotation-preventing extensions 100 and 102 are shown, more or less rotation-preventing extensions 100 and 102 may be used, depending on the number of tube members that are to be retained by a particular tube-holding assembly.

[0026] The rotation-preventing extensions 100 and 102 may be formed of metal, plastic, and/or the like. For example, each rotation-preventing extension 100 and 102 may be integrally molded and formed with the front face 21 of the support body 16. Optionally, the rotation-preventing extensions 100 and 102 may be separately formed from the support body 16 and secured to the front face 21 through fasteners, welding, bonding, adhesives, or the like.

[0027] Each rotation-preventing extension 100 and 102 includes opposed lateral walls 104 extending outwardly from the front face 21. The opposed lateral walls

104 may generally be parallel with a central bisecting axis 108 of the support body 16. The lateral walls 104 of each rotation-preventing extension 100 and 102 are spaced apart from one another a distance that is greater than the diameter of the respective tube members 12 and 14. For example, the lateral walls 104 of the rotation-preventing extension 100 are spaced apart a distance that allows the tube member 12 to fit therebetween. In at least one embodiment, supported portions 110 and 112 of the first and second tube members 12 and 14, respectively, are moved over the rotation-preventing extensions 100 and 102 into the first and second tube support passageways 22 and 24, respectively, in the direction of arrows B and C, respectively. The opposed lateral walls 104 of each rotation-preventing extension 100 and 102 may provide an interference fit with at least a portion of the supported portions 110 and 112, respectively. For example, the opposed lateral walls 104 may be configured to fit on either side of a lower portion of one of the supported portions 110 and 112.

[0028] Figure 2 illustrates a front view of the rotation-preventing extension 100, according to an embodiment of the present disclosure. While Figure 2 shows the rotation-preventing extension 100, it is understood that the structure of the rotation preventing extension 100 may be the same as that of the rotation-preventing extension 102 (shown in Figure 1), but of a different size. Alternatively, the rotation-preventing extensions 100 and 102 may be the same size, shape, arrangement, and the like.

[0029] Referring to Figures 1 and 2, the opposed lateral walls 104 are set apart a distance d , which may generally be greater than the diameter of the first tube member 12. A tube-supporting base 120 extends between the lateral walls 104. The tube-supporting base 120 may have a curvature that generally conforms to the curvature of the first tube member 12. As such, the supported portion 110 of the first tube member 12 may be configured to nest within the tube-supporting base 120. A circumferential ridge 122 may inwardly extend from the tube-supporting base 120. The ridge 122 may be configured to securely wrap around at least a portion of the supported portion 110 of the first tube member 12. A flexible retaining protuberance 124, such as a barb, clasp, spur, or the like, may extend from either end of the ridge 122. The opposed retaining

protuberances 124 may be configured to cooperate to snapably secure the first tube member 12 in place. For example, a portion of the first tube member 12 may be configured to be urged into tube-supporting base 120 in the direction of arrow E. The opposed retaining protuberances 124 inwardly deflect and slide over an outer surface of the first tube member 12, until the first tube member 12 contacts the tube-supporting base 120, at which point the opposed retaining protuberances 124 snap back and over an upper portion of the first tube member 12.

[0030] Optionally, the opposed retaining protuberances 124 may be configured to be retained in reciprocal portions of a tube member, such as grooves, divots, or the like. In this manner, the opposed retaining protuberances 124 may dig into portions of the tube member in order to prevent the tube member from rotating.

An angled or curved transition wall 126 may extend below the tube-supporting base 120. The transition wall 126 may include support struts 128 configured to provide strength to the transition wall 126 and support a curved transition 130 of the first tube member 12. A guide beam 132 may connect to a lower portion of the transition wall 126. The guide beam 132 may be a straight horizontal beam, or may be curved to conform to a shape of a lower portion 134 of the first tube member 12 that connects to the curved transition 130. The guide beam 132 may be aligned and parallel with the central axis 108 of the support body 16, while the tube-supporting base 120 may be aligned and parallel with a central axis 140 of the first tube support passageway 22. As shown, the axis 108 may generally be perpendicular to the axis 140. For example, the axis 108 may be a vertically-aligned axis, while the axis 140 may be a horizontally-aligned axis, as shown in Figure 1. As such, the guide beam 132 may be orthogonal to the tube-supporting base 120.

[0031] Figure 3 illustrates a front view of a rotation-preventing extension 200, according to an embodiment of the present disclosure. The rotation-preventing extension 200 is similar to the rotation-preventing extension 100, except that the extension 200 may include opposed retaining protuberances 224 that are configured to substantially wrap over an upper portion of a tube member.

[0032] Figure 4 illustrates a front view of a rotation-preventing extension 300, according to an embodiment of the present disclosure. The rotation-preventing extension 300 is similar to the extension 100, except that the extension 300 includes a flat tube-supporting base 302 that may connect to a flat transition wall 304 at a right angle.

[0033] Figure 5 illustrates a front view of a rotation-preventing extension 400, according to an embodiment of the present disclosure. The rotation-preventing extension 400 is similar to the extension 300, except that a tube-supporting base 404 and a transition wall 406 may be curved to receive and retain a tube member.

[0034] Figure 6 illustrates a perspective front view of the tube-holding assembly 10, according to an embodiment of the present disclosure. As shown, the tube members 12 and 14 are positioned in an axial position and secured from rotating out of the axial position by the rotation-preventing extensions 100 and 102, respectively. Referring to Figures 1, 2, and 6, the supported portion 110 of the first tube member 12 may or may not be seated within the tube-supporting base 120 between the lateral walls 104. The tube-supporting base 120 may provide a guide support for the supported portion 110. Similarly, the angled transition wall 126 may or may not directly contact the curved transition 130. Further, the guide beam 132 may or may not directly contact the lower portion 134 of the first tube member 12. However, the curved transition 130 and at least a portion of the lower portion 134 are trapped between the opposed lateral walls 104. Thus, if a rotational force in the direction of arc F is exerted into the first tube member 12, any rotation of the first tube member 12 is blocked or halted by the curved transition 130 and/or the portion of the lower portion 134 abutting into one or both of the opposed lateral walls 104. The opposed lateral walls 104 exert an inwardly-directed compressive force into at least a portion of the first tube member 12. The inwardly-directed compressive force resists rotation of the first tube member 12.

[0035] Additionally, the tube-supporting base 120, the angled transition wall 126, and/or the guide beam 132 may securely engage portions of the first tube member 12, such as through snapable engagement, to prevent or otherwise restrict rotational movement of the first tube member 12, as explained above. Also, the tube-supporting

base 120, the angled transition wall 126, and/or the guide beam 132 may also include protuberances, such as protuberances 124, that may be configured to securely mate with reciprocal portions formed on and/or in the tube member, such as grooves, divots, or the like, that further prevent or otherwise restrict rotational movement of the tube member 12.

[0036] The rotation-preventing extensions 102 may be configured similar to the rotation-preventing extension 100. As such, the discussion of the components of the rotation-preventing extension 100 applies to the rotation-preventing extension 102. The rotation-preventing extensions 100 and 102 may merely be sized and/or shaped in a different manner. For example, the rotation-preventing extension 100 may be sized and shaped to support a tube member of a first diameter, while the rotation-preventing extension 102 may be sized and shaped to support a tube member of a second diameter, which differs from the first diameter.

[0037] Figure 7 illustrates a lateral view of the tube-holding assembly 10, according to an embodiment of the present disclosure. As shown, the opposed lateral walls 104 of the rotation-preventing extension 102 are positioned on either side of at least a portion of the curved transition 164 and lower portion 166 of the second tube member 14 (the rotation-preventing extension 100 is hidden from view in Figure 7). Thus, any rotational force exerted into the supported portion 112 would tend to cause the lower portion 166 to outwardly swing in the direction of arc G (shown in Figures 1 and 7). However, the opposed lateral walls 104 of the rotation-preventing extension 102 prevent the lower portion 166 from swinging in the direction of arc G, and therefore prevent the tube member 14 from rotating while secured to the support body 16. Similarly, the rotation-preventing extension 100 prevents the tube member 12 from rotating.

[0038] Referring to Figures 1-7, the tube-holding assembly 10 may be used with various other tube members, such as pipes, conduits, and the like, other than those shown. For example, the tube members may be straight line tubes that do not include curved transitions.

[0039] Embodiments of the present disclosure provide a tube-holding assembly having at least one rotation-preventing extension that extends from a face and proximate to a tube support passageway. At least a portion of the rotation-preventing extension is configured to prevent a tube that connects to the assembly from rotating.

[0040] Embodiments of the present disclosure may be used with standard tubes. The tubes need not be specially formed to be compatible with the tube-holding assembly.

[0041] The tube-holding assemblies described and shown in the present application may be used in vehicles, such as automobiles, to route heating/ventilation/air conditioning (HVAC) lines from an engine compartment across a structural firewall to a passenger compartment. For example, the tube-holding assemblies may be secured to a firewall between an engine compartment and a passenger compartment.

[0042] The tube-holding assemblies described in the present application are configured to secure one or more tube members, such as pipes, conduits, rods, cylinders, or the like, in a predefined axial position. The rotation-preventing extensions prevent the tube member(s) from rotating out of the predefined axial position.

[0043] While various spatial and directional terms, such as top, bottom, lower, mid, lateral, horizontal, vertical, front and the like may be used to describe embodiments of the present disclosure, it is understood that such terms are merely used with respect to the orientations shown in the drawings. The orientations may be inverted, rotated, or otherwise changed, such that an upper portion is a lower portion, and vice versa, horizontal becomes vertical, and the like.

[0044] Variations and modifications of the foregoing are within the scope of the present disclosure. It is understood that the embodiments disclosed and defined herein extend to all alternative combinations of two or more of the individual features mentioned or evident from the text and/or drawings. All of these different combinations constitute various alternative aspects of the present disclosure. The embodiments described herein explain the best modes known for practicing the disclosure and will

enable others skilled in the art to utilize the disclosure. The claims are to be construed to include alternative embodiments to the extent permitted by the prior art.

[0045] To the extent used in the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Moreover, to the extent used in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects. Further, the limitations of the following claims are not written in means-plus-function format and are not intended to be interpreted based on 35 U.S.C. § 112(f), unless and until such claim limitations expressly use the phrase "means for" followed by a statement of function void of further structure.

[0046] Various features of the disclosure are set forth in the following claims.

CLAIMS

1. A tube-holding assembly configured to securely route at least one tube member from an engine compartment across a structural firewall to a passenger compartment of a vehicle, the tube-holding assembly comprising:

a tube support body configured to securely hold the at least one tube member, wherein at least one tube support passageway is formed through the support body, and wherein at least a portion of the at least one tube member is configured to be securely retained within the at least one tube support passageway; and

at least one rotation-preventing extension outwardly extending from the tube support body proximate to the at least one tube support passageway, wherein the at least one rotation-preventing extension is configured to prevent the at least one tube member from rotating with respect to the tube support body.

2. The tube-holding assembly of claim 1, wherein the at least one rotation-preventing extension comprises opposed lateral walls, and wherein at least a portion of the at least one tube member is configured to be positioned between the opposed lateral walls.

3. The tube-holding assembly of claim 2, wherein the at least one rotation-preventing extension further comprises a tube-supporting base spanning between the opposed lateral walls.

4. The tube-holding assembly of claim 2, wherein the opposed lateral walls are configured to exert an inwardly-directed compressive force into the at least one tube member to prevent the at least one tube member from rotating with respect to the support body.

5. The tube-holding assembly of claim 2, wherein the at least one rotation-preventing extension further comprises one or more flexible-retaining protuberances that

are configured to one or both of snapably secure to, or be retained by, at least a portion of the at least one tube member.

6. The tube-holding assembly of claim 3, wherein the at least one rotation-preventing extension further comprises an angled or curved transition wall extending from the tube-supporting base.

7. The tube-holding assembly of claim 6, wherein the at least one rotation-preventing extension further comprises a guide beam extending from the transition wall, wherein the guide beam is orthogonal to the tube-supporting base.

8. A system comprising:

first and second tube members configured to be routed from an engine compartment across a structural firewall to a passenger compartment of a vehicle; and

a tube-holding assembly configured to securely hold the first and second tube members, the tube-holding assembly comprising:

a tube support body securely holding the first and second tube members, wherein first and second tube support passageway are formed through the support body, and wherein at least portions of the first and second tube members are securely retained within the first and second tube support passageways, respectively; and

first and second rotation-preventing extensions outwardly extending from the tube support body proximate to the first and second tube support passageways, respectively, wherein the first and second rotation-preventing extensions prevent the first and second tube members from rotating with respect to the tube support body.

9. The system of claim 8, wherein each of the first and second rotation-preventing extensions comprises opposed lateral walls, and wherein at least a portion of

the first and second tube members is configured to be positioned between the opposed lateral walls.

10. The system of claim 9, wherein each of the first and second rotation-preventing extensions further comprises a tube-supporting base spanning between the opposed lateral walls.

11. The system of claim 9, wherein the opposed lateral walls are configured to exert an inwardly-directed compressive force into one of the first or second tube members to prevent the first or second tube members from rotating with respect to the support body.

12. The system of claim 9, wherein each of the first and second rotation-preventing extensions further comprises one or more flexible-retaining protuberances that are configured to one or both of snapably secure to, or be retained by, at least a portion of one of the first or second tube members.

13. The system of claim 10, wherein each of the first and second rotation-preventing extensions further comprises an angled or curved transition wall extending from the tube-supporting base.

14. The system of claim 13, wherein each of the first and second rotation-preventing extensions further comprises a guide beam extending from the transition wall, wherein the guide beam is orthogonal to the tube-supporting base.

15. A tube-holding assembly configured to securely route first and second tube members from an engine compartment across a structural firewall to a passenger compartment of a vehicle, the tube-holding assembly comprising:

a tube support body configured to securely hold the first and second tube members, wherein first and second tube support passageways are formed through the support body, and wherein at least a portion of each of the first and second tube members is configured to be securely retained within the first and second tube support passageways, respectively; and

first and second rotation-preventing extensions outwardly extending from the tube support body proximate to the first and second tube support passageways, respectively, wherein each of the first and second rotation-preventing extensions is configured to prevent the first and second tube members, respectively, from rotating with respect to the tube support body, wherein each of the first and second rotation-preventing extensions comprises:

opposed lateral walls, wherein at least a portion of the first or second tube members is configured to be positioned between the opposed lateral walls, wherein the opposed lateral walls are configured to exert an inwardly-directed compressive force into the at least a portion of the first or second tube members to prevent the first or second tube members from rotating with respect to the support body, and

a tube-supporting base spanning between the opposed lateral walls.

16. The tube-holding assembly of claim 15, wherein each of the first and second rotation-preventing extensions further comprises one or more flexible-retaining protuberances that are configured to one or both of snapably secure to, or be retained by, at least a portion of one of the first or second tube members.

17. The tube-holding assembly of claim 16, wherein each of the first and second rotation-preventing extensions further comprises an angled or curved transition wall extending from the tube-supporting base.

18. The tube-holding assembly of claim 17, wherein each of the first and second rotation-preventing extensions further comprises a guide beam extending from the transition wall, wherein the guide beam is orthogonal to the tube-supporting base.

1/3

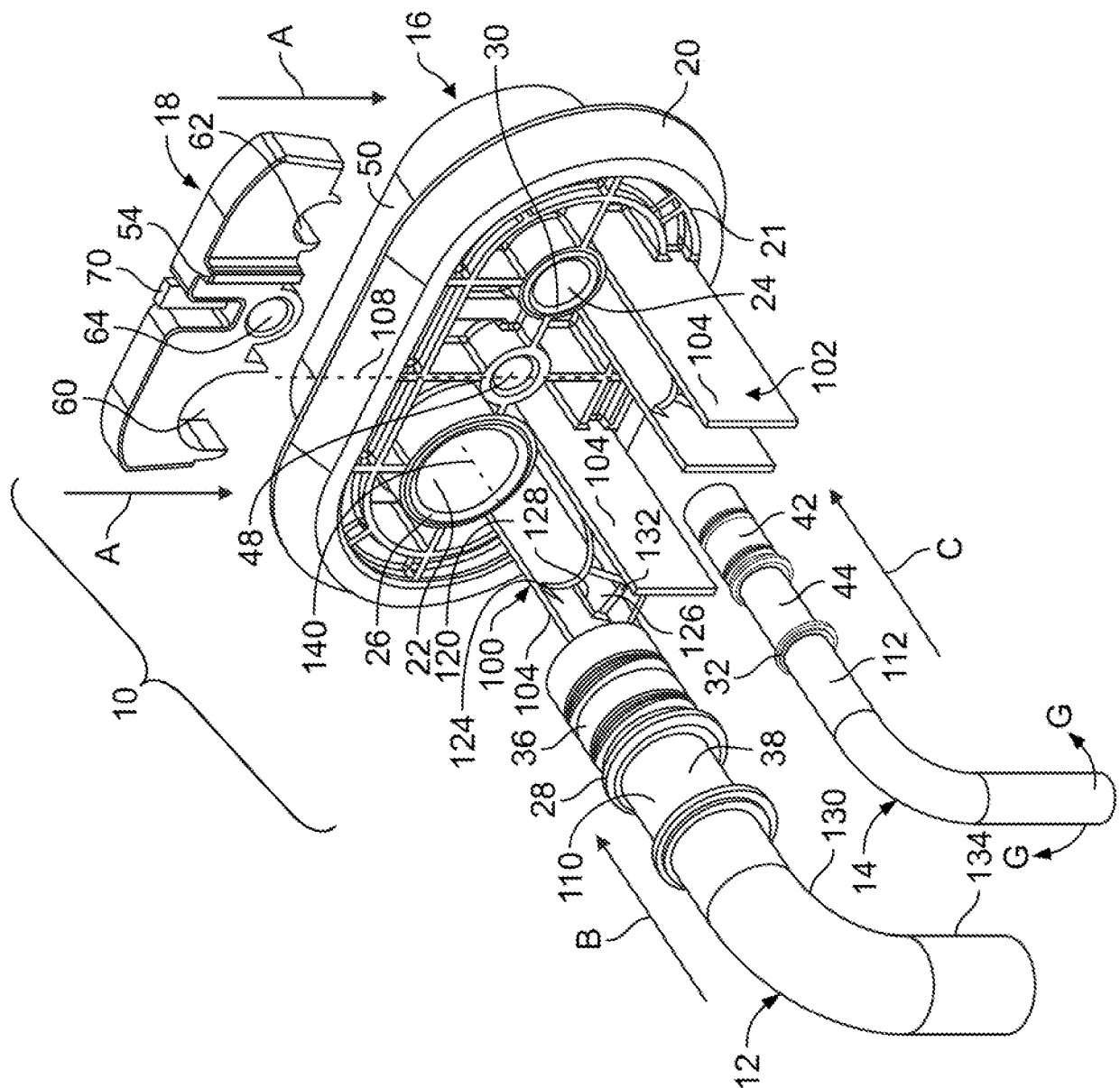


FIG. 1

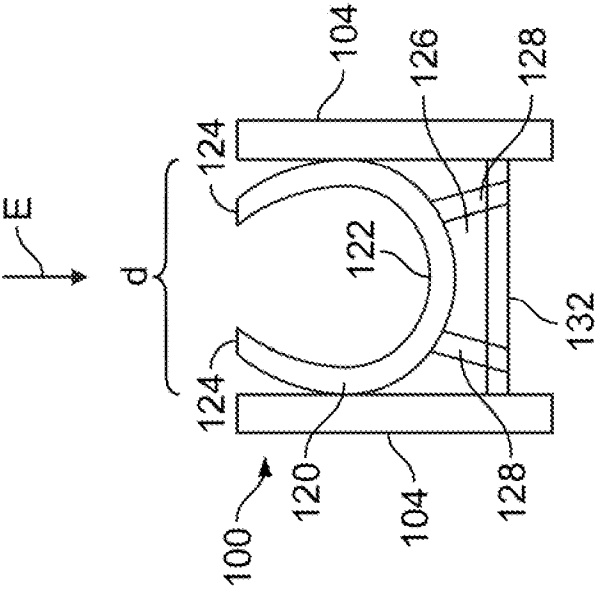


FIG. 2

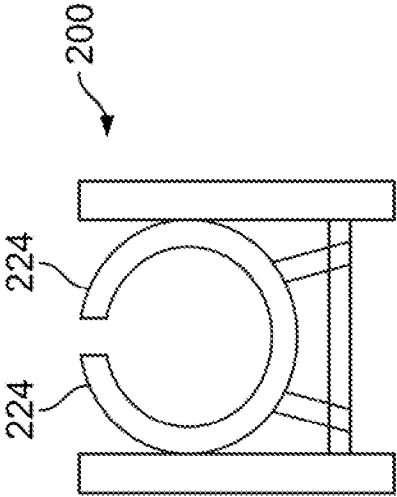


FIG. 3

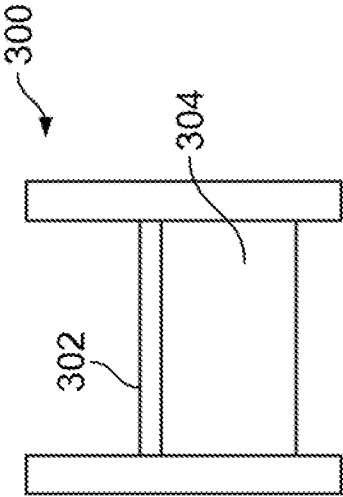


FIG. 4

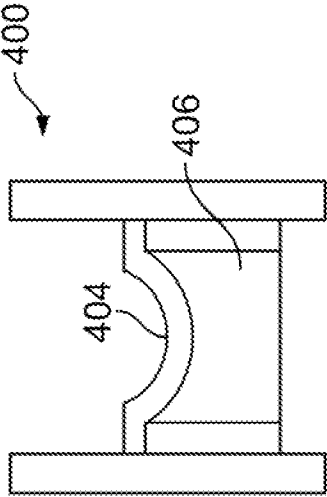


FIG. 5

3/3

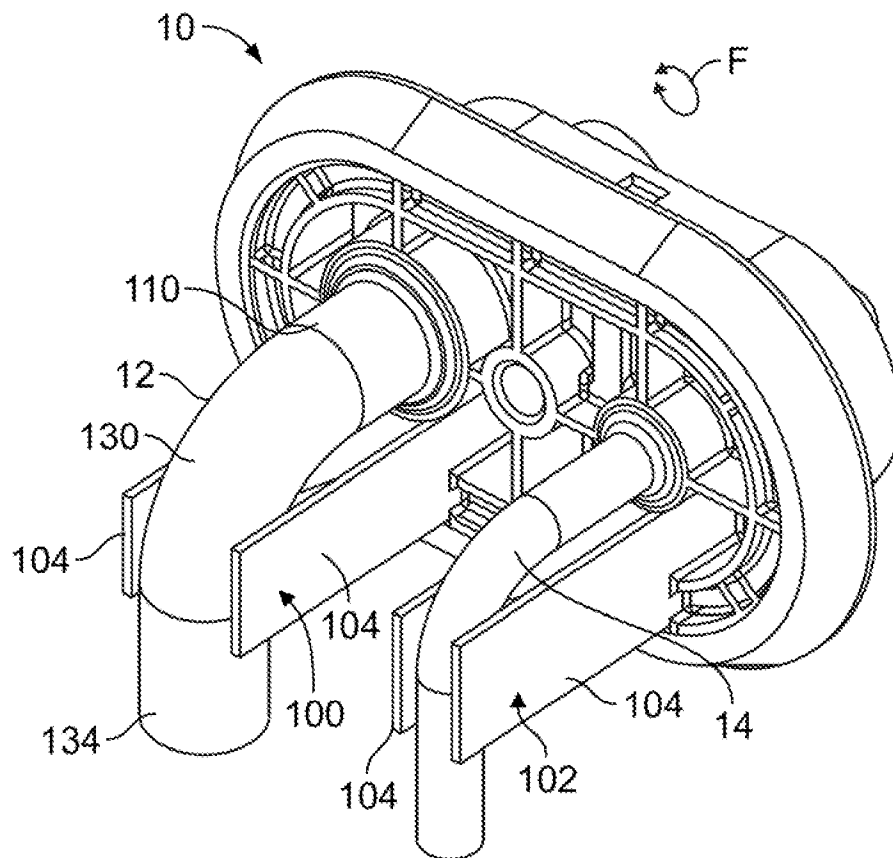


FIG. 6

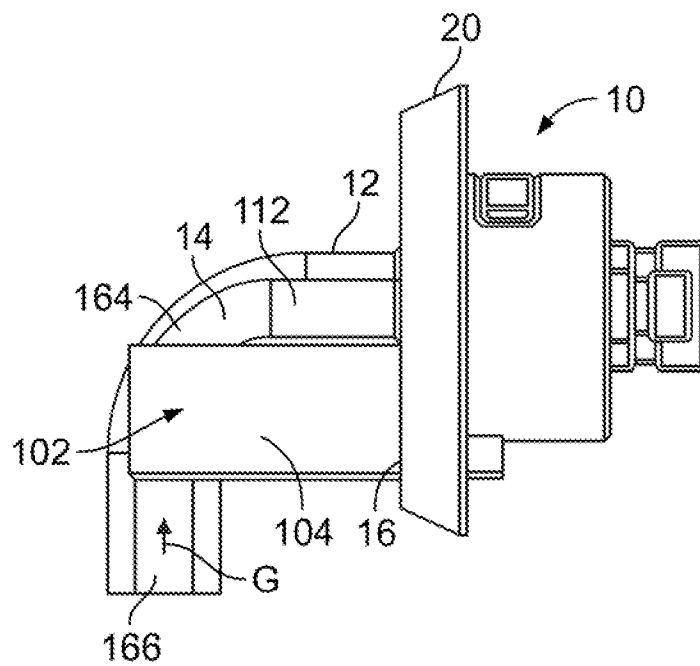


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2014/017860

A. CLASSIFICATION OF SUBJECT MATTER
 INV. F16L5/12 B60H1/00
 ADD.

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)
 F16L B60H

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 014 838 A2 (VILLEROY & BOCH GUSTAVSBERG AB [SE]) 14 January 2009 (2009-01-14)	1-4,6,7
Y	paragraph [0034]; figures 2, 3, 4	8-11, 13-15
A		5,12, 16-18
X	----- US 2006/001261 A1 (MIYAJIMA ATSUO [JP] ET AL) 5 January 2006 (2006-01-05)	1-4,6, 8-11,13, 15
Y	figures 1, 3a	8-11, 13-15
A	----- -/-	5,7,12, 16-18



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

"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

12 May 2014

Date of mailing of the international search report

19/05/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040,
 Fax: (+31-70) 340-3016

Authorized officer

Dauvergne, Bertrand

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2014/017860

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 489 917 A2 (AUTOTUBE AB [SE]) 22 August 2012 (2012-08-22)	1,8
A	figure 1 -----	2-7,9-18
X	DE 12 64 180 B (E G O ELEKTRO GERAETE BLANC; FISCHER) 21 March 1968 (1968-03-21) figure 1 -----	1,8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/017860

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2014838	A2	14-01-2009	DK 2014838 T3 13-05-2013 EP 2014838 A2 14-01-2009 SE 0701614 A 04-01-2009
US 2006001261	A1	05-01-2006	NONE
EP 2489917	A2	22-08-2012	NONE
DE 1264180	B	21-03-1968	NONE