



(51) International Patent Classification:

F16B 5/12 (2006.01) B60T 17/04 (2006.01)

F16B 21/08 (2006.01) F16L 3/223 (2006.01)

(21) International Application Number:

PCT/US2019/046829

(22) International Filing Date:

16 August 2019 (16.08.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

201821030981 18 August 2018 (18.08.2018) IN

(71) Applicant: ILLINOIS TOOL WORKS INC. [US/US];

155 Harlem Avenue, Glenview, Illinois 60025 (US).

(72) Inventors: GOKAVI, Mahantesh; c/o Illinois Tool Works Inc., 155 Harlem Avenue, Glenview, Illinois 60025 (US).

JADHAV, Satish; c/o Illinois Tool Works Inc., 155 Harlem Avenue, Glenview, Illinois 60025 (US).

(74) Agent: SCHMIDBAUER, Nicholas P. et al.; QUARLES & BRADY LLP (CHI), Attn: IP Docket, 411 E. Wisconsin Ave. Suite 2350, Milwaukee, Wisconsin 53202-4426 (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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, ST, 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,

(54) Title: FASTENING MEMBERS

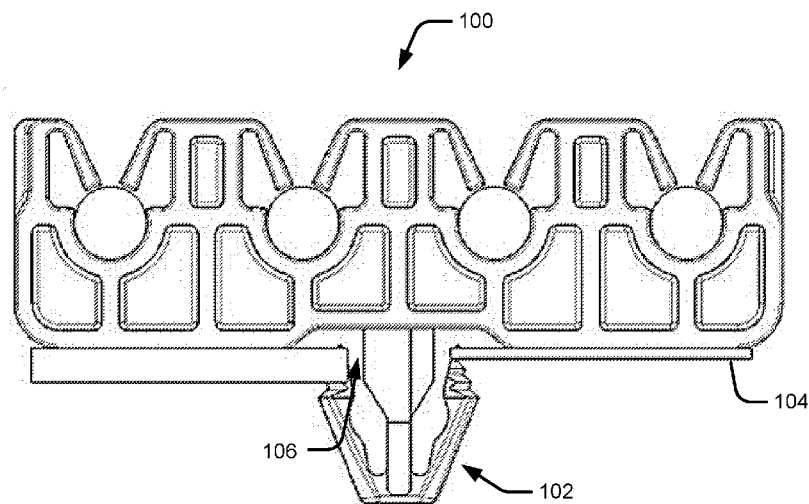


Figure 1A

(57) Abstract: An example multi-component clamp includes an anchoring fastener that includes a shank and a body. The body forms a u-bend at a first end. The body is connected to the shank at the u-bend. The body includes a plurality of arms. Each of the plurality of arms is cantilevered at the shank and extends therefrom in a direction away from the u-bend to be hingeable about the u-bend. Each of the plurality of arms includes an anchor formed at a free end thereof. The anchor includes a stepped locking profile adapted to mate with a mother component.



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))*

Published:

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

FASTENING MEMBERS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to India Application No. 201821030981, filed on August 18, 2018, the entire contents of which is incorporated by reference herein in its entirety.

BACKGROUND

[0002] Various types of fastening members are used for securing components. For example, in case of an instrument panel of a vehicle, fastening members may be used to fix together adjacent panels or to secure one or more objects on the panels. One such type of fastening members is usable with holes of different types, sizes, and shapes provided in one of the components to be secured with another having the fastening member. In other type of fastening members, the fastening member may itself include a cavity which accommodates another component to fasten the two components together. Therefore, while in one case, one of the components is provided with a hole to receive a fastening member, in the other case, the fastening member itself has a cavity to receive the other component.

SUMMARY

[0003] In one aspect, a multi-component clamp is disclosed that includes an anchoring fastener that includes a shank and a body. The body forms a u-bend at a first end. The body is connected to the shank at the u-bend. The body includes a plurality of arms. Each of the plurality of arms is cantilevered at the shank and extends therefrom in a direction away from the u-bend to be hingeable about the u-bend. Each of the plurality of arms includes an anchor formed at a free end thereof. The anchor includes a stepped locking profile adapted to mate with a mother component.

[0004] In another aspect, a multi-component clamp is disclosed that includes a body portion and a clamping fastener formed in the body portion. The clamping fastener includes at least one notch to accommodate a tie component. The at least one notch has a lateral wall extending along a cross-sectional thickness of the multi-component clamp. The lateral wall includes at least one shoulder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Figure 1A and Figure 1B illustrate examples of a multi-component fixture with fastening members, in an assembled position, according to the present subject matter.

[0006] Figure 2A and Figure 2B illustrates an anchoring fastener in the assembled position, according to an example of the present subject matter.

[0007] Figure 3A and Figure 3B illustrate the anchoring fastener in an unassembled position, according to an example of the present subject matter.

[0008] Figure 4A and Figure 4B illustrate a clamping fastener, according to an example of the present subject matter.

[0009] Figure 5 illustrates a cross-sectional view of the clamping fastener, according to an example of the present subject matter.

[0010] Throughout the drawings, identical reference numbers designate similar, but not necessarily identical, elements. The figures are not necessarily to scale, and the size of some parts may be exaggerated to more clearly illustrate the example shown. 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

[0011] Fastening members are widely used for mounting components to one another. Certain fastening members can be used for mounting one component to another having a hole. Few other fastening members may be themselves include a cavity for receiving another component. In either case, the fastening member may usually be formed as a part of the component. As an example, one such application having both the types of fastening members is for a routing clamp for securing brake lines. The brake lines are each tied to the routing

clamp using the latter type of fastening members. The routing clamp is, then, anchored to a panel on an underbody of a vehicle using the former type of fastening member.

[0012] The latter type of fastening members that tie the component to itself may include the notch to accommodate the component. On the other hand, the former type of fastening members that are to be mounted in a hole, generally, include a body portion to which the component is mounted and include a shank which fits into the hole in the other component. The shank includes cantilevered arms having a snap-fit lock at their distal end away from the body portion. The cantilevered arms may be biased to be larger than the hole into which the shank is fitted but yieldable such that the snap-fit lock can engage with a complementary part in the component having the hole and which receives the fastening member. When the mounted fastening member is to be secured in the component, the shank is forced into the hole. As the shank enters and slides through the hole, the cantilevered arms move slightly inwardly to allow insertion of the fastening member, until the snap-fit locks on the arms engage with the component.

[0013] Both of the above type of fastening members are usually limited in design by a degree of ease or difficulty with which the fastening member can be used. For example, in case of the fastening member that is inserted, the design limitation is the degree ease or difficulty of deploying the fastening member in the hole, and, accordingly, withdrawing the fastening member from the hole. In other example, in which the fastening member receives the component, the design may be dependent on the ease or difficulty with which the component can be tied to and withdrawn from the fastening member. In other words, the design of the fastening members is such that if they are easily usable during deployment, then they can be as easily usable during withdrawal. Similarly, if the fastening members are to be made difficult for withdrawal, they are also difficult during deployment. Accordingly, the fastening members which are designed to be ergonomically viable may be found to be lacking in adequately holding the components together, whereas the fastening members which are capable of properly holding the components together may not be ergonomic in application.

[0014] In addition, generally, the fastening members that are to be deployed in a hole are usable with holes or components which have a substantially consistent cross-sectional thickness. In other words, the fastening members of the formed kind discussed previously are usable with the holes that have substantially similar thickness along the periphery.

[0015] Approaches for fastening members used for securing two components together are described. A component to be secured to another can either be formed as having the fastening member, such as an anchoring fastener, or can be mounted to the fastening member, such as a clamping fastener. In one case, the component, such as a multi-component clamps to be mounted can have the fastening member, either formed or mounted, and is referred to as a child component, whereas the other component in which the hole is provided for receiving the fastening component is referred to as a mother component. Such a fastening member is referred to as an anchoring fastener hereinafter. In another case, the component having the fastening member of the type that receives another component can be referred to as the mother component, whereas the other component which is tied to the fastening member is referred to as child component. Such a fastening member is referred to as a clamping fastener hereinafter. As is clear from the foregoing, in both the cases, the component which receives another component is referred to as the mother component, whereas the component that is received is referred to as the child component.

[0016] According to an aspect, the approaches involve designing the fastening member in such a manner that the fastening member is ergonomic in terms of being used. For example, where the fastening member is part of the child component, the fastening member can be ergonomically inserted into and withdrawn from the hole in a component, whereas where the fastening member is part of the mother component, the other component can be ergonomically inserted into and withdrawn from the fastening member. In addition, the fastening member, such as the anchoring fastener, is designed in a way that though the mother component may have variable cross-sectional thickness, the fastening member may be able to accommodate such variation and still effectively secure the child component.

[0017] As mentioned previously, according to one aspect, the fastening member can be the anchoring fastener. In an example, the anchoring fastener can include a body formed by one or more ribs having a plurality of arms extending away from the body to form a u-shape. In other words, the rib can have a u-bend such that each free end of the rib may be an arm extending in a direction away from the u-bend. In addition, the anchoring fastener can include a shank which is connected to the body at the u-bend. Accordingly, each arm may be cantilevered to the shank, for example, at the u-bend, and therefore, may be hingeable towards the shank about a point of connection to the u-bend. An end of the anchoring fastener at the u-bend of the rib can form one end of the anchoring fastener, referred to as a first end. The first end of the anchoring fastener can be formed as being substantially tapered for inserting the

anchoring fastener into the hole in the mother component. The free ends of the arms, referred to as anchors, can form another end of the anchoring fastener referred to as a second end. For ease of understanding, in an example, the anchoring fastener can be considered to have an arrow shape with the shank being the shaft of the arrow and the rib, i.e., the arms of the rib, forming the arrowhead.

[0018] According to an aspect, the rib can be designed to have a profiled shape along their length to enhance their flexural ability without compromising the strength of the ribs. Therefore, the arms can be provided with a profile along their lengths to enhance flexibility of the arms, thereby requiring a low insertion force to be applied for inserting the anchoring fastener into the hole in the component. At the same time, the rib has substantial strength and does not undergo failure during assembly or disassembly. In addition, the profile on the rib leads to less material to be used in manufacturing the anchoring fastener, and therefore, the cost of manufacturing the anchoring fastener may be considerably low.

[0019] In addition, the anchoring fastener can also have features that can facilitate the anchoring fastener in accommodating variations in cross-sectional thickness of the mother component around the hole. According to an aspect, at the free ends of both the arms, i.e., at the anchors, a stepped locking profile can be provided. In an example, the stepped locking profile can be formed on an edge of the anchor, referred to as a mating edge, that mates with the hole in the mother component to secure the anchoring fastener. The stepped construction of the anchor facilitates the anchoring fastener to accommodate variations in the thickness of the mother component at the hole. Accordingly, in an example, the number of steps of the stepped locking profile as well as the height of each step can be determined based on the difference in variation that the anchoring fastener is designed to accommodate.

[0020] Further, according to another aspect, as mentioned previously, the fastening member can be a clamping fastener. In an example, the clamping fastener can be formed as a part of the component to which the other component is to be coupled. For instance, the clamping fastener can include a notch formed in a body portion of the multi-component clamp having the clamping fastener. The notch may have a shape which matches a cross-sectional shape of the component that is to be tied to the clamping fastener.

[0021] Further, the notch can be designed in such a way that the component, referred to as a tie component, once tied or coupled is unable to easily dislodge from the notch, and at the same time, the design of the clamping fastener can make the insertion of the tie component

ergonomic. According to an aspect, a lateral wall of the notch, for instance, along a thickness of the multi-component clamp, can be designed to allow easy clamping of the tie component to the notch of the clamping fastener. Accordingly, the lateral wall can be provided with one or more shoulders which perform a biting action on the tie component, such as the brake lines, when mounted into the clamping fastener. In an example, the shoulders can be provided at the two diametrically opposite edges of the notch which are proximal to an opening of the notch from where the tie component is inserted into the notch. The provision of the shoulders facilitates in application of a predetermined thrust force on the tie component in the assembled condition. As a result, the predetermined thrust force facilitates in holding the tie component and prevents it from dislodging by requiring a high separation force for detaching the child component. In addition, the shoulders are positioned and designed in such a way that the insertion force for coupling the tie component to the clamping fastener is not high, while, as mentioned, the separation force is relatively high.

[0022] In addition, the clamping fastener may include one or more catchers, for example, formed as cantilevered extensions from the body portion of the mother component. The catchers can be positioned to locate and direct the tie component towards the notch of the clamping fastener. At the same time, once the tie component is assembled, the catchers also prevent the tie component from dislodging, thereby, supplementing the separation force requirement for the clamping fastener.

[0023] According to yet another aspect, a component having the fastening members, for instance, the anchoring fastener as well as the clamping fastener, is envisaged by the present subject matter. For example, the tie component can be parts of a brake assembly of a vehicle. In said example, the component can be, for instance, a routing clamp for holding brake lines of the brake assembly. In such a case, the mother component can be a part on an underbody of the vehicle. Accordingly, the anchoring fastener on the routing clamp can be used to secure the routing clamp, and therefore, the brake lines to the vehicle underbody.

[0024] The above aspects are further illustrated in the figures and described in the corresponding description below. It should be noted that the description and figures merely illustrate principles of the present subject matter. Therefore, various arrangements that encompass the principles of the present subject matter, although not explicitly described or shown herein, may be devised from the description and are included within its scope. Additionally, the word “coupled” is used throughout for clarity of the description and may include either a direct connection or an indirect connection.

[0025] Figure 1A illustrates a multi-component clamp 100 with a fastening member in an assembled state, according to an example of the present subject matter. As can be seen, Figure 1A illustrates a front view of the multi-component clamp 100. In said example, the fastening member can be an anchoring fastener 102 which can be used for anchoring the multi-component clamp 100 to another component. In an example, the multi-component clamp 100 can be formed as having the anchoring fastener 102. In other words, the multi-component clamp 100 and the anchoring fastener 102 can be formed as a single, integrated, part. In another example, the multi-component clamp 100 can be mounted to the anchoring fastener 102. Therefore, the multi-component clamp 100 having the anchoring fastener 102 is alternately referred to as the child component 101 hereinafter. The mother component 104 is adapted to receive the anchoring fastener 102 to couple the child component 101, i.e., the multi-component clamp 100, to the mother component 104. Accordingly, the mother component 104 can have a hole 106 to receive the anchoring fastener 102 of the child component 101. In an example, the multi-component clamp 100, can be made of plastic whereas the mother component 104 can be made of metal or an alloy. In another example, the child component 101 as well as the mother component 104 can be made of plastic material.

[0026] According to an aspect, the anchoring fastener 102 can have features that can facilitate the anchoring fastener 102 in accommodating variations in cross-sectional thickness of the mother component 104 around the hole 106. In other words, the anchoring fastener 102 is designed in a way that though the mother component 104 may have variable cross-sectional thickness, the anchoring fastener 102 may be able to accommodate such variation and still effectively secure the child component 101. As can be seen in Figure 1A, the cross-sectional thickness of the mother component 104 is different at the two edges of the anchoring fastener 102 that mate. The features so provided in the anchoring fastener 102 for accommodating the variations in the cross-sectional thickness of the mother component 104 are explained further with reference to Figure 2A, Figure 2B, Figure 3A, and Figure 3B.

[0027] Figure 1B illustrates a front view of the multi-component clamp 100 with the fastening member, in an assembled state of the fastening member, according to another example of the present subject matter. In said example, the fastening member can be a clamping fastener 103 which can be part of the multi-component clamp 100 and which receives one or more tie components as described further.

[0028] In one example, the multi-component clamp 100 can be a routing clamp, for example, for a brake assembly, which holds a plurality of tie components, such as brake lines

108-1, 108-2, ... 108-N, collectively referred to as tie components 108. In other examples of the present case, the multi-component clamp 100 can be any other component, such as a clamp for securing cables of spark plugs of an engine or a clamp for holding various wires inside a dashboard of a vehicle. As will be understood, the cables of spark plugs, or the wires, as the case may be, are the tie components 108 in this case.

[0029] Further, the clamping fastener 103 can be designed in such a way that the tie component 108 once tied or coupled is unable to easily dislodge from the clamping fastener 103. In addition, the features can facilitate the clamping fastener 103 in making the insertion of the tie component 108 ergonomic. The features so provided in the clamping fastener 103 for allowing ergonomic insertion of the tie component 108 and, and at the same time, adequately holding the tie component 108 are explained further with reference to Figure 4A, Figure 4B, and Figure 5.

[0030] Coming back to the example where the fastening member is the anchoring fastener 102, Figure 2A and Figure 2B illustrate a close-up view of the anchoring fastener 102, according to an example of the present subject matter. For the sake of brevity and ease of understanding, Figure 2A and Figure 2B are described in conjunction with each other. According to the example shown in Figure 2A and Figure 2B, the anchoring fastener 102 can include a body 110 formed by a rib 112. The rib 112 can have a plurality of arms 114 extending away from the body 110 to form a u-shape or a u-bend 116. In other words, the rib 112 can have the u-bend 116 and the free ends of the rib 112 may form the arms 114 extending in a direction away from the u-bend 116. In addition, the anchoring fastener 102 can include a shank 118 which is connected to the body 110 at the u-bend 116. Accordingly, each arm 114 may be cantilevered to the shank 118, for example, at the u-bend 116. Such a cantilevered structure of the arms 114 allows hingeability of the arms 114, such that the arms 114 can hinge towards the shank 118 about a point of connection to the u-bend 116. The free ends of the arms 114, referred to as anchors 120, can form the mating portions of the anchoring fastener 102 that, in the assembled state of the anchoring fastener 102, can mate with the mother component 104 at the hole 106. The hingeability of the arms 114 allow the anchoring fastener 102 to effectively secure the multi-component clamp 100 to the mother component 104.

[0031] Though the example illustrated in Figure 1, Figure 2A, and Figure 2B illustrates the anchoring fastener 102 having one rib 112, in other examples, the anchoring fastener 102 may have a plurality of ribs 112 running parallel to each other to provided high strength to the anchoring fastener 102. In such a case, the anchoring fastener 102 may be find use in

applications that involve high forces and stresses on the anchoring fastener 102, and at the same time having enough flexibility that the use is ergonomic, as will be explained in detail later.

[0032] An end of the anchoring fastener 102 at the u-bend 116 of the rib can form one end of the fastener, referred to as a first end 122, and an opposite end to the first end, referred to a second end 124 can be formed at the anchors 120. The first end 122 of the fastener can be formed as being substantially tapered for inserting the anchoring fastener 102 into the hole 106 in the mother component 104. Accordingly, as can be seen in the figures, in an example, the anchoring fastener 102 can be formed as being arrow-shaped with the shank 118 forming the shaft of the arrow and the rib 112 with the u-bend 116 forming the arrowhead.

[0033] As mentioned previously, the anchoring fastener 102 is designed in a way that though the mother component 104 may have variable cross-sectional thickness, the anchoring fastener 102 may be able to accommodate such variation and still effectively secure the child component 101. Accordingly, in accordance with an aspect, the anchoring fastener 102 can be provided with a stepped locking profile 126 at the anchors 120. For instance, the stepped locking profile 126 can be formed on an edge of the anchor 120 that mates with the hole 106 in the mother component 104 to secure the fastener. Such an edge of the anchor 120 is referred to as a mating edge 128, 129.

[0034] As can be seen clearly in Figure 2B, the stepped construction of the anchor 120 facilitates the anchoring fastener 102 to accommodate variations in the thickness of the mother component 104 at the hole 106. In other words, even when the thickness of the mother component 104 is 0.7 units at one mating edge 128 of the fastener whereas the thickness of the mother component 104 is 2.3 units at the other mating edge 129, the stepped locking profile 126 can effectively accommodate the variation and lock with the mother component 104 to effectively secure the anchoring fastener 102 to the mother component 104. The steps 130 of the stepped locking profile 126 provides a notched variation in a gradient along the anchors 120. Along the gradient on the anchors 120, the mating portions of the mother component 104 at the hole 106 may find complementary notches in one of the steps on either of the anchors 120 to lock with the anchoring fastener 102. In an example, the number of steps 130 of the stepped locking profile 126 as well as the height of each step 130 can be determined based on the difference in variation that the anchoring fastener 102 is designed to accommodate.

[0035] Further, the design of the anchoring fastener 102 can be based on an insertion force to be applied for inserting the anchoring fastener 102 into the hole 106. According to an

aspect, the anchoring fastener 102 can be designed in a way that the insertion force of the anchoring fastener 102 is substantially low, whereas the holding force for the anchoring fastener 102 is considerably high. In other words, the anchoring fastener 102 may require a nominal insertion force to make it ergonomic for use by a user, and at the same time, the design can also be such that that anchoring fastener 102 requires a considerably high separation force in comparison to the insertion force. In addition, as shown in Figure 2A, the applications where the anchoring fastener 102 may be used may require different flexibility of the arms 114, i.e., one arm 114 may have to flex greater than the other arm 114 when the anchoring fastener 102 is assembled. The design aspects of the anchoring fastener 102 relating to flexibility are discussed in detail with respect to Figure 3A and Figure 3B.

[0036] Figure 3A and Figure 3B illustrate the anchoring fastener 102 in an unassembled position, according to an example of the present subject matter. In said example, the anchoring fastener 102 can be designed to be ergonomic in use and, therefore, the insertion force can be a factor in designing the ribs 112, as flexural ability of the ribs 112, i.e., the arms 114, may have a direct bearing on the insertion force. Accordingly, as shown in Figure 3A and 3B, to enhance the flexural ability of the rib 112 without compromising their strength, the arms 114 can be designed to have an arcuate profile 300 along their length. The high flexural ability of the arms facilitates in designing the anchoring fastener 102 to have a nominal insertion force, such that the rib 112 may be yieldable or flexible enough to bend and enter the hole 106 ergonomically and after entering may almost regain their original shape, without undergoing failure in the process. However, the design of the arms 114 is carefully selected so as to not compromise the separation force for the anchoring fastener 102, i.e., the force to be applied on the anchoring fastener 102 for withdrawing the anchoring fastener 102 from the mother component 104.

[0037] As Figure 3A and Figure 3B illustrate as an example, each of the arms 114 can have the arcuate profile 300 formed along the length of the arm 114. In an example, the arcuate profile 300 can be provided at about mid-length of the arm 114. For instance, with the provision of the arcuate profile 300, a width or thickness, or both, of the arms 114 may be less at the arcuate profile 300 in comparison to the rest of the portion of the arm 114, thereby enhancing flexibility as well as the hingeability of the arms 114 with respect to the shank 118. However, the size and shape of the arcuate profile 300 can be determined based on a trade-off between the insertion force, the separation force, and a point of failure of the anchoring fastener 102. In

one example, the size and shape of the arcuate profile 300 can be determined based on a material of the anchoring fastener 102, duly considering the above discussed factors in addition.

[0038] Accordingly, the anchoring fastener 102 can be designed in a way that the anchoring fastener 102 may have a nominal insertion force of about 50 to 90 Newtons (N) and have a considerably high holding strength or separation force of a minimum of about 200 N. As will be understood, the above values of insertion force and holding strength/separation force are provided as examples and are not to be construed to be limiting.

[0039] In addition, as understood, the arcuate profile 300 may be formed by removal of material from the rib 112 or, in other words, the arms 114. Accordingly, the provision of the arcuate profile 300 on the arms 114 leads to less material to be used in manufacturing the anchoring fastener 102, and therefore, the cost of manufacturing the anchoring fastener 102 may be considerably low.

[0040] According to another aspect, as mentioned previously, the fastening member can be the clamping fastener 103 used to clamp tie components 108. Figure 4A and Figure 4B illustrate close-up views of the clamping fastener 103, according to an example of the present subject matter. While Figure 4A illustrates a close-up perspective view of the clamping fastener 103 in an unassembled state, Figure 4B illustrates a cross-sectional front view of the clamping fastener 103 in an assembled state. For the sake of brevity and for ease of understanding, Figure 4A and Figure 4B are described in conjunction with each other.

[0041] As can be seen in Figure 4A, the clamping fastener 103 can be formed in a body portion 402 of the multi-component clamp 100 of Figure 1B. In an example, the clamping fastener 103 can be formed as having a notch 404 formed in the body portion 402. For instance, the notch 404 can be formed as having a lateral wall 406, the lateral wall 406 extending along the cross-sectional thickness of the multi-component clamp 100. Accordingly, the height of the lateral wall 406 of the notch 404 is formed by the cross-sectional thickness of the multi-component clamp 100. In simple words, the notch 404 can be formed as a depression in the multi-component clamp 100 along a direction of the cross-section of the multi-component clamp 100.

[0042] Further, the notch 404 is formed in the shape of the tie component 108 that is to be clamped to the clamping fastener 103. As described previously, the multi-component clamp 100 can be, for example, a routing clamp of a brake assembly for clamping brake lines, a clamp for holding cables connected to the spark plugs, or a clamp for tying wires inside the dashboard.

In said examples, the notch 404 can take the shape of a cross-section of the tie component 108, i.e., the cables, the brake lines, or the wires that are to be tied using the clamping fastener 103. For instance, the tie component 108 can have a circular cross-section, and the notch 404 is, accordingly, made in a circular shape to accommodate the circular tie component 108.

[0043] As mentioned previously, the clamping fastener 103 can be designed to have features which allow for an ergonomic usage as well as for adequate performance of the clamping fastener 103. In other words, the clamping fastener 103 is designed to require a considerably low insertion force while coupling the tie component 108 thereto, and at the same time, is designed to be capable of holding the tie component 108 with a substantial thrust force. Therefore, the tie component 108 can be clamped to the clamping fastener 103 with relative ease; however, requires substantial separation force for being detached from the clamping fastener 103.

[0044] Accordingly, in an aspect, the lateral wall 406 of the notch 404 of the clamping fastener 103 can be provided with at least one shoulder. In another aspect, the lateral wall 406 may have two shoulders provided at two diametrically opposite edges of the notch 404 which are proximal to an opening of the notch 404 from where the tie component 108 can be inserted for clamping. In yet another aspect, the clamping fastener 103 can include a plurality of shoulders. For instance, as shown as an example in Figure 4A and Figure 4B, the clamping fastener 103 can include three shoulders 408-1, 408-2, and 408-3, individually referred to as a shoulder 408 and collectively referred to as the shoulders 408. In such a case, two of three shoulders 408-1, 408-2 can be provided as being diametrically opposite to each other and near an opening 410 of the notch 404, whereas one of the three shoulders 408-3 is provided opposite to the opening of the notch 404.

[0045] The shoulder 408 can be formed as a protrusion extending from the lateral wall 406 of the notch 404. Figure 5 illustrates a cross-sectional view of the clamping fastener 103, also showing a cross-section of the shoulder 408, as an example. In said example, as can be seen in Figure 5, the shoulder 408 protrudes from the lateral wall 406 of the notch 404 in a tapered shape. Accordingly, in said example, a mating portion 502 of the shoulder 408, referred to the portion of the shoulder 408 that is in contact with the tie component 108 when clamped to the clamping fastener 103, is formed as having an edge 504. Therefore, in said example, the shoulder 408 is formed as having a peak as the edge 504, extending from the lateral wall 406. In another example, the shoulder 408 can be formed as a truncated peak having a flat mating portion 502.

[0046] The edge 504, and therefore, the shoulder 408, can perform a biting action on the tie component 108, such as the cables or the brake lines, in order to apply a predetermined thrust force on the tie component 108 to substantially prevent the tie component 108 from detaching. In an example, the shoulder 408 can be designed to apply a thrust force in a range of about 30 Newtons and 70 Newtons on the tie component 108 in the assembled condition.

[0047] In the above examples, the mating portion 502 of the shoulder 408 is formed as an edge 504 or as a flat portion, depending on the design requirements for the clamping fastener 103. Therefore, the design is achieved in such a way that the clamping fastener 103 can meet the thrust force requirement as well as is ergonomic for use. For example, in addition, to the thrust force as mentioned above, the shoulder 408 can be designed as having an edge so that the insertion force for the clamping fastener 103 is a maximum of about 70 Newtons. In such a case, using the shoulder 408 having a flat mating portion 502 may be unable to achieve the thrust force requirement as mentioned above, in comparison to the shoulder 408 having the edge 504. In case the height of the flat mating portion 502 is increased to achieve the thrust force requirement, the insertion force requirement for the clamping fastener 103 may also be high. Therefore, for the abovementioned requirements for thrust force and insertion force, i.e., for the design of the clamping fastener 103 to be ergonomic as well as hold the tie component 108 with adequate force, the shoulder 408 with the edge 504 strikes a balance between the thrust force and the insertion force.

[0048] Coming back to Figure 4A, the clamping fastener 103 may also include one or more catchers 412. In an example, the catcher 412 can be formed as a cantilevered extension from the body portion 402 of the multi-component clamp 100. Further, the each catcher 412 can include a surface 414 facing an opening of the notch 404 to prevent inadvertent separation of the tie component 108 from the notch 404, and therefore, from the clamping fastener 103. Once the tie component 108 is assembled in the notch 404 of the clamping fastener 103, the catchers 412 may prevent the tie component 108 from dislodging, thereby, supplementing the separation force requirement for the clamping fastener. As an example, the separation force for detaching the tie component 108 from the clamping fastener 103 can be a minimum of about 100 Newtons. As will be understood, the design of the shoulder 408, or the catchers 412, or a combination thereof, may have a bearing on the separation force of the clamping fastener 103. In addition, the catchers 412 can allow for locating and directing the tie component 108 towards the notch 404 of the clamping fastener 103, thereby facilitating in the clamping of the tie component 108.

[0049] Further, in addition to meeting the insertion and separation force requirements, the design of the shoulders 408 may be contingent on adequate operation of the clamping fastener 103. For instance, as shown in Figure 4A and Figure 4B, two of the three shoulders 408 can be provided as being diametrically opposite to each other and near the opening 410 of the notch 404 to provide the appropriate biting force on the tie component 108. In addition, the third shoulder 408 may be provided opposite to the opening of the notch 404 to achieve an effective fit of the tie component 108 in the notch 404. In an example, the shoulders 408 are designed and positioned in the notch 404 in such a manner that the tie component 108 does not exhibit a see-saw motion about the shoulder 408, such as the third shoulder 408-3, when clamped in the notch 404. For instance, when the shoulder 408 is provided as a single, continuous rib along the entire lateral wall 406, the tie component 108 may exhibit a see-saw motion, whereas the above described design of the shoulders 408, and therefore, of the clamping fastener 103, prevents any such motion of the tie component 108.

[0050] According to yet another aspect, the present subject matter also relates to a component, such as the multi-component clamp 100 shown in Figure 1A or in Figure 1B, having the anchoring fastener 102 as well as the clamping fastener 103, in a single component. As an example, the multi-component clamp 100 can be a part of a brake assembly of a vehicle, such as a routing clamp for holding brake lines of the brake assembly. The multi-component clamp 100 can include the clamping fastener 103 for tying the brake lines of the brake assembly thereto. In addition, the multi-component clamp 100 can include the anchoring fastener 102 which can secure the multi-component clamp 100, and therefore, the brake lines to a vehicle underbody. The structural and functional aspects of such an anchoring fastener 102 and a clamping fastener 103 have already been described above with reference to the Figures 1A to Figure 5.

[0051] Although examples for fastening members 102, 103 and components having fastening members 102, 103 have been described in language specific to structural features and/or methods, it is to be understood that the appended claims are not limited to the specific features described. Rather, the specific features are disclosed as examples of fastening members 102 and components having fastening members 102, 103.

CLAIMS

What is claimed is:

1. A multi-component clamp (100) comprising:
 - an anchoring fastener (102) comprising:
 - a shank (118); and
 - a body (110) forming a u-bend (116) at a first end (122), the body (110) being connected to the shank (118) at the u-bend (116), the body (110) comprising a plurality of arms (114), each of the plurality of arms (114) cantilevered at the shank (118) and extending therefrom in a direction away from the u-bend (116) to be hingeable about the u-bend (116), each of the plurality of arms (114) comprising an anchor (120) formed at a free end thereof;
 - wherein the anchor (120) comprises a stepped locking profile (126) adapted to mate with a mother component (104).
2. The multi-component clamp (100) as claimed in claim 1, wherein each anchor (120) comprises a mating edge (128, 129) to mate with the mother component (104), the stepped locking profile (126) formed at the mating edge (128, 129).
3. The multi-component clamp (100) as claimed in claim 1, wherein each of the plurality of arms (114) comprises an arcuate profile (300) along a length.
4. The multi-component clamp (100) as claimed in claim 3, wherein the arcuate profile (300) is formed by removal of material from each of the plurality of arms (114).
5. The multi-component clamp (100) as claimed in claim 1, wherein the anchoring fastener (102) is designed for a separation force of greater than about 200 Newtons and an insertion force in a range of about 50 Newtons and 90 Newtons.
6. The multi-component clamp (100) as claimed in claim 1, wherein the multi-component clamp (100) comprises a body portion (402), and the anchoring fastener (102) is integrated with the body portion (402).
7. The multi-component clamp (100) as claimed in claim 1, further comprising:
 - a body portion (402); and
 - a clamping fastener (103) formed in the body portion (402), the clamping fastener (103) comprising at least one notch (404) to accommodate a tie component (108), the

at least one notch (404) having a lateral wall (406) extending along a cross-sectional thickness of the multi-component clamp (100), wherein the lateral wall (406) comprise at least one shoulder (408).

8. The multi-component clamp (100) as claimed in claim 7, wherein the at least one notch (404) comprises a plurality of shoulders (408), wherein one shoulder (408-1) is diametrically opposite to another shoulder (408-2).

9. The multi-component clamp (100) as claimed in claim 8, wherein one of the plurality of shoulders (408) is provided opposite to an opening of the notch (404).

10. The multi-component clamp (100) as claimed in claim 7, wherein the at least one shoulder comprises a mating portion (502) formed as having an edge (504) to mate with the tie component (108).

11. The multi-component clamp (100) as claimed in claim 10, the edge (504) is formed as a truncated peak having a flat mating portion (502).

12. The multi-component clamp (100) as claimed in claim 7, wherein the clamping fastener is designed to apply a thrust force in a range of about 30 Newton to 70 Newton on the tie component (108) when assembled.

13. The multi-component clamp (100) as claimed in claim 7, wherein the clamping fastener (103) further comprises at least one catcher (412) formed as a cantilevered extension from the body portion (402), wherein the at least one catcher (412) comprises a surface (414) facing an opening of the notch (404) to prevent inadvertent separation of the tie component (108) from the notch (404).

14. The multi-component clamp (100) as claimed in claim 7, wherein the clamping fastener is designed for an insertion force of less than about 70 Newtons and a separation force of greater than about 100 Newtons.

15. A multi-component clamp (100) comprising:

a body portion (402); and

a clamping fastener (103) formed in the body portion (402), the clamping fastener (103) comprising at least one notch (404) to accommodate a tie component (108), the at least one notch (404) having a lateral wall (406) extending along a cross-sectional thickness of the multi-component clamp (100), wherein the lateral wall (406) comprise at least one shoulder (408).

16. The multi-component clamp (100) as claimed in claim 15, wherein the at least one notch (404) comprises a plurality of shoulders (408), wherein one shoulder (408-1) is diametrically opposite to another shoulder (408-2).
17. The multi-component clamp (100) as claimed in claim 16, wherein one of the plurality of shoulders (408) is provided opposite to an opening of the notch (404).
18. The multi-component clamp (100) as claimed in claim 15, wherein the at least one shoulder comprises a mating portion (502) formed as having an edge (504) to mate with the tie component (108).
19. The multi-component clamp (100) as claimed in claim 18, the edge (504) is formed as a truncated peak having a flat mating portion (502).
20. The multi-component clamp (100) as claimed in claim 15, wherein the clamping fastener is designed to apply a thrust force in a range of about 30 Newton to 70 Newton on the tie component (108) when assembled.
21. The multi-component clamp (100) as claimed in claim 15, wherein the clamping fastener (103) further comprises at least one catcher (412) formed as a cantilevered extension from the body portion (402), wherein the at least one catcher (412) comprises a surface (414) facing an opening of the notch (404) to prevent inadvertent separation of the tie component (108) from the notch (404).
22. The multi-component clamp (100) as claimed in claim 15, wherein the clamping fastener is designed for an insertion force of less than about 70 Newtons and a separation force of greater than about 100 Newtons.

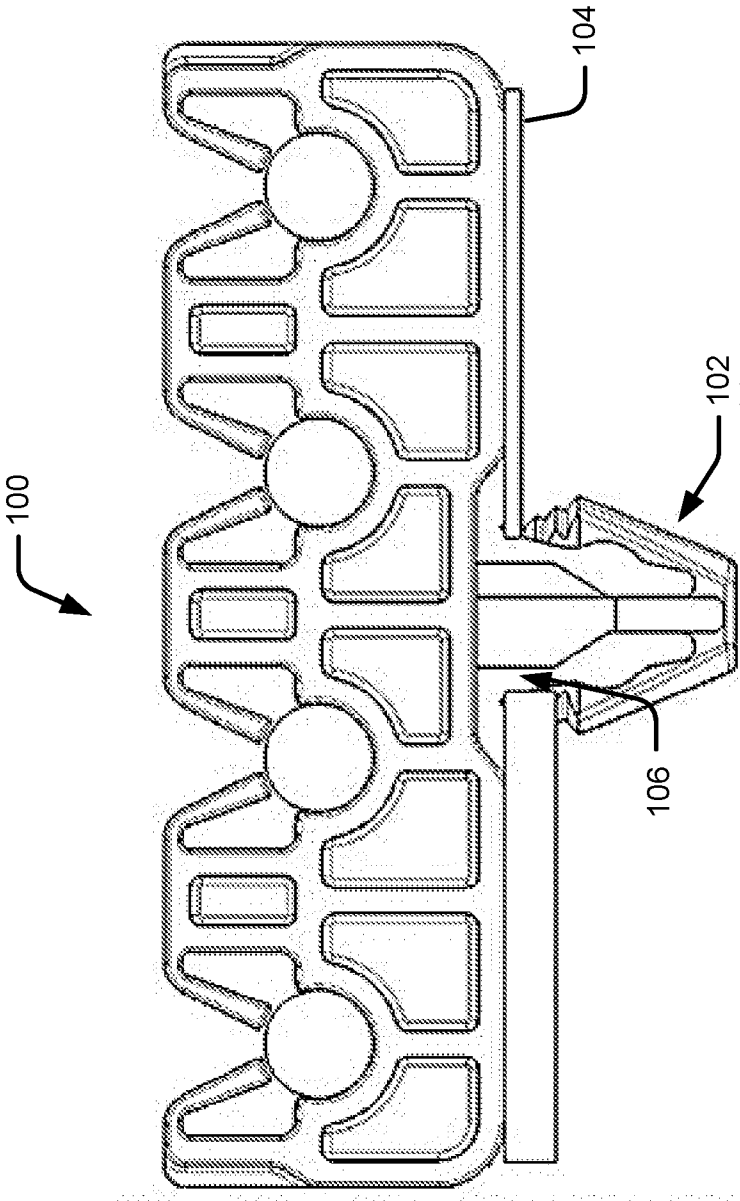


Figure 1A

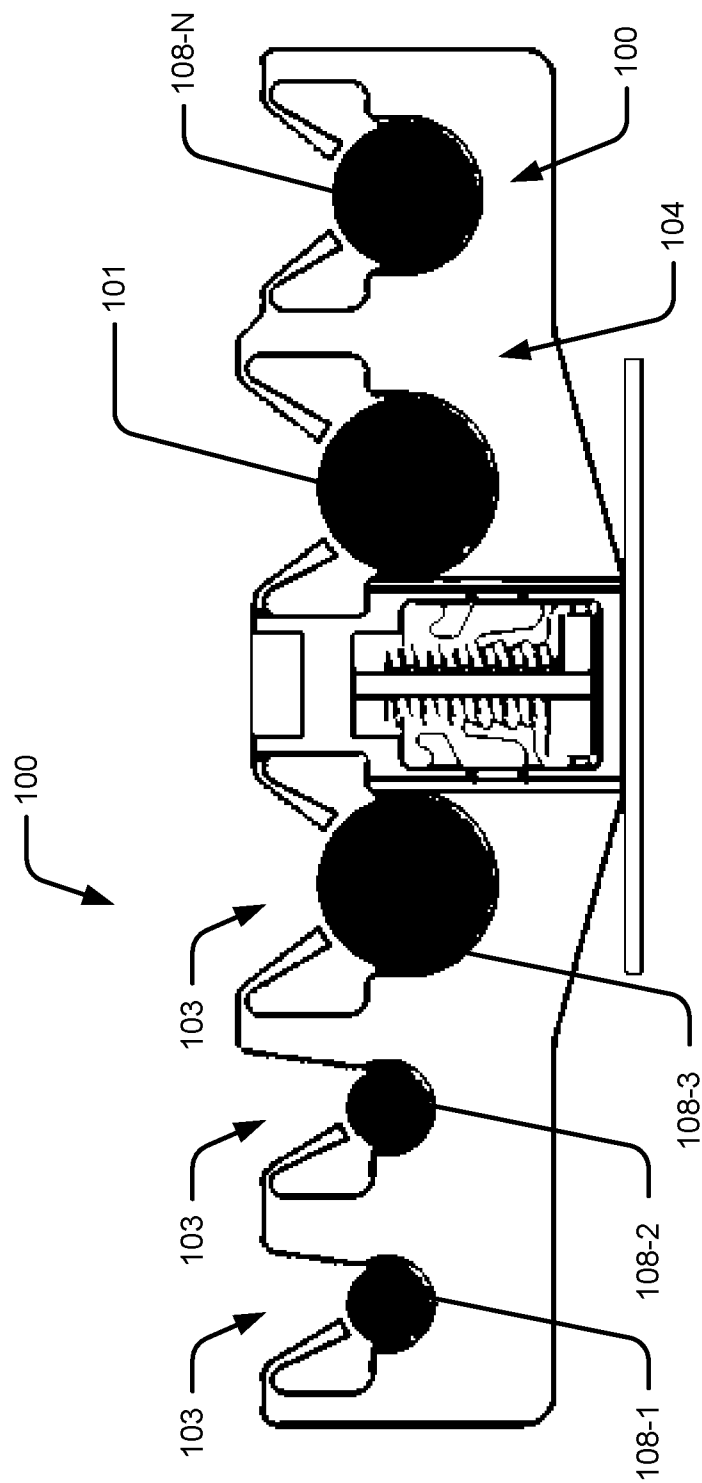


Figure 1B

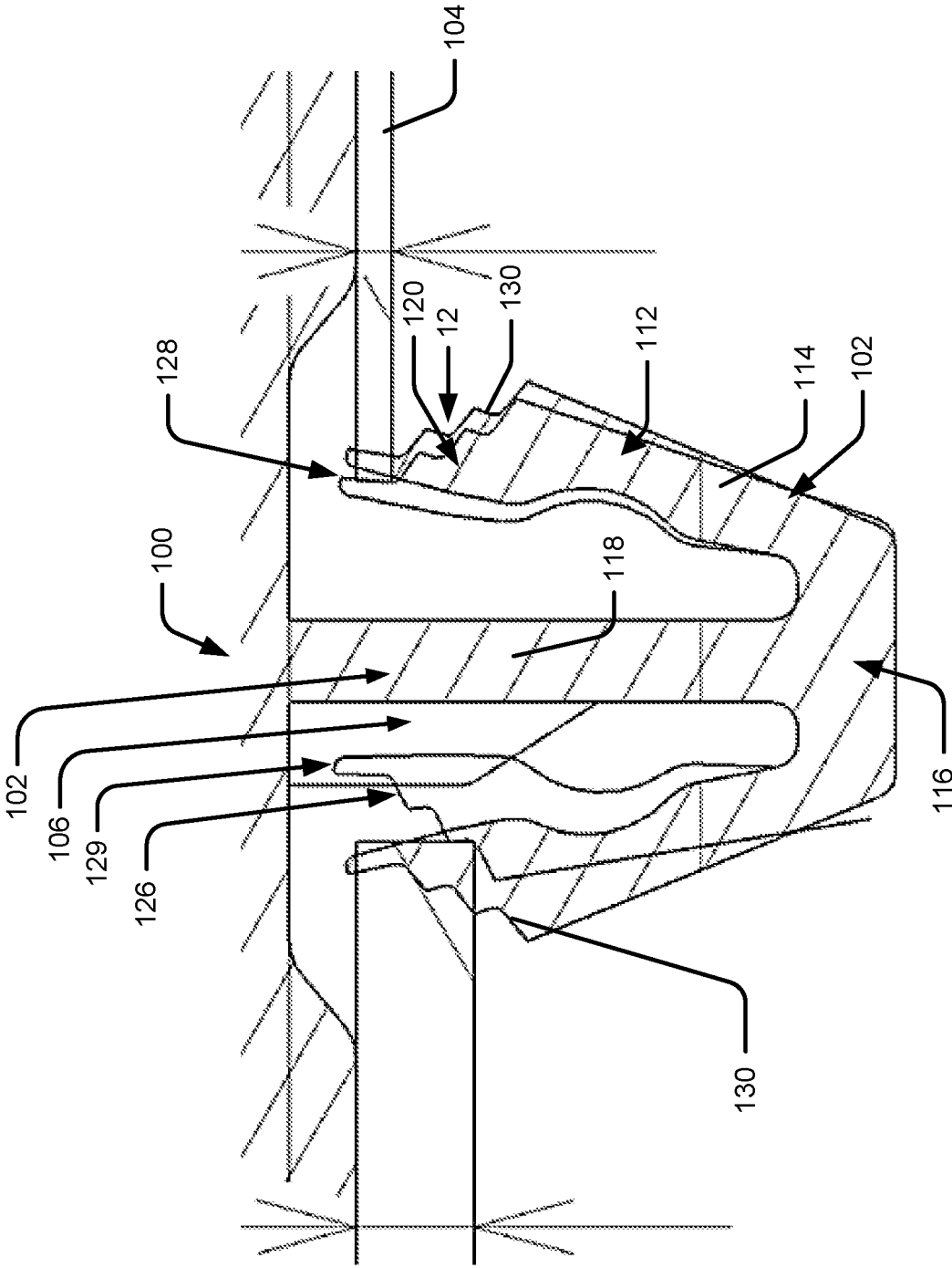


Figure 2A

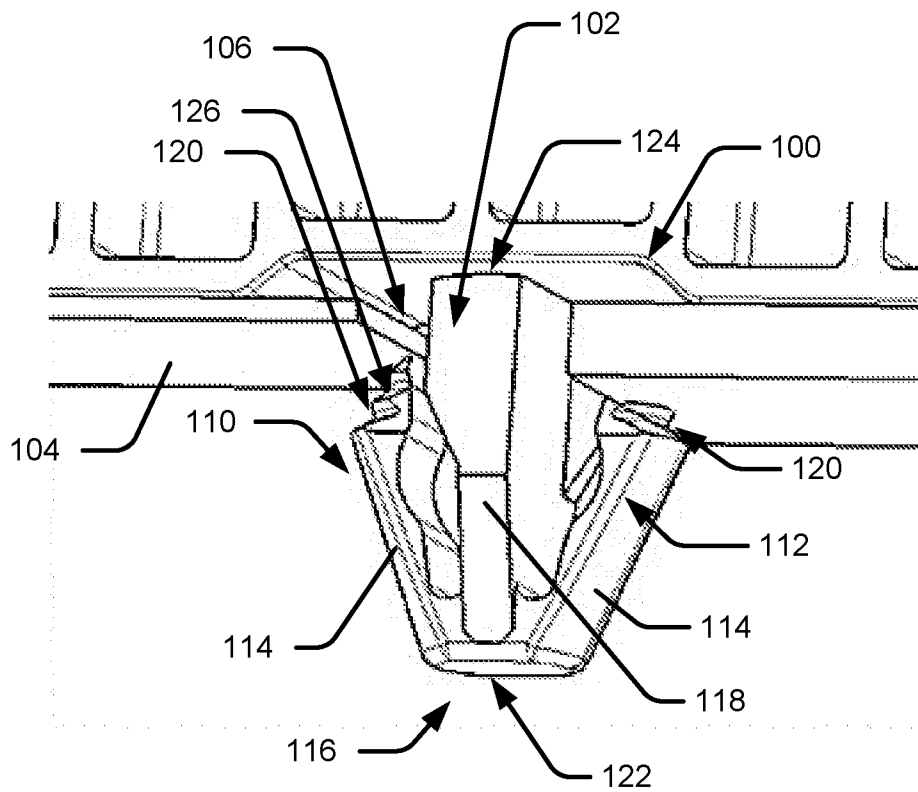


Figure 2B

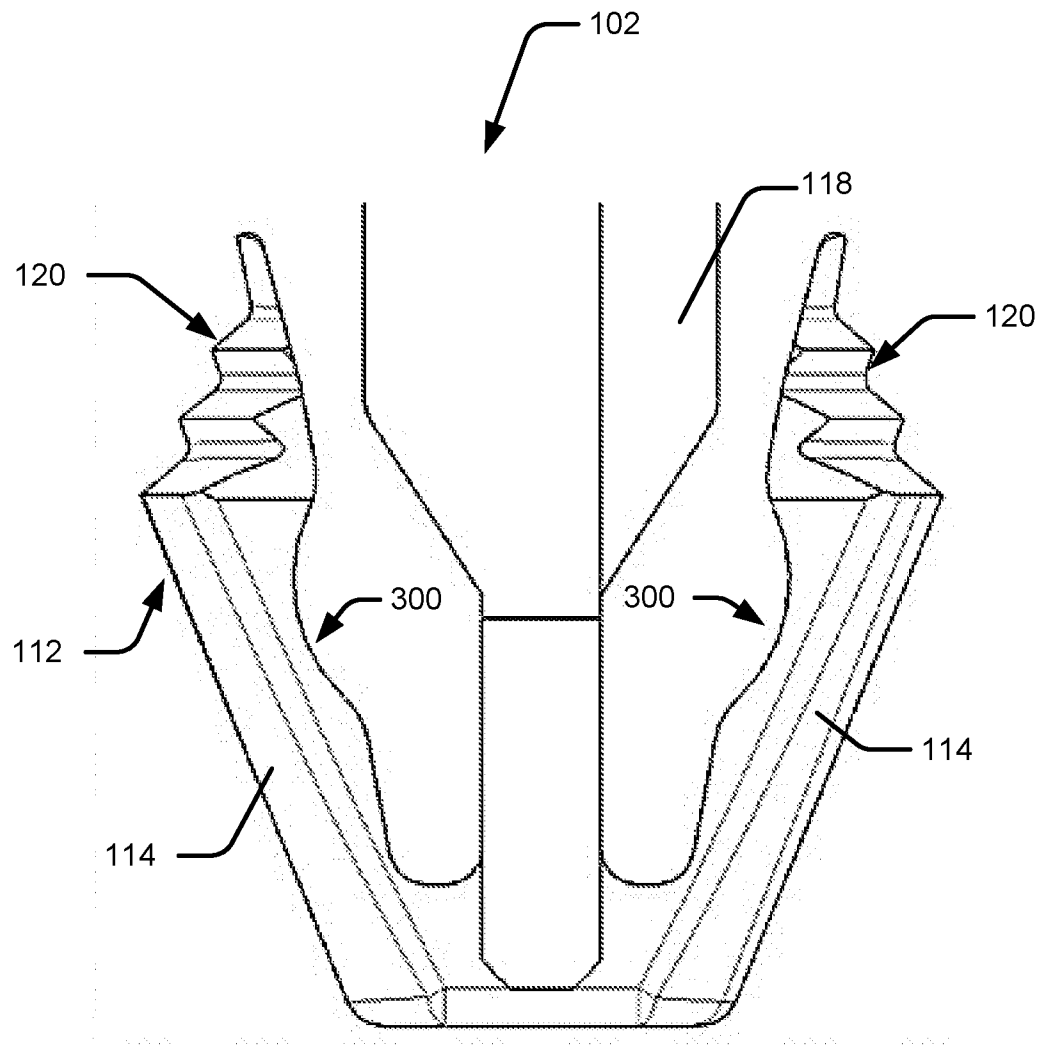


Figure 3A

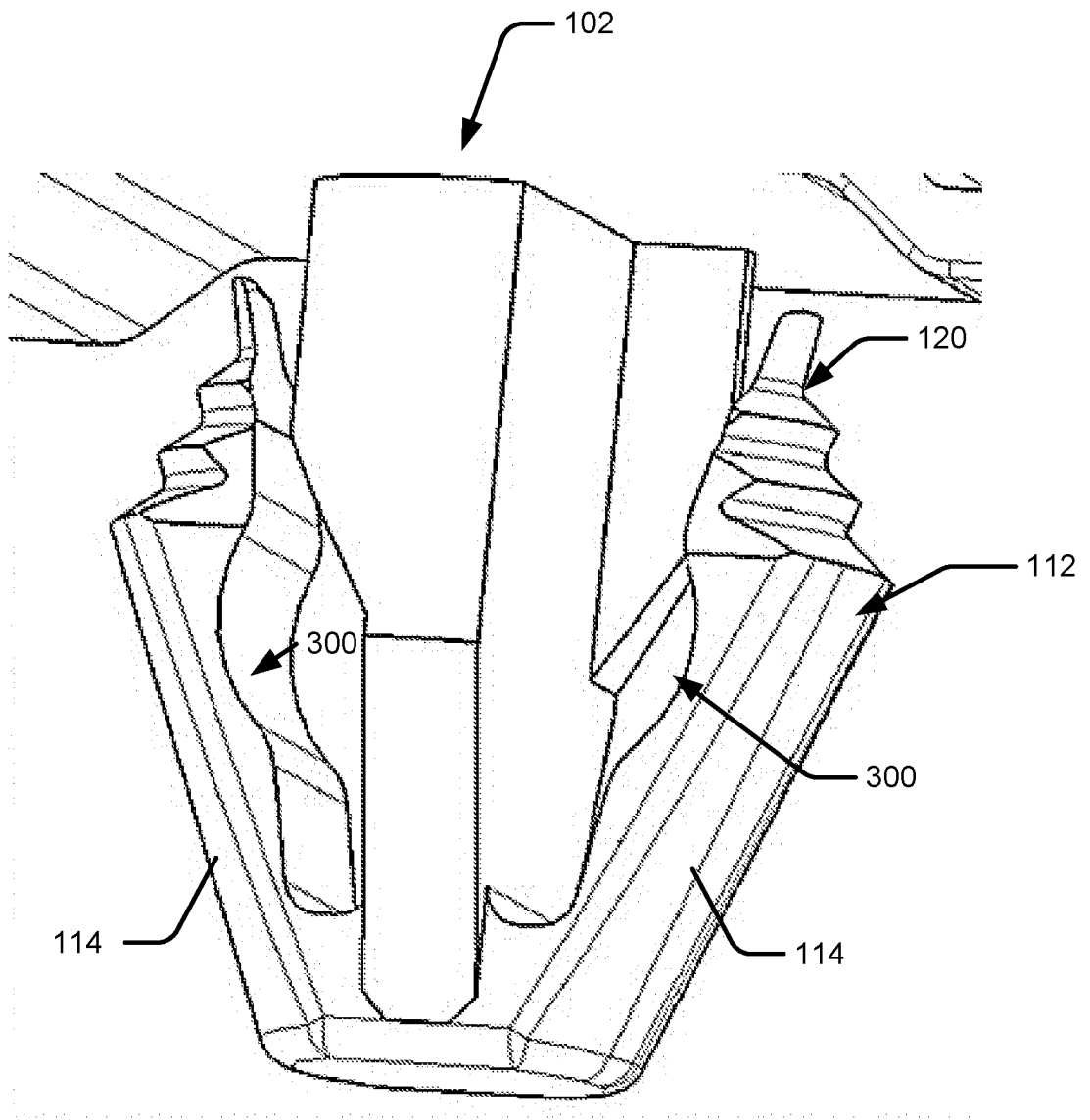


Figure 3B

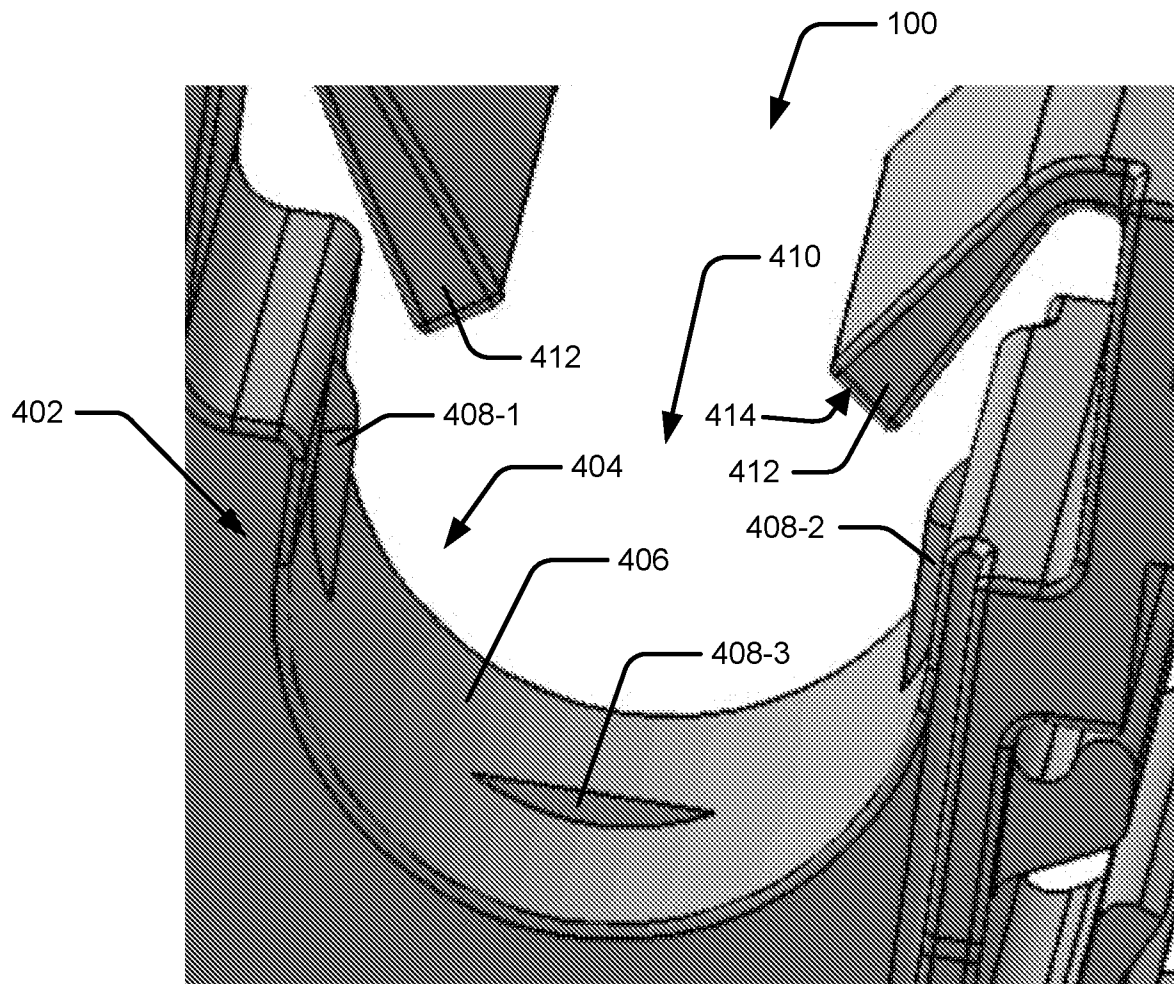


Figure 4A

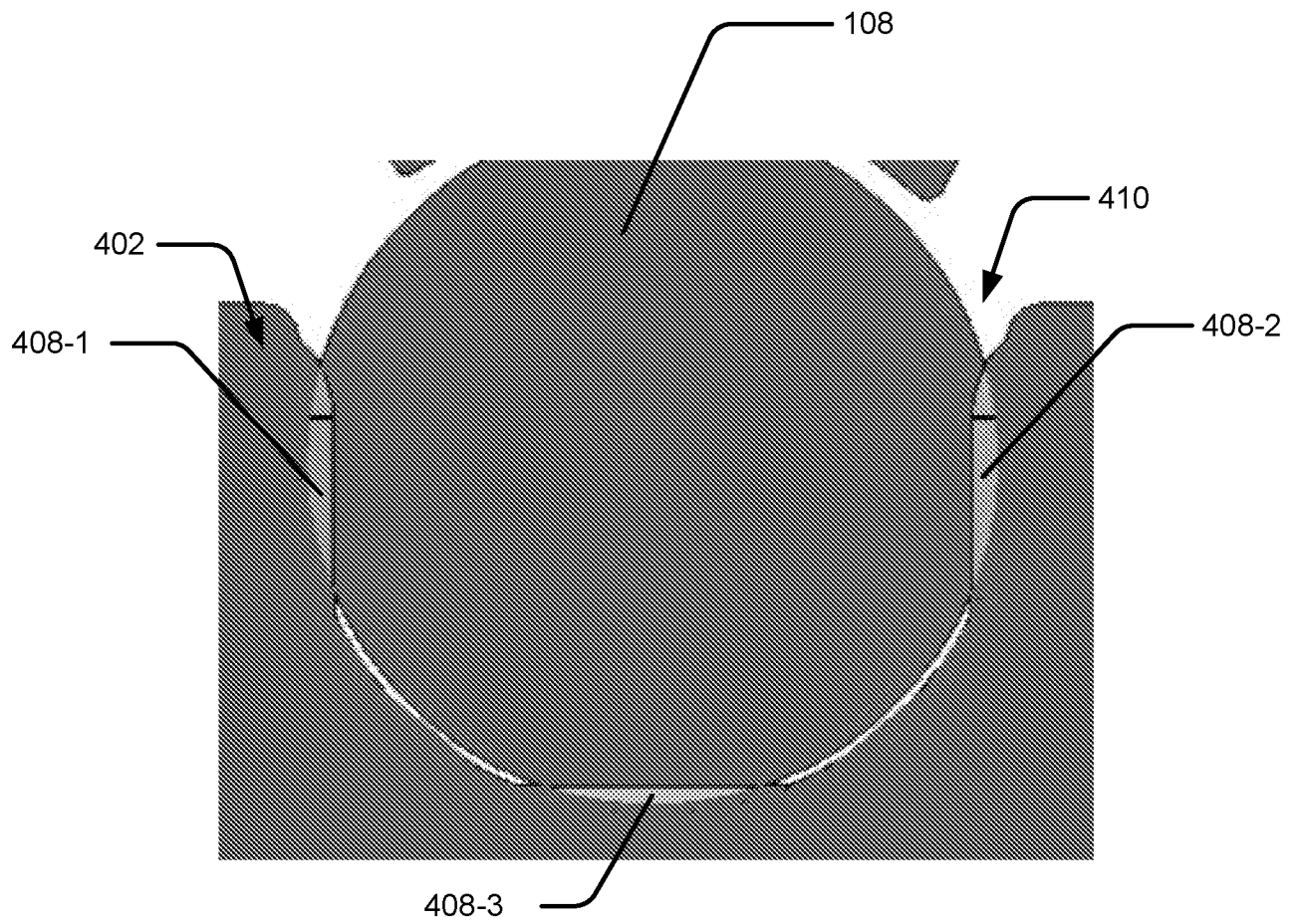


Figure 4B

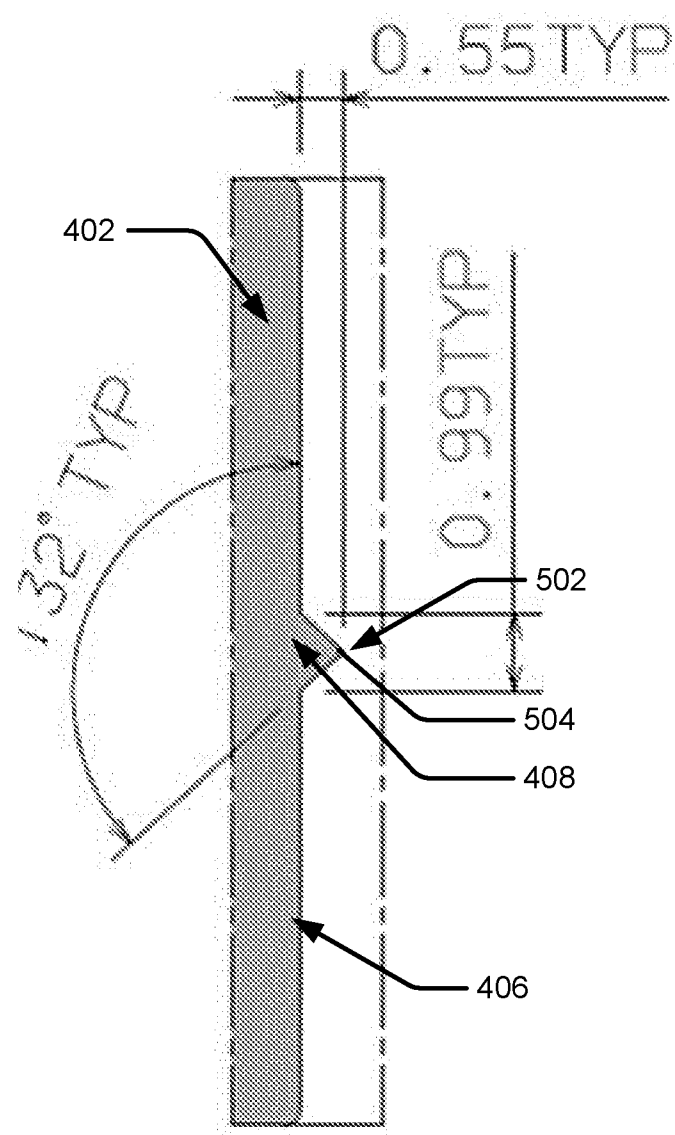


Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/046829

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16B5/12 F16B21/08 B60T17/04 F16L3/223
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)
F16B B60T F16L

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2017/219126 A1 (KATO HIROYUKI [JP]) 3 August 2017 (2017-08-03) Figures 1A-2D; Paragraphs 7-17 -----	1-22
X	EP 1 858 130 A2 (HELLERMANNTYTON CO LTD [JP]) 21 November 2007 (2007-11-21) Figures 1-12; Claim 1 -----	1-14
X	US 2002/131846 A1 (KOJIMA TSUTOMU [JP] ET AL) 19 September 2002 (2002-09-19) Paragraph 44; Figures 7A-7C; Claims 1-6 -----	1-14
X	US 2008/296444 A1 (GEIGER GERARD G [US]) 4 December 2008 (2008-12-04) Claim 1; Paragraph 45; Figures 11-13 ----- -/-	1-14



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

24 October 2019

Date of mailing of the international search report

05/11/2019

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

Garmendia, Ion

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2019/046829

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/159779 A1 (KANIE HIDEKI [JP]) 11 June 2015 (2015-06-11)	15-22
A	Paragraphs 10,22; Claims 1,2,4,5,7; Figures 1-4 -----	8-14
X	GB 1 226 569 A (MAYR AF) 31 March 1971 (1971-03-31)	15-22
A	Claims 1,2,4-6; Figures 1-15 -----	8-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/046829

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2017219126 A1	03-08-2017	JP 2017137905 A US 2017219126 A1 WO 2017135339 A1	10-08-2017 03-08-2017 10-08-2017
EP 1858130 A2	21-11-2007	EP 1858130 A2 US 2007272807 A1	21-11-2007 29-11-2007
US 2002131846 A1	19-09-2002	FR 2822506 A1 GB 2373542 A JP 4299471 B2 JP 2002276633 A US 2002131846 A1	27-09-2002 25-09-2002 22-07-2009 25-09-2002 19-09-2002
US 2008296444 A1	04-12-2008	US 2007023586 A1 US 2008296444 A1	01-02-2007 04-12-2008
US 2015159779 A1	11-06-2015	BR 112014026045 A2 JP 6401153 B2 JP 2015526656 A JP 2018165575 A US 2015159779 A1 WO 2013188473 A1	27-06-2017 03-10-2018 10-09-2015 25-10-2018 11-06-2015 19-12-2013
GB 1226569 A	31-03-1971	AT 268421 B BE 714309 A CH 471482 A DE 1765140 A1 DK 122697 A DK 122697 B FR 1566861 A GB 1226569 A NL 6805799 A SE 330196 B	10-02-1969 16-09-1968 15-04-1969 01-07-1971 24-10-2019 27-03-1972 09-05-1969 31-03-1971 29-10-1968 09-11-1970