



(51) International Patent Classification:

F16L 3/10 (2006.01) *F02M 35/10* (2006.01)
F16L 23/08 (2006.01) *F02B 39/00* (2006.01)
F01N 13/18 (2010.01) *F16B 37/04* (2006.01)

(21) International Application Number:

PCT/EP2015/065591

(22) International Filing Date:

8 July 2015 (08.07.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1412221.2 9 July 2014 (09.07.2014) GB

(71) Applicant: **JAGUAR LAND ROVER LIMITED**
 [GB/GB]; Abbey Road, Whitley, Coventry Warwickshire
 CV3 4LF (GB).

(72) Inventors: **BRINKMANN, Karsten**; c/o Jaguar Land
 Rover, Patents Department W/1/073, Abbey Road, Whit-
 ley, Coventry Warwickshire CV3 4LF (GB). **PIERCE,**
Jonathan; c/o Jaguar Land Rover, Patents Department
 W/1/073, Abbey Road, Whitley, Coventry Warwickshire
 CV3 4LF (GB).

(74) Agent: **HOLMES, Matthew**; c/o Jaguar Land Rover, Pat-
 ents Department W/1/073, Abbey Road, Whitley, Coventry
 Warwickshire CV3 4LF (GB).

(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, 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, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
 GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: IMPROVED FASTENING DEVICE

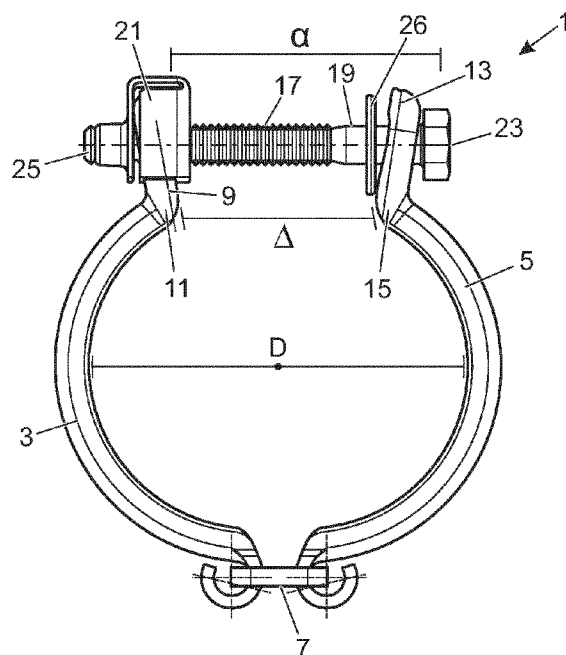


Figure 1a

(57) Abstract: Fastening device comprising a band clamp, a fastening bolt (19) and a fastening nut (21, 47). The clamp comprises a band with first and second end flanges (9, 13) extending outward from respectively first and second ends (11, 15) of the band. The bolt (19) comprises a threaded shank (17). The flanges (9, 13) can be drawn together via the bolt (19), in order to tighten the clamp. The nut (21, 47) comprises: a first side wall (27) comprising a first face (31) and an alignment hole (37) for guiding the shank (17) through the first side wall (27); a second side wall (29, 49) comprising a second face (33) having a threaded bore (39) aligned with the hole (37) and arranged to engage the shank (17). The faces (31, 33) are arranged in spaced, opposing relation and are joined together by a spacing wall (35). The first side wall (27), the second side wall (29, 49) and the spacing wall (35) define a volume (43) arranged to receive the first end flange (9) of the clamp between the faces (31, 33), such that in use as the shank (17) is guided through the hole (37) and the first end flange (9), the first face (31) abuts with the first end flange (9) to restrict displacement of the nut (21, 47) relative to the bolt (19) in a direction parallel to a length of the shank (17) to facilitate engagement of the shank (17) with the threaded bore (39).



Published:

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

Improved Fastening Device

TECHNICAL FIELD

5 The present invention relates to an improved fastening device for joining tubular bodies together, such as vehicle exhaust system components. The invention also relates to an exhaust system of a vehicle comprising a fastening device for joining tubular bodies.

BACKGROUND

10 Band clamps, including V-band clamps, are widely known in the art. Band clamps generally comprise an elliptically shaped band (e.g. a circularly shaped band) extending from a first band end to a second band end. The first and second band ends are configured with a clamp tightening mechanism for bringing the first and second band ends together. The clamp tightening mechanism typically comprises first and second end flanges extending
15 outward, respectively, from the first and second band ends. The first and second end flanges are movable towards each other in order to tighten the band clamp, and are also movable away from each other to loosen the band clamp. The tightening mechanism further comprises a fastening bolt having an at least partly threaded shank and a fastening nut. The fastening nut comprises a threaded portion suitable for engagement with the fastening bolt's
20 at least partly threaded shank. The first and second end flanges are configured with alignable bolt holes for receiving the fastening bolt's shank. To fasten the band clamp in place, the shank of the fastening bolt is passed through both alignable bolt holes, such that the bolt head is seated on the outside surface of the first end flange, and the at least partly threaded shank exits through the bolt hole of the second end flange and is engaged with the
25 threaded portion of the fastening nut seated on the outside surface of the second end flange. The first and second end flanges are brought closer together to tighten the band clamp by varying the position of engagement of the nut along the length of the shank. Specifically, the band clamp is tightened by reducing the distance of separation between the position of engagement of the nut along the bolt shank and the bolt head, and loosened by increasing
30 the distance of separation between the position of engagement of the nut along the bolt shank and the bolt head.

A V-band clamp is a special class of band clamp. The clamp comprises two ribs joined at one end by a joint, enabling each rib to rotate freely relative to the other rib. In a majority of
35 applications the ribs are semi-circular in shape, although other shapes are also provided for and selected to complement the shape of the object around which the clamp is to be affixed.

The free end of each rib comprises one of the first and second end flanges of the clamp tightening mechanism. The joint facilitates fixation of the band around tubular-shaped objects, but the V-band clamp is otherwise structurally substantially similar to the afore-described band clamp.

5

A shortcoming of traditional band clamps, including V-band clamps, is that the fastening nut must be firmly held in place with respect to the bolt shank, to enable engagement of the shank thread with the nut thread. This is often achieved by using a tool, such as a wrench or a socket tool, to aid a user in holding the fastening nut firmly in place whilst the fastening bolt is engaged. In practice, a user is required with one hand to hold the fastening nut in place using the tool, and with the other free hand to drive the fastening bolt for engagement with the nut. This presents significant difficulties and discomfort to an operator working in areas with reduced space, such as engine compartments, or exhaust systems, where often there is insufficient space to enable the operator to simultaneously hold the fastening nut in place and to drive the fastening bolt for engagement with the nut.

10
15

It is an object of the present invention to provide an improved fastening device, which does not suffer from the shortcomings of the prior art, and which enables one-handed assembly and operation.

20

SUMMARY OF INVENTION

According to an aspect of the invention, there is provided a fastening device comprising a band clamp, a fastening bolt and a fastening nut. The band clamp comprises a band configured with first and second end flanges extending outward from respectively first and second ends of the band. The fastening bolt comprises a shank provided with first engagement means, for example the first engagement means being in the form of a screw thread, the first and second end flanges being arranged in confronting relation and being arranged to be drawn together via the fastening bolt in order to bring the first and second band ends together for tightening the clamp. The fastening nut comprises: a first side wall comprising a first face having an alignment hole for guiding the shank of the fastening bolt through the first side wall; a second side wall comprising a second face having second engagement means, for example in the form of a threaded bore, aligned with the alignment hole of the first side wall and arranged to engage the first engagement means of the shank. The first and second faces are arranged in spaced, opposing relation and are joined together by a spacing wall extending between the first and second faces. The first side wall and the second side wall define a volume arranged to receive the first end flange of the band clamp

25
30
35

between the first and second faces, such that in use as the shank is guided through the alignment hole and the first end flange, the first face abuts with the first end flange to restrict displacement of the fastening nut relative to the fastening bolt in a direction parallel to a length of the shank to facilitate engagement of the shank with the second engagement means of the fastening nut. In this way, a user may operate the fastening device using a single hand. Displacement of the fastening nut is restricted by the arrangement of first side wall and second side wall, which arrangement defines the volume arranged to receive the first end flange between the first and second faces. Accordingly, as the operator guides the bolt shank through the alignment hole and the first end flange the fastening nut is displaceable in a direction parallel to the bolt shank until the first face abuts with the first end flange, and subsequent displacement of the fastening nut in a direction parallel to the bolt shank is prevented as the bolt shank engages with the fastening nut's second engagement means. In this way the bolt shank may be engaged with the fastening nut without requiring the operator to hold the nut in place relative to the fastening bolt. This is particularly advantageous when using the fastening device in restricted spaces, such as within engines or exhaust systems. A further advantage of the fastening device results from its modular design. Since the band and the fastening nut are separable, each is individually replaceable as required. For example, for maintenance purposes. This advantage arises as a direct result of the fastening nut's configuration, which is configured to receive the first end flange of the band clamp (e.g. it rests over the flange, and is not otherwise formed integral with the clamp, or fixated thereto). This configuration enables the fastening nut to be removed with ease and exchanged, without also having to exchange the clamp. Similarly, the clamp may be exchanged independently from the fastening nut by disengaging the fastening nut from the clamp. The fastening nut may also be easily replaced with a fastening nut having a different sized threaded bore as may be required for a specific application. In this way, the configuration of the fastening device also facilitates the swapping and interchanging of different fastening nuts with different sized clamps as required.

The fastening device may comprise a rotation arresting member extending between the first and second faces of the fastening nut. The rotation arresting member is arranged in use to abut with the band clamp's band when the fastening nut is rotated relative to the band clamp, such that in use as the shank engages with the second engagement means of the fastening nut, the fastening nut is rotatable until the rotating arresting member abuts with the band clamp thereby restricting rotation of the fastening nut relative to the fastening bolt. Once the rotation arresting member abuts with the band clamp the fastening bolt is rotatable relative to the rotation arresting member. This enables the bolt shank to engage with the

fastening nut. This feature advantageously improves the ease with which the fastening bolt's shank engages with the fastening nut's engagement means, and is achieved by restricting rotation of the fastening nut relative to the fastening bolt.

5 The fastening nut's spacing wall may be configured as the rotation arresting member. In this way, advantageously, the fastening nut's spacing wall restricts rotation of the fastening nut relative to the fastening bolt, thus facilitating engagement of the fastening bolt with the fastening nut.

10 The fastening device's fastening nut may comprise at least one edge wall extending between the first and second faces, and wherein the edge wall is configured as the rotation arresting member. The at least one edge wall further restricts the rotation of the fastening nut relative to the fastening bolt.

15 In certain embodiments the at least one edge wall may be arranged substantially perpendicular to the spacing wall.

The second engagement means may comprise a threaded bore suitable for receiving the at least partly threaded shank of the fastening bolt. This enables the bolt shank to engage with the fastening nut, for tightening or loosening of the band clamp.

20

The threaded bore may comprise a threaded cylinder. This improves the grip with which the bolt shank is gripped, by distributing stress over a greater threaded surface area, and also by increasing the surface area that engages with the shank thread.

25 The threaded cylinder may be arranged to extend substantially perpendicular with respect to the second side wall of the fastening nut.

The alignment hole of the fastening nut may form a filleted edge with the first side wall. This helps to guide the bolt shank through the first end flange for engagement with the second engagement means of the fastening nut. This is particularly useful when the fastening device is used in a setting where the operator does not have a direct line of sight of the fastening device, and guiding the bolt shank through the end flange can prove difficult. The filleted edge helps to guide the shank through the end flange, without first requiring that the bolt shank and the alignment hole are perfectly aligned, as would otherwise be required.

35

The first side wall, the second side wall and the spacing wall of the fastening nut may be formed from a single sheet of material. Similarly, the at least one edge wall of the fastening nut may be formed from the same sheet of material as the first side wall, the second side wall and the spacing wall. This greatly simplifies manufacturing of the fastening nut. The material may comprise a metal, and/or a plastic.

The fastening device's band clamp may relate to a V-band clamp.

Another aspect of the invention relates to a fastening device comprising a band clamp, a fastening bolt and a fastening nut. The band clamp comprises a band configured with first and second end flanges extending outward from respectively first and second ends of the band. The fastening bolt comprises a shank provided with first engagement means, the first and second end flanges being arranged in confronting relation and being arranged to be drawn together via the fastening bolt in order to bring the first and second band ends together for tightening the clamp. The fastening nut comprises: a first side wall comprising a first face, the first side wall having an alignment hole for guiding the shank of the fastening bolt through the first side wall; a second side wall comprising a second face having second engagement means aligned with the alignment hole of the first side wall and arranged to engage the first engagement means of the shank of the fastening bolt, the first and second faces being arranged in spaced, opposing relation and being joined together by a spacing wall extending between the first and second faces; and at least one edge wall extending between the first and second faces. The first side wall, the second side wall, the at least one edge wall, and the spacing wall define a volume arranged to receive the first end flange of the band clamp between the first and second faces, such that in use as the shank is guided through the alignment hole and the first end flange, the first face abuts with the first end flange to restrict displacement of the nut relative to the fastening bolt in a direction parallel to a length of the shank to facilitate engagement of the first engagement means of the shank with the second engagement means of the fastening nut. The at least one edge wall is arranged in use to abut with the band when rotated relative to the band clamp, such that in use as the first engagement means of the shank engages with the second engagement means of the fastening nut, the fastening nut is rotatable until the at least one edge wall abuts with the band clamp thereby restricting rotation of the fastening nut relative to the fastening bolt. In this way, displacement of the fastening nut in a direction parallel to the length of the shank and rotation of the fastening nut is restricted relative to the fastening bolt, thus facilitating engagement of the bolt shank with the fastening nut. Furthermore, the fastening device may be operated with a single hand. This aspect of the invention functions

in a substantially similar was as preceding aspects and also benefits from the same advantages.

5 According to another aspect of the invention, there is provided a vehicle comprising a turbocharger and an exhaust system, the turbocharger being connected to the exhaust system via the previously described fastening device.

A further aspect of the invention relates to a fastening nut for use with the aforementioned fastening device.

10

A further aspect of the invention relates to a vehicle comprising the aforementioned fastening device.

15 Yet a further aspect of the invention relates to an assembly comprising a turbocharger and an exhaust system, the turbocharger being connected to the exhaust system via the aforementioned fastening device.

Further aspects and features of the invention are disclosed in the ensuing detailed description.

20

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. Features described in connection with one embodiment are applicable to all embodiments, unless such features are incompatible.

25

BRIEF DESCRIPTION OF THE DRAWINGS

30 One or more embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figures 1a, 1b, 1c and 1d are schematic illustrations of a fastening device in accordance with an aspect of the invention, the fastening device comprising a band clamp, specifically a V-band clamp, a fastening bolt and a fastening nut, and wherein:

35

Figure 1a is a front view of the fastening device;

Figure 1b is a side view of the fastening device;

Figure 1c is a perspective view of the fastening device; and

Figure 1d is a top view of the fastening device;

- 5 Figures 2a, 2b, 2c and 2d are schematic illustrations of the fastening nut of Figures 1a to 1d, and wherein:

Figure 2a is a front view of the fastening nut's first side wall;

- 10 Figure 2b is a side view of the fastening nut showing an edge wall of the fastening nut;

Figure 2c is a perspective view of the fastening nut; and

Figure 2d is a top view of the fastening nut, which shows the fastening nut's spacing wall;

- 15 Figures 3a, 3b, 3c and 3d are schematic illustrations of an alternative fastening nut for use with the band clamp and fastening bolt of Figures 1a to 1d, in accordance with an alternative embodiment of the invention, wherein:

Figure 3a is a front view of the fastening nut's first side wall;

- 20 Figure 3b is a side view of the fastening nut;

Figure 3c is a perspective view of the fastening nut; and

Figure 3d is a top view of the fastening nut, showing the fastening nut's spacing wall;

- 25 Figure 4 is a schematic cut-away side view diagram of a turbo fixated to an exhaust with the fastening device of Figures 1a, 1b, 1c and 1d; and

Figure 5 is a perspective illustration of a vehicle comprising the fastening device of any one of Figures 1a, 1b, 1c, 1d and/or the nut of Figures 2a, 2b, 2c, 2d or Figures 3a, 3b, 3c, 3d.

30 DETAILED DESCRIPTION

- Figures 1a through 1d illustrate different schematic views of a fastening device 1 in accordance with an embodiment of the invention. The fastening device 1 comprises a band clamp, which in the illustrated embodiment is a V-band clamp comprising a first rib 3 and a second rib 5, the ribs being joined at one end by a joint 7. The joint 7 enables each rib 3, 5 to rotate about the joint 7 independently from the other rib. The first rib 3 comprises a first end flange 9 extending outward from a first band end 11. Likewise, the second rib 5 comprises a
- 35

second end flange 13 extending outward from a second band end 15. The first and second end flanges 9, 13 are each configured with a hole arranged to receive a shank 17 of a fastening bolt 19. The shank 17 is provided with first engagement means in the form of a screw thread. The holes allow the shank 17 to pass through each end flange 9, 13 such that the fastening bolt head 23 abuts the second end flange 13, and the shank's free end 25 extends through the first end flange 9 where it is arranged for engagement with a fastening nut 21. The first and second end flanges 9, 13 are arranged in confronting relation, and are arranged to be drawn together via the fastening bolt 19, in order to bring the first and second band ends 11, 15 closer together to tighten the fastening device – e.g. by shortening the distance of separation Δ between the first and second band ends 11, 15. Similarly, the fastening device 1 is loosened by increasing the distance of separation Δ between the first and second band ends 11, 15. In this way, the diameter D of the fastening device 1 is varied to accommodate fixation around tubular-shaped objects, such as vehicle exhaust components for example.

The fastening bolt's threaded shank 17 is configured to engage with the fastening nut 21 in order to fixate the distance of separation Δ between the first and second band ends 11, 15. To this end, the fastening nut 21 is configured with second engagement means in the form of a threaded bore suitable for engagement with the screw thread of the bolt shank 17. The first and second band ends 11, 15 are drawn together or driven apart by varying the position of engagement of the fastening nut's engagement means along the length of the threaded shank 17. This is achieved by rotating the threaded shank 17 relative to the fastening nut 21, and specifically by rotating the threaded shank 17 relative to the fastening nut's second engagement means. Conventionally, a clockwise rotation of the shank 17 relative to the fastening nut 21 decreases a distance of separation α between the bolt head 23 and the position of engagement of the fastening nut's engagement means along the length of the bolt shank 17, to tighten the fastening device. Similarly, an anti-clockwise rotation of the shank 17 relative to the fastening nut 21 increases the distance of separation α between the bolt head 23 and the position of engagement of the fastening nut's engagement means along the length of the bolt shank 17. The fastening device 1 also comprises a washer 26 fitted to the bolt 19, and located between the first and second end flanges 9, 13.

Figures 2a, 2b, 2c and 2c illustrate different perspective views of the fastening nut 21. The fastening nut 21 comprises a first side wall 27, and a second side wall 29, both of which are visible in Figures 2b, 2c and 2d. The first side wall 27 comprises a first face 31, which is obscured in Figure 2a but is indicated with a broken line in Figures 2b and 2c. Similarly, the

second side wall 29 comprises a second face 33, visible in Figures 2b and 2c. The first face 31 and the second face 33 are arranged in spaced, opposing relation, and are joined together by a spacing wall 35, which extends between the two faces 31, 33. The first side wall 27 is configured with an alignment hole 37 suitable for guiding the fastening bolt's shank 17 through the first side wall 27 and into second engagement means 39 in the form of a threaded bore comprised in the second side wall 29. The alignment hole 37 is visible in Figures 2a and 2c. The alignment hole may be threaded in certain embodiments.

In the embodiment illustrated in Figures 2b, 2c and 2d the second engagement means comprises a threaded cylinder 41 aligned with the alignment hole 37, and arranged to receive and engage with the fastening bolt's shank 17. Accordingly, the diameter of the threaded cylinder is complementary to the diameter of the bolt shank. The threaded cylinder 41 is arranged to extend substantially outward from and perpendicular to the second side wall 29. The threaded cylinder 41 improves shank grip, by distributing stress over a greater threaded surface area, and also by increasing the surface area that engages with the shank thread. Alternative engagement means configurations are envisaged that fall within the scope of the present invention, and which achieve the same desired effect. One of these alternatives is discussed below in relation to Figures 3a to 3d.

The first side wall 27, the second side wall 29, and the spacing wall 35 define a volume 43 arranged to receive the fastening device's first end flange 9. The fastening nut's first and second side walls 27, 29 and the spacing wall 35 bound a volume 43, which is located within the fastening nut 21 and has been indicated in Figure 2b via the broken line. The volume 43 is suitable for receiving the first end flange 9.

In use, the fastening nut 21 sits atop the first end flange 9, which is received within the defined volume 43, as shown in Figures 1a, 1c, and 1d. The threaded cylinder 41, and the alignment hole 37 are configured to both align with the hole present in the first end flange 9, such that the bolt shank 17 may be passed through the alignment hole 37 and the first end flange 9 for engagement with the threaded cylinder 41. As the fastening bolt shank 17 is guided through the alignment hole 37 and the first end flange 9, the nut's first face 31 abuts with the first end flange 9, such that displacement of the fastening nut 21 relative to the fastening bolt 19, in a direction parallel to a length of the bolt shank 17, is restricted. Restricting the movement of the fastening nut 21 relative to the fastening bolt 19 facilitates engagement of the bolt shank 17 thread with the threaded cylinder 41, such that thread

engagement is achievable without the necessity of an operator holding the nut 21 in place relative to the fastening bolt 19, using a tool or otherwise.

The fastening device, and specifically the fastening nut comprises a rotation arresting member extending between the nut's first and second faces. The rotation arresting member is arranged in use to abut with the band when the fastening nut is rotated relative to the band clamp, in order to restrict rotation of the nut relative to the fastening bolt. Restricting rotation of the nut relative to the bolt shank further improves the ease with which the bolt shank 17 is engageable with the fastening nut's second engagement means. In this way, both displacement of the nut in a direction parallel to the length of the bolt shank and rotation relative to the bolt shank are restricted. This facilitates engagement with the fastening nut's second engagement means when the fastening bolt 19 is tightened by clockwise rotation of the bolt shank 17 relative to the fastening nut 21, and facilitates disengagement of the bolt shank from the second engagement means when the bolt shank 17 is rotated in an anti-clockwise direction relative to the fastening nut 21, without requiring that the fastening nut 21 be independently held in place relative to the fastening bolt 19.

In certain embodiments the fastening nut 21 comprises at least one edge wall arranged substantially perpendicular to the spacing wall 35. In the embodiment illustrated in Figures 2a, 2b, 2c and 2d, the fastening nut 21 comprises two edge walls extending between the first and second faces 31, 33. A first edge wall 45 is visible in Figures 2b and 2c. The second edge wall, which is not visible in Figures 2b and 2c, is arranged in confronting relation relative to the first edge wall 45. The first edge wall 45 and second edge wall, in combination with the first and second side walls 27, 29, and the spacing wall 35 further bound the defined volume 43 arranged to receive the first end flange 9. In use, once the fastening nut 21 is fitted to the first end flange 9, the first edge wall 45 is configured to abut with the band clamp, in order to arrest rotation of the fastening nut 21 relative to the bolt shank 17. For example, and depending on the size of the fastening nut 21, the first edge wall 45 is arranged to abut with any one of the first end flange 9, the first band end 11, or the first rib 3, as the fastening nut 21 rotates in a clockwise direction relative to the bolt shank 17. Similarly, the second edge wall is arranged to abut with any one of the first end flange 9, the first band end 11, or the first rib 3, as the fastening nut 21 rotates in an anti-clockwise direction relative to the bolt shank 17. The first edge wall and the second edge wall are arranged substantially perpendicular to the spacing wall 35 and to the first and second faces 31, 33.

Alternative configurations of rotation arresting member are envisaged which do not require a first or second edge wall, such as the embodiment illustrated in Figures 3a to 3d and discussed below. It is to be appreciated that the fastening nut 21 of Figures 2a to 2d could function equally well if configured with one edge wall. In such embodiments, the function of the rotation arresting member may be carried out by different structural elements of the fastening nut depending on the relative direction of rotation of the fastening nut 21 relative to the bolt shank 17. For example, if the fastening nut 21 is configured with the first edge wall 45 only, then the first edge wall 45 acts as the rotation arresting member for clockwise rotation of the fastening nut 21 relative to the bolt shank 17, whilst the spacing wall 35 acts as the rotation arresting member for anti-clockwise rotation of the fastening nut 21 relative to the bolt shank 17.

Figures 3a, 3b, 3c, and 3d illustrate an alternative embodiment of the fastening nut 47. The illustrated fastening nut 47 shares all the same structural features with the embodiment illustrated in Figures 2a to 2d with the exception of the first edge wall 45 and the second edge wall, which are both absent. Furthermore, the second side wall differs from the second side wall 29 of previous embodiments in that the second side wall is a reinforced second side wall 49, which is substantially thicker than the second side wall 29 of the previous embodiment. For clarity, in Figures 3a to 3d features common to the embodiment illustrated in Figures 2a to 2d share the same numbering, whereas differing features are numbered differently.

In the embodiment illustrated in Figures 3a to 3d, the spacing wall 35 is configured as the rotation arresting member, and is configured to abut with any one of the first end flange 9, or the first band end 11, in use as the fastening nut 47 rotates relative to the bolt shank 17 to restrict rotation of the fastening nut 47 relative to the bolt shank 17. The reinforced second side wall 49 is configured with the second engagement means 39 in the form of the threaded bore, which is completely contained within the reinforced second side wall 49 and is indicated by the hatched line in Figures 3b and 3c. The reinforced second side wall 49 provides similar advantages to the threaded cylinder 41 of the previous embodiment – namely, it improves shank grip, by distributing stress over a greater threaded surface area, and by increasing the surface area that engages with the shank thread. Furthermore, the reinforced second side wall 49 is very robust and is well suited to withstand the inevitable wear and tear, which occurs through normal use.

In addition, the embodiment illustrated in Figures 3a to 3d may be readily manufactured, for example in a press.

5 The fastening nut 47 of Figures 3a to 3d is fitted to the band clamp's first end flange 19 in the same way as described in relation to the embodiment of Figures 2a to 2d. In particular, the first side wall 27, the reinforced second side wall 49 and the spacing wall 35 define the volume 43 arranged to receive the first end flange 19. The fastening nut 47 benefits from the same advantages as the previously described fastening nut 21, in particular when used in combination with a band clamp, comprising the V-band clamp of Figures 1a to 1d. In use, an operator can engage the bolt shank 17 with the fastening nut 47 without having to fixate the fastening nut 47 in place relative to the bolt shank 17. In this way, and when fitted to a band clamp, the fastening nut 47 enables one handed operation, and specifically one handed tightening and/or loosening of the band clamp.

15 In certain embodiments, the alignment hole 37 forms a filleted edge with the first side wall 27. The filleted edge helps to guide the bolt shank 17 through the first end flange 9 for engagement with the engagement means. This is particularly beneficial when working in confined spaces where the operator does not have a direct line of sight of the fastening device, and passing the bolt shank 17 through the end flanges of the fastening device and the first and second sidewalls 27, 29 of the fastening nut 21, 47 can prove particularly difficult. The alignment hole 37 also provides support to resist rotation of the nut 21, 47 in reaction to contact of the spacing wall 35 with, for example, any one of the first end flange 9, the first band end 11, or the first rib 3.

25 It is also to be appreciated that in use the first face 31 of the fastening nut 21, 47 abuts with the first end flange 9 as the bolt shank 17 is pressed into the second engagement means 39, thereby restricting displacement of the fastening nut 21, 47 relative to the bolt 19, in a direction along the length of the bolt 19. This improves engagement of the bolt shank 17 with the second engagement means 39.

30 In certain embodiments the fastening nut is manufactured from a single sheet of material, which material is metal. For example, the fastening nut 21 of Figures 2a to 2d is fashioned from a single sheet of metallic material. This comprises printing an outline of the fastening nut 21 on the metallic sheet. Fold lines are scored on the outline, indicating where the sheet is folded in order to obtain the fastening nut configuration illustrated in Figures 2a to 2d. The threaded cylinder 41 is pressed out of the metallic sheet or is welded to the second side wall

35

29, in order to provide a robust engagement means for the bolt shank 17. However, the fastening nut can also be manufactured from other materials, and such alternative materials fall within the scope of the present invention.

5 The fastening nuts of the present invention have been described for use with band clamps, and in particular V-band clamps. However, it is to be appreciated that the fastening nuts of the present invention could also be used with other types of fastening device where one-handed engagement of the bolt shank with the fastening nut is required, and such alternatives fall within the scope of the present invention.

10

The improved fastening device of the present invention is particularly suited for use in joining tubular shaped objects, such as exhaust system components together. In particular, the fastening device of the present invention is suited for use in joining a turbo charger to an exhaust system, as illustrated in Figure 4.

15

In particular, Figure 4 is a cut-away side view illustration of an exhaust 50 joined to a turbo charger 52 comprised in a vehicle 54 illustrated in Figure 5. The turbo charger 52 comprises a flanged lip 56 arranged for engagement with a flanged end 58 of the exhaust 50. The flanged end 58 of the exhaust and the flanged lip 56 of the turbo charger 52 are complimentary in shape, enabling them to be brought into abutting relation as illustrated. The point of contact between the flanged end 58 of the exhaust 50 and the flanged lip 56 of the turbo charger 52 defines a contact surface 60. In order to maintain the contact surface 60 (i.e. in order to maintain the flanged end 58 of the exhaust 50 in contact with the flanged lip 56 of the turbo charger 52) the fastening device 1 of the present invention is fastened around both the flanged end 58 of the exhaust 50 and the flanged lip 56 of the turbo charger 52. To improve grip, the fastening device is configured with a band having a V- or U-shaped cross-sectional profile as illustrated in Figure 4. In use, the band is placed over both the flanged lip 56 of the turbo charger 52 and the flanged end 58 of the exhaust. The fastening device 1 is tightened as described previously, in order to hold both the flanged lip 56 and the flanged end 58 together, and to ensure that a hermetic seal is generated to prevent the excretion of exhaust gases flowing between the turbo charger 52 and the exhaust 50.

20
25
30

Figure 5 is a perspective illustration of a vehicle 54 comprising the fastening device 1 of Figure 1. For example, the fastening device 1 may be used to join a turbo charger 52 together with an exhaust 50 as illustrated in Figure 4.

35

Further aspects and features of the invention are set out in the below clauses:

1. A fastening device comprising a band clamp, a fastening bolt and a fastening nut, the band clamp comprising a band configured with first and second end flanges extending outward from respectively first and second ends of the band, the fastening bolt comprising a shank provided with a first engagement member, the first and second end flanges being arranged in confronting relation and being arranged to be drawn together via the fastening bolt in order to bring the first and second band ends together for tightening the clamp, the fastening nut comprising:

a first side wall comprising a first face, the first side wall having an alignment hole for guiding the shank of the fastening bolt through the first side wall;

a second side wall comprising a second face having a second engagement member aligned with the alignment hole of the first side wall and arranged to engage the first engagement member of the shank of the fastening bolt, the first and second faces being arranged in spaced, opposing relation and being joined together by a spacing wall extending between the first and second faces; and wherein

the first side wall, the second side wall and the spacing wall define a volume arranged to receive the first end flange of the band clamp between the first and second faces, such that in use as the shank is guided through the alignment hole and the first end flange, the first face abuts with the first end flange to restrict displacement of the nut relative to the fastening bolt in a direction parallel to a length of the shank to facilitate engagement of the first engagement member of the shank with the second engagement member of the fastening nut.

2. The fastening device of clause 1, wherein the fastening nut comprises a rotation arresting member extending between the first and second faces, and arranged in use to abut with the band when rotated relative to the band clamp, such that in use as the first engagement member of the shank engages with the second engagement member of the fastening nut, the fastening nut is rotatable until the rotating arresting member abuts with the band clamp thereby restricting rotation of the fastening nut relative to the fastening bolt.

3. The fastening device of clause 2, wherein the spacing wall of the fastening nut is configured as the rotation arresting member.

4. The fastening device of clause 2, wherein the fastening nut comprises at least one edge wall extending between the first and second faces, and wherein the edge wall is configured as the rotation arresting member.
- 5 5. The fastening device of clause 4, wherein the at least one edge wall is arranged substantially perpendicular to the spacing wall.
6. The fastening device of clause 1, wherein the second engagement member comprises a threaded bore for receiving the at least partly threaded shank of the fastening bolt.
- 10 7. The fastening device of clause 6, wherein the threaded bore comprises a threaded cylinder for receiving the shank.
8. The fastening device of clause 7, wherein the threaded cylinder is arranged to extend
15 substantially perpendicular with respect to the second side wall of the fastening nut.
9. The fastening device of clause 1, wherein the alignment hole of the fastening nut forms a filleted edge with the first sidewall of the fastening nut.
- 20 10. The fastening device of clause 1, wherein the first side wall, the second side wall and the spacing wall of the fastening nut are formed from a single sheet of material.
11. The fastening device of clause 2, wherein the fastening nut comprises at least one edge wall extending between the first and second faces; the edge wall is configured as the
25 rotation arresting member; and the first side wall, the second side wall, the at least one edge wall and the spacing wall of the fastening nut are formed from a single sheet of material.
12. The fastening device of clause 10, wherein the material comprises a metal.
- 30 13. The fastening device of clause 11, wherein the material comprises a metal.
14. The fastening device of clause 1, wherein the band clamp is a V-band clamp.
- 35 15. A fastening nut for use with the fastening device of clause 1.
16. A vehicle comprising a turbocharger and an exhaust system, the turbocharger being connected to the exhaust system via a fastening device, the fastening device comprising

a band clamp, a fastening bolt and a fastening nut, the band clamp comprising a band configured with first and second end flanges extending outward from respectively first and second ends of the band, the fastening bolt comprising a shank provided with a first engagement member, the first and second end flanges being arranged in confronting relation and being arranged to be drawn together via the fastening bolt in order to bring the first and second band ends together for tightening the clamp, the fastening nut comprising:

a first side wall comprising a first face, the first side wall having an alignment hole for guiding the shank of the fastening bolt through the first side wall;

a second side wall comprising a second face having a second engagement member aligned with the alignment hole of the first side wall and arranged to engage the first engagement member of the shank of the fastening bolt, the first and second faces being arranged in spaced, opposing relation and being joined together by a spacing wall extending between the first and second faces; and wherein

the first side wall, the second side wall and the spacing wall define a volume arranged to receive the first end flange of the band clamp between the first and second faces, such that in use as the shank is guided through the alignment hole and the first end flange, the first face abuts with the first end flange to restrict displacement of the nut relative to the fastening bolt in a direction parallel to a length of the shank to facilitate engagement of the first engagement member of the shank with the second engagement member of the fastening nut.

17. The vehicle of clause 16, wherein the fastening nut comprises a rotation arresting member extending between the first and second faces, and arranged in use to abut with the band when rotated relative to the band clamp, such that in use as the first engagement member of the shank engages with the second engagement member of the fastening nut, the fastening nut is rotatable until the rotating arresting member abuts with the band clamp thereby restricting rotation of the fastening nut relative to the fastening bolt.

18. The vehicle of clause 17, wherein the spacing wall of the fastening nut is configured as the rotation arresting member.

19. The vehicle of clause 17, wherein the fastening nut comprises at least one edge wall extending between the first and second faces, and wherein the edge wall is configured as the rotation arresting member.

20. The vehicle of clause 19, wherein the at least one edge wall is arranged substantially perpendicular to the spacing wall.

5 21. The vehicle of clause 16, wherein the second engagement member comprises a threaded bore for receiving the at least partly threaded shank of the fastening bolt.

22. The vehicle of clause 21, wherein the threaded bore comprises a threaded cylinder for receiving the shank.

10 23. The vehicle of clause 22, wherein the threaded cylinder is arranged to extend substantially perpendicular with respect to the second side wall of the fastening nut.

15 24. The vehicle of clause 16, wherein the alignment hole of the fastening nut forms a filleted edge with the first sidewall of the fastening nut.

25. The vehicle of clause 16, wherein the first side wall, the second side wall and the spacing wall of the fastening nut are formed from a single sheet of material.

20 26. The vehicle of clause 17, wherein the fastening nut comprises at least one edge wall extending between the first and second faces; the edge wall is configured as the rotation arresting member; and the first side wall, the second side wall, the at least one edge wall and the spacing wall of the fastening nut are formed from a single sheet of material.

25 27. The vehicle of clause 25, wherein the material comprises a metal.

28. The vehicle of clause 26, wherein the material comprises a metal.

29. The vehicle of clause 16, wherein the band clamp is a V-band clamp.

30

CLAIMS

1. A fastening device comprising a band clamp, a fastening bolt and a fastening nut, the
5 band clamp comprising a band configured with first and second end flanges extending
outward from respectively first and second ends of the band, the fastening bolt
comprising a shank provided with first engagement means, the first and second end
flanges being arranged in confronting relation and being arranged to be drawn together
10 via the fastening bolt in order to bring the first and second band ends together for
tightening the clamp, the fastening nut comprising:

a first side wall comprising a first face, the first side wall having an alignment hole for
guiding the shank of the fastening bolt through the first side wall;

a second side wall comprising a second face having second engagement means
aligned with the alignment hole of the first side wall and arranged to engage the first
15 engagement means of the shank of the fastening bolt, the first and second faces being
arranged in spaced, opposing relation and being joined together by a spacing wall
extending between the first and second faces; and wherein

the first side wall, the second side wall and the spacing wall define a volume
arranged to receive the first end flange of the band clamp between the first and second
20 faces, such that in use as the shank is guided through the alignment hole and the first
end flange, the first face abuts with the first end flange to restrict displacement of the nut
relative to the fastening bolt in a direction parallel to a length of the shank to facilitate
engagement of the first engagement means of the shank with the second engagement
means of the fastening nut.

2. The fastening device of Claim 1, wherein the fastening nut comprises a rotation arresting
member extending between the first and second faces, and arranged in use to abut with
the band when rotated relative to the band clamp, such that in use as the first
engagement means of the shank engages with the second engagement means of the
30 fastening nut, the fastening nut is rotatable until the rotating arresting member abuts with
the band clamp thereby restricting rotation of the fastening nut relative to the fastening
bolt.

3. The fastening device of Claim 2, wherein the spacing wall of the fastening nut is
35 configured as the rotation arresting member.

4. The fastening device of Claim 2, wherein the fastening nut comprises at least one edge wall extending between the first and second faces, and wherein the edge wall is configured as the rotation arresting member.
- 5 5. The fastening device of Claim 4, wherein the at least one edge wall is arranged substantially perpendicular to the spacing wall.
6. The fastening device of any preceding Claim, wherein the second engagement means comprises a threaded bore for receiving the at least partly threaded shank of the
10 fastening bolt.
7. The fastening device of Claim 6, wherein the threaded bore comprises a threaded cylinder for receiving the shank.
- 15 8. The fastening device of Claim 7, wherein the threaded cylinder is arranged to extend substantially perpendicular with respect to the second side wall of the fastening nut.
9. The fastening device of any preceding Claim, wherein the alignment hole of the fastening nut forms a filleted edge with the first sidewall of the fastening nut.
20
10. The fastening device of any preceding Claim, wherein the first side wall, the second side wall and the spacing wall of the fastening nut are formed from a single sheet of material.
11. The fastening device of Claim 10 when dependent on Claim 4, wherein the at least one
25 edge wall of the fastening nut is formed from the same sheet of material as the first side wall, the second side wall and the spacing wall.
12. The fastening device of Claim 10 or 11, wherein the material comprises a metal.
- 30 13. The fastening device of any preceding claim, wherein the band clamp is a V-band clamp.
14. A fastening device comprising a band clamp and a fastening nut substantially as illustrated in any one of the appended figures.
- 35 15. A fastening nut for use with the fastening device of any preceding claim.
16. A vehicle comprising a turbocharger and an exhaust system, the turbocharger being connected to the exhaust system via the fastening device of any one of Claims 1 to 13.

17. A vehicle comprising the fastening device of any one of Claims 1 to 13.

18. An assembly comprising a turbocharger and an exhaust system, the turbocharger being
5 connected to the exhaust system via the fastening device of any one of Claims 1 to 13.

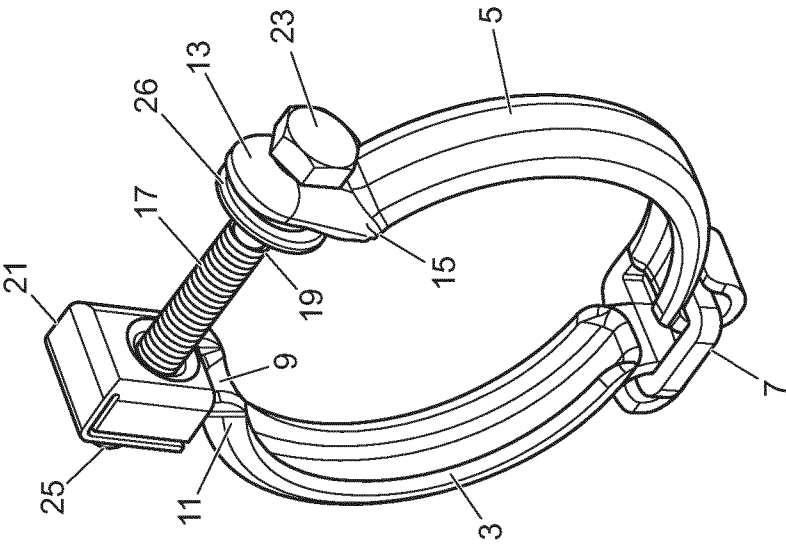


Figure 1c

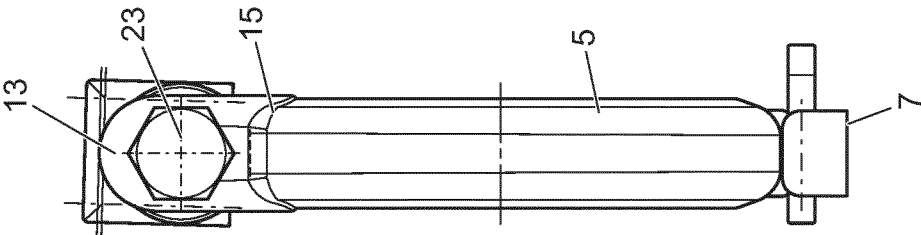


Figure 1b

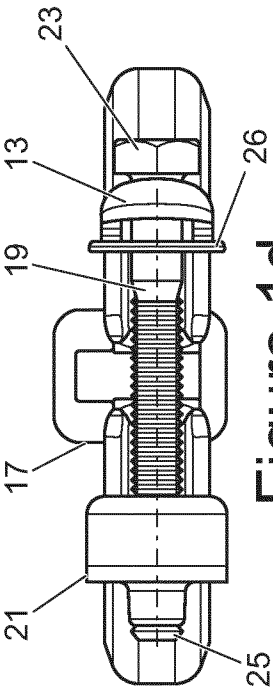


Figure 1d

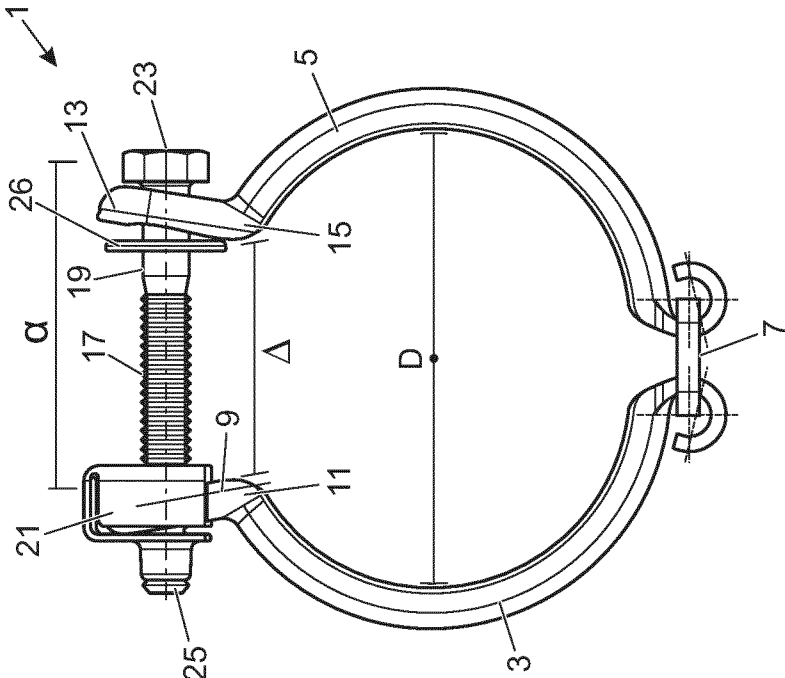


Figure 1a

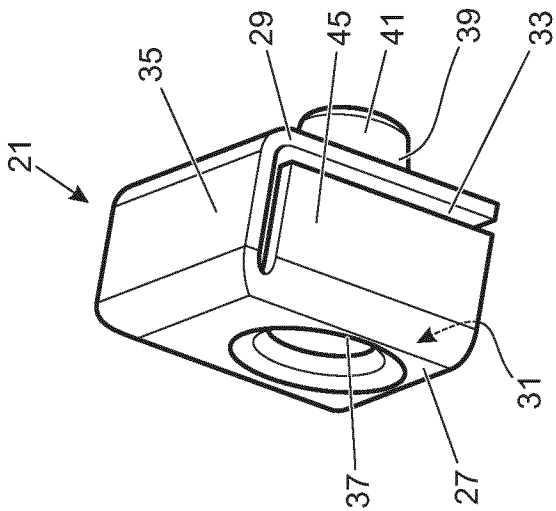


Figure 2c

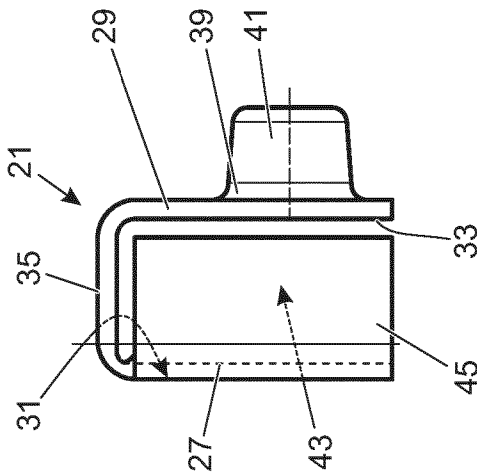


Figure 2b

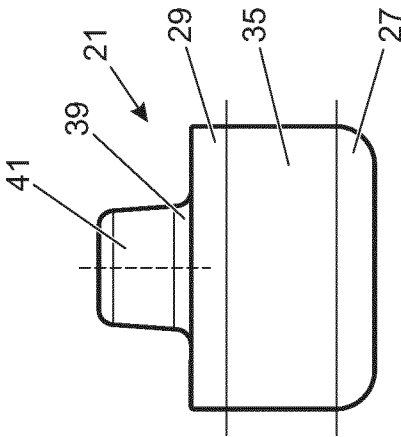


Figure 2d

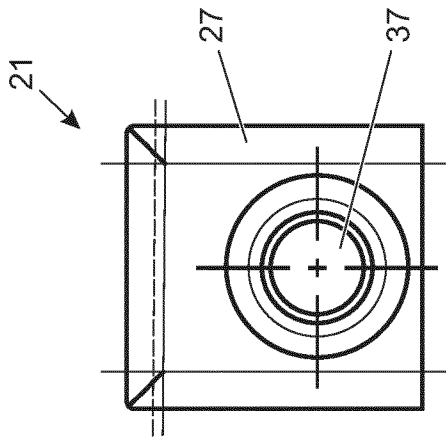


Figure 2a

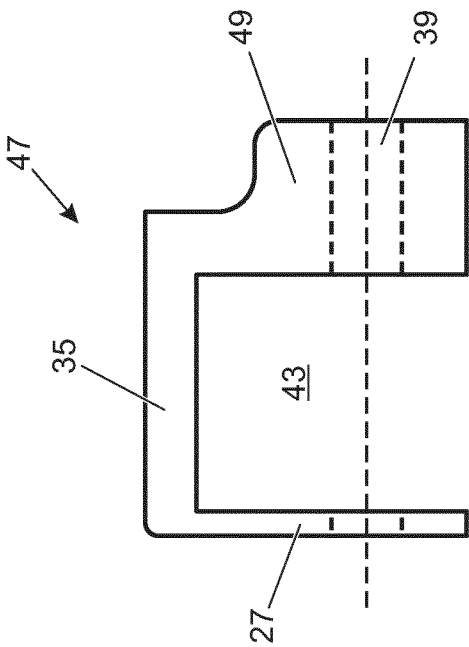


Figure 3b

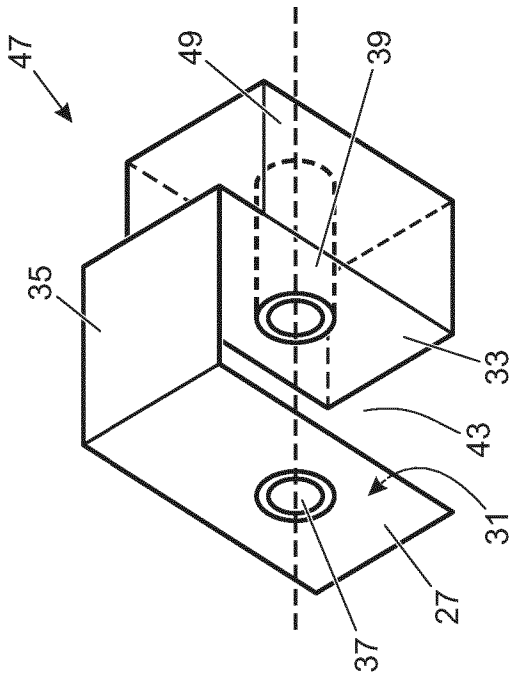


Figure 3c

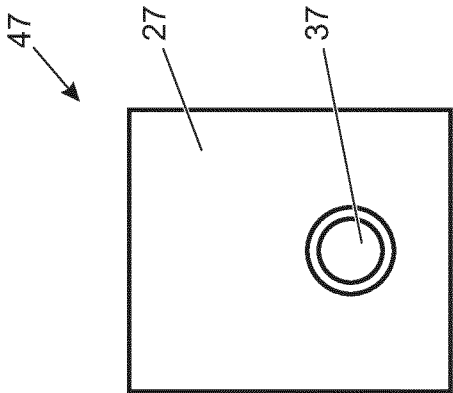


Figure 3a

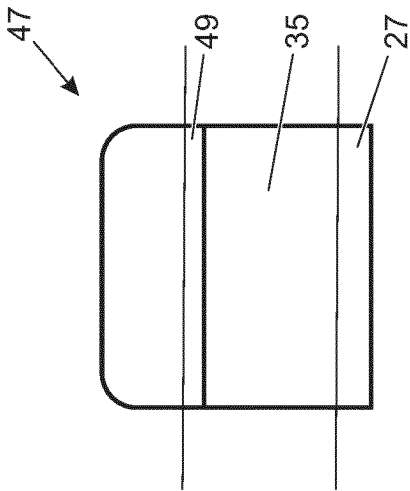


Figure 3d

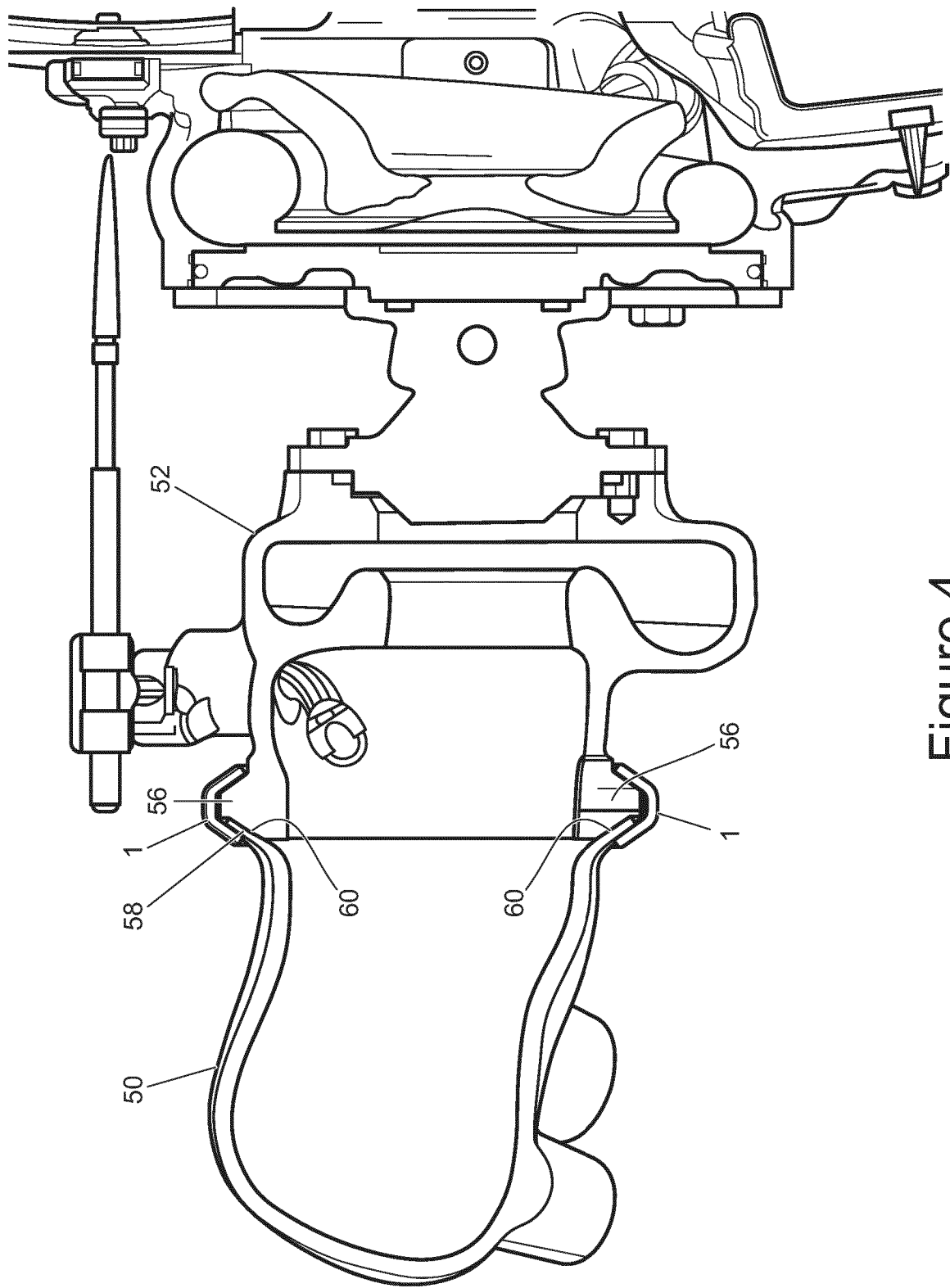


Figure 4

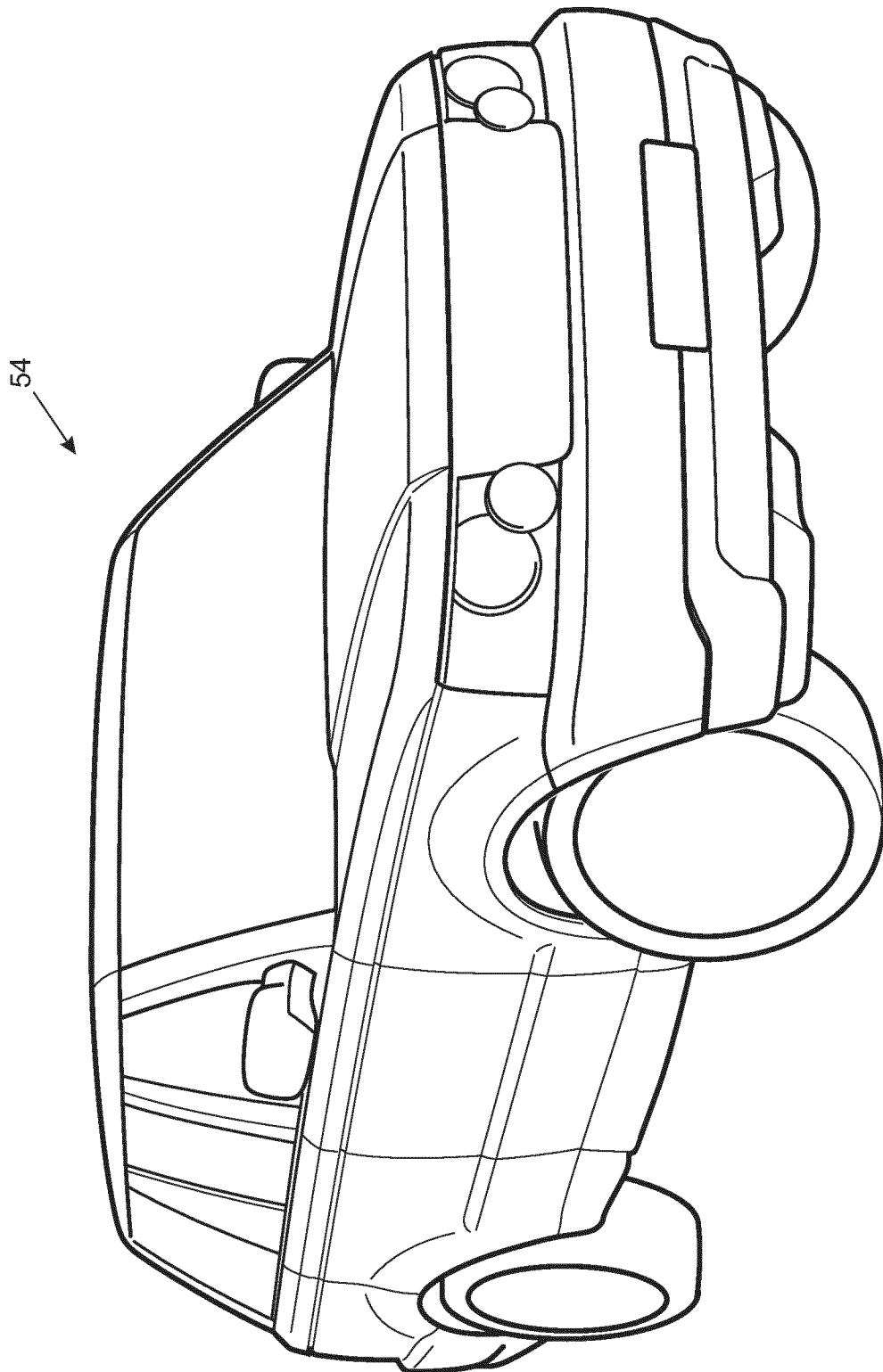


Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/065591

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16L3/10 F16L23/08
ADD. F01N13/18 F02M35/10 F02B39/00 F16B37/04

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 F16B F01N F02M F02B

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	FR 2 863 335 A1 (CAILLAU ETS [FR]) 10 June 2005 (2005-06-10)	1-8,10, 11,13-15
Y	page 11, line 3 - page 14, last line; figures 5-6A page 7, line 29 - page 8, line 2 -----	9
X	EP 2 098 768 A2 (GIA S P A [IT]) 9 September 2009 (2009-09-09) paragraph [0014] - paragraph [0026]; figures -----	1-3,6, 10-12, 14,15
X	DE 20 2011 000809 U1 (JIANGMEN EUROFIX METAL AND RUBBER PRODUCTS CO [CN]) 9 June 2011 (2011-06-09) paragraph [0017] - paragraph [0022]; figures 2-6 ----- -/-	1-6,14, 15



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

8 September 2015

Date of mailing of the international search report

22/09/2015

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

dall'Amico, Mauro

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/065591

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 1 840 439 A2 (TECONNEX LTD [GB]) 3 October 2007 (2007-10-03) paragraph [0001] - paragraph [0006] paragraph [0015] - paragraph [0016] paragraph [0031] - paragraph [0043]; figure 3 -----	1,6-8, 13-18
X	EP 1 336 763 A2 (GOBIN DAUDE [FR]) 20 August 2003 (2003-08-20) paragraph [0016] - paragraph [0073]; figures -----	15
X	EP 2 481 939 A1 (NORMA GERMANY GMBH [DE]) 1 August 2012 (2012-08-01)	15
Y	paragraph [0017] - paragraph [0034]; figures -----	9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/065591

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2863335	A1	10-06-2005	AT 502242 T 15-04-2011
		BR PI0416818 A 06-03-2007	
		CN 1890500 A 03-01-2007	
		EP 1697672 A1 06-09-2006	
		FR 2863335 A1 10-06-2005	
		KR 20060133992 A 27-12-2006	
		WO 2005057071 A1 23-06-2005	
EP 2098768	A2	09-09-2009	EP 2098768 A2 09-09-2009
		ES 2390208 T3 07-11-2012	
		PT 2098768 E 12-09-2012	
DE 202011000809	U1	09-06-2011	NONE
EP 1840439	A2	03-10-2007	AT 471479 T 15-07-2010
		EP 1840439 A2 03-10-2007	
EP 1336763	A2	20-08-2003	AT 349627 T 15-01-2007
		DE 60310624 T2 04-10-2007	
		EP 1336763 A2 20-08-2003	
		ES 2277041 T3 01-07-2007	
		FR 2835891 A1 15-08-2003	
		PT 1336763 E 30-03-2007	
EP 2481939	A1	01-08-2012	CN 102620070 A 01-08-2012
		DE 102011009536 A1 02-08-2012	
		EP 2481939 A1 01-08-2012	
		JP 5484492 B2 07-05-2014	
		JP 2012154485 A 16-08-2012	
		KR 20120087085 A 06-08-2012	
		US 2012192387 A1 02-08-2012	