

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
30 March 2006 (30.03.2006)

PCT

(10) International Publication Number
WO 2006/034047 A2

- (51) International Patent Classification:
A44B 1/04 (2006.01)
- (21) International Application Number:
PCT/US2005/033190
- (22) International Filing Date:
16 September 2005 (16.09.2005)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/610,377 16 September 2004 (16.09.2004) US

(71) Applicant (for all designated States except US): **BREEZE INDUSTRIAL PRODUCTS CORPORATION** [US/US]; 3582 Tunnelton Road, Saltsburg, PA 15681 (US).

(72) Inventors; and
(75) Inventors/Applicants (for US only): **AMENDOLEA, Richard, M.** [US/US]; 4546 Quaker Ct., Canfield, Ohio 44406 (US). **ZEMLOCK, Kenneth** [US/US]; 1601

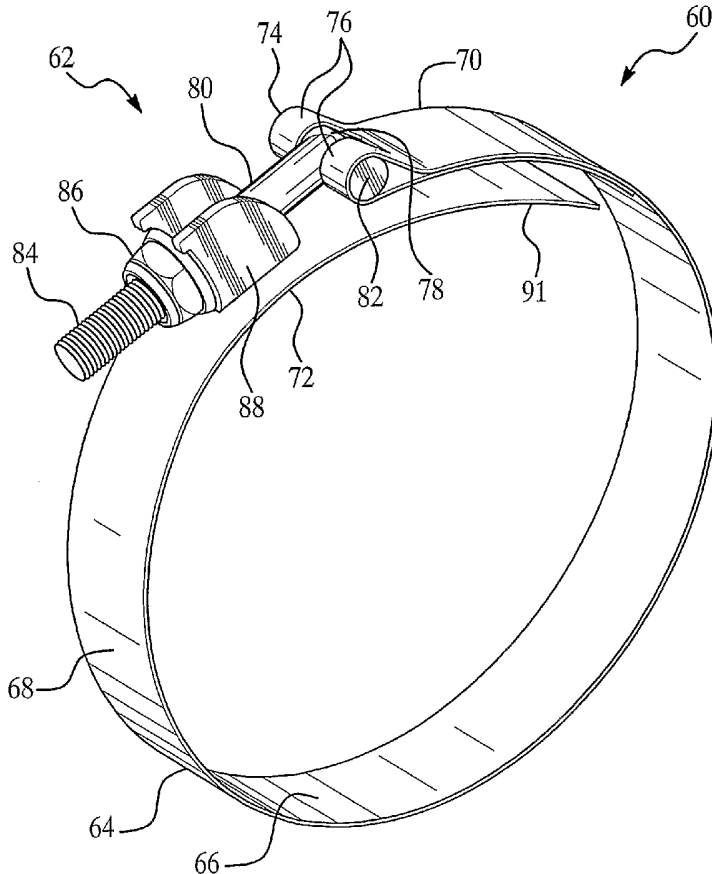
Camp Faith Road, Penn Runn, Pennsylvania 15765 (US). **MEYHOFER, Eric** [US/US]; 3951 Hickory Hill Road, Murrysville, Pennsylvania 15668 (US).
(74) Agent: **STEVENS, James, D.**; Reising, Ethington, Barnes, Kisselle, P.C., P.O. Box 4390, Troy, MI 48099-4390 (US).

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

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: T-BOLT CLAMP



(57) Abstract: A band clamp that includes an annular band having a bearing loop at one end and a clip at its opposite end. The clamp uses a T-bolt fastener that includes a nut and a T-bolt having a head and a threaded shank. The fastener connects between the bearing loop and clip so that tightening of the fastener draws the two ends of the band together. The clip has spaced side walls and a bottom wall that together give it a Ushaped cross-section which defines an open channel sized to receive the shank of the T-bolt. In one embodiment, the T-bolt head is connected to the bearing loop and the nut threads onto the shank and engages the clip to draw the ends of the band together. In another embodiment, the head engages the clip and a trunnion is used at the bearing loop end to engage the nut for tightening.

WO 2006/034047 A2



European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

- *without international search report and to be republished upon receipt of that report*

T-BOLT CLAMP

FIELD OF THE INVENTION

5 The present invention relates generally to a latching mechanism for band clamps, and more particularly, to a T-bolt clamp for mechanically fastening objects together.

BACKGROUND OF THE INVENTION

10 Figs. 1-3 show a prior art T-bolt clamp 10 that includes a latch assembly 12 connected to a flexible, flat metal band 14 having an inner surface 16 and an outer surface 18. The band 14 has a first loop end 20 and a second loop end 22 and is adapted to mechanically fasten objects together (not shown). The objects can include any object that can be mechanically fastened or connected to another object. A non-limiting example includes mechanically attaching a conduit, such as a hose, tube, or pipe to another conduit. The loop ends 20, 22 can be formed by a portion of the band 14 being bent back and attached to the outer surface 18 of the band 14 by welding, crimping, mechanical fasteners such as rivets, or by any other suitable means. Referring to Figs 2-3, the first loop end 20 includes two laterally-spaced first end bearing loops 24 defining a first end cutout 25 therebetween. Likewise, the second loop end 22 includes two laterally-spaced second end bearing loops 26 defining a second end cutout 27 therebetween.

25 Referring to Fig. 1, the assembly 12 includes a latch bolt 30 having a head portion 32 and a threaded shank portion 34, a trunnion 36, and a nut 38. The head portion 32 of the bolt 30 is pivotally received within the first end bearing loops 24 on the first loop end 20 of the band 14. The trunnion 36 includes a stem portion 40 having a first end 42 and a second end 44 and two opposed cylindrical members 46, (46' shown in Fig. 2), each extending laterally from the first end 42 of the stem portion 40 of the trunnion 36. The cylindrical members 46, 46' are received within the second end bearing loops 26 on the second loop end 22 of the band 14. A passageway

(not shown) for receiving the shank portion 34 of the bolt 30 is defined in the trunnion 36 and extends from the first end 42 to the second end 44 of the stem portion 40. Referring to Figs. 1-3, the shank portion 34 of the bolt 30 passes through the first end cutout 25 and the second end cutout 27 through the passageway of the trunnion 36, and the nut 38 is threadably received on the shank portion 34 of the bolt 30. A gap bridge 50 is attached to the first loop end 20 and extends to the second loop end 22 of the band 14. The gap bridge 50, which is made of a rigid metal, protects an object from being damaged by the loop ends 20, 22 whenever the loop ends 20, 22 are drawn toward one another.

10 In use, the flexible band 14 is fastened to an object or objects such as a conduit (not shown) and the shank portion 34 is inserted through the passageway of the trunnion 36. A nut 38 is threadably fastened to the shank portion 34 and rotated toward the head portion 32 of the bolt 30, thus contacting the second end 44 of the stem portion 40 of the trunnion 36. As the nut 38 continues to move toward the head
15 portion 32 of the bolt 30, the loop ends 20, 22 draw closer to each other, thereby tightening the band 14 around an object.

One of the drawbacks of the prior art T-bolt clamp 10 is that it requires the gap bridge 50 which adds extra materials and cost to the construction of the clamp 10. It would be advantageous if a portion of the band 14 could be used as the gap bridge 50, thus eliminating this extra metal piece. It would also be advantageous if the latch assembly 12 occupied less space on the band 14 while maintaining its strength, thus
20 providing an improved low profile T-bolt clamp.

In clamps of the types discussed herein above, it is advantageous if the clamp is capable of rapid attachment and detachment to an object. However, in most prior art
25 T-bolt clamps, the tightening or loosening process is relatively slow and tedious because the shank portion 34 of the bolt 30 has to be inserted into the passageway of the trunnion 36 before attachment can occur.

Therefore, it is an object of the present invention to overcome the disadvantages discussed previously in connection with known prior art T-bolt clamps
30 by providing a low profile, quick latching T-bolt clamp.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a band clamp that includes an annular band extending from a first end portion that comprises a loop end to a second end portion that includes a clip, with the band clamp further including a fastener for drawing the clip and loop end together to thereby permit tightening of the clamp. The clip includes a pair of side walls that extend radially outwardly from the outer surface of said band. These side walls also extend circumferentially along the outer surface from a first end of the clip located near the loop end to a second end of the clip located farther away from the loop end. The fastener extends from the loop end, through an open channel in the clip, and to the second end of the clip.

In one embodiment, the fastener comprises a T-bolt having a head portion that is retained within the loop end and a shank that extends from the head, through the open channel in the clip, to the second end of the clip. A nut can be threaded over the end of the shank until it engages the second end of the clip. In another embodiment, the head of the T-bolt engages the second end of the clip, and a trunnion is used at the loop end for securing the fastener at that end. The trunnion is retained in place by the loop end and includes an internal channel or passageway through which the shank extends. The nut can then be threaded onto the shank until it engages the trunnion.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred exemplary embodiments of the invention will hereinafter be described in conjunction with the appended drawings, wherein like designations denote like elements, and wherein:

Fig. 1 is a perspective view of a prior art T-bolt clamp;

Fig. 2 is a perspective view of a portion of the prior art T-bolt clamp shown in Fig. 1;

Fig. 3 is a top perspective view of the prior art T-bolt clamp shown in Fig. 2;

Fig. 4 is a perspective view of a T-bolt clamp made in accordance with the present invention;

Fig. 5 is a perspective view of a portion of the T-bolt clamp shown in Fig. 4;

Fig. 6 is a top plan view of a portion of the T-bolt clamp shown in Fig. 4;

Fig. 7 is a side elevational view of the T-bolt clamp shown in Fig. 4;

Fig. 8 is a side elevational view of a portion of the T-bolt clamp shown in Fig.

5 7;

Fig. 9 is a front elevational view of the T-bolt clamp shown in Fig. 4;

Fig. 10 is a front elevational view of a portion of the T-bolt clamp shown in Fig. 9;

Fig. 11 is a perspective view of a channel attached to the T-bolt clamp shown in Fig. 4;

Fig. 12 shows a washer assembly made in accordance with the present invention for use on the T-bolt clamp shown in Fig. 4;

Fig. 13 shows the washer assembly shown in Fig. 12 contacting the channel of the T-bolt clamp shown in Fig. 4;

Fig. 14 is a side perspective view of a portion of a T-bolt clamp made in accordance with a second embodiment of the present invention;

Fig. 15 is a front perspective view of the T-bolt clamp shown in Fig. 14;

Fig. 16 is a top view of the T-bolt clamp shown in Fig. 14; and

Fig. 17 is a side perspective view of the T-bolt clamp shown in Fig. 14 wherein a latch assembly is disengaged.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs. 4-10, there is shown a first embodiment of the present invention which is in the form of a band clamp 60. The band clamp 60 includes a latch assembly 62 connected to an annular, flat metal band 64 having an inner surface 66 and an outer surface 68. The band 64 has a first end portion 70 and a second end portion 72 and is adapted to mechanically fasten to an object (not shown). In this

embodiment the first end portion 70 comprises a loop end 74 that can be formed in a similar manner to the loop ends 20, 22 of the prior art clamp 10. The loop end 74 includes two laterally-spaced bearing loops 76 defining a cutout 78 therebetween.

Referring particularly to Figs. 4 and 5, the latch assembly 62 includes a clip 88 and a fastener which comprises a latch bolt 80 and nut 86. The latch bolt 80 has a head portion 82 and a shank portion 84 which is threaded at its free end. The head portion 82 of the bolt 80 is pivotably received within the bearing loops 76 of the loop end 74 of the band 64. The nut 86 is adapted to be threadably received on the shank portion 84 of the bolt 80. The clip 88 is attached to the outer surface 68 of the second end portion 72 of the band 64. The U-shaped cross section of the clip defines a channel 96 that is adapted to receive the shank portion 84 of the bolt 80. The clip 88 can be attached to the band 64 by welding, crimping, mechanical fasteners, such as rivets, or by any other suitable means. The second end portion 72 of the band 64 includes an extended band section 91 that extends toward the first end portion 70 of the band 64 and functions similar to the gap bridge 50 as previously discussed in connection with the prior art clamp 10.

As best shown in Figs. 5 and 11, the clip 88 has a first end 89 and a second end 90 and includes two spaced-apart side walls 92, 92' attached to a bottom wall 94. These walls 92, 92', 94 together define the open channel 96. The first end 89 has an angled surface 98 and the second end 90 has a planar surface 100, wherein the surfaces 98, 100 are defined by walls 92, 92', and 94 of the clip 88. The end surface 100 of the clip 88 is adapted to abut against the nut 86 (shown in Fig. 5). A pair of tabs 102, 102' defined on an upper end of the planar surface 100 extends outwardly from each of the side walls 92, 92', respectively, in order to prevent the nut 86 from sliding off the planar surface 100 of the side walls 92, 92'.

In use, the band 64 is positioned around an object or objects (not shown) and the shank portion 84 of the bolt 80 is received within the channel 96 of the clip 88. Nut 86 can then be threadably fastened to the shank portion 84 until the nut 86 abuts against the planar surface 100 on the second end 90 of the clip 88. When the nut 86 is moved in a direction toward the head portion 82 of the bolt 80, the loop end 74 draws closer to the first end 89 of the channel 88, thereby tightening the band 64 around the object (not shown). An advantage of clamp 60 over the prior art clamp 10 is that the

shank portion 84 of the bolt 80 does not have to be inserted into a trunnion 36, thereby providing a quick attachment and detachment of the clamp 60 from an object (not shown).

5 Figs. 12 and 13 show a washer assembly 110 that includes a washer 112 having a first end 114 and a second end 116 and a nut 118 having a spherical-shaped (convex) surface 120. The assembly 110 can be used to replace the nut 86 used in T-bolt clamp 60. The first end 114 of the washer 112 is adapted to abut against the planar surface 100 of the second end 90 of the channel 88 (shown in Fig. 13). The second end 116 of the washer 112 has a spherical recess (concave surface) 122 that is
10 adapted to receive the spherical surface 120 of the nut 118. The assembly 110 has the added advantage of accommodating for misalignment of the shank portion 84 of the bolt 80 with respect to the clip 88, while maintaining complete contact between the first end 114 of the washer 112 and the planar surface 100 of the second end 90 of the clip 88.

15 Figs. 14-17 show a second embodiment in the form of a T-bolt clamp 130 having components that are similar to portions of the prior art T-bolt clamp 10 and the band clamp 60. Like reference numerals will be used for like parts. The clamp 130 includes a latch assembly 132 connected to a flexible, flat metal band 64 having an inner surface 66 and an outer surface 68. The band 64 having a first end portion 70 and a second end portion 72 is adapted to mechanically fasten to an object (not
20 shown). The latch assembly 132 on the first end portion 70 of the band 64 is similar to the latch assembly 12 on the second loop end 22 of the prior art T-bolt clamp 10 (shown in Figs. 1-3). The first end portion 70 of the band 64 includes a loop end 74 that is formed from two laterally-spaced bearing loops 76 defining a cutout 78 therebetween. The latch assembly 132 includes a latch bolt 80, a trunnion 36, a nut 86, and a clip 140. The latch bolt includes a rounded head portion 82 and a threaded shank portion 84. The trunnion 36 includes a stem portion 40 having a first end 42 and a second end 44 and two opposed cylindrical members 46, 46', each extending laterally from the first end 42 of the stem portion 40 of the trunnion 36. The
25 cylindrical members 46, 46' are received within the bearing loops 76 on the first end portion 70 of the band 64. The trunnion includes an internal channel or passageway for receiving the shank portion 84 of the bolt 80, and this passageway extends from
30

the first end 42 to the second end 44 of the stem portion 40. The shank portion 84 of the bolt 80 passes through the cutout 78 and through the passageway of the trunnion 36, and the nut 86 is received on the shank portion 84 of the bolt 80. The second end portion 72 of the band 64 includes an extended band section 91 that extends toward
5 the first end portion 70 of the band 64.

The clip 140 has a U-shaped cross-section defining an open channel 96 and is attached to the outer surface 68 of the second end portion 72 of the band 64. The clip 140 is adapted to receive the shank portion 84 of the bolt 80. The clip 140 can be attached to the band 64 in a way similar to the attachment of clip 88 of T-bolt clamp
10 60. The clip 140 is similar to clip 88 and includes a first end 89, a second end 90, two spaced-apart sidewalls 92, 92' attached to a bottom wall 94, which together define the channel 96. The second end 90 of the clip 140 has a recessed surface 142 adapted to receive the head portion 82 of the bolt 80.

In use, the band 64 is positioned around an object or objects (not shown) and
15 the shank portion 84 is inserted through the passageway of the trunnion 36. A nut 86 is fastened to the shank portion 84 and threaded toward the head portion 82 of the bolt 80 until the head portion 82 is received within the recessed surface 142. With continued tightening at the nut 86, the loop end 74 draws closer to the first end 90 of the channel 140, thereby tightening the band 64 around the object (not shown). When
20 loosening the clamp 130, the nut 86 is moved in a direction away from the head portion 82, wherein the head portion 82 moves away from the recess surface 142, thereby allowing a quick attachment and detachment of the clamp 130 from an object (not shown).

In the prior art clamp 10 (shown in Figs. 1-3), the nut 38 is typically fastened
25 to the bolt 30 when packaged. In order for the clamp 10 to be used after being unpacked, the nut 38 has to be first unfastened from the bolt 30 of the clamp 10. This step adds additional time to the attachment process. The band clamps 60 and 130 of the present invention are ready to be used after being unpacked without the additional step of unfastening the nut 86 from the shank portion 84 of the bolt 80. Another
30 advantage of the present invention is that the T-bolt clamps 60 and 130 eliminate the need for a separately attached gap bridge 50 as in the prior art clamp 10.

It is to be understood that the foregoing description is not a description of the invention itself, but of one or more preferred exemplary embodiments of the invention. The invention is not limited to the particular embodiment(s) disclosed herein, but rather is defined solely by the claims below. Furthermore, the statements
5 contained in the foregoing description relate to particular embodiments and are not to be construed as limitations on the scope of the invention or on the definition of terms used in the claims, except where a term or phrase is expressly defined above. Various other embodiments and various changes and modifications to the disclosed embodiment(s) will become apparent to those skilled in the art. All such other
10 embodiments, changes, and modifications are intended to come within the scope of the appended claims.

As used in this specification and claims, the terms "for example," "for instance," and "such as," and the verbs "comprising," "having," "including," and their
15 other verb forms, when used in conjunction with a listing of one or more components or other items, are each to be construed as open-ended, meaning that that the listing is not to be considered as excluding other, additional components or items. Other terms are to be construed using their broadest reasonable meaning unless they are used in a context that requires a different interpretation.

What is claimed is:

1. A band clamp comprising:
 - an annular band having a first end portion and a second end portion;
 - a clip having a channel extending from a first end of said clip to a
5 second end of said clip, wherein said clip is attached to said second end portion of
said band with said first end of said clip confronting said first end portion of said
band;
 - a first member having a head portion and a shank portion, said head
portion of said first member attached to said first end portion of said band, said shank
10 portion adapted to be received within said channel; and
 - a second member adapted to be fastened to said shank portion of said
first member, said second member adapted to contact said second end of said clip,
wherein said first end portion draws closer to said first end of said clip as said second
member is moved toward said head portion of said first member.
- 15 2. The band clamp as claimed in claim 1, wherein said band is made from
a unitary piece of flexible metal.
3. The band clamp as claimed in claim 1, wherein said first and second
members together comprise a fastener that includes a T-bolt as said first member and
a nut as said second member, wherein said shank portion of said T-bolt is threaded
20 and said nut threads onto said shank and into engagement with said second end of said
clip to thereby draw said second end portion of said band towards said first end
portion.
4. The band clamp as claimed in claim 1, wherein said first end portion of
said band comprises a loop end.
- 25 5. The band clamp as claimed in claim 4, wherein said loop end
comprises a unitary portion of said band that has a cutout centered between lateral
sides of said band, with said portion of said band being looped back and attached to
said band to thereby define a pair of loops separated axially by said cutout and sized
to receive said head portion.

6. The band clamp as claimed in claim 5, wherein said head portion of said first member is pivotably received within said loops with said shank portion of said first member passing through the cutout of said loop end and extending into and through said channel of said clip.

5 7. The band clamp as claimed in claim 1, wherein said clip is a unitary component having two spaced-apart side walls extending upwardly from a bottom wall, such that said clip has a U-shaped cross section.

8. The band clamp as claimed in claim 7, wherein each of said side walls has an angled surface on said first end of said clip and a planar surface on said second
10 end of said clip.

9. The band clamp as claimed in claim 8, wherein each of said side walls further includes a tab extending away from the planar surface on said second end of said clip.

10. The band clamp as claimed in claim 7, wherein said first member is a
15 T-bolt having a threaded shank, and said second member is a nut that threads onto said shank, wherein said band clamp further comprises a washer that fits over said shank between said nut and said second end of said clip.

11. The band clamp as claimed in claim 10, wherein said nut has a convex surface and said washer has a concave surface that mates with said convex surface of
20 said washer.

12. A band clamp comprising:
an annular band having a first end portion and a second end portion;
a clip having a channel extending from a first end of said clip to a
second end of said clip, wherein said clip is attached to said second end portion of
25 said band with said first end of said clip confronting said first end portion of said band;

a first member having a head portion and a shank portion, said head portion of said first member being adapted to contact said second end of said clip, said shank portion being adapted to attach to said first end portion of said band; and

a second member adapted to be fastened to said shank portion of said first member, wherein said first end portion of said band draws closer to said first end of said clip as said second member is moved toward said head portion of said first member.

5 13. The band clamp as claimed in claim 12, wherein said clip has a U-shaped cross section and comprises two spaced-apart side walls extending upwardly from a bottom wall.

 14. The band clamp as claimed in claim 13, wherein each of said side walls has an angled surface on said first end of said clip and a curved surface on said
10 second end of said clip.

 15. The band clamp as claimed in claim 14, wherein said head portion of said first member is adapted to abut against the curved surface of each of said side walls on second end of said clip.

 16. The band clamp as claimed in claim 12, further comprising a third
15 member having an internal channel and being attached to said first end portion of said band, wherein said shank portion extends through said internal channel and said second member engages said third member and draws said first and second end portions of said band together as said second member is moved toward said head portion of said first member.

20 17. The band clamp as claimed in claim 16, wherein said first end portion of said band comprises a loop end, and said third member comprises a trunnion attached to said loop end.

 18. A T-bolt clamp, comprising:
 an annular band having a first end portion and a second end portion,
25 said first end portion comprising a loop end;
 a clip attached to an outer surface of said second end portion, wherein said second end portion includes an extended band section that extends underneath said first end portion of said band;

a fastener that includes a T-bolt having a head and a shank, wherein said fastener attaches to said clip and said loop end such that tightening of said fastener draws said first and second end portions of said band together;

5 wherein said clip includes a pair of side walls that extend radially outwardly from said outer surface of said band, said side walls further extending circumferentially along said outer surface from a first end located near said loop end to a second end located farther away from said loop end, said clip having an open channel with said shank of said fastener extending from said loop end through said channel to said second end of said clip.

10 19. The T-bolt clamp as claimed in claim 18, wherein said loop end includes a pair of loops separated by a cutout, and said head of said T-bolt is pivotally disposed in said loop end with said head extending into each of said loops and said shank extending from said head out of said loop end through said cutout.

15 20. The T-bolt clamp as claimed in claim 19, wherein said shank is threaded and said fastener includes a nut that threads onto said shank and engages said second end of said clip to thereby draw said clip towards said loop end during continued threading of said nut onto said shank.

20 21. The T-bolt clamp as claimed in claim 18, wherein said loop end includes a pair of loops separated by a cutout, said T-bolt clamp further comprising a trunnion pivotally mounted in said loop end with said trunnion including a stem portion extending out of said loop end through said cutout, said stem portion having an internal channel sized to receive said shank, wherein said head of said T-bolt spans said side walls of said clip and engages said second end of said clip with said shank extending through said channel of said clip and through said channel of said trunnion.

25 22. The T-bolt clamp as claimed in claim 21, wherein said shank is threaded and said fastener includes a nut that threads onto said shank and engages an end of said stem portion of said trunnion to thereby draw said loop end towards said clip during continued threading of said nut onto said shank.

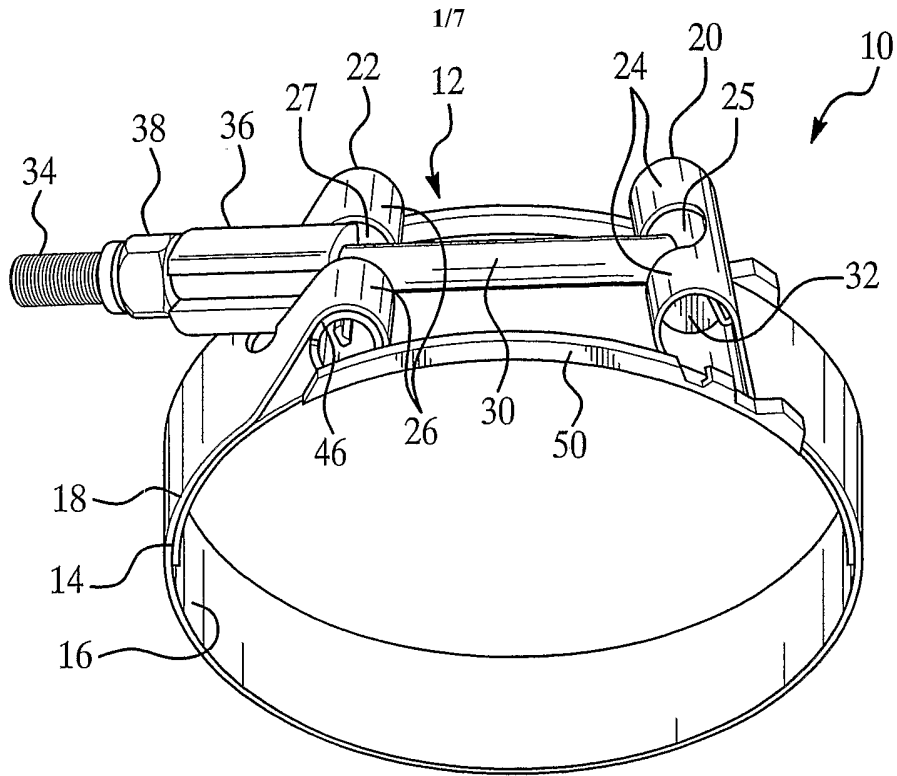


Figure 1
Prior Art

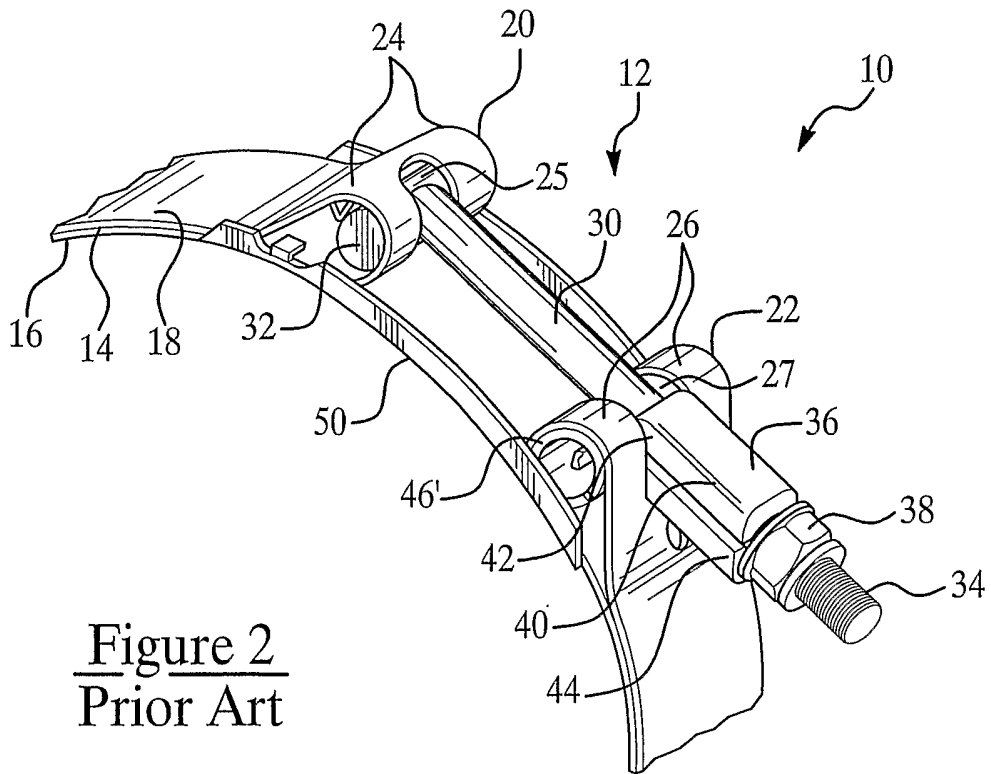


Figure 2
Prior Art

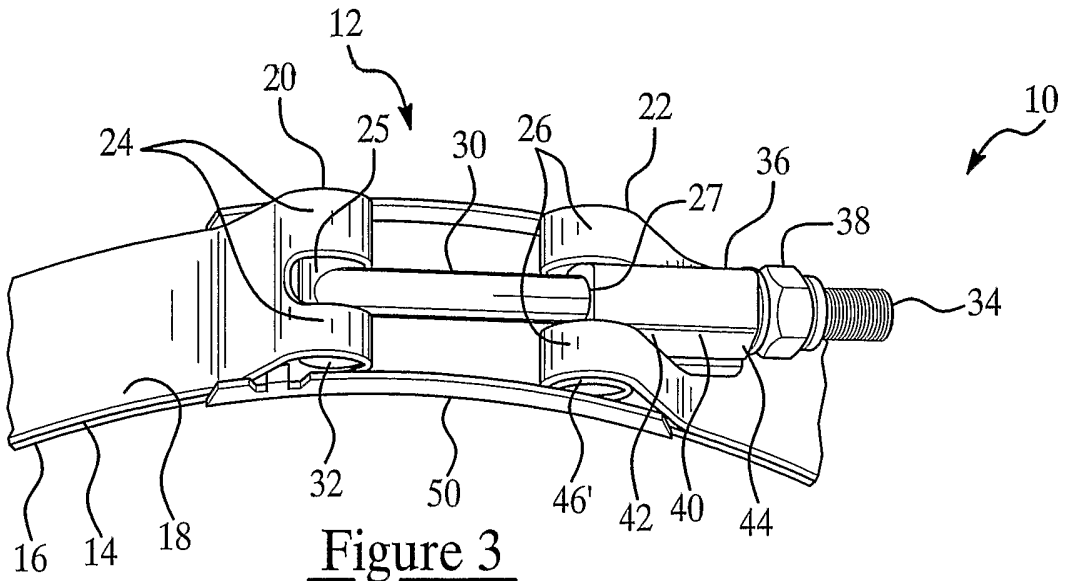


Figure 3
Prior Art

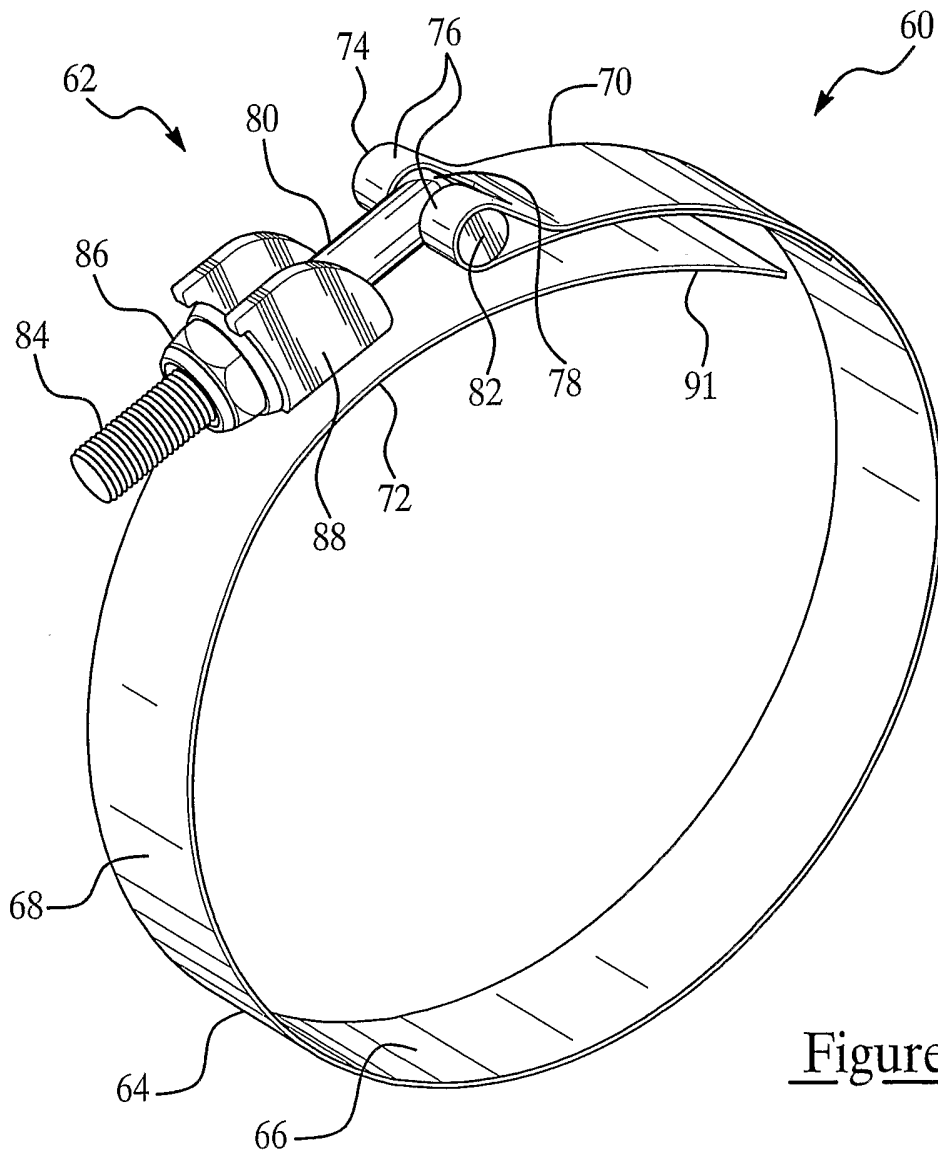


Figure 4

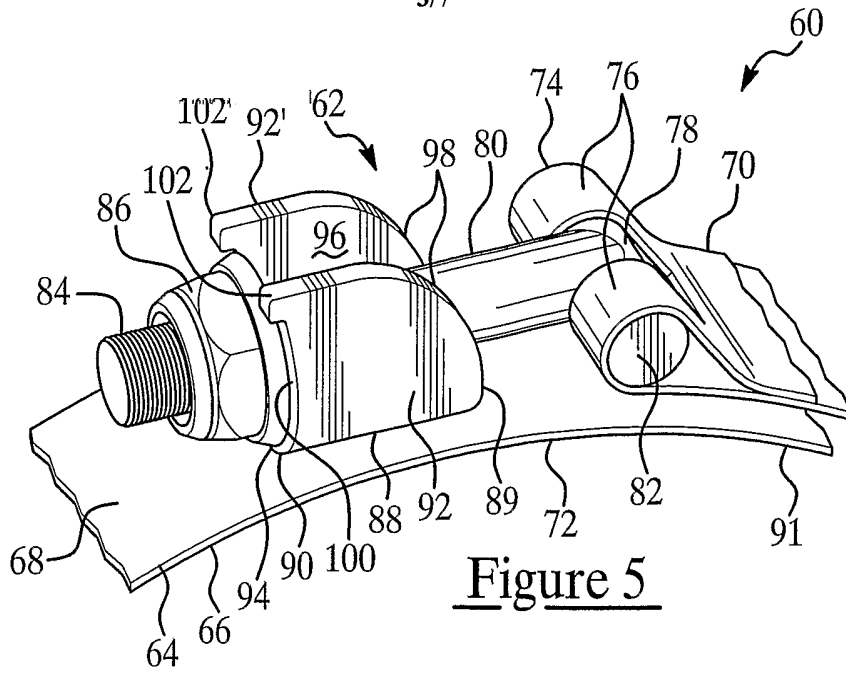


Figure 5

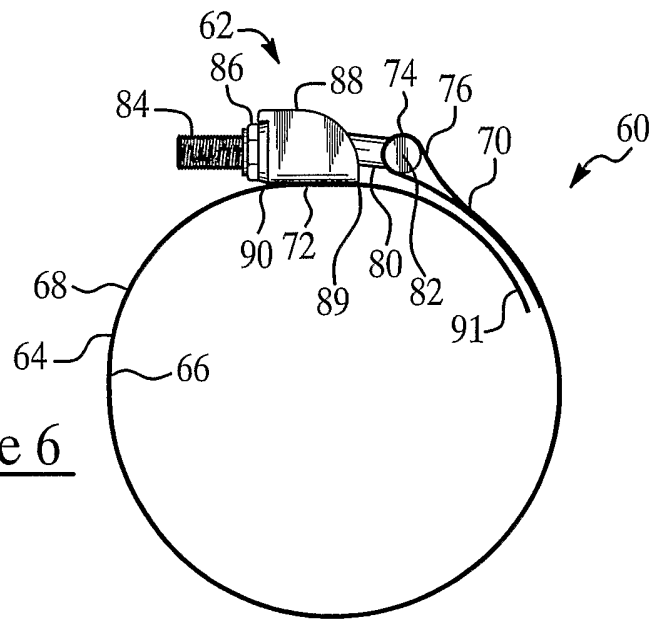


Figure 6

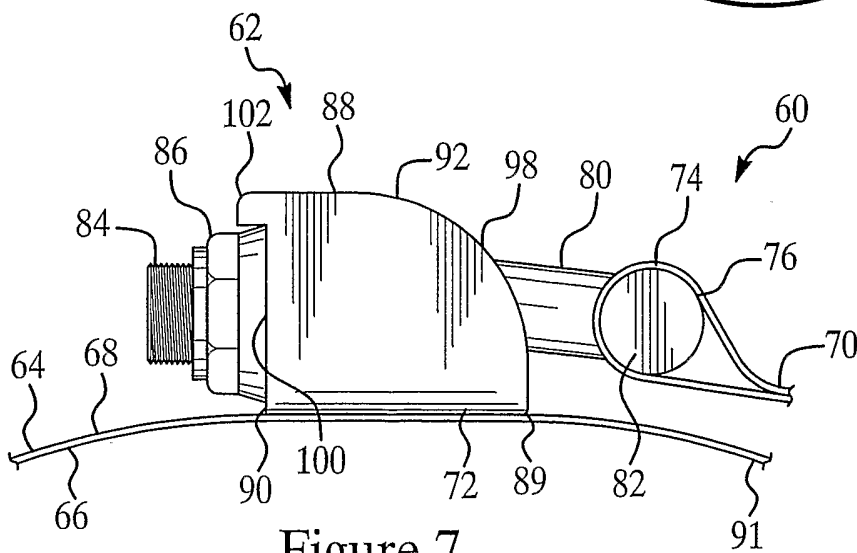


Figure 7

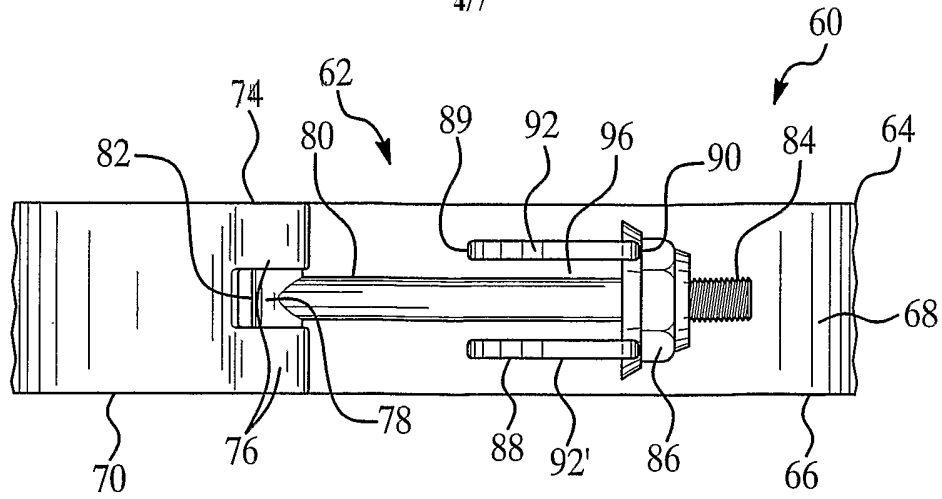


Figure 8

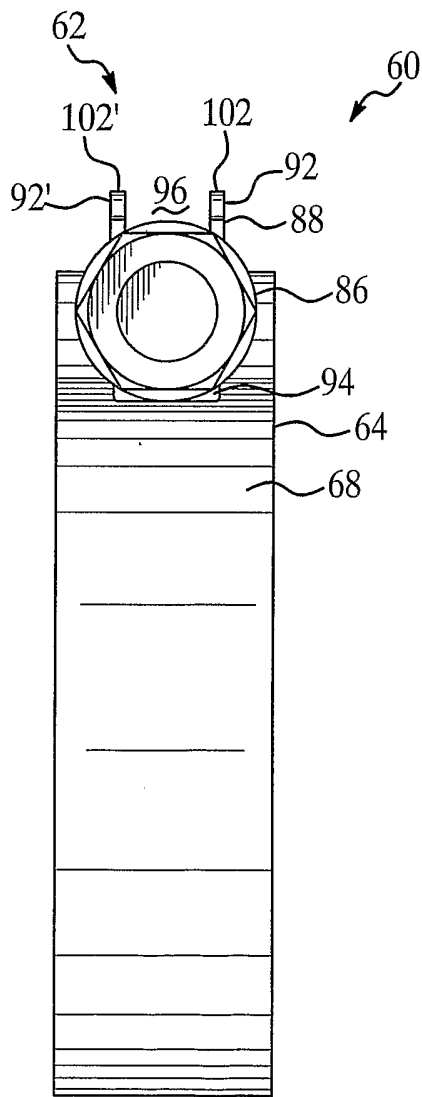


Figure 9

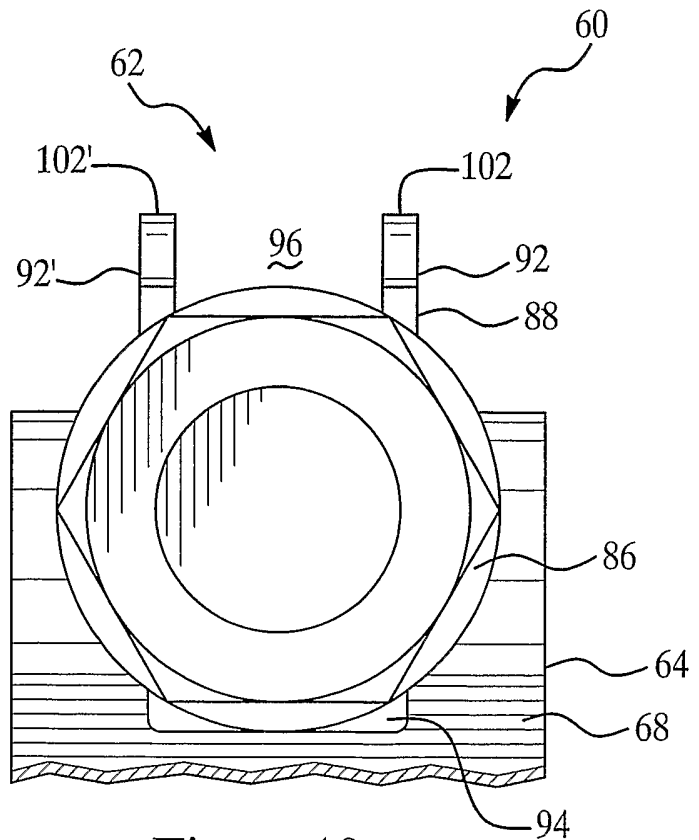


Figure 10

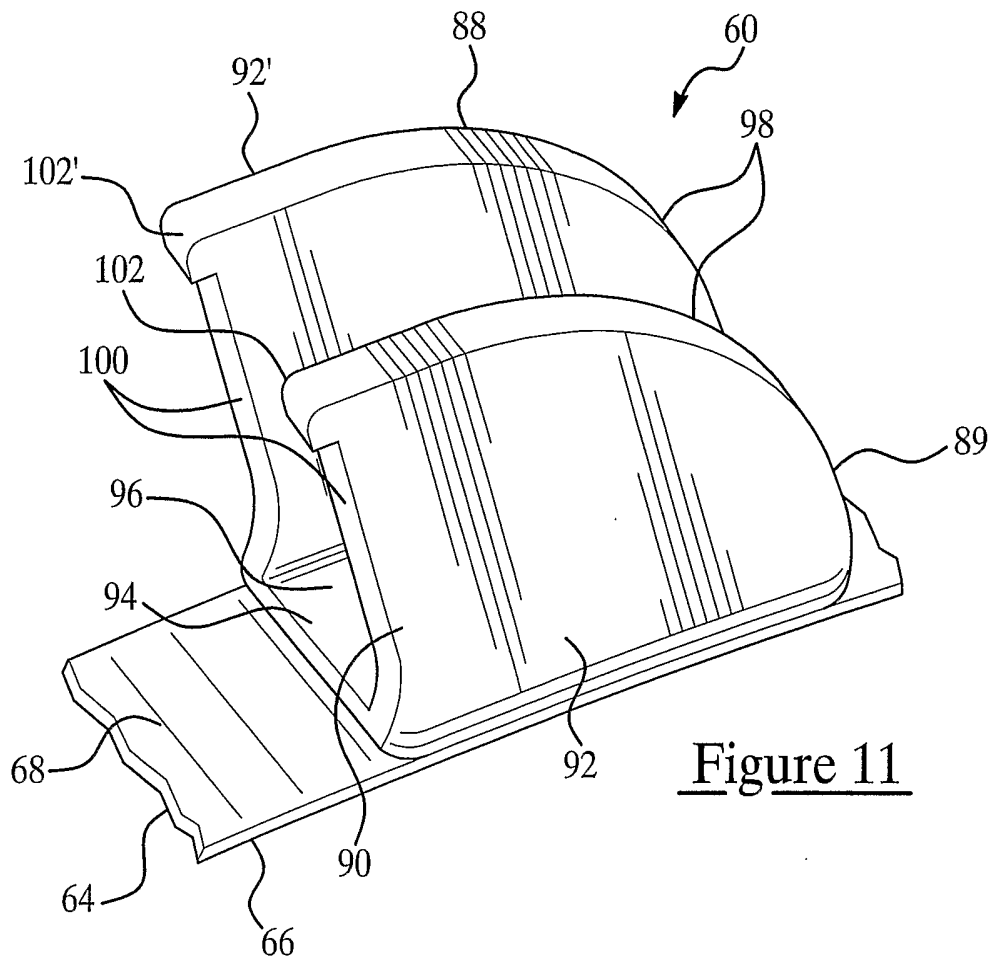


Figure 11

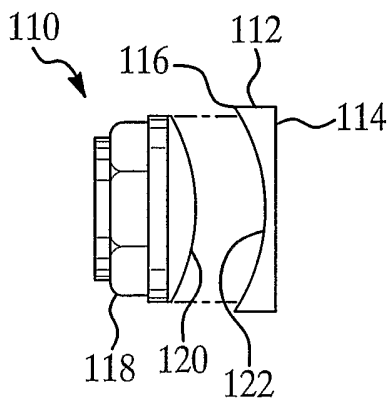


Figure 12

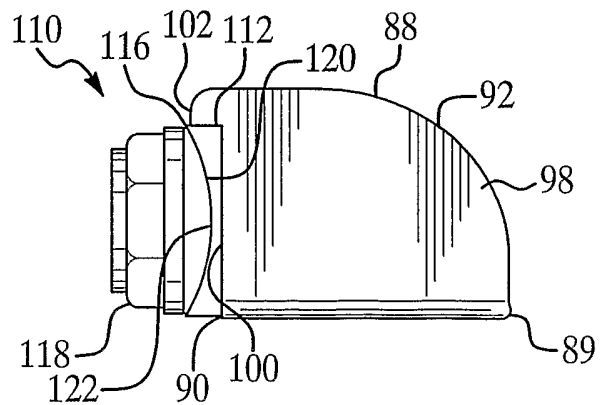


Figure 13

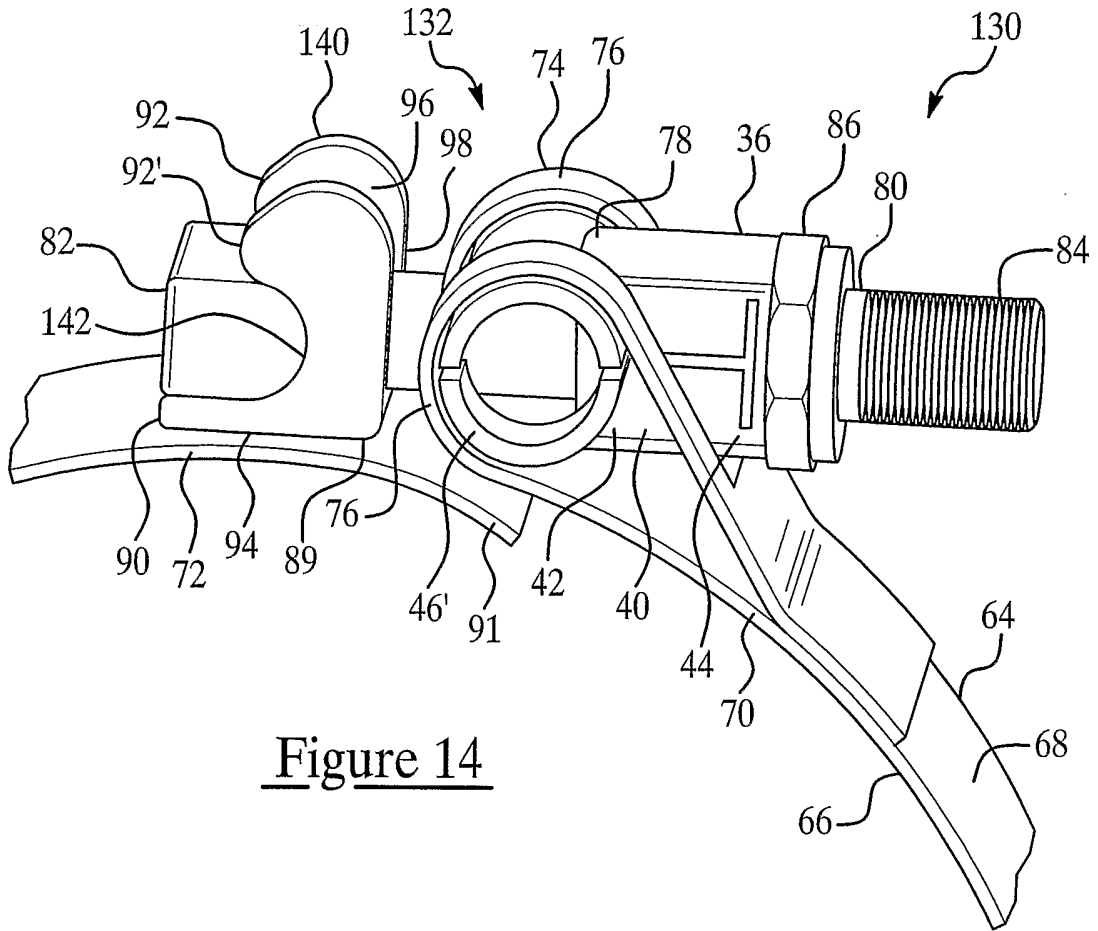


Figure 14

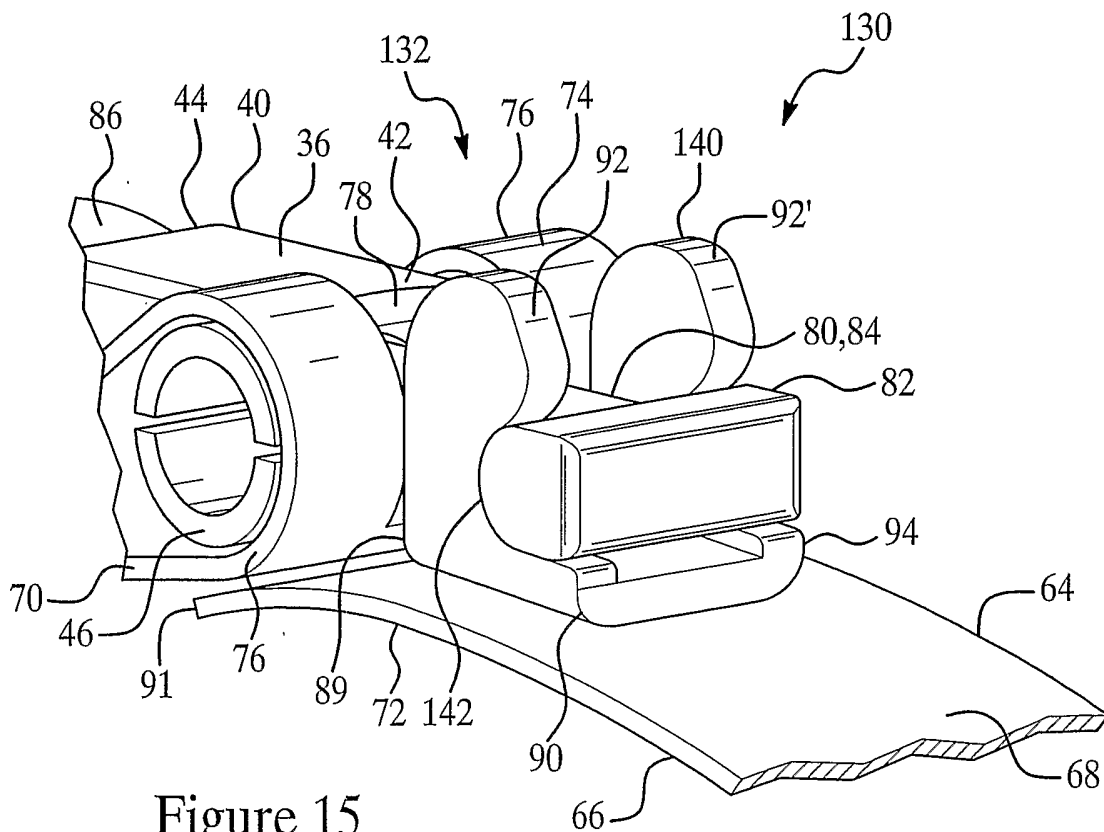


Figure 15

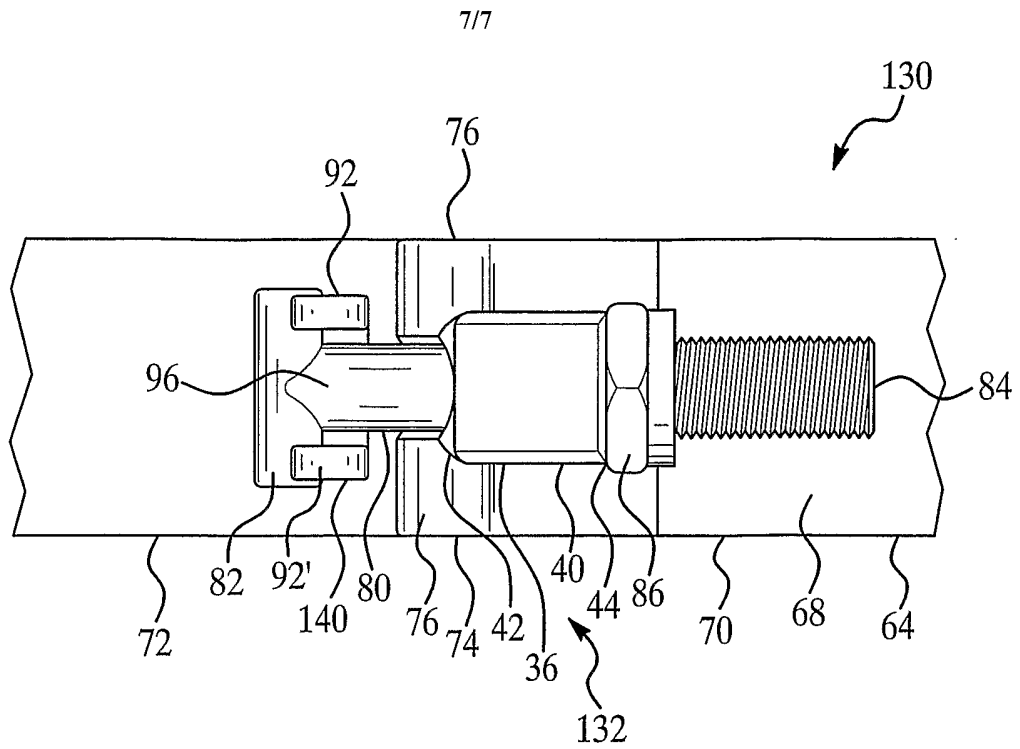


Figure 16

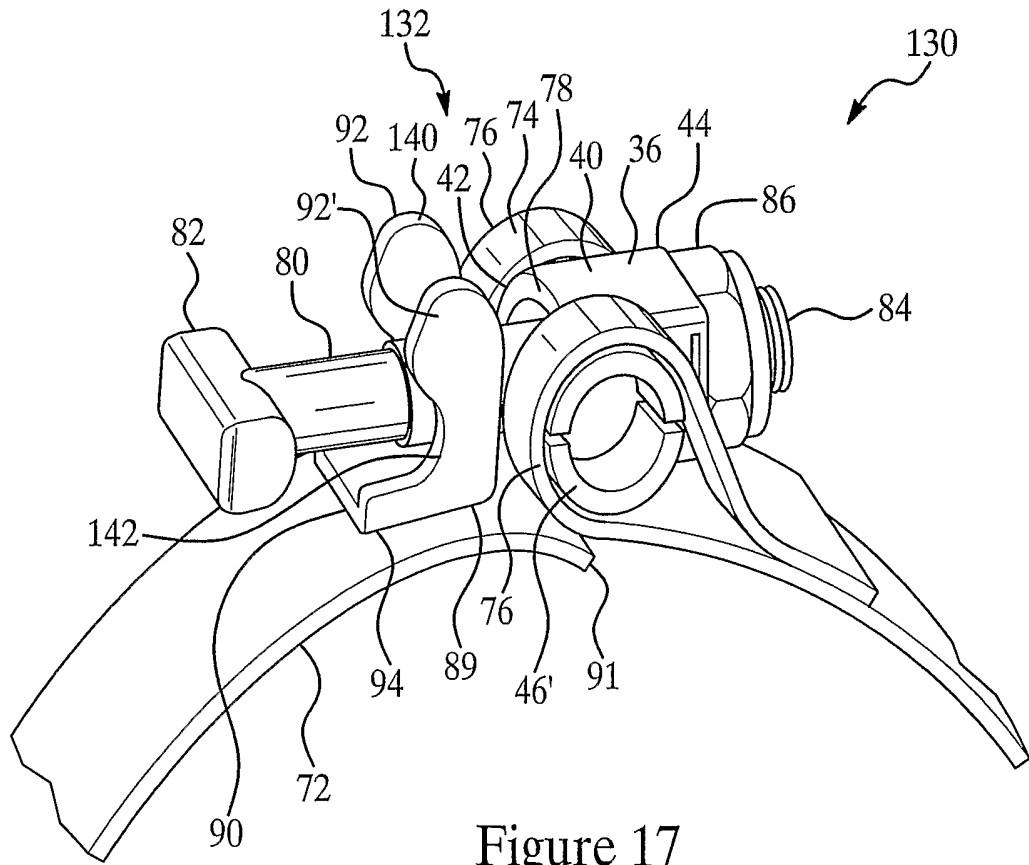


Figure 17