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(54) HARNESS CLAMP TIE

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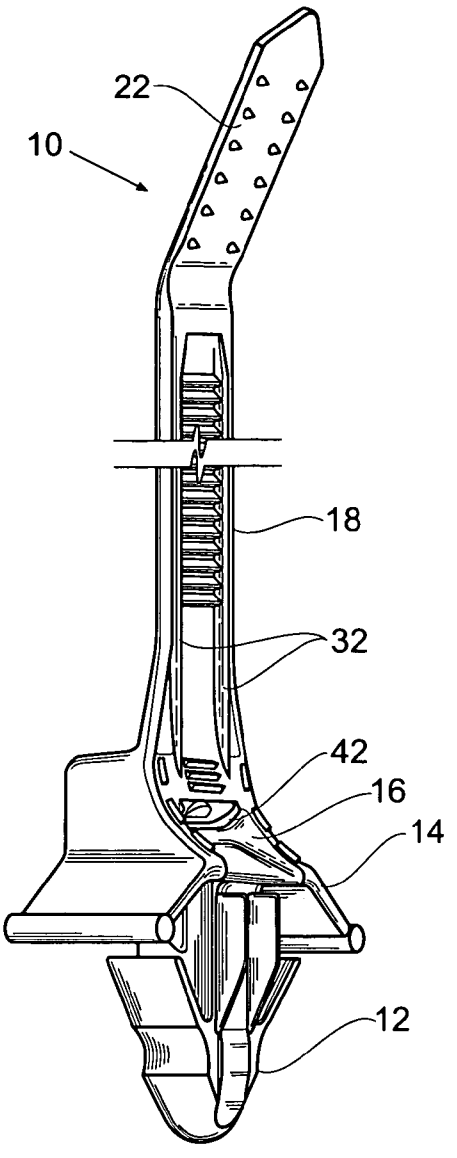
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(57) **ABSTRACT**

A harness clamp tie includes a locking head and a flexible strap extending outwardly from the locking head. The strap is insertable through the locking head to form a loop that can be used at least one item. A pawl in the locking head secures the strap. Nonslip rails formed along the outer edge of the strap face and clamping rails formed on the locking head aid in securing small items. Conic friction points are formed on both sides of the strap surface to provide a mechanical grip for pulling the strap through the locking head. A mounting fastener extends from the locking head in the opposite direction. The fastener secures the tie to a mounting structure such as an aperture in a panel. The fastener includes a pair of flexible winged springs which help to stabilize the tie and hold the tie perpendicular to the panel.



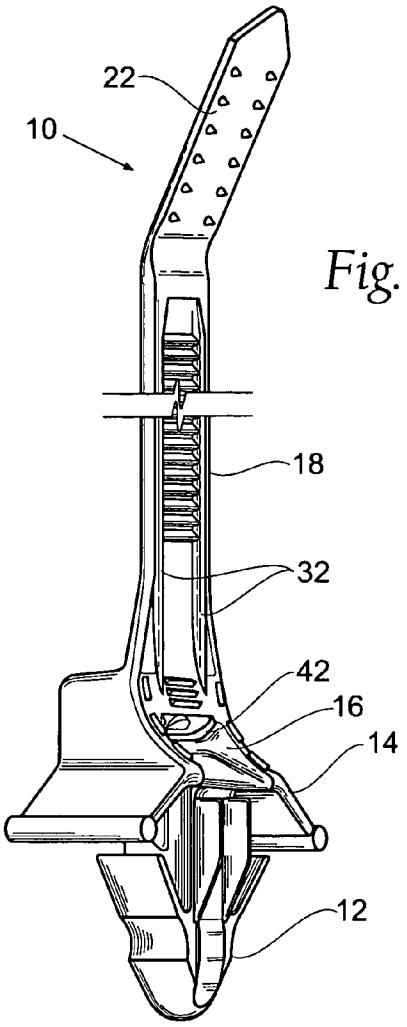


Fig. 1

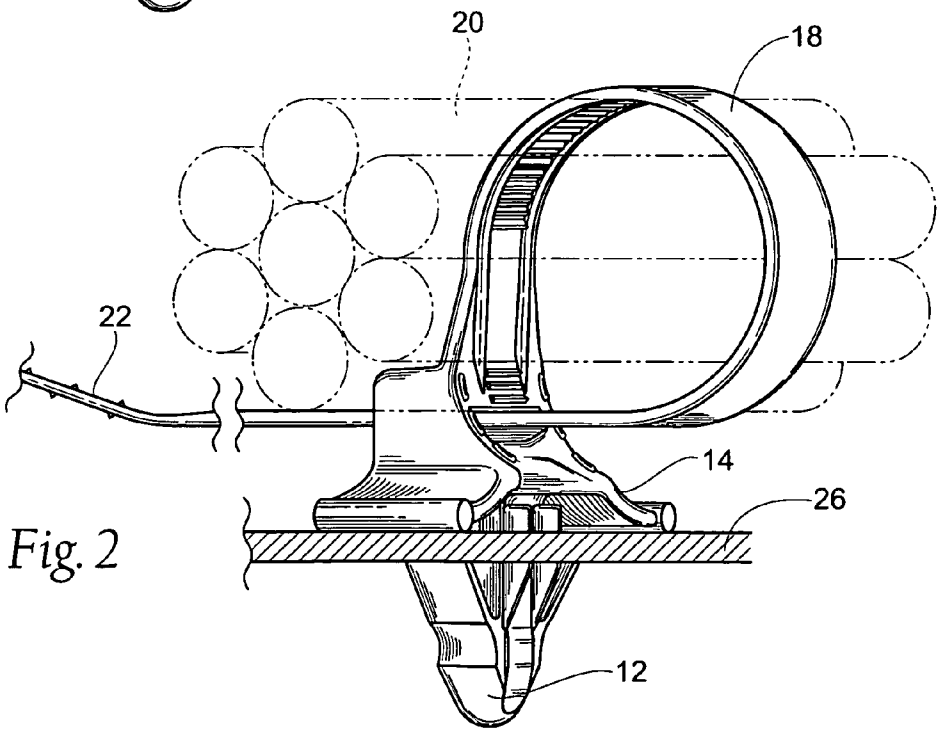


Fig. 2

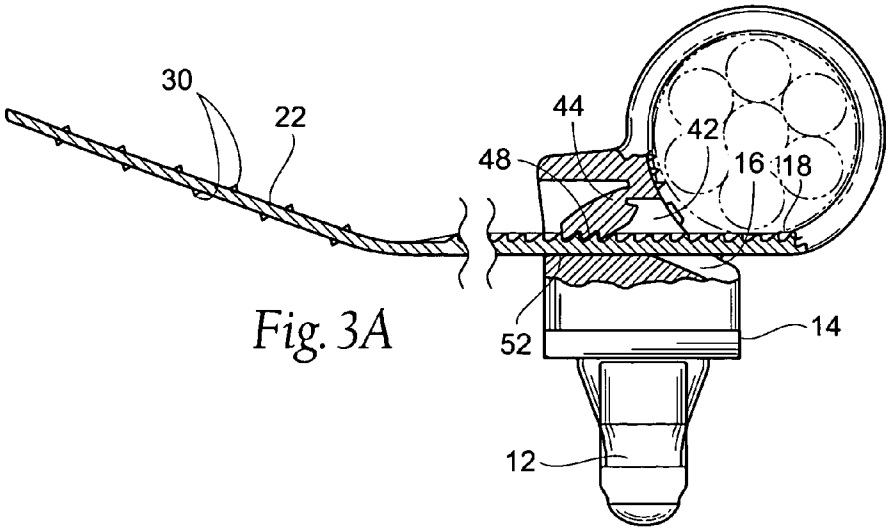


Fig. 3A

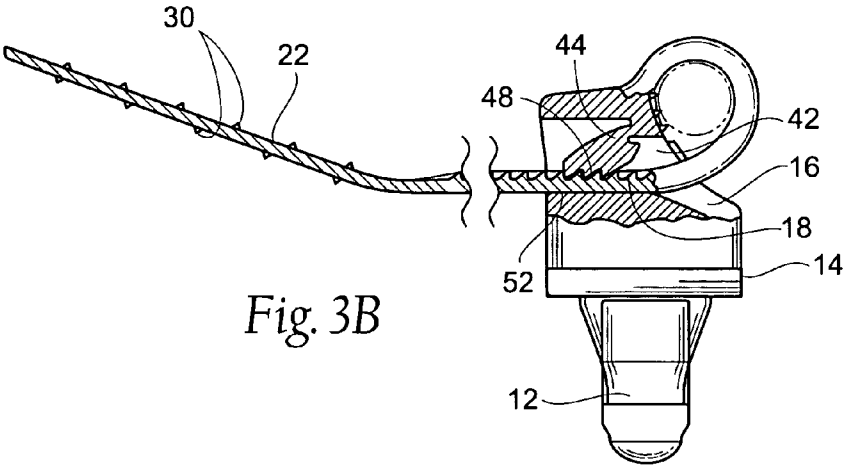


Fig. 3B

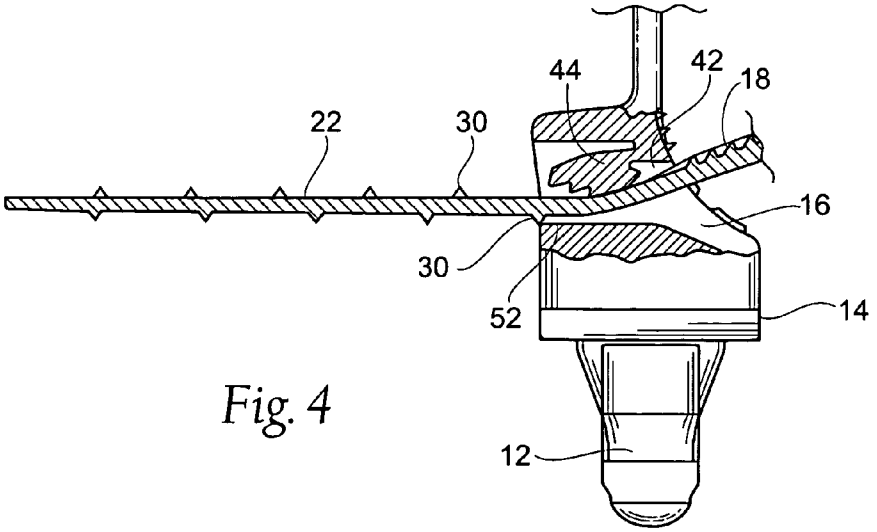


Fig. 4

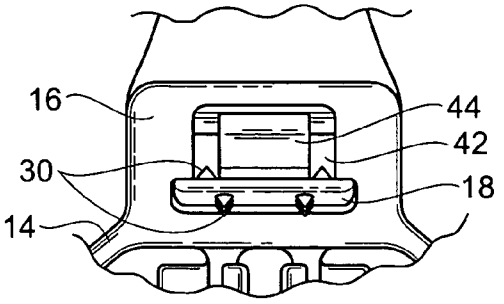


Fig. 5

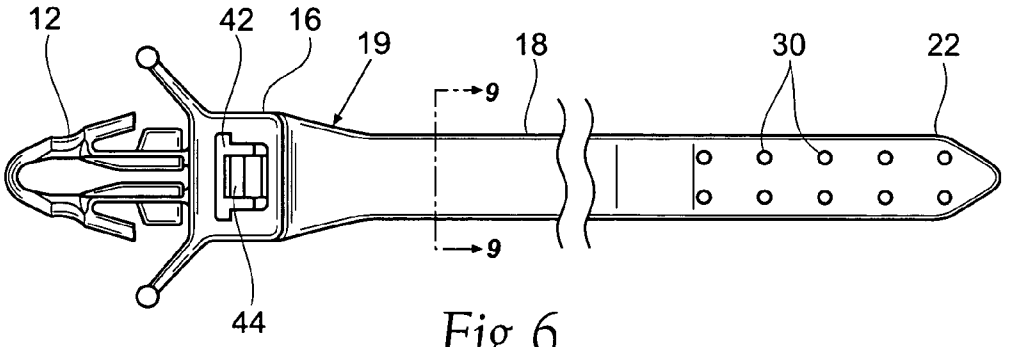


Fig. 6

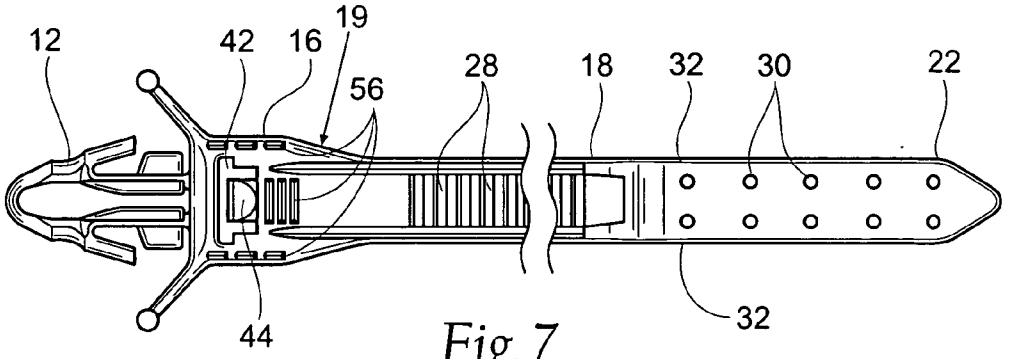


Fig. 7

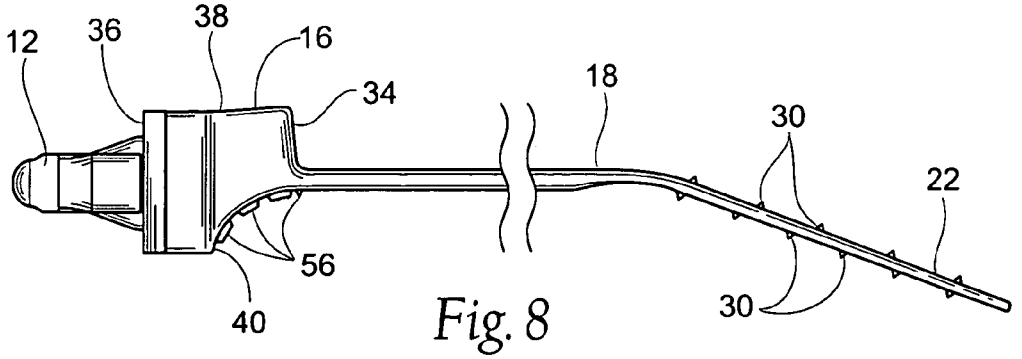


Fig. 8

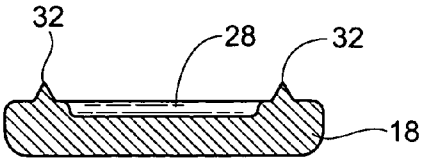


Fig. 9

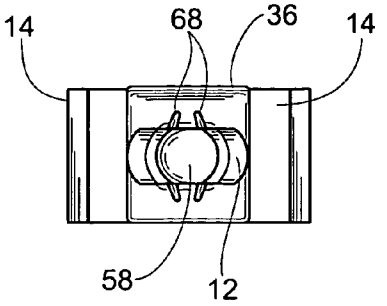


Fig. 10

Fig. 11

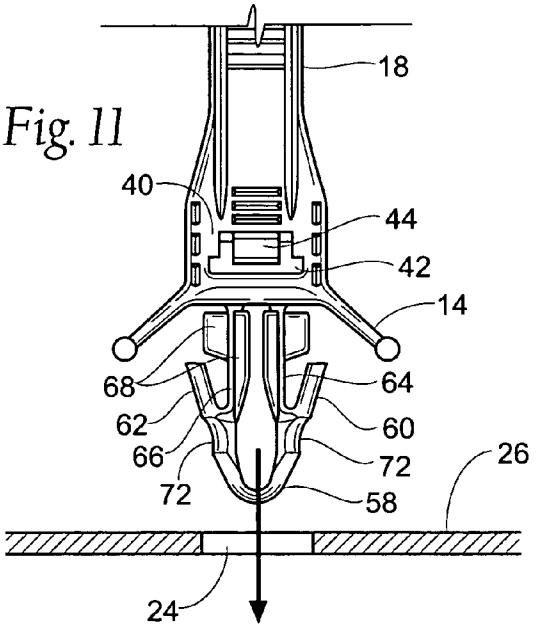


Fig. 12

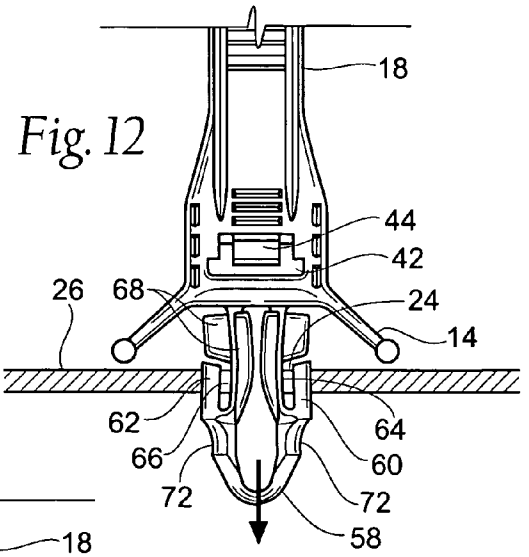
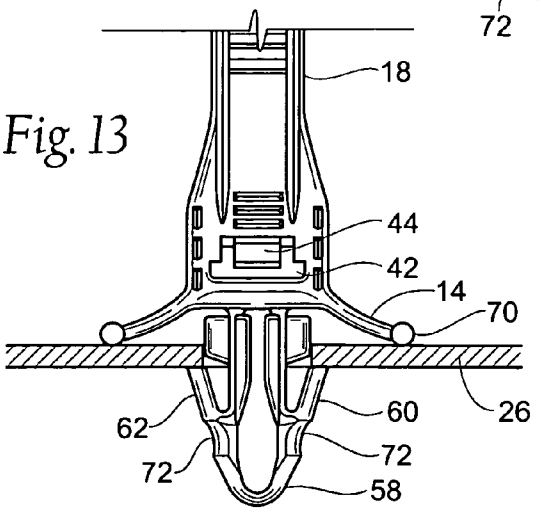


Fig. 13



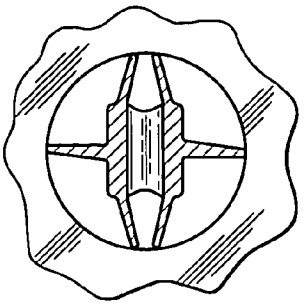


Fig. 14A

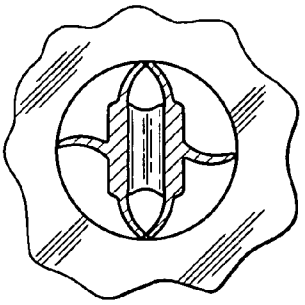


Fig. 14B

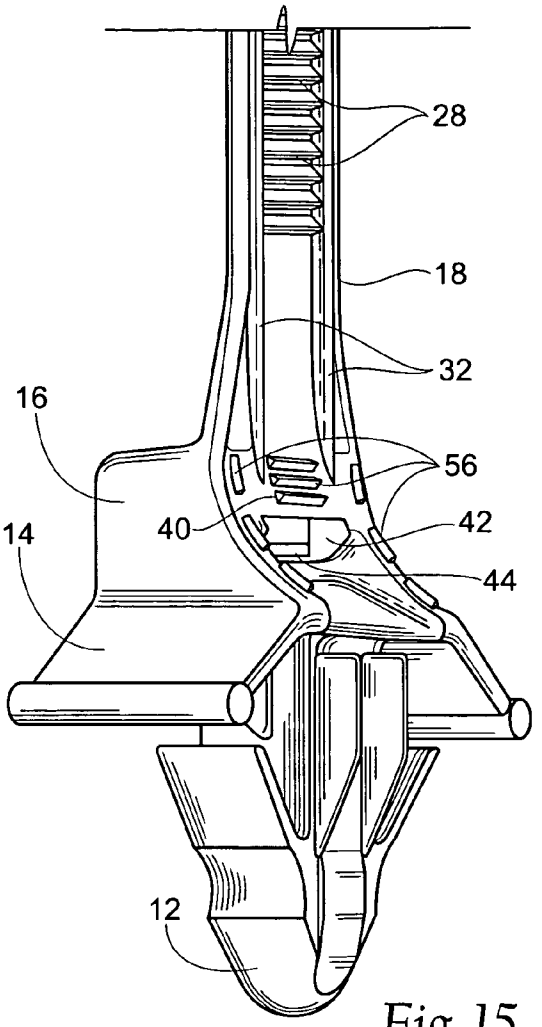


Fig. 15

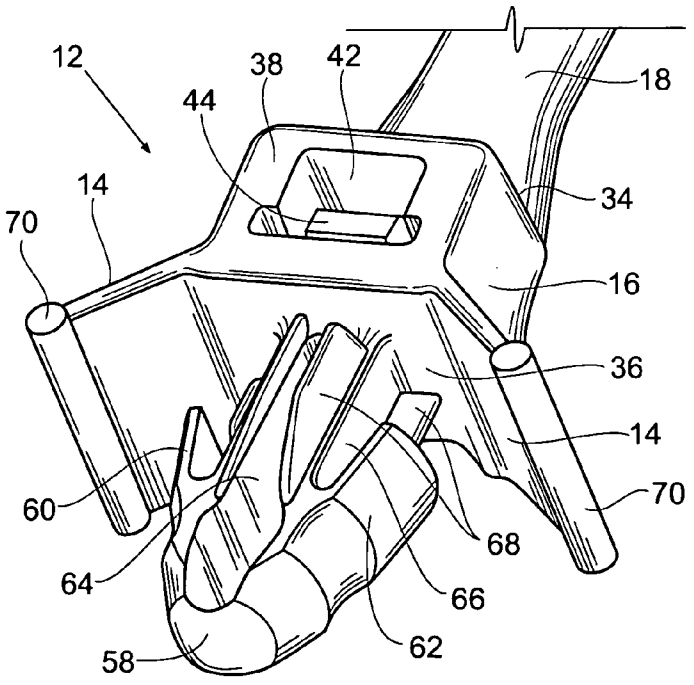


Fig. 16

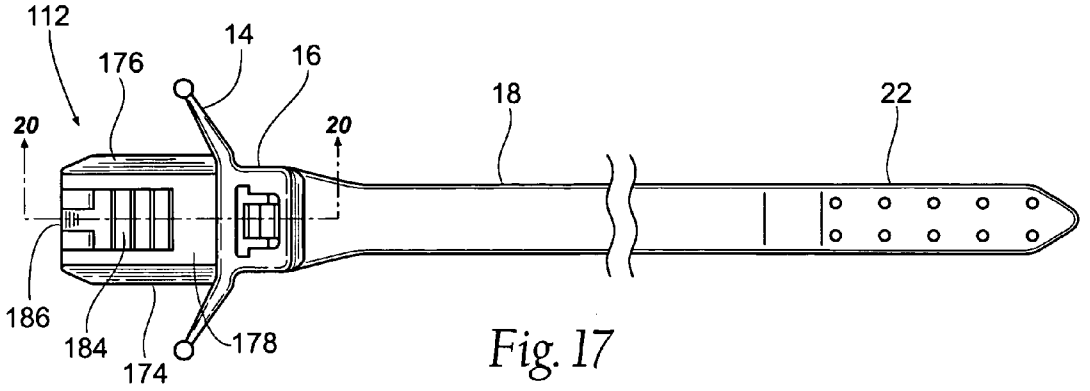


Fig. 17

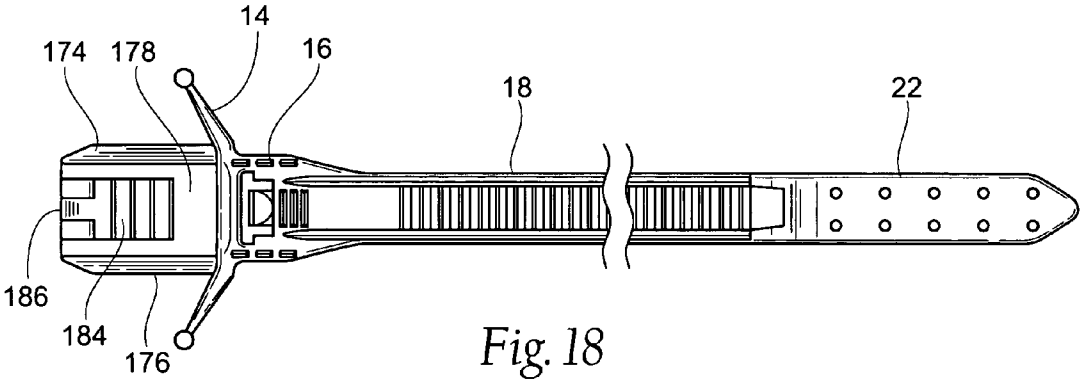


Fig. 18

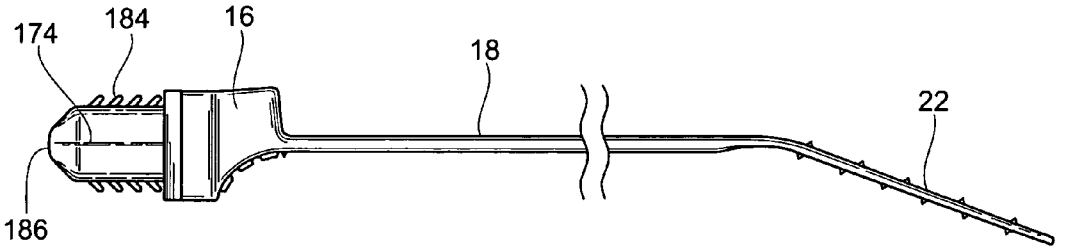


Fig. 19

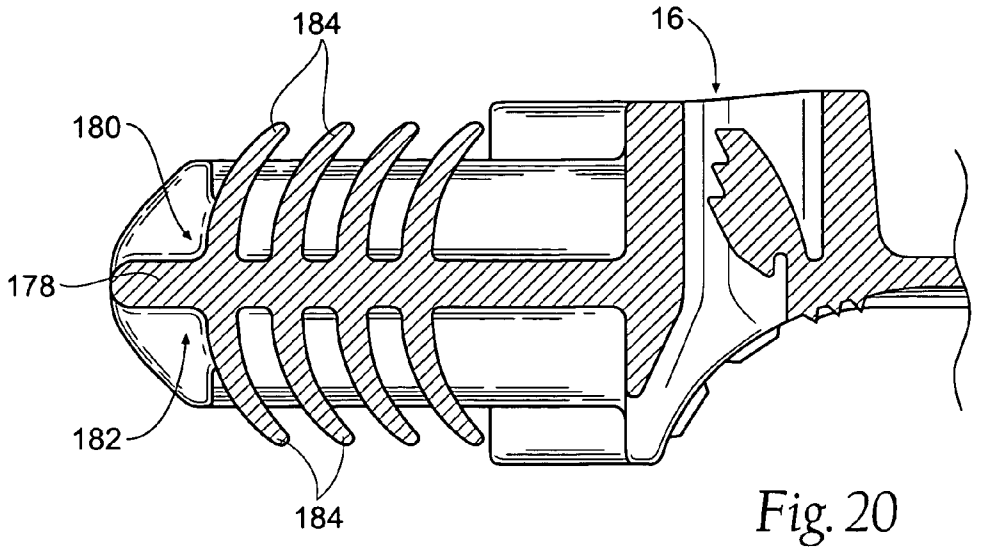


Fig. 20

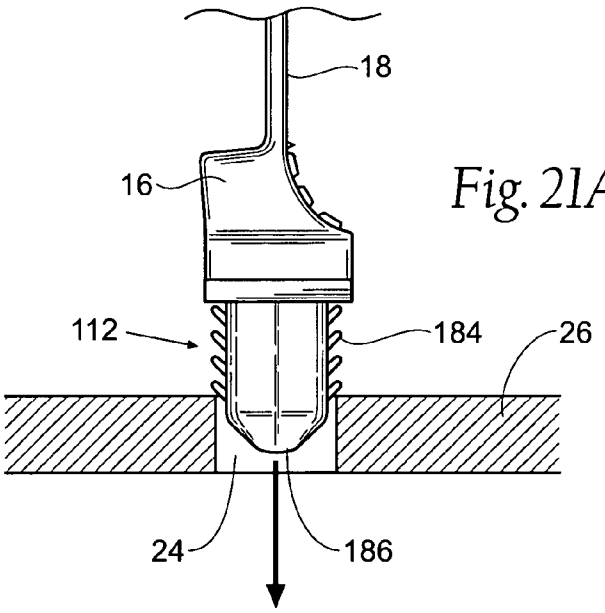


Fig. 21A

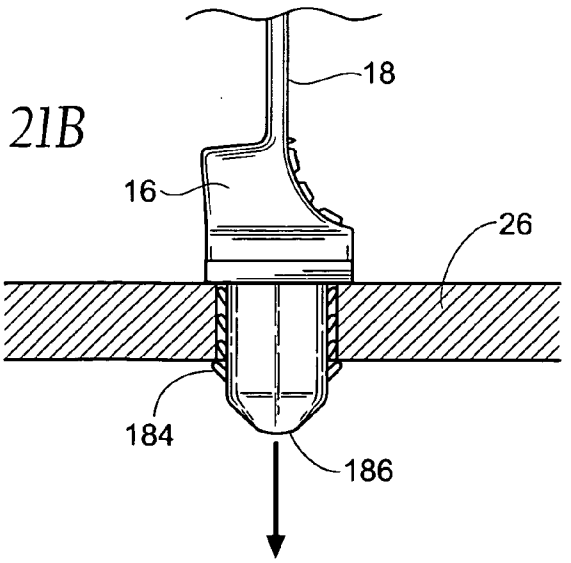


Fig. 21B

HARNESS CLAMP TIE

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a one piece flexible tie having a locking head to harness elongate objects such as wires in a bundle and having means for securing the bundled wires to an aperture in a mounting surface.

[0002] Various devices have been developed to bundle and secure cables or wires to an aperture in a mounting surface. Among these devices are ties used to secure a multitude of wires, cables, tubing and similar items into tight, neat bundles. These cable ties are frequently used on electrical wires or cables to form harnesses in telecommunications equipment, aircraft, appliances, vehicles, and the like. Examples of such ties are shown in U.S. Pat. Nos. 4,875,647, 4,919,373, 4,944,475, and 5,131,613.

[0003] Although these known cable ties possess some desired characteristics, they also include many undesirable characteristics. For example, while effective for bundling larger groups of items, none of the devices shown in these patents provides for securely fastening a small bundle of items, or only one item, to a panel. Additionally, a reduction in the insertion force needed to apply the cable tie to a panel is desired. It is also desirable to reduce the tension required to close the cable tie around a bundle of elongate objects. These improvements would lead to ease in use and installation of the cable tie and a reduction in the incidence of carpal tunnel syndrome in users. Additionally, it is desirable to have a cable tie with increased stability when the cable tie is in use and fastened to a panel.

SUMMARY OF THE INVENTION

[0004] The harness clamp tie of the present invention has a locking head, a thin flexible strap extending in one direction from the locking head, and a fastener extending from the locking head in the opposite direction. A portion of the strap is formed with serrations. Clamping rails are formed along each edge of the bottom surface the strap. Rows of conic friction points are integrally formed on a portion of both the top and bottom surfaces of the strap. Additional clamping rails are formed on the bottom side of the locking head. A pawl is disposed within a slot in the locking head for engaging and retaining at least one of the serrations on the strap when the strap is looped around a bundle of items and returned through the slot.

[0005] The fastener is integrally formed with the locking head. The fastener may be inserted through an aperture in a panel to secure the cable tie to the panel. The fastener has an arrowhead shape with two blades connected by a leading tip. Each blade is integrally formed to an arm that is also integrally formed to the fastener side of the locking head. The blades and arms are inwardly compressible to allow the fastener to be inserted into the aperture in the panel. Several outwardly extending vanes are formed on the arms of the fastener, the vanes being adapted to adjust to varying diameters of apertures.

[0006] An alternate embodiment of the fastener has a rectangular fir tree shape. This embodiment of the fastener has a first section and a second section with a center section extending therebetween. The center section has a first surface and a second surface with a plurality of branches being formed on both surfaces. The branches are compressible to allow the fastener to be inserted into the aperture in the panel.

[0007] It is an object of this invention to provide a harness clamp tie for the bundling of wires of various diameters, including smaller diameters, that has reduced installation tension, increased fastener stability, and a fastener requiring a reduced insertion force.

[0008] It is also an object of thins invention to provide a harness clamp tie which is easier to tighten around bundles and not prone to breakage while applying.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a perspective view of the preferred embodiment of the harness clamp tie of the present invention.

[0010] FIG. **2** is a perspective view of the harness clamp tie of the present invention secured around a bundle of wires (shown in phantom) and inserted into an aperture in a panel, as it is in normal use.

[0011] FIG. **3**A is a sectional view of the locking head of the harness clamp tie of the present invention, with the strap inserted through the locking head supporting a bundle of elongate items.

[0012] FIG. **3**B is a sectional view of the locking head of the harness clamp tie of the present invention, with the strap inserted through the locking head supporting a single elongate item.

[0013] FIG. **4** is a sectional view of the locking head of the harness clamp tie of the present invention, with the strap inserted through the locking head, showing the location of the pawl when a conic point engages the interior of the slot.

[0014] FIG. **5** is a top plan close up view of the pawl disposed in the locking head of the harness tie clamp of the present invention.

[0015] FIG. **6** is a top plan view of the harness clamp tie of FIG. **1**.

[0016] FIG. **7** is a bottom plan view of the harness clamp tie of the present invention.

[0017] FIG. **8** is a side elevation view of the harness clamp tie of the present invention.

[0018] FIG. **9** is a cross sectional view of the strap of the harness clamp tie of the present invention.

[0019] FIG. **10** is an end view of the harness clamp tie of the present invention.

[0020] FIG. **11** is a view of the fastener and locking head end of the harness clamp tie of the present invention just prior to insertion into an aperture.

[0021] FIG. **12** is a view of the fastener and locking head of the harness clamp tie of the present invention as the locking head is being inserted into an aperture.

[0022] FIG. **13** is a view of the fastener and locking head end of the harness clamp tie of the present invention inserted and retained in an aperture of a panel.

[0023] FIG. **14**A is a cross sectional view of the vanes of the fastener of the harness clamp tie of the present invention when the fastener is inserted into an aperture.

[0024] FIG. **14**B is a cross sectional view of the vanes of the fastener of the harness clamp tie of the present invention when the fastener is inserted into an aperture.

[0025] FIG. **15** is a close up perspective bottom view of the fastener and locking head end of the harness clamp tie of the present invention.

[0026] FIG. **16** is a close up perspective top view of the fastener and locking head end of the harness clamp tie of the present invention.

[0027] FIG. **17** is a top plan view of a second embodiment of the harness clamp tie of the present invention utilizing a rectangular fir mount.

[0028] FIG. **18** is a bottom plan view of a second embodiment of the harness clamp tie of the present invention utilizing a rectangular fir mount.

[0029] FIG. **19** is a side elevation view of a second embodiment of the harness clamp tie of the present invention utilizing a rectangular fir mount.

[0030] FIG. **20** is a partial enlarged side elevation view of the harness clamp tie fastener and locking head shown in FIG. **19**.

[0031] FIG. **21**A is a view of the fastener and locking head end of the harness clamp tie just prior to insertion into an aperture.

[0032] FIG. **21**B is a view of the fastener and locking head of the harness clamp tie inserted and retained in an aperture of a panel.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0033] Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention that may be embodied in other specific structures. While the preferred embodiment has been described, the details may be changed without departing from the invention, which is defined by the claims.

[0034] FIG. **1** shows the preferred embodiment of the harness clamp tie **10** of the present invention. As seen therein the tie includes a fastener **12**, a pair of winged springs **14**, a locking head **16**, and an elongate flexible strap **18**. FIG. **2** shows the preferred embodiment of the present invention in use. The strap **18** is looped around a bundle of items **20**, such as wires, and secured by inserting the strap tail portion **22** through a slot **42** in the locking head **16** and pulling the strap **18** tight. As shown in FIGS. **3**A and B, a pawl **44** is disposed within the slot **42** to secure the strap **18** within the slot **42**. A shown in FIG. **11**, the harness clamp tie **10** is secured to a panel **26** by insertion of the fastener **12** into a mounting aperture **24** in a panel **26**.

[0035] Referring to FIGS. **6** and **7**, one end of the strap **18** is integrally formed with the locking head **16**. The strap transition **19** between the locking head **16** and the strap **18** is tapered to increase the strap **18** strength at that junction. This will help prevent breakage, particularly in dry conditions. The free end of the strap **18** ends in a strap tail portion **22**. The strap tail portion **22** extends from the strap **18** at an angle. The strap **18** itself has a generally rectangular shape, except that the free end of the strap tail portion **22** tapers to a point, and the clamping rails **32** as shown in FIG. **9**. The strap **18** is generally of a uniform thickness; however the strap tail portion **22** has a reduced thickness and the thickness of the strap **18** begins to taper just before the strap tail portion **22**.

[0036] The strap **18** has a bottom surface and a top surface. The bottom surface is shown in FIGS. **1** and **7**. The strap **18** has a series of spaced apart serrations **28** integrally formed on the bottom surface thereof. As will be described in more detail below, the serrations **28** on the bottom surface of the strap **18** will engage the pawl **44** when the strap **18** is inserted into the locking head **16**. As is best seen in FIGS. **1**, **9**, and **15**, the strap **18** is also formed with nonslip rails **32** extending along both edges of the bottom surface of the strap **18**, which prevent longitudinal motion of the bundled items and allows for a lower tension setting in a Tension and Cutoff Tool, as will be described further below. FIG. **9** shows a cross sectional view of the strap **18**, including the nonslip rails **32**.

[0037] The tail portion **22** of the strap **18** has a series of conic friction points **30** integrally formed on both the bottom surface and the top surface thereof. These friction points **30** serve to provide extra grip for an operator when the strap **18** is being pulled tight around a bundle of items **20** which may reduce the incidence of carpal tunnel syndrome. The friction points **30** also provide tactile engagement stops when the strap **18** is inserted into the locking head **16**. In the preferred embodiment each set of fiction points **30** is substantially aligned in two rows, each row containing several friction points **30**, as shown in FIGS. **6** and **7**. The rows of friction points **30** on the bottom surface of the strap **18** straddle the pawl **44** as shown in FIG. **5**. However, as shown in FIG. **4**, the rows of friction points **30** on the top surface of the strap **18** engage the interior of the slot **42** as the tail portion **22** is inserted through the slot **42**. The pawl **44** flexes back slightly when a friction point **30** engages the interior of the slot **42** and the conic friction point **30** is slightly compressed between the slot wall and the pawl **44**. The relief and reduction of force when the conic friction point **30** pops out of the slot **42** provides the tactile engagement stops referred to above.

[0038] As best shown in FIG. **8**, the locking head **16** has an opposing strap side **34** and back side **36**, as well as an opposing top surface **38** and bottom surface **40**. The locking head **16** has a slot **42** therethrough. The slot **42** is generally perpendicular to the longitudinal extent of the strap **18**. The slot **42** is shaped and dimensioned to allow the tail portion **22** of the strap **18** to be inserted therethrough. The tapered tail portion **22** of the strap **18** facilitates insertion of the strap **18** through the slot **42**. The items **20** to be secured by the harness clamp tie **10** are secured by looping the strap **18** around the items **20** and inserting the tail portion **22** of the strap **18** though the slot **42** in the adjacent locking head **16**. The tail **22** with friction points **30** is then pulled to tighten strap **18** around the items **20**.

[0039] As shown in FIGS. **3** and **15**, a pawl **44** is provided within the slot **42** of the locking head **16** for securing the strap **18** within the slot **42** and around the items **20** to be

secured. The pawl **44** has a generally wedge or cam shaped cross section. A forward surface of the pawl **44** is provided with a plurality of teeth **48** that engage the complementary serrations **28** formed on the bottom surface of the strap **18** when the strap **18** is looped around the bundle of items **20** to be secured and the tail portion **22** is inserted through the slot **42**.

[**0040**] As best seen in FIGS. **3**A and B, the pawl **44** is hingedly connected to the locking head **16** to allow the pawl **44** to pivot relative to the locking head **16**. Preferably the pawl **44** is biased toward the inserted portion of the strap **18** to pinch the strap **18** between the pawl **44** and the interior backwall **52** of the slot **42**. This arrangement helps ensure intimate contact between the serrations **28** on the strap **18** and the teeth **48** of the pawl **44**. Preferably, the teeth **48** of the pawl **44** and the serrations **28** on the strap **18** are ramped in opposite directions to provide for a slip resistant grip.

[**0041**] The ramped surfaces of the teeth **48** and the serrations **28** are formed to push the pawl **44** away from the strap **18** as the strap **18** is inserted through the slot **42**. Withdrawing movement of the strap **18** relative to the slot **42**, however, pulls the pawl **44** into engagement with the serrations **28** of the strap **18**. By this engagement, withdrawing movement of the strap **18** is prevented and the strap **18** is secured within the slot **42** and around the bundle of items **20** to be secured. The harder the strap **18** is pulled, the more the pawl **44** is wedged, and the more secure the bundle of items **20** is.

[**0042**] FIG. **15** shows the bottom surface **40** of the locking head **16** in further detail. The bottom surface **40** of the locking head **16** is smoothly curved. The curved bottom surface **40** provides circumferential clamping force around bundles. As seen in FIGS. **3**A and B, the bottom surface **40** closely mates with the bundle diameter. The curved bottom surface is also adapted to provide added support for the bundle tie relationship when the user pushes on the bundle in the vicinity of the harness clamp tie **10**, to engage the harness clamp tie **10** with the panel-mounting aperture **24** as shown in FIGS. **11-13**.

[**0043**] A multitude of anti-rotational and anti-slide clamping rails **56** are formed on the bottom surface **40** of the locking head **16**. These clamping rails **56** can be seen most clearly on FIG. **15**. The preferred embodiment of the cable tie has nine (9) clamping rails **56** formed on the bottom surface **40** of the locking head **16**. As described above and shown in FIGS. **3**A and B, two nonslip rails **32** are formed on the bottom surface of the strap. Therefore the preferred embodiment has a total of eleven (11) rails. In the preferred embodiment of the invention the clamping rails **56** have a triangular cross section. These clamping rails **56** prevent rotational and sliding movement on both large and small bundle diameters by biting into the surface of the items to be bundled **20** when the strap **18** is secured around the bundle **20**. The clamping rails **56** also allow for a lower tension setting on the Tension and Cutoff Tool, as will be described below in more detail.

[**0044**] Referring to FIG. **16**, the fastener **12** is integrally formed to the back side **36** of the locking head **16**. The fastener **12** extends from the locking head **16** in the direction opposite the strap **18**. The longitudinal axis of the fastener **12** is substantially aligned with the flexible strap **18**. In the preferred embodiment, the fastener **12** has an open-centered arrowhead shape. The fastener is a two bladed arrowhead having a first blade **60**, a second blade **62**, and a leading tip **58** connecting the blades **60**, **62** at their farthest point from the fastener side of the locking head **16**. The leading tip **58** is sectioned as thin as possible to allow it to flex or fold while being inserted into the mounting aperture **24**. The first blade **60** is connected to a first arm **64** and the second blade **62** is connected to a second arm **66**. Each arm **64**, **66** extends out perpendicularly from the back side **36** of the locking head **16** and is generally rectangular in shape. Each arm **64**, **66** sits in a plane that is generally perpendicular to the plane of the strap **18**, however the arms **64**, **66** are inwardly compressible and upon insertion of the fastener **12** into the mounting aperture **24**. The blades **60**, **62** are biased slightly outward and are also inwardly compressible upon insertion of the fastener **12** into the mounting aperture **24**. The compression of the arms **64**, **66** and blades **60**, **62** will be discussed further below.

[**0045**] Vanes **68** are integrally formed on the arms **64**, **66** of the fastener **12** near the point of attachment to the locking head **16**. In the preferred embodiment of the clamp tie **10**, six (6) vanes **68** are utilized. Three vanes **68** are formed on each arm **64**, **66**. One vane **68** extends from each edge of each arm **64**, **66** in generally the same plane as the arm **64**, **66**. The vanes **68** are adapted to adjust to varying aperture **14** diameters. However each pair of vanes **68** can be angled inward to control the direction in which they curl or collapse. The third vane **68** extends outward from the arm **64**, **66** parallel to the plane of the flexible strap **18**. FIG. **14**A shows a cross section of the vanes **68** in a mounting aperture **24**. FIG. **14**B shows a cross section of the vanes **68** in a slightly smaller mounting aperture **24**, showing the vanes **68** collapsing to fit the mounting aperture **24**. The vanes **68** are tapered such that each vane **68** is slightly thicker at the point where it is connected to the arm **64**, **66** than at the free end. This provides increased flexibility in the vanes **68**. The configuration of the vanes **68** serves to maintain consistent force and self center the fastener **12** in the mounting aperture **24** to provide maximum retention of the fastener **12** in the mounting aperture **24**.

[**0046**] A pair of opposed flexible winged springs **14** are integrally formed to the back side **36** of the locking head **16**. The flexible winged springs **14** engage the panel **26** when the fastener **12** is completely inserted into the mounting aperture **24** in the panel **26**. The flexible winged springs **14** are generally rectangular and extend out from the locking head **16** at an angle of greater than 90 degrees with respect to the back side **36** of the locking head **16**. To facilitate flexing, the flexible winged springs **14** get thinner at the free end thereof. The flexibility of the winged springs **14** is important because if the winged springs were to fold upon compression, there would be a loss of spring force. The flexibility allows the flexible winged springs **14** to apply more tension when compressed fully and to apply tension even in the thickest panels **26**. The preferred embodiment of the flexible winged springs **14** has a generally cylindrical portion **70** at each of the free end of the flexible winged springs **14**. These cylindrical portions **70** are used to allow ejector pins to push the part out of the mold during the molding process.

[**0047**] The high flexibility of the winged springs **14** aids in the reduction of required insertion force and maintenance of uniform spring force throughout various panel thicknesses. The function of the flexible winged springs **14** can

best be seen in FIGS. **11-13**. In use, the fastener **12** of the harness clamp tie **10** is lined up with the mounting aperture **24** in the panel **26**. The leading tip **58** is inserted into the mounting aperture **24**. When the harness clamp tie **10** is pushed further into the mounting aperture **24**, blades **60**, **62** are wedged into the inner surface of the mounting aperture **24** and the arms **64**, **66** are compressed. When the arms **64**, **66** are compressed to point that they contact each other, the blades **60**, **62** begin bend toward the arms **64**, **66**. As is shown in FIG. **13**, when the harness clamp tie **10** is further advanced in the mounting aperture **24** such that the blades **60**, **62** clear the mounting aperture **24**, the blades **60**, **62** and the arms **64**, **66** spring back to their normal biased position. This springing back of the blades **60**, **62** and the arms **64**, **66** provides a tactile indication to the installer. This tactile indication is useful in installations where the installer can either not clearly see the installation, or in loud manufacturing environments.

[**0048**] The harness clamp tie **10** is retained in the mounting aperture **24** by the blades **60**, **62** on one side of the panel **26**, and the flexible winged springs **14** on the opposite side of the panel **26**. The cylindrical portions **70** of the winged springs **14** engage the panel **26** to make the system more stable. The flexibility of the flexible winged springs allows the harness clamp tie to be utilized on panels with various thicknesses. As stated above, the cylindrical portions **70** exist in the rounded shape to accommodate an ejector pin or a similar size and shape that ejects the harness clamp tie **10** out of the mold.

[**0049**] As seen in FIG. **2**, the harness clamp tie **10** may be used to tie together a bundle of wires **20** or the like and to attach this bundle **20** to a panel **26** with a mounting aperture **24**. The tail end **22** of the strap **18** is wrapped around the bundle of items **20** such that the serrated portion of the strap **18** is located on the inside surface of the loop. The tail **22** of the strap **18** is then inserted through the slot **42** in the locking head **16**. The tail **22** of the strap **18**, which is now protruding from the slot **42**, is pulled. As the strap **18** is pulled, the serrated portion of the strap **18** enters the slot **42**. The pawl **44** disposed within the slot **42** then engages at least one of the serrations **28** such that movement of the strap **18** in the opposite or withdrawal direction is prevented. When the strap **18** is pulled tight, the objects are secured in a neat bundle. The fastener **12** of the harness clamp tie **10** can then be inserted into a mounting aperture **24** in a panel **26**, securing the harness clamp tie **10** to the panel **26**. It should be noted that the strap **18** can be fastened around a single item in order to attach that a single item to a panel **26** or around multiple items as illustrated.

[**0050**] FIGS. **17-21**B show a second embodiment of a harness clamp tie **110** according to the present invention. The embodiment of FIGS. **17-21**B is similar to the embodiment of FIGS. **1-16**, however instead of an open-centered arrowhead fastener **12**, the second embodiment utilizes a rectangular fir fastener **112**.

[**0051**] FIG. **17-19** show a top, bottom, and side view of the harness clamp tie **110** of the present invention including a rectangular fir fastener **112**. FIG. **20** shows a sectional view of the rectangular fir fastener **112** and the locking head **16**. The rectangular fir fastener **112** has three sections: a first section **174**, a second section **176**, and a center section **178** located intermediate of the first section **174** and the second section **176**. The three sections **174**, **176**, **178** extend from the back side **36** of the locking head **16**. The plane of the center section **178** is generally perpendicular to the plane of the first section **174** and the second section **176**. The center section **178** has a top side **180** and a bottom side **182**. A plurality of branches **184** extend from both the top side **180** and bottom side **182** of the center section **178**. As can be seen in FIG. **20**, the braches **184** curve toward the locking head **16** of the strap **18**, and each branch **184** is tapered at its free end. The rectangular fir fastener **112** has a leading tip **186** which is opposite the locking head **116**. The leading tip **186** is tapered so as to aid in insertion of the fastener **112** into a mounting aperture **24**.

[**0052**] FIGS. **21**A and **21**B show how the rectangular fir fastener **112** is inserted into a mounting aperture **24**. The leading tip **186** of the fastener **112** is lined up with the mounting aperture **24** in the panel **26** as seen in FIG. **21**A. The leading tip **186** is inserted into the mounting aperture **24**. When the fastener **112** is pushed further into the aperture **24**, the branches **184** are wedged into the inner surface of the aperture **24**. As seen in FIG. **21**B, the branches **184** spring back to their original configuration after they exit the mounting aperture **24** on the opposite side of the panel **26**.

[**0053**] When the fastener **112** is securely inserted into a mounting aperture **24**, the free end of a set of branches **184** will engage the backside of the panel **26**. The flexible winged springs **14** operate as in the previous embodiment to engage the mounting panel **26** when the fastener **112** is completely inserted into a mounting aperture **24** in the panel **26**. The fastener **112** is retained in the aperture **24** by the ends of the branches **184** engaging the backside of the panel **26**, and the flexible winged springs **14** engaging the opposite side of the panel **26**.

[**0054**] The harness clamp tie **10** could be fabricated of various materials; however the preferred embodiment of the present disclosure is made a synthetic material such as nylon 6/6 IMHSUV. In the preferred embodiment, the harness clamp tie **10** as described is adapted to fit bundle diameters ranging from 1.5 mm to 44 mm (0.06 inches to 1.57 inches).

[**0055**] The fastener **12** of the harness clamp tie **10** is adapted to be inserted into a tie mounting aperture **24** in a panel **26**. In the preferred embodiment, the mounting aperture **24** diameter can range between 6.1 mm to 7.2 mm (0.24 inches to 0.28 inches). The thickness of the panel **26** can range between 0.6 mm to 2.6 mm (0.023 inches to 0.102 inches).

[**0056**] After the objects are secured into neat bundles with strap **18** or a single object is secured with strap **18**, the leading tip **58** of the fastener **12** is inserted into the mounting aperture **24**. In the preferred embodiment, the maximum force required to push the harness clamp tie **10** fastener **12** into the mounting aperture **24** is 15 lbs. The minimum force required to remove the fastener **12** from the aperture **24** is 50 lbs. When the harness clamp tie **10** is securely attached to the panel **26** it is possible to remove the harness clamp tie **10** with sufficient force, however the fastener **12** will be damaged and not reusable.

[**0057**] The harness clamp tie **10** is adapted to be used with the Handheld Tension and Cut-off Tool as described in U.S. Pat. No. 5,492,156, owned by the same assignee. The Tension and Cut-off Tool is a gun-shaped housing with a

hand grip and barrel portion. After the tail portion **22** of the strap **18** has been looped around a bundle and inserted into the locking head **16** slot **42**, the tail portion **22** is inserted into the nose slat at the end of the barrel of the tool. The tool engages the tail portion **22** of the strap **18** and pulls it through until a predetermined tension has been reached. The tool then automatically cuts off the excess tail portion **22** closely adjacent the locking head **16**. Specifically, the non-slip rails **32** and the clamping rails **56** provide a concentrated force to grip the bundle preventing rotational and longitudinal movement which allows for a reduced tension setting on the Tension and Cut-off Tool. Both rotational and longitudinal movements are reduced because the rails **32**, **56** bite into insulation on the wires being bundled. The thin strap **16** is easier to cut which reduces hand fatigue and carpal tunnel.

[**0058**] The foregoing is considered as illustrative only of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described. While the preferred embodiment has been described, the details may be changed without departing from the invention, which is defined by the claims.

1: A one piece cable tie adapted to be inserted into a mounting aperture on a panel, the cable tie comprising:

a longitudinally elongate flexible strap having opposed locking head and tail ends and opposing bottom and top surfaces, the strap having a tail portion formed at the tail end thereof, the strap being of a substantially fixed length, and having a series of serrations being formed on the bottom surface of the strap;

a locking head being integrally connected to the locking head end of the strap, the locking head having opposed strap and back sides, as well as opposing top and bottom sides, the locking head having means defining a slot therethrough, said slot being generally perpendicular to the longitudinal extent of the strap for receiving the strap, a pawl disposed within said slot adapted to engage at least one of the serrations of the strap when the strap is looped around a bundle;

said locking head having opposing top and bottom surfaces, said bottom surface of said locking head being curved between the locking head and the bottom surface of the strap; and

a fastener integrally formed to the back side of the locking head for securing the cable tie on a panel, the fastener having a generally arrowhead shape with a leading tip and two blades, each of the blades being integrally formed to an arm, each arm being integrally formed and extending between the blade and the locking head, the blades and arms being inwardly compressible upon insertion of the fastener into the mounting aperture.

2: The one piece cable tie as claimed in claim 1 wherein a plurality of conic friction points formed on both opposing surfaces of the tail portion of the strap.

3: The one piece cable tie as claimed in claim 1 wherein the bottom surface of the strap has nonslip rail formed on each edge.

4. (canceled)

5: The one piece cable tie as claimed in claim 1 wherein a pair of flexible winged springs are integrally formed to the back side of the locking head, the flexible winged springs engaging the panel when the fastener is inserted into the mounting aperture.

6: The one piece cable tie as claimed in claim 1 wherein the fastener has multiple vanes extending substantially outward from the arms of the fastener.

7: The one piece cable tie as claimed in claim 1 wherein the locking head has opposed top and bottom sides and several anti-rotational and anti-slide clamping rails are formed on the bottom surface of the locking head.

8: A one piece flexible cable tie adapted to be tightened around a bundle of at least one wire and fixed to a tie mounting aperture in a panel, said cable tie comprising:

a longitudinally elongate flexible strap having opposed locking head and tail ends and opposing surfaces, said strap being of a substantially fixed length with a series of serrations formed on one surface thereof, said strap having a tail portion formed at the tail end;

a locking head being integrally connected to the locking head end of the strap, the locking head having an opposing strap and back sides, as well as opposing top and bottom surfaces, the locking head having means defining a slot therethrough, the slot being generally perpendicular to the longitudinal extent of said strap for receiving the strap, a pawl disposed within said slot and adapted to engage one of said serrations of said strap when said strap is looped around a bundle;

a fastener integrally formed to the back side of the locking head for securing the cable tie on a panel, the fastener having a generally arrowhead shape with a leading tip and two blades, each of the blades being integrally formed to an arm, each arm being integrally formed and extending between the blade and the locking head, the blades and arms being inwardly compressible upon insertion of the fastener into the mounting aperture, a plurality of vanes being integrally formed to the fastener at the arms, the vanes extending substantially outward from the fastener axis;

a plurality of opposed flexibly winged springs integrally formed to the back side of the locking head, the flexible wings engaging the panel when the fastener is completely inserted into the mounting aperture;

the locking head having integrally formed anti-rotational and anti-slide clamping rails on the bottom surface thereof;

the strap tail being formed with a plurality of conic friction points on the opposing surfaces;

the bottom surface of the strap being formed with a nonslip rails on each edge;

the bottom surface of the locking head being curved between the locking head and the bottom surface of the strap, as such being adapted to provide support when pushing on the harness to install the fastener in the mounting aperture.

9: A one piece cable tie comprising:

a longitudinally elongate flexible strap having opposed locking head and tail ends and opposing bottom and top surfaces, the strap having a tail portion formed at the tail end thereof, the strap being of a substantially fixed length, said strap having a series of serrations being

formed on the bottom surface of the strap, and said strap tail portion having a plurality of conic friction points formed on both the top surface and bottom surface thereof;

a locking head being integrally connected to the locking head end of the strap, the locking head having opposing top and bottom surfaces, the locking head having means defining a slot therethrough, said slot being adapted to receive the strap, a pawl disposed within said slot adapted to engage at least one of the serrations of the strap when the strap is looped around a bundle and

said locking head having opposing top and bottom surface, said bottom surface of said locking head being curved between the locking head and the bottom surface of the strap.

10: A one piece cable tie adapted to be inserted into a mounting aperture on a panel, the cable tie comprising:

a longitudinally elongate flexible strap having opposed locking head and tail ends and opposing bottom and top surfaces, the strap having a tail portion formed at the tail end thereof, the strap being of a substantially fixed length, and having a series of serrations being formed on the bottom surface of the strap;

a locking head being integrally connected to the locking head end of the strap, the locking head having opposed strap and back sides, as well as opposing top and bottom sides, the locking head having means defining a slot therethrough, said slot being generally perpendicular to the longitudinal extent of the strap for receiving the strap, a pawl disposed within said slot adapted to engage at least one of the serrations of the strap when the strap is looped around a bundle;

a fastener integrally formed to the back side of the locking head for securing the cable tie on a panel, the fastener having a first section and a second section with a center section extending between said first section and said second section, the center section having a first surface and a second surface with a plurality of branches formed on both the first surface and the second surface, each branch being integrally formed to the center section, and the branches being compressible upon insertion of the fastener into the mounting aperture.

11: The one piece cable tie as claimed in claim 10 wherein a plurality of conic friction points formed on both opposing surfaces of the tail portion of the strap.

12: The one piece cable tie as claimed in claim 10 wherein the bottom surface of the strap has nonslip rail formed on each edge.

13: The one piece cable tie as claimed in claim 10 wherein the locking head has opposing top and bottom surfaces and the bottom surface is curved between the locking head and the bottom surface of the strap to be adapted to provide support when the fastener is passed through the mounting aperture.

14: The one piece cable tie as claimed in claim 10 wherein a pair of flexible winged springs are integrally formed to the back side of the locking head, the flexible winged springs engaging the panel when the fastener is inserted into the mounting aperture.

15: The one piece cable tie as claimed in claim 10 wherein the locking head has opposed top and bottom sides and several anti-rotational and anti-slide clamping rails are formed on the bottom surface of the locking head.

16: A one piece flexible cable tie adapted to be tightened around a bundle of wires or the like and fixed to a tie mounting aperture in a panel, said cable tie comprising:

a longitudinally elongate flexible strap having opposed locking head and tail ends and opposing surfaces, said strap being of a substantially fixed length with a series of serrations formed on one surface thereof, said strap having a tail portion formed at the tail end;

a locking head being integrally connected to the locking head end of the strap, the locking head having an opposing strap and back sides, as well as opposing top and bottom surfaces, the locking head having means defining a slot therethrough, the slot being generally perpendicular to the longitudinal extent of said strap for receiving the strap, a pawl disposed within said slot and adapted to engage one of said serrations of said strap when said strap is looped around a bundle;

a fastener integrally formed to the back side of the locking head for securing the cable tie on a panel, the fastener having a first section and a second section with a center section extending between said first section and said second section, the center section having a first surface and a second surface with a plurality of branches formed on both the first surface and the second surface, each branch being integrally formed to the center section, and the branches being compressible upon insertion of the fastener into the mounting aperture;

a plurality of opposed flexibly winged springs integrally formed to the back side of the locking head, the flexible wings engaging the panel when the fastener is completely inserted into the mounting aperture;

the locking head having integrally formed anti-rotational and anti-slide clamping rails on the bottom surface thereof;

the strap tail being formed with a plurality of conic friction points on the opposing surfaces;

the bottom surface of the strap being formed with a nonslip rails on each edge;

the bottom surface being curved between the locking head and the bottom surface of the strap, as such being adapted to provide support when pushing on the harness to install the fastener in the mounting aperture.

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