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(54) Title: CABLE ATTACHMENT FOR USE IN SECURITY DEVICES

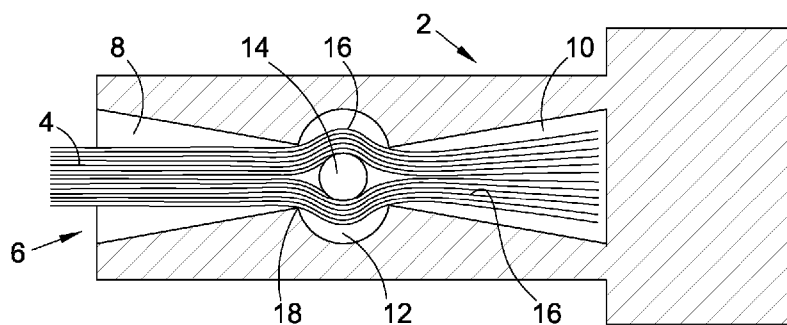


Figure 1

(57) Abstract: A cable attachment comprises a plurality of multi-yarn cables fixed in a block. The block is formed with multiple first passages arranged to receive multiple cables. Each first passage extends past the second passage and has at the intersection an enlarged dimension perpendicular to the first passage, thereby forming a locking section. A cable in each first passage extends on both sides of the locking section, which cable comprises multiple yarns. A pin in the second passage disrupts the cable at the intersection in such a way that the cable yarns are displaced by the pin in the locking section into space in the locking section created by the different dimensions perpendicular to the plane of the first and second passages. The multiple cables are typically arranged in substantially planar formation and normally embedded in a common body of typically flexible plastics material, to form a strap. The cables project from the plastics material and into the block.



## Cable Attachments for use in Security Devices

This invention relates to security devices and more particularly to the attachment of cables to units for coupling to fixtures or other cable ends. Devices for securing baggage and light vehicles are described in various Patent publications including International Specification Nos. WO2010/103327 and WO2015/087067; and US Patent Nos. 5,706,679 and 6,510,717. This invention has particular relevance to security devices such as bicycle or motorcycle locks in which two ends of a cable or strap comprising a number of cables are to be locked together, but can be used in many circumstances in which the end of a strap or cable must be secured.

In its primary embodiments the present invention focuses on cables embedded in straps for use in devices of the kind referred to above. Such straps are known from for example; European Patent Specification No. 1 102 933 and our International Specification No. WO2016/193750, to which reference is directed. Reference is also directed to US Patent No. 2,563,113 and French Patent No. 1,239,298 which disclose similarly embedded wire in flat belts or cables. The disclosures of each of these documents and those referred to above, are hereby incorporated by reference.

According to the present invention a cable attachment comprises a block formed with a plurality of first passages and a second passage intersecting with each first passage and defining a plane at each intersection. At each intersection the first passage extends past the second passage and has at the intersection an enlarged dimension perpendicular to the first passage forming a locking section. A cable in each first passage extends on both sides of the respective locking section, which cable comprises multiple yarns; and a pin in the second passage at each intersection disrupts the cable yarns at the intersection such that cable yarns are displaced by the pin in each locking section into space defined by the different dimensions perpendicular to the plane of the first and second passages in the locking section.

In cable attachments of the invention the plurality of first passages are normally formed in the block with their axes arranged in a substantially common plane, and able to receive multiple cables. The block is formed with a second passage associated with each of the first passages with a pin, or two

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pins, in the second passage displacing cable yarns in the respective locking sections. Alternatively, the block may be formed with a single second passage intersecting with all the first passages. In this arrangement a single pin can be used to disrupt cable yarns in all the first passages, or possibly two pins entering the second passage from opposite ends.

In embodiments of the invention, and particularly those in which the first passages are arranged in substantially planar formation in the block, the cables are normally embedded in a common body of typically flexible plastics or elastomeric material, to form a strap. The elastomeric material is typically thermoplastic, but thermosetting materials can also be used in some applications. The preferred material is polyurethane. Because such elastomeric materials can be thermally reactive, the strap preferably has an outer heat-proof coat. This may be a layer or coating, or a sleeve which might be moulded, or a fabric. A knitted fabric sleeve has some advantages by virtue of its ready elasticity and flexibility, providing an additional impediment to cutting by virtue of the mobility of its yarn components.

A preferred plastics material is thermoplastic polyurethane, but other thermoplastic or thermosetting materials can be used. In a particularly preferred such embodiment in which the first passages in the block are in a substantially common plane, at least one side of the strap is formed with a plurality of longitudinally extending grooves to facilitate bending. The grooves will normally extend parallel with and between cables. Such grooves are normally formed only on one side of the strap. Free longitudinal movement of the cables in the strap can be possible, but at least some bonding between the cables and the material of the strap is preferred. It is also possible in some circumstances, to combine multiple cables in non-planar formation, normally where little or no flexibility is required.

The locking section of each first passage in attachments according to the invention will normally extend perpendicular to the plane defined at the intersection on opposite sides thereof, enabling the cable yarns to be displaced into spaces formed thereby on opposite sides of that plane. The cross section of the pin relative to the cable and the first passage determines how securely

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each cable is attached to the block. Generally, the cross section of the first passage as it approaches the intersection will be substantially that of the cable, and ratio of the cross section of the pin to that of the cable will be at least 0.85; preferably at least 0.9. In a typical attachment of the invention a cable of diameter 5.4mm is held in a block with a pin of diameter 5.0mm. The second passage will normally extend substantially perpendicular to the first passage at least at the respective intersection. In most embodiments it extends through the block and is thereby open at both ends.

In order to enhance the securement of the cables in the block the locking section in each first passage may be formed with a step proximate the intersection at the boundary with the locking section. The displaced cable yarns extending in the first passage are thus forced around the step into the locking section. Where the locking section extends on both sides of the plane defined at the intersection, such a step may be formed on opposite sides of the first passage. One or two such steps can of course be formed at both axial ends of the locking section if required. The step or steps may have a sharp edge to engage the cable yarns, but a smooth or chamfered edge can be sufficient to lock the cable in place if the disruption of the cable yarns results in enough pressure between the yarns and the edge. A chamfered edge on the opposite side of the second passage can assist in ensuring the cable passes through the locking section, but the respective cable end can be sealed to smooth its movement in the passage and into and where appropriate past the locking section.

In some embodiments of the invention each second passage extends past the intersection enabling the pin in the second passage to pass the intersection and cross the locking section. In an alternative arrangement with the second passage extending past the intersection two pins can be used; one engaging the cable from one side of the intersection, and the other from the opposite side. In this arrangement the two pins might have complementary ends which engage within the cable in the locking section.

An attachment according to the invention can be assembled by feeding cables having multiple yarns into the first passages of a block of the kind described

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above. In this procedure, and in order to facilitate the delivery of the cable into and past the intersection of the passages, in a preferred embodiment each first passage has an entry section extending and tapering from a boundary of the block toward the intersection. The cross section of the passage at the boundary with the locking section will be close to if not equal to that of the cable to enhance the relative displacement of the cable yarns in the locking section. There can be a short length of the first passage of uniform cross section between the entry section and the locking section. The block in an attachment of the invention is normally formed in metal such as stainless steel, as are the pins, but plastics material can be used. The cables used will also normally be metal, but again plastics materials can be used. Where different materials are used for the block and cable or cables, care should be taken to ensure that the materials are compatible to minimise any risk of an adverse chemical reaction that might weaken the attachment. The materials can be selected to achieve a bond between the block and the disrupted cable yarns; for example by pressure or chemical welding. Adhesives can also be used.

Cable attachments of the invention are particularly suitable for use in security devices. Such a device comprises a locking element formed with a plurality of multi-yarn cables preferably arranged in a substantially planar array, in which the cables at each end of the element are received in the block of an attachment having multiple first passages. The cables are held in the block, either individually or together by one or more pins, again as described above. The two blocks are formed with complementary elements adapted for locking engagement, and the device includes a mechanism for selectively establishing such engagement. The cables in the locking element are preferably confined in a mass of plastics material to form a strap of the kind described above.

In another application, attachments of the invention can be used within a length of cable or strap to attach a unit at a particular position on it or to attach the cable or strap at a particular location. The block can be moved along the cable or strap, and the pin or pins installed when the requisite location has been reached. A simple clamping device can be provided to accomplish this.

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The invention will now be described by way of example and with reference to the accompanying schematic drawings wherein:

Figure 1 shows a cross section through the block of an attachment according to the invention, illustrating how a cable is held therein;

Figure 2 shows a plan view of the block of an attachment according to a first embodiment of the invention, with four cables held therein;

Figures 2A and 2B show pins that can be used to hold the cables in the block of Figure 2;

Figure 3 shows a plan view of the block of an attachment according to a second embodiment of the invention, with four cables held therein;

Figures 3A and 3B show pins that can be used to hold the cables in the block of Figure 3;

Figure 4 shows a cross section through the block of an attachment according to the invention, illustrating an alternative profile for the passages at the locking section, but without the cable;

Figure 5 shows an enlarged cross sectional view of the locking section taken on line X-X in the block of Figure 4;

Figure 6 shows a security device embodying the invention with a lock securing attachments at opposite ends of a multi-cable strap; and

Figure 7 shows the cross-section of a strap similar to that in the device of Figure 6, but having six cables.

Figure 1 shows the block 2 of an attachment according to the invention with a multi-filament cable 4 held therein. The cable extends in a first passage 6 which has an entry section 8 and an exit section 10. Between the entry and exit sections is a locking section 12 formed at the intersection of a second passage (not shown) extending perpendicular to the first passage 6. The intersection defines a plane, and at the intersection the first passage is

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enlarged in a dimension perpendicular to the first passage and to the plane to form the locking section 12. A pin 14 in the second passage projects into and across the locking section disrupting and displacing the filaments 16 of the cable into the space created by the enlarged dimension of the first passage 6 in the locking section 12 on both sides of the first passage 6. The cable filaments are pressed by the pin against a step 18 formed at the point where the first passage is enlarged to form the locking section 12. Although the step 18 is shown with a sharp edge, as described below with reference to Figure 5, it may be smooth or chamfered depending upon the relative geometry of the pin 14; the cable 4, and the first passage 6 where it reaches the intersection.

The locking section in the block shown in Figure 1 defines the end of the entry section 8 and the start of the exit section 10, with a step 18 of the kind described above at both at both of its axial ends relative to the first passage 6. It will be appreciated that the cable is received in the block prior to the installation of the pin 14, and will pass freely into the exit section 10. However, the cross section of the first passage at the start of the exit section may be greater than at the end of the entry section to minimise the risk of the filaments being caught in the locking section as the cable is passed through it. When the pin 14 is installed, the filaments 16 disrupted in the locking section 12 will spread in the exit section 10 with divergent walls as indicated, but the reverse taper in the exit section is not essential. In an alternative arrangement the end of the cable can be sealed to prevent its filaments being caught in the locking section.

To facilitate the reception of the cable in the block, the block is formed with a tapering entry section 8. Thus, as the cable 4 is introduced to the block 2, its filaments 16 are brought together (if required) by the entry section so that the cable can readily traverse the locking section into the exit section 10 in preparation for installation of the pin 14. Figure 1 illustrates the securement of one multifilament cable 4 in the block 2. Figure 2 shows how a strap comprising a plurality of cables 4 can be held a simultaneously in a single block 20. Four cables 4 are shown received in tapering entry sections 22 shown in dotted lines, of separate first passages, not shown. Four separate second passages 24 are indicated, extending perpendicular to the first passages and

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forming four separate intersections at which the first passages are enlarged in a dimension perpendicular to the plane of the intersection to form a locking section as described above with reference to Figure 1. Each cable passes through the locking section in each first passage, and a separate pin is installed in each second passage 24 to disrupt the cable filaments and hold the respective cables in the block in the manner described above. The first passages are in a substantially common plane, although this is not essential if for example, there is less need for flexibility in the strap. Figure 2A shows a single pin 26 for installation from one side of the block 20 to disrupt the cable filaments. Figure 2B shows a pair of pins 28 suitable for installation from opposite sides, and with complementary ends such that they converge smoothly within the locking section.

Figure 3 is similar to Figure 2, and shows four cables held in a single block. It differs in that rather than using separate pins (or pin pairs) to hold each cable, it uses a single pin 32 or pin pair 34 (see Figures 3A and 3B) which is installed in a single second passage which traverses the block in the same plane as that of the first passages to create four separate intersections.

Figures 2 and 3 each show four cables exposed between their exit from a plastics sleeve 36 and their entrance to the block 20. This is primarily for illustration. In security devices embodying the invention the cable or cables will be encased in a sleeve, normally of plastics material, and in practice the spacing between the casing and the block 2 or 20 will be as small as possible. The entrance to the block will in any event, normally be protected by a casing 56 (see Figure 6).

As noted above, the cables used in attachments according to the invention are multi-yarn. A typical cable will have seven yarns with six twisted around a central core yarn. Each yarn in such a high tensile steel cable would have a diameter of 1.8mm, making the diameter of the cable as a whole around 5.4mm. The diameter of the first or each passage in the block 2 or 20 as described above at the entrance to the respective locking section will be substantially the same, and the diameter of the or each pin only slightly smaller, at around 5.0mm to ensure displacement of yarns in the locking

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section sufficient to secure the attachment of the cable(s) in the block. Of course different multi-yarn cables can be used, but fine yarns risk breakage when displaced by the pin in the locking section. This risk can be reduced if the step, rather than having a sharp edge has a smooth or chamfered edge. This and other possible design features are illustrated in Figures 4 and 5.

The cross section view of Figure 4 is similar to that of Figure 1, but the cable and pin are not shown. The entry section 8 is tapered as in Figure 1, but to a section 40 of uniform diameter between it and the locking section 12. Moreover, at the entrance to the locking section the step (18 in Figure 1) is replaced by a chamfered or bevelled edge 42. A similar edge 42 is formed at the exit from the locking chamber as indicated. In the embodiment of Figure 4 the exit section 44 (10 in Figure 1) is of uniform cross section or diameter, thereby preventing the cable yarns from spreading or restricting their spread after the pin is installed. Each of these features can be used alone or together in the various embodiments described herein.

The locking section may take many forms, so long as it accommodates the displaced cable yarns when the pin is installed. Its cross section can be elliptical, but its final shape may well depend upon the tooling used. It can of course extend all round the first passage 8 forming a donut shaped space on either side of the second passage 24 which as shown traverses the first passage. It is preferred though, to restrict it to opposite sides of the first passage, as indicated in Figure 5.

Where chamfered or bevelled edges are used at one or both of the entry to and exit from the locking section, the pressure applied by the pin to the cable yarns against both edges when the pin is installed will determine the strength of the attachment of the cable to the block. In all embodiments of the invention the materials of the cable yarns and the block can be selected to achieve their best attachment. The combination of a relatively hard high tensile steel for the cable yarns and a relatively soft metal casting for the block can be very effective, and result in the creation of a chemical or pressure weld at the step or chamfered or bevelled edge. The security of the attachment

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may also be enhanced by the use of a glue composition when the pin is installed.

In the assembly of an attachment according to the invention, after a cable has been passed into the block, and past the locking section into the exit section, a pilot punch may be used to cause an initial disruption of the cable yarns before it is removed and the pin is installed. Once the pin is installed, it is fixed in place by welding or gluing or, if a single pin is used in a second passage that is open at both ends, by spreading the distal end to prevent its withdrawal.

A security device embodying the invention is shown in Figure 6. A strap 46 having four cables embedded in a plastics sleeve is attached at each of its ends to a block 48, 50 in the manner described above. The outer side of the strap as shown is indented to facilitate bending. The entrance of the cables into each block is protected by a casing 56. The block 48 extends to form a clasp 52 which receives the block 50 and holds it in place by a locking mechanism (not shown in detail) operated by a key 54.

Figure 7 is a cross-section of a strap similar to that in the device of Figure 6, but formed with an array of six cables 58 embedded in a cooled and cured elastomeric material 60. As can be seen, the material is indented forming grooves 62 on one side between the cables. The resistance to bending of the strap is reduced by the removal of material from the one side, particularly around an axis on the other side. The overall width of the strap is around 5cms, and its thickness around 8mms. On either edge of the strap the material is formed with a 2.5mm shoulder 64. The cross-section is flat on its lower face with a minimum of around 1.5mms between the lower face and each cable 58, and a minimum of around 1mm over each cable on the upper face. The diameter of each cable is around 5.4mm, as is the depth of each indent, but where indentations are formed in any strap in a device embodying the invention, their depth is normally in the range 55-80% of the strap thickness, preferably 56-70%.

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Claims:

1. A cable attachment comprising a block formed with a plurality of first passages and a second passage intersecting with each first passage and defining a plane at each intersection, wherein at each intersection the first passage extends past the second passage and has at the intersection an enlarged dimension perpendicular to the first passage forming a locking section; a cable in each first passage extending on both sides of the respective locking section, which cable comprises multiple yarns; and a pin in the second passage at each intersection disrupting the cable at the intersection, the cable yarns being displaced by the pin in each locking section into space defined by the different dimensions perpendicular to the plane of the first and second passages in the locking section.
2. An attachment according to Claim 1 wherein the locking section of each first passage extends on opposite sides thereof, and wherein the cable yarns are displaced into spaces formed thereby on said opposite sides.
3. An attachment according to Claim 1 or Claim 2 wherein at each intersection the dimension of the second passage perpendicular to the plane is less than or equal to that of the first passage away from the intersection.
4. An attachment according to Claim 3 wherein the ratio of the cross section of the pin at each intersection to that of the undisrupted cable is at least 0.85.
5. An attachment according to any preceding Claim wherein at each intersection the first passage is formed with a step proximate the intersection at the boundary with the locking section, the displaced cable yarns extending in the first passage and around the step.
6. An attachment according to Claim 5 wherein the first passage is formed with a step at both axial ends of the locking section.
7. An attachment according to Claim 5 or Claim 6 wherein the or each step has a chamfered edge.

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8. An attachment according to any preceding Claim wherein at at least one intersection the second passage extends past the locking section.
9. An attachment according to Claim 8 wherein a pin extends in the second passage past the locking section.
10. An attachment according to Claim 8 wherein at said at least one intersection a first pin engages the cable from one side of the locking section, and a second pin engages the cable from the other side.
11. An attachment according to Claim 10 wherein the first and second pins have complementary ends which engage within the cable in the locking section.
12. An attachment according to any preceding Claim wherein each first passage has an entry section extending from a boundary of the block toward a respective intersection, the cross section of the entry section progressively reducing from the boundary to the intersection.
13. An attachment according to Claim 12 wherein each said first passage has a length of uniform cross section between the entry section and the locking section.
14. An attachment according to any preceding Claim wherein the cable in each first passage forms a chemical or pressure weld with the block in the locking section.
15. An attachment according to any preceding Claim wherein the axes of the said first passages are arranged in a common plane.
16. An attachment according to any preceding Claim wherein the block has multiple second passages, each second passage intersecting with a specific first passage.
17. An attachment according to any of Claims 1 to 15 wherein the block has a single second passage intersecting with all the first passages.

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18. An attachment according to Claim 17 wherein a single pin in the second passage disrupts cable yarns in the locking section in all of the first passages.
19. An attachment according to Claim 17 including two pins in the second passage, each pin engaging the cables from opposite sides.
20. An attachment according to any preceding Claim wherein the multiple cables project from a common body of material forming a strap, each cable extending into a said first passage.
21. An attachment according to Claim 20 wherein the material of the body is an elastomeric material.
22. A method of making an attachment according to any preceding Claim comprising installing a plurality of multi-yarn cables in one or more first passages in a said block such that the or each cable extends past the respective said intersection; and inserting one or more pins in the or each respective second passage to disrupt cable yarns at each intersection and displace them in the or each respective locking section.
23. A security device in which a locking element comprises a plurality of cables each having multiple yarns, with each end of each cable extending in a first passage of the block of an attachment according to any of Claims 1 to 21, the blocks having complementary units adapted for locking engagement, and the device including a mechanism for establishing such engagement.
24. A method of making a security device according to Claim 23 comprising installing each end of said plurality of multi-yarn cables in the first passages in a said block such that the or each cable extends past a respective said intersection; and inserting one or more pins in the or each respective second passages to disrupt cable yarns at each intersection and displace them in the or each respective locking section, the blocks having complementary units adapted for locking engagement.

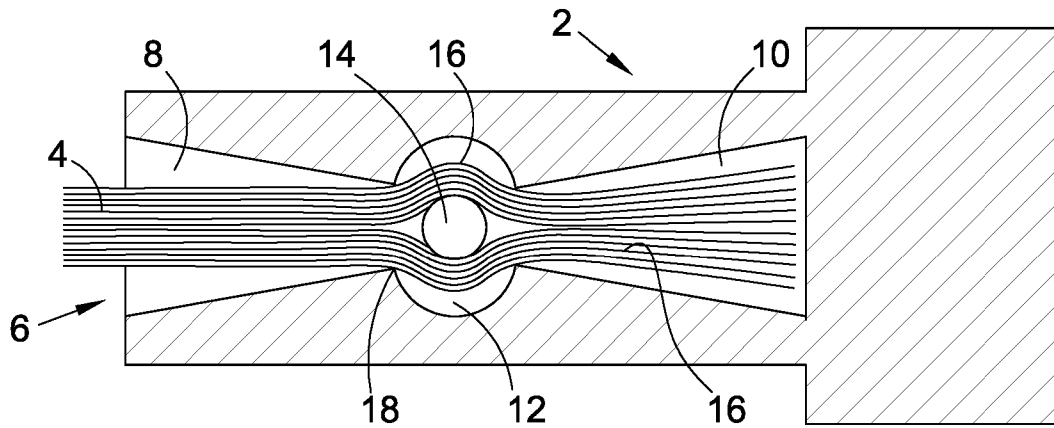


Figure 1

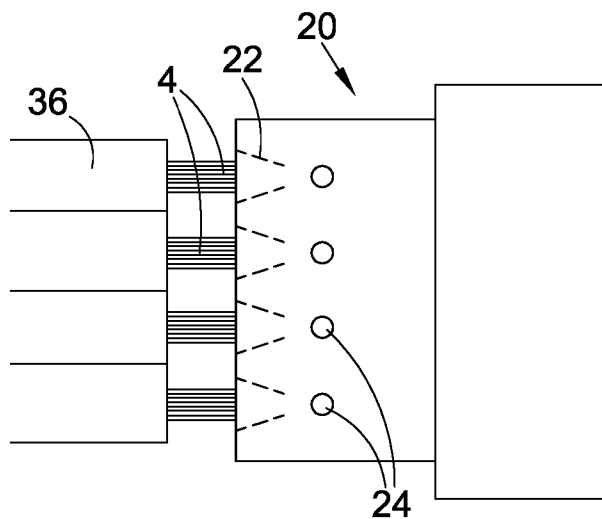


Figure 2

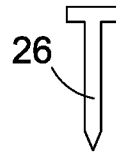


Figure 2a

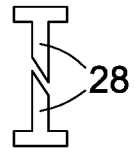


Figure 2b

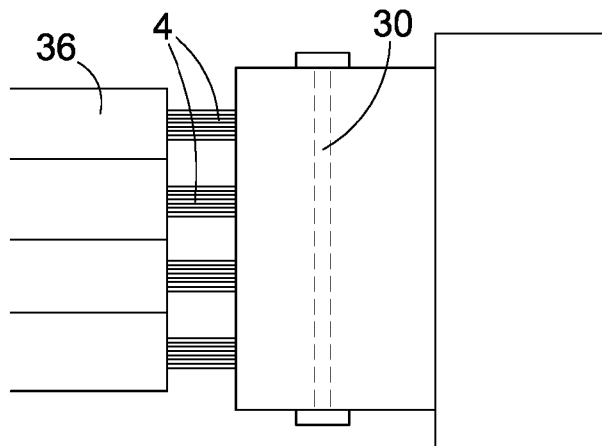


Figure 3

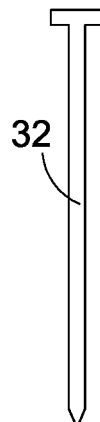


Figure 3a

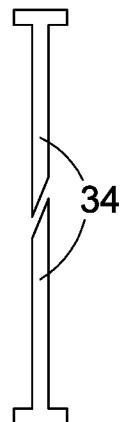


Figure 3b

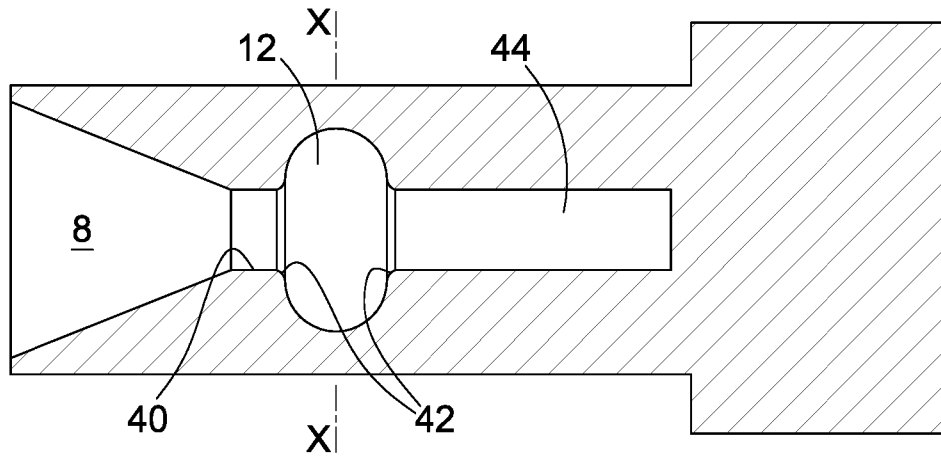


Figure 4

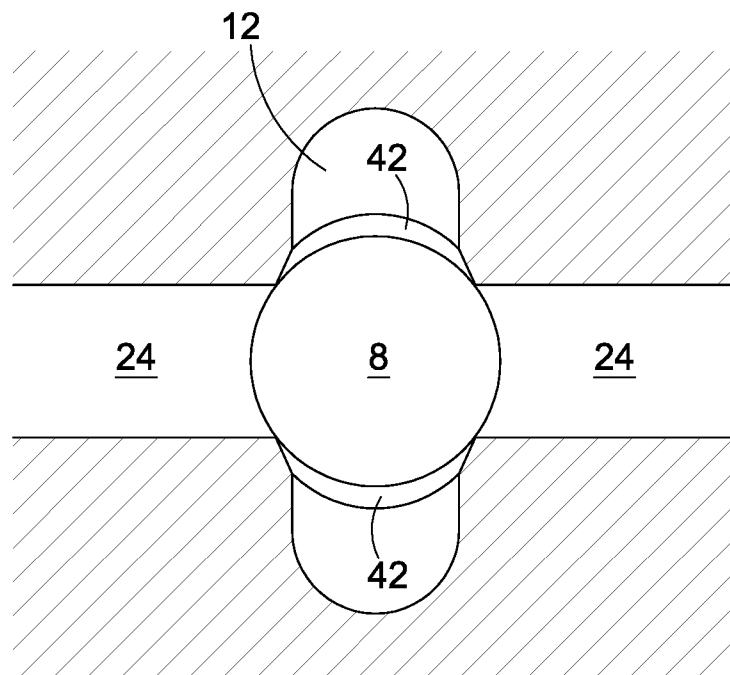


Figure 5

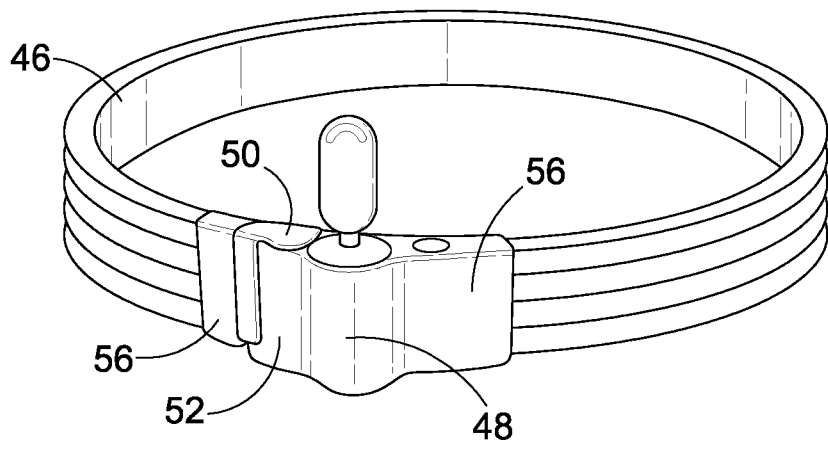


Figure 6

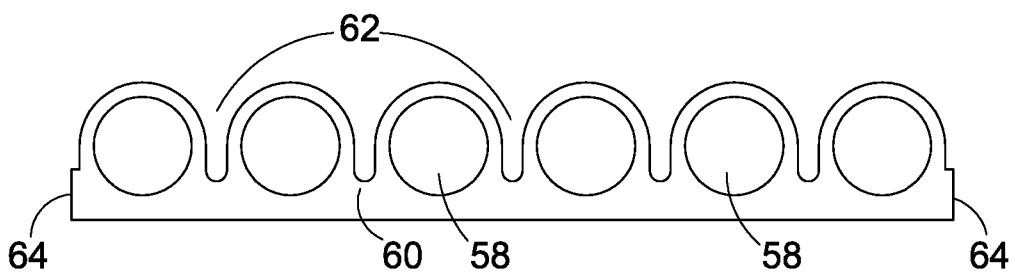


Figure 7

## INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2019/051829

A. CLASSIFICATION OF SUBJECT MATTER  
 INV. E05B17/00 B62H5/00 E05B67/00  
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 E05B B62H

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.
Y	WO 2016/193750 A1 (ZEAL INNOVATION LTD [GB]) 8 December 2016 (2016-12-08) cited in the application page 4, line 11 - line 31 page 5, line 37 - page 6, line 31 figures 1-7	1-24
Y	----- US 5 743 574 A (KOHN RAYMOND F [US]) 28 April 1998 (1998-04-28) column 6, line 63 - column 9, line 52 figures 1-6A	1-24
Y	----- US 3 466 712 A (BEHNEY ROBERT J) 16 September 1969 (1969-09-16) column 1, line 66 - column 4, line 4 figures 1-6	1-24
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Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search

10 September 2019

Date of mailing of the international search report

17/09/2019

Name and mailing address of the ISA/

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Antonov, Ventseslav

## INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2019/051829

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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