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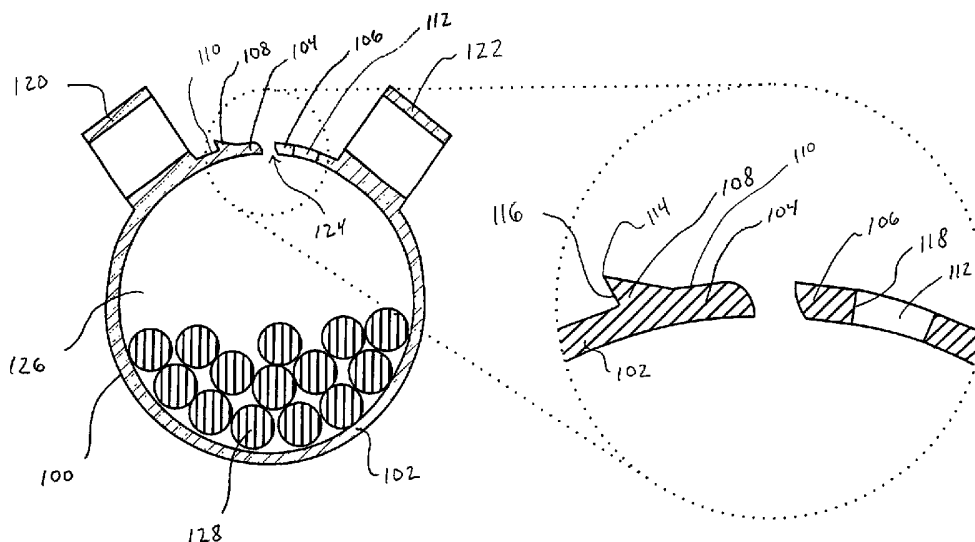
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(54) Title: SINGLE-HANDED CORD/CABLE MANAGEMENT DEVICE



(57) Abstract: The present invention is directed to a device (100) for bundling cables, ropes, wires, or other long flexible materials that are desired to be bundled. The device comprises an arcuate strap (102) for encircling bundled cables. The strap is preferably discontinuous, with first (104) and second (106) ends forming a mouth (124) into a central cavity (126) formed by an arcuate strap. Finger grips (120, 122) are located adjacent to the first and second ends, allowing fingers of a user to be used to pull the first and second ends of the strap to open the normally closed mouth of the device. The device also preferably includes engagement features on the first and second ends to allow the first and second ends to be forced into engagement to lock cables into the cavity formed by the arcuate shape of the strap.



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.

**Single-Handed
Cord/Cable
Management Device**

Field of the Invention

The present invention pertains generally to the organization and storage of flexible tubes and cables, and more particularly to devices for releasably constraining
5 flexible tubes and cable together in a manner amenable to quick and repeatable bundling.

Background of the Invention

The need to coil or bundle wires, cables, flexible tubes, ropes and hoses exists
10 throughout industry and home life. Devices such as extension cords, cables, air hoses, ropes, and other long, flexible articles (hereinafter referred to generically as “cables”) present a storage problem, where coiled cables often become tangled due to the lack of constraints to keep the cables properly coiled. The traditional storage method is to wrap the cables around a person's elbow and between the thumb and forefinger. Once the

cable has been coiled, some form of strap is placed around the coil and fastened to prevent the coil from tangling or uncoiling.

An early device devised to act as a strap consisted of a simple piece of bendable wire which could be twisted to retain the wire around the bundled cables. Twist ties, as
5 these wire retainers are frequently called, provide an economical tie, but can not be easily attached single-handedly, and furthermore have limited lifespans due to fatiguing of the wire. Furthermore, untwisting the tie can often be difficult.

Plastic variations of the twist tie have been developed which rely on toothed engagement fasteners to prevent the tie from coming lose. One variation of a plastic tie
10 uses a serrated end which is passed through a slot in the opposite end of the tie as a means of adjustably fastening the tie. Although this construction is economical, it likewise does not lend itself to single-handed installation. Furthermore, once fastened, the serrated edges can be difficult to withdraw from the slot, making it difficult to remove the tie, and thus release bundled cables.

15 Later developments, such as the tying means shown in United States Patent No. 4,958,791 to Nakamura, incorporate one or more teeth on the end or ends of the strap to lock the strap in the closed position. These straps also utilize a normally open position to ease the difficulties of placing cables into the cavity of the device, allowing easier single handed operation. Once the device has been wrapped around the object or objects to be
20 constrained, the ends of the strap are forced into engagement, locking the tie into place. Nakamura provides a pair of tabs to release the engagement teeth, allowing the band once fastened to be unlocked. Once unlocked, however, the mouth of the band is open, allowing bundled cables or wires to fall from the device. Furthermore, grouping the cables one at a time into the Nakamura device is difficult, since there is no method
25 provided for holding the device while individual cables are placed into the device.

It is therefore an object of the present invention to provide a cable management device which is easily held to allow cables to be placed into the device one at a time, while reducing the likelihood of cables already placed into the device from falling out of the device. It is also an object of the present invention to provide a cable management
5 device having a controllable mouth gap to ease the difficulties of placing cables or wires into the device. Finally, it is also an object of the present invention to provide a cable management device that can be readily released and reused.

Summary of the Invention

10 The present invention is directed to a cable bundling device. The cable bundling device has a flexible strap portion for surrounding the bights of a bundled group of cables, wires, or other long flexible articles (hereafter referred to generically as "cables"). The strap forms a circular shape to surround the bights. The circular shape forms a central cavity within which the cables may be restrained. The strap has three states. The
15 strap has a first and a second end which form a discontinuity in the perimeter of the strap. Finger grips are mounted adjacent to the ends of the strap, allowing the fingers of a user to be inserted into the finger grips to pull the ends apart, thereby opening a mouth into the cavity of the cable bundling device. The strap has a relaxed state wherein the first and second ends are close together, such that the mouth of the device must be opened
20 through use of the finger grips before cables can be placed into or removed from the cable bundling device. The strap also has an open state wherein the ends of the strap have been pulled apart to form the mouth.

In a further embodiment, the cable bundling device has engagement features located on the ends of the strap, allowing the strap ends to be locked together. The
25 engagement features may be a tooth extending from a first end of the strap, and a slot

extending from the second end. Placement of the tooth into the slot limits the ability of the two ends to be separated, thereby locking cables into the cavity of the cable bundling device. Placement of the tooth into the slot may be accomplished by forcing the ends of the strap to overlap, allowing the tooth and slot to enter into an interlocked state.

5 In a still further embodiment, engagement features may include a plurality of teeth on one end, with at least one tooth on the opposite end, such that the position of the two strap ends can be varied in the locked state allowing the cable bundling device to be tightened around a group of bundled cables.

Other features and advantages of the invention will be apparent from the
10 following description of the preferred embodiment, and from the claims.

Brief Description of the Drawings

Figure 1 shows a cross-sectional view of a cable bundling device according to the present invention as viewed along the long axis of the device, where the cable bundling device is shown in a relaxed state.

15 Figure 1A is a detail view of the mouth area of Figure 1.

Figure 2 shows a cable bundling device according present invention in an opened state.

Figure 3 shows a perspective view of a cable bundling device according to the present invention, with the cable bundling device nested in the palm of a user's hand.

20 Figure 4 shows a cable bundling device according to the present invention in cross-section as viewed along the long axis of the device, where the cable bundling device is shown in locked state.

Figure 5 shows in perspective a cable bundling device according to the present invention, wherein the device is formed from a metallic strap.

Figure 6 shows a view in partial cross-section along plane B-B as shown in Figure 7 of a cable bundling device as viewed along an axis perpendicular to the long axis of the device, wherein the finger grips comprise channels and backstraps.

Figure 7 shows a view in partial cross-section along plane A-A as shown in Figure 6 of a cable bundling device as viewed along the long axis of the device, wherein the finger grips comprise channels and backstraps.

Figure 8 shows a cross-sectional view of a cable bundling device according to the present invention as viewed along the long axis of the device, where the cable bundling device utilizes multiple teeth engagement means on both ends to provide a variable locked position.

Detailed Description of the Invention

In the Figures, wherein like numerals indicate like elements, there is shown a presently preferred embodiment of a cable bundling device according to the present invention. As shown in Figure 1, the device 100 includes a flexible arcuate strap 102. The strap 102 is preferably made from a material having an elastic tendency to return to a relaxed state. Such materials include various plastics, such as nylon and teflon. Alternately, the strap may be formed from a metallic material such as spring steel, as shown in Figure 5, and discussed further below.

The device 100 of the present invention has three states. The normal state is associated with a relaxed state of the device 100, in which the first 104 and second 106 ends substantially abut, preventing cables 128 bundled in the device 100 from freely falling from the cavity 126 of the device 100. The second state of the device is when the first 104 and second 106 ends have been forced apart to open the mouth 124 of the device 100. The third state is a locked state discussed further below.

The strap of the present invention may be made from any flexible material, as long as the material has sufficient strength and resiliency to accomplish the present invention. Flexible plastics, metal, rubber, are preferred due to the ease with which the cable bundling device can be formed from these materials. The finger loops which are
5 provided to allow the two ends to be separated may be integrally formed with the strap, or may be formed separately and attached to the strap, such as through bonding, welding, or mechanical fastening.

The strap has a first 104 and a second 106 end. In the relaxed state, the ends 104 and 106 of the strap substantially complete the circumference of the arcuate shape of the
10 strap. The first end 104 of the strap has a male engagement structure such as a raised tooth 108 (shown in Figure 1A which is a detail view of the mouth area of Figure 1) extending above the outer surface 110 of the strap. The tooth 108 is at its highest at its point 114 opposite the first end 104 of the strap, and tapers to join the outer surface 110 of the strap 102 adjacent the first end 104 of the strap. The second end 106 of the strap
15 102 has a slot 112 through the material of the strap 102. The slot 112 has a front edge 118 which is parallel to a long axis of the device (shown in Figure 3 as 302), such that when the tooth 108 is placed in the slot 112, the face 116 of the tooth rests against the front edge 118 of the slot 112.

First 120 and second 122 finger grips are located adjacent to the first 104 and
20 second 106 ends of the strap 102. The finger grips 120, 122 are preferably closed rings or loops through or into which a finger can be inserted. Other shapes, such as a finger hook or a thimble or loops or cup-shaped shell not necessarily closed, can be used, however such shapes may present a tendency to snag on other objects.

The relaxed state of the device 100 results in the mouth 124 of the device
25 (forming the entrance into the cavity 126 of the device) being substantially closed. The

first 104 and second 106 ends of the strap 102 may be allowed to overlap, as the desired result is to restrain cables 128 from freely leaving the cavity 126 unless the device 100 is forced into an open state.

As shown in Figure 2, the circumference of the arcuate strap 102 is preferably
5 chosen so that the strap 102 comfortably rests in the palm 202 of a user's hand between the thumb 204 and middle fingers 206. The finger grips 120, 122 are disposed such that the middle finger 206 and the thumb 204 can be inserted into the first 120 and second 122 finger grips. The circumference of the arcuate strap 102 may varied to accommodate differing sizes and amounts of cables to be bundled. Variance of the circumference of
10 the arcuate strap 102 may be coordinated with re-positioning of the finger grips 120, 122 to maintain correct ergonomic positioning. Although the preferred embodiment allows the arcuate strap 102 to rest in the palm 202 of a user's hand, the only size limitation is the ability of a user to single-handedly operate the finger grips 120, 122 to open the device 100.

15 As shown in Figure 3, the length 302 of device 100 may be sufficiently long to provide a protective layer in the palm 202 of a hand when cables 118 are being placed into the device 100. The protection provided both helps in keeping a user's hand clean, since the cables do not contact the hand holding the device 100, but also provide a protective layer to prevent friction from causing injury to the hand. Also, the protection
20 provided insulates a user from rough or frayed surfaces associated with a cable.

The orientation of the device 100 in the palm 202 of a user's hand furthermore allows the elbow (not shown) of a user to be used to maintain loop length while cable 128 is being wound into the device 100. With the device 100 in the palm 202 of the hand, the mouth 124 can be opened each time a bight is passed into the device 100, or
25 held continuously open while cable 128 is bundled.

As shown in Figure 4, the device 100 may be placed into a locked closed state by forcing the first end 104 of the arcuate strap 102 into a position under the second end 106, such that the engagement tooth 108 extends through the slot 112 in the second end 106. The strap 102 is preferably formed such that the first end 104 of the strap 102 is
5 biased against the second end 106 when the tooth 108 is inserted into the slot 112. In order to release the locked engagement, the finger grip 120 on the first end 104 may be pushed inward, disengaging the tooth 108 from the slot 112 and allowing the mouth 124 of the device 100 to be opened.

Although the device is preferably fabricated from a plastic, the device may be
10 fabricated from other materials. Shown in Figure 5, the device 100 may be fabricated from a spring metal strap 502. The finger grips 504, 506 may be attached to the spring metal strap 502, such as by bonding or mechanical fastening. The finger grips 504, 506 are shown in Figure 5 as being riveted 508 to the strap 502. The engagement tooth 108 may also be formed from a separate piece and bonded or mechanically fastened to the
15 strap 502, or may alternately be formed by punching a raised tooth or displaced portion into the strap 502 itself. The slot 112 when used with a metallic strap may also be formed by punching a rectangular hole or displaced portion through the strap 502, or may alternately be formed by punching a tooth shape into the second end 106, such that when the tooth 108 of the first end 104 is aligned with the tooth 508 of the second end 106, the
20 pocket formed by the tooth 508 of the second end allows the tooth 108 of the first end to nest into and engage the tooth 508 of the second end. In order to accomplish such nesting, the second tooth 508 must be sized such that the first tooth 108 will nest inside the second tooth 508.

As shown in Figures 6 and 7, the finger grips 120, 122 do not need to be external
25 to the strap 102, but may rather be integrally formed into the strap 102 itself. Figure 6,

shown in partial cross-section, shows a cable bundling device 100 according to the present invention wherein channels 602 have been molded into the sides of the device 100 to allow fingers to pass between backstraps 604 and the body 606 of the device 100. As shown in Figure 7, the channels 602 result in a constriction in the cavity 126 when
5 viewed along the long axis of the device 100.

Although the presently preferred embodiment relies on a single toothed engagement system for simplicity, multiple tooth engagement systems may be used in conjunction with the cable bundling device 100 of the present invention. Shown in Figure 8 is a multi-tooth engagement system used in conjunction with the present invention. A
10 first end 802 of the strap 102 has multiple teeth 804, each tooth 804 having a consistent size. The teeth 804 face the exterior 808 of the arcuate strap 102 in its relaxed state . The second end 806 of the strap 102 has an inner surface 810 on which multiple teeth 812 are formed, with the size of the teeth 812 consistent with the size of the teeth 804 on the first end 802. The teeth 804, 812 on the first 802 and second 806 ends are preferably
15 back-cut, such that tension in the strap 102 when engaged causes engaged teeth 804, 812 to pull together.

The teeth 804, 812 when engaged can be released simply by pressing inward on the first end 802 of the device. With the device 102 cradled in the palm 202 of a hand, the device 100 can be opened to allow cables 124 to be passed through the mouth 120
20 into the cavity 122, relaxed to restrain the cables 124 within the cavity 122, and closed to a locked engagement state without having to change the position of the device 100 within a user's palm 202.

Should the user desire to release the cables 124 , the user can again place the bundling device 100 into the palm 202 of his or her hand, with a thumb 204 and an
25 opposing digit such as the middle finger 206 inserted into the finger grips 120, 122. As

the engagement means of the bundling device 100 have an overlying and an underlying feature, the locked state of the bundling device 100 can be released by extending the digit in the finger grip 122 adjacent to the over-riding engagement feature, and extending the finger. Alternately, the engagement feature may be released by clenching the digit in the
5 finger grip 120 adjacent to the underlying engagement feature, or by a combination of extending one digit and clenching the other to cause the engagement features to disengage from each other.

The description of the embodiments herein are provided to enable any person skilled in the art to make and use the present invention. Various modifications to these
10 embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

15

Claims

What is claimed is:

5

1) A cable bundling device comprising:

a flexible arcuate strap portion, said strap portion having a first and a second end, and an inner surface and an outer surface, said outer surface forming a perimeter of said flexible arcuate strap portion, wherein said first and second ends form a discontinuity in said perimeter of said arcuate strap portion, and wherein said inner surface forms a cavity;

first and second finger grips, said first finger grip being located adjacent to said first end, and said second finger grip being located adjacent to said second end, wherein said first and second finger grips allow interposition of a finger between said flexible arcuate strap and said finger grip, wherein said first and second ends substantially abut each other when said flexible arcuate strap portion is in a relaxed state .

15

2) The cable bundling device of claim 1, wherein said first and second ends overlap when said flexible arcuate strap portion is relaxed.

20

3) The cable bundling device of claim 1, further comprising a male engagement feature located adjacent to said first end, and a female engagement feature located adjacent to said second end, wherein said male and female engagement features interlock when said flexible arcuate strap is forced into a closed state.

25

4) The cable bundling device of claim 3, wherein said male engagement feature is a tooth extending above said outer surface of said flexible arcuate strap, and said female engagement feature is a slot through said second end of said flexible arcuate strap.

5

5) The cable bundling device of claim 3, wherein said male engagement feature is a tooth extending above said outer surface of said flexible arcuate strap, and said female engagement feature is a pocket formed in said interior surface of said flexible arcuate strap adjacent to said second end.

10

6) The cable bundling device of claim 3, wherein said finger loops comprise features integrally formed with said flexible arcuate strap.

15

7) The cable bundling device of claim 6, wherein said flexible arcuate strap is formed from a plastic material.

8) The cable bundling device of claim 3, wherein said flexible arcuate strap is formed from a metallic material.

20

9) The cable bundling device of claim 3, wherein said finger grips are formed separately from said flexible arcuate strap, and are bonded to said flexible arcuate strap.

10) The cable bundling device of claim 3, wherein said finger grips are formed separately from said flexible arcuate strap, and are mechanically fastened to said flexible arcuate strap.

5 11) The cable bundling device of claim 3, wherein said male engagement feature comprises at least one tooth, wherein said at least one tooth extends from said outer surface of said flexible arcuate strap adjacent to said first end, said at least one tooth having a highest end opposite from said first end of said flexible arcuate strap, and wherein said female engagement feature comprises a plurality of teeth, said plurality of
10 teeth extending from an inner surface of said flexible arcuate strap adjacent to said second end and having a highest end opposite from said second end of said flexible arcuate strap.

12) The cable bundling device of claim 3, wherein said male engagement feature comprises a plurality of teeth, said plurality of teeth extending from said outer
15 surface of said flexible arcuate strap adjacent to said first end, said plurality of teeth further having a highest end opposite from said first end of said flexible arcuate strap, and wherein said female engagement feature comprises at least one tooth, said at least one tooth extending from an said surface of said flexible arcuate strap adjacent to said second end and having a highest end opposite from said second end of said flexible
20 arcuate strap.

13) The cable bundling device of claim 1 wherein at least one finger grip comprises a ring, said ring being substantially circular in shape and having an opening through the center of said ring, said opening being sufficiently large to allow insertion of
25 a user's digit into said opening, said ring being oriented substantially perpendicular to

said outer surface of said flexible arcuate strap and affixed to said outer surface of said flexible arcuate strap adjacent to said first end.

14) The cable bundling device of claim 1 wherein at least one finger grip
5 comprises a cup-shaped shell, said cup shaped shell oriented to allow insertion of a digit associated with a hand of a user when said device is cradled in the hand of a user.

15) The cable bundling device of claim 1 wherein at least one finger grip
comprises a channel formed in said flexible arcuate strap, said channel comprising a
10 depression in said flexible arcuate strap, said channel further comprising a back strap, said back strap positioned to constrain movement of a digit in said channel.

16) A cable bundling device comprising:
a flexible arcuate strap portion, said strap having a first and a second end,
15 and a relaxed state said first and second ends forming a discontinuity in a perimeter of said arcuate strap, said strap further having an inner and an outer surface, wherein the perimeter of the strap forms a cavity into which cables can be inserted, said cavity being oriented along a long axis, said long axis passing through an approximate center of said cavity;

20 a first finger loop adjacent said first end, said finger loop forming an opening into which a user's digit may be extended, wherein said opening is substantially perpendicular to said long axis;

a second finger loop adjacent said second end, said finger loop forming an opening into which a user's digit may be extended, wherein said opening is substantially
25 perpendicular to said long axis; and

at least one male and at least one female engagement feature, wherein said male and female portions interlock when said first and second ends of said arcuate strap are forced into overlapping contact,

wherein said first and second ends of said flexible arcuate strap abut when
5 said flexible arcuate strap is in said relaxed state .

17) A cable bundling device according to claim 16, wherein said male engagement feature comprises at least one tooth extending from said outer surface of said flexible arcuate strap, said at least one tooth having an engagement surface extending
10 substantially perpendicularly from said outer strap and parallel to said discontinuity formed by said first and second ends, said tooth further having a top edge along an edge of said engagement surface located distally from said outer surface of said flexible arcuate strap, said tooth tapering from said top edge to said outer surface of said strap adjacent to said first end of said strap.

15

18) A cable bundling device comprising:
a flexible strap, said strap having a related state, said strap in said relaxed state forming a cylindrical shell about an axis of rotation, said strap further having a width and an inner and an outer surface, said strap further having a discontinuity through said strap
20 along a line substantially parallel to said axis of revolution;

a first end, said first end forming a first boundary of said strap along said discontinuity;

a second end, said second end forming a second boundary of said strap along said discontinuity, said second end being opposite from said first end across said
25 discontinuity;

a first finger grip located adjacent said first end; and
a second finger grip located adjacent said second end.

19) A cable bundling device comprising:

5 a flexible strap portion, said strap portion having a first and a second end, said strap portion is a relaxed state forming an arcuate perimeter, wherein said first and second ends form a discontinuity in said perimeter of said strap portion;

first and second finger grips, said first finger grip being located adjacent to said first end, and said second finger grip being located adjacent to said second end, wherein
10 said first finger grip allows interposition of a finger between said flexible strap and said first finger grip, and said second finger grip allows interposition of a finger between said flexible strap and said second finger grip;

wherein said first and second ends are separated from each other a distance smaller than a cable to be inserted into said device when said flexible strap portion is in
15 said relaxed state.

20) A cable bundling device, said cable bundling device comprising:

a cable bundling means for constraining substantially parallel bights of a cable, said cable bundling means having a relaxed state for restraining cables within said cable
20 bundling means, said cable bundling means further comprising an opening for allowing cables to be placed within said cable bundling means, said cable bundling means further comprising a closed state for preventing said cable bundling means from being unintentionally opened;

first and second opening means for allowing a user to force said cable bundling
25 means into an open state; and

an engagement means for engaging said cable bundling means into said closed position.

21) A cable bundling device according to claim 20, wherein said cable
5 bundling means comprises an arcuate plastic collar.

22) A cable bundling device according to claim 21, wherein said first opening
means comprises a finger hook, said finger hook extending from said cable bundling
means such that a digit of a user can be interposed between at least a portion of said
10 finger hook and said cable bundling means.

23) A cable bundling device according to claim 21, wherein said first opening
means comprises a finger loop, said finger loop being connected to said cable bundling
means, wherein said finger loop is for receiving a finger of a user, said finger loop being
15 positioned such that a finger in said finger loop may be used to urge said cable bundling
means into an open state .

24) A cable bundling device according to claim 20, wherein said cable
bundling means comprises a flexible metallic strap.
20

25) A cable bundling device according to claim 24, wherein said engagement
means further comprises a first and a second displaced portion of said flexible metallic
strap, said first and second displaced portions positioned such that said first displaced
portion nests in said second displaced portion when said cable bundling means is forced
25 into said closed position.

Figure 1

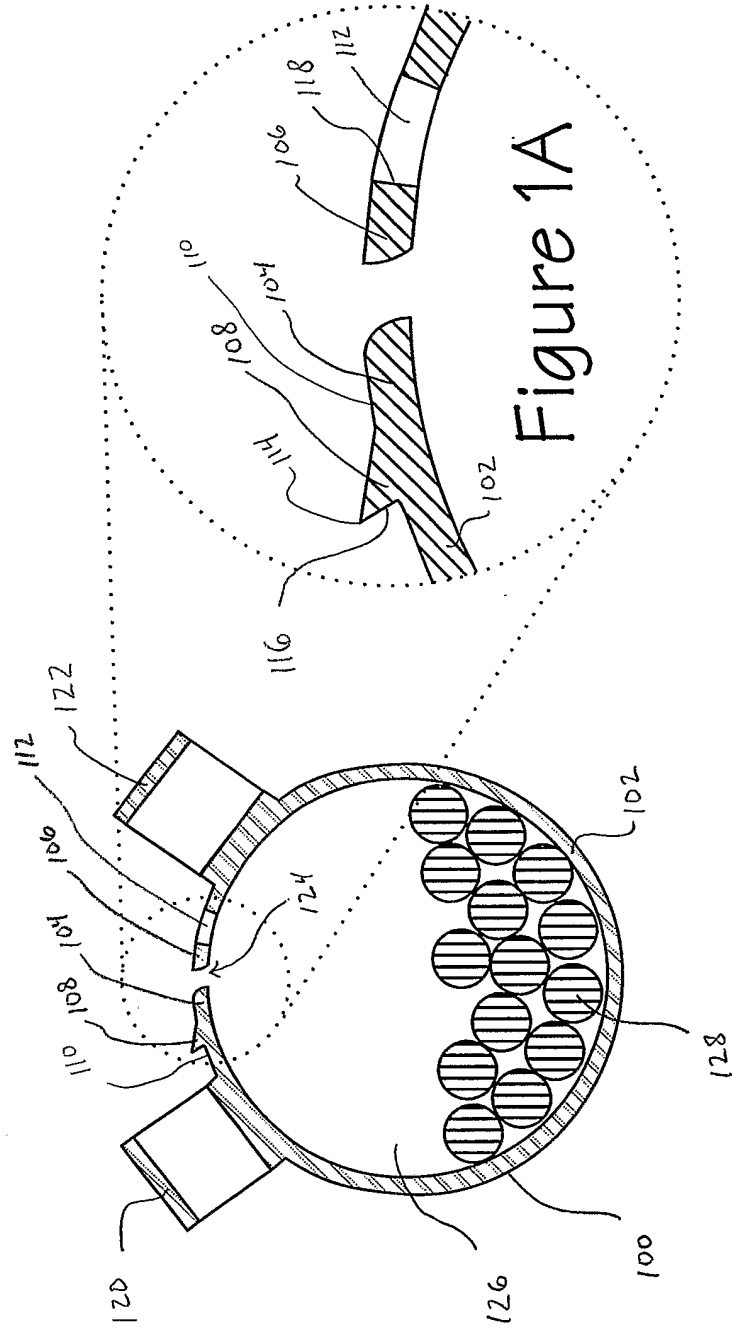


Figure 3

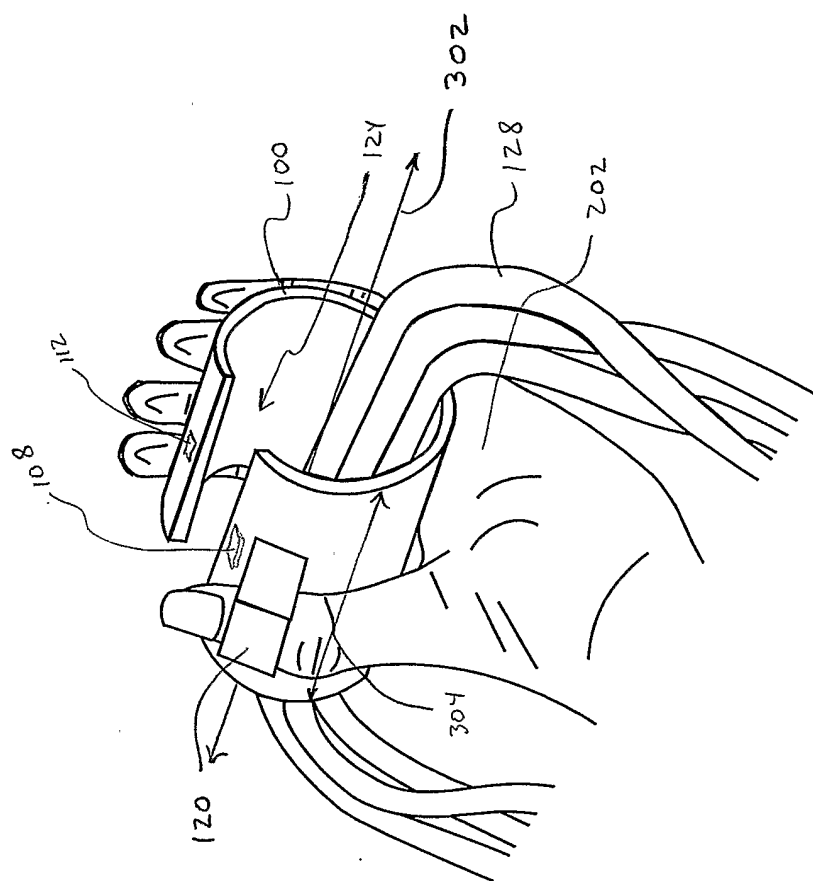


Figure 4

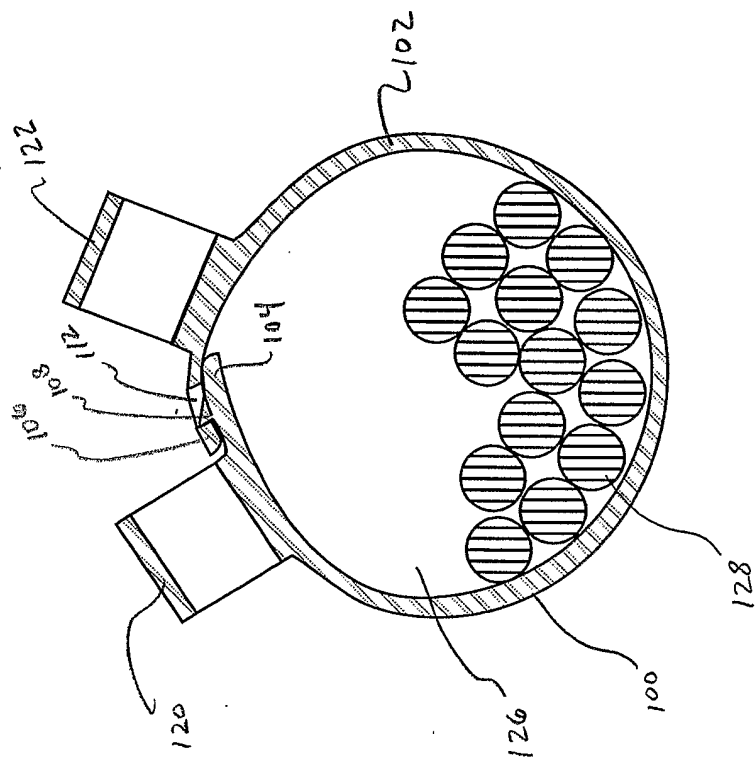


Figure 5

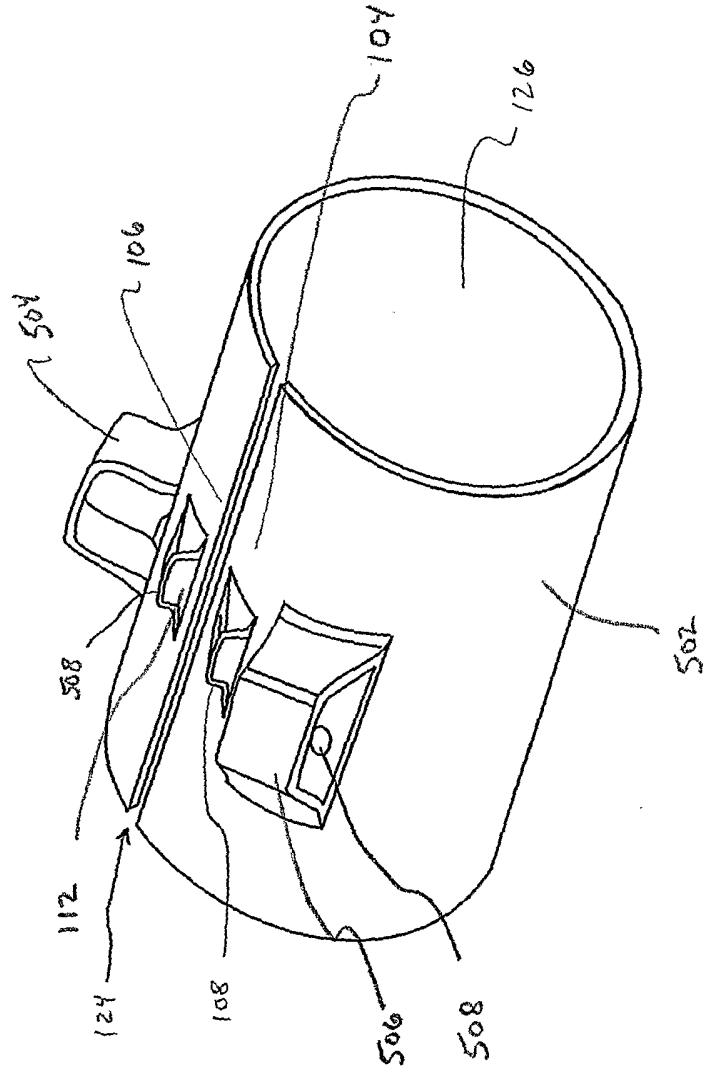
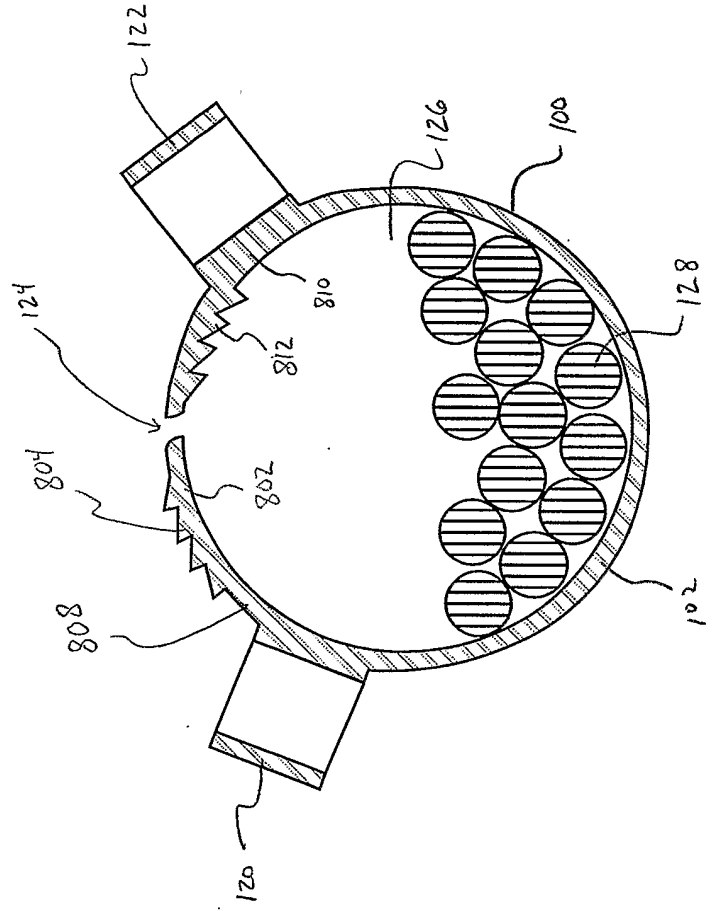


Figure 7

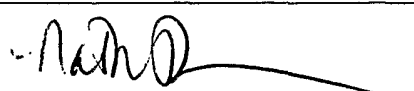
Figure 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/22355

A. CLASSIFICATION OF SUBJECT MATTER IPC(7) : F16L 3/12; B42F 1/02 US CL : 248/74.3, 74.1, 68.1; 24/16PB, 545, 557 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) U.S. : 248/74.3, 74.1, 68.1; 24/16PB, 545, 557 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched NONE Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) NONE		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3,571,861 A (OLSON) 23 March 1971 (23/03/1971), see entire document.	1-25
A	US 4,674,720 A (FETSCH) 23 June 1987 (23/06/1987), see entire document.	1-25
X --- Y	US 5,414,911 A (ADAMS) 16 May 1995 (16/05/1995), see entire document.	1-3, 19, & 20 ----- 6, 7, 13, 16, 17, 22, & 23
X	US 5,423,501 A (YU) 13 June 1995 (13/06/1995), see entire document.	1-3, 5, 8, 9, 11, 12, 18-21, 24, & 25
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,533,696 A (LAUGHLIN ET AL) 09 July 1996 (09/07/1996), see entire document.	1-4, 8, 18, 19, 20, 24, & 25
Y	US 5,625,931 A (VISSER ET AL) 06 May 1997 (06/05/1997), see entire document.	6, 7, 13, 16, 22, & 23
Y	US 5,079,802 A (BLASE ET AL) 14 January 1992 (14/01/1992), see entire document.	17
A	US 4,958,791 A (NAKAMURA) 25 September 1990 (25/09/1990), see entire document.	1-25
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