US009907345B2

(12) **United States Patent**
O'Neill

(10) **Patent No.: US 9,907,345 B2**
(45) **Date of Patent: Mar. 6, 2018**

(54) **MAGNET AND FRICTION BASED INFINITELY VARIABLE STRAP TIGHTENING SYSTEM AND METHOD**

(71) Applicant: **Devin O'Neill**, Denver, CO (US)

(72) Inventor: **Devin O'Neill**, Denver, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 385 days.

(21) Appl. No.: **14/544,816**

(22) Filed: **Feb. 20, 2015**

(65) **Prior Publication Data**

US 2015/0237938 A1 Aug. 27, 2015

Related U.S. Application Data

(60) Provisional application No. 61/942,702, filed on Feb. 21, 2014.

(51) **Int. Cl.**

A41F 1/00	(2006.01)
A41F 9/00	(2006.01)
A44B 11/04	(2006.01)
B60P 7/08	(2006.01)

(52) **U.S. Cl.**

CPC ***A41F 1/002*** (2013.01); ***A41F 9/002*** (2013.01); ***A44B 11/04*** (2013.01); ***B60P 7/0823*** (2013.01); *Y10T 24/2192* (2015.01); *Y10T 29/49826* (2015.01)

(58) **Field of Classification Search**

CPC A41F 1/002; A41F 9/002; A41B 11/04; B60P 7/0823; Y10T 24/2192

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,453,294 A	6/1984	Morita	
4,480,361 A	11/1984	Morita	
5,560,089 A	10/1996	Morita	
5,604,960 A	2/1997	Good	
5,987,715 A	11/1999	Khon	
7,373,696 B2	5/2008	Schoenig et al.	
7,398,559 B2	7/2008	Flatt	
7,412,730 B2	8/2008	Schroeder	
7,793,518 B1	9/2010	Holleman	
7,817,002 B2	10/2010	Fullerton et al.	
8,316,515 B2	11/2012	Slank	
8,353,064 B2	1/2013	Tagatz	
8,474,108 B2	7/2013	Eisenberger	
8,640,266 B2	2/2014	Best et al.	
2005/0102802 A1*	5/2005	Sitbon	A41F 1/002 24/303
2008/0104742 A1	5/2008	Alperin et al.	

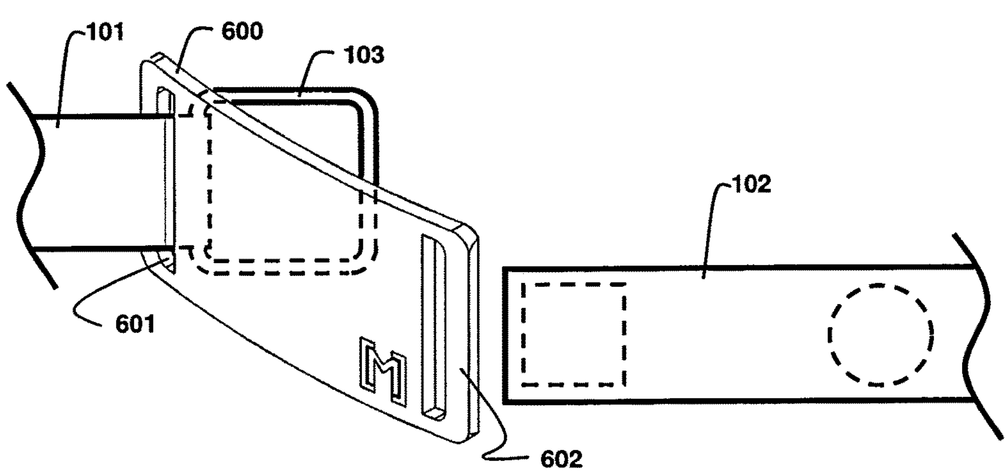
(Continued)

Primary Examiner — Robert Sandy
Assistant Examiner — Michael S Lee

(57) **ABSTRACT**

A fastening module is used to attach a first end of a first material to a second end of a second material to form a strap. The fastening module has a first attachment feature and a second attachment feature. The first end is attached to the first attachment feature. The second end is attached to the second attachment feature by wrapping the second end around a bar-like feature. The second end comprises a non-slidable magnetically attractive material near its tip and a slideable magnetically attractive material further from the tip. The tip of the second end is wrapped around the bar like feature and engages with the slidable magnetically attractive material to secure the strap. Adjustment of the strap can be accomplished by sliding the slidable magnetically attractive element.

19 Claims, 7 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0193675	A1*	8/2009	Sieber	A41H 1/02 33/759
2011/0083254	A1	4/2011	Trutna et al.	
2011/0119813	A1	5/2011	Nate	
2012/0097812	A1	4/2012	Zampelli	
2012/0180197	A1	7/2012	Cosky	
2012/0216374	A1	8/2012	Manuello	
2013/0205476	A1	8/2013	Gentile et al.	
2016/0088885	A1*	3/2016	Campbell	A41D 13/04 2/51

* cited by examiner

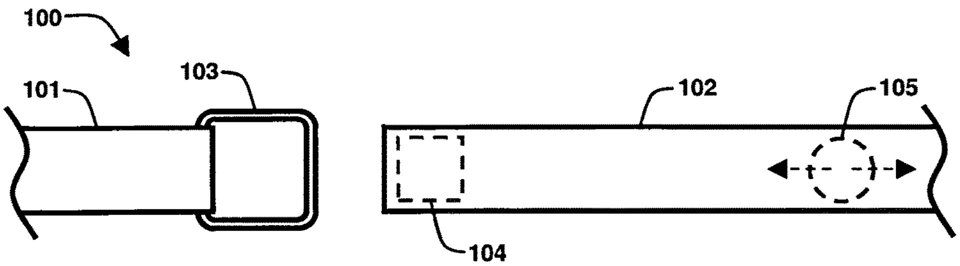


Fig. 1A

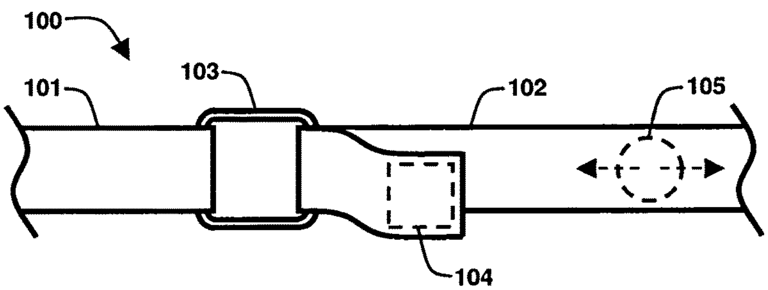


Fig. 1B

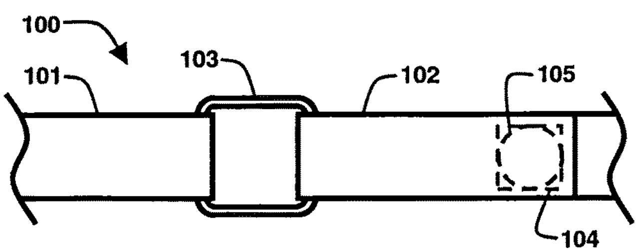


Fig. 1C

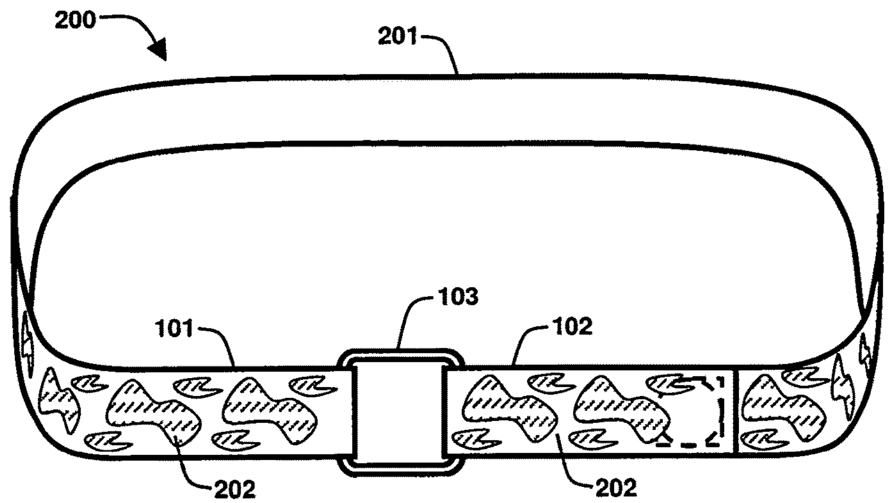

200
201
103
101
102
202
202

Fig. 2

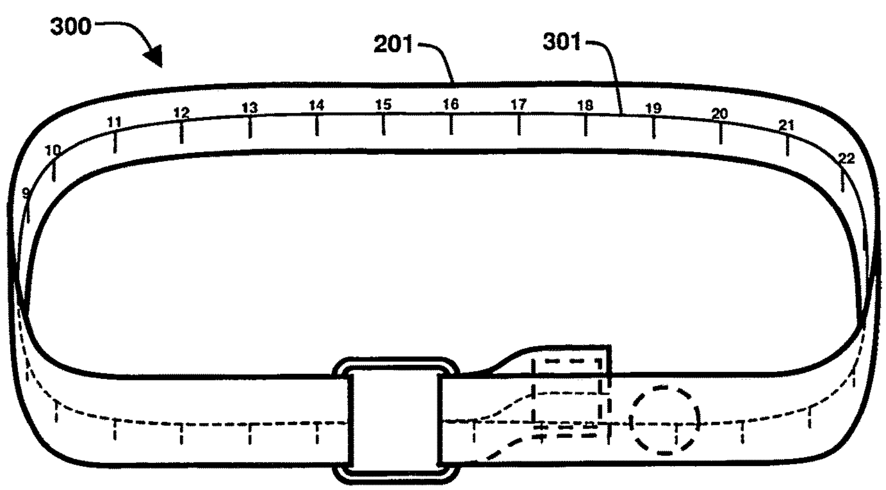

300
201
301
9
10
11
12
13
14
15
16
17
18
19
20
21
22

Fig. 3

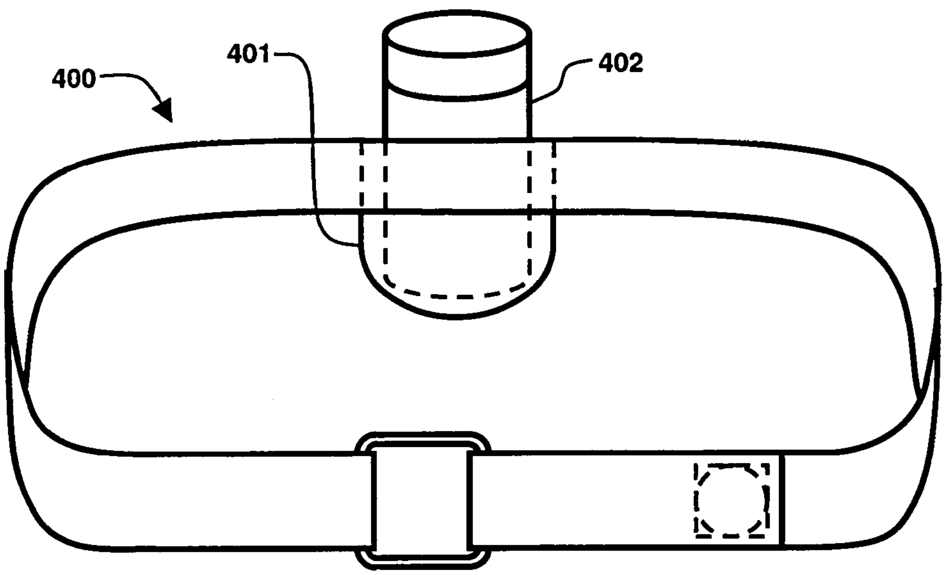


Fig. 4

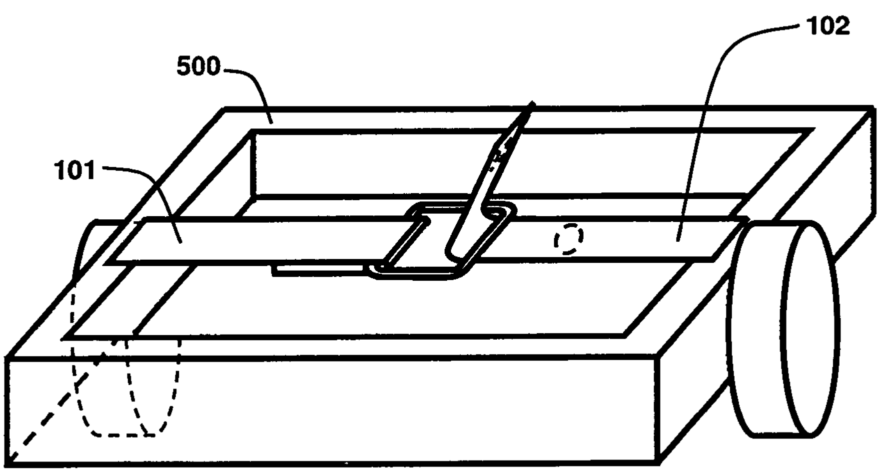


Fig. 5

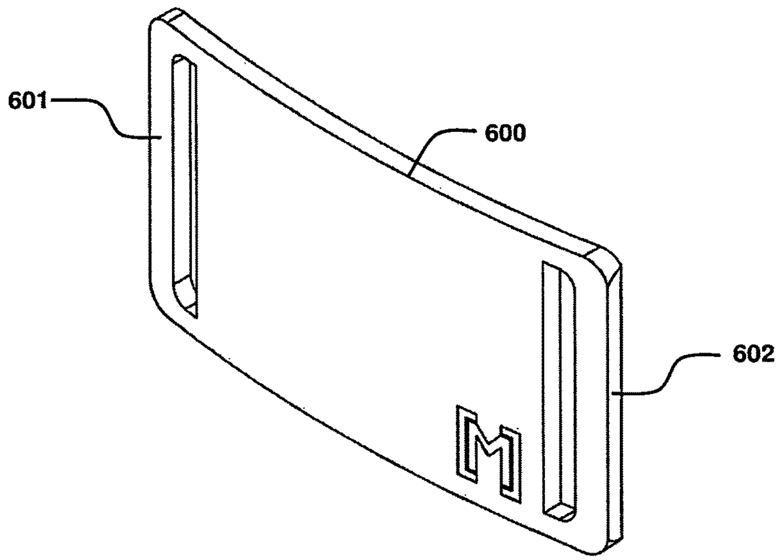


Fig. 6A

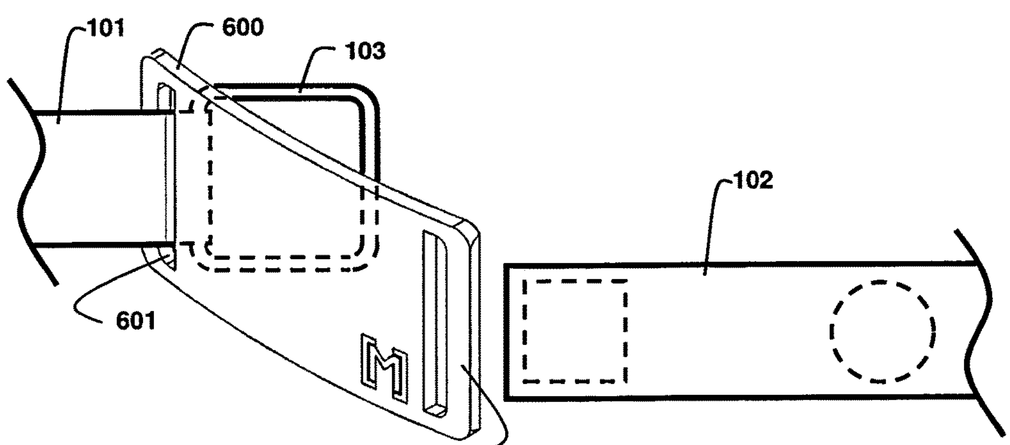


Fig. 6B

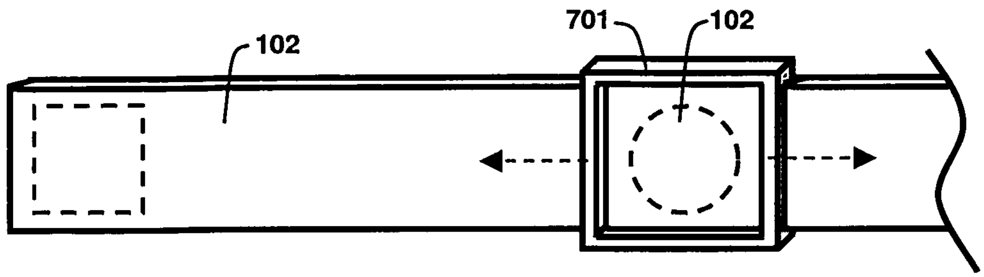


Fig. 7

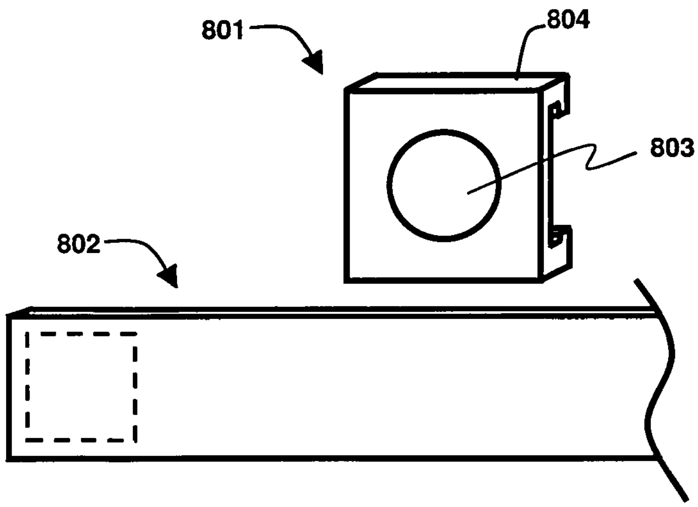


Fig. 8A

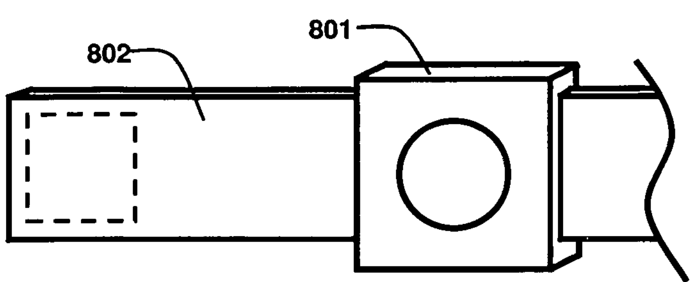


Fig. 8B

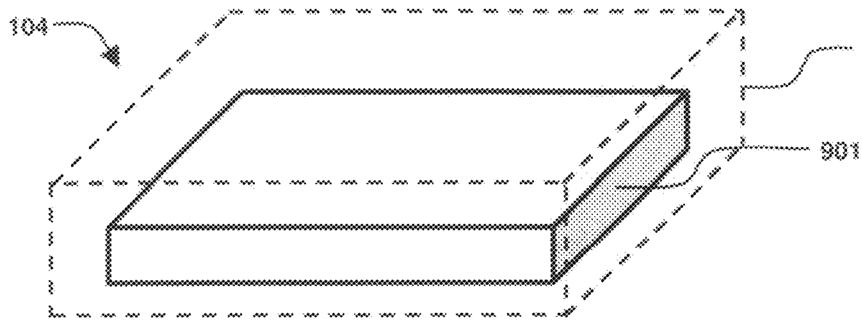


Fig. 9A

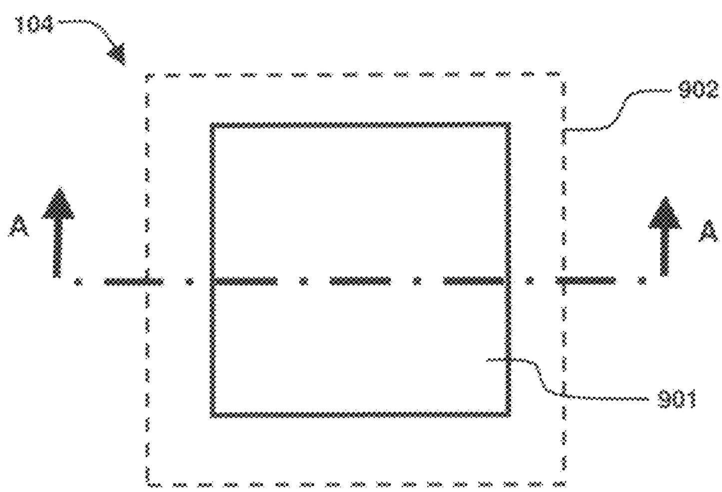


Fig. 9B

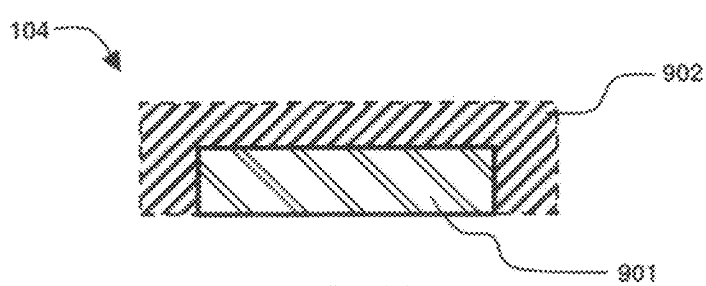


Fig. 9C

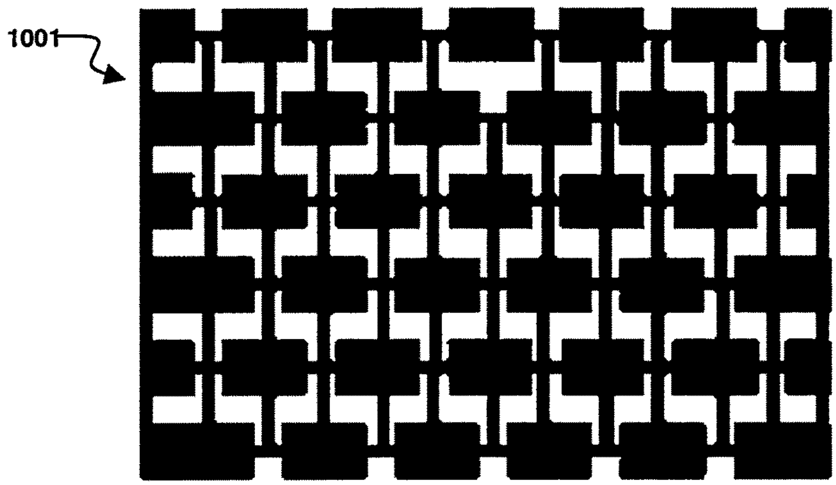


Fig. 10A

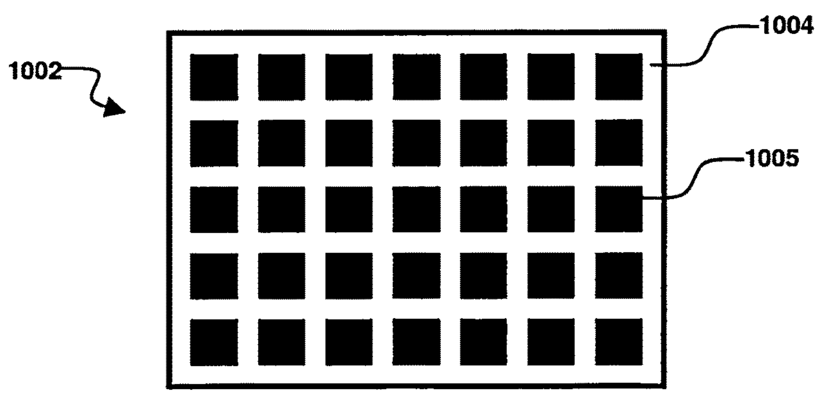


Fig. 10B

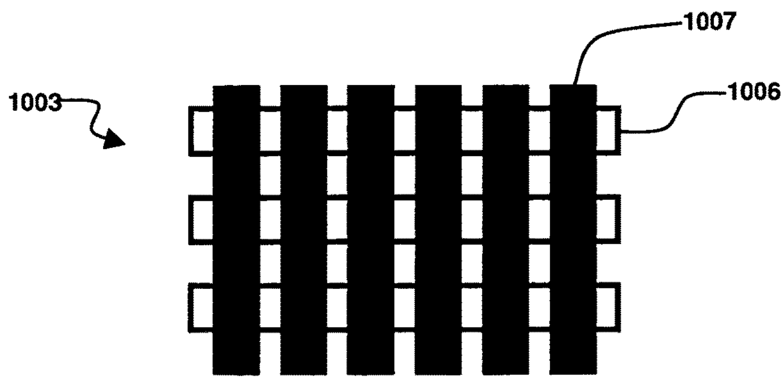


Fig. 10C

MAGNET AND FRICTION BASED INFINITELY VARIABLE STRAP TIGHTENING SYSTEM AND METHOD

This application claims benefit of U.S. Provisional Patent Application Ser. No. 61/942,702 filed 21 Feb. 2014, the entire disclosures of which are incorporated by reference herein.

BACKGROUND

The present invention relates to buckles, buttons, clasps, clamps, and other systems used to attach two pieces (or two ends) of flexible material, such as fabric, leather, straps, chains, ropes, etc.

One example of a field of use is belts. Traditional belts have a strap with holes on one end and a clasp on the other end. The clasp includes a pin that goes through one of the holes to secure the belt at a fixed length. Belt holes become worn and frayed over time and the belt itself can develop a crease from constant folding and unfolding. Moreover, the size of the belt is limited to the number and location of the holes in the one end. Those belt holes are at discrete locations. There are belts incorporating clamps that grasp at an infinitely variable number of points and there are many other ways of holding two pieces or to ends of flexible material together such as VELCRO™ or a pair of rings that the end of a strap is threaded through and tightened and held using friction. However, these prior art infinitely variable tightening systems can have drawbacks such as their use of materials that can fray or wear easily, thereby creating or holding dust. These prior art tightening systems can also have a non-optimal appearance. These prior art tightening systems can have cost or ease of use limitations. These prior art-tightening systems can make noise when they are opened, closed, or moved.

There are prior art devices that use magnets as part of the clasping system. These prior art devices typically have two magnets at fixed locations or a magnet and a magnetically attractive element at fixed locations. These prior art magnetic tightening systems typically do not provide a closure that can be adjusted to an infinitely variable set of positions. Embodiments of the present invention overcome these limitations by providing a novel magnet-based infinitely variable system for tightening a strap or similar piece of flexible material that has two pieces or two ends.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure is described in conjunction with the appended figures in which:

FIG. **1**A shows a strap assembly prior to threading a second end through a fastening module attached to a first end;

FIG. **1**B shows the strap assembly as the second end is threaded through the fastening module;

FIG. **1**C shows the strap assembly after the second end is doubled back on itself and a fixed magnetically attractive element is secured to a slidable magnetically attractive element;

FIG. **2** shows a hunting belt;

FIG. **3** shows a weight loss belt;

FIG. **4** shows a carrier belt;

FIG. **5** shows a strap attached to a trailer;

FIG. **6**A shows a second fastening module;

FIG. **6**B shows a second fastening module used in conjunction with a first fastening module;

FIG. **7** shows a second end further comprising an external slider over the sliding magnet;

FIG. **8**A shows an external sliding magnetically attractive module and an alternate configuration second end;

FIG. **8**B shows an external sliding magnetically attractive module slidably attached to the alternate configuration second end;

FIG. **9**A shows an isometric view of a magnet covered by a mu-metal;

FIG. **9**B shows a bottom view of the magnet covered by a mu-metal depicted in FIG. **9**A;

FIG. **9**C shows a view of Section A-A of the magnet covered by mu-metal of FIG. **9**B;

FIG. **10**A shows a geometrically flexible configuration of a magnetically attractive element;

FIG. **10**B shows a plastic molded configuration of magnetically attractive pieces; and

FIG. **10**C shows a taped configuration of magnetically attractive pieces.

It should be understood that the drawings are not necessarily to scale. In certain instances, details that are not necessary for an understanding of the invention or that render other details difficult to perceive may have been omitted. It should be understood that the invention is not necessarily limited to the particular embodiments illustrated herein.

DETAILED DESCRIPTION

The ensuing description provides preferred exemplary embodiment(s) only, and is not intended to limit the scope, applicability or configuration of the disclosure. Rather, the ensuing description of the preferred exemplary embodiment(s) will provide those skilled in the art with an enabling description for implementing a preferred exemplary embodiment. It should be understood that various changes could be made in the function and arrangement of elements without departing from the spirit and scope as set forth in the appended claims.

Specific details are given in the following description to provide a thorough understanding of the embodiments. However, it will be understood by one of ordinary skill in the art that the embodiments may be practiced without these specific details. For example, shapes and geometries may be shown generically and details may be left out in order not to obscure the embodiments in unnecessary detail.

FIGS. **1**A, **1**B, and **10** show a strap assembly at **100**. The strap assembly **100** comprises a first end, shown at **101**, and a second end, shown at **102**. The first end **101** and second end **102** can be part of the same strap, in which case the regions beyond the break lines could be connected, or the first end **101** and second end **102** could be part of two different straps (i.e. the first material used for the first end could be different than the second material used for the second end). There is a fastening module, shown at **103**, attached to the first end **101**. The fastening module shown at **103** comprises a rectangular loop (in this case, more specifically a square loop) with a central aperture. The first end **101** is attached to the fastening module **103** by threading the first end strap through the aperture. The tip of the second end **102** can be threaded through the fastening module **103**, as shown by FIG. **1**B.

Further referring to FIGS. **1**A, **1**B, and **1**C, the second end **102** comprises a fixed magnetically attractive element, shown at **104**, and a sliding magnetically attractive element, shown at **105**. In one embodiment, the fixed magnetically attractive element, **104** is encapsulated between two layers of flexible material in a pocket in a region near the tip of the second end. One method for encapsulating this fixed magnetically attractive element **104** can be the use of two layers of woven nylon webbing that are sewn together on their top and bottom sides with a vertical sewn seam to prevent the fixed magnetically attractive element **104** from sliding horizontally along the length of the second end **102**. Other methods of fabricating the fixed magnetically attractive element **104** into the second end **102** can be used and other flexible materials can be used in configurations capable of being understood by anyone knowledgeable in the art.

The second end **102** also comprises a slidable magnetically attractive element, shown at **105**. In one embodiment, the slidable magnetically attractive element **105** is located further from the tip of the second end **102** than the location of fixed magnetically attractive element **104**. In one embodiment, the slidable magnetically attractive element **105** is encapsulated inside of a horizontal cavity between two layers of flexible material with boundaries near the top and bottom of the second end **102**. One method of fabricating the bounded horizontal cavity would be the use of two layers of nylon webbing that are sewn together on their top and bottom sides without having any vertical sewn seams, allowing the slidable magnetically attractive element **105** to slide horizontally. Other methods of fabricating the fixed magnetically attractive element **104** and the slidable magnet into the second end **102** can be used and other flexible materials can be used in configurations capable of being understood by anyone knowledgeable in the art.

FIG. **1**C shows the strap when the fixed magnetically attractive element **104** and the slidable magnetically attractive element **105** are on top of one another. The second end **102** can be tightened by using attraction of the two magnetically attractive elements, **104** and **105**, to move the slidable magnetically attractive element **105** in the bounded horizontal cavity. The sliding friction of the flexible material that separates the two magnetically attractive elements, **104** and **105**, prevents the strap from loosening once the second end **102** has been secured. By selecting the strength of attraction of the magnetically attractive elements, **104** and **105**, and the roughness of the flexible material used for the second end **102**, one can make configurations of the tightening system **100** that work for various applications.

The amount of longitudinal force that embodiments of the variable strap tightening system can hold is a function of:

(a) magnetic pull of the magnetically attractive elements;

(b) the coefficient of friction (mu) of the materials that would need to slide in order to respond to the longitudinal force; and

(c) any other friction elements, pulleys, or "pulley-like" features in the system that amplify or reduce forces based on engineering mechanics principles capable of being understood by anyone skilled in the arts.

Mu is a function of the materials that would need to slide, and whether there are any lubricants between these materials. Mu can also be different depending upon whether static friction (prior to movement) or dynamic friction (after movement) is being measured. Static friction can also be called static mu. Dynamic friction can also be called kinetic friction or sliding mu. Typical values for mu (with no lubricants) are shown in the table below:

MATERIAL 1	MATERIAL 2	STATIC MU	SLIDING MU
Teflon (PTFE)	Teflon (PTFE)	0.04	0.04
Graphite	Graphite	0.1	0.1
Nylon (smooth)	Nylon (smooth)	0.15-0.25	0.15-0.25
Nylon (webbed belt)	Nylon (webbed belt)	0.4-1.0	0.4-1.0

-continued

MATERIAL 1	MATERIAL 2	STATIC MU	SLIDING MU
Leather	Clean metal	0.6	0.4
Iron	Iron	1.0	1.0
Aluminum	Aluminum	1.05-1.35	1.4
Rubber	Steel	1.0-4.0	1.0-4.0

Embodiments of the present invention can take the form of a variety of straps. A belt is one example of a strap in which the first end **101** and the second end **102** are part of the same material. Belts are commonly worn around the waist of a person. Straps can have the first end **101** and second end **102** be part of the same material or the first and second ends can be different materials and these different materials can either be connected to one another somewhere other than the first end **101** and the second end **102** or they can be used to attach two separate items together by attaching the first end **101** to the second end **102**. Further examples of straps can include bag and courier straps, backpack straps, yoga straps, utility straps used to tighten things down, helmet straps, bra straps, guitar straps, dog collars, medical straps such as those used to help brace a back, headlamp straps, knee straps, straps to tighten a hat or cap such as those used on a baseball cap, straps to hold on a an apron, watch bands, arm bands, organizer straps for hanging things like a coil or rope, straps on a boot, or any other kind of strap capable of being understood by anyone skilled in the art.

The configuration shown in FIGS. **1**A, **1**B, and **1**C can be part of a variety of embodiments used in a variety of applications. One embodiment and application can be a belt used for hunting, shown at **200** in FIG. **2**. When used in this application, the belt using magnetically attractive elements has the advantage that little or no noise is produced when the belt is put on, taken off, tightened or loosened. One benefit of low noise is that animals will not be scared away. As shown by FIG. **2**, the first end **101** and the second end **102** are part of the same strap material, shown at **201**. In this configuration, the strap material **201** can have a camouflage pattern, shown at **202**. This camouflage pattern **202** can be printed on the belt or added to the belt using any technology cable of being understood by anyone skilled in the art. It is especially desirable to have this camouflage pattern **202** on the visible outside of the belt and on the inside of the strap material on the second end **102** if the belt is to be worn with the second end **102** looping to the outside through the fastening module **103**.

Another embodiment and application can be a weight loss belt shown at **300** in FIG. **3**. The weight loss belt can comprise a linear measurement scale (such as that found as part of a tape measure), shown at **301**. The linear measurement scale **301** can be on the inside surface of the strap material **201** so that the linear measurement scale **301** is not visible when the belt has been tightened, but can be seen during the tightening process, by looking inside the belt. The linear measurement scale **301** can be printed on the belt. The linear measurement scale **301** could be part of a separate item (such as a tape measure) that is attached to the belt. When used as a belt, the configuration shown in FIGS. **1**A, **1**B, **1**C, and **2** can have a large range of adjustment from a small size to one that is almost two times as long. This can be useful in applications such as when used as a pregnancy belt. The belt can gradually be loosened as the abdomen expands. When used in conjunction with a linear measurement scale **301**, the belt can be used to track the expansion of the abdomen during pregnancy. The linear measurement scale **301** can be used for many applications other than weight loss, such as measuring the distance between two points—one example of which would be to remove the belt shown in FIG. **3** and use the linear measurement scale to measure the size of a fish.

Another embodiment and application can be as a carrier belt or carrier strap shown at **400** in FIG. **4**. Such carrier belts (or carrier straps) **400** can further comprise holders for things such as water, water bottles, tools, portable electronic devices, and many other types of items that a person might want attached to themselves that are capable of being understood or implemented by anyone skilled in the art. The carrier belt **400** comprises a water bottle holder, shown at **401** that holds a water bottle, shown at **402**. Variations can include a carrier belt around one's waist, a carrier strap held on one's arm, and a hidden gun holder under a wearer's baggy pant leg.

The strap material shown at **201** in FIGS. **2** and **3** and the first end **101** and second end **102** shown in FIGS. **1**A, **1**B, and **1**C can be fabricated from variety of materials. In one embodiment, the strap material **201** is made of woven nylon webbing. The strap can be made of other types of woven and nonwoven fibrous material. The strap can be made of a thin strip of plastic that could have been extruded, cut from a blown film, or made using any fabrication process capable of being understood by anyone skilled in the art. The strap can be made of non-ferrous metal. The strap can be made of leather or other animal-derived materials including cat gut. The strap can be made of plant-derived material. The strap can be a single color. The strap can be in multiple decorative colors. The strap can carry printing. The printing can include symbols, letters, numbers, and other characters. The printing can include photos. The printing can include illustrations. The printing can look like a flag.

FIG. **5** shows a strap attached to a trailer. The trailer is shown at **500**. The first end of the strap is shown at **101**. The second end of the strap is shown at **102**. These two ends of the strap, **101** and **102**, are similar to the configuration shown in FIG. **1**A, FIG. **1**B, and FIG. **1**C and illustrate that the material for the first end **101** can be different than the material for the second **102**. Thus, it is possible to use embodiments of the present invention to attach two items together in any configuration capable of being understood my anyone skilled in the art. Examples might be straps on backpacks or similar carrying devices, straps for lifting an engine out of a car, straps for holding a tarp over items in the back of a pickup truck, straps for fastening an article of footwear (such as a ski boot), suspenders to hold up a pair of paints, bra straps, straps for fastening boots to snow shoes, and straps used in rock climbing.

The fastening module, previously shown as **103** in FIGS. **1**A, **1**B, and **1**C can have a variety of shapes and configurations and can be made of a variety of materials. The fastening module can also be interchangeable from one tightening system to another. FIG. **6**A shows a second fastening module, **600**, in the form of a curved (body-fitting) plate with a first attachment feature, shown at **601**, and a second attachment feature, shown at **602**. The first attachment feature **601** comprises a slot in the fastening module **600** that can be used to attach the first end, **101** in FIG. **1**A. When the first attachment feature **601** is used to directly attach the first end **101**, the second fastening module can substitute for the fastening module **103**, shown in FIG. **1**A.

Referring to FIG. **6**B, the second fastening module **600**, can also be used in conjunction with the first fastening module, **103**, that was previously shown in FIG. **1**A. When used in this configuration, the second fastening module **600** can be used as a decorative belt buckle. In this configuration, the strap assembly that was shown in FIG. **1**A, FIG. **1**B, and FIG. **1**C is threaded through the slot in the first attachment feature **601** and pulled until the first fastening module **103** rests against the back of the second fastening module **600**.

Referring to FIG. **6**A and FIG. **6**B, the second attachment feature **602** comprises a vertical bar-like attachment member that can be used to attach the second end, shown at **102**. Note that the bar in the bar-like attachment member **602** does not need to be a straight bar, it can also be curved. This second fastening module **600** could be made out of a stamped metal. The metal could be aluminum. The metal could be brass. The metal could be silver. The metal could be titanium. The fastening module could be machined. The fastening module could be laser cut, flame cut, plasma cut, or water jet cut. The fastening module could be etched. The fastening module could be made out of plastic. The fastening module could be made out of wood. The fastening module could be made out of bone. The fastening module could be made out of a seashell. The fastening module could be made out of coconut. The fastening module could be made out of tagua nut (genus *Phytelaphas*). The fastening module could be made out of any other material using any fabrication method capable of being understood by anyone skilled in the art.

FIG. **7** illustrates a second end, shown at **102**, further comprising an external slider, shown at **701**, over the region of the sliding magnetically attractive element, shown at **105**. One of the benefits of incorporating an external slider **701** is that it makes it easier to find the location of the sliding magnetically attractive element **105**. Another benefit is that the magnetically attractive element **105** may be moved by moving the external slider **701** longitudinally along the second end **102**. The external slider **701** can be made of any non-magnetically attractive material in any configuration capable of fitting over the second end **102** and capable of being understood by anyone skilled in the art.

FIG. **8**A shows an external sliding magnetically attractive module, at **801**, and an alternate configuration second end, at **802**. The external sliding magnetically attractive module **801** comprises an alternate magnetically attractive element, shown at **803**, and an external magnetically attractive element holder, shown at **804**. FIG. **8**B shows the same external sliding magnetically attractive module **801** after it has been attached to the outside of the alternate configuration second end **802**. Referring to FIG. **8**A and FIG. **8**B, the alternate configuration second end **802** is different from the second end shown at **102** in FIG. **1**A, FIG. **1**B, and FIG. **1**C in that the alternate configuration second end **802** does not need to incorporate a sliding magnetically attractive element **105** inside of the second end **102**.

Referring back to FIG. **1**A, FIG. **1**B, and FIG. **1**C, it should be noted that only one of the two magnetically attractive elements, **104** or **105**, must be a magnetic. The other magnetically attractive element only needs to be a magnetically attractive material. The magnet that is magnetic, **104** or **105**, can be a permanent magnet or this magnet can be an electromagnet with an electrical power source. Examples of the types of materials used in permanent magnets for embodiments of the present invention can include iron, nickel, cobalt, and rare earth (lanthanide) elements having atomic numbers from 57 to 71 such as lanthanum, cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium. Permanent magnets used in embodiments of the present invention can also comprise ceramics such as sintered powdered iron oxide with barium/strontium carbonate, sintered or cast aluminum/

nickel/cobalt with iron and small amounts of other materials (typically called Anico, Alni, Alcomax, Hycoma, Columax, or Ticonal). Some examples of permanent magnetic materials that use rare earth metals are samarium-cobalt and neodymium-iron-boron (also known as neodymium magnets or, NdBeB, NIB, or Neo magnets). Examples of magnetically attractive materials can include iron, nickel, and cobalt.

A magnet can be either a permanent magnet or an electromagnet. Magnetic pull force (also described in this document as the "magnetic attractiveness") can exist between two magnets or between a magnet and a second material that is not a permanent magnet, not configured as an electromagnet, and yet is magnetically attracted to a magnet. Such second materials are called magnetically attractive materials in this disclosure. Thus, in this disclosure we can talk about three distinct types of materials: "magnets", "magnetically attractive materials", and materials that are neither magnets or nor magnetically attractive, which are called "non-magnetically attractive materials" in this disclosure. Magnetic pull force in a particular configuration is a function of:

(1) whether the configuration uses two magnets or a magnet and a magnetically-attractive material;
(2) the strength of the magnets (or magnet if this is a configuration with a magnet and a magnetically attractive material);
(3) the geometric shape of the magnets (or magnet if this is a configuration with a magnet and a magnetically attractive material);
(4) the size of the magnets (or magnet if this is a configuration with a magnet and a magnetically attractive material);
(5) the distance between the magnets (or magnet if this is a configuration with a magnet and a magnetically attractive material); and
(6) the composition of the of the magnetically attractive material if this is a configuration with a magnet and a magnetically attractive material.

Maximum energy product, typically called BHmax, (and typically measured in Mega-GaussOersted) is a commonly used measure of the strength of a permanent magnet. For many types of magnets, the grade of the material provides information of the maximum energy product as measured in Mega-GaussOersted (MGOe). For example, a sintered neodymium-iron-boron permanent magnet that has a grade of N28 has a maximum energy product (BHmax) of approximately 28 MGOe. Typical commercial grades of sintered neodymium-iron-born permanent magnets can have BHmax values ranging from 28 MGOe (grade N28) to 52 MGOe (grade N52). Typical bonded neodymium-iron-boron permanent magnets have BHmax values ranging from 4 MGOe (grade BDM-4) to 12 MGOe (grade BDM-12). Typical samarium-cobalt permanent magnets have BHmax values ranging from 18 MGOe (grade YX18) to 30 MGOe (grade YXG30B). Typical aluminum-nickel-cobalt permanent magnets have BHmax of 1.13 MGOe (grade LN9) to 9 MGOe (grade LNGT72). Typical ceramic ferrite permanent magnets have a BHmax of 1.05 MGOe (grade C1) to 4.3 MGOe (grade C11). Typical flexible rubber permanent magnets made by mixing ferrite or neodymium magnet powders and synthetic or natural rubber binders have a BHmax ranging from 0.6 MGOe (grade FRM-5) to 1.55 MGOe (grade FRM-12).

The magnetically attractive elements, **104** and/or **105** (and **803** in FIG. **8**A) (and **803** in FIG. **8**A), can be coated or shielded with a material that demagnetizes one side so that items would not stick to the belt or strap. Mu-metals have a high magnetic permeability and are named mu-metals because mu is the Greek letter used to specify magnetic permeability. Mu-metals can be composed of a nickel-iron alloy, such as one that has 77% nickel, 16% iron, 5% copper, and 2% chromium or molybdenum. Mu-metals can also be composed of other materials, examples of which include Co-Netic, supermalloy, supermumetal, nilomag, sanbold, molybdenum permaloy, Sendust, M-1040, Hipernom, HyMu-80, and amumetal. FIG. **9**A, FIG. **9**B, and FIG. **9**C show a configuration and method for shielding a rectangular magnet. FIG. **9**A is an isometric view. FIG. **9**B is a bottom view. FIG. **9**C is a view of section A-A of FIG. **9**B. In FIG. **9**A, **9**B, and FIG. **9**C, a fixed rectangular magnetically attractive element is shown at **104**. This fixed rectangular magnetically attractive element is the same as **104** in FIG. **1**A, FIG. **1**B, and FIG. **1**C. The fixed magnetically attractive element comprises a rectangular permanent magnet, shown at **901** and a magnetic shield, shown in dotted lines at **902**. The magnetic shield **902** can be composed of a mu-metal and the mu-metal can be any thickness and can be attached to any surface of any permanent magnet **901**. The permanent magnet **901** can be of any shape or size and can comprise any magnetic material capable herein disclosed or capable of being understood by anyone skilled in the art.

The magnetically attractive elements, **104** and **105**, shown in FIGS. **1**A, **1**B, and **1**C can have a variety of shapes and configurations. The magnetically attractive elements, **104** and/or **105** (and **803** in FIG. **8**A), can be liquid or solid. One or both of the magnetically attractive elements, **104** and/or **105** (and **803** in FIG. **8**A), can be monolithic. One or both of the magnetically attractive elements, **104** and/or **105** (and **803** in FIG. **8**A), can be comprise a plurality of magnetic pieces that are mechanically attached to one another in a way that improves flexibility or provides other desirable attributes. Methods for improving flexibility can include a geometrically flexible configuration, shown at **1001** in FIG. **10**A, a plastic molded configuration shown at **1002** in FIG. **10**B, and a taped configuration shown at **1003** in FIG. **10**C. In the geometrically flexible configuration **1001**, the magnetically attractive piece is monolithic, but comprises larger blocks attached through narrower sections that enhance flexibility. The geometrically flexible configuration **1001** can be fabricated using an etching process, a laser cutting process, a water jet cutting process or any other process capable of being understood by anyone skilled in the art. One method for creating the plastic molded configuration **1002** is the placement of multiple magnetically attractive pieces, shown at **1005**, into a binder material, such as plastic, shown at **1004** using any process capable of being understood by anyone skilled in the art, such as casting, injection molding, and vacuum forming. The taped configuration **1003** can be created by taking multiple magnetically attractive pieces, shown at **1007**, and attaching these pieces together using an adhesive on a substrate, shown at **1006**.

The magnetically attractive elements, **104** and/or **105** in FIG. **1**A, FIG. **1**B, and FIG. **1**C, and **803** in FIG. **8**A, can be solid or hollow. The magnetically attractive elements, **104**, **105** and/or **803**, can be stiff or flexible. The magnetically attractive elements, **104**, **105** and/or **803**, can be in the shape of a substantially cylindrical flat disk. The magnetically attractive elements, **104**, **105** and/or **803**, can be in the shape of a flat square. The magnetically attractive elements, **104**, **105** and/or **803**, can be in the shape of a flat rectangle. The magnetically attractive elements, **104**, **105** and/or **803**, can comprise spheres, cylinders, squares, hexagons, balbis-shapes, nonagons, octagons, vesica pisces, lemniscates, or any other shape or configuration capable of being understood by anyone skilled in the art.

Benefits of embodiments of the present invention can include:

(1) Little or no noise when strap is tightened or loosened;
(2) Little or no wear or fraying of any of the components;
(3) Fast and easy to use;
(4) Can be used with gloves on;
(5) Can be used without needing to see strap (self fastening when magnetically attractive elements get close);
(6) Ability to fit an infinite number of continuously variable positions;
(7) Fastening materials (i.e. magnetically attractive materials) may be embedded in other materials to reduce potential for contamination, etc;
(8) Limits of magnetic pull force can serve as a safety release;
(9) Potential for shielding the magnets in a mu metal;
(10) Attractive appearance;
(11) Low cost; and
(12) Adaptability to a large number of colors, patterns, configurations, and sizes.

A further number of variations and modifications of the disclosed embodiments can also be used. The principles described here can also be used for in applications other than attachment systems. While the principles of the disclosure have been described above in connection with specific apparatuses and methods, it is to be clearly understood that this description is made only by way of example and not as limitation on the scope of the disclosure.

I claim:

1. An infinitely variable strap tightening system, the system comprising:

a first end of a first flexible non-magnetically attractive material;

a second end of a second flexible non-magnetically attractive material;

a first fastening module and a second fastening module wherein:

the first fastening module comprises a loop that surrounds an aperture;

the first end is attached to the loop;

the second fastening module comprises a first attachment feature and a second attachment feature;

the first attachment feature comprises a first slot;

the first material is threaded through the first slot;

the loop is retained against one side of the second fastening module; and

the second attachment feature comprises a second slot and a bar-like attachment member wherein the second material threads through the second slot and wraps around the bar-like attachment member when the strap tightening system is in use;

a non-slideable magnetically attractive element fixedly encapsulated in the second material near the tip of the second end; and

a slideable magnetically attractive element captured within the second material in a manner that allows the slideable magnetically attractive element to move longitudinally along the second material while preventing the slideable magnetically attractive element from moving transversally in the second material, the slideable magnetically attractive element being captured in a region where the non-slideable magnetically attractive element and the slideable magnetically attractive element can be magnetically attracted to each other once the second end has been wrapped around the bar-like attachment member in the second fastening module and the non-slideable magnet in the second end is located proximate to the second material in a region proximate to the slideable magnetically attractive element.

2. The system of claim **1** wherein:

the first material comprises woven nylon webbing;

the second material comprises woven nylon webbing;

the first material and the second material are a single piece of the same material, which makes the first end and the second end the two ends of a single strap comprising woven nylon webbing;

the second fastening module comprises a material selected from the group of metal, plastic, wood, bone, sea shell, coconut, and tagua nut;

the slideable magnetically attractive element is in the shape of a substantially round flat disk;

the slideable magnetically attractive element comprises iron;

the non-slideable magnetically attractive element comprises neodymium; and

the non-slideable magnetically attractive element comprises a mu-metal wherein the mu-metal further comprises nickel, iron, and copper.

3. The system of claim **2** wherein:

the system further comprises a water bottle holder;

the single strap further comprises printing;

the printing further comprises a linear measurement scale;

the second fastening module is curved;

the second fastening module comprises tagua nut;

the second fastening module is fabricated using a laser cutting process;

the non-slideable magnetically attractive element further comprises boron and iron; and

the non-slideable magnetically attractive element is balbis-shaped.

4. The system of claim **1** wherein:

the first fastening module loop comprises a substantially rectangular shape surrounding a substantially rectangular aperture;

the first material and the second material are a single piece of the same material.

5. The system of claim **1** wherein:

the slideable magnetically attractive element is in the shape of a substantially round flat disk.

6. The system of claim **1** wherein:

the slideable magnetically attractive element comprises iron.

7. The system of claim **1** wherein:

the non-slideable magnetically attractive element comprises neodymium.

8. The system of claim **1** wherein:

the non-slideable magnetically attractive element comprises a mu-metal; and

the mu-metal further comprises nickel, iron, and copper.

9. The system of claim **1** wherein:

the system further comprises a holder for a device selected from the group of a water bottle, a tool, a portable electronic device, and a gun.

10. The system of claim **1** wherein:

the first material and the second material are a single piece of the same material;

the system comprises a belt;

the second fastening module comprises a belt buckle;

the belt further comprises printing;

the printing comprises a linear measurement scale; and

the system is used as a weight loss belt.

11. The system of claim 1 wherein:
the first and second materials further comprises printing;
the printing is in multiple colors;
the printing comprises a camouflage pattern.

12. The system of claim 1 wherein the non-slideable magnetically attractive element comprises a plurality of magnets.

13. The system of claim 1 wherein:
the second fastening module is user removable and interchangeable from one tightening system to another.

14. The system of claim 1 wherein:
the system is reconfigurable in a second mode as a tightening system without the second fastening module by threading the second end through the loop of the first fastening module.

15. The system of claim 1 wherein:
one of the slideable magnetic element or the non-slideable magnetic element further comprises a magnetic shield wherein:
the magnetic shield comprises a metal; and
the magnetic shield is configured for altering the shape of the magnetic field surrounding the slideable or non-slideable magnetic element.

16. An infinitely variable belt comprising:
a first end of a first flexible non-magnetically attractive material;
a second end of a second flexible non-magnetically attractive material;
a first fastening module and a buckle wherein:
the first fastening module comprises a loop that surrounds an aperture;
the first end is threaded through the aperture and attached to the loop;
the buckle comprises a first attachment feature and a second attachment feature;
the first attachment feature comprises a first slot;
the first material passes through the first slot;
the first fastening module is retained against one side of the buckle; and
the second attachment feature comprises a second slot and a bar-like attachment member wherein the second material threads through the second slot and wraps around the bar-like attachment member when the belt is in use;
a non-slideable magnetically attractive element fixedly encapsulated in the second material near the tip of the second end; and
a slideable magnetically attractive element captured within the second material in a manner that allows the slideable magnetically attractive element to move longitudinally along the second material while preventing the slideable magnetically attractive element from moving transversally in the second material, the slideable magnetically attractive element being captured in a region where the non-slideable magnetically attractive element and the slideable magnetically attractive element can be magnetically attracted to each other once the second end has been wrapped around the bar-like attachment member in the buckle and the non-slideable magnet in the second end is located proximate to the second material in a region proximate to the slideable magnetically attractive element.

17. The belt of claim 16 wherein:
the first material comprises woven nylon webbing;
the second material comprises woven nylon webbing;
the first material and the second material are a single piece of the same material, which makes the first end and the second end the two ends of a single strap comprising woven nylon webbing.

18. An infinitely variable strapping method, the method comprising the steps of:
establishing a first flexible non-magnetically attractive material;
establishing a second flexible non-magnetically attractive material;
fastening a loop to an end of the first material;
sliding the first material through a first slot of a buckle until the loop rests against one side of the buckle;
fastening an end of the second material to the buckle, wherein fastening an end of the second material comprises:
threading the end of the second material through a second slot of the buckle;
wrapping the end of the second material around a bar-like attachment member of the buckle;
a non-slideable magnetically attractive element fixedly encapsulated in the second material near the tip of the second end; and
a slideable magnetically attractive element captured within the second material in a manner that allows the slideable magnetically attractive element to move longitudinally along the second material while preventing the slideable magnetically attractive element from moving transversally in the second material, the slideable magnetically attractive element being captured in a region where the non-slideable magnetically attractive element and the slideable magnetically attractive element can be magnetically attracted to each other once the second end has been fastened to the fastening module and the non-slideable magnet in the second end is located proximate to the second material in a region proximate to the slideable magnetically attractive element.

19. The method of claim 18 wherein the slideable magnetically attractive element comprises a different material from the non-slideable magnetically attractive element.

* * * * *