A fastening system comprising a sheet of filaments that form a plurality of loops that are bent to form hooks, attached to a support matrix, such that when a first sheet and second sheet of filaments are brought into contact, the hooks can mate with the loops of the opposing sheet in a reversible locking position. In a second embodiment, the fastening system comprises a first base material having a multiplicity of filament loops and a second base material having a carpet of straight filaments, each filament having at least one notch sized to lock onto the filament loops of the first base material. Methods for manufacturing said materials are also described.
HOOK-AND-LOOP FASTENER

[0001] This invention relates fastening systems and materials utilizing a hook and loop mechanism of binding. This application claims benefit under 35 U.S.C. §120 of the filing date for application Ser. No. 61/790,055 filed Mar. 15, 2013.

BACKGROUND OF THE INVENTION

[0002] Traditional hook and loop fasteners, such as Velcro®, are based in part on the characteristics of a burr, the seed body of a plant that often gets entangled in fur and clothing. A burr is covered with a series of hooks that grab onto virtually any surface. It is commonly used by plants as a mechanism of seed propagation. In 1948, George de Mestral took this idea and combined it with a loop assembly to create the separable hook and loop fastener system called Velcro® (Bellis). Separable hook and loop fasteners such as Velcro have great versatility for multiple uses, but they do have some serious drawbacks.

First, the system has two distinct hook and loop systems that make it up; it isn’t one interconnected system. While the hook assembly of Velcro does grab accurately and consistently onto the loop assembly, it also grabs any other object that it comes into contact with. Common complaints include hair, lint, and other debris getting caught in the assembly, making the Velcro system “dirty” over time. This property also causes the Velcro system to frequently tangle objects messily in a tumble dryer. Another drawback to the hook part of the assembly is that it has a rough texture, and feels scratchy when in contact with skin, causing irritation.

[0003] A fastener system that eliminates the need for distinct hook and loop systems can be used for a wider range of applications without as many annoyances and drawbacks. Also, by using a different design of fastener that eliminates the abrasive side of the hook, irritancies and “dirtying” problems associated with the system can be eliminated.

[0004] This improved hook and loop fastener invention addresses the drawbacks of standard hook and loop fasteners and overcomes these drawbacks. The hooks are designed as loops that can form into hooks, and are made of a non-abrasive material that reduces irritation due to scratches as well as the “dirtying” aspect. With a simple design akin to that of the Velcro system, the applications of this fastener system are numerous and widespread, with the same magnitude and scope of application as that of Velcro fastener systems.

[0005] Improvements on the traditional Velcro hook and loop fastener system include U.S. Pat. No. 3,387,345 by Jean-Claude Savoir, Savoir found that the traditional Velcro system did not have a favorable fastening effect because the surfaces of the loop and hook assemblies were different, decreasing compatibility and effectiveness. The design therefore consists of a single tape that has both loop and hook assemblies on it, which are then cut to create the familiar opposing two-stripe system. This creates better adherence because the surfaces of the two tapes are the same (Savoir). However, this system does not solve the problem of annoyances through irritation to the skin or the accumulation of unwanted debris on the system due to the hook assembly’s tendency to pick up everything it comes into contact with.

[0006] U.S. Pat. No. 5,369,853 discloses a hook-and-loop fastener system comprising a carpet surface on which hook and loop elements are assembled on same-sided surfaces. Each loop element rises above each hook element by about 1 mm to increase interlocking forces between hooks and loops. The hooks are also made from a thermostatic resin material (Murasaki and Okawa). The main drawback of this system is that it uses the traditional Velcro format of loops catching onto hooks in order to create a fastener. Therefore, it is subject to most of the drawbacks of the already-addressed Velcro system, including problems such as irritation to the skin or the accumulation of unwanted debris on the system. Also, the manufacturing process will become more complex in order to assemble loops and hooks on the same surface and at different heights. This will therefore increase manufacturing costs.

BRIEF SUMMARY OF THE INVENTION

[0007] To improve on previous systems, the current invention tries to solve the problems of unfavorable fastening, costly manufacturing, irritant texture, and annoying collecting properties through a system that uses the same material for both the hook and the loop, decreases manufacturing costs, uses non-irritating materials, and ensures that the hook only binds to the corresponding loop and to nothing else.

[0008] The current invention consists of a fastening system comprised of a system of hooks and loops that interlock. However, these hooks are made from loops, instead of being a separate system as in prior art fastening systems. These hooks/loops are made of a material that is soft to the touch and not irritating to the skin because the hook material is not ruggedly abrasive, but rather smooth and rounded because they are made from loops. The material can be made using filaments, monofilaments, or any other type of thread material that has enough stiffness to maintain its shape after manufacturing. These filaments are the reason for the softness of the hooks compared to the traditional Velcro design. An added benefit is that the loops/loops are designed to grab each other, and not other objects, such as debris, hair, lint, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 depicts the basic hook/loop structure of the fastening system of the invention.

[0010] FIG. 2 shows the positions of the woven hooks at open positions.

[0011] FIG. 3 shows the positions of the woven hooks in an interlocked position.

[0012] FIG. 4 shows an alternate embodiment where the loops are made with interlocking notches.

[0013] FIG. 5 shows a second alternate embodiment where the loops are made with interlocking notches and how they can fit into a system.

[0014] FIG. 6 depicts a one-sided (FIG. 6A) and two-sided (FIG. 6B) roller press method and apparatus for using a textured wheel to press notches into the material.

[0015] FIG. 7 shows an apparatus and process of using a screw press to make more rounded notches in a filament, monofilament, or thread material.

DETAILED DESCRIPTION OF THE DRAWINGS AND INVENTION

[0016] The improved hook/loop fastener could be made through many different processes including a weaving process, in much the same way that terry cloth or carpeting is woven; the difference from terry cloth is that the filaments that form the hook loops are of a material that is stiff enough to be able to hold its shape. The filaments can be rotated or twisted as the loops are woven which creates a loop in the shape of a hook. When forming, the loops can be twisted a partial turn, a full turn, or multiple turns to create a hook.
These loop/hooks have no sharp or scratch points and do not have the aggressive gripping action to everything that burrs or traditional hook and loop fasteners have.

[0017] Other methods of manufacture include the use of a thermally setting material as the filament, monofilament or thread and forming the filament into the hook/loop shape before the weaving process or forming loops into a hook shape after the weaving process. These forming processes could include the application of heat and or pressure to form the material as desired. The thermoplastic material could be heated through either radiant heat or a directed hot air jet. Once the monofilament is softened, it can be pressed over through the use of mechanical force, such as with a tool or robotic implement. The material can also use gravity to fold over, or alternatively be blown over with a jet of hot air.

[0018] In addition to weaving processes, the object of this invention could be made by sewing the filament, monofilament or thread into or onto a support matrix or fabric. Sewing or stitching the hook/loops directly onto the clothing, shoes, or other object could greatly simplify the manufacturing process and also add to the decorative possibilities. A sewn-in hook/loop fastener could have a sleek design while the functional aspects of the hook/loop assembly could be hidden in the design of the object.

[0019] The fasteners could also be feasibly mass-produced through the use of a conveyer belt system. As the monofilament moves along the continuous belt, it could go over a sharp edge or a roller with a small diameter. As it goes over, the loops are better exposed because of their isolated position as they go over the edge. A jet of heat could be directed very precisely on that edge, heating the monofilament material. As it goes over the edge, a low-friction guide could fold them over into their J-hook shape. This method allows the loops to be assembled in close proximity to each other while decreasing loop entanglement by folding loops more specifically.

[0020] An alternate embodiment can also be created where loops are made with notches that can interlock with opposing loops with notches. This creates a combined male/female fastener that hooks to itself and not to everything else. Because the fastener is constructed of loops, the material would feel soft to the touch and not scratchy like the hook portion of a hook and loop fastener. The filament, monofilament or thread material making up the loops could be pre-made with the notches already in place. With pre-made notches the filament, monofilament or thread can easily be woven or stitched as desired.

[0021] There are two different methods in making the notches in this alternate embodiment. First, the filament, monofilament or thread could run through a press where a textured wheel presses notches into the material. The press could use either heat or pressure or both to create the notches. Conversely, the notches could be formed in the material through the use of a screw press, where the threads of the screw as the screw rotates in contact with the material and presses or cuts notches into the material.

[0022] FIG. 1 shows a basic embodiment of the invention, in which a carpet surface is comprised of plurality of hooked loops. Each loop is attached to a support matrix surface that defines an x-y plane when laid flat. Each loop initially rises up, substantially along the z-axis perpendicular to the x-y plane of the support matrix surface, and then is bent into a J-hook at a point at least halfway along the plane of the loop rising perpendicular to the backing surface. These hook/loop filaments are attached to a support matrix surface.

[0023] The weaving process can be done through a sewing machine. During the process, the threads are rotated at least a half-turn to a full turn before the second is stitched through. This twisting action in the microfilament creates a J-hook. While not shown in FIG. 1, the hook-loops could be assembled on both sides.

[0024] In FIGS. 2 and 3, we can see the open and interlocked positions of the fastener system. Having a single material for hooks and loops makes it so that they only interlock with the same material, eliminating the annoyance of having the hooks grip onto any other miscellaneous object. The advantage of using a specific type of monofilament is that the hooks are stiff enough to stay in place. The rounded loop style of the hooks is also advantageous because it is softer to the touch, being less likely to aggressively pick up lint, hair, and other debris. Note that while this representation only shows a partial turn, the material forming the loops could be twisted a partial turn, a full turn, or multiple turns to create a hook.

[0025] The fasteners used to create the hook and loop system may be made of a soft thermoplastic material and create a soft J-hook that does not cause irritation to the skin.

[0026] FIGS. 4 and 5 show alternate one-sided fastener systems. It doesn’t attract lint, and is one-sided. In FIG. 1, the embodiment’s loops are bent and twisted over in a J-shape hook to catch loops. In this embodiment, the loops do not twist into a J-shape hook; rather, at least one side has notched sites for where opposing loops can attach onto. The loops would catch in the notches, similar to how they would catch a J-hook hook such as in the first embodiment. The most ideal spacing between loops in the loop assembly is approximately less than 10% of the diameter of the material. However, as manufacturing concerns present themselves, the loops may be manufactured with a spacing of no more than ½ of the diameter of the microfilament material. For this embodiment, there are different methods of assembly. In one option, both mating sides could be identical, with a carpet of loops interspersed with notches for the opposing assembly’s loops to attach onto. In another option, one of the mating sides could be simply a loop assembly without notches. Addressing manufacturing concerns, it may be more feasible to manufacture this embodiment with identical opposing sides. FIG. 4 shows the placement of loops on a surface material. FIG. 5 shows how loops lock on to other loops in the system, by interlocking with the opposing side loops.

[0027] FIG. 6 goes into detail on how a wheel press can be used to create the alternate embodiment in FIGS. 4 and 5. A wheel press could use either heat or pressure or both to create the notches, using the right size hole maker. As shown in the Figure, the microfilament 1 would pass through the wheel press. As it passes, protrusions 3 on the surface of the wheel press 2 would create a beveled notch 6 into the monofilament 1 as the protrusions 3 hit the monofilament as shown at 4. An alternate methods shown in FIG. 6b includes using a wheel press on both sides 7 of the monofilament to create notches 8 on both sides. A method not shown comprises rotating the microfilament as an alternate method of creating notches on both sides of the monofilament material.

[0028] FIG. 7 shows in detail the process of using a screw press to make notches in filament, monofilament, or thread material. Compared to other methods of manufacture, the screw press presses more rounded notches into the microfilament as opposed to traditional beveled notches created by devices such as the wheel press. This is more desirable for the fastener system because a rounded notch better fits the shape
and profile of the cross section of the opposing loops in embodiments such as the one in FIG. 3. Beveled notches would tend to pop out of place more often. Looking to FIG. 3, the fastener component created with notches will have greater strength in opposition to forces parallel to the orientation of the loops. In order to allow perpendicular movement, the manufacturing device will need to deform each and every one of those loops, and bend them over. In this J-hook state, movement is parallel to the loops and needs to disengage the notches.

A threaded section 2 rotates inside the cylinder of the wheel press. Between the threads 3 and the side walls 4 of the cylinder, there is a hole that is about half the diameter of the microfilament. This hole is where the microfilament would feed into the screw press. As the microfilament travels past the thread, the threads would cut a notch 5 into the microfilament, as seen in the finished side. Note that unlike the beveled notches created from a wheel press in FIG. 6, the notches created by the screw press are rounded.

There are options for method variability as manufacturing concerns arise. One option includes having two threaded parts, where monofilament is fed between the two threaded parts to create notches on both sides. This would be especially feasible when the monofilament cannot be fed through a hole in the side wall.

1. A hook-and-loop fastening material, comprising:
   a carpet surface comprised of a plurality of hooked loops of filaments, each loop being attached to a support matrix surface, wherein each loop of the plurality of hooked loops rises up perpendicular to the support matrix surface, and each loop is bent into a J-hook at a point at least halfway along the plane of the loop rising perpendicular to the support matrix surface.

2. The hook-and-loop fastening material of claim 1, wherein each said loop is placed in an irregular pattern within each row.

3. The hook-and-loop fastening material of claim 1, further comprising a second carpet surface comprised of a second plurality of hooked loops of filaments, each loop of the second plurality of hooked loops being attached to a second support matrix surface, wherein each loop of the second plurality of hooked loops rises up perpendicular to the support matrix surface and is bent into a J-hook at a point at least halfway along the plane of the loop rising perpendicular to the second support matrix.

4. A fastening material, comprising:
   a first base web having a plurality of filament loops attached in a series of rows and columns;
   a second base web having a plurality of fastening strands mounted on the base web in rows and columns, each fastening strand attached in substantially perpendicular to the base web, each fastening strand having at least one notch with a mouth sized to fit the filament loops on the first base web.

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