United States Patent

Brumlik

[15] **3,686,718**

[45] **Aug. 29, 1972**

[54] **SELF-GRIPPING FASTENING DEVICE**

[72] Inventor: **George C. Brumlik,** 154 Upper Mountain Ave., Montclair, N.J.

[22] Filed: **Dec. 8, 1969**

[21] Appl. No.: **883,141**

[52] **U.S. Cl.**.....**24/204,** 24/73

[51] **Int. Cl.**.....**A44b 17/00**

[58] **Field of Search**.....24/204, 203, 73.12, 146, 147, 24/228, 204; 85/30, 14

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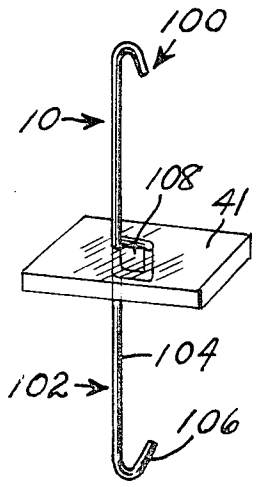
Primary Examiner—Bernard A. Gelak

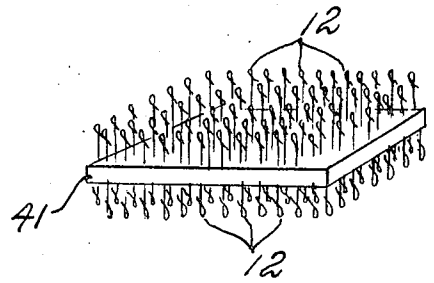
Attorney—Edward F. Levy

[57] **ABSTRACT**

A self-gripping fastening device for connecting together a pair of articles, only one of which is required to be provided with the device, comprises a plurality of hooked fastening elements made of metal wire or coated metal wire, each being secured to one of the articles. Each of the elements has at least one elongated shank terminating at its free end in a hook, and bent at its other end to provide an enlarged portion which anchors the element in the article to which it is secured by penetration of the shank through the surface. When the fastening device on the one article is pressed against the opposing surface of the other article, the free ends of the fastening elements penetrate and lodge in the other article to thereby effect adhesion between the pair of articles.

13 Claims, 17 Drawing Figures





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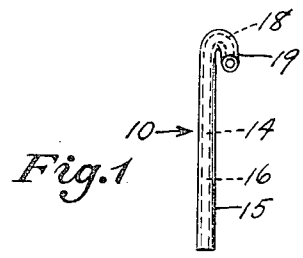


Fig.1

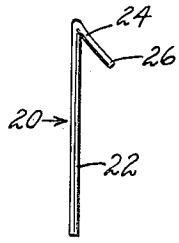


Fig.2

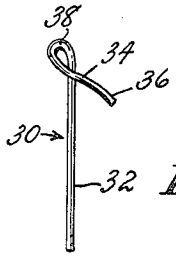


Fig.3

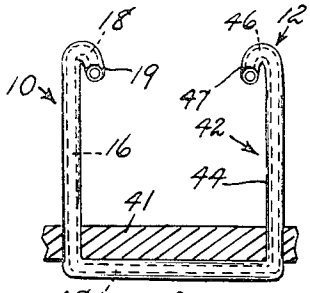


Fig.4

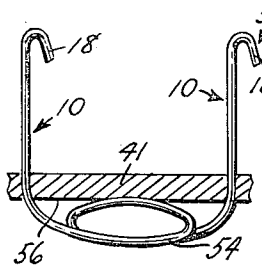


Fig.5

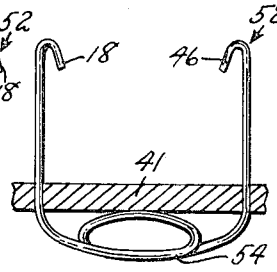


Fig.6

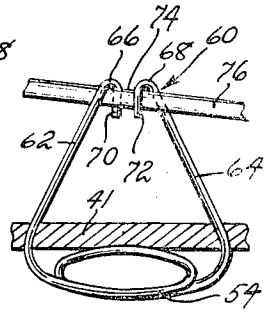


Fig.7

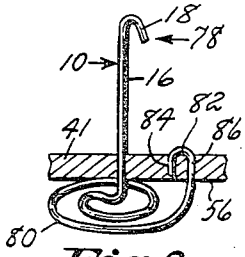


Fig.8

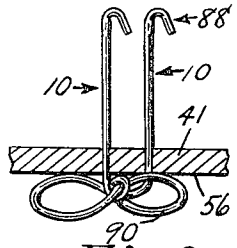


Fig.9

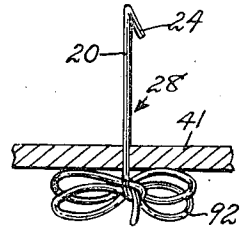
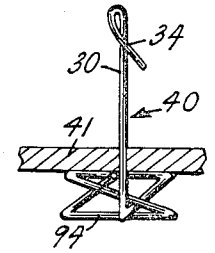


Fig.10



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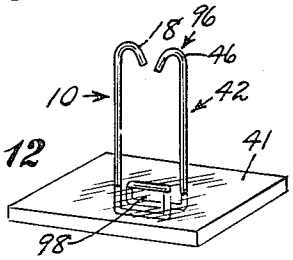

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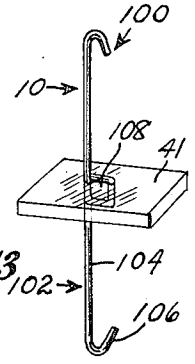


Fig.13

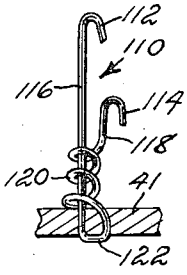


Fig.14

Fig.17

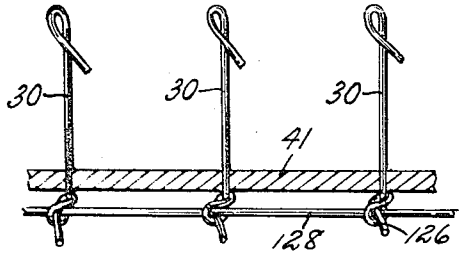


Fig.15

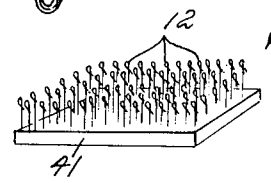
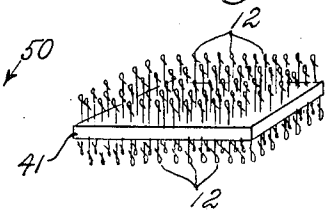


Fig.16



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SELF-GRIPPING FASTENING DEVICE

The present invention relates to fastening devices and in particular to a novel and improved fastening device which is operative to grip an opposed surface upon contact therewith in a self-adhering action.

Various self-gripping fasteners, particularly suitable for releasably fastening fabrics and the like are presently available. Typical of such fasteners is a self-gripping fastener assembly presently marketed under the trademark "Velcro" and which is in the form of pairs of fabric strips which are respectively sewn or otherwise secured to the opposing fabrics to be fastened together. In the "Velcro" fastener, multiple rows of small vertically extending open plastic loops are secured to the outer surface of one of the matching strips, while matching small plastic hooks are secured to the outer surface of the opposite strips. Thus, when the two opposing strips are press-contacted, the hooks on one strip link with the opposing loops so that the opposing strips are interlocked in a gripping action. The opposing strips may be released by pulling them apart with sufficient force to cause the above-mentioned hooks to disengage from their corresponding loops.

While the above-described "Velcro" fastener provides an effective gripping action, the cost of manufacture thereof is relatively expensive. Furthermore, it is apparent that a "Velcro" type grip requires that both of the opposing surfaces have matching "Velcro" type strips in order to effect an interlocking grip.

In my co-pending U.S. Pat. applications, Ser. No. 657,295 filed July 31, 1967, Ser. No. 675,609 filed Oct. 16, 1967, and Ser. No. 697,527 filed Jan. 12, 1968, I have disclosed similar types of fastening arrangements employing hooked or barbed filaments, particularly adapted to be formed of plastic, which filaments are secured in a random array on the surface of an article by flocking or like methods of deposition. While such fastening assemblies provided adequate gripping properties in specific uses, their gripping strength was limited to the material employed and their method of attachment.

The present invention is directed to a fastener device which is relatively inexpensive and simple to manufacture, is advantageous over the "Velcro" type fastener in that only one surface is provided with fastener means, and is advantageous over the fastener device of my aforesaid patent applications in that it provides unusually strong tensile and peel strength and is adapted to be applied to a surface in selected patterns.

It is therefore an object of the present invention to provide an economical and simple fastening device having improved gripping properties, ability to penetrate and grasp opposed surfaces, and the ability to be made in very fine, miniature form.

Another object of the present invention is to provide a fastening device of the character described which is particularly adapted to be readily and conveniently formed of fine metal wire.

Another object of the invention is to provide a fastening element which may be applied rapidly and economically to a sheet-like body by machine in a predetermined pattern in which the elements are selectively spaced throughout the body, thereby permitting a fastening assembly to be manufactured with the advantages and economies of present day mass production techniques.

A further object of the invention is to provide a fastening device in the form of a sheet-like body having gripping hooks on both sides thereof, whereby two objects may be fastened to one another merely by disposing the body between the two objects to be joined and pressing the latter together to cause the hooks to grip each of the objects.

In accordance with principles of the present invention, there is provided a self-gripping fastening device for connecting together a pair of articles. The device of the present invention comprises a plurality of fastening elements secured to one of the articles to be gripped. Each of the fastening elements comprises an elongated stem extending from one surface of said article and having a hook formed at the free end thereof. The stem passes through said article and is bent at its end opposite said free end to form an anchoring portion extending laterally from said stem, the anchoring portion being located at least partially on the surface of the article opposite to the surface from which the stem extends for preventing said stem from being pulled out of said article. Accordingly, when the fastening device of the present invention is pressed against the other article, the elongated stems at their respective free ends pierce and penetrate the other article and lodge the hooks therein, to thereby effect adhesion between the pair of articles.

Additional objects and advantages of the invention will become apparent during the course of the following specification when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view on an enlarged scale, of a portion of a fastening element made of coated wire according to one embodiment of the invention;

FIG. 2 is an elevational view on an enlarged scale, of a portion of a fastening element made of uncoated wire according to a second embodiment of the invention;

FIG. 3 is an elevational view of a portion of a fastening element according to another embodiment of the invention;

FIG. 4 is a perspective view of a complete fastening element utilizing the type of fastening element portion shown in FIG. 1, the element being shown secured to a portion of a supporting sheet of material which is shown in section;

FIG. 5 is a perspective view, similar to FIG. 4, of another embodiment of a fastening element shown secured to a portion of its supporting sheet;

FIG. 6 is a perspective view of a modified form of fastening element shown secured to a portion of its supporting sheet;

FIG. 7 is a perspective view of another embodiment of fastening element shown secured to its supporting sheet, and showing the manner in which the fastening element grasps an opposed filament;

FIGS. 8 and 9 are perspective views of two additional embodiments of fastening elements each utilizing the hook-type fastening element portion shown in FIG. 1 and each shown secured to its supporting sheet;

FIG. 10 is a perspective view of another embodiment of fastening element utilizing the fastening element portion shown in FIG. 2 and shown secured to its supporting sheet;

FIG. 11 is a perspective view of a further embodiment of fastening element utilizing the fastening element portion shown in FIG. 3 and shown secured to its supporting sheet;

FIG. 12 is a perspective view of another embodiment of fastening element shown secured to a portion of its supporting sheet;

FIG. 13 is a perspective view of a further embodiment of fastening element in which hooked element portions project from opposite surfaces of the supporting sheet to which it is secured;

FIG. 14 is an elevational view of yet another embodiment of fastening element shown secured to its supporting sheet;

FIG. 15 is an elevational view of a plurality of modified fastening elements shown connected and secured to their supporting sheet by an anchoring member;

FIG. 16 is a perspective view of a fastening device constructed in accordance with the present invention comprising a plurality of fastening elements secured to a supporting sheet of material on one surface thereof; and

FIG. 17 is a perspective view of a fastening device similar to FIG. 16, except that a plurality of fastening elements are secured to a supporting sheet on both surfaces thereof.

DETAILED DESCRIPTION

Referring in detail to the drawings, there is shown in FIG. 1 on an enlarged scale, one embodiment of a portion 10 of a fastening element, the aforesaid portion 10 being adapted to be used on various embodiments of fastening elements. For example, the fastening element portion 10 is utilized with the embodiment of a complete fastening element 12 shown in FIG. 4. The fastening element portion 10 is shown in its preferred form as being made of a length of metal wire 14 having a coating 15 of dissimilar material. Element portion 10 comprises an elongated stem 16 terminating at its end in a hook 18, the latter being in the form of an inverted U having a short depending leg 19, and with the stem 16 and hook 18 being disposed in the same general plane. The coating 15 may be made of glass, plastic, adhesive, dissimilar metal, semi-conductive material or other suitable material. The element portion 10 may also be made of non-coated wire, as presently explained.

In the embodiment of FIG. 2, a fastening element portion 20 made of uncoated metal wire comprises an elongated stem 22 terminating at its end on a sharp ended hook 24 in the form of an inverted V but with the shorter leg 26 of the V-shaped hook being bent to one side so that the hook 24 and stem 22 are not disposed in the same general plane as in the case of the FIG. 1 embodiment. The fastening element portion 20 is utilized, for example, with a complete fastening element 28 shown in FIG. 10. The hook 24 in this instance is made by crimping the metal body of the element portion 20.

In the embodiment of FIG. 3, a fastening element portion 30 comprises an elongated stem 32 terminating at its end in a hook 34. The hook 34 is defined by a generally laterally and downwardly depending end portion 36 formed by doubling back on itself an end section of the stem 32 to form a loop 38 and to dispose the end portion 36 downwardly and laterally off to the side of the stem 32. The fastening element portion 30 is utilized, for example, with a complete fastening element 40 shown in FIG. 11.

It will be appreciated that the hooks 18, 24 and 34 in FIGS. 1, 2 and 3 respectively, are shown by way of illustration, and that a variety of other hook configurations may be used in practicing this invention. It will also be understood that any of the element portions 10, 20 and 30 may be formed of metal wire or coated metal wire.

Turning now to the complete fastening element, FIG. 4 shows one embodiment of fastening element 12 in detail on an enlarged scale and also illustrates the manner in which the fastening element is mounted on a body 41. The fastening element 12 comprises a length of coated metal wire bent into the configuration illustrated and including as a part thereof the element portion 10 of FIG. 1, with its stem 16 and hook 18. Element 12 also includes a second element portion 42 having a stem 44 and hook 46 with depending leg 47. The second portion 42 is identical to the first element portion 10, except that the hook 46 is turned to the left instead of to the right. The two element portions 10 and 42 are joined by a connecting portion 48 which extends perpendicularly therebetween and serves as an anchor member in mounting the element 12. It will be seen that the two stems 16, 44 project generally upright from one side of the body 41 with the base portions of each stem 16, 44 passing through the body 41 to the opposite side where the two stems are joined by the anchoring portion 48.

FIG. 4 shows only one fastening element, on a portion of a body 41; however, in order to form a complete article, a plurality of such fastening elements are utilized. Thus, FIG. 16 shows an article 50 comprising a sheet-like body 41 onto which has been applied a plurality of fastening elements 12. The article 50 is intended to be secured to an opposing penetrable surface. To fasten article 50 to an opposing surface, it is pressed against the opposing surface with sufficient force to cause the fastening elements 12 to penetrate the opposing material and lodge therein. Article 50 will thus be firmly interlocked with the opposing material by the combined gripping action of the large number of fastening elements 12 embedded and locked in the opposing material. The size, number and distribution density of fastening elements 12 on sheet 41 will be determined by the size and nature of the opposing material to be gripped, as described hereinafter in greater detail.

In the preferred form of the article 50, the fastening elements 12 are of uniform size and are made small for mounting closely to one another in a selected pattern on the sheet 41 such as the pattern of uniform rows shown in FIG. 16, or in other patterns such as spirals, etc. Typically, the fastening elements 12, as well as the alternate embodiments illustrated in FIGS. 5 to 15, have an overall length ranging approximately from one sixty-fourth to one-half inch, and a diameter ranging approximately from five ten-thousandths to one one-hundredths of an inch. The fastening elements may, for example, be formed from wire made from metal, such as steel, aluminum, copper, brass, bronze, zinc, stainless steel, beryllium-copper or the like, either bare or coated and formed in the shapes shown in a manner

which will be presently explained. Typically, the sheet-like body 41 may be made of plastic, wood, leather, rubber, fabric metal, metal mesh, printed circuit composite or the like.

In order to provide an article surface with a fastening assembly capable of gripping an opposing material, a large number of fastening elements, for example the element 12 of FIG. 4, are required to be secured to the article 50 in the manner shown. This may be accomplished by starting with a generally U-shaped piece of wire having the configuration shown in FIG. 4 but on which the hooks 18 and 46 have not yet been formed. The aforesaid U-shaped wire is applied to the article by having the straight legs of the U penetrate the article 41 from the bottom, the aforesaid being effected by a suitable machine (not shown), which merely forces the wire legs of the U through the article 41. A suitable die (not shown) may be disposed on the side of the article 41 from which the wire legs emerge to form the hooks 18 and 46 as the fastening element 12 is applied to the material body 41. Thus, the die may have separate channels to receive each of the straight stems 16, 44 as they emerge from the article 41 and an arcuate abutment at the end of the channels to turn or bend back the ends of the stems 16, 44 as the latter encounter the arcuate abutments and are forced thereagainst by the aforementioned machine. The aforesaid abutments form the inverted U-shaped hooks 18, 46 on the ends of the stems 16, 44 respectively, as the latter are supported in the channels in the die. It will be appreciated that a large number of fastening elements 12 may be applied rapidly by machine in this manner and further, that such elements 12 may be applied in a predetermined and uniform pattern in which the elements are uniformly spaced throughout the article.

As an alternative, the elements 12 may be preformed in the shape shown in FIG. 4 and merely inserted in that form by machine, the pre-formed hooks 18 and 46 penetrating the material body 41. In either mounting process, the transverse portion 48 of element 12 engages the under surface of the material body 41 and anchors the element in mounted position, preventing the element from passing entirely through the material body.

With a large number of fastening elements 12 secured in relatively thick profusion to the support sheet 41 and projecting in upstanding condition from the surface thereof, as shown in FIG. 16, the fastening assembly is capable of gripping an opposed object or material which is sufficiently soft or penetrable to be pierced by the individual fastening elements. For example, the opposed material may be made of plastic, plastic foam, foam rubber, fabric, felt or the like. The article 50 may be secured to the surface of said opposed object by pressing it thereagainst with sufficient pressure to cause the exposed portions of the fastening elements 12 to penetrate the material to a depth dependent upon the particular material involved or the spacing desired. When such pressure is exerted on the article 50, the metal hooks 18, 46 of each fastening element 12 will enter the opposed object, and because the fastening elements are made of metal and the opposing object is made of a softer material, the hooks 18, 46 will penetrate through the surface of the opposed object to the desired depth in the object.

When the article 50 is applied to an opposed material as above described, the inserted hooks grasp the opposed material and provide a considerable resistance to disengagement. Thus, when force is applied in the opposite direction, the short depending legs 19, 47 (FIG. 4) of each hook 18, 46 pierces or engages the material of the attached opposed article to restrain movement of the hook out of said attached article. For a given penetrable material, the resistance to disengagement therefrom will be determined by the thickness and strength of the hooks which are engaged by the penetrable material, by the number of hooks so engaged and by the strength of the materials so fastened. The adhesion provided thereby is permanent to a relative degree that is to say, the hooks will resist withdrawal of the fastening elements from the attached material unless sufficient force is applied thereto to cause either a distortion of the hooks or some tearing or yielding of the attached material on either of the joined articles.

FIG. 5 shows another embodiment of a fastening element 52 comprising two upstanding fastening element portions 10, previously described with reference to FIG. 1, and an anchoring base portion 54 in the form of a closed loop joining the two portions 10 on the opposite side of the material body 41. The hooks 18 of the element portions 10, in this instance, face in the same direction. It will be appreciated that while the loop of the connecting portion 54 is shown in perspective for illustrative purposes, so that sections thereof appear spaced from the bottom surface of the body 41, in the preferred arrangement, substantially the entire loop is actually disposed in a general plane parallel to and abutting the bottom flat surface 56 of the sheet-like body 41.

As previously indicated, the diameter of the wire used for making the fastening elements, typically ranges from five ten-thousandths to one one-hundredths of an inch. Accordingly, when using extremely fine diameter wire in this range, it may be desirable to add more body and provide a more substantial base to the fastening element in order to enhance its rigidity, particularly the rigidity with which the fastening element is secured to the body 41. It will be apparent that the loop in anchoring portion 54 will provide a more substantial supporting base for the element 52 than the straight anchoring portion 48 in the fastening element 12 of FIG. 4. As may be determined by the diameter of the wire used for making the fastening elements and by the physical properties of the material of the wire and of the body 41, various configurations, as will hereinafter be set forth in describing further alternate embodiments, may be formed in the base of the various fastening elements to enhance the rigidity as aforesaid.

Returning more specifically to the fastening element 52 of FIG. 5, it will be appreciated that such elements 52 may be applied to the material body 41 in substantially the same manner previously described in connection with the fastening element 12 in the FIG. 4 embodiment. It will further be appreciated that although the hooks 18 on the fastening element 52 both face in the same direction and the hooks 18 and 46 in fastening element 12 (FIG. 4) face in opposite directions, an article such as the article 50 shown in FIG. 16, having affixed thereto a plurality of fastening elements 52, may

be applied and fastened to an opposing object and will function in substantially the same manner, as previously described in connection with the fastening element 12.

FIG. 6 shows an alternate type of fastening element 58 which combines features of the elements of FIGS. 4 and 5. Thus, fastening element 58 has oppositely facing hooks 18 and 46, as in the FIG. 4 embodiment, and a connecting portion 54 identical to that of the FIG. 5 embodiment. In view of the prior detailed description of the embodiments of FIGS. 4 and 5, it is believed that the functional features of fastening element 58 will be understood without further repetition.

FIG. 7 shows another form of fastening element 60 somewhat similar to the element 58 of FIG. 6, but having stems 62, 64 inclined towards one another. The stems 62, 64 each has an inverted U-shaped hook 66, 68 with short downwardly depending legs 70, 72 respectively. The stems 62, 64 are disposed and arranged so that the depending legs 70, 72 of the hooks are slightly separated to form a space or gap 74 as illustrated. Accordingly, when the fastening element 60 is mounted on an article which is to be fastened to a fabric-like material by pressing the article against the latter, one or more of the fibers or strands, for example the strand 76 in FIG. 7, of the material will pass downwardly through the gap 74 between the legs 70, 72. The gap 74 between the legs 70, 72 may be smaller than the diameter of the strand 76, however, the stems 62, 64 will momentarily flex to widen the gap 74 and allow the strand 76 to pass therebetween as the article is pressed onto the fabric-like material. Once the strand 76 passes through the gap 74, the stems 62, 64 will return to their unflexed position in which the gap 74 is smaller than the diameter of the strand 76. Thus, the strand 76 will be captured between the stems 62, 64 and upon any attempt to separate the fastening element 60 from the material of which strand 76 is a part, the latter will be caught by at least one of the hooks 66, 68 rather than pass out from between the stems through the gap 74, in the manner shown in FIG. 7. Although only one strand 76 is shown in the drawings, it will be understood that a plurality of such strands may initially pass downwardly through the gap 74. It will be apparent from the above that the fastening element 60 of FIG. 7 may be advantageously used on articles adapted to be fastened to materials consisting of filaments, fibers or hair to provide a strong adhesion therebetween.

FIG. 8 shows another embodiment of fastening element 78 comprising a single upstanding fastening element portion 10, previously described with reference to FIG. 1, and an anchoring base portion, comprising a spiral-like loop 80, and a terminating end portion in the form of an inverted U-shaped hook 82. As illustrated, the hook 82 has its two legs, 84, 86 embedded in the material body 41 to thereby firmly anchor the fastening element 78 to said body. It will be appreciated that although for illustrative purposes the spiral-like loop 80 is shown in perspective such that sections thereof appear spaced from the bottom surface 56 of the article 41, in actual practice, substantially the entire loop 80 would be disposed in a general plane parallel to and abutting the bottom flat surface 56 of the body 41. The fastening element 78 may be applied to the body 41 by starting with a length of wire having the configuration substantially as shown in FIG. 8 in which the spiral-like loop 80 is disposed in a single plane and the stem 16 and leg 86 extend substantially perpendicularly therefrom, and in which the hooks 18 and 82 have not yet been formed. The aforesaid length of wire is applied by machine to the article by having the straight stem 16 and leg 86 penetrate the body 41 from the bottom surface of the latter. A suitable die (not shown) may have a channel to receive the straight stem 16 and a suitable arcuate abutment to form the hook 18 on the stem 16 as previously described in connection with the FIG. 4 embodiment. The die may also have an abutment to form the hook 82 so that the leg 84 is turned back into the body 41.

FIG. 9 shows another alternate fastening element 88 comprising two upstanding fastening element portions 10, previously described, and a base in the form of a double-looped knot 90 as illustrated. The knot 90 adds more body and provides a more substantial base to the fastening element as previously described in connection with the description of the FIG. 5 embodiment. The fastening element 88 may be applied by machine in substantially the same manner as previously described, by inserting the two element portions 10 through the material body 41 until the knot 90 engages the under surface 56 and serves as anchoring means for the element 88.

FIG. 10 shows a further alternate fastening element 28, previously mentioned, comprising a single fastening element portion 20, of the type shown in FIG. 2, having a crimped hook 24. The element 28 includes an anchoring base in the form of a quadruple looped knot 92. The knot 92 provides a more substantial base than the double-loop knot 90 of FIG. 9. Otherwise, the description of the FIG. 9 embodiment is equally applicable to FIG. 10.

FIG. 11 shows another alternate fastening element 40, previously mentioned, having a fastening element portion 30 of the type shown in FIG. 3, with a looped hook 34. The element 40 also includes an anchoring base 94 which has been crimped into the irregular configuration shown. Here again, the crimped base 94 serves the same anchoring function as the knots 90 and 92 in FIGS. 9 and 10 respectively.

In connection with the elements 20 and 30 shown in FIGS. 10 and 11, it will be observed that since each of these elements has a single upstanding shank which penetrates the material body 41, and since the respective anchoring bases 92 and 94 of the elements engage the bottom surface 56 of the material body without penetrating the body, the elements 20 and 30 are rotatable in the material body 41. This rotation permits a screwing-in action of the element hooks as the latter pierce and penetrate the material body, thereby facilitating the mounting operation. In addition, rotation of the hooks tends to restrain longitudinal pull-out of the elements from the material body in which they are mounted.

FIG. 12 shows another alternate type of fastening element 96 having upper portions 10 and 42 similar to those of the embodiment of FIG. 4, wherein the hooks 18 and 46 face each other. The fastening element 96 may be applied to the material body 41 by starting with a straight piece of wire and forcing the latter longitu-

dinally through and against suitable dies (not shown) disposed above and below the body 41 to cause the wire to follow the helical path shown to form a closed loop 98 in which a portion of the body 41 is enclosed. Thus, the wire may initially be forced longitudinally downwardly by a machine (not shown) to penetrate the body 41. Upon emerging from the bottom of the body 41, the end of the wire will encounter a first abutment on a lower die to turn the wire perpendicularly extend along the lower surface of body 41 and then to turn the wire upwardly to again penetrate the body 41. Upon emergence from the top of body 41, the end of the wire will encounter an abutment on an upper die to turn the wire perpendicularly along the upper surface of body 41 and then downwardly to again penetrate the body 41. This is followed by engagement of a second abutment in the bottom die to once again turn the wire perpendicularly and then upwardly to penetrate the body 41. The upper die may be provided with a channel having an abutment at the end thereof to form the hook on the portion 42 as previously described. It will be appreciated that since the anchoring base of fastening element 96 is looped about a portion of the body 41, the element 96 will be firmly anchored to the body 41 preventing either an upward, downward, or lateral disengagement.

FIG. 13 shows another alternate fastening element 100 comprising an upper element portion 10, of the type shown in FIG. 1, located above the body 41, and a lower element portion 102 having a stem 104 and hook 106 similar to the stem and hook in upper portion 10, except that the element 102 is inverted and is located below the body 41. The element 100 also includes an anchoring portion in the form of a closed loop 108. As in the case of the previous embodiment of FIG. 12, the closed loop 108 encloses a portion of the body 41 to firmly anchor the fastening element 100 to the body 41. The fastening element 100 may be applied to the body 41 utilizing upper and lower dies (not shown) to form the loop 108 in a manner similar to that described for the embodiment of FIG. 12, except that in this instance, the hooks 18 and 106 are formed at both free ends of the element 100.

It will be observed that the fastening element 100 in FIG. 13 differs from all the other illustrated embodiments in that it includes fastening hooks on both surfaces of the body 41, so that objects may be fastened to both sides of said body.

It will be understood that the fastening elements shown herein may be made of electrically conductive wire so as to serve the function of electrical connectors as well as to fasten together a pair of articles. Thus, an assembly of fastener elements of the types disclosed herein may be mounted on a printed circuit panel and be employed to join thereto a corresponding circuit panel, at the same time electrically connecting selected circuit elements on the panels. In addition, if the fastener elements are made of coated wire, as previously described, with the coating made of insulating material, a capacitor effect in complex patterns can be achieved.

As previously indicated, any of the various fastening elements shown herein may be made of bare metal wire or coated wire. When the wire is coated, a greater control over the physical qualities of the elements may be achieved. For example, the resiliency of the hooks, as well as tensile strength and peel strength of the fastening assembly can be selectively varied. The coating may also be employed to impart rigidity to the stem of each fastener element while retaining the elasticity of the hooks which may be left uncoated. Further, if the coating material is softer than the metal wire, it will also serve to reduce the abrasiveness of the fastener assembly and prevent scratching of the skin of the user. Suitable coatings can also be employed to provide resistance to corrosion and chemical action, as well as making it possible to achieve both a gripping force and an adhesive force in a combined manner in the same fastener assembly.

There has thus been provided a variety of base-anchored metal fastening elements which may be readily mounted in selected patterns on an article and which present hooked ends capable of penetrating and gripping an opposed article so as to fasten the two articles together. Where the elements are of the type shown in FIGS. 4 through 11, wherein the base anchor portion is located beneath and in abutment with the bottom surface of the article in which the elements are mounted, the elements may be preformed and then mounted by machine in the article in a simple penetration action. On the other hand, where the elements are of the type shown in FIGS. 12 through 14, wherein the base anchoring portion is embedded in the article, the elements are not pre-formed but are formed by machine during the mounting operation.

FIG. 14 shows another alternate fastening element 110 having a pair of hooks 112, 114 arranged at different elevations above the body 41. The hook 112 is carried on the end of a straight stem 116 while the hook 114 is carried on the end of a stem 118 which is partially coiled, as indicated at 120, around the lower section of the straight stem 116. The fastening element 110 also includes a closed loop 122 which extends through the body 41 and anchors the element 110 thereto.

FIG. 15 shows yet a further alternate fastening element 124 comprising an upper portion 30 of the type previously described in connection with FIG. 3, and a base formed into a knot 126. An elongated element in the form of a wire 128 passes through a loop in the knots 126 of a plurality of such fastening elements 124 to provide a firm anchorage for the fastening element 124 on the body 41. In FIG. 17 there is illustrated an article 130 comprising the material body 41 with a large number of elements 100 mounted thereon in a selected pattern. In this view, the element portions 10 and 102 are shown protruding respectively from the top and bottom surfaces of the body 41. Such an article 130, utilizing the elements 100, may be used advantageously where it is desired to join two penetrable objects. In such an instance, it is not necessary to mount a plurality of fastener elements to one of the bodies in the manner described in connection with the other element embodiments herein. Instead, the double-faced article 130 is merely placed between the two penetrable objects to be joined and the objects are pressed together, sandwiching the article 130 therebetween. The fastening elements 10 on one surface of the sandwiched article 130 will then penetrate and grasp one object, and the elements 102 on the opposite surface of article 130 will

penetrate and grasp the other object, so that the two objects are effectively joined.

It will be understood that while in the preferred form of fastening elements, the elements have been shown and described as being made of metal wire, it is contemplated that the bodies of the elements may be made of glass in filament form, or single crystal whiskers, both of which have high tensile strength and resilience. Further, when the term "wire" is used in this application, it is intended to include not only the usual drawn wire, but also fine, striplike filaments cut from sheets of metal, the latter having appreciably greater tensile strength than drawn wire of very small diameter.

While preferred embodiments of the invention have been shown and described herein, it will be obvious that numerous omissions, changes and additions may be made in such embodiments without departing from the spirit and scope of the invention.

What is claimed is:

1. A self-gripping fastening assembly for connecting together a pair of articles, said fastening assembly comprising a plurality of fastening elements secured to one of said articles, each of said fastening elements comprising an elongated straight stem upstanding substantially perpendicularly from the upper surface of said article and having a hook formed at the free end thereof with said hook curving toward said upper surface and having a penetrating profile, said stem passing through said article and being bent at its end opposite said free end to form an anchoring portion extending laterally from said stem, said anchoring portion including a loop having at least a portion underlying the lower surface of said article for preventing said stem from being pulled out of said article, whereby when said upper surface of said one article is pressed against the other of said articles, the penetrating profiles at the free ends of said elongated stems penetrate said other article and lodge the hooks therein, to thereby effect adhesion between said pair of articles.

2. A self-gripping fastening assembly according to claim 1, wherein said fastening element is formed from metal wire of a substantially uniform diameter.

3. A self-gripping fastening assembly according to claim 1 in which said fastening element is formed from coated metal wire.

4. A self-gripping fastening assembly according to claim 1 wherein each of said fastening elements comprises a pair of spaced stems extending from said upper surface of said article, each of said stems having a hook formed at the free end thereof, and wherein said loop joins said pair of spaced stems.

5. A self-gripping fastening assembly according to claim 4 wherein said anchoring portion is formed as a closed loop disposed on the lower surface of said one article, said loop being in a plane parallel to said lower surface and being in flush engagement with the latter.

6. A self-gripping fastening assembly as according to claim 4 wherein said second article is a fabric-like material having fibers or strands, said pair of stems being inclined to approach one another at greater distances from said one article, said hooks on said stems being separated by a gap which is smaller than the diameter of said fibers or strands, said stems being adapted to momentarily flex as one or more fibers or strands are forced through said gap, whereby said fibers or strands are captured between said pair of stems by the hooks on the ends of said stems.

7. A self-gripping fastening assembly according to claim 1 in which said anchoring portion comprises a length of wire bent upon itself to provide an enlarged body of substantially larger transverse dimension than the elongated stem of said fastening element.

8. A self-gripping fastening assembly according to claim 7 in which said anchoring portion is in the form of a knot including said loop.

9. A self-gripping fastening assembly according to claim 7 in which each of said fastening elements comprises a single elongated stem extending through said one article and terminating in a hook at its free end, the enlarged body of said anchoring portion underlying said opposite surface of said body, said fastening elements being rotatable in said one article.

10. A self-gripping fastening assembly according to claim 1 wherein said anchoring portion is defined by a closed loop having sections thereof extending on opposite sides of said one article, whereby a portion of said one article is included within the closed loop.

11. A self-gripping fastening assembly as defined in claim 10 wherein each of said fastening elements also includes a second stem extending from the loop of said anchoring portion and projecting from said lower surface of said one article, said second stem having a hook at its free end.

12. A self-gripping fastening assembly according to claim 7 in which each of said fastening elements comprises a single elongated stem extending through said one article and terminating in a hook at its free end, the enlarged body of said anchoring portion underlying said opposite surface of said body, said anchoring portion also including an elongated member underlying said opposite surface and extending through and connecting the anchoring portion bodies of selected fastening elements.

13. A self-gripping fastening assembly for connecting together a pair of objects comprising a sheet-like body, a plurality of self-gripping fastening elements secured to said body, each of said fastening elements including a pair of elongated stems extending respectively from opposite surfaces of said body, each of said stems having exposed hook means thereon, whereby when said body is disposed between said pair of objects and the latter are pressed together, the stems will penetrate and lodge in said objects to thereby cause said hook means to effect adhesion and join said pair of objects to one another.

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