Sept. 30, 1969 H. E. WHITACRE 3,469,289

QUICK RELEASE HOOK TAPE

Filed Feb. 6, 1969 3 Sheets-Sheet 1

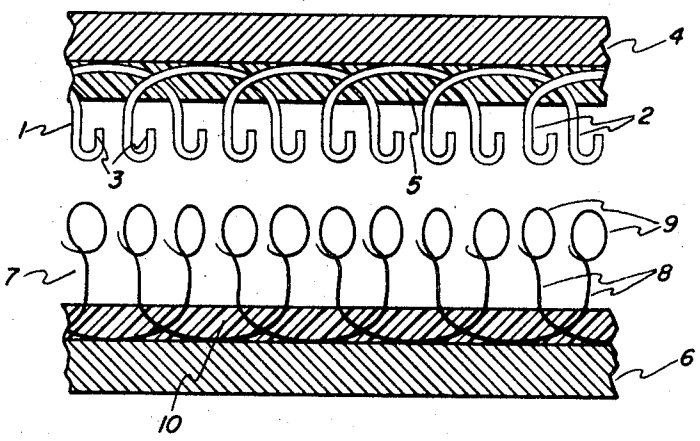

FIG. 1

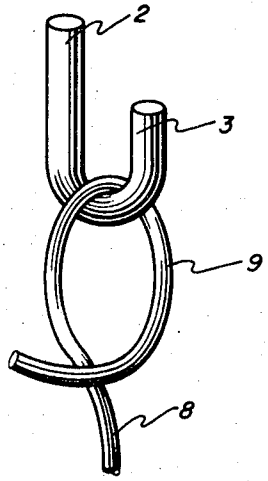

FIG. 2

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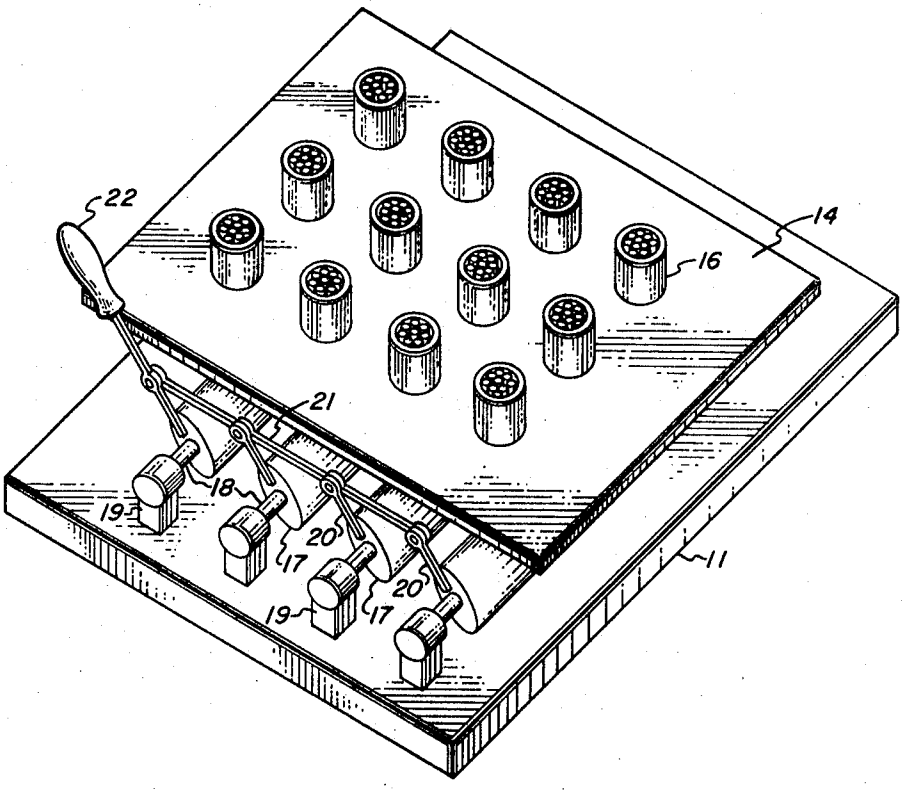

FIG. 3

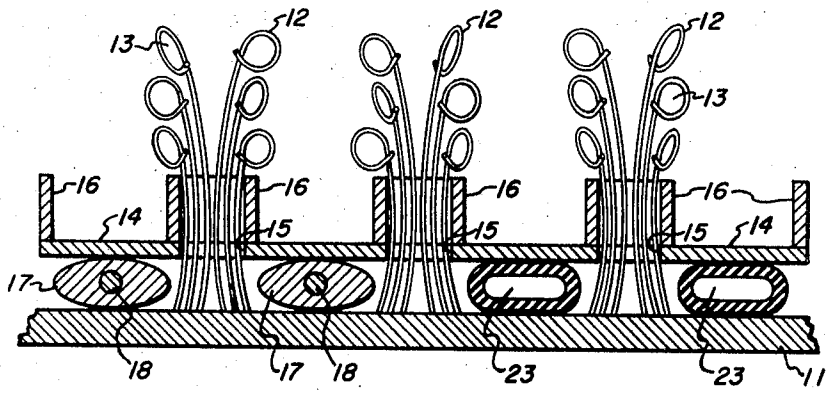

FIG. 4

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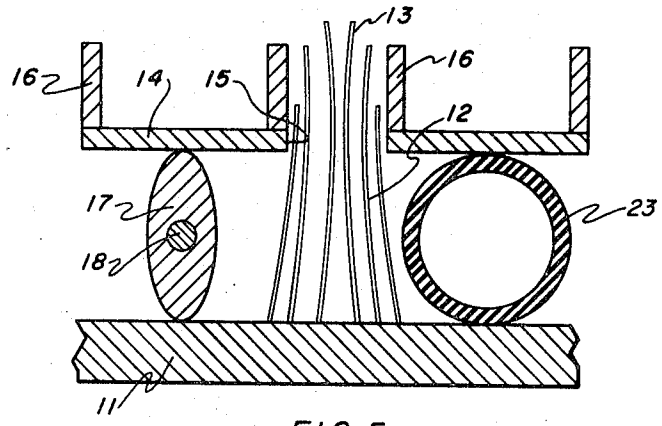

FIG. 5

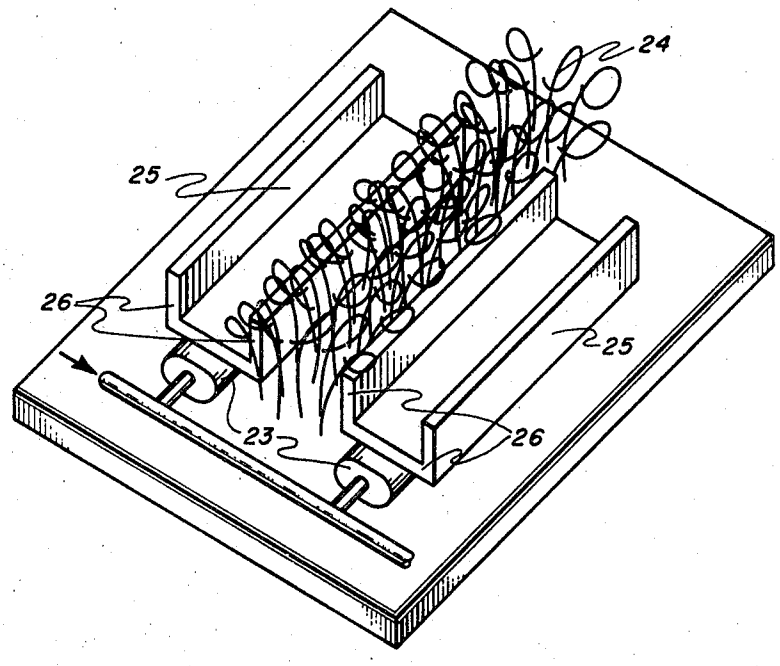

FIG. 6

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3,469,289

QUICK RELEASE HOOK TAPE

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Int. Cl. A44b *13/00*
U.S. Cl. 24—205.17 9 Claims

ABSTRACT OF THE DISCLOSURE

Two relatively large and rigid surfaces may be secured together with hook and loop fastener surfaces in a manner allowing relative rapidity and ease of separation by providing expansible means distributed over the pile of one of the surfaces in such a manner as to apply substantially uniformly distributed separation forces between the two mating pile surfaces when separation of the respective surfaces is desired.

ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

This invention relates to structural fasteners of the quick releasing type. More specifically, this invention relates to a quick release mechanism for fasteners of the hook and loop type.

Hook and loop fasteners of the prior art have been described in U.S. Patents Nos. 2,717,473; 3,009,235, and 3,154,837. Hook and loop fasteners of this type have been manufactured by the American Velcro Corporation under the registered trademark of "Velcro."

Hook and loop fasteners of the prior art comprise sheets or types of co-operative fabric pile. Respective hook pile sheets and loop pile sheets are secured, contiguously, to the surfaces of two respective structures that are to be releasably fastened together. The individual pile elements of a hook sheet are a multiplicity of upstanding hook members. The elements of the loop pile may comprise a multiplicity of upstanding loops or curled strands or both. These latter types of pile surfaces are sometimes characterized as Astrakhan pile. When one hook and loop fastener pile surface is pressed against the pile of the other surface, the hooks of the one engage the loops or eyes formed by the curls of the other surface.

In order to disengage the two surfaces from each other, it is necessary to bend the engaged hooks or curls until all the co-operatively engaged elements are released from each other. Each element is formed of a resilient material and requires a particular quantitiy of stressing force to bend each hook sufficiently to release it from a co-operative loop or curl. Although the disengaging force required to release each individual pair of hooks and loops is small, measured in units of ounces, yet when the cumulative effect of such small holding forces multiplied by the number of engaged pairs in a square inch of hook and loop fastener pile is considered, the holding force may grow to the magnitude of 5 to 40 pounds per square inch depending on the particular material from which the pile is fabricated. Typical of those materials that have been successfully used in the past are nylon, polyester, and stainless steel.

One of the more interesting facets of the hook and loop fastener is the facility of exerting uniformly distributed securing forces over the entirety of the joined surface

area without resorting to adhesives, fusing, or bonding agents. Accordingly, the two surfaces may be repeatedly joined and separated at will. However, if the joined area is of any appreciable size, the total force required for separation may become enormous. For this reason, the hook and loop fasteners has been limited in the past to structural surface pairs in which at least one member of the pair is sufficiently flexible so as to allow the structure to be folded back on itself or "peeled" away from the other surface member. Examples of such uses are garment closures or the attachment of fabric sheets to rigid surfaces.

SUMMARY OF THE INVENTION

The present invention offers an apparatus by which large areas of mutually rigid surfaces may be secured together by the hook and loop fastener technique and subsequently released by forces distributed broadly over the entire joined surface.

By providing rows of selectively expansible apparatus, such as pneumatic tubes or strip cams, over one of the co-operative rigid surfaces secured by hook and loop fastener pile, the mutual engagement of the respective hook and loop elements is unhindered when such apparatus is retracted. When the expansible apparatus is expanded, however, the rigid bases of the two surfaces are forced sufficiently far apart as to allow the mutual release of the hook and loop elements comprising co-operating hooks and Astrakhan pile elements each from the other.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects of the present invention may be more readily seen and understood by reference to the following detailed description of the drawings wherein:

FIGURE 1 is an enlarged cross-sectional representation of a hook and loop fastener as it may be applied to rigid surfaces.

FIGURE 2 is a detailed illustration of the engagement relationship between hook and loop components of a hook and loop fastener.

FIGURE 3 is a perspective view of one embodiment of the invention.

FIGURE 4 is a cross-sectional view of the invention as applied to the hook and loop fastener pile surface and illustrates two possible expansion mechanisms in the collapsed condition.

FIGURE 5 shows a portion of the FIGURE 4 illustration with the expansion mechanisms in the expanded condition.

FIGURE 6 is a perspective view of another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIGURE 1 there is shown a typical hook and loop fastener mechanism wherein a mat **1** of fabric-like strands **2** having ends formed in the shape of hooks **3** is secured to a rigid surface **4** by means of a bonding agent **5**. The opposite rigid surface **6** is provided with a dense pile mat **7** of loops or strands **8** having the ends thereof curled in the shape of loops **9**. The mat **7** may also be secured to the surface **6** by means of a bonding agent **10**.

When pressed together, co-operative hook and loop elements **3** and **9**, respectively, engage in the manner illustrated in FIG. 3 thereby firmly securing surfaces **4** and **6** together.

Since the material from which the hook and loop strands **2** and **8** are fabricated, i.g. nylon or stainless steel, for example, is of a resilient nature, it is necessary to overcome the preset shape of the strand ends **3** and **9** by applying bending stress to separate the two surfaces

4 and 6. In the case where one or both of the surfaces 4 or 6 is of a flexible nature or is constituted of the mat per se, this separation may be accomplished by peeling the particular flexible mat so that only the force necessary to overcome the disengaging stresses of those co-operative hook and loop elements along the line of peeling flexure need be applied. However, when hook and loop fasteners are used to secure rigid surfaces together, as in the case to which the present invention is addressed, it is necessary to apply sufficient separation force to overcome the disengaging stresses of all engaged hook and loop elements over the entire area of the joined surfaces simultaneously. When such surfaces are reasonably large, this task becomes mechanically difficult.

One possible embodiment of applicant's invention is illustrated in FIG. 3 where there is shown a rigid surface 11 to which is attached, as by bonding means for example, groups 12 of curled end pile elements 13 (FIGS. 4 and 5). Retraction plate 14 having apertures 15 therethrough distributed over the plane of said plate at intervals of spacing consistent with the spacing of the pile groups 12 is positioned adjacent the surface 11 with the pile elements 13 projecting through the apertures 15. Collars 16 may also be disposed around the groups 12 for purposes to be seen hereafter.

The retraction mechanism may include strip cams 17 rotatably disposed about journal shafts 18 mounted in bearing blocks 19. A parallelogram linkage comprising crank links 20 pivotally secured at their ends to a thrust link 21 ties the pivoted crank link 20 ends together for simultaneous operation by an operating handle 22.

When the operating handle 22 is turned down adjacent the surface 11, all strip cams 17 will rotate to the narrow profile position between surface 11 and retraction plate 14 shown in FIG. 4 thereby allowing the curled loops 13 of pile groups 12 to project beyond the collars 16. In this position the loops 13 are adapted to receive hooks of a co-operative hook and loop fastener surface for attachment thereto.

To separate the two rigid surfaces, it is only necessary to rotate the handle 22 to an upright position with respect to surface 14 thereby rotating strip cams 17 to the wide profile position between surface 11 and plate 14 shown in FIG. 5. This action exerts an evenly distributed displacing force between surface 11 and plate 14 and draws the strands of pile groups 12 into the confines of collars 16 to straighten out the loops 13 and consequently release all hooks engaged therewith.

In place of the rotating cam strips 17, expansible pneumatic tubes 23 may be used to displace the plate 14 relative to surface 11 as also shown in FIGS. 4 and 5.

In another embodiment of the invention, illustrated in FIG. 6, the pile groups may be arranged in continuous rows 24 separated by channel elements 25. Guide means (not illustrated) may be provided to assure the perpendicularly parallel displacement of channels 25 relative to surface 11 when forced by the expansion of tubes under the force of pressurized fluid such as air. Such expanded displacement of channels 25 draws the strands of pile strips 24 between opposing faces of channel legs 26 to disengage the loops of said strips from co-operative hooks secured to an opposite surface.

Obviously, many modifications of the present invention are possible in light of the above teachings. Although the described embodiments have been directed toward the loop or Astrakhan pile portion of the hook and loop fastener co-operatives, it should be understood that the description could have just as well been directed to the hook portion of the fastener. It should also be understood that the mutually rigid mating surfaces to which this invention is directed need not be flat or parallel planar surfaces, necessarily. It is sufficient that the mating surfaces share a substantially common topographical contour. Depending on the type of release mechanism employed, the

respective mating surfaces may be surfaces of straight line revolution or warped. Accordingly, the invention may be practiced other than as specifically described.

What is claimed is:

1. Releasable structural fastening means comprising:
a first rigid surface;
a second rigid surface topographically conforming with said first rigid surface;
a multiplicity of resilient, thin strand, hook elements distributed over said first surface and secured thereto at one end;
Astrakhan pile means of resilient fabric secured to said second surface; and,
rows of expansible element, force exerting means secured to one of said surfaces to force said surfaces sufficiently far apart to disengage said hook elements from said pile means when the two are co-operatively engaged.

2. Fastening means as described in claim 1 wherein:
said pile means comprises a multiplicity of curled strands having one end secured to said surface, said strands being arranged in substantially equally distributed groups over said second surface;
structural plate means having apertures distributed over the surface thereof, each of said curled strand groups projecting through respective ones of said apertures; and,
the rows of said force exerting means being disposed between the surface secured ends of said strands and said plate means.

3. Fastening means as described in claim 1 wherein:
said hook elements are arranged in substantially equally distributed groups over said first surface;
structural plate means having apertures distributed over the surface thereof, each of said hook element groups projecting the hooks thereof through respective ones of said apertures; and,
the rows of said force exerting means being disposed between said first surface and said plate means.

4. Apparatus as described by claim 1 wherein groups of said hook elements are distributed over said surfaces in rows; and,
channel means disposed between respective rows of said hook elements, said expansible means being disposed between said surface and said channel means.

5. Apparatus as described by claim 4 wherein said expansible means comprise expansible tubular means adapted to be expanded by pressurized fluid.

6. Apparatus as described by claim 4 wherein said expansible means comprise rotatable cam elements.

7. Apparatus as described by claim 1 wherein groups of said pile means are distributed over said surface in rows; and,
channel means disposed between respective rows of said pile means, said expansible means being disposed between said surface and said channel means.

8. Apparatus as described by claim 7 wherein said expansible means comprise expansible tubular means adapted to be expanded by pressurized fluid.

9. Apparatus as described by claim 7 wherein said expansible means comprise rotatable cam elements.

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U.S. Cl. X.R.

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