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FLUID-TIGHT SLIDE FASTENER
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ABSTRACT OF THE DISCLOSURE

A water-tight slide fastener in which helicoidal or meandering continuous coupling elements have spaced convex heads engaging respective continuous strips of elastomeric material along the other coupling element having outwardly concave portions between the heads and dished sockets complementarily engaging the heads of the other coupling element and resiliently compressible thereby.

My present invention relates to fluid-tight slide-fastener arrangements and, more particularly, to an improved but simplified water-tight slide-fastener construction.

Earlier water-tight slide-fastener arrangements have generally comprised a pair of fluid-impermeable support tapes or bands disposed along opposite edges of the surfaces to be united by the slide fastener and carrying the slide-fastener coupling members in fluid-impermeable connection with the respective support bands. The slide-fastener halves are interfitted by the slider in the usual manner except that a tight seal is obtained between the two halves by rubber sealing strips which are brought together under pressure by the uniting of the slide-fastener halves. Such arrangements, however, involve the use of special slides and special fastener or coupling chains. It will be understood that the term "chain," as used herein, is intended to refer to the coupling members of the slide-fastener halves and such members have hitherto involved spaced-apart metallic or synthetic-resin members adapted to be interleaved between corresponding members of the other slide-fastener half as well as continuous undulating, helical, meandering or wave-like elements, usually of a linear polymeric material (e.g. nylon or other polyamide) whose turns interfit with the turns of a complementary coupling element in a similar manner. Since conventional water-tight slide fasteners require specially designed coupling members, the manufacturing processes for such members to be modified by comparison with the usual manufacturing steps while available coupling members cannot be employed.

It is, therefore, an important object of the present invention to provide a fluid-tight coupling arrangement in the form of a slide fastener which is able to overcome these disadvantages and make use of more or less conventional slide-fastener chains, especially those of the continuous type mentioned above.

A further object of this invention is to provide an improved slide-fastener arrangement which does not require special manufacturing steps for the coupling members and can be readily adapted to substantially any closure pur-

Yet another object of this invention is to provide a relatively inexpensive, compact and effective water-tight slide-fastener closure arrangement.

These objects and other which will become apparent hereinafter are attained, in accordance with the present invention, through the provision of a slide-fastener arrangement which includes a pair of continuously interfitting closure members affixed to and running along respective elongated carrier bands and provide with respective elastomeric masses within the coupling members (preferably substantially encapsulating same) adapted to bear upon portions of the other slide-fastener half upon interconnection of the coupling members. This improvement is particularly applicable to coupling members of the so-called "helicoidal" or meandering type wherein a multiplicity of formations is provided along a strip of filament or a synthetic resin such as nylon. It will be understood that such helicoidal or meandering elements can have various configurations, as is well-known in the art; for example, the turns of the helix may be of elliptical axial projection while the spaced-apart formations may be enlarged or provided with protruberances engageable between adjacent turns of the other coupling member or cooperating with complementary recesses thereof. The coupling members of this invention are formed in the usual manner from a synthetic-resin filament, preferably of the orientable, linear-polymer type, best results being obtained with linear polyamides such as nylon and thermoplastic which, like nylon, can be set in the desired configuration. The coupling members are mounted in a water-tight manner upon respective fluid-impermeable carrying bands or tapes while the elastomeric masses extending continuously along these coupling members are preferably composed of a synthetic-resin-type elastomer.

According to an important feature of this invention, the synthetic-resin masses along each of the coupling members are pocketed between the respective male formations to accommodate the male formations of the other coupling member when the two are drawn together and interfitted by the slider. Thus, these pockets may be constituted as recesses generally in the plane of the coupling member, i.e. a plane parallel to the carrying bands, although it has been found to be highly advantageous to enclose these recesses above and below this plane, i.e. above and below the coupling member, with flange-like portions of the elastomeric material whereby the masses of elastomer have the general configuration, in an open condition of the slide fastener, of a U; the bight portion of the latter forms the pocket for receiving the male parts of the other slide-fastener half but its flanges, corresponding to the shanks of the U; bear against the corresponding flanges or lips of the other elastomeric mass to seal the fastener above and below the interfitting portions of the members.

According to still another feature of this invention, the coupling members can be stitched onto their respective carrying bands or manufactured integrally therewith (e.g. by heat bonding) using one of the methods commonly employed heretofore for the assembly of meandering or helical slide-fasteners halves. Upon such assembly, a mass of elastomeric material is deposited and thereby bonded either to the slide-fastener tape or to the coupling member or, preferably, to both.

A further feature of this invention resides in the provision of means for sealing the assembly in the region of the slider in a closed condition of the assembly. It is common practice to provide the usual slide-fastener slider with a projection extending between the coupling members in order to facilitate the opening and closing thereof and this projection frequently gives rise to fluid penetration in conventional arrangements. I have found that it is possible to substantially completely avoid such leakage by disposing in the region of the slider station, in the closed condition of the device, an elastomeric backing sheet which is affixed to the carrier bands and bears upon the coupling members and the slider at this station with a resilient sealing force. Advantageously, this resiliently compressible backing member is supported further by a rigid link spanning the bands and underlying the backing member to prevent deflection thereof while permitting its resilient compression by the slider as it is displaced to and from this station.

In accordance with another aspect of this invention, the
slide fasteners of the aforedescribed type are produced by an improved process which involves the molding of the elastomeric material, e.g., a foamed thermoplastic, around at least the coupling members by deposition or extrusion of the plastic material around a continuously moving slide-fastener half, it is also possible to roll the thermoplastic material into the coupling members in a continuous manner. The elastomeric material can then be applied to each of the coupling halves separately and only subsequent to setting is the fastener closed. When the elastomeric material is a polystyrene or other thermosetting substance, the setting can be effected prior to the closure of the members. Furthermore, the elastomeric material can be applied to the closed slide-fastener assembly by extrusion or rolling and, after only partial setting, compressed and permitted to set fully so that the elastomeric material will exert a sealing force upon the interfitting portions of the coupling members. In this arrangement, a better fit of the elastomeric material to the male portions of the slide-fastener turns or heads is obtained.

It is also contemplated, in accordance with this invention, to apply the elastomeric material to the individual slide-fastener halves and then close the assembly after a partial setting has been effected, this closure being followed by a rolling step to stress the seal. It has been found advantageous, in this connection, to provide the confronting surfaces of the sealing mass with a parting compound to prevent adhesion of these surfaces when the slide fastener is closed and the assembly is compressed and heated, as indicated earlier. Such a parting compound can be a silicone or the like as is commonly used in the casting industry for preventing adhesion of elastomeric molds to elastomeric materials or other surfaces. It has also been found to be desirable, during the course of the encapsulating process by which the coupling members are embedded in the elastomeric material, to ensure that the carrier bands, if they are of a textile material, the stitching holes and the like do not form fluid passages. Thus, it is contemplated, in accordance with this invention, to immerse the slide-fastener halves in or spray it with a solvent-thinned elastomeric synthetic resin or to apply the thermoplastic material by extrusion across the entire band and connecting means by which the coupling members are joined to the band. Thus, the elastomeric mass can form a monolithic coating for the entire band and the connecting threads and fillets employed to join the coupling members to the band. When the solvent-thinned thermoplastic resin is deposited upon the band provided with the coupling member, it is desirable to provide the spray injection device with a further nozzle opening for dispensing a stream of the thermoplastic material sufficient to completely envelop the connecting threads and fillets and to fill the stitch holes. It is, however, also possible to coat the band and/or the coupling member and then join them together although stitching is, in this case, rendered difficult by the considerable friction coefficient of the elastomeric coating. Thus, I prefer to attach the coupling member to its carrier band with an adhesive or to thermally bond the parts together when they are to be joined after application of the elastomeric material thereto. According to a further feature of this invention, the encapsulating of the coupling member and/or the band or the entire slide-fastener assembly is carried out by extrusion of the material around the assembly, member or band with the aid of an extrusion press whose die is formed in the manner of cable-sheathing dies. Thus, the band, member or assembly can be drawn through the die as the elastomeric material is extruded around them. When the slide fasteners are passed through such an apparatus, in a closed state, the pockets are formed with precisely the configuration of the interfitting heads and, thereafter, the members may be separated and the sealing bodies deformed, as previously indicated, by rollers or the like, to ensure the proper degree of sealing pressure when the assembly is again closed.

It will be understood that this arrangement provides a slide-fastener assembly which is of relatively simple and inexpensive construction and can make use of substantially any conventional coupling members. In practice, it is found that the seal of a nature to permit the device to be used in water tanks, rubber rafts or the like and even under some water pressure. Other practical applications have been in camping equipment (e.g., sleeping bags), rainwear, military equipment and receptacles and protective enclosures of all types.

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a perspective view of a completed slide-fastener assembly according to this invention;

FIG. 2 is a perspective view of a deformed portion of one slide-fastener half in accordance with this invention;

FIG. 3 is a cross-sectional view taken generally along the line III—III of FIG. 1;

FIG. 4 is a cross-sectional view corresponding generally to FIG. 3 but illustrating an embodiment of this invention;

FIG. 5 is a view similar to FIG. 4 of the same open condition.

In FIGS. 1—3, I show a slide-fastener assembly whose carrying bands or tapes 1', 1" of the respective slide-fastener halves each carry a respective helical coupling member 2', 2". The latter interfits as illustrated at 2a to form the closure. The coupling members 2' and 2" are conventionally formed from a linear-polyamide filament by heat setting and are joined to the respective carrying tapes 2' and 2" which can be composed of rubber or rubberized fabric and thus are fluid impermeable or can be made so. Coupling members of this type are well known in the art and, as illustrated in greater detail in FIG. 2, can be provided on the forwardly-extending portions 2a of the respective turns with enlarged heads 4 or coupling surfaces which interfit with the heads of the other slide-fastener half to link the two halves together as the slider 8 is displaced along the coupling members. Between the turns of the coupling members, I provide elastomeric synthetic-resin bodies 3 which are formed with pockets 5 complementary to the forward surfaces of the heads 4 of the other slide-fastener halves so that, in the closed condition of the assembly, the heads 4 are pressed into the resilient masses 3 which fit around and hug these heads to form a fluid-tight seal. Since this other slide-fastener half is likewise formed with such bodies 3 between its turns for fitting engagement with the heads 4 of the first-mentioned slide-fastener half, a seal is guaranteed throughout the length of the closure assembly.

The coupling members 2' and 2" are attached to the respective bands 1', 1" by chain-stitching, fillets or the like as represented generally at 6. At the upper and lower ends of the closure assembly, the slide-fastener heads are joined by endstop members 7a and 7b in the usual manner, these stop members preventing the withdrawal of the slider 8 from the closure assembly.

In order to ensure a fluid-tight seal in the region of the slider, which generally has a projection extending between the coupling members, I have found it to be advantageous to provide an elastic backing member 9 spanning the tapes 1' and 1" and cemented to the underside thereof so as to bear tightly upon the underside of the slider 8 in the region of the position of the slider in the closed condition of the assembly. This backing member 9 is cemented to the bands 1' and 1" at least along the periphery of the cross-sections of the bands but preferably to the zone in which the coupling members 6 are stitched thereto so that the backing member 9 presses as tightly as possible against the underside of the slider 8 and the coupling members 2', 2" in the region thereof.

In order to improve the contact of the backing member 9, which is of sufficiently resilient compressibility to
permit the slider to move along the coupling members 2", 2" even when the backing member is not deflectable thereby, I provide a reinforcing link 10 which supports the backing member 9 in the region of the slider position when the fastener assembly is closed. This rigid link 10 is composed of metal and, as is best illustrated in Fig. 3, can be joined to the backing member 9 and the tapes 1" and 1" by large head hollow rivets of 10" and 10". The stitches 6 securing the coupling members 2" and 2" to the tapes 1" and 1" are coated with elastomeric material 11 which also serves to fill the holes in the tapes produced by the sewing operation and prevent the passage of fluid along the stitches. The elastomeric material 11 can be applied by dipping the band or by strip-application of the material in the liquid state followed by curing or vulcanization of the solvent.

In Figs. 4 and 5, I show a modified slide-fastener arrangement wherein the bands 101", 101" are composed of a fluid-permeable material such as a textile fabric. The helical slide-fastener halves 102", 102" are attached to the strips 101" and 101" with the aid of fillets 115" and 115" extending through the coupling members 102", 102" fixed to the bands 101" and 101" by transverse stitches 116", 116". The synthetic-resin sealing masses 103" and 103" of these coupling members encapsulate the coupling members 102", 102" and are monolithic with respective layers 103a", 103a" completely sheathing the respective bands 101" and 101". The synthetic-resin elastomeric fastener can be formed by spraying a solvent-diluted solution of the synthetic resin onto the assembled slide-fastener halves by extruding the elastomeric mass around the slide-fastener members as indicated earlier.

As can be seen in Fig. 5, the synthetic-resin sealing masses are provided with respective pockets 105", 105" shaped to receive the ends 102a" and 102a" which are provided with heads 104", 104" respectively. Flanking the pockets 105", 105", the sealing strips of elastomer 103", 103" are formed with confronting lips 112", 112" and 112", 112" to bear upon each other in the closed condition of the fastener (Fig. 4). The contact of these lips is effected in the separating plane S under the pressure of the resiliently compressed lips which, therefore, extend beyond the pockets 105", 105" and preferably are coplanar (planes S' and S" of Fig. 5) with the heads 104", 104" in the separated condition of the fastener. When the masses 103" and 103" are extruded onto the slide-fastener halves, with the slide-fastener assembly closed, it is preferred to have the height of the synthetic-resin masses slightly in excess of the final height as represented by the dot-dash lines E', E". This excess height is eliminated when, after partial curing and separating of the slide-fastener halves, the elastomeric masses are compressed by rolling under heat to produce the solid-like configuration of Fig. 5. It is understood that the elastomeric material will bear under pressure against the opposing slide-fastener head. Advantageously, the rear sides 117" of the coupling members are left free from the elastomeric material to provide guides for the slider.

The invention described and illustrated is believed to admit of many modifications within the ability of person skilled in the art, all such modifications being considered within the spirit and scope of the appended claims.

Claim 1.

1. A fluid-tight slide fastener comprising:
a pair of carrier bands having juxtaposed edges;
a pair of elongated coupling members respectively affixed to said bands along said edges and matingly interfittable along their length for joining said bands together;
a respective strip of elastomeric material at least partly received within each of said coupling members and provided with pockets complementary to interfitting portions of the other coupling members and resiliently compressible by said interfitting portions upon connection of said coupling members so as to bear sealingly upon the other coupling member, each of said coupling members being a continuous member formed with longitudinally spaced heads forming said interfitting portions, said strips of elastomeric material being respectively continuous and formed with said pockets between the heads of the respective coupling members;

stitching means for connecting each of said coupling members to the respective band;
a layer of said elastomeric material covering said stitching means;
and a slider movable along said coupling members for engaging and disengaging them with respect to one another.

2. An assembly as defined in claim 1 wherein each of said strips is provided with a pair of lips of said elastomeric material extending in the direction of the other of said strips and aligned with the lips thereof for compression thereagainst upon interengagement of said coupling members.

3. An assembly as defined in claim 1 which is provided with a slider station at an end of said assembly in a closed condition thereof, said assembly further comprising a resiliently compressing backing member along an underside of said bands and bridging same at said station for bearing upon said coupling members and said slider and sealing said slider at said station, and a rigid member underlying said backing member for limiting deflection thereof upon movement of said slider.

4. A fluid-tight slide-fastener assembly comprising:
a pair of carrier bands having juxtaposed edges;
a pair of elongated continuous openwork coupling members respectively affixed to said bands along said edges and having spaced convex heads matingly interfittable along their length for joining their bands together;
a respective continuous strip of elastomeric material extending along and at least partly received within each of said coupling members and provided with outwardly concave portions between the respective heads and within the respective coupling member forming dished sockets complementary to interfitting portions of the other coupling member and resiliently compressible by the convex heads of the other coupling member upon connection of said coupling members whereby said sockets bear sealingly upon and are in surface contact with said heads;
and a slider movable along said coupling members for engaging and disengaging them with respect to one another.

5. An assembly as defined in claim 4, further comprising stitching means for connecting each of said coupling members to the respective band, and a layer of said elastomeric material covering said stitching means.

6. An assembly as defined in claim 5 wherein each of said strips is provided with a pair of lips of said elastomeric material extending in the direction of the other of said strips and aligned with the lips thereof for compression thereagainst upon interengagement of said coupling members, and a respective core extending through each of said members and wholly embedded in said elastomeric material.

7. An assembly as defined in claim 5 which is provided with a slider station at an end of said assembly in a closed condition thereof, said assembly further comprising a resiliently compressing backing member along an underside of said bands and bridging same at said station for bearing upon said coupling members and said slider and sealing said slider at said station, and a rigid member underlying said backing member for limiting deflection thereof upon movement of said slider.

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