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(54) Entrance and egress system for protective shelters and garments.

(57) A method and apparatus is provided for attaching and detaching two panels (10A & 10B), each of which has an opening defined by mating parts of a continuous flexible fastener strip. The panels may be part of protective enclosures, one of which can be portable (a garment or a mobile unit), and which afford a protective environment to persons or things therewithin. A first opening is formed in one panel and a second opening in the other panel, the openings being co-extensive when in abutting position. Primary fasteners, such as zippers (12A & 12B), are attached to each of the openings for repeated opening and closing thereof. Secondary covering fasteners, including flaps (14A & 14B) with fabric hook-latch material, located on the exterior of the panels surround and cover the primary fasteners. The fasteners interengage to fasten the panels together with the openings aligned, thus forming a passage between the interiors of said enclosures.

FIG-2

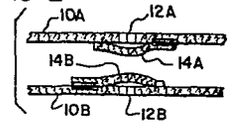


FIG-3

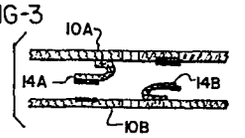


FIG-4

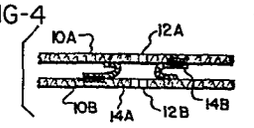
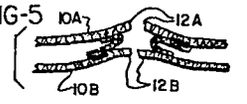


FIG-5



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ENTRANCE AND EGRESS SYSTEM FOR PROTECTIVE SHELTERS AND GARMENTS

This invention relates to the rapid and safe movement of encapsulated individuals and/or materials into and out from protective structures. Encapsulation may consist, for example, of protective garments for personnel or suitable wrappings for packages. Protective structures may consist, for example, of military collective protective systems designed to protect troops from chemical warfare attacks, buildings, aircraft, spacecraft, or even an individual protective garment. Historically, everyone concerned with collective protective structures is aware of the major logistic problems in moving people and objects in and out of shelters.

Within the scope of personnel protection against a chemically contaminated environment, such as would result from a chemical warfare attack, individual protection receives a high priority. The encapsulation of personnel in a protective garment with a face mask, respiration system, etc., is very effective. However, the garment and respiration system can produce physiological and thermal stresses in combination with limited filter capacity, thereby severely limiting and restricting the effective wear duration. In order to control and limit the wear cycle for individual protection garments in the contaminated environment increasing emphasis has been placed on collective protection shelters for longer terms.

A presently accepted method to be reasonably sure the contamination will not get into such a collective main shelter is by requiring that all entry and egress of personnel be made via an airlock system. The airlock concept requires a minimum of two doorways and a separate intermediate compartment, sufficiently large to accommodate such functions as decontamination, undressing, and storage of contaminated garments. The airlock concept also greatly increases the demand for filtered air for ventilating and purging of the airlock compartment. This additional requirement results in a major increase in the size and cost of the air purification equipment necessary to operate the collective protection system.

It is generally agreed that one of the major problems associated with present collective protection structures is the logistics of rapid and safe entry of personnel or movement of equipment or stores into shelters when exposed to chemical agents. Typically a large time interval (10 to 15 minutes) is now required per person to execute safely and completely the entry procedures for a shelter equipped with a conventional positive pressure airlock system.

A number of patents have issued on special suits or systems that disclose variations on the airlock concept. Among these are U. S. Patents Nos. 4,302,848; 3,355,230; 2,813,022; 3,744,055; 3,439,966; 3,501,213; 3,670,718; 3,802,416 and British 1,000,674. However none of this prior art offers a simple, re-usable, direct and rapid entry/egress system.

In connection with the foregoing, the conventional zipper fastener used in a variety of clothing articles and other products has evolved into a number of fastener systems. One line of development is exemplified by U.S. patents 3,990,130, 4,308,644, 4,275,467, and 3,924,305 in which air or water tightness had been the objective. Extra flaps of material are used many times to obtain such a fluid tight seal. Others have used the extra flaps in a more aesthetic manner, such as to conceal the zipper teeth and slide mechanism. In addition, these extra flaps can be used for protective means. Boots, jackets, gloves, pants, etc. employ these various ideas to protect an inner environment (e.g., a person's body) from the external elements.

Another development of the basic zipper concept is set forth in U.S. Patent 2,229,216, where a pair of slides are joined into a component to allow for a double-sealing mechanism of extra strength and durability. This type of double slide component has been employed in articles that use a removable interior liner of some sort, or that require extra strength in the fastener system.

The present invention encompasses a new approach, a single-stage rapid entry and egress system. This system uses a novel air-lockless concept to replace the conventional airlock system now used in conjunction with collective protection shelters, and enables a person or package equipped

with a suitably designed protective garment (or wrapping) to complete the entry process, and also provides for multiple entries and exits to occur simultaneously, while reducing significantly the time required for this operation. This is so because several airlock procedural stages can be eliminated or reduced; such items include decontamination and special storage of the outer garments, purging time for the airlock compartment and body or package decontamination. The simplified approach of the present invention in some respects reduces the entry procedures to a two-dimensional operation from a three-dimensional one, because the entry process only involves the interface between the mating outer surfaces of both the protective garment and the protective shelter.

The objective of the invention is to "skin" the individual (package) from his (its) protective outer garment (wrapping) and immediately and safely transfer him inside the collective protection shelter, leaving his (its) contaminated garment (wrapping) on the outside. To accomplish this transfer, mating normally closed and covered openings are provided on the garment and on the shelter entrance wall. When mated and each opened, the pair comprises a single opening which provides free transfer from one contamination-free space to the other. Hereinafter, the words "individual", "personnel" and "garments" are intended to include in their meaning "packages" and "wrappings".

The invention utilizes a combination of mating primary fasteners, such as zippers, and as

may be necessary flaps with additional or secondary fasteners, such as fabric hook-latch types, located on both the exterior of the shelter entrance wall and the outer protective personnel garment, to cover the primary fasteners as needed. These features enable the individual to secure (or have secured) his outer garment to the exterior of the shelter entrance and also provide a seal for the passageway between the interior area of both the garment and the collective protective shelter compartment, thereby excluding any contamination from the outside environment. Once the attachment is accomplished, the garment and compartment primary fasteners, now located within the sealed non-contaminated interior area surrounded by the attached flaps, can be opened in sequence by the person from inside his garment (or from inside the shelter).

This invention also relates to fastener systems themselves, more specifically to those which employ a compatible pair of fasteners. Using a pair of compatible zipper type fasteners, the invention simultaneously joins or separates two panels, each of which is provided with an opening controlled by one of the fasteners. A slider according to the invention combines the pair of fasteners in such a manner that while the fastener pairs are being opened at one end of the slider, opposite adjacent members of those pairs are being joined together at the opposite end. To achieve this, the slide member embraces both fasteners and disconnects the zipper tape pairs in the conventional manner, but then the tape members are twisted or rotated 90° before

reattachment. The 90° rotation causes each tape member from one pair to be aligned with a mating tape member from the other pair, to which it is then joined.

The sequence of events to accomplish the rapid entry process is thus: (1) approach the shelter entrance, (2) secure garment to the entrance, (3) step into the shelter, (or transfer package into the shelter) and (4) leave the outer garment stored on the outside for reuse.

For personnel entry/exit the garment may be designed with the opening extending from the shoulder to approximately the knee, and boot clamps and a mask hook may be provided on the exterior of the shelter compartment to help secure the outer garments to the ouside of the shelter wall. These features also guide the individual mating surfaces of the secondary fasteners to proper alignment and aid the individual in stepping out of the protective garment. Several other designs have been considered to accomplish entry under special circumstances, but for brevity will not be described here.

Once inside the shelter compartment the individual protective garment is temporarily a part of the shelter outside wall. The inside of both the garment and collective shelter are respectively sealed from the contaminated or non-life sustaining environment as previously described. The sealing effectiveness can be enhanced by positive pressure maintained within the shelter; any airflow (leakage) is thereby from the inside to the outside of the shelter and garment. Only interior garment surfaces

would be exposed to the interior structure wall area, thereby precluding transfer of contamination.

After entering the collective protection shelter, both interior or primary zipper fasteners can (but need not) be closed, while the garment remains on the exterior of the collective protection structure. After protected functions in the shelter are completed (e.g. eating, bodily functions, sleeping, etc.), the individual can reopen both interior zippers, reenter his garment, close zippers, and separate himself from the collective protection structure while closing the flaps and secondary fasteners, to safely continue his duties in the exterior contaminated environment. A single collective protection compartment can be equipped with several entrance systems, for example with the total equal to the number of personnel it is intended to protect at any one time. The invention thus does not restrict the number of personnel entering or leaving the shelter at any one time, and effectively provides a parallel entry/egress system rather than an essentially serial system.

Numerous applications of the basic concept for transferring personnel and equipment from one protected area to another include, entry and egress to military ground vehicles, amphibious vehicles, boats, aircraft and onboard ships. Other applications are casualty handling in the field, and providing for food, drink, and personal hygiene requirements to people in protective garments. The protection afforded by the shelter compartments and/or garments can be against gaseous or liquid

agents, or radiation, excessive heat or cold, harmful to humans, or with respect to an environment which is simply non-supportive of human life.

Thus, the object of the invention is to provide a system and method for safe passage between a pair of protective enclosures, at least one of which is portable, such as a garment, wrapping (cover), or mobile unit, and which afford a protective environment to persons or items therewithin, said enclosures each comprising an eveloping structure and being adapted to be brought in position such that the panels abut, a means defining openings in the panels dimensioned and arranged to be co-extensive (or jointly removed) when the panels are in abutting position, primary fasteners such as zippers attached to each of the openings for repeated opening and closing thereof, and as needed secondary fasteners including flaps with hook-latch fabric or the like on the exterior of each of the panels surrounding and totally covering the primary fasteners means, the secondary fasteners being cooperative when opened to interengage and to fasten the panels together with the openings aligned permitting controlled opening of the primary fasteners and thus forming a passage between the interiors of the enclosures; to provide a method and apparatus for attaching and detaching two panels, each panel being provided with an opening and the sides of said openings including mating parts of a continuous flexible fastener strip, wherein a slide member having four separate passages is constructed and arranged to bring the

fastener strips into contiguous relation, with the mating parts arranged such that one part of each fastener strip is capable of mating with an opposite part of the other fastener strip, by simultaneously and progressively separating the mating parts of the fastener strips and joining the parts with opposite parts of the other fastener strip in response to movement of the slide member along the fastener strips with the strips engaged in passages of the slide member;to provide such a system wherein the portable enclosure is a wrapping for package or equipment or a garment to be worn by a person and the opening in the wrapping or garment is of a size sufficient to accommodate passage of the package or person; to provide such a system wherein the other enclosure may be a pouch or wrapping containing protected items such as tools or nourishment, or for disposal of waste, or another garment into which the person can transfer; to provide such a system wherein the other enclosure is a compartment into which the person or items can transfer, such compartment having one or more openings each adapted for connection to a protective wrapping or garment, and optionally including hanger means on the exterior of the compartment adjacent each of said openings for retaining a garment or wrapping in position with the panels connected while the wrapping or garment is vacant.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:-

Fig. 1 is a perspective view of one panel with the secondary fastener flap open;

Figs. 2 - 5 are diagrammatic partial cross-section views showing the sequence of opening the secondary fasteners and mating them, then opening the primary fasteners to form a passage;

Figs. 6 and 7 are perspective views of the joined panels with the passage closed and open;

Fig. 8 is a drawing of a shelter compartment and several garments, also showing a person exiting a garment into the compartment;

Fig. 9 shows a person within one of the garments using a pouch to obtain nourishment;

Figs. 10 and 11 show a mobile compartment interacting with a garment and with a stationary compartment to pick up and transport disabled personnel;

Figs. 12 and 13 are perspective views of a package being transferred from its wrapping into a protective compartment and illustrates one of several "zipper" configurations useful for equipment transfer.

Fig. 14 is an exploded view of the slide member with a pair of cross-sectional separations illustrating the pathways of the channels;

Fig. 15 is a perspective view of the slide member;

Fig. 16 is the same embodiment as shown in Fig. 5, with zipper tape members inserted;

Fig. 17 is another embodiment of the slider, divided into a separate secondary slide and a main slide;

Figs. 18-21 illustrate in sequence the embodiment in Fig. 17, with Fig. 18 particularly showing the female zipper terminals affixed on the zipper tape members, Fig. 19 showing the affixed male zipper terminals, Fig. 20 showing the secondary slide inserted into the main slide, and Fig. 21 illustrating the secondary and main slides after partial advancement of the tape members through the embodiment; and

Fig. 22 is an exploded perspective view of another embodiment of slider.

Referring to Figs. 1 - 7 of the drawings, which illustrate a preferred embodiment of the essential features of the invention, Fig. 1 shows a segment of a panel 10 of a flexible material, in which an elongated slit-like opening is formed, closed by a primary fastener 12 which is illustrated schematically as a zipper, and which may have tabs on both sides for operation from either side of the panel. Fastened to the panel 12, along one side of the zipper, is a flap 14 which is sealed to the surface of the panel 10 along a line which also defines the hinge of the flap 14.

The flap is sufficient in dimension to be folded completely over and beyond the zipper, and the face of the flap which folds toward the panel surface, along with the surface of the panel surrounding the zipper, and onto which the free

edges of the flap engage, are provided with a secondary fastener which is indicated by reference numerals 15a and 15b, being the complementary parts of a secondary fastener means which may be, for example, a hook-latch type of fastener such as disclosed in U. S. Patent No. 2,717,437 issued to Velcro S. A. This type of fastener device is per se well known. It should be noted that the flap, together with the secondary fastener 15a - 15b, provides a secondary fastener means that covers the slit-like opening in the panel and totally surrounds the primary fastener means or zipper 12. Thus, if the exterior of the panel 10 is exposed to a contaminated environment, the flap 14 totally covers and protects the primary fastener means and the surrounding region covered by the closed flap.

In accordance with the invention two complementary devices such as above described, and shown in Fig. 1, are provided on a pair of protective enclosures, at least one of which is portable and may be a garment or suit, a package, or or a panel on an enclosed vehicle. Figs. 2 - 5 illustrate the sequence of mating the panels of the two enclosures in order to form quickly a passageway between the enclosures. Thus, in Fig. 2 the upper panel 10A is shown with its flap 14A closed and its primary zipper fastener 12A closed, while a complementary device including a panel portion or section 10B having a closed primary zipper fastener 12B, and a closed secondary fastener means including flap 14B, is brought into essentially face-to-face relationship with the panel section 10A.

In Fig. 3, the flaps 14A and 14B are opened. It will be noted that at this time the fastener means on the two panels are arranged in complementary fashion; that is, the hook material on the flap, for example, is aligned with the latch material on the surface of the opposite panel section. These are pressed together, as shown in Fig. 4, thereby providing a rather narrow elongated and totally surrounded protective area 17 as shown in Fig. 4, with the primary fastener zippers still closed. In the event that the few moments of opening the two flaps might allow some contaminate to enter the region beneath the flaps and around the zippers, a decontaminate agent can be introduced by, for example, having a suitable decontaminate available within this region in a frangible capsule or the like, should this precaution be necessary.

With the two panels attached by way of the flaps 14A and 14B, the primary fasteners or zippers can now be opened, as shown in Fig. 5, resulting in a direct passageway or opening between the two enclosures of which the panels 10A and 10B form a part. Fig. 6 is a perspective view which illustrates the attachment of the two panel sections as viewed from the inside of one of the enclosures with the primary fastener or zipper closed, and Fig. 7 shows this arrangement with the zippers open and the opening flexed apart, thereby providing a passage between the two enclosures which can be distended as necessary to accommodate movement of material and/or personnel through the resultant controlled opening.

Fig. 8 illustrates one typical application of the invention wherein personnel are provided with protective garments or suits 20A, 20B, 20C and 20D, each of which includes a helmet portion with a visor, a flap-sealed main opening 22, optional additional smaller flap-sealed openings 23 and 24, together with arms and legs, gloves, and foot coverings (boots) which totally envelop the wearer. A retainer loop 26 may be attached to the top of the helmet part, or other appropriate location on the garment for use as later described. In the illustration, the four garment enclosures provide protection for four persons while they function within the environment outside a protective shelter 30 which includes a panel having appropriate openings 22A that are flap covered and closed, as previously shown and described. The shelter 30 can be a small protective collective enclosure or a vestibule leading into a larger safe shelter. Above each opening, as above 22A, or at other appropriate location surrounding openings 22A, there is provided a hook 32 which can be interengaged with the loop 26 on the garment, and inverted guides 33 are provided at the base of the shelter 30 below opening 22A, adapted to receive the two portions of the boot parts of the garments.

In Fig. 8 the four garments 20A -- 20D are shown in different stages of use, the person in garment 20A being independent of the shelter 30 and approaching the closed flap-covered opening 22A. The person in garment 20B is shown attaching the hook to the loop on the helmet part of the garment

with the boot parts inserted into the guides 33. Subsequent to this step, the person opens the secondary fastening means (such as flaps 14A and 14B which correspond to the flaps on openings 22 and 22A) and after pressing the flaps together to seal them to the opposite panels, and decontaminating the region undercovered by the flaps if necessary, the person can then open the primary zipper fasteners in the garment, then open the zipper fastener in the panel of the shelter, and step through the resultant open passageway to the interior of the shelter as shown in dotted lines with the garment 20C. The garment (such as 20D) is then left attached to the exterior of the shelter, hanging in position, preferably with the primary or zipper fasteners closed, available for further use by the same or other personnel.

Fig. 9 illustrates another application of the invention, wherein nourishment such as a beverage is provided totally enclosed within a protective pouch 40 having a smaller flap-covered and sealed opening corresponding to the smaller opening 23 on the garment. The wearer of the garment can pick up the pouch, attach the flaps, open the zippers, and then reach into the pouch and withdraw the container, and when finished drinking (or eating) dispose of the resultant waste in like manner by reversing the process. The flap covered openings 24 in the garments may be utilized in similar fashion to provide for elimination of body waste. Fig. 9 also illustrates an optional sleeve expansion zipper 27 which when opened provides

adequate fabric under the arm to permit extraction of the arm from the sleeve to operate zippers 22, 23 or 24 from inside of the uniform, but when closed permits reasonably form fitting apparel that is appropriate for unrestricted activity.

Fig. 10 and Fig. 11 illustrate a further application of the invention in connection with the retrieval of ill or injured personnel from the non-life sustaining environment where they are enclosed within a protective garment, but unable to attach their garment to a more permanent shelter in the manner previously described. In Fig. 10 a sealed ambulance or retrieval vehicle 50 is shown having a rear compartment 52 provided with panels which contain the same form of flap covered zippered contolled openings. The compartment is attached to the main body of the vehicle by a sealed bellows structure 53, and the compartment may be moved vertically through power operated lift mechanism shown schematically at 54.

In the example shown in Fig. 10 the compartment 52 has a back panel 56 with an opening 57 and a bottom panel 58 with a controlled opening 59 which is shown open, attached to a garment from which an injured person is being removed by attendants operating within the safety of the compartment 52. A further immobilized person is shown lying on the ground with his protective garment in place. With the assistance of a person outside the vehicle in a protective garment, should this assistance be necessary, the attendants can direct the movement of the vehicle such that the

compartment 52 is located over the immobilized person outside, then the compartment can be lowered and the opening 58 aligned with the closed opening on the garment of the immobilized person. The sequence of Figs. 2 - 5 is then followed to allow the person to be pulled within the shelter of the compartment 52, and placed within the body of the vehicle 50, on a stretcher if necessary. The bottom panel 58 may be provided with integral arm and glove attachments (not shown) to enable personnel within compartment 52 to manipulate the fasteners as necessary to perform this task.

Fig. 11 illustrates use of the same vehicle and compartment, having been brought into face-to-face relation with a shelter 60 which may be the vestibule to a field hospital. The opening 57 on the back of the compartment 52 has been mated with a like opening in a side wall panel of the shelter 60. The attendants can then remove the personnel which have been collected from the field, on stretchers if necessary as shown, through the resultant opening into the safe and life-sustaining interior of the shelter 60.

It will be appreciated by those skilled in the art that many additional uses of the invention are available. Personnel can change from one garment to another, or exchange food, tools, and other items using the aforementioned pouches.

Referring to Figs. 12 and 13, another form of the invention is shown in connection with a shelter compartment 70, the near wall of which is broken away to reveal in an end wall 72 a panel 74

which is surrounded on three sides by a two stage fastener 75, as previously described, the panel 74 remaining connected along its bottom to the larger wall 72 of the compartment. Outside the compartment 72 there is a rectangular box-shaped cover or wrapping 76 which has a like panel 77 surrounded by a two stage fastener 78 of the same outline configuration as the fastener 75.

The wrapping 76 is brought into contact with the compartment wall 72, the primary and secondary fasteners are open, and the panels 74 and 77 can be drawn into the compartment 72, providing an opening through which a container or other item 80 can be brought into the compartment or moved out of the compartment and secured within the wrapping 76. It is also possible, should there be a need to do so, to provide the primary and secondary fasteners on each of the fastener members 75 and 78 with a fourth side and to provide releaseable slides on the primary zipper fasteners. With such an arrangement the panels 74 and 77 can be completely removed if desired.

Figs. 14 -22 show embodiments of fasteners having complementary mating parts which can be engaged to interconnect them without exposing any enclosed volumes to the external environment. For ease in understanding, the embodiment in Fig.14 is shown as a multi-piece member, but it is understood that it is integrated as a single component. To assist in its description, the slide member120 of the fastener system will be examined as three segments.

The first segment 125 receives two joined tape member pairs through contiguous channels 121 and 122 and contiguous channels 123 and 124. The first segment 125 is of conventional design as described in U. S. Patent 2,229,216 in which the contiguous channels 121-124 diverge at the exit end of the first segment.

In the second segment 130 of the slide member each of the four channels 121-124 is twisted approximately 90° in a helical fashion about a vertical axis thus realigning the tape members into new pairs for entry into the third segment.

The third segment 135 of the slide member is basically identical in structure with the first segment. The orientation of the third segment though is different, having been rotated 180° about a horizontal axis and 90° about a vertical axis with respect to the first segment's position. Due to this orientation, the third segment will join the individual tape members into new pairs as described later. The channels merge as 121 and 123, 122 and 124, in the third segment guiding the tape members together. At the exit end of the third segment 135, channels 121 and 123 are now contiguous, as are channels 122 and 124.

Fig. 15 is a perspective view of the integrated component described as three separate segments in Fig. 14. The channels 121, 122, 123, 124 are clearly illustrated in this view depicting the path of the tape members through the slide member. In Fig. 16 the pairs of fasteners, which each comprise two tape members (111, 112 and 113, 114

respectively) and compatible interlocking parts 115, are inserted into the slide member embodiment previously described in Figs. 14 and 15. The tape members are joined by the interlocking parts, here exemplified by zipper teeth although it is understood that the interlocking parts can be of many types. These tape members are paired 111 with 112 and 113 with 114 before entry into the slide member 120. As the slide member moves upward relative to the tape member pairs, as designated by the arrow, the tape pairs 111, 112 and 113, 114 are disconnected as a result of the diverging channels. Midway through the slide member the tape members are no longer connected pairs but instead are four separate members in the process of being twisted or rotated, yet all the tape members are captured and protected from the external environment. The 90° twist of the separate members results in new pairs; the new arrangement pairs tape 111 with 113 and tape 112 with 114. Finally as the channels merge forming contiguous pairs, the interlocking parts 115 of the tape members engage to join the tape pairs as just described.

Another embodiment is set forth in Fig. 17. Its design and operation is similar to that in Fig. 15 but the slide member involves two separate sections, the secondary tab or slide 140 and the main tab or slide 145, rather than a single integrated piece. Since the embodiment is similar to that described in Figs. 14-16, like numbers with a prime notation are applied to like parts.

This configuration allows application of the fasteners to other practical situations, wherein two panels can remain abutted against one another at will and yet allow for at least one to be independent and mobile. When the panels are detached, the secondary slide 140 is used as a regular zipper slide, so the fastener tapes which it controls can be opened and closed in conventional fashion. Similarly, the primary slide 145 also can be used as a conventional slide to open and close the fastener on the panel with which it remains; see Figs. 18 and 19. The parts of channels 123' and 124' in the primary and secondary slides are designed to match and, along with channels 121' and 122', receive tape members from a second panel and guide them through the tabs. Without tape members in channels 122' and 124' however the primary slide simply opens and closes the fastener. When the panels are attached (see Figs. 18 - 21) the channels 121', 122', 123', and 124' in the combined slide perform the 90° rotation of the tape members to form new tape pairs.

It is of course possible to have a third independent slide component or tab (not shown) comparable to the secondary slide 140, but at the opposite end of the main slide 145. The two secondary slides can function to provide independent control of each fastener, and greater flexibility can be achieved, as might be desired in a topological game or puzzle.

Figs. 18-21 illustrate the mechanics of the embodiment illustrated in Fig. 17. Tape members

111' and 112' joined by interlocking parts 115' are shown inserted in the main slide 145 with female end terminals 150 and 151 protruding from channels 121' and 122' at the bottom of Fig. 18. Similarly in Fig. 19, tape members 113' and 114' are shown inserted in the secondary slide 140 with flexible male zipper terminals 155, 156 extending below channels 123' and 124'. The male terminals are designed for insertion into the main parts of channels 123' and 124' in the main slide and are of small enough diameter and sufficient flexibility to pass easily through the channels. Fig. 20 shows the connection that occurs once the male terminals 155, 156 pass through the main slide channels and insert into the female terminals 150, 151. Once connected in this manner the combination main slide and secondary slide perform just like the embodiment of Figs. 14-16. The realigning of the pairs is further illustrated in Fig. 21 which shows the reversal of the connections of the tape members. In this embodiment it is sometimes desirable to provide a locking device (not shown) joining the main and secondary slides 145 and 140, to prevent their inadvertent separation and resultant exposure of enclosed volumes to the exterior environment.

Fig. 22 illustrates another embodiment of the invention in which the central portions of the main slides 120 or 145 are constructed as a shell comprising two identical end pieces 160 attached to and separated by four identical pieces side 162 (two inverted).

The end pieces 160 are rotated 90° with respect to each other, and each contain channels 121", 122" and 123", 124" for receiving the fastener tapes. These channels can be lengthened and merged, as in Fig. 15, if desired. The end pieces have a ledge 163 which receives the ends of the side pieces 162, and all of these are united, for example with a suitable adhesive. Such a construction has certain cost advantages from a manufacturing cost standpoint, as will be clear to those skilled in this art.

CLAIMS

1. Apparatus for attaching and detaching and providing passage between a pair of panels such as wall members of protective enclosures at least one of which is portable, and which may afford a protective environment to persons or items therewithin,

said enclosures each comprising an enveloping structure having at least one panel (10A, 10B, or 112, 114), said enclosures being adapted to be brought in position such that said panels abut,

means defining a first opening in one of said panels and a second opening in the other panel, said openings being dimensioned and arranged to be co-extensive when said panels are in abutting position,

fastener means (12A & 12B, or 115) attached to each of said openings and adapted for repeated opening and closing thereof and including fastener flaps (14A & 14B) on the exterior of each of said panels surrounding and totally covering said fastener means,

said flaps and fastener means being cooperative when opened to interengage and to fasten said panels together with said first and second openings aligned and thus forming a passage between the interiors of said enclosures.

2. A system as defined in claim 1, wherein the portable enclosure is a garment (20A) to be worn by a person.

3. A system as defined in claim 2, wherein the opening (22) in the garment extends across the front thereof and is of a size sufficient to accommodate passage of the person.

4. A system as defined in claim 2 or 3, wherein the other enclosure is also a garment into which the person can transfer.

5. A system as defined in claim 2 or 3, wherein the other enclosure is a compartment (30) into which the person can transfer.

6. A system as defined in claim 5, said compartment having a plurality of openings (22A) each adapted for connection to a protective garment.

7. A system as defined in claims 5 or 6, including hanger means (32) on the exterior of said compartment adjacent each of said openings for retaining a garment (20A) in position with said panels connected while the person vacates the garment.

8. Apparatus as defined in any preceding claim, for attaching and detaching two flexible panels, the sides of said openings including mating parts of a continuous flexible fastener strip, and

an elongated slide member (120) having four generally elongated passages (121, 122, 123, 124) including merging parts of said passages at

one end of said slide member adapted to receive said parts of said fastner strips, said passages separating in the central part of said slide member and having parts merging different ones of said passages at the other end of said slide member to bring said fastener strips (115) into contiguous relation with the mating parts arranged such that one part of each fastener strip is mated with an opposite part of the other fastener strip by moving said slide member along said strips simultaneously and progressively separating the mating parts of the fastener strips and joining the parts with opposite parts of the other fastener strip,

whereby joining and/or separating the edges of the two openings is accomplished to form and/or close a distendable passage through the panels, said passage being defined by the parts of the two joined fastener strips.

9. Apparatus as defined in claim 8, wherein said slide member includes a separable secondary slide (140) cooperable with one of said fastener strips and capable of joining with the main slide member (145) to assist in transfer of the fastener parts, and of operating on the parts of one fastener strip independently of the main slide member.

10. Apparatus for providing safe passage between a pair of protective enclosures (20A & 30) as defined in claim 1,

said enclosures each comprising a totally enveloping structure having at least one flexible panel, said enclosures being adapted to be brought in position such that said panels abut,

a first fastener means (12A) attached to said first opening and adapted for repeated opening and closing thereof.

second fastener means (14A) on the exterior of said one panel surrounding and totally covering said first fastener means,

a third fastener means (12B) attached to said second opening and adapted for repeated opening and closing thereof,

a fourth fastener means (14B) on the exterior of said other panel totally covering said second opening and cooperative with said second fastener means to fasten said panels together with said first and second openings aligned to permit controlled opening of said first and third fastener means and thus forming a passage between the interiors of said enclosures.

11. A fastener system for connecting and disconnecting a pair of panels as set forth in claim 1, comprising:

first (111), second (112), third (113), and fourth (114) tape members wherein said first and second tape members can interlock to form one fastener pair (111, 112) adapted to be attached to one of said panels and said third and fourth tape members can interlock to form a second fastener

pair (113, 114) adapted to be attached to the other of said panels,

interlocking parts (115) associated with each pair of tape members such that one tape member of each pair is compatible for connection with any opposite tape member of the other pair,

an elongated slide member (120) having opposed ends and also having first (121), second (122), third (123), and fourth (124) channels extending therethrough from one end to the other to receive and guide said tape members and their associated interlocking parts through joining and separating movements,

said first and second channels (121, 122) having merging portions at one end of said slide member wherein said interlocking parts of the first and second tape members (111, 112) are disengaged upon entry into that end of the slide member to separate said first and second tape members, or wherein said interlocking parts are engaged upon exiting said one end of the slide member to join said first and second tape members,

said third and fourth channels (123, 124) having merging portions at said one end of said slide member wherein said interlocking parts of the third and fourth tape members (113, 114) are disengaged upon entry into that end of the slide member to separate said third and fourth tape members, or wherein said interlocking parts are engaged upon exiting said one end of the slide member to join said third and fourth tape members,

said four channels having separated central portions in said slide member for guiding all four of said tape members in spaced relation,

said first and third 121, 123 channels having merging portions at the other end of said slide member wherein said interlocking parts of said first and third tape members 111, 113 are disengaged upon entry into the other end of the slide member to separate said first and third tape members, or wherein said interlocking parts are engaged upon exiting the other end of the slide member to join said first and third tape members,

said second and fourth channels (122, 124) having merging portions at the other end of said slide member wherein said interlocking parts of said second and fourth tape members (112, 114) are disengaged upon entry into the other end of the slide member to separate said second and fourth tape members, or wherein said interlocking parts are engaged upon exiting the other end of the slide member to join said second and fourth tape members.

12. A fastener system as defined in claim 11, wherein said slide member comprises a main slide (145) and a secondary slide (140) detachable from said main slide,

said secondary slide having first and second merging channels (123', 124') capable of mating with said main slide along the central portions of its first and second channels and

merging at one end of said secondary slide for joining and separating said first and second tape members,

first and second male terminals (155, 156) attached to an end of said third and fourth tape members, and

first and second female terminals (150, 151) attached to an end of said first and second tape members and of small enough diameter to pass through said first and second channels of said main slide and engage with said first and second female terminals respectively.

13. A method of providing safe passage between a pair of protective enclosures, at least one of which may be portable, and which afford a protective environment to persons or items therewithin, said enclosures each comprising an enveloping structure having at least one panel with an opening therein, said openings being dimensioned and arranged to be co-extensive when said panels are in abutting position and being controlled by fastener means attached to each of said openings and adapted for repeated opening and closing hereof, said fastener means including flaps on the exterior of each of said panels surrounding and covering said fastener means; the steps comprising

bringing the flaps on one of the panels into abutting relation with the flaps on the other panel and interlocking the two fastener means to

provide a connection between the panels surrounding the fastener means while

opening the fastener means to form a passageway between the enclosures which is surrounded and sealed by the interengaged fastener means.

14. The method of attaching and detaching two flexible panels, each of which is provided with an opening, the sides of which include mating parts of a continuous flexible fastener strip, comprising the steps of

bringing the fastener strips into contiguous relation with the mating parts arranged such that one part of each fastener strip is capable of mating with an opposite part of the other fastener strip,

thereby joining and/or separating the edges of the two openings and forming and/or closing a distendable passage through the panels which is defined and enclosed by the parts of the two joined fastener strips.

15. The method of claim 14, wherein the mating parts of the fastener strips are twisted through approximately 90° in the step of separating them and joining them to a part of the other strip.

FIG-1

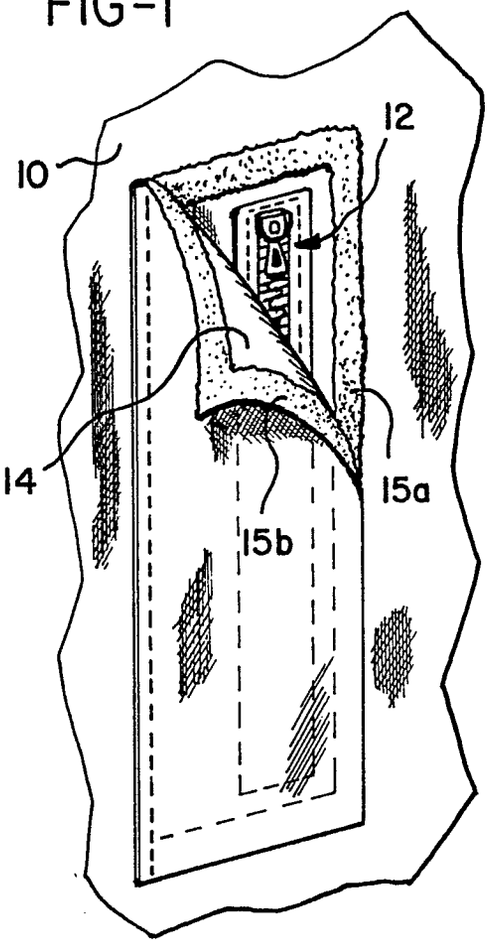


FIG-2

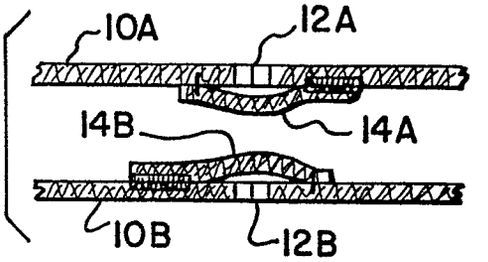


FIG-3

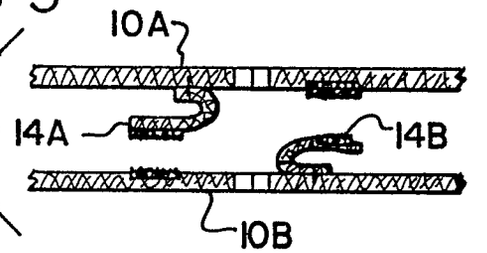


FIG-4

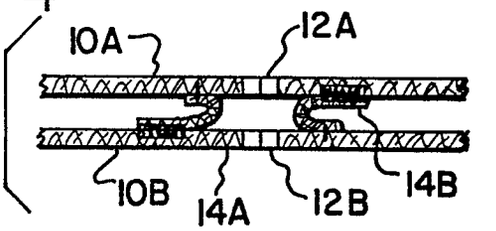


FIG-5

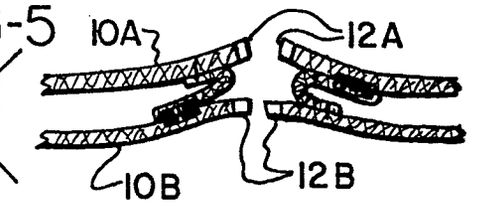


FIG-6

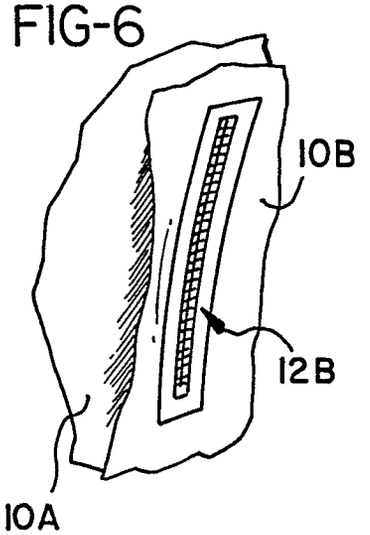


FIG-7

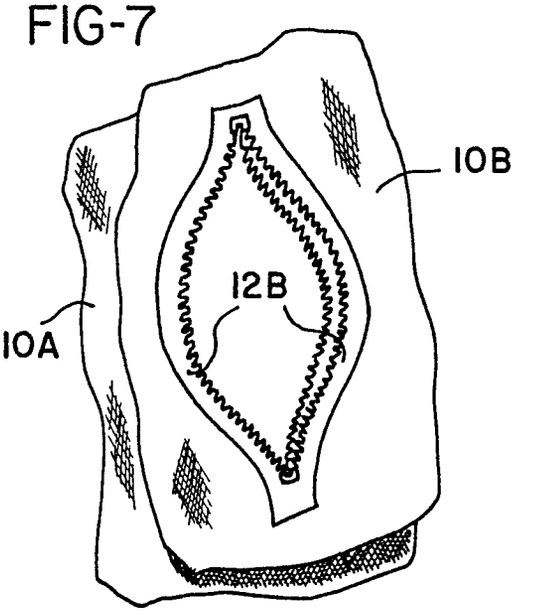


FIG-9

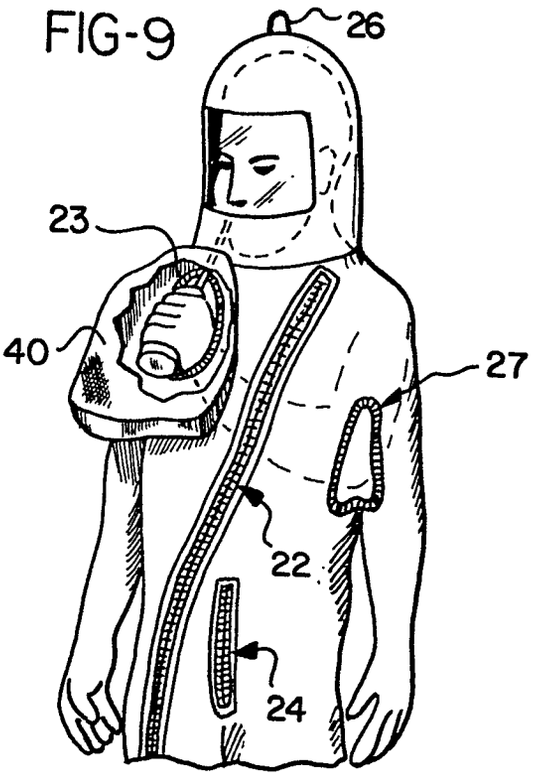


FIG-8

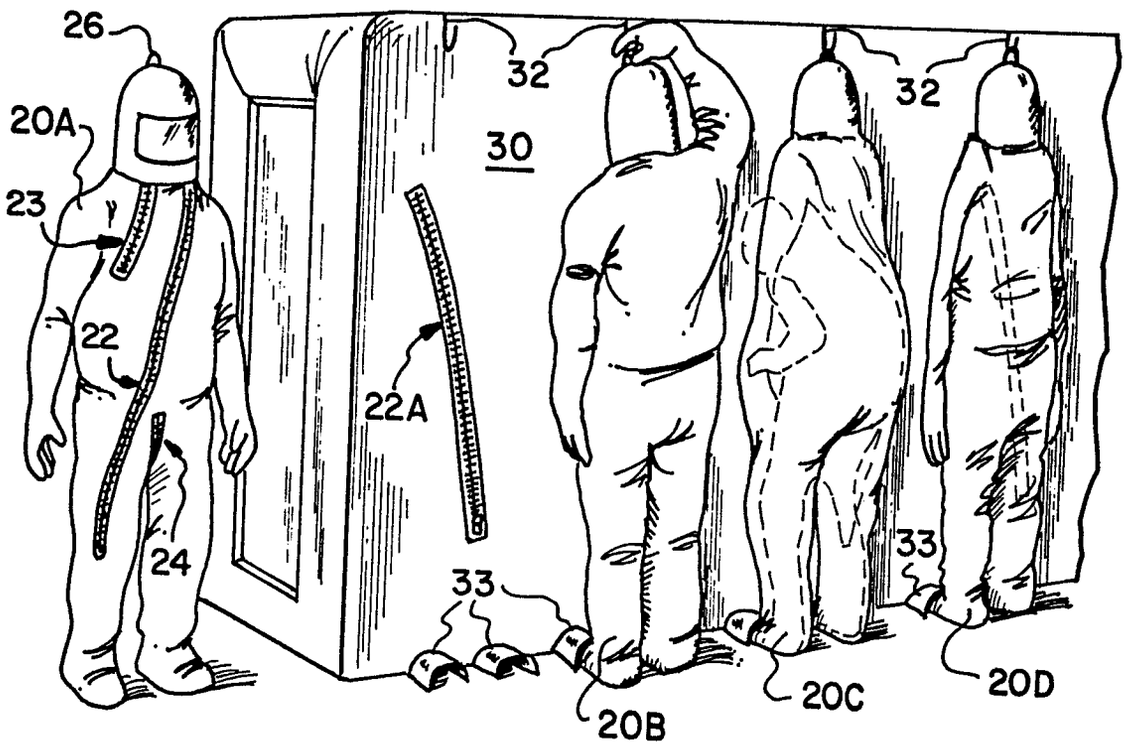


FIG-10

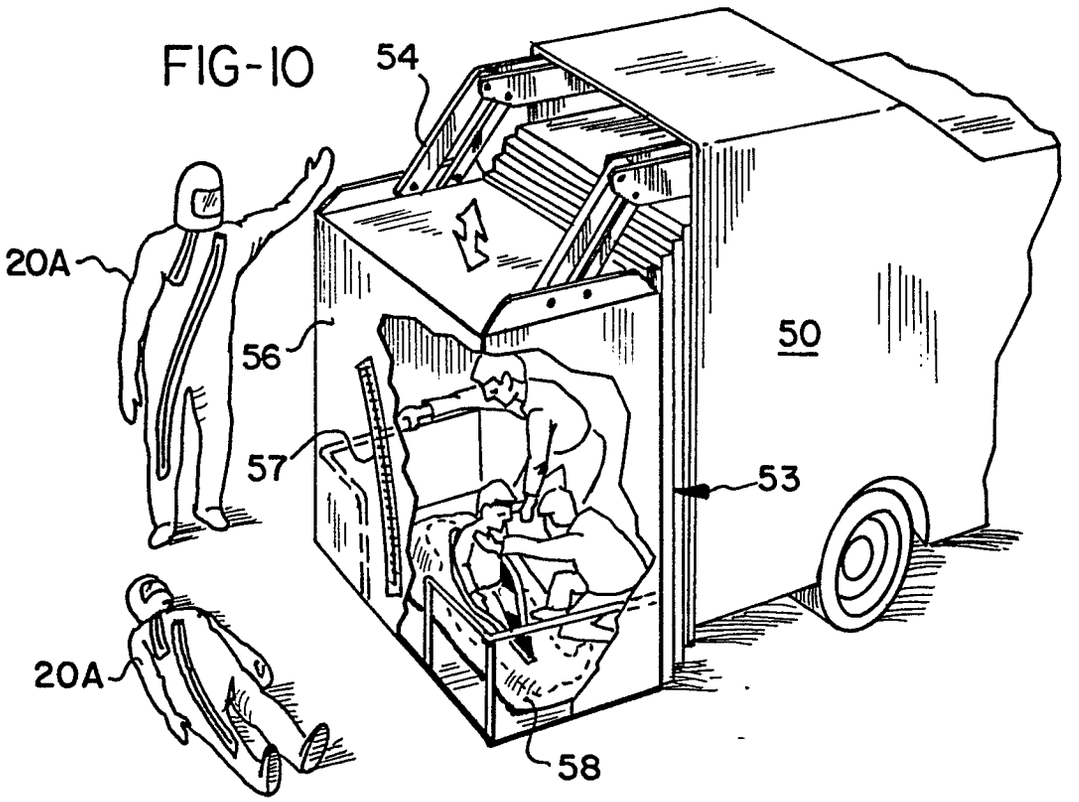


FIG-11

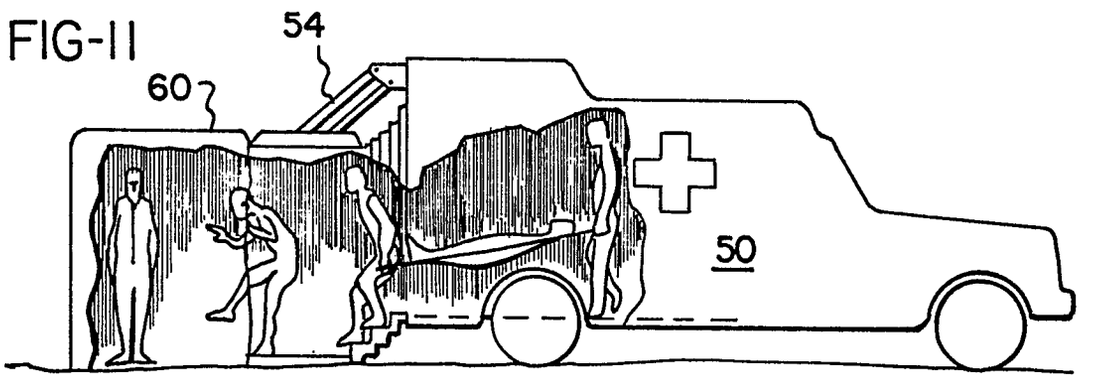


FIG-12

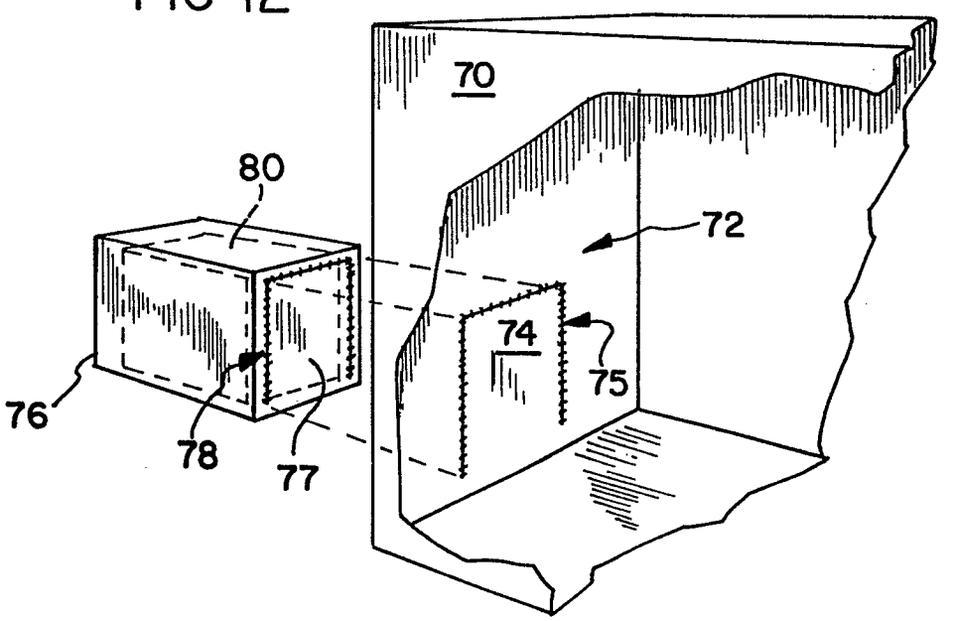


FIG-13

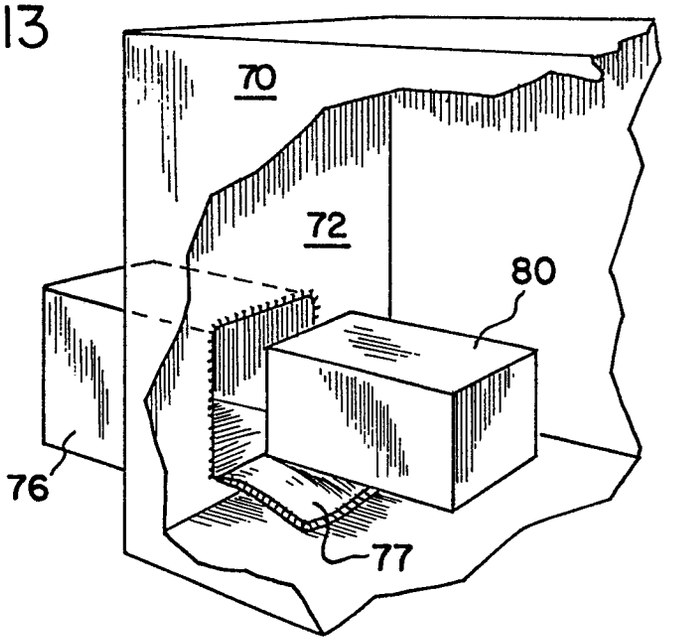


FIG-14

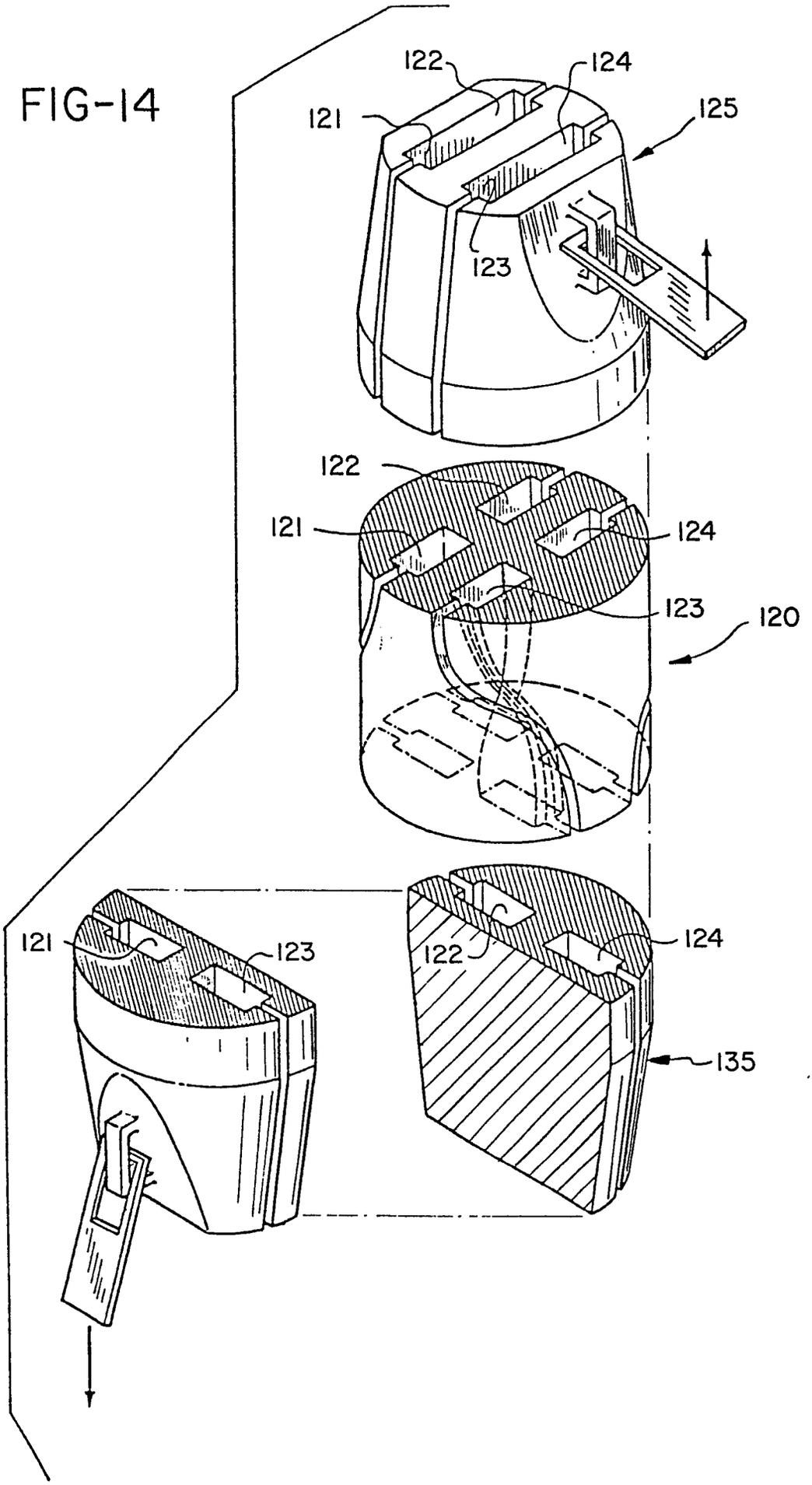


FIG-15

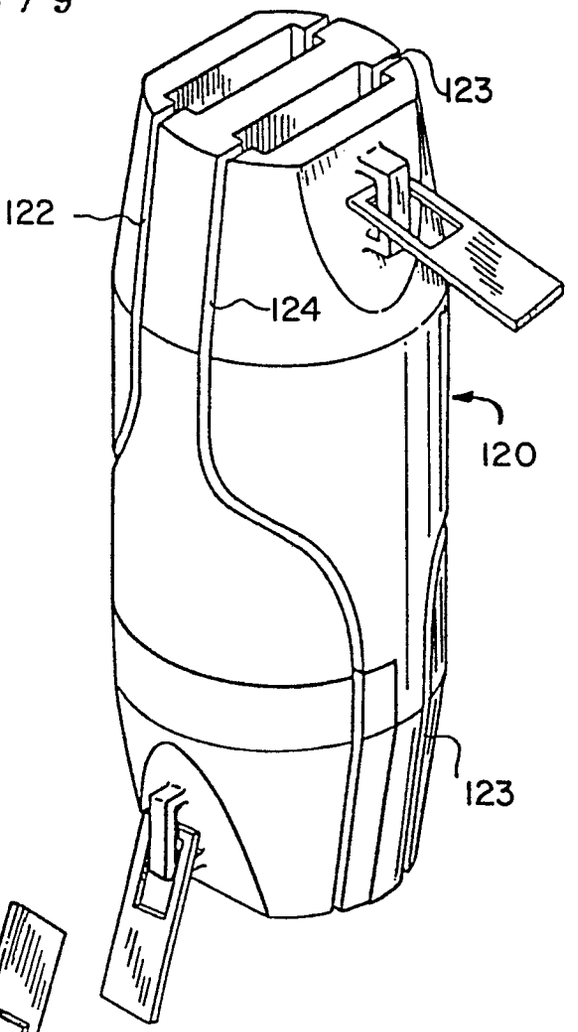


FIG-17

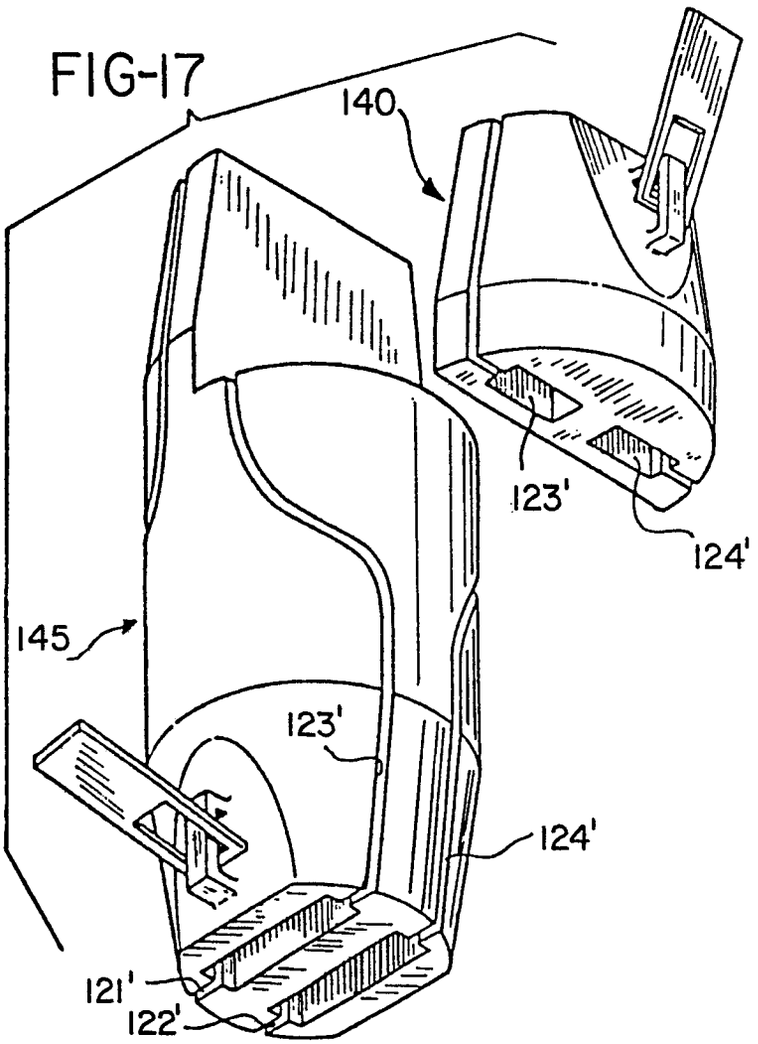
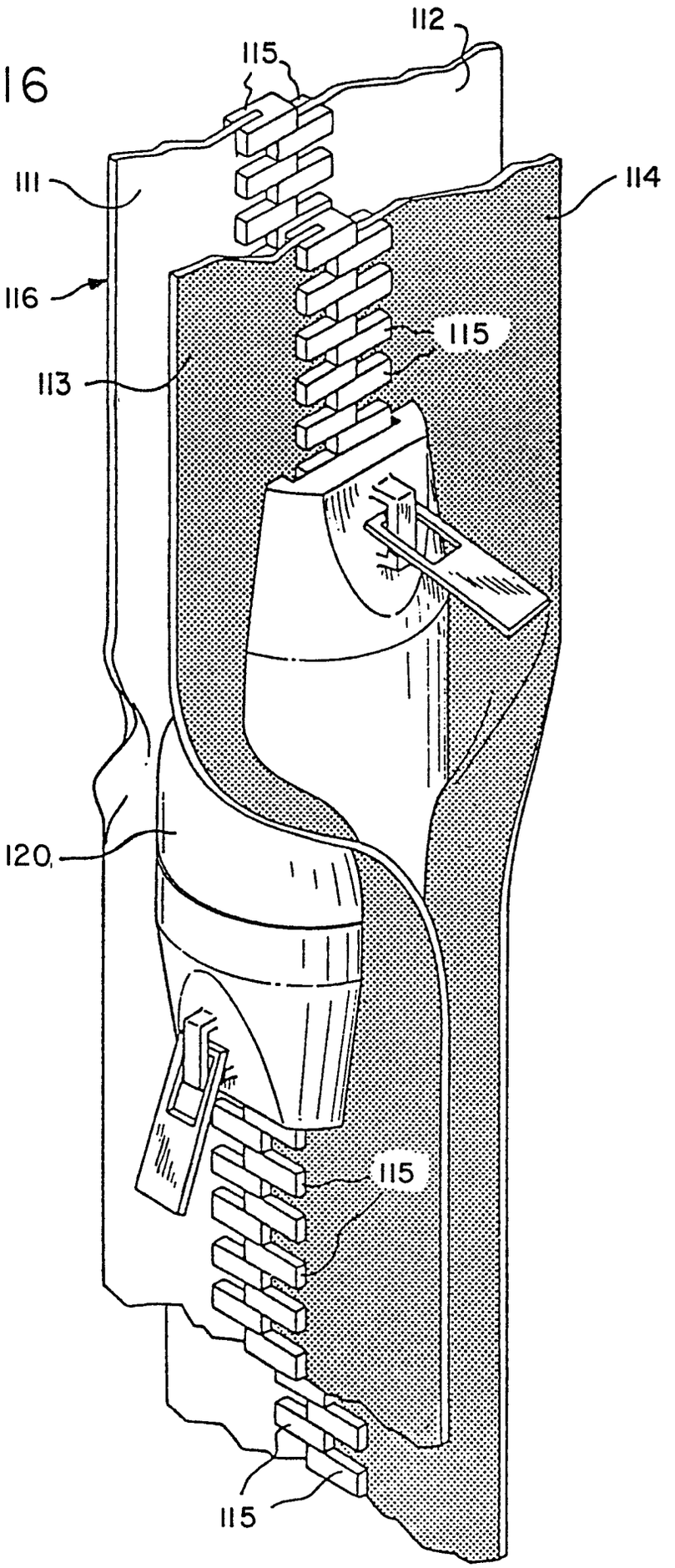


FIG-16



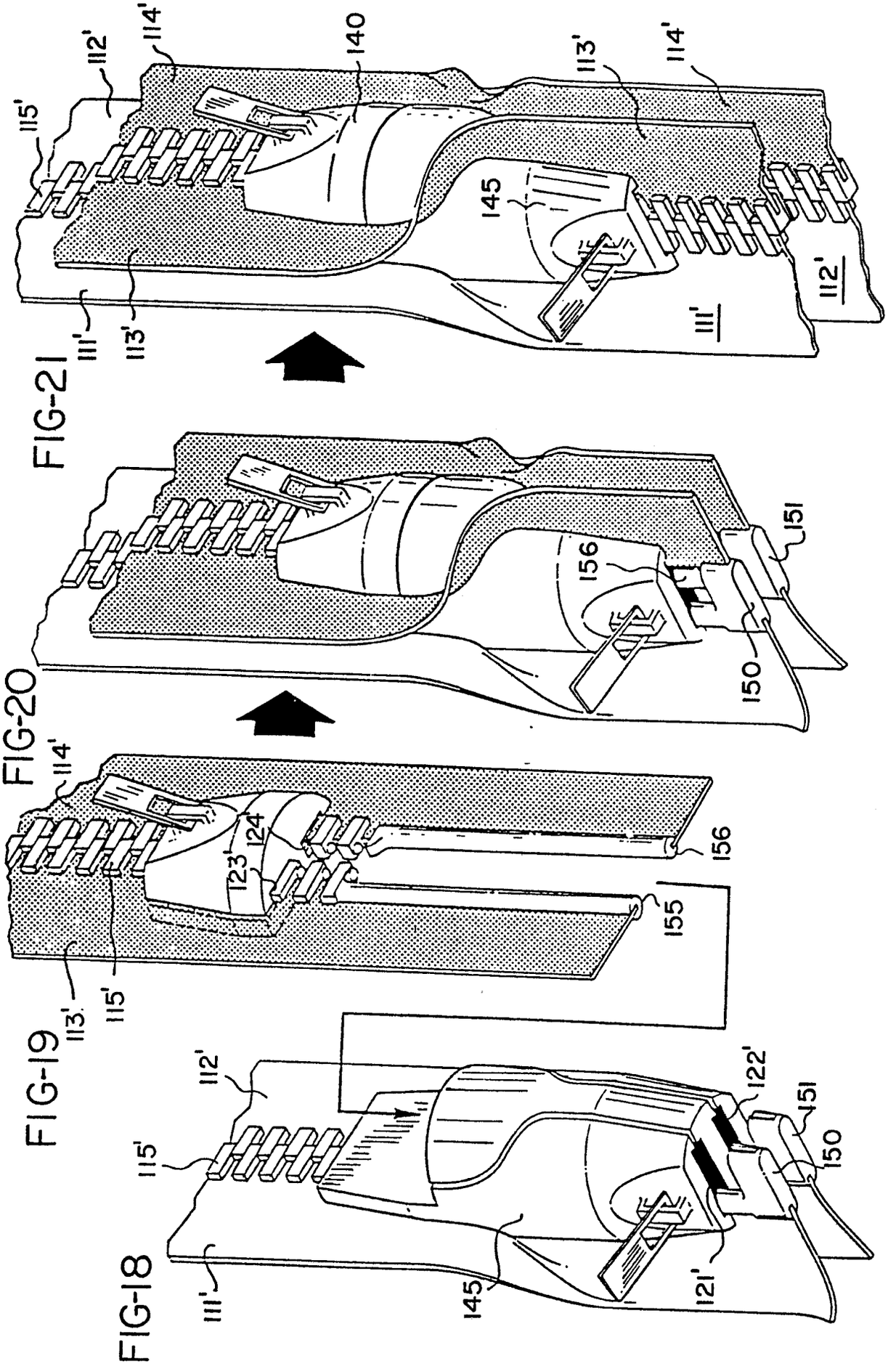


FIG-21
112'
114'
140
113'
114'
115'
145
111'
113'
111'
112'
FIG-20
151
156
150
FIG-19
114'
124'
123'
156
155
113'
115'
FIG-18
112'
122'
151
115'
150
111'
145
121'

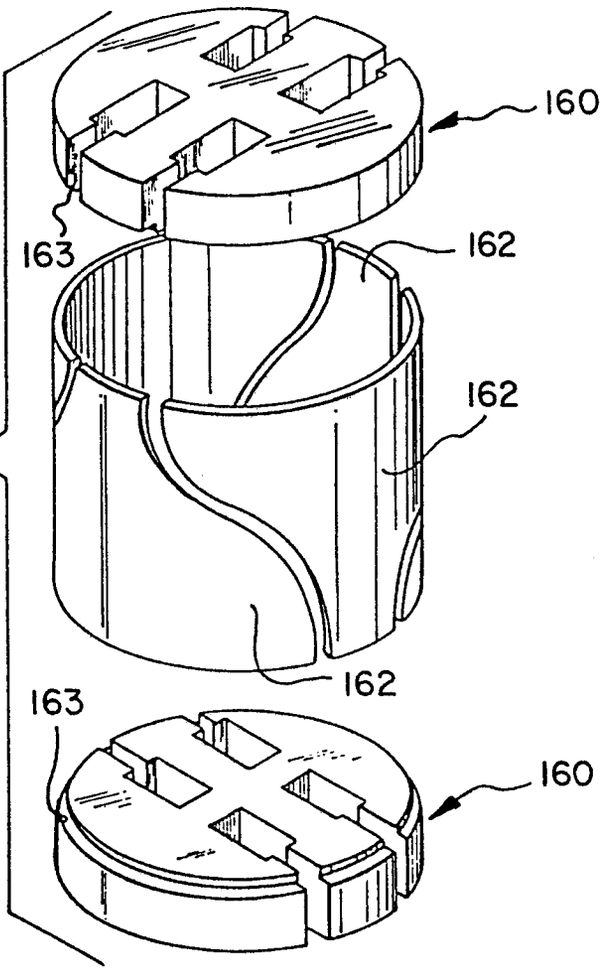


FIG-22

0097514

European Patent Office

Application number

EP 83 30 3536

EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	DE-C-1 014 492 (PÜSCHNER et al.)		A 62 B 17/00 A 62 B 31/00
A	GB-A-1 415 951 (GESELLSCHAFT FÜR KERNFORSCHUNG MBH)		
A	GB-A-2 020 164 (UNITED KINGDOM ATOMIC ENERGY AUTHORITY)		
A	US-A-2 664 890 (WALLACE)		
A	US-A-3 526 066 (HAGAR et al.)		
D,A	GB-A-1 000 674 (SPEMBLY LTD.)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
D,A	US-A-3 355 230 (TREXLER)		A 44 B 19/00 A 45 F 1/00 A 61 M 16/00 A 62 B 17/00 A 62 B 31/00 E 04 B 1/00 G 21 F 3/00 G 21 F 7/00
D,A	US-A-3 501 213 (TREXLER)		
D,A	US-A-4 302 848 (OTSUKA et al.)		
D,A	US-A-2 229 216 (MARINSKY)		

-/-

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	16-09-1983	KANAL P K

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
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D : document cited in the application
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& : member of the same patent family, corresponding document

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EUROPEAN SEARCH REPORT

0097514
Application number

EP 83 30 3536

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
D,A	US-A-4 308 644 (BROWN)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

The present search report has been drawn up for all claims

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