

Dec. 30, 1969

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3,486,285

MODULAR WALL SYSTEM AND METHOD AND JOINT ASSEMBLY THEREFOR

Filed Oct. 24, 1967

4 Sheets-Sheet 1

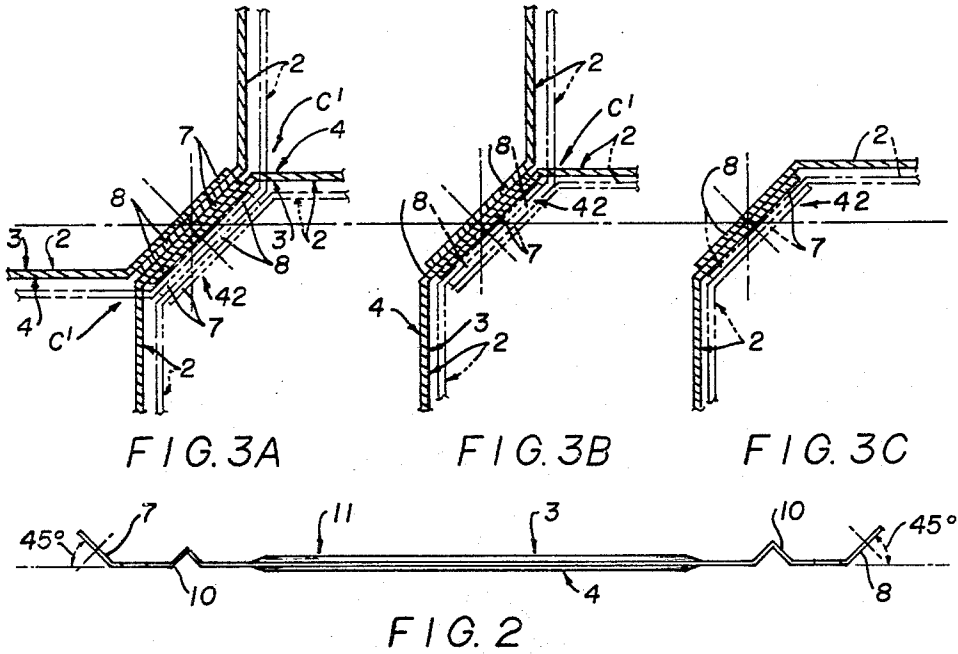
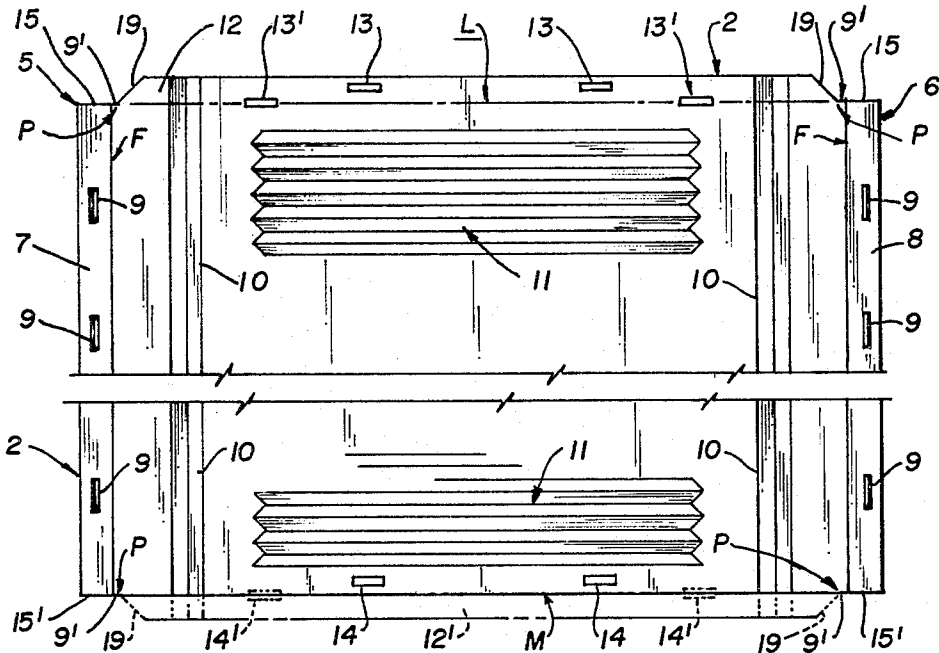


FIG. 1

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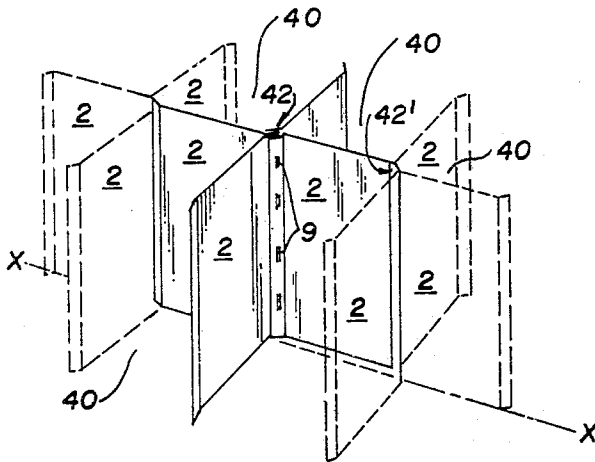


FIG. 9

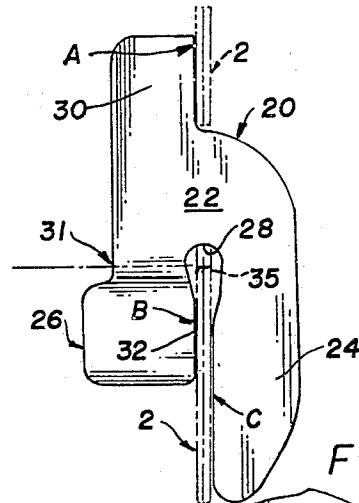


FIG. 4

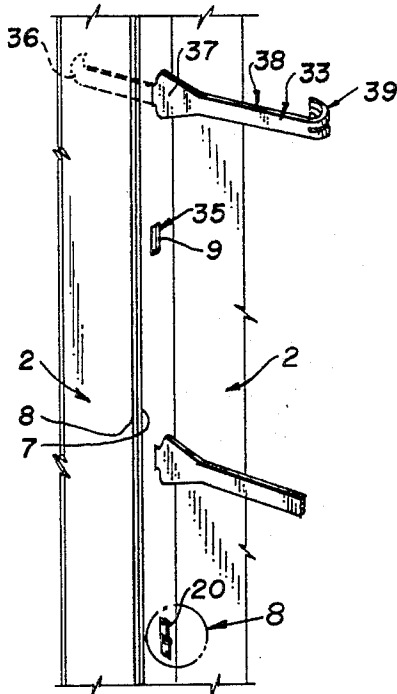


FIG. 7

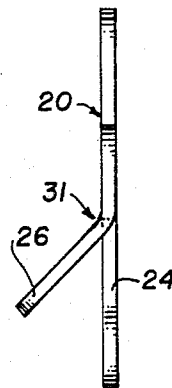


FIG. 5

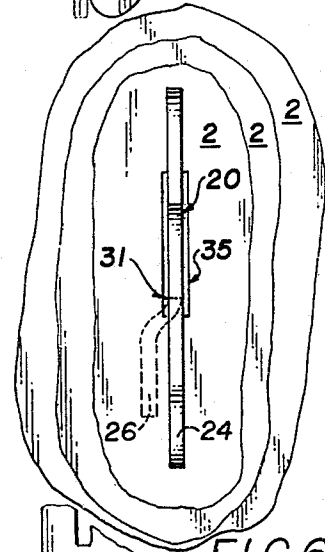


FIG. 6

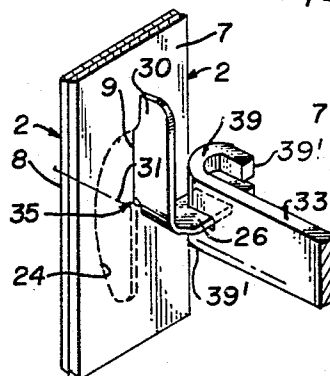


FIG. 8

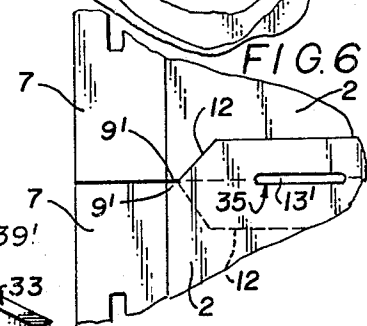


FIG. 11

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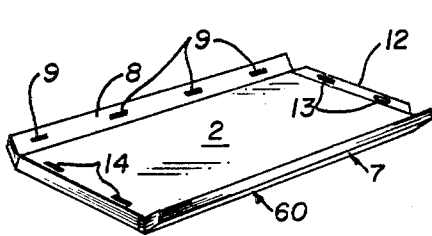


FIG. 14

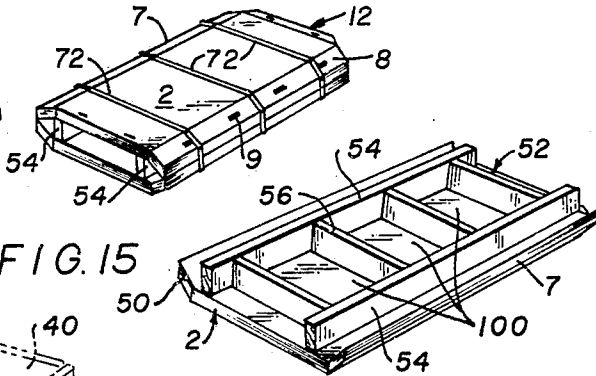


FIG. 15

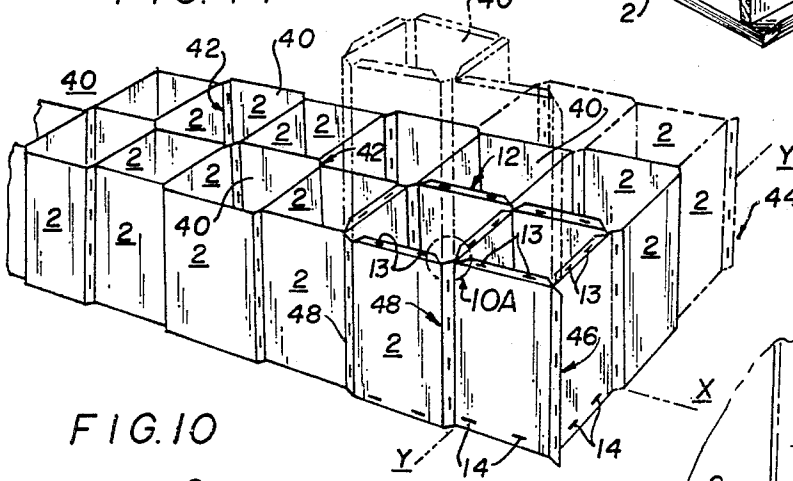


FIG. 10

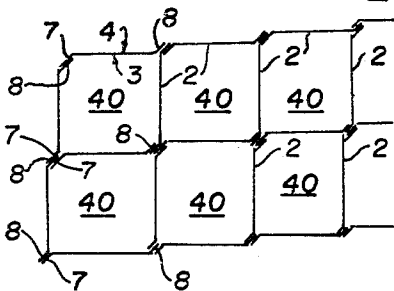


FIG. 12

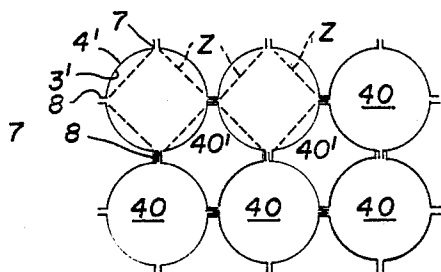


FIG. 13

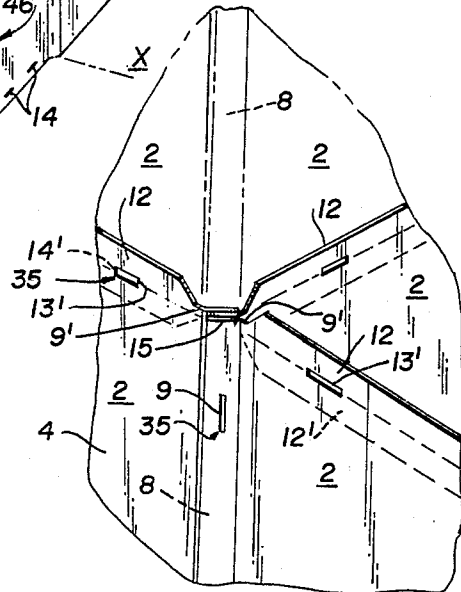


FIG. 10A

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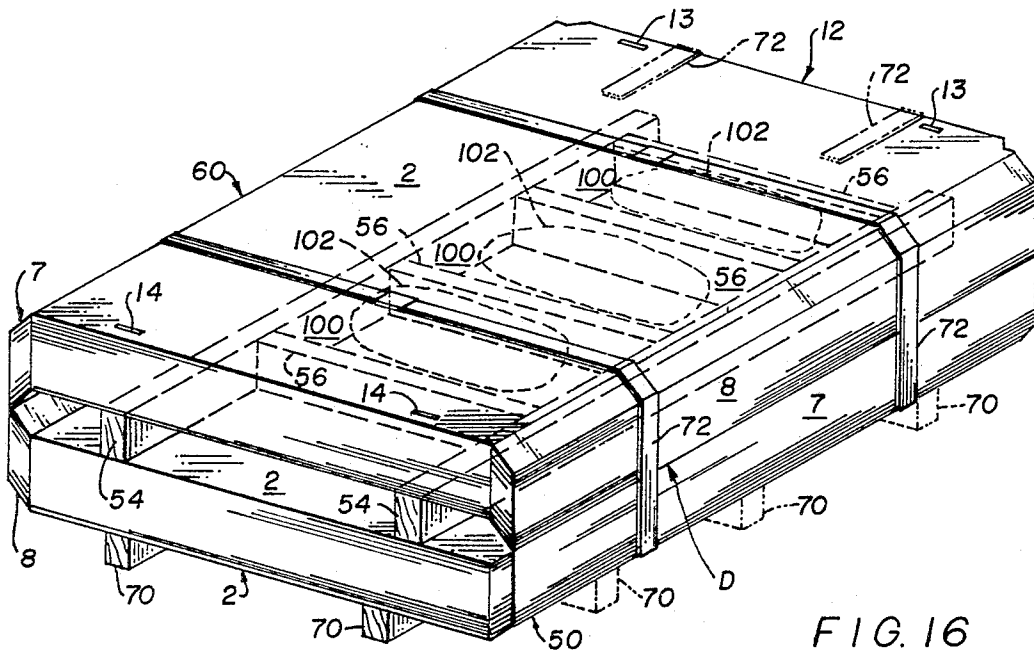


FIG. 16

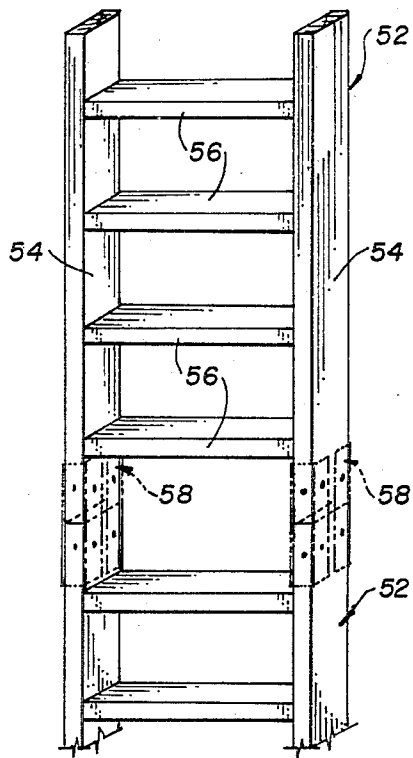


FIG. 17

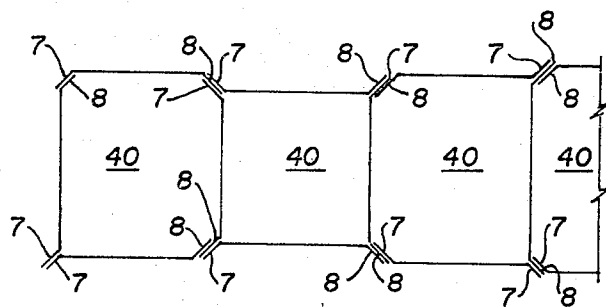


FIG. 18

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3,486,285 MODULAR WALL SYSTEM AND METHOD AND JOINT ASSEMBLY THEREFOR

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Int. Cl. E04b 1/54; E04c 3/08, 2/38

U.S. Cl. 52—284

19 Claims

ABSTRACT OF THE DISCLOSURE

A modular wall system comprised of a plurality of similarly configured panels, certain ones of which are arranged at angles to others of said panels to form at least one layer of a network of interconnected panels that define a cell-like structure. The panels are joined together at the flanged portions thereof which are apertured in such a fashion that when the panel flanges are overlapped, the various apertures in the panel flanges are placed in full registry with one another. Means, such as an improved clamp-like element, is removably inserted in the various registered apertures of the overlapped panel flanges whereby upon a preselected deformation of the clamp-like element the overlapped flanges of the panels are forced together.

Background of the invention

This invention relates to a modular wall system that can be used for revetments and the like and made up of a series of interconnected and similarly configured panels together with improved fastening elements for demountably securing the panels together. Various schemes have been proposed in the past for assembling a series of modular and similarly configured panels into a modular cell-like wall structure by means of removable fastening elements to form revetments and the like. However, these different schemes have had one or more serious drawbacks. For example, certain panels and/or fastening elements that were used were of such a structure and configuration that they did not always compensate for the ordinary tolerances involved in commercial manufacturing operations. In some instances, the panels and/or fastening elements were of complex and intricate design, which required special tools and skill during panel assembly as well as expensive and complicated tools and equipment for manufacturing the same. In other instances, the panels were of such a configuration and structure that once secured together they could not be readily disassembled without destroying the integrity of the individual panels themselves so that they could be used over again. Finally, other prior art panels and fasteners did not lend themselves to being applied in layers or to varying conditions of installation.

Summary of the invention

Accordingly, it is the primary purpose of the instant invention to provide an improved modular wall assembly made up of a series of interconnected and generally similarly configured panels together with improved fastening elements for demountably securing the panels together in a minimum amount of time and with a minimum amount of effort. The panels and fastening elements are such that they can be readily and cheaply manufactured on conventional fabricating equipment and readily assembled on the job site by relatively unskilled operators and with a minimum amount of tools. A novel scheme is also provided for installing the modular wall system in a simplified fashion. A novel packaging arrangement for the panels and panel fasteners is covered in another applica-

tion being filed concurrently herewith, namely, application Ser. No. 677,712, filed Oct. 24, 1967.

Brief description of the drawings

FIG. 1 is a broken side elevational view of one preferred form of panel used in practicing the instant invention with a modification thereof shown in dotted lines;

FIG. 2 is a top plan view of the panel shown in FIG. 1;

FIGS. 3A, 3B and 3C are three views in dotted and solid lines and illustrate different types of joints or hub assemblies that can be formed by the overlapped flanges of two or more of the panels of FIG. 1 and how other panels can be superposed thereon;

FIG. 4 is a front elevational view of a preferred form of fastener or clamp-like element that can be used to secure a panel of FIG. 1 with other similarly configured panels to form a modular wall assembly and with parts of the joined together panels being shown in dotted lines;

FIG. 5 is a side elevational view of the clamp-like element of FIG. 4;

FIG. 6 is a fragmented view of several flanged panel elements secured together at the flanges thereof by means of the deformable clamp-like element depicted in FIGS. 4 and 5 and illustrates the manner in which various parts of the clamp-like element engage various portions of the overlapped panel flanges;

FIG. 7 is a fragmented perspective view of a pair of overlapped panel flanges and illustrates the procedure used in lining up the flanges of the panels to be joined and the final condition of a clamp-like element after it has been inserted in certain aligned apertures of the panel flanges and deformed;

FIG. 8 is an enlarged perspective view taken within the circumscribing line 8 of FIG. 7 and illustrates the manner in which the fastening element can be deformed by an appropriate tool so as to finally assume the configuration shown in FIG. 7;

FIG. 9 is a perspective view of a four-way panel joint assembly and at the same time illustrates a preferred first step used in assembling the panels to start an initial layer or wall course made up of the panels of the instant invention;

FIG. 10 illustrates the manner of assembling the various wall panels of the instant invention together to form first and second layers of angularly disposed course segments with certain parts shown in dotted lines and other parts removed for the sake of clarity;

FIG. 10A is an enlarged fragmentary view generally taken within the circumscribing line 10A of FIG. 10 with parts added and illustrates a typical joint assembly formed between various panels when a second layer or course is applied over the first layer or course of panels during erection of the modular wall system of the instant invention;

FIG. 11 is a fragmentary side elevational view of a pair of superposed panels and illustrates the manner in which one panel can be overlapped by a superposed panel in forming a second course or layer of panels;

FIGS. 12 and 13 illustrate modified forms or configurations for the panel elements that can be used in making up the wall structure as well as the modular wall systems formed thereby;

FIGS. 14 and 14A are perspective views of different parts of a disassembled package made up of the panels and panel fasteners, etc. of the instant invention;

FIG. 15 is a perspective view of the overall package made from the assemblage of the various elements shown in FIGS. 14 and 14A;

FIG. 16 is an enlarged perspective view of the package shown in FIG. 15 with parts added in dotted and solid lines;

FIG. 17 is a perspective view of a novel ladder element that can be formed from the spacer device used in the package of FIGS. 14-16; and

FIG. 18 illustrates a further modified wall system that can be assembled from the panels of the instant invention.

With further reference to the drawings, and in particular FIGS. 1 and 2, a preferred form of panel element 2 which can be used in practicing the instant invention is generally quadrilateral in shape and made from a suitable material such as flexible sheet steel of the appropriate thin gauge on the order, for example, or .018". The panel is roll or press formed in such a fashion that the main body portion or module generating axis of the panel is provided with a pair of main generally planar panel faces 3 and 4 and opposing side edges 5 and 6. The side edges 5 and 6 are advantageously bent at preferably a 45° angle to one face, such as face 4, to form side flanges 7 and 8 which are then disposed at about a 135° angle relative to the other major face 3 of the panel. Each of the side flanges 7 and 8 are further provided with a plurality of apertures that can be in the form of elongated slots 9. These slots are also located at predetermined fixed distances apart and from the free marginal edges of the flanges of the panels so that when the panel flanges are overlapped, in a manner to be described hereinafter, the apertures 9 of the overlapped flanges of various panels 2 will be registered one with another for receiving the deformable clamp-like element or clip 20. If desired, the panels may have longitudinal corrugations 10 and lateral corrugations 11 or other stiffening elements embossed therein for the purpose of reinforcing the same.

In a further advantageous embodiment of the invention, the top edge of a panel 2 is provided with an end tab 12. Elongated slots 13 similar to the elongated flange slots 9 are located in this end tab 12 for receiving one of the deformable clamp-like elements 20 when one panel 2 is superposed above and upon another panel 2 and the bottom edge of the topmost panel 2 is overlapped with the tab end of the lowermost panel 2 in a manner to be more fully described. The bottom edge of the panel 2 may be formed so as to have a similar end tab 12', if desired, and shown in dotted lines in FIG. 1.

In the event a panel is not provided with a further end tab 12' at the bottom thereof, then the longitudinal center lines of the slots 14 in the bottom edge of the panel are located inwardly the same distance from the free edge of the bottom portion of the panel as the longitudinal center lines of the slots 13 at the top are located inwardly of the free edge of the top end tab 12 for registry purposes during overlapping of the top and bottom edges of superposed panels.

On the other hand, when the panels 2 carry a further bottom end tab 12', then a slightly modified end top and bottom slot arrangement is used. In this case, the top end tab slots 13' are located on the panel such that their longitudinal center lines generally coincide with the projected line L which is aligned with the top free edges 15 of the flanges 7 and 8, where the bottom tab slots 14' are located such that their longitudinal center lines coincide with the line M aligned with the bottom free edges 15' at the bottom of a panel 2. In other words, the sets of slots 13 and 14 or 13' and 14', as the case may be, are so arranged depending on which set is used whereby the slots at the top of one panel will fully coincide and register with the bottom slots of another panel 2 when the panels 2 are superposed and overlapped so that the clamp-like elements 20 can be inserted through the aligned sets of slots. The slots 13 and 14 or 13' and 14' are also so located in the ends of panel 2 so as not to interfere with any mating of the corrugations 10 in the overlapped panels during any overlapping of the panels.

When one panel 2, provided with top and bottom end tabs 12 and 12' is superposed upon another and similarly shaped panel 2 in the fashion indicated in FIG. 11, each of the opposing end tabs 12 and 12' of the two panels

overlaps one another on either the outside or inside surface of the final joint structure and with the side flanges 7 and 8 of a bottom panel 2 serving as bearing supports or columns for similar flanges of the topmost panel 2 which rest thereon.

As indicated in the drawings, the beveled edges 19 at the longitudinal ends of the top and bottom end tabs 12 and 12' of a panel 2 are advantageously offset somewhat inwardly of the fold line F between the body of the panel 2 and the associated side flanges 7 or 8 whereby the beveled edges 19 intersect the top or free edges 15 or 15', as the case may be, at a point P spaced inwardly of the fold line F along the top or bottom edge 15 and 15' relative to the associated side edge 7 or 8. The point P is spaced an appropriate small distance from the projection of the relatively closer fold line F thereby leaving in effect a ledge portion 9' which minimizes or eliminates interference between the overlapped tabs 12 and 12' of panels 2 when these panels are superposed.

With reference particularly to FIGS. 4, 5 and 6, a preferred form of deformable clamp-like element or clip 20, that can be used to secure a series of panels 2 together at the flanged and tab portions thereof, is generally comprised of a main body or waist portion 22 and a pair of opposing legs 24 and 26 which are joined to the waist portion of the clip in the manner shown particularly in FIG. 4. At the point of joinder of the legs 24 and 26 with the waist portion 22, the legs narrow or taper down to form an enlarged arcuate recess 28 formed by the curvilinear inner portions of the legs 24 and 26. Thus, at their point of juncture with the waist 22, the legs are advantageously normally spaced further from one another than at other portions along their lengths even when one of the legs has been deformed. In addition to the legs 24 and 26, the clip is advantageously provided with a shoulder portion 30 at the top thereof and preferably on the same side of the clip as leg 26. One of the legs, such as leg 26, is deformable and it is provided on the inner section thereof with a cam-like portion 32. When the leg 26 of clip 20, which upon manufacture of the clip is usually disposed at an angle to the normal plane of the clip, is bent along the bending axis of the clip generally indicated at 31 in FIG. 4, by a suitable tool 33, shown in FIGS. 7 and 8, the leg 26 then assumes the position shown in FIGS. 6 and 7. When in this position leg 26 roughly parallels the main plane of the leg while being somewhat spaced therefrom. The clip 20 can be made of suitable steel material whereby it can be deformed as noted above.

The manner of assembly of the flanged panels is generally accomplished as follows. After at least one pair of apertured flanges on opposing panels 2 are placed in overlapping engagement with each other, the various slots 9 in the overlapped flanges are brought into registry with one another so that each registered set of apertures 9 in the overlapped flanges at any given point form an overall opening 35 within which the clip-like element 20 is inserted. In order to effect a full registry of the various apertures 9, a suitable tool element 33 can be employed. This tool is provided with a hook section 36 which fits within the apertures 9 making up an overall opening 35 and a wing portion 37 which acts as a stop for the tool. The hand engaging portion 38 of the tool has a claw 39 thereon. Since the apertures 9 are all located at selected registrable points on each panel when one series of apertures in several panels are aligned, the other series of apertures in the overlapped flanges of the same panels will be automatically aligned. This hook section 36 fits within one series of aligned apertures and when tool 33 is temporarily held in place in a series 35 of apertures, it holds the flanges together long enough for clamp-like elements 20 to be inserted in the other series 35 of aligned apertures in the same flanges. Then while the flanges are held together by the previously inserted clips 20, the tool can be removed from the given set of apertures and replaced by a final clip element 20.

A clip element 20 is disposed in a series of aligned apertures of overlapped panels by first inserting the leg 24 in the apertures or slots and then turning the clip 20 at an angle until the leg 24 engages the exposed surface of the flange of one of the panels 2 and shoulder 30 engages the flange of another panel. Since the intermediate or waist portion 22 of the clip is somewhat smaller than the overall length of the apertures 9 and because of the enlarged opening 28 at the point of joinder of the legs and waist 22, the clip 20 can be readily maneuvered into position. Next, the foldable leg 26 is gripped between the claw elements 39' of tool 33 and deformed by being bent about axis 31 until leg 26 extends in the same general direction as the rest of the clip. As the leg 26 is deformed, the cam portion 32 thereof engages the exposed flange surface of a panel 2 while leg 24 continues to engage the exposed flange surface of another panel 2. As the cam portion 32 of the clip engages its associated panel 2, it acts to draw the flanges of all of the panels making up a given joint assembly tightly together.

During this drawing together of the lapped panels, the shoulder 30 of the clip 20 engages the same panel as leg 26 so as to advantageously effect a triangulated engagement or a three point contact between the panels and a given clip at an overall opening 35 by means of the shoulder 30 at point A, the leg 26 at point B and the other leg 24 at point C.

As noted above, the waist portion 22 of each clamp-like element has a shorter overall dimension as well as less thickness than an aperture or slot 9 so that it fits relatively loosely in the overall slot or opening 35 formed by a given series of aligned apertures 9 in the lapped panels. This feature not only allows the clip 20 to adjust itself to various tolerances in the slots 9 resulting from manufacture, but also facilitates removal of the clip when the leg 26 thereof is redeformed if it is desirable to disassemble the panels for any reason. During deformation of the clip, the shoulder 30 of the clip serves as a bearing support for the clip to facilitate the deforming of leg 26.

The same basic clip installation procedure described above for securing adjacent lapped panel flanges together in one layer or course is employed for effecting the joinder between the panels making up further layers and the top and bottom edges of superposed and lapped panels 2 of the various layers, reference being made particularly to FIGS. 10A and 11 of the drawings. As indicated in FIGS. 10A and 11, when the opposing end tabs of a pair of superposed panels are overlapped, a clip element 20 is insertable and deformable in the overall aperture 35 formed by an aperture 13' in the top end tab 12 of the bottom panel 2 and an aperture 14' in the bottom end tab of the top panel. Where a panel 2 is not provided with a bottom tab 12', then an aperture 13 of the top tab 12 in the bottom panel combines with an aperture 14 registered therewith in the bottom edge of the topmost panel to form an overall aperture 35 for receiving a clip 20.

A typical modular wall system that can be formed by the panels 2 and clamp-like elements 20 of the instant invention is illustrated in FIGS. 9 and 10. This wall system, comprised of a network of interconnected panels that form individual open cells 40, may be used for retaining walls, aircraft revetments and the like with the open cells being filled with earth, sand, gravel or the like. The walls, revetments, etc. can also be built in several layers, if desired, depending upon the size of the panels. The final wall assembly then can include two-way, three-way and four-way hub-like joint structures made up of superposed layers of overlapped panels, such as those shown in FIGS. 3A, 3B and 3C, with the particular angular disposition of the panel flanges 7 and 8 being of material assistance in giving the panels flexibility of disposition in this regard.

As indicated in dotted lines in FIGS. 3A and 3B, in forming the superposed layers of panels 2 so as to have corresponding overlapped and aligned three-way and four-way lap joints, it may be desirable in some instances

and as indicated by the dotted lines in these figures to offset the main joint formed by the panels of one layer with the main joint formed by the panels in another layer. In such instances, offsetting the end tabs 12 and 12' inwardly of the fold line F as aforescribed is used to advantage to obtain a smooth interfit and overlapping relationship of all of the various panels.

A preferred mode of assembly of the wall or revetment of FIGS. 9 and 10 is as follows. Firstly, four panels 2 are oriented relative to one another in a generally right angular relationship such that the flanges of all of the panels are in overlapping relationship and are combined to form a hub-like joint structure 42. At the same time, the various apertures 9 of all of the lapped flanges at this joint structure 42 are aligned to form individual overall apertures 35 and two of the panels 2 are arranged in a straight line along what may be considered to be the center line X for the wall. Thereafter, the deformable fasteners 20 are inserted in the overall openings 35 formed by the individual apertures 9 of the lapped panels at the first formed hub-like joint structure 42 and then deformed in the manner previously described.

A second hub-like joint structure 42' is formed by overlapping, for example, the flange of one of the panels 2 making up the first hub-like joint structure 42 along like X with the flanges of a plurality of other flanged and similarly configured panels 2 in the fashion shown in dotted lines in FIG. 9. This second hub-like joint structure 42' is formed from four flanges of four different panels 2, all of which have alignable apertures 9. Clip-like fasteners 20 are first inserted and then deformed in these new aligned apertures 9 as aforescribed. Additional hub-like joint structures 42' are then formed from previously joined together panels 2 and new panels 2 until the desired overall wall system of the type shown in FIG. 9 has been built up along the same general center line X in at least one layer.

If it is desired to build a wall extension 44 at an angle to the main center line X previously described, then additional hub-like joint structures are formed by new panels assembled in the manner previously described along a new center line or axis Y disposed at an angle to center line or axis X to form at least one layer of cells in the wall extension 44. Each wall section may be made as wide as desired simply by adding new cells 40 by way of additional panels.

The openings between any pair of panels located on the outside of the wall structure are closed off by either two-way or three-way partial hub-like joint structures 46 and 48 respectively. In this instance, the opening between a pair of panels 2 located on the outside of the wall structure is closed by interposing similarly configured enclosing panels 2 provided with apertured flanges 7 and 8 therebetween and overlapping the flanges 7 and 8 of the last mentioned enclosing panels with the flanges 7 and 8 of the pair of panels being enclosed such that the apertures 9 of all of the overlapped and overlapping panel flanges are in registry. Thereafter the deformable fastening elements 20 described above are removably inserted in the last mentioned apertures and deformed.

In the design of the panels 2 wherein flanges 7 and 8 are bent inwardly at approximately a 45° angle so that the interior angles of the flanges are approximately 135°, this particular angular disposition of the flanges is used to advantage in packaging of the panels for shipment and storage and in forming an overall unique panel packaging arrangement which will now be described, reference being made particularly to FIGS. 14-18.

In the improved panel packaging system, it is contemplated that a first series of panels 2 be nested with each other with their flanges 7 and 8 being upturned to form a stack 50 of panels. Thereafter, a spacer element 52 advantageously made in the form of a ladder-like framework provided with longitudinal legs 54 and cross members 56, all secured together, is placed upon the

first nested series 50 of panels 2 in the fashion shown in FIG. 14A. If desired, and as indicated particularly in FIG. 17, the two longitudinal legs 54 can be provided with hollow end caps 58 appropriately nailed or stapled to the legs and providing in part hollow sockets for receiving the uncapped ends of similar ladder-like spacers 52 of other panel packs so that a full ladder can be formed for use in the installation and erection of the panels 2 in a multi-layer modular wall or revetment system of the instant invention.

After locating the spacer 52 on the first panel series 50, all of the various fasteners 20 and tools 33 that would be used for a given package of panels are inserted in the hollow spaces or recesses 100 formed by the cross runners 56 and the longitudinal legs 54, the fasteners 20 and tools 33 being located in the sacks 102 disposed in pockets 100. If desired, end caps 58 can be also placed in these recesses or pockets 100. Then a second series of nested panels making up a stack 60 is placed over top of the first pack or stack 50 with the flanges of both stacks 50 and 60 of the panels 2 being turned inwardly so as to contact each other and close off the sides of the package and with the spacer element 52 being interposed between the major faces of the panels 2 in stacks 50 and 60. Finally, the assemblage of packs 50 and 60 and spacer 54 is placed upon a pair of wooden skids or runners 70 that can extend parallel or crosswise to the longitudinal axis of the package. The entire package is then strapped together in a fashion shown in FIGS. 15 and 16 by means of the usual strapping or bundling elements 72. The endmost spacer elements 56 serve as effective closures for the final package. The ground engaging spaced runners 70 permit engagement of the package by the forks of the usual fork lift trucks, etc. and serve as supports for the final package during shipment and storage. When the final packages are stored one on another, the runners 70 effectively separate the packages one from another so that each package can be individually grabbed or grasped by the forks of the fork lift truck. The converging flanges of the panels in the final package act to create appropriate bumper and side elements protecting the side edges of the panel package from damage.

Although a preferred form of modular wall assembly has been illustrated in FIGS. 9 and 10 and made up the panels 2 shown in FIGS. 1 and 2, it is within the contemplation of this invention that the panels may have different designs and configurations from that specifically shown in FIGS. 1 and 2. For example, as indicated in FIG. 12, the apertured flanges 7 and 8 of a panel 2 may project outwardly at the preferred interior angles of 135° to different major faces of the panel 2 instead of the same major face. When this occurs, the flanges of the modified panels 2 can still be overlapped and secured together by clips 20 in the same general fashion as the panels 2 of FIGS. 1 and 2.

Further, in lieu of using apertured flanged panels 2 which have planar faces 3 and 4, the panels 2 may be somewhat curved so that faces 3' and 4' thereof are respectively concave and convex. In any event, the module generating axis of a plane defined by the dotted lines Z of each panel in FIG. 13 is, for all practical purposes, a straight line with the flanges 7 and 8 of a given panel still being located at about the desired interior angles of 135° relative to the module generating axis Z of such a curved panel. In this case, the apertured flanges 7 and 8 of the panels 2 of FIG. 13 can likewise be held together by clips 20.

Finally, various combinations of panels 2 can be used as indicated in FIG. 18 to form modular wall systems. Thus, for example, panels 2 of the type shown in FIGS. 1 and 2 can be used with the modified flanged panels 2 of FIG. 12 provided with the usual apertured flanges and with clips 20 being used to hold the panels together in the manner previously described.

When multi-layered wall or revetment systems are desired, the panels 2 of the first layer are overlapped and tied together in the manner previously described. In this instance, a preferred method of doing this involves overlapping the innermost panels 2 of the wall system with similar panels 2 first and then working outwardly from the innermost line of cells 40 formed by the panels 2.

An advantageous embodiment of the invention has been disclosed and described. It is obvious that various changes and modifications may be made therein without departing from the spirit and scope thereof, wherein:

What is claimed is:

1. In a demountable modular wall system comprised of a plurality of panels, certain ones of which are arranged at angles relative to others of said panels to form a network of inter-connected panels that define a cellular-like structure, the combination of a plurality of similarly configured and apertured flanged panels, the flanges of said panels being planar and arranged at angles to the major faces of the panels, the planar flanges of adjacent panels being arranged in overlapping registered relationship and surface-to-surface abutting contact with each other and with the apertures in the overlapped abutting flanges being aligned with each other, and a deformable clamp-like element removably inserted in a series of the aligned apertures of the overlapped panel flanges for securely and tightly yet removably locking said panel flanges abuttingly together, said clamp-like element being provided with triangulated flange engaging components comprised of a pair of opposing legs one of which is deformable for engaging a panel flange and for drawing the panel flanges associated therewith tightly together when said clamp-like element is inserted in the series of aligned apertures and then deformed and a shoulder disposed on the same side of the clamp-like element as the deformable leg but in opposition to said deformable leg.

2. A modular wall system as set forth in claim 1, wherein each of the said flanges is arranged at about a 135° angle to one of the major faces of the panel with which it is associated.

3. A modular wall system as set forth in claim 1 wherein each panel is provided with opposing side flanges and said flanges are bent outwardly in diverging relationship to each other and at about a 135° angle relative to the same major face of the panel.

4. A modular wall system as set forth in claim 1 wherein each panel is provided with a tab disposed at one end thereof and intermediate the flanges of said panel.

5. A modular wall system as set forth in claim 1 wherein the flanged panel apertures are in the form of elongated slots and wherein the legs of the clamp-like element are each engageable with different overlapped flanges in the joint formed by the flanges of the flanged panels.

6. A modular wall system as set forth in claim 1 wherein certain of said panels are provided with panel stiffening elements.

7. A demountable modular wall system comprised of a plurality of panels, certain ones of which are arranged at angles relative to others of said panels to form at least one layer of a network of interconnected panels that define a cell-like structure, the combination of a plurality of similarly configured panels provided with apertured planar side flanges which are disposed at an angle of about 135° to certain major faces of the panels with which they are associated, the side flanges of adjacent panels being arranged in overlapping relationship and surface-to-surface abutting contact with each other, each of said panels also being provided with apertured end tabs disposed intermediate the side flanges of the panels, and a first series of deformable clamp-like elements inserted in aligned apertures of the overlapped panel flanges for tightly and securely yet removably locking said panel flanges together, said clamp-like elements each being provided with means for enlarging and drawing the panel flanges associated therewith together when said clamp-like elements are in-

served in said aligned apertures and thereafter deformed, one of said clamp-like elements being provided with triangulated flange engaging components comprising a pair of opposing legs one of which is shorter than the other, said shorter leg also being deformable and a shoulder disposed on the same side of the one clamp-like element as the deformable leg but in opposition both to said deformable leg and the longer opposed leg.

8. A modular wall system as set forth in claim 7 wherein a second layer of similarly configured, tabbed flanged and interconnected panels are superposed upon the panels of said first mentioned layer, tab portions of the bottom edges of the panels in the second layer being in overlapping engagement with the end tabs of the panels in the first mentioned layer, and with a flange of a panel in the first layer serving as a bearing support that receives and engages a flange of the panel located immediately above the first layer panel.

9. A modular wall system as set forth in claim 8 wherein the tabs and bottom edges of the panels in said wall system are provided with registerable apertures and a clamp-like element similar to said first mentioned clamp-like elements inserted in the apertures of an overlapped tab of one panel and the bottom edge of another panel when the apertures of the respective two panels are registered with each other.

10. In a demountable modular wall system comprised of a plurality of panels, certain ones of which are arranged at angles and abuttingly overlapped relative to others of said panels to form at least one layer of a network of interconnected panels that define a cell-like structure, the combination of a plurality of similarly configured panels provided with opposing planar side flanges disposed at angles to the major faces of the panels with which they are associated and inwardly offset top ends tabs disposed intermediate the said flanges, said side flanges, top end tabs and the bottom ends of said panels having apertures therein, and the center line of an aperture in the bottom end of a panel being located substantially the same distance inwardly of the free edge of said bottom end as the distance the center line of an aperture in the top end tab is located inwardly of the free edge of the top end tab and deformable clamp-like elements inserted in aligned apertures of a plurality of overlapped and abutted panel flanges for tightly yet removably locking said panel flanges together, all of said clamp-like elements being provided with means for engaging and drawing the panel flanges associated therewith together when said clamp-like elements are inserted in said last mentioned apertures and thereafter deformed, one of said clamp-like elements being provided with triangulated flange engaging components comprised of a pair of opposed legs one of which is deformable and a shoulder disposed on the same side of the one clamp-like element as said deformable leg said shoulder also being oppositely disposed to each of said opposed legs.

11. A modular wall system as set forth in claim 10 wherein a second layer of similarly configured flanged and interconnected and angularly oriented panels are superposed upon said first mentioned layer of panels and with the panels in said second layer being generally aligned with similarly oriented panels in said first layer, portions of the bottom ends of the panels in the second layer being in overlapping engagement with the top end tabs of the panels in the first layer, and with the apertures in the overlapping top end tabs and bottom ends of the panels in said layers being aligned, and a flange of a panel in said first layer serving as a bearing support for the flange of the panel of the second layer that is located immediately above the said first layer panel.

12. A modular wall system as set forth in claim 10 wherein the flanges on each of the panels are disposed at about an angle of 135° to a major face of the panel with which the flanges are associated.

13. A modular wall system as set forth in claim 10

wherein clamp-like elements to said one of said first mentioned clamp-like elements are used to removably yet securely lock superposed panels together, said second clamp-like elements being insertable in the apertures of the overlapped top end tabs and bottom ends of the superposed panels when the apertures of the said tabs and bottom ends are aligned.

14. In a modular wall system as set forth in claim 10 wherein each of said panels of generally quadrilateral shape, and provided with diverging flanges at opposing sides thereof which diverge at angle of about 135° from the same major face of the panel and wherein the apertures of the flanges, top end tabs and bottom ends are in the form of elongated slots.

15. A method of constructing a modular wall structure for use as a revetment or the like from a plurality of similarly configured wall panels each of which is provided with apertured side flanges on opposed sides thereof comprising the steps of orienting four such panels in generally right angular relationship to each other and such that the flange of one panel overlaps and combines with the flanges of the other panels to form a hub-like joint structure and with the various apertures in all the lapped flanges being aligned, removably inserting deformable fasteners in the aligned apertures of the panel flanges at said hub-like joint structure, then forming additional hub-like structures by overlapping the free side flange of one of the flanges of a plurality of other flanged and similarly configured panels to form a second hub-like joint structure, inserting deformable fasteners in the aligned apertures of the panel flanges at said second hub-like joint structure and continuing the formation of additional hub-like joint structures in the manner aforescribed and finally closing off any opening between pairs of panels on the outside of said wall structure by interposing similarly configured panels provided with flanged apertures therebetween and overlapping the flanges of the last mentioned enclosing panels with the flanges of certain pairs of panels on the outside of said wall structure and aligning the apertures of all of the last mentioned overlapped flanges and thereafter inserting deformable fastening elements in the aligned apertures of the flanges of the enclosing panels and the flanges of the pairs of panels being enclosed and deforming said fastening elements.

16. A method as set forth in claim 15 wherein certain of the panels forming said various joint structures are disposed along the same axial line.

17. A method of constructing at least one layer of cellular wall structure for use as a revetment or the like from interconnected panels of similar configuration and each of which is provided with opposing and apertured side flanges and apertured end tabs disposed intermediate said side flanges, comprising the steps of orienting four such panels in generally right angular relationship to each other and such that the side flange of any one panel overlaps and combines with one of the flanges on each of the other panels to form a hub-like assembly at the point of joinder of the panel flanges and with the various apertures in all the overlapped panel flanges at said hub-like assembly being aligned, removably inserting deformable fasteners in the aligned apertures of the overlapped panel flanges at said hub-like assembly and deforming said fasteners to draw and removably lock said overlapped panel flanges together, forming additional hub-like assemblies by overlapping the free side and apertured flange of one of the joined panels with the apertured flanges of a plurality of other similarly configured and flanged and apertured panels, then after aligning all of the last mentioned apertures of said last mentioned flanges removably inserting deformable fasteners in the aligned apertures of said last mentioned panel flanges, and continuing the formation of additional hub-like assemblies and the interconnection of further panels as aforescribed, and finally closing off any opening between any pair of panels located on the outside of said wall structure

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by interposing similarly configured enclosing panels provided with apertured flanges therebetween and overlapping the flanges of the last mentioned enclosing panels with the flanges of the pairs of panels being enclosed such that the apertures in all of the overlapped panel flanges are in registry and then removably inserting deformable fastening elements in said last mentioned apertures and then deforming said fastening elements.

18. A method as set forth in claim 17 wherein certain of the panels forming said various hub-like assemblies are disposed along the same axial line.

19. In a modular wall system comprised of a plurality of similarly configured panels, the module generating axis of certain ones of which are arranged at angles relative to the module generating axis of others of said panels to form at least one layer of a network of interconnected panels that define a cell-like structure, at least certain of said similarly configured panels being provided with opposing apertured planar side flanges which are arranged at angles of about 135° relative to the module generating axis of the panels and means for tightly yet removably securing said flanged panels together when said flanges of said last mentioned panels are overlapped and abutted one with another and the apertures thereof aligned, said means comprising deformable clamp-like elements inserted in the aligned apertures of the overlapped panel flanges, said clamp-like elements being provided with means for engaging and drawing the panel flanges associated therewith tightly together when said clamp-like elements are inserted in said apertures and thereafter deformed, one of said clamp-like elements having triangu-

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lated flange engaging components comprised of a pair of opposing legs one of which is deformable and a shoulder disposed on the same side of the one clamp-like element as said deformable leg but in opposition to both of said opposing legs.

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CERTIFICATE OF CORRECTION

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Lin W. Bowling et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 11, "or" should read -- of --; line 58, "where" should read -- while --. Column 6, line 26, "like" should read -- line --. Column 8, line 74, "enlarging" should read -- engaging --. Column 9, line 44, "flnages" should read -- flanges --. Column 10, line 1, "elements to" should read -- elements similar to --; line 9, "panels of" should read -- panels is of --; line 26, after "hub-like" insert -- joint --; line 27, "one of the flanges" should read -- one of the panels making up said first hub-like joint structure with the flanges --.

Signed and sealed this 24th day of November 1970.

(SEAL)

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Commissioner of Patents