

Oct. 29, 1968

H. G. YATES ET AL

3,407,546

FOLDABLE SHELTER STRUCTURE WITH ZIG-ZAG ROOF PROFILE

Filed Feb. 23, 1965

2 Sheets-Sheet 1

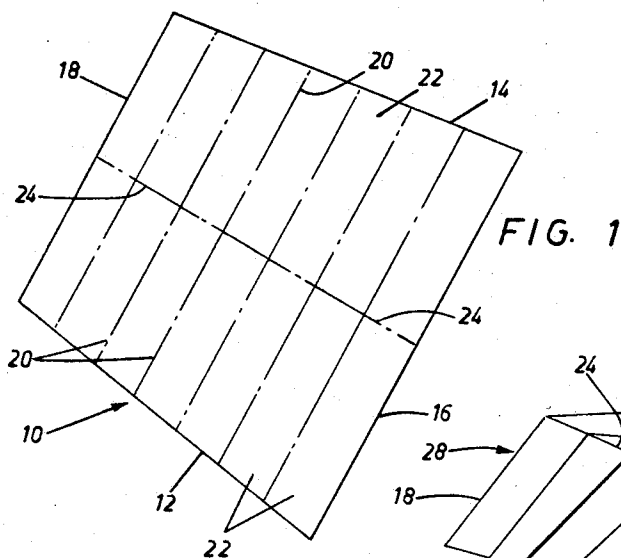


FIG. 1

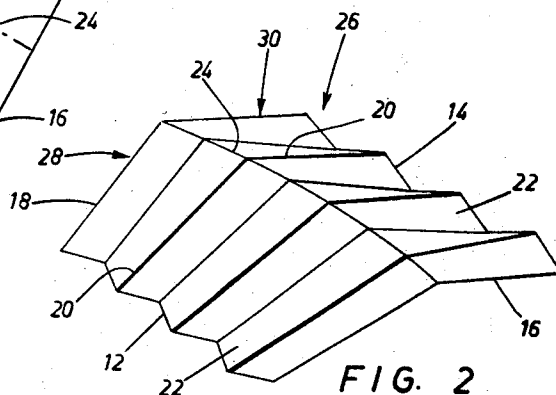


FIG. 2

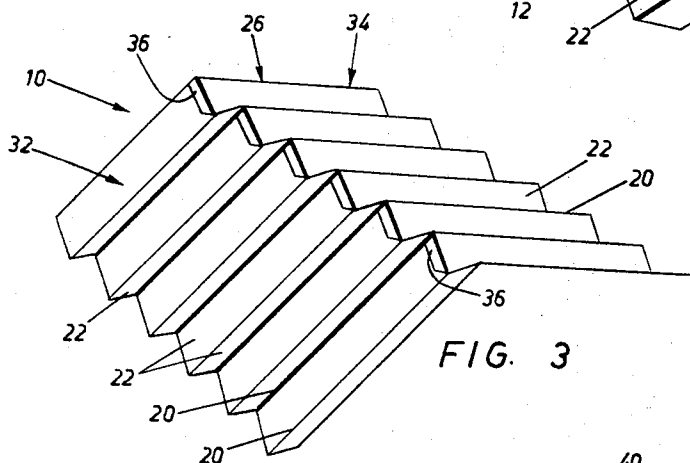


FIG. 3

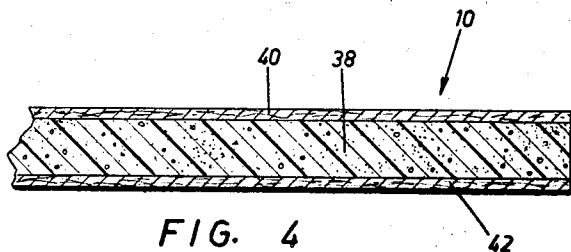


FIG. 4

INVENTOR.
HERBERT G. YATES
GEOFFREY WILCOX

BY

Daugherty S. Johnson

Attorney

Oct. 29, 1968

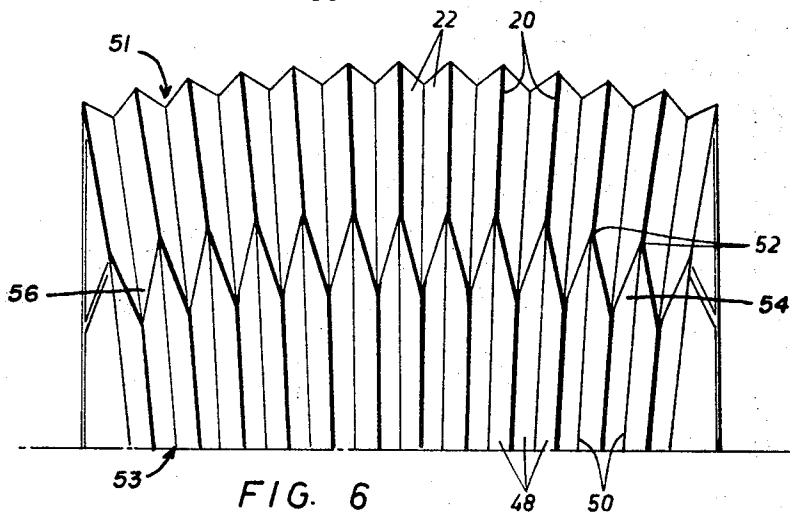
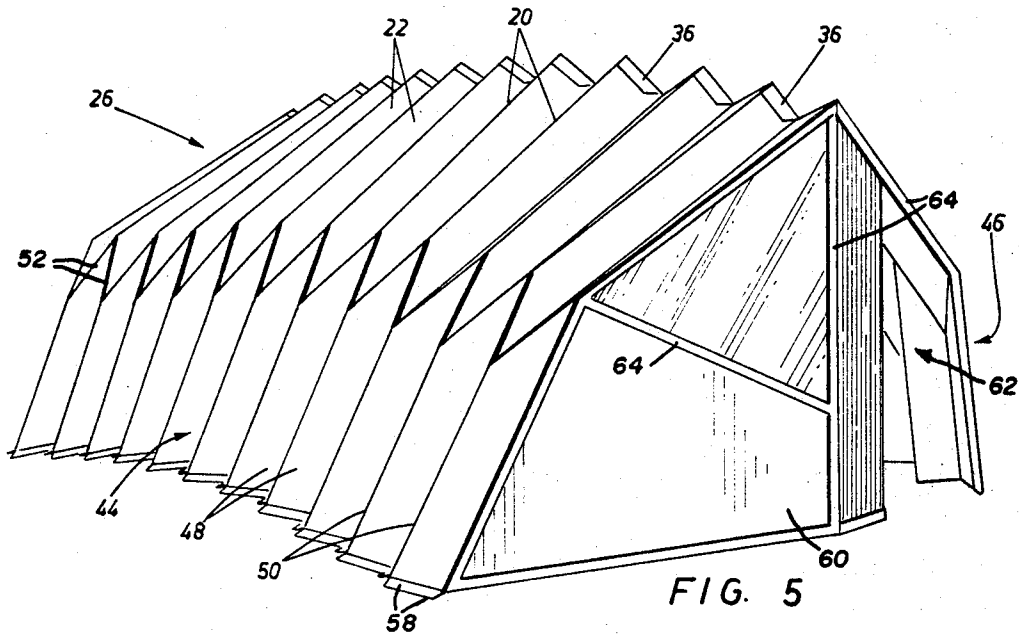
H. G. YATES ET AL

3,407,546

FOLDABLE SHELTER STRUCTURE WITH ZIG-ZAG ROOF PROFILE

Filed Feb. 23, 1965

2 Sheets-Sheet 2



INVENTOR.
HERBERT G. YATES
GEOFFREY WILCOX

Douglas S. Johnson

Attorney

1

3,407,546

FOLDABLE SHELTER STRUCTURE WITH ZIG-ZAG ROOF PROFILE

Herbert G. Yates, Scarborough, and Geoffrey Wilcox,
Richmond Hill, Ontario, Canada, assignors to Format
Industrial Corporation Ltd., Toronto, Ontario, Canada

Filed Feb. 23, 1965, Ser. No. 434,365

3 Claims. (Cl. 52—18)

ABSTRACT OF THE DISCLOSURE

A foldable shelter structure with a roof made from sheets of semi-rigid material that have been pleated or accordianated into parallel panels along fold lines normal to the roof peak. The roof peak has a zig-zag profile by reason of the two slopes of the roof being joined such that the outwardly projecting fold lines of each slope meet, and the inwardly projecting fold lines of each slope meet. Pairs of adjacent panels are then given mutually opposed twists about a line roughly parallel to their line of intersection, thereby to strengthen the panels.

This invention relates to a shelter structure and has particular relation to a foldable panel type shelter structure which will stand erect without the need for an auxiliary frame to provide the requisite rigidity.

A number of proposals have been made to provide panel type foldable portable shelter structures which are cheap and easy to manufacture but one difficulty encountered in their construction arises from the necessity to provide rigidity, particularly at the apex of the roof, without resorting to the use of struts or trusses to prevent collapse.

It is an object of the invention to provide a panel type foldable shelter structure which is quick and easy to erect and has a high degree of rigidity, particularly in the region of the apex of the roof, without the use of struts or trusses.

The invention will now be described in relation to the accompanying drawings, in which:

FIGURE 1 is a view of a length of sheet material provided with fold lines from which the panels of a shelter structure can be formed;

FIGURE 2 is a perspective view of the folding of the sheet of FIGURE 1 to provide the stressed condition in the panels;

FIGURE 3 is a view of another embodiment of the structure illustrated in FIGURE 2 but formed from a pair of attached scored sheets;

FIGURE 4 is a cross section of a preferred type of sheet;

FIGURE 5 is a view of a preferred type of shelter structure constructed according to the invention having side walls;

FIGURE 6 is a side elevation of the shelter structure shown in FIGURE 5.

Referring first to FIGURE 1 there is shown a plane sheet of material 10 having a front edge 12, a back edge 14 and sides 16 and 18. The size of the sheet 10 will vary with the length and height of the structure which it is desired to construct.

The sheet 10 is provided with a plurality of spaced apart fold lines 20 which extend from the front edge 12 to the back edge 14. The fold lines 20 are arranged whereby they define alternatively inwardly and outwardly projecting edges on the application of pressure to the sides 16 and 18 of the sheet of material 10.

The next step is to provide a further fold line 24 on the sheet 10 intermediate of the front edge 12 and the back edge 14 and substantially parallel thereto. The flat

2

sheet 10 is then transformed to the condition of FIGURE 2 by folding along the fold line 24 whereby the front edge 12 and the back edge 14 move downwards and the fold line 24 forms the roof of a shelter 26 in which the panels 22 form opposed side portions 28 and 30 with the fold lines 20 defining alternatively inwardly and outwardly projecting edges. The next step is to supply the requisite rigidity and in this embodiment rigidity is provided as indicated in FIGURE 2 by gathering the bottom of the side portions 28 and 30 together in concertina fashion and maintaining them in this position; it will be observed that the roof along the fold line 24 adopts an arcuate configuration. As a result of this movement of the bottom portions 28 and 30 each of the panels 22 is twisted about an imaginary line roughly parallel to the lines 20 defining its edges. It is to be noted that the twist in any two adjoining panels in relation to their length is in opposite directions. In this embodiment the provision of stress in opposed directions to an adjoining pair of panels 22 on erection of the structure 26 gives the roof along the fold line 24 the requisite strength without the necessity of providing separate roof struts.

Another embodiment of this invention is illustrated in FIG. 3 of the drawings. Here, the structure 26 is constructed of a sheet 10 comprised of two parts 32 and 34 each provided with the requisite fold lines 20. Each of the parts 32 and 34 is provided with flaps 36 and the two parts 32 and 34 are then aligned such that inwardly and outwardly projecting edges of the part 32 are aligned, respectively, with inwardly and outwardly projecting edges of the part 34, upon which the flaps 36 are glued in position as shown.

In the structure shown in FIG. 3, it is not absolutely necessary to give a twist in opposite directions to each pair of adjacent panels 22, and no such twist has been shown in FIG. 3. Twisting of the panels in this embodiment is not essential because considerable rigidity and strength is lent to the structure by the zig-zag profile of the roof "peak." Unless the individual panels 22 of the parts 32 and 34 are expanded or contracted in accordion fashion the zig-zag roof profile will strongly resist any attempt to change its peak angle. Naturally, it would not hurt to give the panels some degree of mutually opposed twist, but this will merely increase the considerable rigidity and strength that the structure already possesses.

The sheet 10 preferably has a thermally insulative core 38 sandwiched between a skin 40 and an opposed skin 42. Folding of the sheet 10 in the desired manner is conveniently induced by scoring the sheet 10 alternatively, in other words with respect to any one score line 20 on one skin 40 the immediately adjacent score lines 20 are provided on the opposed skin 42. A particularly useful type of sheet material comprises a core 38 of polyurethane which has been suitably attached to a skin 40 and an opposed skin 42 of linear board, the latter being then treated with suitable agents such as a concrete latex paint or polyethylene to ensure its ability to repel moisture and prevent deterioration.

As indicated in FIGURE 5 the stressed panels 22 of the roof structure 26 shown in FIG. 3 may be incorporated in a form of building in which there are lower side wall portions 44 and 46 which also have a pleated configuration of panels 48 which are substantially the same width as the panels 22. The side wall portions 44 and 46 may also be conveniently formed from sheets of the type already described and in order to provide the panels 48 the sheets are scored vertically with lines 50 which are also alternate with respect to the opposed outer skin 40 and inner skin 42.

The side wall portions 44 and 46 are joined to the roof structure 26 whereby the whole is foldable along the

junctions of pairs of panels 22 and 48. This is achieved by tapering each pair of adjacent panels 48 towards each other at their upper ends along diagonal lines 52 whereby each pair of panels 48 forms a tooth 54; the lower ends of each of a pair of panels 22 of the roof structure 26 are similarly tapered to form a tooth 56 corresponding in size with the tooth 54. The side walls 44 and 46 are then aligned to the roof structure 26 whereby the teeth 54 and 56 complement each other; the junction is made along the lines 52 by suitable means such as glue to provide a fold line connecting a score line 20 and 50 bearing the same relation with respect to the outer skins 40 and 42 respectively whereas aligned score lines 20 and 50 will bear an alternate relation with respect to the outer and inner skins 40 and 42 respectively of the material. In the result if pressure is applied to the ends of the roof structure 26 and the side wall portions 44 and 46 the whole will foldably collapse along the folding score lines 20 and 50 and connecting fold lines 52.

It is also possible to score a single sheet in such a way as to provide one half of the roof structure 26 integrally with its adjoining side wall portion, i.e., the side wall portion 44 and the half of the roof structure 26 visible in FIG. 5. This is accomplished by scoring the as yet unfolded sheet with a plurality of fold lines running from the "roof peak" edge of the sheet to the edge which will form the base of a side wall. The lines are scored such that, for example, a given line begins at 51 (FIG. 6) as an inwardly projecting edge line, and extends as such to its junction with the connecting fold line 52, at which point it changes to an outwardly projecting edge line and so continues to the point 53. The next adjacent line is exactly reversed, beginning at the "roof peak" as an outwardly projecting edge line, and changing to an inwardly projecting edge line where it meets line 52. The score lines alternate in this fashion over the whole width of the sheet. The entirety of the zig-zag fold line 52, however, is scored as an outwardly projecting edge.

Although considerable strength and rigidity are already present in the structure of FIGS. 5 and 6 due to the zig-zag profile of the roof peak, it is possible, as in the embodiment shown in FIG. 3, to increase the strength of the structure by giving mutually opposed twists to pairs of adjacent panels. Such stressing of the panels 22 in the structure 26 in the erected position illustrated in FIGURE 5 is achieved by application of pressure inwards at the mid point of the side wall portions 44 and 46 whereby they adopt an arcuate position, and the tension in the panels 22 is maintained by securing the bases of the side wall portions 44 and 46 by means of flaps 58. The ends of the side walls 44 and 46 will then be positioned closer together than the ends of the roof structure 26 and the panels 22 of the latter will adopt the twisted configuration already described with respect to FIGURE 2.

Alternatively, the length of the outer panels 22 and 48 of the wall portions 44 and 46 respectively may be adjusted whereby the bases are in a substantially straight line and the stress is still applied by bringing the ends closer together.

As indicated in FIGURE 5 the ends of the structure 26 with side walls 44 and 46 may be closed by suitable partitioning 60 provided with an opening 62. It will be appreciated, however, that the struts 64 simply support the partitioning 60 and are not necessary to provide the req-

uisite strength in the roof structure 26. Thus by way of example and not by way of limitation the structure as shown in FIGURE 5, without closed ends, constructed of $\frac{1}{4}$ " polyurethane sheet covered with cardboard which is primed with a latex paint withstood wind velocities up to 100 m.p.h. without collapse.

While certain embodiments have been illustrated and described for the purpose of disclosure, it will be understood that the invention is not limited thereto, but contemplates such modifications and other embodiments as may be utilized without departing from the invention.

We claim:

1. A collapsible shelter structure comprising a first and a second roof section, and a first and a second wall section, said sections being of semi-rigid weather proof material, each section comprising a plurality of substantially parallel-sided panels connected to one another by panel fold lines at said substantially parallel sides, said panel fold lines defining alternatively inwardly and outwardly projecting edges in the sections, the first and second roof section being connected to each other to provide an apex to said structure, said apex having a zig-zag profile by reason of the first and the second roof section being connected so that inwardly and outwardly projecting edges of the first roof section are aligned, respectively, with inwardly and outwardly projecting edges of the second roof section, the first and the second wall section being connected to the first and the second roof section respectively, the panel fold lines in each roof section being aligned with the panel fold lines in the corresponding wall section such that an inwardly projecting edge of a roof section meets an outwardly projecting edge of its corresponding wall section, and vice versa, each adjacent pair of panels having a mutually opposed twist along their length, such that each adjacent pair of panels is strengthened by torsion.

2. A collapsible shelter structure as claimed in claim 1, in which the ends of the wall sections are disposed outwardly with respect to their intermediate portions to give adjacent pairs of panels said mutually opposed twist.

3. A collapsible shelter structure as claimed in claim 1, in which the opposed lower ends of each wall section are closer together than the ends of said apex, whereby each pair of adjacent panels in the sections is subjected to said mutually opposed twists.

References Cited

UNITED STATES PATENTS

3,186,524	6/1965	Spaeth	52—630
2,982,290	5/1961	Hunziker	52—81
3,118,186	1/1964	Moss	52—71
3,203,144	8/1965	Fuller	52—81

FOREIGN PATENTS

1,280,028	11/1961	France.
1,162,042	1/1964	Germany.
380,933	10/1964	Switzerland.

OTHER REFERENCES

Modern Plastics, December 1958, pp. 91-93.

FRANK L. ABBOTT, *Primary Examiner.*

C. G. MUELLER, *Assistant Examiner.*