May 28, 1963 L. E. NICHOLSON 3,091,002

DEMOUNTABLE SHELTER

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Fig. 1.

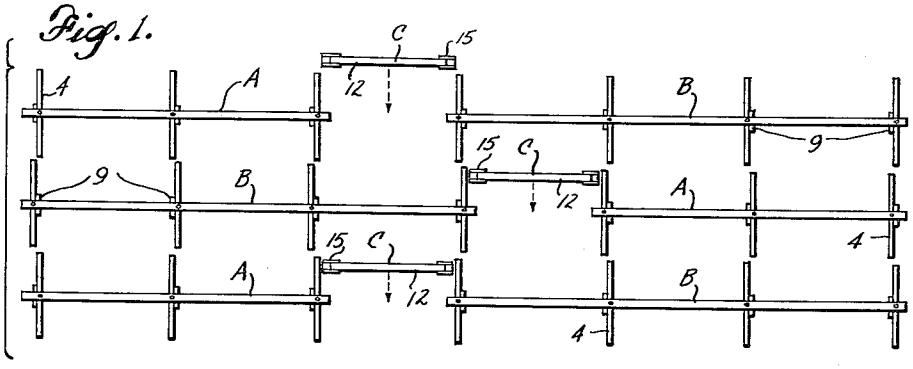
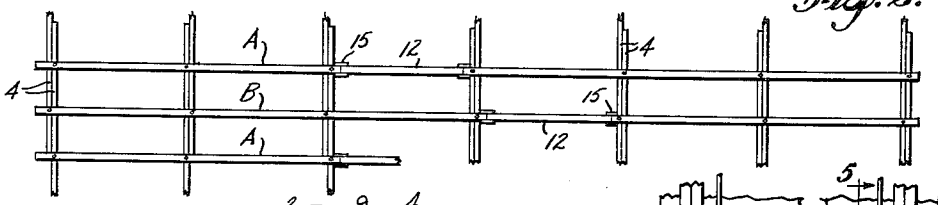


Fig. 2.



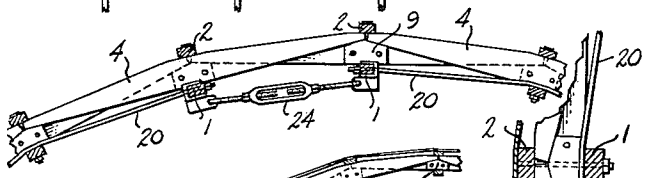


Fig. 6.

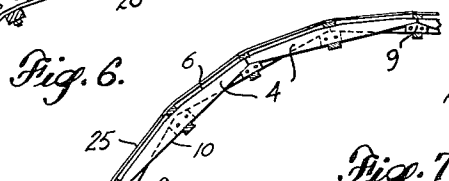
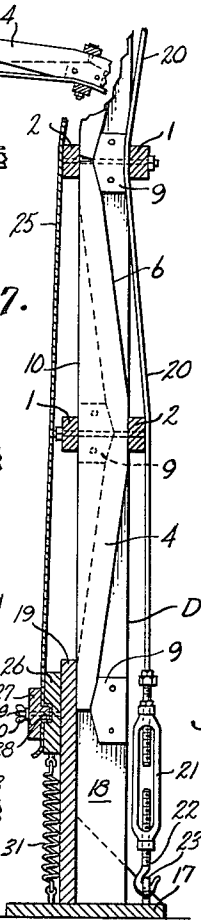


Fig. 7.



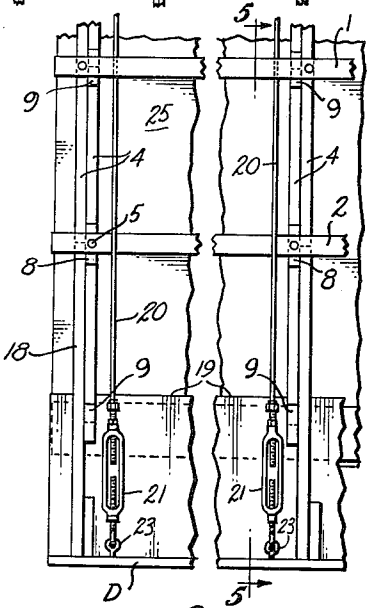


Fig. 4.

Fig. 5.

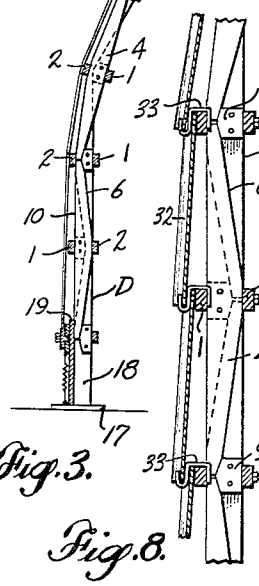


Fig. 3.

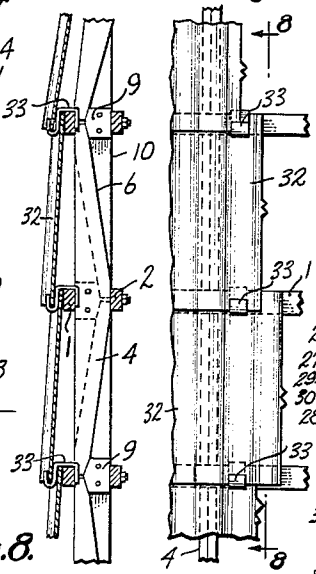


Fig. 8.

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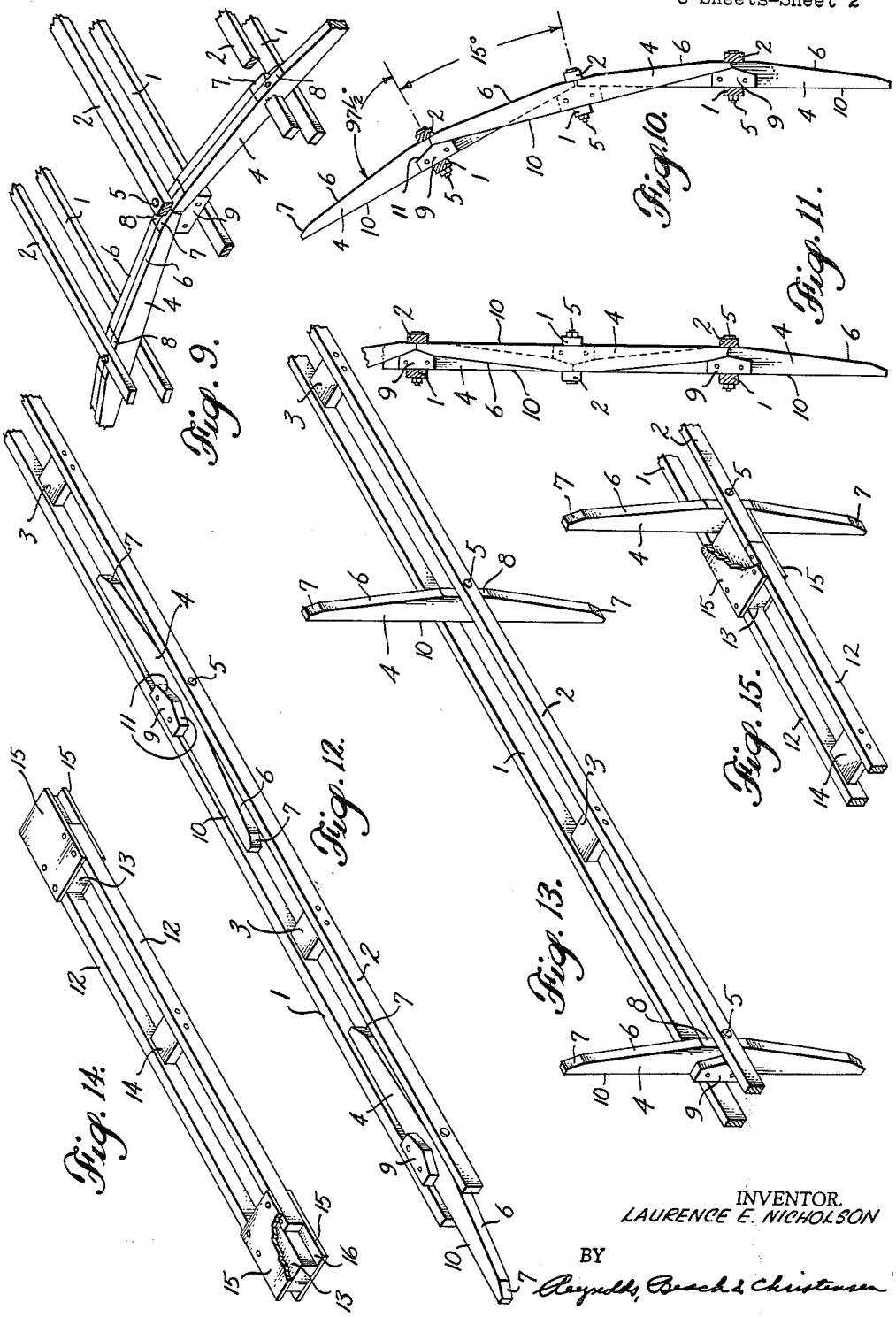


Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

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Fig. 16.

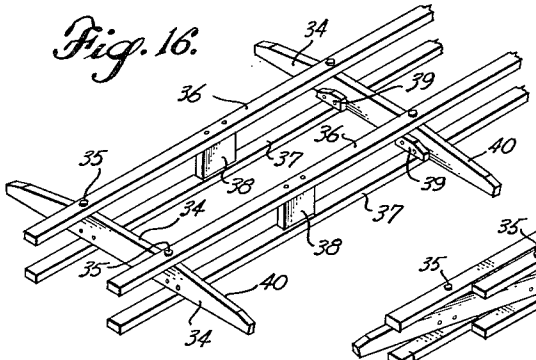
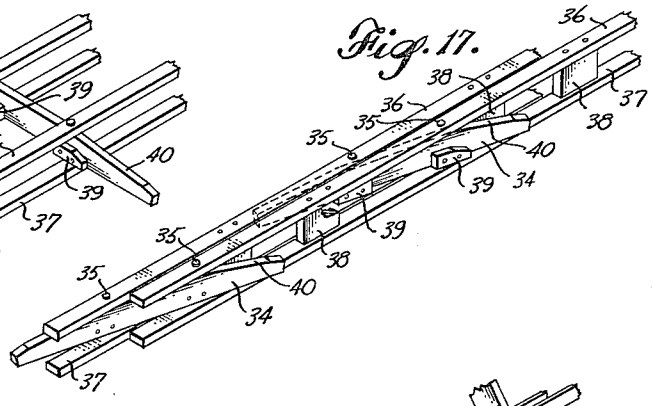


Fig. 17.



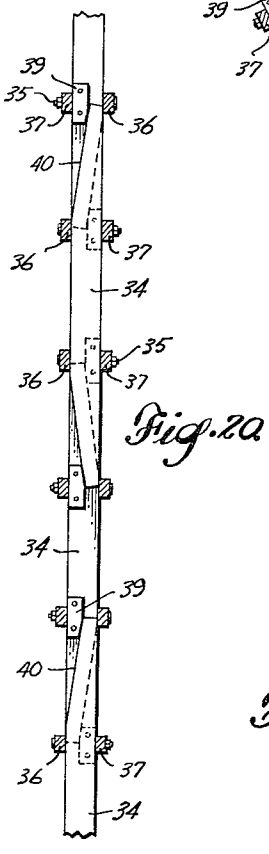


Fig. 20.

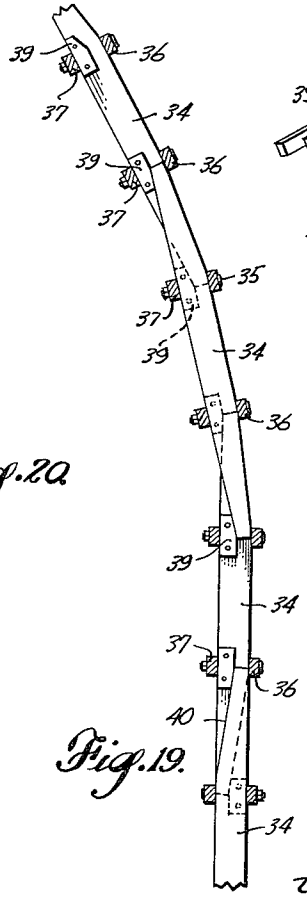


Fig. 19.

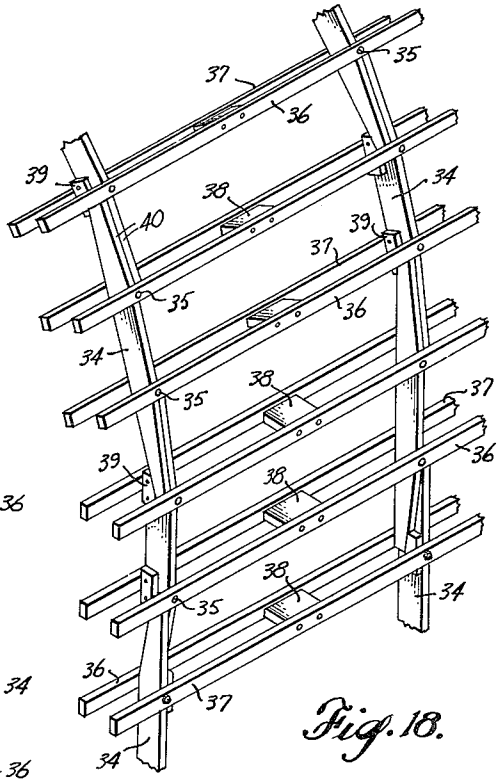


Fig. 18.

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Fig. 21.



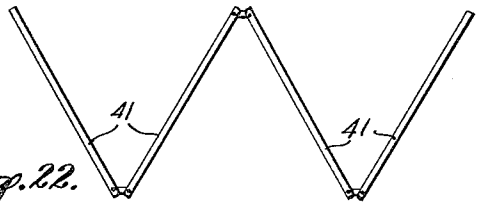


Fig. 22.

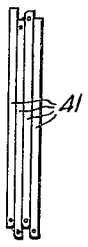


Fig. 23.

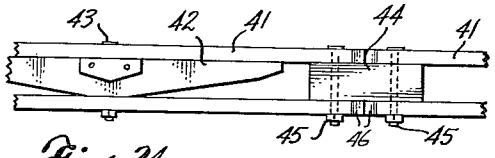


Fig. 24.

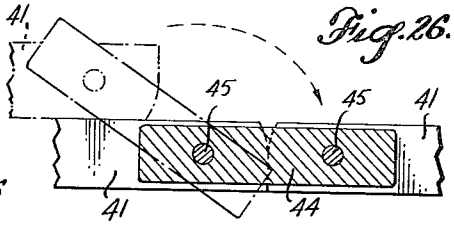


Fig. 26.

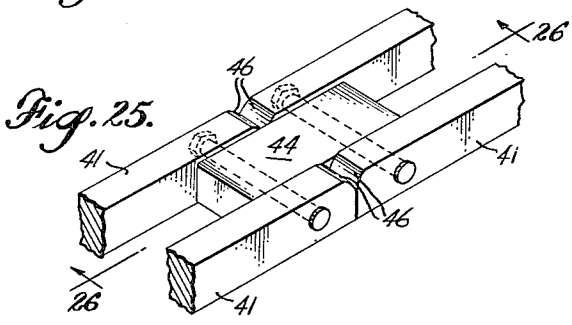


Fig. 25.

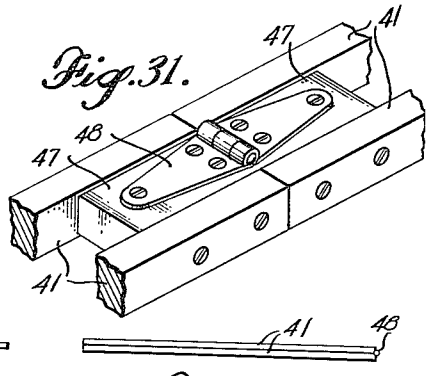


Fig. 31.

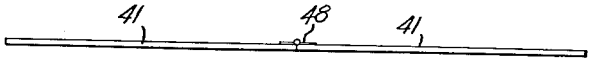


Fig. 27.

Fig. 28.

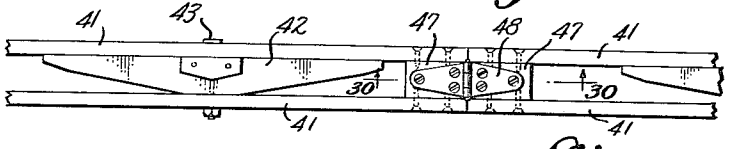


Fig. 29.

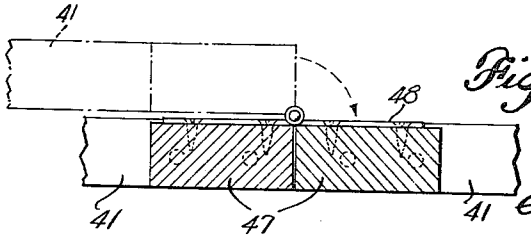


Fig. 30.

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Fig. 36.

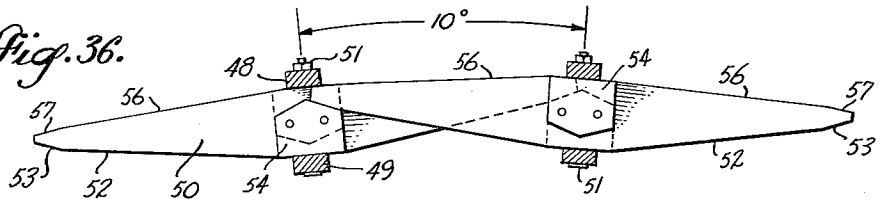


Fig. 37.

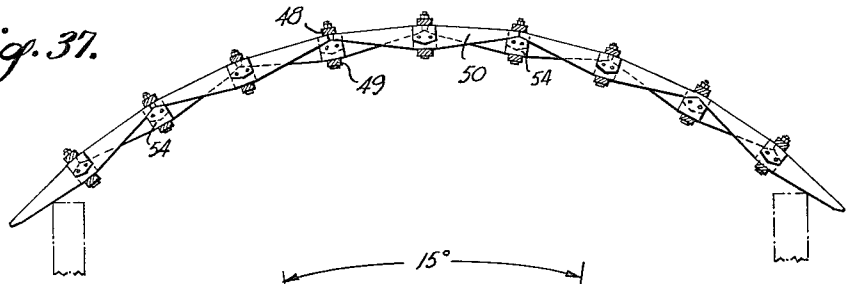
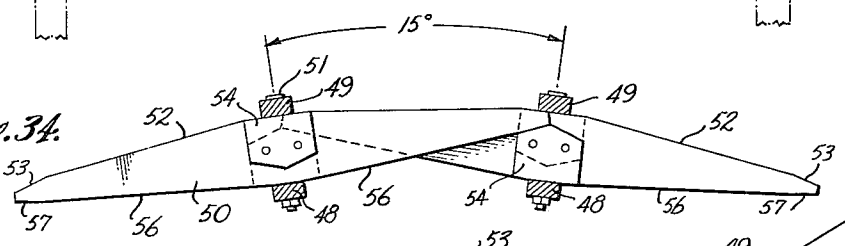


Fig. 34.



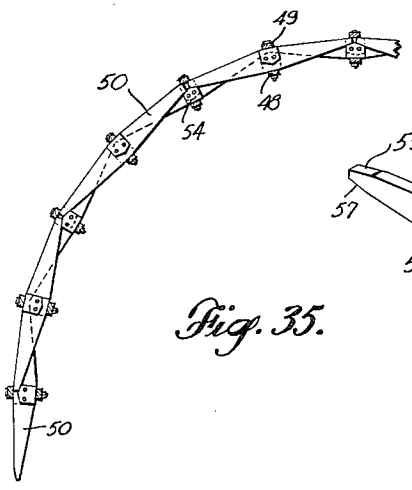


Fig. 35.

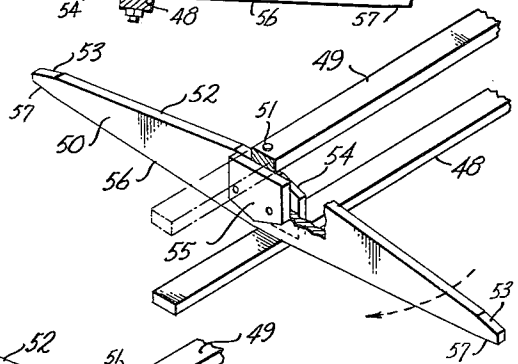


Fig. 32.

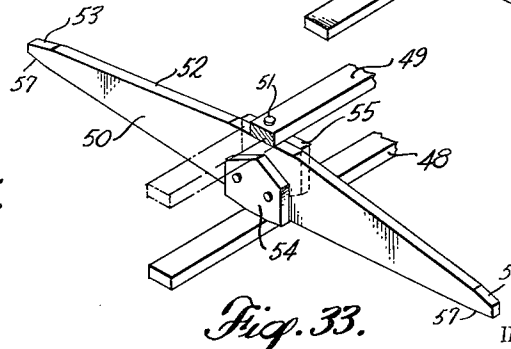


Fig. 33.

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Fig. 39.

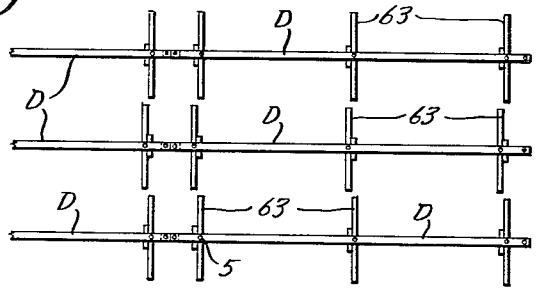
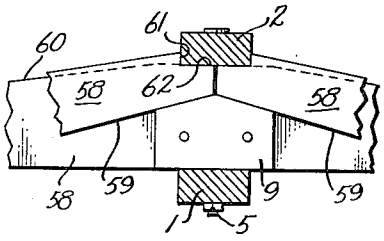


Fig. 38.



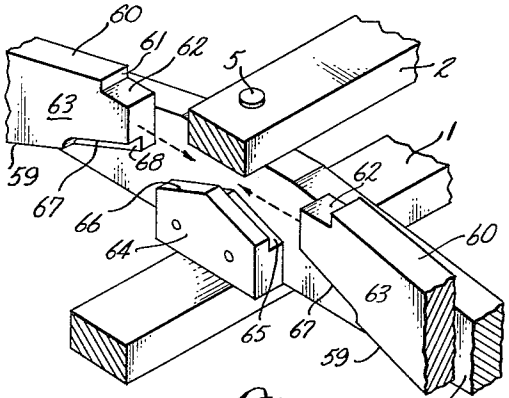


Fig. 40.

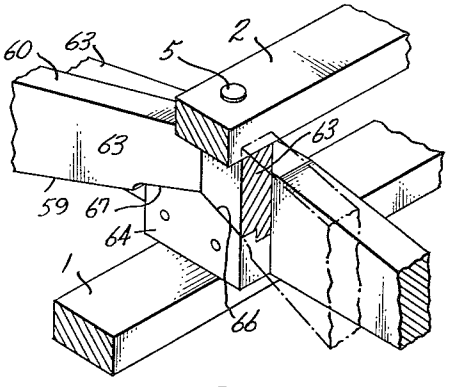


Fig. 41.

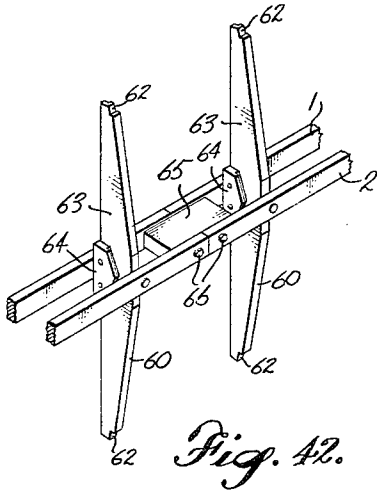


Fig. 42.

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United States Patent Office

3,091,002
Patented May 28, 1963

3,091,002

DEMOUNTABLE SHELTER

Laurence E. Nicholson, 404 2nd St., Anacortes, Wash.

Filed Nov. 21, 1958, Ser. No. 775,413
8 Claims. (Cl. 20—2)

The shelter of the present invention is intended primarily for temporary use and has special utility for protecting from the weather articles or materials to be stored, or may be used as a workshop such as during the construction of a building of permanent type.

A principal object of the present invention is to provide a shelter structure which is light and made of a minimum quantity of economical materials while being strong and rigid.

To facilitate temporary use of the shelter, it can be erected or set up easily and quickly without special tools and can be knocked down again with equal facility.

The components of the shelter can be assembled and held in assembled condition without being connected by fastening devices such as nails, screws, clips or the like, although the shelter is fabricated from a large number of small components. The variety of such components is kept to a minimum, however, and they can be assembled in different relationships to provide shelters of different shapes. Moreover, components of the same type can be made in different sizes and the number of components utilized can be varied to construct shelters of different size. When disassembled, the components can be stored compactly.

A shelter structure having these advantages can be constructed from a multiplicity of wood stringer and rib spreader components. Each principal component includes at least one stringer and a plurality of rib spreaders which are collapsible for storage, such as the spreaders being swiveled on the stringers. For shelters of considerable length, connector components may be utilized to bridge between adjacent stringers. The assembled components can be bound together to form a rigid frame which can be covered by a skin of either stiff or limp sheet material.

FIGURE 1 is a view showing components in relationship to be assembled but still disengaged, and FIGURE 2 is a similar view showing such components interengaged.

FIGURE 3 is a fragmentary vertical sectional view through an assembled shelter.

FIGURE 4 is a fragmentary inside elevation of an end portion of such a shelter, and FIGURE 5 is an enlarged vertical section taken on line 5—5 of FIGURE 4.

FIGURE 6 is a fragmentary elevation view of an alternate type of shelter frame structure.

FIGURE 7 is a fragmentary exterior elevation of a modified form of shelter, and FIGURE 8 is a sectional view on line 8—8 of FIGURE 7.

FIGURE 9 is a top perspective view of portions of components shown interengaged with parts broken away.

FIGURE 10 is an end view of components assembled in the relationship shown in FIGURE 9, and FIGURE 11 is a similar view showing an alternate assembly of such components.

FIGURE 12 is a top perspective view of an end portion of a stringer component in collapsed condition, and FIGURE 13 is a similar view of such a component, in expanded condition.

FIGURE 14 is a top perspective view of a connector component with parts broken away.

FIGURE 15 is a top perspective view of an end portion of a stringer component in expanded condition engaged with an end portion of a connector component, parts being broken away.

FIGURE 16 is a top perspective view of an end portion of another type of stringer component in expanded condition, and FIGURE 17 is a similar view of such component collapsed.

FIGURE 18 is a top perspective view of end portions of assembled stringer components of the FIGURE 16 type, and FIGURE 19 is a vertical sectional view through such assembly.

FIGURE 20 is a vertical sectional view through stringer components of the FIGURE 16 type assembled in a relationship different from that of FIGURE 18.

FIGURE 21 is an edge view of a foldable stringer component in unfolded condition, FIGURE 22 is a similar view of such component partially folded, and FIGURE 23 is a similar view of such component fully folded.

FIGURE 24 is a side view of a portion of the stringer component of FIGURE 21 from line 24—24 of FIGURE 21.

FIGURE 25 is a top perspective view of a folding joint shown in FIGURE 24, and FIGURE 26 is a sectional view through the joint on line 26—26 of FIGURE 25.

FIGURE 27 is an edge view of a different type of stringer component shown in unfolded condition, and FIGURE 28 is a similar view of such component folded.

FIGURE 29 is a side view of a portion of the component of FIGURE 27 in unfolded condition, and FIGURE 30 is a sectional view through a portion of such component taken on line 30—30 of FIGURE 29. FIGURE 31 is a top perspective view of a foldable joint in such a component.

FIGURE 32 is a top perspective view of an end portion of an alternative type of stringer component with parts broken away, shown expanded in one manner, and FIGURE 33 is a similar view of the same component expanded in a different manner. FIGURE 34 is a transverse section through such components expanded in the manner illustrated in FIGURE 32 and shown interengaged, and FIGURE 35 is a similar view showing a multiplicity of such components assembled. FIGURE 36 is a transverse sectional view through such components expanded in the manner illustrated in FIGURE 33, and shown interengaged, and FIGURE 37 is a similar view showing a multiplicity of such components interengaged.

FIGURE 38 is a fragmentary elevation of modified components assembled.

FIGURE 39 is a view of further modified stringer components ready for assembly. FIGURE 40 is a fragmentary perspective view of portions of such components in adjacent relationship, and FIGURE 41 is a similar view of the same parts of such components assembled. FIGURE 42 is a top perspective view of a joint between such components.

Especially in connection with construction work, it frequently is desirable to protect from the weather lumber and other building materials. In some instances, it is desirable to provide an area protected from the weather for processing such materials, such as for cutting steel and lumber and perhaps fabricating building elements by welding or laminating. Also, shelters of temporary character are frequently useful for covering vehicles such as automobiles and boats during storage, or while building a boat, for example. Temporary shelters are also useful for actually housing construction crews, especially during the summer. Shelters embodying the present invention may be used either as temporary shelters or for extended periods.

The shelter of the present invention has a curved roof which preferably is curved substantially semi-cylindrically and may be of any length. The degree of roof curvature and the width of the building are governed principally by the particular design of the individual rib components because each component will span a predetermined angle. The formation of the rib section will determine the size of such angle and the length of the chord over which such

angle is turned. In the following description, representative angles of 15° and 10° between stringers have been selected for purposes of illustration, but it will be understood that such angles may be increased or decreased by altering the design of the building components.

The shelter is fabricated from three principal types of structure: first, a frame composed of stringer components including rib spreader elements which can be assembled in interfitting relationship and may include connector stringer components; second, tying structure to integrate the stringer components in assembled condition into a unitary shelter frame; and third, a skin of sheet material covering the frame which may be either transparent, translucent or opaque, continuous or in sections, of stiff material or limp material, and, if of stiff material, may be smooth or corrugated. Also, a wide variety of materials can be used such as cloth, plastic or metal.

While the stringer components forming the frame also can be made of metal, plastic or other materials, it is preferred for the sake of economy to use wood. The strength and weight of wood is quite satisfactory for shelters of reasonable size. A preferred type of stringer component is shown in FIGURES 12 and 13 as including a stringer formed by parallel stringer strip elements 1 and 2 interconnected in spaced parallel relationship by filler blocks 3 secured between them at intervals along their length. Rib spreaders 4 are carried by the stringer extending transversely of the length of the stringer and spaced lengthwise of it. Such spreaders are of a width to be received between the stringer strips 1 and 2. It is preferred that the stringer components be collapsible, for which purpose rib spreaders are mounted by pivots 5 for swiveling between the collapsed position shown in FIGURE 12, in which the spreaders are disposed substantially coplanar with the stringer strips 1 and 2, and the expanded condition of FIGURE 13, in which the rib spreaders are disposed tranversely of the stringer strip elements 1 and 2 so that their end portions project equidistantly beyond opposite sides of the stringer elements. The intervals between the filler blocks 3 preferably are sufficiently great to accommodate rib spreaders 4 disposed lengthwise between the filler blocks.

The length of the spreaders 4 determines the spacing between the stringers when the stringer components are assembled. When adjacent stringer components are assembled in side-by-side relationship, as shown in FIGURES 2 and 9, the end portions of rib spreaders of adjacent components will overlap. Consequently, the spacing of the stringers will be approximately one-half of the length of the spreaders 4, and the width of a composite rib measured lengthwise of the stringers will be twice the thickness of a spreader 4. Such arrangement provides quite a strong and rigid frame structure.

It is, of course, necessary to interengage elements of adjacent components when they are assembled so as to transmit stresses from one component to the next component lengthwise of the spreaders when they are in expanded condition. To provide proper fitting of the spreaders of adjacent components, the opposite end portions of each spreader are tapered, each spreader having an edge with end portions inclined oppositely from the central portion of such spreader edge over the major portion of the spreader length. One edge 10 of the spreader may be perpendicular to a central plane through the stringer carrying such spreader and the opposite edge portion 6 will be at an angle greater than 90° to such plane. In forming such taper or edge incline, consideration should be given to the angular displacement desired between the central planes of adjacent components. In order to enable the inclined edges of the rib spreaders to be disposed coplanar when the components are assembled as shown in FIGURE 9, the angle between the central radial plane through the stringer and the inclined edge 6 of the end portion of the rib spreader extending

transversely of the stringer will be 90° minus one-half of the angle between the central radial planes through stringers of adjacent components when measured from the inner side of the components, and 90° plus one-half of the angle between such planes of adjacent components when measured at the outer side of the components. Stated in another way, the angle between the pivot axis 5 and each inclined edge 6 of the end portion of a rib spreader in expanded condition will be 90° plus one-half of the angle between the pivots 5 of adjacent interengaged components.

In the particular example shown in FIGURE 9, the angle between the central radial planes through adjacent stringer components and between the pivots 5 of adjacent components is shown in FIGURE 10 as being 15°. Consequently, the exterior angle between a central radial stringer plane or a pivot axis and the outer inclined edge 6 of the rib spreader, when measured at the outside of the shelter, will be 90° plus one-half of 15°, making 97½°.

The surface of the stringer strip 2 facing the stringer strip 1 is perpendicular to the axes of pivots 5 if the strips 2 are of rectangular cross section as is preferred. If the ends of rib spreaders of adjacent stringer components are to underlap the stringer strips 2, therefore, and bear evenly against their undersides, the tips of the rib spreaders must have chamfered corners 7. The included angle between the spreader edge portions 6 and 7 will be 180° minus one-half of the angle between the pivots 5 of adjacent components which, in the illustration given, will be 180° minus 7½°, or 172½°. When adjacent stringer components in expanded condition are assembled as shown in FIGURES 9 and 10, therefore, the edges of the overlapping spreader end portions will be in registry so that the surfaces 6 of adjacent spreaders will be coplanar and the chamfered corner surface 7 of each spreader will be coplanar with the central portion 8 of the adjacent spreader edge.

In order to enable the components to fit together tightly, sockets are provided for the ends of the rib spreaders. Such a socket may be formed by a bearing block 9 projecting from a side face of the central portion of a rib spreader and having an edge spaced from the stringer strip 2. Such block may be secured to the rib spreader by any suitable means such as nails, screws, rivets or adhesive. Each block has edges facing the stringer element 2 which are shaped for abutment by the inner edges 10 of the rib spreaders 4 of adjacent components and together form a peaked edge. If such spreader edges 10 are planar throughout their entire length, such peaked edge of the block 9 will have inclined surfaces 11 having an included angle of 180° minus twice the angle between the radial stringer planes or between the axes of pivots 5. Thus in the particular example given, the angle between edges 11 will be 180° minus twice 15°, or 30°, making the total included obtuse angle 150°.

In order to assemble the stringer components in side-by-side relationship as shown in FIGURES 3, 9 and 10, the pivots 5 of adjacent components must be offset lengthwise equal to the thickness of the spreaders in order to enable such spreaders to be disposed in face-to-face overlapping relationship, as shown in FIGURE 9. If the pivots 5 were spaced equidistantly along all the components, it would be necessary to have all the spreaders of one component in expanded condition on corresponding sides of the spreaders in the adjacent component in expanded condition. A disadvantage of such an arrangement is that there would be a possibility of adjacent stringers moving relatively lengthwise so that the shelter would tend to become narrower and finally to collapse. Relative endwise shifting of adjacent stringer components is prevented by providing two different types of components arranged in alternating relationship as shown in FIGURE 1.

In FIGURE 1, the two different types of components are designated A and B. In both of such components, the distances between adjacent pivots 5 along the lengths of the stringers is unequal according to a pattern. Thus the spacing between the rib spreaders in one bay will be greater than the spreader spacing in the adjacent bays along the length of a particular component by an amount equal to twice the thickness of a spreader. The spacing of the pivots 5 will vary correspondingly. The bearing blocks 9 will be located at the opposite ends of the longer bays and the shorter bays will not contain any bearing blocks 9.

When components are oriented in relationship to be assembled, narrow bays of one component will be placed in registry with wide bays of the adjacent component, as shown in FIGURE 1. Thus the components A each have one narrow bay and one wide bay, whereas the components B have two wide bays and a narrow bay between them. Such components are shown with two bays and three bays, respectively, only for purposes of illustration, and such components could be made much longer such as components A having four bays and components B having five bays, for example. In every instance, however, the bays will alternate in width along the length of each component. At each end of each component it is preferred that the stringer elements project at least a short distance beyond the rib spreaders.

While stop means could be provided in each component so that any given spreader could be swung in only one direction from its collapsed position to its expanded position, and only in the opposite direction back again to the collapsed position, provision of such stop means is unnecessary and it is quite satisfactory for each spreader to be rotatable without restraint about its pivot 5. In expanding the components from collapsed position by swinging the rib spreaders, it is only necessary to remember that such spreaders must be swung to dispose the bearing blocks 9 in the wider bays of the spreaders, as illustrated in FIGURE 1. Also, the components should be arranged so that the gap between the ends of adjacent components occurs in a narrow bay in each instance. Such selection of the gaps will insure that the gaps in adjacent lines of stringer units will be staggered as shown in FIGURE 1.

When the stringer components have been arranged on the ground with the rib spreaders in expanded condition, in the relationship shown in FIGURE 1, they can readily be assembled progressively to erect a shelter frame. If the stringer elements of the components extend over the full length of the shelter, no joint between components in alignment will be required. If the components do not extend over the entire length of the shelter, however, as is the case of the shelter structure shown in FIGURE 1, the endwise adjacent components should be assembled into a continuous unit lengthwise before it is assembled laterally with an adjacent component or components by movement transversely of its length. Thus, starting from the bottom of FIGURE 1, the first step will be to insert the stringer connector component C between the two components A and B, so that the stringers of all three components are in alignment.

Details of the stringer connector component are shown in FIGURE 14. Such component includes stringer strip elements 12 which are held in spaced parallel relationship by end filler blocks 13 and, if necessary, a central filler block 14. Side plates 15 overlap the end portions of the stringer strips 12 and the side faces of the end filler blocks 13 so as to provide sockets 16 adjacent to opposite edges of the filler blocks 13. The manner in which the end projections of the stringer strips 1 and 2 fit in the sockets 16 of the stringer connector components is shown in FIGURE 15. These sockets may be of any desired length parallel to the stringer strip elements 12, and transversely of such elements are of a cross-sectional size and shape the same as the cross-sectional size and

shape of the stringer strip elements 12, 1 and 2. The stringer elements 12 may be of any length, but the aggregate length of each of such stringer elements and the projections on opposite ends of a component A or B should be equal to the width of a narrower bay of the stringer and rib spreader components.

When the components A and B in the lower row of components shown in FIGURE 1 have been joined by the adjacent end portions of the stringer strips 1 and 2 being fitted in the sockets 16 of the interposed stringer connector component C, and the components A and B of the next row of components have been similarly joined by the interposed stringer connector C, such aligned and joined components are assembled laterally by relative movement transversely of their lengths. By such movement, the adjacent ends of the rib spreaders will be placed in overlapping relationship as shown in FIGURE 2, and the ends of the spreaders will be wedged into the sockets between the blocks 9 and the stringer components 2 in the manner shown in FIGURES 9 and 10. By such assembly, the pivots 5 of adjacent components and the radial planes of such components will of necessity be tilted at the angle of tilt for which the rib spreaders are designed which, in the present example, has been assumed to be 15°.

Following lateral assembly of the two lower components as described, the next row of aligned components shown at the top of FIGURE 1 will be joined in end-to-end relationship by insertion of the stringer connector component C between them. Such row or line of components will then be ready for assembly laterally with the already assembled rows of components by movement transversely of its length until the ends of its rib spreaders are wedged into the sockets provided, as described above. Additional components or rows of components may be assembled laterally in similar fashion, each one being tilted through the arc for which the rib spreaders were designed until an arcuate frame of the desired peripheral extent has been formed. Usually, it is preferred that the extent of such arc be approximately 180° so as to form a semi-circular frame. A frame of such arcuate extent would require thirteen frames assembled in such lateral relationship where the radial angles between adjacent frames were 15° in order to complete it.

In order to provide additional head room in a shelter having a semi-circular vaulted roof, it may be desirable to provide vertical side walls at each side of the roof frame. Such vertical side walls can be of any desired height and, as shown in FIGURES 3, 5 and 11, can be fabricated from the same type of stringer components described above. To form such a planar frame section, it is only necessary to assemble the components in a different fashion, namely to reverse alternate rows of components side-for-side. Thus, instead of all the inclined spreader edges 6 being at the same side of the frame, the arrangement of such edegs will alternate with the straight edges 10.

As shown best in FIGURE 11, the tip of the spreader 4 shown at the top of this figure may be considered to be the center spreader 4 shown in FIGURE 10. The top stringer shown in FIGURE 11 would then be the bottom stringer of FIGURE 10. Instead of the next lower row of components being arranged with their inclined edges 6 facing to the right, such row of components will be reversed side-for-side so that such inclined edges face to the left while the planar edges 10 face to the right. Because of this arrangement, the planar edges 10, instead of the chamfered corners 7, will abut the stringer strip 2, while such chamfered corners of the spreaders will abut the blocks 9. Similarly, the planar edges 10 of the spreaders of the components next to the top in FIGURE 11 will abut the stringer strips 2 of the reversed row of components and the chamfered corner surfaces 7 at the bottom of the spreaders will abut the blocks 9 of the reversed row of components.

The next lower row of components will not be reversed, but the inclined surfaces 6 of their spreaders will face to the right and the planar surfaces of such spreaders will face to the left. Again, however, the planar surfaces of the spreaders in the next to the bottom row of components will abut the stringer elements 2 of the lower row rather than the blocks 9, and the planar edges 10 of the upper ends of the spreaders of the lower row of components will abut the stringer strips 2 of the reversed row of components next to the bottom. If the planar wall is to be continued downward, the next lower row of components also would be reversed so that their planar edges would face to the right and their inclined edges would face to the left. In this fashion, the wall width may be continued to any desired extent by simply reversing side-for-side the alternate rows of components.

When the vertical portion of the side wall has been bulit to the height desired, the lowermost row of components may be base components differing from the stringer components A and B described above. Such base components D are shown in FIGURES 3, 4 and 5. Such base components include a sill element 17 on which the frame rests, and spreaders 18 are mounted stationarily on the sill 17. The lower portions of the spreaders may be of any convenient height and, at a location spaced upwardly from the sill 17, will have attached to them blocks 9 to fit rib spreaders 4 of the next higher component.

The block 9 in each instance will be located adjacent to the inner edge of the spreader 18 and a baseboard 19 will extend alongside and be secured to the outer edges of the spreaders 18. Such baseboard preferably is of a width to extend from the sill 17 upward to a location above the blocks 9 secured to such spreaders. The spacing between such baseboard and the blocks 9 will be proper to accommodate the tips of the rib spreaders projecting downwardly from the component next above the base component. Also, the portion of spreader 18 above the block 9 projecting from it will, in each instance, be tapered upwardly and of a length corresponding to one-half of the rib spreaders 10 of the other components. Consequently, the components above the base component may be assembled to provide a vertical frame portion of greater or lesser width above the base component or such upper components can be assembled into arcuate shape immediately above the base unit.

While the components have been described as being assembled with relation to each other in a general way either to form a frame of arcuate cross section or of partially straight and partially arcuate cross section, actually, in erecting a shelter frame, the components normally would be assembled progressively from opposite base units and would be joined at the middle, or the stringer components could be assembled starting in the middle of the arch and progressing toward the sides. Alternatively, sections of the frame could be constructed and then such sections could be assembled. The components could even be assembled so that the convex side of the frame would be downward, and the resulting frame is sufficiently light and strong that, after it has been completed, it can be inverted into standing upwardly convex condition.

By whatever procedure the frame or frame sections are fabricated, it is desirable to secure the stringer components in their assembled relationship. Conveniently, the assembled components can be bound together by ties 20 illustrated in FIGURES 4 and 5 as light rods or wires. Opposite ends of these ties will be secured to the opposite sides of the shelter or shelter section constructed and will be drawn tight by turning turnbuckles 21. A convenient anchor for such ties may be a hook 22 on one end of the turnbuckle 21 which is engaged in an eye 23 anchored in the sill 17 of a base component. As shown in FIGURE 5, these tie members can extend upward over the inner side of the vertical wall portion and then will pass between the stringer strips 1 and 2 and bear against the inner stringer strips 1 throughout the arched portion of the shelter frame. Tightening of the turnbuckles 21 will therefore draw all the spreaders of the stringer components into closely fitting relationship with the stringer strips and blocks forming the sockets in which they engage.

If the shelter is erected in sections, such a shelter conveniently can be constructed in two halves, in which case the tie members 20 for the opposite sections could be anchored to adjacent stringer elements approximately at the center of the shelter's arch. When the two sections of the shelter are assembled, the projecting ends of the rib spreaders 4 would be fitted with the stringer strips and blocks in the manner previously described and as shown in FIGURE 6. The stringer strips of the edge components of the sections can then be connected at intervals by turnbuckle tie members 24, and such turnbuckles can be tightened to draw the two sections into snugly fitting relationship and to hold them in such position.

After the frame has been erected in the manner described, its assembled and overlapping rib spreaders will be stronger than a laminated beam of similar proportions. The ends of the spreaders are not pierced by holes and take nearly al ltheir load in compression so that there is virtually no tendency of the wooden rib spreaders to split. Also, there are no stress concentration points produced by reliance upon clips or other fastening devices. To fabricate laminated beams, the wood must be bent, whereas the elements of the components in the frame of the present invention are all made of straight wood pieces or pieces cut to shape. Even the cut pieces do not have weak sections running parallel to the grain. The frame has the further advantage which a laminated beam or arch does not have of being able to be knocked down readily for storage by separating all the components and collapsing them one by one by swinging the rib spreaders into substantial parallelism with the stringer elements. Alternatively a shelter frame can be stored by disconnecting the turnbuckle connectors 24 and storing the separated sections without disassembling them.

The frame in erected condition can be covered by a skin 25 which may be composed of stiff or limp material as desired. In FIGURE 5, the skin is made of limp sheet material, the edges of which can be anchored to the base component alongside the baseboard 19. For this purpose, a strip 26, having in its outer side a longitudinal groove, is located alongside the baseboard in face-to-face relationship with it. The limp sheet material may be secured in such groove by a further strip 27 which has a tongue or rib 28 seated in the groove. The two strips are secured together by bolts 30 including wing nuts to facilitate tightening them. Marginal strip assemblies secured to opposite edges of the skin 25 can be drawn toward the sills 17 to tension the skin by helical tension springs 31 interconnecting the strip assemblies and the sill at intervals. Such springs will also urge the strip 26 into contact with the baseboard 19.

In FIGURES 7 and 8, a stiff sectional type of skin is illustrated, composed of corrugated strips 32 of a width to span from one component to the next component. Preferably, the opposite edges of each strip overlap completely the stringer elements behind them, and the edge portions of adjacent strips therefore overlap a distance equal to the width of a stringer element. Such sheet material, while being designated as "stiff," may be of corrugated aluminum, for example, of sufficiently thin gauge so that each strip can be rolled up for storage purposes. Alternatively, this strip material may be made of suitable plastic such as fiber-glass reinforced polyester resin which would be used in sections extending for a convenient distance lengthwise of the shelter, such as six to eight feet.

In either case, the skin section strips 32 can be supported from the outer stringer strips by hanger hooks 33 having one end portion to engage over a stringer element and an outer upwardly opening portion into which the lower edge of a strip can fit. In order to provide waterproof joints, such skin section strips can be arranged in shingled relationship so that the upper edge of each skin strip lies behind and above the lower edge of the next higher skin strip. As shown in FIGURE 8, the inner hook portion of the hanger hooks can be of a width to fit over both a stringer strip and the upper edge of a skin strip 32 and clamp these elements tightly together. When the lower edge of the next higher skin strip has been engaged in the upwardly opening hooks of the hangers, such skin strips will hold the hangers down in engagement with the stringer strips which the hanger hooks engage. A suitable cap strip may be provided of double the width of skin strips 32 and can be slid endwise to engage its opposite edges with the hanger hooks, which will keep the hanger hooks engaged by it positively spaced.

While the stringer components of the shelter frame described above have included rib spreaders assembled with only a single stringer, it is quite feasible to combine rib spreaders with two or more stringers if desired. It is preferred to have more stringer members spaced closer together where it is expected that the shelter will be subjected to greater loads. In the components shown in FIGURES 16 to 20, inclusive, the rib spreaders are pivoted to and interconnect a plurality of stringers. While each of the components illustrated includes only two stringers, a greater number of parallel stringers could be connected in similar fashion. Thus the rib spreaders 34 are connected by pivots 35 to parallel stringers including stringer strips 36 at one side of the rib spreaders and 37 at the opposite side of the rib spreaders. Moreover, to increase the strength further, it will be evident that the rib spreaders 34 could be made shorter and located closer together if desired.

Between the rib spreaders 34, it is preferred that the stringer strips be secured together and spaced apart positively by filler blocks 38 secured between the stringer strips. In the expanded condition shown in FIGURE 16, and in the collapsed condition of FIGURE 17, the rib spreaders and the stringers will remain parallel because the pivots 35 form of these members a parallelogram. In fully expanded condition the rib spreaders 34 will be disposed perpendicular to the stringers 36, 37, but as the stringers are moved closer together, in the process of the components being collapsed, the rib spreaders will be swung toward parallelism with the stringers but cannot be swung quite far enough to reach precise parallelism. The width of the stringer strips 36, 37 governs the closeness of the approach of the rib spreaders to parallelism with the stringers as indicated in FIGURE 17. The rib spreaders in collapsed condition of the components will, however, be nearly enough parallel to the stringers so that the components can be stored easily.

The expanded components can be assembled as shown in FIGURES 18, 19 and 20 in a fashion similar to the procedure for assembling the components described previously. Blocks 39 will be secured to the appropriate side of each rib spreader to be engaged by the ends of spreaders of adjacent components. Since each rib spreader is pivoted to a plurality of stringers, such spreaders cannot be swung side-for-side about a pivot relative to a particular stringer. Consequently, it is necessary for the blocks 39 to be attached to a particular side of each spreader so that, on adjacent spreaders, the blocks will project from sides facing each other. The spreaders will be secured to the stringers at locations such that adjacent spreaders of one component will fit inside adjacent spreaders of the next component as shown in FIGURE 18. When thus assembled, the portions of the spreaders projecting in cantilever fashion beyond the stringers will overlap similarly projecting portions of spreaders of adjacent components.

Components incorporating a plurality of stringers can have spreaders formed to enable a frame of generally arcuate character or a planar frame to be formed. The end portion of each spreader includes an inclined edge 40 and if such inclined edges are disposed all at the same side of the frame, the resulting frame will have a generally arcuate contour, as shown in the upper portion of FIGURE 19. If, however, alternate components are reversed side-for-side before being assembled, the resulting assembly will be planar as shown in the lower portion of FIGURE 19 and in FIGURE 20. As in the type of shelter described previously, the components may be arranged to form a planar frame of any desired height integrated with a generally arcuate frame portion. When the components have been assembled as shown in FIGURES 18 and 19, they can be secured in such erected condition by binding them together with tie members as described in connection with FIGURES 4 and 5. Also, a shelter frame thus constructed can be covered with a skin of either limp or stiff sheet material, using the construction and following the procedure described in connection with FIGURES 4, 5, 7 and 8.

While the components described above can be collapsed laterally into compact form for storage purposes in the manner described, it may be desired to enable the components to be stored in a relatively short space. Instead of the stringers being formed of continuous elements, therefore, such stringers can be formed of comparatively short sections which can be folded into overlapping relationship. One type of foldable component structure is shown in FIGURES 21 to 26, inclusive, as including stringer sections 41 connected by hinge means at locations between rib spreaders 42 swingably secured to the stringers by pivots 43. The hinge means utilized in this structure includes a filler block 44, which is connected to the adjacent ends of adjacent stringer sections 41 by pivot bolts 45, respectively. As shown best in FIGURE 25, the corners of the stringer elements at one side of the hinged joint have chamfered corners 46. The space between such corners will enable the stringer sections 41 to be folded from the solid line position of FIGURE 26 toward the broken line position without interference. Even though the pivots 45 are spaced from each other more than the width of a stringer 41, the stringer sections can be folded into contiguous edge-to-edge engagement by swinging the filler block 44 into the broken line position of FIGURE 26 which serves as a connecting link.

In collapsing a component of the type shown in FIGURES 21 to 26 inclusive, the first step is to swing the rib spreaders 42 into positions parallel to the respective stringer sections in which they are mounted, as shown in FIGURE 21. The next step is for the sections of the components to be folded alternately in opposite directions about the pivots 45 toward the relationship shown in FIGURE 22. The folding is then continued until the sections are in side-by-side contiguous abutment, as illustrated in FIGURE 23. During such folding of the sections, the hinge linkage will move from the solid line position of FIGURE 26 to the broken line position. By reverse movement of the sections 41, they can again be stretched from the relationship of FIGURE 23 through the relationship of FIGURE 22 into the aligned relationship of FIGURE 21.

An alternate type of hinge means for connecting the adjacent ends of adjacent stringer sections is shown in FIGURES 27 to 31. While, in these figures, only two stringer sections 41 are shown, it will be evident that any number of sections can be connected end-to-end simply by reversing the application of the hinge means at the opposite ends of each section. The rib spreaders 42 are mounted swingably between the elements of the stringer sections 41 by pivots 43 in the manner described in connection with

FIGURE 24. In this instance, the filler blocks 47 are secured between the end portions of the stringer strips for each section, such as by wood screws shown in broken lines in FIGURES 29 and 30, or by suitable adhesive or both. These filler blocks are then interconnected by a strap hinge 48, the leaves of which are secured respectively to the filler blocks 47 by screws shown in full lines in FIGURES 29 and 31, and in broken lines in FIGURE 30.

The axis of the hinge pintle, as shown best in FIGURE 30, is disposed n the plane of the joint between the two stringer sections 41, and is disposed alongside such stringer sections so that, in the folded condition shown in FIGURE 28, and in broken lines in FIGURE 30, the sections will lie close alongside each other but their ends will not interfere with each other in swinging from extended aligned position into folded position. Conversely, when the stringer sections are unfolded from the position of FIGURE 28 to that of FIGURE 27, relative swinging movement of the sections will be interrupted when they reach alignment by abutment of the adjacent ends of the stringer sections.

As has been explained above, the components described can be assembled to form either an arcuate frame portion or a planar frame portion. In some instances, it may be desirable to provide stringer and rib spreader components which can be employed in assembling frames of arcuate shape, but of different curvatures. Stringer and rib spreader components of this type are shown in FIGURES 32 to 37 inclusive. Such components are generally similar to the components shown in FIGURES 9 to 13 inclusive as including inner and outer stringer strips 48 and 49 with rib spreaders 50 mounted swingably between them by pivot bolts 51. Moreover, the edges 52 and chamfered corners 53 may be identical with the edges 6 and chamfered corners 7 of the spreaders shown in FIGURES 9 to 13.

A block 54 projecting from the side of each spreader 50 adjacent to its edge remote from the inclined surfaces 52 is comparable to the block 9 of each spreader 4 in the component shown in FIGURES 9 to 13. The ends of the spreaders 50 of adjacent components can be overlapped and engaged with the blocks 54 and stringer strips 49 in the manner shown in FIGURE 34 which is directly comparable to the engagement of the spreaders of adjacent components as shown in FIGURE 10. Progressive assembly of such components, with the inclined edges 52 of all components being on corresponding sides, will produce an arcuate frame as shown in FIGURE 35 which is of the same curvature as the frame shown in FIGURE 3, that is, the angle between the pivots or stringer planes of adjacent components is 15° as indicated in FIGURE 34 and FIGURE 10.

The same components of FIGURES 32 and 33 alternatively can be assembled to form an arcuate frame having a different degree of curvature which, for purposes of illustration, has been selected as of lesser curvature than the frame of FIGURE 35. In such alternate frame, the angle between the pivots or stringer planes of adjacent components has been selected as 10° as shown in FIGURE 36 instead of 15° as indicated in FIGURE 34. A frame having 10° angles between the pivots of adjacent components may be used to form an arched roof frame, for example, as illustrated in FIGURE 37. A frame of this type can be assembled from the components shown in FIGURES 32 and 33 simply by swinging all of the rib spreaders 50 end-for-end relative to the stringer elements 48 and 49, as indicated by the arrow in FIGURE 32 from the position of that figure to the position shown in FIGURE 33. Such reversal will place blocks 55, projecting from the sides of the rib spreaders 50 opposite blocks 54, at opposite sides of the wider bays of the components and facing each other in lieu of blocks 54.

When adjacent components are now assembled by lateral movement, the rib spreaders will be tilted oppositely because the blocks 55 are located adjacent to the edges 52 of the spreaders instead of remote from them. The curvature shown in FIGURES 36 and 37 results from the edges 56 of the rib spreaders 50 not being linear or planar as are the edges 10 of the rib spreaders shown in FIGURES 12 and 13, but such edges 56 also are inclined with respect to planes perpendicular to the pivots 51. Instead of being inclined relative to such planes by an angle of 7½° as are the edges 52, the edges 56 are inclined relative to such planes by an angle of only 5°. The chamfered corners 57 at the ends of the edges are inclined relative to the edges 56 also at an angle of 5°.

It will be evident that in designing the peaked edges of blocks 54 and 55, consideration must be given to the angles of both chamfered corners 56 and 57. Since, in both instances, the tips of the rib spreaders must fit between an inner surface of a stringer strip and the adjacent edge of a block 54 or 55, the peak angles of such blocks 54 and 55 will be the same. The angle between each side of the block's peak and the inner surface of the adjacent stringer strip will be 25°, taking into account the angle of both chamfered corners 53 and 57. Consequently, the obtuse peak angle of each block 54 and 55 will be 130°.

In the stringer and rib spreader components described above, location of adjacent components relative to each other depended upon the ends of the spreaders being pushed firmly into engagement between a stringer element 2 and a bearing block 9, as shown in FIGURES 9 and 10, for example. The tips of the spreaders are tapered and depending upon the moisture content of the wood of which the components are made the elements of each component will shrink or swell to some extent. Also, some persons might force the end of a stringer into its socket with greater pressure than another. If the spreader ends are not located reasonably accurately relative to their sockets, one stringer end may project beyond the peak of a bearing block 9. In that event, the end of the other spreader engaging such bearing block may be inserted into its socket an insufficient distance and so as to be looser than desired. Also, if the end of one spreader is forced into its socket with greater force than desirable, the bearing block and stringer elements may be subjected to excessive force.

In order to insure proper location of the ends of the spreader members relative to their sockets in adjacent stringer components, the ends of the spreaders can be provided with stop shoulders limiting movement of the spreader tips into their sockets. Such a construction is shown in FIGURE 38 in which the spreaders 58 are mounted on pivots 5 between the stringer strips 1 and 2. These stringer strips are like those shown in FIGURES 9 to 13, inclusive, and the bearing blocks 9 are of similar character. The central portions of the rib spreaders 58 are similar to the central portions of the rib spreaders 4 shown in the same figures, and one edge 59 of each of such spreaders is planar. The opposite edge 60 of each rib spreader is inclined but the taper between edges 59 and 60 will be less than the taper between edges 6 and 10 of the spreaders 4 for a given angle between the central radial planes of adjacent stringers when the components are assembled.

The reduction in angle between the opposite edges 59 and 60 of the spreaders 58 will provide sufficient stock width at the tips of the spreaders to form a shoulder 61 adjacent to the chamfered corners 62 of the spreader tips. Such shoulders will be spaced from the extreme end of the spreaders a distance approximately equal to one-half the width of the stringer elements 2. Consequently, when the tips of the spreaders are pushed into their sockets, their seating movement will be limited by abutment of the shoulders 61 with the sides of the stringer element 2. When the spreader tips are thus disposed, their extreme inner ends will not project into their sockets beyond the center of the stringer element 2. Each spreader element will therefore have adequate engagement in its socket.

In the stringer and rib spreader components described above, the spreader pivots are spaced unequally along the stringers so as to provide alternate wide bays and narrow bays. Such pivot spacing enables the spreader ends of adjacent components to be interfitted in overlapping relationship as illustrated in FIGURES 1 and 2. For such construction, however, as has been explained previously, it is necessary to provide two different types of components designated in FIGURES 1 and 2 as components A and components B. It is possible, however, to employ the principles of the present invention in a construction fabricated from components all of the same type. Such a construction is illustrated in FIGURES 39 to 42, inclusive.

In FIGURE 39, components D are shown arranged in side-by-side relationship ready for assembling by relative movement transversely of their length. It will be evident that the rib spreaders **63** of these components are arranged to be interfitted by such movement so that the adjacent ends of the spreaders of adjacent components will be disposed in overlapping relationship even though the pivots **5** are spaced equidistantly along the stringers **1**, **2**. While each of the components D is shown as having only two stringer bays, it will be evident that each component may have as many bays as desired, and the stringers can be continuous or can be foldable like the constructions described above.

While the shelter frame of the type shown in FIGURE 2 requires three different types of components to be interfitted, a comparable frame structure can be formed of the single type of component D shown in FIGURE 39, and such components can be joined end-to-end to form a shelter of any desired length by the simple expedient of positioning the components in adjacent stringer rows alternately end-for-end. While the spreaders **63** are all swung in the same direction relative to the stringer for each component, the blocks of alternate components will face in opposite directions as shown in FIGURE 39. Moreover, the length of the stringer section projecting beyond the last spreader pivot at one end of the component will differ from the projection of the stringer beyond the spreader pivot at the other end of such component by the thickness of a bearing block **64** or a spreader **63**.

When the adjacent stringer and rib spreader components are reversed end-for-end and the ends of adjacent components are in registry transversely of the length of the stringers, the spreaders of adjacent components are disposed in relationship offset sufficiently so that their adjacent ends can be assembled in side-by-side overlapping relationship. As the components are moved toward each other transversely of their lengths, therefore, the adjacent spreader ends will pass each other and the tips of the spreaders will engage in their respective sockets between the stringer element **42** and a bearing block **64** attached to the side of a spreader. Adjacent ends of stringers in longitudinally aligned components can be connected together to form a continuous stringer in any suitable fashion such as by placing a filler block **65** bridging between the adjacent ends of the stringer elements **1** and **2** in adjacent components and securing such block and the stringer ends together by bolts **66** as shown in FIGURE 42.

If the spreaders and bearing blocks of the components D, shown in FIGURE 39, were constructed like the rib spreaders **4** and bearing blocks **9** of the components shown in FIGURES 9 to 13, it would be possible for the components to be moved relatively endwise to move the overlapping ends of the spreaders apart. Such movement is prevented where components of the types designated A and B are interfitted as shown in FIGURE 1. In the arrangement of FIGURE 39, however, all of the spreaders of one component are at corresponding sides of the spreaders of adjacent components.

In order to prevent such separating movement of overlapping spreader ends, the spreader tips and their sockets are formed for interlocking engagement. The suitable interlocking construction is shown in FIGURES 40 and 41. The inclined sides of these spreaders have the same shape as the spreaders shown in FIGURE 38, namely an inclined edge **60** which is inclined at an angle less than the edges **6** of the spreaders shown in FIGURES 9 to 13. Such edges, then, have a shoulder **61** spaced from their extreme ends a distance equal to half the width of a stringer element **2** and between the shoulder and the extreme end of the spreader is the chamfered corner **62**. The opposite edge **59** is planar throughout its length, although the width of such surface is not uniform throughout its length.

The bearing block **64** projecting from one face of a spreader **63** has its peaked edge stepped so as to form a ledge **65** adjacent to the spreader and a ridge **66** spaced from the spreader defining a groove between the ridge **66** and the adjacent side of the spreader. The bottom of the groove formed by the ledge is spaced from the stringer strip **2** a distance equal to the spacing of the peaked edge of bearing block **9** from the stringer strip **2** in the components shown in FIGURES 9 to 13 and 38. The ridge **66** projects beyond the ledge **65** by any desired reasonable amount.

In order to enable the tips of spreads **63** to fit into the sockets between the bearing blocks **64** and the stringer strip **2**, it is necessary to form in the tip end portion of each spreader a recess **67** of a depth to accommodate the ridge **66**. Also, the extent of such recess transversely of the spreader must in each instance be at least equal to the thickness of a ridge **66**. As the end portions of the spreaders **63** are moved transversely of the lengths of the stringers toward their sockets as indicated by the broken arrows in FIGURE 40, the projections **68** of the spreader ends will lodge in the grooves **65** while the ridges **66** wedge into the recesses **67**, as shown in FIGURE 41. Such engagement of the projections **68** in the grooves will prevent the ends of the spreaders fitted into their sockets from being moved past the ridges **66** and, consequently, the overlapping end portions of the spreaders will be held against separation in a direction transversely of the lengths of the spreaders and parallel to the lengths of the stringers.

After the components D have been assembled in the manner described, they may be secured together into sections of a shelter or into a complete shelter frame in the manner described in connection with FIGURES 4 and 5, and then the frame can be covered with a skin as discussed with relation to FIGURES 4, 5, 7 and 8.

I claim as my invention:

1. A demountable shelter component comprising elongated stringer element, an elongated rib spreader, having its length extending transversely of the length of said stringer element, pivot means mounting said rib spreader at one side of said stringer element for swinging between an expanded position disposed transversely of said stringer element and a collapsed position disposed substantially parallel to said stringer element, and a block secured to one of the sides of said rib spreader and spaced from said stringer element in a direction transversely of said rib spreader, forming between said block and said stringer element a socket for reception of the end portion of a rib spreader of another similar shelter component.

2. A demountable shelter component comprising an elongated stringer having its length divided into a plurality of elongated sections and having hinge means interconnecting said sections for relative folding from substantially end to end aligned relationship into overlapping relationship to reduce the overall length of said stringer for storage, an elongated rib spreader for each stringer section, and pivot means located between the ends of stringer sections, respectively, and mounting each rib spreader on its stringer section for swinging between an expanded position projecting from its stringer section transversely of the length of such stringer section and a collapsed

position swung toward parallelism with its section, and socket means on each of said stringer sections for engagement with a rib spreader of another shelter component.

3. A demountable shelter component comprising an elongated stringer, a plurality of elongated rib spreaders, a plurality of pivot means disposed in spaced relationship along the length of said stringer and mounting said rib spreaders, respectively, for swinging between expanded positions disposed transversely of said stringer and collapsed positions swung toward said stringer, and socket means forming a notch between said stringer and one of the sides of each of said rib spreaders adjacent to said stringer for engagement with a rib spreader of another shelter component.

4. A demountable shelter frame structure comprising a plurality of stringer components each including a stringer, said stringer components being assembled with their stringers in parallel relationship, a first one of said stringer components having a rib spreader pivotally mounted between its ends on a stringer of its stringer component for movement between a position extending transversely of such stringer and a collapsed position generally parallel to such stringer, and socket means on one side of said first stringer component rib spreader spaced from the ends of such rib spreader and engaging the end portions of adjacent stringer component spreaders in relationship lengthwise overlapping said first stringer component rib spreader.

5. A demountable shelter component comprising a stringer, a plurality of rib spreaders, a plurality of pivot means disposed in spaced relationship along said stringer and mounting the central portions of said rib spreaders, respectively, for swinging of said rib spreaders relative to said stringer between expanded positions disposed transversely of said stringer with their opposite free end portions extending a substantial distance beyond said stringer for engagement with adjacent stringers, respectively, and collapsed positions swung toward said stringer, and each of said rib spreaders having socket means spaced from its ends of a shape complemental to the end portions of said rib spreaders for receiving an end portion of a rib spreader of a similar adjacent component.

6. A demountable shelter component comprising a stringer including spaced parallel inner and outer stringer strips, a plurality of rib spreaders disposed between said stringer strips, a plurality of pivot means disposed in spaced relationship along and extending between said stringer strips and mounting the central portions of said rib spreaders, respectively, for swinging of said rib spreaders between expanded positions disposed transversely of said stringer with their opposite free end portions extending a substantial distance beyond said stringer for engagement with adjacent stringers, respectively, and collapsed positions swung substantially parallel to said stringer, and each of said rib spreaders having socket means spaced from its ends of a shape complemental to the end portions of said rib spreaders for receiving an end portion of a rib spreader of a similar adjacent component.

7. A demountable shelter frame structure comprising a plurality of spaced, substantially arcuate, substantially parallel upright frames, each of said frames being composed of rib spreaders assembled with portions of adjacent spreaders disposed in lengthwise overlapping relationship, and a plurality of elongated substantially horizontal stringer elements disposed in parallel arrangement spaced lengthwise of said frames, each of said stringer elements having a surface disposed substantially tangential to one of said arcuate frames bearing on an edge portion of a first rib spreader in such frame between the ends of such first rib spreader, and said stringer element having a surface disposed substantially perpendicular to said first rib spreader abutting a surface of a second rib spreader in the same frame which surface is disposed transversely of the length of said second rib spreader, for preventing movement of such stringer element lengthwise of such frame.

8. The demountable shelter frame structure defined in claim 7, in which the stringer element engaging the frame is disposed outwardly of such frame, the inner surface of such stringer element engages the outer edge of the first rib spreader and an end portion of the second rib spreader has a notch adjacent to its outer edge forming a shoulder constituting the surface of the second rib spreader abutted by the stringer element.

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