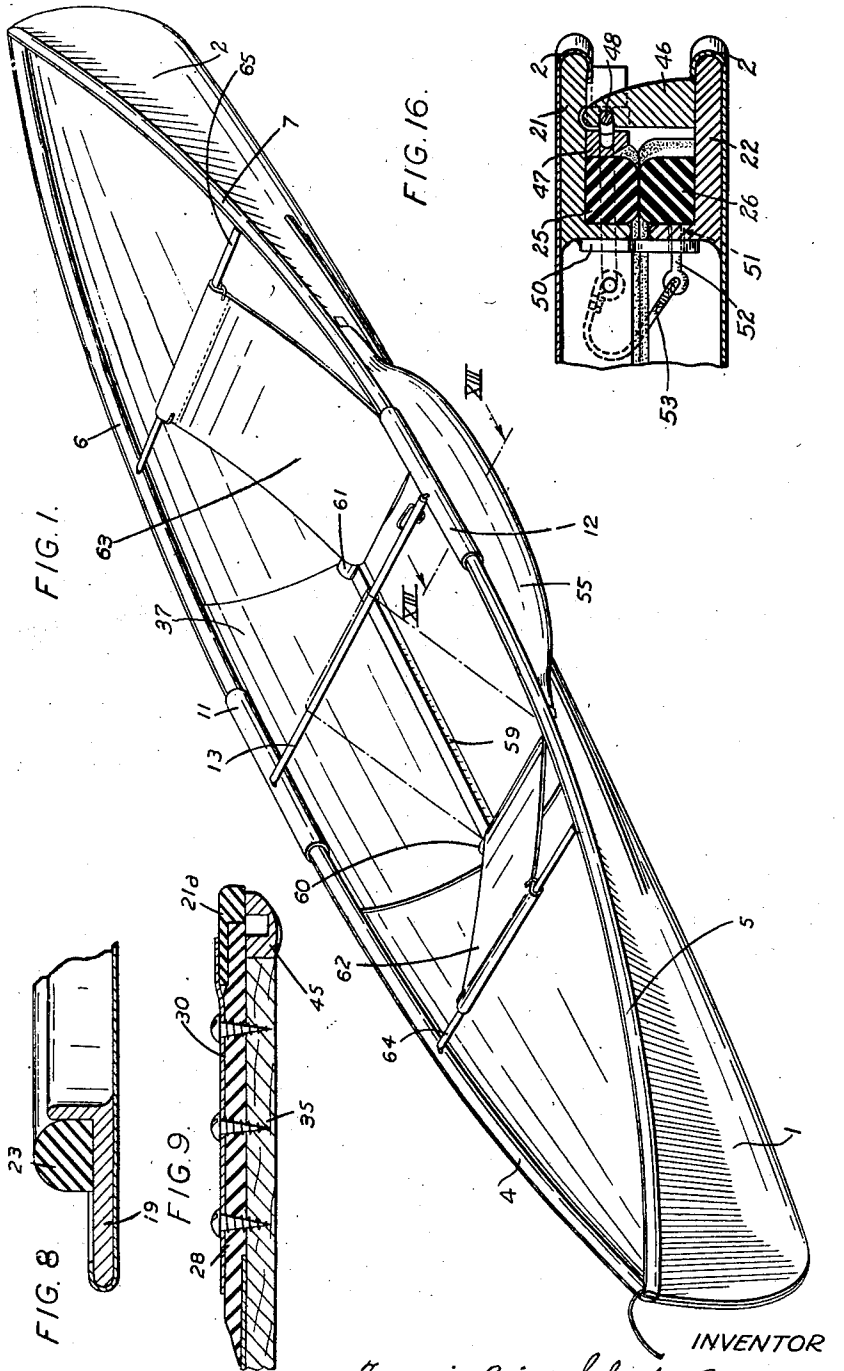
June 17, 1952 F. B. S. GRIMSTON 2,600,757

FOLDING BOAT

Filed Oct. 21, 1946 4 Sheets-Sheet 1



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FOLDING BOAT

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FIG. 7.

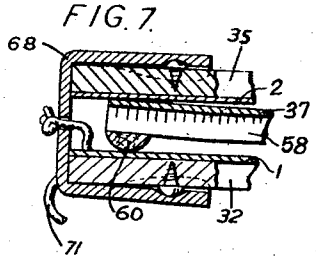
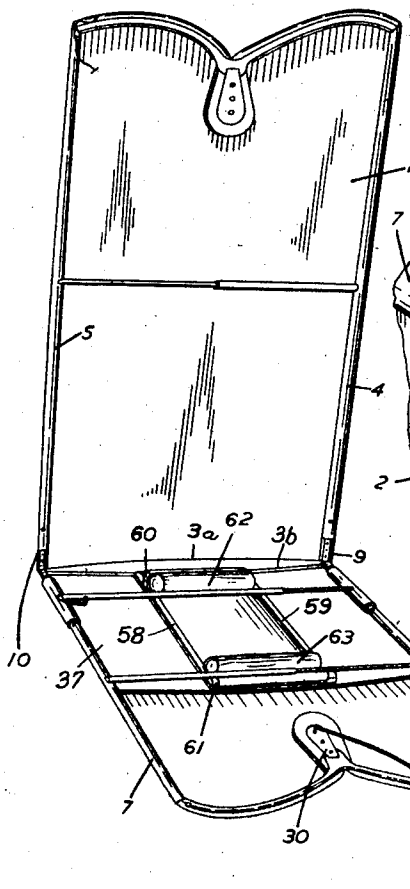


FIG. 2.

FIG. 3.



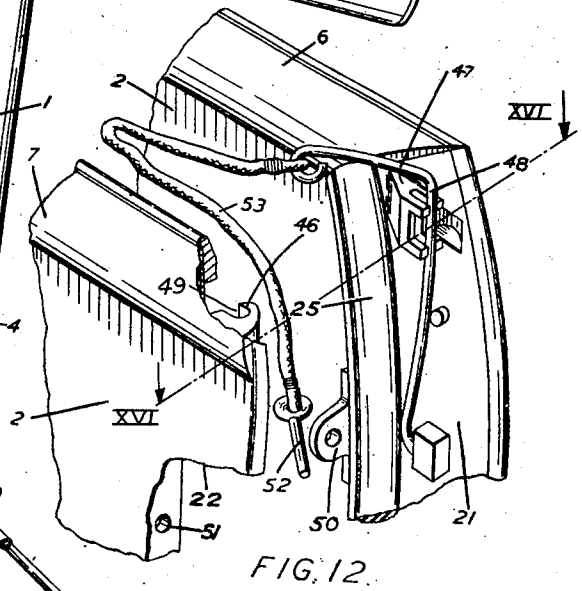


FIG. 12.

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FOLDING BOAT

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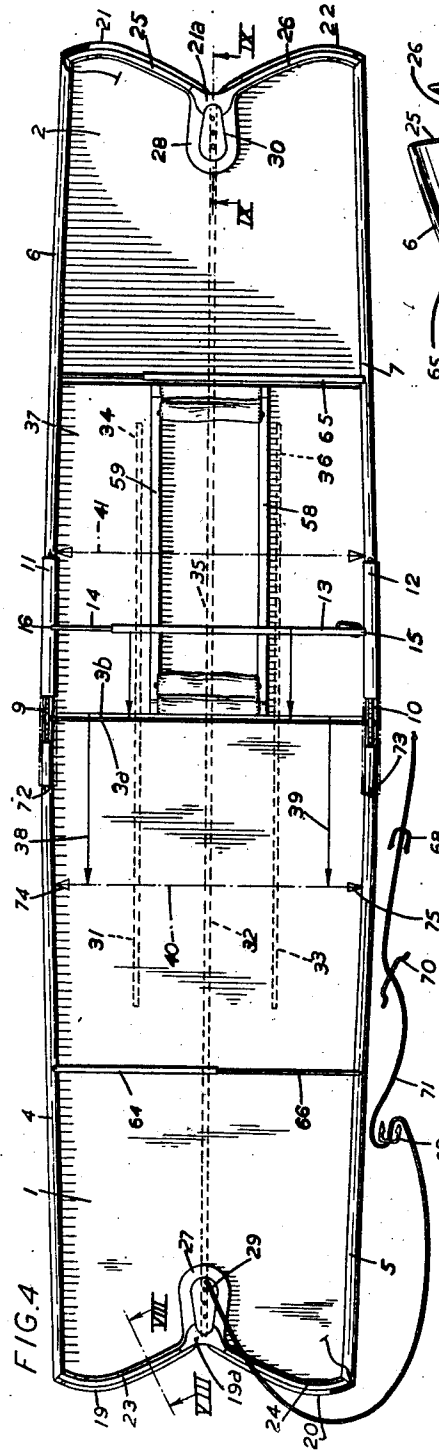


FIG. 4

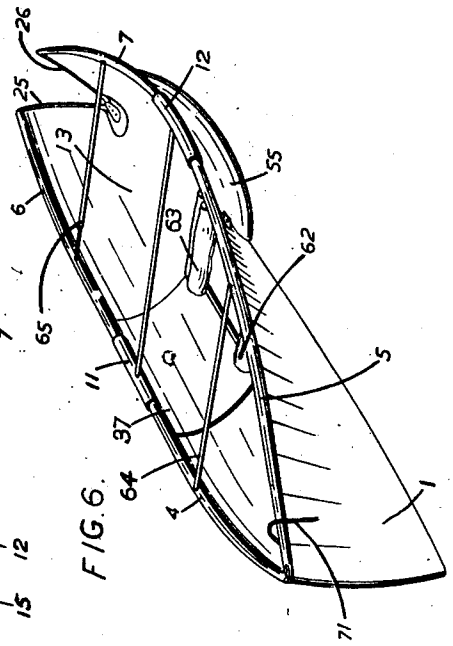


FIG. 6.

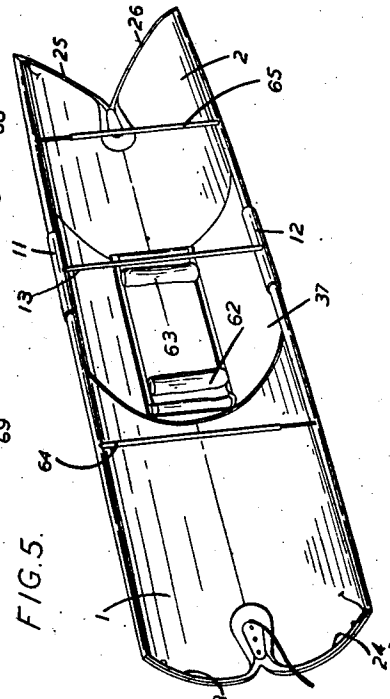


FIG. 5.

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FOLDING BOAT

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FIG. 13.

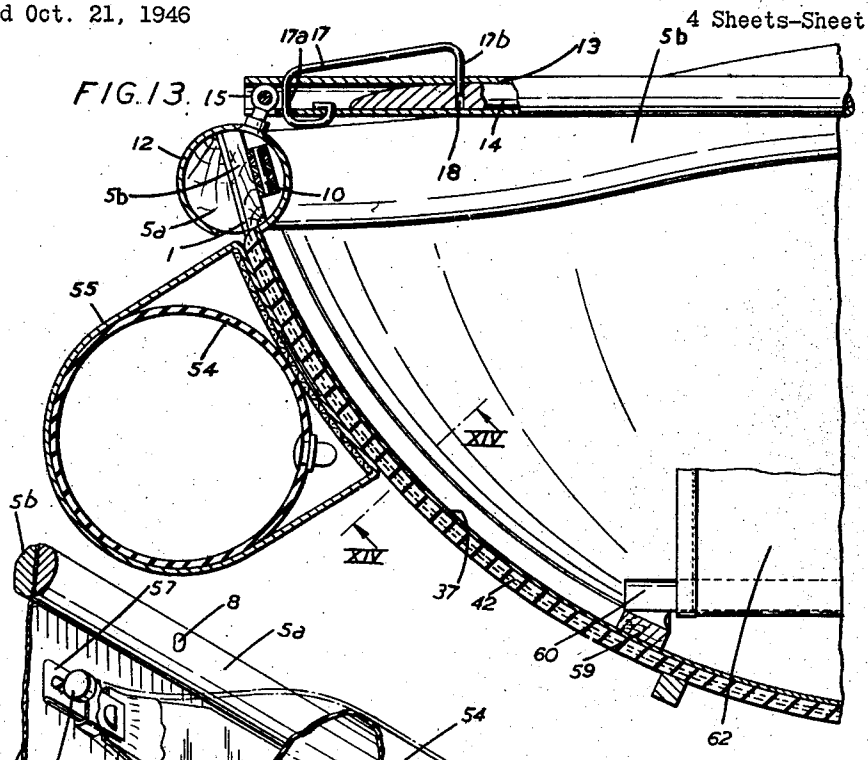


FIG. 15.

FIG. 14.

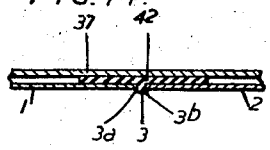


FIG. 10.

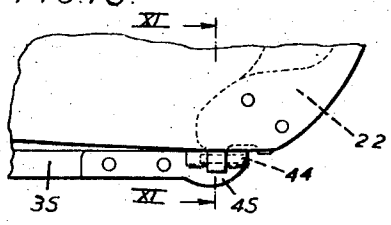
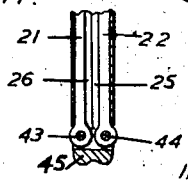


FIG. 11.



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2,600,757

FOLDING BOAT

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Application October 21, 1946, Serial No. 704,664
In Great Britain July 25, 1945

Section 1, Public Law 690, August 8, 1946
Patent expires July 25, 1965

12 Claims. (Cl. 9—2)

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The invention relates to boats of the type constructed of sheet material, such as plywood, thin metal or alloy sheet, plastic sheet or plastic impregnated fabric or other material, which is arched or curved to form the skin or shell of the craft, at the same time providing some at least of the necessary rigidity to resist deformation. More particularly, but not restrictively, the invention relates to boats of this type which are collapsible.

One object of the invention is to provide a new and simple method of constructing such boats without the use of any subsidiary framework, either temporary or permanent, for forming, shaping or bracing the boat.

Another object of the invention is to provide a method of constructing a boat, at one stage of which a complete assembly of the constructive elements of the boat is provided in the form of a substantially flat, readily transportable unit.

A further object of the invention is to provide a sub-assembly of boat constructing elements which can readily be converted into a boat by simply arching the sub-assembly.

Yet another object of the invention is to provide a collapsible boat of the type set forth, which can readily be collapsed flat, by unlocking interengaging parts, and can be re-erected by flexing the parts until the interengaging parts interlock.

A still further object of the invention is to provide a collapsible boat of this kind, which may readily be folded when collapsed.

A subsidiary object of the invention is to provide a form of joint for use in the construction and erection of collapsible boats of the type set forth.

The invention accordingly provides a method of constructing a boat, in which the principal constructive elements are assembled together in substantially one plane, and the assembly is thereafter flexed to boat shape and the elements secured in their operative positions.

In accordance with one feature of the invention, the boat hull is prefabricated in one plane into a single flat unit, from a skin of resilient sheet material and members which are subsequently to form a framing for the hull. The boat is then erected by flexing the composite unit within the elastic limit of the component parts to boat shape, and then securing appropriate frame members together to form a rigid stressed structure. Seams which are thus formed at adjoining end parts of the unit are rendered watertight, preferably by means of soft rubber or like strips which are pressed together between the seams on erection.

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Another important feature of the invention resides in the fact that the flexing of the skin or skin portions to the desired compound curvature during erection of the hull is controlled by frame members, which are preferably unstressed when in the flat position, but are so shaped and of such resilience that they co-act with the inherent springiness of the skin material to produce the necessary three dimensionalled boat shape, symmetrical about the vertical fore and aft plane. When the frame members are in the flat position, they serve to maintain the resilient skin portions flat and avoid buckling.

A constructional embodiment of the invention as applied to a collapsible canoe is illustrated by way of example in the accompanying drawings, in which

Figure 1 is a perspective view of the canoe when erected for use.

Figure 2 is a perspective view of the canoe in the folded condition for transport.

Figures 3, 4, 5 and 6 are views showing the canoe in successive stages of erection, Figures 3, 5 and 6 being in perspective, while Figure 4 is essentially a plan view.

Figure 7 is a sectional view on an enlarged scale of a securing clip taken on the line VII—VII in Figure 2.

Figure 8 is a sectional view on an enlarged scale of a detail of construction taken on the line VIII—VIII in Figure 4.

Figure 9 is a sectional view on an enlarged scale of another detail of construction taken on the line IX—IX of Figure 4.

Figures 10 and 11 are side elevation and end sectional elevation views, respectively, on an enlarged scale, of a detail of the construction, the section of Figure 11 being taken on the line XI—XI of Figure 10.

Figure 12 is a perspective view, on an enlarged scale of the means for securing the abutting end portions of the canoe together.

Figure 13 is a sectional transverse elevation on an enlarged scale of the boat taken amidships on the line XIII—XIII in Figure 1.

Figure 14 is a sectional view taken on the line XIV—XIV of Figure 13.

Figure 15 is a partially sectional perspective view of a buoyancy element, and

Figure 16 is a sectional view on an enlarged scale taken substantially on the line XVI—XVI of Figure 12 showing one end of the boat in assembled condition.

Referring to the drawings, the canoe is constructed of a skin consisting of two panels of sheet metal such as aluminium, magnesium or

alloy, 1, 2, each of which when flat is of the roughly rectangular shape shown in Figure 4. These panels are arranged so as nearly to abut at their inner edges 3a and 3b as shown, and at their outer ends they are formed with shallow curved V notches as shown in Figure 4.

The longitudinal edges of the sheets 1 and 2 are bowed outwardly slightly as shown and are reinforced with gunwale stringers 4, 5, and 6, 7, respectively, these stringers being each formed as shown in Figure 15 of two lengths of wood 5a and 5b each of substantially half round section disposed one on either side of the sheet 1 and riveted and screwed together through the sheet as shown at 8. These gunwale stringers are substantially cylindrical in form at the centre of the boat, but taper towards the ends and serve to reinforce the edges of the sheets and prevent buckling when the boat is erected.

The pairs of gunwale stringer halves 4, 6, and 5, 7 are hinged together at their abutting inner ends as shown in Figures 3, 4 and 13, by hinges 9 and 10 respectively, so that the sheet 1 can be folded over on to the sheet 2 as is shown in Figure 2, or can be opened out flat as shown in Figure 4.

In order to lock the gunwale stringer halves 4, 6, and 5, 7, in alignment, slotted tubular elements 11 and 12 are slidably mounted respectively on the gunwale stringers 6 and 7, and are adapted to be slid over the hinges 9 and 10, to engage also the stringers 4 and 5, the hinges 9 and 10 being recessed into the stringers as shown in Figure 13 to permit easy movement of the elements.

The elements 11 and 12 are connected together by a telescopic tie rod comprising a tubular member 13 in which engages a sliding rod 14. The tubular member is hingedly connected to a lug 15 projecting from the slotted element 12 and the opposite end of the rod 14 is similarly connected to a lug 16 on the element 11.

The tubular member 13 is long enough to extend between the slotted elements 11 and 12 when the boat is erected, and the rod 14 is long enough to engage the tubular member 13 when the boat is knocked down flat as shown in Figure 4. Near its hinged end, the tubular member 13 is provided with a spring catch, in the form of a spring wire 17 (see Figure 13) which is secured on the tube at one end 17a and extends at its other end 17b through a transverse hole in the tubular member to form a locking catch which engages a slot 18 in the rod 14 in the erected position of the boat. The rod 14 and tube 13 when locked together thus constitute a tie rod which serves to keep the gunwales in their correct relative spaced position when the boat is erected and also during erection. Alternatively it serves as a strut if necessary.

The outer ends of the sheets 1 and 2 are formed with shallow curved V notches as shown in Figure 4, and these curved edges are reinforced with flanged aluminium strips 19, 20, 21 and 22 respectively, one of the strips, 19, being shown in section in Figure 8. Each strip is of L-section and between the flanges are accommodated strips of rubber 23, 24, 25 and 26 respectively of the cross section shown in Figure 8. At their inner ends, the rubber strips are joined to rubber pads shaped as shown at 19a and 21a in Figure 4.

The pairs of strips 23, 24, and 25, 26 are arranged to abut when the ends of the boat are drawn together, as shown in Figure 11.

Reinforcing strips of wood 31, 32, 33, and 34, 35, 36 respectively are secured on the under sides of the sheets 1 and 2, the strips 32 and 35 extending along the longitudinal axis of the abutting sheets and serving to form a keel member. The other strips 31, 34, and 33, 36, constitute bilge keels.

In order to avoid the metal of the sheets 1 and 2 being folded too sharply at the ends, central recesses are formed in the ends, and, as shown in Figures 4 and 9, sheets of soft rubber 27 and 28 are secured in these recesses by a suitable waterproof adhesive or by any other convenient water-tight means, metal cover plates 29 and 30 respectively being arranged over the rubber inserts and secured therethrough to the keel members 32 and 35 respectively.

A covering panel 37 is provided to form a water-tight joint where the ends of the sheets 1 and 2 adjoin at 3a, 3b. The covering panel is of rectangular shape and is slightly less in width than the width between the gunwales 6 and 7. When the boat is knocked down, the covering panel is accommodated in the position shown in Figure 4, but when the boat is to be erected the panel is slid axially in the direction of the arrows 38, 39, until it is centrally disposed as indicated by the chain dotted lines 40 and 41.

The under side of the panel 37 is fitted centrally with a transversely extending flat strip of soft rubber 42 as shown in Figures 13 and 14, which becomes pressed out at 3 between the abutting ends 3a, 3b, of the sheets 1 and 2, as shown in Figure 14. In its central position the side edges of the covering panel 37 are engaged by the inner sides of the slots in the slotted tubular elements 11 and 12, as shown in Figure 13, with the edges abutting against the inner or under sides of the gunwales, so that when the sheets 1 and 2 are arched in erecting the boat, the side edges of the covering panel 37 are pressed tightly against the gunwales. This tangential pressure causes the rubber 42 to be forced radially between the adjoining edges 3a, 3b, of the sheets 1 and 2 as shown in the fragmentary sectional view, Figure 14, over the whole length of the rubber strip 42.

At their lower ends, the pairs of metal strips 19, 20 and 21, 22, are hinged as shown in Figures 10 and 11 to the outer ends of the half keel members 32, 35. The hinge pins 43 and 44 are arranged side by side and extend longitudinally of the keel member 35 in a metal shoe 45, one of which is secured at the end of each half keel member so as to constitute a part of the keel member. At their upper ends, the metal reinforcing strips are provided with securing means such as are shown in Figure 12 on the strips 21, 22. The strip 22 supports a latching member 46 which is adapted to engage a slotted member 47 on the strip 21 and be secured therein by a spring locking rod 48 which is slidable axially of the boat and engages a slot 49 in the latching member 46 to lock the reinforcing strips together, with the rubber strips 25 and 26 held in water-tight engagement with one another.

In order additionally to secure the strips 21 and 22 together, the strip 21 is provided with a protruding apertured lug 50 which in the assembled position overlaps an aperture 51 in the strip 22 and the aligned apertures are engaged by a pin 52, connected by a captive cord 53 to the end of the latching rod 48. The cord also serves to pull the rod 48 out of engagement with the latch 46.

The boat is provided on either side with buoyant blisters or elements comprising inflatable rubber tubes 54 within canvas casings 55. These

casings are secured to the sides of the boat under the gunwales by means of turn fasteners 56 which engage slotted securing members 57 to which the ends of the canvas casings 55 are secured. The turn fasteners are spaced so that the rubber tubes are stretched somewhat when secured, thus ensuring that the blisters fit snugly against the side of the boat.

The covering panel 37 is provided centrally with two longitudinal extending bearer members 58 and 59 which are connected at their central portions only to the panel and support at their ends transverse stretchers 60 and 61 to which are secured strips of canvas 62 and 63 respectively. These strips of canvas may be tucked under the stretchers when the boat is knocked flat, and when the boat is erected they may be untucked and secured at their free ends to tubular struts 64 and 65 extending athwart the boat between the central tie rod 13 and the ends of the boat. The free ends of the strips are wrapped around the struts and are secured thereto by inwardly projecting clip members under which the canvas may be tucked. Pads of soft rubber are secured to the ends of the canvas strips in order to cushion the rods, and the strips 62 and 63 thus provide deck chair types of seats facing in opposite directions. If it is desired that the seats should face the same direction the strip 62 can be secured at its free end to the central tie rod 13 as shown by the dotted line in Figure 1.

The struts 64 and 65 comprise tubular elements which are hingedly attached respectively to the gunwales 4 and 7 and are telescopically engaged by rods 66 and 67 respectively, which are hingedly connected to the gunwales 5 and 6. The rods 66 and 67 are long enough to remain in telescopic engagement with the tubular elements when the boat is knocked down flat, so that the tubular elements are automatically guided during erection of the boat.

When the boat is folded flat, the sheets 1 and 2 are held together by a pair of U-shaped clips 68 and 69 (Figures 2, 3 and 4) which engage respectively the inner and outer adjacent ends of the sheets as shown in Figure 7, the ends of the keel halves 32, 35 being provided with upstanding pips which engage corresponding recesses in the clips to retain them in position. A detachable handle 70 is formed with slots which engage upstanding headed pins on the side of the keel member 32, to provide the means whereby the folded boat may be carried, as shown in Figure 2. A captive cord 71 attached at one end to the cover plate 30 (Figure 3) passes through holes in the clips 68 and 69 and the handle 70. This cord serves as a painter when the boat is erected, and the clip 68 may be used additionally as securing means at the end of the painter.

In order to erect the boat it is first laid flat and the clips 68 and 69 removed together with the handle 70. The upper sheet 1 is then lifted as shown in Figure 3 and laid flat as shown in Figure 4, with its inner edge 3*a* adjoining the inner edge 3*b* of the sheet 2. The covering panel 37 is then slid to its position as indicated by the dotted lines in Figure 4, so that the rubber strip 42 covers the joint at 3. In order to ensure correct positioning of the panel 37, indicating marks 74,75 are provided on the sheet 1 or on the gunwales.

The slotted tubular members 11 and 12 are then slid along to stops 72 and 73 respectively in the gunwales 4 and 5 so that the tie rod 13, 14 becomes disposed over the joint 3*a*, 3*b*, and the gunwale halves 4, 6 and 5, 7 are securely locked in alignment. The slotted tubes 11 and 12 are rotated slightly outwardly until the outer edges of the covering panel 37 are engaged in the inner sides of the slots, so as to ensure the sides of the covering panel being kept in close engagement with the inner sides of the gunwales. The composite sheet is now ready to be curved to boat shape, and although this can be accomplished by the single operation of bringing the mating end portions together at each end, it is preferable to carry out the operation in two stages. In this, the composite sheet is first arched as shown in Figure 5 by raising the sheets on to the gunwales 5 and 7 and pressing the tubular member downwardly until the telescoping rod 14 is engaged by the latch 17.

The boat is then rolled on to its keel, and the ends of the boat are joined together by bringing the reinforcing strips at the ends into engagement until the catches are secured as shown at one end in Figure 6. The pins 52 are inserted into the aligned holes 51, 52, and finally the seats are secured to the supports 64 and 65, or 13.

In order to collapse the boat, the reverse procedure is adopted.

The pins 52 are first pulled out, and then the catch 48 is released by pulling the captive cord 53, thus allowing the ends of the boat to spring open under the resilient action of the sheets. The latching member 17 is then raised to release the tie rod 13, and in order to do this it may be necessary to force the gunwales towards each other slightly. The boat is then allowed to fall flat. The covering panel 37 is slid along to the position shown in Figure 4, and the slotted tubes 11 and 12 are slid along to the position shown in Figure 4. The sheet 1 is then folded over on to the sheet 2 and secured in position by the clips 68 and 69. The handle 70 is then attached, and the collapsed boat is ready for transport.

It will be evident that the above described form of canoe constitutes a light, robust and simple form of collapsible boat which can be manufactured without elaborate tools or forming means, and can be erected and knocked down readily and simply without demanding particular skill. When erected, the boat is well shaped and founded, and of attractive lines and general appearance.

While the invention has been described in detail when applied to a specific form of collapsible canoe, this example is illustrative only, and is not given as a limitation. It will be apparent to those skilled in the art, that the canoe described is susceptible of considerable modification within the scope of the invention, which is to be understood as limited only as indicated in the appended claims.

I claim:

1. A composite structure for erection to a boat by flexure, comprising a pair of corresponding units hinged together about a transverse axis so as to be foldable one on the other, each of said units comprising a substantially rectangular skin portion of flexurally resilient sheet material, having one end inwardly notched, and having secured thereto frame constituting members comprising gunwale stringers, a keel member, end reinforcing strips connected to the notched end and hinged at their inner ends to the keel member, and frame interconnecting means comprising latching means connected to the outer ends of the reinforcing strips, strips

of soft rubber attached to the engaging faces of the end reinforcing strips and adapted to form a watertight joint when the strips are latched together, and a panel slidable between opposite gunwale stringers over the joint between the skin portions of the unit when the units are unfolded, having a strip of soft rubber for engaging the joint, and adapted for engagement at its longitudinal sides with the gunwale stringers to force the rubber strip into intimate engagement with the joint on erection of the boat.

2. A structure according to claim 1, in which a portion at the centre of the end of the resilient sheet which becomes sharply folded on erection of the boat comprises a sheet of resilient waterproof material, watertightly inserted in a recess in the sheet.

3. A boat constructing unit according to claim 1, in which each of the latching means comprises a hook secured on one of the reinforcing strips, adapted to engage a corresponding recess in the other reinforcing strip, and a manually releasable spring member sliding in said recess to engage the hook.

4. A boat constructing unit according to claim 1, in which one reinforcing strip is provided with an apertured lug which aligns in the latched position with an aperture in the other strip, and including a pin adapted to engage both apertures whereby the strips may be locked together.

5. A collapsible boat-forming structure comprising a skin of flexurally resilient material having a normally flat state when unstressed and capable of being bent to boat shape without stressing the material beyond its elastic limit, said skin being divided into bow and stern sections along a transverse line intermediate its ends, means hingedly connecting said bow and stern sections together adjacent their side edges so that said sections may be folded one on the other, the adjacent end edges of said sections being otherwise unconnected, a strip of soft rubber overlying the joint between the adjacent end edges of said bow and stern sections when the latter are unfolded into the same plane, and means for forcing a portion of said strip into said joint to render the latter water-tight when the skin is bent into boat shape.

6. A collapsible boat-forming structure comprising a skin of flexurally resilient material having a normally flat state when unstressed and capable of being bent to boat shape without stressing the material beyond its elastic limit, said skin being divided into bow and stern sections along a transverse line intermediate its ends, means hingedly connecting said bow and stern sections together adjacent their side edges so that said sections may be folded one on the other, the adjacent end edges of said sections being otherwise unconnected, a strip of resilient water-impervious material overlying the joint between the adjacent edges of said bow and stern sections when the latter are unfolded into the same plane, a juxtaposed covering panel of flexurally resilient material, and means for preventing movement of the sides edges of said panel relatively to the side edges of said skin sections when the latter are bent into boat shape.

7. A collapsible boat-forming structure comprising a skin of flexurally resilient material having a normally flat state when unstressed and capable of being bent to boat shape without stressing the material beyond its elastic limit, said skin divided into bow and stern sections along a transverse line intermediate its ends, a plurality of normally unstressed frame members permanently secured to each of said skin sections including gunwale members extending along the side edges thereof, means hingedly connecting the gunwale members of said skin sections together so that said sections may be folded one on the other, the adjacent end edges of said sections being otherwise unconnected, and means for forming a water-tight joint between the adjacent end edges of said sections when the boat is erected including a panel of flexurally resilient material slidable lengthwise of said skin sections with its side edges in engagment with said gunwale members, the transverse width of said panel being only slightly less than the distance between said gunwale members when the skin sections are in flat state, and a strip of resilient water-impervious material mounted on said panel between the latter and the skin, whereby said panel and strip may slid over the joint between the skin sections when the latter are unfolded into the same plane and the material of said strip may be forced radially into the joint betwen the skin sections when the gunwale members are moved toward one another during bending of the skin into boat shape.

8. A boat of the character described comprising a pair of skin sections of flexurally resilient material having a normally flat state when unstressed and capable of being bent to boat shape without stressing the material beyond its elastic limit, said skin sections being adapted to form the bow and stern parts, respectively, of the boat, a plurality of normally unstressed frame members permanently secured to each of said skin sections including a transversely extending cross-bracing member adjacent one end of each section and a pair of post members at the opposite end, means for releasably securing said pairs of post members together to close the ends of the boat when the skin sections are bent to boat shape, and means for connecting the skin sections together.

9. A boat of the character described comprising a pair of skin sections of flexurally resilient material having a normally flat state when unstressed and capable of being bent to boat shape without stressing the material beyond its elastic limit, said skin sections being adapted to form the bow and stern parts, respectively, of the boat, a plurality of normally unstressed frame members permanently secured to each of said skin sections including a transversely extending cross-bracing member adjacent one end of each section and a pair of post members at the opposite end, means for releasably securing said pairs of post members together to close the ends of the boat when the skin sections are bent to boat shape, and means for connecting said sections together in alignment with one another.

10. A collapsible boat-forming structure comprising a skin of flexurally resilient material having a normally flat state when unstressed and capable of being bent to boat shape without stressing the material beyond its elastic limit, said skin being divided into bow and stern sections along a transverse line intermediate its ends, a plurality of normally unstressed frame members permanently secured to each of said skin sections including gunwale members extending along the side edges thereof, means hingedly connecting the gunwale members of said skin sections together so that said sections

may be folded one on the other, the adjacent end edges of said sections being otherwise unconnected, a pair of rigid sleeve members longitudinally slidable on the opposite gunwale members and each of a length sufficient to simultaneously engage the hingedly connected ends of the gunwale members on one side of the skin so as to lock said members in alignment with each other, and means for forming a water-tight joint between the adjacent end edges of said bow and stern sections when the latter are unfolded into the same plane and then bent into boat shape.

11. A collapsible boat-forming structure according to claim 10 including a transversely extending telescopic cross-bracing member connected at its ends to said sleeve members.

12. A collapsible boat-forming structure according to claim 10 wherein each of said skin sections includes a transversely extending telescopic strut member connected at its ends to the gunwale members intermediate the ends of the latter.

FRANCIS BRIAN SYLVESTER GRIMSTON.

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