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(54) Sectionalised boat.

(57) A boat (10) having a plurality of separable water-tight transverse sections (14, 16, 17, 18) combined end-to-end to form a hull assembly (12). A pair of tendons (34) extends longitudinally along the hull assembly and each tendon is attached to the bow and stern sections. The tendons follow geodesic lines along opposite sides of the longitudinal centre line (B) of the hull below the waterline and below the neutral axis (A').

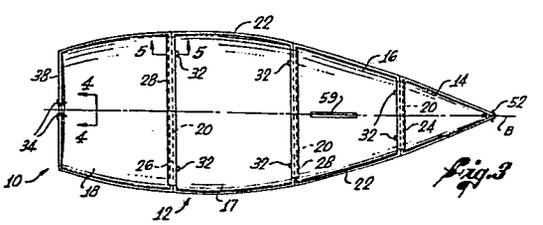

Fig. 3

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TITLE MODIFIED
see front page

Title: "A Boat"

THE PRESENT INVENTION relates to boats and, more particularly, to disassemblable boats formed in sections.

The assembly of the hull of a small boat by combining transverse sections has a number of important advantages. It is particularly advantageous when storing or transporting the boat. For example, many smaller cruising boats are ill suited to carrying a rigid, non-inflatable lifeboat or a dinghy for use in reaching shore once the larger boat has been moored. However, a rigid lifeboat or a dinghy that can be disassembled may be more easily stored on deck or below deck. Conventionally constructed boats used for fishing, sailing, and other recreational activities are often transported by automobiles or small trucks and must be carried by trailer, whereas a disassemblable boat might be carried on the vehicle itself.

There are, however, a number of significant disadvantages associated with boats formed of separable sections that may account for their lack of popularity. The assembly of such boats so that their sections are secured together in an acceptable manner can be a difficult and time-consuming project. In many cases, the construction is such that the sections cannot be assembled in the water, thereby defeating many of the potential advantages of a disassemblable boat, since room must be available in which to assemble it and sufficient personnel or equipment must be available to lift it into the water after it has been assembled. Obviously, a boat which requires time-consuming, out-of-the-water asssembly is entirely unsuitable for use as a lifeboat.

Another serious problem that may be encountered with disassemblable boats is that of leakage. Whenever connections are required below the waterline, it is common to use through fasteners around which leakage can occur.

A principal object of the present invention is to provide a disassemblable boat of sectional construction which avoids, or at least mitigates, the problems and disadvantages mentioned above.

Accordingly, the present invention provides a boat comprising: a plurality of separable, water-tight, transverse hull sections combined end-to-end to form a hull assembly having a predetermined external curvature, the said plurality of sections comprising at least a bow section and a stern section; a pair of tendons extending externally and longitudinally along the said hull assembly from the bow to the stern below the waterline and below the neutral axis on opposite sides of the longitudinal centre line, each of the said tendons following a curved geodesic line along an exterior surface of the hull assembly; and an attachment means for securing the tendons to the said bow and stern sections and for holding the tendons in tension, thereby preventing separation of the said sections from one another.

The tendons are best situated on the keel-most panels of the hull and below the chines. Preferably, the tendons are positioned in open grooves on the exterior surface of the boat hull and are held in the grooves by tension alone.

An attachment means is conveniently provided for securing the tendons to the hull and holding them in tension. Preferably, the attachment means consists of a towing eye at the bow and a tensioning means inside the stern section for tensioning the tendons against the eye.

The tendons can be used in combination with through fasteners that connect adjacent sections above the waterline, the tendons preventing separation beneath the waterline. It is preferable that the various sections be so shaped and dimensioned that they can be nested as a further aid to storage with a minimum of space occupied.

So that the invention may be more readily understood and so that further features may be appreciated, two boats in accordance with the invention will now be described by way of example and with reference to the accompanying drawings, in which:

FIGURE 1 is a diagrammatic side elevation of an assembled boat constructed in accordance with the invention;

FIGURE 2 is a diagrammatic illustration of the boat of Figure 1 in which the lines A-K correspond to similar lines indicated in Figure 1;

FIGURE 3 is a plan view of the assembled boat of Figures 1 and 2;

FIGURE 4 is an enlarged fragmentary elevation of a portion of the inside of the transom of the boat of Figure 3, taken as indicated by the arrow 4-4 on Figure 3 and showing the attachment of the aft end of an tendon;

FIGURE 5 is an enlarged fragmentary section of a portion of the hull of Figure 1, taken along arrows 5-5, showing an interlock between hull sections;

FIGURE 6 is an end elevation of the stern of the boat;

FIGURE 6a is an enlarged fragmentary view of a portion of the stern section, taken as indicated by arrow 6a in Figure 6, two tendons being omitted to show two grooves;

FIGURE 7 is a end elevation of the bow of the boat;

FIGURE 8 is a plan view of the boat in a disassembled condition with the sections nested;

FIGURE 9 is a side elevation, similar to Figure 1, showing a second boat constructed in accordance with the invention;

FIGURE 10 is a plan view of the boat of Figure 9;

FIGURE 11 is an end elevation of the stern of the boat of Figure 9; and

FIGURE 12 is an end elevation of the bow of the boat of Figure 9.

A boat 10, constructed in accordance with the present invention and shown in Figures 1-8 of the accompanying drawings, includes a hull assembly 12 formed by four transverse sections arranged end-to-end, namely a bow section 14, two mid-sections 16,17 and a stern section 18. The sections 14, 16, 17 and 18 form respective water-tight enclosures open only at the top. When disassembled, the sections 14, 16, 17 and 18 can be nested as shown in Figure 8. The second mid-section 17 is the largest in each dimension so that it can receive the first mid-section 16 which in turn receives the stern section 18. The bow section 14, which is the smallest, fits within the stern section 18.

The sections 14, 16, 17 and 18 can be made of, for example, a glass fibre/resin matrix, metal or wood. Alternatively, they can be laminated, preferably using a low density core. The lines of this particular hull assembly 12, while exhibiting a compound curvature, can be developed from plywood.

The fore and aft ends of the mid-sections 16, and 17 are each closed by respective transverse bulkheads 20, which are partitions of about the same, or slightly less, height as the vertical sides 22 of the boat 10. At the aft end of the bow section 14 is a similar bulkhead 24 that mates and is contiguous with the fore bulkhead 20 of the first mid-section 16. In a similar manner, a fore bulkhead 26 on the stern section 18 mates with the aft bulkhead 20 of the second mid-section 17.

As an aid in assembling the hull 12 and aligning the sections 14, 16, 17 and 18, the bulkheads 20 of the mid-sections 17 and 18 carry lips 28 which extend over, and engage the top edges of, the adjoining bulkheads 24 and 26 (as is best shown in Figure 5). Thus, the sections 14, 16, 17 and 18 are interlocked and properly positioned.

There are apertures in the mating bulkheads 20, 24 and 26 that receive through fasteners 32. These fasteners 32 are positioned well above the waterline of the hull 12 so that there is no significant leakage around them. Although ordinary marine bolts can be used, the preferred fasteners 32 are quarter turn cam lock fasteners of a type conventionally used for marine applications.

It will be noted that once the hull 12 is assembled and placed in the water, any weight in the centre of the hull will tend to force the sections 14, 16, 17 and 18 apart at the bottom and together at the top. This is because the buoyancy at the longitudinal outer limits of the hull 12 places the entire floating structure under a substantial bending moment, thereby applying compressive forces at the top and tensile forces at the bottom. There is an imaginary neutral axis "A' " (Figure 1) extending longitudinally through the hull 12 where the structure is neither in compression nor in tension. To counteract the tendency of the sections 14, 16, 17 and 18 to separate at the bottom, it is necessary to secure them below the waterline (not indicated) because there are practical limits on the strength, rigidity, size and weight of the sections that are obtainable in a structure intended to float.

Attachment of the sections 14, 16, 17 and 18 below the waterline is accomplished by two corrosion-resistant, woven steel tendons 34 that extend along the hull 12 from the bow to the stern. To receive these tendons 34, two downwardly-facing longitudinal grooves 36 are provided, each extending along the bottom of the entire hull assembly 12 (see Figures 4 and 6a).

The lines followed by the tendons 34 and the grooves 36 are geodesic. That is to say, they are lines on the external surface of the hull 12 naturally followed by the tendons 34 when in tension, i.e. they are the shortest lines between the points at which the tendons are secured to the hull. Thus, it is not necessary to position the tendons 34 manually along the length of the grooves 36. The tendons 34 naturally fall into the grooves 36 when stretched over the hull 12 and tend to resist forces that would displace them laterally out of the grooves. However, the use of the grooves 36 prevents the tendons 34 from chafing against the hull 12. The grooves 36 also prevent the tendons 34 from snagging on underwater obstacles and debris and protect the tendons when the boat 10 is beached.

To hold the tendons 34 in tension, they are preferably held at their fore ends by an eye 52 (Figures 1 and 7), which is referred to as a "towing eye" because it can also serve as an attachment point for a painter. The towing eye 52 is placed at an appropriate height to serve this dual purpose.

The aft ends of the tendons 34 extend up the outside and over the top edge of the transom 38, and are releasably secured to over-centre levers 58 that are permanently mounted on the interior surface of the transom above the waterline and inside the stern section 18. Once the over-centre levers 58 have been latched, the tendons 34 firmly secure the hull sections 14, 16, 17 and 18 together along their adjoining lower edges.

It should be noted that the hull 12 is symmetrical, the tendons 34 being equally spaced from opposite sides of the longitudinal hull centre line "B" and passing on opposite sides of the centre board trunk 59 and any rudder assembly (not shown). The tendons 34 must be located below the neutral axis "A' " and below the waterline of the hull 12.

One important advantage which has been found to follow from the use of two tendons 34 is that a redundancy is provided, because the hull 12 is kept substantially intact and operational even if one tendon fails. To minimize the asymmetry if one tendon 34 fails, the geodesic lines chosen should be close to the longitudinal centre line "B" (Figure 3), or to the keel if there is one. In addition, placing the tendons 34 close to the centre line "B" displaces them as far as possible from the neutral axis "A' ", thereby giving the tendons the maximum holding power for their tensile strength.

There are no apertures in the hull 12 below the waterline to serve as sources of leakage. Moreover, each of the hull sections 14, 16, 17 and 18 can be made to float by itself, permitting the boat 10 to be assembled in the water. Very little time or skill is required to assemble the boat 10. Once disassembled, it requires a minimum of space since the hull sections 14, 16, 17 and 18 can be nested and the tendons 34 can be coiled and placed inside the sections.

The principles of the invention are further illustrated by a second boat 60, shown in Figures 9-12. The hull 61 includes three hull sections 62, 64 and 66, instead of four as in the case of the first boat 10. There are two tendons 70 that extend symmetrically along geodesic lines of the hull 61, lying in grooves 72. At the bow, the tendons 70 are attached to a towing eye 74 while in the stern section 68 they are held in tension by over-centre levers 76.

The principal difference between the boat 10 and the boat 60 lies in the shape of the hull 61. Although the hull 61 is less efficient, having a less complex curvature with hard chines, it is less difficult to fabricate and less expensive. The placing of the tendons 70, however, is similar to that of the first boat 10, being below the neutral axis and near to the centre line. The tendons 70 are, in accordance with the parameters given above, below the lowest chines of the hull 61 and on the keel-most panels of the hull.

CLAIMS:

1. A boat comprising: a plurality of separable, water-tight, transverse hull sections combined end-to-end to form a hull assembly having a predetermined external curvature, the said plurality of sections comprising at least a bow section and a stern section; a pair of tendons extending externally and longitudinally along the said hull assembly from the bow to the stern below the waterline and below the neutral axis on opposite sides of the longitudinal centre line, each of the said tendons following a curved geodesic line along an exterior surface of the hull assembly; and an attachment means for securing the tendons to the said bow and stern sections and for holding the tendons in tension, thereby preventing separation of the said sections from one another.

2. A boat according to claim 1, wherein each of the said sections has at least one transverse bulkhead adjoining a corresponding bulkhead of an adjacent section, and the boat further comprises a respective fastening means for securing the said adjoining bulkheads of each such pair of bulkheads to each other above the said waterline.

3. A boat according to claim 1 or 2, wherein the hull assembly has a pair of grooves therein extending along geodesic lines, the tendons being disposed within the grooves.

4. A boat according to claim 3, wherein the tendons are held in the grooves by tension alone.

5. A boat according to any one of the preceding claims wherein the hull assembly defines chines, the tendons being positioned beneath the said chines.

6. A boat according to any one of the preceding claims wherein at least part of the said attachment means is disposed within the hull assembly.

7. A boat according to any one of the preceding claims wherein the said attachment means comprises a towing eye at the bow of the hull assembly and a tensioning means mounted in the said stern section for tensioning the

said tendons against the said eye.

8. A boat according to any one of the preceding claims wherein the hull sections are adapted to be nested within one another when not forming the hull assembly.

9. A boat comprising: at least three separable, water-tight, transverse sections combined end-to-end to form a hull assembly having a predetermined external curvature, the said plurality of sections comprising at least a bow section, a mid-section, and a stern section, the said sections comprising adjoining, transverse bulkheads, and the said sections being so shaped and dimensioned as to be nestable when disassembled; an interlocking means carried by at least one of the said sections for positioning the said sections in proper alignment; a fastening means extending through the said bulkheads above the waterline of the hull assembly for connecting the said sections to one another; a pair of flexible steel tendons extending externally and longitudinally along the hull assembly from the bow to the stern below the waterline and below the neutral axis and on opposite sides of the longitudinal centre line, each of the said tendons following a curved geodesic line along an exterior surface of the hull assembly; a towing eye secured to the bow of the hull assembly to which eye the said tendons are attached; a tensioning means mounted in the said stern section for tensioning the tendons against the said eye; and a pair of open longitudinal grooves defined by the hull assembly within which grooves the tendons are disposed, the said grooves extending along the said geodesic lines and the tendons being held in the said grooves by tension alone.

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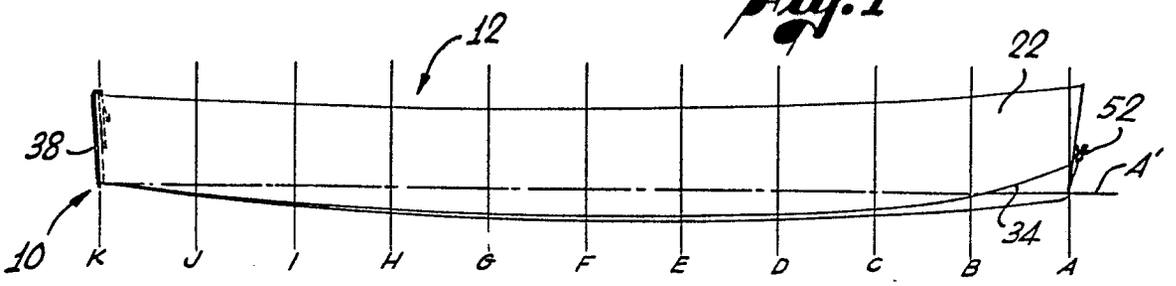
Fig.1



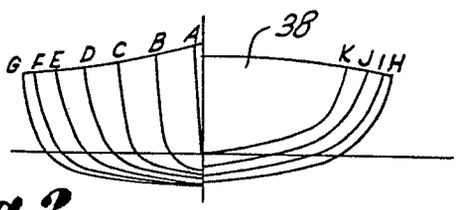


Fig.2

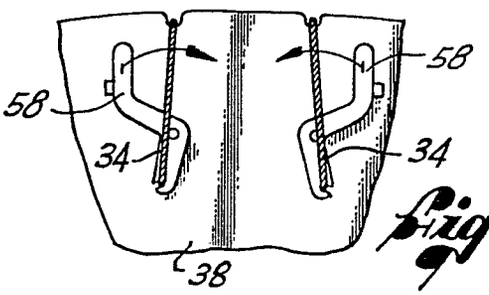


Fig.4

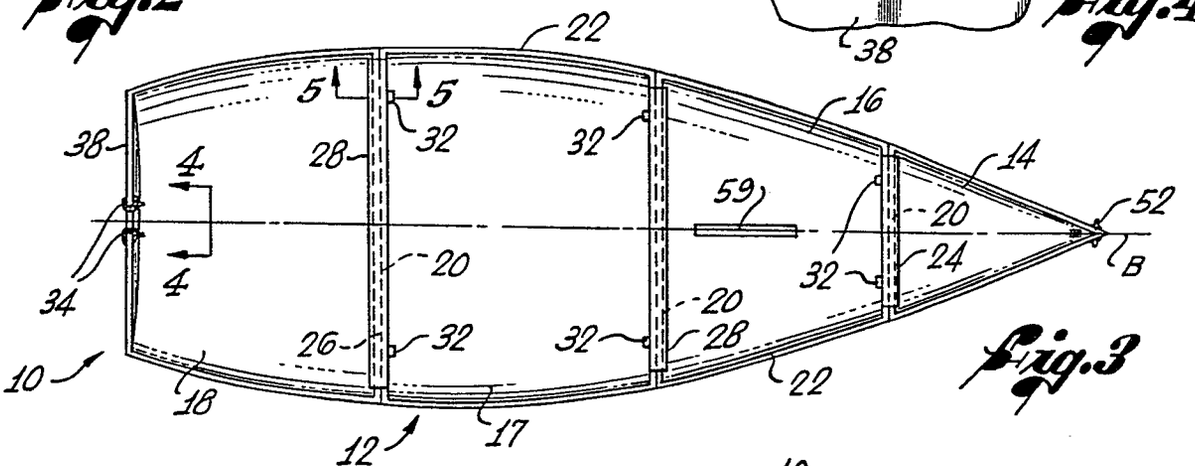


Fig.3

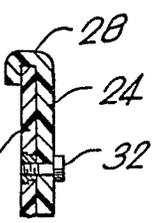


Fig.5

Fig.8

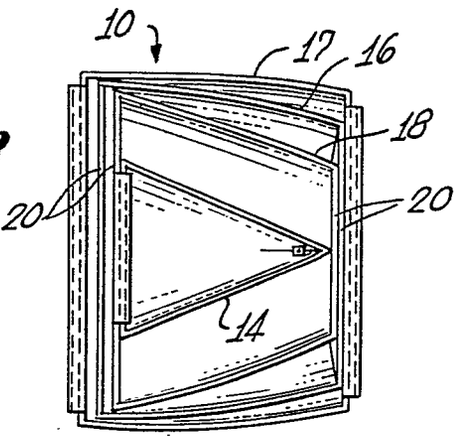


Fig.6

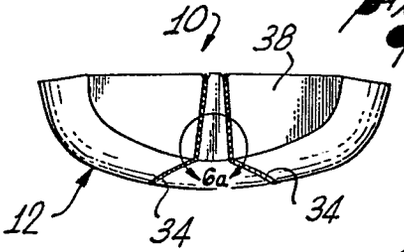


Fig.6a

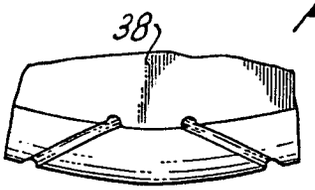


Fig.7

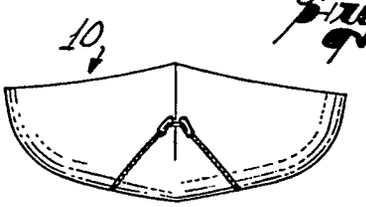


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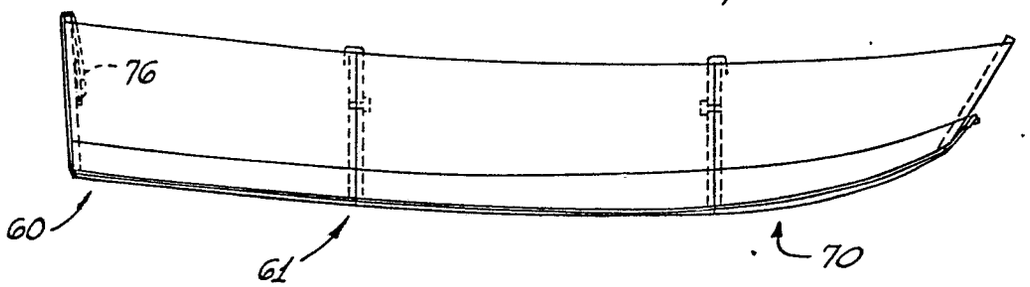
Fig.9



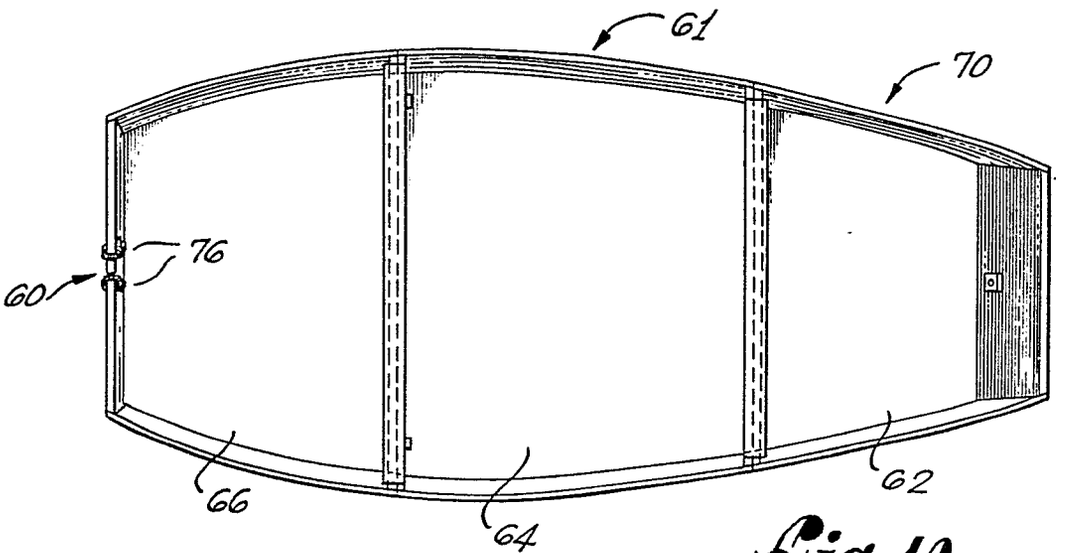
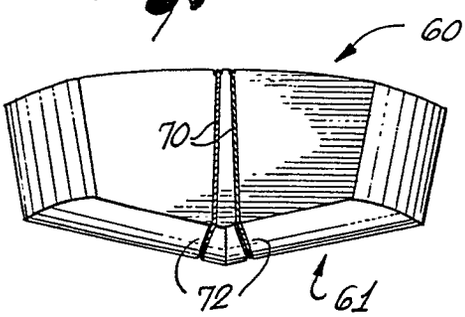


Fig.10

Fig.11



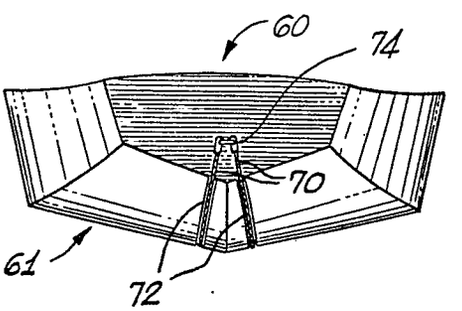


Fig.12