H. Higginson,

Ship Building.

Sheet 1. 2 Sheets.

No 673.

Patented. Apr. 4. 1838.

Fig. 1.

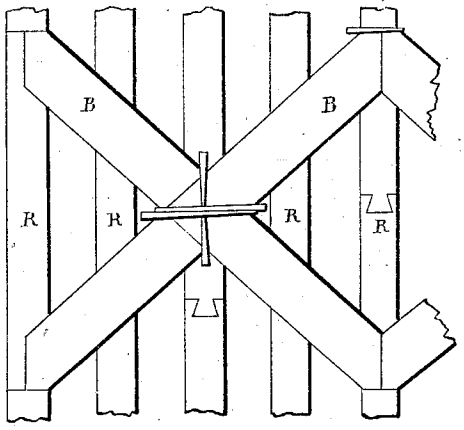


Fig. 2.

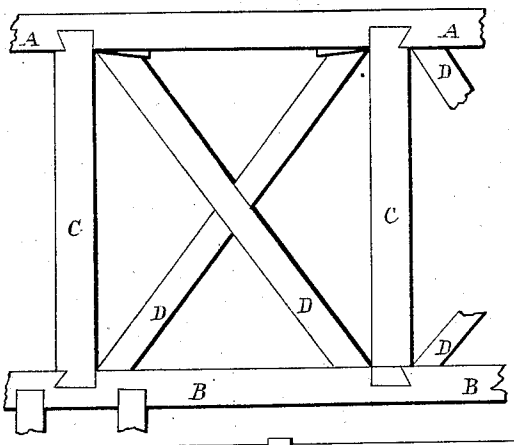
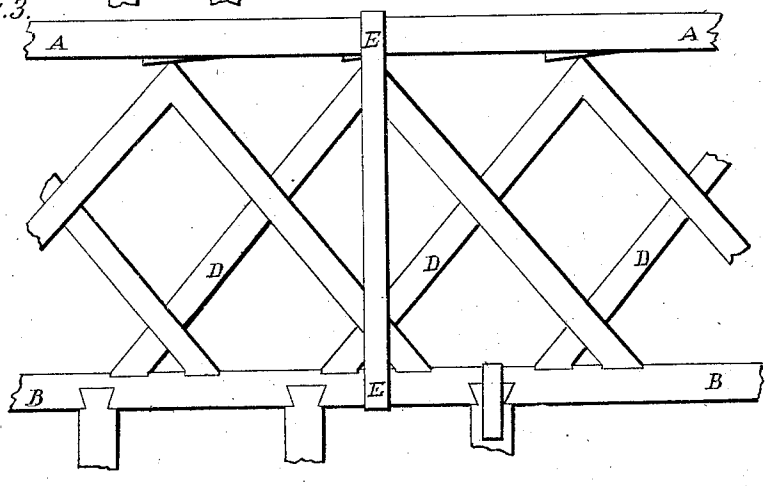


Fig. 3.



Sheet 2 - 2 Sheets.

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Fig. 5.

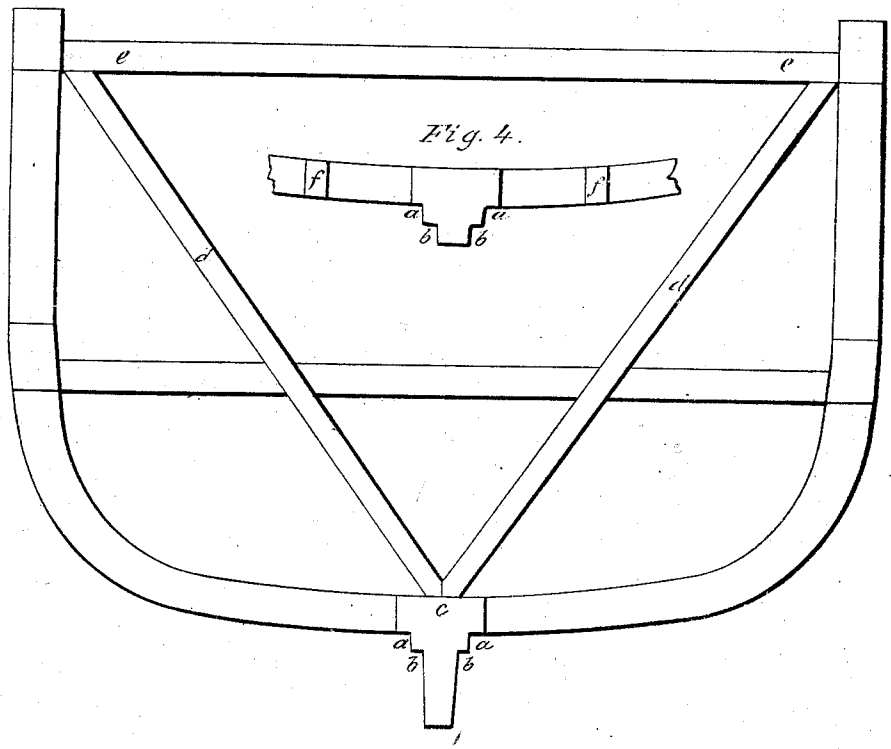
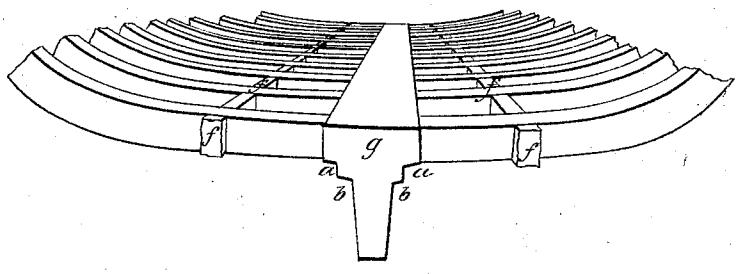


Fig. 4.

Fig. 6.



UNITED STATES PATENT OFFICE.

HENRY HIGGINSON, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN THE MODE OF BUILDING SHIPS AND OTHER VESSELS.

Specification forming part of Letters Patent No. **673**, dated April 4, 1838.

To all whom it may concern:

Be it known that I, HENRY HIGGINSON, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in the Mode of Building Ships and other Vessels Used in Navigation; and I do hereby declare that the following is a full and exact description thereof.

The object which I have in view in my improvements in the construction of ships and other vessels for naval service is so to arrange, combine, and unite the materials of which they are built as to give to them a much greater degree of strength and stability than they usually possess without any material increase in their cost or loss of room for stowage, and to accomplish this end I have devised several new modes of precedure, which may be used in whole or in part, as may be preferred.

One of my improvements in building ships or other navigable vessels with a view to increase their strength consists in placing outside of the timbers composing the frame of vessels two or more courses of planking running horizontally and parallel to each other, or as nearly so as may be.

I am aware that double planking is not new, vessels having been constructed entirely of plank, such vessels having been formed upon a mold and the layers of plank having been made to cross each other at various angles, so as in their combination to retain the form given to them without the use of a frame. The frames of vessels have also been double-planked, with the grain of the two layers crossing each other, so as to constitute a brace by such crossing. I am aware, also, that thick plank has sometimes been scarfed to a certain extent to enable it to be bent the more readily over quick curves, as in passing round the bows of a vessel; but my plan is distinguished from each of these in object and means. My object is to obtain great longitudinal strength by causing the grain of each layer of plank to run horizontally, or nearly so, and confining the layers together by tree-nails, spikes, bolts, or other means.

Each layer of plank is to be well calked, and between the layers tarred paper, tarred cloth, or paper or cloth covered with paint, or a layer of any suitable kind of cement, is to be interposed, as has been repeatedly done when cross-planking has been resorted to. The double calking, the close fitting of the layers of plank, and the intervention of a substance which resists the percolation of water, in connection with the stiffness derived from the employment of two or more layers of plank running horizontally, will tend to prevent the admission of moisture between the planking, and consequently insure its durability. For this same purpose of durability I omit the inner ceiling now so generally used, believing the same to be positively and greatly detrimental in promoting decay by confining the wet and moisture between that and the planking.

Another improvement consists in strengthening the frame by a new mode of applying diagonal braces and vertical and horizontal ties, either in combination with said two or more courses of horizontal planks or with plank employed in the usual manner in a single course. Such braces may be variously modified in size, arrangement, and material, as may be determined by the builder. They are to be placed between the timbers of the frame, and they may be flush with the outside of said timbers, so that the plank shall be in contact with them; or they may be so placed as to allow a flux of air between them and the plank, as may be preferred. In the former case the plank is to be fastened to them as it is now fastened to the ordinary ribs or other parts of the frame. I intend sometimes to dispense with a considerable portion of the ribs as now used in building vessels and to allow the diagonal braces and the ties to constitute a large portion of the frame and to serve as a substitute for ribs.

Figure 1 in the accompanying drawings will serve to show the manner in which diagonal braces may be applied. This figure may be taken as representing a section of about six feet square—say the usual height between decks—though a larger section would generally be preferably. R R R are the ribs, seen from the inside. They are supposed to be eight inches square with ten-inch spaces between them. B B are braces of plank, say, twelve inches wide and three inches thick let into the ribs where they cross the same, so as to be flush on the inside; or, instead of plank, they may be of timber of suitable size. They are braced against the two outer ribs of the section, as seen in the drawings, and are driven hard to their bearings by wedges. Bolts or other fastenings may be employed to

keep the braces in place, and the wedges also are to be so secured that they cannot work out by the working of the vessel. The timbers of each rib I intend to connect endwise by dovetail, which is a new mode of fastening them, more secure and efficient than the old-fashioned chock or than Seppings dowel, as neither of these has any tendency to resist a pull endwise.

In deep vessels whose sides continue down in a direction nearly perpendicular below the lower deck, I place diagonal braces there also. They may also be continued on the bottom; but I do not deem this necessary, there being but little tendency in a vessel to twist or strain sidewise.

The sectional drawing above referred to exhibits more timber than will be found necessary when diagonal braces are properly used, as the ribs may be reduced in number and size, as may also be the case with the braces, a thing which must necessarily be governed by the size of the vessel, the judgment of the builder, the material employed, and other circumstances. In this drawing the braces are represented as placed so as to be flush with the inside of the ribs; but the better way is to place them flush with the outside of the ribs in contact, or nearly so, with the planking, and the planking to be fastened thereto as now fastened to the ribs, the said braces being first wedged hard to their bearings. By this method the braces will take place of the ribs and much timber be saved, while at the same time will be attained in a great dedree that inflexibility which is the main object of my improvements, and which is the design of bracing in all kind of structure. Inflexibility has generally been thought inapplicable to ship-building; but it would seem more needful in vessels than anywhere else, as unlike most other structures they are subject to strains in all directions, being sometimes sustained or upheld by the two ends and sometimes by the center only, and under the circumstances of ordinary use they are strained more or less in all directions, producing a tendency to loosen and open the plank-seams, which nothing but inflexibility in the frame-work can continuously resist.

I do not pretend that there is anything absolutely new in the application of diagonal braces or of ties, these having been applied in nearly all possible ways in ordinary carpentry, as in the framing of bridges and other structures of timber. The novelty of my improvement in this part consists in employing devices well known in carpentry to the perfecting of naval architecture in the essential points of strength and tightness, and the manner of effecting this object as herein described I believe to be new and useful.

Fig. 2 in the accompanying drawings exhibits another method of using braces and ties, which I deem preferable to those already described. Horizontal bands of stout timber, generally two, as A A B B, are carried entirely round the vessel and dovetailed, clamped, or otherwise securely fastened to the stem and stern posts. The several pieces of timber composing these bands are also to be dovetailed, clamped, or otherwise secured together endwise, so as to form horizontal or longitudinal ties, which will resist the force of any strain lengthwise to which they are likely to be subjected. The band A A is to be placed nearly on a level with the upper deck, and the other B B ten, fifteen, or any other suitable number of feet below it, according to the size of the vessel. These two bands are connected and prevented from separating by upright timbers C C, placed at such distance apart as may be preferred, and dovetailed, clamped, or otherwise securely fastened to the horizontal bands, and thus forming vertical ties. Brace-timbers D D are then placed diagonally and driven hard to their bearings by wedges, as already described, thus rendering the frame-work inflexible and unyielding. Although the bands of timber have been spoken of as being placed horizontally, this term is not used in an absolute sense, as in vessels nearly every part of the structure is more or less curved, and these bands may be made to curve either upward or downward in any required degree without interfering with their efficiency or changing their mode of action.

It has been already observed that the principle of applying braces and ties may be modified in numerous ways, while the same end will be obtained, and differences of this sort have been exemplified in Figs. 1 and 2.

Fig. 3 is another variation, in which A A and B B are portions of the bands of timber before described, and D D are diagonal braces, the vertical ties C C (shown in Fig. 2) being omitted, and in place of which bars or bands of iron E E are passed over the upper and under the lower band of timber, so as to allow of and resist the action of the wedges in straining all up tight. As some of the methods of using diagonal braces here described bear a resemblance to the plan invented by Sir Robert Seppings and since adopted in the British naval service, it may be well to point out in what respects they differ from mine in order that my improvement may be better understood. Seppings braces are simply diagonal timbers placed on the inner side of the ribs and fastened upon them (not let into them) by bolts, the whole breadth of said braces projecting into the hold of the vessel. This plan of bracing, though greatly conducive to strength, and therefore an important advancement in the art of ship-building, is defective in several respects. One defect is the space thus occupied in the hold. Another is that the whole strain comes upon the bolts, which always yield more or less, and a third is that braces thus arranged cannot be forced to their bearings, without which diagonal braces on any plan lose half their efficiency.

Another improvement I have invented is

applicable to all modes of framing, and is for the purpose of strengthening the garboard strake, or where the planking joins the keel, stem and stern posts, and this is effected by doubling the planking for a few feet in width all along that line, and thinning off the edge of the outer layer which runs along parallel with that line. For this purpose I form a double rabbet along the line of the junction of the planking with the stem and stern posts and also along the keel in such a manner as that the edges of the inner and outer planks shall have a separate bed or resting-place, allowing in this way the ends and edges of the outer layer of plank to overlap the inner layer, each resting and being fastened within the rabbet adapted to it in thickness and extent.

Fig. 4 represents a cross-section of the keel, as also of the stem or stern posts, *a a* being the rebate for the inner and *b b* that for the outer layer of plank.

My next improvement consists in using diagonal braces midship, which are to slope upward and outward from the keel or keelson to the ends of the deck-beams or against the upper band of timber before described or against the side timbers near the level of the upper deck, as shown at Fig. 5, where *c* is the keel, *d* the brace, and *e* the deck-beam, the object and effect of which device being to strengthen the vessel generally, and also to cause the weight of the ship and cargo to be upheld in part by the side timbers instead of being as at present wholly sustained by the floor from the upward pressure of the water. This plan would alone prove of especial advantage in the flat-bottomed vessels now so generally used, the floors of which have a strong tendency to arch inward, and consequently to open the seams near the bilge. Instead of or in addition to the manner of placing the diagonal braces just described, braces from the keel may slope up fore and aft, so that their upper ends may press upon the centers of such beams, and in this manner transfer the strain to the sides. In like manner, the better to support the stem and stern and to counteract the tendency to hogg, I intend sometimes to use braces extending from the keel to those parts at an angle of about forty-five degrees with the horizon. These braces sloping upward form the keel fore and aft, may cross each other, and be multiplied at pleasure, and this would greatly increase the strength of the vessel in all respects in the same manner and perhaps to a greater degree than the diagonal braces on the sides, and they would thus form a continuous diagonal frame-work running along midship similar to that on the sides.

A further improvement, which is applicable to nearly all vessels, is to place between the floor-timbers at each side of the keel and at the distance of six or eight feet therefrom (more or less, according to circumstances) stout pieces of timber running lengthwise of the vessel, said pieces to be in a line with each other and to butt up against the floor-timbers, while they are also capable of being wedged up at one end. In Fig. 6, *f f* represent such timbers, *g* being the keel and *h* the floor-timbers. These pieces, which chock in between the floor-timbers and are wedged fast, assist greatly in strengthening the bottom and in preventing hogging or bending downward at the ends, as in so doing the deck and upper works must stretch or partially separate while the bottom is compressed. Whatever, therefore, has the effect of counteracting either of these tendencies must be so far useful in preventing their taking place. In combination, therefore, with the foregoing device I dovetail to the deck-beams the timbers or planks running lengthwise of the vessel from one deck-beam to another, and secure them further by clamps or other means, so that they shall bear a powerful tension without the danger of yielding; or for the same purpose of resisting the tendency to stretch in the upper works I use a thicker plank on deck—say four inches—on the under side of which I cut grooves of one or one and one-half inch depth, in which grooves the deck-beams are to rest and be wedged hard, and thus the whole deck may be rendered more capable of resisting the longitudinal strain before mentioned.

To secure the various timbers together, whenever treenails are used, I make such treenails of a larger size than would admit of their being driven in the ordinary way, and I then compress and condense such treenails, so that they may easily be driven into the holes prepared for them and become tight by expansion. This compressing may be effected by means of grooved rollers, by forcing the treenails through suitable holes in a metallic plate, or by any other adequate means; but to the method of effecting this I do not mean to make any claim, but only to their use; or, they may made of compressed wood and used with equal effect.

I have spoken of the employment of wedges for tightening the diagonal braces of the frame and for other purposes; but I intend to carry the system of wedging still farther by using them in all cases wherever they can be applied for giving firmness to the frame by forcing all parts to their proper bearings. This mode of tightening, as formerly observed, has been extensively used in carpentry, but has been overlooked in the framing of vessels, to which object I believe the application to be essentially new, and also of great importance in making the whole frame firm and inflexible, and wedges thus used are designed to become a stationary and permanent part of the frame.

Having thus fully described the various improvements made by me in the manner of building ships or other vessels, and also the way in which the same may be carried into effect, I do hereby declare that the following

are the improvements in this art which I claim as having been invented by me and which I desire to secure by Letters Patent:

1. The use of two or more courses of planking running longitudinally upon the vessel, arranged in the manner and for the purpose described.

2. The employment of diagonal braces placed between the ribs of the vessel, or so placed that the braces themselves may form part of the ribs, and so arranged as to be in contact with the outer planking, or nearly so—that is to say, without any timber, plank, or other substance of considerable thickness between the said braces and planking—the said braces being at the same time so adjusted that they may be forced hard to their bearings by means of wedges, the whole of which arrangement having for its object the producing a greater degree of inflexibility in the frame than has been ordinarily attained. In making this claim it is to be understood that I confine myself to the strengthening of the hull of the vessel by wedged braces between the ribs or by using braces as a substitute for ribs, a thing which will be readily distinguished from such frame-work as has sometimes been used above the deck in certain vessels, (as on steamboats for supporting the boilers and other parts of the machinery,) and not, therefore, properly connected with ship-building. By referring to the description of such braces in this specification it will be seen that I do not intend to limit myself to any particular form or combination of them, but to vary this and the material employed as I may think proper, while the plan and object remain intirely the same.

3. The combination of two or more courses of planking outside the frame with the use of diagonal braces of any form or material, believing such a combination to be new and eminently conducive to both strength and tightness.

4. The use of one or more bands of timber surrounding the vessel horizontally, or nearly so, and employed in the manner and for the purposes set forth.

5. The employment of iron bands passed over and under the upper and lower horizontal bands of timber as a substitute for such ties of timber as I sometimes use for the purpose of resisting and sustaining the force of the wedges employed with the diagonal braces, as described.

6. The double rabbet along the keel and the stem and stern posts to receive the double planking and to allow the outer layer of plank to overlap the inner layer, which said double rabbet and double planking may be used with or without my other improvements herein described.

7. The use of diagonal braces sloping up from the keel or keelson to the ends or center of the deck-beams or to the side timbers of the vessel, or to the stem or stern posts, in the manner and with the intention herein made known.

8. The manner of using one or more ranges of stout timber between the floor-timbers running lengthwise of the vessel and so constructed as to be wedged up, whether used alone or in combination with dovetailed ties uniting and bracing the deck-beams in order to prevent hogging, as described.

9. The use of plank grooved in the manner described for receiving the deck-beams, and thus add strength to the upper works generally.

10. The employment of the system of wedging not only as applied to my diagonal braces, but to braces of any form or material or to any other part of the ship's frame, as being the best and most convenient method of forcing all parts to their bearings, and thereby producing a great degree of firmness and inflexibility, which I hold to be essentially necessary in this sort of structure.

I do not claim the use of wedges in the art of ship-building generally, but I limit my claim to the use thereof for the purpose of stiffening the frame in all its parts, and as stationary appendages thereto.

Boston, January 17, 1838.

HENRY HIGGINSON.

Witnesses:

ROBERT ROGERS,
G. M. HIGGINSON.