Oct. 18, 1966 R. O. SCHMIDT 3,279,141

SUB-STRUCTURE FOR BOAT DOCKS

Filed May 28, 1963 3 Sheets-Sheet 1

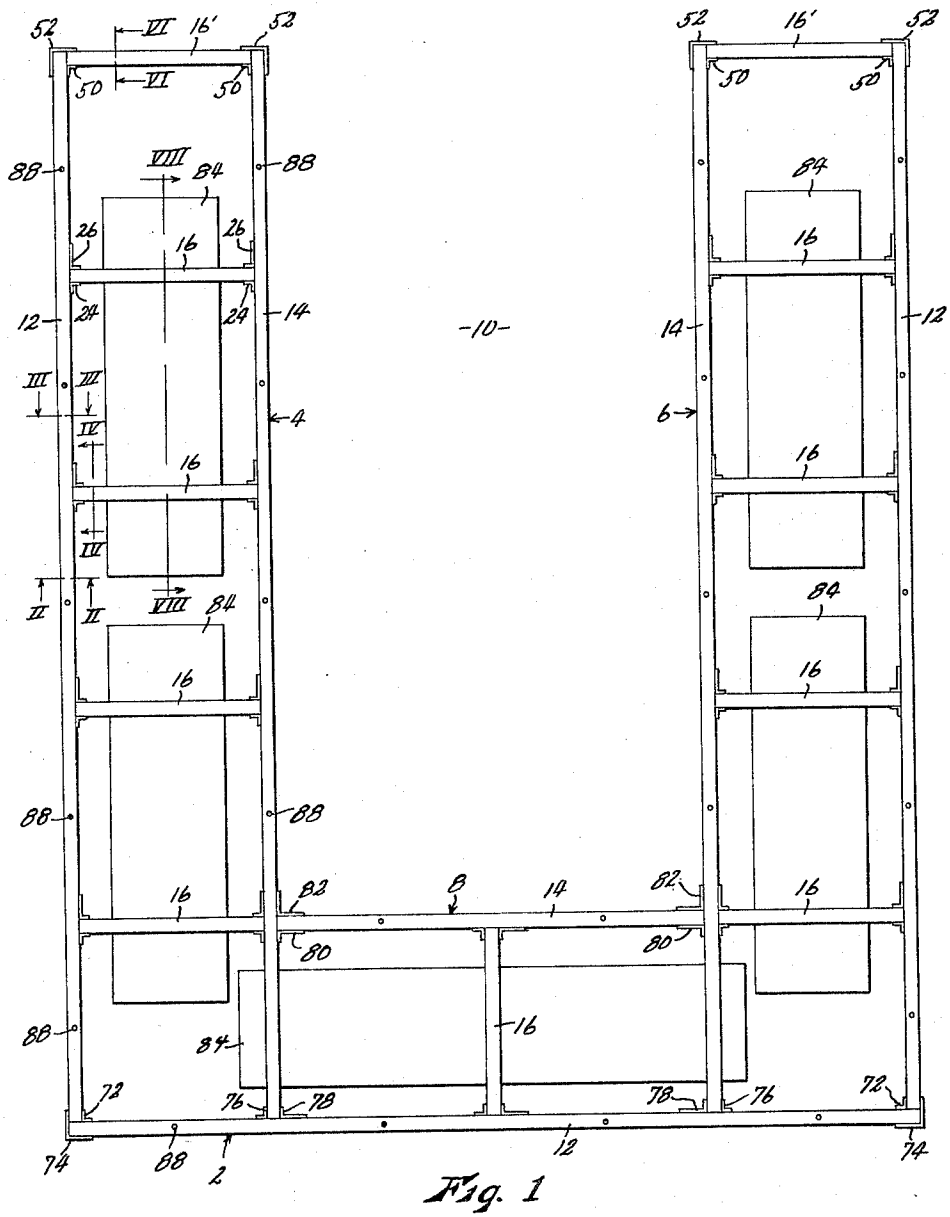


Fig. 1

INVENTOR.
Richard O. Schmidt
BY John A. Hamilton
Attorney.

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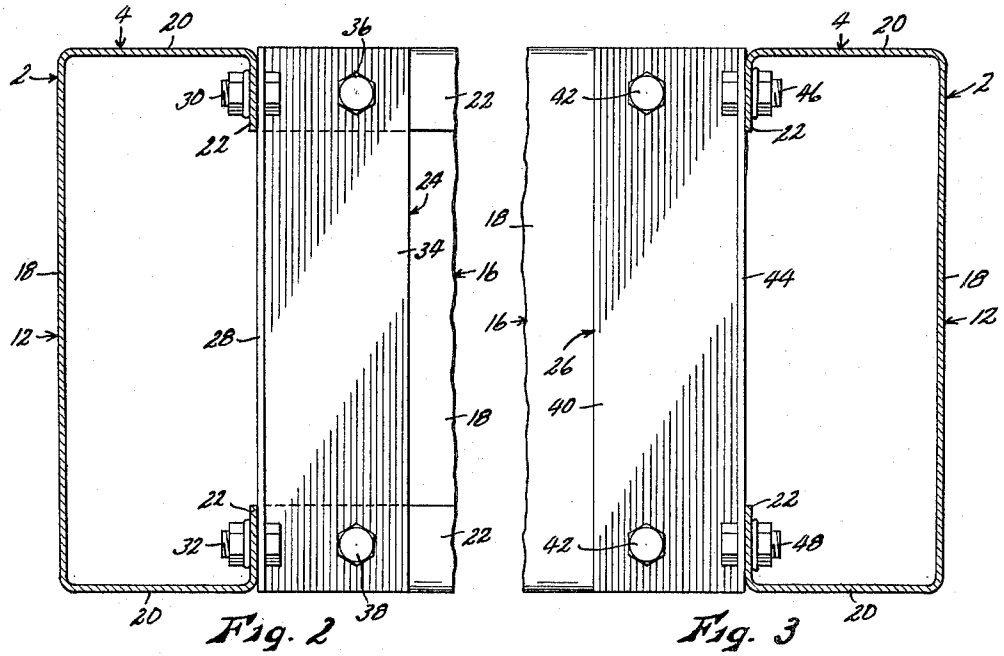


Fig. 2

Fig. 3

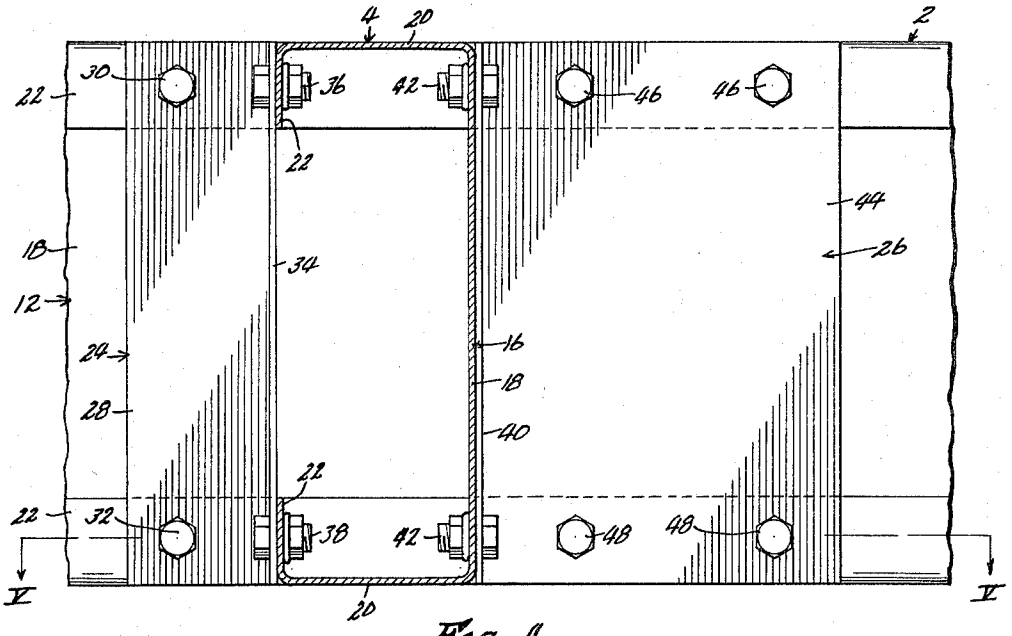


Fig. 4

INVENTOR.
Richard O. Schmidt
BY
John A. Hamilton
Attorney.

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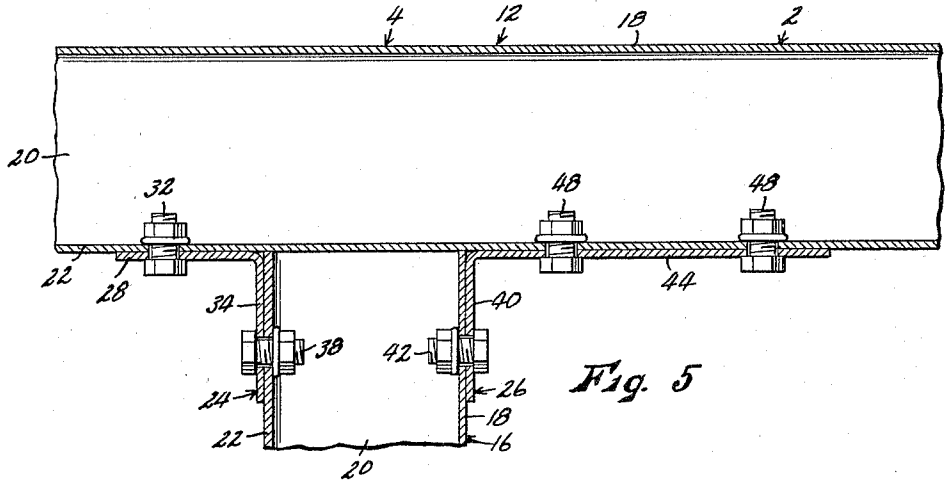


Fig. 5

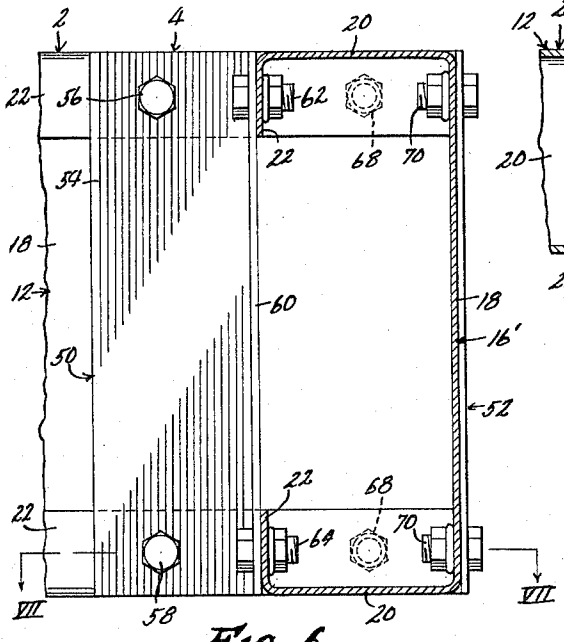


Fig. 6

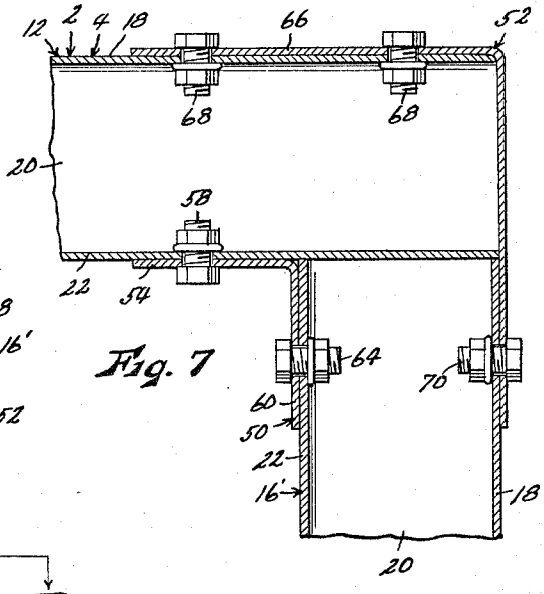


Fig. 7

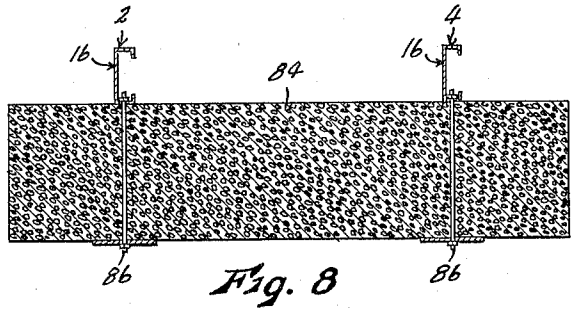


Fig. 8

INVENTOR.
Richard O. Schmidt
BY
John A. Hamilton
Attorney.

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SUB-STRUCTURE FOR BOAT DOCKS

Richard O. Schmidt, Prairie Village, Kans., assignor to The Firman L. Carswell Manufacturing Co., Inc., Kansas City, Kans., a corporation of Kansas

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3 Claims. (Cl. 52—656)

This invention relates to new and useful improvements in boat docks, and has particular reference to the sub-structures of boat docks, said sub-structure being that portion of a boat dock which is supported by the flotation elements of the dock, and which in turn supports the decking or flooring of the dock.

The principal object of the present invention is the provision of a boat dock sub-structure which is especially resistant to breakage or damage caused by rough water resulting from bad weather, boat wakes, and the like. More especially, the sub-structure forming the subject matter of the present invention derives its resistance to rough-water damage not from great strength or rigidity, but from a yieldability or flexibility which allows the dock to bend or flex to accommodate waves or other roughnesses occurring in the water supporting the dock. To this end, the sub-structure is composed of elements of such configuration, and connected together in such a manner, that while possessing entirely adequate strength for maintaining its general configuration and for performing its basic functions, nevertheless has the requisite flexibility for permitting any given portion thereof to rise and fall independently of other portions thereof in response, for example, to a wave passing thereunder.

Another object is the provision of a boat dock substructure of the character described in which the flexibility or yieldability described is confined largely to a vertical movement, and which is comparatively rigid in a horizontal plane. The horigontal rigidity causes the dock to retain its horizontal shape, which is very important if the dock is of complex shape having projecting arms forming boat wells therebetween, while the vertical flexibility permits the structure to yield or flex in response to rough water.

Other objects are simplicity and economy of construction, efficiency and dependability of operation, and adaptability to be furnished in small basic units which may be assembled to form docks of any desired size or design.

With these objects in view, as well as other objects which will appear in the course of the specification, reference will be had to the accompanying drawing, wherein:

FIG. 1 is a top plan view of a boat dock including a sub-structure embodying the present invention, with the decking removed to show the sub-structure,

FIG. 2 is an enlarged, fragmentary sectional view taken on line II—II of FIG. 1,

FIG. 3 is an enlarged, fragmentary sectional view taken on line III—III of FIG. 1,

FIG. 4 is an enlarged, fragmentary sectional view taken on line IV—IV of FIG. 1,

FIG. 5 is a fragmentary sectional view taken on line V—V of FIG. 4,

FIG. 6 is an enlarged, fragmentary sectional view taken on line VI—VI of FIG. 1,

FIG. 7 is a fragmentary sectional view taken on line VII—VII of FIG. 6, and

FIG. 8 is an enlarged, fragmentary sectional view taken on line VIII—VIII of FIG. 1.

Like reference numerals apply to similar parts throughout the several views, and the numeral 2 applies generally to a boat dock sub-structure embodying the present invention, said sub-structure consisting of a plurality of sections 4, 6 and 8 arranged generally in a U-shape lying

horizontally, section 8 forming the base of the U and sections 4 and 6 extending in parallel, spaced apart relation from the opposite ends of section 8 to form a boat well 10 therebetween. This is, of course, only one possible arrangement of the sections. By using any desired number of sections and assembling them as desired, docks of nearly any size and shape can be produced. For example, straight sections of any length can be used and the boats simply secured alongside, or a long central section can be used with multiple right angled sections extending from either or both sides thereof to define a large number of boat wells. It will of course be understood that the sub-structure as shown is normally covered by a deck applied thereto. However, the specific arrangement of the sections is not particularly pertinent to the present invention, and except for minor details, the principle of the invention will be apparent from a description of the structure and function of a single section, as will appear below.

Each of the sections 4, 6 and 8 is ladder-like in form, consisting of a pair of parallel side bars 12 and 14 connected at intervals along their lengths by a series of parallel, spaced apart cross bars 16 disposed at right angles to said side bars. The principal feature of the invention resides in the configuration of said side bars and cross bars, and in their mode of attachment to each other. As best shown in FIGS. 2–7, each of said side bars and cross bars is formed of sheet metal, preferably steel having a substantial degree of resilience, and is in the form of a C-shaped channel having a main web 18, a pair of parallel flanges 20 extending from the opposite edges of said main web, and an inturned lip 22 at the free edge of each of said flanges. This configuration renders said side bars and cross bars extremely resistant to general bending flexure, but leaves them relatively free to twist resiliently about their longitudinal axes, for a purpose which will presently appear. Where the side bars and cross bars are arranged to form squares of about four feet, as shown, and where the channels are about 8 x 3 inches, a 16 gauge steel has been found to perform satisfactorily in actual use, but these dimensions obviously are by way of example only.

The cross bars 16, except those at the extreme free end of any section, extend between and abut the side bars 12 and 14, lying in the same horizontal plane as said side bars, and each end of each cross bar is secured to the associated side bar by a pair of vertically extending sheet metal angles 24 and 26 fitted in the corners between said cross bar and said side bar. As shown in FIGS. 2–5, angle 24 has one leg 28 secured to the upper lip 22 of the side bar by a single bolt 30 and to the lower lip 22 of said side bar by a single bolt 32, and a second leg 34 affixed to the upper lip 22 of the cross bar by a single bolt 36, and to the lower lip of the cross bar by a single bolt 38. Angle 26 has a leg 40 affixed to web 18 of the cross bar by a pair of bolts 42 disposed respectively adjacent the upper and lower edges thereof, and a wide leg 44 affixed to upper lip 22 of the side bar by a pair of bolts 46 spaced apart longitudinally of the side bar, and affixed to lower lip 22 of the side bar by a pair of bolts 48 spaced apart longitudinally of the side bar. Said angles are also formed of sheet metal having a substantial degree of resilience, and the bolts closest to the bends of said angles are spaced apart from said bends sufficiently to allow flexing of the angles between the bolts.

It will be seen that the above described connection permits a limited degree of universal movement between each of the cross bars and the side bars to which it is attached. That is, due to the resilient yieldability of the lips 22 of the side and cross bars relative to the main webs 18 thereof, and due to the resilient yieldability of the connecting angles 24 and 26, each cross bar may to

a limited extent "pivot" both horizontally and vertically with respect to the side bars to which it is attached. It will of course be apparent that the same action could be obtained by substituting spot welding for the bolts as shown. However, a bolted construction is preferable in that welding burns off the galvanizing or other corrosion resistant coating of the sheet steel, so that rusting occurs, and also usually deteriorates the temper or crystalline structure of the steel to render it brittle and subject to breakage. The latter result of welding is particularly objectionable in a structure subject to virtually continuous and repeated flexing. The use of one wide leg on the angles 24 and 26 connected to lips 22 of the side bars (leg 44 of angle 26 as shown) serves to distribute the load applied to said lips by the cross bars along greater lengths of said lips, thereby to assist in preventing permanent deformation of said lips, by repeated flexing thereof.

With the structure thus far described, each of the sections could be easily deformed by relative longitudinal shifting of the two side bars 12 and 14, which would be possible due to the yieldable connections of cross bars 16 thereto. This general deformation of the section would of course be objectionable, and in the present structure is prevented by the use of a special cross bar connecting the side bars at the free end of any section. Such special cross bars, designated at 16', are shown at the upper ends of sections 4 and 6 in FIG. 1, and in FIGS. 6 and 7. Each cross bar 16' is identical to cross bars 16, but is secured to the related side bars by special means including an internal sheet metal angle 50 and an external sheet metal angle 52. Internal angle 50 corresponds to previously described angles 24, having one leg 54 affixed to the lips 22 of the side bar by bolts 56 and 58 respectively, and a second leg 60 affixed to the lips 22 of cross bar 16' by bolts 62 and 64 respectively. Angle 52 caps the external corner formed by the side bar and cross bar 16', having one leg 66 secured to the web 18 of the side bar by a plurality of bolts 68, and to the web 18 of cross bar 16' by a plurality of bolts 70. This connection of cross bar 16' renders the joints thereof with the side bars substantially rigid, at least to a much greater extent than the connections between said side bars and cross bars 16, and effectively retains the section in its general horizontal shape.

When sections are joined together in angular relationship, as sections 4 and 6 are joined to section 8 in FIG. 1, it is also desirable that the angles therebetween be specially braced for greater rigidity, in order that the entire structure will more accurately retain its general shape, for example to insure that sections 4 and 6 will remain properly spaced apart along their entire lengths to maintain the boat well 10 therebetween in its intended size and shape. To this end, it will be seen in FIG. 1 that the side bars 12 and 14 of sections 4 and 6 extend across section 8, and that outer side bar 12 of section 8 extends across the ends of sections 4 and 6. Outer side bars 12 of sections 4 and 6 are each joined to an end of outer side bar 12 of section 8 by an internal sheet metal angle 72 and an external sheet metal angle 74 corresponding in all respects to angles 50 and 52 respectively. The inner side bars 14 of sections 4 and 6 are each connected to outer side bar 12 of section 8 by a pair of sheet metal angles 76 and 78 corresponding in all respects to angles 24 and 26 respectively. Inner side bar 14 of section 8 extends between inner side bars 14 of sections 4 and 6, and each end thereof is affixed to the associated side bar by a sheet metal angle 80 corresponding to angles 26, and a sheet metal angle 82 corresponding to angles 52. The various bolts by which all of the sheet metal connecting angles are secured are not shown in FIG. 1, due to the small scale thereof.

The sub-structure thus far described is rendered buoyant by a plurality of flotation units 84 consisting of large blocks of plastic foam or other buoyant material disposed beneath each of sections 4, 6 and 8, and being connected

to cross bars 16 by long bolts 86 as best shown in FIG. 8. The end portions of the block 84 disposed beneath section 8 are also bolted to the side bars 14 of sections 4 and 6. Other flotation means could of course be used, but the plastic foam blocks have proved efficient and durable in use, and further have the advantage of being sufficiently flexible themselves not to interfere with the flexibility of the sub-structure itself. Any chance that said blocks might stiffen the sub-structure is further lessened by the fact that said blocks are secured to each cross bar 16 by only a single bolt 86, so that relative movement between the block and said cross bar is permitted. It will be understood also that in actual use the substructure shown is covered by a decking formed of wood or the like, not shown, the upper flanges 20 of side bars 12 and 14 having holes 88 formed therein at intervals for receiving bolts to secure the decking in place. The specific design of the decking is immaterial, except that it of course should be sufficiently flexible not to interfere with the flexibility of the sub-structure. If, as is most common, the decking is formed by board slats, the requisite degree of flexibility or yieldability is inherent.

In use, the box-like configuration of side bars 12 and 14 of each section of the sub-structure, and the consequent resistance to general flexing or bending thereof, imparts to each section a strong resistance to horizontal deformation thereof. Thus, for example, there will be no appreciable flexing of section 8 which would permit the free ends of sections 4 and 6 to move closer together or further apart, and no appreciable horizontal flexing of sections 4 and 6, which would have the same result. The dock thereby strongly maintains its horizontal layout even in very rough water, which is quite necessary particularly in an extensive dock forming a large number of boat wells 10, wherein such horizontal movement might be cumulative. Nevertheless, if a wave or other disturbance of the water passes under the dock, the portion of the sub-structure directly above the wave will be free to yield resiliently upwardly independently of other portions of the dock. Considering one section of the sub-structure, this vertical yieldability of selective portions thereof is not obtained by general flexure or bending of side bars 12 and 14, since as previously described said side bars are highly resistant to this type of flexure. Rather, it is obtained by a torsional twisting of said side bars, to which they have relatively low resistance, it being apparent that if a C-channel as shown is strained torsionally about its longitudinal axis, it tends to assume a "corkscrew" shape, so that portions thereof can be disposed at a higher elevation than other portions. Moreover, the upward pressure of water at any point along the length of the dock automatically forces that portion of the side rails into the "corkscrew" twist just described, and as a wave traverses the length of a dock section, the undulation of side bars 12 and 14 moves accordingly. In actual observation tests, as a wave traverses the length of a dock section as just described, a corresponding though reduced undulation of the top surface of the dock is easily observable with the naked eye.

The corkscrew twisting of side bars 12 and 14 as just described results in slight changes of angularity, both horizontal and vertical, between said side bars and cross bars 16, these changes being permitted by the universally yieldable connection between said side and cross bars, as provided by angles 24 and 26. Also, since if a wave is angular to the extent of the dock, the point of maximum deflection of side bar 12 may not correspond to the point of maximum deflection of side bar 14, there may be a twisting strain exerted on cross bars 16. While the yieldable end connections of the cross bars will permit such twisting to some extent, it is desirable that the cross bars themselves also be torsionally yieldable, and for this reason said cross bars are formed of C-channel just as are the side bars.

It is important also that side bars **12** and **14** open toward each other in opposed relation as shown, rather than opening in the same direction, since if they opened in the same direction, upward pressure at one point thereof, as by a wave, would tend to twist both of the side bars in the same direction, and this would cause a slight angling of the section in a horizontal plane, at the point actually under the twisting strain. However, with the side bars opposed as shown, they tend to twist in opposite directions, so that any tendency of one side bar to angle off horizontally is counteracted by an opposite tendency of the other side bar, and the section remains straight as viewed from above.

The actual movements of the side bars and cross bars are extremely complex and difficult to analyze and describe with accuracy, but it is believed that the structure and operation will be clear from the foregoing description. Briefly, the principle of my invention is the provision of a boat dock sub-structure which resists rough water damage thereto by resiliently yielding to vertical stresses applied thereto by rough water in which it is supported, rather than by rigidly resisting such stresses. Rough water, over a period of time, is capable of damaging and eventually demolishing many docks which are much more heavily built, and more expensive to construct, than that shown in the present application. In similar service, my sub-structure has provided much longer, trouble free service without appreciable damage from rough water, and with a lighter, less expensive structure. Moreover, this vertical yieldability has been achieved without appreciable sacrifice of rigidity in a horizontal plane, so that even complex docks with many boat wells will retain their shape indefinitely.

While I have shown and described a specific embodiment of my invention, it will be readily apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention as defined by the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent is:

1. A sub-structure for boat docks comprising one or more elongated sections adapted to be disposed in a horizontal plane, each of said sections being generally ladder-like in form and comprising:

(a) a pair of parallel, spaced apart side bars each formed of resilient sheet metal and being a C-shaped channel in cross-sectional contour, whereby to resist bending flexure strongly but to be relatively non-resistant to twisting about its longitudinal axis, said channels opening horizontally toward each other,

(b) a series of parallel, spaced apart cross bars extending between said side bars at right angles thereto,

(c) means attaching the opposite ends of each of said cross bars respectively to the lip portions at the free edges of said side bar channels, whereby the flexible yieldability of said lip portions relative to the remaining portions of said side bar channels permits limited universal movability of said cross bars relative to said side bars, and

(d) means connecting said side bars to resist relative longitudinal movement thereof strongly.

2. A sub-structure for boat docks comprising one or more elongated sections adapted to be disposed in a horizontal plane, each of said sections being generally ladder-like in form and comprising:

(a) a pair of parallel, spaced apart side bars of such configuration as to resist bending flexure strongly but to be relatively non-resistant to twisting about their longitudinal axes,

(b) a series of parallel, spaced apart cross bars extending between said side bars at right angles thereto,

(c) a pair of vertically extending resilient sheet metal angles disposed at horizontally opposite sides of each of said cross bars at each end thereof and fitting in the corners formed between said cross bar and the adjacent side bar,

(d) means securing one leg of each of said angles to its associated cross bar,

(e) means securing the other leg of each of said angles to the associated side bar, both of said securing means being spaced sufficiently apart from the apices of said angles to permit resilient flexing of said angles between said securing means, whereby to permit limited universal movement of said cross bars relative to said side bars, and

(f) means connecting said side bars to resist relative longitudinal movement thereof strongly.

3. The sub-structure as recited in claim **2** wherein each of said side bars is formed of resilient sheet metal and is a C-shaped channel in cross-sectional contour, and wherein said means securing each of said angles to each of said side bars is affixed only to the lip portions at the free edges of said side bar channels, whereby the resilient yieldability of said lip portions relative to the remaining portions of said side bar channels contributes to the universal movability of said cross bars relative to said side bars.

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RICHARD W. COOKE, JR., *Primary Examiner.*