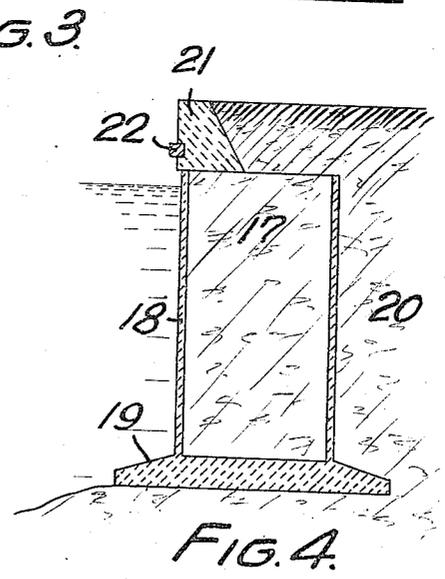
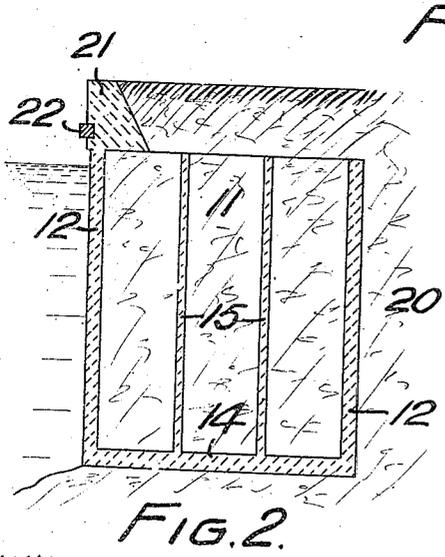
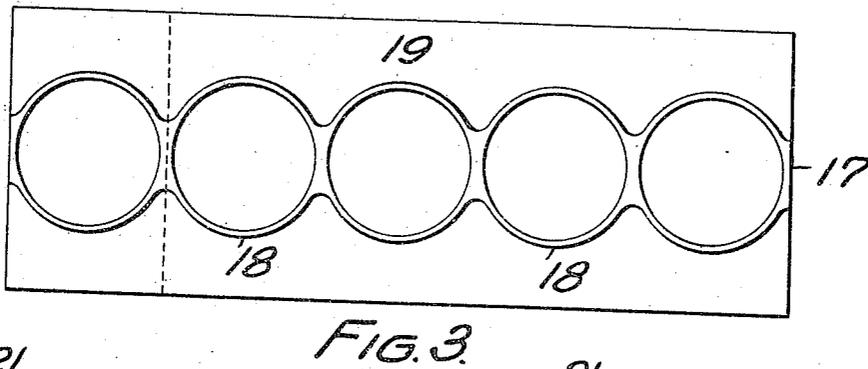
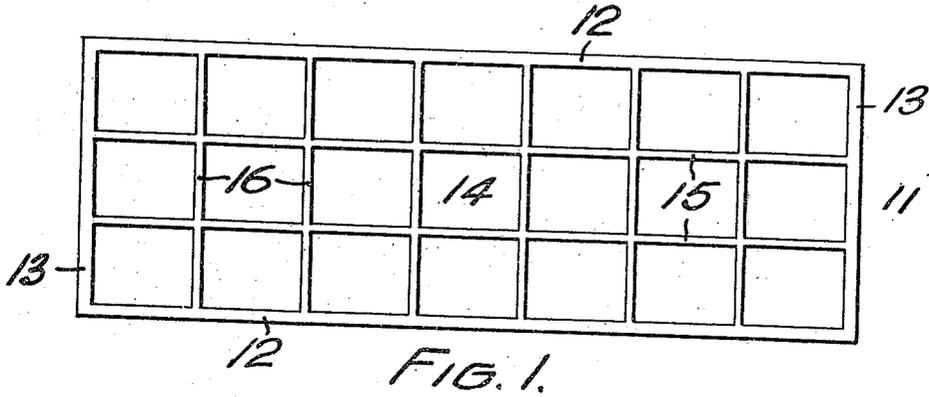


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CONCRETE SUBSTRUCTURE CAISSON.
APPLICATION FILED DEC. 1, 1913.

1,294,556.

Patented Feb. 18, 1919.
2 SHEETS—SHEET 1.



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CONCRETE SUBSTRUCTURE-CAISSON.

1,294,556.

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To all whom it may concern:

Be it known that I, JAMES SPELMAN, a subject of the King of Great Britain, and resident of the city of Montreal, in the Province of Quebec and Dominion of Canada, have invented new and useful Improvements in Concrete Substructure-Caissons, of which the following is a full, clear, and exact description.

This invention relates to improvements in concrete or reinforced concrete substructure caissons, and the object of the invention is to provide means by which a substructure caisson may be constructed much lighter and with greatly reduced expense for time, material and form work than at present.

A further object is to provide a structure of this character which will be much lighter and therefore more easily handled than the forms at present in use.

A still further object is to provide a structure which will have greater buoyancy than the type at present used.

In the construction of submarine foundations for wharves, piers, revetments or buildings, the present practice is to construct on dry land large caissons of concrete, or reinforced concrete, which when finished are floated to a position over the desired resting place and then sunk either by filling the caisson with water or with solid matter. These caissons are usually built with flat walls as shown in Figures 1 and 2. These structures are of course very heavy and when floated are to a considerable extent submerged, so that there is enormous external pressure, which under some circumstances increases as the caisson is sunk. This pressure requires that the outer walls be made very strong, and in large structures, also necessitates the use of internal bracing walls. All this additional material greatly adds to the cost and increases the weight, so that the buoyancy of the completed caisson is very small. In the present invention, these disadvantages are overcome by building up the caisson of a number of cylindrical cells, which owing to their shape are much stronger and do not require the same wall thickness nor any internal bracing. Moreover, the volume of this structure is much greater compared to the weight of material

than in the ordinary form, so that the structure has greatly increased buoyancy.

In the drawings which illustrate this invention:—

Fig. 1 is a plan view of the present form of substructure caisson.

Fig. 2 is a vertical transverse section at the center of same.

Fig. 3 is a view of the improved substructure caisson corresponding to Fig. 1.

Fig. 4 is a vertical transverse view at the center of the caisson shown in Fig. 3.

Fig. 5 is a perspective view showing a completed pier, wharf or the like, the water and filling being removed in the foreground to show the arrangement of the substructure sections.

Before referring more particularly to the drawings, it may be stated that the drawings are approximately to scale, the wall thicknesses being as nearly in proportion as possible.

Referring now to the drawings, 11 designates a substructure caisson of the type at present in use, which is particularly a rectangular box having the sides 12, ends 13 and bottom 14 formed integral. When this structure is being floated to the site, the external pressure of the water against these flat walls is very great, so that it is necessary to make the walls very thick and strong, and in addition to support them by internal bracing walls 15 and 16, the walls 15 being parallel with the side walls 12 and the walls 16 parallel with the end walls 11. These bracing walls add greatly to the weight of the structure, but are nevertheless indispensable to support the outer walls. If these outer walls were made sufficiently heavy to withstand the external pressure, the weight of material would become so great in proportion to the total volume that the structure would have no buoyancy, and would in addition be extremely difficult to handle on account of the great weight. Such great weight would necessitate the sections used being made smaller, so that the stability of the finished structure would be less. In this invention, the caisson 17 is built up of a number of cylindrical portions 18 integral with one another and with a base 19. This base 19 may be the same width as

the base of the caisson 11, but the diameter of the cylindrical portions need not be as great as the width of the caisson 11, as clearly shown by comparison of Figs. 1 and 3. The circular form of the walls enables a much lighter wall to be used, and yet withstand the same external pressure as the flat walls 12 and 13. Furthermore, these circular walls brace themselves and do not require any internal support.

It is impossible to narrow the upper part of the caisson 11 and thus reduce the amount of material, for example, by eliminating the side walls 12 and increasing the walls 15 in thickness and perhaps spacing them slightly farther apart. The reason that this structure is impossible from a practical point of view is that the volume is not sufficient to give buoyancy. It is well known that with one exception, a rectangular solid has the least volume in proportion to its surface, while with the exception of spherical and ellipsoidal bodies, the cylindrical structure has the greatest volume in proportion to its surface. It will thus be seen that even disregarding the thickness of the walls, the cylindrical structure has the advantage of greater buoyancy. The cylindrical shape which permits walls of reduced thickness adds to this advantage. In point of actual fact, the heavy base 19 which is placed under the cylindrical type to give stability to the finished structure is necessary to give stability to the structure during flotation, as without this great bottom weight the cylindrically formed portion would float so high in the water that it would readily capsize. The heavy base, however, makes the structure extremely stable in the water, and yet allows it to float sufficiently high to be very seaworthy. On the other hand, the rectangular structure shown in Fig. 1, which has comparatively little buoyancy, floats very low in the water and has great tendency to roll, so that there is always danger of such a structure filling and sinking while it is being floated to its site.

In order that the great difference may be more completely understood, it may be stated that in two caissons constructed according to Figs. 1 and 3, each with a length of 100 feet, a width of 35 ft. and a depth of 39 ft., the outer walls of the rectangular form would require to be 20 inches thick, and the inner supporting walls 10 inches thick, giving a total weight of approximately 3,000 tons. In the improved form, shown in Fig. 3, the cylindrical walls would require to be only 8 inches thick for a diameter of 20 ft., and the complete structure including the base would only weigh about 1,200 tons. It will be readily seen what an enormous saving in material and labor can be effected by this means, and also in lumber

and time for form work. The improved substructure caisson shown in Fig. 3 may be manufactured more cheaply and more quickly than the ordinary form shown in Fig. 1. The flotation to site will be accompanied by less risk and may be effected more quickly as the body to be moved offers less resistance. The improved structure will have for all intents and purposes as great stability in the finished work as the form shown in Fig. 1. In fact, by means of this invention, the subaqueous foundation sections may be made larger than heretofore, thus further reducing the liability of movement between the foundation sections.

When the sections have been made, they are floated to the site of the proposed pier, wharf, revetment or the like, and sunk either by filling with water, or solid matter. The water may be introduced in any suitable way either by opening seacocks or by pumping into the caisson. The solid matter may be floated out on barges or may be supplied by dredges from the sea or river bottom. Each section as it is floated out is moored or otherwise secured over its site so that it will sink exactly into the desired position. This course is absolutely necessary as it would be obviously impracticable to move these enormous sections after they have been sunk. When the line of caisson substructure is complete, the back filling designated 20 is put in and the top of the structure finished off with a retaining wall 21, which in the case of wharves, piers or the like may be provided with a removable rub strake 22. If buildings are to be erected on the substructure, the retaining wall 21 is generally omitted and the foundations placed directly on the substructure, but this of course differs according to the design of each installation.

While the caisson has been shown as consisting of a number of cylindrical cells arranged in a single row, it is obvious that in some classes of work, only single cell caissons would be desirable. Furthermore, it may be found desirable to arrange the cells in two or more rows in plain or staggered relation. It may also be found desirable to make the cells of any polygonal form approximating the cylindrical structure. The more nearly this polygonal structure approaches the cylindrical, the more economical the result will be. While for external pressures, cylindrical walls of plain concrete are quite sufficient, it may be found necessary to reinforce the concrete if the structure is subject to any internal pressure. The base may also be reinforced to prevent fracture. The form of substructure having a wide base and narrow upper portion as shown possesses another advantage of stability over plain rectangular forms;

that is, the center of gravity remains much nearer the center line of the base if the structure should become slightly inclined. This enables sections of this form to better
5 withstand any force such as water pressure tending to upset them.

Having thus described my invention, what I claim is:—

10 A caisson unit comprising a row of complete cylindrical cells having walls of uni-

form thickness, a base formed integral with said cells, the walls of said cells merging into each other at their point of contact with each other.

In witness whereof, I have hereunto set
my hand in the presence of two witnesses. 15

JAMES SPELMAN.

Witnesses:

S. R. W. ALLEN,

G. M. MORELAND.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."