M. M. UPSON.

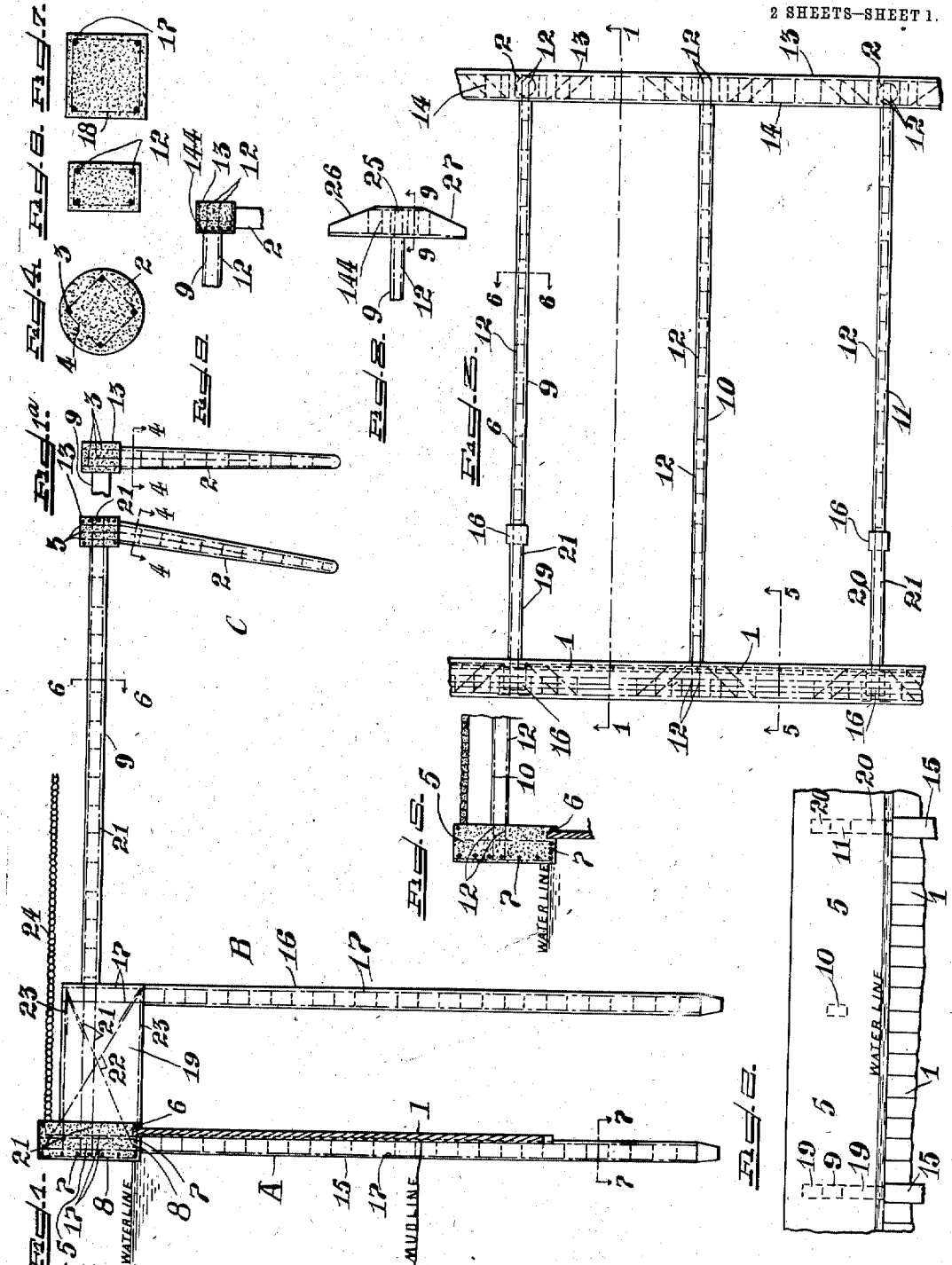
BULKHEAD.

APPLICATION FILED AUG. 18, 1909.

982,697.

Patented Jan. 24, 1911.

2 SHEETS—SHEET 1.



Attest:

C. S. Ashley

Wm. J. Forbes, Jr.

Inventor:

Maxwell M. Upson:

by

Philip Farnsworth

his Atty

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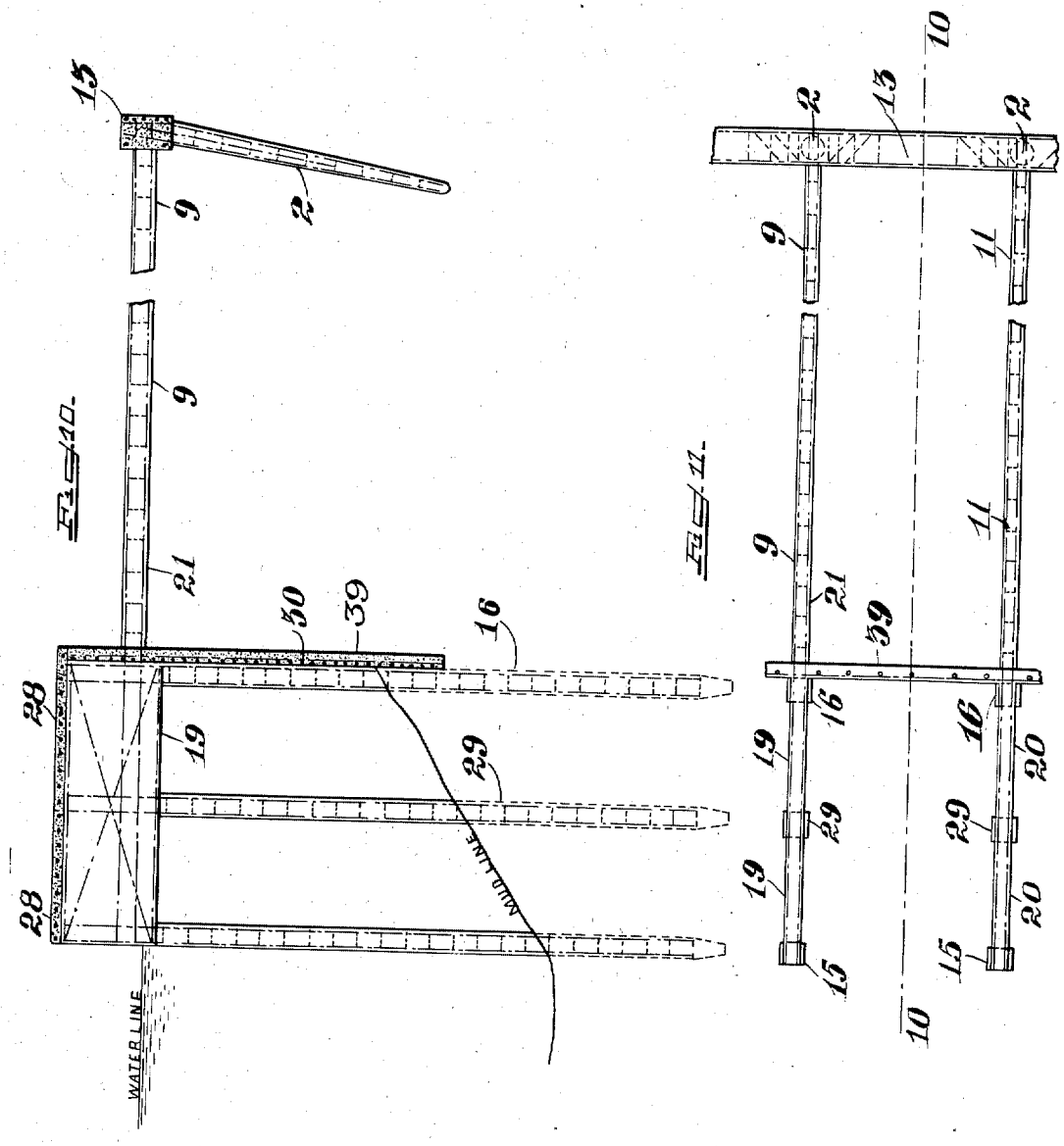

FIG 10.

FIG 11.

Attest:
C. S. Ashley
Wm. J. Forbes, Jr.

by

Inventor:
Maxwell M. Upson:
Philip Farnsworth
his Atty

UNITED STATES PATENT OFFICE.

MAXWELL M. UPSON, OF ENGLEWOOD, NEW JERSEY, ASSIGNOR TO RAYMOND CONCRETE PILE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

BULKHEAD.

982,697. Specification of Letters Patent. Patented Jan. 24, 1911.

Application filed August 18, 1909. Serial No. 513,444.

To all whom it may concern:

Be it known that I, MAXWELL M. UPSON, a citizen of the United States of America, and a resident of Englewood, New Jersey, have invented certain new and useful Improvements in Bulkheads, the principles of which are set forth in the following specification and accompanying drawing, which disclose the form of the invention which I now consider to be the best of the various forms in which the principles of the invention may be embodied.

This invention relates to improvements in the construction of bulkheads and the like, as for docks and similar applications, the object being a rigid, permanent structure of low cost, and the invention consisting of embodiments having said characteristics and others to be explained more fully hereinafter in connection with the drawings, of which—

Figures 1–7 illustrate one embodiment, and Figs. 10–11 an alternative embodiment; Fig. 1 being a longitudinal section of the entire structure, taken at right angles to the water-front at the left, and along 1—1 of Fig. 3; Fig. 1ª is a section like Fig. 1 of a modified arrangement of an anchor-pile relative to that of Fig. 1; Fig. 2 is a front elevation of a portion of the sea-frontage of the structure; Fig. 3 is a plan of that portion of the structure as a whole, which is shown in Fig. 2, but showing the same longitudinally complete from the sea-front to the anchorage to the right in the rear; Fig. 4 is a section at 4—4 of Fig. 1; Fig. 5 is a section at 5—5 of Fig. 3; Fig. 6 is a section at 6—6 of Fig. 1; Fig. 7 is a section at 7—7 of Fig. 1; Fig. 8 is a plan of a modification of the deadman 13 of Figs. 1 and 3; Fig. 9 is a section at 9—9 of Fig. 8; and Figs. 10—11 are a longitudinal section and a plan, respectively, of a modified form of the inventions as an entirety, the section Fig. 10 being taken at 10—10 of Fig. 11.

A characteristic feature of the invention, which comprises a novel structure generally, is that in addition, such novel structure is particularly adapted for the employment of such compound material, as and in fact preferably comprises a structure substantially entirely of reinforced concrete. Reinforced concrete, containing the two elements concrete and steel, integrally combined and arranged respectively to resist strains of tension and compression, lends itself readily and effectively to forms of structure which would not be practicable if constructed of separate building elements such as steel or wood, or concrete alone.

The principal function of the structure, in general, is the maintenance of the earth adjacent the water as a support for the dock-flooring or pavement. Preliminary to that end the retaining wall 1 is sunk down to the desired depth. If the structure is to be located at a point beyond which the water extends a considerable distance landward (toward the right, Fig. 1), the spaces A, B will be water-filled, little or no dredging will be required at A, and a considerable earth-fill will be required at B. On the other hand, if the structure is to be located at a point farther inland, little or no earth-fill will be required at B, and considerable dredging will be required at A down to the mud-line shown. In any case the wall 1 is sunk to a considerable distance below the mud-line. The wall 1 preferably consists of sheet-piling, and the sheet or sheets may be composed of timber, steel, or other material, but are preferably of reinforced concrete, particularly above the mud-line. This retaining piling is sunk, as by driving or water-jetting successive elements, one element at a time, closely adjacent to each other and in line with the water-front, to form a substantially tight wall; and this wall is of such height that when sunk to the proper depth, it extends upwardly to the water-line or above it. If entirely of timber it should not extend up above the water-line. The function of this retaining piling is to retain the earth-fill, and prevent any movement of the earth toward the water, either beneath or above the piling. In any case, during the stage of construction at which only the piling 1 is in place, the earth level in spaces A and B is uniform, so the piling is not subjected to strains until after space B is earth-filled or space A is dredged, or both. Then, preparatory to any of the last-named operations, the remainder of the structure is installed, to reinforce the piling 1 to resist the strains of the subsequent earth-fill B.

The space C (Fig. 1) is at such distance

from the ultimate sea-wall that it naturally comprises ground sufficiently solid to retain anchor-piles 2 (or other suitable rear-anchorage), or a partial earth-fill may be made for this purpose at C, which fill shall not yet, however, be extended so as to bear against retaining piling 1. These piles 2 are placed a considerable distance apart (Fig. 3) in a row parallel with piling 1, and they may be sunk perpendicularly to be parallel with said sheet piling 1, as in Fig. 1ª, or at an angle as in Fig. 1. Piles 2 are preferably of reinforced concrete, at least as to their upper parts which will be above the moist earth below the water line, in the case of the preferable and economical construction to be described. But piles 2 are of those parts of the structure which need not be of concrete. When piles 2 are of concrete, however, the reinforcement may consist of steel rods 3 (Figs. 4, 1, 1ª) held in place during molding, as by stirrups 4. These piles 2 are preferably specially constructed, (when composed of concrete), in that steel rods 3 project upwardly beyond the pile itself for the purpose of being cast integrally with the reinforced concrete superstructure which is next installed, piling 1 and row of piles 2 having been placed or grounded previously.

In preparation for the casting of the reinforced concrete superstructure, wooden forms (not shown) are placed on retaining piling 1 and on the rear anchorage, as piles 2, the use of such forms for such purpose being in general pursuance of the art of reinforced concrete construction, and likewise the reinforcements described hereinafter are placed in the wooden forms or molds, and the concrete then placed in the forms to surround the reinforcements. After the concrete has set, the forms are removed, according to custom. The resulting superstructure is clearly shown in the drawings, and consists essentially of the reinforced concrete beam 5 extending integrally across the entire water-front of the structure and upon the retaining piling 1, having an inset 6 for the reception of the top of said piling. The function of this beam 5 is to carry the horizontal and vertical load, and it is therefore termed the "horizontal and vertical beam". The reinforces of beam 5 comprise steel rods 7 on the tension side, and retaining wires or stirrups 8. In correspondence with the other parts, the piling 1 may, if desired, have reinforces projecting from its top and embedded in the concrete of beam 5; but that is not necessary, because the inset arrangement shown is sufficient to take care of the strains, notwithstanding that nearly all of the strains take effect at the inset. Piling 1 may be of any desired character, and indeed it may be any suitable retaining wall; but, as above stated, it is far preferably some form of sheet piling, such as concrete piles grounded close together, and interlocked or not as desired, or water-insulated by grouting or not, as desired; or this wall 1 may be sheet piling consisting partially or entirely of timber or steel. The horizontal and vertical beam 5 may extend below the water-line, as shown. Beam 5 is also cast integral with concrete tie-beams 9, 10, 11 containing reinforcements 12 which extend into the concrete of beam 5 (see tie-beam 10, Figs. 3 and 5) to strengthen the integral concrete of beams 5 and 10 at their joint. The cross section of the tie-beams is shown in Fig. 6. The tie-beams 9, 10, 11 are also integral with the reinforced concrete anchor-beam or deadman 13 which is located on top of anchor-piles 2 or on or in the ground in case anchor-piles are not used; this integrity with the tie-beams being obtained by the co-molding of the concrete of both the tie-beams and deadman 13, and by the projection of tie-beam reinforces 12 into the deadman. The deadman is also preferably integral with anchor-piles 2, when those are used, by reason of the projection of pile-reinforces 3 up into the concrete of the deadman. The concrete of deadman 13 and piles 2 is also welded together, particularly if the piles are molded in place at the time the deadman is molded, as preferred, instead of being premolded. (The deadman also has its own reinforces 14, Fig. 3. Thus the integral reinforced concrete structure comprises anchor-piles 2, deadman, tie-beams, and beam 5. But the deadman is not an essential element between tie-beams and anchor-piles, although it may exist in forms other than in Fig. 3. If the deadman exists in any form, it simply aids the tie-beams and anchor-piles in bearing on the earth-fill to sustain the weight of the structure and of superincumbent material such as the earth-fill, pavement 24, etc., above the superstructure. The piles 2, while preferable, are not necessary, and the deadman alone may be used, or, in fact, any other suitable form of rear-anchorage.

An important feature of the invention is the buttress-construction for the retaining-piling 1, now to be described. This need not be employed, and the tie-beams might directly engage beam 5 supported on its grounded supports, such as piling 1, but the buttress-structure is almost invariably a most desirable addition to coöperate with the simpler structure above described. Prior to the placing of the molding-forms above referred to, transverse rows of piles 15, 16 may be placed or grounded as shown in Fig. 1. Two of the piles of the front row, 15, are shown in the front elevation of Fig. 2. Two of the piles of the rear row, 16, are

shown in the horizontal section of Fig. 3. As shown in the section Fig. 7 at 7—7 of Fig. 1, these piles are reinforced at 17, 18, and the reinforcing rods 17 extend upwardly beyond the top of the piles (Fig. 1) into the beam 5; so that when the molding forms are placed as stated above, the piles 15 of the front pile-row will be cast integrally with beam 5, and preferably also with the tie-beams, etc. Also the reinforces 17 of rear pile-row 16, project upwardly into the the buttress-walls 19, 20 (Figs. 1 and 3) so that those piles are cast integrally with said walls. The reinforces 21 of the buttress-walls 19, 20 also project into beam 5, said walls and beam being also cast integrally in the same molding forms. Thus buttress-walls 19, 20, as well as piles 15, 16, form part of the integral structure with beam 5, tie-beams 9, 10, 11, etc. In fact, in the case of buttress-walls 19, 20, their reinforces 21 extend into tie-beams 9, 11; and the reinforces 12 of tie-beams 9, 11 extend into buttress-walls 19, 20; *i. e.*, as shown, the reinforces 12 and 21 may be continuous and identical. In fact reinforces 21 extend from the interior of beam 5 to the interior of deadman 13. Buttress-walls 19, 20 have additional diagonal reinforces, 22, 23, which, as shown in Fig. 1, project into beam 5, in addition to reinforces 21. The elementary buttress-structure for the retaining-piling 1 is thus an integral reinforced concrete combination consisting of functioning elements which include pile 15, horizontal and vertical beam 5, buttress-wall 19 (or 20), and pile 16. This construction takes the shear between piles 15, 16, and resists outward strains resulting from the earth pressure on retaining piling 1. The complete buttress-structure comprises the row of piles 15, 15, etc., (Fig. 2), and the successive buttress-walls 19, 20 combined with rear pile-row 16. In some cases, as shown at tie-beam 10 (Fig. 3), it is not necessary that a pile 16 be used for every tie-beam, but the latter may extend directly into horizontal and vertical beam 5 as shown. As shown in Figs. 1 and 2, retaining piling 1 may adjoin pile-row 15; indeed piles 15 may, as shown, form a part of the retaining piling, such that the sheet piling may be in sections between successive piles 15; but the retaining piling may have any desired location relative to piles 15 or 16; or it may bear only in the earth, and at its upper portions in the buttress upper structure or in the horizontal and vertical beam, or both. The strains take effect chiefly where piling 1 engages in beam 5 (Fig. 1).

The horizontal and vertical beam 5 is a prominent feature of the invention, and comprises a body of concrete, preferably so combined and reinforced as to permit of the integral incorporation with it of the stay-walls 19, 20, and also the tie-beams, deadman (when used) and anchor-piles 2 (when used).

When desired, the piling 1 may serve alone in place of the row of piles 15, when the piling 1 is located substantially under the left of the stay-walls 19, 20.

After the concrete construction is completed, the fill is made, up to the height (Fig. 1) where it is desired to lay the pavement or flooring 24. The weight of the structure is distributed not only on piling 1 and also preferably on buttress-piles 15, 16; but also the following members rest on the fill, *i. e.*, stay-walls 19, 20, tie-beams 9, 10, 11, and deadman 13; and anchor-piles 2 take some of the weight. In cases of naturally existing fills in space C (Fig. 1) the reinforced concrete construction of the tie-beams is productive of economy, as there is no necessity for excavation, as would exist in cases of destructible materials, in order to locate the materials below the water-line for protective purposes. Deadman 13 may be omitted entirely; or, if desired to employ some equivalent, a sectional deadman may be used, consisting of sections 25 (Fig. 8) each integrally united with its corresponding tie-beam and having wings 26, 27 to rest on the earth-fill, on opposite sides of the tie-beam, having thus a cantaliver action. Sections 25 also have their reinforcement 144 (Figs. 8 and 9) just as in the case of the continuous deadman 13 of Fig. 3.

The advantages of the above structure are chiefly its permanency, rigidity and low cost, all of which are of a high order as compared with prior structures for similar purposes.

In the modified form of Figs. 10 and 11, retaining piling 1 is shown in the rear (to the right) of stay-walls or buttress-walls 19, 20, instead of in front of them as in Fig. 1; the effect, however, being the same, as to the action of the buttress-structure relative to the retaining piling. Also, while in Figs. 10, 11, beam 5 of Fig. 1 is functionally combined in each wall 19, 20 of Figs. 10 and 11, yet the function of beam 5 of Fig. 1 in connecting together the piles 15 in the front pile-row, is, in Figs. 10, 11, executed by substitute piling 39 through which extend horizontal reinforces 30. The function of beam 5 of Fig. 1 remains, however, in 19, 20 of Fig. 10, as to carrying the horizontal and vertical load. The bays between successive pairs of stay-walls 19, 20 are in practice spanned by a floor-slab 28 (Fig. 10, not shown in Fig. 11), as of reinforced concrete, as shown. In Figs. 10 and 11 also there is an addition to the buttress-structure consisting of a third or intermediate row of piles 29.

The buttress-structure and the piles thereof, may be embodied in various equivalent forms, but the piles constitute by far the most desirable supports for the buttress.

The invention can be embodied in various other structures and used for various analogous purposes, and the advantages above specified as to the form first above described, are inherent to a greater or less degree in all possible forms of the invention.

In the claims, the expression "horizontal and vertical beam" is used to define that part of the structure, such as beam 5 of Fig. 1 or the corresponding functioning part of Fig. 2 or of any other modification, which takes the horizontal and vertical load of the structure and earth-fill.

I claim:

1. A structure for bulkheads and the like, which comprises a front retaining wall; and a buttress-structure therefor consisting of a plurality of rearwardly extending rows of piles, a horizontal and vertical beam connecting the front row of piles, and longitudinal stay-walls connecting respective piles of a front row with corresponding piles of a rear row; said retaining wall and buttress-structure and horizontal and vertical beam being combined to allow the latter to take outward strains on the retaining wall.

2. A structure for bulkheads and the like, which comprises a retaining wall; a buttress-structure therefor; rear-anchor piles having reinforcing projections, and tie-beams connecting the buttress structure with the anchor-piles; said tie-beams and buttress being of reinforced concrete molded integrally with each other and with the said projections of the anchor-piles.

3. A structure for bulkheads and the like, which comprises a retaining wall; a buttress-structure therefor comprising grounded supports and means transversely connecting the same; a rear-anchorage composed of piles having reinforcing projections; and tie-beams connecting the anchorage and buttress-structure; said grounded supports, transverse connecting means and said tie-beams being of reinforced concrete, integrally molded together.

4. A structure for bulkheads and the like, which comprises a retaining wall; a buttress structure carried by a plurality of transverse rows of grounded supports; stay-walls connecting the supports of one row with the supports of another row; a rear anchorage composed of piles having reinforcing projections; and tie-beams connecting the rear anchorage with said stay-walls, said tie-beams and stay-walls comprising an integral structure of reinforced concrete.

5. A structure for bulkheads and the like, which comprises a retaining wall; a buttress structure carried by a plurality of transverse rows of grounded supports; stay-walls connecting the supports of one row with the supports of another row; a transverse beam connecting together the supports of one row; a rear anchorage composed of piles having reinforcing projections; and tie-beams connecting the rear-anchorage with said buttress structure; said transverse beam and stay walls comprising an integral structure of reinforced concrete.

6. In a structure for bulkheads and the like, a deadman integrally united with rear anchorage piles.

7. In a structure for bulkheads and the like, a deadman composed of reinforced concrete integrally united with a rear anchorage pile and with a corresponding tie-beam.

8. In a structure for bulkheads and the like, a sectional deadman composed of reinforced concrete each section being integrally united with a tie-beam and having wings resting upon the earth fill.

MAXWELL M. UPSON.

Witnesses:
H. R. MOYER,
I. A. FISK.