Sept. 11, 1923. 1,467,470

F. G. BORG

CONCRETE BULKHEAD OR RETAINING WALL

Original Filed Jan. 3, 1921. 4 Sheets-Sheet 1

FIG. 1

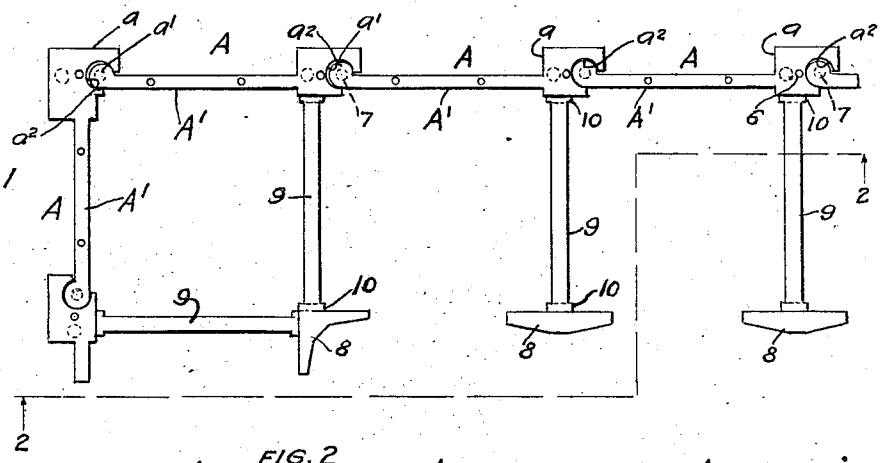
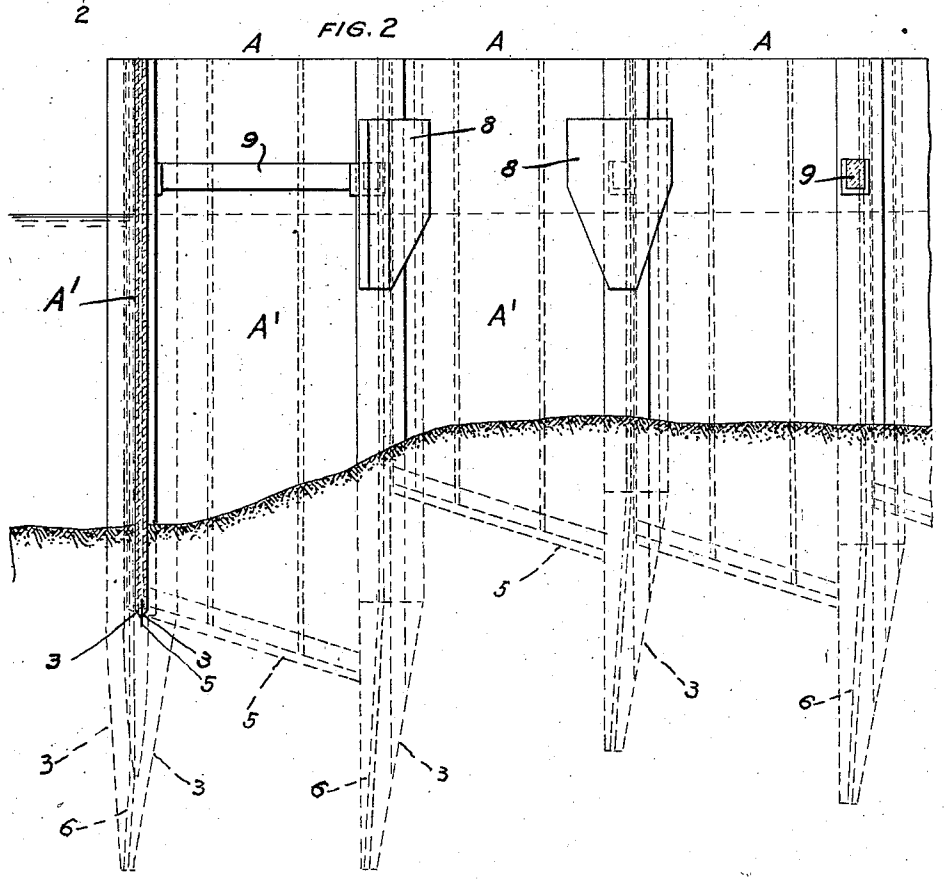


FIG. 2



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Original Filed Jan. 3, 1921 4 Sheets-Sheet 2

FIG. 3

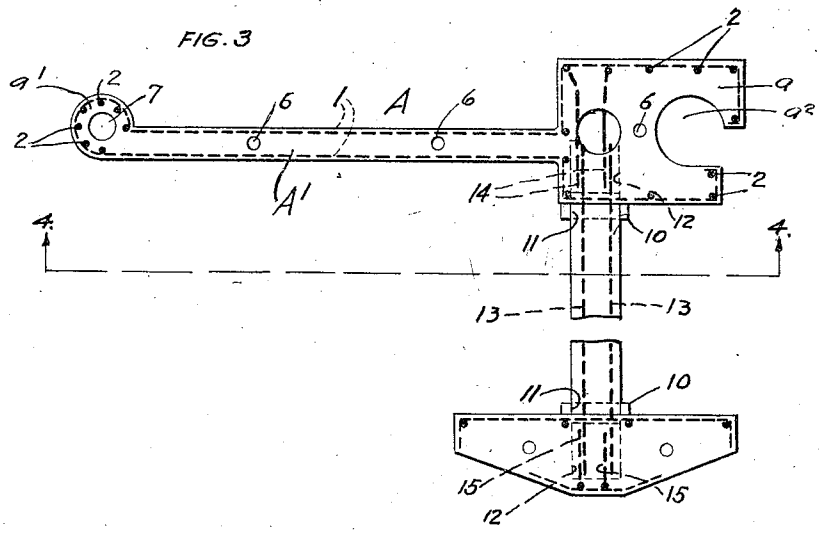
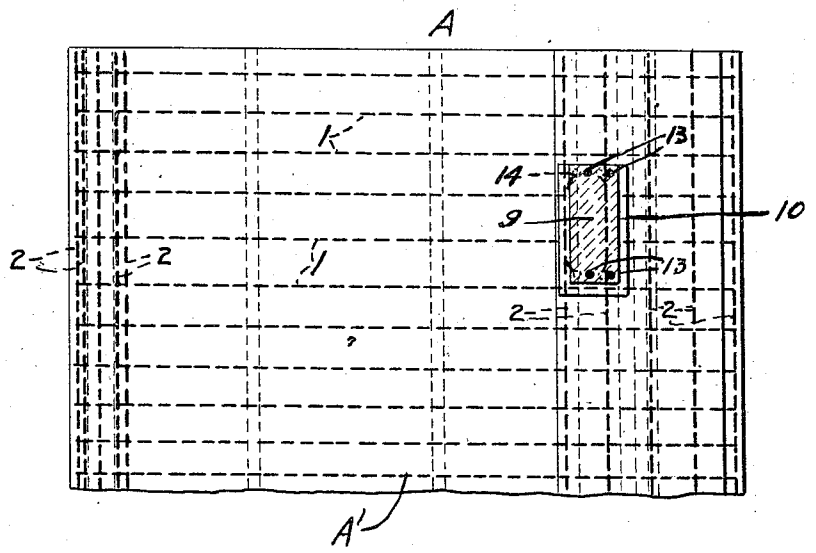


FIG. 4



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CONCRETE BULKHEAD OR RETAINING WALL

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FIG 5

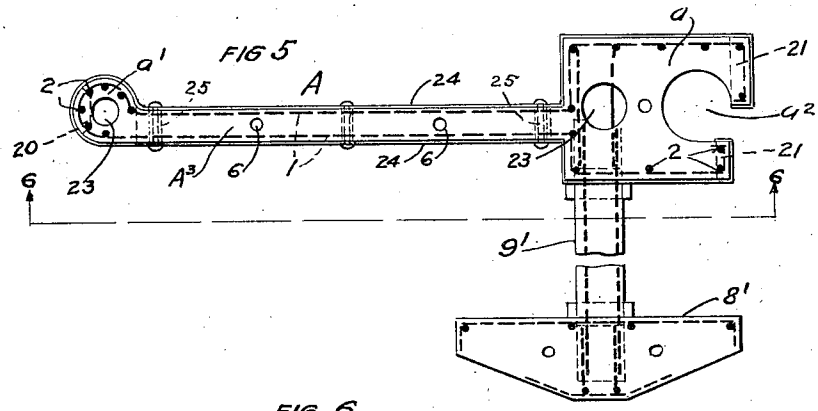


FIG. 6.

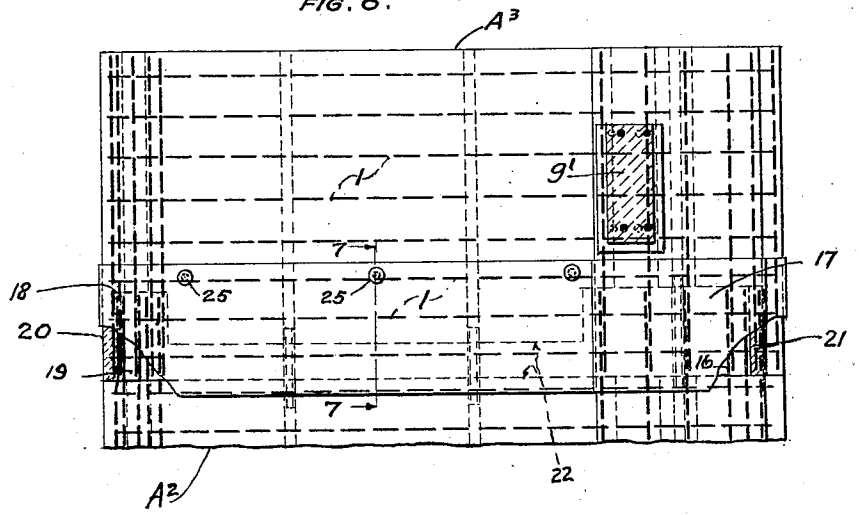
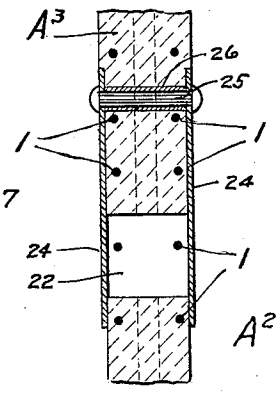


FIG. 7



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CONCRETE BULKHEAD OR RETAINING WALL

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FIG. 8

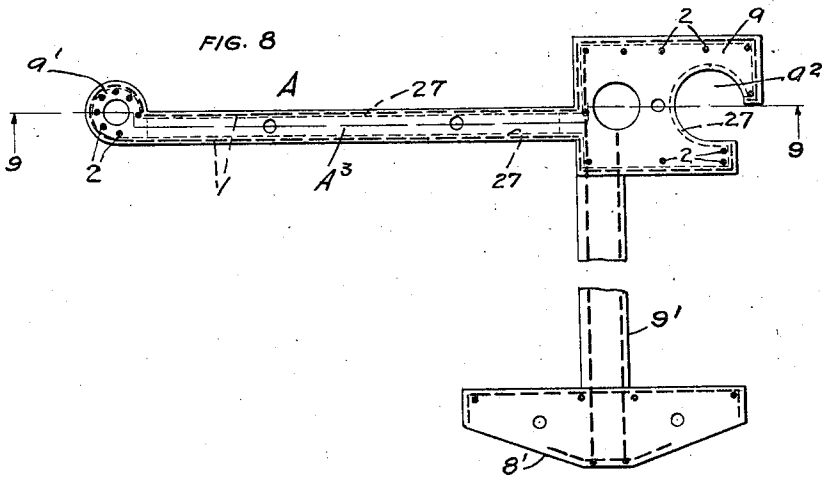
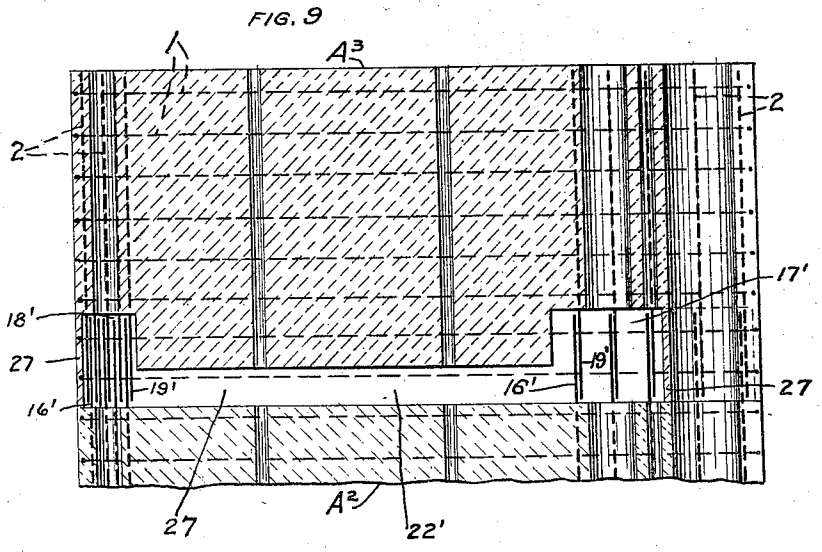


FIG. 9



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Patented Sept. 11, 1923. 1,467,470

UNITED STATES PATENT OFFICE.

FREDRIK G. BORG, OF CHICAGO, ILLINOIS.

CONCRETE BULKHEAD OR RETAINING WALL.

Application filed January 3, 1921, Serial No. 434,853. Renewed June 16, 1923.

To all whom it may concern:

Be it known that I, FREDRIK G. BORG, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Concrete Bulkhead or Retaining Wall, of which the following is a specification.

This invention relates to reinforced concrete bulkheads or retaining walls and relates particularly to the type of bulkhead or retaining wall consisting of a plurality of rigidly connected sections adapted to be fabricated separately at a central plant or factory and shipped to and erected on the job.

The object of the present invention is to provide a construction for bulkheads or retaining walls of the type specified, of improved and simplified construction which will be relatively strong and durable and which may be constructed at small cost as compared with any bulkhead or retaining wall of which I have any knowledge.

A further object of the invention is to provide a bulkhead or retaining wall consisting of panels reinforced and strengthened at intervals by means of concrete buttresses applied thereto, all forming a substantially integral structure.

To effect the foregoing objects, a bulkhead or retaining wall of my invention consists of a plurality of panels, of relatively large size, each comprising a web portion, formed at the edges of which are a buttress section and a bead, said buttress section being provided with a groove or channel adapted to receive the bead on another panel, thereby rigidly connecting said panels. Said channels will also form guides for the beads of succeeding panels, which will insure that said panels will be properly positioned.

The invention also comprises the various other features, combinations of features and details of construction hereinafter described and claimed.

In the accompanying drawings, in which my invention is fully illustrated,

Figure 1 is a top plan view of a bulkhead or dock embodying my invention.

Figure 2 is a sectional elevation thereof on the line 2—2 of Fig. 1.

Figure 3 is an enlarged top plan view of one of the panels shown in Figs. 1 and 2.

Figure 4 is a fragmentary side view from the position 4—4 of Fig. 3, the stay-plate supporting beam being shown in section.

Figure 5 is a view substantially similar to Fig. 3 illustrating a modified construction.

Figure 6 is a fragmentary side view from the position 6—6 of Fig. 5, showing the stay-plate supporting beam in section.

Figure 7 is an enlarged fragmentary sectional view on the line 7—7 of Fig. 6.

Figure 8 is a view substantially similar to Fig. 5 illustrating another modification; and

Figure 9 is a vertical sectional view on the line 9—9 of Fig. 8.

In the accompanying drawings, I have for purposes of clear and definite illustration shown my invention and improvements as embodied in a dock, which, however, merely typifies one of many different applications of my improved bulkhead or retaining wall.

To effect the object of the invention as it relates to forming a dock of separate sections adapted to be fabricated at a central plant or factory as a manufacturing proposition, and then shipped to and erected on the job, a dock of my invention comprises a plurality of panels A, each comprising web portion A^1, formed at opposite lateral edges of which are an enlarged columnar projection a, and what may be designated a bead a^1. The panels A^1 are adapted to be rigidly connected to form the dock or bulkhead, by engaging the bead a^1 on one panel with a groove or channel a^2 formed longitudinally in the columnar projection a of another panel. As shown, the beads a^1 and grooves a^2 are substantially circular in cross-section, said beads being preferably somewhat smaller than the grooves or channels a^2, but larger than the open sides of said grooves or channels, thereby forming, in effect, dove-tailed joints. In the finished structure, the enlarged columnar projections a project from the face of the bulkhead or retaining wall, forming buttresses thereon which will impart strength and stability thereto, being proportioned and adapted to sustain the total pressure to which the bulkhead will be subjected in use. Said enlarged columnar projections may therefore be appropriately referred to as buttress sections and will hereinafter be so designated, both in the specification and in the claims.

The panels A′ are reinforced and strengthened by means of reinforcing bars 1, which extend transversely of the web portions A^1 thereof and around both the inner and outer sides of the buttress sections

a and also around the grooves or channels a^2 formed therein. As shown, said reinforcing bars are bent or looped at the opposite edges of said panels and are imbedded in the beads a^1.

Said buttress sections a and beads a^1 are reinforced or strengthened by longitudinal bars 2 which extend substantially the entire length thereof.

In erecting the dock or bulkhead, after one panel has been set into position, successive panels are set with the beads a^1 thereof in engagement with the grooves a^2 and so on, said panels being set successively until the dock is completed.

After the panels are set, any spaces between the beads a^1 and the sides of the grooves or channels a^2 will preferably be filled with concrete, or grout, thereby uniting the connected panels to form a substantially unitary structure.

The lower ends of the buttress sections a and of the webs A^1 are preferably tapered as shown at 3 and the lower edges of the webs A^1 are preferably inclined, as shown at 4. Also, in order to provide a strong cutting edge therefor, steel plates 5 are secured in the lower edges of said webs in such relation that they will project a desired distance beyond the edges of the concrete portions thereof.

In practice, the panels A may be set by pile drivers or by jets of water under pressure, in a familiar manner.

To provide for setting said panels by means of jets, holes or openings 6 and 7 are formed lengthwise through the buttress sections a and the beads a^1, and, if desired, in the webs A^1 to which jet pipes may be connected.

The panels A may be of different widths and lengths depending upon conditions and the pressure to which they will be subjected in use. A desirable width for ordinary purposes is about ten feet. As regards their length, it is practicable to make and set panels of any length up to one hundred feet and possibly of greater length.

The panels A having been set, they are adapted to be supported by means of backstays or anchors. As shown, said backstays or anchors consist of concrete plates 8 imbedded in the ground or back-fill at a distance from said dock or bulkhead and connected thereto by means of beams 9. Said anchor plates 8 and beams 9 will preferably be fabricated at the factory and shipped to and erected on the job, means being provided for rigidly connecting the ends of said beams 9 to said anchor plates 8 and to the buttress sections a of the panels A. Simple means for this purpose are as follows:—

Formed on said anchor plates 8 and buttress sections a are brackets 10, formed in the upper surfaces of which and extending into said anchor plates and buttress sections respectively, are recesses 11 adapted to receive the ends of the beams 9, which are made of such length and are so positioned that they will terminate short of the inner ends of said recesses 11, forming cavities 12. Said recesses 11 and cavities 12 may, however, be formed wholly in the brackets 10 or wholly in the anchor plates 8 and buttress sections a. Said connection also comprises reinforcing bars 13 embedded in the beams 9, the ends of which extend beyond the ends of said beams and project into the cavities 12 and overlap the ends of reinforcing bars 14 and 15 secured in the buttress sections a and stay plates 8, respectively, and which project laterally therefrom into said cavities 12. After said beams 9 are placed in position with the ends of the reinforcing bars 13, 14 and 15 overlapping, in the manner described, the cavities 12 are filled with concrete, in which the projecting, overlapping ends of the reinforcing bars 13, 14 and 15 will become imbedded when said concrete sets and hardens, thus rigidly connecting the anchor plates 8 with the dock or bulkhead A, in the manner described. As shown, the ends of the beams 9 extend inwardly slightly beyond the sides of the anchor plates 8 and the buttress sections a.

The length of the overlapping ends of the reinforcing bars 13, 14 and 15 is such that the adhesion between said bars and the concrete in which they are embedded will develop the full strength of said bars and will produce only compression stresses in the bodies of concrete which fill the cavities 12 and in which the overlapping ends of said reinforcing bars are embedded.

To illustrate the adaptability of my improved construction for forming docks or bulkheads comprising sections extending at angles to each other, I have in said Figs. 1 and 2, shown a dock or bulkhead comprising sections extending at right angles to each other. With my improved construction this can be effected in a simple manner, by forming a groove or channel a^2 in the corner buttress section a disposed at right angles to the panel A^1 thereof, instead of in alignment therewith, as with webs used in "straight" construction. Also, said corner buttress section is so formed that it will extend symetrically on both sides of the angle formed by the sections of the dock or bulkhead connected thereby.

Also, where the dock or bulkhead comprises sections extending in different directions, the buttress sections a adjacent to the corner buttress are anchored to a common anchor or stay-plate 8, which comprises sections which extend substantially parallel with the different sections of the dock or

bulkhead, said anchors or stay-plates and buttress sections being connected by beams 9 in the manner heretofore described.

Instead of making the panel A in one piece, my invention contemplates equally making them in two or more parts adapted to be rigidly connected in superposed position on the job as erection progresses. This built up construction is of particular advantage where the panels are of such length that their size and weight render them hard to handle, or when for any other reason it is desirable.

This modification of my improved bulkhead or retaining wall is shown in Figs. 5 to 7 of the drawings, in which the anchor or stay-plates 8, the beams 9 which connect said anchor or stay-plates to the panels A, and the upper portions of said panel parts to which said beams are connected, are shown as made in one piece. It will be understood, however, that the short top portions of said panels are merely typical and that said panel may consist of any number of parts of any length to meet different conditions and requirements.

Referring now to said Figs. 5 to 7, A^2 designates the main lower part of the panel section, A^3 the upper part thereof, 8^1 the anchor or stay-plates, and 9^1 the beams which connect said anchor or stay-plates with the upper panel portions A^3. As regards their usual features all of the foregoing parts will conform substantially to the corresponding parts shown in Figs. 1 to 4 and will be readily understood by persons familiar with the art without a description thereof in detail.

In accordance with my invention, as it relates to this feature, the top portions A^3 of said panels A are adapted to be connected to the top edges of the main lower portions A^2 thereof, in the following manner:—The top edges of the main lower portions A^2 of said panels are preferably made straight and embedded therein are reinforcing bars, the ends of which project upwardly from the top edges thereof, as shown at 16. The bottom edges of the top portions A^3 of said panels are also straight and are cut-away at their ends, forming recesses 17 and 18, and secured in said top panel portions A^3 are reinforcing bars the ends of which project down into said recesses 17 and 18, as shown at 19, and which overlap the projecting ends 16 of the reinforcing bars secured in the bottom panel portions A^3.

As shown, said projecting reinforcing bars, 16 and 19 are grouped within the areas of the recessed ends 17 and 18 of the top portions A^3 of said panels, but this arrangement may be varied as desired.

In setting said top panel portions A^3, means are also preferably provided for supporting said top panel portions in spaced relation relatively to the top edges of the bottom portions A^2 thereof. This may be effected in a simple manner by making the projecting reinforcing bars, 16 and 19 of proper lengths to form supports for this purpose. In practice, however, the means which I prefer for this purpose consists of projections formed directly on either or both parts of said panel sections. As shown, said projections are formed on the top panel portions A^3 and consist of ledges 20 and 21 formed around the edges of the beads a' and around the grooves or channels a^2 of the buttress sections a thereof, said ledges being of proper length to form desired spaces, designated 22 between the parts of said panels.

In the course of erection, the spaces 22 are grouted in or filled with concrete, holes 23 of sufficient size and properly positioned for pouring the concrete, being formed in the top panel portions A^3, the lower ends of which communicate with the spaces 22. To retain the concrete in said spaces 22, the sides thereof are closed. Simple means for this purpose consists of plates 24, preferably made of thin sheet steel, say one-eighth ($\frac{1}{8}$) of an inch thick or less, applied to the open sides of said spaces, the edges of which overlap the sides of the panel portions A^2, A^3, above and below said spaces. Said plates will preferably be made in the form of what may be described as a thimble, shaped to conform to the shape in cross-section of the panel sections and of such size that they will fit over the same. If desired, my invention contemplates securing said thimbles permanently to one or the other of the panel portions A^2, A^3 which may be done at the factory or plant. As shown, said thimbles are secured to the top panel portions A^4, the depending edges thereof being adapted to be inserted over the tops of the bottom portions A^2 of said panels.

In the preferable construction shown, the thimble formed by the plates 24 is secured to the top panel portion A^3 by means of tie rods 25 which extend through holes formed in said top panel portion A^3 and in the plates 24, the ends of which are riveted to said plates. Said thimbles may be attached to said panel portions during the process of manufacture in a simple manner by placing said thimbles into the holes for casting said panel portions with the sides thereof connected by the rods 25, said thimbles being supported in such positions that when the concrete for forming the same is poured into said molds the rods 25 will become imbedded in the body of concrete forming said panel portions. Preferably, also, the plates 24 forming opposite sides of said thimble are maintained in desired spaced relation preparatory to pouring the concrete by means of tubular spacing members 26 in-

serted over the rods 25, in a familiar manner.

In order to overlap the upper edges of the bottom panel portion A^2, the plates 24 will necessarily be wider than the length of the ledges 21 which define the spaces between the panel portions A^2, A^3, and will project beyond the same, thus protecting said ledges or projections from being broken or damaged in handling and in transit.

After the main bottom panel portions A^2 have been set, the top panel portions A^3 are placed in position on top thereof and concrete is poured into the cavities formed by the space 22 through the pour holes 23 until said cavities are filled. When said cavities are filled with concrete, the overlapping reinforcing bars 16 and 19, which extend into said cavities, will become embedded in said concrete, thus rigidly connecting said panel portions A^2, A^3, to form a substantially integral structure.

In order that the joints or connections formed by the overlapping ends of the reinforcing bars 16 and 19, when embedded in the concrete poured into the cavity formed by the spaces 22, shall develop the full strength of the reinforcing bars, acting either in tension or compression, and in order that the concrete in which they are embedded shall be subjected to compression only due to stresses sustained by said bars, the ends of said reinforcing bars overlap such distances that the strength of the adhesion between said reinforcing bars and concrete shall equal the strength of said reinforcing bars. And in order that the full strength of said reinforcing bars shall be developed to resist bending stresses which the dock or bulk-head may sustain in use, said reinforcing bars comprise bars positioned in spaced relation adjacent to opposite sides of the dock or bulk-head and particularly in the relatively thick buttress-sections *a*.

In case it is desired to set the panels to a greater depth after the top panel portions A^3 have been secured in position, the holes 6 designed for setting the panels by means of water jets, are extended upwardly through the cavities formed by the space 22 and through the top panel portions A^2.

Instead of closing the sides of the space 22 by means of the plates or thimbles 24, I contemplate as a modification of the structure shown in Figs. 5 to 7, closing the sides of said space by concrete flanges formed integral with one or the other of the panel portions 20 and 21 entirely around the edges of the panel portions on which said ledges are formed. This modification is shown in Figs. 8 and 9.

Referring now to said Figs. 8 and 9, A^2 designates the main bottom panel portions, A^3 the top panel portions, 8^1 the anchor or stay-plates, and 9^1 the beams which connect the said anchor or stay-plates with said upper panel portions A^3; 16^1, 19^1 the overlapping reinforcing bars, secured in the panel portion A^2, A^3, respectively, 17^1 and 18^1 the cut-away end portions of the top panel portions A^3 and 22^1, the space between the panel portions A^2, A^3.

In accordance with the present modification, the cut-away portions 17^1, 18^1 and the space 22^1 are closed to form a cavity adapted to be filled with concrete by means of flanges 27 formed entirely around the marginal edges of the upper panel portions A^3.

Said upper panel portions A^3 will be provided with concrete pour holes and, if desired, with jetting holes for setting said panel sections to a greater depth, if this is contemplated.

As regards other features, the modified structure shown in said Figs. 8 and 9 may conform to similar features shown in Figs. 5 to 7, heretofore described, and will be readily understood without a further description thereof in detail.

I claim:

1. A buttressed dock or bulkhead made of concrete, consisting of a plurality of panels initially fabricated separately and each comprising a web, a bead formed at one edge of said web, the other edge of said web terminating in an enlarged columnar projection constituting a buttress and formed integral with the web, the said buttress being provided with a vertical groove at its outer edge adapted to receive the bead of another panel to thereby rigidly connect the panels, the buttress projections being adapted to sustain the total pressure to which the bulkhead will be subjected in use.

2. A buttressed dock or bulkhead made of concrete, consisting of a plurality of panels initially fabricated separately and each comprising a web, a bead formed at one edge of said web, the other edge of said web terminating in an enlarged columnar projection constituting a buttress and formed integral with the web, the said buttress being provided with a vertical groove at its outer edge adapted to receive the bead of another panel to thereby rigidly connect the panels, the buttress projections being adapted to sustain the total pressure to which the bulkhead will be subjected in use, said web being reinforced by transverse rods and said beads and columnar projections being reinforced by longitudinal rods.

3. A buttressed dock or bulkhead made of concrete, consisting of a plurality of panels initially fabricated separately and each comprising a web, a bead formed at one edge of said web, the other edge of said web terminating in an enlarged columnar projection constituting a buttress and formed integral with

the web, the said buttress being provided with a vertical dovetail groove at its outer edge adapted to receive the bead of another panel to thereby rigidly connect the panels, the buttress projections being adapted to sustain the total pressure to which the bulk-head will be subjected in use, said columnar projections extending downwardly beyond the lower edges of the webs.

4. A buttressed dock or bulk-head made of concrete, consisting of a plurality of panels initially fabricated separately and constructed and arranged to be set on the job as units, each of said panels comprising a web, a buttress section and a bead formed at opposite edges thereof, said buttress section being provided with a groove adapted to receive the bead on another panel, thereby rigidly connecting said panels, each of said panels comprising a plurality of parts adapted to be connected in superposed position on the job, the means for thus connecting the parts of said panels comprising means for supporting the adjacent ends of the parts to be connected in spaced relation, reinforcing bars secured in said parts to be connected, the ends of which project into the space between said panel parts and being of such length that the bars on one part will overlap the bars on the other, and means for closing the sides of the space between the parts of said panel, said panel being provided with a pour hole for filling the cavity formed by said space with concrete, substantially as described.

5. A buttressed dock or bulk-head made of concrete and constructed and arranged to be set on the job as units, consisting of a plurality of panels initially fabricated separately, each of said panels comprising a web, a buttress section and a bead formed at opposite edges thereof, said buttress section being provided with a groove adapted to receive the bead on another panel, thereby rigidly connecting said panels, each of said panels comprising a plurality of parts adapted to be connected in superposed position on the job, the means for thus connecting the parts of said panels comprising means for supporting the adjacent ends of the parts to be connected in spaced relation, reinforcing bars secured in said parts to be connected, the ends of which project into the space between said panel parts and being of such length that the bars on one part will overlap the bars on the other, and means for closing the sides of the space between the parts of said panel, said panel being provided with a pour hole for filling the cavity formed by said space with concrete, the overlapping ends of said reinforcing bars being of such lengths that when embedded in the concrete poured into the cavity into which they project, the adhesion between said reinforcing bars and concrete will develop the full strength of said reinforcing bars, substantially as described.

6. A buttressed dock or bulk-head made of concrete, consisting of a plurality of panels initially fabricated separately and constructed and arranged to be set on the job as units, each of said panels comprising a web, a buttress section and a bead formed at opposite edges thereof, said buttress section being provided with a groove adapted to receive the bead on another panel, thereby rigidly connecting said panels, each of said panels comprising a plurality of parts adapted to be connected in superposed position on the job, the means for thus connecting the parts of said panels comprising means for supporting the adjacent ends of the parts to be connected in spaced relation, reinforcing bars secured in said parts to be connected, the ends of which project into the space between said panel parts and being of such length that the bars on one part will overlap the bars on the other, and means for closing the sides of the space between the parts of said panel, said panel being provided with a pour hole for filling the cavity formed by said space with concrete, the overlapping ends of said reinforcing bars being of such lengths that when embedded in the concrete poured into the cavity into which they project, the adhesion between said reinforcing bars and concrete will develop the full strength of said reinforcing bars, and will subject said concrete to compression stresses only, substantially as described.

7. A buttressed dock or bulk-head made of concrete, consisting of a plurality of panels initially fabricated separately and constructed and arranged to be set on the job as units, each of said panels comprising a web, a buttress section and a bead formed at opposite edges thereof, said buttress section being provided with a groove adapted to receive the bead on another panel, thereby rigidly connecting said panels, each of said panels comprising a plurality of parts adapted to be connected in superposed position on the job, the means for thus connecting the parts of said panels comprising means for supporting the adjacent ends of the parts to be connected in spaced relation, reinforcing bars secured in the buttress sections and beads of said panel parts comprising bars positioned adjacent to opposite sides thereof, and the overlapping ends of said reinforcing bars being of such lengths that when embedded in the concrete poured into the cavity into which they project, the adhesion between said reinforcing bars and concrete will develop the full strength of said reinforcing bars, substantially as described.

8. A buttressed dock or bulk-head made of concrete, consisting of a plurality of panels

initially fabricated separately and constructed and arranged to be set on the job as units, each of said panels comprising a web, a buttress section and a bead formed at opposite edges thereof, said buttress section being provided with a groove adapted to receive the bead on another panel, thereby rigidly connecting said panels, each of said panels comprising a plurality of parts adapted to be connected in superposed position on the job, the means for thus connecting the parts of said panels comprising means for supporting the adjacent ends of the parts to be connected in spaced relation, reinforcing bars secured in the buttress sections and beads of said panel parts comprising bars positioned adjacent to opposite sides thereof, and the overlapping ends of said reinforcing bars being of such lengths that when embedded in the concrete poured into the cavity into which they project, the adhesion between said reinforcing bars and concrete will develop the full strength of said reinforcing bars, and will subject said concrete fill to compression stresses only, substantially as described.

9. A buttressed dock or bulk-head made of concrete, consisting of a plurality of panels initially fabricated separately and constructed and arranged to be set on the job as units, each of said panels comprising a web, a buttress section and a bead formed at opposite edges thereof, said buttress section being provided with a groove adapted to receive the bead on another panel, thereby rigidly connecting said panels, a back-stay adapted to be embedded in the back-fill and a beam which connects said back-stay with a panel, each of said panels comprising a plurality of parts adapted to be connected in superposed position on the job, the top part of said panel, the back-stay or anchor and beam being fabricated as a unit, substantially as described.

10. A buttressed dock or bulk-head made of concrete, consisting of a plurality of panels initially fabricated separately, and constructed and arranged to be set on the job as units, said panels each comprising a web, a buttress section and a bead formed at opposite edges of said web, said buttress section being provided with a groove adapted to receive the bead on another panel, thereby rigidly connecting said panels, the lower ends of said panels being downwardly tapered, and a sheet of metal set edgewise in the lower edge of the web thereof so as to project therefrom, substantially as described.

In testimony that I claim the foregoing as my invention, I affix my signature this 29th day of December, 1920.

FRED G. BORG.