This invention relates to coffer-dam constructions and aims to provide an improved wall structure formed by sections of sheet metal piling.

It is universally known that the building of ships of increased drafts necessitates the deepening of harbors. To accomplish this, existing quay ways must be strengthened or else re-built so as to withstand the stresses placed upon them. Sheet metal piling is generally conceded to be the most suitable material for the purpose and also for replacing the comparatively more expensive pile foundations. Nevertheless, the sheet piling constructions heretofore known are incapable of meeting the latest requirements. Most of those now in use are built with sections of channel or other form, the moments of resistance of which cannot be sufficiently increased or improved, so that further development of sheet piling according to these requirements calls for new structural forms.

The only type of section found to be suitable as the basis of these structural forms is the I section, which alone is able to provide the maximum moments of resistance. Moreover, the material is most economically utilized in this type of section. A number of different constructions embodying I sections are known but none of them meets present day requirements for the following reasons, viz:

1. Where solid walls are composed of said type of sections, the conditions under which anchoring means must be attached are unfavorable because the central webs of the sections interfere while their flanges are considerably weakened by the passage of heavy anchoring members therethrough.

2. Under ramming blows, all sheet piling splays in the direction of the wall axis and accordingly gets out of the perpendicular so that provision must be made to counteract the ramming effect. This is done in the case of channel sections for example, by hammering or pressing out some of the pile members into tapered form and inserting the same at definite intervals, so as to bring the next pile member to the perpendicular. In the case of I sections however, where the central webs are at right angles to the wall axis, this corrective expedient cannot be utilized since the sections cannot be tapered.

3. It is necessary for the walls to be free of projections, so that ladders or the like must be countersunk or recessed into the walls, which is impracticable when they are constructed solely of I sections, unless special and expensive constructional forms are additionally used.

4. In order to produce efficient and satisfactory piling walls, it is necessary insofar as possible to eliminate excess hydrostatic pressures causing rearward filling, but this cannot be accomplished with walls constructed solely of I sections without reducing their moment of resistance.

From the foregoing it will be apparent that the problem to be solved resides in the construction of a sheet piling which consists mainly of sections having webs disposed at right angles to the axis of the wall, and which in combination with a high moment of resistance will have the added advantages of (1) enabling easy attachment of the anchoring means; (2) permitting the effect of ramming to be easily counteracted; (3) permitting arrangements of auxiliary constructions such as ladders to be made in countersunk or recessed relation to the main front or surface of the structure; and (4) providing simple structural means for excluding excess hydrostatic pressures.

The present invention solves the aforesaid problem by providing a structure in which I sections are alternated, either singly or in groups of two or more, with sections which are open toward the face of the wall, such for example as channel sections or H sections with the central web running parallel to the wall axis. In such structure, the I sections, whether alternated singly or in groups of a plurality, give strength and greatly increased moment of resistance to the wall, while the interposed channel or H sections serve to counteract the result of ramming and for the attachment of recessed auxiliary structures or members besides providing for easy attachment of the anchoring means and for the exclusion or reduction of excess hydro-
static pressures. This construction has the still further advantage of reducing the weight per unit area of the wall since the interposed channel or H sections occupy spaces along the walls somewhat wider than the respective I sections.

The invention will be best understood by further description with reference to the attached drawings showing two practical embodiments thereof in a coffer-dam wall structure.

In said drawings:
Fig. 1 is a sectional plan view of one form of wall structure; and
Fig. 2 is a similar view of another form of wall structure.

The walls of the illustrative structures are shown formed by metal piling sections of I-shape connected together with their central webs disposed at right angles to the wall axis. In this instance the sections are connected together by T-shape members or bars d, complementally fitting between flanges of adjacent sections along their edges, but any other suitable joining means may be used or the sections may be interintered directly in complementary joints as may be preferred, the manner of connecting the individual sections being relatively immaterial. These sections compose the basic structural members of the wall and by virtue of their form impart thereto the necessary moment of resistance.

At predetermined intervals along the wall are interposed trough-like sections having their central portions or webs extending in the axial direction of the wall or running substantially parallel therewith. These last mentioned sections may be in the form of channel members b as shown in Fig. 1, or in the form of H-shaped members c as shown in Fig. 2. They are shown fitting complementarily with the flange portions of the I sections between which they are interposed as unitary parts of the wall, but may otherwise be connected in place by substantially water-tight joints. These sections b or c are interposed or connected preferably between groups of two or more of the I sections, but if desired, may be alternated with single of these sections. In the present instance the I sections are represented in groups of three but according to requirements in actual constructions there may be less or more in any group and the greater the number in each of the groups the greater will be the resistive moment of the wall.

These trough-like sections b and c may be tapered by spaying or compressing so as to restore the perpendicular relation or alinement of the I sections at points where interposed in the wall so as to counteract the effects of ramming as hereinbefore stated. They thus serve as corrective members in the wall structure. They also serve to particular advantage for attachment of the necessary anchoring means, as obviously heavy shafts or bars may be extended through and bolted to them more easily than the I sections. Such anchorage attachment moreover will avoid weakening the wall as unavoidably results from attachment to any I section. By reason of the fact that these trough-like sections in effect recede into the wall, they afford the possibility of accommodating recessed auxiliary appliances, such as ladders, fire hose, mooring devices, etc. Their interposition at intervals between groups of the I sections has the still further advantage of reducing the weight of the wall per unit area.

A greatly improved wall piling is thus produced in which the advantages of I-shape sections with those of channel or trough-like sections are combined in a less costly and more perfect structure of greatly increased strength and resistance moment with a reduction of weight per unit of wall area.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. A sheet piling wall comprising a plurality of trough-sections, connected together in substantially water-tight joints along their flanged edges, the majority of said sections being arranged in groups of two or more with their webs at substantially right angles to the wall axis and the others being arranged individually between the groups with their webs substantially parallel to said axis.

2. A sheet piling wall comprising I-sections and trough-section members connected together, the I-sections being arranged with their webs at right angles to the axis of the wall and said trough-section members being arranged between groups of a plurality of said I-sections with their webs running in the line of said axis.

3. A sheet piling wall comprising a plurality of I-sections connected together in substantially water-tight joints along their flanged edges, some of said sections being arranged in groups of two or more with their webs at substantially right angles to the wall axis and the others being arranged therebetween with their webs running parallel to said axis.

4. A sheet piling wall comprising a plurality of I-shaped and trough-shaped sections connected together in substantially water-tight joints, the I-shaped sections being arranged in groups of two or more with their webs disposed at substantially right angles to the wall axis and at least one of the trough-shaped sections being arranged between each of the groups of said I-shaped sections with its web extending substantially parallel to said axis.

5. A sheet piling wall constructed of uniform I-shaped sections connected together at their flanges and arranged with the webs
of the majority thereof disposed at substantially right angles to the wall axis, while the others at predetermined intervals along the wall are arranged with their webs disposed substantially parallel to said axis.

6. A sheet piling wall constructed of uniform I-shaped sections connected together at their flanges and arranged with the webs of the majority thereof in groups of two or more disposed at substantially right angles to the wall axis, while the others of said sections at predetermined intervals along the wall are arranged individually between the groups with their webs disposed substantially parallel to said axis.

7. A sheet piling wall constructed of I-shaped and trough-shaped sections connected together at their flanges, the I-shaped sections being arranged in groups of two or more with their webs at substantially right angles to the wall axis and at least one of the trough-shaped sections with its web disposed parallel to said axis being arranged between each of the groups of I-shaped sections.

8. A sheet piling wall constructed of I-shaped and trough-shaped sections connected directly together at their flange ends in substantially water-tight joints and arranged alternately with the webs of the I-shaped sections at substantially right angles to the wall axis and with the central portions or webs of the trough-shaped sections running substantially parallel to said axis.

9. A sheet piling wall comprising a plurality of trough-iron sections connected together and rammed into place, the majority of said sections being arranged in groups of two or more with their webs at substantially right angles to the wall axis and forming the main part of the wall with a high moment of resistance, and the other of the sections being arranged individually between the groups with their webs substantially parallel to the wall axis and serving the manifold purpose of counteracting or compensating inclinative effects of ramming, accommodating recessed auxiliary appliances, affording attachment of anchoring means for the wall and facilitating drainage as described.

10. A coffer-dam wall comprising I-shaped sections of sheet metal piling connected together in groups of a plurality according to the desired strength of the wall with related piling sections of trough-like form, the I-shaped sections being arranged with their central portions or webs at substantially right angles to the wall axis and the trough-like sections being arranged with their central portions or webs substantially in line with said axis.

11. A sheet piling wall comprising trough-shaped sections having flange-end connection together in substantially water-tight joints, the majority of said sections being arranged in groups with their central portions or webs at substantially right angles to the wall axis and the others being arranged at intervals therebetween with their central portions or webs running substantially parallel to said axis.

12. A sheet piling wall comprising a plurality of I sections connected together at their flange ends in substantially water-tight joints, some of said sections being arranged in groups of a plurality with their webs at substantially right angles to the wall axis and the others being arranged singly at spaced intervals between the groups with their webs running parallel to said axis.

In testimony whereof we have affixed our signatures.

ENNO BECKER.

FRIEDRICH WILHELM BRUSCH.