Oct. 25, 1932. M. G. HILPERT 1,884,686

METAL PILING

Filed Oct. 10, 1927 4 Sheets-Sheet 1

Fig. 1.

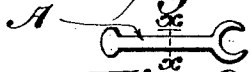


Fig. 2.

Fig. 3.

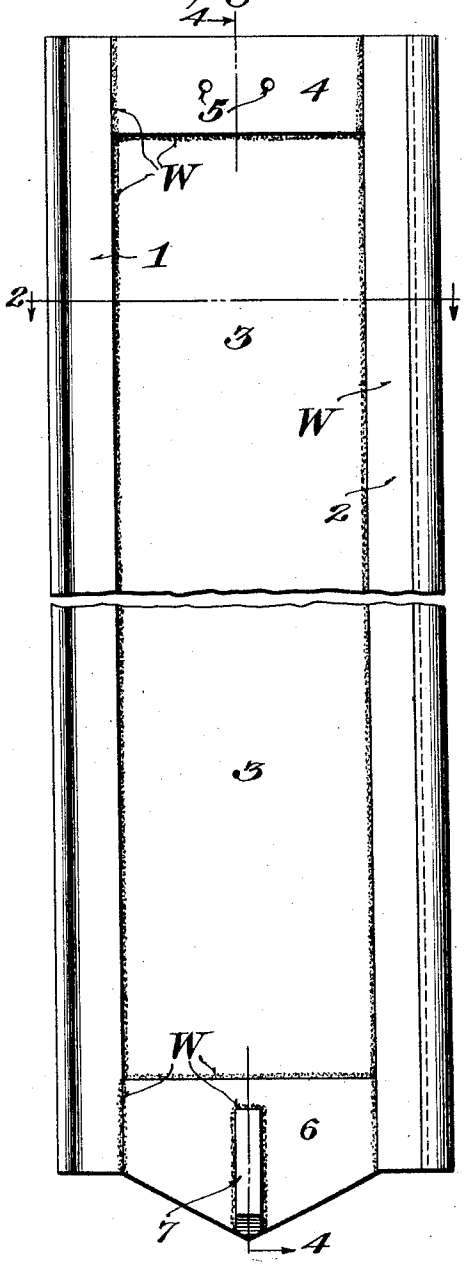


Fig. 4.

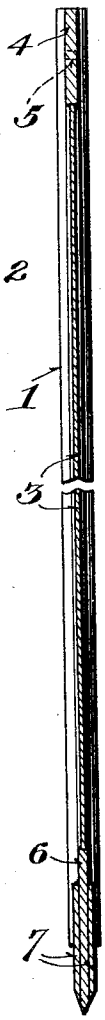


Fig. 5.

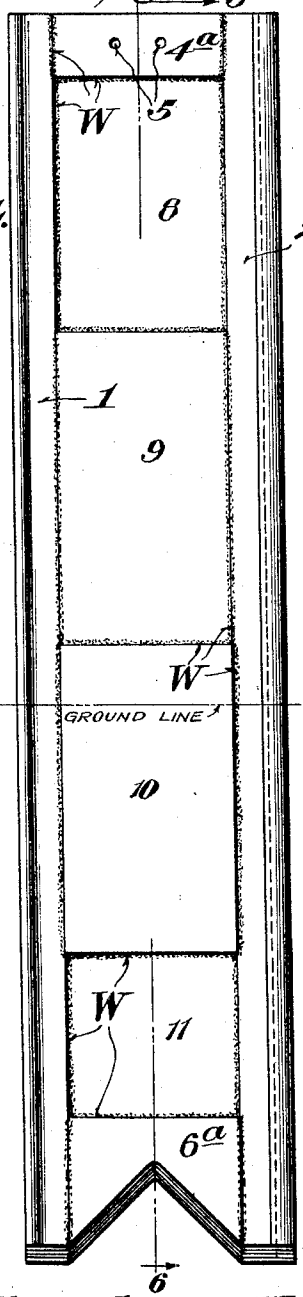
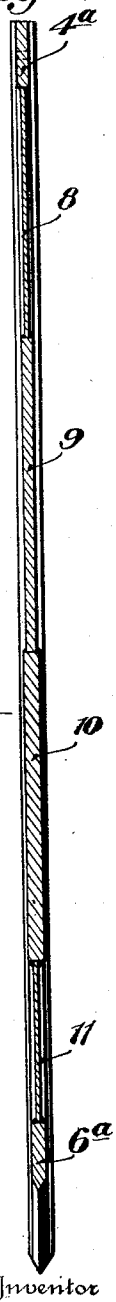


Fig. 6.



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Oct. 25, 1932. M. G. HILPERT 1,884,686

METAL PILING

Filed Oct. 10, 1927 4 Sheets-Sheet 2

Fig. 7.

Fig. 8.

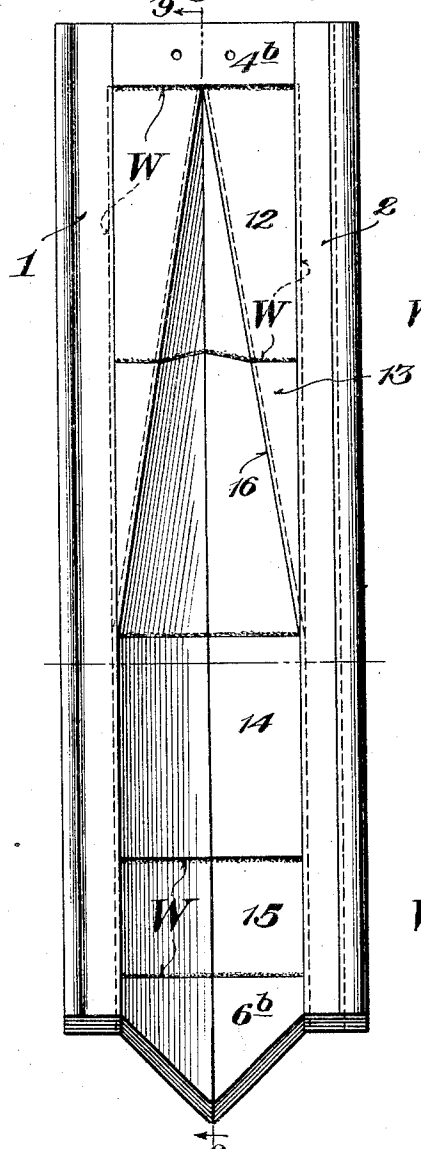


Fig. 9.

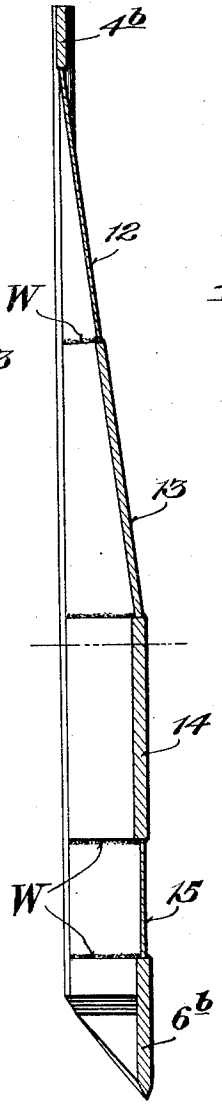
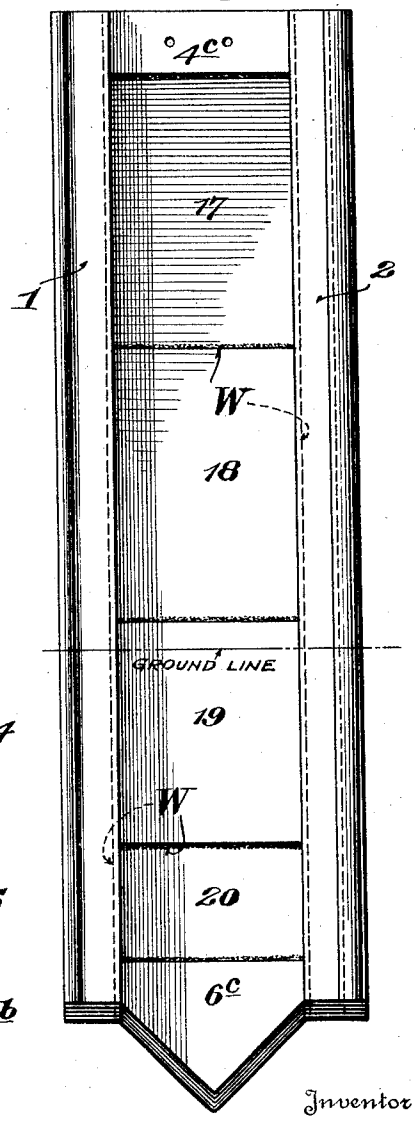


Fig. 10.

Fig. 11.



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Oct. 25, 1932. M. G. HILPERT 1,884,686

METAL PILING

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Fig. 12.

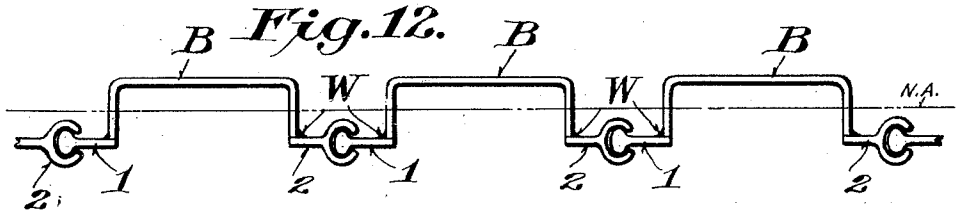


Fig. 13.

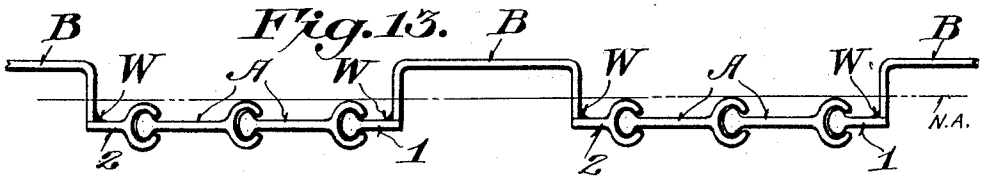


Fig. 14

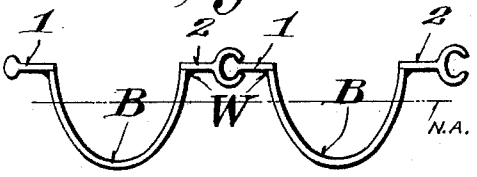


Fig. 15.

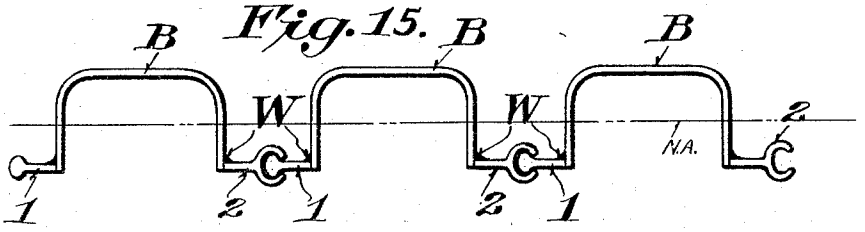
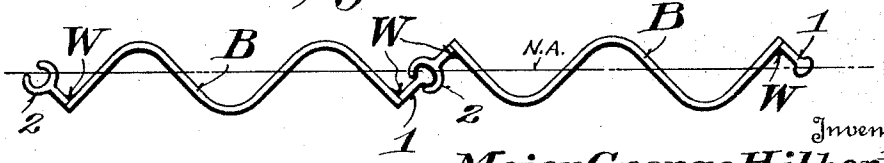


Fig. 16.



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Oct. 25, 1932. M. G. HILPERT 1,884,686

METAL PILING

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Fig. 17.

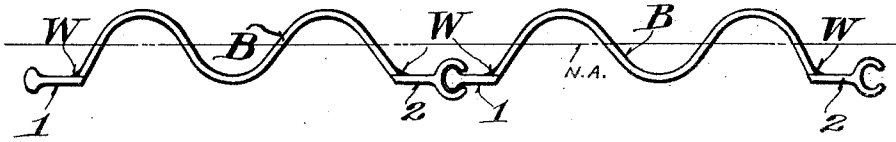


Fig. 18.

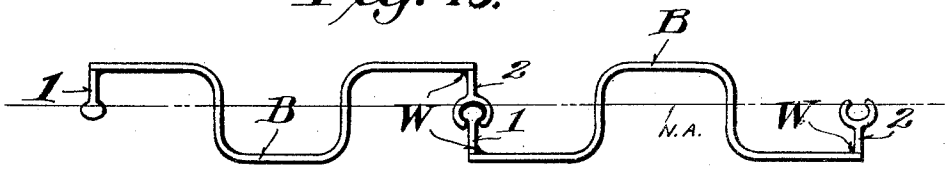
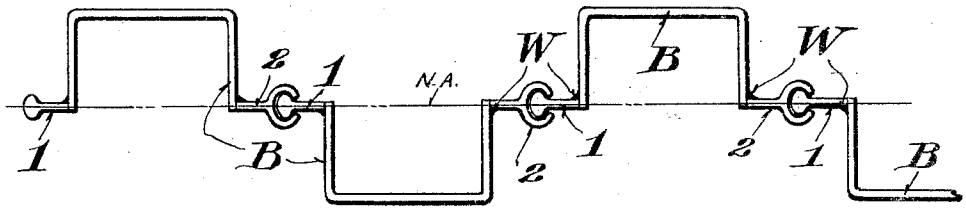


Fig. 19.

Fig. 20.



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UNITED STATES PATENT OFFICE

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METAL PILING

Application filed October 10, 1927. Serial No. 225,269.

This invention relates to metal piling and more particularly to a novel construction which permits of a wide range of different embodiments of the structural elements used whereby many advantages result both to the manufacturer, designer and user.

Steel piling as used for the construction of dams, docks, seawalls, water bulkheads, casings, break waters, wharves, dikes, locks and other forms of construction where it is necessary to resist the percolation of water has many recognized advantages over wood piling, and these advantages have been long recognized in the art. The first departure from wood piling to steel piling involved principally a fabricated construction made up of bolted or riveted standard sections or plates arranged to provide interlocks so as to allow each sheet or pile to be driven one against the other in a continuous wall. Such construction however, was soon displaced by rolled steel piling since the fabricated piling was not economical either as to weight per square foot or cost per pound, and was not easily driven or pulled. This last factor alone was quite determining in the departure from fabricated piling to rolled piling, since a large part of the cost of a sheet steel wall is the cost of placing and then removing it after it has served its purpose, and it was found that the many rivets per lineal foot of a fabricated piling not only required more power to drive each sheet a given distance, but also required much heavier machines to drive the same satisfactorily. Naturally heavier machinery drives the whole piling more severely and thus reduces its value for re-driving, which means a further loss of the money invested.

Accordingly, rolled steel sheet piling has been generally and extensively used in preference to a fabricated piling of the type referred to but there is still a serious handicap to this type of piling, namely, the cost of a set of rolls for each size and type. The varying combinations required to meet different kinds of soils, various practical depths, and different purposes, as for example, a retaining wall, or for water tightness, or for foundations, or as a seawall, etc., each require a different piling for each case, and the most economical piling for each particular installation can be readily determined. However, the cost of the rolls limits any one manufacturer to but a few sections of his type of piling; that is, to his particular type of interlock and some of these sections can only be rolled at an increased cost. Therefore, the user is usually required to adopt a section which is only partially satisfactory in order to limit the cost.

Therefore, a primary object of the present invention is to overcome the objections noted by providing a construction to which due consideration has been given to all of the factors entering into the design, manufacture and use of steel sheet piling. In that connection the invention contemplates the use of a rolled steel sheet piling section having an interlock at each edge, the same being split or divided and used in combination with intervening standard plate sections which form a web or panel therebetween and are united to the inside edges of the rolled section by welding thereby to provide a rigid and homogeneous structure. In its primary aspect, therefore, the present invention not only permits of the use of any desired type of interlock design to meet various requirements but also permits of designing the web or panel to meet any strength or soil condition encountered at a particular site or installation, thus deep arching of the web may now be designed to meet the loadings to be imposed.

In the above connection an important object of the invention is that it permits the shallowing up or lessening of the arching of the web for any desired portion of the piling's length. This feature, combined with the accepted methods of driving, to wit, setting up and interlocking all of the piling as in cylinders, squares, rectangles and even in walls, and then driving part way successively and repeating until fully driven makes possible two new attainments in steel sheet piling; (1) a piling which when driven will have a constantly tightening interlock above a certain depth, to wit, a desired unwatering depth; (2) and a piling which when driven will develop an initial stress on the arch and

in the jaws at a predetermined depth which initial stress may be opposed to the loads to be applied when the piling is unwatered, and thus this interlocked pre-stressed pile wall will not move or deflect when loaded by unwatering or by placing of filling against the wall as does the constant section arched piling wall of the type heretofore used.

Another object of the invention is to provide a construction which permits of making a piling of any thickness desired, and in which the web or panel may be of any desired shape such, as for example, flat, curved, arched or angular according to various pressure conditions to be resisted. This feature of the invention permits the use of different metals in the construction of the individual piles. For example, where mere water tightness is desired for levee work a thin cooper web might be as good or better than two or three times the thickness of ordinary steel under the same conditions. Also, different thicknesses of metal as well as different metals may be combined to effectually resist corrosion.

A further object of the invention is to provide a fabricated steel sheet piling which entirely obviates the use of rivets or other headed fastenings which have a tendency to build up resistance in either driving or pulling and at the same time produce a more rigid and homogeneous structure which is not likely to buckle or warp. That is to say, it is proposed to weld the various parts together in such a way as to provide a smooth joint which not only offers little or no resistance to the operation as referred to, but also provides means for giving an effectual water-tight piling where the occasion demands.

With the above and other objects in view which will more readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated and claimed.

Preferred and practical embodiments of the invention are illustrated in the accompanying drawings, in which:—

Figure 1 is a detail end elevation of a rolled steel sheet piling made by a rolling operation and having interlocking means at opposite edges thereof, the dotted line indicating the point of division thereof to adapt the same to the present invention.

Figure 2 is a transverse sectional view taken on the line 2—2 of Fig. 3.

Figure 3 is an elevation of a simple form of piling constructed in accordance with the present invention.

Figure 4 is a vertical sectional view taken on the line 4—4 of Fig. 3.

Figure 5 is an elevation of a piling having a modified form of web.

Figure 6 is a vertical sectional view taken on the line 6—6 of Fig. 5.

Figures 7 and 8 are respectively a top plan view and elevation of a further modified form of piling.

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

Figures 10 and 11 are respectively top plan and elevations of a piling having a channel web portion.

Figures 12 to 20 inclusive are more or less diagrammatic top plan views illustrating various forms of webs which may be used to meet special requirements, thereby illustrating the wide range of application of the invention.

Similar reference characters designate corresponding parts throughout the several figures of the drawings.

In carrying the invention into effect it is proposed to utilize a commercial rolled steel sheet piling having any desired type of interlock, an example of which is shown in Fig. 1 and designated generally as A. This type of piling is made in accordance with standard rolling mill practice and in various lengths, the types of interlock varying with different manufacturers or mills. Therefore, the type of interlock shown in the drawings is merely representative of a form of rolled steel sheet piling, and which because of the limitations of rolling mill practice must necessarily have certain characteristics which adapt a given section only for a particular use and work. That is to say, rolled steel sheet piling is limited as to thinness because the interlocks require certain thickness to give requisite strength to hold the bond and maintain alinement when driving, and the intermediate web part must be proportionately thick. Also, pilings of this type are limited as to the number of thicknesses since each thickness requires a complete set of rolls (rolls cannot be parted for a thicker section) since the special interlock bevels will not allow of the usual practice for the thickening of a section. Furthermore, because of the special work that the rolls must do on the interlocks at each side, rolled pilings are limited as to width, and since sections of limited width cannot furnish sufficient plate or web for maximum depth of arch requirements, deep arching or curving of the center web to provide for maximum transverse bending stresses is prohibited.

According to the present invention, it is proposed that an integral steel piling (A) may be of any width, width being limited by the possibilities of driving only and not limited by rolling mill practice; (B) may be practically of any desired transverse strength so as to resist bending by applying rolled or pressformed channel or arched members of the desired arch depth as webs; (C) may have a variable strength at different points in its

length to resist varying bending requirements by the shallowing or lessening of the depth of the arches or channels of the web for the section of piling opposing the varying loads; (D) and if supplied with a varying depth arched or channeled web said piling will drive with a tighter interlock and with initial stress in both the interlock and in the web of the pile prior to unwatering or adding loadings.

Accordingly, the present invention contemplates the utilizing the advantages of rolled steel sheet piling as it is now available, and also greatly augmenting said advantages in the particulars referred to herein by cutting or bisecting the piling unit A at or about the dotted line *x*—*x* Fig. 1, thereby to provide the opposite side sections 1 and 2, the former having a head or key portion formed thereon and the latter having a groove or channel for receiving the head or key of an adjacent unit. The said side sections 1 and 2, are according to all forms of the invention, connected or joined by an intermediate web or panel B which may assume various forms and characteristics according to the use of the piling.

Figs. 2, 3 and 4 of the drawings illustrate a simple or basic form of piling in which a single web 3 of uniform thickness throughout is welded as indicated at W to the inner edges of the side sections 1 and 2 thereby to rigidly unite the web and side sections and provide an integral body structure. To facilitate the driving and removing of the pile the upper end thereof is provided with a pulling head or cap 4 which is welded to the side sections and also to the web and may be provided with holes 5 to permit of the engagement of a clamp, grip, or other means of handling the pile; and, the bottom of the pile is provided with a penetrating point or shoe 6 which is also welded to the side sections and to the web as indicated, and preferably reinforced on opposite sides by lugs 7 forming shoulders to be engaged by an implement for driving the piling. Thus, in its fundamental aspect the present invention contemplates a steel piling including a body having standard interlock side sections and an intervening web or plate which gives area to the piling not otherwise obtainable in rolled steel pilings as heretofore used.

In connection with the weld W it may be pointed out that the said welds may be continuous as shown or may be of the tack fusion type according to whether water tightness is or is not essential. That is to say, for sea wall purposes where water tightness is not necessary tack welding may be used but for cofferdam purposes and the like continuous welds should be used.

When a web of variable strength is required different thickness of metal may be used at different locations on the vertical height of the piling, thereby providing a stepped formation and distributing the weight as well as the strength where it is most needed to be effective.

Accordingly, by reference to Figs. 5 and 6 of the drawings it will be observed that the side sections 1 and 2 are united by a plurality of plates constituting the web, said plates being designated respectively as 8, 9, 10 and 11 and all being of different thickness and weight, thereby permitting of a saving in the total weight of the web while at the same time taking care of various pressures. In this embodiment of the invention the piling is provided with a driving head 4^a having the same features and characteristics as the driving head 4, and the foot thereof may also be provided with a penetrating shoe 6^a of the fish-tail type, the body of the shoe being formed with an inverted V-shaped notch by burning or otherwise removing the metal to provide the shape referred to.

By way of illustrating the range of modification permitted through the use of the present invention reference may be made to Figs. 7 to 11 inclusive, which show a departure from the flat web type of piling to an angular or arched formation. In this construction the side sections 1 and 2 are united by angular web members 12, 13, 14 and 15, the said upper sections 12 and 13 being provided with a channel portion flaring downwardly from the point of contact with the head member as indicated at 16, until the member 14 is reached. The members 14 and 15 are of full angular cross section formation, and all of the channel members are of different thickness. The bottom or foot of the piling is provided with an earth boring shoe or point 6^b for assisting the emplacement of the pile in the earth.

According to Figs. 10 and 11 the side sections 1 and 2 are connected by the full channel sections 17, 18, 19 and 20 while the top is provided with the driving head 4^c and the bottom is provided with an earth boring shoe 6^c. The edge portions of the channel members referred to are welded to the side sections and the upper members 17 and 18 are provided with a tapered or inclined face or wall 17^a which brings the upper edge thereof interlined with the driving head 4^c.

Figure 12 of the drawings illustrates diagrammatically the arrangement of a plurality of piles of channel shape formation, the same having the interlocking side sections 1 and 2 arranged in alinement with the channel web members B located all on the same side of the interlocks. In this form of embodiment, the side walls of the channel webs are disposed at right angles to the plate portions of the sections 1 and 2 and the welds W are formed in the included angle resulting from this arrangement. Figure 13 illustrates a further carrying forward of the type

of pile shown in Fig. 12 in combination with rolled steel sheet piles of standard construction.

Figures 14 and 15 illustrate the use of different forms of webs B in combination with interlocking side sections welded to the arched web members in the same manner as described in connection with Fig. 12.

Figure 16 illustrates a double corrugated web B having the interlocking side sections 1 and 2 welded thereto on the same side of the web and at right angles to the plane of the end wings of the web. In this arrangement all of the interlocking joints are arranged on the center. Figure 17 illustrates a further carrying forward of the double bend type of web with the side sections 1 and 2 welded to the webs at an oblique angle which has the effect of locating all of the interlocks in line at one side of the transverse center of the webs.

Figures 18 and 19 illustrate the use of rolled channel sections having wing portions lying parallel with the bottom of the channels to constitute the web B of the piling. In Figure 18 the interlocking side sections 1 and 2 are welded to the wings at right angles thereby to locate the longitudinal axis of the joint parallel to the line of direction of pressure exerted on the piling. In Figure 19 the side sections 1 and 2 have an edge to edge engagement with the side edges of the webs so that in effect the interlocking side sections are continuations of the flat portions of the webs as they have been welded thereto as indicated at W.

Figure 20 shows a structural arrangement similar to Fig. 12 but with the webs B reversed thereby placing them at opposite sides of a center line intersecting the joints provided by the interlocking side sections 1 and 2.

From the foregoing it will be apparent that the present invention permits of the utilization of any type of interlock desired as well as any strength of web required in a practical and expeditious manner, while at the same time providing a fabricated piling which will in no way increase the difficulty, cost, or size of driver to be used for driving the same because obstructions such as rivets, or other fastenings are eliminated through the use of smooth and uniform welds. Furthermore, the invention not only provides for making a pile of varying thickness where the pile resists varying pressures, and permits of making a piling of practically any transverse strength by interposing a web section having any desired moment of resistance either as a curved or formed solid web, or by interposing a web made up of rolled sections having the desired moment of resistance.

Not only does the invention provide for economically fabricating the piling units at a plant but also permits of the fabrication thereof at the site and permits of the change of the design of the piling as the work proceeds, and because stock plates and shapes and even scrap shapes and plates of various thickness and sizes may be used, comparatively light plate bending appliances may be readily used to advantage.

Without further description it is thought that the features and advantages of the invention will be readily apparent to those skilled in the art, and it will of course be understood that changes in the form, proportion and minor details of construction may be resorted to, without departing from the spirit of the invention and scope of the appended claims.

I claim:—

1. In a fabricated metal piling having side sections provided with interlocking means at the outer edges thereof for engaging with adjacent piling units, an intermediate web comprising plates of varying thickness connected edge to edge throughout the vertical height of the piling.

2. In a fabricated metallic piling having side sections provided with interlocks at the outer edges thereof, a web member connected to the inside edges of the said sections, said web member comprising connected plates of different thickness to provide interlocking strength at the bottom of the web and maximum transverse strength at a point intermediate the ends of the piling, the plates above said point being of decreased thickness successively and relative to each other towards the upper end of the piling.

3. In a fabricated metal piling having side sections provided with interlocking joint portions at the outer edges thereof, an intermediate web member comprising plate sections of different thickness, the middle of the thickest plate section being spaced from the lower end of the piling a distance corresponding substantially to the depth that the piling is adapted to enter the ground.

4 In a fabricated metallic piling having side sections provided with outer edge portions adapted to interlock with adjacent piling units, a plurality of transversely arched web members connected to each other and said side sections, one of said web members being relatively thick and being located intermediate the ends of the piling and the web members above and below the same being relatively thin.

5. In a fabricated metallic piling having side sections provided with interlocks at the outer edges thereof, a web comprising plates of different thickness, the plate of greatest thickness being at the medial portion of the web.

6. In a fabricated metallic piling having side sections provided with interlocks at the outer edges thereof, a web member, said web

member being of maximum thickness and strength at a point spaced from the lower end of the piling a distance corresponding substantially to the depth that the piling is adapted to enter the ground and being of less thickness towards the upper and the lower ends of the piling, said web member being composed of a plurality of web sections each of uniform thickness.

7. In a fabricated metallic piling, having side sections provided with standard type interlocks at the outer edges thereof, a web member, said member being thinner at its top and bottom edges than at its medial portion.

8. In a fabricated metal piling having side sections formed with interlocking joint portions at the outer edges thereof, an intermediate web member consisting of a plurality of plates of varying thickness secured to each other and to said side sections, a portion of the thickest plate being spaced from the lower end of the piling a distance corresponding substantially to the depth that the piling is adapted to enter the ground.

9. In a fabricated metal piling having side sections formed with interlocking joint portions at the outer edges thereof, an intermediate web member consisting of a plurality of plates, certain of said plates being transversely arched.

10. In a fabricated metal piling having side sections formed with interlocking joint portions at the outer edges thereof, an intermediate web member consisting of a plurality of plates of different thickness, certain of said plates being transversely arched.

11. In a fabricated metal piling having side sections formed with interlocking joint portions at the outer edges thereof, an intermediate web member consisting of a plurality of transversely arched plates of different thickness connected end to end to each other, and at their side edges with the side sections.

12. In a fabricated metal piling having side sections formed with interlocking joint portions at the outer edges thereof, an intermediate web member consisting of a plurality of transversely arched plates, inclined downwardly and outwardly relative to the plane of the interlocks.

13. In a fabricated metal piling having side sections formed with interlocking joint portions at the outer edges thereof, an intermediate web member consisting of a plurality of plates, the plates at the lower end of the piling being of transverse V-shaped formation, said V-shaped formation gradually diminishing in width toward the top of the pile.

14. In a fabricated metal piling having side sections formed with interlocking joint portions at the outer edges thereof, an intermediate web member consisting of a plurality of plates of transverse channel shaped formation secured to each other and to the side sections, and certain of the walls of said channel shaped plate sections inclining outwardly and downwardly from the top of the pile.

15. A metal piling comprising a self-sustaining frame composed of spaced side members and transverse top and bottom connecting members which are relatively stiff and sturdy to hold the frame against collapse, and a relatively thin and less stiff and sturdy web filling said frame.

16. A metal piling comprising a self-sustaining frame composed of spaced side members and transverse top and bottom connecting members which are relatively stiff and sturdy to hold the frame against collapse, the bottom connecting member being arched relative to the plane of the side members, and a relatively thin and less stiff and sturdy web filling said frame.

17. A metal piling comprising a self-sustaining frame composed of spaced side members and transverse top and bottom connecting members which are relatively stiff and sturdy to hold the frame against collapse, the top connecting member being straight and being disposed in the plane of the side members, the bottom connecting member being arched relative to the plane of the side members, and a relatively thin and less stiff and sturdy web filling said frame.

18. A metal piling as set forth in claim 15 in which the bottom transverse connecting member is provided with a driving lug.

19. A metal piling as set forth in claim 15 in which the bottom transverse connecting member is provided on opposite side faces thereof with driving lugs.

20. A metal piling as set forth in claim 15 in which the web is composed of plates which are of increasing thickness respectively from the ends of the piling towards a point spaced from the lower end of the piling a distance approximately equal to the depth that the piling is adapted to enter the ground.

21. A metal piling comprising straight side members and a connecting web a portion of which is inclined downwardly and outwardly relative to the plane of the side members.

22. A metal piling as set forth in claim 21 in which a portion of the web is of substantially V-shaped formation in cross section.

23. A metal piling as set forth in claim 21 in which a portion of the web is of channel shape in cross section.

In testimony whereof I hereunto affix my signature.

MEIER GEO. HILPERT.