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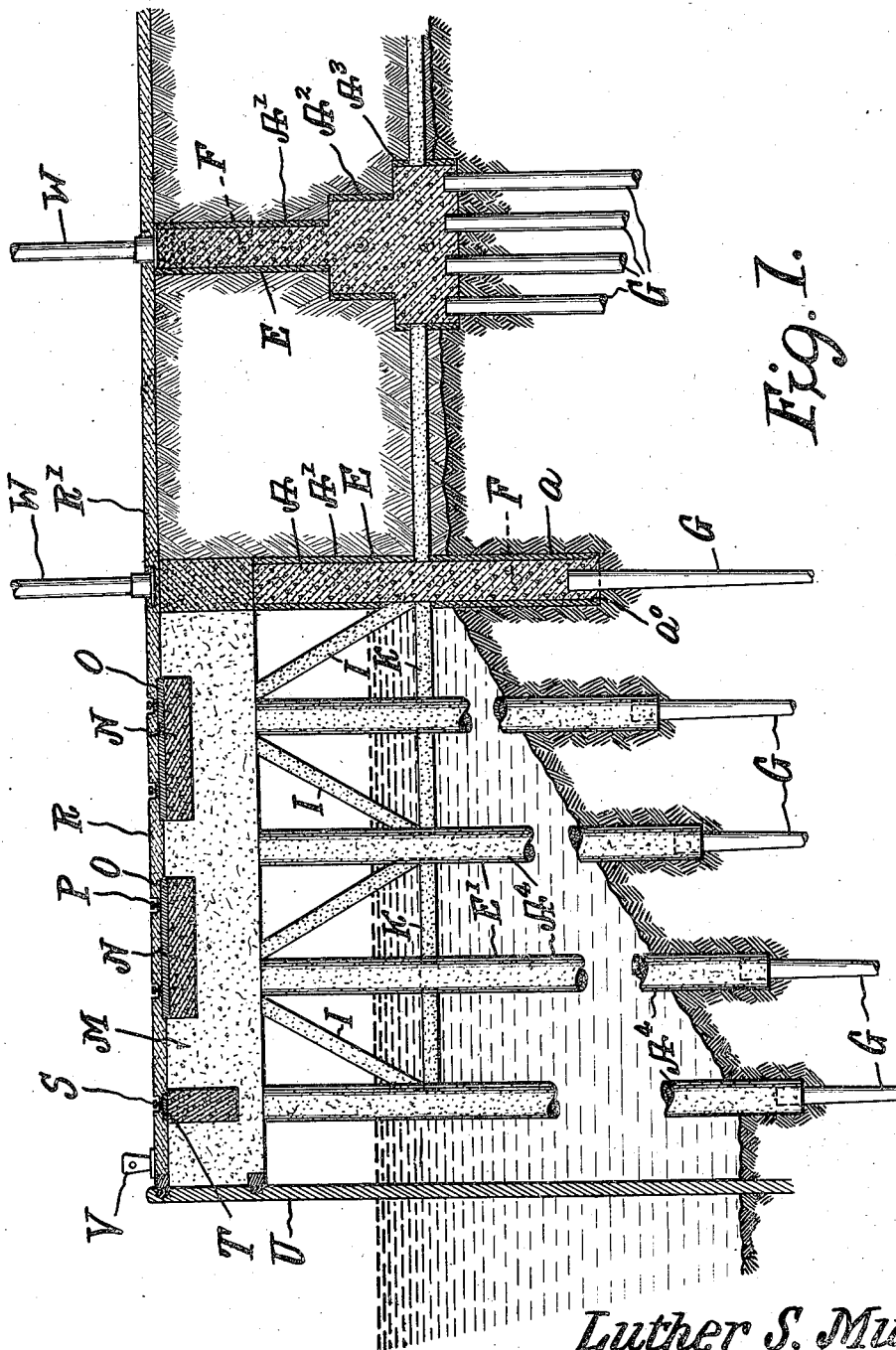
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REINFORCED CONCRETE CONSTRUCTION

Filed April 17, 1920

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

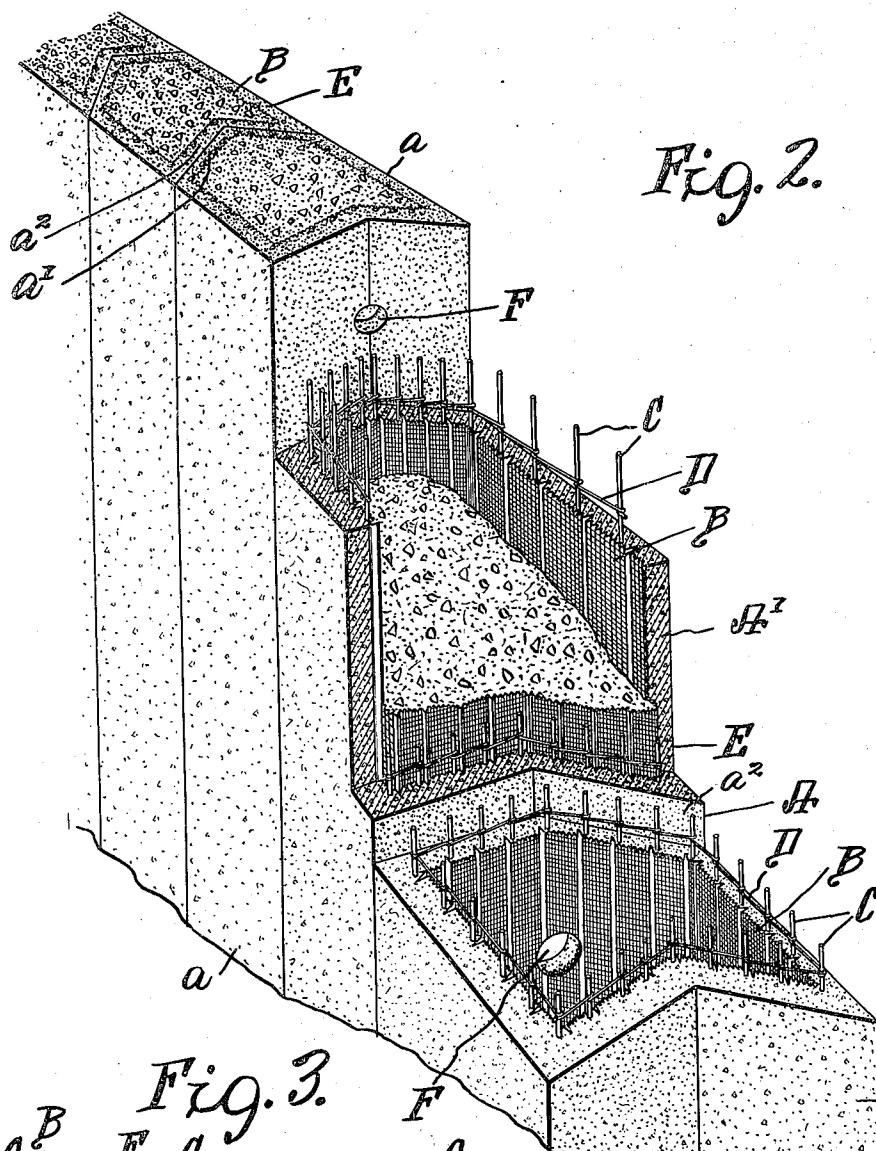


Fig. 2.

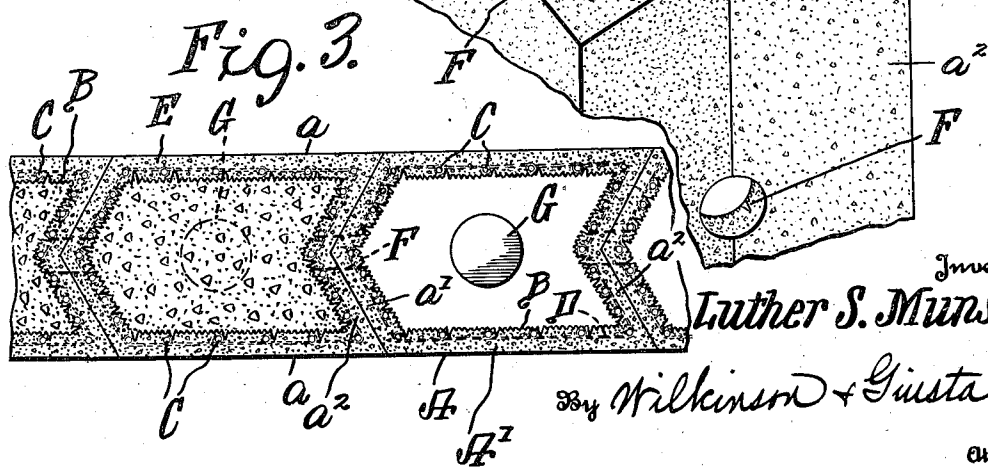


Fig. 3.

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UNITED STATES PATENT OFFICE.

LUTHER S. MUNSON, OF WASHINGTON, DISTRICT OF COLUMBIA.

REENFORCED-CONCRETE CONSTRUCTION.

Application filed April 17, 1920. Serial No. 374,722.

To all whom it may concern:

Be it known that I, LUTHER S. MUNSON, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Reenforced-Concrete Construction; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to improvements in reenforced concrete construction, and especially relates to such construction as is intended to be used in constructions located on or near water fronts or in other locations where there is considerable water in the soil though other uses will readily suggest themselves to those skilled in the art.

The invention is primarily intended to provide a concrete pile arrangement intended for use in piers, wharves, sea walls, shore protection, and foundations used in connection therewith and its primary purpose is to provide means whereby the constituent parts of such structure may be so bound together as to make the structure itself when completed practically monolithic.

The invention includes, amongst other features, the providing of a hollow shell made of reenforced concrete of a high degree of density and consequently of a comparatively rich or expensive nature, and filling into the shell so formed a sustaining core of a leaner mixture preferably composed of a less proportion of cement and a greater proportion of sand, gravel, or crushed rock. The shell is formed by plastering or shooting the concrete on a form of predetermined shape, which form is ordinarily made of expanded metal lath, whose use is well known in the reenforced concrete art.

This concrete is applied only from the exterior of the lath, and is applied in such thickness as to effectually cover the metal lath embedded therein, and to form a wall which is practically impervious to water. Such walls may be of two, three or more inches in thickness, but I have found in practice that a wall of three inches will prove abundantly thick to protect the reinforcing metal from the action of salt water.

In addition to the metal lath just referred

to, additional reinforcing means may be provided, such, for instance, as rods, bars, wire wrapping, or the like, all of which are well known in the art.

In any event it is essential that this reinforcing metal should be effectually protected from the access of salt water where the structure is used adjacent to salt water fronts, and this is secured by having the concrete applied to the metal reinforce of great richness and density.

This concrete shell, which may be tubular, or rectangular, or of other suitable shape, may be transported to the place where it is intended to be used and there mounted in position, and the core filled in, as will be hereinafter described. In addition to filling in the core, it is frequently desirable to mount the hollow shells over pre-arranged wooden piling driven into earth foundation on which the concrete structure is to be built. This additional piling provides an additional bearing where the structure is to be built over any soft foundation, such as mud, sand, or the like.

Instead of a single pile, a plurality of piles may be used to support any given mass of concrete, as will be hereinafter more fully described. The present invention relates more especially to an improved reenforced concrete wall composed of a plurality of pillars or piles connected together by concrete while in the semi-fluid or plastic state to form a substantially monolithic structure.

My invention will be more fully understood after reference to the accompanying drawings, in which like parts are indicated by similar reference symbols throughout the several views, and in which:—

Figure 1 shows a section through a marine terminal construction, in which there is an open wharf with a platform carried thereby, and a fill provided with a retaining wall and supports for buildings.

Figure 2 is a perspective view showing the construction of the retaining wall made of sheet piling of the character herein described, parts being shown broken away.

Figure 3 is a plan view of the sheet piling arrangement shown in Figure 2, but on a somewhat smaller scale, one of the hollow piles being shown as unfilled.

Figure 4 is a modification showing a wharf in which wooden piles are used in an earth fill, but the piles and the fill are pro-

ected by reinforced concrete sheet piling walls constructed according to my invention; and

Figure 5 shows a section along the line 9—9 of Figure 4, and looking down.

Referring to Figures 1 to 5, A represents a wall made of reinforced concrete piling, each pile comprising an outer shell A' having parallel back and front sides a ; and wedge-shaped interlocking edges a' and a'' . One of these edges is made convex, as at a' , and the other concave, as at a'' , so that the two fit snugly together and form to all intents and purposes a tongue and groove or interlocking construction. These reinforced concrete shells, as shown in Figure 2, comprise the expanded metal lath B, and the rods C, which rods are held together by tie wires D.

The wall E of cement of great richness and corresponding density is either applied by plastering, or is blown on with a gun, and hereinafter will be known under the technical term of "guncrete."

Where used as a retaining wall or interlocking piling, the shells are preferably made interlocking, as shown, but they may be made of cylindrical construction, or of any preferred construction, as will be hereinafter more fully described.

One of the purposes of my invention is to provide a wall in which the several parts are so joined to each other as to make the wall practically monolithic and impervious to the destructive action of the salt water. In Figs. 2 and 3, I have shown one method by which I accomplish this result, other methods will readily suggest themselves to the skilled workman. As shown I preferably provide sealing holes F of sufficient size to permit part of the concrete filling that is poured into the hollow pile, when it is in place, to flow from one pile to another and harden, and thus form a substantially tight joint between the adjacent piles of the wall. As these holes F are preferably located about three feet apart, it can readily be seen that the concrete flowing from one pile to another, filling the holes and hardening, makes a water tight joint, binding the piles securely together, and forming a practically monolithic sheet pile wall.

The hollow piles are transported from the place of construction to the place of use in any convenient way, and are then set up in position in the usual well known way. Where they are to be mounted on soft ground, it will be cheaper and more convenient to drive into the ground a series of wooden piles G with their heads so arranged that their heads, when the pile is driven to the desired depth, will project into the open bottom of the hollow concrete pile. After the abutting concrete piles are in place, the concrete core, made of a

leaner mixture, is poured in, using the well known "Tremie" process by which water is excluded from mixing with the concrete as it is poured in. The concrete, after setting, forms a core engaging the head of the wooden pile and completely fills the cavity in the hollow shell; the whole forming a composite pile with a wooden shoe and a heavy reinforced concrete body portion; the latter comprising a heavy core of a lean mixture of concrete, and a rich, dense and impervious shell made of richer concrete containing the reinforced metal.

The concrete setting also ties the piles together, forming the substantially monolithic wall already described.

A retaining wall made up of piles of the construction hereinbefore described is shown in section in Figures 1, 3, and 4, in perspective in Figure 2, and in plan in Figure 5.

If it be desired to use the reinforced concrete construction to sustain heavy weights on soft earth, the bottom of the concrete body portion of the pile may be expanded, as shown to the right of Figure 1, in which the wall A¹ rests upon a still wider wall A², and it in turn rests upon a still larger wall A³, which latter rests upon a plurality of wooden piles G, instead of upon a single pile. In such construction the outer shell of the several pairs of piles containing the wall may be built up of the reinforced concrete construction described in detail with reference to Figure 2.

The bottoms of these reinforced concrete piles are preferably provided with cutting edges a^0 so as to cut into the soft earth in which the piles are ordinarily used, but these cutting edges also serve as guides to engage the wooden piles G.

In the structure shown to the left of Fig. 1, I have provided braces I and ties K which connect together the supporting piles A⁴ for the wharf structure and connect these piles and this structure to the retaining wall.

On top of the open reinforced concrete structure shown in Figure 1, I may provide a suitable platform of any character, such as the concrete beams M supporting the longitudinal beams N carrying the cross ties O on which the rails P are mounted, and the whole top of the platform may be covered with a concrete floor R. In Figure 1, I have also shown a crane or gantry rail S, mounted on the gantry beam T, and the outer edge of the wharf may be protected by fender piles, U, preferably made of wood or other suitable material. I have also shown the mooring bit V mounted on the floor R.

On the interior part of the structure shown in Figure 1, I may continue the concrete floor as at R', and suitable columns W may be mounted to support any desired form of building structure, not shown.

In the modification shown in Figures 4

and 5, the wall A, made of reenforced concrete sheet piling, preferably of the character shown in Figure 2, is provided, inside of which is the earth filling X into which the wooden piles G are driven, which piles are preferably mounted in rows as shown in Figure 5, to support the concrete beams Y over which is laid the platform Z of wood or other material, and above which is an earth filling X' carrying the cross ties O' on which the rails P' are mounted. In this case the gantry rail S is supported directly upon the retaining wall A.

In the construction shown in Figs. 4 and 5, fenders U' may be used similar to those already described in connection with Figure 1.

It will be noted that in the hereinbefore described construction, I provide a comparatively light hollow shell made of reenforced concrete which may be conveniently transported from the place of manufacture to the place of use, and which is stiff enough to stand up under handling and in transport, and which structure may be then mounted in place, but without the heavy core which is subsequently filled in. After this structure is mounted in place, the core made of leaner concrete is poured in which constitutes by far the greater weight of the body, and this core serves not only as an anchor to the entire mass, but it serves also as greatly increasing the strength of the structure, rendering it practically incompressible; and it also serves as a locking means for connecting the pile to the braces and ties, each tie forming with its brace and pile a substantially monolithic structure, and the several ties being connected together in such a way as to form of the entire structure an extremely strong, rigid, cheap and durable arrangement.

By having the piles formed hollow and mounted over one or more supporting wooden piles, the light hollow piles may be more conveniently mounted in place and then when the concrete core is poured in, this core, when it has set, forms a unitary structure in which the wooden pile serves as a foot or ferrule rigidly attached to the mass of concrete above and protects the head of the wooden pile from rot or borers.

The body portion of the wooden pile will be driven so deep in the earth that it will be in a large measure protected against destructive elements and would then become practically indestructible, as will be evident from the borings in alluvial regions where perfectly sound logs have been found embedded in silt, and where they have remained in a perfectly preserved condition for ages.

Amongst the advantages hereinbefore described may be briefly stated that the metal reinforcing is protected against deteriora-

tion by the impervious wall of rich concrete in which it is embedded, and that the wooden piling which forms a support is also protected at its head by being embedded in the concrete, and lower down by being embedded in such a depth of earth as not to be subject to normal decay.

By using the wooden piling for feet instead of the single continuous concrete pile, great saving in weight of concrete is secured, and consequent saving in cost, the reenforced concrete being more expensive to install than the wood.

It will be obvious that various modifications might be made in the herein described construction, and in the combination and arrangement of parts which could be used without departing from the spirit of my invention; and I do not mean to limit the invention to such details except as particularly pointed out in the claims.

Having thus described my invention what I claim and desire to secure by Letters Patent of the United States is:—

1. A reenforced concrete wall comprising a series of contiguous piles, each formed of a reenforced hollow shell provided with openings registering with the openings of the adjacent pile when in the assembled relation, and with a monolithic concrete mass filling the central portions of adjacent piles and projecting from one pile to another through said openings and forming a concrete bond tying said piles together, the whole forming a substantially monolithic structure.

2. A reenforced concrete wall comprising a series of contiguous piles having their engaging faces respectively V-shaped and wedge-shaped so as to interlock, each pile being formed of a reenforced hollow shell provided with openings registering with the openings of the adjacent pile when in the assembled relation, and with a monolithic concrete mass filling the central portions of adjacent piles and projecting from one pile to another through said openings and forming a concrete bond tying said piles together, the whole forming a substantially monolithic structure.

3. A reenforced concrete wall for use in wharves, comprising a series of contiguous piles, each formed of a reenforced hollow shell of concrete impervious to water and provided with openings registering with the openings of the adjacent pile when in the assembled relation, and with a monolithic concrete mass of cheaper concrete filling the central portions of adjacent piles and projecting from one pile to another through said openings and forming a concrete bond tying said piles together, the whole forming a substantially monolithic structure.

4. A reenforced concrete wall for use in

wharves, comprising a series of contiguous piles having their engaging faces respectively V-shaped and wedge-shaped so as to interlock, each pile being formed of a reinforced hollow shell of concrete impervious to water and provided with openings registering with the openings of the adjacent pile when in the assembled relation, and with a monolithic concrete mass of cheaper concrete filling the central portions of adjacent piles and projecting from one pile to another through said openings and forming a concrete bond tying said piles together, the whole forming a substantially monolithic structure.

5. The method of constructing reinforced concrete walls which consists in providing a series of hollow piles made of reinforced concrete and provided with edges adapted to register with each other, with perforations in the contiguous edges of adjacent piles, mounting said hollow piles in place with the perforations on adjacent piles registering, and then pouring plastic concrete into said hollow piles allowing it to flow from one pile to the other through said perforations, and also to fill in any interstices between the contiguous edges of the adjacent piles, and to form when set a substantially monolithic structure.

6. The method of constructing reinforced concrete walls for use in marine construction, which consists in providing a series of hollow piles made of reinforced concrete impervious to water and provided with

edges adapted to register with each other, with perforations in the contiguous edges of adjacent piles, mounting said hollow piles in place with the perforations on adjacent piles registering, and then pouring cheaper plastic concrete into said hollow piles allowing it to flow from one pile to the other through said perforations, and also to fill in any interstices between the contiguous edges of the adjacent piles, and to form when set a substantially monolithic structure.

7. A wall for water fronts including plastic nested shells impervious to water and each equipped with a filler which extends into adjacent shells to bond the shells together as a unit.

8. A wall for water fronts including hollow independent elements impervious to water and of complementary design to interfit and provide a substantially monolithic uniplanar wall.

9. A method of making walls for water fronts consisting in forming tubular bodies of plastic materials impervious to water and making perforations therein at predetermined intervals, then nesting the bodies together so as to bring said perforations into register, after which a filler is deposited into said bodies and permitted to flow through said perforations from one body to another and allowed to harden for uniting said bodies.

LUTHER S. MUNSON.