F. T. LLEWELLYN.

STEEL CONCRETE SHEET PILING.

APPLICATION FILED JULY 30, 1910.

1,193,033.

Patented Aug. 1, 1916.

3 SHEETS—SHEET 1.

Fig. 1.

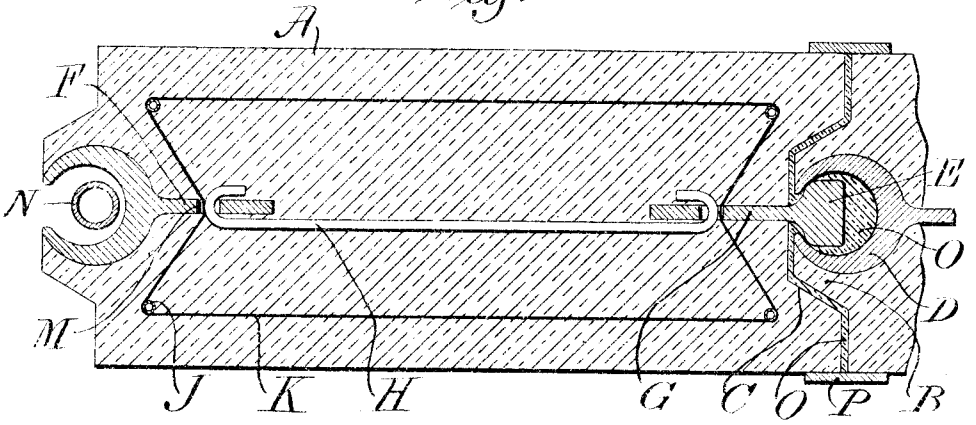


Fig. 2.

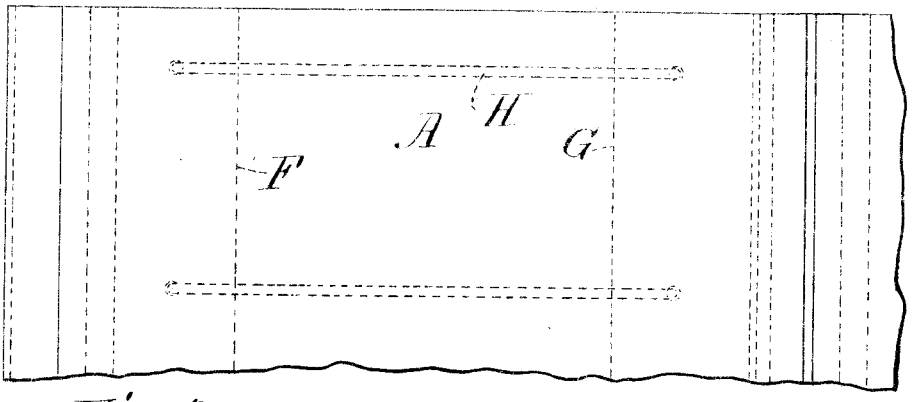


Fig. 3

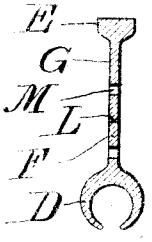
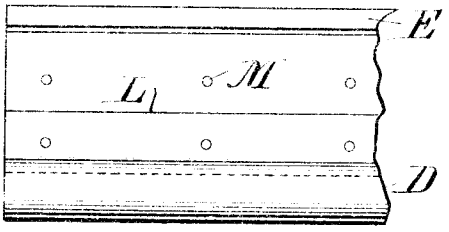


Fig. 4.



WITNESSES

William N. Beecwagen

Walter Kubenwell

INVENTOR

Frederick T. Llewellyn

BY

Linthicum, Belt & Fuller

ATTORNEYS

F. T. LLEWELLYN.

STEEL CONCRETE SHEET PILING.

APPLICATION FILED JULY 30, 1910.

1,193,033.

Patented Aug. 1, 1916

3 SHEETS—SHEET 2.

Fig. 5.

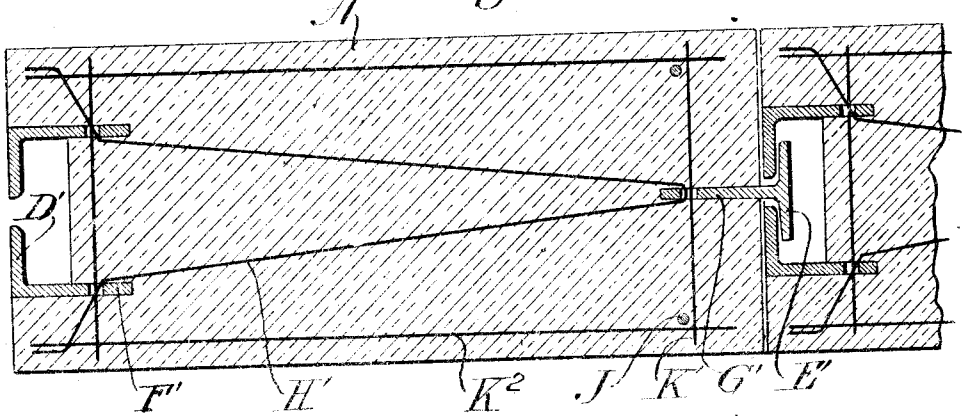
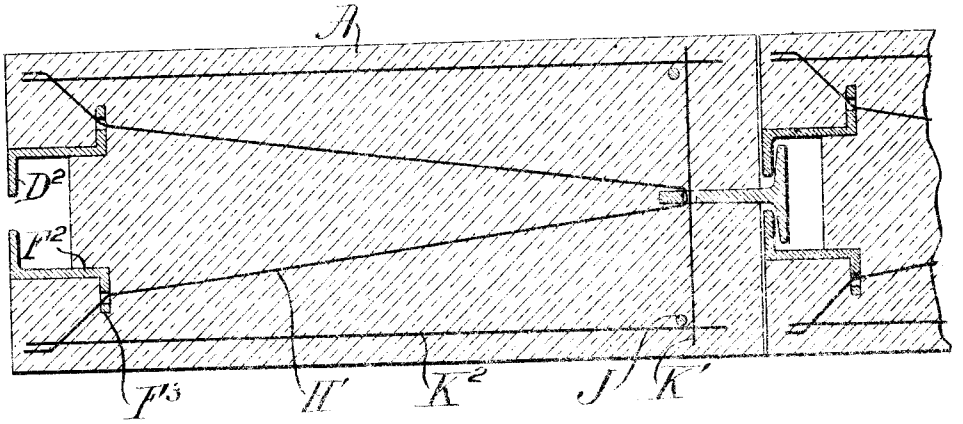


Fig. 6.



WITNESSES

William K. Beevogen

Lulu Stubenvoll

INVENTOR

Frederick T. Llewellyn

BY

Linthicum, Belt & Fuller

ATTORNEYS

F. T. LLEWELLYN.

STEEL CONCRETE SHEET PILING.

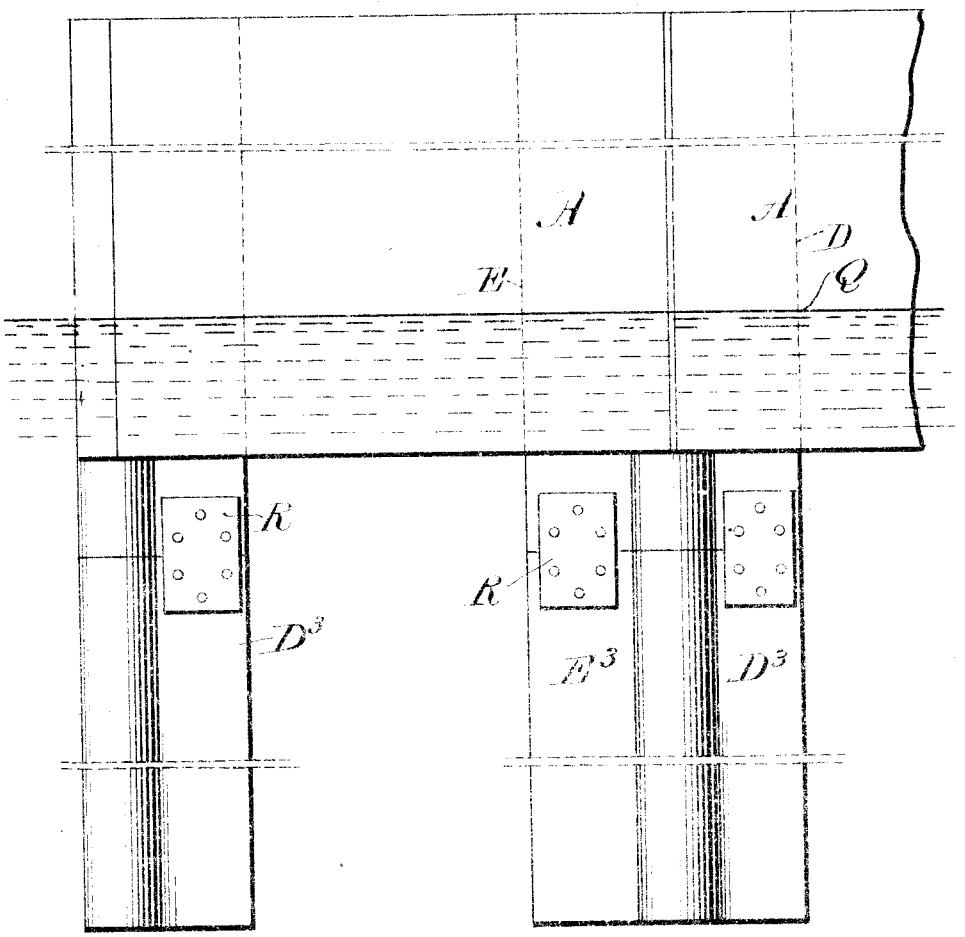
APPLICATION FILED JULY 30, 1910.

1,193,033.

Patented Aug. 1, 1916.

3 SHEETS—SHEET 3.

Fig. 7.



WITNESSES

William M. Beauregard

Lester Stockwell.

INVENTOR

Frederick T. Llewellyn

BY

Linthicum, Bell & Finlayson

ATTORNEYS

UNITED STATES PATENT OFFICE.

FREDERICK T. LLEWELLYN, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO CARNEGIE STEEL COMPANY, OF HOBOKEN, NEW JERSEY, A CORPORATION OF NEW JERSEY.

STEEL-CONCRETE SHEET-PILING.

1,193,033. Specification of Letters Patent. Patented Aug. 1, 1916.

Application filed July 30, 1910. Serial No. 574,602.

To all whom it may concern:

Be it known that I, FREDERICK T. LLEWELLYN, a citizen of the United States, residing at Montclair, Essex county, New Jersey, have invented new and useful Improvements in Steel-Concrete Sheet-Piling, of which the following is a specification.

This invention provides an improved pile having in general the advantages of metal piling in addition to those of concrete. The metal contributes chiefly its strength and the concrete its freedom from corrosion, the metal parts being protected by the concrete.

The principal feature of the improvement is in providing a pile having at least its exposed faces, and preferably substantially its entire body, of concrete, and having interlocking edges which are reinforced by metal. The metal members which reinforce the interlocking edges of the pile are preferably of the same shape as these interlocking edges and preferably also are the actually exposed edges, whereby the manufacture and use of the interlocking connection are facilitated. Other features of improvement are referred to in detail hereinafter.

The accompanying drawings illustrate embodiments of the invention.

Figure 1 is a horizontal section of a pile, showing an interlocking connection with the adjacent edge of the next pile. Fig. 2 is a side elevation of the same. Figs. 3 and 4 are respectively a cross section and side elevation illustrating a mode of manufacture of the interlocking metal parts. Figs. 5 and 6 are views similar to Fig. 1, but omitting the grouting between the piles, illustrating other embodiments of the invention. Fig. 7 is a side elevation similar to Fig. 2, illustrating another embodiment of the invention.

Referring to the embodiments of the invention illustrated the pile in Fig. 1 has a body A of concrete. At one edge the concrete is extended to form a tongue B adapted to fit a groove C at the other edge. The tongue B is formed with a socket which is reinforced and preferably lined with a metal socket member D having inturned edges. The socket is of a style familiar in interlocking metal sheet piles, extending continuously along the vertical edge of the pile. Any known or suitable style of socket member may be used, a number of such styles being known. At the opposite edge of the pile (or at any adjacent face or edge where a special corner pile is desired) a projecting head E of metal is provided fitting freely in the socket D, the latter having inturned edges for embracing the head, thus opposing relative motion between two adjacent piles either transversely of the wall or longitudinally thereof.

The socket member and head may be held in place in the concrete in any suitable way. Preferably they are provided with webs F and G respectively extending back into the concrete, of a total width somewhat less than the width of the concrete so as to permit the latter to be molded in practically a single integral body extending through the space or spaces between the inner edges of the webs, the webs being connected to each other at intervals, as for example by hook rods H engaging holes in the webs and embedded in the body of concrete. Preferably also the concrete is reinforced near its corners and faces by any suitable arrangement of embedded metal, such for example as rods J and wires or wire netting K passing around said rods and tied to the webs F and G by passing through holes therein.

In the manufacture of such piles a mold is formed and the metal interlocking members D and E are set in place at opposite edges separated from each other and tied together by the rods H, and the reinforcing rods J and wires K are set in place, after which the concrete is poured in and allowed to set. This mode of manufacture gives a stiff strong body of concrete and at the same time separates the head and socket by a greater distance than is practicable with metal interlocking members of similar design, taking advantage of the thickness of concrete to give lateral stiffness and of the separation of the webs of the metal members to give a strong integral body of concrete.

The interlocking metal members may be formed separately. Or they may be conveniently formed in the rolls now used for the forming of metal interlocking piles in the manner shown in Figs. 3 and 4. These figures show the style of metal interlocking pile which is adapted for use in the pile of Fig. 1. It is only necessary to split such a pile along the line L, and to punch the

webs with holes M to secure the desired socket member D and head E with their webs F and G. Such piles may be driven in any usual or suitable way as by hammering or jetting. A jet pipe N for example, is shown located at the free edge of the pile of Fig. 1. After two or more piles have been driven a tight joint between them may be formed and the exposed metal may be further protected against corrosion by pouring or forcing grout O into the space between the edges of the piles and the cavities adjacent to the metal interlocking members. To hold the grout, boards P may be driven along the faces of the joint. These will ordinarily be driven to a depth below the level of corrosion. This depth is ordinarily the lowest point at which the structure may be subjected to contact of both air and water.

Fig. 5 shows a form of the pile which departs from that of Fig. 1 in several details. The edge of the pile is flat. The socket member is composed of two halves each consisting of a metal angle D′ with a web F′ embedded in the concrete. The metal head is the base E′ of a T, the web G′ of which is embedded in the concrete. The flanges F′ and G′ are punched and tied together by tie rods or wires H′, the free ends of which are held by simply bending before embedding them in the concrete. The reinforcement of the body of concrete consists in this case of vertical rods J, end wires or rods K′, passing through the holes in the web F′ and G′, and side wires or rods K² which may rest upon the end wires. This construction, and that of Fig. 6 hereinafter described has the advantage of using metal shapes of standard design which are manufactured by all mills, rather than the special shapes designed for the construction of Fig. 1.

According to Fig. 6 there are used instead of the angles D′ members D² of Z-shape which have not only webs F² embedded in the concrete but also flanges F³ which give a better attachment of the metal to the concrete. The ties between the socket member and the head member are the same as in Fig. 5 and the reinforcement of the body of the concrete is the same except for the omission of the end wire K′ at the socket end, the flanges F³ serving substantially the same purpose.

Below the corrosion level it will not be necessary in all cases to extend the concrete. There are cases in which it would be necessary to extend only the metal members to the extreme depth. For such cases a pile may be constructed with heavy metal members, such as the head and socket members previously described, extending below the base of the concrete. Fig. 7 shows such a construction. The concrete A extends to a suitable depth below the water line indicated at Q and the socket D and head E are continued below the bottom of the concrete. For embedding in the concrete in the manner shown in the previous figures the metal should be rolled rather light, the reinforcing of the concrete being its principal function, and being itself well supported by the concrete. For such use it is found that the lighter metal produces a better pile, one in which the concrete is less apt to be injured by driving. Where the metal is to be extended to a point below the concrete, where it is unsupported laterally by the concrete, I prefer that the extension shall be of heavier metal (or greater thickness or width). For such a construction, therefore, I prefer to use extensions D³ and E³ having the same internal contour of the socket and external contour of the head as for the members embedded in the concrete, but being in other respects of greater thickness. These heavier members may be fastened to the projecting lower ends of the lighter members by splice plates R riveted or bolted upon the webs of the members.

Though I have described with great particularity of detail certain specific embodiments of my invention yet it is not to be understood therefrom that the invention is restricted to the particular embodiments disclosed. Instead of making a single style of pile with a head at one edge and a socket at another two styles of pile may be used, one having heads at both edges and the other having corresponding sockets at both edges.

Various other changes may be made in detail and in the arrangement and combination of the parts by those skilled in the art without departing from the invention.

What I claim is:

1. A composite sheet pile comprising a concrete monolith with exposed concrete faces and having longitudinally extending tongues and grooves on opposite faces thereof, metal interlocking members embedded in the tongued and grooved faces of the concrete, and ties embedded in the concrete connecting the interlocking members at separated intervals in the length thereof, said interlocking members having means whereby to hold adjoining piles in interlocking engagement.

2. A composite sheet pile comprising a concrete monolith with exposed concrete faces and having the web portions of metal interlocking members embedded in opposite faces of the concrete, and metal ties embedded in the concrete securing said interlocking members together at separated intervals in the length thereof, said interlocking members having means whereby to secure the adjoining edges of adjacent piles in interlocking engagement.

3. A composite interlocking sheet pile formed of a concrete monolith having exposed concrete faces with longitudinally extending recesses in opposite faces thereof, and having metal interlocking members located in said recesses with metal ties embedded in the concrete and said interlocking members having means whereby the adjoining edges of adjacent piles are secured in interlocking engagement.

4. A piling element comprising a pile composed of concrete and having embedded in it at each of two of its respective sides, separate metallic members, each constructed to interlock with adjacent piling elements, said pile having a tie embedded in it between said two members and connecting them together.

5. A piling element comprising a pile composed of concrete and having a metallic interlocking member embedded in the concrete of the pile to extend only within the pile, the pile being formed with a passage adjacent the interlocking member to permit engagement of the latter with an adjacent piling element.

6. Piling comprising successive piles composed of concrete and joined together by a metallic interlock embedded in only a portion of the pile-concrete to avoid affecting the integrity of the concrete pile.

7. Piling comprising successive piles composed of concrete, the adjacent piles being formed respectively with a laterally-interlocking groove and concrete tongue, and interlocked in the line of the piling by a metallic interlock held inside the concrete of the adjacent piles.

8. Piling comprising successive piles composed of concrete and joined together by metallic interlocks held inside the respective piles.

9. Piling comprising successive piles composed of concrete and connected by a metallic interlocking vertical guide held inside the respective piles.

10. Piling comprising successive piles composed of concrete and joined together by a metallic interlock embedded in the concrete of at least one of the piles.

11. Piling comprising piles composed essentially of concrete and arranged in succession to form the piling, and metallic means supported by the piling and extending from one pile to a point beyond the facing side of the next pile, to prevent displacement of the latter in a direction transverse to the line of the piling.

12. Piling comprising piles composed essentially of concrete and arranged in succession to form the piling, and metallic means for each pair of adjacent piles, each such means being secured to both of its adjacent piles, substantially rigidly in the line of the piling, to prevent material separation of the piles from each other in the line of the piling.

13. Piling comprising piles composed essentially of concrete and arranged in succession to form the piling, and metallic means substantially rigidly secured to both of two adjacent piles, in directions transverse to and in the line of the piling, to prevent material displacement of the individual piles in any horizontal direction.

14. Piling comprising successive piles composed of concrete, and a metallic member extending from inside the concrete of one pile to the inside of the concrete of the next pile.

15. Piling comprising successive piles composed of concrete, one having an embedded metallic interlocking member, and the other an interlocking cavity to receive the metallic member.

16. Piling comprising successive piles composed of concrete held together by metallic interlocking members.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

FREDERICK T. LLEWELLYN.

Witnesses:
WILLIAM W. CORLETT,
D. ANTHONY USINA.