

APPLICATION FILED DEC. 7, 1908.

5 SHEETS--SHEET 1.

Fig. 1. Fig. 2. Fig. 3.

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Fig. 3.

Fig. 1.

Fig. 4.

Fig. 6. 10.

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1,049,432.

Patented Jan. 7, 1913.

5 SHEETS—SHEET 2.

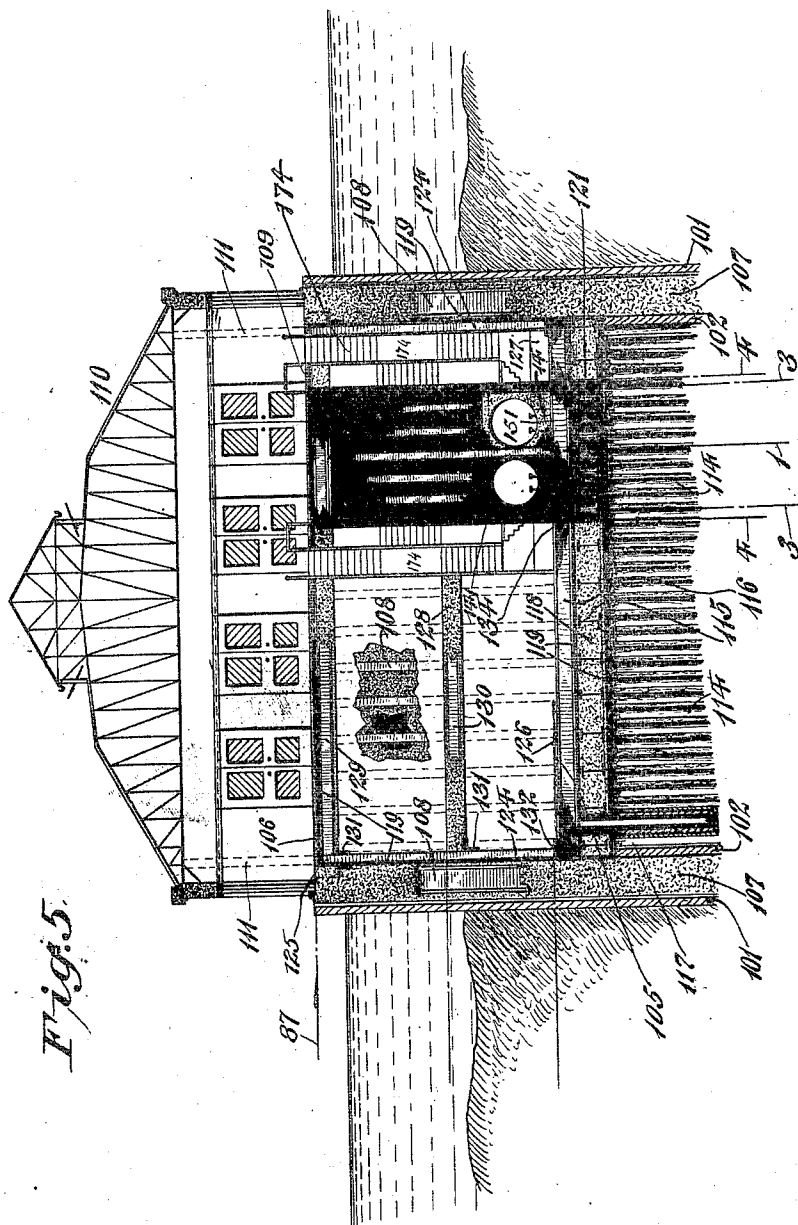


Fig. 5.

Witnesses

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5 SHEETS—SHEET 3.

Fig. 9.

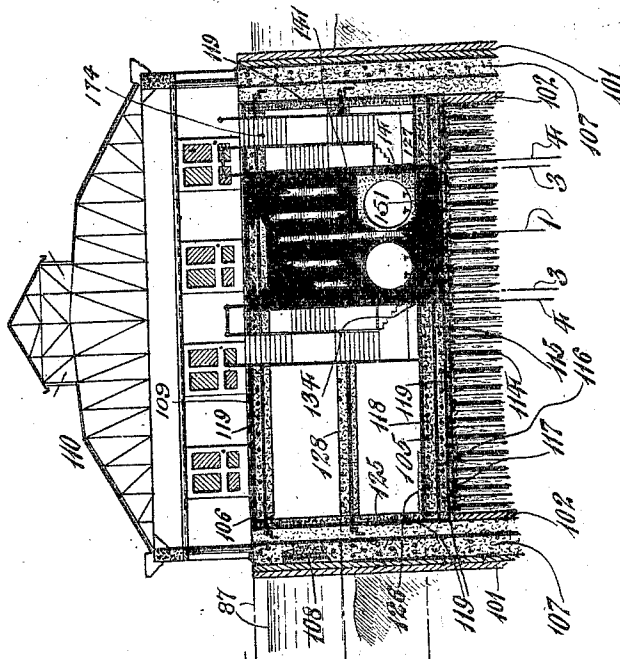
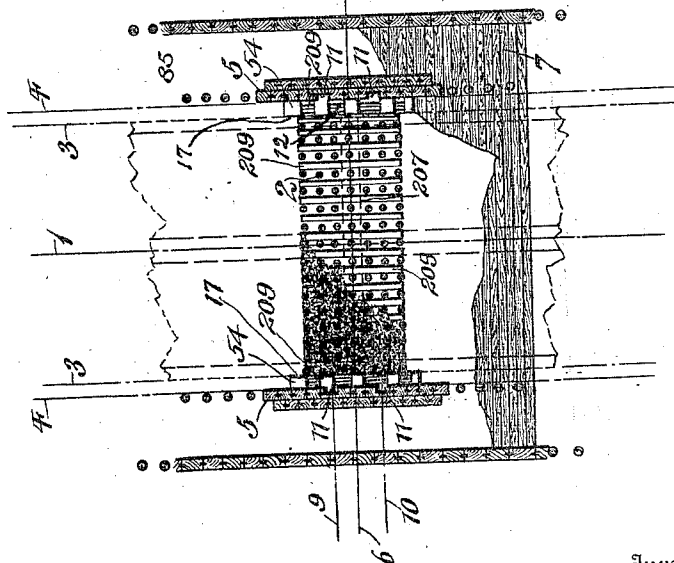


Fig. 7.



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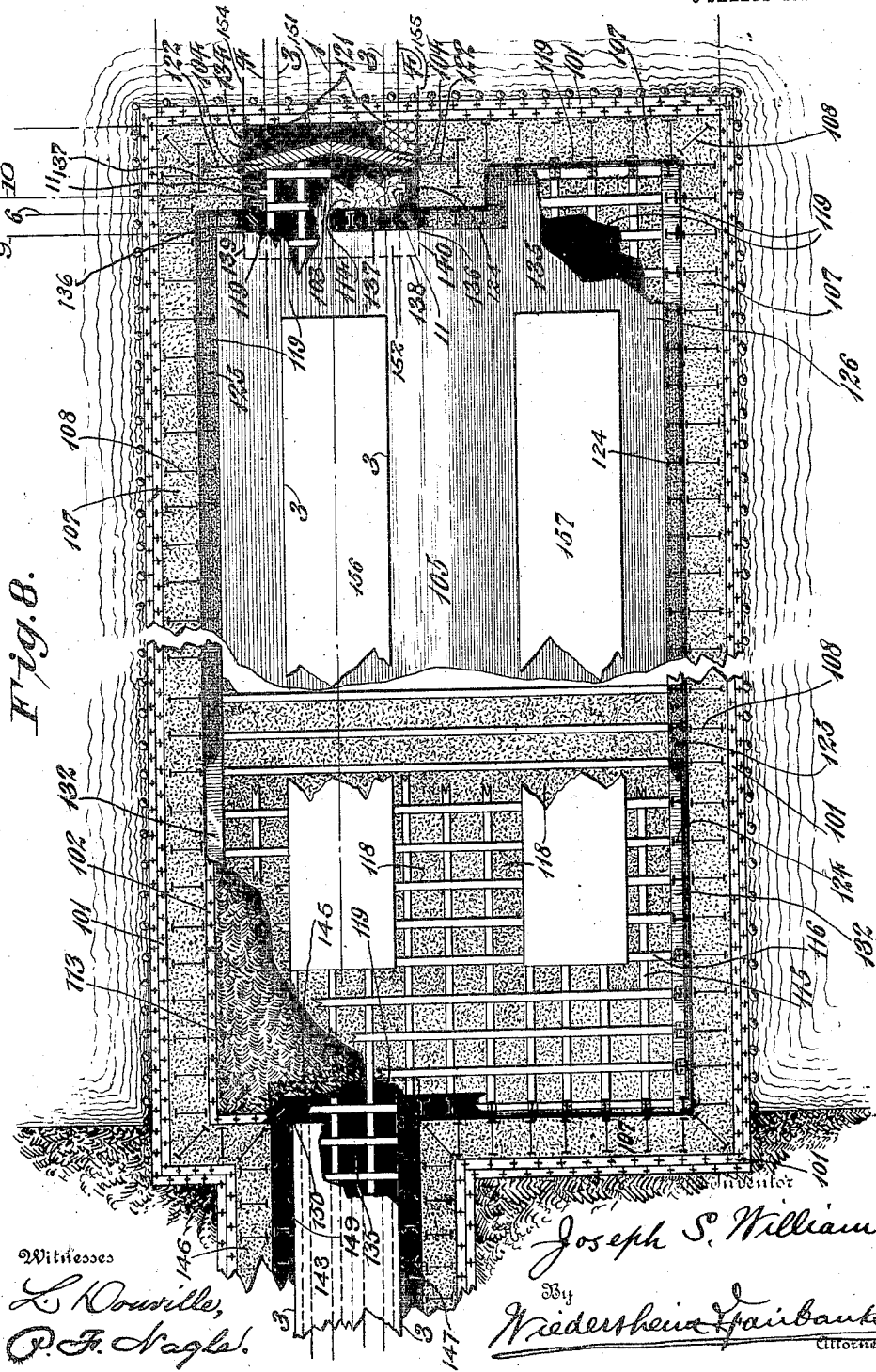
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5 SHEETS-SHEET 4.



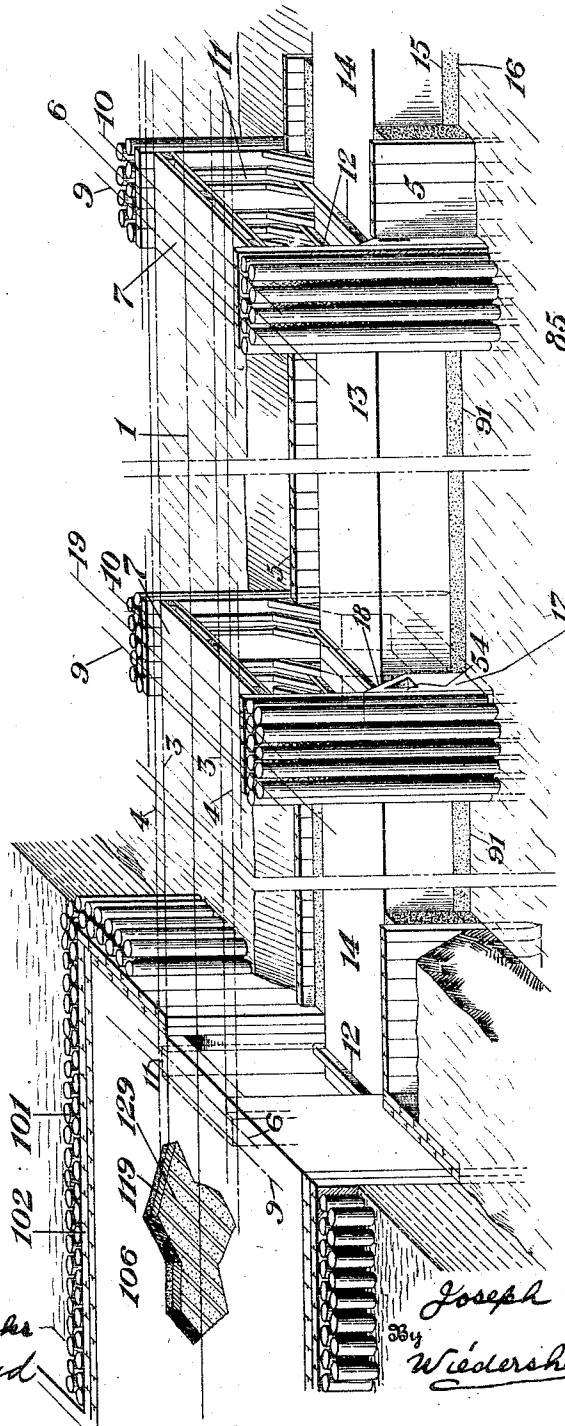
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5 SHEETS—SHEET 5.

Fig. 10.



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UNITED STATES PATENT OFFICE.

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1,049,432.

Specification of Letters Patent.

Patented Jan. 7, 1913.

Application filed December 7, 1906. Serial No. 346,774.

To all whom it may concern:

Be it known that I, JOSEPH S. WILLIAMS, a citizen of the United States, residing at Riverton, in the county of Burlington, State of New Jersey, have invented a new and useful Pier or Wharf, of which the following is a specification.

My present invention in its broad aspects, consists in novel methods and means whereby piers along the water front of cities and other desired places are provided with water proof subaqueous chambers for various and special uses with one or a series of water tight chambers therein located under a water proof wharf floor, above which latter may be established a building with a desired number of stories for wharfage or other purposes.

My invention further consists in novel methods and means whereby piers with water proofed subaqueous or sub-wharf line chambers may be expeditiously and economically built with any desired degree of stability in order to render such chambers absolutely free from leakage, such chambers being adapted, if desired, to be connected with a system of subway rail lines extending under or along the street for the conveyance of passengers and freight.

My invention further consists in a novel construction of piers located along the shore and water line, whereby such may be constructed and employed to form a part of one or more subaqueous tunnel lines, joined thereto and sealed therewith against leakage, and if desired such tunnel lines may extend through the pier structure to a subway tunnel so as to provide, through lines of transportation, wharfage and depot capacity for passengers and freight conveyed through the tunnel lines and along the water way.

It further consists of a novel means of constructing piers or wharves wherein such piers are provided with lock gates, the ends being adapted to be open or closed, whereby the pier structure will be adapted to first serve as a dry dock, wherein sections of tunnel construction can be erected and subsequently conveyed therefrom so as to be placed along a suitable dredged, ballasted and equipped foundation bed of construction in exact and proper alinement, both longitudinally and sectionally for the construction of a subaqueous tunnel line, as de-

scribed herein and also in my co-pending applications for patents filed on even date herewith and bearing Serial Nos. 346,774, 346,891 and 346,892.

My invention further consists of a novel construction of piers or docks and novel means for uniting therewith subaqueous tunnel structures so that the foundation of the pier or dock will be adapted for forming a sectional part of the subaqueous tunnel line and broadly and generally a water tight passageway for a transportation system between the end of the pier and the shore.

It further consists of a novel construction of a pier, wharf or dock and novel means for uniting therewith, when desired, lines of transportation, such as for example, subway or tunnel lines and establishing trunk line systems of transportation therethrough and interchangeable relationship between water, rail, subwater, subway and roadway traffic systems.

For the purpose of illustrating my invention I have shown in the accompanying drawings one form thereof which in practice will give satisfactory and reliable results, although it is to be understood that the various instrumentalities of which my invention consists can be variously arranged and organized and that my invention is not limited to the precise arrangement and organization of the instrumentalities as herein set forth.

Figure 1 represents a sectional plan view of a dock or pier embodying my invention, the same being shown in connection with a subway line and adapted to be connected with a subaqueous tunnel line. Fig. 2 represents a sectional elevation of my novel pier or wharf. Fig. 3 represents a sectional plan view of a portion of the construction. Fig. 4 represents a sectional plan view showing a portion of the pier or dock structure united with a subaqueous tunnel. Fig. 5 represents in section, an elevation of my novel pier or wharf. Fig. 6 represents a perspective view of the end of the pier, showing especially the lock gates. Fig. 7 represents a plan view of a working and aligning pier. Fig. 8 represents a sectional plan view of my pier or wharf, the sections being taken on different horizontal planes. Fig. 9 represents a sectional elevation of my pier or wharf, showing a modified form of

construction which may be employed if desired. Fig. 10 represents a perspective view, partly in section, showing on a larger scale a tunnel section and the wharf during certain stages of construction.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings: In order to more clearly set forth the novel construction of my pier or wharf I will describe the different operations which are employed in building the wharf in the natural or logical sequence in which they take place, it being understood that the present construction is so built that subaqueous tunnel structures may be constructed therein, and in which the passageways are opened by lock gates or floatable vessels so that the structures can be floated therefrom into position and when the last tunnel section is laid the free end thereof will be sealed in water tight union with the passageway communicating with the water proof chamber in the pier or wharf.

1 designates the longitudinal center line of the surveyed tunnel line having the lines 3—3 parallel therewith and equidistant therefrom, said lines representing the exact structural width of a tunnel line.

4—4 designates two lines parallel with the center line and equidistant therefrom, such lines being located outside of the lines 3—3 and representing the approximate alining lines for the establishing of guide piling 5—5 of the alining piers, as seen in Figs. 4 and 7. According to these lines I establish the alining members 17—17, 18—18 and between and along the same, grade line resistances 2 and alining and supporting piers or cradles 85 on defined section lines 6, 19, 9 and 10 and alining parts 11—11 to cooperate with guide bars 12, see Fig. 11, in order to provide for first securing accurate and rapid construction and guiding the tunnel sections along the dredged and if desired ballasted and graded tunnel line bed between the approximate alining pilings 5—5 on both sides thereof and under the working platform 7, established on or over the piers, and ultimately provide for the easy and accurate placement of the tunnel sections upon fixed pier or cradle carrying grade line supports 2, provided along the line at fixed distances apart below said platform 7 according to the predetermined grade of the tunnel line and in accurate longitudinal and sectional alinement.

After establishing the lines in accordance with which the tunnel structure is to be constructed and established and the piers and fixed grade line resistances are to be established, with provision for such lines passing through the pier or dock at a desired point, I establish a double row or rows of sheet,

interlocking metal or other piling 101—102 around the pier or dock area to the necessary depth to provide for securing a stable foundation. Such double rows of piling 101—102 are at such distances apart as will define the thickness of the concrete or concrete reinforced wall to be afterward established between such rows of pilings.

103 designates a passageway in the water end of the dock area in cases in which a subaqueous tunnel line is to be constructed and combined therewith, it being noted that lock gates 104 are established in any suitable manner, said gates being adapted to open outwardly and provide a passageway extending from the floor 105 of the subaqueous chamber of the dock or pier to the top or wharf floor line 106 of the pier. In order to establish a stable foundation under such area which includes the foundation area of the passageway and extending to the outer piling line 101, wood or concrete pilings 114 may be established in the bottom and such pilings are capped with concrete or cement 117 over the entire area and in intimate contact with the inner surface of the encompassing wall 107, extending around the chamber of the dock and on both sides of the passageway 103. When such foundation bed 105 is provided and prior thereto, if desired, the inner row of piling 102 is cut away, as shown in Figs. 2, 5 and 9 in order that the capping material 117 on the pilings 114 will be carried into intimate contact with the inner surface of the wall 107 over the entire area and so that subsequent water proofing of the foundation 105 may be carried up the inner surface of the wall 107. The concrete capping 117 is then covered over the entire area of the piling 114 and into intimate contact with the encompassing wall 107 with one or more layers of asphaltum or other water proofing 119 in order to insure a water tight covering over said capping 117 and if desired in addition to the asphaltum, water proof paper, felt, canvas, open-work metal or other fabric may be placed under the same or between one or more layers thereof and extend over the entire area of the capping 117 and into intimate contact with the vertical wall 121 of the passageway 103, it being understood that the water proofing material 119 is so applied that it will be in intimate contact and water tight union with the grade capping 117.

The vertical water proofing 119 extends upwardly to a sufficient height to provide for laying the full depth of the foundation floor 105 above the capping 117, as herein-after described or the water proofing 119 may be carried up to the top on the inside of the vertical walls 107 and 121 to the water proofing on the wharf flooring 106. A grid-iron system of I-beams or other metal bars

115 are then placed on the water proof foundation over its entire area so as to extend to the opposite sides and ends of the foundation flooring 105 and the passageway 103 to establish a definite area unit of reinforcement in and over such bed. After the placement of the lower set of such bars or I-beams 115, they are embedded in concrete or cement 118 or both over the entire area, so that they will be in intimate contact with the vertical portion of the water proofing 119 which is placed on the walls 121 of the tunnel way 103 as well as on the inner surface of the encompassing wall 107. The embedding material 118 is then leveled and the surface of the entire area covered with one or more layers of water proofing or cement, after which a layer of hot pitch or asphaltum is applied thereto over the entire area with or without using a water proof paper or fabric therewith which is suitably water sealed at the lapping parts so as to cover the entire area and intimately connect the same with the vertical portion of the water proofing 119 which extends on the vertical walls 107 and 121. Such water proofing material can again be covered with hot pitch and another layer of water proof material or a series of such and one or more layers of such material may be used for the surfacing or finishing coat of asphaltum to cover the entire area and to unite with the vertical water proofing on the inner sides of the surface of the wall 107 of the chamber of the dock and the wall 121 of the passageway. Another set of I-beams or bars 116 are then set on such secondary layer of water proofing of the foundation bed and extend transversely of the lower set 115 or at such angle thereto as may be desired. These are preferably so located as to not only cover the entire foundation 105 of the dock and the lock gate tunnel way but so as to be adapted to be united with the metal framing 124 of the vertical walls of the inner lining structure 125, which preferably not only lines the chamber of the dock but also the passageway 103 from the foundation floor 105 to the floor line of the floor 106 so that the water proofing between the same and the outer surface of the wall will be continuously supported and reinforced over the entire surface and so that loads on the vertical walls will be distributed with uniformity over the bed and so that the tensile reinforcing element and framing of the flooring will in turn reinforce the vertical framing and walls. The I-beams or metal bars 116 of the foundation 105 are then embedded in concrete or other suitable material 118 which is again covered with cement and asphaltum or other desired water proofing material by and upon which the working floor 105 can be established over which the rail or transportation system tracks of the tunnel can be

laid and passenger and freight platforms 127 and other equipments for a depot established. The inner lining structure 125 provides for supporting and reinforcing the water proofing and for supporting the wharf line floor 106 and the intermediate flooring 128, as well as supporting the foundation floor.

The structural framing of the inner lining structure 125 as best seen in Figs. 1, 2, 3, 5, and 9, is shown constructed of vertical I-beams 124 carried up in close proximity to the vertical portion of the water proofing 119, with the I-beam flooring girders 129 of the wharf floor 106 carried across the dock to form a complete roof or covering for the chambers below. The intermediate flooring 128 is then established by connecting the I-beams 130 with the vertical I-beams 124 or the girder plates 131 carried thereby.

I have shown the vertical I-beams 124 as resting upon a bed plate 132, which latter rests upon the I-beams 116 or the foundation flooring 105, as before described and the supporting girders 129 and 130 of the upper and intermediate flooring 128 are secured to the vertical I-beams 124 in the usual manner or to angle plates 131, extending across the vertical I-beams 124 and secured thereto in order to support and carry the I-beams 129 and 130. An additional layer of water proofing material such as hot pitch or asphaltum subsequently to the erection of such vertical I-beams of the inner structure 125, can be applied on the surface of the vertical portion of the water proofing 119 so as to fill in any space between the metal of the inner structure 125 and the water proofing 119, thereby producing a better reinforcement of water proofing material. After finishing or facing the surface of the water proofing material with suitable water proofing material as cement or asphaltum, the whole of the vertical framing of the inner structure 125 is embedded in concrete or cement from the foundation floor 105 to the top of the dock or wharf floor 106, it being understood that the ends of the water proofing material 119 are united together. The concrete or cement or other suitable material in which the framing of the inner surface 125 is embedded forms therewith a strongly reinforced concrete, cement or other wall against and in intimate contact with the vertical water proofing from the water proofing in the foundation to the water proofing in the wharf floor and into union with the water proofing on the inner surface of the outer wall 107.

The outer wall 107 may be reinforced by structural metal 108 extending through the concrete of the wall from the top to the bottom thereof or to any desired extent and this structural metal may include I-beams,

rods or any other desired forms of such construction. In Figs. 1 and 3 the flooring girders 129 of the wharf floor 106 are shown in plan without the spaces between the same being filled in with concrete, while in Fig. 8 the gridiron flooring bars are shown with some of the bars embedded in the concrete.

Referring now more particularly to Fig. 9, it will be understood that I have shown the respective flooring as being provided with transverse and longitudinally extending reinforcing members or bars, such bars extending into the opposite walls and in the usual manner to plates embedded in the concrete. It will now be apparent that the water proofing of the various foundation and wharf floors are united in such a manner as to envelop the entire subaqueous chamber of the dock or pier construction and the passageway thereof, extending to the end of the outer line of piling 101 so that there can be no leakage into the subaqueous chamber or the pier otherwise than through the passageway, which will be prevented when such passageway is closed or when the tunnel construction has been sealed therein, as hereinafter described. The outer and inner water proof linings are united by a water proofing material to the vertical water proofing material on both sides of the passageway and the water proofing in the foundation flooring so that a complete water tight union is effected between the tunnel construction when placed in the passageway of the water proofed chamber of pier construction.

In order to provide a simple and effectual means for uniting the water proofing of the subaqueous chamber and the water proofing of the passageway, I employ a water proofing material such as asphaltum or cement for embedding the metal I-beams of the flooring under the passageway, as indicated by 134, so that the layers of water proofing extending through the foundation and flooring are connected into a water proof reinforced construction extending from the floor line to the metallic elements, 116, which extends along the walls on both sides of the passageway so that the inner and lining structure both of the water proof chamber and the passageway will consist of I-beams or metal bars embedded in the water proof material from the inner surface of the outer wall and from the inner surface of the passageway on both sides thereof and from the water proof flooring of the passageway to the water proofing of the wharf floor.

As seen most clearly in Figs. 1, 2, 4, 6 and 8, the passageway 103 is located in the water area end of the pier and the outer row of sheet metal piling 101 is established across the passageway, as seen in Figs. 1 and 8 and the inner row of pilings are established

in order to provide for the increased thickness of wall necessary to give the desired stability and strength for the walls 121 of the lock gate passageway 103, so as to provide for the proper placement and support of the metallic or other framing or carrying members 122, by which the closure gates 104 are supported.

In order to provide the requisite stability for the foundation area of the passageway and to provide for such foundation operating as a grade line pier or support for the tunnel construction the area under the pier is excavated and the foundation area is driven with piling, which is capped with concrete as in the construction of a grade line pier or the foundation flooring 105, as hereinbefore explained. The elements of grade reinforcing members and the water proofing of the flooring foundations of the different chambers of the dock are extended to unite with water proof flooring in the passageway on the outer piling 101 over the entire width of the passageway 103 so that the water proofing of the flooring of the passageway 103 will be in intimate contact or union with the inner surface of the vertical walls of the passageway. The vertical water proofing of such walls may be supported and reinforced by extending the lining and reinforcing wall or structure 125 of the main chamber to cover and reinforce the water proofing on the inner surface of the outer side walls 121 of the passageway 103, as best seen in Fig. 8. By such means the lock gate passageway and the foundation 105 will be enveloped from the wharf flooring 106 down to and under the sub-water line chamber by an unbroken and uniform protection of water proofing reinforced by the lining structure 125 and by the horizontal capping and reinforcing parts of the flooring or foundation structure 105 which may be built up and embedded in water proof material.

In order to prevent leakage into the passageway through the material of the inner structure or terminal ends or parts of such inner structure, a filling of water proof material such as cement or asphaltum or both is used in the sides of the foundation of the passageway throughout its length or in the parts thereof back of the closure gates 104 and such water proof material may be reinforced by metal bars or beams similar to those employed for the inner lining structure. Such water proof and reinforced parts as indicated at 137 and 134 in Fig. 8 are in intimate and direct connection with and practically form a part of the water proofing which envelops the chamber and the passageway 103.

156 represents a tunnel structure which has been constructed within the chamber and in line for being floated through the

passageway 103 provided with the lock gate 104 or other means employed for opening and closing the same. The grade line of the floor 105 is adapted to be on the tunnel grade line 115 which extends to the grade of the pier line resistances 2.

It will now be understood that when it is desired to float the tunnel structures completed within the water proof chamber, that the outer row of pilings 101 as shown across the end of the passageway 103 in Figs. 1 and 8 between the lines 154 and 155 are cut away on a line with or below the surface of the passageway foundation flooring. Water is admitted into the water proof chamber so that the tunnel sections 156 and 157 may be floated out into their proper location after the means of closure 104 of the passageway 103 have been actuated. The passage 103 is provided with suitable means 11 so as to hold a tunnel section in proper sectional alinement by means of bars 12 or otherwise, as the same is lowered into position on the foundation bed 151. The vertical side framing or lock gate supporting members 122, seen in Figs. 1 and 8 are connected with a distancing head piece or platform 123, see Fig. 6, and a similar or equivalent framing member may be employed at the bottom of the passageway 103 to secure the vertical members in proper relation, such passageway framing having a portion thereof nearest to the passageway 103 embedded in or coated with the water proof material of the alining and reinforcing walls of the inner structure 125. The walls of the inner structure are shown at 136 extending from the dock chamber and along both sides of the passage 103 over and upon the reinforced water proof foundation 105 in close proximity to or in contact with the outer walls of the water proofing thereon, as indicated at 137. The walls 136 on both sides of the passageway 103 are constructed of metal reinforcements embedded in suitable water proofing material, such as asphaltum or cement or a combination of such materials along both sides of the passageway 103.

The tunnel structure is placed in the passageway so that the inner end thereof will extend beyond the section line 6, see Fig. 4. The inner and outer ends of the passageway 103 are then closed in any desired manner to form a chamber adapted to be filled with concrete or other material to establish a continuity of the outer wall 107 across the passageway 103 with the tunnel structure embedded therein. The space between the tunnel and bottom of such chamber is filled in with water proof material or cement grouting so that the entire tunnel structure is surrounded by material which will close the passageway and firmly unite the tunnel structure therein, it being

understood that any desired reinforcements may be employed.

After the establishing of the double lines of pilings 101 and 102 to include the passageway 103 a concrete wall 107 is built up therein of such thickness as to provide the necessary resistance against the water pressure and working conditions to which such wall may be subjected. In order to secure greater stability in such walls the same may be reinforced by structural metal or sets of bars or beams 108 extending from the base to the top of the wall, if desired. After such encompassing wall 107 has been built the area encompassed thereby is excavated to the grade of the tunnel line and to such greater depth as may be required to secure the desired stability of the foundation floor 105 of such encompassed area. The structural metal of the metal framing or the reinforced grade walls of the inner structure 125 may extend above the floor 106 as designated by 111 to provide a framing or supporting wall for the upper structure 110.

In order to compensate for the difference of lateral pressure at different heights in the water proof chamber, I either employ the reinforced walls of the inner structure of such thickness and stability as will compensate for difference in pressure between the bottom and top of the construction with ample factors for safety therein or I provide for such difference of pressure by constructing the inner walls with a gradual increase and stability of lateral pressure from bottom to top, as seen at 160 in Fig. 2 or by constructing the walls of the inner structure of the lower chamber with a greater thickness and stability than the upper portion of the upper chamber. Such differences in stability and resistance may be provided by increasing the thickness of the walls or by increasing the metal reinforcing elements thereof.

As will be clearly apparent from Fig. 5, I provide means of passage communicating with the different chambers of the wharf structure and with the tunnels united therewith such means being shown for purposes of illustration as consisting of the stairs or elevators 174 preferably located on each side of the tunnel structures and leading from the foundation floor of the wharf structures to the wharf floor.

One of the essential features of my construction in the use of subaqueous piers and docks is to not only secure absolute stability and resistance against leakage in the pier or dock proper but to provide for connecting and constructing the subaqueous and subway line tunnels and passageways thereto with water tight unions between such passageways and tunnels and the water proof chamber and tunnel line passageway of the pier,

whereby such piers or docks will be adapted to serve as extensions or line connections of shore or subaqueous lines or both and as depots without any liability of the leakage of water thereinto. The shore line section of the subway 143 is provided with a water proof lining or construction, as at 144, which corresponds to the water proof construction of the passageway 103 and such construction extends from above the water line or shore to the water proof lining of the subaqueous pier or dock with which such water proofing and the other structural or reinforcing elements are united in water proof and reinforced construction.

The shore line or subway is placed between the extension walls 146 of the dock with reinforced water proofing 147 between such walls and the shore line section 143, it being understood that this forms a water proof construction. The end of the shore line tunnel 143 as indicated at 145, is shown extending into union with the structural metal and reinforced water proof wall 148 united with 125 of the pier or dock and such shore line tunnel section is in water proof union with the water proof floor 103, as indicated at 149, at which point the water proofing is shown as extending from within the chamber of the pier end and in union with the water proofing of the walls 148 of the inner structure 145 so that the water proofing of the floor and walls will be effectually united with the construction of the pier. The water proof walls 147 are extensions or continuations of the walls 107 and are built upon the water proof floor 149, the construction being similar to that before described with reference to the passageway 103. The water proof walls 147 and 146 are connected with the water proofing 119 of the wharf structure and they may be capped or united by a water proof capping member extending along and over the shore tunnel line on a line with the wharf floor or on any other suitable grade. The water proofing of the shore line section terminates in an increased section 150 of water proofing which unites with the water proofing portions 147 and 148 and the water proof flooring 149, it being understood that such union 150 extends completely around the shore line structure 143 into intimate contact and union with the water proofing 147 and 149 so as to form a water proof union between the subway tunnel and the pier. In order to provide absolute stability in such shore line extensions from the pier or dock I preferably extend the walls 107 along the subway, as designated at 146 and line the same with reinforcing or lining walls 147, having a standard of resistance adapted to resist the pressure of the water and leakage of the same therethrough and by establishing in union therewith a stable foundation

capped with concrete and water proofing I provide a stable construction corresponding to that already described with reference to the foundation flooring 103 of the chamber and the passageway 103.

In order to provide the requisite standard of capacity and resistance in the foundation of the dock, the area bed of construction is reinforced so that the road bed or passage through the chamber of the pier is reinforced to the requisite standard for supporting with predetermined requisite factors of safety the maximum traffic loads which can possibly be imposed upon such construction.

It will now be apparent that I have devised a novel and useful construction of a pier or wharf which embodies the features of advantage enumerated as desirable in the foregoing and while I have in the present instance shown and described but a single embodiment thereof which will give in practice reliable and satisfactory results, it is to be understood that it is susceptible of modification in various particulars without departing from the spirit or scope of the invention or sacrificing any of its advantages. Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. A tunnel wharf structure, comprising a chamber extending below the water line, a reinforced foundation floor therefor, a floor covering said chamber, a tunnel line in waterproof union with said chamber and reinforced water proofing enveloping said chamber, in combination with a wharf floor.

2. A tunnel wharf structure comprising a water proof foundation floor in water proof union with encompassing walls in which the waterproofing is between the outer and inner elements thereof, and forming a chamber extending above the water line, and covered by a wharf floor with a passage way therefrom into said chamber, and a tunnel line in waterproof union with said chamber.

3. A tunnel wharf structure, comprising a waterproof foundation floor below the water line, an outer wall having its outer face protected by pilings and its inner face water proofed, an inner wall engaging said water proof and extending into union with a water proof wharf floor and forming a water proof chamber, a tunnel line in waterproof union with said chamber and means of passage from such chamber to the wharf floor.

4. A tunnel wharf structure, comprising a reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extending into water tight union with a water proof wharf floor above the water line to form a water proof chamber, with the foundation floor and water proofing thereon reinforced by an inner structure, with a gridiron sys-

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tem of reinforcement in the foundation floor, embedded in reinforcing material and a tunnel line in waterproof union with said chamber.

5 5. A tunnel wharf structure, comprising a water proof foundation floor below the water line, in water proof union with encompassing walls extending upwardly into union with elements of a wharf floor, and
10 forming a chamber in subaqueous tunnel way alinement, with the foundation floor reinforced and ballasted for structural alinement of transportable tunnel structure, and a passageway in one end of such chamber
15 equipped with lock gates.

6. A tunnel wharf structure having a water proof encompassing wall, in water tight union with a wharf floor above a water proof foundation floor below the
20 water line, a roofed superstructure carried by said wall, a reinforced water proof wharf floor, a tunnel line in waterproof union with said encompassing wall and means of passage to and from such floors.

25 7. A tunnel wharf structure having an area extending from the shore, with a water-way encompassing wall outwardly reinforced and protected by pilings, with such encompassing elements extending below the water bed to a suitable resistance bed therefor, and from below the structural and
30 grade foundation bed of a subaqueous tunnel therewith alined, to a tunnel alining water proof foundation floor and from such
35 to a wharf floor line above a water way.

8. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls
40 extending to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, with the water proofed foundation floor and the walls reinforced by an inner element of
45 structure extending over and into intimate union with the water proofing of the chamber and into union with the wharf floor and a tunnel line in waterproof union with said chamber.

50 9. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a
55 water proof wharf floor above the water line to form a water proof chamber, with the water proofed foundation floor and encompassing walls reinforced by an inner element of structure extending over and into
60 intimate union with the water proofing of the chamber and into union with the wharf floor, with such inner element of structure reinforced by a structural metal frame work embedded therein extending from union
65 with the foundation floor to and into union

with the water proof wharf floor, and a tunnel line in waterproof union with said chamber.

10. A tunnel wharf structure comprising an earth bed reinforced foundation floor
70 below the water line, water proofed into union with the water proof encompassing walls extended to and in water-tight union with a water proof wharf floor above the water line to form a water proof chamber,
75 with the water proofed foundation floor and encompassing walls reinforced by an inner element of structure extending over and into intimate union with the water proofing of the chamber and into union with
80 the wharf floor, with such inner element of structure reinforced with the metal frame-work embedded therein extending from union with the foundation floor to and into supporting union with the water proof wharf
85 floor, such framing being further reinforced by a reinforcing framing in the foundation floor which is embedded into a unit of reinforced structure therewith and a tunnel line in waterproof union with said chamber.

11. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls
95 extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, with the water proofed foundation floor and encompassing walls reinforced by an inner
100 element of structure extending over and into intimate union with the water proofing of the chamber and into union with the wharf floor, with such inner element of structure with the metal frame-work embedded there-
105 in extending from union with the foundation floor to and into supporting union with the water proof wharf floor, such framing being reinforced by a reinforcing framing in the foundation floor which is embedded
110 into a unit of reinforced structure therewith, and with such framing further reinforced by a reinforced framing in the wharf floor embedded into a reinforced and reinforcing unit of structure therewith and a tunnel line in waterproof union with said
115 chamber.

12. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls ex-
120 tended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, with the water proofed foundation floor and encompassing walls reinforced by an inner ele-
125 ment of structure extending over and into intimate union with the water proofing of the chamber and into union with the wharf floor, with such inner element of structure with the metal frame-work embedded there-
130

in extending from union with the foundation floor to and into supporting union with the water proof wharf floor, such framing being further reinforced by a reinforcing framing in the foundation floor which is embedded into a unit of reinforced structure therewith, and with such framing further reinforced by a reinforced framing in the wharf floor embedded into a reinforced and reinforcing unit of structure therewith, and further reinforced by an intermediate floor framing supported thereby and embedded in a reinforced and reinforcing unit of structure and a tunnel line in waterproof union with said chamber.

13. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, with the foundation floor reinforced by metal suitably embedded and extending into union with the encompassing side walls and a tunnel line in waterproof union with said chamber.

14. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, reinforced by an inner element of structure having metal embedded therein to reinforce the water proofing and structural unit against subaqueous pressure and working conditions and a tunnel line in waterproof union with said chamber.

15. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber reinforced by an inner element of structure having metal embedded therein to reinforce the water proofing and structural unit against subaqueous pressures and working conditions, and reinforced by an intermediate floor having metal reinforcements embedded therein and into a reinforced unit of structure with the encompassing and supporting walls and a tunnel line in waterproof union with said chamber.

16. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls, extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, reinforced by an inner element of structure

having metal embedded therein to reinforce the water proofing and structural unit against subaqueous pressures and working conditions, and said wharf floor having metal reinforcements embedded therein and into a reinforced and reinforcing unit of structure with the encompassing and supporting walls and a tunnel line in waterproof union with said chamber.

17. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, reinforced by an inner element of structure having metal embedded therein to reinforce the water proofing and structural unit against subaqueous pressure and working conditions, and supporting metal reinforcements of the wharf and intermediate floors which are embedded into reinforced and reinforcing union therewith and a tunnel line in waterproof union with said chamber.

18. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, with the water proofed foundation floor and encompassing walls reinforced by an inner element of structure extending over and into intimate union with the water proofing of the chamber and into union with the wharf floor, with such inner element of structure reinforced by a structural metal frame-work embedded therein extending from union with the foundation floor to and into union with the water proof wharf floor, and reinforced by an intermediate floor having metal reinforcements embedded therein and into a reinforced unit of structure with the encompassing and supporting walls and a tunnel line in waterproof union with said chamber.

19. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, with the water-proofed foundation floor and encompassing walls reinforced by an inner element of structure extending over and into intimate union with the water proofing of the chamber and into union with the wharf floor, with such inner element of structure reinforced by a structural metal frame work embedded therein extending from union with the foundation floor to and into union with the water proof wharf floor, and said wharf

floor having metal reinforcements embedded therein and into a reinforced and reinforcing unit of structure with the encompassing and supporting walls and a tunnel line in waterproof union with said chamber.

20. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a water proof wharf floor above the water line to form a water proof chamber, with such elements of structure reinforced by an inner element of structure which constitutes a unit of structure therewith and establishes a combination of inner reinforcements for the waterproofing and encompassing walls of the chamber of the wharf and a tunnel line in waterproof union with said chamber.

21. A tunnel wharf structure having an earth bed reinforced foundation floor below the water line, in water tight union with encompassing walls extending from a suitable resistance bed below the foundation floor to the wharf line above the water way and forming a water tight chamber above the foundation floor, said encompassing walls at a passage way part being of suitable section or extending back into the encompassed area to form a reinforced passage way, the earth bed of such passage way being reinforced by such walls and between the same by further reinforcements and by capping of ballast and water proofing into union with the side walls to the passage way, and by the extension of the reinforcing and water proofed foundation floor of the chamber into and over the bed of the passage way into union with the water proof elements of the side walls thereof.

22. A tunnel wharf structure having a sub water line water tight wharf chamber, with foundation floor thereof reinforced and water proofed extending into a passage way over a reinforced bed thereof and supporting the end of a subaqueous tunnel construction, in water tight union therewith and the side walls of the passage way and the closing wall of the passage way to the wharf line.

23. A tunnel wharf structure having a sub water line water tight wharf chamber, with a reinforced and ballasted earth bed and reinforced water proofed foundation floor ballasted into union therewith and extending into union with the reinforced earth bed encompassing walls, extending from a suitable resistance bed to the wharf line above the water, and a subway water proof reinforced foundation floor in water tight and bridging capacity union with the foundation floor of the wharf chamber and between and in water tight union with water proofing side walls of the subway, said side walls of the subway being in water tight union with the encompassing walls of the

wharf chamber from the foundation bed thereof below the foundation floor to and into water tight union with a water proof roof of the subway, which is also in water tight union with water tight chamber of the wharf and a tunnel line in waterproof union with said chamber.

24. A tunnel wharf structure having a sub water line water tight wharf chamber with encompassing walls extending below the earth bed of the foundation floor of the chamber, such encompassed earth bed below the floor line being reinforced by ballast and water proofing with suitable reinforcements embedded in reinforcing and water proofing material to a graded floor line and into union with the encompassing walls, said reinforced foundation floor being in reinforced bridging capacity water tight union with the reinforced foundation floor of a subway passage and the encompassing walls thereof.

25. A tunnel wharf comprising a metal frame work embedded in waterproofing and concrete, and having a waterproof chamber extending below the water line, and a tunnel line extending into said chamber and in water tight union with the walls thereof.

26. A tunnel wharf comprising a metal frame work embedded in waterproofing and concrete, and having a chamber extending below the water line, piling exterior of said frame work, and a tunnel line extending into said chamber and in water tight union with the walls thereof.

27. A tunnel wharf comprising a piled and ballasted bed, a reinforced concrete frame work supported on said piled and ballasted bed, said frame work having a water tight chamber extending below the water line, and a tunnel line communicating with said chamber and in water tight union with the walls thereof.

28. A tunnel wharf comprising a metal frame work embedded in waterproofing and concrete, and having a waterproof chamber extending below the water line, a tunnel line extending into said chamber and in water tight union with the walls thereof, and a subway line communicating with said chamber and in water tight union with the walls thereof.

29. A tunnel wharf comprising a reinforced concrete construction having a plurality of waterproof chambers extending below the water line, a tunnel line communicating with one of said chambers and in water tight union with the walls thereof, and a layer of waterproofing material surrounding the walls of said chambers on the inner faces thereof.

30. A tunnel wharf comprising a piled and ballasted bed, a structural metal framing supported on said bed and enveloped in waterproofing and concrete, and having a plurality of chambers extending beneath the

water line, one of said chambers having a passage therefrom, and means for controlling said passage.

31. A tunnel wharf structure comprising
5 a structural metal frame work embedded in waterproofing and concrete and provided with a wharf floor and a water tight chamber in communication therewith and extending below the water line, and a tunnel
10 line in communication with said chamber.

32. A tunnel wharf structure comprising a structural metal frame work embedded in waterproofing and concrete and provided with a wharf floor and a water tight chamber in communication therewith and extending
15 below the water line, a tunnel line in communication with said chamber, and a subway line in communication with said chamber.

33. A tunnel wharf comprising a metal frame work embedded in a unit of waterproofing material and concrete, and having
20 a water tight chamber extending below the water line with a passage therefrom, the walls of said passage comprising a metal frame work embedded in concrete and waterproofing which is in union with said unit of
25 waterproofing material, and a tunnel line

extending between the walls of said passage and in water tight union therewith. 30

34. A tunnel wharf structure comprising an earth bed reinforced foundation floor below the water line, water proofed into union with the water proof encompassing walls extended to and in water tight union with a
35 water proof wharf floor above the water line to form a water proof chamber, with the water proofed foundation floor and encompassing walls reinforced by an inner element of structure extending over and into intimate
40 union with the waterproofing of the chamber and into the wharf floor, with such inner element of structure reinforced by a structural metal frame work embedded therein extending from union with the foundation floor to and into union with the water
45 proof wharf floor and supporting metal reinforcements of the wharf and intermediate floors which are embedded into reinforced and reinforcing union therewith and a tunnel line in waterproof union with said chamber. 50

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Witnesses:

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