No. 745,454. PATENTED DEC. 1, 1903.

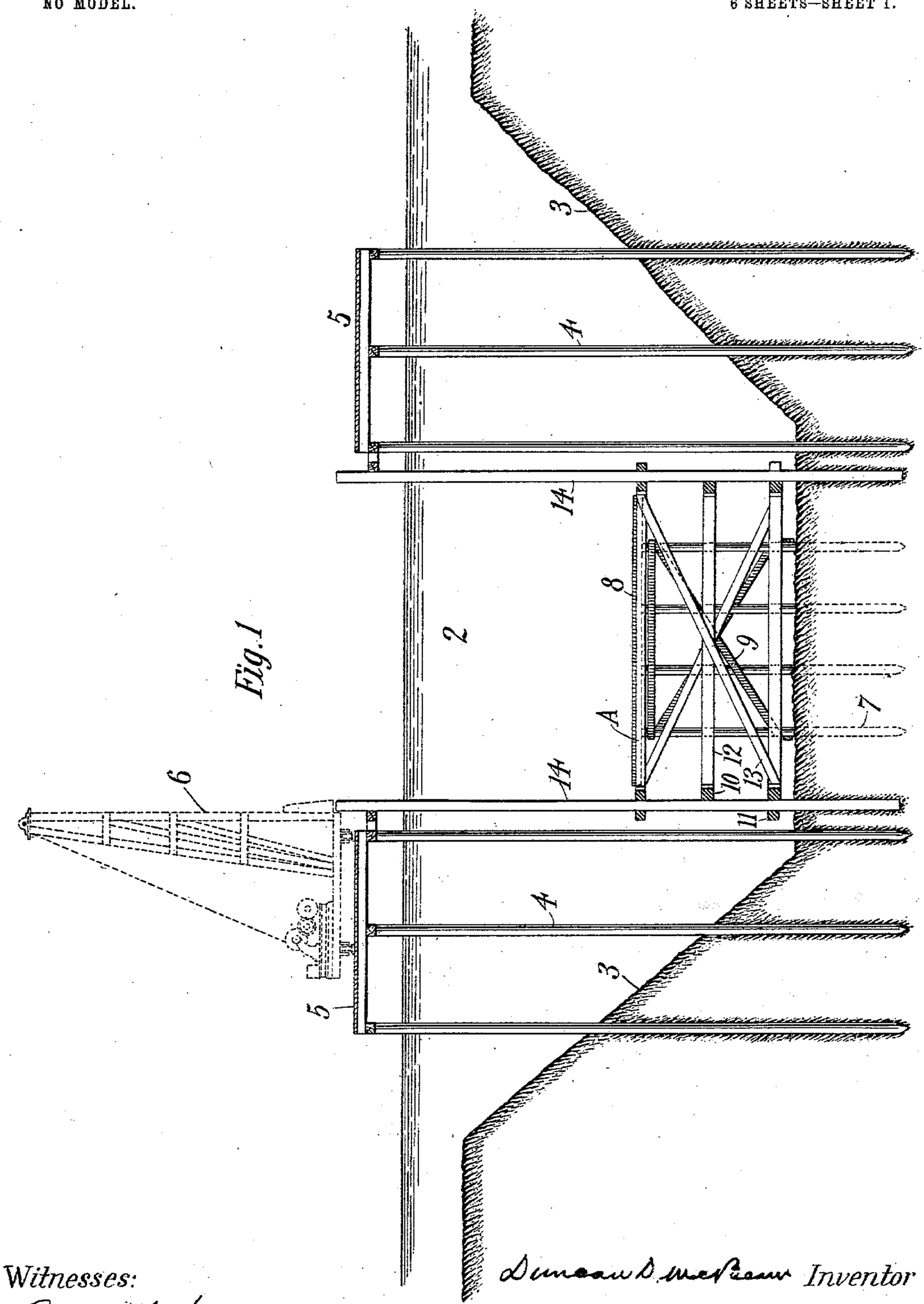
D. D. McBEAN.

SUBAQUEOUS WORKING CHAMBER.

APPLICATION FILED MAY 9, 1903.

NO MODEL. 6 SHEETS—SHEET 1.

Fig. 1



Witnesses:
Raphael Netter
Pierce Powers

Duncan D. McBean Inventor

by L. D. Mercein Atty

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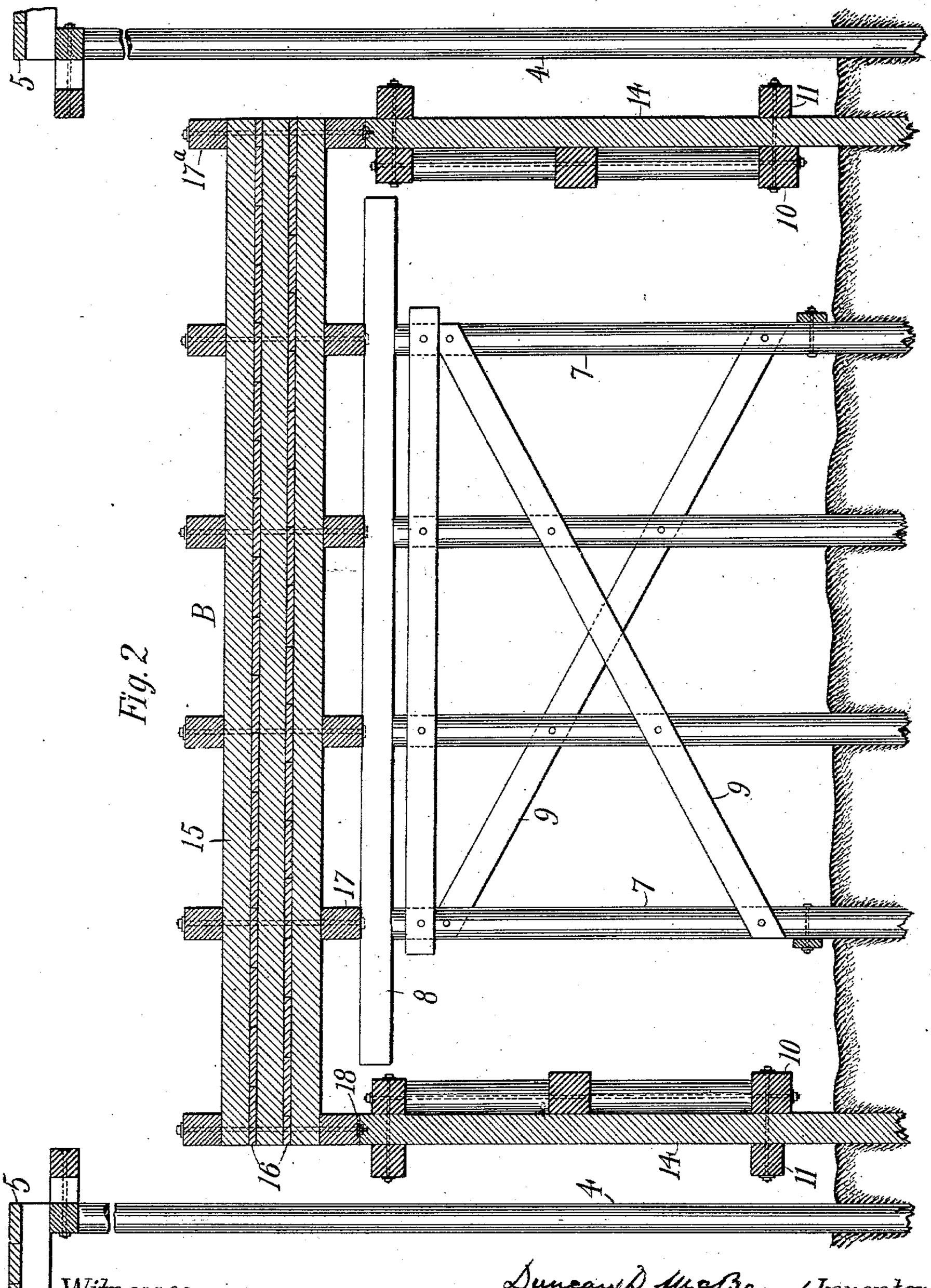
NO MODEL. 6 SHEETS—SHEET 2.

Fig. 2



Witnesses.
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Pierce & Powers.

Duncan D. MacBean Inventor
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NO MODEL. 6 SHEETS—SHEET 3.

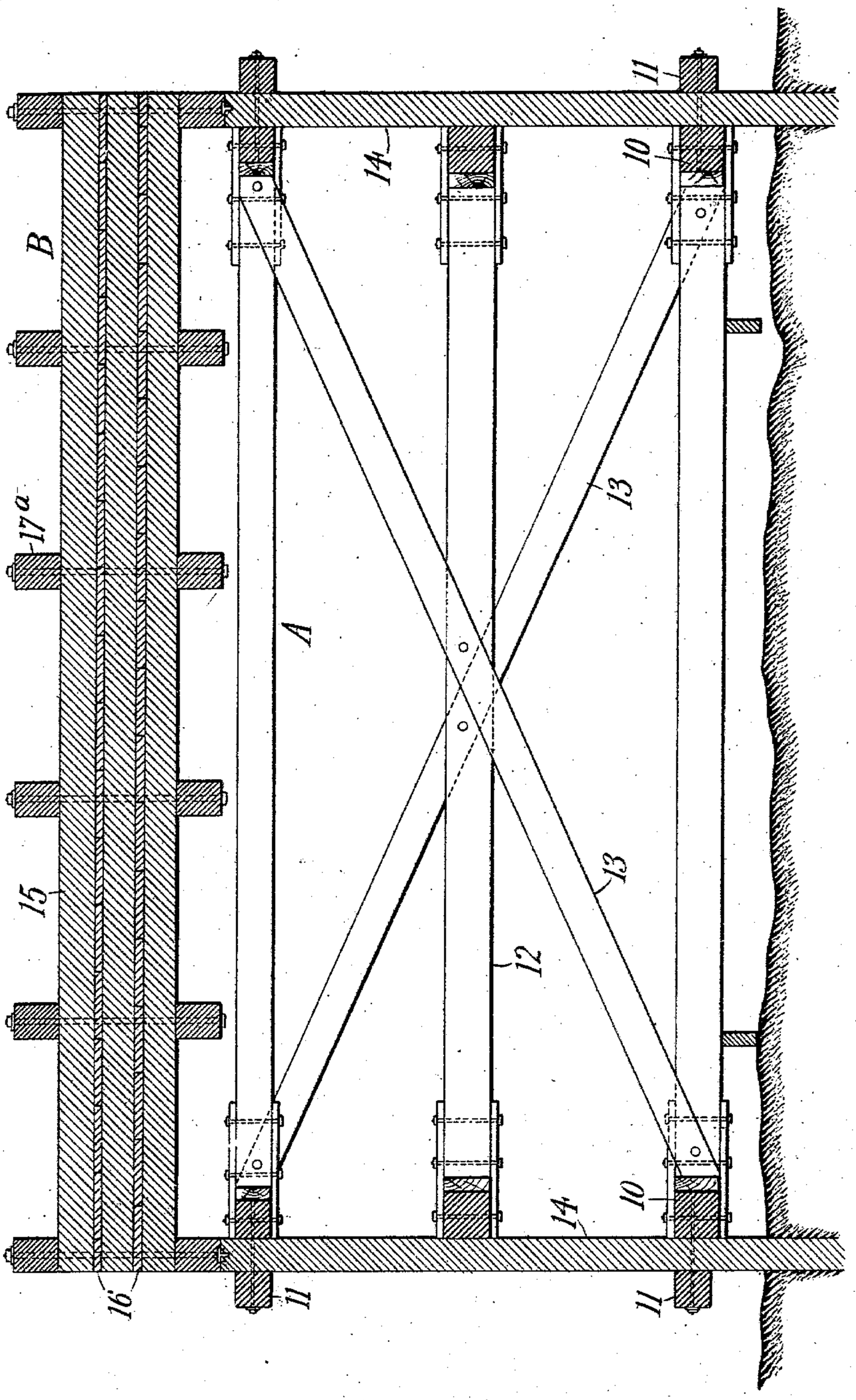

Fig. 3

Witnesses:
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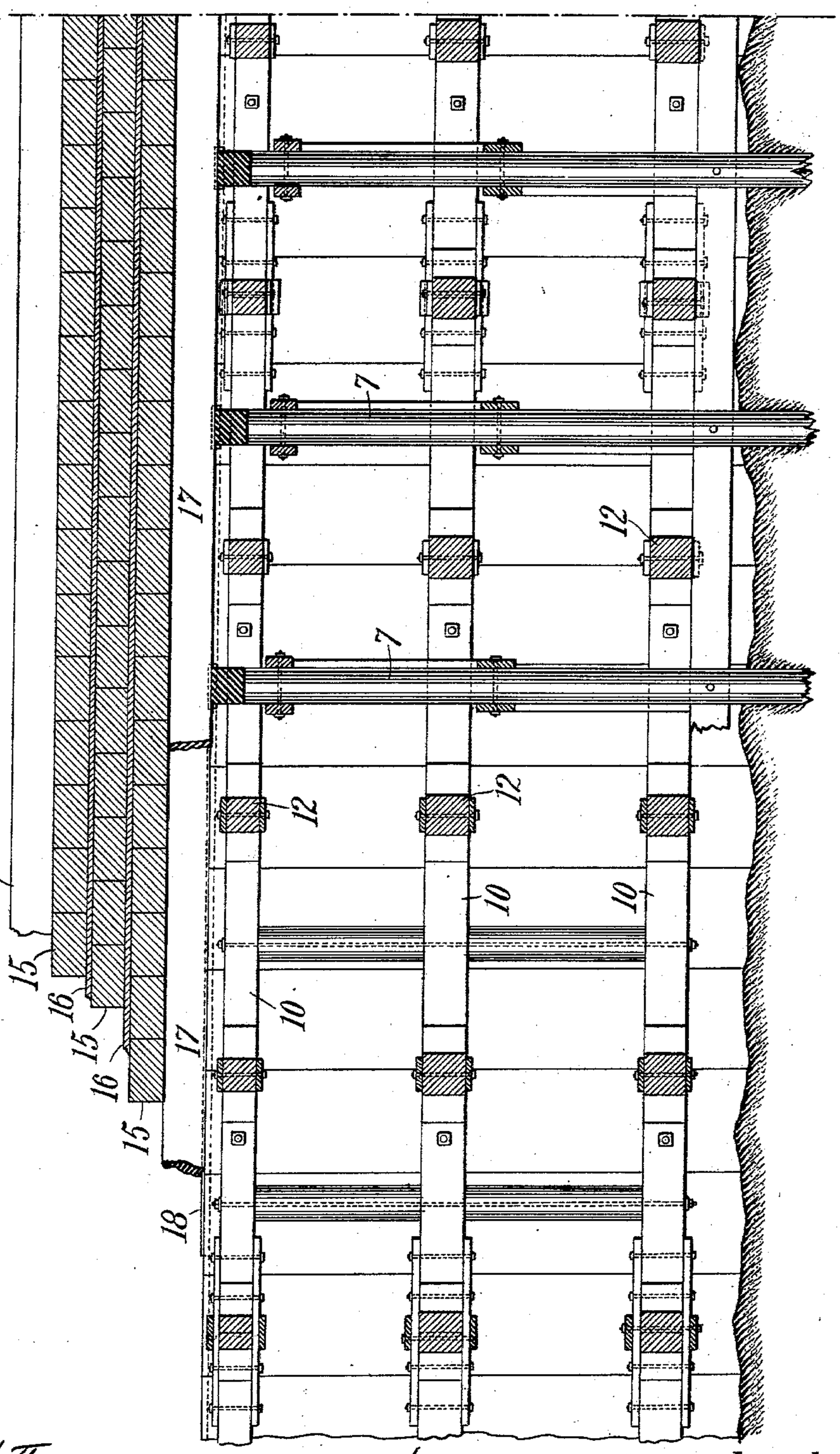
NO MODEL. 6 SHEETS—SHEET 4.

Fig. 4.



Witnesses:
Raphael Fetter
Pierce J Powers.

Duncan D. McBean Inventor
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APPLICATION FILED MAY 9, 1903.

NO MODEL. 6 SHEETS—SHEET 5.

Fig. 6

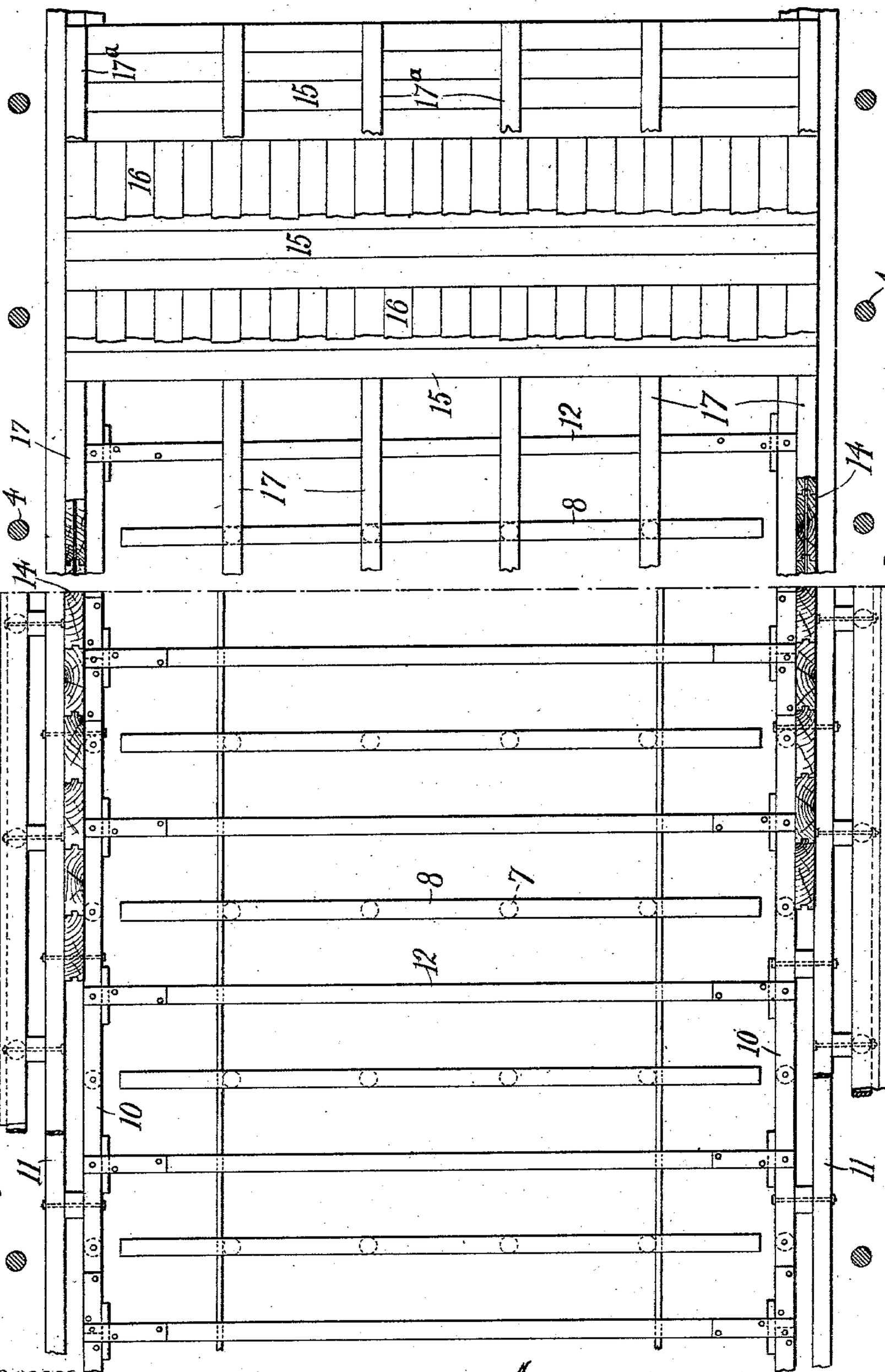

Fig. 5

Witnesses:
Raphael Netter
Pierce & Powers

Duncan D. McBean Inventor
by T. D. Merwin Atty

No. 745,454. PATENTED DEC. 1, 1903.

D. D. McBEAN.

SUBAQUEOUS WORKING CHAMBER.

APPLICATION FILED MAY 9, 1903.

NO MODEL. 6 SHEETS—SHEET 6.

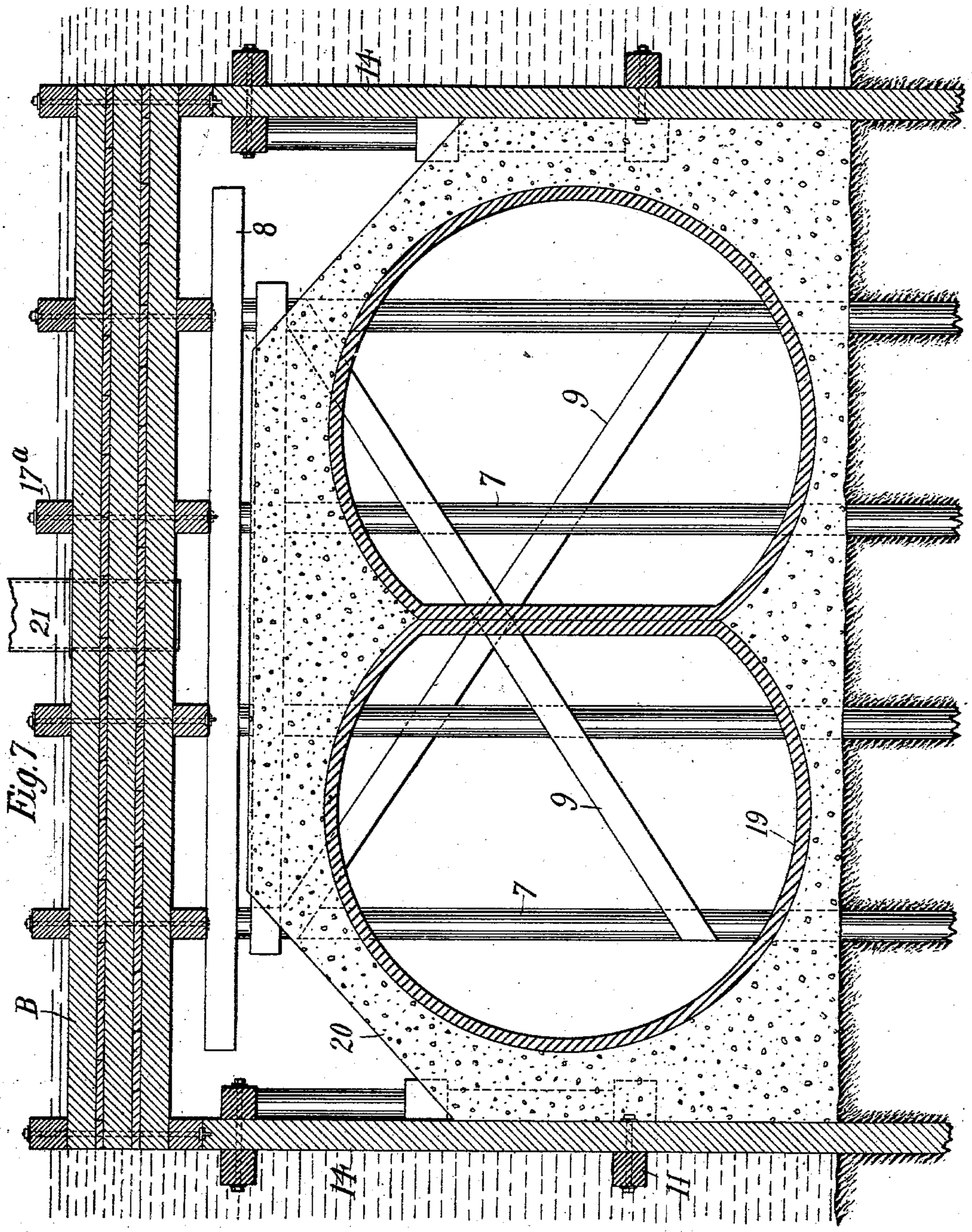

Fig. 7.

Witnesses:
Raphael Netter
Peirce J. Powers.

Duncan D McBean Inventor

by F. D. Merwin Atty

No. 745,454. Patented December 1, 1903.

UNITED STATES PATENT OFFICE.

DUNCAN D. McBEAN, OF NEW YORK, N. Y.

SUBAQUEOUS WORKING-CHAMBER.

SPECIFICATION forming part of Letters Patent No. 745,454, dated December 1, 1903.

Application filed May 9, 1903. Serial No. 156,408. (No model.)

To all whom it may concern:

Be it known that I, DUNCAN D. McBEAN, of the city, county, and State of New York, have invented a new and useful Improvement in Subaqueous Working-Chambers, of which the following is a specification.

My invention relates to improvements in the methods and devices employed in subaqueous tunnel and other subaqueous concrete constructions, its object being to provide improved means and methods for carrying on such work without interference with navigation above the same and to avoid other difficulties incident to the ordinary methods employed in such work.

To this end my invention consists in first preferably dredging out, as far as convenient or practicable, the space in which the work is to be done and then constructing in place around and inclosing the space in which the structure is to be built a working-chamber practically water and air tight, then pumping the water out of said chamber and replacing it with air under sufficient pressure to equalize the load of the superincumbent water and transmit the pressure of the same to the side walls and earth bottom of the chamber. The pressure of the air contained in the chamber thus serves to assist in sustaining the walls of the chamber and also to prevent leakage into the chamber of water through, around, or beneath the walls. The roof and side walls of the chamber are also braced and supported by suitable framework, permitting the work of further excavation of the material to be freely carried on and the building of the concrete structure in place, after which the roof of the chamber can be removed and the space above the completed structure filled in, if necessary, with other material. The specific steps of the method and the features of construction are hereinafter more particularly described and claimed. For the purpose of avoiding ambiguity I define certain of the terms hereinafter used as follows: "earth," sand, clay, and other material except bed-rock; "pile," a tree-trunk, sawed timber, or other structure of similar form of any suitable material adapted to be driven into the earth; "fixed" chamber or wall, one which remains stationary during the progress of work as distinguished from structures which are wholly or in part advanced during the progress of the work and in which the bottom of the chamber is the substance to be excavated, and the walls of such chamber are seated on bed-rock or penetrate to a proper depth in other materials.

In the accompanying drawings, forming part of this specification, Figure 1 illustrates a dredged channel, to be further excavated for a tunnel, having piles driven into the bed thereof supporting a framework and sheeting walls driven into the earth at both sides of the channel. These feature are shown, described, and claimed in a concurrent application. Fig. 2 is a cross-sectional elevation of the working-chamber, the cross and diagonal braces of the framework being removed to afford a clearer view of the other parts, the sheeting walls being shown cut off and the roof seated thereon. Fig. 3 is a similar view showing the framework of bracing and walings in the working-chamber, but with the piles shown in Fig. 2 removed. Fig. 4 is a longitudinal sectional elevation showing one of the sheeting walls of the chamber in elevation, a section of the roof, and the supporting-piles therefor. Fig. 5 is a plan view with the roof of the chamber removed. Fig. 6 is a similar view showing the roof partly broken away, and Fig. 7 is a cross-sectional elevation showing the completed tunnel built within the inclosing walls of the chamber.

The body of water in which the work is to be carried on is indicated by 2.

3 is the sloping wall of the dredged channel.

4 represents piles driven to support the working-platforms 5, upon which is indicated in dotted lines a sheeting-driver 6.

7 represents piles driven in the bed of the excavation, 8 caps upon the piles, and 9 sway-braces.

10 and 11 are walings interspaced sufficiently to receive the sheeting 14 and to serve as guides therefor while being driven. 12 represents the cross and 13 the diagonal braces, all constituting a framework, (designated A.) This framework is first arranged and supported in proper alinement upon the piles 7, after which the sheetings 14 are driven to bed-rock or several feet below the deepest part of the required excavation. The sheetings are then cut off in horizontal plane at or above the level

of the top of the tunnel or other structure to be built. The roof B, preferably constructed of series of transverse timbers 15 and intermediate longitudinal tongued-and-grooved plank 16 and stringers 17 and 17ª, so disposed as to rest, respectively, upon the sheeting walls 14 and the series of piles, as shown in Fig. 2, after being thoroughly calked is lowered into place upon the structure. The outside stringers 17 are provided on their lower face with T-irons 18, which are forced by the weight of the roof and superposed water into the top of the sheetings, thus assisting in making the joint between water-tight. After the roof is in place the space between the sheeting walls and the earth slopes 3 is filled in with earth to the level or above the top of the roof. Cross-bulkheads (not shown) constructed in the same manner as the side walls of sheeting are arranged at right angles with the sheeting to form the other side walls of the chamber. Shafts 21 may be carried through the roof B, extended above the surface of the water, and provided with proper locks (not shown) to serve as a means of communication with the chamber. The described structure being completed, the water is pumped out of the chamber, the joints in the walls being calked as the water recedes, so as to make them water and air tight, and air is pumped in, under pressure preferably, to counterbalance the weight of the superincumbent water and transmit the pressure of the same to the earth beneath and to the side walls, whereby additional support is afforded to the walls and leakage into the chamber retarded. The work of further excavation can be then freely carried on, and as material is removed to lower depths suitable braces and framework are added beneath the original structure to properly support the sheeting walls. After the excavation has been completed the concrete structure is built in place, the piles being cut off and other parts of the temporary structure removed as the work progresses. Fig. 7 illustrates the concrete work of a tunnel completed and fitted with the iron tubes 19, supported in the mass of the concrete 20. After the completion of the work the roof B may be floated off from the structure for use at another point.

I claim—

1. A subaqueous working-chamber, comprising walls inclosing the space in which work is to be performed, and penetrating to the full depth to which earth is to be excavated, and a roof seated thereon.

2. A subaqueous working-chamber built in place comprising sheeting walls and removable roof.

3. A subaqueous working-chamber inclosing the space within which work is to be done, comprising sectional walls, the sections being severally put in place to the depth to which earth is to be excavated, and a roof seated thereon.

4. A subaqueous working-chamber built in place and inclosing the space in which work is to be carried on, comprising sectional walls driven into the earth beneath said chamber and a roof arranged thereon and held in place by gravity.

5. In subaqueous building construction in combination, a submerged working-chamber comprising sheeting walls driven into the earth beneath, and a roof seated upon the same, and means for supplying air under pressure to said chamber to transmit the pressure of the superincumbent water to the side walls and bottom of said chamber.

6. In subaqueous construction, the combination with sheeting walls of an intermediate bracing structure, supporting-piles therefor and a roof seated upon the top of the sheeting and piles.

7. In subaqueous tunnel construction, the combination of the sheeting walls and the roof seated upon the top of the same, and having means for engaging with the tops of the sheeting to seal the joints, and to secure the roof in place thereon.

8. In subaqueous tunnel construction, the combination with the sheeting walls, the intermediate bracing structure and the intermediate piles, of a roof seated upon the top of the sheeting and supported upon the same and upon said piles, substantially as and for the purposes specified.

9. A fixed subaqueous working-chamber for the purpose specified, the walls of which are situated around and above the site to be excavated.

10. A fixed subaqueous working-chamber, the walls of which are seated on bed-rock, or extend at least deep enough into the earth to prevent lateral inflow at the extreme depth of excavation.

11. The method of constructing a tunnel under water, consisting in erecting vertical walls around the site extending to bed-rock or below the bottom of the proposed tunnel, then placing a roof thereon to form therewith a chamber, then forcing air into said chamber and expelling the water therefrom, and then constructing the tunnel in place therein.

12. The method of excavating and erecting structures in the excavated space under water, consisting first in inserting sectional walls into the earth to the depth to which it is to be excavated and surrounding the space within which the work is to be performed, then seating a roof thereon, then forcing air into the chamber so formed and expelling the water therefrom, then excavating and removing the requisite amount of material and building the structure in place thereof.

13. The method of excavating and building under water, consisting in first driving sectional walls into the material to be excavated to the depth to which it is to be removed and inclosing the space in which the work is to be done, then seating a roof thereon, then unwatering the chamber thus formed, then forcing air thereinto under pressure, and then

excavating and removing the material and building the structure in place thereof while maintaining such air-pressure.

14. The method of building concrete structures under water, consisting in first driving wooden sheetings into the earth to a depth equal to that to which it is to be excavated, so as to form walls surrounding the space within which work is to be performed, then cutting off said walls in a plane above the top of the structure to be built, then seating a roof upon said walls, then forcing air into the chamber so formed and expelling the water therefrom, then excavating the earth and erecting the structure in place thereof while maintaining the air-pressure therein.

Signed at New York city this 4th day of May, 1903.

DUNCAN D. McBEAN.

Witnesses:
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J. T. CRANE.