G. A. M. LILJENCRANTZ.

CONCRETE CONSTRUCTION AND METHOD OF PRODUCING THE SAME.

APPLICATION FILED AUG. 22, 1908.

925,204. Patented June 15, 1909.

3 SHEETS—SHEET 1.

Fig. 2.

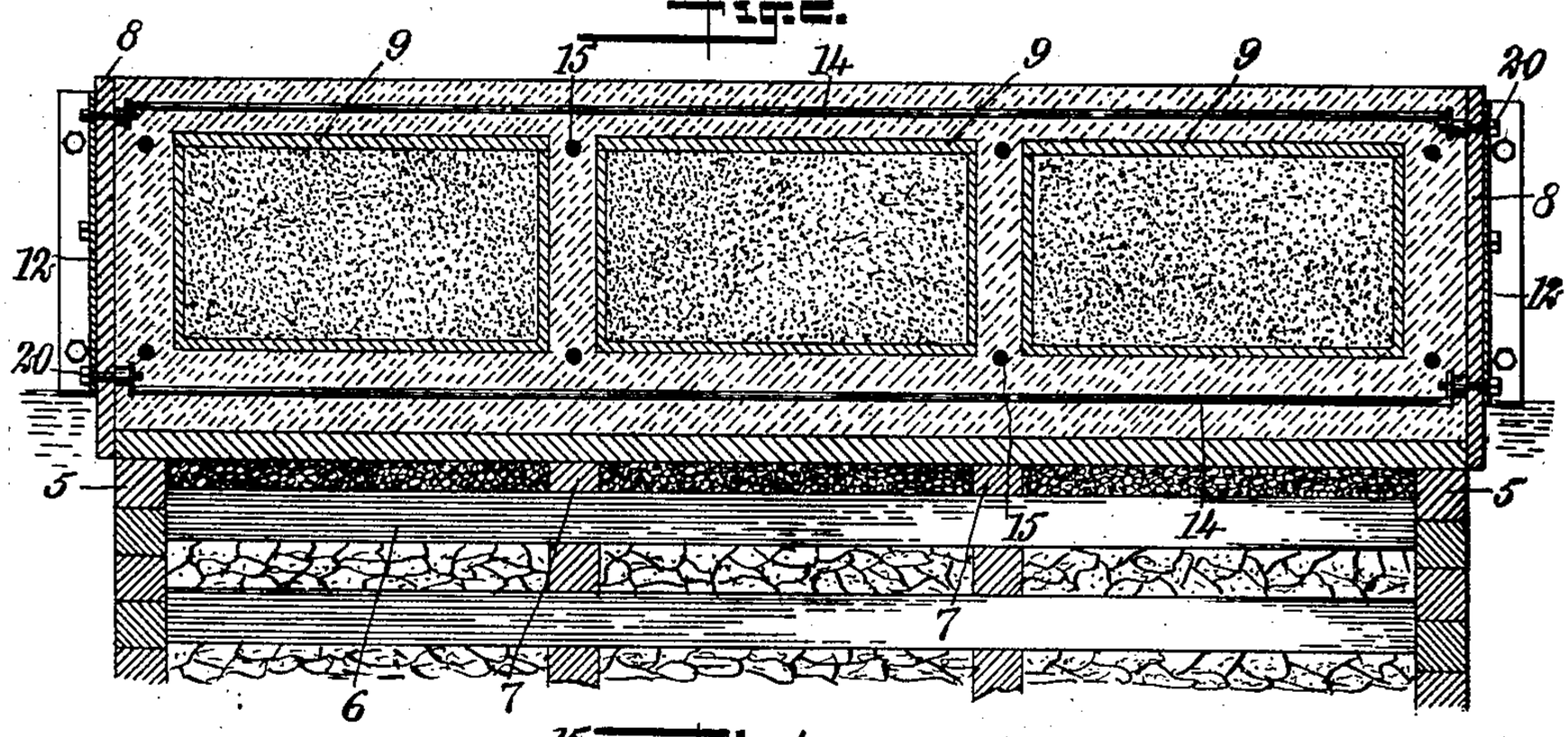
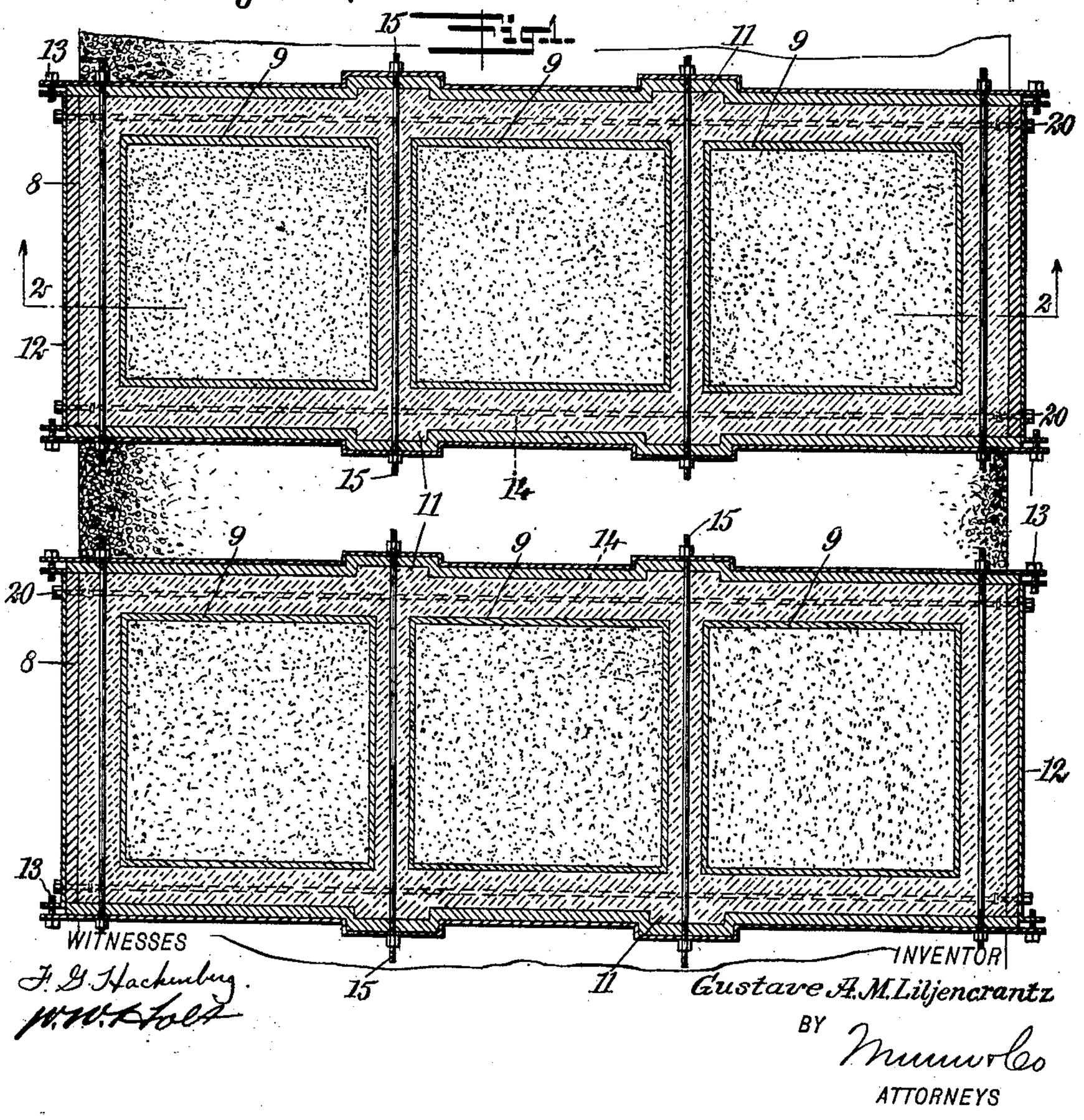


Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 4.

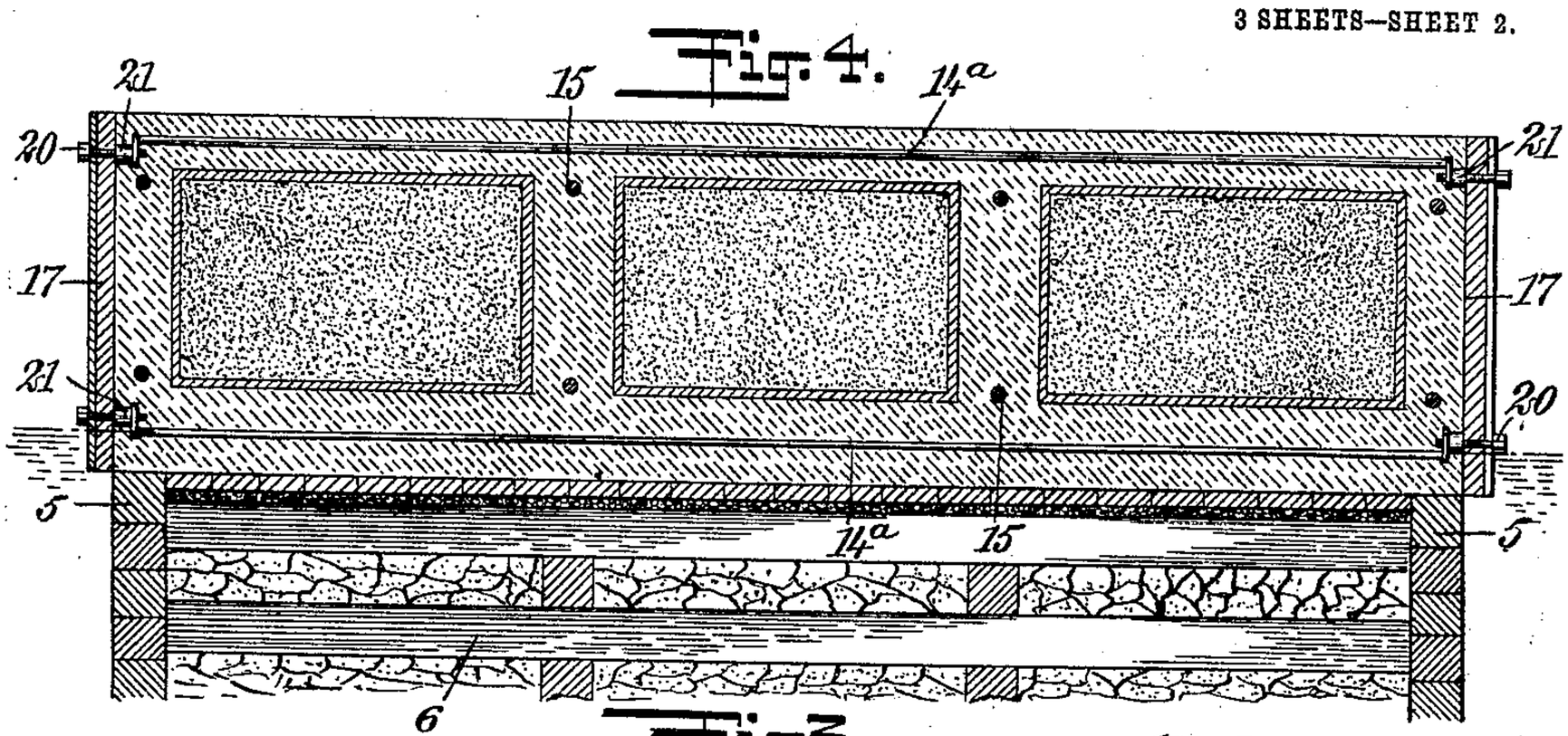
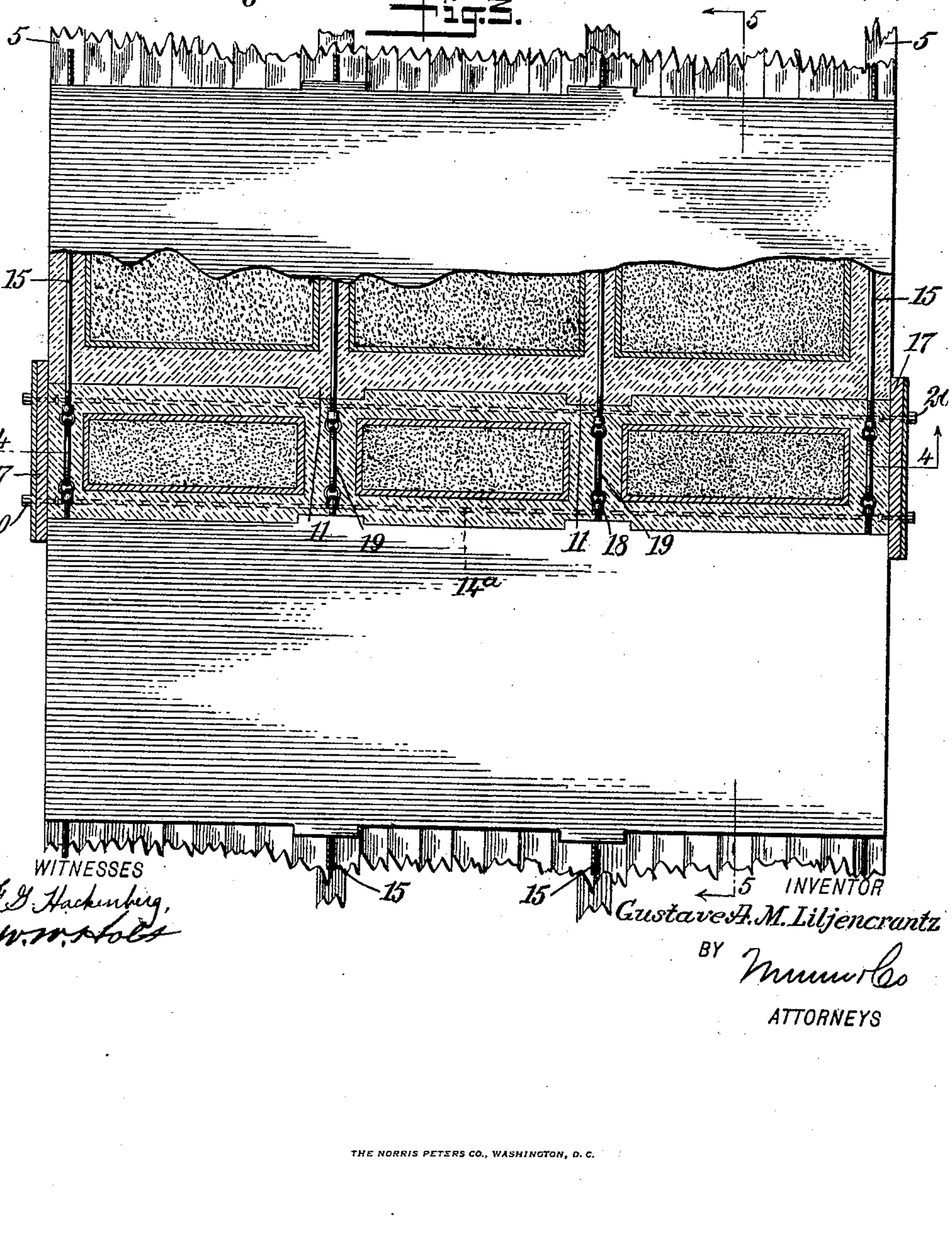


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 5.

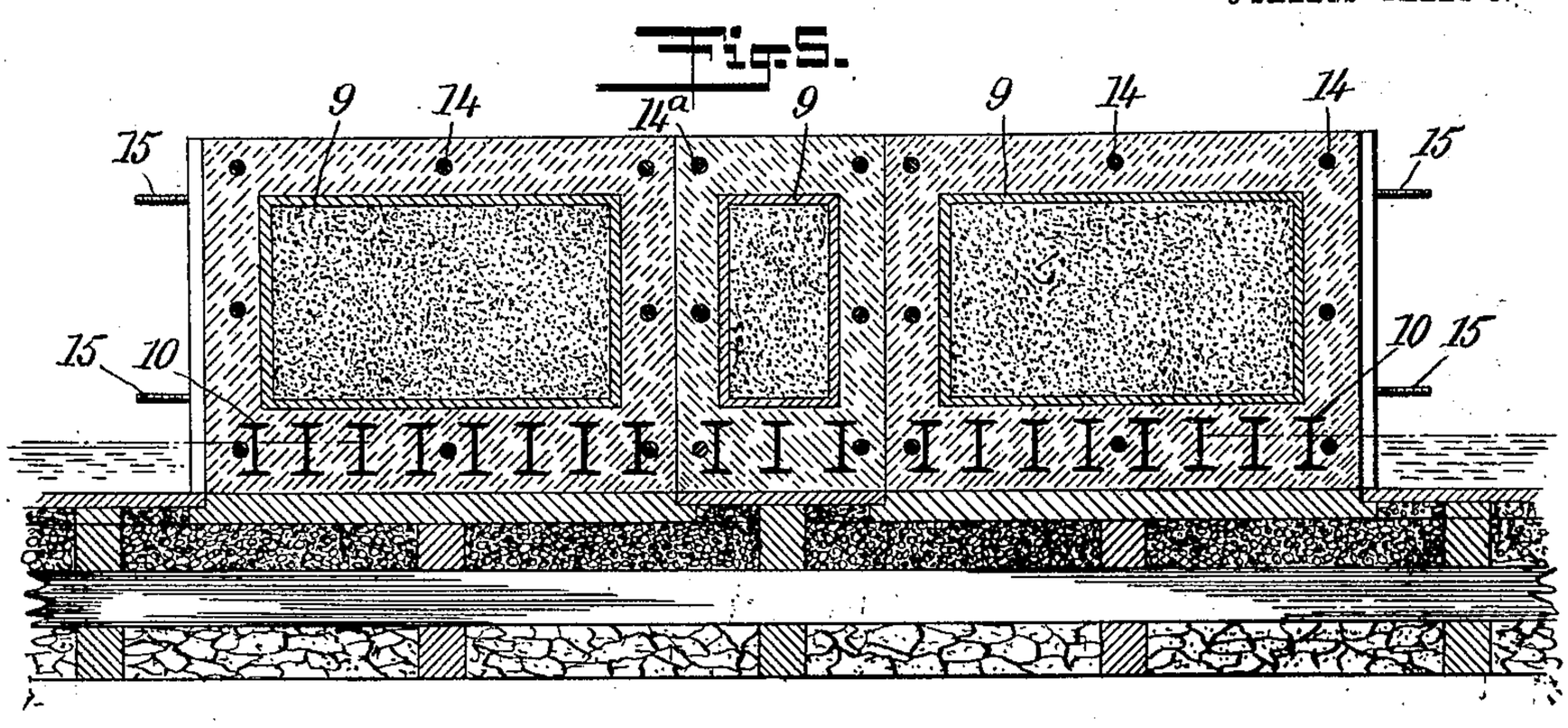


Fig. 6.

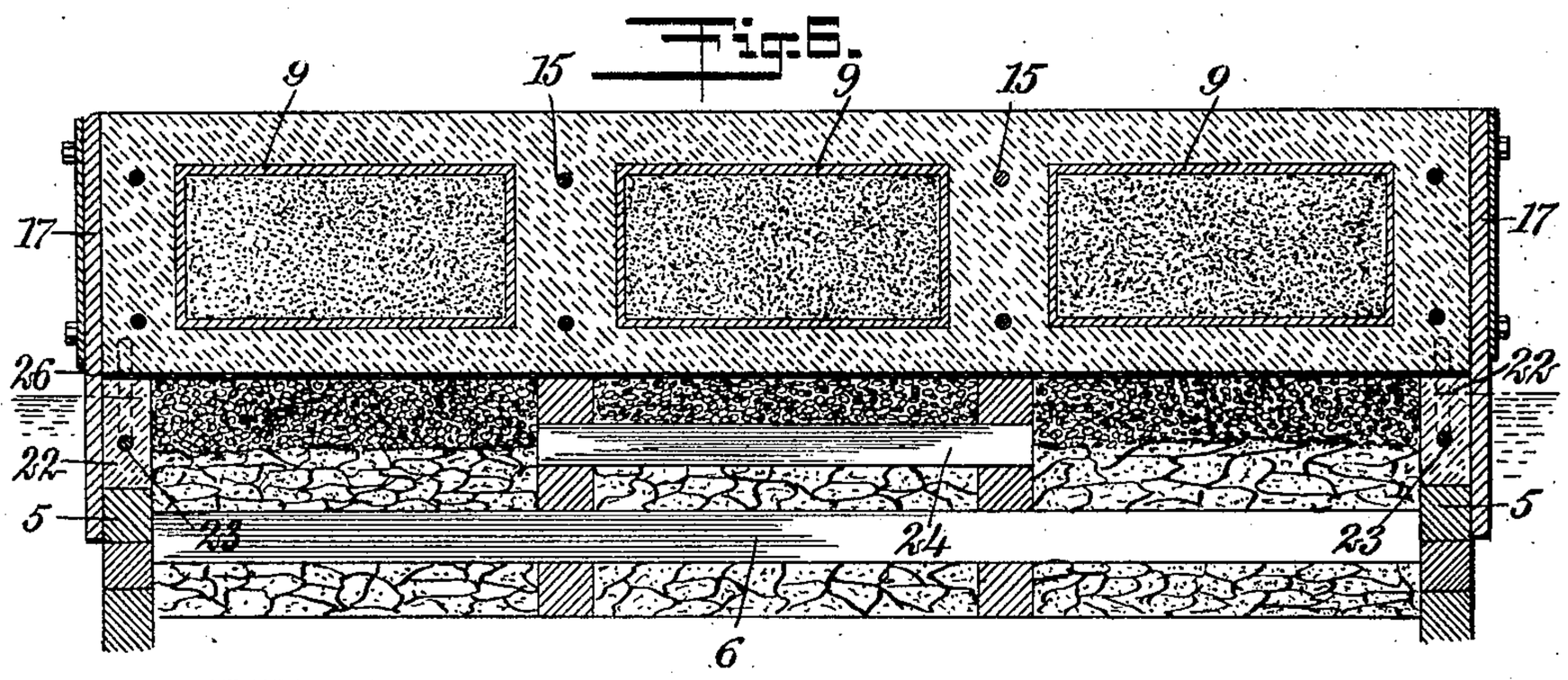


Fig. 7.

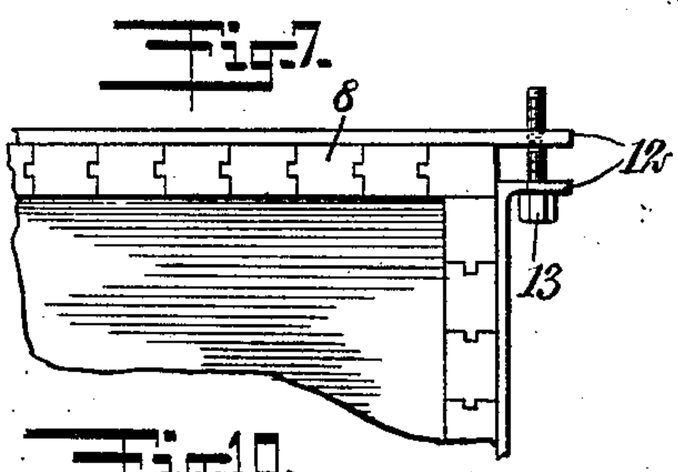


Fig. 8.

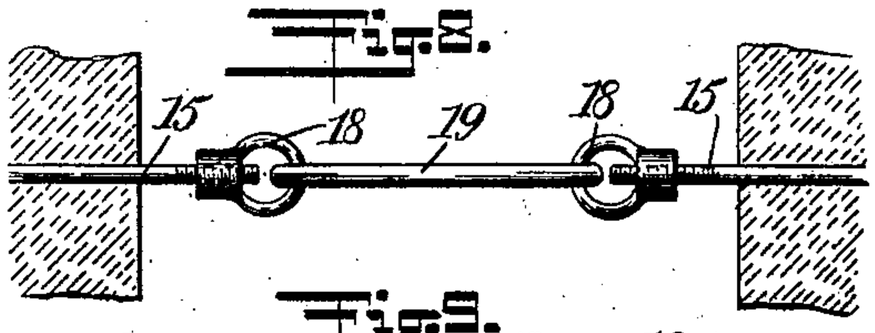


Fig. 9.

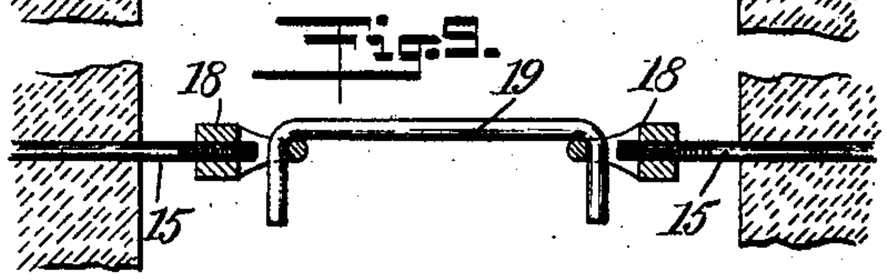


Fig. 10.

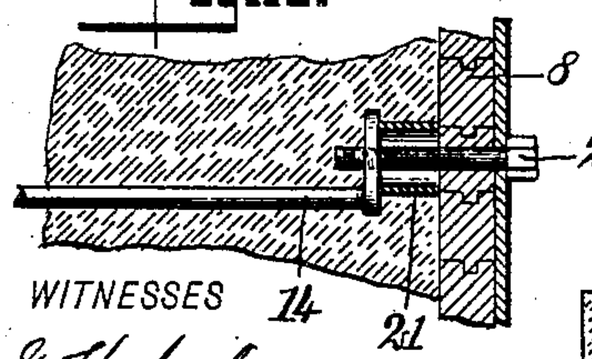
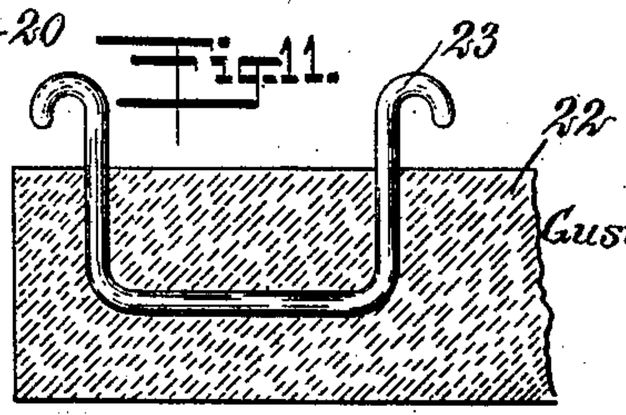


Fig. 11.



WITNESSES

F. G. Hackenberg

W. W. Cole

INVENTOR

Gustave A. M. Liljencrantz

BY Munn & Co.

ATTORNEYS

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

GUSTAVE A. M. LILJENCRANTZ, OF CHICAGO, ILLINOIS.

CONCRETE CONSTRUCTION AND METHOD OF PRODUCING THE SAME.

No. 925,204. Specification of Letters Patent. Patented June 15, 1909.

Application filed August 22, 1908. Serial No. 449,812.

To all whom it may concern:

Be it known that I, GUSTAVE A. M. LILJENCRANTZ, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented a new and Improved Concrete Construction and Method of Producing the Same, of which the following is a full, clear, and exact description.

The invention consists in a general way in the formation of large concrete blocks at intervals crosswise of the structure to be produced, and connecting these blocks, as also their reinforcing, by intermediate blocks of approximately like construction, each block being constructed within a box form having a number of cell boxes which are placed therein, spaced from each other and from the walls of the principal box or form, and filled with sand, rock or other cheap material at the same time the spaces thereabout at the outside are filled with concrete. When the concrete reaches the tops of the cell boxes the latter are covered and the concrete carried a suitable distance thereabove, thus producing absolute monoliths.

Blocks made in accordance with my process may be used in the construction of new superstructures over cribs sunk to the proper height; for rebuilding superstructures over old crib work; for new pier work or docks, in which case large blocks should be placed on a pile foundation sawed off at a suitable height; for docks in lakes or rivers where the bottom consists of solid rock; for bridge abutments or intermediate piers; for retaining walls, dams and other bulky, heavy structures where the cross-section and base must be of considerable magnitude and would consequently make the work very expensive if of solid concrete.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a sectional plan of my improved concrete construction at an intermediate stage of the process; Fig. 2 is a section on the line 2—2 of Fig. 1, looking in the direction of the arrows; Fig. 3 is a plan of the construction, partly in section, at an advanced stage of the process; Fig. 4 is a cross-section of the same substantially on the line 4—4 of Fig. 3; Fig. 5 is a longitudinal section of the structure on the line 5—5 of Fig. 3; Fig. 6 illustrates the construction of the intermediate blocks when it is preferred to keep the sea water out of the concrete during the period of setting; Fig. 7 is a fragmentary plan of one of the outer box forms; Figs. 8 and 9 are sectional views illustrating the manner of connecting the reinforcing of the initially formed blocks preparatory to forming the intermediate connecting blocks of the structure; Fig. 10 is a sectional view illustrating the connection of the side walls of the form with the transverse tie-rods; and Fig. 11 is a longitudinal section through one of the concrete blocks used below the normal water level in constructing the foundation for the intermediate blocks, as in Fig. 6.

For all structures built on concrete, as retaining walls, etc., the construction will be very simple and will be readily understood from the following detail description, which covers that for the building of pier superstructures. These have been especially selected for a more minute description, because having to be built in part below water level it requires special treatment in several respects.

The hitherto adopted method of building new concrete superstructures over old crib work, consisted in brief in the removing of the old timber work to one or two feet below low water, to form thereon a timber foundation suitable to support the concrete blocks of sufficient height to bring their top surfaces above the average high water mark; by connecting these blocks on opposite sides of the pier by means of anchor or tie-rods; filling the spaces between them with concrete, and finally constructing the upper part on the foundation so formed according to some adopted design. This manner of procedure requires much of the lower work to be done below two, three or more feet of water, which is necessarily costly and slow.

The construction in accordance with my invention is as follows: After the old crib work, and protruding drift bolts, have been removed to the desired elevation, generally about one foot below low water, where the timber may be considered as always wet and, therefore, not liable to rot, and it is found that the tops of the side timbers 5, 5, are in a horizontal plane, there is nothing further required in forming the foundation than the placing lengthwise of the pier, and resting on the top cross-ties 6, in one or more rows, as may be deemed necessary for the support

of the large forms with their concrete filling, timbers 7, with their upper surfaces in the same horizontal plane as those of the side timbers 5. Should there be any notable difference in elevation between the side timbers on opposite sides of the pier, this may be remedied by shimming. A slight difference, however, may be ignored, as the top of the concrete can be given absolutely the desired elevation when formed, as will hereinafter appear. The foundation being thus secured, the spaces between the side timbers and supports respectively should be filled as near as practical to the height of the tops of these timbers, when all is in readiness for placing the forms thereon. These forms or boxes are of two kinds, first, the large boxes 8, and, second, the smaller boxes 9, which, for the purpose of convenience, I will term respectively, the block forms and the cell boxes. The outer or block form determines the outside dimensions of the finished concrete block, and the cell boxes the dimensions of the cells or openings in the concrete mass.

The block forms 9 are preferably constructed of sound and merchantable lumber. As the lower part is to be submerged some two or three feet below the water level, that much of the box must be made water-tight or at least substantially so. For this reason they should be made from matched lumber of a thickness to give them sufficient strength to resist the pressure of the concrete filling when in a plastic condition before its setting, and the seams should be calked, if required. The bottom of the block form must also be made strong enough to carry the weight of the concrete before the setting of the latter, although the supporting timbers 7 decrease this requirement materially, and after the concrete has set, the bottom of each block form will in itself have all necessary strength to be supported by the side timbers alone by reason of I-beams 10 or other suitable reinforcing, arranged transversely of the structure to be produced.

The ends of the block forms which are to shape the sides of the superstructures will be detachably connected or nailed to the bottom of the form, and must have the inner side smooth to give the concrete a finished surface. The sides of these forms are also made detachable but need not have smooth surfaces except at the joints. In the construction of these sides they are made to form buttresses 11, as best shown in Fig. 1, which are located at two or more places at each side of the finished concrete block, to insure a better connection between intermediate blocks and provide against any tendency of the connecting blocks being disturbed by heavy wave motion against the pier. After the four side walls of the block form are in their proper positions they are secured together by as many iron bands 12 (see Figs. 1 and 2) as may be necessary. These bands are fastened together at the corners by bolts 13. The bands are provided with holes at suitable points, through which pass tie-rods 14 and 15, respectively arranged crosswise and lengthwise of the pier, and designed to hold the opposite sides of the forms together, and also reinforce the finished construction. The inside length of the block form is made equal to the width of the crib, as that dimension will determine the width of the new superstructure, the width of the form depending upon the size of form that can be conveniently handled with a derrick. Thus, for a pier of comparatively small width, the form may be larger than for a pier of larger width, and vice versa.

The cell boxes 9 are preferably made of the cheapest kind of lumber, and since they are generally uniform in shape and dimensions, this lumber may be cut to order in the mills to the required size and afterward nailed together, thus diminishing the cost of manufacture in so far as practicable. In order that the cell boxes may be sufficiently strong to resist the pressure of the concrete before it sets, they may be braced on the inside, or, more generally, filled with sand, slag, riprap, or any other heavy cheap material, simultaneously with the placing of the concrete in the spaces formed between them and the block form, maintaining both the filling of the cell boxes and the concrete at the same level during the process of construction. The cell boxes should also be such as not to absorb water from the concrete, which condition is insured by coating the wood with paraffin, asphaltine or the like.

In placing the block forms in position, they should be so arranged that the ends at the inside are in exact line with the proposed site of the finished concrete superstructure. I-beams 10 or other suitable reinforcing (see Fig. 5) are then placed in the bottom of the box, extending from side to side, and after concrete has been filled in sufficiently to cover them, the cell boxes, with their tops open, are properly located between the longitudinal and transverse tie-bars. The filling of these boxes and of the outlying spaces, then simultaneously proceeds until the tops of the cell boxes are reached, when the covers are applied and the concrete continued over as well as around them until the desired crown is attained. Thus the whole height of the superstructure from the base to the crown is formed by a continuous operation, and will constitute, when finished, a perfect monolith. If the side timbers 5 of the foundation do not lie in a horizontal plane, this inequality is compensated for when the top of the superstructure is reached, which can be given any desired finish either with a crown along the

middle or sloped in either direction, etc. In locating the succession of block forms they must be placed sufficiently far apart to permit of the removal of the detachable sides. If this distance is just large enough for the purpose, and the intervening space is filled with solid concrete, it will make the wall unnecessarily heavy. It is, therefore, deemed better to make the space large enough to place the cell boxes in, as shown in Figs. 3 and 5, and proceed with the filling in a similar manner as for the initial blocks, after the forms for producing the walls at the sides have been placed in position, as indicated in Fig. 3.

In connecting the initially formed blocks with the intermediate blocks, after the former have been made and had sufficient time to set, the sides of the block forms are removed to make room for the special end forms 17 (see Fig. 3), which are held in place by means of tie-bars 14ª, which, in construction, are the same or similar to the tie-bars 14. The end forms 17 should reach below the side timbers. In removing the side walls of the block forms, the nuts are taken off the tie-bars 15 and the bolts 13 removed, at which time the side walls may be slipped from the concrete. The threaded ends of the bolts are then connected with a turn-buckle, preferably as illustrated in Figs. 8 and 9, this buckle consisting of eye-nuts 18 and a connecting link 19, the link being applied after each eye-nut has been threaded to the proper position. These connections will form a strong reinforcement when surrounded with the concrete.

It will be observed from Fig. 10 that the tie-bars 14 instead of being in the nature of a continuous rod, at each end are provided with a foot in which is threaded the bolt 20 passed through the end wall of the block form, the ends of the tie-bar proper being spaced from the end wall by a thimble 21, and when the bolt and wall are detached, the hole in the concrete produced by the thimble can be filled up with a thick wet mixture of cement and sand, which will prevent the rust marks usually left upon the concrete after the iron bolts have been cut off at the surface.

The formation of the foundation for the concrete between the initially finished blocks may be made by either of the following methods: The first is illustrated in Fig. 4, wherein the water surface in this space may be reached some two feet or more above the upper tie of the sub-construction which forms the main support for the concrete work. This construction is preferable where the placing of the concrete directly in the water is not objectionable, in which case the flooring is formed resting on the cross-ties and crib filling and the concrete placed over this until it reaches above the water level. After the I-beams 10 have been placed in position the cell boxes are then properly located and the filling proceeded with, as described for the initially formed blocks. If the placing of the concrete in the water is objectionable then the construction may be carried out in the manner shown in Fig. 6. This involves the use of two concrete blocks 22, as shown in Fig. 11, equal in length to the space between the two finished concrete sections, and having a width equal to that of the side timbers of the crib, the height of the blocks being about equal to the height of the water level above the top of the side timbers. For each block 22 is provided a U-shaped hanger 23 having hooked extremities which serve the double purpose of convenience in handling and placing by means of a derrick, and, further, to make a strong connection with the mass of concrete placed about and above them. In this construction an intermediate support will be provided in the nature of timbers 24. When the two concrete side blocks and the timbers referred to are in place, the regular stone filling of the crib should be built up equal to the height of the blocks and the side timbers, then covered with small stone and gravel, as is done for the whole foundation. Over this gravel is placed a covering of burlap 26. The building of the superstructure proceeds when the intermediate connecting blocks or sections of the pier are completed. The forms 17 are removed in the same manner as the end walls of the block forms.

The process of construction as herein described is comparatively cheap, embodies simplicity, and permits of increasing or decreasing the strength of the structure, as desired, according to the requirements under different conditions, by means of the cell boxes. By making these boxes smaller, the concrete walls will be larger and consequently stronger. By constructing a greater number of cell boxes there will be a greater number of cross walls, also adding to the strength of the structure. The cell boxes may be placed in several layers, thus adding one or more horizontal walls and accordingly increasing the strength, as, for example, in high retaining walls.

By the term "pier" in the appended claims, I mean to include docks, wharves, break-waters and similar structures.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. The herein-described process of constructing the superstructure of a pier over crib work, which consists in filling in the substructure with ballast to a point slightly below low water level to provide a foundation, arranging on this foundation in spaced relation a succession of approximately

water-tight box forms each having cell boxes, filling in the spaces between the cell boxes and forms with concrete, removing the walls of the forms after the concrete has set, and joining the blocks produced to concrete blocks of like construction.

2. A pier having a superstructure composed of a series of cellular concrete sections arranged cross-wise of the pier and connected together.

3. The herein-described process of constructing the superstructure of a pier, which consists in arranging on the foundation of the pier, in spaced relation, a succession of box forms each having cell boxes, filling in the forms around the boxes with concrete, removing the walls of the forms and joining the blocks produced to concrete blocks of like construction.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GUSTAVE A. M. LILJENCRANTZ.

Witnesses:

JAMES J. REYNOLDS,

H. E. MARSHALL.