No. 782,383. PATENTED FEB. 14, 1905.

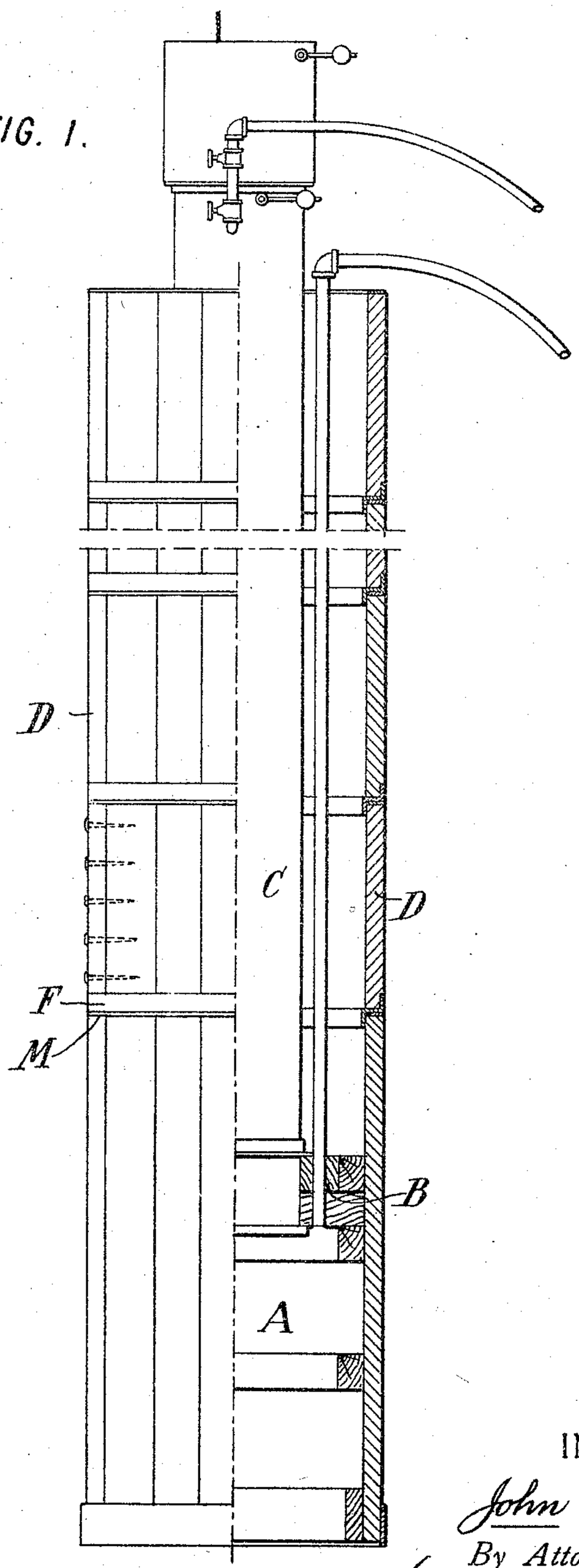
J. W. DOTY.

CAISSON OR COFFER-DAM.

APPLICATION FILED JULY 2, 1904.

4 SHEETS—SHEET 1.

FIG. 1.



WITNESSES:
Fred Whitg
René Bruine

INVENTOR:
John W. Doty,
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4 SHEETS—SHEET 2.

FIG. 2.

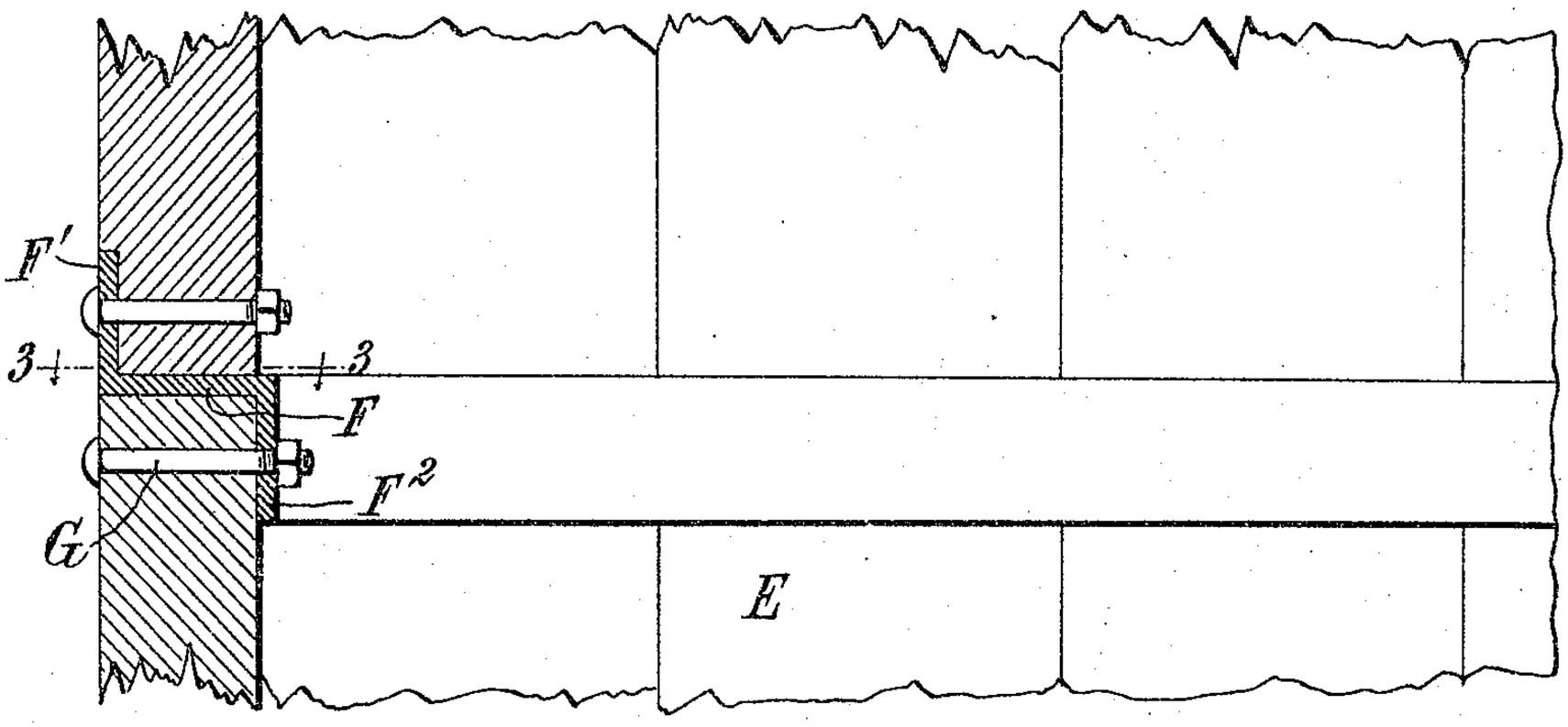


FIG. 3.

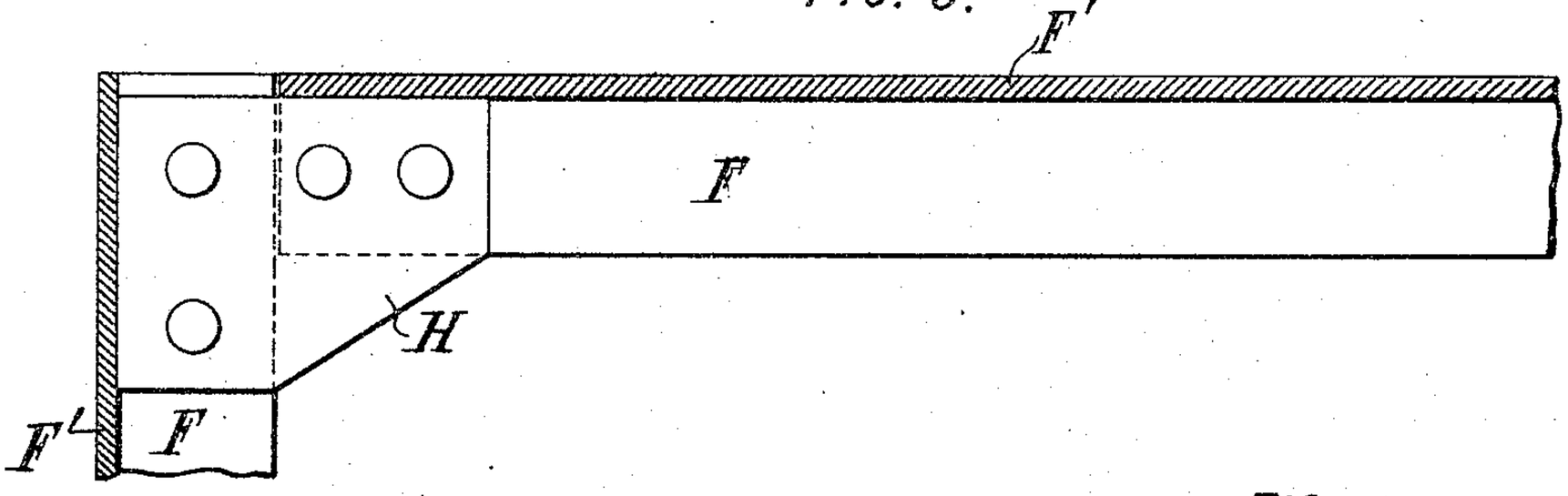


FIG. 4.

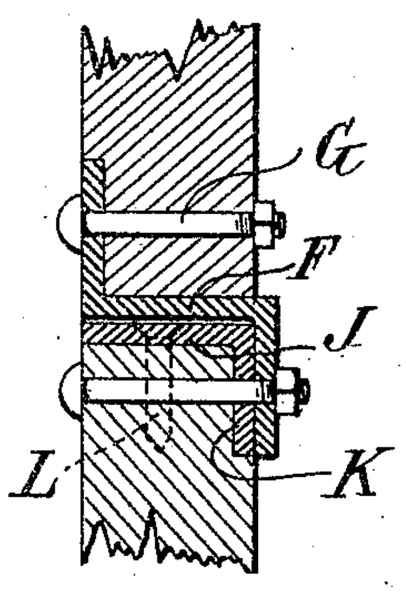


FIG. 5.

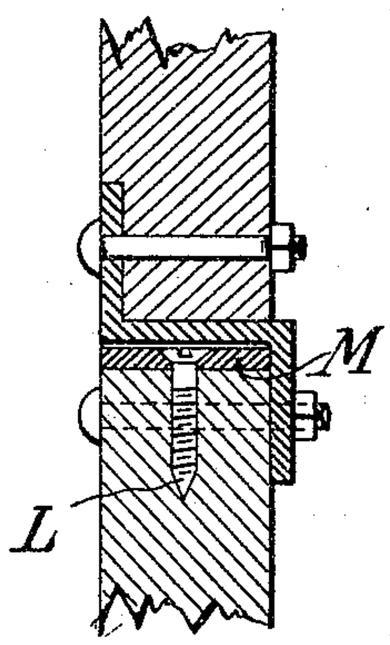
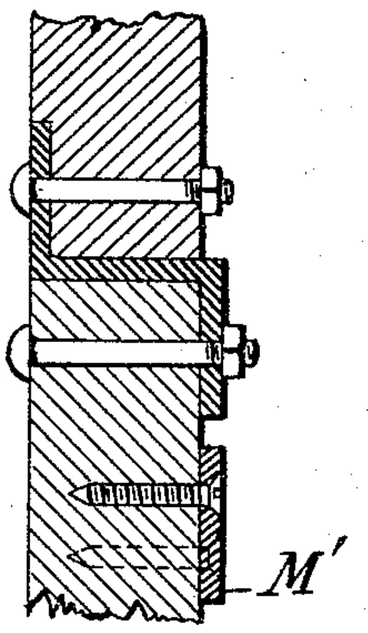


FIG. 6.



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4 SHEETS—SHEET 3.

FIG. 7.

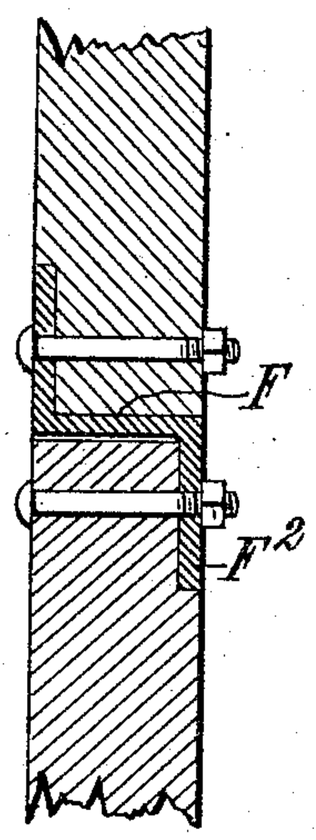


FIG. 8.

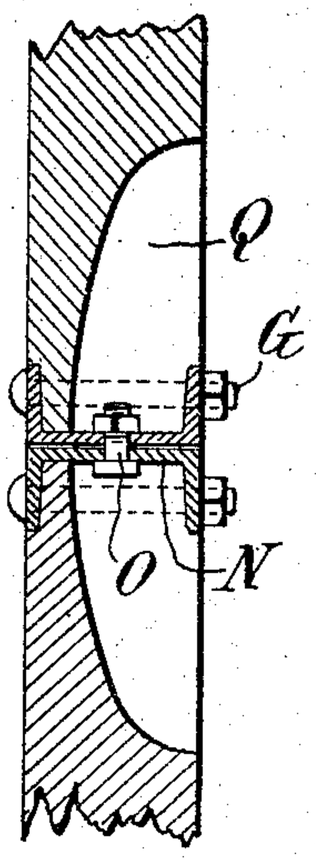


FIG. 9.

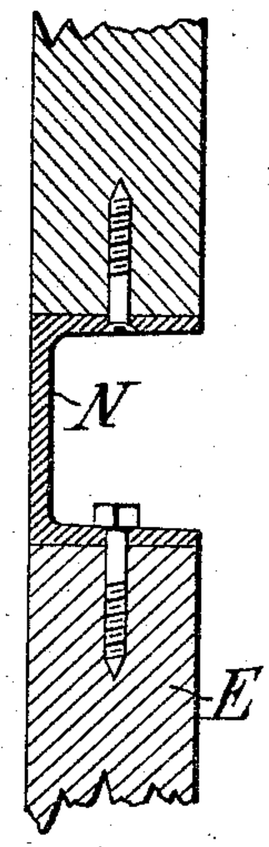


FIG. 10.

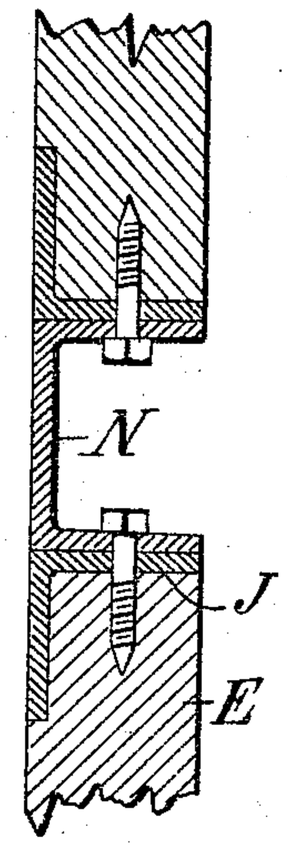


FIG. 11.

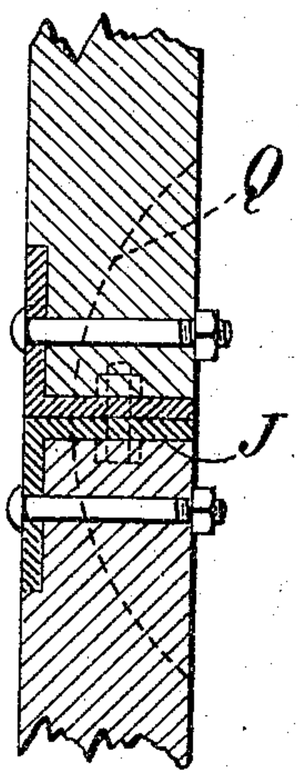


FIG. 12.

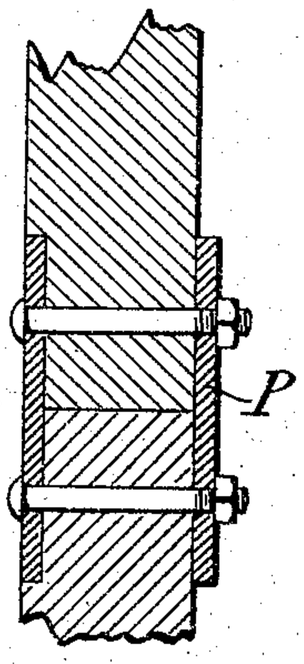


FIG. 13.

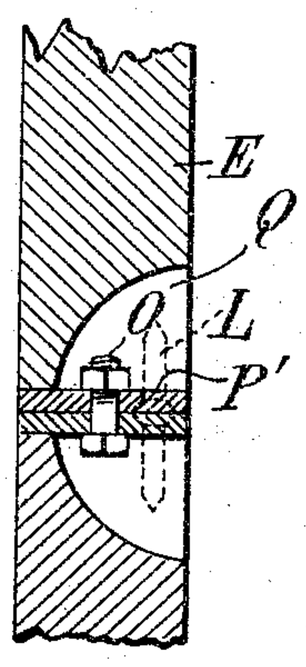


FIG. 14.

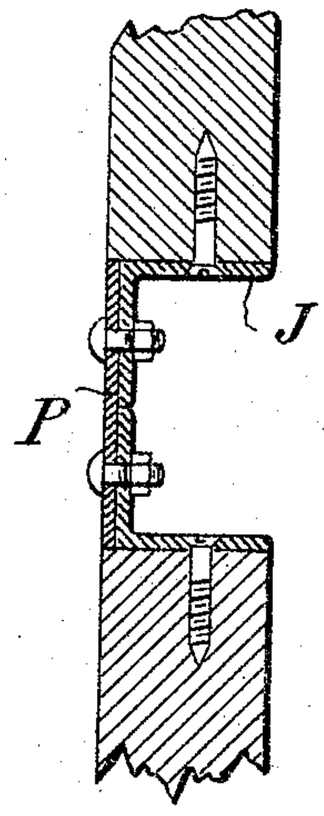
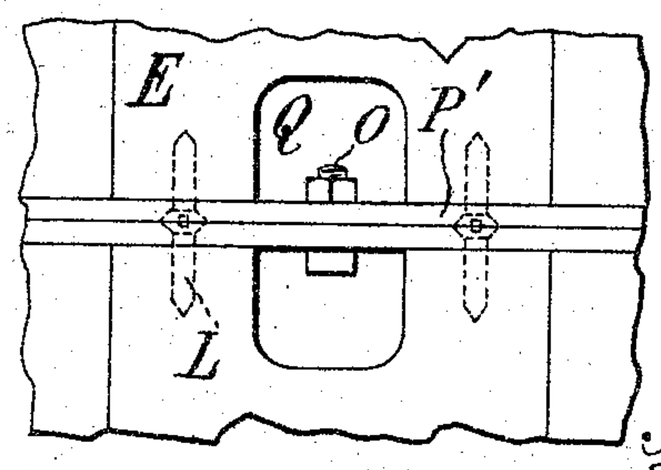


FIG. 15.



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4 SHEETS—SHEET 4.

FIG. 16.

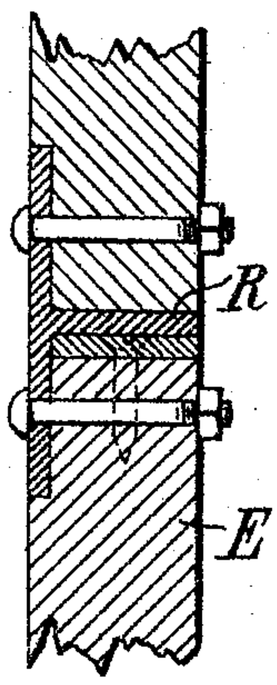


FIG. 17.

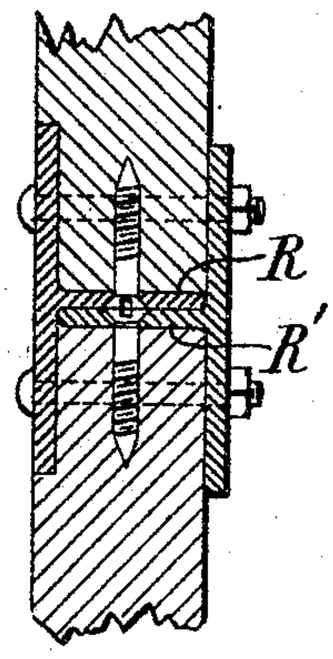


FIG. 18.

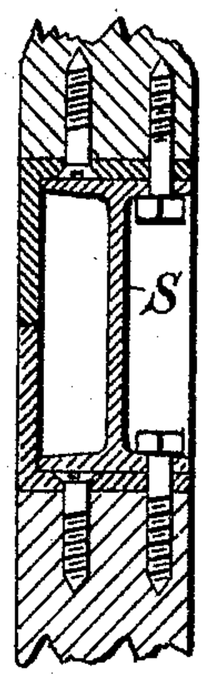
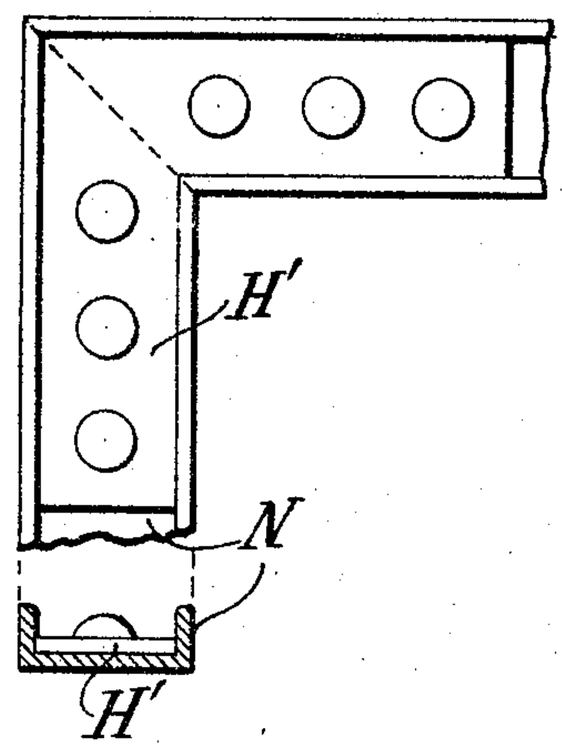


FIG. 21.



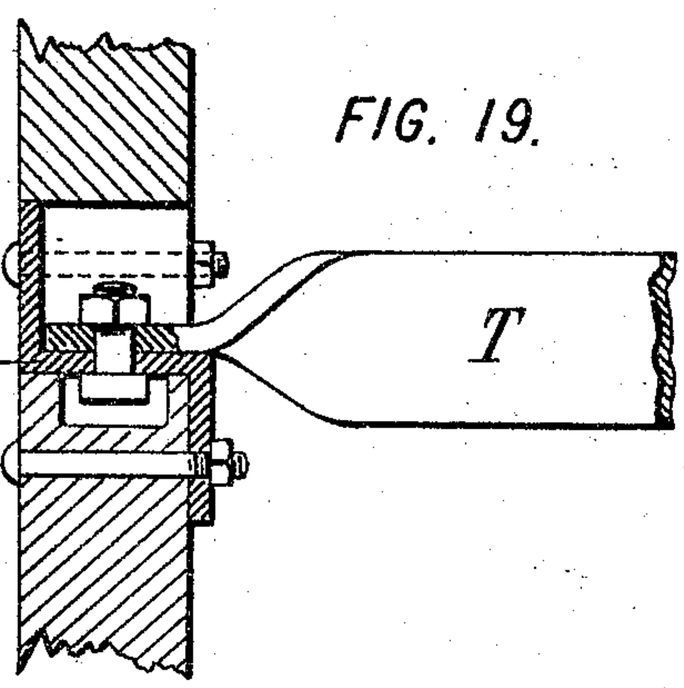


FIG. 19.

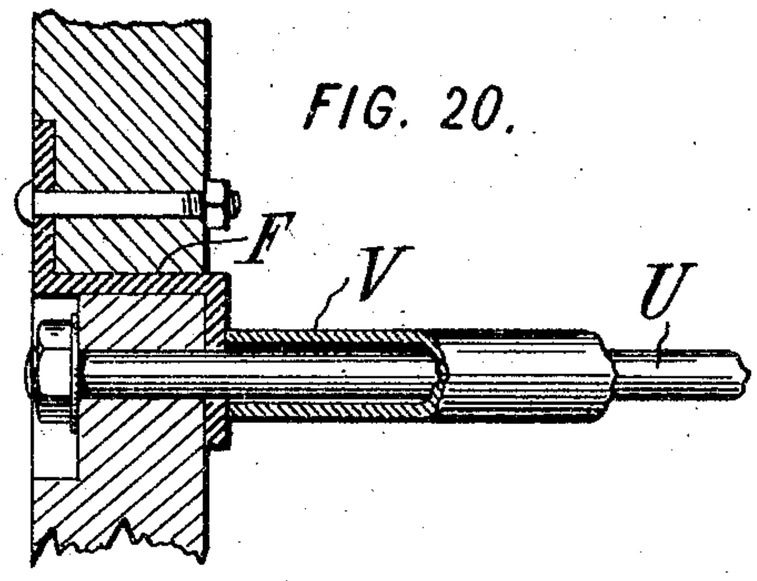
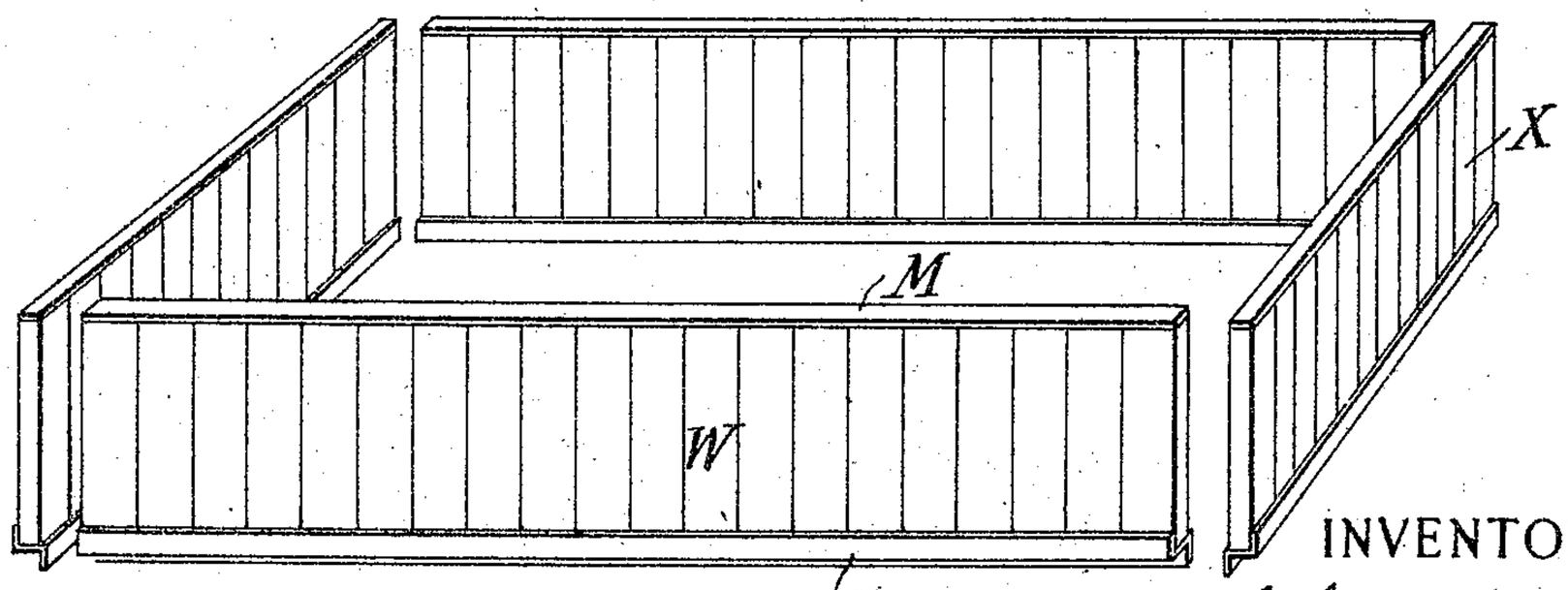


FIG. 20.

FIG. 22.



WITNESSES:
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René Bruine

INVENTOR:
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By Attorneys,
Arthur C. Fraser & Co

No. 782,383. Patented February 14, 1905.

UNITED STATES PATENT OFFICE.

JOHN W. DOTY, OF NEW YORK, N. Y.

CAISSON OR COFFER-DAM.

SPECIFICATION forming part of Letters Patent No. 782,383, dated February 14, 1905.

Application filed July 2, 1904. Serial No. 215,055.

To all whom it may concern:

Be it known that I, JOHN W. DOTY, a subject of the King of Great Britain, residing in the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Caissons or Coffer-Dams, of which the following is a specification.

This invention aims to provide certain improvements in the arrangement of the strengthening and stiffening members of coffer-dams, and especially of the type of coffer-dams now commonly used in sinking pneumatic foundations composed of vertical wooden staves and horizontal stiffeners of angle-iron or other shapes. It is common to stiffen the sides of the coffer-dam by means of angle-irons arranged horizontally along the inner faces of the wooden staves with one web of the angle-iron extending three inches, or thereabout, into the interior of the coffer-dam. A number of these stiffeners are used at intervals of from four to eight feet along the height of the wall. It is well understood when the caisson has been sunk to the required depth it, as well as the coffer-dam above it, is filled with concrete, which forms a foundation-pier for the building. Ordinarily the concrete is estimated as having the same cross-sectional dimensions as the interior of the coffer-dam; but it will be observed that with the inwardly-projecting stiffening-angles forming grooves three inches or more deep entirely around the concrete and at comparatively frequent intervals in its height the effective cross-section of the concrete column is reduced by six inches or more in each direction. It is necessary, therefore, to make the excavation six inches or more greater in each horizontal direction in order to get the effective cross-section of column desired and at the same time to fill in a great quantity of concrete lying between the successive stiffening-angles and having little or no value as a support for the load. These two items represent a large outlay on a job of any considerable size.

According to the present invention it is proposed to form the coffer-dam with a substantially smooth inner face, so that there shall be substantially no ineffective concrete within it. Preferably also the outside face of the coffer-dam is substantially smooth to facilitate sinking the same and to avoid any unnecessary excavation. At the same time the walls of the coffer-dam are stiffened by angles or other stiffeners extending transversely to the principal members, these stiffeners being preferably embedded in the wall of the coffer-dam, so as to be out of the way. With this construction the horizontal portion of the stiffener, which is the most effective portion, may be of any dimension up to a little more than the thickness of the wall. At the same time it is proposed to utilize these stiffeners in connecting successive rings or sections of the coffer-dam to each other.

The invention provides also other improvements referred to in detail hereinafter.

The accompanying drawings illustrate embodiments of the invention.

Figure 1 is an elevation, partly in section, of a pneumatic caisson with a wooden coffer-dam. Fig. 2 is a vertical section of a portion of a coffer-dam formed with vertical wooden staves and in which a Z-bar is used as a stiffener and as a means for forming a horizontal joint between two rings or sections. Fig. 3 is a section of Fig. 2 approximately on the plane 3 3. Figs. 4 to 14, inclusive, are vertical sections of various other stiffeners embodying the invention. Fig. 15 is a face elevation of Fig. 13. Figs. 16 to 20, inclusive, are vertical sections of other forms of stiffener. Fig. 21 is a plan of a corner-joint with the stiffener of Fig. 8. Fig. 22 is a perspective view showing the preferred method of constructing the caisson.

Referring to the embodiment illustrated, A is the working chamber formed with a roof B, through which passes the shaft C for carrying men and materials to or from the working chamber or for supplying compressed air. Carried upon the roof of the working chamber and extending upward to the surface is the coffer-dam, which I designate as a whole by the letter D, which serves to keep back earth or mud and which after the required depth has been reached is, like the working chamber and the central shaft, filled with concrete to form the finished pier. The coffer-dam is formed in several horizontal sections,

each of which is composed of a number of vertical staves E. Extending horizontally between the successive sections are stiffeners consisting of Z-bars F, with a horizontal web, an outer vertical flange F′, and an inner vertical flange F^2, the outer flange overlapping the outer face of an upper section of the wall and the lower flange overlapping the inner face of the adjacent lower section. By means of bolts G the wall-sections are connected to the flanges of the stiffener, and therefore to each other. Preferably the bolts are rounded on the outer end, and the flange F′ is countersunk within the wall, so as to provide a very smooth outer face to facilitate the sinking of the coffer-dam. The slight projection of the bolts and nuts within the wall and the comparatively slight thickness of the flange F^2 of the stiffener are not important; but these parts may also be countersunk, if desired. The connections at the corners may be made in a variety of ways—as, for example, by means of a gusset-plate H, Fig. 3, riveted or bolted to the abutting ends of the stiffeners F. The staves are first connected together to form horizontal tiers of the caisson, and then these tiers are connected one upon another as the caisson is sunk. Where it is desired to connect together the ends of the staves opposite the stiffener, so as to facilitate handling the tier of staves, this may be done by a separate connecting device—such, for example, as the angle-plate J, shown in Fig. 4 and having a horizontal web and a vertical flange K, which serve in a finished structure similar functions to the horizontal web and vertical flanges of the principal stiffener F. The angle-iron, for example, may be fastened to each of the staves by means of screws L or spikes, or, as shown in Fig. 5, the connection between the ends of the staves may be made by a simple flat plate M, extending along the ends of the staves and screwed thereto or by a similar plate M′, Fig. 6, screwed along the inner face near the ends of the staves.

Figs. 7 to 18 illustrate a number of modifications, each of which in turn is but typical of many more variations which may be made upon the broad idea. Fig. 7 shows a Z-bar F similar to that of Fig. 1, but with its inner flange F^2 countersunk within the face of the staves. Fig. 8 illustrates the use of channels N as stiffeners, these being connected to each other by means of a bolt O and set upon the ends of the staves and bolted thereto by bolts G. Fig. 9 illustrates a single channel N with its flanges horizontal and its web vertical, the flanges being connected by either screws or bolts, as desired, upon the ends of the staves E. Fig. 10 illustrates an extension of the same idea, the ends of the staves being first held together by means of angles J and being then connected through the intermediate channel N. Fig. 11 illustrates a simple construction in which angles J are connected together and extended along the ends of the staves. Fig. 12 illustrates the use of plates P, arranged vertically, while Fig. 13 shows similar plates P′, arranged horizontally, the former construction being more easily erected, but the latter being more efficient as a stiffener, because of its greatest dimension extending in the direction of the strain—that is, transversely. Fig. 14 illustrates a convenient arrangement of angles J and plate P. Fig. 15 illustrates the manner of affording access to the bolts O of Figs. 8, 11, and 13, the staves being provided with recesses Q at suitable intervals for this purpose. Fig. 16 illustrates a simple arrangement of a T R, with its web horizontal and its two head-flanges vertical and bolted to the staves. Fig. 17 illustrates a duplication of the construction of Fig. 16, a second T, R′, being added, with its head-flanges on the opposite face of the wall. Fig. 18 illustrates the use of an I-beam S in a manner which needs no detailed description.

The arrangement of the stiffening-webs above described gives great strength to the wall in proportion to its thickness and permits economy in this direction. In very long walls, however, it may be advantageous to extend braces across the coffer-dam at intervals. Such braces, for example, may be made as in Figs. 19 and 20. In Fig. 19 a flat bar T is used, with its body portion vertical, so as to occupy as little horizontal space as possible, and with its ends twisted and bolted to the horizontal portion of the stiffener F, or, as shown in Fig. 20, a bolt U may be used for tying the opposite walls together, and a brace may be provided in the form of a sleeve V, surrounding the bolt and abutting against the inner face of the stiffener F.

Fig. 21 illustrates a slightly-different form of corner-joint from that previously described, in which an L-shaped plate H′ is riveted or bolted to the horizontal faces of the stiffeners N.

In the preferred method of application of this improvement the construction and setting in place of the coffer-dam is greatly facilitated. According to the usual practice either the entire coffer-dam is built in place piece by piece or the smaller pieces are formed into complete rings (circular or rectangular) of varying heights, according to convenience, these rings being then lifted bodily and lowered into place by powerful derricks, the second method being generally more expeditious and less costly. The principal objection to the second method is the difficulty of lowering an unbroken ring over the air-lock and shafting and also over the air-pipe with its flexible connection leading to the air-compressors. The air connection cannot be broken completely, and it is necessary to lower the ring until it encounters the hose, and then make a new air connection over the ring, afterward breaking the original connection

and lowering the ring into place. According to an invention of Daniel E. Moran and myself, covered, broadly, in application Serial No. 220,555, filed August 12, 1904, the coffer-dam is built up in sections forming only a portion of the perimeter—that is to say, one or more vertical joints are provided, or the ring previously referred to is broken to permit its erection in place without having to break the hose connection. At the same time the sections thus formed comprise easily-transportable units, generally flat, which may be very easily constructed at a distance rapidly and cheaply. This system of construction lends itself especially to the arrangement of the stiffeners extending inward from the face of the wall, as above described. The construction is illustrated in detail where a ring of a rectangular caisson is broken into side sections W and X, respectively, which are formed of vertical staves held together at the bottoms by the Z-bars F and at the tops by flat plates M. The two sections W and the two sections X may together constitute the entire perimeter of the coffer-dam, or this perimeter may be further divided, or the perimeter may be divided into two parts along any vertical joints. It will be seen that these sections can be readily placed upon the lower ring without interference from the air connections or without having to lift them over the air-lock and also that they can be very quickly built in the workshop at a distance from the job, and because of their shape can be very easily transported to the job.

In each of the cases illustrated the stiffener forms also at least a part of the joint; but obviously the same principle of a stiffener extending inward from the face of the wall may be applied at other points than at the joints. Various other fastenings than the bolts and screws may be used. The stiffeners may be shaped to conform to straight or curved faces of the coffer-dam, and they may also be made continuous around any angle or change of direction. For example, circular stiffeners may be welded or fastened together by plates or otherwise. Likewise at a corner the stiffener may be bent around instead of being fastened by gusset-plates, as illustrated.

Though I have described with great particularity of detail certain embodiments of the invention, yet it is not to be understood therefrom that the invention is limited to the specific embodiments disclosed. Various modifications thereof in detail and in the arrangement and combination of the parts may be made by those skilled in the art without departure from the invention.

What I claim is—

1. A coffer-dam having stiffeners extending transversely of its principal members, and having a substantially smooth inner face.

2. A coffer-dam having stiffeners extending transversely of its principal members, and having substantially smooth inner and outer faces.

3. A coffer-dam composed of wooden staves and having a metal stiffening member embedded therein and extending transversely of said staves.

4. A coffer-dam comprising vertical members and horizontal stiffeners and having a substantially smooth interior face.

5. A coffer-dam comprising vertical members and horizontal stiffeners and having substantially smooth inner and outer faces.

6. A coffer-dam comprising vertical wooden staves and horizontal metal stiffeners embedded therein.

7. A coffer-dam comprising vertical wooden staves and horizontal stiffeners embedded therein and forming joints between successive staves.

8. A section of a coffer-dam comprising vertical staves, and at one end a horizontal stiffener extending inward from the face thereof and connected to said staves to hold the same together.

9. A coffer-dam comprising vertical wooden staves and having a horizontal joining-piece substantially embedded in the wall thereof.

10. A coffer-dam comprising vertical wooden staves, and stiffeners comprising metal bars having horizontal portions extending across the ends of said staves, and a vertical portion extending along the faces thereof.

11. A coffer-dam having a substantially smooth inner face and comprising vertical members and horizontal stiffeners, the latter being connected together at the corners.

12. A coffer-dam comprising vertical members and horizontal stiffeners embedded therein, and having braces connected to said horizontal stiffeners and extending across the coffer-dam.

13. A coffer-dam comprising vertical members and horizontal stiffeners, and a brace comprising a flat bar T with its body portion extending in a vertical plane.

14. A coffer-dam formed in separate sections consisting each of a number of vertical staves having a stiffener along a horizontal edge, and extending inward from the face thereof, and forming each a portion of the perimeter.

15. A coffer-dam formed in separate sections consisting each of a number of vertical staves having a stiffener along a horizontal edge, and extending inward from the face thereof and forming each a portion of the perimeter, said stiffener being adapted to form a connection between two adjacent sections.

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

JOHN W. DOTY.

Witnesses:
DOMINGO A. USINA,
FRED WHITE.