

(No Model.)

2 Sheets—Sheet 1.

W. V. JUDSON.
RETAINING WALL, BULKHEAD, &c.

No. 592,738.

Patented Oct. 26, 1897.

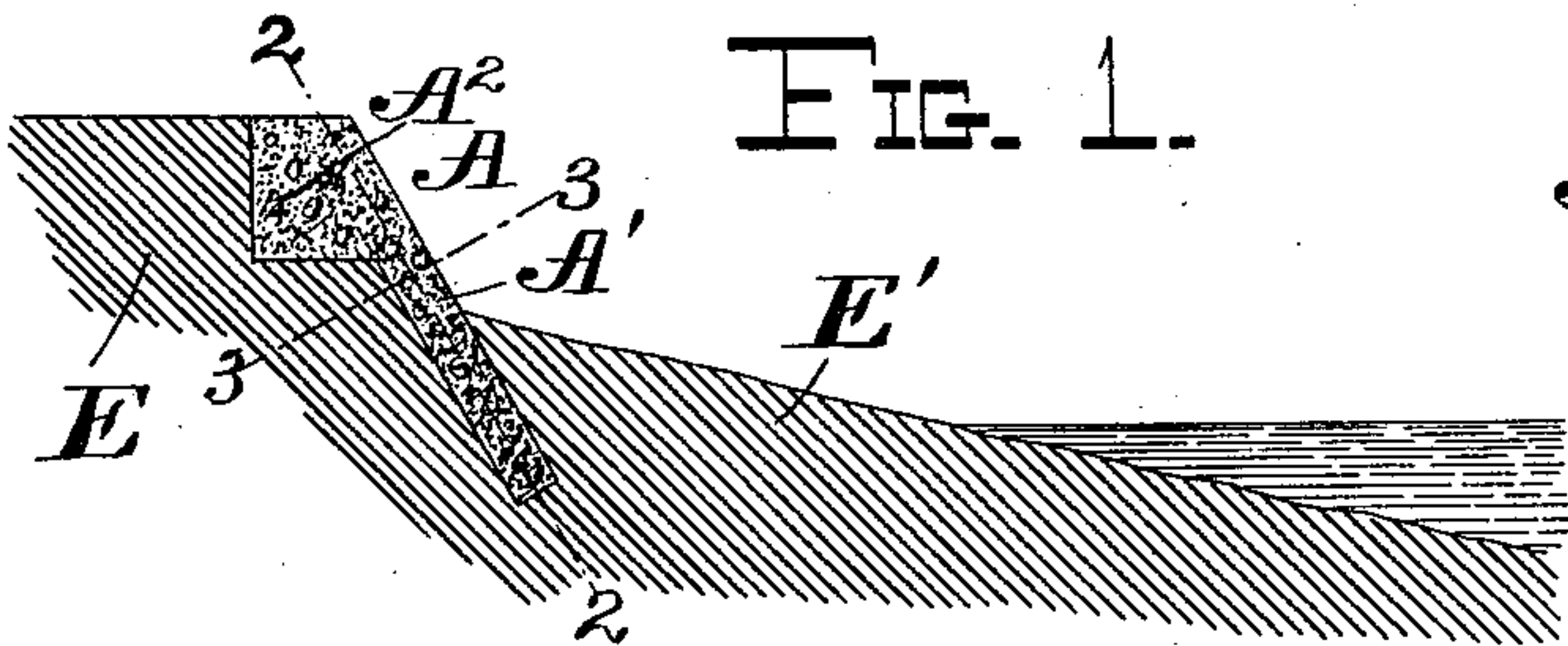


FIG. 1.

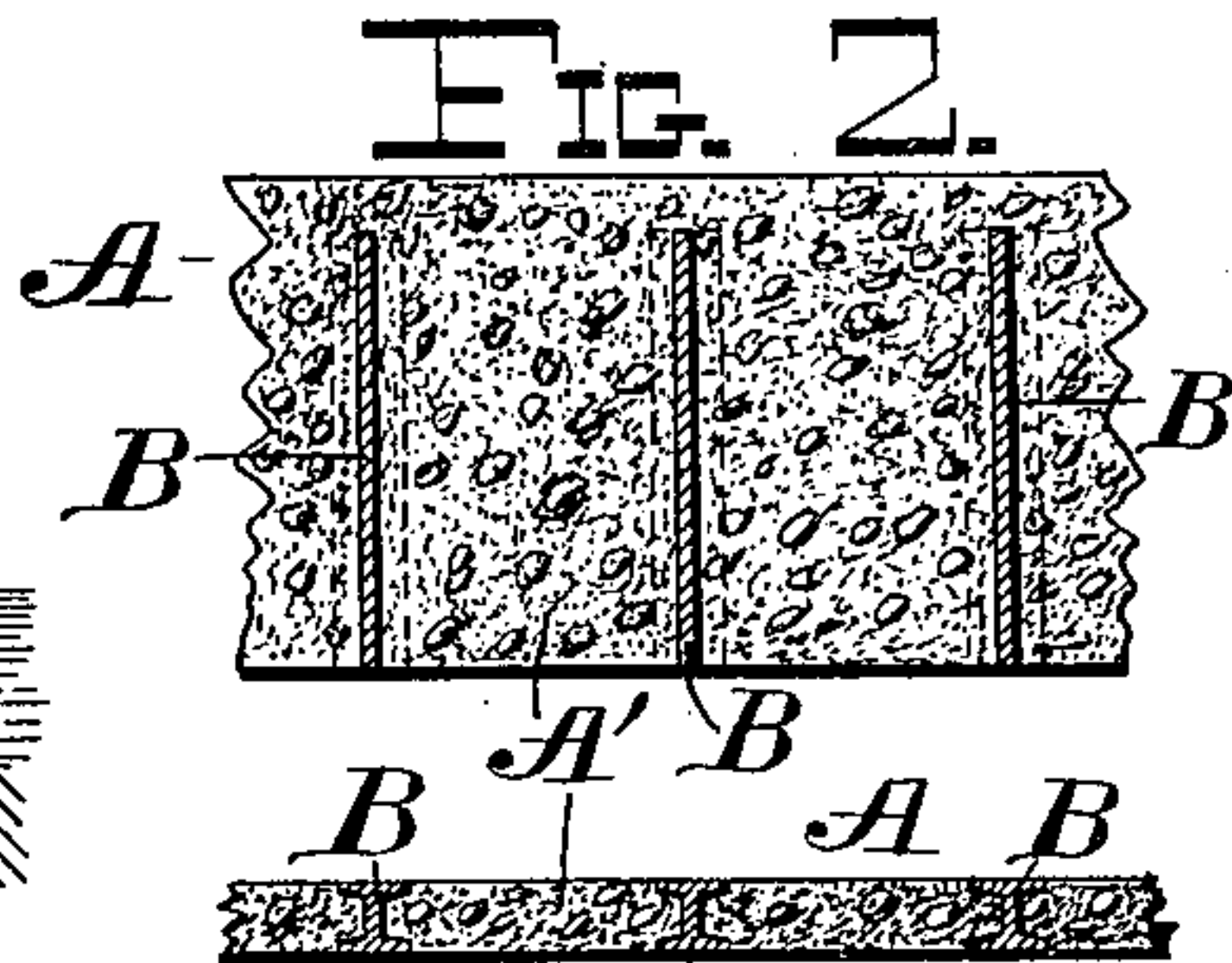


FIG. 2.

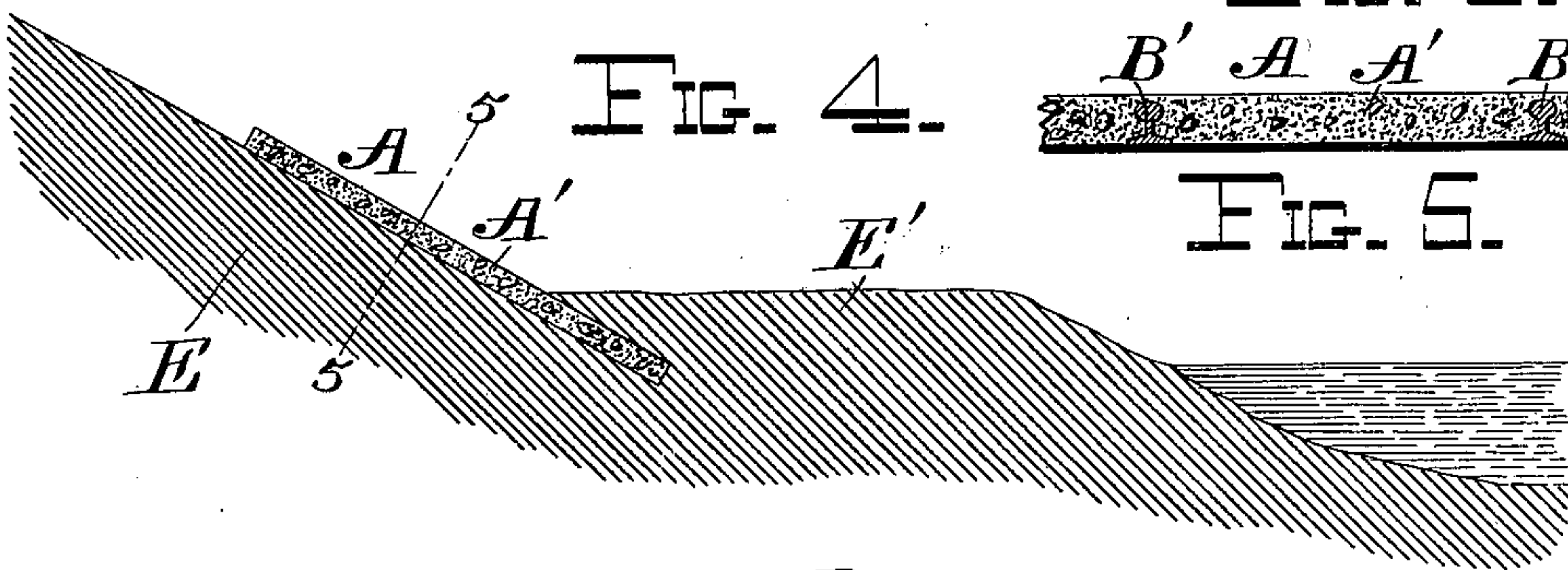


FIG. 4.

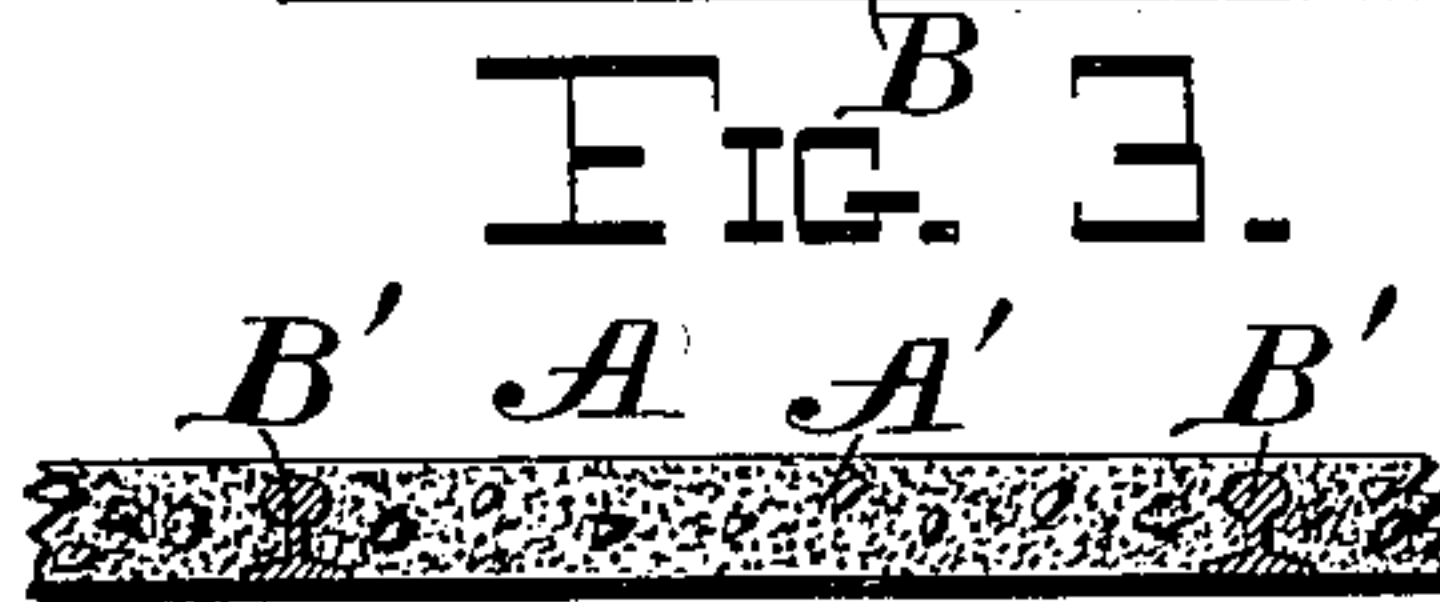


FIG. 3.

FIG. 5.

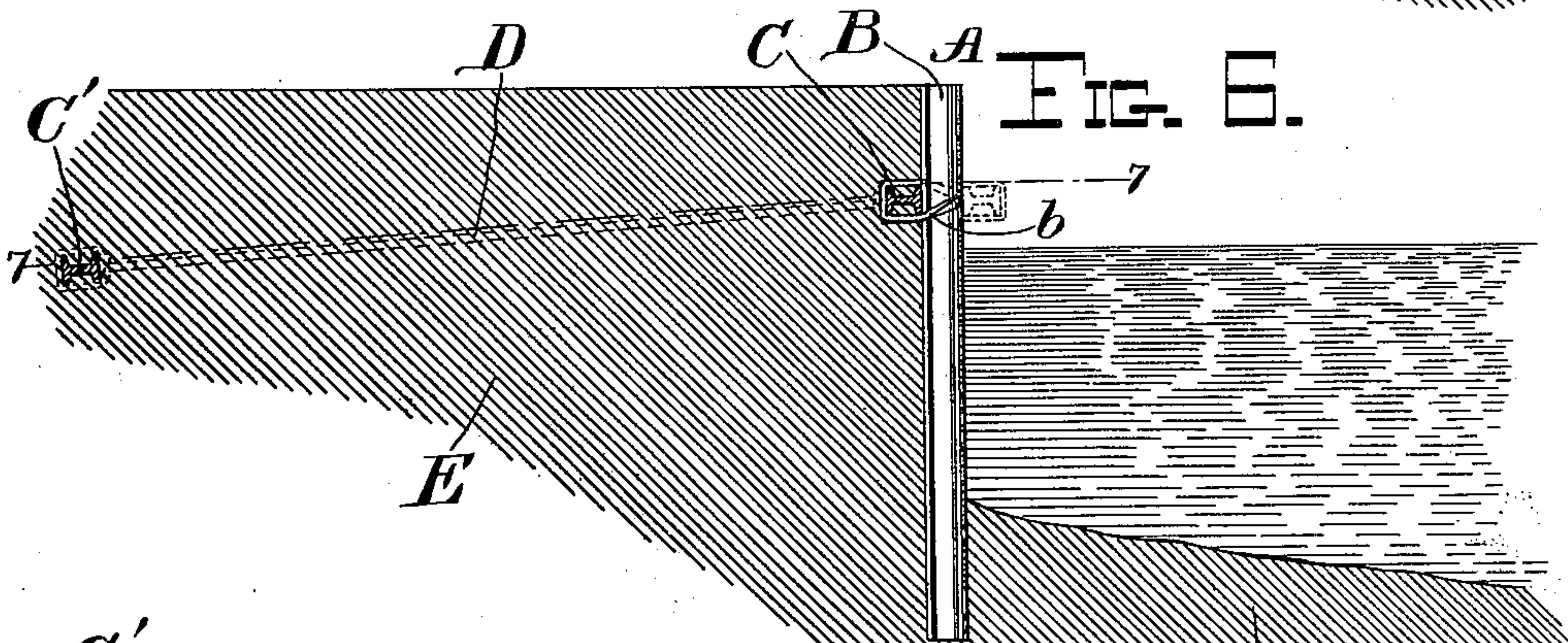


FIG. 6.

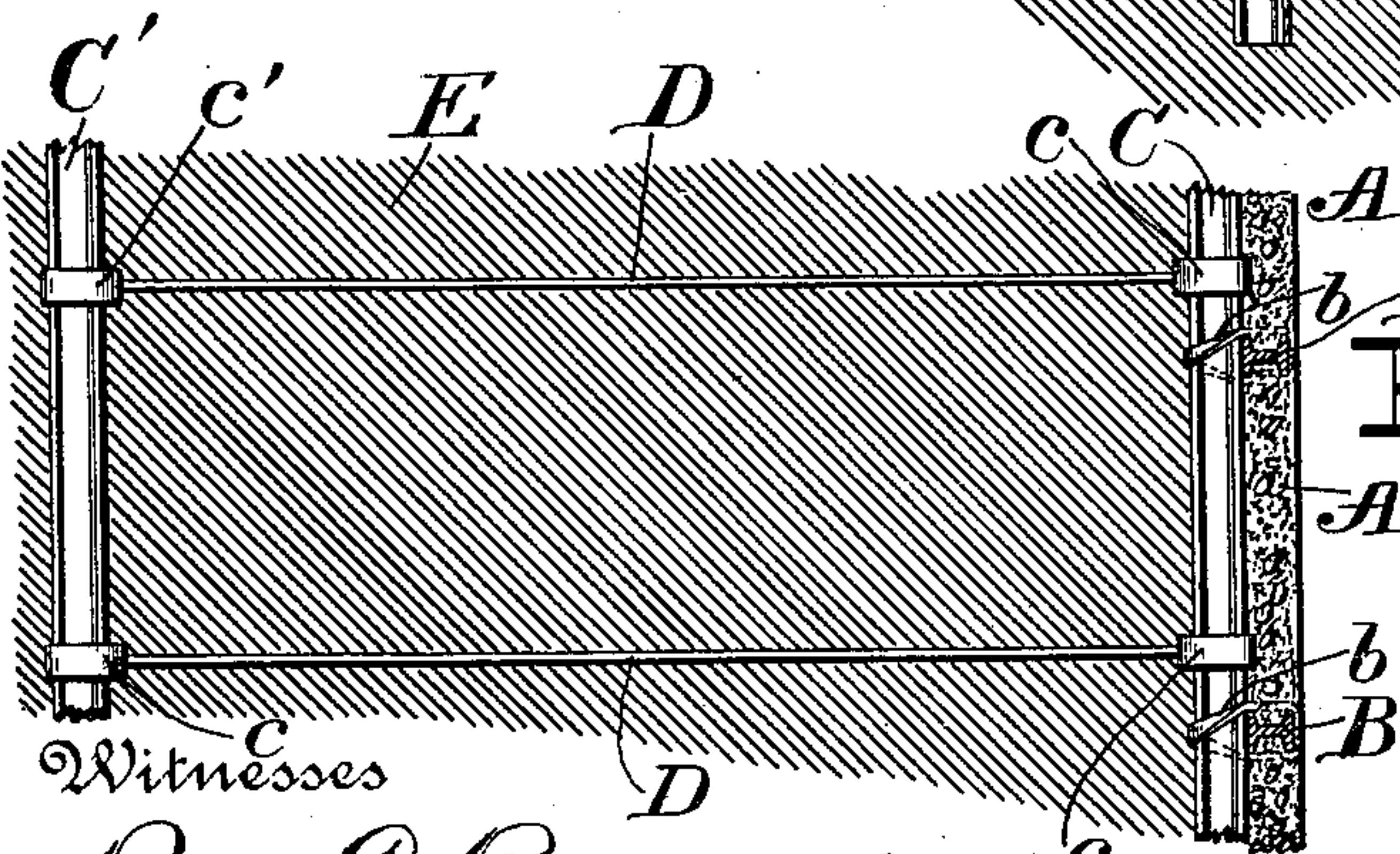


FIG. 7.

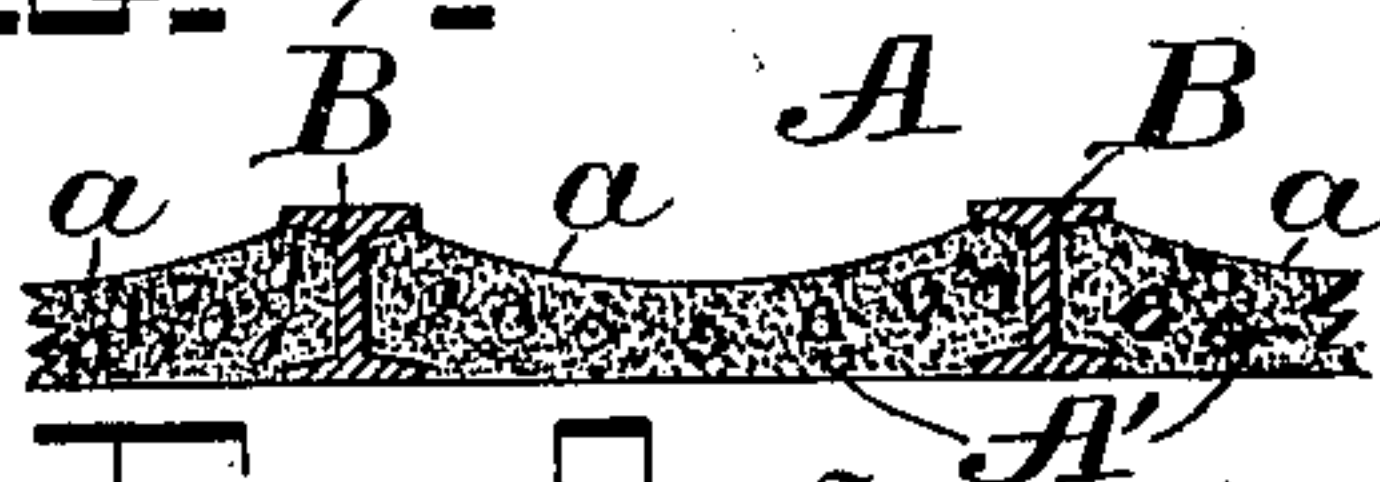


FIG. 8.

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FIG. 9.

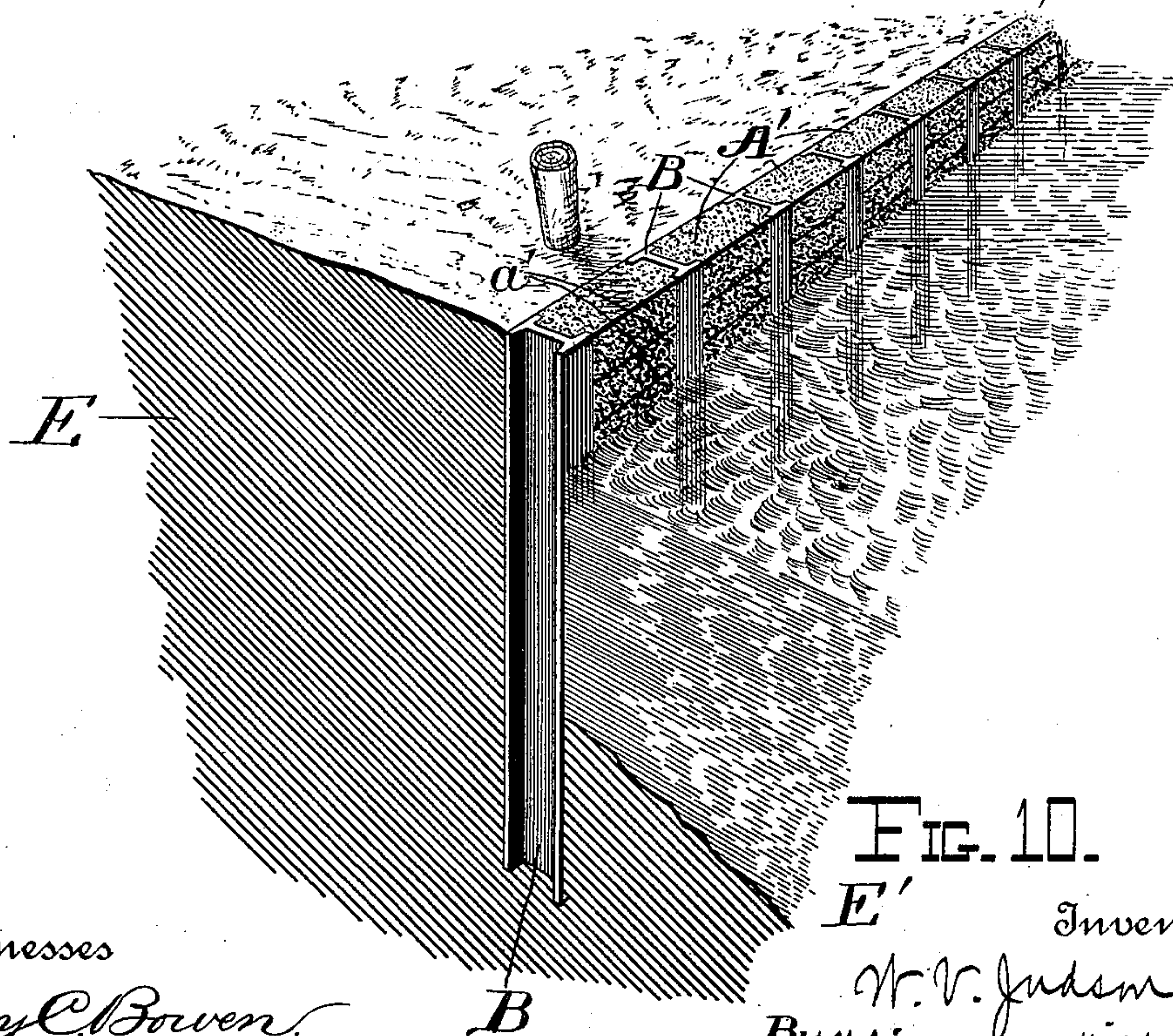
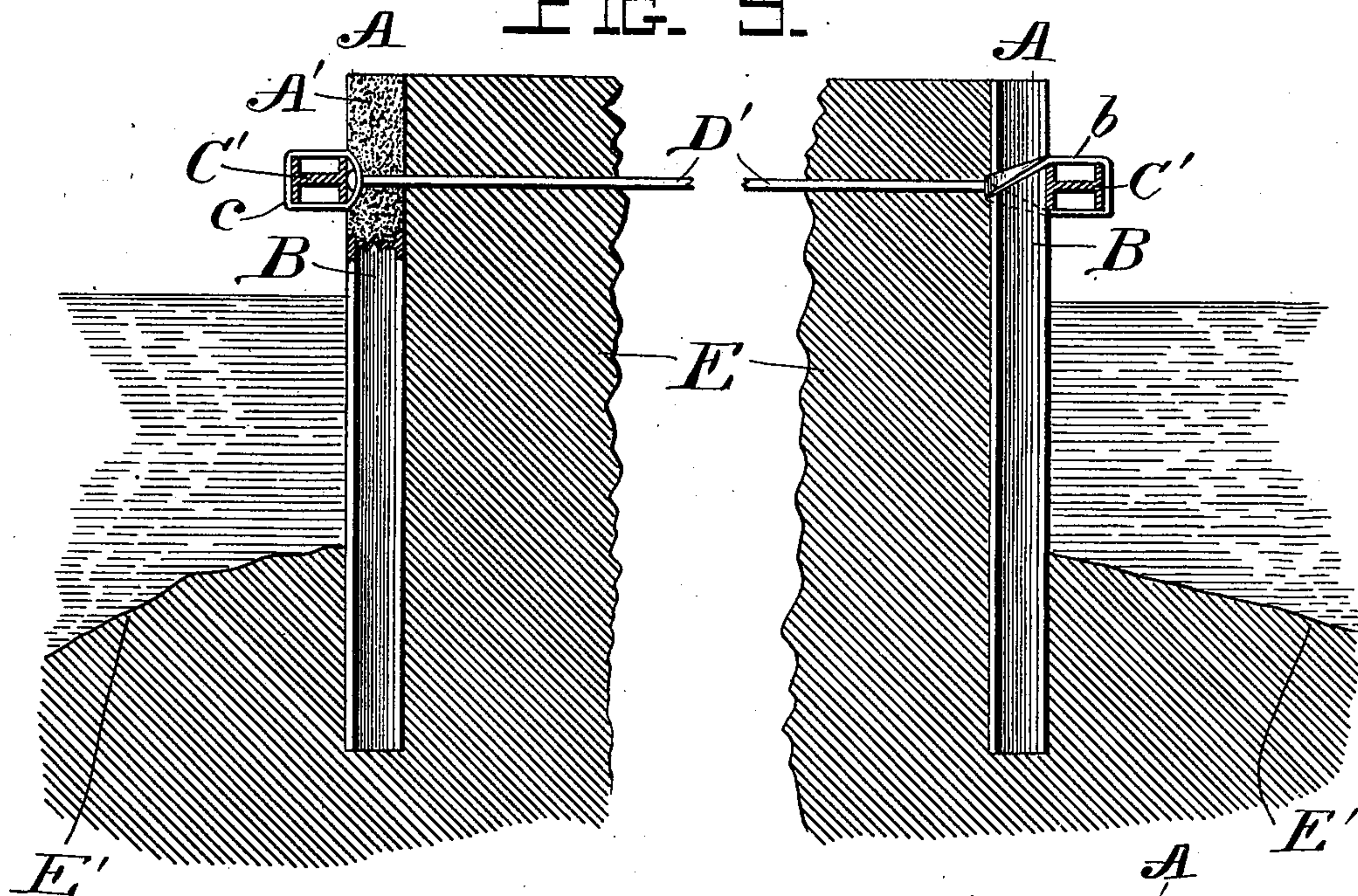


FIG. 10.

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UNITED STATES PATENT OFFICE.

WILLIAM V. JUDSON, OF THE UNITED STATES ARMY.

RETAINING-WALL, BULKHEAD, &c.

SPECIFICATION forming part of Letters Patent No. 592,738, dated October 26, 1897.

Application filed February 2, 1897. Serial No. 621,650. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM V. JUDSON, first lieutenant Corps of Engineers, United States Army, a citizen of the United States, stationed at Galveston, in the county of Galveston and State of Texas, have invented certain new and useful Improvements in Retaining-Walls, Bulkheads, Revetments, and Protective Facings for Moles, Docks, Banks, &c.; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in retaining-walls and non-erosive facings for sea-walls, piers, moles, and the like, and also for banks of streams and other places where it is desired to protect the bank or face of the ground from erosion, either by the beating of the waves or the washing of rain or from the bulging out due to the pressure of retained earth or other material.

The said invention consists in providing for the face to be protected a layer of cement or concrete stiffened with I-beams or other similar stiffening made of metal or wood, but preferably of metal, and in also providing such additional stiffening and bracing as may be required.

My invention will be understood by reference to the accompanying drawings.

Figure 1 represents a sectional view of one form of my invention, showing the same in use on a sea-wall. Fig. 2 represents a section of the device shown in Fig. 1 along the line 2 2 of the said figure. Fig. 3 represents a transverse section of the device shown in Fig. 1 along the line 3 3 of the said figure. Fig. 4 represents another form of my invention adapted to protect the soft bank of a river which is liable to overflow and earth slopes in general liable to constant or occasional wash. Fig. 5 represents a section through the device shown in Fig. 4 and along the line 5 5 of the said figure. Fig. 6 represents my invention as applied to protecting one edge of a pier or mole. Fig. 7 represents a section along the line 7 7 of Fig. 6 and looking down. Fig. 8 represents a modified form of the invention in which the concrete is in the arch form. Fig. 9 represents a section

showing the two sides of a pier or breakwater protected according to my invention; and Fig. 10 represents a perspective view of a form of my improved protective facing, showing the concrete with planes of weakness.

In all the various figures similar letters refer to corresponding parts throughout the several views.

A represents the protective face, which is made up of concrete A' and I-beams B, embedded in the concrete, as shown in Figs. 1 to 5, or between which the concrete is held, as shown in Figs. 8 to 10.

In the device shown in Figs. 1, 2, and 3 the protective face extends down beneath the surface of the ground, and stability is added and the effect of massiveness produced upon the eye by a concrete coping, as at A². Instead of concrete, as at A², stone or other material may be used.

In the form of device shown in Figs. 4 and 5 the beams B are in the shape of the ordinary bulb-rails, and old worn-out rails from railways are eminently adapted for use in this connection.

In Fig. 4 and also in Fig. 1 the slant of the protecting-face should be sufficient to prevent the pressure of the earth when moist from tilting over the said face, except that the heavy retired coping, placed as shown in Fig. 1, may be relied upon to assist in effecting stability.

In the form shown in Figs. 6 and 7 the protective face is made perpendicular with the ends of the beams projecting into the ground below the bottom of the harbor, and they are anchored against pressure toward the water by means of transverse beams C' or other suitable anchors connected by the rods D to the transverse beams C, which may be secured to the protective face in any convenient way, as by means of the straps b, or, if preferred, these beams C may be placed outside of the protective face, as shown in dotted lines in Fig. 6.

I propose to construct the walls shown in Figs. 6 and 7 in the following manner: First, dredge a trench along line of proposed wall to a depth slightly greater than is subsequently to exist along the face of said wall; second, pump or drive I-beams or similar stiffeners sufficiently into the earth in a row

in the trench, as shown; third, drive a row or rows of piles at a suitable distance back of the wall, to which temporarily affix the anchor-beam, so that it shall be in its proper relation to the wall, as shown in the drawings; fourth, bolt or otherwise affix a horizontal beam to the outer face of the row of I-beams or other stiffeners and by means of tie-rods connect this horizontal beam to the anchor-beam, as shown; fifth, place temporary movable shutters against the I-beam, so that the interval between two adjacent beams is made into a mold. These shutters may rest against the beams or be held out by battens to insure the covering of the outer and inner faces of the beams with concrete. The shutters are fastened by being tapped into the ground at the bottom and by clamps across the top. Fill in the space between the shutters with concrete or other composition with or without planes of weakness, as hereinafter described, and shown in Fig. 10.

In the device shown in Fig. 7 the concrete is shown arched, as at *a*, and in this case the flat side of the protective face should be placed on the side from which the maximum pressure comes, whereby economy of material is effected. Horizontal planes of weakness may be produced, as at *a'*, by introducing during construction tar-paper or other separator. This would prevent irregular cracking of concrete due to excessive earth thrust bending the beams or due to blows of vessels or to contraction and expansion. Where the maximum pressure is from the water side, the curved side should be next the earth, and where the maximum pressure is from the earth side the arches should be next the water.

In the form of device shown in Fig. 9 the opposite sides of the mole, pier, or break-water are protected by vertical facings similar to those shown in Figs. 6 and 7, except that the beam *C'* is on the outside of the mole and serves as a fender therefor, while the two facings are tied together by stay-bolts *D'*, and thus the two sides mutually support each other. The same method of building the side walls of an aqueduct may be adopted. At the left of Fig. 9 the beam *C'* is shown connected by the straps *c* to the bolt *D'*, between the vertical I-beam *B*, while in the right of said figure the strap incloses both I-beams *B* and *C'*. Either method of securing the bolt to the horizontal beam *C'* may be adopted, or any other suitable means of accomplishing the same result may be adopted.

In the form of device shown in Fig. 10 the vertical I-beams are projected so far into the bottom of the harbor at the side of the mole that the transverse bracing—such as the tie-bolts *D'* in Fig. 9 or the anchors *C'* and bolts *D* in Figs. 6 and 7—may be dispensed with.

By any of the above structures it will be noted that a stiff, strong, durable, and comparatively non-erosive face is secured, which combines great structural strength with comparative cheapness of construction.

In the various figures, *E* represents the earth to be protected, and *E'* represents the earth forming the bottom of the stream or harbor.

The various advantages of the herein-described invention will readily suggest themselves to any competent hydraulic engineer.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a protective face for banks, moles and the like, the combination with a layer of concrete or cement, of a plurality of I-beams arranged parallel to each other and rigidly embedded in the said concrete, other I-beams in the rear of the said facing and stays securing the said I-beams to those embedded in the concrete, substantially as described.

2. In a protective face for banks, moles and the like the combination with a wall of concrete or cement having planes of weakness, of a plurality of I-beams rigidly embedded therein, other I-beams in the rear of said wall and stays securing the said I-beams to those embedded in the wall, substantially as described.

3. In a protective face for banks, quays, lock and dock walls, moles, and the like, the combination with a layer of concrete, of vertical I-beams or other similar stiffeners embedded therein, and transverse I-beams or other stiffeners secured to the face of said I-beams, and stays attached to said transverse I-beams, substantially as and for the purposes described.

4. In a protective face for banks, beaches, and the like, the combination of a heavy retiring coping with an inclined or vertical facing of concrete, and I-beams or other similar stiffeners, substantially as and for the purposes described.

5. In a protective face for banks, quays, lock and dock walls, moles, and the like, the combination with a layer of concrete, of vertical I-beams or other similar stiffeners embedded therein, and transverse I-beams or other stiffeners secured to the face of said I-beams, and stays attached to said transverse I-beams or other similar stiffeners and to a similar wall or facing adapted to form the other side of a pier or mole, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM V. JUDSON.

Witnesses:

H. C. WILSON,

E. M. HARTRICK.