No. 780,884. PATENTED JAN. 24, 1905.

J. L. HOLMES.

METAL STRUCTURE AND ANCHORAGE THEREFOR.

APPLICATION FILED FEB. 18, 1904.

5 SHEETS—SHEET 1.

Fig. 1

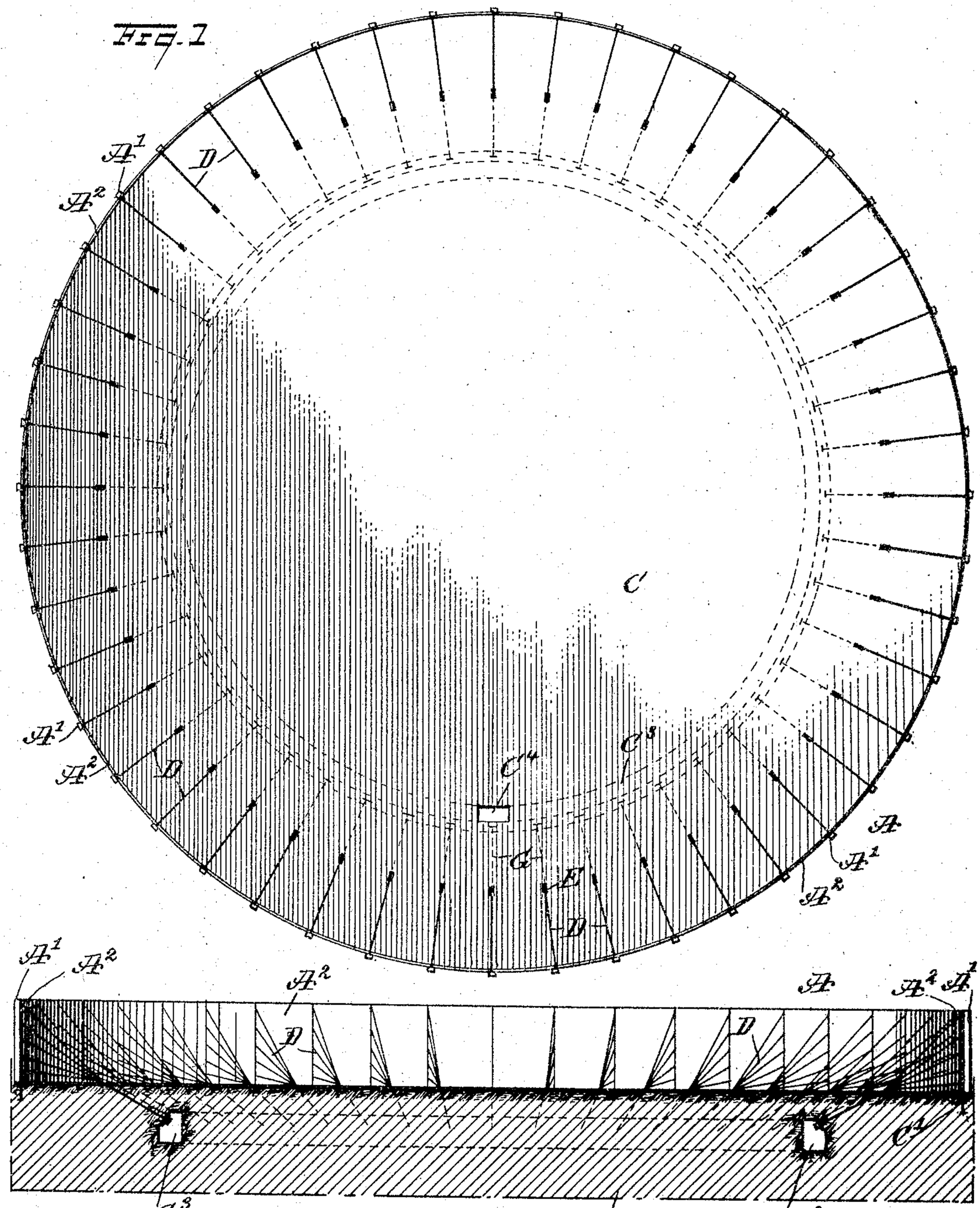

Fig. 2

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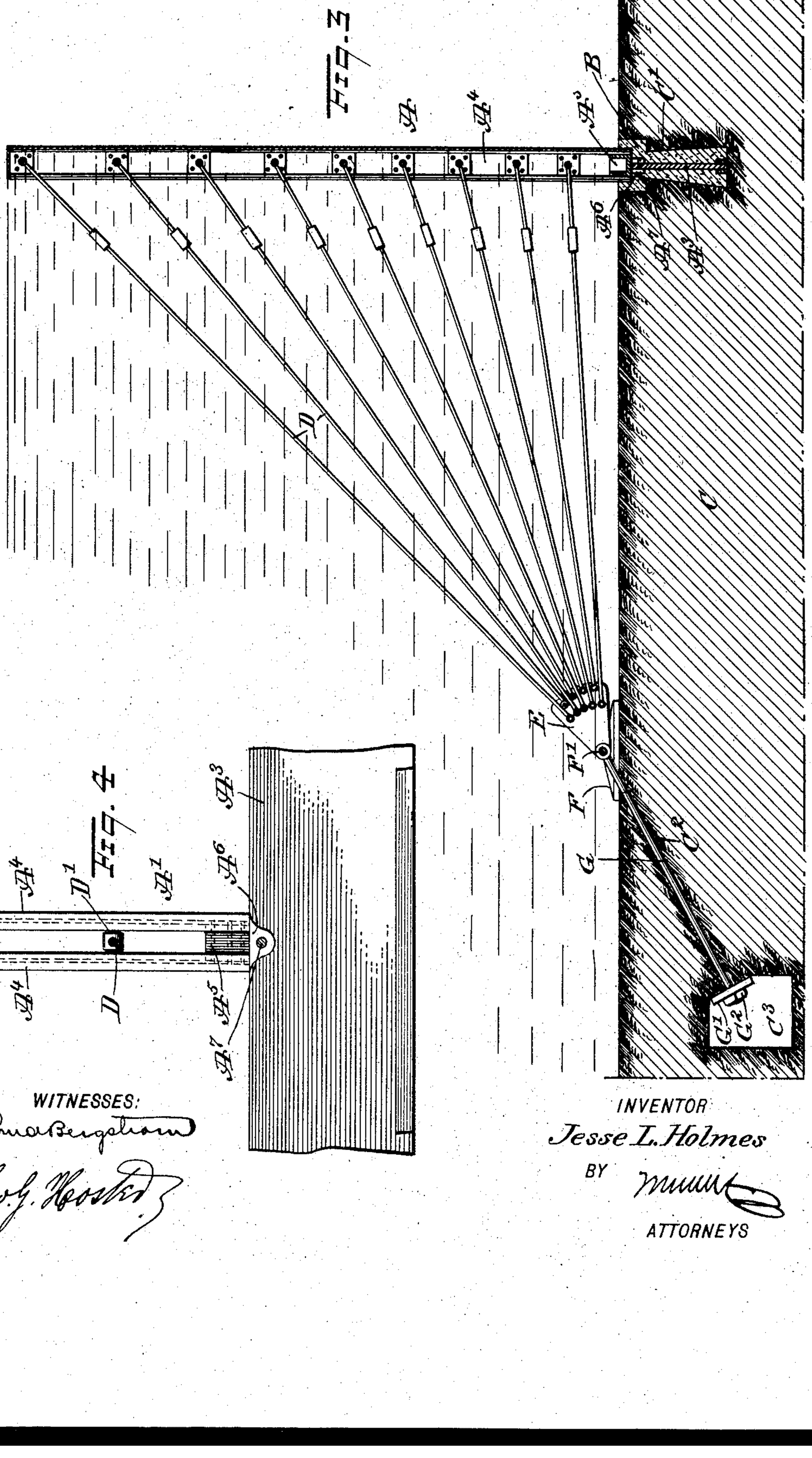

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5 SHEETS—SHEET 3.

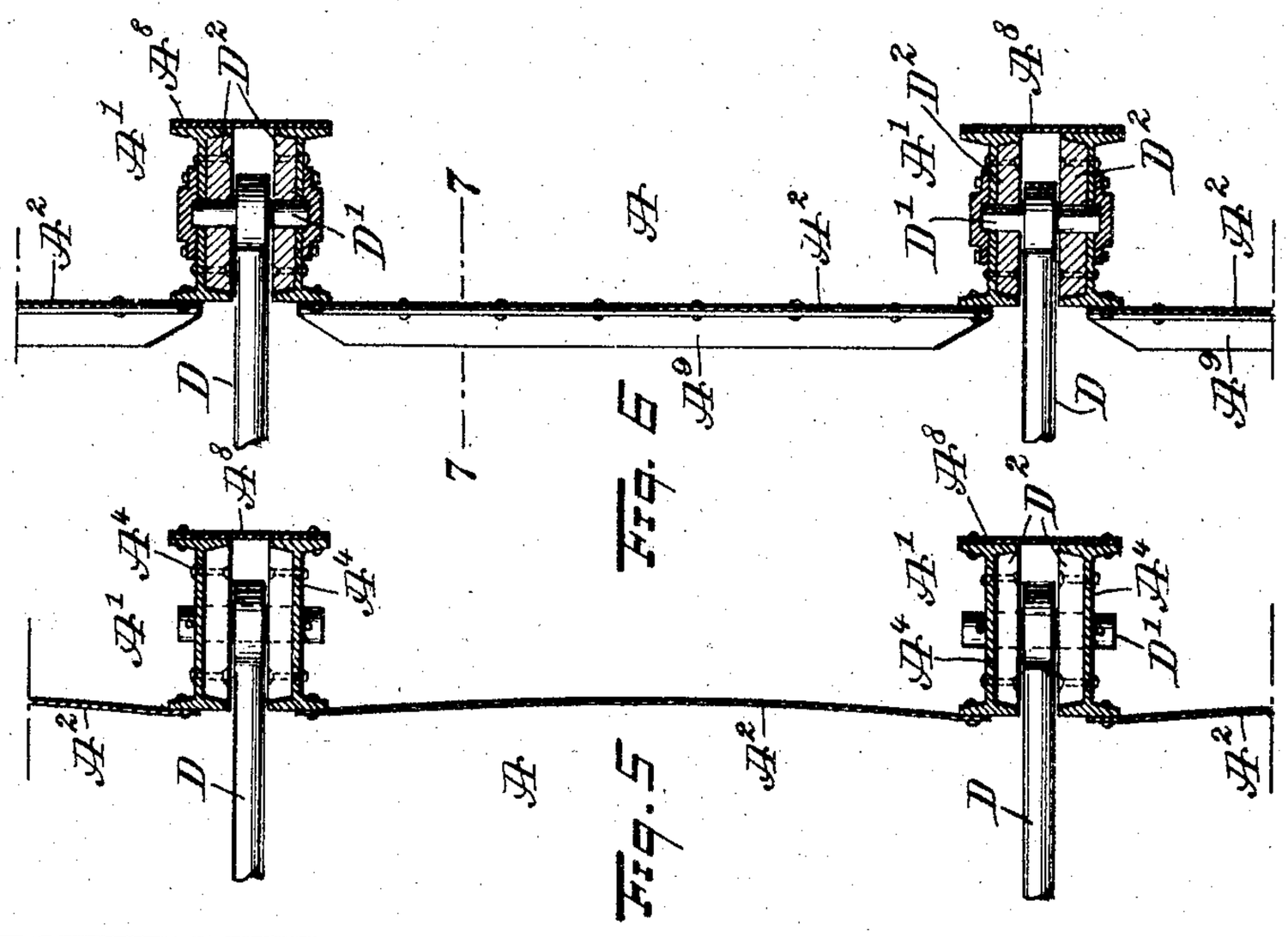

FIG. 5

FIG. 6

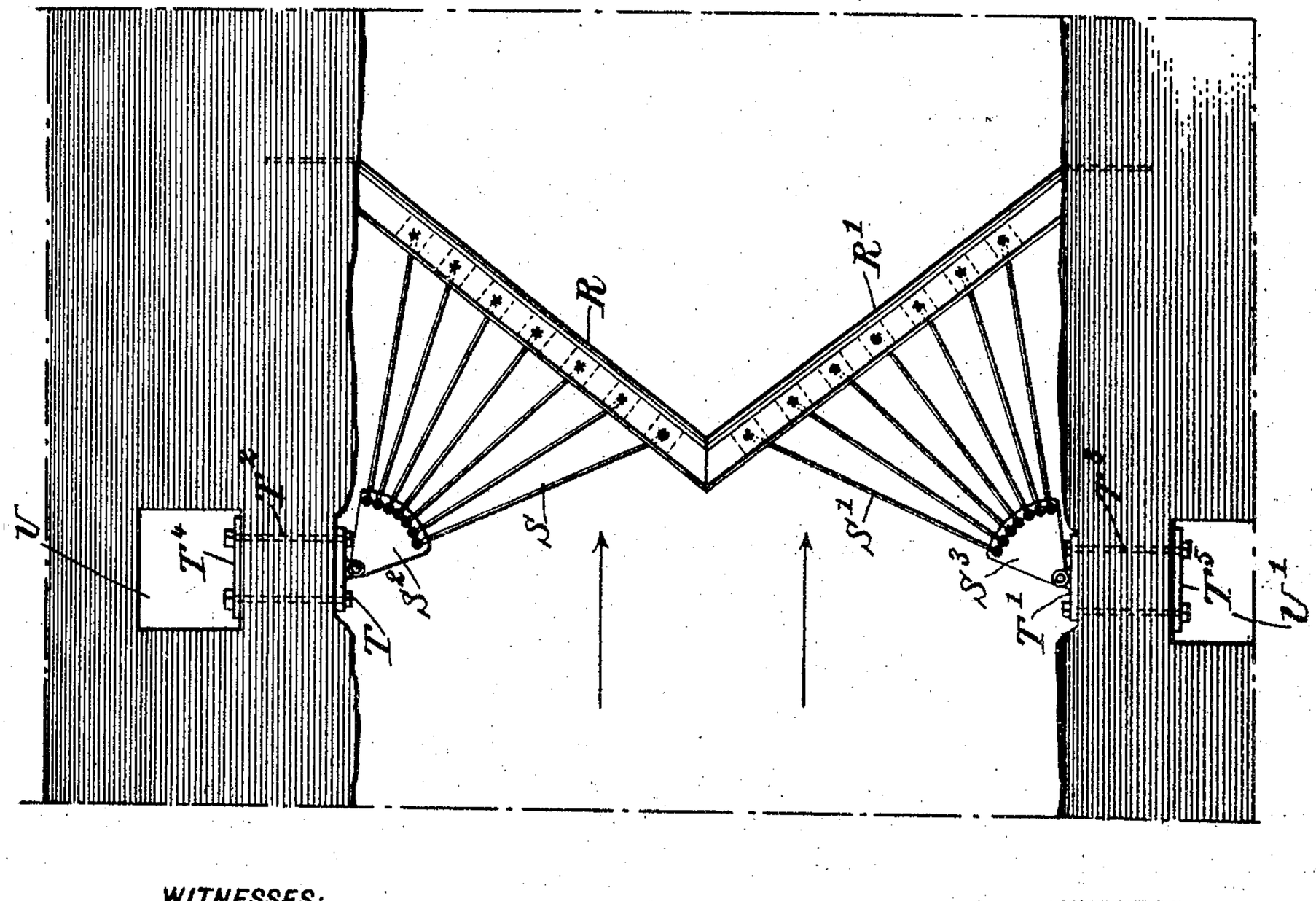

FIG. 7

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5 SHEETS—SHEET 4.

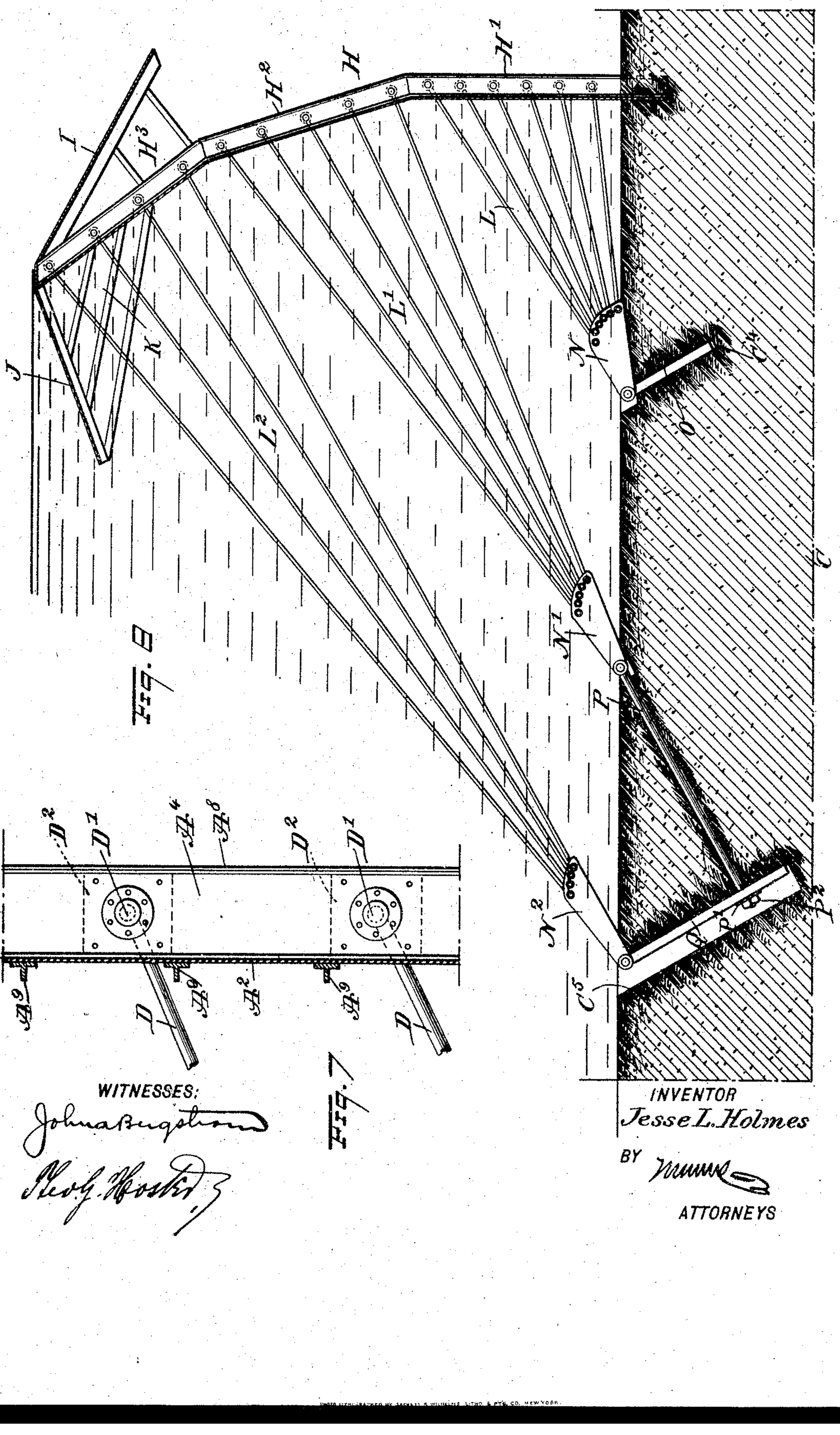

FIG. 8

FIG. 7

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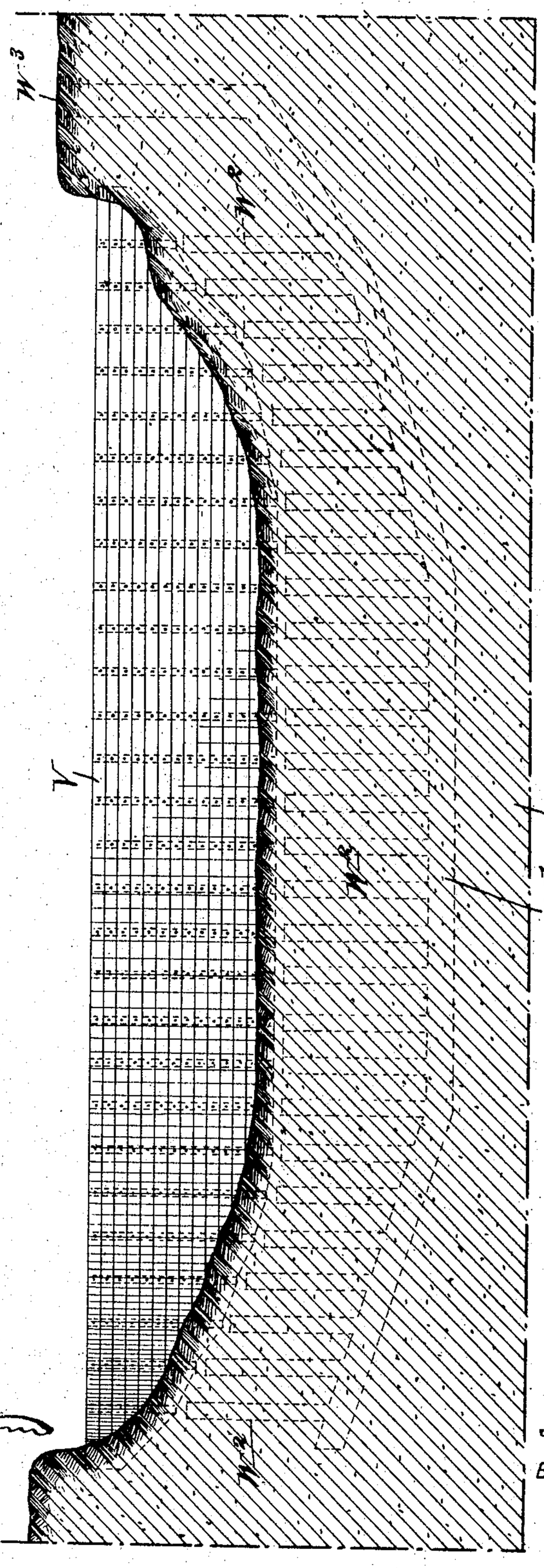
5 SHEETS—SHEET 5.



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No. 780,884. Patented January 24, 1905.

UNITED STATES PATENT OFFICE.

JESSE LINCOLN HOLMES, OF BUTTE, MONTANA.

METAL STRUCTURE AND ANCHORAGE THEREFOR.

SPECIFICATION forming part of Letters Patent No. 780,884, dated January 24, 1905.

Application filed February 18, 1904. Serial No. 194,147.

To all whom it may concern:

Be it known that I, JESSE LINCOLN HOLMES, a citizen of the United States, and a resident of Butte, in the county of Silverbow and State of Montana, have invented a new and Improved Metal Structure and Anchorage Therefor, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved metal structure and anchorage therefor more especially designed for forming reservoirs, dams, and the like and arranged to withstand the pressure of the water without the use of abutments and other costly masonry and to allow of quickly erecting the structure and in the case of a dam permit its erection without interfering with the flow of the water.

The invention consists of novel features and parts and combinations of the same, as will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in 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 plan view of the improvement arranged as a reservoir. Fig. 2 is a sectional side elevation of the same. Fig. 3 is an enlarged sectional side elevation of the same. Fig. 4 is an inside face view of part of the side wall of the structure. Fig. 5 is an enlarged sectional plan view of the side wall of the structure. Fig. 6 is a similar view of a modified form of the same. Fig. 7 is a sectional side elevation of the same on the line 7 7 in Fig. 6. Fig. 8 is a sectional side elevation of the improvement arranged as a dam. Fig. 9 is a plan view of a modified form of dam, and Fig. 10 is a cross-section of a waterway and the dam in position.

The circular side wall A of the reservoir (shown in Figs. 1, 2, 3, 4, 5, 6, and 7) has its lower end embedded in concrete B, held in a recess C′, cut in the rock construction C of the site on which the reservoir is located, and the said side wall A is preferably formed of posts A′, spaced apart and connected with each other at their inner faces by metal plates A^2, forming the facing of the side wall, the lower end of which is provided with a bottom foundation-plate A^3, set in the concrete B, all as more fully shown and described in detail in the application for Letters Patent of the United States for a metal dam, Serial No. 178,856, filed by me October 28, 1903.

To each post A′ are attached braces in the form of truss-rods D extending inwardly and downwardly and pivotally connected with a plate E, fulcrumed on a pivot F′, held on a stand F, set on the surface of the rock construction C, and the said stand is anchored to the rock or other material of the rock construction, so that the pressure of the stored water against the side wall A is mainly taken up by the inherent strength of the anchorage portion on the rock bottom, and to which inherent strength must be added the weight of the water above the said anchorage portion.

The pivot F′ of each stand F is engaged by a tie-rod G, extending through a passage C^2, formed in the rock construction C and leading into a tunnel C^3, arranged circularly and approximately concentric to the annular recess C′, in which the lower end of the side wall A is embedded. Access to the tunnel C^3 is had through a shaft C^4 (see Fig. 1) to enable the workmen to place a washer G′ or like device on the inner end of the tie-rod G and to securely hold the washer in place against the inner wall of the tunnel C^3 by screwing up a nut G^2 on the inner end of the tie-rod G.

By the arrangement described the pressure of the water against the side wall A is taken up by the truss-rods D, which in turn are anchored to the rock foundation, so that the pressure of the stored water against the side wall is taken up by the rock portion, and consequently an exceedingly strong and durable structure is produced.

The truss-rods D are arranged in sets, preferably one set for each post A′, and in each set the truss-rods extend in a vertical plane and in spread-out or fan shape, the vertical plane also passing through the passage C^2 to the center of the tunnel C^3, as will be readily understood by reference to Fig. 1.

Each post A′ consists, preferably, of two spaced **I**-beams A^4, connected with each other at their lower ends by a bottom plate or block A^5, resting with the **I**-beams on the top of the foundation-plate A^3, and from the under side of the bottom plate or block A^5 depend lugs A^6, straddling the foundation-plate A^3 and secured thereto by a suitable bolt A^7. (See Figs. 3 and 4.)

The **I**-beams A^4 are spaced sufficient distances apart to permit the entrance of the upper ends of the truss-rods D, and which ends are connected by transverse pivot-pins D′ with bearing-plates D^2, bolted or otherwise fastened to the inner faces or webs of the **I**-beams A^4, as plainly shown in Figs. 5 and 6. The downstream sides of the **I**-beams A^4 are connected with each other by a vertically-disposed plate A^8 for retaining a filling of hydraulic cement or a mixture of hydraulic cement and crushed rock, the said filling being placed into the spaces between the **I**-beams, so as to prevent leakage of the water by way of the pins.

The metal plates A^2 for forming the facing of the structure are riveted or otherwise secured to the flanges of the opposite **I**-beams of adjacent posts A′, so as to leave a space between the flanges of the **I**-beams A′ of a post for the passage of the truss-rod D. The plates A^2 may be flat, as shown in Fig. 6, or arched, as illustrated in Fig. 5. In case the flat plates (shown in Fig. 6) are used the longitudinal joints of the plates are covered by bars A^9, preferably made of **T**-iron and riveted or otherwise fastened to the adjacent plates to greatly increase and reinforce the plates and prevent leakage of the water at the joints.

In constructing metal dams the dam structure H (see Fig. 8) is embedded at its lower end in the recess of the rock construction, and the ends of the said dam structure are likewise embedded in the rock forming the side walls of the waterway, also as more fully shown and described in the application for Letters Patent above referred to, so that further description thereof is not deemed necessary. In such metal dam structures H, however, it is desirable to curve or incline the structure H in an upstream direction and from the bottom upwardly, as indicated in Fig. 8, it being understood that in this case the structure H is preferably formed of a number of superimposed sections H′, H^2, and H^3, of which the lower section H′ is approximately vertical, the next section H^2 extends in an upstream direction at an angle to the upper end of the section H′, and the top section H^3 extends from the top of the middle section H^2 and at an angle thereto, so that the dam structure is more able to withstand the pressure of the water. As shown in Fig. 8, the upper end of the section H^3 of the structure H is provided with a spillway I, extending downstream, and with a shield J, extending upstream and in a downward direction from the top of the structure H. The shield J is connected by suitable braces K with the upper section H^3, so as to strongly reinforce the shield, the latter serving mainly to prevent logs and other floating matter from directly striking the structure H and by the inclination of the shield tend to guide such floating matter over the top of the dam.

The sections H′, H^2, and H^3 are connected at each post by sets of truss-rods L, L′, and L^2 and with plates N, N′, and N^2, respectively, of which the plate N′ rests on the bottom of the waterway and is pivotally connected with a plate O, extending into a recess C^4, formed in the rock foundation C approximately at right angles to the pull exerted by the truss-rods L. The plate N′ is pivotally connected by a tie-rod P with a plate Q, extending in a recess C^5, cut into the rock foundation from the top thereof, and to this plate Q is pivotally connected the truss-rod plate N^2, as plainly shown in Fig. 8. The tie-rod P is connected by a washer P′ and nut P^2 to the plate Q, which stands approximately at right angles to the strain exerted by the truss-rods L′ and L^2, so that the principal strain is taken up by the rock foundation on the upstream side of the dam structure.

From the foregoing it will be seen that in the case described the tunnel is entirely dispensed with; but the anchorages are located upstream and the strain is exerted against the rock material in the bottom of the waterway.

In the construction shown in Fig. 9 the metal dam structure is made of two parts R and R′, embedded at their lower ends in a recess in the bottom of the waterway and extending toward each other in **V** shape, formed with the apex on the upstream side and with the ends of the sections embedded in the side walls of the waterway. Braces S and S′ for each section R and R′ are likewise located on the upstream side and connect with plates S^2 S^3, respectively fulcrumed on anchorage-plates T and T′, connected by tie-rods T^2 T^3 with plates T^4 T^5, abutting against the inner wall of shafts U and U′, sunk in the side walls of the waterway, the said tie-rods T^2 and T^3 extending through passages in the side wall from the faces thereof to the shafts U and U′. Thus by the construction described the strain is taken up by the rock material in the side walls of the waterway, so as to insure great stability of the dam structure.

As illustrated in Fig. 10, the metal dam structure V extends across the waterway, and its lower portion as well as the ends are embedded in the rock formation W, and the tunnel W′, formed transversely in the rock formation for gaining access to the tie-rod passages W^2, opens at one end into a shaft W^3 in

the side wall or bank of the waterway to enable the workmen to place the tie-rod washers and nuts in position for the washers to bear against a wall of the tunnel.

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

1. An anchorage for reservoirs, comprising a rock foundation having an endless tunnel of a general annular form therein and passages leading radially from said tunnel to the surface of the rock foundation, a tie-rod extending through each passage and secured at one end to anchoring mechanism engaging the surface of the tunnel, and a wall of a general annular form connected with said tie-rods.

2. An anchorage for reservoirs comprising a rock foundation having an endless tunnel formed therein and passages leading radially from the tunnel to the surface of the rock foundation, a tie-rod extending through a passage and secured at one end to the structure to be anchored, and means on the other end of the tie-rod, bearing against a wall of the tunnel, the said passages and tie-rods therein extending obliquely and in vertical planes passing through a common central point encircled by said tunnel, as set forth.

3. A reservoir comprising a rock foundation having an annular recess, a circular tunnel approximately concentric to the recess and a distance inward from the same and passages leading from the tunnel to the surface of the rock foundation, a distance inward from the said recess, a metal structure having its lower end embedded in concrete in the said recess, braces extending inwardly from the said structure, and tie-rods extending in the said passages and connected at their outer ends with the said braces and at their inner ends with the wall of the tunnel, as set forth.

4. A metal structure comprising a continuous metal side having its lower end embedded in the material of the site of the structure, and braces extending inwardly from the pressure-face of the said side and anchored to the material of the site of the reservoir, as set forth.

5. A metallic reservoir comprising a continuous metal side having its lower end embedded in the material of the site of the bed of the reservoir, braces extending inwardly from the said side, and an anchorage for the braces, anchored in the material of the site of the reservoir, as set forth.

6. A metallic reservoir comprising a circular metal side formed of posts and metal face-plates, the side being embedded at its lower end in the material of the site of the reservoir, braces disposed radially from each post in an inward direction, and an anchorage for the braces from each post and anchored in the material of the site of the reservoir, as set forth.

7. A metallic reservoir comprising a circular metal side formed of posts and metal face-plates, the side being embedded at its lower end in the material of the site of the reservoir, braces disposed radially from each post in an inward direction, and an anchorage for the braces from each post and anchored in the material of the site of the reservoir, the anchorage consisting of a stand set on the bottom of the reservoir, a brace-plate pivoted on the stand and on which the inner ends of the braces are secured and a tie-rod extending from the stand through the material of the reservoir-bottom into a tunnel and bearing against a wall thereof, as set forth.

8. A metallic structure having posts and metal face-plates attached to the posts, the posts and face-plates having their lower ends embedded in the bottom of the site of the structure, the structure being bent from the bottom upward in a direction toward the pressure to be exerted against the structure, as set forth.

9. A metal dam structure curved from the bottom upward in an upstream direction, as set forth.

10. A metal dam structure provided with a shield at the upper portion and extending on the pressure side of the structure, as set forth.

11. A metal dam structure, and a shield extending from the top of the said structure in a downward direction and on the upstream side of the structure, as set forth.

12. A metal dam structure, a shield extending from the top of the said structure in a downward direction and on the upstream side of the structure, and braces connecting the under side of the shield with the said structure, as set forth.

13. A metal dam structure appearing in V shape when viewed in plan, in combination with means for anchoring said dam structure from the side from which the water-pressure is exerted.

14. A metal dam structure appearing in V shape when viewed in plan, the apex of the structure extending upstream, in combination with means for anchoring said dam structure from a point upstream, substantially as described.

15. A metal dam structure appearing in V shape when viewed in plan, the apex of the structure extending upstream, bracings extending from each wing of the said structure, toward the corresponding side wall of the waterway, and an anchorage on each side wall, connected with the corresponding bracing, as set forth.

16. A metal dam structure appearing in V shape when viewed in plan, the apex of the structure extending upstream, bracings extending from each wing of the said structure, toward the corresponding side wall of the waterway, and an anchorage on each side wall, connected with the corresponding brac-

ing, the anchorage consisting of a rock formation having a shaft and passages leading from the said shaft to the outer face of the said wall and tie-rods in the passages, secured at their inner ends to a wall of the shaft and secured at their outer ends to the corresponding bracing, as set forth.

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

JESSE LINCOLN HOLMES.

Witnesses:

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W. Y. PEMBERTON.