No. 771,071. PATENTED SEPT. 27, 1904.

J. L. HOLMES.

METAL DAM.

APPLICATION FILED OCT. 28, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

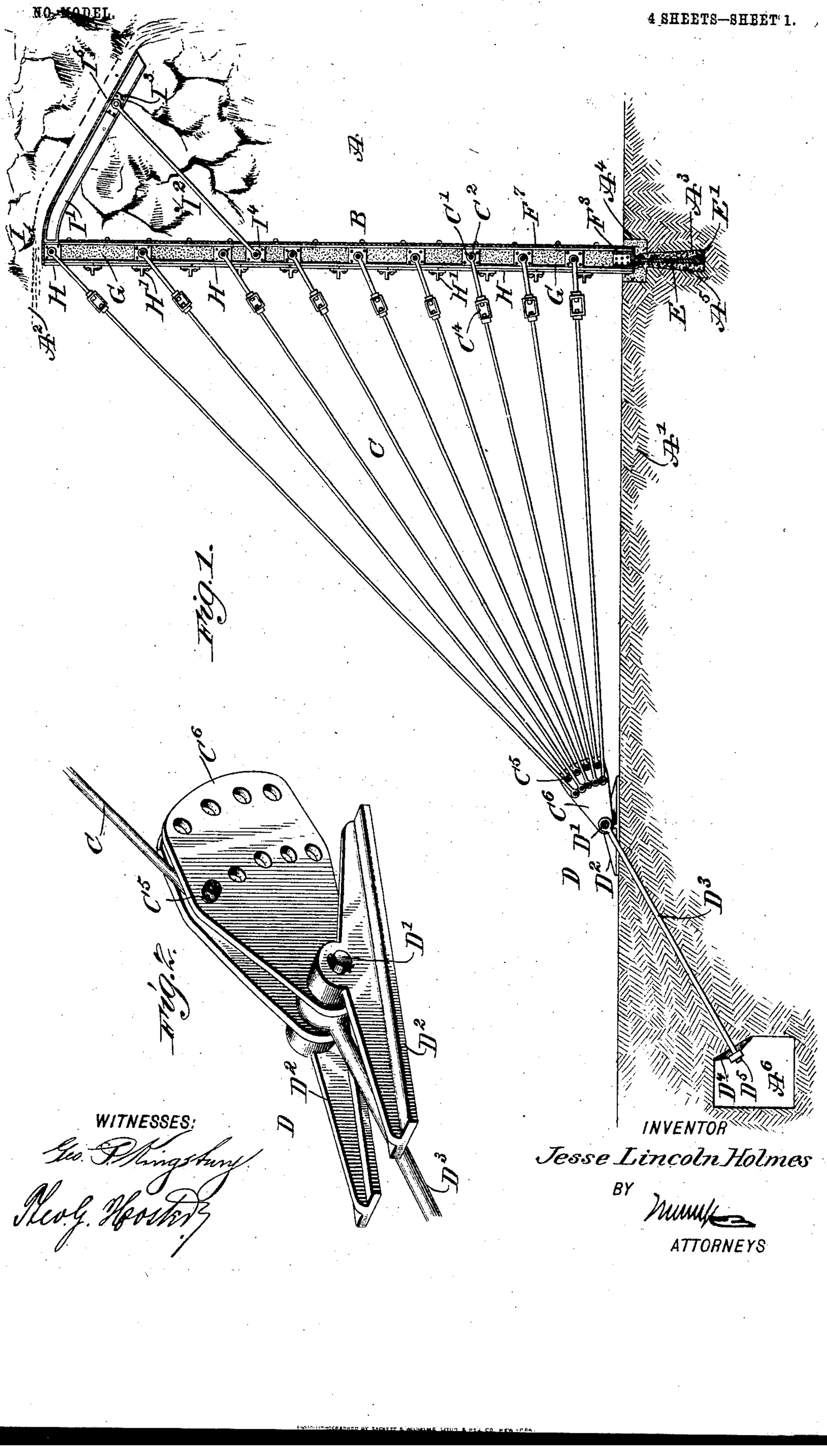

Fig. 1.

Fig. 2.

WITNESSES:

Geo. P. Kingsbury

Reo. F. Hoosier

INVENTOR

Jesse Lincoln Holmes

BY

ATTORNEYS

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NO MODEL. 4 SHEETS—SHEET 2.

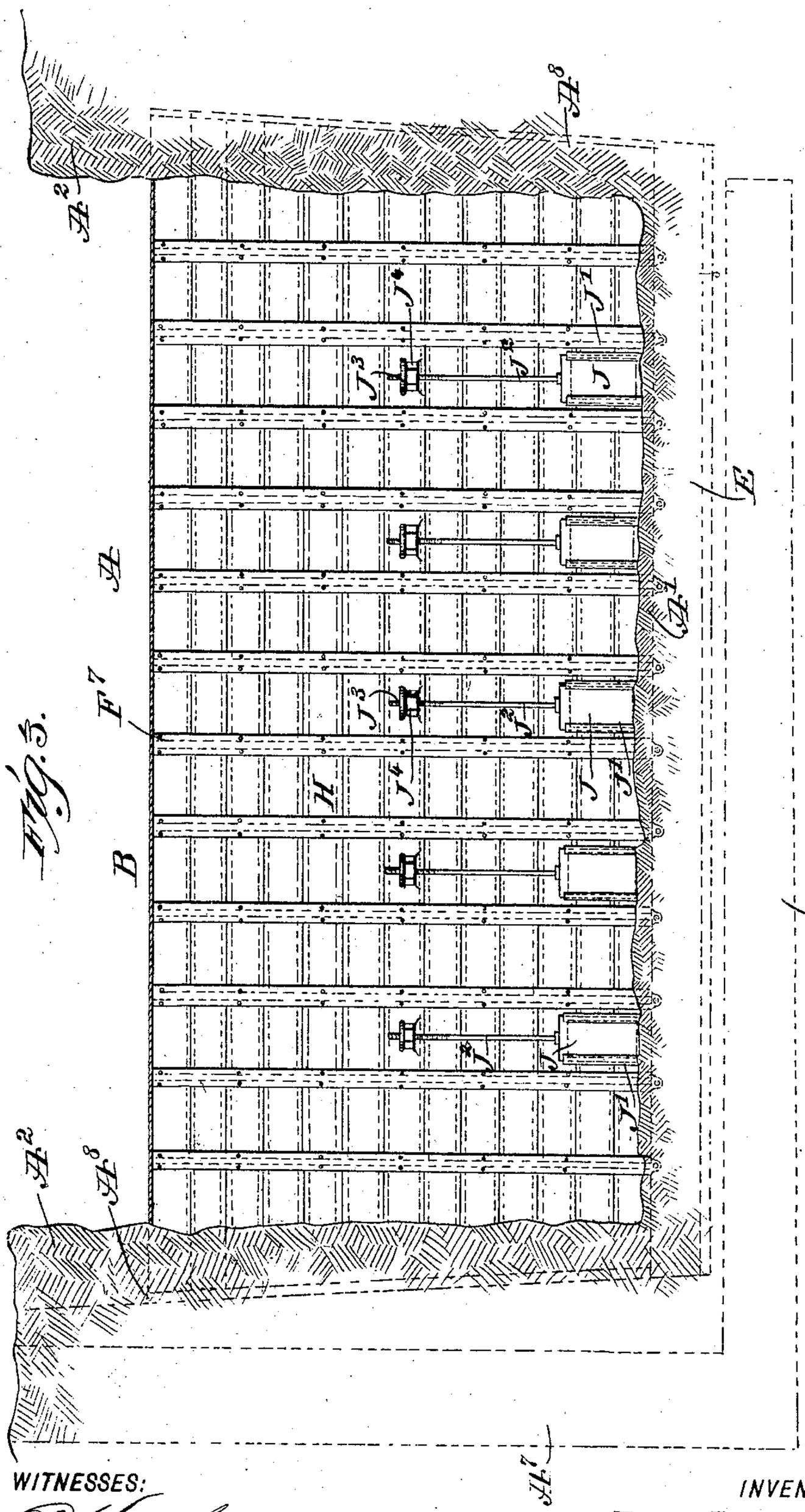

Fig. 5.

WITNESSES:

Geo. P. Kingsbury.

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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 4.

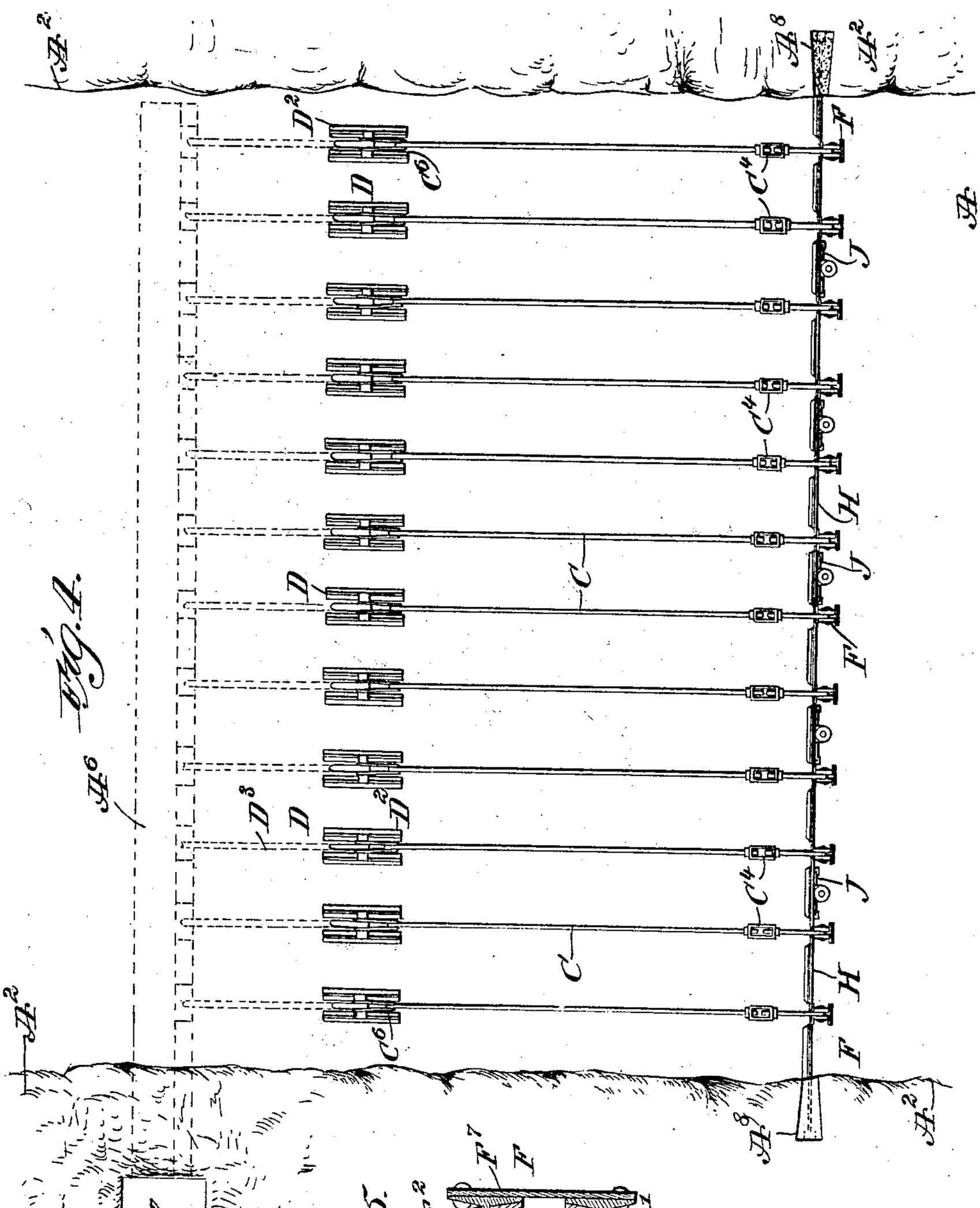

Fig. 5.

WITNESSES:

Geo. P. Kingsbury.

Henry Hoosier.

INVENTOR

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4 SHEETS—SHEET 4.

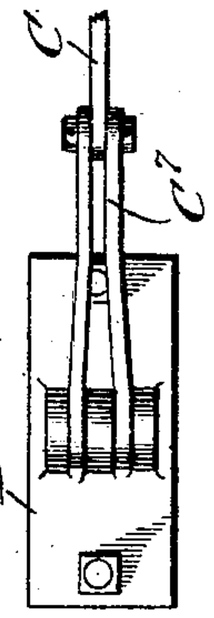

Fig. 10.

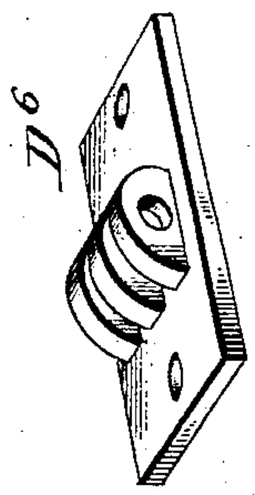

Fig. 11.

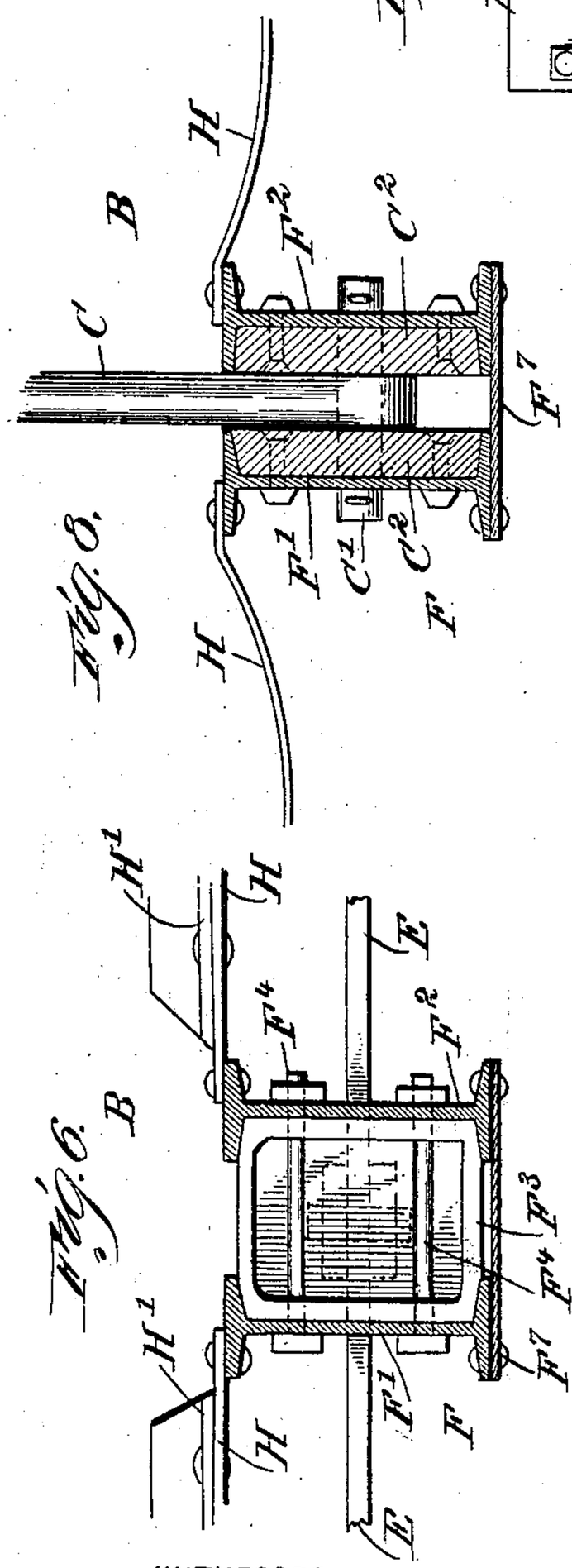

Fig. 8.

Fig. 6.

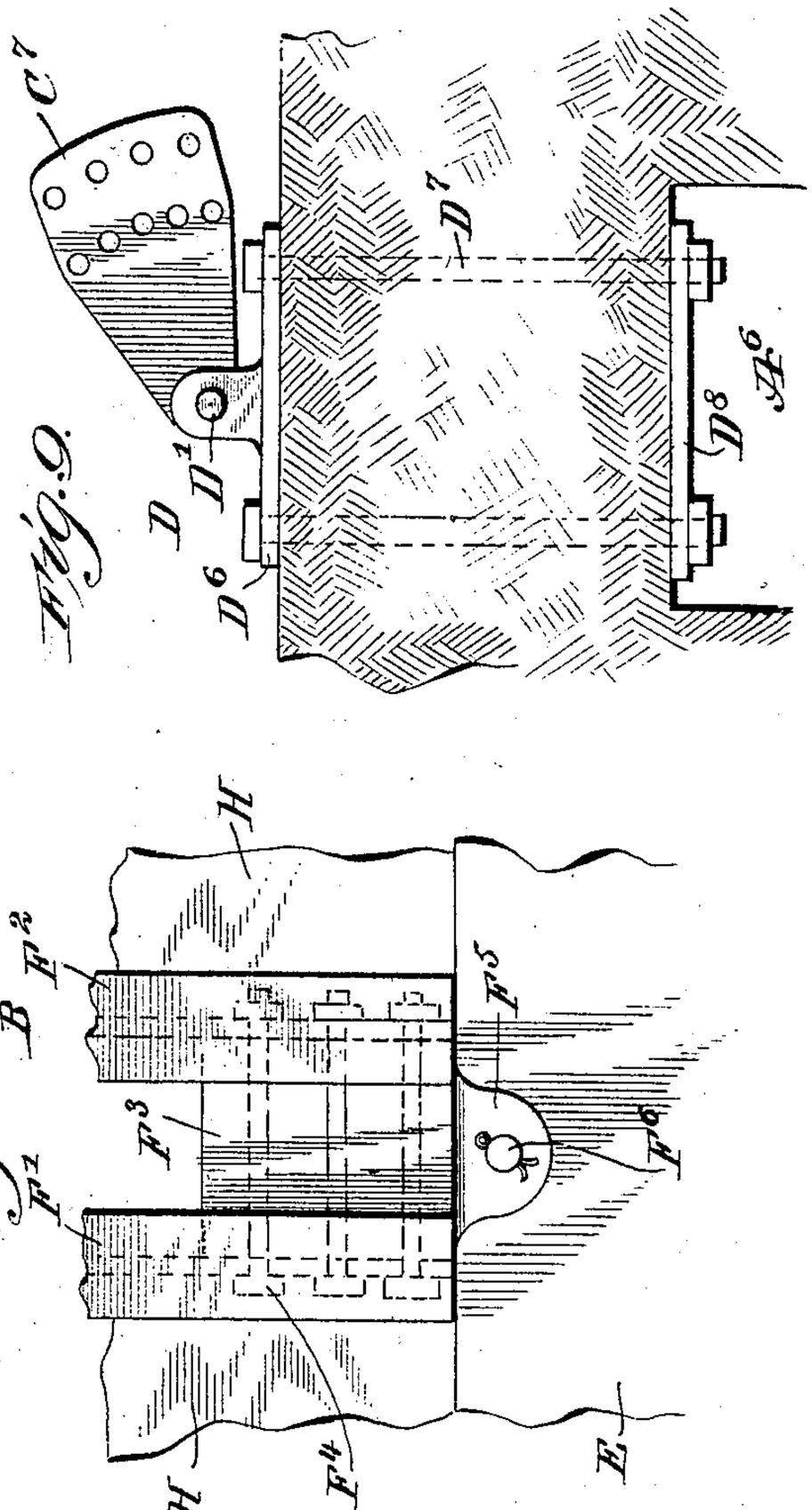

Fig. 9.

Fig. 7.

WITNESSES:

G. P. Kingsbury.

Rud. J. Hoosier

INVENTOR

Jesse Lincoln Holmes

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ATTORNEYS

No. 771,071. Patented September 27, 1904.

UNITED STATES PATENT OFFICE.

JESSE LINCOLN HOLMES, OF BUTTE, MONTANA.

METAL DAM.

SPECIFICATION forming part of Letters Patent No. 771,071, dated September 27, 1904.

Application filed October 28, 1903. Serial No. 178,856. (No model.)

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 Dam, of which the following is a full, clear, and exact description.

The invention relates to the formation of reservoirs for the storage of water used in power plants for irrigation purposes and the like.

The object of the invention is to provide a new and improved metal dam more especially designed for use in canyons, streams, and other waterways having steep or slanting banks, which dam can be readily set up, is exceedingly strong and durable, and is arranged to dispense almost entirely with the use of masonry and to allow of building the dam without seriously interfering with the natural flow of the water in the waterway.

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 longitudinal sectional elevation of the improvement as applied. Fig. 2 is an enlarged perspective view of one of the anchorages for the truss-rods. Fig. 3 is a face view of the downstream side of the improvement as applied, the spillway and the waterway being shown in section. Fig. 4 is a plan view of the improvement as applied, the spillway being omitted. Fig. 5 is an enlarged sectional plan view of part of the dam structure and brace connection. Fig. 6 is an enlarged sectional plan view of a post, the foundation-plate, and part of the facing. Fig. 7 is a face view of the same. Fig. 8 is an enlarged sectional plan view of a modified form of facing and connection with a brace. Fig. 9 is a side elevation of a modified form of anchorage as applied to the bed of the waterway. Fig. 10 is a plan view of the anchorage shown in Fig. 9, and Fig. 11 is a perspective view of the stand for the anchorage shown in Fig. 9.

The dam extending across a waterway A consists in its general construction of a metallic dam structure B, embedded at its bottom in the bottom A′ of the waterway A and embedded at its ends in the sides or banks A^2 of the waterway, so as to dispense with abutments and other masonry, and the said dam structure B is braced by braces in the form of truss-rods C, extending on the upstream side of the dam and connected with upstream anchorages D, set and held on the bottom A′ of the waterway. The foundation of the dam structure B is formed of an upright transversely-extending metallic plate E, (see Figs. 1, 6, and 7,) resting on the bottom of a recess A^3, formed transversely in the waterway and widened at the top, as at A^4. After the foundation-plate E is set in the recess A^3 it is locked therein by a filling A^5, of hydraulic cement or the like, and in order to prevent the foundation-plate E from being pulled up on an upward strain the side walls of the said recess A^3 are made tapering to enlarge the recess at the bottom, as plainly indicated in Fig. 1, and the lower end or base of the foundation-plate E is widened by the use of metallic strips E′, extending on both sides of the plate and throughout the length thereof.

On the top of the foundation-plate E are set posts F, placed suitable distances apart and each consisting of two spaced **I**-beams F′ and and F^2, (see Figs. 6, 7, and 8,) connected with each other at the lower ends by a bottom plate or block F^3, fastened in position by bolts F^4 and flush at its under side with the lower edges of the **I**-beams, so as to rest with the latter on the top of the foundation-plate E. From the under side of the bottom plate or block F^3 depend lugs F^5, straddling the foundation-plate E and secured thereto by a suitable bolt F^6, to prevent shifting of the post in either direction on the foundation-plate E.

It is understood that the web of each **I**-beam F′ and F^2 extends at right angles to the foun-

dation-plate E, as will be readily understood by reference to Fig. 6, and the said I-beams are spaced sufficient distances apart to permit the entrance of the outer ends of the truss-rods C, which outer ends are connected by transverse pivot-pins C′ with bearing-plates C^2, bolted or otherwise fastened to the inner faces of the webs of the I-beams F′ and F^2, as plainly illustrated in Fig. 5. The pivot-pins C′ preferably extend through openings in the said webs, and the outer ends of the said pivot-pins are covered by suitable caps C^3, likewise bolted or otherwise fastened to the webs of the I-beams and to the bearing-plates.

The downstream sides of the I-beams F′ and F^2 are connected with each other by a vertically-disposed plate F^7 for retaining the filling G of hydraulic cement or a mixture of hydraulic cement and crushed rock, the said filling being placed into the spaces between the I-beams, as will be readily understood by reference to Fig. 1, so as prevent leakage of the water by way of the posts.

The truss-rods C of the bracing are each preferably made in sections, connected with each other by a turnbuckle C^4, as plainly illustrated in Fig. 1, and the truss-rods for each post are pivotally connected by pivot-pins C^5 with a brace-plate C^6, fulcrumed on a pivot-pin D′, held in stands D^2, forming part of the anchorage and resting on the top of the bottom A′ of the waterway, as plainly shown in Fig. 1. It will be seen that the bearing-plates C^2 for the truss-rods are spaced suitable distances apart at the I-beams of each post, the said bearing-plates being spaced farther apart from the bottom upward, as less bracing is required near the upper end of the dam structure than near the lower end thereof. By the construction described the truss-rods C extend in a vertical plane and in a spread-out or fan shape from the brace-plate C^6, pivoted on the anchorage D. By use of the turnbuckle C^4 each truss-rod may be adjusted to a nicety when setting up the post, so as to insure proper bracing of each post throughout the entire length thereof from the anchorage D, located on the upstream side of the dam.

The pivot-pin D′ of each anchorage is engaged by the eye of an eyebolt D^3, extending through a bore-hole in the bottom A′ of the waterway. The bore-hole for the eyebolt D^3 is drilled from a tunnel A^6, formed transversely in the bottom A′ of the waterway and leading to a shaft A^7 (see Fig. 3) for the workmen to enter the tunnel in boring the said holes. The eyebolt D^3 extends into the tunnel, and its nut D^5 screws against a washer D^4, resting against one wall of the tunnel A^6, so that the strain of the brace for each post is exerted against the rock or other material forming the bottom A′ of the waterway, it being understood that the eyebolt D^3 extends in an angular direction and in the same vertical plane as the truss-rod C, so that an exceedingly strong anchorage for the truss-rod is provided.

The stand D^2 is preferably made in two parts, as illustrated in Fig. 2, but it may be made in one part, as shown in Figs. 9, 10, and 11; but in each case the eyebolt D^3 is pivotally connected with the stand, and the brace-plate C^6 is similarly connected with the stand and preferably at the same pivot which connects the eyebolt D^3 with the stand.

After the posts are erected and braced, as described, the dam-facing is placed in position on the upstream side of the posts, and this facing consists of metal plates H, riveted or otherwise secured to the flanges of the opposite I-beams of adjacent posts, so as to leave space between the flanges of the I-beams F′ and F^2 of a post for the passage of the truss-rods C. The plates H may be flat, as shown in Fig. 6, or arched, as illustrated in Fig. 8. In case the flat plates (shown in Fig. 6) are used the longitudinal joints of the plates are covered by bars H′, preferably made of T-iron and riveted or otherwise fastened to adjacent plates to greatly reinforce the facing and prevent leakage of the water at the joints.

The plates at the sides of the facing are extended into recesses A^8, formed in the banks or side walls of the waterway and are embedded in a filling of hydraulic cement to render the facing proof against leakage, to securely hold the dam structure in place without the use of abutments or other masonry.

By reference to Fig. 1 it will be seen that the bottom plates and the lower ends of the posts extend into the enlarged portion A^4 of the recess A^3, and the said parts are embedded in the hydraulic cement filled into the top portion A^4 after the plates H are in position on the posts erected on the already-embedded foundation-plate E.

The spillway I is formed of curved bars I′, bolted or otherwise secured to the upper ends of the posts B and extending from the same in a downstream direction, as plainly shown in Fig. 1. Braces I^2 are pivoted on bearing-blocks I^3 and I^4, of which the blocks I^4 are secured to the I-beams of the posts, the same as the bearing-blocks C^2 for the truss-rods C, and the blocks I^3 are secured to the webs of the bars I′. The bars I′ are covered by metallic plates I^5, which form the bottom of the spillway.

By the arrangement described the water flowing over the spillway I is projected a considerable distance downstream away from the foundation of the dam structure, so as not to injure the foundation, at the same time leaving a water-free space on the downstream-face of the dam structure for workmen to enter for repairs, inspection, and other purposes.

On the downstream side of the facing H are arranged gates J for covering openings in the facing at the lower end thereof to allow of draining the reservoir whenever it is desired to do so. The gates J are mounted to slide in vertical guideways J′, secured to the facing, and each gate is provided with an upwardly-extending rod J^2, having its upper threaded end engaged by a nut-wheel J^3, abutting against a bearing J^4 for the rod J^2 and secured to the facing. Now on the operator turning the nut-wheel J^3 the gate is raised or lowered, according to the direction in which the nut-wheel J^3 is turned. Other means may be employed for the same purpose.

Various parts of the dam may be differently constructed without deviating from the spirit of my invention. For instance, the anchorages D may each be made of a single-piece stand D^6, as shown in Figs. 10 and 11, and the base of such stand fastened by bolts D^7 to the bottom A′ of the waterway, the bolts D^7 engaging a retaining-plate D^8, resting against the roof of the tunnel A^6, as shown in Fig. 9. The brace-plate C^7 for the truss-rods C instead of being made of one piece may be made in sections, as shown in Figs. 9 and 10; but the said brace-plate in either case is pivotally connected with the anchorage-stand, and the truss-rods are pivotally connected with the brace-plate. The facing-plates H may be curved or arched in a transverse direction, as shown in Fig. 8, to increase the strength of the plates and to compensate for transverse expansion and contraction of the dam structure, owing to the variations in temperature during the several seasons. A similar result is obtained by having the **I**-beams F′ and F^2 of each post spaced apart to allow transverse yielding of the **I**-beams on undue expansion and contraction.

In building the dam the recesses A^3 A^8 and the tunnel A^6 and its shaft A^7 are formed in the waterway, and then the foundation-plate E is set in the recess A^3 and embedded in hydraulic cement, and while this operation is going on the holes for the anchorage eyebolts D^3 may be drilled from within the tunnel A^6 and temporarily closed—that is, until the eyebolts are inserted. The posts F are now erected on the foundation-plate E and the anchorages D placed in position and bolted down, and then the truss-rods C for the bracing are used and adjusted to properly brace the posts. Now while this work is going on the flow of the water in the waterway is not interfered with to any great extent. After the posts are in position and braced then the facing-plates are put in position, with the gates J, however, open to allow free flow of the water in the waterway, the gates being of such number and capacity that the entire volume of the water in the waterway can flow on without causing the level of the water to rise to any great extent. The lower portions of the facing and posts are embedded in hydraulic cement and the ends of the side plates of the facing are likewise embedded and the posts are filled with a filling material G to render the same solid and water-tight. When the dam structure is completed, the gates J are closed to dam up the water on the upstream side of the dam, thereby storing water for use in power plants or for irrigation and other purposes.

In the dam described the dam structure B, which has to retain the water, extends vertically, and hence exposes the least possible surface to the pressure of the water, and as the bracing for the dam structure and the anchorages therefor are all on the upstream side of the dam structure it is evident that the overflow passing over the spillway I does not come in contact with the bracing or anchorages, and hence it cannot interfere with or damage the same.

As the stored water is over the anchorages for the bracing it is evident that the weight of the water assists in holding the anchorages in place to withstand the strain exerted by the water against the dam structure and its bracing. By having the anchorages and bracing on the upstream side of the dam structure and submerged in the stored water, they are not liable to be injured by floating matter, ice, floods, &c. It will also be noticed that by the construction described every unit of support is dependent only on itself, and hence if a part should become weak or give out it does not necessarily invalidate the remaining parts, although the dam may be incapacitated for the time being.

When using the dam for wide waterways having slanting banks, the metal plates of the facing extend into the bed-rock the same as above described, but the posts are made shorter as the ends of the dam at the banks of the waterway are reached.

It will be understood that more than one tunnel A^6 may be employed for the anchorages to provide more rock resistance for the anchorages and braces.

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

1. A metal dam comprising a transverse dam structure having a facing and embedded at its bottom in the bed of the waterway and embedded at its ends in the sides of the waterway, and a bracing anchored upstream in the bed of the waterway and connected with the said dam structure, as set forth.

2. A metal dam comprising a transverse metallic dam structure having a sheet-metal facing and embedded at its bottom and ends in recesses in the bottom and sides of the waterway, upstream braces connected with the

said structure, and anchorages spaced from the structure at the upstream side thereof and engaged by the said braces, as set forth.

3. A metal dam comprising metal foundation-plates embedded in a transverse recess in the bed of the waterway, posts erected on the said foundation-plates, and a facing attached to the posts, as set forth.

4. A metal dam comprising metal foundation-plates embedded in a transverse recess in the bed of the waterway, posts erected on the said foundation-plates, and a facing attached to the posts, the ends of the facing being embedded in recesses in the sides of the waterway, as set forth.

5. A metal dam comprising metal foundation-plates embedded in a transverse recess in the bed of the waterway, posts erected on the said foundation-plates, a facing attached to the posts, and a bracing anchored upstream in the bed of the waterway and connected with the said posts, as set forth.

6. A metal dam comprising spaced posts erected in the waterway and extending in a row across the waterway, a dam-facing attached to the said posts, and braces anchored upstream and connected with the said posts, as set forth.

7. A metal dam comprising spaced posts erected in the waterway and extending in a row across the waterway, a dam-facing attached to the said posts, and braces anchored upstream and connected with the said posts, each brace consisting of a plurality of truss-rods arranged in a vertical plane and spread fan shape, the outer ends being connected with the corresponding post at different points in the height of the post, as set forth.

8. A metal dam comprising spaced posts erected in the waterway and extending in a row across the waterway, a dam-facing attached to the said posts, and braces anchored upstream and connected with the said posts, each brace consisting of an eyebolt anchored in the bed of the waterway and in longitudinal alinement with the corresponding post, a stand on the bed of the waterway, engaged by the eyebolt, a brace-plate pivoted on the said stand and truss-rods connecting the brace-plate with the post at different points of the height of the post, as set forth.

9. A metal dam comprising a metal foundation embedded in recesses formed in the bottom of the waterway, spaced posts erected on the foundation, braces anchored upstream and connected with the said posts, and a dam-facing of sheet metal attached to the said posts, as set forth.

10. A metal dam comprising a transverse row of posts erected in the waterway, each post consisting of a pair of spaced I-beams, bottom plates connecting the I-beams of a pair together, a dam-facing attached to the posts, braces, one for each post and pivotally connected therewith, and upstream anchorages for the said braces, as set forth.

11. A metal dam comprising a transverse row of posts erected in the waterway, each post consisting of a pair of spaced I-beams, bottom plates connecting the I-beams of a pair together, a dam-facing attached to the posts, braces, one for each post, each brace consisting of a plurality of truss-rods extending between the spaced I-beams, to pivotally connect with the same at their webs, and upstream anchorages for the said braces, as set forth.

12. A metal dam comprising a structure extending across the waterway and consisting of a metallic foundation embedded in a recess in the bottom of the waterway, posts erected on the said foundation, and a metal-dam facing on the said posts, the lower ends of the posts and the bottom of the facing being embedded in the bottom of the waterway, and the ends of the facing being embedded in the sides of the waterway, as set forth.

13. A metal dam comprising a structure extending across the waterway and consisting of a metallic foundation embedded in a recess in the bottom of the waterway, posts erected on the said foundation, a metal-dam facing on the said posts, the lower ends of the posts and the bottom of the facing being embedded in the bottom of the waterway, and the ends of the facing being embedded in the sides of the waterway, and a bracing for the said structure, consisting of upstream anchorages extending into a tunnel in the bed of the waterway and braces pivotally connecting the anchorages with the posts of the dam structure, as set forth.

14. A metal dam provided with posts, a facing consisting of metal plates attached to the posts, and bars over the joints of abutting plates, for reinforcing the facing and for closing the joints, to prevent leakage, as set forth.

15. A metal dam provided with spaced posts, each consisting of a pair of spaced I-beams and a bottom plate connecting the posts with each other, and a metal foundation-plate on which the bottom plate is secured, as set forth.

16. A metal dam provided with spaced posts, each consisting of a pair of spaced I-beams and a bottom plate connecting the posts with each other, each bottom plate having depending lugs, and a metal foundation-plate, on which rests the bottom plate and to which the lugs are secured, as set forth.

17. A metal dam provided with spaced posts, each consisting of a pair of spaced I-beams and a bottom plate connecting the posts with each other, and a metal foundation-plate on which the bottom plate is secured, the said posts resting with the lower edges of their webs on the said plate, as set forth.

18. A metal dam provided with spaced posts, each consisting of a pair of spaced I-beams and a bottom plate connecting the posts with each other, a metal foundation-plate on which the bottom plate is secured, and a metal facing consisting of plates secured to the I-beams of adjacent posts, as set forth.

19. A metal dam provided with spaced posts, each consisting of a pair of spaced I-beams and a bottom plate connecting the posts with each other, a metal foundation-plate on which the bottom plate is secured, a metal facing consisting of plates secured to the I-beams of adjacent posts, bearing-plates on the inner or opposite faces of the webs of the I-beams, anchorages, and truss-rods pivotally connecting the anchorages with the said bearing-plates, as set forth.

20. A metal dam provided with spaced posts, each consisting of a pair of spaced I-beams and a bottom plate connecting the posts with each other, a metal foundation-plate on which the bottom plate is secured, a metal facing consisting of plates secured to the I-beams of adjacent posts, bearing-plates on the inner or opposite faces of the webs of the I-beams, anchorages, truss-rods pivotally connecting the anchorages with the said bearing-plates, and closing devices for the said I-beams, to render the posts proof against leakage, as set forth.

21. A metal dam provided with an anchorage for the dam, braces consisting of anchor-stands set on the bottom of the waterway, an anchor-rod extending from the stand through the bed of the waterway into a tunnel in the bed, and means for securing the end of the anchor-rod in the tunnel in position against the wall of the tunnel, as set forth.

22. A metal dam provided with an anchorage for the dam, braces consisting of anchor-stands set on the bottom of the waterway, an anchor-rod pivotally connected with the anchor-stand and extending from the stand through the bed of the waterway into a tunnel in the bed, and means for securing the end of the anchor-rod in the tunnel in position against the wall of the tunnel, as set forth.

23. A metal dam provided with a dam structure, a stand fastened to the bed of the waterway, a brace-plate fulcrumed on the stand, and a series of truss-rods fulcrumed on the brace-plate and pivotally connected with the dam structure, as set forth.

24. A metal dam provided with a dam structure, a stand fastened to the bed of the waterway, a brace-plate fulcrumed on the stand, and a series of truss-rods fulcrumed on the brace-plate and pivotally connected with the dam structure, the truss-rods extending in fan shape from the brace-plate to pivotally connect with the dam structure at different points of its height, as set forth.

25. A metal dam comprising a transverse dam structure having a facing and embedded at its bottom in the bed of the waterway and embedded at its ends in the sides of the waterway, a bracing anchored upstream in the bed of the waterway and connected with the said dam structure, and a metal spillway attached to the upper end of the dam structure and extending downwardly from the downstream face of the structure, as set forth.

26. A metal dam comprising metal foundation-plates embedded in a transverse recess in the bed of the waterway, posts erected on the said foundation-plates, a facing attached to the posts, a bracing anchored upstream in the bed of the waterway and connected with the said posts, and a metal spillway, provided with bars attached to the upper ends of the posts, braces between the bars and posts and a metal bottom supported by the said bars, as set forth.

27. A metal dam comprising metal foundation-plates embedded in a transverse recess in the bed of the waterway, posts erected on the said foundation-plates, a facing attached to the posts, a bracing anchored upstream in the bed of the waterway and connected with the said posts, and a metal spillway consisting of curved bars secured to the upper ends of the posts, braces pivotally connecting the posts with the said bars and metal bottom plates supported on the said bars, as set forth.

28. A metal dam comprising metal foundation-plates embedded in a transverse recess in the bed of the waterway, posts erected on the said foundation-plates, a facing attached to the posts, a bracing anchored upstream in the bed of the waterway and connected with the said posts, and gates on the downstream side of the facing, as set forth.

29. A metal dam comprising a transverse dam structure having a facing and embedded at its lower end in the bed of the waterway and embedded at its ends in the sides of the waterway, a bracing anchored upstream in the bed of the waterway and connected with the said dam structure, a metal spillway attached to the upper end of the dam structure and extending downwardly from the downstream face of the structure, and gates on the said facing, below the spillway, as set forth.

30. A metal dam provided with a post formed of spacing I-beams, and a plate connecting the downstream-flanges of the beams with each other and leaving the upstream-flanges spaced apart, for the passage of braces, as set forth.

31. A metal dam provided with a post formed of spaced I-beams, a connecting bottom plate for fastening the beams together, a pair of bearing-plates attached to the inner faces of the webs of the I-beams, a brace-pin engaging the bearing-plates, and a brace extending between the I-beams and fulcrumed on the brace-pin, as set forth.

32. A metal dam provided with a post

formed of spaced I-beams, a connecting bottom plate for fastening the beams together, a plate connecting the flanges of the I-beams with each other, and a filling for the space between the I-beams, as set forth.

33. A metal dam provided with a metal dam structure embedded at its bottom and ends in the bottom and sides of the waterway, as set forth.

34. A metal dam provided with a bracing extending upstream therefrom in a plane parallel with the general direction of the water-pressure, said bracing being anchored in the bed of the waterway.

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

JESSE LINCOLN HOLMES.

Witnesses:
EDWIN M. LAMB,
W. Y. PEMBERTON.