No. 795,511. PATENTED JULY 25, 1905.

L. HOLMES.

DAM.

APPLICATION FILED SEPT. 10, 1904.

6 SHEETS—SHEET 1.

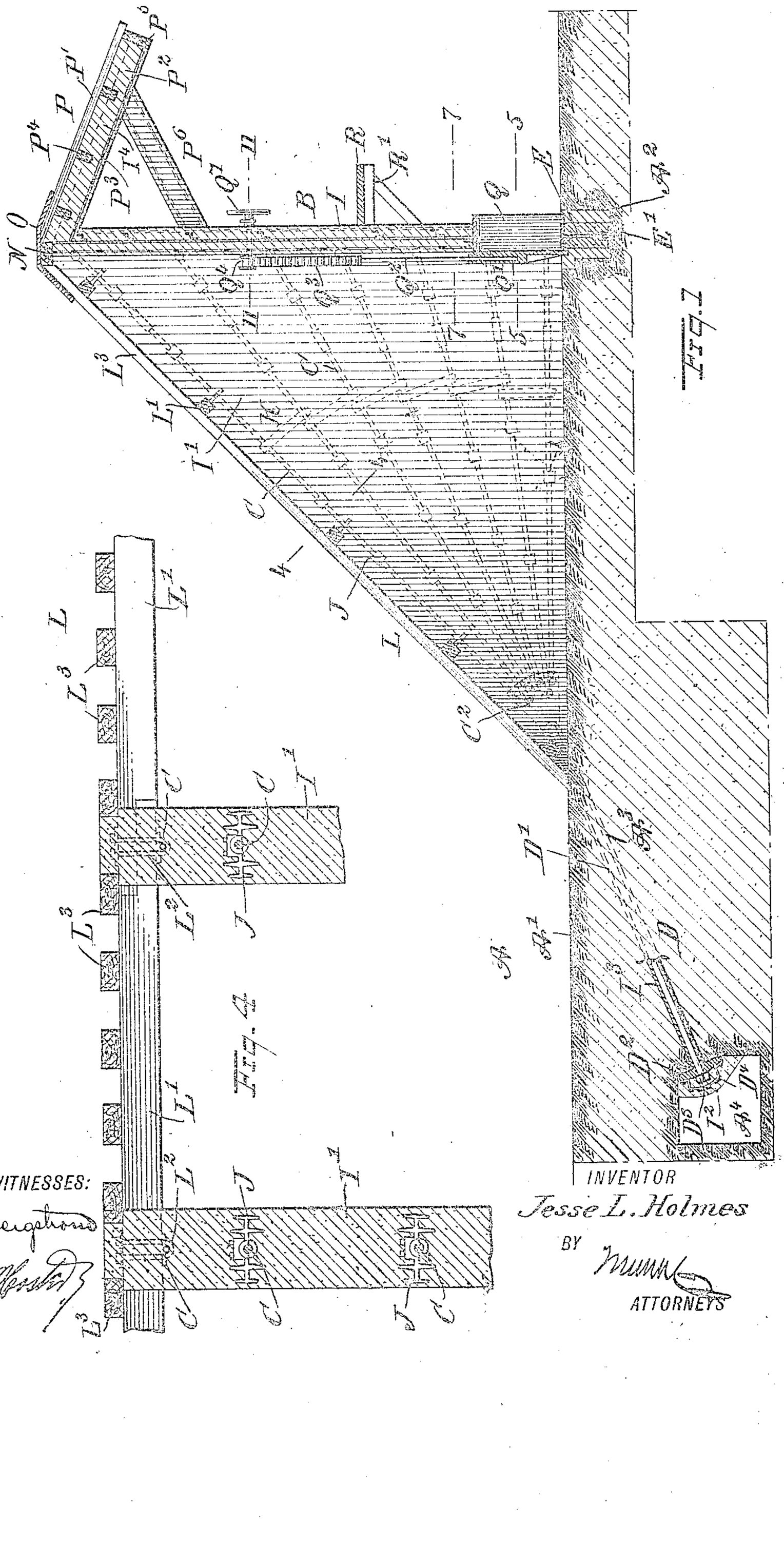

Fig. 1.

WITNESSES:

John A. Berglund

Rud. J. Hensler

INVENTOR

Jesse L. Holmes

BY Munn & Co.

ATTORNEYS

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6 SHEETS—SHEET 2.

Fig. 3

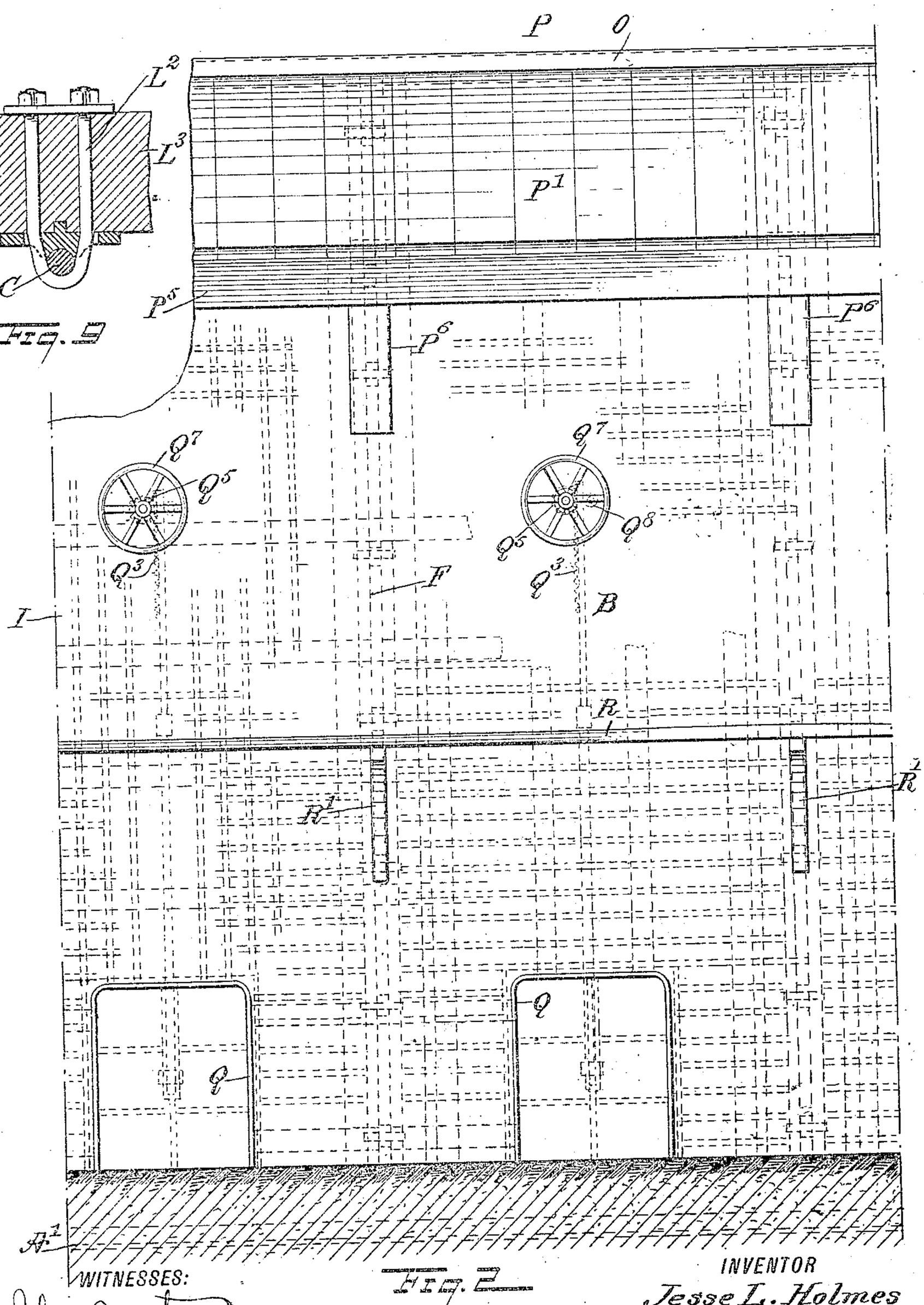

Fig. 2

WITNESSES:

John A. Bergstrom

Rud. J. Hoosteg

INVENTOR

Jesse L. Holmes

BY Munn & Co

ATTORNEYS

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J. L. HOLMES.

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6 SHEETS—SHEET 3.

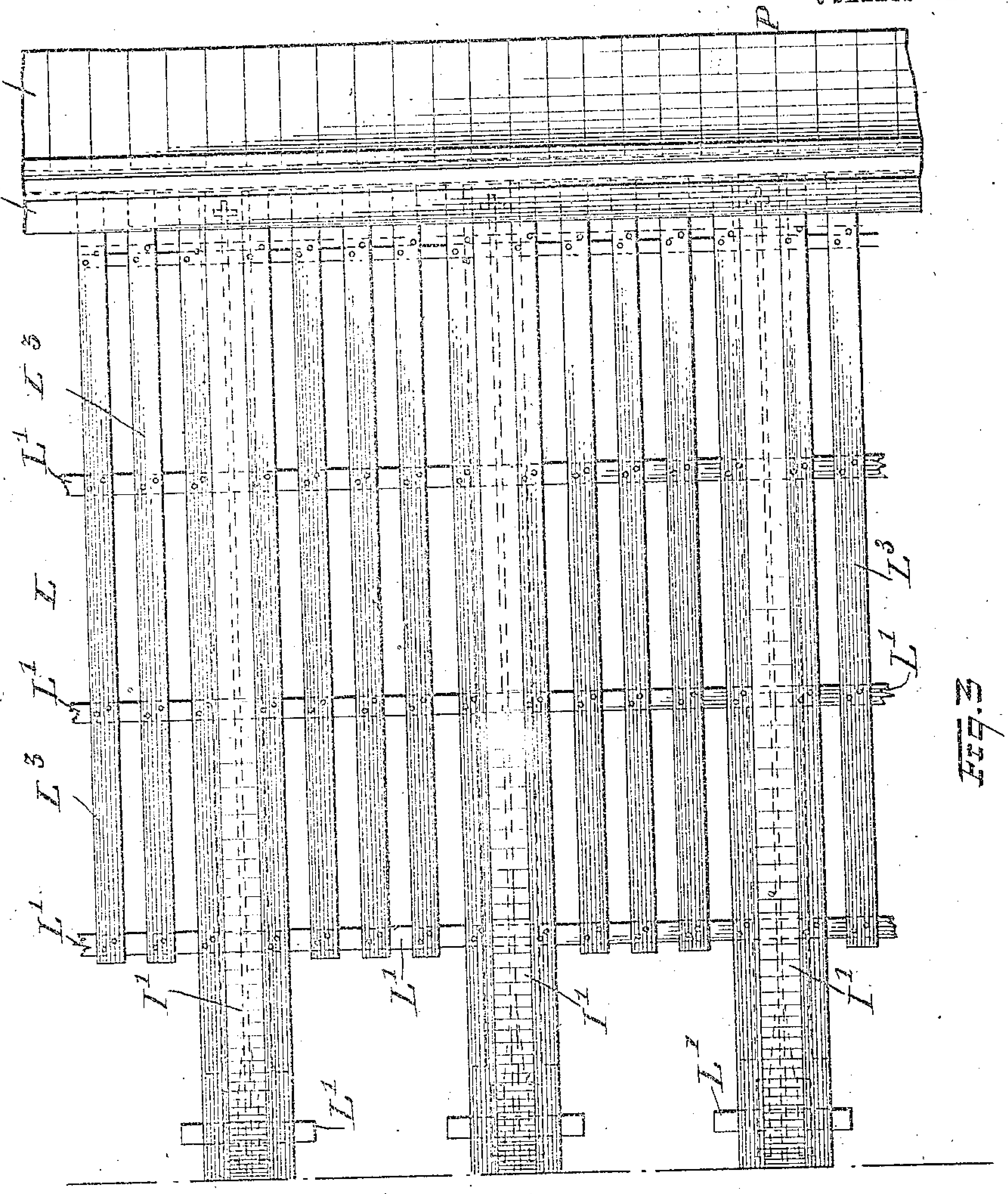
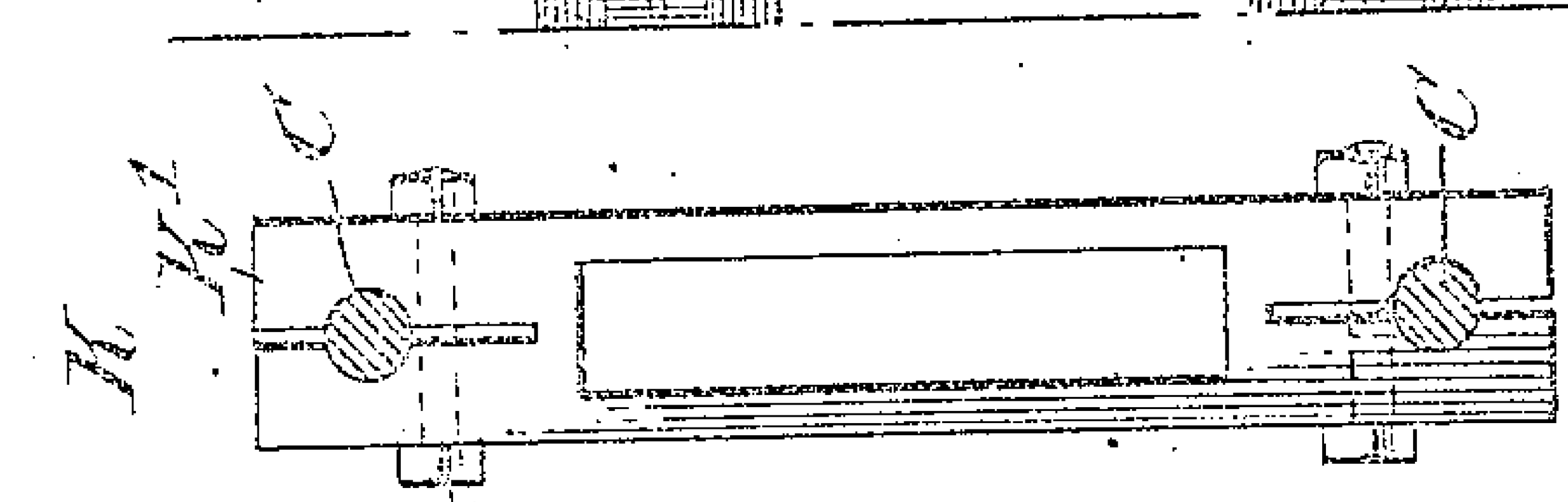


FIG. 9.



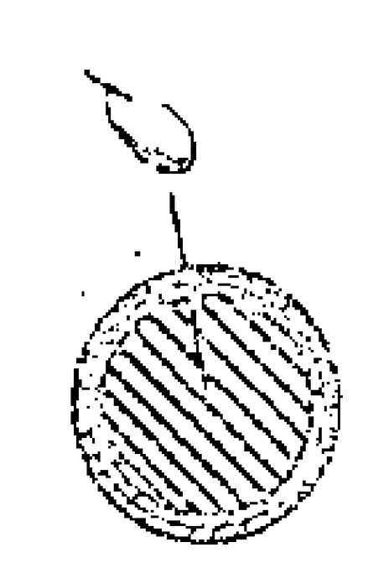


FIG. 10.

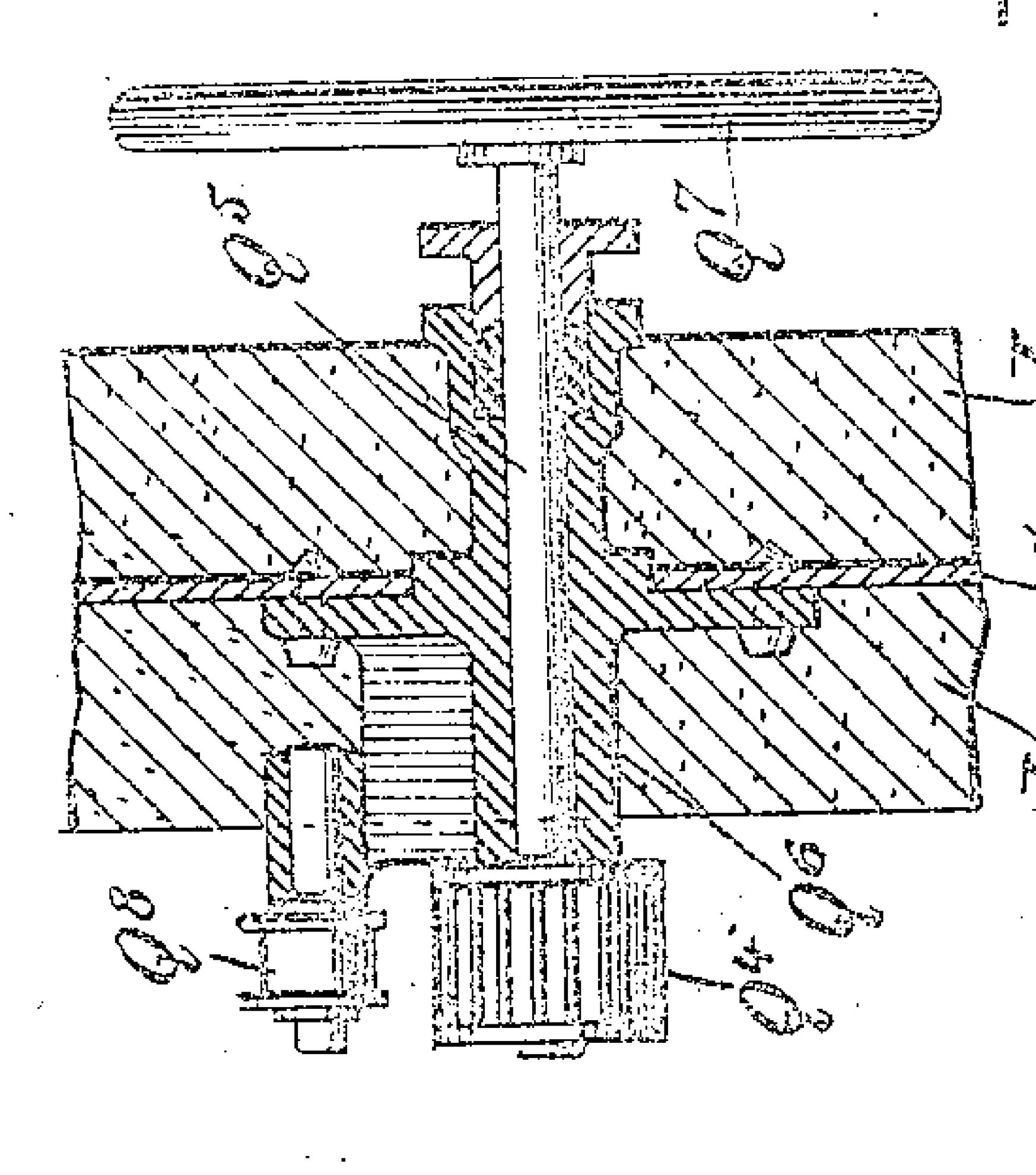


FIG. 11.

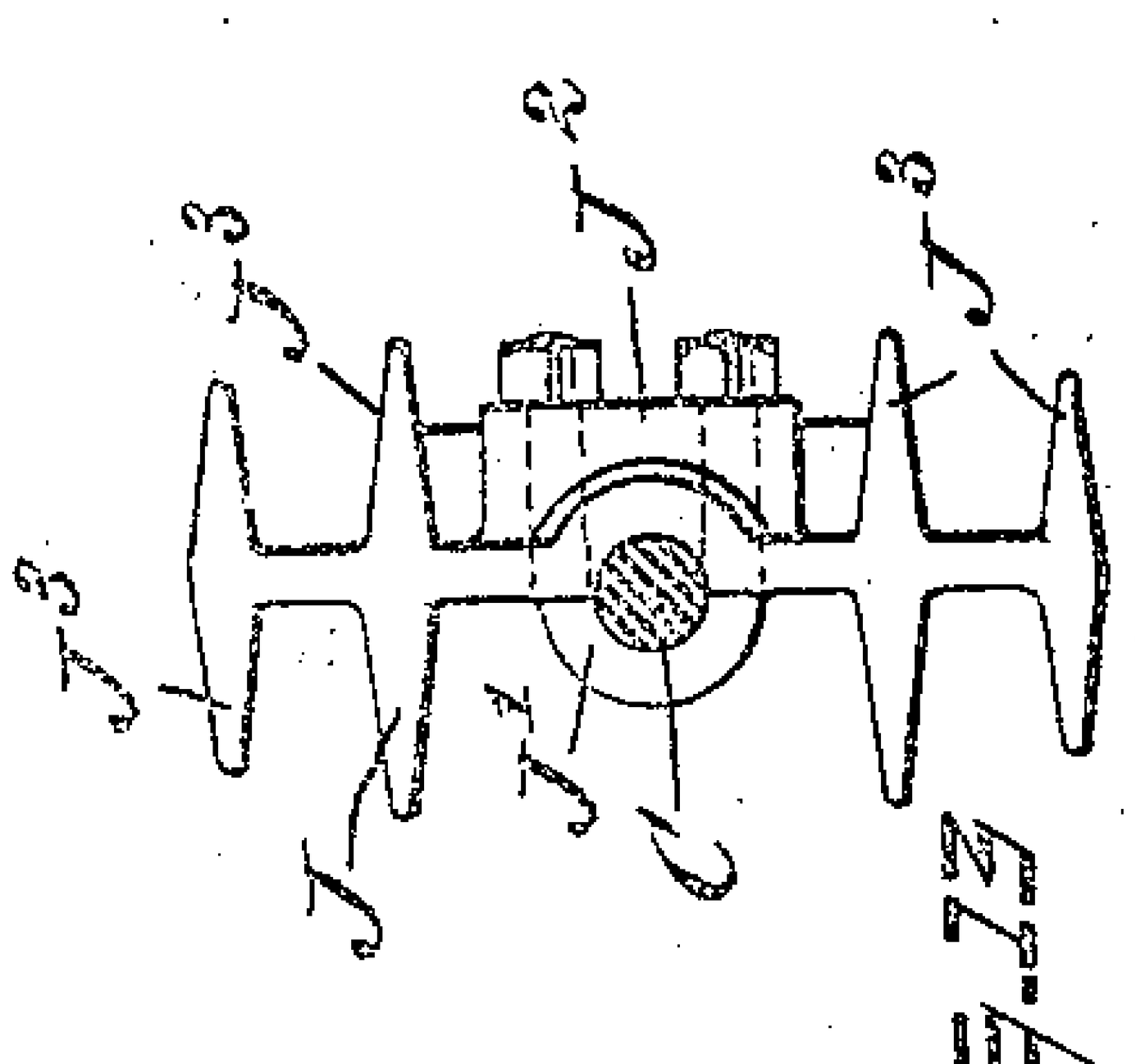


FIG. 12.

WITNESSES:

John A. Bergstrom

Geo. J. Hendricks

INVENTOR

Jesse L. Holmes

BY Munn & Co

ATTORNEYS

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J. L. HOLMES.

DAM.

APPLICATION FILED SEPT. 10, 1904.

6 SHEETS—SHEET 4.

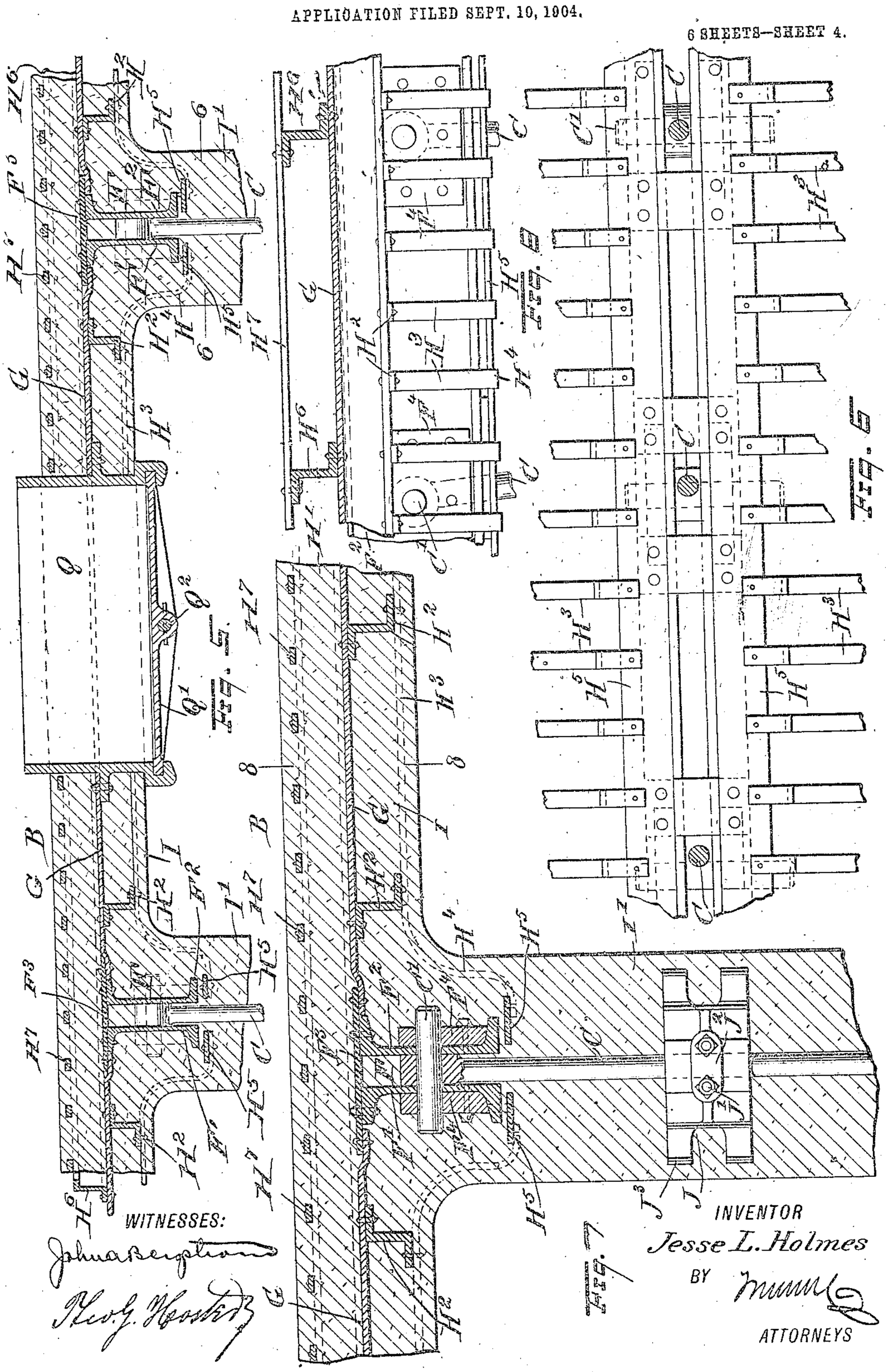

FIG. 6.

WITNESSES:

John A. Bergstrom

Rud. J. Hoos

INVENTOR

Jesse L. Holmes

BY Munn & Co

ATTORNEYS

No. 795,511. PATENTED JULY 25, 1905.

J. L. HOLMES.

DAM.

APPLICATION FILED SEPT. 10, 1904.

6 SHEETS—SHEET 5.

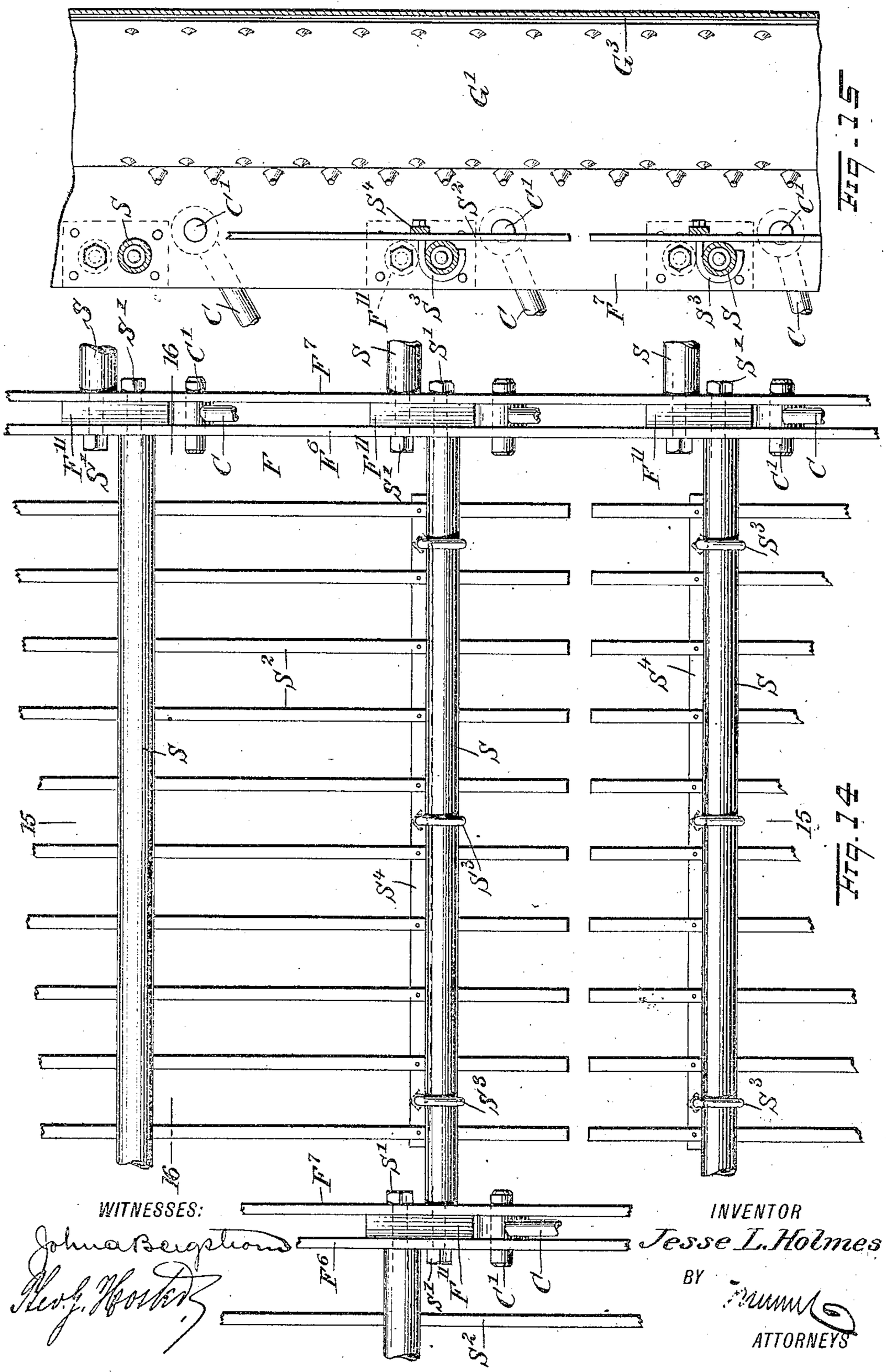

FIG. 7.

FIG. 7A

WITNESSES:

John A. Bergstrom

Alex. J. Hoover

INVENTOR

Jesse L. Holmes

BY

Munn & Co

ATTORNEYS

No. 795,511. PATENTED JULY 25, 1905.

J. L. HOLMES.

DAM.

APPLICATION FILED SEPT. 10, 1904.

6 SHEETS—SHEET 6.

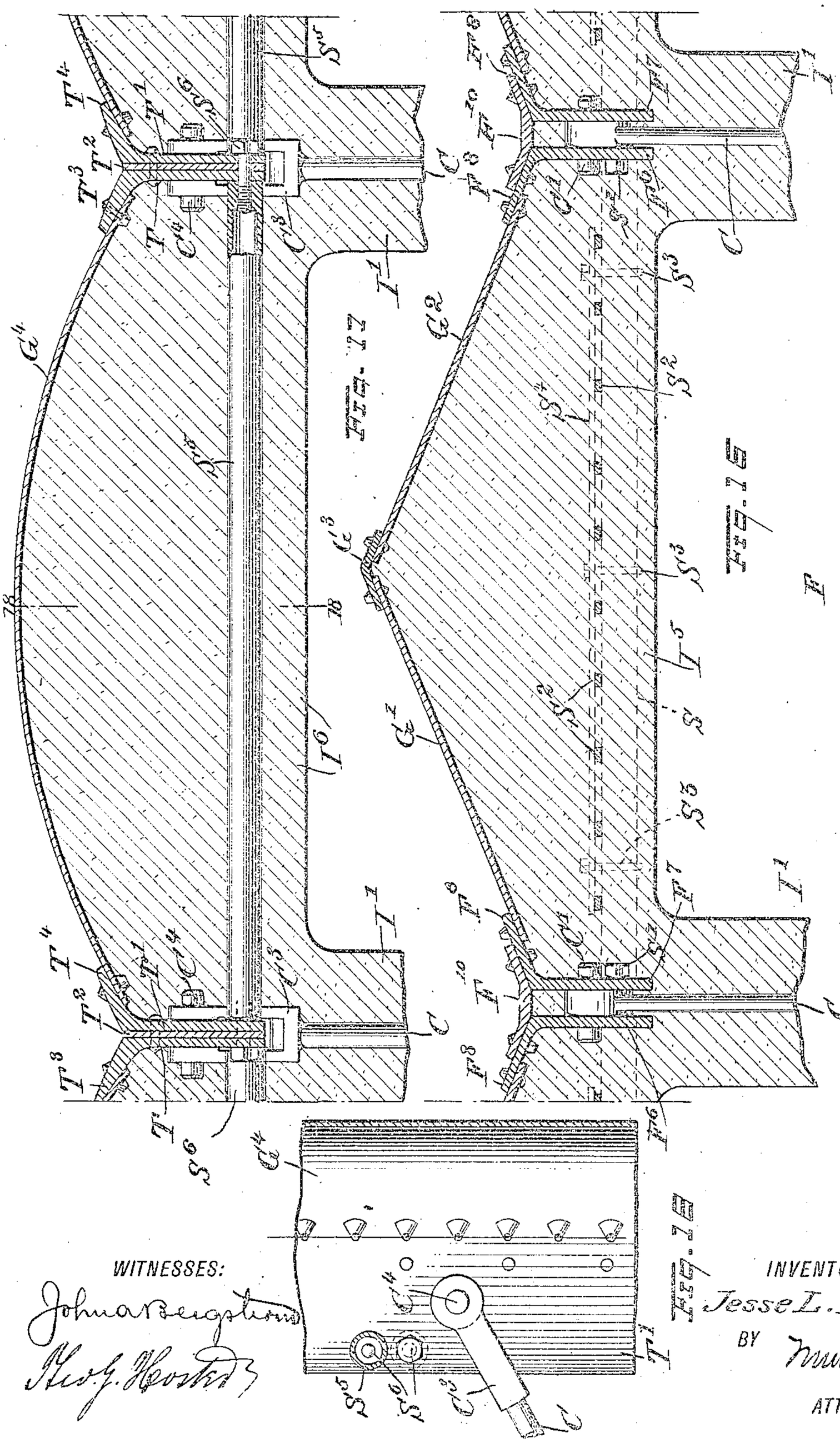

Fig. 17.

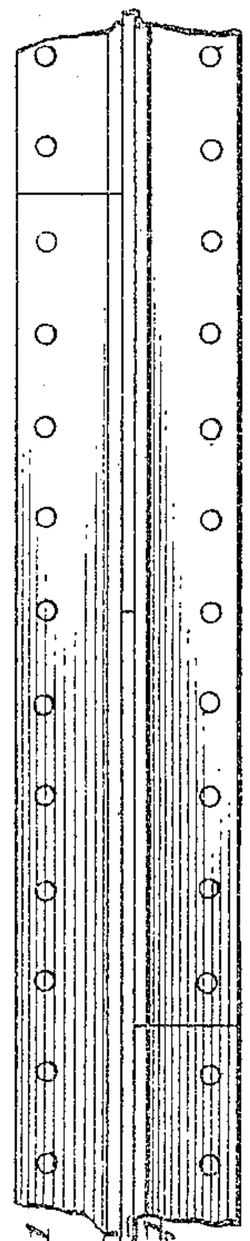

Fig. 18.

Fig. 19.

WITNESSES:

John A. Berglund

Rud. J. Hoosten

INVENTOR

Jesse L. Holme

BY Munn & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

JESSE LINCOLN HOLMES, OF BUTTE, MONTANA.

DAM.

No. 795,511. Specification of Letters Patent. Patented July 25, 1905.

Application filed September 10, 1904. Serial No. 224,010.

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

The invention relates to metal dams, such as shown and described in the application for Letters Patent of the United States, Serial No. 178,856, filed by me October 28, 1903, and allowed July 9, 1904.

The object of the present invention is to provide a new and improved dam for rivers and other waterways to permit of utilizing the dammed-up water for use in power plants, for irrigation, and other purposes, the dam being arranged to prevent or retard the corrosive action of the water and air on the metal-work of the dam, to properly brace the dam and hold the same against tipping over in an upstream direction when the water is withdrawn, and to protect the structure against ice, logs, and other floating matter.

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 sectional side elevation of the improvement. Fig. 2 is a downstream face view of the same. Fig. 3 is a plan view of the same. Fig. 4 is an enlarged cross-section of part of the upstream bracings, the section being on the line 4 4 of Fig. 1. Fig. 5 is an enlarged sectional plan view of the improvement on the line 5 5 of Fig. 1. Fig. 6 is a transverse section of the same on the line 6 6 of Fig. 5. Fig. 7 is an enlarged sectional plan view of the improvement on the line 7 7 of Fig. 1. Fig. 8 is a sectional side elevation of the same on the line 8 8 of Fig. 7. Fig. 9 is an enlarged cross-section of the fastening device for securing the cross-beam of the wooden grate to the uppermost truss-rod of a bracing. Fig. 10 is an enlarged cross-section of one of the metallic rods covered with a preservative fabric to prevent corrosion. Fig. 11 is an enlarged sectional plan view of the gear for operating a sluice-gate, the section being on the line 11 11 of Fig. 1. Fig. 12 is a cross-section of a pair of truss-rods and their connecting member. Fig. 13 is a cross-section of one of the truss-rods and an anchor-block thereon. Fig. 14 is a face view of a portion of the metallic part of a dam structure of modified form. Fig. 15 is a sectional side elevation of the same, the section being on the line 15 15 of Fig. 14. Fig. 16 is a sectional plan view of a dam structure of modified form, the metal-work of which is shown in Figs. 14 and 15, the section being on the line 16 16 of Fig. 14. Fig. 17 is a similar view of another modified form of the improvement. Fig. 18 is a sectional side elevation of the same on the line 18 18 of Fig. 17, and Fig. 19 is a side elevation of one of the posts of the main dam structure.

The dam extending across a waterway A consists in its general construction of a dam structure B, formed partly of metal and partly of concrete, the said structure being embedded at its bottom in a transverse recess A^2 in the bottom A′ of the waterway, and the said structure is also embedded at its ends in the sides or banks of the waterway, so as to dispense with abutments and other masonry, and the said dam structure B is braced by bracings in the form of truss-rods C, extending on the upstream side of the dam and connected with upstream anchorages D, held in the bottom A′ of the waterway, the said truss-rods C being embedded in concrete which forms a wing for the concrete of the dam structure B.

The foundation of the dam structure B is similar to the one shown and described in the application above referred to—that is, it consists of an upright transversely-extending metallic plate E, resting on the bottom of the said recess A^2, formed transversely in the waterway, the said plate being provided at its lower end with metallic strips E′ to form a broad bearing-face for the said plate. The concrete for the dam structure embeds the plate E and the remaining portion of the recess A^2 is filled with hydraulic cement, concrete, or other material, as plainly indicated in Fig. 1, to securely hold the foundation-plate and its concrete portion in position in the bed of the waterway.

On the top of the foundation-plate E are set posts F, spaced suitable distances apart and each consisting, preferably, of two spaced double L-beams F' and F^2, (see Figs. 5, 6, 7, and 8,) connected with each other at the upstream side by a plate F^3, to the projecting side of which is secured the facing of the dam structure B, the said facing consisting of metal

plates G. To the plates G of the facing, on both the up and down stream sides of the structure, are secured metallic supports for retaining the concrete filling I employed for embedding the metallic parts of the dam structure B, so as to protect the said metallic parts against the corrosive action of water and air. The support on the upstream side of the dam structure consists of vertically-disposed Z-shaped beams H^2, riveted or otherwise fastened to the plates G, and on the said beams H' are secured transversely-extending bars H^3, having curved ends H^4, attached to vertically-disposed plates H^5, set in front of the double L-beams F' and F^2 of the posts F, as plainly indicated in Figs. 5 and 7. The support on the downstream side of the dam structure consists of transversely-disposed Z-shaped beams H^6, riveted or otherwise fastened to the plates G, and on the said beams H^6 are secured vertically-disposed bars H^7. Now both supports H^2 and H^6 form a very convenient retaining device for holding the concrete filling I in position as the latter is built up in erecting the dam structure, the said concrete filling I being joined at each bracing by the concrete filling I' for the said bracing, so that this concrete filling I' forms an integral wing of the concrete filling I for the main structure.

The truss-rods C for each bracing are arranged in fan shape and are connected to pins C', extending transversely through the webs of the double L-beams F' and F^2 and through blocks F^4, secured to the said webs of the double L-beams, as plainly indicated in Fig. 7. The truss-rods C are pivotally connected at their upstream ends with a plate C^2, pivotally connected with the end of an eyebolt D', forming part of the anchorage D and extending through a hole A^3, drilled in an inclined direction in the bed or bottom A' of the waterway A. The eyebolt D' extends with its forward end into a tunnel A^4, formed transversely in the bed of the waterway, and on the said end of the eyebolt D' is held a washer D^2, against which screws the nut D^3 of the bolt D. The washer D^2 rests against the wall of t tunnel A^4, and on the said washer D^2 is secured a support D^4 for supporting a concrete filling I^2 to protect the forward end of the eyebolt and its washer D^2 against the corrosive action of water and air. The hole A^3, through which the eyebolt D' passes, is drilled somewhat larger than the eyebolt, so as to allow of filling the space between the eyebolt and the wall of the hole with a concrete or cement filling I^3 to protect the eyebolt against corrosive action.

In order to hold the truss-rods C against movement in the concrete filling I', each truss-rod is provided with one or more anchor-blocks J, (see Fig. 13,) each fastened by a U-shaped clip-bolt J' and clip-plate J^2 to the corresponding truss-rod. Each of the anchor-blocks J is preferably provided with a number of prongs J^3 to increase the efficiency of the anchor-block in holding the truss-rod against movement in the concrete filling.

In order to render each bracing very rigid, connecting members K are employed (see Figs. 1 and 12) for connecting adjacent truss-rods C with each other, each connecting member K having split ends K', engaged by bolts K^2, which when drawn up securely clamp the end K' on the corresponding truss-rod C.

In order to protect the concrete filling I' for the several bracings against ice, logs, and other floating matter, a suitable and preferably wooden grate L is provided, attached to the top face of the concrete filling I', and each top face is inclined from the bottom of the waterway upward to the top of the main dam structure B, as plainly indicated in Fig. 1. The grate L consists of transvere beams L', set into the concrete filling I', and the transverse beams L' are fastened by clips L^2 to the uppermost truss-rods C. (See Figs. 4 and 9.) On the transverse beams L' are secured grate-bars L^3, spaced suitable distances apart, as plainly indicated in Figs. 3 and 4, to form a wooden grate which prevents ice and other floating matter from injuring the concrete filling I'. The latter is preferably extended between the grate-bars L^3 adjacent to the upper sides of each filling I', as plainly indicated in Fig. 4. The lowermost transverse beams L' for the said adjacent grate-bars L^3 on the sides of each concrete filling I' do not reach from one bracing to the other, as it is not necessary to extend the entire wooden grate down to the bottom of the waterway.

A protecting-beam N, preferably of wood, extends on the top of the concrete filling I, against which abut the upper ends of the grate-bars L^3, and over the said beam N and the upper portions of the grate-bars L^3 extends a metallic cap O, which also extends over the upper portion of planks P' for a spillway P, presently to be described in detail. The spillway P extends from the upper end of the main dam structure B in an inclined direction, and downwardly on the downstream side of the structure B. The spillway P is formed partly of metal, concrete, and wood, and for this purpose the spillway is provided with metal bars P^2, secured to the posts F, and on the under side of the said metal bars P^2 is secured a grate or retainer P^3 for holding the concrete filling I^4 in position to embed the bars P^2 and also the transverse wooden beams P^4, on which the planking P' is fastened. The lowermost cross-beam P^5 forms a retainer for the lower end of the concrete filling I^4, the said beam being for this purpose made wider, as plainly indicated in Fig. 1. The spillway P is connected by braces P^6 with the posts F, each brace being made partly of metal bars embedded in concrete, as indicated in Fig. 1.

One or more sluiceways Q are provided for the main dam structure B, and each sluiceway Q is arranged preferably midway between adjacent bracings, and each sluiceway is preferably in the form of a casting set in and secured to a face-plate G, as plainly shown in Fig. 5, reference being also had to Figs. 1 and 2. On the upstream side of the sluiceway Q are formed suitable guideways for a gate Q′ to slide in in a vertical direction, the said gate being held on the lower end of a rod Q^2, provided at its upper end with rack-teeth Q^3, in mesh with a pinion Q^4, (see Fig. 11,) secured on one end of a shaft Q^5, mounted to turn in a suitable bearing Q^6, attached to a facing-plate G and extending through the concrete filling I at both faces thereof.

On the downstream end of the shaft Q^5 is secured a hand-wheel Q^7, which when turned by the operator causes the shaft Q^5 and the pinion Q^4 to rotate, so that the pinion Q^4 acts on the rack-teeth Q^3 to cause the gate Q′ to slide upward or downward, according to the direction in which the hand-wheel Q^7 is turned. In order to hold the rack Q^3 in engagement with the teeth of the pinion Q^4, a retaining pulley or roller Q^8 is provided, (see Fig. 11,) engaging the back of the said rack and journaled in suitable bearings formed on the main bearing Q^6.

A distance below the hand-wheels Q^7 is arranged a transversely-extending running-board R for the operator to stand on while turning the hand-wheels Q^7, the said running-board R being supported on brackets R′, attached to the downstream face of the main structure B. By the arrangement described it will be seen that the wheels Q^7 and the running-board R are located under the spillway P, which thus forms a protector or hood to prevent water passing over the spillway from reaching the operator manipulating the wheels Q^7.

The metal structure and the concrete for the main dam structure B may be differently arranged, especially when it is desired to build a heavier and stronger dam. For instance, as shown in Figs. 14, 15, and 16, each post F is formed of two members F^6 and F^7, spaced apart and having flanges F^8 extending in opposite directions and at obtuse angles to the members F^6 F^7, as will be readily understood by reference to Fig. 16. The metal facing of the dam in this case is preferably formed of two plates G′ and G^2, secured to the oppositely-disposed flanges F^8 of adjacent posts, and the face-plates G′ and G^2 are arranged at an obtuse angle relative one to the other and their adjacent ends are connected with each other by an angle-iron G^3. The truss-rods C are connected by their pins C′ with the spaced members F^6 and F^7 of each post.

In order to support the concrete filling I^5, a support is provided, consisting, essentially, of transversely-extending tubes or pipes S, having their ends formed with interior screw-threads engaged by bolts S′, extending through the members F^6 and F^7 of a post, the bolts S′ also passing through the spacing-blocks F^{11} between the members F^6 F^7 of the post, and the said ends of each tube S abutting against the opposite faces of adjacent posts. To the several tubes S are secured vertically-extending grate-bars S^2 by the use of suitable clip-bolts S^3 and clip-bars S^4.

By reference to Fig. 16 it will be seen that the concrete filling I^5 is only on the upstream side of the dam structure B; but this filling I^5 is joined by the concrete fillings I′ for the several bracings. The filling I^5 also passes between the spaced posts F^6 and F^7 and is retained in position therein by a connecting-plate F^{10}, riveted or otherwise fastened to the flanges F^8 of the members F^6 and F^7 at the downstream side of the dam structure. The plates F^{10} extend the entire length of the posts.

In the modified form shown in Figs. 17, 18, and 19 each vertical post is formed, essentially, of three flat members T, T′, and T^2, of which the members T and T′ are the outside members and the member T^2 is the middle member, placed between the members T and T′, the three members being riveted or bolted together. The members T, T′, and T^2 for a post of considerable length are each made in sections, the sections breaking joints, as plainly indicated in Fig. 19, to give the desired strength to the post. The outside members T and T′ are provided on the downstream side of the structure with flanges T^3 and T^4, to which the face-plates G^4 are riveted or otherwise secured, the said face-plates G^4, as shown, being preferably curved and made of one single piece instead of three parts, as shown in Fig. 16 and previously described.

The support for holding the concrete filling I^6 in place on this post (T T′ T^2) consists of tubes S^5, similar to the tubes S previously described and likewise fastened to adjacent posts by bolts S^6. (See Fig. 17.) In this case the metallic grate-support, consisting of the grate-bars S^2, is omitted, but the same may be employed. The truss-rods C for the post shown in Fig. 17 are provided with forks C^3, straddling the members T, T′, and T^2 of the corresponding post and secured to the same by the truss-rod pin C^4, extending through all the members.

By the arrangement described and shown the metal-work of the dam, with the exception of the cap N and the gates and their operating mechanisms, is embedded, and hence protected by the walls of concrete, hydraulic cement, or like material against the corroding influence of the water and air to insure long life of the dam.

The metal-work of the dam forms in itself a water-tight structure; but by the addition of the concrete fillings the efficiency of the

dam as to leakage is somewhat increased, though the principal function of the concrete filling is to protect the metal-work and to add to the stability of the entire structure. The concrete fillings also assist quite essentially in carrying the weight of the metal-work, and in dams of considerable heights—say, a hundred feet or more—this weight is considerable.

By having the concrete fillings I' for the bracings and integrally connecting the fillings I' with the fillings I the dam proper is braced against the tension of the truss-rods C, thus obviating all possible tendency of the dam structure B from tipping upstreamwardly when the water is run out, as the tendency of the truss-rods C is to draw the dam structure B upstreamwardly as soon as the water-pressure against the dam structure B is removed.

It will be seen that by protecting the concrete fillings I' and the bracings embedded therein by the use of the wooden grate L injury to the dam by floating ice, logs, &c., is prevented. In addition, to embed the metal parts in the concrete fillings it is desirable to inclose the metal parts in a waterproof fabric U by wrapping the latter around the metal parts, (see, for instance, Fig. 10,) which shows one of the truss-rods C covered by the fabric. This covering of the metal parts is mainly serviceable at the contact of wood and iron, as the tendency of the water is to work along the wood to the iron to corrode the same, especially as the wood and iron do not usually combine sufficiently close to form a water-tight joint. The metal parts instead of being covered by a waterproof fabric may be coated with a suitable waterproof paint or similar substance to obtain the same result.

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

1. A dam comprising a transverse metal dam structure, a bracing anchored upstream in the bed of the waterway and connected with the said dam structure, and a concrete filling for the said dam structure and that portion of the said bracing exposed to the action of the water.

2. A dam provided with a transverse metal dam structure formed of posts and plates connecting the posts with each other and closing the spaces between them, and a concrete filling for the posts and plates.

3. A dam provided with a transverse metal dam structure formed of posts and plates connecting the posts with each other and closing the spaces between them, and a concrete filling for the posts and plates, the concrete filling embedding the posts and plates.

4. A dam provided with a transverse metal dam structure, a bracing connected with the said dam structure upstreamwardly from the bed crossed thereby, a concrete filling for the said dam structure, and a concrete filling for the said bracing, integrally united with the dam-structure filling.

5. A dam provided with a transverse metal dam structure, a bracing connected with the said dam structure upstreamwardly from the bed crossed thereby, a concrete filling for embedding the said dam structure, and a concrete filling for embedding the said bracing and integrally united with the dam-structure filling.

6. A dam comprising a transverse metal dam structure consisting of spaced posts, facing-plates connecting the posts with each other, a concrete support, and a concrete filling on the said support and facing-plates.

7. A dam comprising a transverse dam structure consisting of spaced posts, facing-plates secured to the said posts, a support for the concrete attached to the said facing-plates, and a concrete filling held on the said support and against the facing-plates.

8. A dam comprising a transverse dam structure consisting of spaced posts, facing-plates secured to the said posts, supports for the concrete on both faces of the said facing-plates, and concrete fillings on both faces of the said plates and held on the said supports.

9. A dam comprising a transverse dam structure consisting of spaced posts, facing-plates secured to the said posts, supports for the concrete on both faces of the said facing-plates, and concrete fillings on both faces of the said plates, held on the said supports, the latter being embedded in the concrete fillings.

10. A dam comprising spaced posts, facing-plates attached to the posts, a support for the concrete between the posts, and a concrete filling held on and embedding the said support, the filling covering the face of the plates.

11. A dam comprising a metal dam structure, a concrete filling for the same, and a spillway for the dam, consisting of metal bars attached to the said dam structure at the upper end thereof, a metal grating on the said bars and a concrete filling on the said bars and grating.

12. A dam comprising a metal dam structure, a concrete filling for the same, and a spillway for the dam, consisting of metal bars attached to the said dam structure at the upper end thereof, a metal grating on the said bars, a concrete filling on the said bars and grating and planks covering the said concrete filling.

13. A dam comprising a metal dam structure, a concrete filling for the same, and a spillway for the dam, consisting of metal bars attached to the said dam structure at the upper end thereof, a metal grating on the said bars, a concrete filling on the said bars and grating, transverse wooden bars embedded in the top concrete filling and planks arranged lengthwise and secured to the said bars.

14. A dam comprising a metal dam structure, a metal bracing for the same, a main concrete filling for the said structure, a concrete filling for the said bracing, forming a

wing extending from the main concrete filling of the structure, and a protecting-cover for the top of the said concrete filling for the bracing.

15. A dam comprising a metal dam structure, a metal bracing for the same, a main concrete filling for the said structure, a concrete filling for the said bracing, forming a wing extending from the main concrete filling of the structure, the top of the said concrete-filling wing being inclined, and a cover for the said top of the filling-wing.

16. A dam comprising a metal dam structure, a metal bracing for the same, a main concrete filling for the said structure, a concrete filling for the said bracing, forming a wing extending from the main concrete filling of the structure, the top of the said concrete-filling wing being inclined, a cover for the said top of the filling-wing, and a cover for the top of the said main concrete filling for the structure.

17. A dam comprising a metal dam structure, a metal bracing for the same, a main concrete filling for the said structure, a concrete filling for the said bracing, forming a wing extending from the main concrete filling of the structure, the top of the said concrete-filling wing being inclined, a cover for the said top of the filling-wing, a cover for the top of the said main concrete filling for the structure, and a metallic cap over the said covers.

18. A dam comprising a metal dam structure, a metal bracing for the same, a main concrete filling for the said structure, a concrete filling for the said bracing, forming a wing extending from the main concrete filling of the structure, the top of the said concrete-filling wing being inclined, a cover for the said top of the filling-wing, a cover for the top of the said main concrete filling for the structure, a spillway of metal and concrete, extending from the upper end of the said structure, a planking covering the top face of the spillway, and a cap covering the said covers and the planking.

19. A dam comprising a main structure of metal and concrete, and a bracing of metal and concrete, the metal of the bracing connecting with the metal of the main structure and the concrete of the bracing connecting with the concrete of the main structure, to form a wing for the same, the said metal of the main structure being constituted in part of undivided face-plates.

20. A dam comprising a main structure of metal and concrete, a bracing of metal and concrete, the metal of the bracing connecting with the metal of the main structure and the concrete of the bracing connecting with the concrete of the main structure, to form a wing for the same, and a spillway extending downwardly, inclined from the upper end of the said main structure, the spillway being metal, concrete and a wooden covering, the spillway metal being supported from the metal of the main structure and the covering being on top of the concrete.

21. A dam comprising a main structure of metal and concrete, a bracing of metal and concrete, the metal of the bracing connecting with the metal of the main structure and the concrete of the bracing connecting with the concrete of the main structure, to form a wing for the same, the concrete of the bracing having an inclined top, and a wooden covering for the said top.

22. A dam provided with a metal bracing extending upstream and anchored in the bed of the waterway, and a concrete filling embedding the said bracing.

23. A dam provided with a bracing formed of truss-rods spread in fan shape and having a common anchorage, and a concrete filling in which the truss-rods are embedded.

24. A dam provided with a bracing formed of truss-rods spread in fan shape, and connecting devices connecting adjacent truss-rods with each other at points between their ends.

25. A dam provided with a bracing formed of truss-rods, a concrete filling in which the truss-rods are embedded, and anchor-blocks on the truss-rods and embedded in the concrete.

26. A dam provided with a bracing formed of truss-rods spread in fan shape, connecting devices connecting adjacent truss-rods with each other at points between their ends, anchor-blocks on the said truss-rods, and a concrete filling embedding the said truss-rods, the connecting devices and the said anchor-blocks.

27. A dam provided with a series of spaced bracings, each formed of metal and concrete, and a protector secured to the bracings and extending from one to the other.

28. A dam provided with a series of spaced bracings, each formed of metal and concrete, the metal being embedded in the concrete, and a wooden protecting-grate secured to the bracings and extending over the bracings from one to the other.

29. A dam provided with a series of spaced bracings, each formed of metal and concrete, the metal being embedded in the concrete, and a wooden protecting-grate comprising transverse beams embedded in the said concrete and attached to the metal and longitudinal grate-bars attached to the said beams.

30. A dam provided with a spillway of metal, concrete and a wooden covering for the concrete.

31. A dam provided with a spillway of metal, concrete and a wooden covering for the concrete, and a metallic cap over the top of the dam and the upper portion of the said covering.

32. A dam provided with a spillway of metal, concrete and a wooden covering for the

concrete, and braces of metal and concrete, connecting the dam with the spillway.

33. A dam comprising spaced metal posts, a sheet-metal dam-facing connecting the posts with each other, a support on the said facing, formed of transverse and vertical bars, and a concrete filling for the facing and the said support and embedding the latter.

34. A dam comprising spaced metal posts, a sheet-metal dam-facing connecting the posts with each other, a support on the said facing, formed of transverse and vertical bars, the transverse bars being secured to the facing and the vertical bars being fastened to the said transverse bars, and a concrete filling for the facing and the said support and embedding the latter.

35. A dam comprising spaced metal posts, a sheet-metal dam-facing connecting the posts with each other, supports on both faces of the said facing, formed of transverse and vertical bars, and concrete fillings for the facing and the said supports.

36. A dam comprising spaced metal posts, a sheet-metal dam-facing connecting the posts with each other, supports on both faces of the said facing, formed of transverse and vertical bars, the transverse bars of one support being fastened to the facing and the vertical bars of this support being secured to its transverse bars, and the vertical bars of the other support being secured to the facing and its transverse bars to the vertical bars, and concrete fillings for the facing and the said supports.

37. A dam provided with a spillway extending downwardly inclined from the upper end of the dam, gates in the dam, mechanisms for operating the gates and having controlling devices located on the downstream face of the dam, and a running-board on the downstream face of the dam, the said spillway forming a hood for the said running-board and the controlling devices.

38. A dam comprising a main structure of metal and concrete, a bracing of truss-rods and concrete, and an anchorage in the bed of the waterway, connected with the truss-rods.

39. A dam comprising a main structure of metal and concrete, a bracing of truss-rods and concrete, and an anchorage in the bed of the waterway, connected with the truss-rods, the anchorage consisting of an eyebolt connecting with the head-plate of the truss-rods, the eyebolt extending through a hole in the bed of the waterway into a tunnel, a washer on the bolt, abutting against the tunnel-wall and a concrete covering for the end of the bolt and the washer, within the said tunnel.

40. A dam comprising a main structure of metal and concrete, a bracing of truss-rods and concrete, and an anchorage in the bed of the waterway, connected with the truss-rods, the anchorage consisting of an eyebolt connecting with the head-plate of the truss-rods, the eyebolt extending through a hole in the bed of the waterway into a tunnel, a washer on the bolt, abutting against the tunnel-wall, and a concrete covering for the end of the bolt and the washer, within the said tunnel, the concrete covering consisting of a support fastened to the washer and a concrete filling held on the support and embedding the same.

41. A dam provided with a bracing formed of truss-rods, and devices connecting adjacent truss-rods with each other between their ends.

42. A dam provided with a bracing formed of truss-rods, a concrete filling in which the truss-rods are embedded, and anchor-blocks on the truss-rods embedded in the concrete and provided with projecting prongs.

43. A dam provided with a series of spaced bracings having common anchorage, and each brace formed of metal and concrete, and a protector secured to the bracings and extending from one to the other.

44. A dam provided with a series of bracings spread in fan shape and having common anchorage at one end, each brace formed of metal and concrete, the metal being embedded in the concrete, and a protecting-grate secured to the bracings and extending thereover and from one to the other.

45. A dam provided with a metallic post consisting of at least three members, of which two are the outside members and one is the middle member, placed between the outside members, the latter having integral side flanges extending outwardly in opposite directions.

46. A dam provided with a metallic post consisting of at least three members, of which two are the outside members and one is the middle member, placed between the outside members, the latter having integral side flanges extending outwardly in opposite directions and at obtuse angles.

47. A dam provided with a metallic post consisting of at least three members, of which two are the outside members and one is the middle member, placed between the outside members, each member being made in sections and arranged to break joints one with the other.

48. A dam provided with a plurality of posts, each formed of at least three members fastened together, the outside members having flanges, facing-plates attached to the said flanges, and a brace connecting adjacent posts with each other.

49. A dam provided with a plurality of posts, each formed of at least three members fastened together, the outside members having flanges, facing-plates attached to the said flanges, and a brace connecting adjacent posts with each other, the brace consisting of a tube having interiorly-threaded ends and bolts passing through the posts and screwing in the said threaded ends.

50. A dam provided with a plurality of posts, each formed of at least three members fastened together, the outside members having flanges curved facing-plates attached to the

said flanges, and a brace connecting adjacent posts with each other.

51. A dam comprising a metal dam structure, a series of metal bracings for the metal dam structure, an anchorage for each of the bracings, held in the bed of the waterway, a concrete filling for embedding the said metal dam structure and resting on the bed of the waterway, and a concrete filling for embedding each of the said bracings and resting on the bed of the waterway.

52. A dam comprising a metal dam structure, a series of metal bracings for the metal dam structure, an anchorage for each of the bracings, held in the bed of the waterway, a concrete filling for embedding the said metal dam structure and resting on the bed of the waterway, a concrete filling for embedding each of the said bracings and resting on the bed of the waterway, and anchor-blocks secured to the bracings and embedded in the concrete filling for the bracings.

53. A dam comprising a metal dam structure, a series of metal bracings for the metal dam structure, an anchorage for each of the bracings, held in the bed of the waterway, a concrete filling for embedding the said metal dam structure and resting on the bed of the waterway, and a concrete filling for embedding each of the said bracings and resting on the bed of the waterway, the top of the concrete filling being inclined upwardly from the bottom of the waterway to the top of the dam.

54. A dam comprising a metal dam structure, a series of metal bracings for the metal dam structure, an anchorage for each of the bracings, held in the bed of the waterway, a concrete filling for embedding the said metal dam structure and resting on the bed of the waterway, a concrete filling for embedding each of the said bracings and resting on the bed of the waterway, the top of the concrete filling being inclined upwardly from the bottom of the waterway to the top of the dam, and an inclined wooden grate on the said inclined tops of the concrete fillings for the bracings.

55. A dam comprising a metal dam structure, a series of metal bracings for the metal dam structure, an anchorage for each of the bracings, held in the bed of the waterway, a concrete filling for embedding the said metal dam structure and resting on the bed of the waterway, a concrete filling for embedding each of the said bracings and resting on the bed of the waterway, the top of the concrete filling being inclined upwardly from the bottom of the waterway to the top of the dam, and an inclined wooden grate on the said inclined tops of the concrete fillings for the bracings, the grate consisting of transverse beams embedded in the concrete fillings for the bracings, means to secure the transverse beams to the bracings and longitudinal spaced grate-bars attached to the said beams.

56. A dam comprising a metal dam structure, a series of metal bracings for the metal dam structure, an anchorage for each of the bracings, held in the bed of the waterway, a concrete filling for embedding the said metal dam structure and resting on the bed of the waterway, a concrete filling for embedding each of the said bracings and resting on the bed of the waterway, and metallic supports on both faces of the said structure, for retaining the concrete filling for the dam structure.

57. A dam comprising a metal dam structure, a series of metal bracings for the metal dam structure, an anchorage for each of the bracings, held in the bed of the waterway, a concrete filling for embedding the said metal dam structure and resting on the bed of the waterway, a concrete filling for embedding each of the said bracings and resting on the bed of the waterway, and metallic supports on both faces of the said structure, for retaining the concrete filling for the dam structure, each support consisting of spaced transverse and spaced vertical bars.

58. A dam provided with a spillway inclined downwardly from the upper end of the dam, gates in the dam, and means for operating each of the gates, having controlling devices located on the downstream face of the dam.

59. A dam provided with a plurality of posts, each formed of at least three members fastened together, the outside members having flanges, face-plates attached to the said flanges, a brace connecting adjacent posts with each other, and upstream truss-rods connected with the posts and having common anchorage.

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.