No. 764,916. PATENTED JULY 12, 1904.

W. L. CHURCH.

CONCRETE DAM.

APPLICATION FILED MAY 12, 1904.

NO MODEL.

Fig. 1.

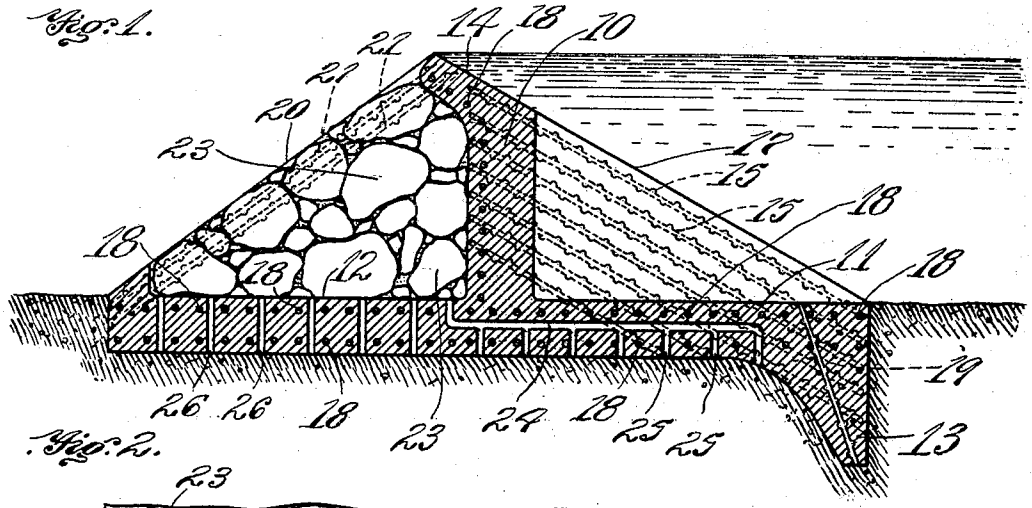



Fig. 2.

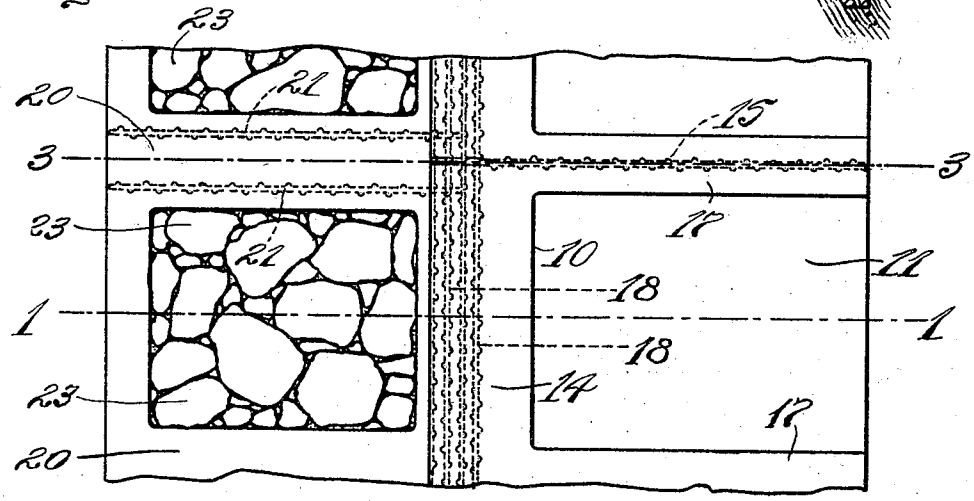
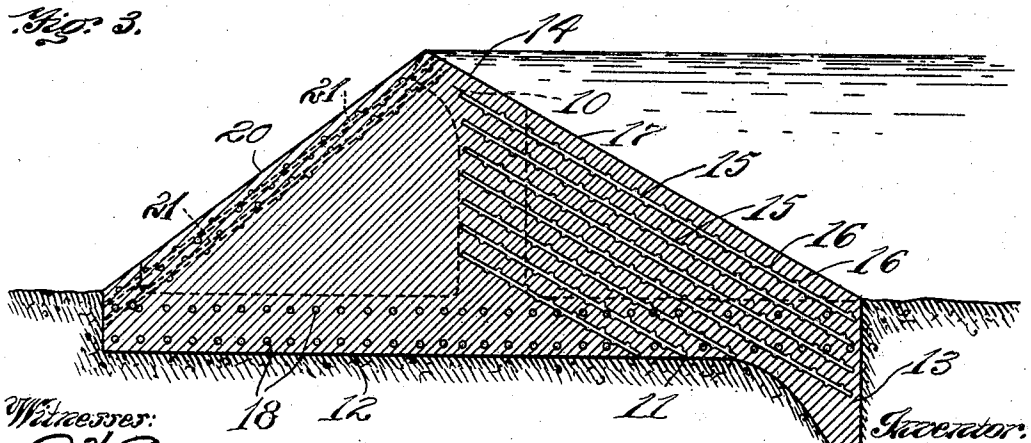



Fig. 3.




Witnesses:
P. W. Pezzetti
E. Batchelder

Inventor:
W. L. Church
by Wright, Brown & Quinby
Attys.

No. 764,916. Patented July 12, 1904.

# UNITED STATES PATENT OFFICE.

WILLIAM L. CHURCH, OF BOSTON, MASSACHUSETTS.

## CONCRETE DAM.

SPECIFICATION forming part of Letters Patent No. 764,916, dated July 12, 1904.

Application filed May 12, 1904. Serial No. 207,604. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM L. CHURCH, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Concrete Dams, of which the following is a specification.

This invention relates to the construction of concrete and metal dams, especially for low heads; and its main objects are, first, to provide such a disposition and combination of the elements and materials entering into the structure of the dam as will afford the requisite degree of strength to withstand the strains peculiar to these structures and yet reduce the amount of material and expense in building to a lower point than has heretofore been reached, and, secondly, to provide means for neutralizing static upward pressure on the floor of a dam of the above character. Other incidental results attained will appear in the more detailed description.

Of the accompanying drawings, Figure 1 represents a vertical transverse section of a dam constructed according to my invention. Fig. 2 represents a top plan view thereof. Fig. 3 represents a section on line 3 3 of Fig. 2.

The same reference characters indicate the same parts in all the figures.

The dam as I have shown it in the drawings is constructed to act both as a gravity-dam and as a pressure-dam, the weight of the water in the former case being the main factor of stability and the downstream length of the dam and the weight of said dam and its contents being the main factor in the second case.

10 is the substantially vertical water-retaining wall.

11 is a bottom wall or floor on the upstream side, and 12 is a floor on the downstream side, both floors integral with the vertical wall and all the walls made of concrete or an equivalent material. On the upstream lower edge the floor 11 is shown as formed with a cut-off wall 13.

The crest or lip of the vertical wall 10 overhangs on the downstream side and is inclined at 14 on the upstream side to form a slideway for ice. Neither of these latter features, however, is essential to the invention.

The vertical wall 10 is joined to the upstream floor 11 by a series of parallel inclined tie rods or bars 15 15, which are made of a self-locking character by projections 16 16 formed thereon at close intervals, or by other suitable means, so as to become fixed in the concrete by the interlocking action of the individual bar. These bars, or the majority of them, should preferably be embedded at their ends in the material of the wall 10 and floor 11 a distance sufficient to give them an anchorage which will cause them to break before pulling out of the walls. This in the case of a locking-bar made of Bessemer steel is about thirty times the diameter of the bar. With a sufficient number of bars thus disposed the tensile strain is practically borne entirely by the bars. It will be noted also that each of the bars has an individual hold on the concrete independent of the others. This avoids any tendency to cleavage of the concrete walls in planes parallel to their faces and does away with welds or other metallic joints, making an extremely strong and durable structure and one which may be cheaply and quickly built. To avoid exposure of the tie-rods 15, they are preferably incased in concrete partitions 17. In both horizontal and vertical walls are also embedded horizontal self-locking metallic bars or rods 18 18 of a character similar to the tie-rods 15, but not jointed thereto. The cut-off wall 13 is provided with similar rods 19. These several rods serve to impart strength to the concrete walls and tie one portion of the concrete to another. On the downstream side the vertical wall 10 is connected with the bottom wall or floor 12 by a series of compression-bearing buttresses 20 20, of concrete, integral with said walls and containing inclined self-locking bars 21 for maintaining the solidity of the buttresses. The floor 12 subserves several functions. It extends the fulcrum or overturning-point of the dam on the downstream side. It distributes the pressure transmitted by the buttresses 20 uniformly over the base or bed on which the dam rests, and in the case of a soft bottom on the downstream side it receives the impact of the water fall and prevents undermining. It furthermore acts as a support for the

boulders 23 23, with which I prefer to fill in the compartments existing between the buttresses 20, these boulders acting as ballast for increasing the stability of the dam and also serving to break the fall of the water from the dam-crest and diminish its destructive effects.

To relieve the floors 11 and 12 from the upward static pressure of any water which may permeate the bed of the dam, I form the floor 11 with a series of trunk-ducts 24, extending longitudinally of the stream-flow from points near the upstream edge of said wall to outlet-points on the downstream side of the vertical wall 10, each having a series of branches 25 25 extending to the lower face of said floor. The floor 12 is formed with a series of vertical ducts 26 26 opening on its upper and lower faces for a like purpose. These ducts drain off any leakage water from under the dam and prevent it from exerting an upward pressure on the dam.

It will be understood that when the conditions permit certain of the features herein described may be omitted—as, for instance, when there is a rock bed it may be desirable to omit the downstream floor 12 and under other conditions to omit other parts, which may be done without departing from the scope of the invention.

I claim—

1. A dam comprising an upright wall, bottom walls or floors integral with said upright wall on both its upstream and downstream sides, all of said walls formed of concrete, metallic tension locking-rods embedded at their ends in upright wall and upstream floor, and compression-buttresses connecting upright wall and downstream floor, and integral therewith.

2. A dam comprising an upright wall, a substantially horizontal floor integral therewith, both formed of concrete, inclined independently-anchored self-locking bars connecting said wall and floor, and concrete partitions incasing said bars and forming compartments open at the top.

3. A dam comprising an upright wall, a substantially horizontal upstream floor integral therewith, both formed of concrete, and a series of tension-rods formed to be self-locking in the concrete and having their ends embedded independently of neighboring bars in the said wall and floor for a distance giving substantially an irremovable anchorage.

4. A dam comprising integral concrete upright and downstream horizontal walls, the latter forming a ballast-supporting floor, compression-buttresses connecting said walls at intervals and forming ballast-compartments open at the top, and boulders in said compartments supported on said floor.

5. A dam comprising integral concrete upright and downstream horizontal walls, the latter forming a ballast-supporting floor, compression-buttresses connecting said walls at intervals and forming ballast-compartments open at the top, independently-anchored inclined self-locking metallic bars embedded in said buttresses, and boulders in said compartments supported on said floor.

6. A dam comprising an upright wall, a substantially horizontal floor integral therewith, both of concrete, and a pressure-relieving conduit structure formed in the floor of said structure and having numerous inlets on the lower face of the floor and a discharge-outlet on the downstream side of the upright wall.

7. A dam comprising an upright wall, a substantially horizontal upstream floor integral therewith, both formed of concrete, and a duct formed in said floor and having numerous branch inlets on the lower face of the floor on the upstream side of said wall, and a discharge-outlet on the downstream side of said wall.

8. A dam comprising an upright wall, a substantially horizontal downstream floor integral therewith, both formed of concrete, said floor having numerous through perforations extending from its lower to its upper face.

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

WILLIAM L. CHURCH.

Witnesses:

R. M. PIERSON,

A. C. RATIGAN.