

N. L. HALL.
 MEANS FOR DRAINING HYDRAULIC FILL DAMS.
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2 SHEETS—SHEET 1.

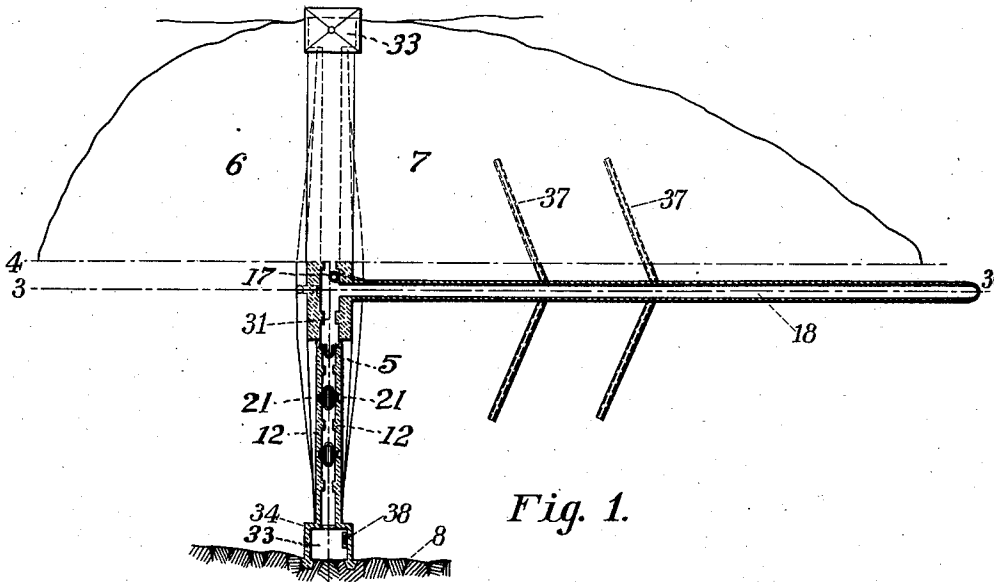


Fig. 1.

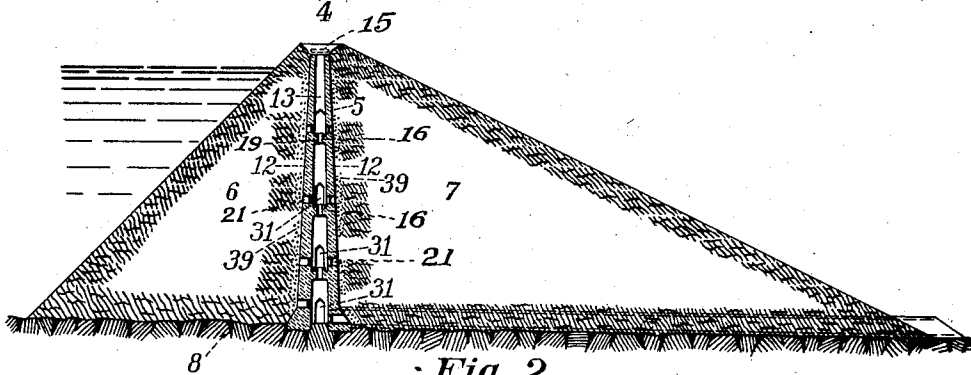


Fig. 2.

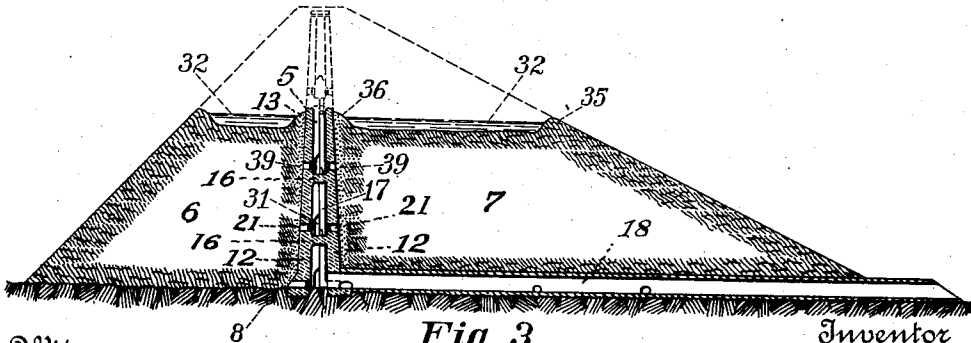


Fig. 3.

Witnesses

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 MEANS FOR DRAINING HYDRAULIC FILL DAMS.
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2 SHEETS—SHEET 2.

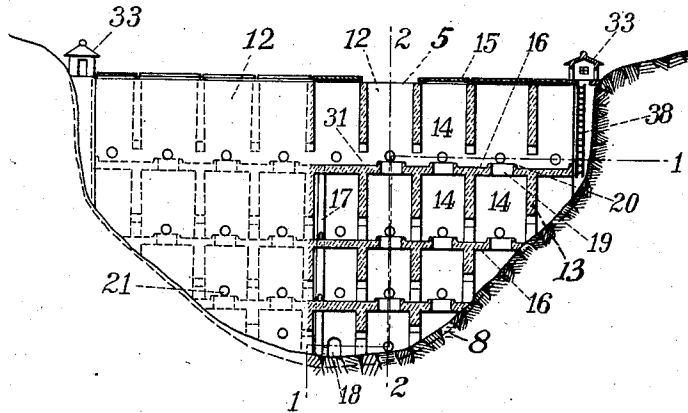


Fig. 4.

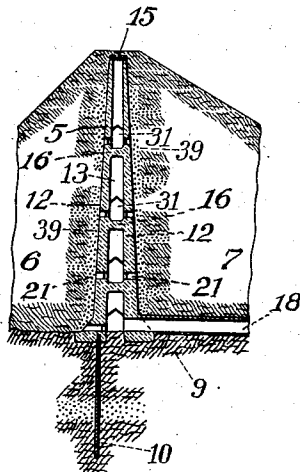


Fig. 5.

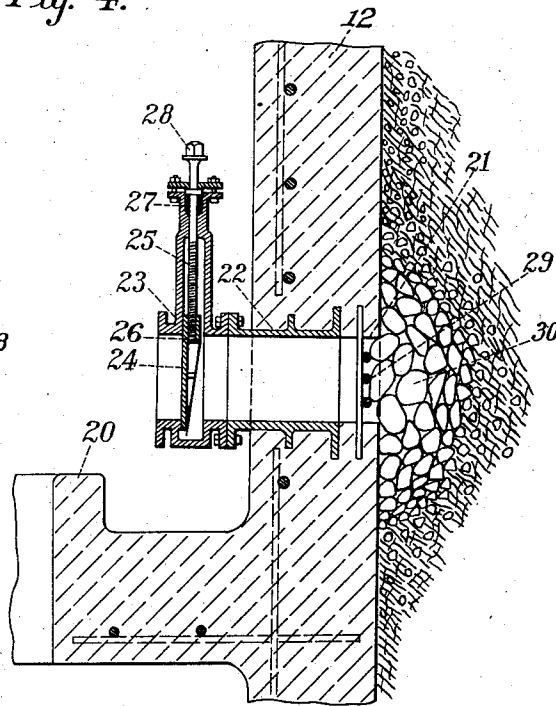


Fig. 6.

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MEANS FOR DRAINING HYDRAULIC-FILL DAMS.

1,011,427.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, NEWTON L. HALL, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Means for Draining Hydraulic-Fill Dams; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in means for draining hydraulic fill dams.

Hydraulic fills in dams have heretofore been drained by standpipes or by a system of drains laid along the rockbed. My improved system, of which the hollow core disclosed in United States Letters Patent No. 923,831, issued June 8, 1909, is the basis, provides primarily for the draining of the heart of hydraulic fills, and for lowering the head of the suspended sluicing water; provides a safe method of draining for an excessive amount of sluicing water, and technically draws the sedimentary deposit toward the core. The core wall is divided and floored so that the sluicing water of an elevation is locally drained, thereby preventing the flooding of the core. There is a main drainage tunnel large enough for men to enter. From this tunnel branch drains may be laid to assist in draining the lower fill. A vertical drainage duct drains each floor and empties into a drainage tunnel. There are gates in the core wall of simple construction, to drain the sluicing water adjacent the core primarily, and after the fill has become set the gates in the upper wall are closed. The gates in the lower wall are similarly closed, but can be opened if desired to keep the fill drained of surface water. The drainage gates are operated from within the core. This method of drainage would assist to obviate a resaturation of the fill should such tend to occur, and also decrease the liability for any portion of the fill to slide. The core wall is built with a slab top covering so that the slabs or cover sections may be removed separately and admittance gained directly below into the hollow of the core

through the traps in the floor. These traps are curbed above the floor so that water on the floor will not pass through, but flow to the corresponding drainage duct leading downwardly from that floor. As in my former patent, the hollow feature insulates one fill from any hydraulic effect on the other.

The hydraulic method employed in making fills of the character herein described, moves material having particles of less than 100 pounds weight, but this material generally consists of clay, silt, gravel or sand. In the best practice the fill and the core should be maintained at about the same level during construction, to obviate exposure of the core to temperature change, and thus avoid temperature cracks. At each end of the core under the entry house, the core walls are elbowed and offset, so that the expansion and contraction due to temperature change are not wholly met by direct thrust or withdrawal of the core from the abutments. On foundations of earth or gravel any underflow is cut off by a row of sheet piling, as in common practice. However, in this case it is quite desirable that no hydrostatic pressure shall pass through underlying strata from one fill to the other. Also it is desirable to keep the lower fill as free from saturation as possible and to make the core wall an absolute seal.

The core wall drainage gates can be of several types. As shown, they consist of one-way gate valves connected to a pipe set in the wall of the concrete. This pipe is in turn screened by metal bars against which rest cobbles graded smaller till the standard of the fill has been reached. This tends to filter the drainage water and also prevents the entrance of the gates from becoming clogged. The concrete or cement structure of the core wall is preferably metal reinforced.

Having briefly outlined my improved construction, I will proceed to describe the same in detail, reference being made to the accompanying drawing in which is illustrated an embodiment thereof.

In the drawing: Figure 1 is a view partly in top plan of a dam with my improved core wall in place, the remainder of the view being a horizontal section taken on the line 1—1, Fig. 4. Fig. 2 is a vertical cross section of the dam cutting the core

wall on the line 2—2, Fig. 4. Fig. 3 is a cross section of the dam on the line 3—3, Fig. 1. In this view the dam as illustrated is not completed, but is shown as it would appear in process of construction. Fig. 4 is a view of the core wall partly in elevation and partly in section, the sectionized part being taken on the line 4—4, Fig. 1. Fig. 5 is a fragmentary cross section of the dam similar to Fig. 3, but shown with a soft or earth and gravel foundation, and arranged with a sheet piling cut-off. Fig. 6 is a detail of a discharging gate, being a fragmentary section taken through the core cutting one of the gates and shown on a larger scale.

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

Let the numeral 5 designate my improved core wall, having hydraulic fills 6 and 7 located respectively upon the up-stream and down-stream sides of the core, which in Figs. 1, 2, 3 and 4 is illustrated as resting upon a rock foundation 8, while in Fig. 5 a relatively soft earth or gravel foundation 9 is illustrated, a sheet piling structure 10 extending downwardly from the base of the core to form a cut-off. This core is centrally located between the two fills and has two walls 12, which are separated by spreaders 13 located at suitable intervals between the opposite extremities of the core, the spaces 14 between these spreaders being closed at the top of the core by slabs 15 which are removable in order to give access to the spaces or chambers 14. The core is provided with a number of parallel floors 16, and there are openings 31 through the spreaders 13 just above each floor to allow the drainage water to follow each floor and drain locally, so to speak, from each floor separately, into a vertically disposed drainage pipe 17 which may be said to pass through all the floors, having an outlet for the water of each floor at the level of that floor. The lower extremity of this drainage pipe enters a drainage tunnel 18 communicating with the hollow of the core at the bottom, the tunnel being centrally located, its outer extremity being accessible for the entrance of men underneath one of the hydraulic fills of the dam, as illustrated in the drawing being the fill remote from the water of the reservoir, or being on the down-stream side of the core. Each floor has openings 19 at the top of the chambers 14 below to permit the entrance of men to the core from the top, after removing one or more slabs 15. These openings are curved or surrounded by relatively shallow upwardly projecting flanges 20 see Figs. 4 and 6 forming tracks which prevent the water accumulating on any floor from passing downwardly through these openings into the chambers below, thus compelling the water,

as heretofore stated, to drain locally from each floor through the drainage pipe 17, whence it passes finally into the tunnel 18, whereby no opportunity is given for flooding the core. The drain pipe 17 may be considered a single pipe passing through all the floors and having openings at each floor, or as a series of open-ended pipes passing from one floor to another, all of the said pipes being in vertical alinement. This drainage pipe or duct is perhaps best illustrated in Fig. 3, in which its lower extremity is shown opening into the inner extremity of the drainage tunnel 18.

In order that the core 5 may be utilized for draining purposes, each member 12 thereof is provided with a series of openings 21, there being one of these openings for each chamber 14 of the core, and a series of these openings located slightly above each floor of the core. Each of these openings (see Fig. 6) is provided with a metal lining 22 to whose inner extremity is secured a casing 23 in which is located a gate valve 24 equipped with a screw stem 25 threaded in the upper part 26 of the gate. This stem is journaled in the casing, which permits rotary movement of the stem, and when the latter is revolved it actuates the gate either for opening or closing purposes, depending upon the direction of rotation. The stem has no longitudinal movement. The stem passes through a stuffing box 27, whereby a water-tight joint is formed. The upper and outer extremity 28 of the stem is polygonal in cross section, whereby it is adapted to fit a wrench for purposes of manipulation.

The extremities of the openings 21 adjacent the fill or on the outside of the core wall, are screened by metal bars 29 suitably arranged for the purpose. Beyond this screen stones 30 are located, the same being graded smaller until the standard of the fill has been reached as heretofore explained. This screen together with the filtering construction resulting from the grading of the stones until the standard of the fill is reached, prevents the material of the fill from escaping through the gate-controlled drainage openings 21.

In order that the drainage water from the fills which reaches each floor through the openings 21, may be drained through the central duct 17, it is necessary that the spreaders or buttress partitions 13 shall have openings adjacent the floors, whereby the water may pass along each floor from one compartment or chamber 14 to another, until the drainage duct is reached. These openings are designated 31 and are illustrated in Figs. 1 to 5 inclusive of the drawing.

In Fig. 3 the summit pools 32 are illustrated. These pools are formed at the top of the respective fills while the dam is in

process of construction, the pools being on opposite sides of the core wall.

The core walls at each end under the entry house 33 are elbowed and offset as shown at 5 34, whereby expansion and contraction due to temperature changes are not wholly met by direct thrust or withdrawal of the core from the abutments.

In constructiong the dam the height of 10 the core wall should keep pace with the construction of the fills on opposite sides thereof, the inner and outer walls of the fills being kept slightly higher than the body of the fill as shown at 35 and 36, in order to 15 form basins for the summit pools.

In Fig. 1 I have illustrated branch porous pipes 37 communicating with the drainage tunnel 18 and extending any desired distance into the fill on opposite sides of the 20 tunnel. These branch porous pipes or conduits are not novel in this class of work, but are herein illustrated for the purpose of indicating that they may, if desired, be employed in connection with my improvement.

In Figs. 1 and 4 a ladder 38 is illustrated, 25 being located at one end of the core wall, and extending downwardly from the entry house to the first floor of the core for convenience in entering the core for any purpose. 30

Attention is called to the fact that the openings 31 in the spreaders 13 are contracted at the top. The reason for this is that in design the spreaders ought to be 35 buttresses and take the weight of the structure partly off the walls.

In practice the summit pools vary from one to five feet in depth, depending upon the amount of solid matter contained therein and its stage of settlement. In different 40 localities clays have different characters, such as different degrees of plasticity and settlement, and the stage of settlement in which it is desired to draw off the suspended sluicing water would vary and be determined in practice. Hence if an excess of sluicing 45 water were placed in the summit pool, endangering the banks of the pond to overflow, the sluicing water would be drawn off through the gates directly from the pond, but under normal conditions it would percolate through the settled material and be 50 drawn by virtue of the hydraulic head, toward the gate. The sluiced materials having become set and stratified, would not flow in suspension. Should the draining water be 55 found to be highly loaded or carry too much material in suspension, the gate should be closed to allow further solidification of the fill to take place, after which it can be opened 60 as required for drainage purposes.

If required, a vertical stratum of porous material 39 can be deposited adjacent to each 65 side of the core. This porous stratum would intercept all strata of the fill and thus pro-

vide a porous medium for the seepage water to pass alongside the core to the gates.

In earth fill dam construction with core walls, the tendency of the reservoir water to meet and follow along the face of the 70 core has been a matter of question, but with a core wall constructed on the plan herein described, water passing along the face of the core can be drawn off through the gates should such a condition exist after the dam 75 is in use.

The hollow core drainage feature herein described, provides an efficient means for draining the heart of the fill, which without a drainage provision is the last portion 80 of the fill to drain.

The core wall is expected to make a watertight diaphragm closing the reservoir basin at the dam site. The drainage tunnel and drain pipes do not come in contact with percolating reservoir water, as they are in the 85 lower fill and located down-stream from the core wall, consequently the objections frequently made against placing a structure in the fill which would lead the reservoir water 90 along any of its surfaces and thus develop leakage, do not here apply.

Having thus described my invention, what I claim is:

1. In means for draining fill dams, the 95 combination with the fills, of an interposed hollow core wall having inlets leading from the outer surface of the core to the hollow thereof to permit the entrance of water from the fills, for the purpose set forth. 100

2. In means for draining fill dams, the combination with the up and down stream fills, of a hollow core wall interposed between the fills and supported thereby, the 105 wall having inlets to receive drainage water from the fills, and an outlet tunnel or conduit communicating with the bottom of the hollow core.

3. In means for draining dams of the class described, the combination with the up and down stream fills, of an interposed hollow 110 core wall constructed of such material as to be impervious to water, the opposite sides of the core having inlets at suitable intervals to receive drainage water from the fills. 115

4. The combination with the up and down stream fills of a dam, of an interposed hollow core having inlet openings to permit the drainage water from the fills to enter the hollow of the core, the core being provided with spreaders at suitable intervals, 120 floors arranged one above another, the floors having openings curbed to prevent the passage of drainage water, and the spreaders above each floor having openings adjacent 125 the floor to allow the water to drain locally from each floor, a drainage duct leading downwardly and arranged to receive water from the various floors of the core, and an outlet tunnel with which the drainage duct 130

is in communication, substantially as described.

5. The combination with the fills of a dam, of a hollow core interposed between the two fills, the hollow of the core separating it into two walls, the said walls being connected by spreaders arranged at suitable intervals and by floors arranged one above another, the spreaders having openings adjacent the floors for drainage purposes, the core being equipped with a drainage duct in communication with all the floors, the dam having an outlet tunnel with which the drainage duct communicates, the said tunnel being also in communication with the hollow of the core, the opposite walls of the core having inlets to receive drainage water from the fills, substantially as described.

6. The combination with the fills of a dam, of a hollow core having valve-controlled openings to receive drainage water from the fills, and means in communication with the hollow of the core at the bottom for carrying off the drainage water, substantially as described.

7. The combination with the fills of a dam, of a hollow core interposed between the fills and having valve-controlled inlets to permit the entrance of drainage water from the fills to the hollow of the core, substantially as described.

8. The combination with the fills of a dam, of a hollow core interposed between the fills and having gate-controlled inlet openings to permit the drainage water from the fills to enter the hollow of the core, the core being equipped with floors arranged one above another to permit the draining of water locally from the fills, and a vertically disposed drainage duct communicating with all the floors, the dam having a tunnel with which the duct communicates at the bottom, substantially as described.

9. The combination with the fills of a dam, of an interposed hollow core whose walls are made of such material as to be impervious to water, the core having a number of floors arranged one above another, the floors having curved openings to permit access to the interior of the core and at the same time prevent the water on the floors from passing through the said openings, the core having a drainage duct arranged to receive water locally from all the floors, the dam being provided with an outlet conduit with which the said duct is in communication, substantially as described.

10. The combination with the fills of a dam, of an interposed hollow core separating the two fills and supported thereby, the core having floors arranged one above another, and spreaders or vertically disposed partitions connecting the two walls of the core above each floor, the said partitions

having openings adjacent the floor to allow water to be drained locally from the core, the chambers or compartments between the partitions above the uppermost floor being closed at the top of the dam by removable slabs.

11. The combination with the fills of a dam, of a hollow core impervious to water and having the two sides of the core separated by partitions arranged at suitable intervals, forming chambers, and floors forming the bottom of these chambers, the partitions having openings adjacent the floors, and the floors having openings whereby the chambers above each floor communicate directly with the chambers below the floor, the chambers adjacent the top of the dam being closed by slabs readily removable to permit entrance to the interior of the core.

12. A hollow core wall having interior spreaders or partitions connecting the two walls of the core, floors below the partitions, the latter being interrupted immediately above the floors, the chambers formed by the partitions or spreaders being in communication with each other, and the uppermost series of chambers being closed by removable slabs, the core wall having inlet openings on opposite sides to deliver drainage water from the fills to each floor, and means for draining the water locally from the respective floors, substantially as described.

13. In fill dams, the combination with the fills, of an interposed hollow core impervious to water and having inlets suitably spaced to allow the drainage water to enter the hollow of the core, a stratum of porous material being deposited adjacent each side of the core, to intercept all strata of the fill and provide a porous medium for the seepage water to pass alongside the core to the drainage openings.

14. In fill dams, the combination with the fills, of an interposed hollow core whose walls are impervious to water and provided with gate-controlled inlets for the drainage water to enter the hollow of the core from the fills, a vertical stratum of porous material being deposited adjacent to each side of the core to intercept the strata of the fill and provide a porous medium for the seepage water to pass alongside the core to the gate-controlled inlets.

15. A hollow core of the class described having gate-controlled inlet openings to permit water to enter the hollow of the core for drainage purposes, substantially as described.

16. A hollow core of the class described, the same being widest at the base and tapering toward the top, the hollow of the core separating the opposite side members thereof, which are connected by spreaders or partitions arranged to form chambers, and a series of floors horizontally disposed and

separating the chambers formed by the spreaders or partitions, the chambers having openings communicating with each other, the spreaders having openings adjacent the floors, and the uppermost set of chambers being closed at the top by removable slabs, substantially as described.

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

NEWTON L. HALL.

Witnesses:

A. J. O'BRIEN,
F. E. BOWEN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."
