Sept. 27, 1932. F. A. NOETZLI 1,879,430

DAM AND METHOD OF CONSTRUCTING THE SAME

Filed June 2, 1931

FIG. 1.

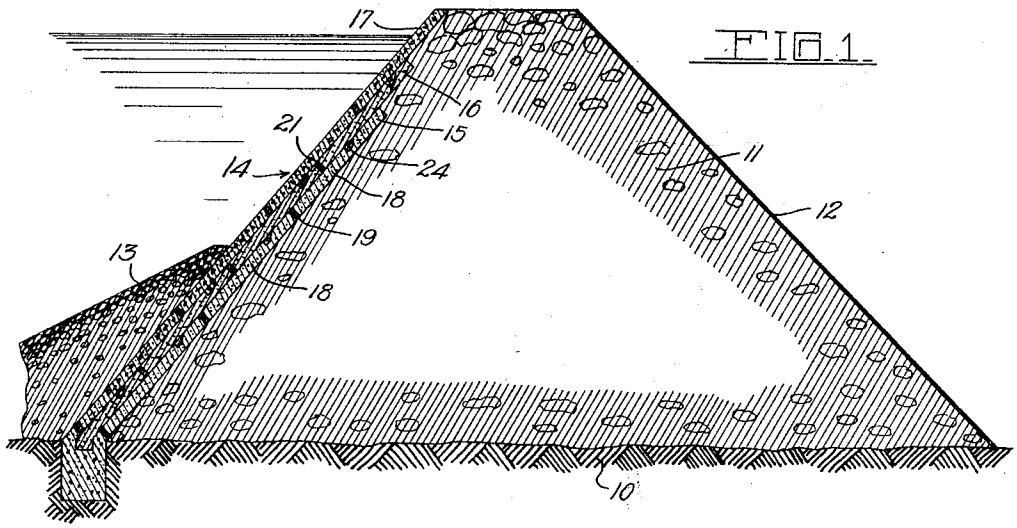


FIG. 2.

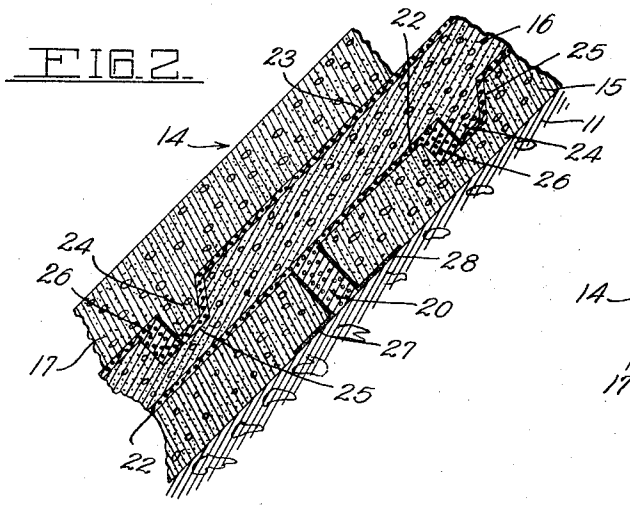


FIG. 3.

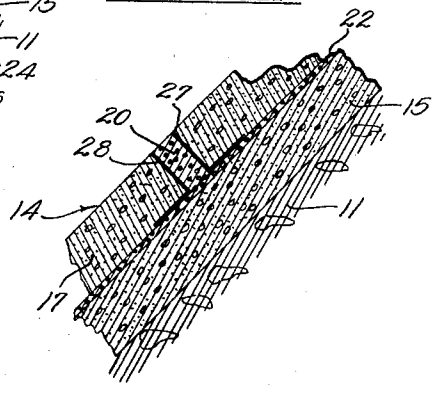
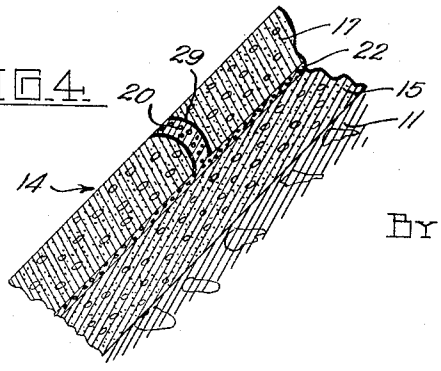


FIG. 4.



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UNITED STATES PATENT OFFICE

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DAM AND METHOD OF CONSTRUCTING THE SAME

Application filed June 2, 1931. Serial No. 541,616.

This invention relates to improvements in dams and may be regarded as an improvement over the construction disclosed in my prior Patent No. 1,602,623, issued October 12, 1926. The invention concerns a dam or embankment of the earth fill, gravel fill, or rock fill type, and a seal wall or core wall for the dam which will seal it against leakage. Dams of this type are now being built of considerable height with the result that when the dam is completed a settling action of the earth or rock fill is of considerable magnitude. The seal wall or core wall assumes an upwardly and rearwardly inclined position in the initial construction of the dam but during the settling of the dam, which may be considerable in large dams of this type, the seal wall or core wall assumes a slightly changed position. This involves a shortening of the height of the seal wall, causing it to have a tendency to buckle, and this buckling action if not otherwise taken care of will produce cracks which may cause leakage. For example, if an earth filled dam, such as is illustrated in Figure 1 of the drawing, is 200 feet high and the seal wall is 250 feet from top to bottom, the dam may settle so that its ultimate height is only 197 feet. As the seal wall is supported by the dam, this settling has a tendency to shorten the seal wall from 250 feet to 247 feet, or thereabouts, and unless provision is made for this shortening of the seal wall during the settling the wall will buckle and the concrete forming the wall will crack.

It is an object of this invention to provide an improved seal wall for filled dams wherein the seal wall is made up of sections defined from each other by contraction joints. These contraction joints are initially relatively wide and are filled with a compressible joint filling material permitting a shortening of the seal wall during settling without involving buckling.

Another object of the invention is to provide a novel seal wall construction for filled dams employing a series of layers of concrete or concrete slabs.

A further object of the invention is to provide a novel method for constructing seal walls of this character defining the sections or slabs by joints formed of the desired compressible material and in this connection still another object of the invention is to provide a method of forming the slabs in such a manner that they will be effectively locked together against material lateral displacement.

With the foregoing and other objects in view, which will be made manifest in the following detailed description, and specifically pointed out in the appended claims, reference is had to the accompanying drawing for an illustrative embodiment of the invention, wherein:

Fig. 1 is a vertical section through an earth filled dam illustrating a seal wall embodying the invention as having been applied thereto.

Fig. 2 is a partial view in section illustrating details of construction of the seal wall.

Fig. 3 is a partial view in section illustrating the manner in which the slabs of the seal wall are formed and defined from each other by the joints.

Fig. 4 is a partial view in section illustrating a slight modification of the method illustrated in Figure 3.

Referring to the accompanying drawing, wherein similar reference characters designate similar parts throughout, the reference character 10 indicates the foundation on which is erected the earth fill, gravel fill, or rock fill dam indicated at 11. 12 indicates the down stream face of the dam and 13 indicates the up stream face. The seal wall embodying the invention is generally designated by the reference character 14. This seal wall is preferably but not necessarily formed of a plurality of layers of concrete, the lowermost layer being indicated at 15, an intermediate layer being indicated at 16, and an uppermost layer being indicated at 17. The lowermost layer 15 is divided into sections indicated at 18 by horizontally extending joints 19. These sections may extend all of the way across the dam, that is from one abutment of the dam to the other, and the horizontal joints may likewise extend continuously across the dam. However, I prefer to divide the section 18 by vertically ex-

tending joints into separate sections or slabs arranged in horizontal rows. The joints 19, as indicated in a somewhat exaggerated form on Figure 1, are initially quite wide and are filled with a compressible joint filling waterproof material indicated at 20. The material which I prefer to employ is now sold on the market under the name of "Elastite", or another material which may be used is in the nature of an asphaltum containing a considerable quantity of air blown into it in the nature of air bubbles. The presence of the air bubbles in the asphaltum renders this material compressible so that if the sections of the lower layer 15 are crowded together, the joint filling material 20 may compress without squeezing this material out of the joint to any excessive extent.

Above the lower layer of concrete 15 there is the second layer which is likewise divided into sections by horizontal joints 21 and these sections may likewise be divided by vertical joints, not shown. The joints 21 preferably have a staggered relation with respect to the joints 19 and where vertical joints are employed these likewise preferably have a staggered relation. A thin layer of asphaltum or equivalent waterproof material indicated at 22 is disposed between the two layers 15 and 16 and, as shown on Figure 1, the top of layer 16 preferably extends higher on the dam than the top of layer 15. Layer 17 is constructed in a similar manner with a layer of asphaltum 23 separating it from layer 16 and this layer is divided into slabs by horizontal and vertical joints which are preferably staggered with respect to the other joints in the other layers. The horizontal joints in all three layers are initially relatively wide and filled with the compressible "Elastite". The sections or slabs of the layers may have on their under sides horizontally extending ribs 24 which loosely extend into grooves 25 formed in the subjacent layers. The loose fit causes considerable space to be present between the rib 24 and the lower side of the groove and this space is filled with the compressible "Elastite" as indicated at 26.

By this construction if the body of the dam settles, lowering its effective height and having the tendency to shorten the height of the seal wall, the individual sections or slabs will be urged to crowd together. Instead of buckling bringing about resulting cracks, the compressible joints filling material compresses permitting this crowding action without squeezing the joint filling material out of the joints to any excessive extent. Ordinarily by making the contraction joints relatively wide the closing of these joints and the compressing of the joint filling material will accommodate all of the settling which is apt to take place in the ordinary fill type dam.

A feature of the invention resides in the method of constructing the slabs of the seal wall. In accomplishing this I preferably employ suitable forms indicated at 27 and 28. These may be sections of heavy tarred paper, or the like, which are bent angularly in form and positioned on the asphaltum layer 22 or 23 as the case may be, or against the forward face of the fill. Between these forms is positioned the "Elastite" and when the joint filling material is so positioned a cement gun deposits "Gunite", a mixture of Portland cement, aggregate, water, etc., on both sides of the forms 27 and 28. The forms 27 and 28 thus keep the joint filling material in place and serve to define the edges of the slabs. In some instances where a relatively thin slabe is used the use of forms may be dispensed with and where the seal wall is of a single layer the joint filling material may be held temporarily in place against the forward side of the fill by wires embedded in the joint filling material and inserted into the fill. Any equivalent anchoring devices for temporarily anchoring the joint filling material while the concrete is being poured or deposited by a cement gun may be used. In Figure 4 the upwardly extending portions of the forms are given a curvature as indicated at 29 so that when the slabs are formed one slab will present a convex edge and the adjacent slab will present a concave edge, with a relatively wide joint between them filled with "Elastite". In this manner crowding of the slabs together is permissible At the same time the slabs are effectively locked together against material relative displacements.

From the above described construction it will be appreciated that a novel, advantageous seal wall construction for fill type dams is provided which makes provision for the settling of the fill or body of the dam. This provision is highly important in large dams where the magnitude of the settling is considerable.

In general the joints herein referred to as being relatively wide should be so designed as to permit a contraction of each joint of between one-eighth of an inch and one inch although in some instances the contraction may exceed this. It will likewise be appreciated that in low dams the contraction of the joints may be only a very slight amount where the total magnitude of the settling is relatively small. It will likewise be appreciated that although I have illustrated the seal wall as having been made of three layers, one layer may suffice in certain circumstances, and two layers may suffice in others. Likewise there may be special conditions in which more than three layers are desirable.

Various changes may be made in the details of construction without departing from

the spirit or scope of the invention as defined by the appended claims.

I claim:

1. In a filled dam, an upwardly and rearwardly inclined wall formed of slabs, there being relatively wide joints between the slabs which space the slabs from those below and those above, and a compressible waterproof material filling the joints enabling the slabs to be crowded together during settling of the dam.

2. In a filled dam, an upwardly and rearwardly inclined seal wall, said seal wall being divided by relatively wide horizontally extending joints, and a compressible joint filling material in the joints enabling the sections of the seal wall to crowd together during settling of the dam.

3. In a filled dam, an upwardly and rearwardly extending seal wall, said wall being formed of a plurality of layers of concrete, waterproofing material between the layers, said layers being divided into sections arranged one above the other by relatively wide horizontally extending joints, and a relatively plastic material in the joints.

4. In a filled dam, an upwardly and rearwardly extending seal wall, said wall being formed of a plurality of layers of concrete, waterproofing material between the layers, said layers being divided into sections arranged one above the other by relatively wide horizontally extending joints, and a relatively plastic material in the joints, the joints of the layers being staggered with respect to each other.

5. In a filled dam, an upwardly and rearwardly extending seal wall, said wall being formed of a plurality of layers of concrete, waterproofing material between the layers, said layers being divided into sections arranged one above the other by relatively wide horizontally extending joints, and a relatively plastic material in the joints, the edges of the sections being interlocked to prevent material lateral displacements of the sections relatively to each other.

6. In a filled dam, a seal wall formed of a plurality of layers of concrete, said layers being divided by horizontally extending joints into sections, the joints of the layers being staggered with respect to each other, there being loose fitting rib and groove connections between the sections of the layers, and a relatively plastic compressible material between the ribs and grooves and in the joints between adjacent sections.

7. In a dam of the filled type, a seal wall made up of a plurality of sections of concrete, means temporarily holding the sections spaced from those below and those above, said means permitting the sections to be moved slightly closer to each other enabling the sections to be crowded downwardly together during settling of the dam.

8. The method of making a seal wall in a filled dam which consists of positioning a layer of concrete divided into sections on the dam, filling the joints between the sections with a relatively compressible plastic material, erecting forms for joint filling material on the upper face of said layer, positioning joint filling material therein, and pouring concrete against said forms thus forming a second layer of concrete made up of sections separated by the forms and joint filling material.

9. The method of making a seal wall in a filled dam which includes positioning a plastic joint filling material at the location of the future joints and simultaneously depositing concrete against both sides of said joint filling material, thus providing sections of the concrete which may be crowded downwardly together during the settling of the dam.

10. In a dam of the filled type, a seal wall formed of a plurality of superposed layers of concrete, at least one of said layers being divided by relatively wide joints into sections which are spaced one above the other, the relatively wide joints permitting the sections to more closely approach each other during settling of the fill.

11. In a dam of the filled type, a seal wall formed of a plurality of superposed layers of concrete, at least one of said layers being divided by relatively wide joints into sections which are spaced one above the other, the relatively wide joints permitting the sections to more closely approach each other during settling of the fill, each superposed layer extending further up the face of the dam than its subjacent layer.

12. In a filled dam, a seal wall formed of a plurality of layers of concrete, said layers being divided by relatively wide horizontally extending joints into sections, the joints in the layers being staggered with respect to each other, there being loose fitting rib and groove connections between the sections of the layers preventing material relative displacement of upper sections relatively to the lower sections, the wide joints permitting the sections of the layers to more closely approach each other during settling of the fill.

13. The method of making an inclined seal wall in a filled dam which comprises positioning joint filling material on the dam at the location of future joints, and spraying concrete onto the dam on both sides of the joint filling material, thus forming slabs defined by the joint filling material.

14. The method of making an inclined seal wall in a filled dam which comprises positioning joint filling material on the dam at the location of future joints, and spraying concrete onto the dam on both sides of the joint filling material, thus forming slabs defined by the joint filling material, positioning joint filling material on the slabs so formed at the

location of the future joints of a superposed layer and spraying concrete on both sides of this joint filling material thus forming a superposed layer of slabs defined by the joint filling material.

15. The method of constructing a dam which consists of erecting a wall of settleable fill, positioning joint defining material on the upstream face of the fill, and depositing concrete on the upstream face of the fill on both sides of the joint defining material thus forming slabs defined and separated by the joint defining material capable of being crowded together without buckling or destruction as the fill settles.

16. The method of constructing a dam which consists of erecting a wall of settleable fill, positioning joint defining material on the upstream face of the fill, and depositing concrete on the upstream face of the fill on both sides of the joint defining material thus forming slabs defined and separated by the joint defining material capable of being crowded together without buckling or destruction as the fill settles, positioning joint defining material on the slabs thus formed and depositing concrete on both sides of this joint defining material thus forming a superposed layer of slabs defined and separated by the joint filling material which are likewise capable of crowding without buckling as the fill settles.

17. In a filled dam, a seal wall adjacent the upstream face of the dam, said seal wall being divided into slabs by relatively wide horizontally extending joints which permit crowding of the slabs downwardly as the fill settles, and means rendering said joints waterproof.

18. In a filled dam, a seal wall adjacent the upstream face of the dam, said wall being formed of a plurality of superposed layers, at least some of the layers being divided into slabs by relatively wide top and bottom joints which permit crowding of the slabs together as the fill settles.

19. In a filled dam, a seal wall adjacent the upstream face of the dam, said wall being formed of a plurality of superposed layers, at least some of the layers being divided into slabs by horizontal and vertical joints, the horizontal joints being relatively wide to permit downward crowding of the slabs as the fill settles, and means rendering the joints water proof.

20. A filled dam having an upwardly and rearwardly inclined seal wall, said wall comprising a plurality of superposed layers of concrete, a plurality of the layers being divided into sections by relatively wide substantially horizontally extending joints, said joints being staggered and enabling the sections to move relatively to each other and relatively to adjacent layers as the fill settles.

21. A filled dam having an upwardly and rearwardly inclined seal wall, said wall comprising a plurality of superposed layers of concrete divided into sections by relatively wide and substantially horizontally extending joints, and means interposed between two of said superposed layers tending to hold them together against material relative displacement.

22. The method of constructing a dam which consists of erecting a wall of settleable fill, disposing a layer of concrete upon the upstream face of the fill, positioning joint defining material on the upstream face of said layer, and disposing concrete upon said layer upon both sides of the joint defining material, thus forming slabs defined and separated by the joint defining material and capable of being crowded together without buckling or destruction as the fill settles.

In testimony whereof I have signed my name to this specification.

FRED A. NOETZLI.