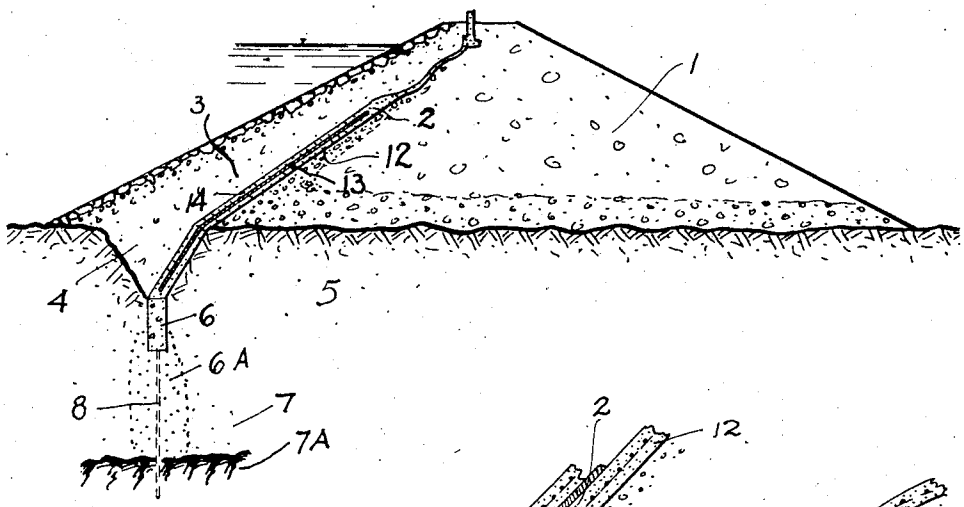
Oct. 12, 1926. 1,602,623

F. A. NOETZLI

DAM AND METHOD OF CONSTRUCTING THE SAME

Filed Sept. 22, 1924

Fig. 1



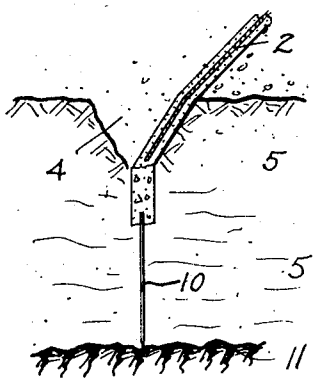


Fig. 2

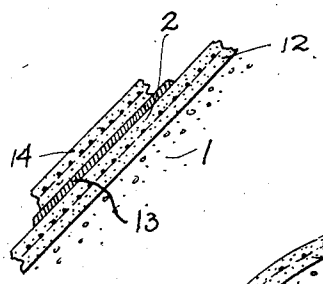


Fig. 3

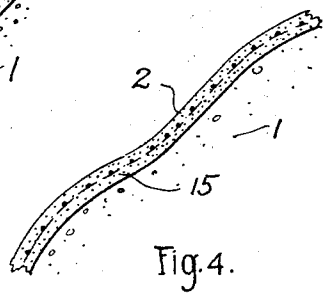


Fig. 4.

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UNITED STATES PATENT OFFICE.

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DAM AND METHOD OF CONSTRUCTING THE SAME.

Application filed September 22, 1924. Serial No. 739,085.

This invention relates to the construction of dams and embankments, particularly those of the earth or rock-fill type, and the primary object of the invention is to provide a dam of this type which will be less expensive, and which can be built in a shorter period of time, than dams such as heretofore constructed.

In earth and rock-fill dams as heretofore constructed, the water tightness of the structure is often effected by a core of impervious material, such as clay puddle, masonry or concrete core, etc. In some dams the upstream face is covered by reinforced concrete slabs or the like. Such masonry or concrete core walls or slabs are liable to crack under the influence of uneven settlements of the earth or rock-fill. Calculations have shown that a great deal of reinforcement is required to reduce such cracks to the hair-crack size which will prevent any appreciable leakage. Such core walls and cover slabs are therefore rather expensive to build, and no rational method for calculating the occurring deformations and stresses is available.

The objects of my invention are first, to build a relatively flexible water tight core wall or membrane of reinforced mortar or concrete in lieu of the formerly employed comparatively thick core walls; second, to construct such a flexible water tight core wall as a combination of a plurality of gunite or concrete slabs with one or more layers of asphalt between said slabs, third, to connect such concrete or combined gunite-asphalt core walls at lower elevation with a concrete wall, or sheet piling driven into the ground, or with sandy or gravelly material made more or less impervious by forcing cement grout into the open pores.

The name "gunite" as used in this specification refers to the product resulting from a mixture of Portland cement, aggregate, water, etc., preferably deposited by means of compressed air, for instance, with a cement gun.

In the accompanying drawings which form part of this specification, I have shown several forms of the construction of my invention, but it is to be understood that I do not limit myself to such forms since the invention as expressed in the claims may be embodied in a plurality of forms.

In the accompanying drawing in which my improved dam is illustrated, Figure 1 is a typical vertical cross section through the dam. Figure 2 is a section of the lower part of a dam showing the application of the invention to a dam resting on a stratified clayey foundation material. Figures 3 and 4 represent enlarged views of portions of the lower, middle and upper parts, respectively, of my improved dam.

Referring to Figure 1, the dam shown comprises earth or rock-fill material 1 on the down-stream side, a core wall 2, and fill material 3 on the up-stream side. The core wall 2 is shown inclined at an angle with a horizontal plane, but it is to be understood that this angle may be of any size and vary for the same dam, for instance similarly as shown by Figure 1.

The lower part of the core wall may extend into a trench 4 excavated from the foundation material 5 upon which the dam is based.

At points where an impervious stratum, for instance, bedrock, is reached at a reasonable depth, the slabs of concrete may be connected with a vertical masonry wall 6 reaching to bedrock, or they may be connected in a suitable manner directly with the bedrock.

At points where the depth to rock is considerable and where sandy or gravelly material 7 overlies the rock 7^A I drill pipes 8 from the bottom of the trench 4 through the material 7, and force cement grout through said pipes 8 into the material 7, such that an impervious wall 6^A is formed. This wall 6^A I connect in a suitable manner with the core wall 2.

At points where grouting is not effective on account of the presence of clay, or for other reasons, I drive sheet-piling 10 to the impervious stratum 11, and connect this sheet piling in a suitable manner with the core wall 2, all as shown by Figure 2.

Referring now to Figure 3, a portion of my improved core wall is shown to a larger scale. A reinforced slab 12 of concrete rests on the earth or rock-fill material 1, of the dam. On the slab 12 rests a membrane 13, of asphalt or other suitable material such as tar, pitch, or the like, and on top of both is a second slab 14 of reinforced concrete. The combination of two thin slabs of reinforced concrete with a layer of asphalt between them forms evidently a relatively flexible and water tight wall which can be built at comparatively small cost inasmuch

as no form work is required. It is to be understood that a plurality of concrete slabs and asphalt layers may be used, if desired.

Referring now to Figure 4, a portion of the upper part of the core wall 2 is shown, for which on account of low water pressure, etc., one single slab 15 of reinforced concrete may be used. A wave-like section of the slab 15 permits considerable settlements of the fill material 1 to occur without producing large cracks in the slab 15.

It will be desirable to have selected fine material and rip-rap placed on the up-stream side of the core wall in order to increase the water tightness and to protect the core wall from injury due to wave action, impact, etc. The weight of the material overlying the core wall will press the asphalt into any cracks in the concrete slabs that may occur, and seal them up tightly.

In carrying out the invention I excavate a trench 4 approximately parallel to the axis of the dam. In sandy or gravelly soil I drive perforated pipes 8 to a suitable depth and force cement grout under pressure through said pipe 8 and into the soil 7, until a more or less impervious wall 6^A is formed. In clayey soil I drive sheet piles 10 down to an impervious stratum. I pile up material 1 to form an embankment with a suitable up-stream slope. I deposit a layer or slab 12 of concrete or mortar upon the prepared up-stream face of the fill material 1, this being preferably done by means of a cement gun, or the like. Upon the slab 12 I deposit a membrane 13 of asphalt or the like, and onto it a slab 14 of concrete or mortar is deposited. The slabs 12 and 14 are preferably reinforced, and also connected in a suitable manner with the wall 6^A or the sheet piles 10, as the case may be. I deposit additional material 3 on the up-stream side of the whole core wall 2 and protect the material 3 in a suitable manner against the action of the waves, etc.

It is to be understood that the material 1, the core wall 2, and the material 3 may be deposited gradually and more or less simultaneously to the desired elevations above the original ground level.

A core wall composed of two relatively thin reinforced concrete slabs with a continuous membrane of plastic impervious material, such as asphalt, pitch, or the like, between the two concrete slabs, has the advantage that such a core wall is relatively flexible and can stand considerable settlement of the fill material. The water tight membrane between the concrete slabs will prevent any water from passing through the core wall even if small cracks should develop in the concrete slabs due to settlement of the fill. The earth embankment can therefore be constructed with less care regarding compacting and rolling of the material and this enables a quicker and more economical construction of such a dam. In case that settlements of the fill material of the dam should occur the core wall would settle together with the fill, and the two slabs could move relatively to each other like the blades of a laminated spring.

An important feature of my invention is this, that the core wall is built at an angle with the horizontal. This angle may correspond approximately to the angle of repose of the fill material of which the dam is constructed. Thus, little or no form work will be required for casting the concrete slabs of the core wall.

I claim:

1. An embankment having an inclined core wall, said core wall having a plurality of slabs of concrete, and asphalt between said slabs.

2. An embankment having an inclined core wall comprising a reinforced slab of concrete, the inclination of said slab varying at different elevations, and fine material overlying said slab.

3. An embankment having a core wall, said core wall having a plurality of slabs of concrete and an asphaltic substance between said slabs, the angle between said core wall and a horizontal plane varying at different elevations.

4. The method of constructing an embankment having a core wall, said method consisting in depositing a fill material, then casting a slab of concrete against the up-stream side of said fill material, then depositing a layer of asphalt onto said slab, then casting a second slab of concrete against said layer of asphalt, and then depositing fine material against said second slab of concrete.

5. An embankment having an inclined core wall, said core wall comprising a plurality of relatively thin slabs of concrete, and an impervious membrane between said slabs.

6. In a dam comprising a fill material, the combination of an inclined core wall, with fill material overlying said core wall, said core wall having a plurality of relatively thin slabs of concrete, and a plastic impervious material between said slabs.

7. The method of constructing a dam having a core wall, said method consisting in depositing a fill material, then casting a relatively thin slab of concrete against the upper side of said fill material, then depositing a membrane of impervious material onto said slab, then casting a second slab of concrete against said membrane, and then depositing fill material against said second slab of concrete.

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