May 9, 1933. F. A. NOETZLI 1,907,999

DAM AND METHOD OF CONSTRUCTING THE SAME

Filed Jan. 19, 1932

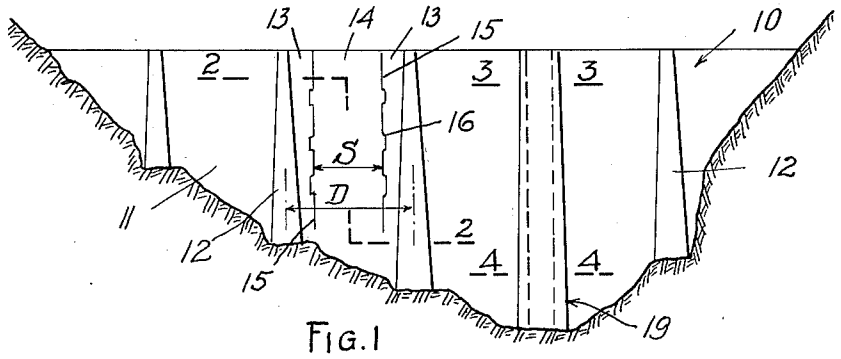

FIG. 1

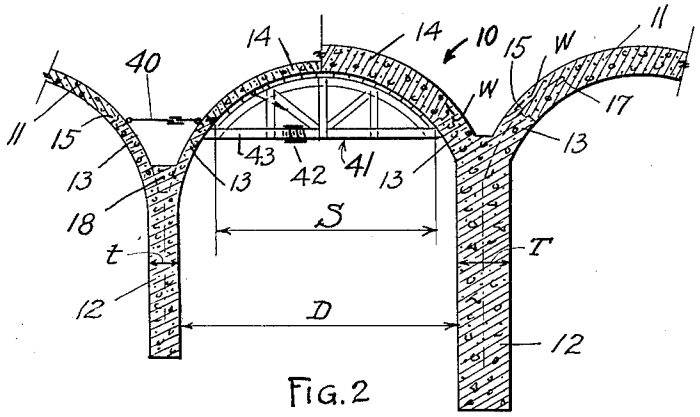

FIG. 2

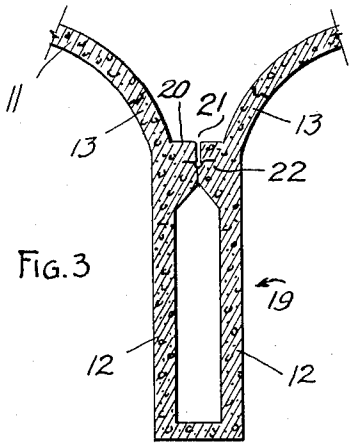

FIG. 3

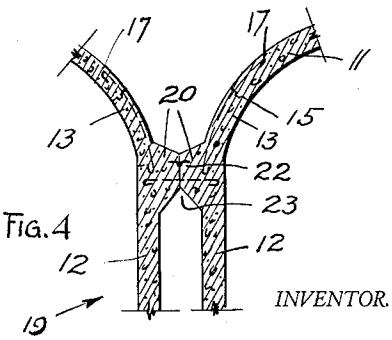

FIG. 4

INVENTOR.

Fred A. Noetzli

Patented May 9, 1933 1,907,999

UNITED STATES PATENT OFFICE

FRED A. NOETZLI, OF LOS ANGELES COUNTY, CALIFORNIA

DAM AND METHOD OF CONSTRUCTING THE SAME

Application filed January 19, 1932. Serial No. 587,516.

This application is divisional in part to my co-pending application Serial No. 319,205, filed November 14, 1928.

This invention relates to improvements in dam constructions.

An object of the invention is to provide a dam of novel construction comprising arches and supporting buttresses or abutments.

Another object of the invention is to pour certain lateral portions of the arches integrally with the buttresses, leaving gaps of uniform width which subsequently are closed by arch constructions for the pouring of which arch centering of uniform span may be used for practically the entire height of the dam.

Another object of the invention is to provide a dam comprising arches and span walls supported by buttresses in which certain portions of the arches and of the span walls are poured monolithically and integrally with the forward part of the buttresses.

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:

Figure 1 is a schematic elevation of the improved dam looking upstream.

Fig. 2 is a horizontal section through a portion of the dam taken for purposes of comparison at two different elevations and may be considered as having been taken upon the line 2—2 of Fig. 1.

Fig. 3 is a horizontal section through the dam and may be considered as having been taken upon the line 3—3 of Fig. 1.

Fig. 4 is a horizontal section through the dam and may be considered as having been taken upon the line 4—4 of Fig. 1.

Referring to the accompanying drawing wherein similar reference characters designate similar parts throughout, the dam 10 consists of arch barrels or arches 11 and supporting buttresses 12. While I have shown in Fig. 1 a dam with several arches and buttresses it is to be understood that the dam may comprise only one arch and two buttresses supporting the ends of the arch, there being a joint between the arch and the buttresses or abutments and interlocking portions serving to prevent vertical displacement of the abutments relatively to the arch.

The left hand portion of Fig. 2 shows a horizontal section through the upper part of a buttress and the adjoining arches or arch barrels. In this part the thickness t of the buttress 12 is relatively small, and the clear span of the arches is relatively large. In the section through the lower part of a buttress the thickness T of the buttress is greater and the clear span of the arches is correspondingly smaller than in the upper part of the dam. This feature of variable arch spans of the arch barrels of the ordinary type of multiple arch dams has necessitated in past constructions arch centering of variable span necessitating continuous adjustments, delays and increased cost of construction.

I prefer to build certain portions 13 of the arches 11 integrally with the forward part of the buttresses 12. These portions 13 are preferably made to extend laterally as far as the forms for the concrete can be built outwardly conveniently together with the forms for the buttresses 12 and to a line such that the gap to be closed by the middle portion 14 of the arch barrel is of uniform width for practically the entire height of the arch barrel. Thus the span S of the middle portion 14 of the arch barrel is constant, and the portion 14 can be poured by the use of arch centering for the uniform and relatively short span S instead of the full and variable arch span D between the sides of the buttresses.

The joint 15 between the arch portions 13 and the middle portion 14 is preferably provided with key and groove connections 16 which will permit a slight adjustment in the joint due to shrinkage of the concrete, changes of temperature, etc. But the connections 16 should prevent a material sliding movement in the joints 15. Across the joints 15 I provide waterstops W of a kind which permit sliding movements. In some cases I may extend steel reinforcing bars 17 across

the joints 15. I may strengthen the portions 13 of the arches by the addition of concrete between the arches at the spring line, such as indicated at 18 in Fig. 2.

For purpose of temporary support during construction I may brace the arch portions 13 at the head of a buttress against each other. This I do preferably by means of a tie 40 indicated in Fig. 2. The tie 40 may be provided with a turnbuckle or other device for pulling the portions 13 together and thereby create initial bending stresses in the parts 13 which stresses are of opposite sign to those produced by the bending of the completed arches 11 due to water load. I may accomplish the same result by applying a temporary thrust in the arch centering 41 for instance by means of a screw indicated at 42 in the horizontal member 43.

I may build certain portions of the dam with so-called double-wall piers 19 shown in Fig. 1 and also shown in section in Figs. 3 and 4. I may bridge the space between the buttresses 12 of a double-wall pier 19 by span walls 20 extending laterally from the buttress 12 and provide the span walls 20 with an open joint 21 sealed by a water stop 22, or with any other kind of joint 23, for instance, as indicated in Fig. 4, and which will permit a slight rotation between adjoining span walls 20. Such a rotation will tend to relieve the arch stresses in the arches 11. The shape of the span walls 20 or the length of the open joint 21 are preferably made such that little or no reinforcement is required in a lateral direction in the span walls 20.

Inasmuch as in the portions 13 of the arches and in the span walls 20 the upstream face is exposed to the water in the reservoir, I prefer to build the portions 13, the span walls 20 and the forward portions of the buttresses 12 of a mixture of concrete of substantially the same proportions and richness in cement as the middle portions 14 of the arches. The rest of the buttresses 12 may be built of a somewhat leaner mixture.

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. A concrete dam construction comprising an arched central portion, means forming abutments in the ends of the arch, there being joints between the arch and the abutment wherein there are interlocking portions serving to prevent vertical displacement of the abutments relatively to said arch.

2. A multiple arch dam comprising buttresses and intervening arch barrels, certain lateral portions of the arch barrels forming integral parts of the buttresses, certain central portions of the arch barrels being joined to said lateral portions by substantially loose joints, there being key and groove connections in said joints preventing other but relatively small movements in a vertical direction between the central and the lateral portions of the arch barrels.

3. A multiple arch dam as described in claim 2 and provided with metal water stops in said joints permitting vertical movements between the central and the lateral portions of the arch barrels without developing leakage through said joints.

4. A multiple arch dam comprising buttresses and intervening arch barrels provided with upwardly extending parallel joints, certain portions of the arch barrels forming an integral part of the buttresses and extending laterally beyond the face of the buttresses and to said joints, the forward part of the buttresses being enlarged such as to decrease the length of the laterally extending portions of said arch barrels.

5. The method of constructing a multiple arch dam comprising arches supported by buttresses, said method comprising constructing certain portions of said arches along the forward end of the buttresses integrally with the buttresses, and subsequently providing appropriate arch constructions between said portions, establishing areas of substantially loose contact between said portions and said arch constructions, and providing means interposed between said portions and said arch constructions for preventing other than relatively small movements relative to each other.

6. The method of constructing a multiple arch dam comprising arch barrels supported by buttresses, said method comprising the construction of certain portions of at least one arch barrel integrally with the forward parts of the adjoining buttresses, said portions extending towards each other to a uniform distance from each other for substantially the entire height of said arch barrel, and building the rest of the arch barrel between said portions

7. The method of constructing a multiple arch dam comprising arch barrels supported by buttresses, said method comprising the construction of certain portions of the arch barrels integrally with the forward parts of the buttresses and in advance of certain middle parts of the arch barrels, said central parts having a uniform span for substantially their entire height, then erecting arch centering and forms between said portions of said arch barrels, and moving said arch centering upwardly along said portions as the construction of the central parts of the arch barrels progresses.

8. A concrete dam comprising arches supported by buttresses, the forward part of said buttresses being joined on one side with said arches, and being provided on the other side with laterally extending span walls, said span walls of two adjoining buttress walls

being provided with an upwardly extending substantially loose joint, said joint enabling a slight rotation of adjoining span walls relative to each other.

9. The method of constructing a concrete dam comprising arches and buttresses supporting said arches, the forward end of the buttresses being provided with laterally extending span walls, by pouring integrally with said buttresses a certain part of said arches and also the said laterally extending span walls.

10. The method of constructing a multiple arch dam, said method comprising the building of certain portions of the arches integrally with certain forward portions of the buttresses and of a mixture of concrete of substantially the same proportions as the concrete of the rest of the arches, and pouring concrete of a leaner mixture for the rest of the buttresses.

11. The method of constructing a multiple arch dam comprising arches and buttresses, said method comprising the construction of certain lateral portions of the arches integrally with the forward parts of the supporting buttresses in advance of certain middle parts of the arches, then providing temporary ties between said portions of the arches tending to stabilize said portions during the construction of the middle parts of the arches.

12. The method of constructing a multiple arch dam as disclosed in claim 11 with the additional provision of means for producing initial bending stresses in the lateral portions of the arches which stresses are of opposite sign to the bending stresses due to water load upon the completed arch.

13. A concrete dam construction comprising buttresses and an arch extending between said buttresses, certain lateral portions of said arch forming integral parts of said buttresses, a central portion of said arch extending between said lateral portions and being joined thereto by joints, said joints at the downstream face of the arch being a substantially uniform distance apart for substantially the entire height of said arch.

14. The method of constructing a concrete dam comprising buttresses and an arch barrel extending between said buttresses, said method comprising the construction of certain lateral portions of the arch barrel integrally with the forward parts of the buttresses and in advance of certain middle portions of the arch barrel, said lateral portions of the arch barrel extending along the downstream side to within an equal distance of each other for the major portion of the height of the arch barrel, then erecting forms between said lateral portions, and moving said forms upwardly as the construction of the central portions of the arch barrel progresses.

FRED A. NOETZLI.