D. E. MORAN, J. W. DOTY & E. S. JARRETT.

DAM AND METHOD OF BUILDING THE SAME.

APPLICATION FILED OCT. 16, 1908.

923,985.

Patented June 8, 1909.

3 SHEETS—SHEET 1.

FIG. 1.

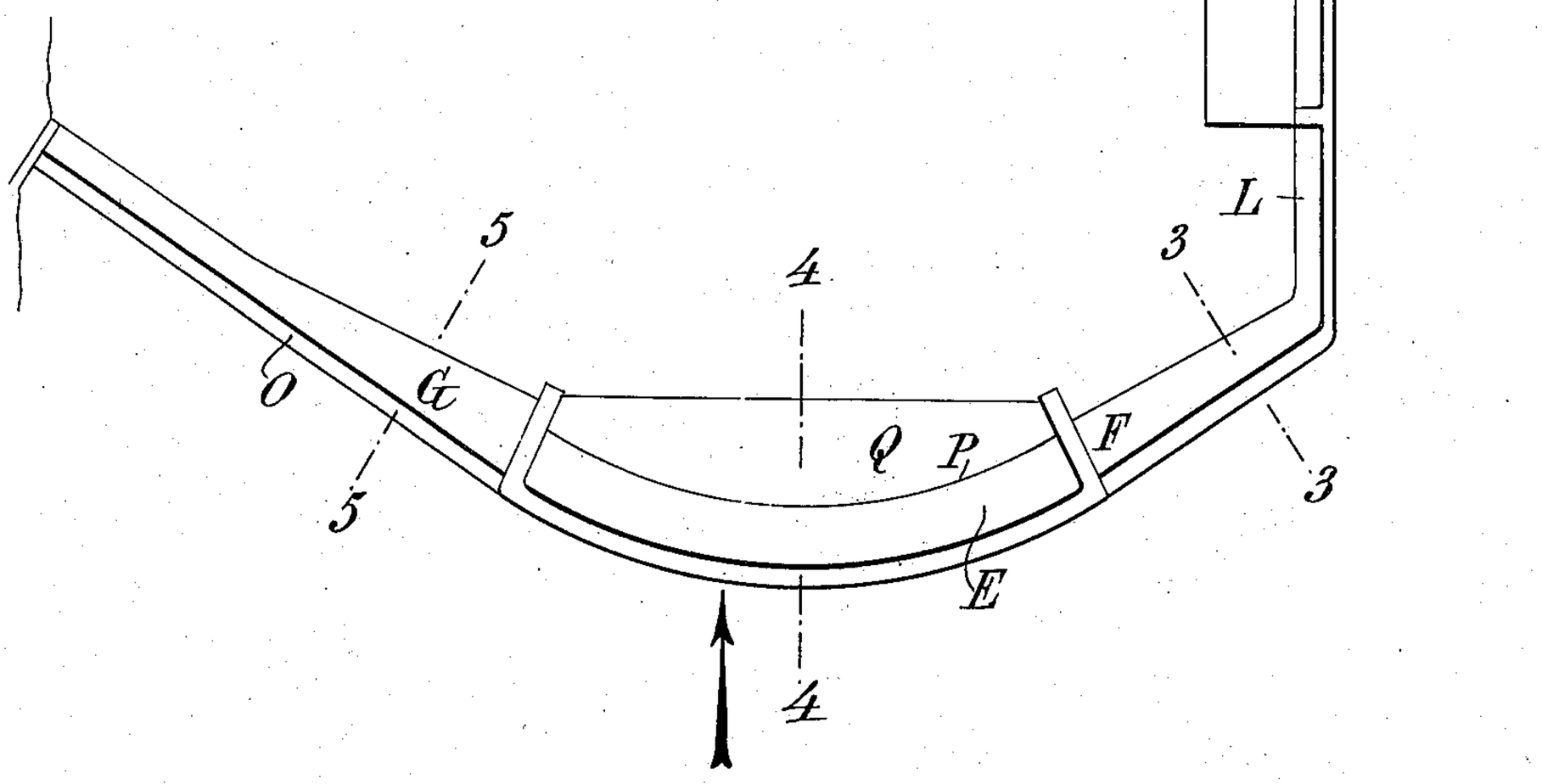

FIG. 2.

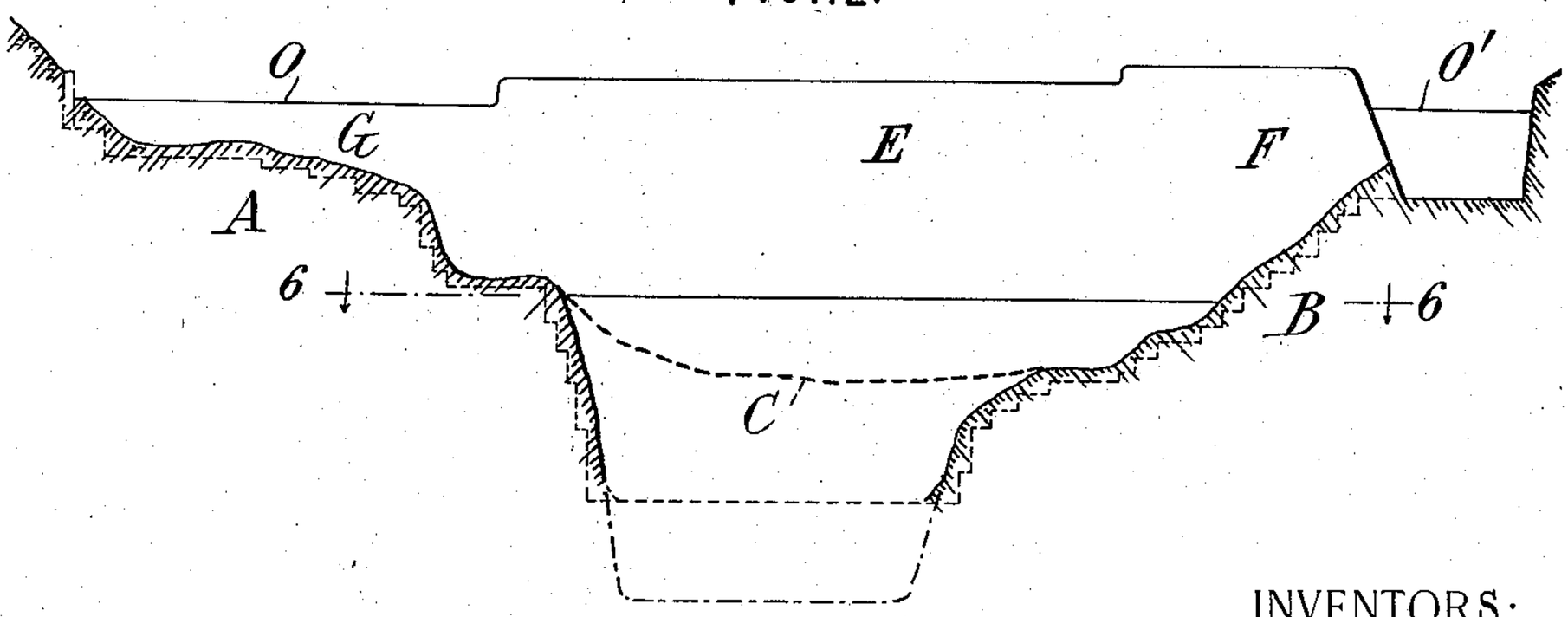

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FIG. 3.

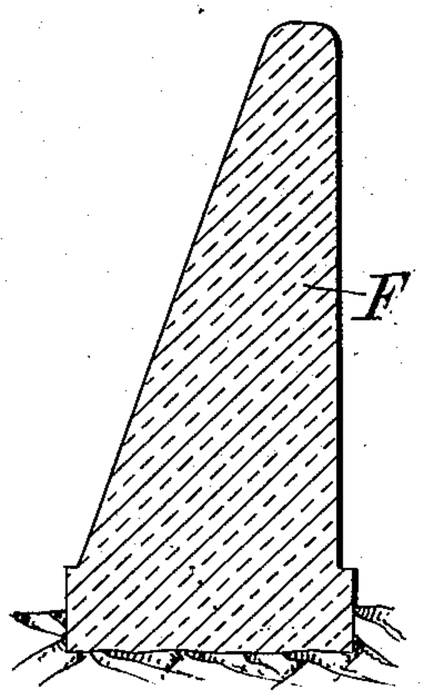


FIG. 4.

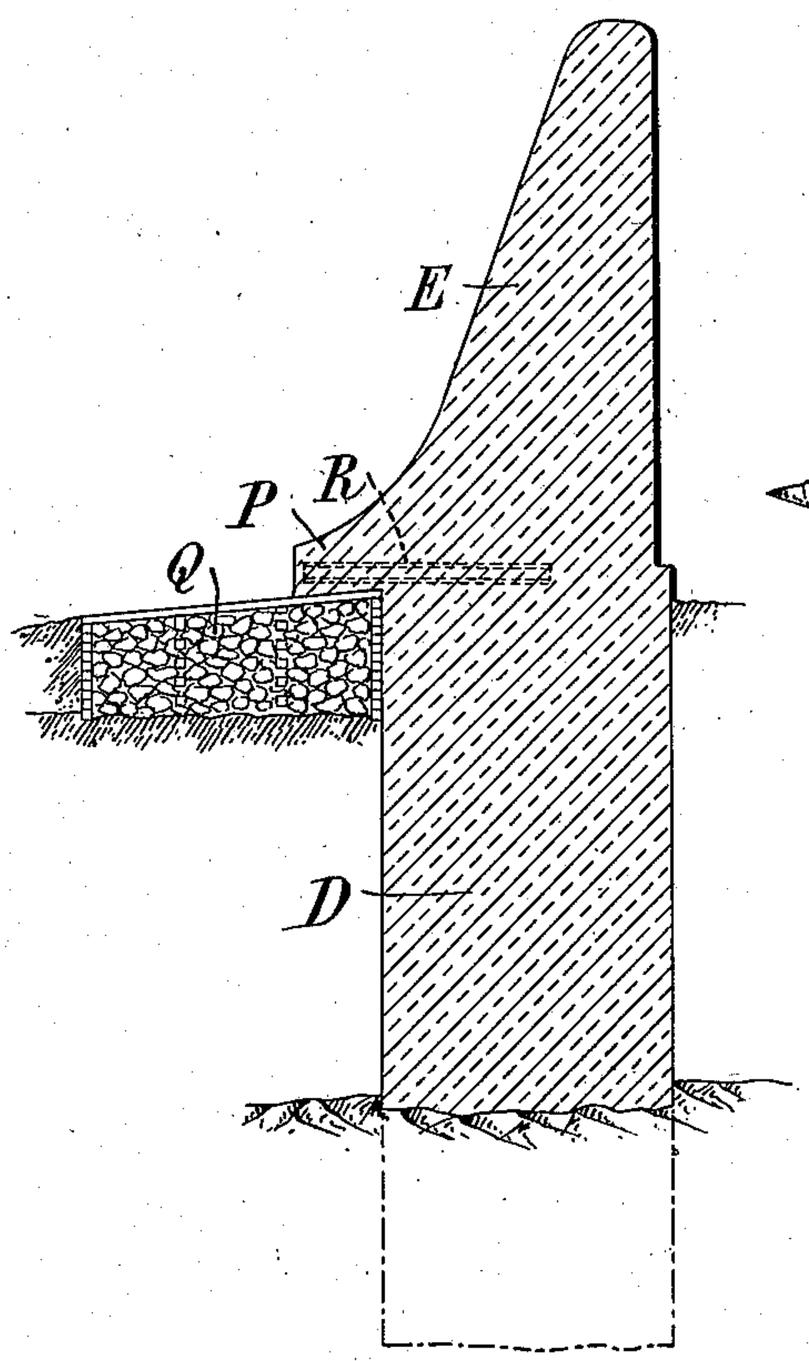


FIG. 5.

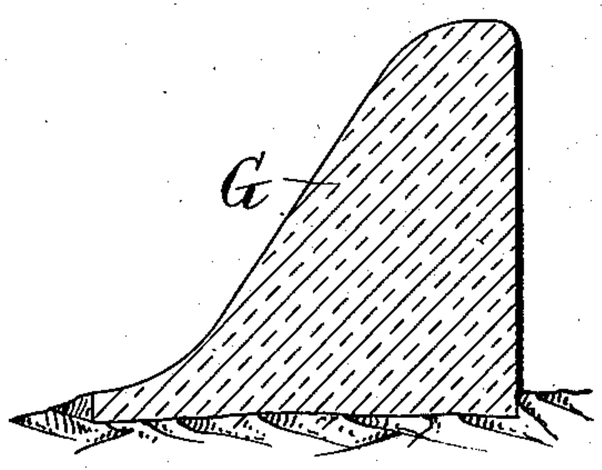


FIG. 6.

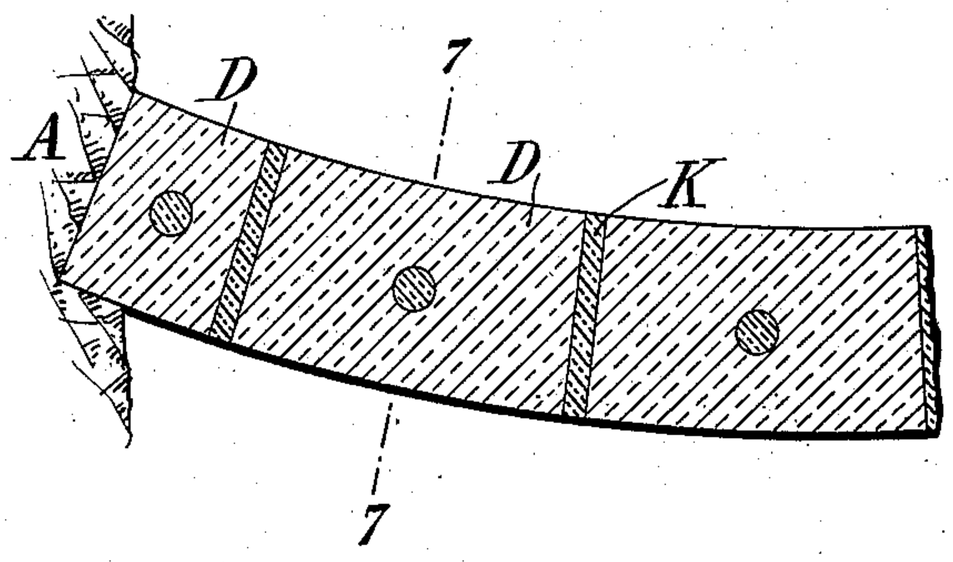
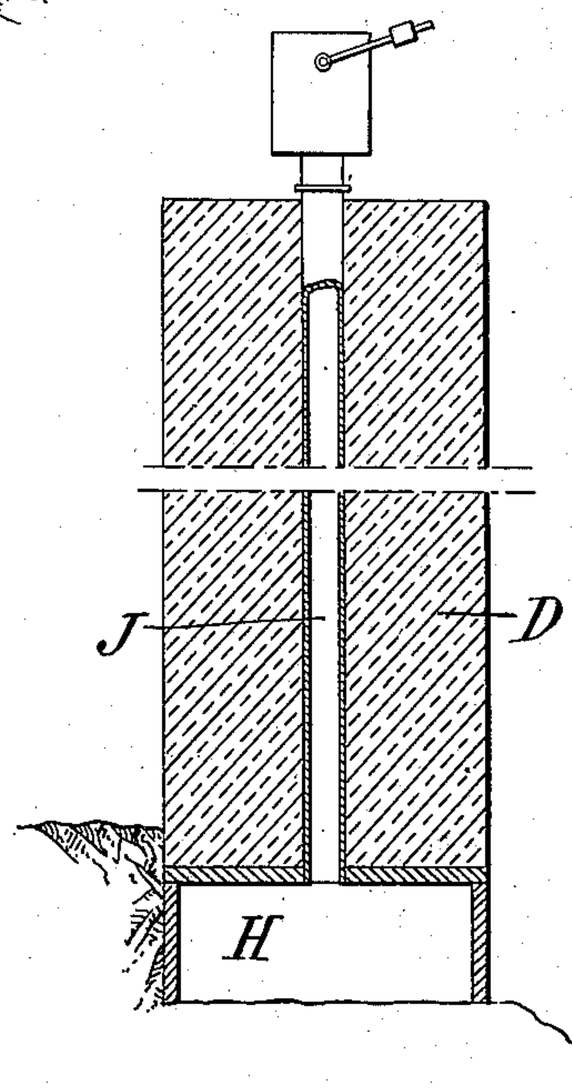


FIG. 7.



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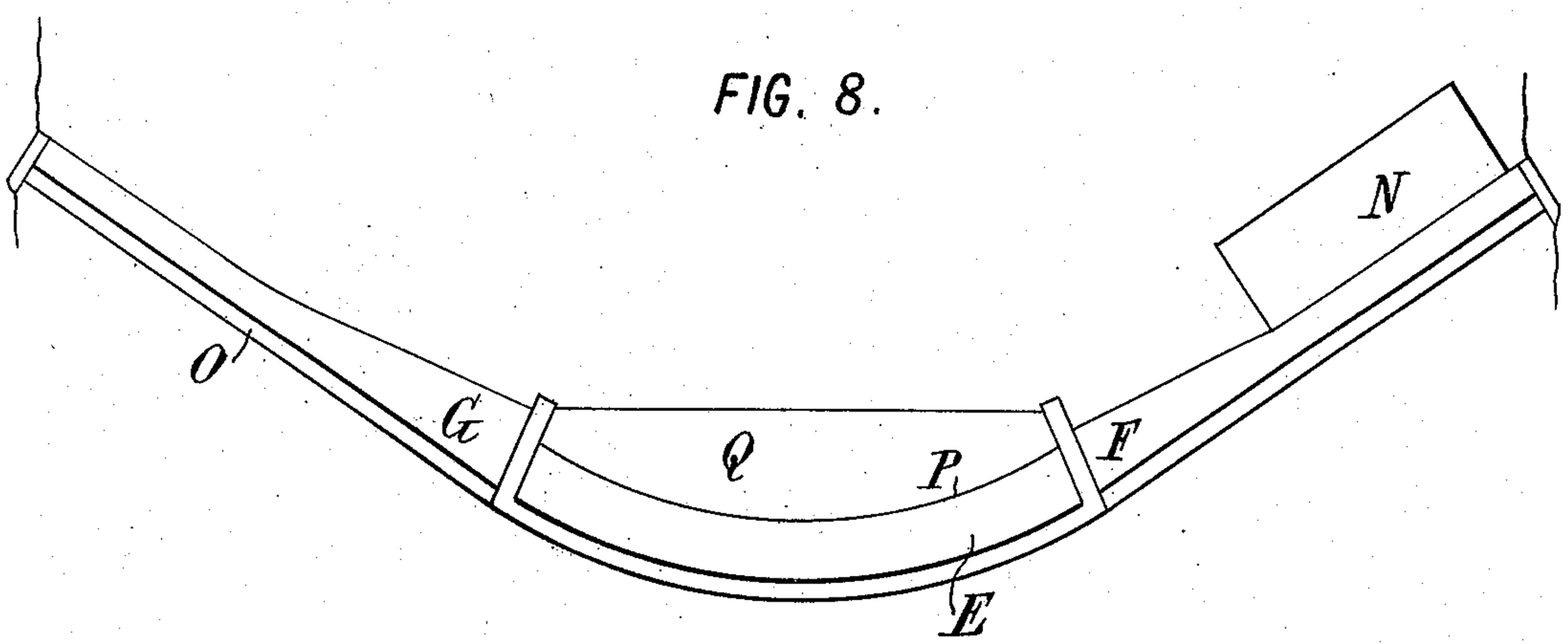
3 SHEETS—SHEET 3.

FIG. 8.



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UNITED STATES PATENT OFFICE.

DANIEL E. MORAN, OF MENDHAM, NEW JERSEY, AND JOHN W. DOTY AND EDWIN S. JARRETT, OF NEW YORK, N. Y.

DAM AND METHOD OF BUILDING THE SAME.

No. 923,985. Specification of Letters Patent. Patented June 8, 1909.

Application filed October 16, 1908. Serial No. 458,007.

To all whom it may concern:

Be it known that we, DANIEL E. MORAN, a citizen of the United States, residing at Mendham, in the county of Morris and State of New Jersey, JOHN W. DOTY, a subject of the King of Great Britain, residing in the borough of Brooklyn, county of Kings, city and State of New York, and EDWIN S. JARRETT, a citizen of the United States, residing in the borough of Manhattan, city, county, and State of New York, have jointly invented certain new and useful Improvements in Dams and Methods of Building the Same, of which the following is a specification.

This invention provides certain improvements relating to the building of dams and similar structures applicable to a great variety of conditions, although especially designed for sites providing an accessible rock foundation under only a part of the length of the dam.

One feature of the improvement consists in the sinking of a series of piers, preferably by the pneumatic method, and erecting the upper part of the dam on the tops of said piers, so that the latter provide a solid foundation for the upper part of the dam.

Another feature of improvement consists in sinking such piers in a horizontal arch (which may be flat or of any suitable degree of curvature) and the lateral thrust of which may be taken either by the natural rock or by an artificial lateral support, or partly by one and partly by the other of these means.

Another point of improvement consists in laying out the dam so that one portion thereof constitutes a horizontal arch, that is to say, a structure which receives the load and transmits the strains to its ends on the well known principle of an arch, and so that another portion is of the ordinary gravity type which resists overturning or yielding to the pressure chiefly by reason of its weight. This construction is especially useful where the foundation is partly easily accessible rock and partly earth through which piers have been sunk to get an equally good foundation; the arch portion of the dam being arranged over the piers, and the gravity portion or portions being arranged upon the accessible rock foundation.

Various other points of improvement are referred to in detail hereinafter.

The accompanying drawings illustrate embodiments of the invention.

Figure 1 is a plan of a dam; Fig. 2 is an elevation from the up-stream side; Figs. 3, 4 and 5 are cross-sections on the lines 3—3, 4—4 and 5—5 respectively; Fig. 6 is a horizontal section approximately on the line 6—6 of Fig. 2; Fig. 7 is a cross-section of one of the piers of Fig. 6 approximately on the line 7—7, and showing the method of sinking; Fig. 8 is a plan of a different style of dam embodying the invention.

In the site illustrated, both the side portions of the bottom A and B are of rock suitable for the direct support of a gravity dam. At the center, however, the rock disappears and is replaced by earth, the top of which is shown approximately at C. The central portion of the dam therefore presents difficulties in the way of its support and in the danger of the water flowing under it and washing out the earth. These difficulties are provided against by sinking a series of piers D (Fig. 6) which serve both to cut off the flow of water under the dam, and also to support the body E, preferably of concrete, which constitutes the upper part of the central portion of the dam. In order to resist the water pressure with a minimum quantity of material, the piers are preferably arranged to act as a horizontal arch with its springing lines supported against the rock at the sides. The body E which is supported upon the piers preferably also follows the line of the piers upon which it is supported, and acts as a horizontal arch with its springing lines resting upon the two lateral bodies F and G which constitute the wings of the dam, and which are preferably tangential to the arch. These wings F and G, especially in the arrangement shown in Figs. 1 and 2, receive a very substantial lateral support from the rock at the sides A and B, so that the entire dam comprising the sections E, F and G and the foundation piers D, will act in the manner of an arch. But the individual sections F and G are not designed to act as arches, but to resist the water pressures entirely by their weight. They are built preferably of con-

crete or other masonry laid directly upon the rock foundation.

The piers D are preferably sunk by the pneumatic method, being completed after sinking by filling up the working chamber H and shaft J; and being preferably arranged along a curved line and forming the voussoirs of an arch. The length of the piers and their widths will depend upon local conditions, the contour of the rock, the head of water &c., and the rock A B will be cut to form a springing line for the arch as in Fig. 6, and will also be cut in vertical steps as is shown in Fig. 2, the layout of the piers being preferably arranged so as to cut as little rock as possible, only enough to secure a good joint. The piers or caissons D are sunk three or four feet apart, and are afterward joined by keys or fillers K.

The dam may be arranged as in Fig. 1 with the wing F bent to provide a portion L extending down the stream, and then bending back again to form a spillway M extending across the stream; the power house N being built alongside the portion L of the dam. The theory of the dam, however, would be carried out better by extending a portion F straight to the end as in Fig. 8, and arranging the power house N alongside of it as shown, or in any other suitable location.

There is an advantage in having the dam only partly curved with one or more straight wings, in that the latter may be used to provide a straight spillway, the water flowing over such a straight edge more quietly than over the curved edge. Where two wings are provided as shown with a power house adjacent to one of said wings F, the opposite wing G is preferably used to form the spillway, so that water running over it shall fall as far away as possible from the power house. Figs. 1 and 2 show this feature of the construction with the spillway O over the section G (and with an auxiliary spillway O′ where the section F adjacent to the power house is run along stream to a point beyond the power house, as shown in Fig. 1).

The toe P of the section E may extend beyond the supporting piers D and may rest upon the crib Q filled with stone, and may be tied by steel rods R to the central portion of the body. Reinforcing rods may be inserted wherever advisable to tie the several parts of the concrete together, or to increase its tensile strength, supposing concrete to be used; or the principal parts of the dam may be made of various other materials instead of concrete.

What we claim is:—

1. A dam including a series of piers, and a body supported on said piers and constituting the upper part of the dam.

2. In the forming of a dam, the method which consists in sinking a series of piers and erecting on them a body constituting the upper part of the dam.

3. In the forming of a dam, the method which consists in sinking a series of piers by the pneumatic process and erecting on them a body constituting the upper part of the dam.

4. In the forming of a dam including a horizontal arch, the method which consists in sinking a series of piers in such a horizontal arch.

5. In the forming of a dam including a horizontal arch, the method which consists in sinking a series of piers by the pneumatic process in such a horizontal arch.

6. A dam including a series of piers sunk in a horizontal arch, and a body supported on said piers and constituting the upper part of the dam.

7. In the forming of a dam, the method which consists in sinking a series of piers in an arch and erecting on said piers a body constituting the upper part of the dam.

8. In the forming of a dam, the method which consists in sinking a series of piers by the pneumatic process in an arch and erecting on said piers a body constituting the upper part of the dam.

9. A dam having a portion constituting a horizontal arch, and a gravity section taking the thrust of the arch.

10. A dam having a center constituting a horizontal arch, and a pair of gravity sections taking the thrust at the two ends of said arch.

11. A dam having a center constituting a horizontal arch, and a pair of gravity sections tangential to said arch.

12. A dam having a portion constituting a horizontal arch, and a substantially straight portion lower than the arch portion so as to form a substantially straight spillway.

13. A dam having a center constituting a horizontal arch, and a pair of gravity sections tangential to said arch, at least one of said tangential sections being lower than the arch so as to form a substantially straight spillway, in combination with a power house at the side opposite said spillway.

14. A dam having a center in the form of a horizontal arch and comprising a series of piers in arch form, and an arched body supported thereon, and a pair of gravity sections taking the thrust at the two ends of the arch.

15. In the forming of a dam, the sinking of a series of piers in a horizontal arch and erecting on them a correspondingly arched body, and erecting gravity sections at the

ends of said arched body to take the thrust of the arch.

16. A dam including a support D, and a body E carried on said support and having a toe P projecting beyond the support, and a supplementary support Q under the projecting toe P.

In witness whereof, we have hereunto signed our names in the presence of two subscribing witnesses.

DANIEL E. MORAN.
JOHN W. DOTY.
EDWIN S. JARRETT.

Witnesses:
M. C. MURPHY,
E. W. MARVIN.