No. 840,042. PATENTED JAN. 1, 1907.

W. L. CHURCH.

DAM.

APPLICATION FILED MAR. 28, 1906.

2 SHEETS—SHEET 1.

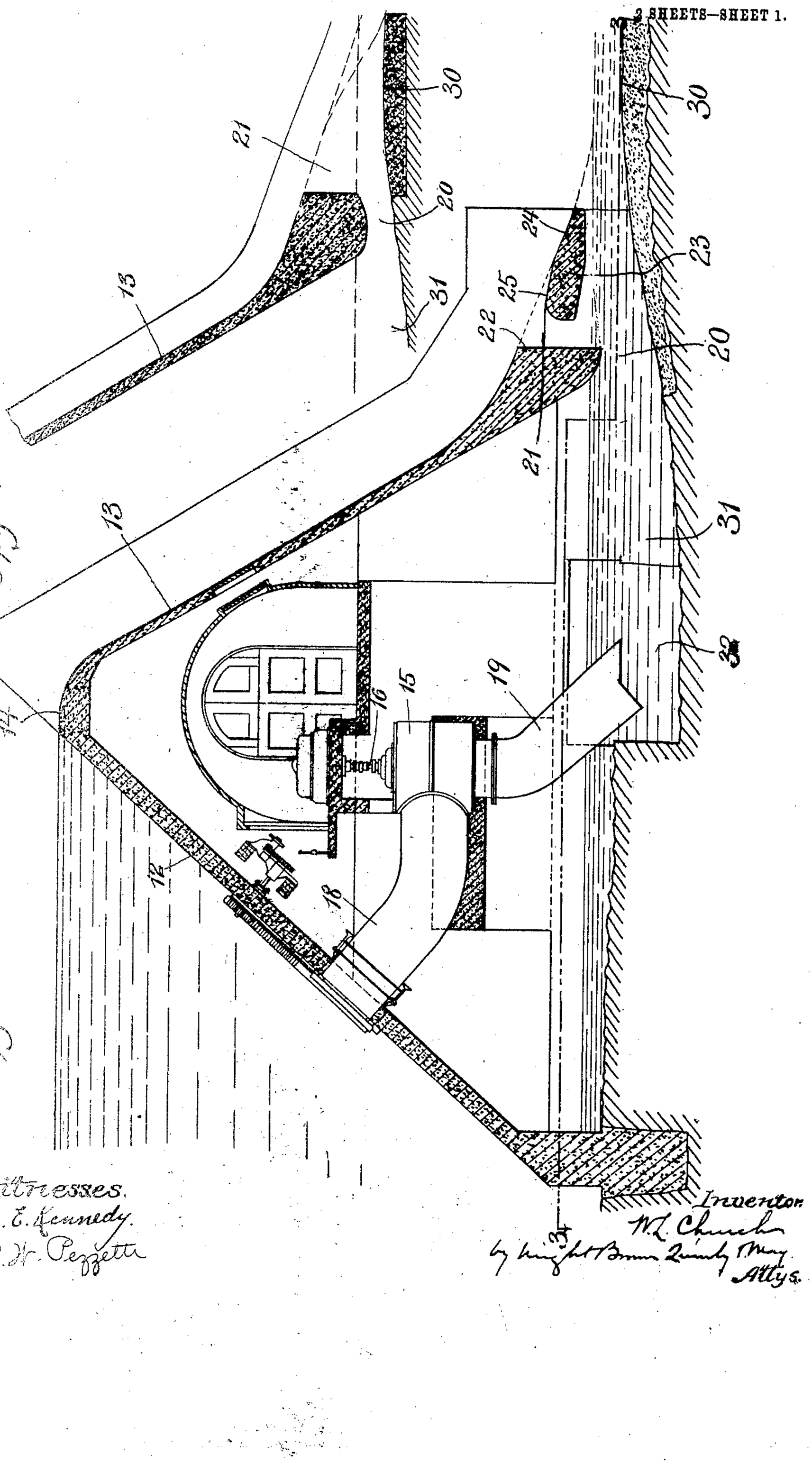

Fig. 2.

Fig. 1.

Witnesses.
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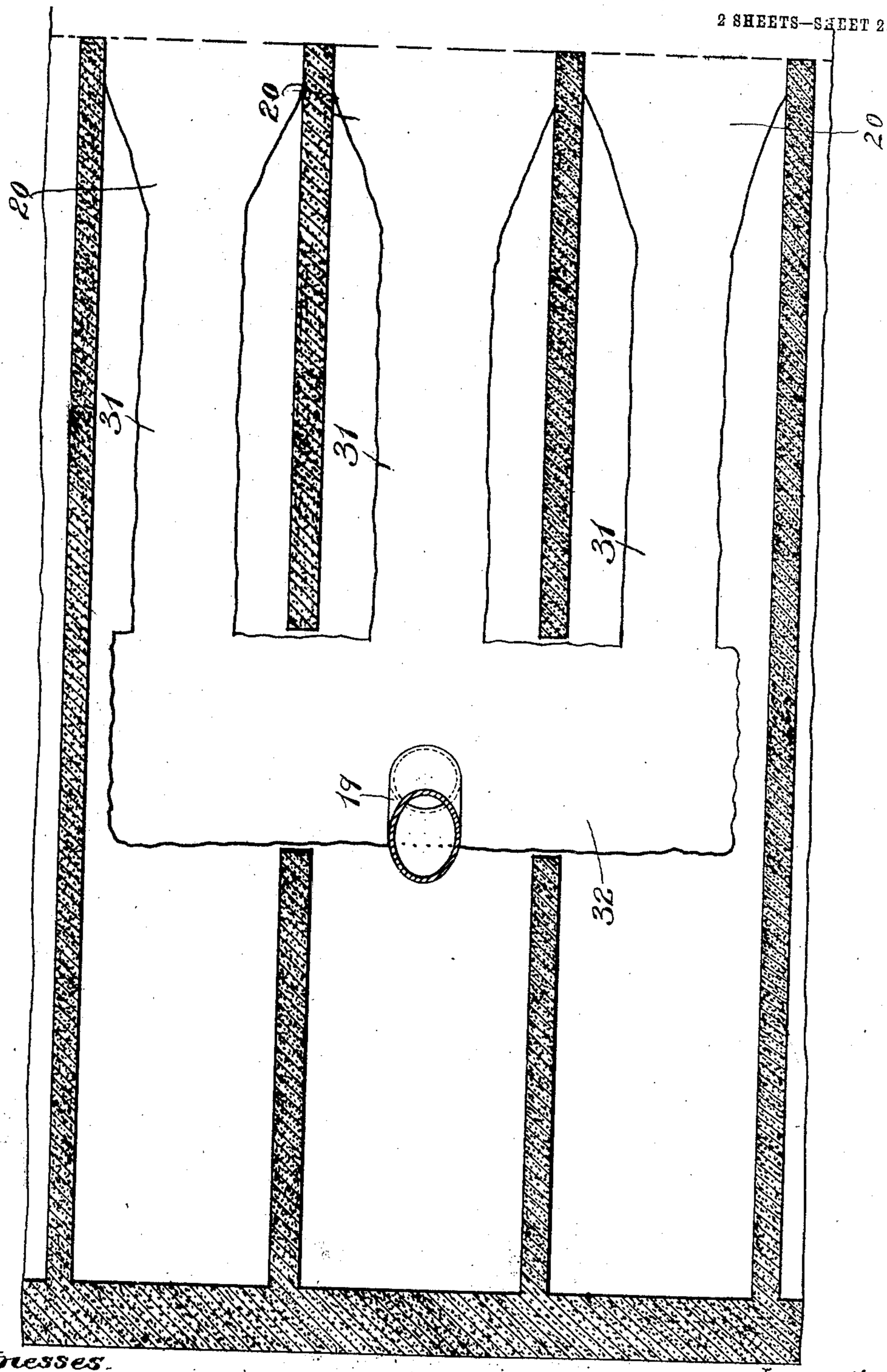
2 SHEETS—SHEET 2.

Fig. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM LEE CHURCH, OF NEWTON, MASSACHUSETTS.

DAM.

No. 840,042. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed March 28, 1906. Serial No. 308,426.

To all whom it may concern:

Be it known that I, WILLIAM LEE CHURCH, of Newton, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Dams, of which the following is a specification.

This invention relates to a dam formed to inclose or protect a space between the upstream and downstream sides of the dam, said space being utilized as a power-station by installing therein power-utilizing means, such as a turbine and its accessories, and a conduit adapted to supply water to the turbine from the upstream side and to discharge the tail-water from the turbine in the lower portion of the protected space. In a power-station of this character it is very desirable to maintain the tail-water at the discharge end of the conduit at a minimum level to the end that the wheel-discharge in the draft-tube portion of said conduit may have a maximum fall or head and its maximum efficiency may be realized. When the backwater level at the downstream side of the dam is relatively high in consequence of high water in the stream or river or from any other cause, the tail-water within the dam, if allowed to stand at the same level, will correspondingly reduce the head of the wheel-discharge through the draft-tube.

My invention has for its object to cause the energy of the overfall or waste water flowing over the apron or spillway of the dam to effect the removal of the tail-water from the interior of the dam, and thereby maintain a relatively low tail-water level within the dam irrespective of the height of backwater below the dam.

To this end the invention consists in the improvements which I will now proceed to describe and claim.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a transverse section of a dam embodying my invention. Fig. 2 represents a fragmentary sectional view showing a modification. Fig. 3 represents a horizontal section on line 3 3 of Fig. 2.

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

In the embodiment of my invention here shown for purposes of illustration the dam is of shell form and of reinforced concrete construction. It comprises a deck 12, an apron 13, and a crest 14, uniting the deck and apron, the whole covering a space between the upstream and downstream sides of the dam. In said space may be installed a turbine the casing of which is shown at 15, the shaft 16 of the turbine being connected with a dynamo or other power-utilizing means.

18 represents a feed-pipe, the intake end of which is in the deck 12, said pipe extending downwardly to the wheel-casing. 19 represents a draft-tube extending downwardly from the wheel-casing and discharging into the lower portion of the space covered by the dam, the said feed-pipe, casing, and draft-tube constituting a conduit taking water under the desired head from the upstream side of the dam, and discharging the tail-water into the lower portion of said space.

20 represents a tail-water outlet formed in the lower portion of the apron and communicating with the accumulation of tail-water in the space covered by the dam. Said outlet is located under the path of the overfall, the portion of the apron over the outlet being so inclined that the overfall is projected forcibly downstream from the delivering end of the outlet, the movement of the overfall causing a strongly-induced flow of tail-water outwardly through and from the outlet. The result of this induction is to maintain the tail-water level within the dam at a lower level than the average level of the backwater at the downstream side of the dam. The top of the outlet 20 is preferably lower than the normal tail-water level within the dam, so that the outlet is usually sealed against the outward passage of air therethrough above the tail-water, a maximum discharge of tail-water being thus assured. The overfall preferably impinges upon a substantially horizontal hearth 30, which is a continuation of the bottom of a flume 31, extending outwardly from the interior of the dam and forming also the bottom of the outlet 20. The hearth 30 should be at about the same height as the bottom of the outlet 20, and there should be no depression to form backwater between the outlet 20 and the hearth. The overfall in its movement across the outlet 20 encounters the stream of tail-water on the hearth 30 and induces an outflow of the tail-water by direct contact with it, the combined streams flowing forcibly downstream from the outlet. The outflow

of tail-water from the interior of the dam may be further increased or augmented by atmospheric pressure. To this end an air-draft flue or passage 21 is preferably provided between the delivering end of the outlet 20 and the overfall projected from above the outlet. The said overfall forms a constantly-moving cover extending across said flue and tending to continuously exhaust air therefrom, and thus augment or accelerate the outflow of tail-water by atmospheric pressure within the dam. The said air-flue is preferably provided by the formation of a recess or opening 22 in the lower portion of the apron, the walls of said opening bounding an air-space which is, in effect, an extension of the tail-water outlet located above the current of tail-water at the discharge end of the outlet.

In Fig. 1 I show the opening 22, provided with a bridge 23, the outer portion 24 of the upper surface of which constitutes an extension of the water-guiding surface of the apron. The inner portion 25 of said surface is depressed and forms the lower side of an extension or enlargement of the air space or flue, the said inner portion and the sheet of overfall over the same forming a V-shaped air-space from which air is drawn by the movement of the sheet. This construction is intended to increase the exhaustion of air from the space over the emerging tail-water.

In Fig. 2 I show a recess or opening 22, which is not provided with the shelf 23.

The height of the outlet 20 and its conducting capacity being limited, I prefer to provide a plurality of said outlets, all connected with a well 32, which receives the tail-water from the draft-tube. Said well is elongated in the direction of the length of the dam and communicates through flumes 31 with the several outlets, of which there may be two or more. Provision is thus made for a sufficiently-rapid discharge of the tail-water to prevent an objectionable accumulation thereof within the dam.

I do not claim the power-chamber located within the space covered or protected by a dam and having walls which are independent of the dam structure.

I claim—

1. A power-space-inclosing dam having a conduit extending downwardly from the upstream side of the dam and discharging in the lower portion of said space, means at the downstream side of the dam for causing a forcible downstream flow of the overfall, and means for connecting the tail-water within the dam with the overfall-current flowing from the dam, whereby an outflow of tail-water from the interior of the dam is induced by the said overfall-current.

2. A power-space-inclosing dam having a conduit extending downwardly from the upstream side of the dam and discharging in the lower portion of said space, a plurality of tail-water outlets in the downstream side of the dam, said outlets being under the path of the overfall, and means for conducting tail-water from the interior of the dam to said outlets.

3. A power-space-inclosing dam having a conduit extending downwardly from the upstream side of the dam, and discharging in the lower portion of said space, and a tail-water outlet in the downstream side of the dam, said outlet being under the path of the overfall, whereby the overfall is caused to induce an outward flow of tail-water through said outlet.

4. A power-space-inclosing dam having a conduit extending downwardly from the upstream side of the dam, and discharging in the lower portion of said space, and a tail-water outlet in the downstream side of the dam, said outlet being under the path of the overfall, and normally sealed by the escaping tail-water against the outward passage of air from said space above the tail-water.

5. A power-space-inclosing dam having an apron or spillway, a conduit extending downwardly from the upstream side of the dam and discharging in the lower portion of the inclosed space, and a tail-water outlet under the lower portion of the apron, the top of said outlet being connected with the path of the overfall by an air-draft passage, which is covered by the sheet of overfall.

6. A power-space-inclosing dam having an apron or spillway, a conduit extending downwardly from the upstream side of the dam and discharging in the lower portion of the inclosed space, and a tail-water outlet under the lower portion of the apron, the said portion being provided with an air-draft passage between the outlet and the path of the overfall.

7. A power-space-inclosing dam having an apron or spillway, a conduit extending downwardly from the upstream side of the dam and discharging in the lower portion of the inclosed space, and a tail-water outlet under the lower portion of the apron, the said portion having a recess located above and communicating with the tail-water outlet, and forming an air-draft flue, the said recess having a bridge, the outer portion of which forms a continuation of the overfall-guiding surface of the apron, while the inner portion forms an extension of the said flue.

8. A power-space-inclosing dam having a conduit extending downwardly from the upstream side of the dam and discharging in the lower portion of said space, a hearth at the downstream side of the dam arranged to deflect the overfall entirely and forcibly downstream as it leaves the dam, and means for connecting the tail-water within the dam with the overfall-current on said hearth.

9. A power-space-inclosing dam having a

conduit extending downwardly from the upstream side of the dam and discharging in the lower portion of said space, a plurality of tail-water outlets in the downstream side of the dam, said outlets being under the path of the overfall, a continuous well elongated in the direction of the axis of the dam, and arranged to receive the tail-water from said conduit, and connections between the well and the said outlets.

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

WILLIAM LEE CHURCH.

Witnesses:

H. L. COBURN,

H. C. WHITE.