W. M. RANSOM.

DAM.

APPLICATION FILED MAY 11, 1908.

899,703.

Patented Sept. 29, 1908.

5 SHEETS—SHEET 1.

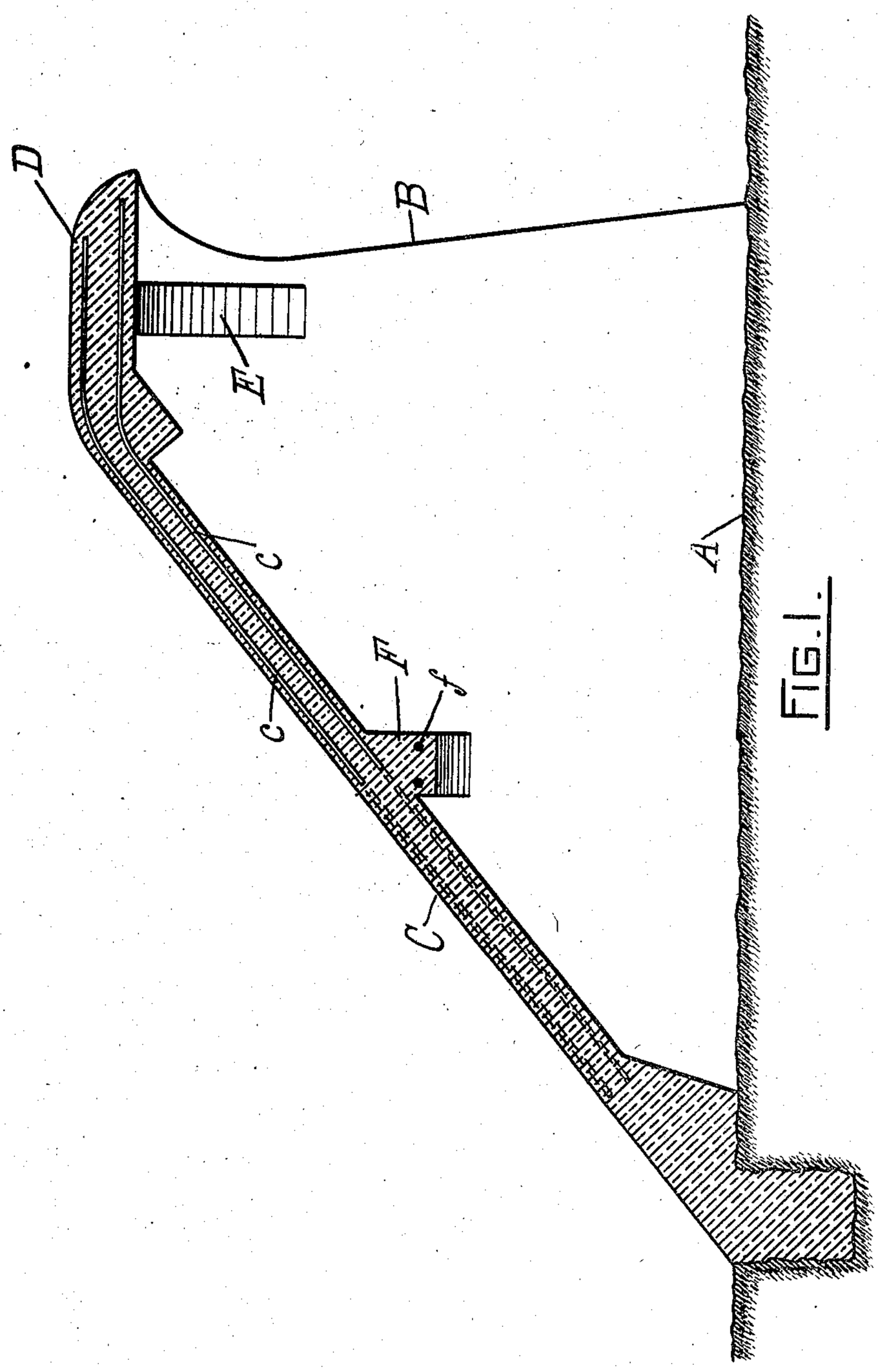

FIG. 1.

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5 SHEETS—SHEET 2.

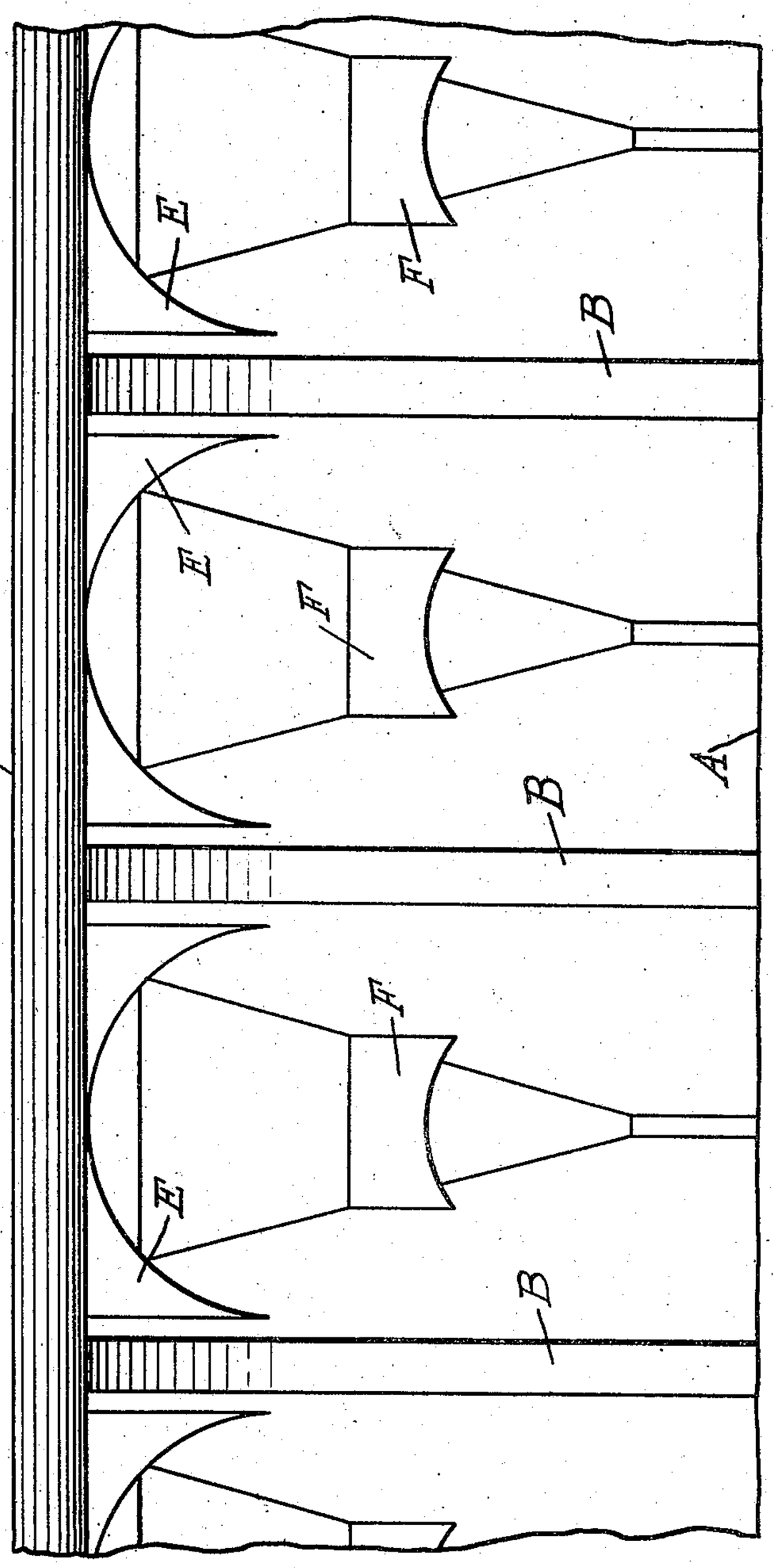

FIG. 2.

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5 SHEETS—SHEET 3.

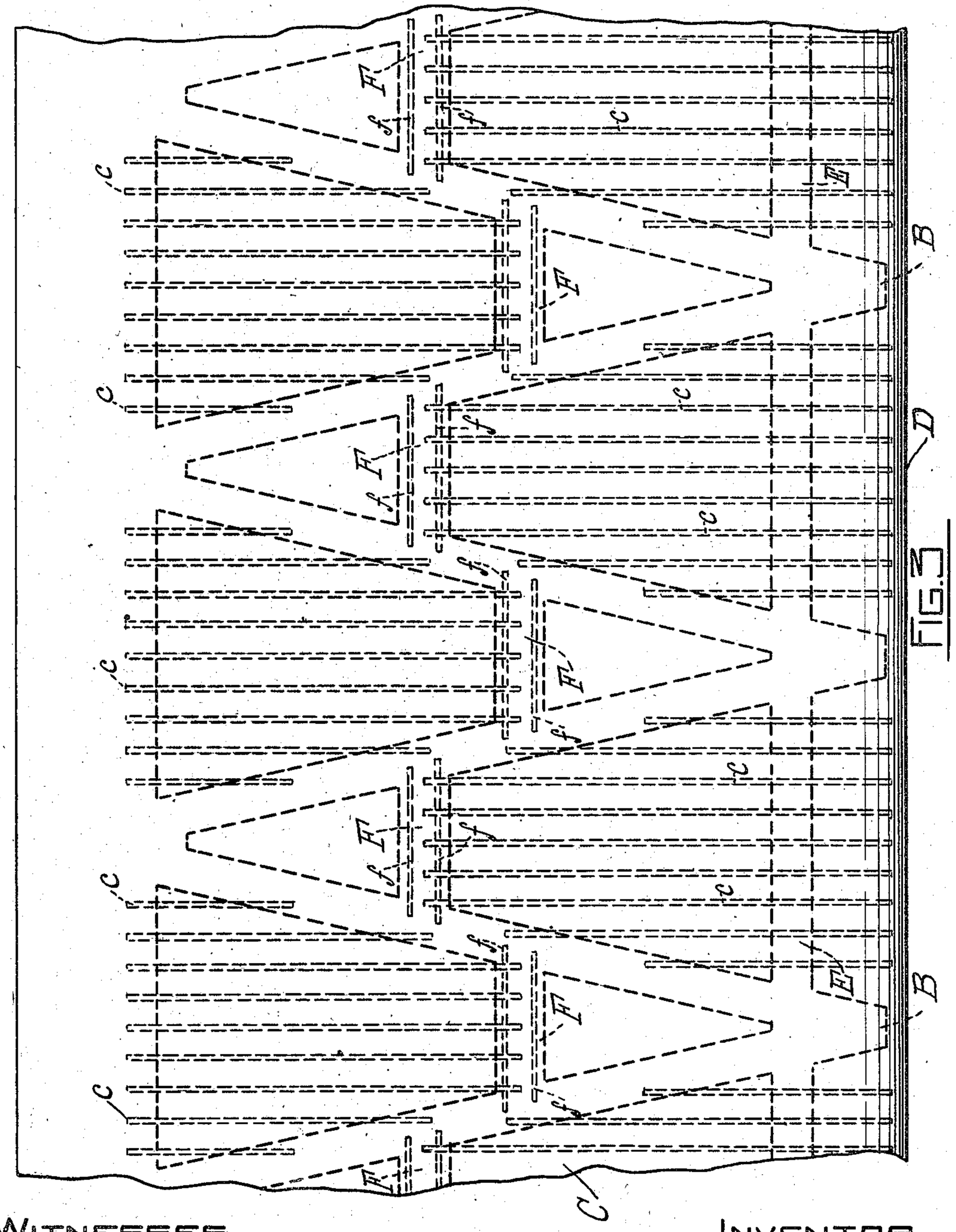

FIG. 3

WITNESSES.

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5 SHEETS—SHEET 4.

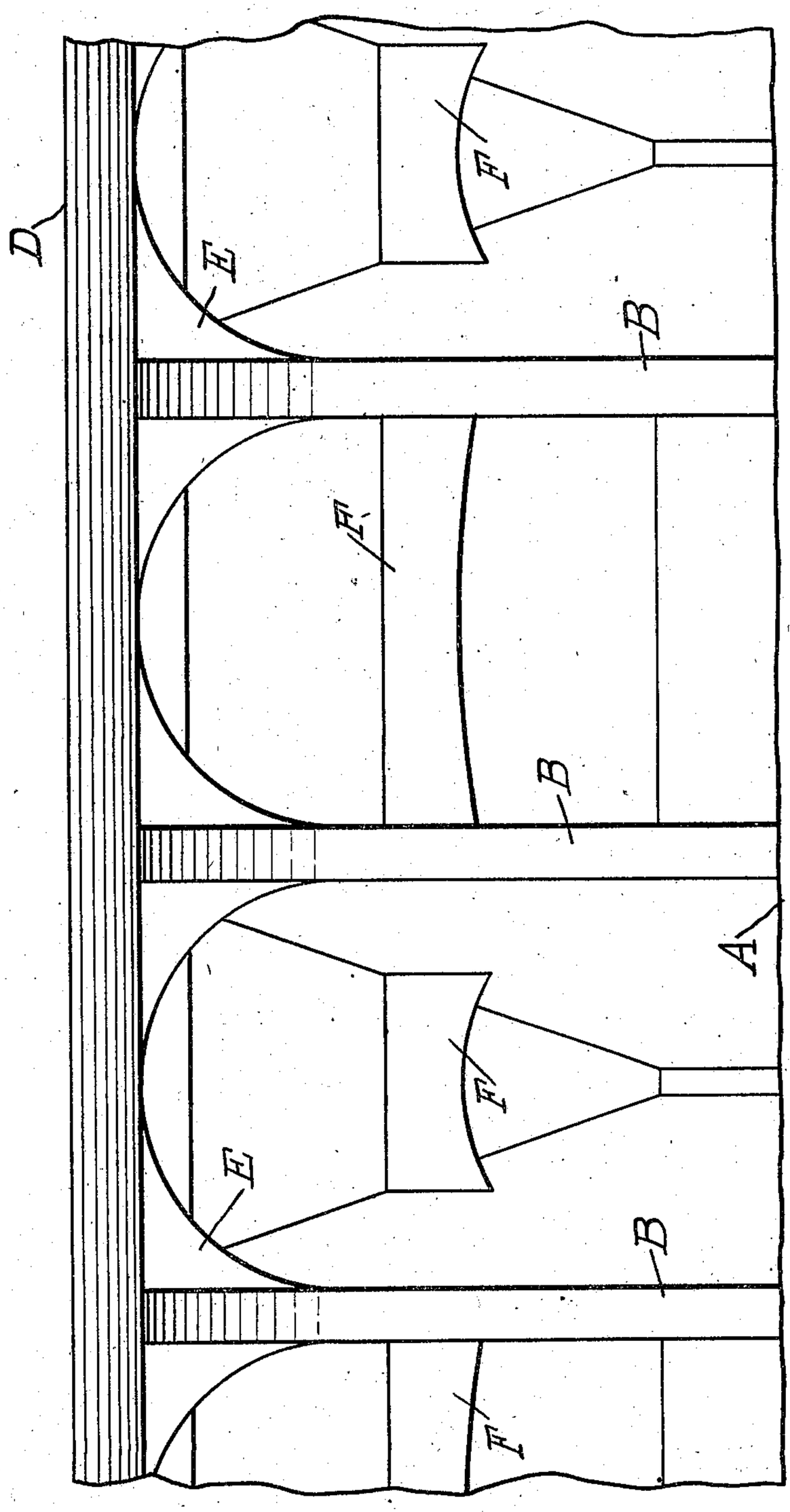

FIG. 4.

WITNESSES.

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APPLICATION FILED MAY 11, 1908.

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5 SHEETS—SHEET 5.

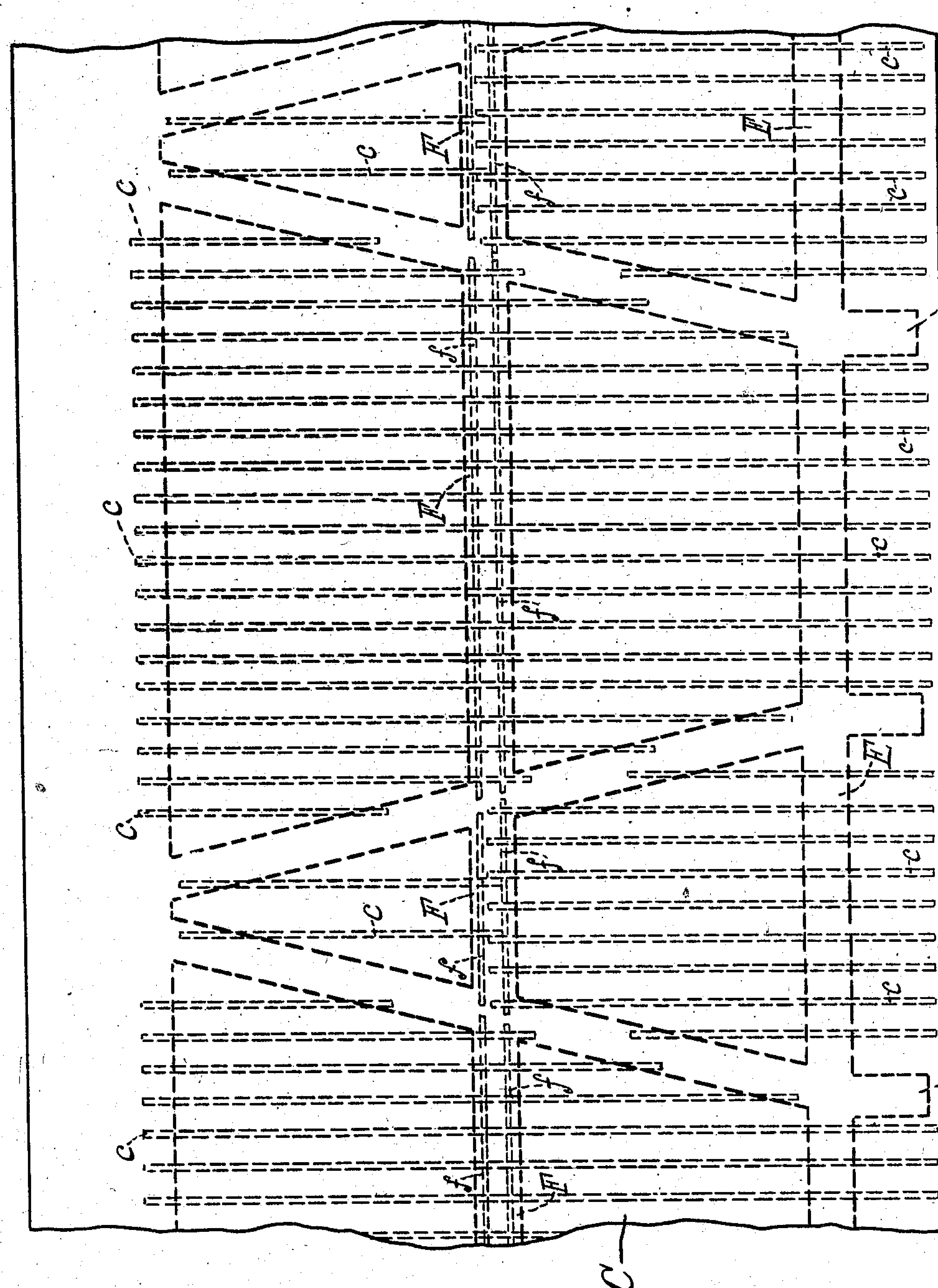

FIG. 5.

WITNESSES.

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UNITED STATES PATENT OFFICE.

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DAM.

No. 899,703. Specification of Letters Patent. Patented Sept. 29, 1908.

Application filed May 11, 1908. Serial No. 432,026.

To all whom it may concern:

Be it known that I, WILLIAM M. RANSOM, of Warren, county of Bristol, and State of Rhode Island, have invented certain new and useful Improvements in Dams; and I do hereby declare the following specification, taken in connection with the accompanying drawings, forming a part of the same, to be a full, clear, and exact description thereof.

The present invention relates to that type of dams known as hollow gravity dams and more particularly to such dams when constructed of concrete.

One object of the invention is to provide a dam which is better adapted to resist a down-stream sliding of the dam under the pressure of the water thereon than is the case with dams of this character as heretofore constructed. A hollow gravity dam embodies a series of buttresses, and as such dams have been heretofore constructed, these buttresses have been arranged parallel with the flow of the stream and consequently parallel with each other.

One feature of the present invention consists in providing a hollow gravity dam the buttresses of which are arranged at an angle to the flow of the stream and angularly with relation to each other, by which construction and arrangement of the buttresses a much greater resistance to the tendency of the dam to slide down stream is afforded.

Another object of the invention is to provide a dam of such construction that the strains set up therein will be largely compressive strains rather than tensile strains. As is well known, concrete has a much greater capacity to resist compressive strains than it has to resist tensile strains. A dam, therefore, the construction of which is that the strains set up therein will be largely compressive strains, is much better adapted to be built of concrete than one in which the strains are largely tensile. Moreover with a construction in which the strains are thus largely compressive strains, the reinforcing of the concrete with metal rods and the like, which is necessary where considerable tensile strain is to be resisted, may be largely, and in some cases entirely, eliminated.

Another feature of the present invention, therefore, consists in providing a hollow gravity dam in which the buttresses are connected at one or more points in their length by arches, whereby when the buttresses, the arches, and the deck or flooring are all united together, a solid structure is produced, and one in which the strains will be largely compressive strains.

A further feature of invention consists in the combination in one and the same dam-structure of the angularly arranged buttresses constituting the first feature of invention above referred to, and the arch construction constituting the second feature of invention referred to, whereby the resulting structure will have great capacity to resist sliding and also to withstand any racking strains thereon, and each section of which will be solid and stable in itself.

Referring to the drawings, Figure 1 is a sectional elevation of a dam embodying the features of invention referred to. Fig. 2 is an elevation of a portion of the down-stream side of the dam. Fig. 3 is a plan view of a corresponding portion of the dam. Figs. 4 and 5 are corresponding views to Figs. 2 and 3, but showing a modified construction.

While a dam embodying the features of the present invention might be constructed of material other than concrete, it will be understood that the dam shown in the drawings is to be constructed of concrete or similar material.

The dam shown comprises a base A which is shown as a natural base, but which if desired may be a constructed or artificial base, buttresses B, and a deck or flooring C, with the spill-way D.

As shown in the drawings, the buttresses B, instead of being arranged parallel with the flow of the stream and parallel with each other are arranged at an angle to the flow of the stream and at an angle to each other. In the preferred construction shown in Fig. 3, both the up-stream ends and the down-stream ends of the buttresses are directly united together, the buttresses thus forming a serrated structure, as shown in Fig. 3. In some cases it may be desirable not to bring the approaching down-stream ends of two adjacent buttresses together, and so that they may be directly united with each other, but instead to leave such down-stream ends separated a greater or less distance, as shown in Fig. 5.

In the dam shown in the drawings two series of arches are provided, one series of arches E being located at or near the down-stream ends of the buttresses and the other series of arches F being located at a point between the down-stream ends of the buttresses and the up-stream ends thereof. In the construction shown in Fig. 3 the arches E are all arranged in line with each other lengthwise of the dam, whereas the arches F are staggered as shown in Fig. 3. If desired, however, the arches F, instead of being thus staggered, may be arranged in line with each other, as shown in Fig. 5. In the construction shown in Figs. 2 and 3, in which the down-stream ends of the buttresses are directly united together, there is an arch E between two adjacent buttresses, and then the next arch E comes between the next two adjacent buttresses. In the construction shown in Figs. 4 and 5, however, in which the down-stream ends of the buttresses are not thus directly united together, but are left separated, there is an arch E between every two adjacent buttresses. In both constructions, however, there is an arch F between every two adjacent buttresses, as shown in Fig. 3 and also in Fig. 5.

With the construction shown and above described, a hollow gravity dam may be constructed entirely of concrete and without the employment of any reinforcing rods or members whatever. It is preferred, however, in some cases to make use of reinforcing rods or members located in the deck or flooring and extending widthwise of the dam, and such reinforcing rods or members *c* are shown or indicated by dotted lines in Figs. 3 and 5.

If desired, short reinforcing rods *f* may likewise be employed in the arches F, but, as will be seen from the drawings, such reinforcing rods *f* when employed do not extend the entire length of the dam and do not extend through or across the buttresses, but are merely short rods which simply extend from one buttress to the next.

With the buttresses of the dam arranged at an angle to the flow of the stream instead of parallel therewith, it will be seen that any tendency of the dam to slide in under the pressure of the water thereon will be resisted by reason of such angular arrangement to a much greater extent than is the case where the buttresses are arranged parallel with the flow of the stream. Moreover with such angular arrangement of the buttresses the dam is much better adapted to resist any racking action thereon, such as would tend to turn the buttresses about their axes of revolution by reason of the fact that the axes of revolution of adjacent buttresses are not parallel, but are instead at an angle to each other. Thus under any racking action, instead of both buttresses tending to turn in the same direction and about parallel axes of revolution, one buttress will tend to turn in one direction and the other in another, and any such tendency of the buttress to turn will, by reason of the angular arrangement of the buttresses, be resisted and practically prevented by the deck or flooring which connects the buttresses together. In other words, with such angular arrangement of the buttresses, two adjacent buttresses cannot both turn on their axes of revolution without first rupturing the intermediate connecting flooring. It will be further seen that this capacity of the dam to resist the effect of any racking action thereon is further increased and the dam as a whole greatly strengthened by the employment of the arches located between and connecting the buttresses and by the combination of such arches with the angularly arranged buttresses referred to.

It will be further seen, as above pointed out, that with a dam constructed as shown and described each and every section of the dam is solid and stable in itself, and consequently the dam may be built in sections comprising, for instance, two buttresses with their connecting arches and connecting flooring, and such section will be entirely stable and does not need the assistance or support of the adjoining sections to enable it to resist any strains that may be imposed thereon, and it is by reason of this fact that when the dam is constructed of concrete it is not necessary to employ reinforcing rods or other reinforcing members extending lengthwise of the dam to hold the portions of the dam structure together, as has heretofore been necessary in the construction of hollow gravity dams of concrete.

What I claim as my invention and desire to secure by Letters Patent is:

1. A hollow gravity dam embodying buttresses arranged at an angle to the flow of the stream.

2. A hollow gravity dam embodying buttresses arranged at an angle to the flow of the stream and having the down-stream ends of the converging buttresses united together.

3. A hollow gravity dam embodying buttresses arranged at an angle to the flow of the stream and a flooring connecting said buttresses.

4. A hollow gravity dam embodying buttresses and arches located between and connecting adjacent buttresses.

5. A hollow gravity dam embodying buttresses, arches located between and connecting adjacent buttresses, and a flooring connecting said buttresses and arches.

6. A hollow gravity dam embodying buttresses and two series of arches located between and connecting adjacent buttresses, one series of arches being located at or near the down-stream ends of said buttresses, and

the other series of arches being located at a point between the down-stream ends and the up-stream ends of said buttresses.

7. In a hollow gravity dam, the combination of buttresses arranged at an angle to the flow of the stream, and arches located between and connecting adjacent buttresses.

8. In a hollow gravity dam, the combination of buttresses arranged at an angle to the flow of the stream and having the down-stream ends of the converging buttresses directly united together, and arches located at or near the down-stream ends of the buttresses and between those buttresses whose ends are not thus united.

9. In a hollow gravity dam, the combination of buttresses arranged at an angle to the flow of the stream, and two series of arches located between and connecting adjacent buttresses, one series of arches being located at or near the down-stream ends of the buttresses, and the other series of arches being located at a point between the down-stream ends and the up-stream ends of said buttresses.

10. In a hollow gravity dam, the combination of buttresses arranged at an angle to the flow of the stream, arches located between and connecting adjacent buttresses, and a flooring connecting said buttresses and arches.

11. In a hollow gravity dam, the combination of buttresses arranged at an angle to the flow of the stream and having the down-stream ends of the converging buttresses directly united together, arches located at or near the down-stream ends of the buttresses and between those buttresses whose ends are not thus united, and a flooring connecting said buttresses and arches.

12. In a hollow gravity dam, the combination of buttresses arranged at an angle to the flow of the stream, two series of arches located between and connecting adjacent buttresses, one series of arches being located at or near the down-stream ends of the buttresses and the other series of arches being located at a point between the down-stream ends and the up-stream ends of said buttresses, and a flooring connecting said buttresses and said arches.

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J. H. THURSTON.