May 24, 1938. C. A. BETTS 2,118,535

HINGED AUTOMATIC FLASHBOARD GATE

Filed Aug. 27, 1937

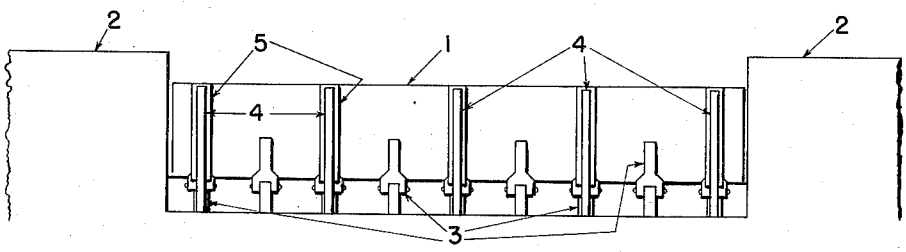
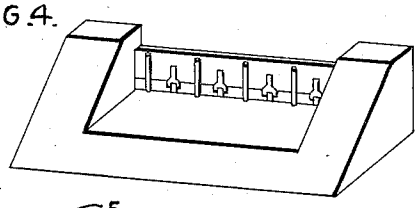


FIG. 1

FIG 4.



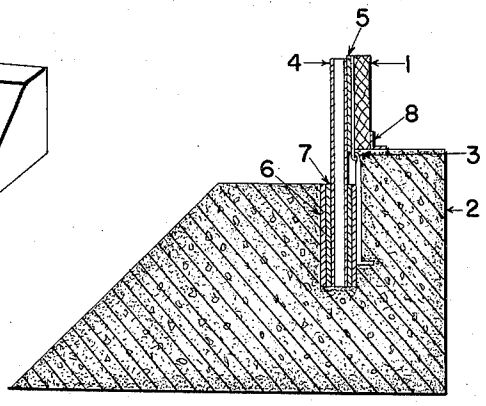


FIG. 3

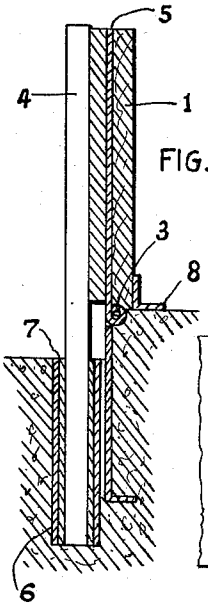


FIG. 7

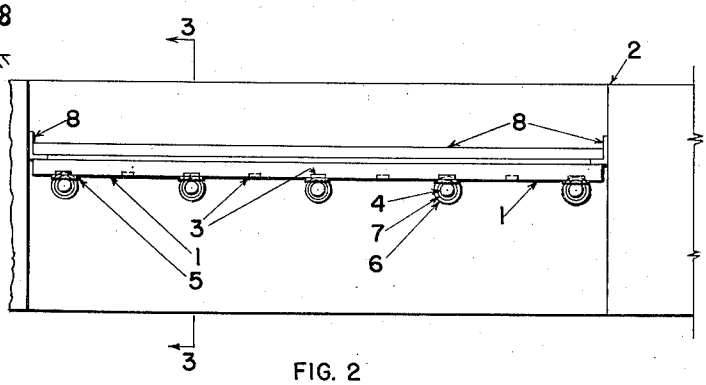


FIG. 2



FIG. 5

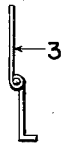


FIG. 6

INVENTOR

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HINGED AUTOMATIC FLASHBOARD GATE

Clifford Allen Betts, Chevy Chase, Md.

Application August 27, 1937, Serial No. 161,181

5 Claims. (Cl. 61—26)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757

This application is made under the act of March 3, 1883, as amended by the act of April 30, 1928, and the invention herein described and claimed, if patented, may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to me of any royalty thereon.

This invention relates to a hinged automatic flashboard gate for use in the spillway of a dam or channel and the like, designed to retain water or other liquids until the liquid reaches a certain head, at which point the gate falls to a horizontal position to by-pass the liquid.

The principle of this invention is applicable to the controlled storage of any liquid and has a common application in the control of floods where the function is to automatically enlarge the spillway capacity of a retaining wall and permit the discharge of a large volume of water when the flow exceeds a predetermined maximum. In this way it is possible to maintain any desired water level with corresponding additional storage and facilities to handle floods at the same time without injury to property above the retaining wall or to the structure itself.

The following specification, together with the accompanying drawing, will fully disclose this invention and further objects and advantages thereof will be apparent.

In the drawing:

Figure 1 is an elevational view of this invention as it appears applied to a retaining wall.

Figure 2 is a plan view of Figure 1.

Figure 3 is a cross-sectional view of Figure 2 along the line 3—3.

Figure 4 is a diminutive perspective view showing the position of the gate with respect to the spillway of a dam.

Figure 5 is a full view of one of the hinge members hereinafter designated by the numeral 3.

Figure 6 is an end view of the member shown in Figure 5.

Figure 7 is an enlarged view illustrating the parts 1, 4, 5, 6, 7, and 8, shown in Figure 3.

Referring with more particularity to the drawing in which like numerals designate like parts, a rigid vertically mounted gate 1 of wood, metal, or other suitable material, is hingedly mounted to the spillway of the retaining wall 2, by means of a plurality of hinges 3, so that said gate can be opened by revolving it on said hinges downstreamwardly. The upper sections of said hinges are fixed to the gate and the lower sections are embedded in the retaining wall, substantially as shown in Figure 3. On the downstream side of said gate a plurality of standards 4, constructed of pipes, pins, or other designs, are set into the retaining wall by means of sockets 6 and filler sleeves 7, and normally serve to support the gate 1 against water pressure exerted upon it. However, when the hydrostatic pressure exerted against the upstream side of the gate reaches a prescribed value, the said standards collapse to an angle of 90 degrees, or more, and permit the entire gate to revolve on the hinges 3 and assume a horizontal position. It is advantageous to locate the axis of the hinge below the spillway crest so that the gate may not obstruct the water-way when lying down after failure of the standards. To re-erect the gate in its normal vertical position, it is only necessary to substitute new standards for the bent or broken ones.

The water level at which the gate opens depends on the ultimate strength of the standards. For a given size and number of standards under given conditions, at a given spacing, a given gate will always fall at the same head of liquid. By changing the size and/or number of standards the water level can be controlled to any desired height.

Adjustable fillers 5 are disposed between gate 1 and the standards 4 to provide a uniform bearing along the standards regardless of the size of the standards used. Since both the hinges 3 and the sockets 6 are disposed in a fixed position such adjustable fillers will be required sometimes when changes are made in the size of the standards supporting the gate.

Leakage around the ends and base of the gate is prevented by the seals 8 attached to the gate. These seals are made of any suitable material such as rubber, canvas, and spring brass.

It is obvious that the spacing of the standards can be regulated to provide the most economical size of standards, as well as the most economical gate construction. Excessive spacing for high gates resquires rigid construction to permit uniform distribution of pressure without distortion of the gate which should be free to act as a unit.

These flashboard gates may be fabricated in sections and the sections so designed as to fall progressively by supporting them with various sizes of standards so that the sections having the weakest standards will have the tendency to fail under lower hydrostatic heads and thus only open a part of the gate at a time.

To avoid too frequent openings of the gate with the accompanying necessity of replacing the standards, and also to prevent premature permanent bending of the standards, the ratio between the water head above the top of the gate and the height of the gate should be such that ordinary floods can go over the gate without permanent bending of the standards.

When standard steel piping is used for standards, which is preferred to other designs now known, before the yield point is reached, the pipe supports will return to approximately their original vertical position after being bent but when the stress reaches the critical value (around

45,000 pounds per square inch for standard steel pipe) the bending accelerates. When the pipe reaches an angle of from 20 degrees to 30 degrees with the vertical, the ultimate stress or modulus of rupture is reached and failure occurs uniformly and positively.

When water flows over the gate a nappe is formed on the downstream side of the gate which may produce a partial vacuum. This vacuum would increase the pressure exerted on the upstream side of the gate. Therefore, allowance for this increased pressure may be made by adopting lower values for the initial stress at the yield point, as well as for the ultimate stress. Where this vacuum exists, earlier failure will result and either larger pipes are required or provision should be made for breaking the vacuum. However, where vacuum is negligible, the following values of moduli of rupture can be depended upon to give practical results for standard galvanized steel pipe:

Nominal inside diameter of pipe (d) (inches)	Section modulus (s) (ins. 3)	Ultimate strength (f) (lbs./sq. in.) empirical No vacuum*
1	.135	77,000
1¼	.235	73,000
1½	.330	72,000
2	.560	70,000
2½	1.070	70,000
3	1.750	70,000
3½	2.400	70,000

* For field installations having vacuum under the nappe, these values averaged from 10% to 30% lower.

The following simple formulae have been found to give results within about 3% of the actual head of water:

(1) $S=\frac{I}{c}=\frac{M}{f}$

(2) $M=125\ h^3L$ (non overflow type)

(3) $M=375\ B^2L(H+B/3)$ (overflow type)

where:—

M=bending moment (in inch-pounds)

S=section modulus of pipe (in inches^3)

I=moment of inertia of pipe (in inches^4)

f=ultimate strength or modulus or rupture of pipe (in lbs. per sq. in.)

c=half of outside diameter of pipe (in inches)

B=height of flashboards above spillway (in feet)

h=height of water above spillway (in feet)

H=water head above flashboards at failure (in feet)

L=span supported by one pipe (in feet)

WS=water surface of lake behind dam

For rough designs and estimates 75,000 pounds per square inch ultimate strength usually gives results to the nearest standard size of pipe.

Having thus described my invention, I claim:

1. An automatic flashboard for spillways of retaining walls, comprising a base section rigidly secured to the spillway, a gate section of predetermined height hingedly mounted to said base section, and a plurality of vertical supports removably secured to the spillway adapted to support said gate section against a body of liquid, the strength of said supports sustaining said gate section against said body of liquid being related to the head of water against said gate section.

2. An automatic flashboard for spillways of retaining walls, comprising a base section rigidly secured to the spillway, a gate section of predetermined height hingedly mounted to said base section, and a plurality of pipe sections removably mounted in said spillway adapted to support said gate section against a body of water, the diameter of said pipe sections being directly related to the height of the water bearing against said gate section.

3. An automatic flashboard for spillways of retaining walls, comprising a base section rigidly secured to the spillway, a gate section of predetermined height hingedly mounted to said base section, and a plurality of pipe sections removably mounted in said spillway adapted to support said gate section against a body of water, the diameter of said pipe sections being proportional to the height of the water bearing against said gate section and to the resulting bending moment according to the formula

$$S=\frac{M}{f}$$

where S is the section modulus of the pipe, M is its bending moment in inch-pounds and f is the ultimate breaking strength of the pipe in pounds per square inch.

4. An automatic flashboard for spillways of retaining walls, comprising a base section rigidly secured to the spillway, a gate section of predetermined height hingedly mounted to said base section, and a plurality of pipe sections mounted in pipe sockets embedded in said spillway adapted to support said gate section against a body of water.

5. An automatic flashboard for spillways of retaining walls, comprising a base section rigidly secured to the spillway, a plurality of gate sections of predetermined height hingedly mounted to said base section, a plurality of variable size pipe sections removably mounted in said spillway adapted to support said gate sections against a body of water, and adjustable fillers disposed between said pipes and said gate sections to render uniform bearing against said variable size pipes.

CLIFFORD ALLEN BETTS.

CERTIFICATE OF CORRECTION.

Patent No. 2,118,535. May 24, 1938.

CLIFFORD ALLEN BETTS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 37, for "resquires" read requires; page 2, first column, line 48, for "or" second occurrence, read of; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of July, A. D. 1938.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)