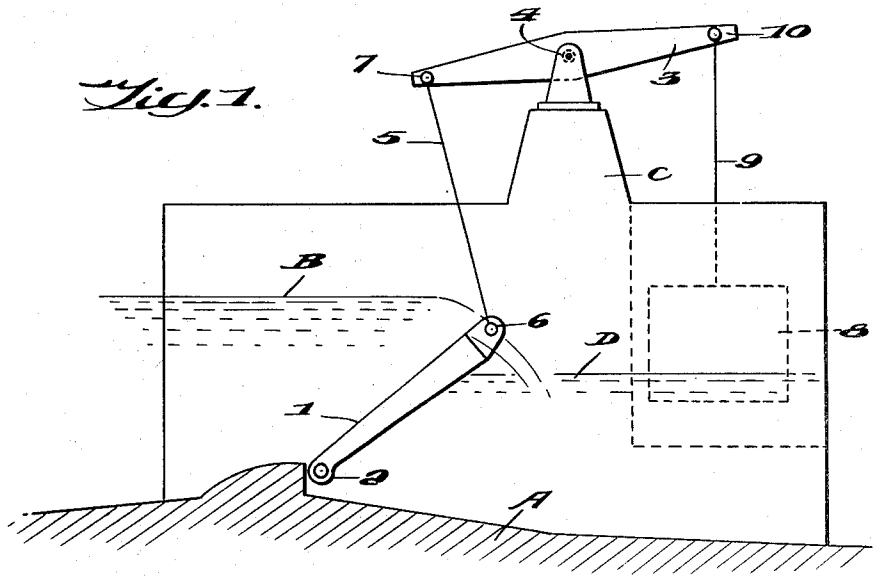
Jan. 8, 1957 A. FORTES 2,776,541

AUTOMATIC BALANCE-BEAM HINGED SHUTTER GATE

Filed Feb. 24, 1953

Fig. 1.



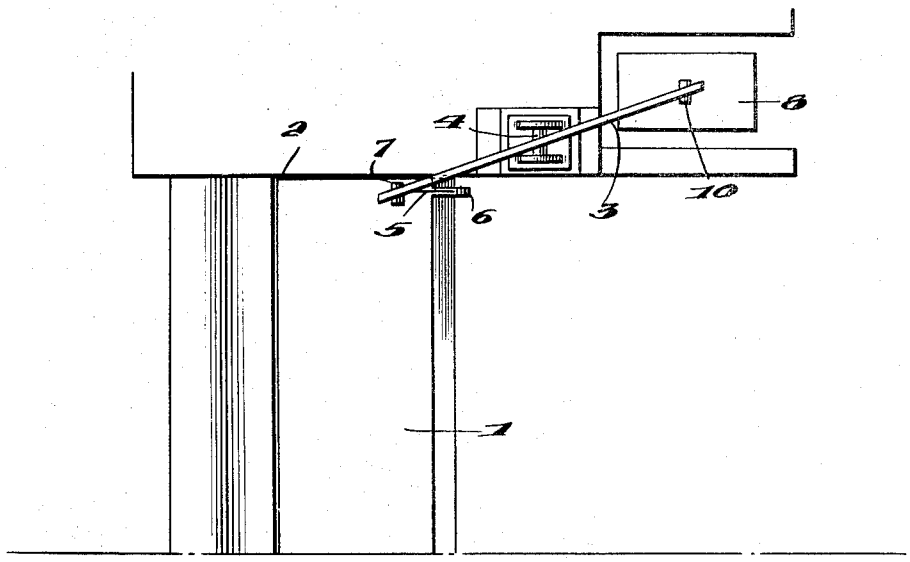


Fig. 2.

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AUTOMATIC BALANCE-BEAM HINGED SHUTTER GATE

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1 Claim. (Cl. 61—25)

The invention relates to an improvement in automatic balance-beam hinged shutter gates of the type in which one end of a balance-beam is connected to a counterweight and the other is connected to the upper or free end of a hinged shutter gate which is subjected to the force of the water to be controlled in regulating the level of a pool for example.

The known gates of this type operate well under good conditions, but it has been found that they cease to operate correctly when the tail waters back up against the downstream face of the gate and exert a pressure which decreases the forces acting on the gate in a direction to open it in relation to the counterweight. When, for example, the gate is placed on the bed of a river with the pivotal axis near the river bed and the relationship between the counterweight and the other parts is adjusted to maintain a certain level on the upstream side of the gate, a heavy flow in the river results in the opening of the gate to such an extent that the downstream level rises until the tail waters exert a hydrostatic pressure which upsets the equilibrium of the system. The counterweight, which has been adjusted to balance only the pressure on the upstream side of the gate, then becomes preponderant and closes the gate whereas it is desirable to maintain it open so long as the flood conditions continue.

There are balance-beam type hinged shutter gates operating on the principle of water chambers with adjustable flow, which have the object of more or less reducing the above mentioned disadvantage. In these gates, the counterweights are displaced inside wells fed by a weir from the upstream side, and comprising an adjustable outlet in the form of a tube opening out on the downstream side. The top of the weir is adjusted to the mark of the level which it is intended to maintain on the upstream side or a slightly lower mark. If the level on the upstream side tends to exceed the said level, a certain flow will pass over the weir. With the outlet tube producing a considerable loss of head the level rises in the wells and, lightening the counterweight through the Archimedean pressure, assists the gate to lower itself. It will be seen that, in this system, the outlet tubes can become obstructed and cause the opening of the gate at the wrong time and, further there is the disadvantage of the compiicated installation comprising the weir and various tubes.

The present invention has for its objects to provide an improved arrangement for controlling automatic balance-beam type hinged shutter gates intended to regulate a pool level on the upstream side and subjected to the pressure of the tail waters, by means of which the disadvantages of the foregoing arrangement and the difficulties of carrying the same into effect are obviated. The arrangement according to the invention permits the regulation of the level where there are slight flows, as in the case of conventional hinged shutter gates, and renders it possible to obtain complete opening for large flows, whatever may be the level of the water on the gate. Thus according to the invention means operatively connected

to the counterweight side of the balance-beam, which may be the counterweight or counterweights, or other floatable means alone or in combination with the counterweight(s), is arranged to be subjected, when the level of the tail waters exceeds a given level, to the hydrostatic action of a body of liquid the level of which varies in accordance with that of the tail waters. This controlling action is designed to neutralize the effect of the pressure of the downstream waters on the shutter.

Other objects and features of the invention will appear from the following description of when considered in connection with the attached drawing in which Fig. 1 is a side elevation of one embodiment of the present invention and

Fig. 2 is a plan view thereof. A indicates the bed of the channel confining the headwaters to be controlled, B indicates the headwaters, C indicates the masonry at one side of the channel and D indicates the tail waters. It is conventional to provide balance beam and counterweight control apparatus at each side of the channel but in the following description reference will be made to the parts and connections of the control apparatus at one side only.

The conventional shutter gate **1** is pivoted at its lower side to provide a hinged mounting **2** carried by the bed A of the channel. A balance-beam **3** is pivoted at **4** on the masonry C and one side of the beam **3** is connected to the upper or free end of the gate **1** by means of a stay **5** which is preferably adjustable in length and is pivotally connected at **6** to the gate **1** and at **7** to the beam **3**. A counterweight or a plurality of counterweights (herein referred to for convenience as a counterweight) **8** is suspended from the other side of the balance-beam **3** by means of a stay **9** connected to the beam **3** at **10**. The stay **9** is longitudinally adjustable and it is adapted to transmit to the beam upwardly directed forces exerted on the counterweight **8** by the hydrostatic action of the tail waters B when the tail waters rise above a predetermined level.

The operation is as follows:

When the flow required in order to maintain the pool level on the upstream side is small and does not cause the water level on the downstream side to rise above a given level, e. g. the level of the pivots, the gate operates exactly like conventional automatic balance-beam type hinged shutter gates, that is to say, the pressure which the waters on the upstream side exerts on the gate causes a moment tending to make the gate open, which is counterbalanced, together with the moment of the movable parts, by the moment produced by the action of the counterweight, which is completely above the tail water; the gate is therefore balanced and maintains its position.

In the event of the flow increasing slightly, the level of the pool tends to rise, thus causing a greater pressure on the gate; the moment of this pressure consequently becomes greater than the moment of the counterweight and the gate commences to open, partially opposing the rise in the pool level; the pressure or thrust moments on the upstream side and of the counterweight vary simultaneously according to the opening of the gate and, finally, the gate is stabilized in a new position (lower than the initial position) in which the moment of the counterweight balances the moment of the pressure. A pool level very slightly higher than the initial level will correspond to the new position of the gate. On the assumption that small flows are involved, to which correspond downstream levels lower than the level of the pivots, the counterweight remains above the downstream water level and the gate continues to operate exactly like conventional balance-beam type hinged leaf gates.

If, on the contrary, the flow to be carried off should decrease instead of increasing, the same action takes place, but in the reverse sense.

Let us now consider the case in which a greater flow is to be carried off and the tail water is established at a level a little higher than the level of the pivots. The gate is in a more open position than that in the case of the above-mentioned flows. According to the invention the stay 9 is adjusted so that the bottom of the counterweight 8 is in the immediate vicinity of the downstream water level. If this were not so, the moment due to the pressure of the downstream waters, which increases with the flow to be carried off and with the opening of the gate, would hinder the opening of the latter. According to the invention, when the gate opens, the counterweight rises as in any balance-beam type hinged shutter gate, but, in the case of the flow under consideration, the counterweight is at the mark of the downstream water level, as has already been mentioned, and its vertical course is calculated so that the rise of the counterweight as a function of the opening of the gate is less than the corresponding rise of the downstream level. Thus, when the flow to be carried off increases, the said counterweight is subjected by the tail waters, to a hydrostatic pressure which is all the greater the higher the level of the tail water, and which, by lightening the counterweight, compensates the unfavourable effect of the pressure exerted by the said waters on the downstream side of the gate.

Thus, when the flow increases beyond the normal flow, the level of the pool tends to rise which increase the pressure on the upstream face of the gate, in consequence of which the gate commences to open. When the gate opens, the downstream level rises. In the conventional hinged shutter gate system, the rise in the downstream level will cause an increase in the pressure on the downstream face of the gate which will limit the opening of the gate or act so as to cause the gate to close according to whether the reaction of the downstream water level is more or less rapid. According to the invention, the rise in the downstream level increasing the hydrostatic pressure on the counterweight 8 lightens it, thus compensating the effect of the pressure of the tail waters on the gate so that it will open normally.

The hinged shutter gate according to the invention will continue to open, in proportion to the increase in the flow, the action of the downstream level on the counterweight becoming greater, until, for the maximum flow, with the counterweight floating completely in the tail water, the gate is completely open, even if there is no appreciable difference in level between upstream and downstream, whereas a conventional hinged shutter gate would cause, for the same flow, a considerable difference in level, since, in order to balance the action of the counterweight, it requires a sufficient difference in pressure between its upstream and downstream faces.

In the hinged shutter gate shown diagrammatically in the accompanying drawing, the counterweight 8 is located on the downstream side of the gate (an arrangement which distinguishes the balance-beam type hinged shutter gates which are the object of the invention even more clearly from the conventional balance-beam type hinged shutter gates), which enables them to be protected from the current which passes over the gate by means of simple guide walls which undergo practically no unbalanced water pressure. Other embodiments are however within the contemplation of the invention. Thus the counterweights or separate floatable means may be located on the upstream side of the gate provided that they are arranged to be subjected to the hydrostatic action of a body of liquid of the same level as the tailwater. Thus the counterweights may be arranged for immersion in a pool on the upstream side of the gate but connected to the tailwaters by a suitable channel.

It is also within the contemplation of the invention to arrange for the immersion of the counterweights in wells capable of being isolated both from the head-water and the tail water so that the gate may be lowered at will by filling the wells with water.

Furthermore, one or more independent floats may be associated with one or more counterweights and the gate may be controlled from one side only in which case it is necessary to provide a gate which is resistant to torsion.

What I claim as my invention is:

An automatic balance beam shutter gate for regulating the level of headwaters independently of the level of tailwaters comprising, a shutter gate hingedly mounted at the lower edge thereof for pivotal movement in a vertical plane, said shutter gate being adapted to open in response to pressure of headwaters, a balance beam, means connecting one end of said balance beam with the upper edge of said shutter gate, a counterweight, a rigid stay connecting the counterweight with the other end of the balance beam, said counterweight retaining said shuttergate closed when the headwaters elevation is below a predetermined level, said counterweight being suspended above a body of liquid the level of which varies as the level of the tailwaters whereby as the tailwaters rise and increase the pressure on the downstream side of the shutter gate the counterweight becomes at least partially immersed thus compensating for the increase in tailwater pressure and offers less resistance to the opening of the shutter gate.

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