United States Patent [19]

Jacobs

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[45] **May 22, 1973**

[54] **TIDAL FLOW SYSTEM AND METHOD FOR CAUSING WATER TO FLOW THROUGH WATERWAYS**

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[21] Appl. No.: **150,286**

[52] **U.S. Cl.** **61/1,** 61/2, 61/16, 61/19, 61/25, 137/236

[51] **Int. Cl.**.....**E02b 3/00,** E02b 15/00

[58] **Field of Search**.....61/1, 2, 10, 12, 61/16, 17, 18, 20, 25; 137/236, 563

[56] **References Cited**

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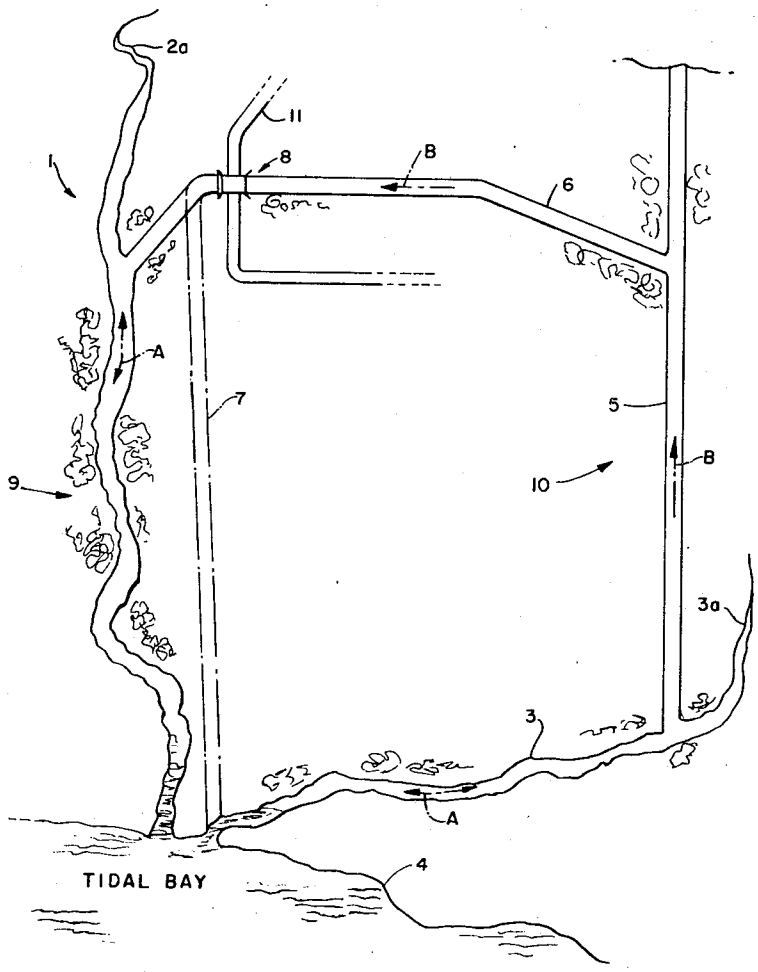
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Primary Examiner—Jacob Shapiro
Attorney—Shoemaker & Mattare

[57] **ABSTRACT**

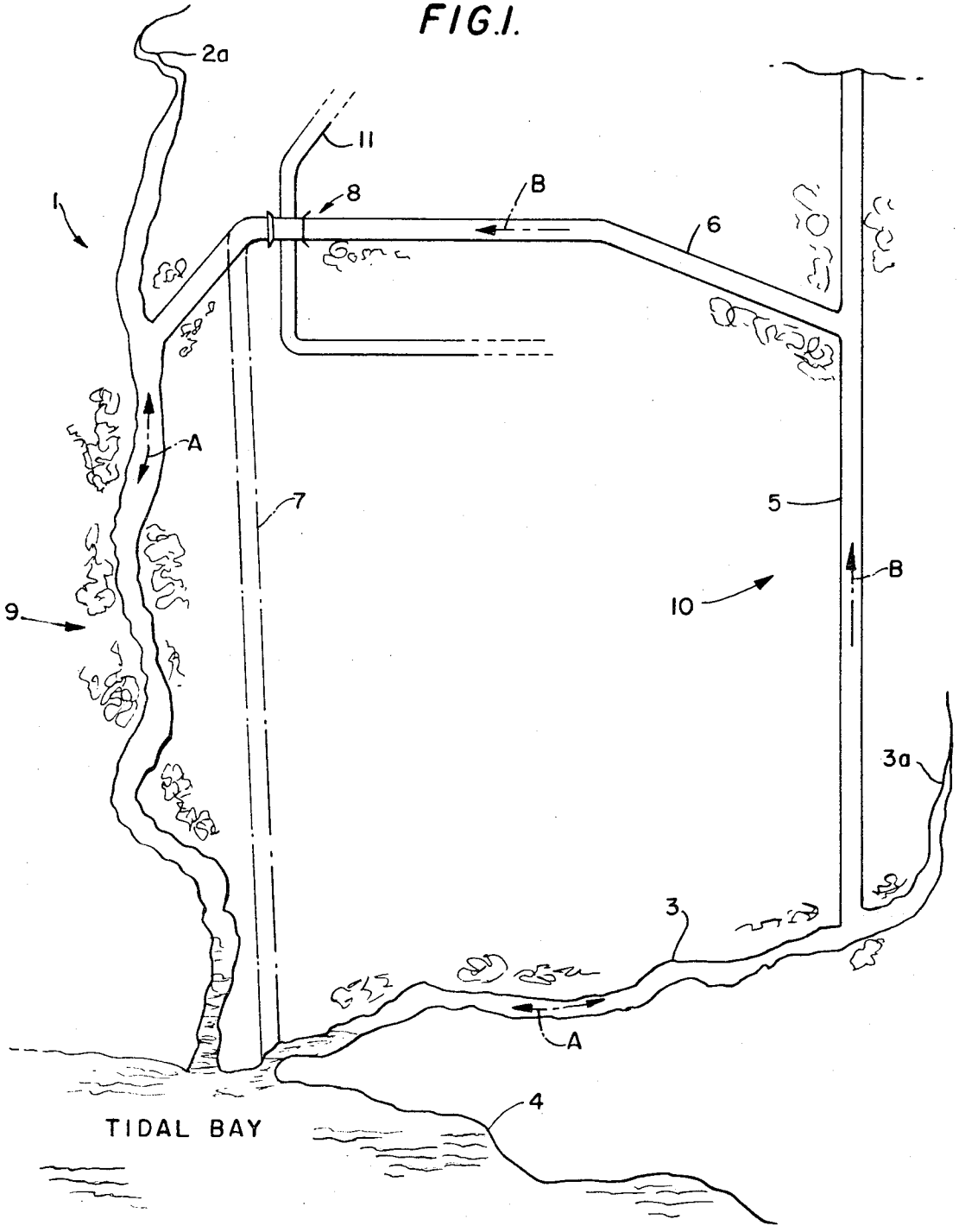
A tidal flow system and method for causing flow of water through waterways to flush said waterways and prevent stagnation of water and accumulation of debris therein, wherein a one-way valve means is in said waterway between the ends thereof, said valve means being closed when the depth of water on the discharge side of the valve is greater than on the inlet side of the valve and said valve means being opened when the depth of water on the discharge side of the valve is less than on the inlet side thereof, the depth of water at least on the discharge side of the valve being controlled by tidal action.

13 Claims, 6 Drawing Figures



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FIG. 1.



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FIG. 2.

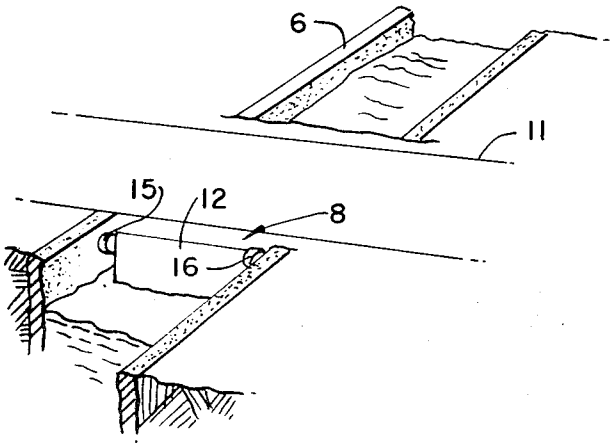


FIG. 3.

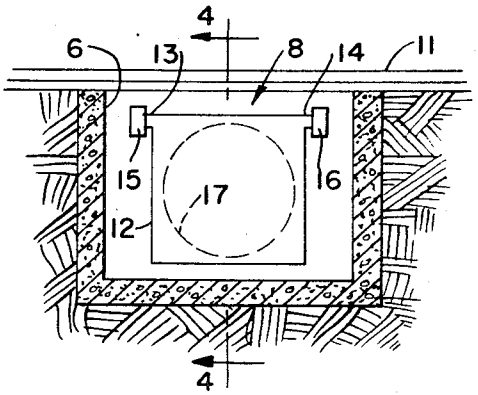


FIG. 4.

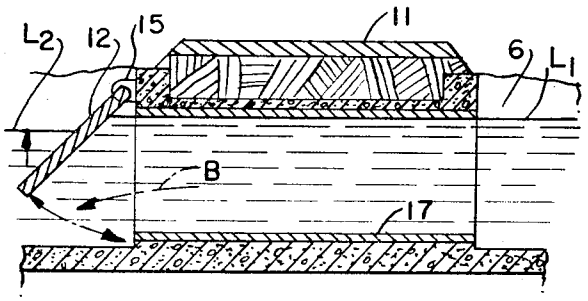


FIG. 5.

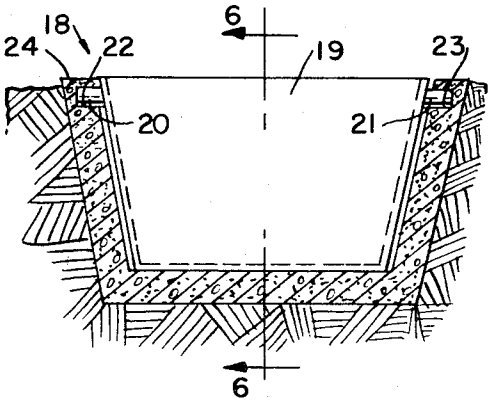
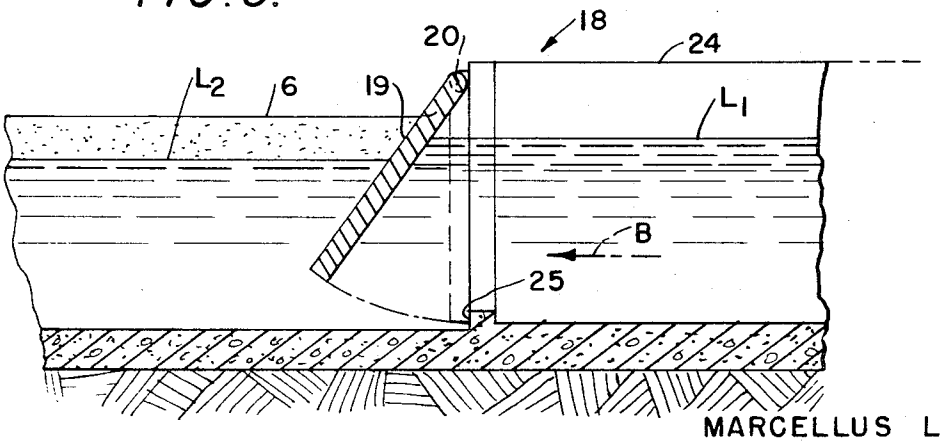


FIG. 6.



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TIDAL FLOW SYSTEM AND METHOD FOR CAUSING WATER TO FLOW THROUGH WATERWAYS

BACKGROUND OF THE INVENTION

In waterways subject to salt water tide level control there is no means in the prior art for positively moving the water through such waterways to prevent stagnation of water therein, particularly at the dead ends thereof, where tide action produces very little or no flushing action. Moreover, there is no means in the prior art to prevent sand bar formation at the entrance to canals or other waterways subject to normal tidal action. Also, fresh water drain ditches which are near sea level are frequently flooded with salt water for several miles inland at high tide, thus destroying vegetation and preventing drain off of fresh water which then stagnates in the ditch.

This invention relates to a means and method for causing flow of water through coastal waterways and the like which are subject to tidal action.

More particularly, the invention is directed to a tidal flow system and method wherein a valve means is so positioned in a waterway that the difference in depth of water on opposite sides of the valve is influenced by tidal action to cause flow of water through the valve means and waterway to flush the waterway.

According to one form of the invention, a freely pivoted flap gate valve is positioned at one end of a culvert or spillway in a waterway system to control the flow of water through the waterway. The flap gate valve is positioned in the waterway between the ends thereof with the opposite ends of the waterway connected to a source of tidal action, such as a tidal bay or river or the like. The flap gate valve is positioned nearer one end of the waterway to provide a relatively long flow path from the tidal source to the valve from the other end of the waterway, thus producing a time differential between high tides on opposite sides of the valve. The longer side of the waterway system is preferably at the inlet side of the valve, and the shorter side is at the discharge side of the valve. Accordingly, when high tide occurs at the source, the depth of water increases in the waterway and high tide will reach the discharge side of the valve quicker than it reaches the inlet side thereof due to the shorter distance the tide must flow on the discharge side of the valve. The higher water level on the discharge side of the valve maintains the valve closed. Depending on the relative lengths of the inlet and discharge sides of the waterway system, the tide will start to recede on the discharge side of the valve prior to the time the high tide reaches the inlet side thereof through the longer side of the waterway. When the water level on the discharge side of the valve is less than on the inlet side thereof, the valve will open under the influence of the higher water level on the inlet side thereof and flow will occur through the waterway from the inlet side to the discharge side, thus flushing the waterway and preventing stagnation of water therein and accumulation of leaves and other debris. Flow through the waterway is always in the same direction rather than back and forth as in normal tidal action, and the formation of sand bars at the entrance to the waterway is thus precluded.

Flow of water through the waterway may be made to go in the opposite direction, if desired, by positioning the valve near a different end of the system. In this way, the flow of water in the waterway can be secured from the cleanest source.

The relative lengths of the discharge and inlet sides of the waterway system may be varied considerably since a time differential between high tides on opposite sides of the valve from 30 minutes to one hour is sufficient to open the valve and produce flow through the valve. Since the tide stays at both the high and low tide levels for some time, a continued flow of water occurs through the valve for an hour or more with each high tide.

The invention can also be used to keep salt water from fresh water drain ditches that discharge into salt water areas. The valve is installed in the discharge end of a fresh water drain ditch so that it normally stays closed against the flow of salt water into the ditch; but when the fresh water drain ditch fills sufficiently with fresh water to create a pressure against the valve, it will open to permit the fresh water to drain into a salt water basin or the like. High salt water tides are prevented from flowing back into the fresh water drain area by the action of the valve, yet the free flow of the fresh water drain is permitted since high salt water tides are only for short periods each day. The fresh water flow out through the valve is only affected during such high tide intervals and then only if the outside salt water level is higher than the inside fresh water level in the drain ditch. The water level in the fresh water ditch is not backed up or raised anymore by use of the invention then it would be if the salt water tide was pushing back up the drain ditch against the fresh water. As soon as the tide recedes, the fresh water in the ditch drains out through the valve in the normal manner.

By use of the present invention, a sufficiently low level drain elevation in fresh water drain ditches can be maintained; and yet at the same time, salt water can be prevented from backing up into fresh water canals and areas and damaging or destroying soil and fresh water vegetation and the like.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a means for causing water to flow through a water way in one direction and under the influence of tidal action to prevent stagnation of water in said waterway.

Another object of this invention is to provide a method of flushing coastal waterways to prevent stagnation of water therein.

A further object of this invention is to provide a means for preventing flow of salt water tides inland into fresh water drain ditches and at the same time for enabling fresh water to drain out of said ditches.

A still further object is to provide a method of preventing the flow of salt water into fresh water drain ditches and enabling drainage of fresh water from said ditches.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a coastal waterway system embodying the present invention.

FIG. 2 is a top perspective view of a waterway or canal with a valve means according to the present invention therein.

FIG. 3 is a view in section of the waterway shown in FIG. 2.

FIG. 4 is a view in section, taken along line 4—4 in FIG. 3.

FIG. 5 is a view in section of a second form of valve means according to the present invention.

FIG. 6 is a view in section taken along line 6—6 in FIG. 5.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, wherein like reference numerals refer to like parts through the several views, a coastal waterway system is indicated generally at 1 in FIG. 1 and comprises a pair of natural waterways such as rivers and the like 2 and 3, extending inland from a tidal bay or the like 4. A first man-made canal or waterway 5 is connected at one end thereof with the waterway 3 and extends inland therefrom. A second man-made canal or waterway 6 is connected at one end with the waterway 2 and at the other end with the canal or waterway 5, thus defining a closed loop for the flow of water with the waterways 2 and 3 and canals or waterways 5 and 6 defining a waterway system extending from the tidal bay inland and then back to the tidal bay. A third man-made canal or waterway indicated in phantom line at 7 in FIG. 1 may be used to connect said one end of waterway 6 with a tidal source which may comprise either the tidal bay 4 or the waterway 3. The waterway or canal 7 could be used, for example, if the natural waterway 2 was not present, or it could be used for any other reason, as desired, rather than using the natural waterway 2.

A suitable valve means, such as a flaptype gate valve indicated generally at 8 is interposed in the waterway system and is preferably positioned nearer one end thereof than the other. As indicated in FIG. 1, the valve means 8 is in the canal or waterway 6 adjacent the natural waterway 2, thus dividing the waterway system into a relatively short portion 9 and a relatively long portion 10 on opposite sides of the valve 8. A roadway or the like 11 is shown crossing over the canal or waterway 6 at the valve means 8.

The flow of water through the waterway system under the influence of tidal action is as indicated by the arrows in FIG. 1, with flow occurring in both directions in the waterways 2 and 3 as indicated by the arrows A and flow occurring in the single direction through the canals or waterways 5 and 6 indicated by the arrows B.

Referring now to FIGS. 2, 3 and 4, a first form of the invention is illustrated and comprises a flap gate valve 12 freely pivotally suspended from a pair of oppositely directed pivot pins 13 and 14 at its upper end thereof received in a pair of pivot bearing support means 15 and 16. The flap gate valve 12 is mounted for pivotal movement toward and away from one end of a culvert 17 extended under the roadway 11.

As shown in FIG. 4, the water level L_1 in the inlet side of the waterway 6 is higher than the level L_2 in the discharge side thereof and the pressure of the water in the inlet side is urging the valve 12 open with flow occurring through the conduit 17 in the direction indicated by the arrow B. When the level L_2 is equal to or greater than the level L_1, the valve 12 will close and flow will not occur through the system.

The levels L_1 and L_2 are dependent upon the flow of water into and out of the waterways 2 and 3 and 5 and 6 as effected by high and low tides in the tidal bay 4. As previously described, it takes longer for the tide to flow through waterway 3 and waterways or canals 5 or 6 to the valve 8 than it does for the tide to flow through waterway 2 and canal or waterway 6 to the valve 8. Accordingly, the level L_2 of the water on the discharge side of the valve will initially be higher than the level L_1 on the inlet side of the valve and the valve will be closed. When the tide recedes in the tidal bay 4, as at low tide, the water will first flow away from the discharge side of the valve, this being the shorter side 9; and in fact, this lowering of the level L_2 in the discharge side of the valve will occur while the level L_1 is still rising on the inlet side of the valve, as for example, when the side 10 is approximately one-third longer than the side 9. As soon as the level L_2 is less than the level L_1, the valve 12 will open and flow will occur therethrough in the direction indicated by the arrows B to flush the system. A portion of the water in the waterways 2 and 3 will flow back through the waterway into the tidal bay 4 with each receding tide as indicated by the arrows A.

Referring now to FIGS. 5 and 6, a modification of the invention is indicated generally at 18. In this form of the invention, a flap gate valve 19 is freely pivotally supported about its upper edge by means of a pair of oppositely extending pivot pins 20 and 21 received in suitable recesses 22 and 23 at the opposite upper sides of a spillway 24 formed in the canal or waterway 6. A shoulder 25 is formed at one end of the spillway 24 against which the valve 19 seats when in its closed position.

As seen in FIG. 6, the level L_1 on the inlet side of the valve is greater than the level L_2 on the outlet or discharge side of the valve and flow is occurring through the spillway and valve in a direction indicated by the arrow B. The operation of this form of the invention is identical to the operation of the form of the invention illustrated in FIGS. 2, 3 and 4.

By way of specific example, the waterways 2 and 3 in FIG. 1 may be approximately 1 mile long from the tidal bay 4 to the respective ends of the canals or waterways 5 and 6, and the canals or waterways 5 and 6 on the inlet side of valve 8 extend for approximately three-fourths of a mile from a waterway 3 to the valve 8. This difference in length of three-fourths of a mile between the long side 10 and the short side 9 on opposite sides of the valve 8 provide approximately a 1 hour difference in high tide levels on opposite sides of the valve 8. A culvert or spillway 36 inches wide in a canal or waterway 50 to 70 feet wide works satisfactorily in such a system.

As seen in FIG. 1, the natural waterways 2 and 3 terminate at their inner ends 2*a* and 3*a*, respectively, at some inland location. These waterways could terminate in small lagoons or other waterways, the important point being that the tidal flow system extends from a body of water subject to tidal action.

As previously noted, the present invention is also applicable to fresh water drain ditches or canals to prevent salt water tides from flowing into the canals and damaging the soil or vegetation, and yet at the same time, enabling the fresh water to drain out of the ditch or canal. The valve 8 or 18 would simply be placed in a fresh water drain ditch near the discharge end thereof.

The flap gate valve may be made of reinforced concrete, steel, wood or any other suitable material, and the canals or waterways 5 and 6 may be made of concrete or any other suitable material, or the canals may simply be formed without any lining, if desired.

As this invention may be embodied in several forms without departing from the spirit or essential character-

istics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents, are therefore intended to be embraced by those claims.

I claim:

1. A tidal flow system for causing flow of water through a waterway in one direction to flush said waterway and prevent stagnation of water and accumulation of debris and pollutants or the like therein and to create a food and water condition for marine life growth superior to that naturally obtained, comprising a pair of laterally spaced waterways extending inland from a body of water subject to tidal action, said waterways connected at one of their ends to said body of water and receiving water therefrom, said waterways connected with each other inland from said body of water to define a closed waterway loop for the flow of water subject to tidal action from said body of water, water operated, one-way valve means in said waterway loop between the ends thereof dividing the waterway loop into a relatively short end on one side of the valve and a relatively long end on the other side thereof so that the level of water rises on said one side of the valve before it rises on the other side thereof due to tidal action and falls on said one side of the valve before it falls on the other side thereof due to tidal action to obtain water flow through the waterway from the cleanest source, said valve being opened to discharge water from one of said ends into the other of said ends of the waterway loop, and closed to prevent the reverse flow, responsive to the difference in water level on opposite sides of the valve, thus causing a flow of water through said waterway in one direction with each change in tide to prevent stagnation of water and accumulation of debris and the like therein and to improve the marine environment in said waterway.

2. A tidal flow system as in claim **1**, wherein said waterway comprises a first man-made waterway connected at one end thereof with a body of water subject to tital action and extending inland at the other end thereof, a second man-made waterway connected at one end thereof with said body of water and extending inland at the other end thereof, and said other ends of said waterways connected together to define said waterway loop.

3. A tidal flow system as in claim **1**, wherein said waterway comprises a pair of natural waterways extending inland from a body of water subject to tidal action, a first man-made waterway connected at one end thereof to one of said natural waterways, a second man-made waterway connected at one end thereof to the other of said natural waterways, said first and second man-made waterways extending inland at their other ends and connected together at their other ends to define said closed waterway loop.

4. A tidal flow system as in claim **1**, wherein said valve opens toward the short end of the waterway to obtain flow from the long end to the short end.

5. A tidal pump system as in claim **1**, wherein said valve means comprises a flap-type gate valve.

6. A tidal pump system as in claim **5**, wherein said flap-type gate valve is freely pivotally supported from its upper edge thereof.

7. A tidal pump system as in claim **6**, wherein said valve is mounted at the end of a culvert.

8. A tidal pump system as in claim **6**, wherein said valve is mounted at the end of a spillway.

9. A tidal pump system as in claim **1**, wherein at least a part of said waterway system comprises a natural waterway.

10. A tidal pump system as in claim **9**, wherein a part of said waterway system comprises a man-made canal.

11. A tidal pump system as in claim **1**, wherein the long side of said waterway system is approximately one-third longer than the short side thereof.

12. A tidal pump system as in claim **1**, wherein said waterway system comprises a man-made canal connected at its opposite ends with a river subject to tidal action.

13. A tidal pump system as in claim **1**, wherein said valve means is in a man-made canal, the opposite ends of said canal being connected to a pair of natural waterways subject to tidal action.

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(12) REEXAMINATION CERTIFICATE (4409th)

United States Patent

Jacobs

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(45) Certificate Issued: Aug. 14, 2001

(54) **CANAL BANK RETAINING WALL MEANS AND METHOD**

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Filed:	**Jun. 7, 1971**

(51) **Int. Cl.**[7] **E02B 3/00**; E02B 3/02; E02B 15/00

(52) **U.S. Cl.** **405/73**; 405/80; 405/87; 405/94; 405/118; 405/108; 137/236.1

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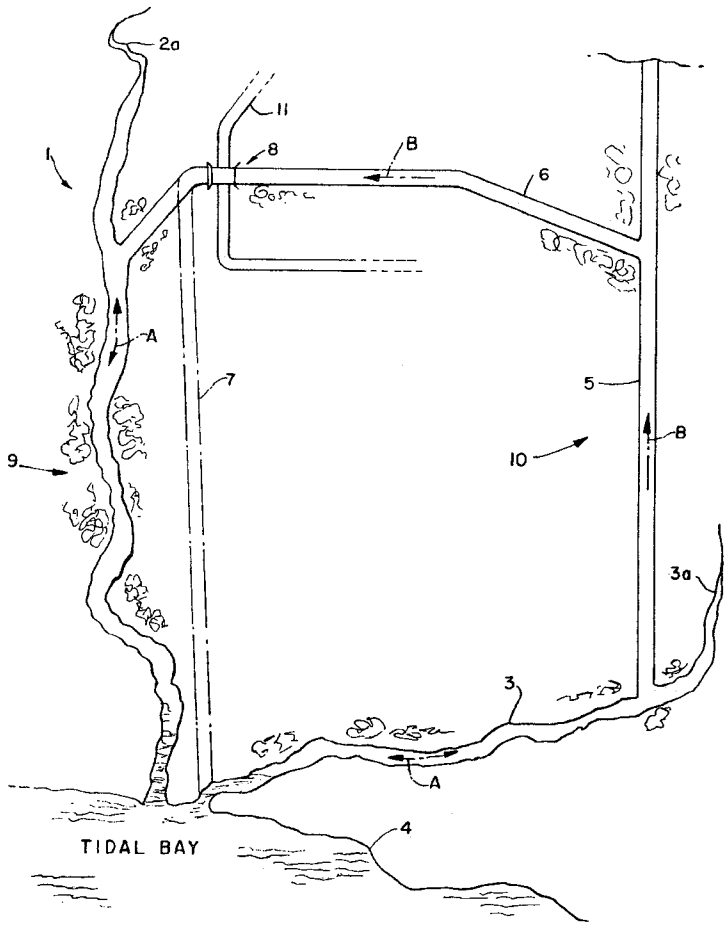
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Primary Examiner—David Bagnell

(57) **ABSTRACT**

A tidal flow system and method for causing flow of water through waterways to flush said waterways and prevent stagnation of water accumulation of debris therein, wherein a one-way valve means is in said waterway between the ends thereof, said valve means being closed when the depth of water on the discharge side of the valve is greater than on the inlet side of the valve and said valve means being opened when the depth of water on the discharge side of the valve is less than on the inlet side thereof, the depth of water at least on the discharge side of the valve being controlled by tidal action.



REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

NO AMENDMENTS HAVE BEEN MADE TO THE PATENT

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **1–13** is confirmed.

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