

- [54] CANAL BANK RETAINING WALL MEANS AND METHOD
[76] Inventors: Paul R. Jacobs; Marcellus L. Jacobs, both of Route 3, Box 722, Fort Myers, Fla. 33901
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[51] Int. Cl..... E02b 5/00, E02b 5/08
[58] Field of Search 61/7, 14, 63, 37, 61/38, 49, 29

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Primary Examiner—Jacob Shapiro
Attorney—Luke A. Mattare et al.

[57] ABSTRACT
A canal bank retaining wall means and method of making same comprising, an elongate wall poured in place on an earthen canal bank immediately after digging said canal, said retaining wall having expansion joint means therein at spaced intervals along the length thereof for enabling expansion and contraction of said wall upon temperature changes in the surrounding environment. If desired, removable sections may be provided in said retaining wall so that said sections may be removed after the canal is constructed in order that a boat slip or a dock the like may be economically built in said retaining wall. Also, the surface of the retaining wall exposed to the water in said canal may be roughened to provide an ecologically better environment for marine life and other organisms, if desired.

20 Claims, 7 Drawing Figures

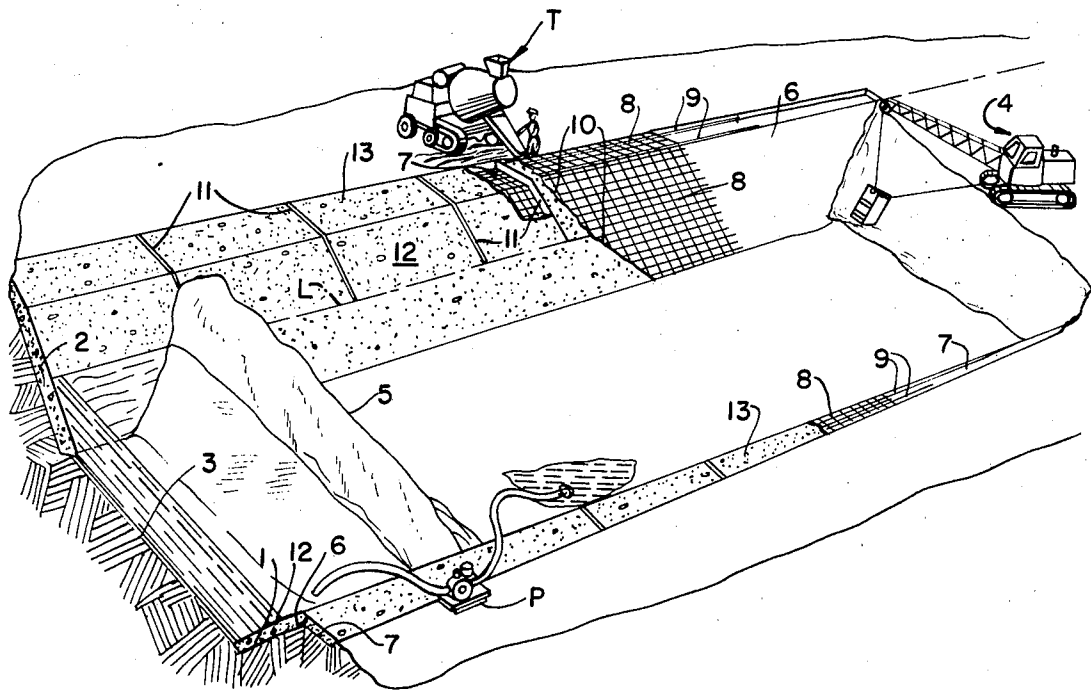


FIG. 1.

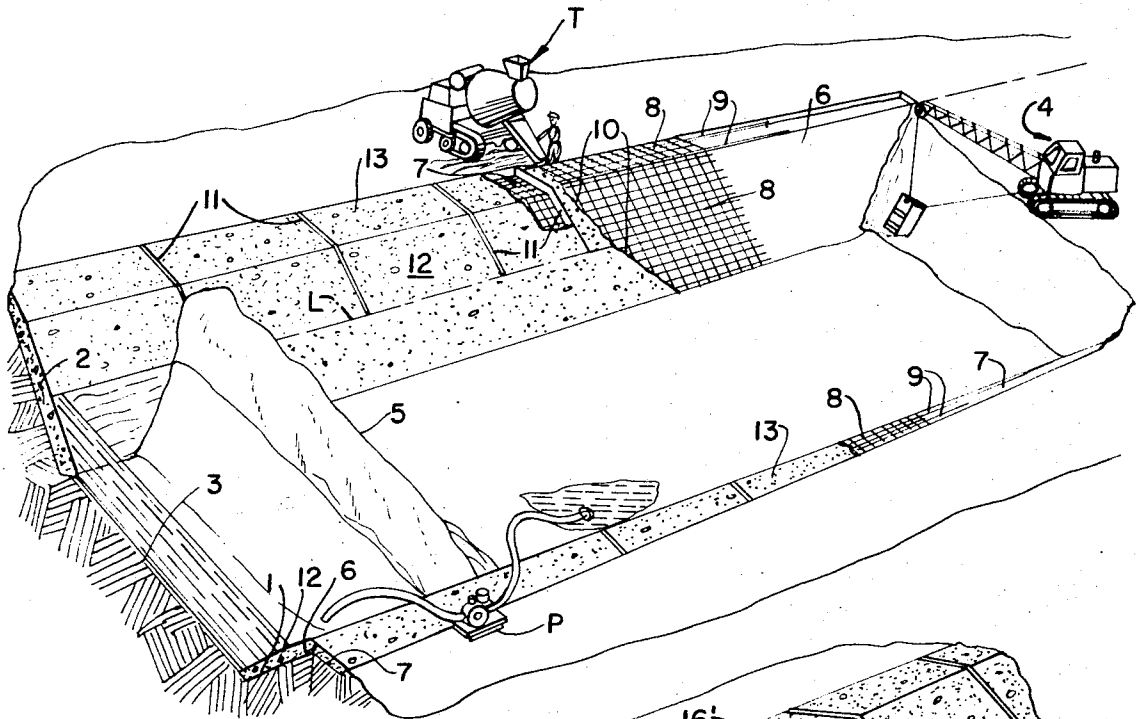
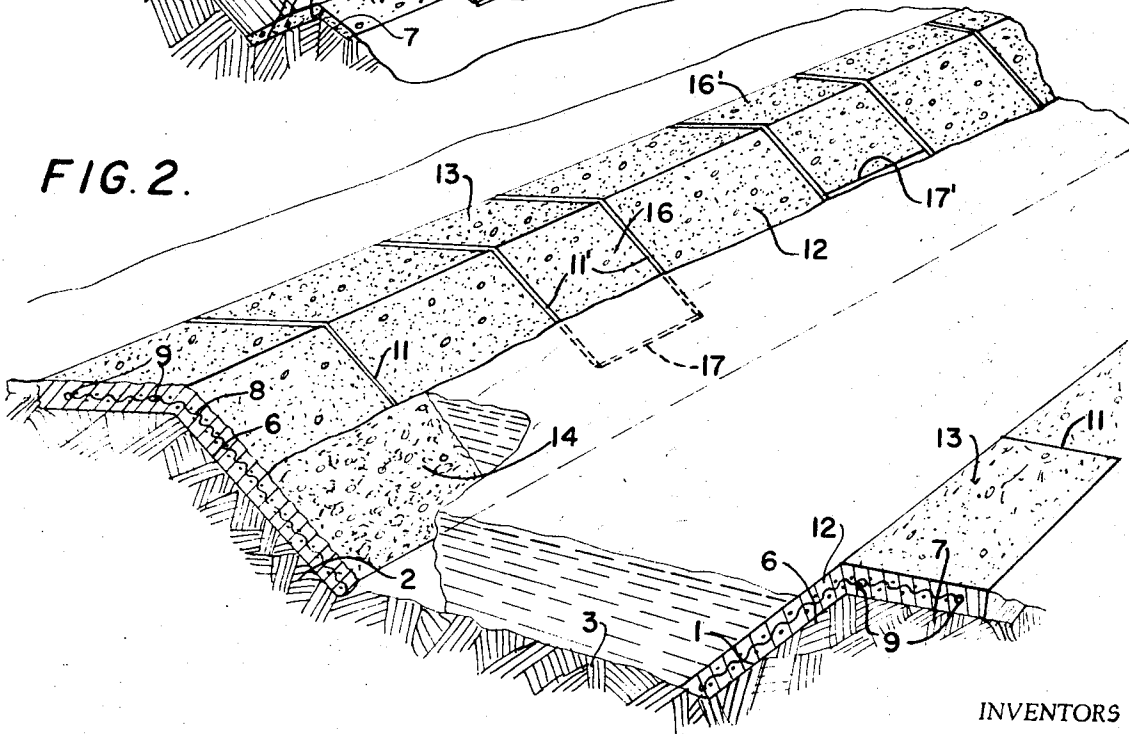


FIG. 2.



INVENTORS
PAUL R. JACOBS &
MARCELLUS L. JACOBS

BY *Shoemaker and Mattare*
ATTORNEYS

FIG. 3.

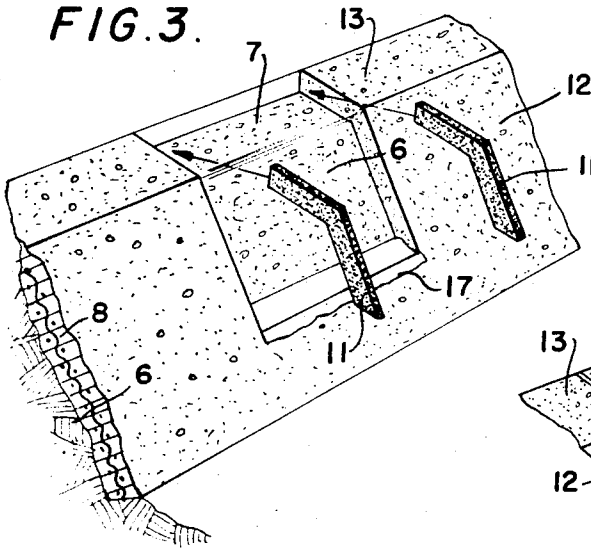


FIG. 4.

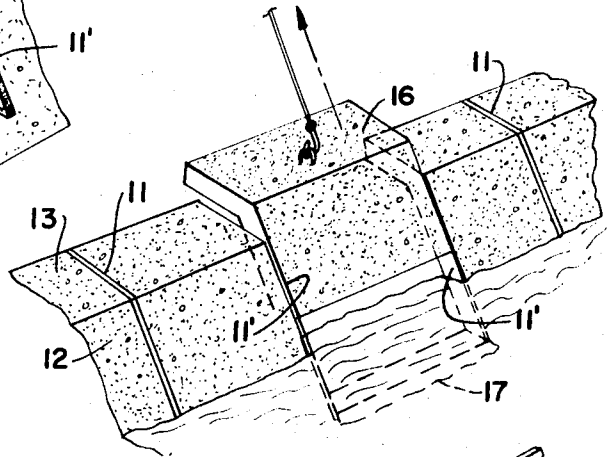


FIG. 5.

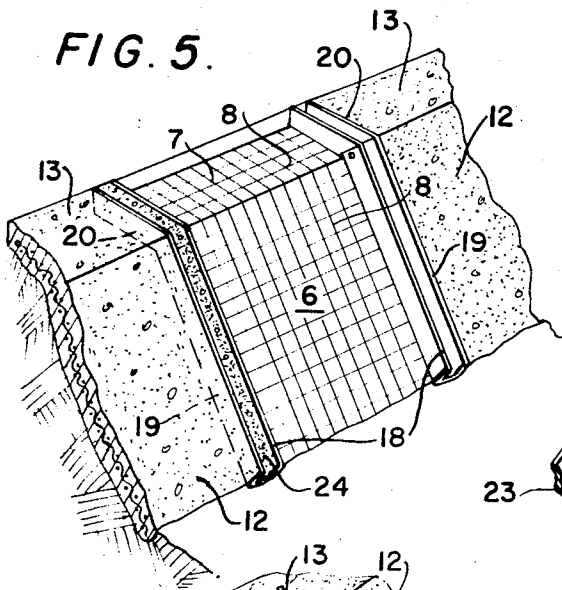


FIG. 6.

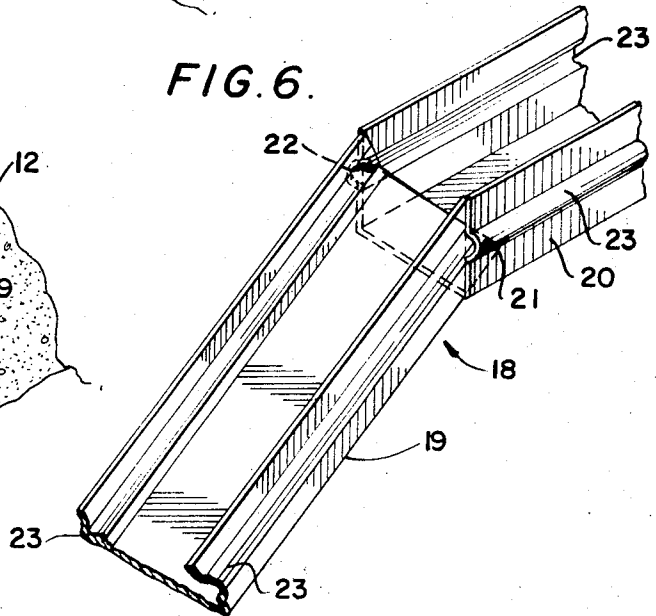
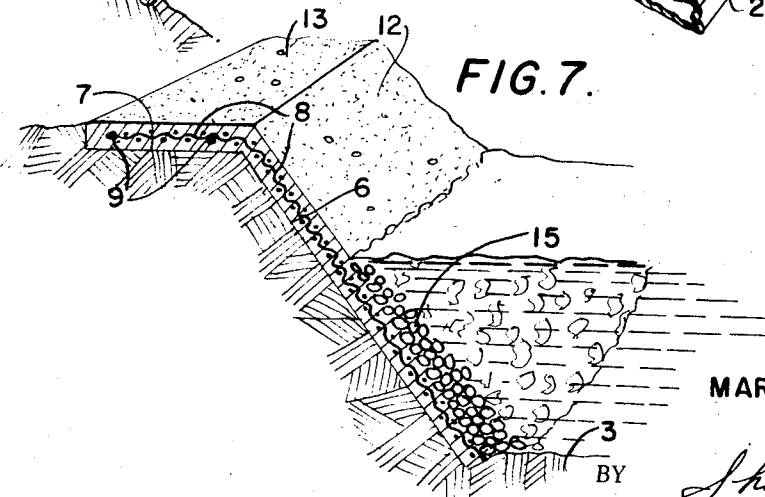


FIG. 7.



INVENTORS
PAUL R. JACOBS &
MARCELLUS L. JACOBS

BY

Shoemaker and Mattare

ATTORNEYS

CANAL BANK RETAINING WALL MEANS AND METHOD

BACKGROUND OF THE INVENTION

This invention relates to unique canal bank retaining wall means and the method of making same.

In some areas, such as along coasts and the like, it is a common practice to dig canals extending from a body of water such as a bay, river, ocean or the like inland into residential or agricultural areas for both recreational and commercial use. It is not uncommon along some coastal areas for many miles of canals to be interconnected in a canal network extending several miles inland and interconnecting residential areas with larger bodies of water for boating and the like. In constructing these canals in the prior art, a portion of a canal is dug and an earthen dam is constructed at one end thereof. Pump means are then provided for pumping water from the canal as it is being dug to prevent springs and the like in the bottom of the canal from filling it with water during construction thereof. The contractor or other person digging the canal frequently constructs several thousand feet or more of canal and then waits for surveyors or the like to survey the canal and adjacent waterfront home sites in order to determine the location of boat slips or docks and the like along the canal. After the canals and adjacent home sites are surveyed and the location of boat slips and the like determined, the contractor or other person then returns and builds a retaining wall on the banks of the canal for preventing the canal banks from collapsing. Such prior art retaining walls are usually constructed from precast slabs of concrete vertically installed along vertical canal banks and earth is then stacked or piled against the retaining wall to prevent it from collapsing or falling into the canal. This earth fill generally extends up to one-third or one-half the height of the retaining wall and in some cases is exposed during low tide or the like. This type of retaining wall and the construction thereof have several serious disadvantages.

First, because the contractor building the canal has to wait for the surveyor to survey the canal and adjacent home sites before the retaining wall can be constructed, the canal becomes filled with water and must be emptied before the retaining wall can be built. This is quite expensive since the pumps used to empty the canal generally cost as much as 200 dollars a day to use. Moreover, during the period of time in which the canal and adjacent home sites are being surveyed, heavy rain fall or the like may severely damage the canal banks which then must be reshaped with equipment brought in for that purpose. Similarly, if the canal becomes filled with water, the wave action of the water in the canal also deteriorates the canal banks.

Further, the location of the boat slips and docks and the like may ultimately turn out to be undesirable or less desirable than other locations, and the construction of boat slips in the canal bank and retaining wall is quite expensive, often doubling the cost of a canal bank retaining wall along a waterfront home site. Moreover, in prior art retaining wall structures, the boat slips or the like are sometimes used to provide expansion means to enable the retaining wall to expand and contract with ambient temperature changes, no other expansion means being provided in prior art retaining wall structures.

Still further, the earth piled at the base of prior art retaining walls creates a muddy environment under the action of waves or wakes of boats and the like and thus tends to pollute the canal and is damaging to marine life and other organisms therein. Additionally, waves due to wind or the wakes of boats and the like strike the vertical prior art retaining walls with considerable force and create noise and spray, which can be damaging to vegetation and the like along the canal.

The present invention provides a unique concrete inclined canal bank retaining wall and method of making same which does not have any of the disadvantages present with prior art retaining walls and methods of constructing same.

According to the present invention, a canal is dug with inclined earthen banks and a concrete, inclined retaining wall is poured onto said canal banks immediately after the canal is dug and before the canal becomes filled with water or the banks are caused to deteriorate by rain storms or wave action or the like. Expansion joint means are provided in the retaining walls of the present invention at spaced intervals along the length thereof to provide for expansion and contraction of the retaining walls upon changes in ambient temperatures. In warmer climates, the expansion joints extend only from the top of the wall to approximately the water line of the canal, thus resulting in a substantially continuous, cohesive mass of concrete below the water line and accordingly a stronger and more durable retaining wall is realized. It is not necessary to extend the expansion joint below the water line of the retaining wall in warmer climates since the temperature does not change sufficiently below the water line to cause damage to the wall. In colder climates, a simple and efficient expansion joint extends from the top all the way to the bottom of the retaining wall to enable expansion and contraction of the wall with ambient temperature changes.

Further, removable sections may be provided in the retaining wall as it is built, and these sections may subsequently be removed for the construction of boat slips or docks and the like at a significantly lower cost than the construction of boat slips according to the prior art.

Additionally, waves tend to wash or rise up along the sloping wall of the present invention and do not splash against it as in prior art vertical walls, thereby substantially reducing noise and spray accompanied with the striking of waves against the wall. Moreover, the sloping wall surface is preferably roughened to provide niches for sheltering marine life and other organisms so that the canal is ecologically suitable for the support of marine life and other organisms.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a canal bank retaining wall means and method wherein the wall is poured in place on the earthen banks of a canal at the time of digging the canal, wherein the retaining wall means is self-supporting and requires no extra supports.

Another object of this invention is to provide a retaining wall for a canal bank, and the method of making same, wherein the retaining wall includes removable sections for the later construction of boat slips and docks and the like.

A further object of this invention is to provide a concrete retaining wall for canal banks wherein the wall

has a roughened surface and is ecologically fit for the support of marine life and other organisms.

An even further object of this invention is to provide a concrete inclined canal bank retaining wall and method wherein the wall has expansion joint means therein at spaced intervals therealong for enabling the retaining wall to expand and contract with changes in ambient temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top perspective view of a canal being dug and an inclined concrete retaining wall means being constructed on the banks thereof.

FIG. 2 is a fragmentary top perspective view of a portion of the canal and inclined concrete retaining wall means of FIG. 1 shown in section.

FIG. 3 is an exploded fragmentary perspective view of a portion of the inclined concrete retaining wall of FIG. 1 showing the expansion joint means and plastic sheet means in position for constructing a removable section in the wall.

FIG. 4 is a top perspective view of a portion of the concrete, inclined canal bank retaining wall of FIG. 1 with one of the removable sections being removed therefrom.

FIG. 5 is a fragmentary top perspective view of a concrete, inclined canal bank retaining wall means such as in FIG. 1, with a modified expansion joint means therein extending from the top to the bottom of the wall.

FIG. 6 is a top perspective view of a portion of a form means used to make the expansion joint of FIG. 5.

FIG. 7 is a fragmentary perspective view of an inclined concrete canal bank retaining wall such as in FIG. 1, with stones or the like on the surface thereof below the water line.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, wherein like reference numerals indicate like parts throughout the several views, a canal C is shown in the process of construction in FIG. 1. The canal is constructed with opposite, sloping earthen banks 1 and 2 and a generally flat bottom 3. Suitable earthworking equipment such as a crane 4 with a drag line or the like may be used to construct the canal. In order to prevent the canal from filling with water while it is being constructed, an earthen dam 5 is constructed across the canal and a suitable pump means P is used to pump water from the portion of the canal being dug into the portion of the canal on the opposite side of the dam 5 therefrom. The opposite banks 1 and 2 of the canal are shaped with suitable equipment so that each bank has a relatively smooth inclined surface 6 extending upwardly and outwardly from the bottom 3 of the canal at an angle preferably between 30° and 60°. A relatively narrow, horizontal cavity or recess 7 is excavated in the earth at the top of the sloping banks 6 and comprises a horizontal extension of the bank 6. Wire mesh reinforcement 8 is placed on the inclined banks 6 and on the bottom of the extensions or recesses 7 after they are shaped. Longitudinally extending reinforcing rods 9 are also preferably positioned in the recesses 7 along with the wire mesh reinforcement means 8.

A stiff mix concrete 10 is poured from a truck T directly onto the inclined portion 6 and horizontal extension 7 of the canal banks and is suitably shaped and fin-

ished with hand tools or the like to provide a substantially even surface and a pleasing appearance. The angle of inclination of the bank 6 and the stiffness of the concrete is such that the poured concrete remains substantially in place on the inclined portion 6 of the canal bank and does not flow or slide off of the inclined portion to the bottom thereof. Depending upon the size of the canal and the thickness desired, the concrete is poured to a depth of approximately 5 inches on the inclined portion 6 and to a depth of approximately 8 inches on the horizontal extension 7. Further, the extension or cavity 7 is preferably excavated to the depth of the desired concrete poured thereon so that the top surface of the concrete is substantially flush with the surface of the ground extending away from the top of the canal bank.

As the concrete is being poured, a plurality of expansion joint means 11 comprising half-inch thick fiber-board strips impregnated with tar and having a width substantially equal to the depth of the poured concrete are placed edgewise on the horizontal portion 7 of the bank and downwardly along the inclined portion 6 to approximately the water level L in the canal at spaced intervals along the banks of the canal. The spacing between the strips is determined by local conditions and may vary from 50 feet to several hundred feet. The concrete is then poured around the strips 11, with the expansion joint strips serving to separate adjacent longitudinal sections of the canal bank retaining wall at the portion thereof exposed above the water line L of the canal. The concrete forms a continuous, cohesive mass below the water line since there are no expansion strips or the like therein and accordingly the retaining wall is much stronger and more durable than prior art retaining walls.

The finished wall thus includes an upwardly and outwardly inclined retaining wall 12 supported directly on the earthen canal bank 6 and a horizontal extension 13 supported in the horizontally extending cavity or recess 7 at the top of the inclined bank 6.

If desired, the surface of the inclined retaining wall 12 may be suitably roughened with hand tools or the like below the water line L as at 14 to provide an ecologically suitable environment for the support of marine life and other organisms.

An alternate means of providing an ecologically suitable environment for the support of marine life or the like is indicated at 15 in FIG. 7 and comprises a layer or several layers of stones placed on the inclined retaining wall 12 immediately after it is poured and before the concrete is cured. The bottom most layer of stones are thus at least partially embedded in the concrete of the inclined retaining wall 12 and are held thereon against wave action and gravity and the like. Subsequent layers of stones placed on top of the bottom layer of stones are held in place by the interstices between the stones. Preferably, the stones are selected from the area in which the canal is constructed so as to be native to the marine life and other organisms present in the canal.

If desired, removable sections 16 may be provided in the wall at spaced locations along the length thereof for the later construction of boat slips or docks and the like. The removable sections 16 are constructed by positioning a pair of spaced apart expansion joint strips or separation strips 11' edgewise on the inclined bank 6 and the bottom of recess 7, with the lower ends of the

strips spaced upwardly from the bottom of the canal. Concrete is then poured onto the inclined canal bank 6 up to the level of the lower ends of the expansion strips 11' and is made substantially smooth and level between the expansion strips 11' with suitable hand tools or the like. A sheet of plastic material or the like 17 is then placed over the concrete between the expansion strips 11' to form a separating means between concrete poured between the strips 11' above the plastic sheet 17 and the concrete poured below the plastic sheet. Concrete is poured onto the inclined canal bank 6 and into the recess 7 in the space defined between the expansion strips 11' and the plastic sheet 17 to form a removable section 16. The stones or other aggregate in the concrete press into the plastic separating sheet to form a roughened surface which mechanically interlocks the concrete above and below the sheet, respectively, against relative slipping movement therebetween. When it is intended that the removable section is to be removed for the later construction of a boat slip, the sheet 17 of plastic material, and accordingly the lower end of the movable section, are spaced a suitable distance below the water line L. If, on the other hand, it is intended that a dock, such as a cantilever design dock, is to be constructed upon removal of the removable section, the plastic separating sheet and accordingly the lower end of the removable section 16, are spaced a suitable distance above the water line L as indicated at 17' in FIG. 2. When the dock is constructed, the cantilever design is preferred since it avoids outer support posts and the like and is aesthetically more pleasing.

When it is desired to remove one of the sections 16, a crane or the like is connected thereto and the removable section is pulled upwardly along the inclined canal bank 6 as indicated in FIG. 4. A boat slip or dock or the like may then be constructed easily and economically in the space left between the expansion strips 11'. This results in a substantial savings over prior art boat slip constructions, wherein the boat slip is formed at the time of constructing the canal and comprises a recess in the bank of the canal lined with concrete. Such prior art boat slips often double the cost of a canal bank retaining wall along an adjacent home site.

Referring now to FIGS. 5 and 6, a modified form of expansion joint 17 is illustrated. In this form of the invention, the inclined wall 12 and horizontal extension 13 are constructed identically to the wall illustrated in FIGS. 1 and 2, except that an expansion joint 18 extends all the way from the top of the retaining wall to the bottom of the canal and is intended to be used in colder climates wherein the temperature change is sufficient to cause expansion and contraction of the concrete below the water line of the canal. The expansion joint 18 comprises a pair of generally trough shaped forms 19 and 20 having a generally U-shaped cross sectional configuration and pivotally joined together at adjacent ends thereof by means of pivot pins 21 and 22 so that the angular relationship between the portions 19 and 20 may be accommodated to canal banks having different angles of inclination. A longitudinally extending retaining rib 23 is formed in the opposite walls of the portions 19 and 20 for anchoring the form in place in the concrete as the concrete is poured therearound. The trough or forms 19 and 20 are then filled with a mixture of cement and vermiculite, which forms the compression material for the expansion joint.

If desired, the removable sections 16 may extend all the way to the bottom of the canal between a spaced pair of expansion joints 18, although the removable sections are preferably identical to those previously described.

Accordingly, the inclined, concrete retaining walls for canal banks comprising the present invention are not only substantially more economical and easier to make than prior art canal bank retaining walls, costing only approximately one-third as much as prior art walls, they are stronger, more durable, and ecologically better than prior art walls.

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

What is claimed is:

1. A reinforced concrete, inclined canal bank retaining wall having a top and a bottom and poured directly on an inclined earthen canal bank, a plurality of spaced apart expansion joint strips in said retaining wall extending from the top thereof to adjacent the water line in the canal, said concrete being continuous and uninterrupted below the expansion joint strips, thus resulting in a strong retaining wall structure.

2. A concrete canal bank retaining wall as in claim 1, wherein said concrete retaining wall has a roughened surface at least below the water line of said canal, said roughened surface comprising a separate layer of stone aggregate on top of the concrete, said stones preferably comprising native rock from local sources, at least some of the stones of the aggregate embedded at least partially in said concrete retaining wall, thereby creating an anchored rock canal bank lining which markedly increases the contact surface of said canal bank retaining wall and thus creates a multitude of ecological niches wherein marine and/or related organisms and the like can attach, live, escape predators, and otherwise exist, thereby greatly improving the marine environment of said canal.

3. A concrete canal bank retaining wall as in claim 1, wherein said retaining wall includes a substantially horizontal extension at the top of said inclined earthen canal bank, said horizontal extension being recessed into the ground so that the top surface thereof is substantially flush with the surface of the ground at the top of said canal bank.

4. A concrete canal bank retaining wall as in claim 3, wherein said expansion joint strips are in both said horizontal extension of said retaining wall and the inclined portion thereof.

5. A concrete canal bank retaining wall as in claim 4, wherein said earthen canal bank and said inclined retaining wall are inclined approximately 30° to 60° relative to the vertical.

6. A concrete canal bank retaining wall as in claim 1, wherein said retaining wall includes means therein defining removable sections which can be removed for the construction of boat slips, or cantilever or other type docks or the like without disturbing adjacent portions of said retaining wall.

7. A concrete canal bank retaining wall as in claim 6, wherein a separating means such as a sheet of plastic or the like positioned substantially horizontally and in a plane perpendicular to the plane of said inclined wall defines a separation area for the lower end of said removable section, and a pair of spaced apart expansion joint means define separation areas at the sides of said removable section.

8. A concrete canal bank retaining wall as in claim 7, wherein said lower end of said removable section is below the water line of said canal.

9. A concrete canal bank retaining wall as in claim 7, wherein said lower end of said removable section is at or suitably above the water line of said canal.

10. A concrete canal bank retaining wall as in claim 7, wherein said expansion joint strips comprise elongate strips of compressible material positioned edge-wise on the inclined bank of said canal and extending perpendicularly from the earthen canal bank to the surface of said poured concrete.

11. A concrete retaining wall means for canal banks comprising: an inclined, elongate poured concrete wall poured directly on an inclined earthen canal bank; expansion joint means in said wall at spaced intervals therealong extending from the top of the wall toward the bottom thereof substantially perpendicular to the longitudinal axis of said wall, and separation strip means in said wall at spaced intervals therealong defining separation areas between adjacent sections of the wall so that sections of said wall between adjacent separation strips can be readily slid upwardly relative to adjacent sections on either side thereof and removed without disturbing adjacent sections of said wall for the construction of boat slips, boat ramps, cantilever and other design docks, and the like.

12. A concrete canal bank retaining wall as in claim 11, wherein said retaining wall is reinforced concrete.

13. A concrete canal bank retaining wall as in claim 11, wherein a plurality of expansion joint means are in said wall and extend from the top of the bank downwardly to at least approximately the water level of said canal.

14. A concrete canal bank retaining wall as in claim 13, wherein said expansion joint means comprises a generally trough shaped member opening upwardly and supported on said earthen canal bank.

15. A concrete canal bank retaining wall as in claim 14, wherein said expansion joint extends from the top to the bottom of the canal bank.

16. A concrete canal bank retaining wall as in claim 15, wherein said trough shaped member comprises a first elongate portion extending from the top to the bottom of said inclined canal bank, and a second portion hingedly joined thereto and extending across the horizontal portion of said canal bank.

17. A concrete canal bank retaining wall as in claim 16, wherein said trough shaped member is filled with a mixture of vermiculite and cement.

18. A concrete canal bank retaining wall as in claim 17, wherein said trough shaped member has elongate anchoring ribs in the opposite sides thereof for holding said trough shaped member in place in said concrete as said concrete is poured on opposite sides thereof.

19. A concrete canal bank retaining wall as in claim 18, wherein the surface of said concrete retaining wall is roughened at least below the water line of said canal to provide shelter for marine life and the like.

20. A concrete canal bank retaining wall as in claim 19, wherein said roughened surface comprises stones placed on the surface of said wall, at least some of said stones embedded at least partially in said concrete retaining wall.

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