United States Patent [19]

Ballu

[11] **3,811,285**

[45] **May 21, 1974**

[54] **FLOATING ANTI-POLLUTION BARRIER DEVICE**

[75] Inventor: **Louis Ballu,** Colombes, France

[73] Assignee: **Pneumatiques Caoutchouc Manufacture et Plastiques Kleber-Colombes,** Paris, France

[22] Filed: **June 9, 1972**

[21] Appl. No.: **261,410**

[52] **U.S. Cl.** ..... **61/1 F**

[51] **Int. Cl.** **E02b 15/04**

[58] **Field of Search** ..... 61/1 F, 1, 5; 210/242, 210/DIG. 21

[56] **References Cited**

UNITED STATES PATENTS

3,579,994	5/1971	Preus et al.	61/1 F
3,686,869	8/1972	Manuel	61/1 F
3,710,943	1/1973	Davidson et al.	210/DIG. 21 X
3,641,771	2/1972	Spandau	61/1 F
3,713,410	1/1973	Ducrocq et al.	61/1 F X

FOREIGN PATENTS OR APPLICATIONS

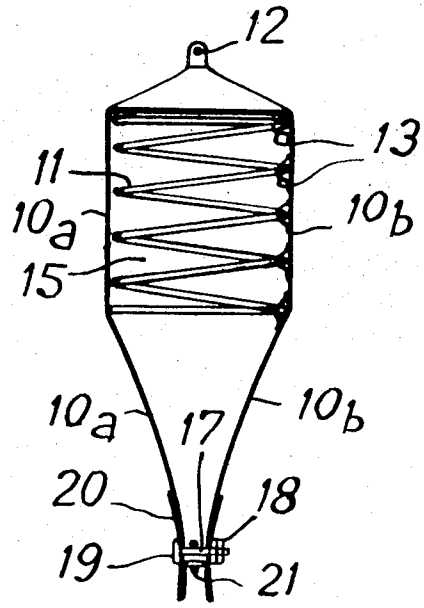
1,528,855	5/1968	France	61/1 F

Primary Examiner—Mervin Stein
Assistant Examiner—Philip C. Kannan
Attorney, Agent, or Firm—Craig and Antonelli

[57] **ABSTRACT**

A floating anti-pollution barrier for use in water which is constituted by a skirt-like element immersed in the water and supported by floating elements which are constituted by air-tight pockets whose openings face in the downward direction when installed in the water; the pockets are thereby connected with one another by bands of flexible fabric.

24 Claims, 6 Drawing Figures



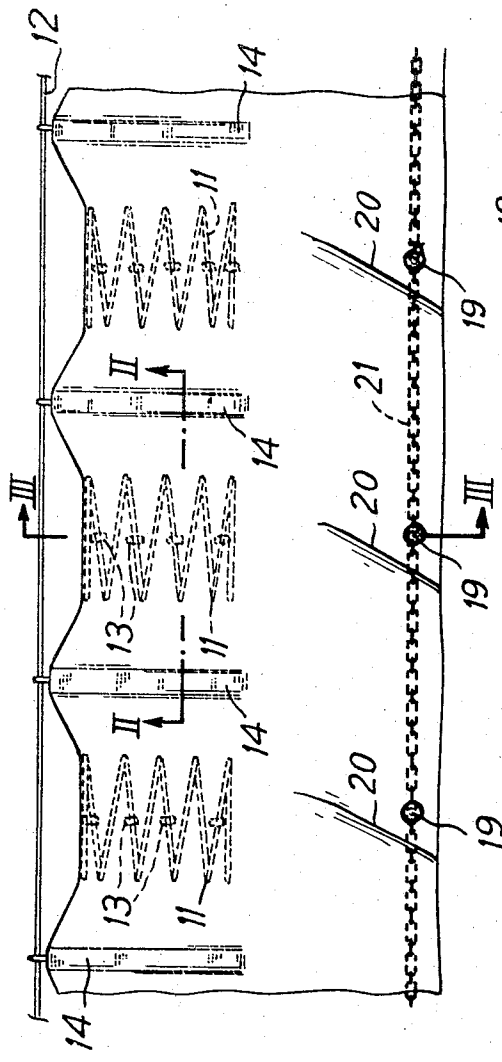


Fig. 1

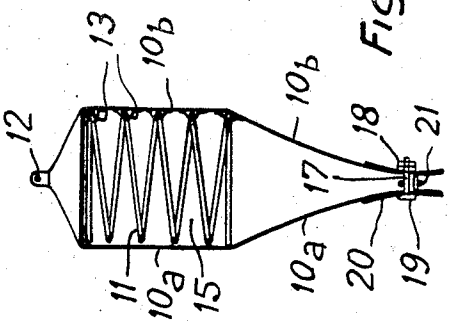


Fig. 3

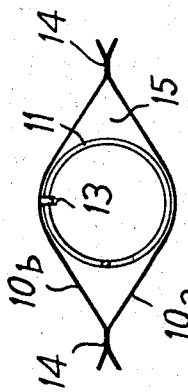
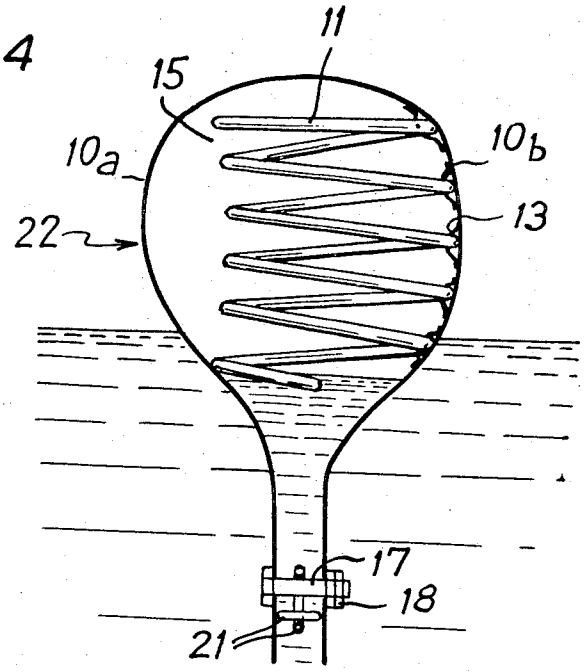


Fig. 2

Fig. 4



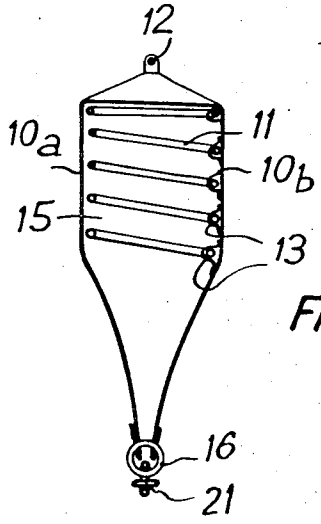
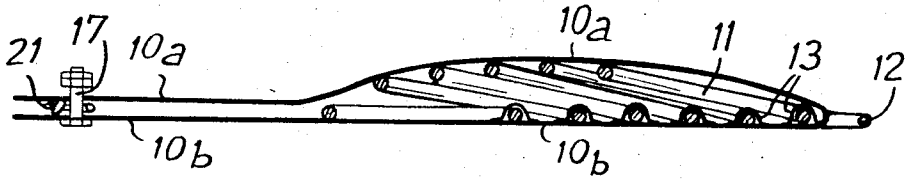


Fig. 6

Fig. 5



FLOATING ANTI-POLLUTION BARRIER DEVICE

The present invention relates to anti-pollution floating barriers intended to stop the bodies or materials floating on the surface of waters and constituted by a submerged skirt supported by one or several floating elements.

It is known that among the numerous qualities which these barriers must exhibit, in addition to the one that they must be insubmersible, two qualities are essential:

On the one hand, particularly with a view to operations of rapid intervention, these anti-pollution devices must be easily and rapidly transportable to the point of utilization, and therefore must be light-weight, must be available under a reduced volume and must be capable of being placed into the water extremely rapidly.

On the other hand, these anti-pollution devices must have a longitudinal feexibility and pliability which is as large as possible in order to be able to adapt themselves well to the movements of the surface of the waters, such as the swell, in such a manner as not to be subjected to excessive stresses and strains and in such a manner that the water does not pass above the same entraining the bodies and the materials which one proposes to stop thereby.

The floating barriers which comprise floating elements formed by rigid boxes or pliable rolls inflated with air or filled with a floating material, do not fulfill the preceding conditions, particularly by reason of the fact that they lend themselves poorly both to a storage that is only slightly encumbering and to a rapid placement into the water or that their longitudinal flexibility is too small.

It has been considered to construct, as in the French Pat. No. 2,085,797, barriers whose floating elements, which are pliable, comprise on the inside thereof mechanical means which unfold in such a manner as to put the floating elements into shape, the air then penetrating into the inside of the floats by orifices provided with valves.

Such anti-pollution floating barriers may be appealing in their principle but they offer, in reality, numerous inconveniences which have as consequence that they can be used only in calm water and that their launching, i.e., placement into the water, is not as rapid as one would wish the same to be.

In effect, the valves must be such that they permit the air to pass in both directions (from the exterior toward the interior during the utilization of the barrier and from the interior toward the exterior when, for storing, the float is deflated and flattened) yet that they oppose the passage of the water; such valves are of difficult design and realization. Furthermore, the dynamic pressure of the water on these valves, when the barrier is in service, is superior to the pressure which the air exerts on the same when the mechanical means unfold; they therefore let the water pass when the barrier will be in service, for example, in an agitated sea.

Moreover, in order that the barrier has a sufficient longitudinal flexibility and pliability, the mechanical means for putting and maintaining the float in shape, are placed every now and then on the latter; it follows therefrom that between two of these mechanical means the forces which the waves or the wind exert constantly on the flexible walls of the float as well as the deformations of the float, drive out the air contained on the inside of the latter and cause the walls to approach one another, and thus cause a diminution of the floating ability (the valves permitting the passage of the air from the interior toward the exterior).

In summary, either the valve is such that it permits the air to pass easily, then the inflation and deflation of the float are easy and rapid but the floatability is not good because air escapes and water enters, or the valve is such that the air escapes slightly and the water enters slightly, whence the inflation and deflation of the float are lengthy and the barrier is in reality installed and stored less rapidly than if its float had been inflated with compressed air.

The object of the present invention is an anti-pollution barrier of which the floating elements also comprise mechanical means for putting into and maintaining the proper shape but which does not entail the aforementioned inconveniences and shortcomings. In particular, the anti-pollution barrier of the present invention is installed very rapidly since, stored while wound on a drum, it suffices to unroll the same in order that the floats take immediately their form and preserve their floating ability when the barrier is in the water, even within agitated water; moreover, its longitudinal pliability is very large.

The floating of the floating barriers of the present invention is assured by pockets or bells of a flexible or pliable materials whose orifice is turned so as to face in the downward direction, and which are put into shape and maintained in shape by mechanical means.

In the barriers of the present invention, it is the water which, when the barrier is put in place, maintains the air imprisoned within the floats in the form of inverted pockets or bells. In effect, these floating pockets which are in communication with the atmosphere by an orifice of large cross section, are filled with air before the barrier is placed into the water; when the barrier placed into the water, with the orifice of the float pockets facing in the downward direction, the water opposes the escape of the air and rises within these floating pockets by compressing the air which is contained therein until equilibrium is attained.

The mechanical means of placing and maintaining the pockets of the barriers of the present invention in their intended shape may be expansible if these barriers are intended to be stored flat. In the opposite case, they may be non-expansible whereby the barriers of the present invention still have the advantages of a large longitudinal flexibility, of a great lightness and of offering above the water a portion whose height may be significant.

If the mechanical means of expansion of the barrier of the present invention are expansible, they are preferably constituted by helicoidal springs with vertical axis which are fixed at a wall of the floating pockets in such a manner that their spirals may pivot about their point of connection to the wall and fold down onto said wall. When the spirals are in this position, one applied again the other, they form a tightened spring and the floating pockets are flat; the barrier may be stored flat, i.e., deflated, either by being wound on a drum or by being folded in accordion fashion whereby the springs are maintained tightened. If one unwinds the barrier or if one unfolds the same, the springs become untightened and impart their shape to the pockets.

The use of helicoidal springs constitutes one of the preferred means of the present invention, though the

latter is not limited to the utilization of such helicoidal springs; one may also utilize any other mechanical means, elastic or non-elastic, without departing from the present invention, which in one position places the floating pockets into shape and which, in another position, retracts and permits the flattening of these pockets.

These and other objects, features and advantages of the present invention will become more apparent from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, two embodiments in accordance with the present invention, and wherein:

FIG. 1 is a partial elevational view of a floating anti-pollution barrier in accordance with the present invention;

FIG. 2 is a cross-sectional view, taken along line II—II of the barrier of FIG. 1;

FIG. 3 is a transverse cross-sectional view, taken along line III—III of the barrier of FIG. 1;

FIG. 4 is a transverse cross-sectional view analogous to that of FIG. 3 with the floating barrier being in the water;

FIG. 5 is a transverse cross-sectional view analogous to that of FIG. 3 with the floating barrier being stored in which conditions the pockets are flat; and

FIG. 6 is a transverse cross-sectional view, similar to FIG. 3, through a modified embodiment of a floating barrier in accordance with the present invention.

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, the floating barriers of the following examples are realized by starting with a band of fabric folded in the longitudinal direction in such a manner as to form two walls **10***a* and **10***b* which are therefore connected with each other along their upper edge. This band is made of a fabric coated with rubber in such a manner as to render the same tight with respect to water and air; however, it may also be made of any other pliable or flexible material which is water-tight and air-tight; it is either made from one piece or results from the assembly of several pieces of lesser width.

On the inside of the fold, helicoidal springs **11** are arranged at regular intervals in such a manner that their axes are vertical; these helicoidal springs **11** are fixed to one of the walls, in the illustrated embodiment to wall **10***b*, in such a manner that their spirals can pivot about the point of fixation. In the illustrated embodiments of the present invention, this fixation is made by means of legs or straps **13** of any conventional type. Between two consecutive springs **11**, the walls **10***a* and **10***b* are applied one against the other and are fixed to one another by conventional bonding, such as, gluing, effected within the zones **14**; these zones **14** extend from the upper portion of each wall, that is, from the upper portion of the barrier up to a point located at the same level as the lower spiral of the springs **11** or still lower; in lieu of connecting the walls **10***a* and **10***b* by gluing, one may also realize the same by any other known means, for example, by means of sewing, but it is then preferable to undertake the same in such a manner that the latter be tight with respect to the air. A series of pockets or bells **15** is thus realized which do not communicate with one another, which are independent of one another, which are all open in the downward direction and which are connected with each other by bands of flexible or pliable fabric **14** that form a partition between two consecutive pockets. At intervals, the walls **10***a* and **10***b* are joined to one another in their lower portion by a ring **16** or a pin **17** provided with two shoulders or two nuts **18** and **19**, which passes through openings provided in the walls **10***a* and **10***b*; the skirt of the floating barrier is thus realized by joining the walls **10***a* and **10***b*. The presence of the springs **11** which spread apart the walls **10***a* and **10***b* one from the other in such a manner as to form the pockets or bells **15**, makes it necessary to refold or double-up in the shape of a triangle the portions **20** of the lower edges of the walls **10***a* and **10***b* in order that the same be rectilinear. Preferably, one places the means for joining the walls **10***a* and **10***b* (such as, the rings **16** or the pins **17**) within these portions **20** in such a manner that these means also join the fold **20** to the corresponding wall **10***a* or **10***b*. Furthermore, one may benefit, as in the illustrated embodiments, of these means and from the fact that they are located within a zone of strong mechanical resistance due to the presence of several layers of fabric, to suspend thereat a ballast chain **21**.

A strap or a cable **12** is fixed to the upper portion of the barrier to permit its traction.

If one causes the spirals of the springs **11** to pivot about their point of connection, the sprials will abut one against the other and form a tightened, flattened spring; in these conditions, the bells or pockets **15** are flat as is shown in FIG. **5**, and the barrier may be wound on a drum or folded in accordion shape.

When the barrier is unfolded or unwound, the spring **11** will unfold and by spreading the walls **10***a* and **10***b* one from the other, form the pockets or bells **15**. This takes place immediately by reason of the fact that the air which passes easily between the lower portions of the walls **10***a* and **10***b* which are spaced one from the other, reaches without difficulty the pockets or bells **15** which it fills; it also fills the space comprised between the walls **10***a* and **10***b* and located below the pockets **15**.

When the barrier is placed into the water, i.e., is launched, it hits the water obliquely with respect to the surface of the water, which has as its effect to place into the water initially one extremity of the barrier and thereafter progressively and in a continuous manner, the following portions of the barrier up to the other end. In the course of this operation, the air which is present within the space located underneath the pockets **15** and comprised between the two walls **10***a* and **10***b* is driven back and eliminated by the water; in contrast thereto, the water imprisons the air contained within the pockets **15** and it rises in the pockets by compressing the air until equilibrium is attained between the weight of the barrier and the lift force, particularly the archimedes forces (buoyancy). The pockets are therefore inflated at a pressure which is slightly greater than the atmospheric pressure; this excess pressure depends obviously on the weight of the barrier, inclusive the ballast, but does not exceed a few grams per cm^2, for example, about 3 to 6 cm^2. This excess pressure is therefore very slight, much smaller than that of the floats inflated with compressed air, with which are provided certain prior art barriers. Under the effect of this excess pressure, the pockets tend to assume a spherical shape (the springs **11** being fixed only to one wall of the pockets) as is shown in FIG. **4**, representing

in cross section the barrier fo FIG. 1 when in the water.

The waves and the wind may exert on the inflated pockets 15, forces having the direction indicated by the arrow 22 which cause the flattening of the pockets the more easily as the excess pressure of inflation thereof is slight; the springs 11 then act by limiting this flattening and by avoiding that the volume of the pockets 15 decreases up to the point of dangerously diminishing the floating ability of the barrier.

If, under the action of the wind or the waves, the pockets turn over, i.e., lie down, the water occupying the space comprised between the walls 10*a* and 10*b* opposes an escape of the air contained in the pockets 15; consequently, a reduction of the floating ability of the barrier will not result therefrom. This property is clearly demonstrated by noting that if a ship passes over the installed barrier, thus forcing the same to lie down and submerge underneath the water surface, the barrier immediately reassumes its position after the passage of the ship.

The different pockets 15 which do not communicate with each other are independent of one another; it follows therefrom that if one of the pockets is damaged, the others continue to play their role as floats; furthermore, the spring 11 of the damaged pocket maintains vertically the walls of this pocket which permits to the same to continue to play completely its barrier role.

Thus, the barriers according to the present invention are easy to store, easy to place into the water and offer great safety in the use thereof.

They also possess a great longitudinal flexibility or pliability by reason of the fact that the pockets 15 are connected with each other by the bands 14 of pliable fabric resulting from the gluing of the walls 10*a* and 10*b* one to the other, that the helicoidal springs 11 extend only over a small portion of the distance separating two bands 14, that is, of the length of a pocket 15, and that the excess pressure of inflation of the pockets 15 is very slight.

This quality of longitudinal flexibility or pliability is independent of the dimension of the barrier which permits to realize barriers whose "water guard," that is, the distance separating the top of the barrier from the level of the water, is large and whose longitudinal flexibility is nonetheless very satisfactory (it is known that if one seeks to increase the "water guard" of barriers comprising sausage-like floatation elements inflated with air or filled with a material of small density, one encounters the difficulty that the barriers become longitudinally rigid).

In the embodiment of the present invention corresponding to FIGS. 1 to 5, the ballast chain is placed between the two walls 10*a* and 10*b*. This offers the advantage of separating the walls one from the other and thus to facilitate, first of all the entry of air when the barrier is unfolded, then the elimination of the air which is present in the space located between the pockets 15 and comprised between the two walls 10*a* and 10*b* when placed into the water; this also offers the advantage of eliminating the danger of a hang-up or entanglement of the chain at various obstacles which are present in the water.

In the embodiment of FIG. 6, the chain is fixed to the lower selvage of the walls 10*a* and 10*b* by a ring 10 which joins the walls 10*a* and 10*b*.

This construction does not offer the advantages of the preceding construction but may nevertheless be utilized in those cases where these advantages are not necessary, for example, when the barriers are of small dimensions intended to be installed in places where there is no danger of hang-up of the chain.

Typical values for all embodiments illustrated and described herein are as follows:

The glued zones 14 have a width of about 40 mm and a height of about 350 mm, and are separated at a distance of about 400 mm; the height of the springs 11 is about 25 mm and their diameter about 220 mm; the height of the portion of the walls 10*a* and 10*b* located underneath the pockets 15 is about 350 mm.

In the described embodiments, the mechanical means for imparting the shape to and maintaining the shape of the pockets are expansible and are constituted by helicoidal springs (it should be mentioned in that connection that one causes these helicoidal springs to work by twisting the spirals and not by stretching or compressing the same, as is done ordinarily), but other mechanical, expansible means may be utilized to put and maintain the pockets in their shape.

One may also utilize any other known mechanical means which are not expansible, for example, rings which are superposed and fixed at the same time to the wall 10*a* and to the wall 10*b* at diametrically opposite points, in this case, the barrier cannot be flattened and stored with a small volume, but nevertheless it possesses all the other qualities mentioned hereinabove and present in the barriers of the present invention which permits that the same can be advantageously utilized in numerous cases.

In lieu of the lower edges of the walls 10*a* and 10*b* coinciding as in the preceding embodiments, the lower edge of one of the walls may be higher than the lower edge of the other wall; the chain or any other ballast element is then fixed to the latter wall and brought back substantially into the vertical plane containing the axes of the springs, that is, the longitudinal plane of symmetry of the pockets, by straps or the like fixed, on the one hand, to the wall carrying the chain and on the other hand, to the other wall at places corresponding to a pocket, for example, at places located opposite the helicoidal springs. In this case, the two walls are not joined to one another; the skirt is constituted only by the wall carrying the chain and the straps maintain the other wall in place.

While I have shown and described two embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to those skilled in the art, and I therefore do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

What I claim is:

1. A floating anti-pollution barrier of the type having a submerged skirt-like structure supported by floating means comprising

a longitudinal band of an air-tight pliable material folded in the longitudinal direction to provide two walls with the fold in the upward direction and an opening in the downward direction,

a plurality of floating pocket means formed between said two walls in the longitudinal direction with

each pocket means having an opening in the downward direction,

a plurality of pliable bands separating each of said plurality of pocket means, and

means for expanding said pocket means into shape such that air filling said pocket means through said opening is imprisoned in said pocket means by water when the barrier is placed in the water.

2. A barrier according to claim **1**, wherein said plurality of pliable bands are formed of pliable fabric.

3. A barrier according to claim **2** characterized in that the pocket-like means are devoid of communication with one another and are connected with one another by way of band-like portions of flexible fabric.

4. A barrier according to claim **1**, wherein said means for expanding said pocket means are mechanical means that maintain the shape of said pocket means, said mechanical means separating the opposite walls of each of said pocket means.

5. A barrier according to claim **4**, wherein said mechanical means are expansible.

6. A barrier according to claim **4**, wherein said mechanical means are helicoidal springs having substantially vertical axes, said helicoidal springs being connected to one wall of each of said pocket means so that the spirals of the springs are pivotable about the point of connection to the wall.

7. A barrier according to claim **1**, characterized in that the skirt-like structure is constituted by an extension of the two opposite walls of the pocket means, said walls being joined at intervals to one another at places located above their lower edges.

8. A barrier according to claim **7**, characterized in that ballast means are suspended at the means for joining the walls.

9. A barrier according to claim **8**, characterized in that the ballast means in a ballast chain.

10. A floating anti-pollution barrier constituted by a submerged skirt-like structure supported by floating means, said floating means comprising pocket-like means being tight with respect to air and being provided with opening means facing in the downward direction, said pocket-like means being connected with one another by pliable band-like portions of a pliable material and expansible mechanical means for putting the pocket-like means into shape and maintaining the shape thereof, said mechanical means being operable to separate opposite walls of the pocket-like means, wherein said mechanical means are helicoidal springs having substantially vertical axes, said helicoidal springs being connected to one wall of the pocket-like means so that the spirals of the spring are pivotable about the point of connection to said wall.

11. A barrier according to claim **10**, characterized in that the pocket-like means are devoid of communication with one another and are connected with one another by way of band-like portions of flexible fabric.

12. A barrier according to claim **11**, characterized in that the skirt-like structure is constituted by an extension of a wall of the pocket-like floating means and is brought back substantially into the plane of longitudinal symmetry of the pocket-like means by joining members fixed to said wall and to the other wall of the pocket-like means.

13. A barrier according to claim **11**, characterized in that the skirt-like structure is constituted by an extension of two opposite walls of the pocket-like means, said walls being joined at intervals to one another at places located above their lower edges.

14. A barrier according to claim **13**, characterized in that ballast means are suspended at the means for joining the walls.

15. A barrier according to claim **14**, characterized in that the ballast means is a ballast chain.

16. A barrier according to claim **15**, characterized in that the ballast chain is placed between the two walls and is suspended at the means for joining said walls, said means for joining the walls being at a distance from the lower edges of said walls such that the ballast chain is completely hidden by said walls.

17. A floating anti-pollution barrier constituted by a submerged skirt-like structure supported by floating means, said floating means comprising pocket-like means being tight with respect to air and being provided with opening means facing in the downward direction, said pocket-like means being connected with one another by pliable band-like portions and mechanical means for putting the pocket-like means into shape and maintaining the shape thereof, said mechanical means being helicoidal springs having substantially vertical axes, said helicoidal springs being connected to one wall of the pocket-like means so that the spirals of the springs are pivotable about the point of connection to said wall.

18. A barrier according to claim **17**, characterized in that the skirt-like structure is constituted by an extension of a wall of the pocket-like floating means and is brought back substantially into the plane of longitudinal symmetry of the pocket-like means by joining members fixed to said wall and to the other wall of the pocket-like means.

19. A barrier according to claim **17**, characterized in that the skirt-like structure is constituted by an extension of the two opposite walls of the pocket means, said walls being joined at intervals to one another at places located above their lower edges.

20. A barrier according to claim **19**, characterized in that ballast means are suspended at the means for joining the walls.

21. A barrier according to claim **20**, characterized in that the ballast means is a ballast chain.

22. A barrier according to claim **21**, characterized in that the ballast chain is placed between the two walls and is suspended at the means for joining said walls, said means for joining the walls being at a distance from the lower edges of said walls such that the ballast chain is completely hidden by said walls.

23. A floating anti-pollution barrier constituted by a submerged skirt-like structure supported by floating means, said floating means comprising pocket-like means being tight with respect to air and being provided with opening means facing in the downward direction, said pocket-like means being connected with one another by pliable band-like portions, wherein the skirt-like structure is constituted by an extension of a wall of the pocket-like floating means, said extension being brought back substantially in the plane of longitudinal symmetry of the pocket-like means by joining members fixed to said wall and to the other wall of the pocket-like means.

24. A floating anti-pollution barrier constituted by a submerged skirt-like structure supported by floating means, said floating means comprising pocket-like means being tight with respect to air and being pro-

vided with opening means facing in the downward direction, said pocket-like means being connected with one another by pliable band-like portions, wherein the skirt-like structure is constituted by an extension of two opposite walls of the pocket-like means, means for joining the walls to one another at intervals are provided at places located above their lower edges, and ballast means of a ballast chain are suspended from the means for joining the walls, said ballast chain being located between the two walls such that the ballast chain is completely hidden by said walls.

* * * * *