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[54] **FLOATING MARINE BARRAGE**

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[52] **U.S. Cl.** ..... **61/1 F;** 114/54
[51] **Int. Cl.²** **E02B 15/04**
[58] **Field of Search** ..... 61/1 F, 5, 69, 6; 114/53, 114/54; 239/562; 210/242, DIG. 21

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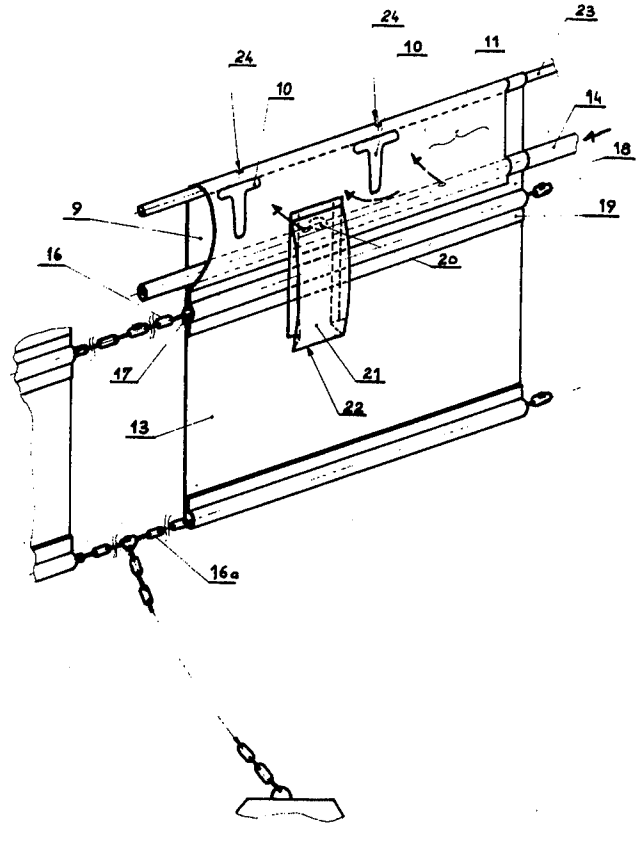
Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

[57] **ABSTRACT**

An inflatable marine barrage having an upper buoyancy chamber and lower ballasting based on an inflatable tube of inverted tear drop cross-sections. Means for inflating and venting the tube can be remotely controlled for effecting raising or lowering of the barrage for bringing into use or rendering it inoperative.

7 Claims, 11 Drawing Figures



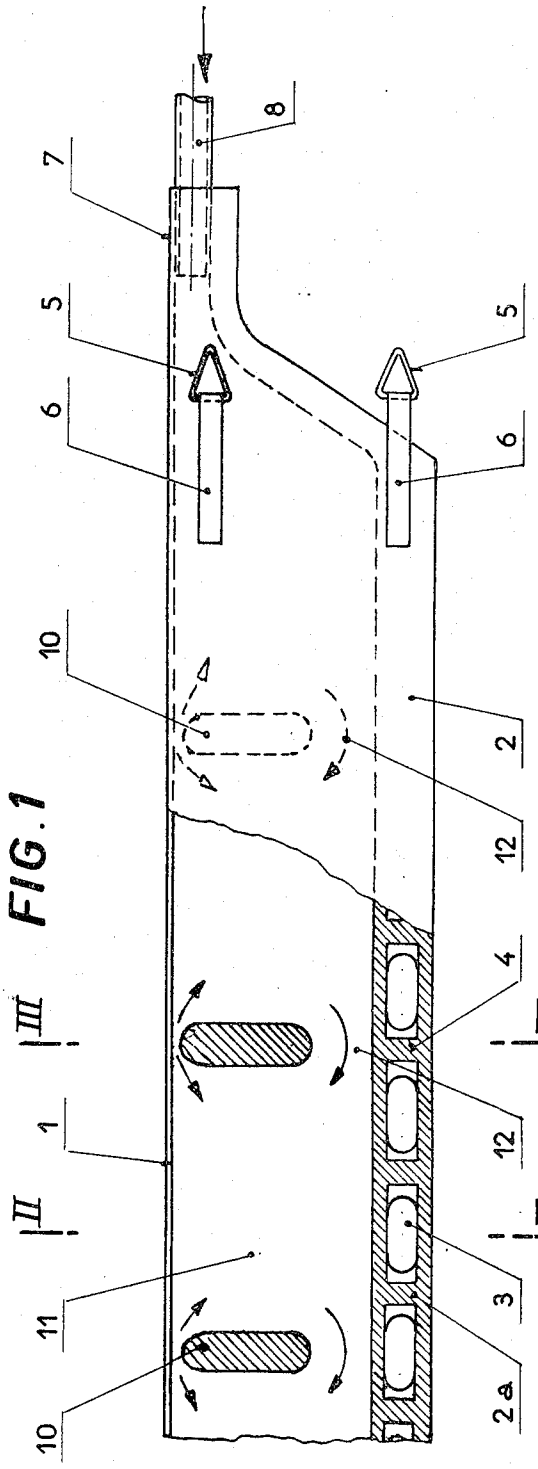


FIG. 1

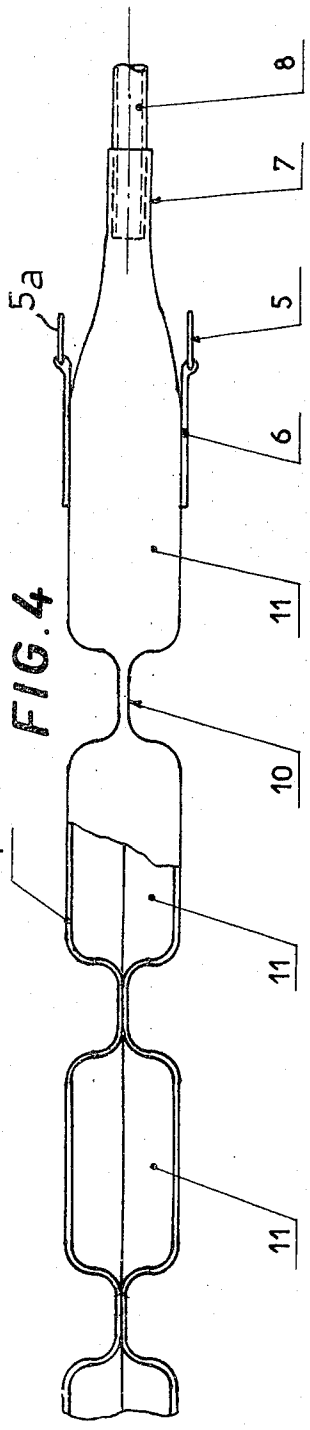
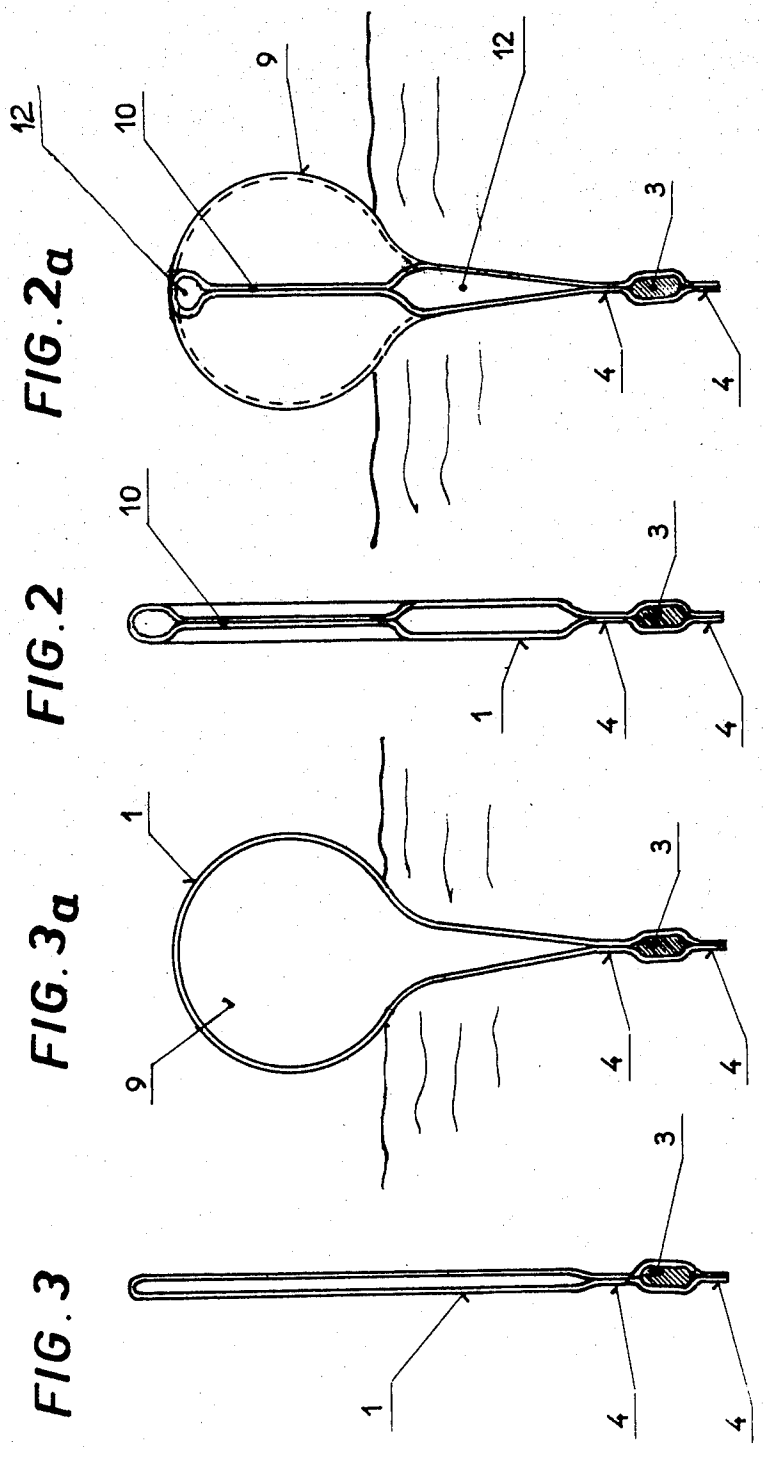


FIG. 4


12
10
9
12
3
4
4
FIG. 2a
10
3
1
4
4
FIG. 2
1
3
9
4
4
FIG. 3a
3
1
4
4
FIG. 3

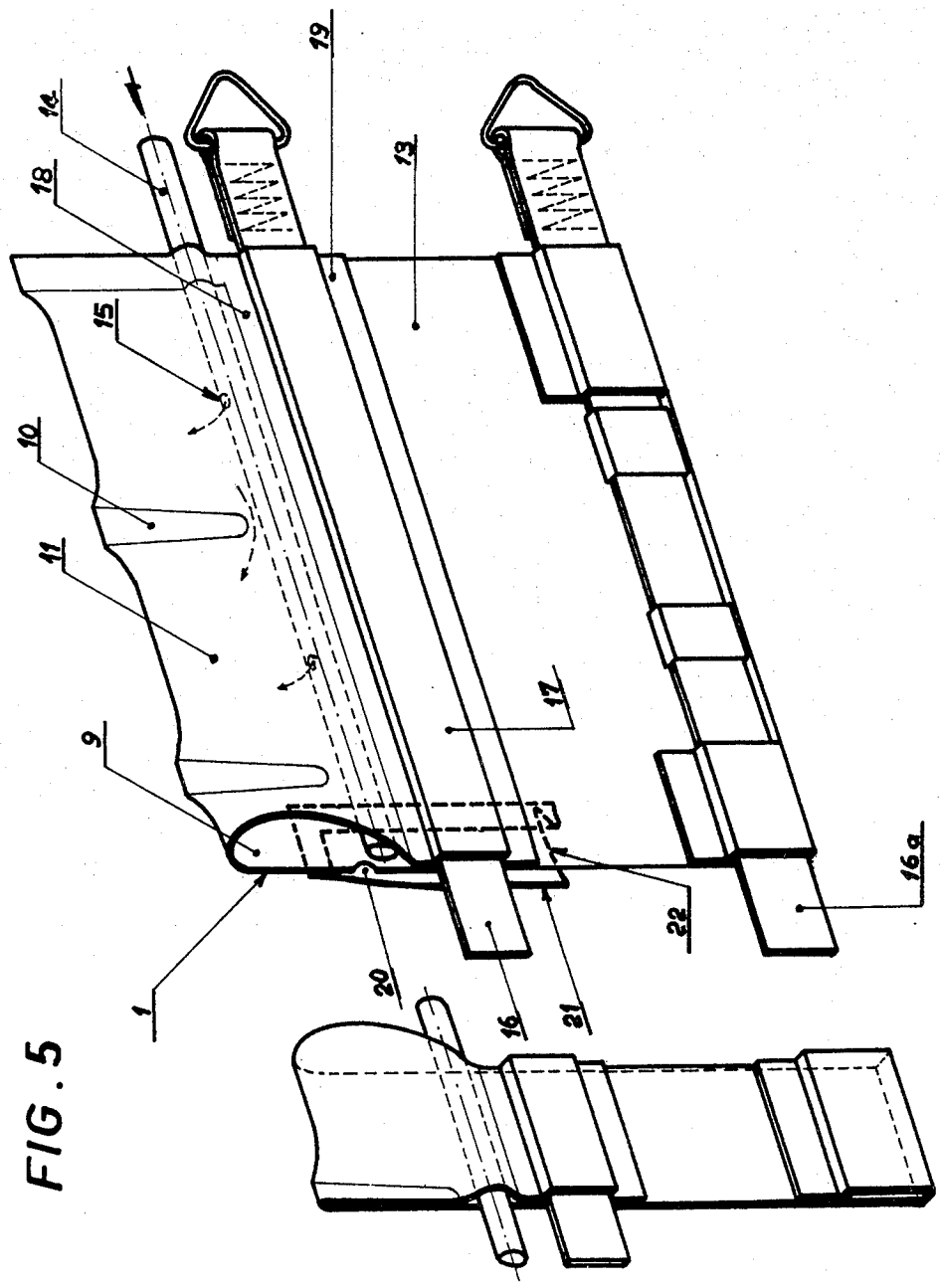


FIG. 5

FIG. 6

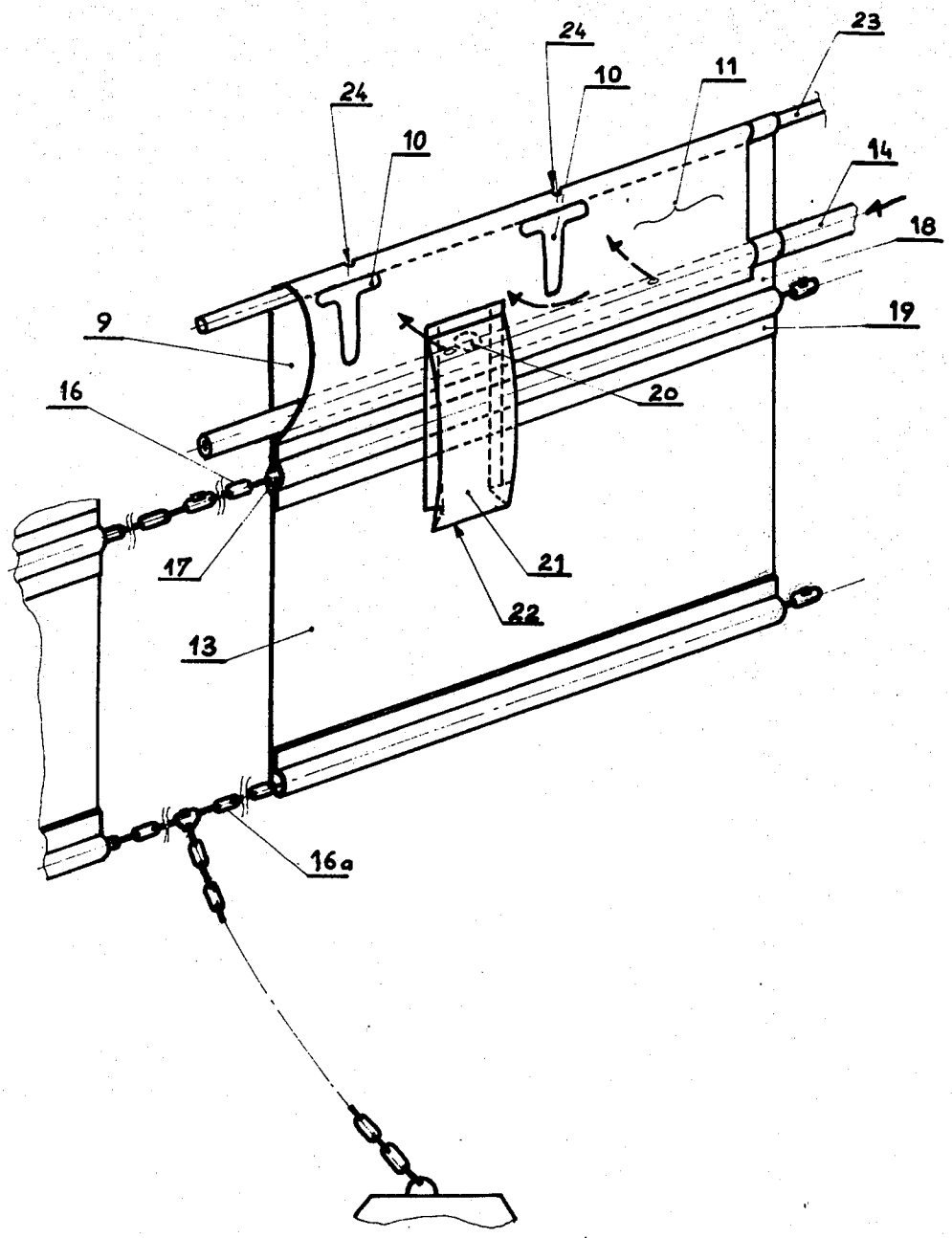


FIG. 7

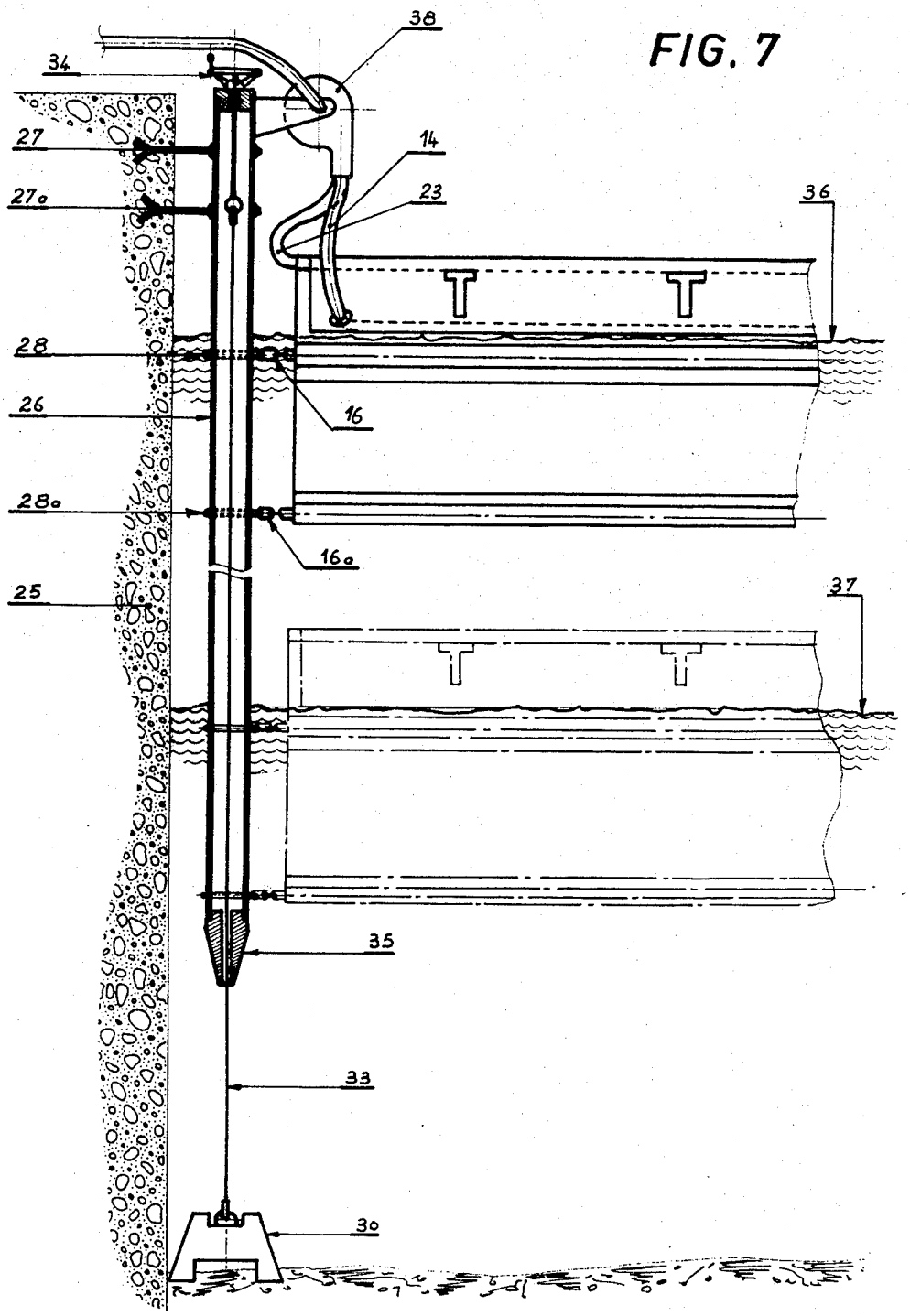


FIG. 8

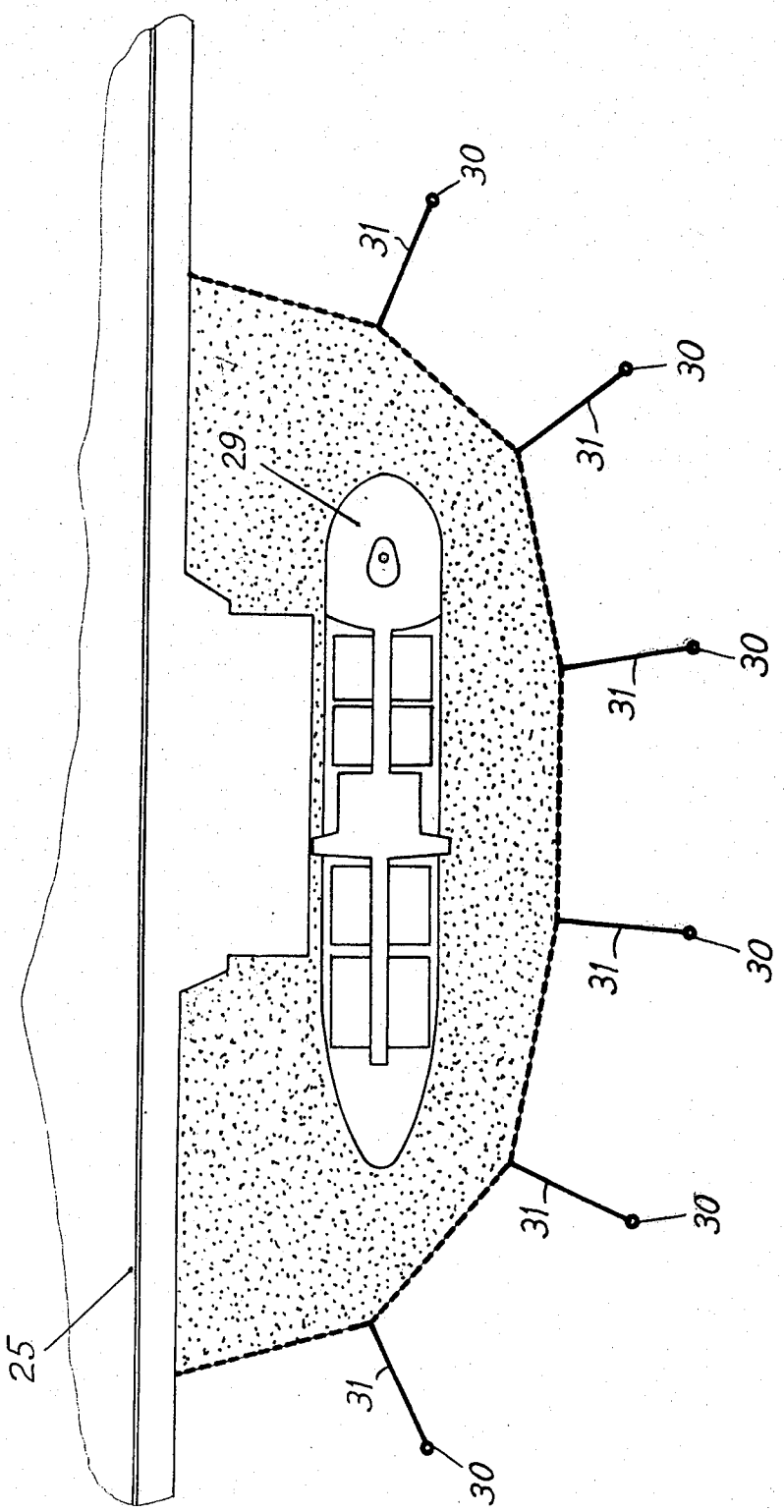
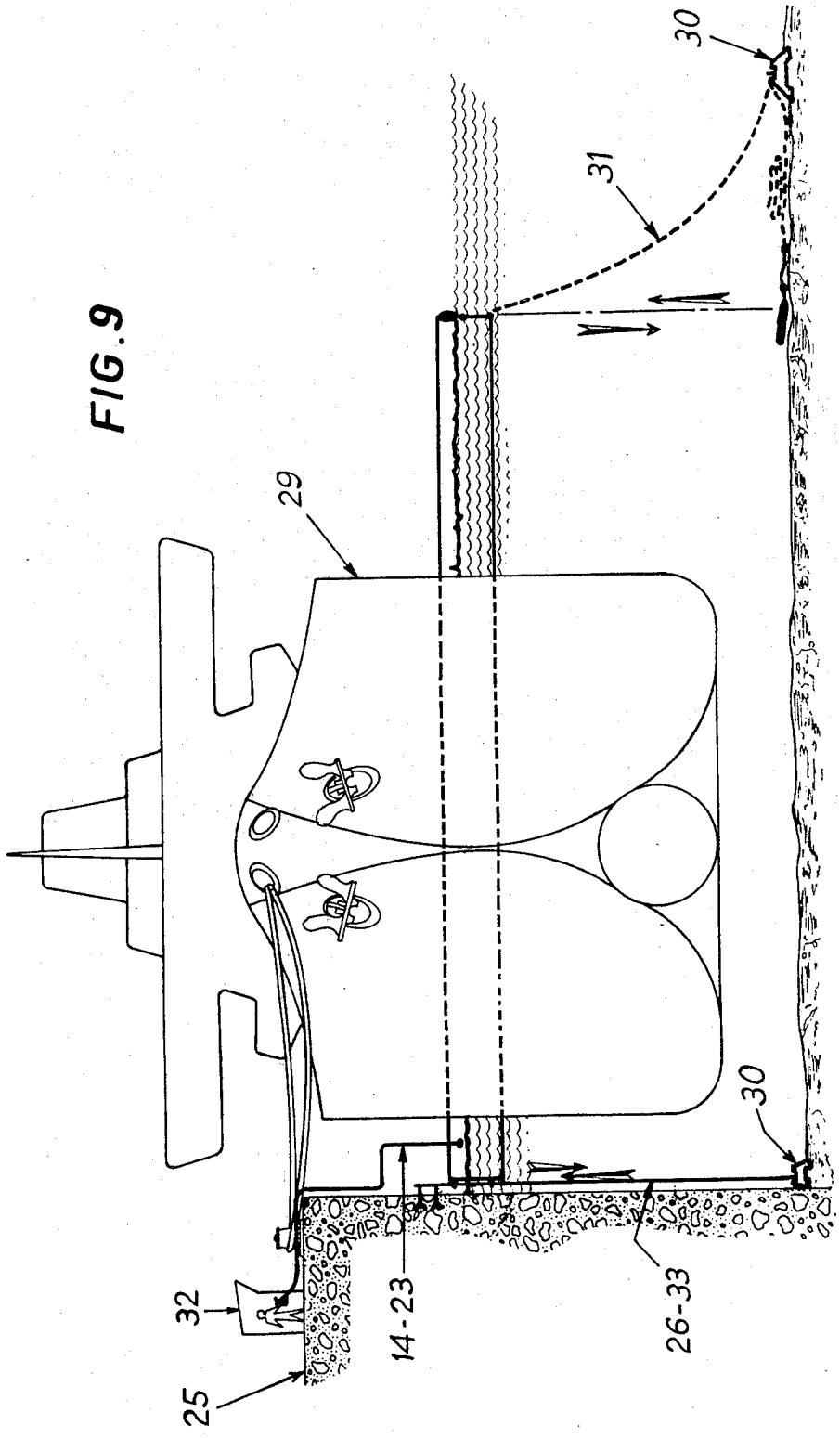


FIG. 9



FLOATING MARINE BARRAGE

The present invention relates to an inflatable marine anti-pollution barrage for confining floating slicks of hydrocarbons.

It is known to confine polluting slicks, more particularly of crude oil, using floating barrages comprised of identical segments which are tied to one another and formed of a rigid floating or inflatable element to the lower portion of which ballast is secured.

Now, the various modes of constructing these barrages result in high manufacturing costs which limit both their use in several areas of the world and the preventing of distribution of intervention equipment in the areas which are subject to frequent pollution. Moreover, the designs used present difficulties of transporting launching and withdrawing the barrages.

According to the present invention there is provided a floating marine barrage of adjustable draught comprising a single, ballasted, flexible, tube having a cross-section which exhibits a buoyancy chamber which assumes the shape of an inverted tear drop with an upper buoyance compartment and a narrower ballasted lower end, and at least one air inlet at one of the ends of the tube, whereby the amount of air blown into the interior of the tube enables its immersion to be adjusted.

The production of such as assembly is particularly economical since its manufacture from a single web of airtight flexible material closed edge to edge on itself necessitates only the absolute minimum of assembly operations.

By virtue of its very composition, the barrage according to the invention can be stored by winding it on a horizontal drum. Its ability to float is obtained by blowing air into the end by which it is uncoiled from the drum, for example under the action of the traction exerted by a tug-boat in the course of launching the barrage which can thus be extremely fast. The barrage can be retracted by means of the same drum while the air trapped in the tube is gradually expelled during the winding up operation.

The tear drop equilibrium shape assumed by the air tube depends both on the amount of air blown into the barrage and the linear density of the ballast secured to the lower edge. Thus the user has the possibility of regulating the height of the emergent portion of the barrage and consequently its draught, thereby enabling optimum adjustment of the device to be achieved having regard to the state of the water level and the intensity of the wind prevailing in the locality.

Preferably the barrage is equipped with metallic ballast plates which are regularly spaced and positioned in sandwich formation at the joint of the two edges of the flexible sheet constituting the structure. As a result, upon inflation, the flat deflated section of the barrage progressively transforms to firstly the shape of an inverted tear drop and then the form of a tennis racket during the launching operation. Inflation is achieved by means of a fan installed on the tug which pulls the free end of the barrage. The upper portion "balloons" under the pressure exerted by the inflating air and forms the float while the lower portion is pulled by the ballast to be progressively flattened because of the hydrostatic pressure gradient and thereby forms the vertically submerged barrier.

The longitudinal buoyancy stability of the barrage may be obtained by uniformly spaced baffles which

partition the ballooning buoyancy chamber portion of the structure into compartments and permit free communication between the compartments at the lower portion of the baffles, and allow circulation of the air blown over all the length of the barrage.

The barrage may suitably further comprise a flexible apron interposed between the said tube and the ballasting, this apron incorporating a ballasted traction chain or belt and the inflation pressure of the buoyancy chamber being regulated by communicating said conduit with the external water via a certain number of orifices in the lower wall of said conduit and each opening into a respective bellows attached to the wall of the tube, those bellows being closed at their upper ends and open at their lower ends.

According to a further aspect of the present invention there is provided a floating marine barrage including an elongate buoyance chamber, and a venting device for expelling air from the buoyancy chamber to enable the barrage to sink to the bottom when the venting device is open and make possible its surfacing and stabilisation when the venting device is closed, said venting device comprising: a succession of single or multiple orifices in the upper wall of each of the compartments of the buoyancy chamber and a flexible, flattenable pipe which closes the orifices when the pipe is inflated and opens the orifices when the pipe is deflated.

Other characteristics and advantages of the invention will become better understood from reading the following description of exemplary embodiments and referring to the accompanying drawings in which:

FIG. 1 is an elevational view, partially sectional, of an end portion of the barrage placed flat and deflated, and comprising the connection of the air inflation tube;

FIG. 2 is a sectional view of a run of the barrage taken along line II—II of FIG. 1;

FIG. 2*a* is a sectional view of a run of the barrage along line II—II when the barrage floats after air has been blown into t he inflation conduit;

FIG. 3 is a sectional view along line III—III of FIG. 1 when the barrage is placed flat and deflated;

FIG. 3*a* is a sectional view along line III—III of FIG. 1 when the barrage floats after air has been blown into the inflation conduit;

FIG. 4 is a view from above and in partial section, showing the barrage of FIG. 1 when floating after air has been blown into the inflation conduit;

FIG. 5 is a perspective view with portions broken away showing one embodiment of a compartmented section of barrage equipped with the inflation device, the device for adjusting the pressure in the compartments, and the two traction belts, with the lower belt ballasted;

FIG. 6 is a perspective view with portions broken away of a further embodiment equipped with chains instead of belts and further provided with the device for expelling air from the floatation conduit from the purposes of immersing the barrage;

FIG. 7 is an illustration of the mode of anchoring the end of the barrage to a quay;

FIG. 8 is an illustration of the disposition of the barrage used to confine a possible polluting slick; and

FIG. 9 is a vertical section of FIG. 8.

FIGS. 1, 2, 2*a*, 3, 3*a* and 4 show a barrage according to the invention which is comprissed of a coated fabric 1 folded on itself and having the edges 2 and 2*a* ren-

dered integral in a suitable manner such as by gluing, welding or sewing, depending on the nature of the coating material which may be an elastomer or a heat-weldable film, Small metal ballast plates **3** are set into the joint **4** of the edges **2** and **2***a*.

At the end of the barrage according to the invention traction rings **5** and **5***a* are fastened to the flexible envelope **1** by glued, welded or sewn straps **6.** These rings are used for a suitable device towing the barrage and for anchoring the barrage when it has been positioned.

This end of the barrage is extended by a triangle of fabric which forms the opening **7** for the inflation pipe **8.**

As shown in FIGS. **1, 2***a*, **4, 5** and **6,** the portion **9** of the barrage which balloons upon inflation comprises baffles **10** obtained by local integration of the two flatly superimposed folds of the envelope **1.** These baffles serve to separate compartments **11** and are regularly spaced along the entire length of the barrage at the upper portions of the compartments, the intercommunication of the compartments at their lower portions being ensured by passages **12** which open as the inflation air enters the barrage from the pipe **8.**

This arrangement ensures the horizontal stabilising of the barrage by ensuring distribution of the buoyancy over the entire length of the barrage.

The fabric **1** forming the flexible structure of the barrage is:

either a fabric of synthetic polyamide or polyester fibres coated with elastomers used in accordance with known principles by cold gluing, sewing or vulcanising,

or a fabric of synthetic fibres coated with a heat-weldable material which, whenever the conditions of use permit, has the advantage that assembly can be made by a rapid and inexpensive method such as high frequency welding or hot air welding.

FIGS. **5** and **6** show a barrage according to the invention which comprises a coated fabric **1** folded and welded together at **18** so as to form a buoyancy chamber **9** and the barrier **13.** At the lower portion of the buoyancy chamber **9** is a flexible tube **14** which feeds air through the orifices **15** into the compartments **11** of the buoyancy chamber. A traction belt or chain **16** is disposed at the upper portion of the barrier **13** in a duct **17** formed by a flap of the fabric **1** between the welds **19** and **19** of the fabric. A ballasted belt or chain **16***a* is disposed in a hem at the lower portion of the barrier **13.**

Staggered orifices **20** along the buoyancy chamber **9** each open into the upper portion of resepctive bellows **21** which are welded to the envelope **1** and are closed at their upper portions and open at their lower ends **22.** These bellows ensure the regulation of the air pressure in the conduit to a value determined by the hydrostatic pressure prevailing at their lower ends.

FIG. **6** shows an alternative form of barrage according to the invention which comprises, in addition to the devices illustrated in FIG. **5,** an embodiment of a device for controlling the submerging of the barrage. This device comprises a flattenable flexible tube **23** which passes along the upper portion of the buoyancy chamber **9** at the top of T-shaped baffles **10** compartmenting the buoyancy chamber. Upwardly of this tube are orifices **24** in the envelope **1** which are shut by pressurisation of the air within the tube **23** causing the tube to contact intimately the contours of the orifices **24.**

FIG. **7** shows in detail the anchoring of the barrage end to a quay **25.** A pipe **26** is vertically secured along the wall of the quay by fastenings **27** and **27***a* disposed above the high water mark level. In active state the barrage is held vertical by virtue of rings **28** amd **28***a* threaded around the pipe **26** and integral with the traction chains or belts **16** and **16***a* which slidingly permit the barrage to rise and fall with the tide or the swell between the high water level **36** and the lowest water level **37.** A cable **33,** having one end hooked to a ballast resting on the bottom or to a suspended deadweight **30** and the other end secured to a tensioning system secured to the upper portion of the pipe **26,** acts as an extension of the vertical guiding function of the pipe **26** down to the sea or river bed, the lower portion of the pipe **36** being to this end equipped with a conical finger **35.**

Flexible hoses **14** and **23** are mounted on an automatic coiling drum **38** so as to follow the vertical movements of the barrage.

FIGS. **8** and **9** illustrate the disposition of the barrage according to the invention to ensure that a polluting slick is confined. A tanker **29** moored at its loading or unloading station is surrounded by the barrage which is anchored by its two ends to the quay **25** as described in FIG. **7** and retained at the bottom by deadweights **30** by means of chains **31.** The two flexible hoses **14** and **23,** which respectively control inflation of the barrage and its emersion on the one hand, and its immersion on the other hand, extend from a handling station **32** (FIG. **9**). Sailing of the tanker necessitates removal of the barrage. Reduction of the pressure in the flexible hose **23** enables the air in the buoyancy chamber **9** to escape via the orifices **24.** Gradually as the barrage sinks under the effect of the chains or weighted belts **16** and **16***a* the air is expelled to atmosphere by the increasing hydrostatic pressure exterted on the envelope **1** of the buoyancy chamber. Under the effect of the two chains or ballasted belts **16** and **16***a* the barrage will lie flat on the bottom, totally evacuated, and be unaffected by any possible current of ebb or flood tide or the wake of the screws of passing vessels.

The barrage according to the invention permits remote control of the barrage between the two extreme situations namely (a) lying flat on the bottom of the sea, or (b) floating in operative state.

I claim:

1. A floatable marine barrage including an elongate buoyancy chamber, and vent means comprising means defining a succession of orifices in the upper portion of said buoyancy chamber for expelling air from the buoyancy chamber when the vent means is open, a flexible inflatable pipe for closing the orifices when inflated and for opening the orifices when deflated, and means for positioning said pipe adjacent said succession of orifices.

2. The combination of a marine barrage as set forth in claim **1,** with guide mans, and means slidably connecting an end of said barrage to said guide means thus permitting the barrage to slide between an upper, active position and a lower inoperative position.

3. A floatable marine barrage of adjustable draft comrpising: a single flexible tube having a cross-section in the shape of an inverted tear drop, with an upper buoyancy chamber, ballast means in the lower end of said tube, at least one inlet at one of the ends of said tube for admitting inflation air into the interior of said tube whereby the extent of its immersion may be ad-

justed, means defining a plurality of orifices in the lower portion of said tube, and bellows means attached to said tube, said bellows means having closed upper portions and open lower ends, each said orifice opening into the upper portion of a respective bellows means to enable the inflation pressure of said buoyancy chamber to be controlled in response to the hydrostatic pressure prevailing at the lower end of said fellows means.

4. A floatable marine barrage of adjustable draft comprising: a single flexible tube having a cross-section in the shape of an inverted tear drop, with an upper buoyancy chamber, ballast means in the lower end of said tube, at least one inlet at one of the ends of said tube for admitting inlation air into the interior of said tube whereby the extent of its immersion may be adjusted, baffle means distributed along the length of said tube and spaced from the top of said buoyancy chamber to define therewith a plurality of passages and further to define compartments to ensure uniformity of immersion and horizontal stability of said tube, said baffle means comprising integration of discrete portions of opposed internal surfaces of said tube, means for evacuating air confined in said buoyancy chamber to enable it to sink, said evacuation means including further means defining a succession of orifices in said passages above said baffle means, and a flexible hose extending along in said passages whereby inflating and deflating said hose controls closing and opening, respectively, of said orifices.

5. A floatable marine barrage comprising: a flexible tube having a cross-section in the shape of an inverted tear drop and defining at least one buoyancy chamber, ballast means in the lower end of said tube, means for admitting inflation air into the interior of said tube whereby the extent of its immersion may be adjusted, means defining at least one orifice in the lower portion of the wall of said tube, at least one bellows means attached to the wall of the barrage and having a closed upper end and an open lower end, said orifice opening into the upper portion of said bellows means to enable the inflation pressure of the buoyancy chamber to be controlled in response to the hydrostatic pressure prevailing at said open lower end of said bellows means.

6. A floatable marine barrage as set forth in claim **5,** and including baffle means distributed along the length of the tube to define inflatable compartments each acting as a buoyancy chamber, means for evacuating air confined in said buoyancy chambers, said evacuation means including further means defining a succession of orifices in that portion of the wall of aid buoyancy chambers remote from the narrow lower end of the connection, said orifices being formed above said baffle means, said baffle means being spaced from the top wall of said buoyancy chambers to define therewith a plurality of passages, and a flexible hose threaded into said passages whereby inflating or deflating said hose effects shutting or opening of the evacuation orifices.

7. The combination of a marine barrage as set forth in claim **5,** with guide means, and means slidable connecting an end of said barrage to said guide means thus permitting the barrage to slide between an upper, active position and a lower inoperative position.

* * * * *