



(11) **EP 1 307 618 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
10.01.2007 Bulletin 2007/02

(21) Application number: **01956261.0**

(22) Date of filing: **27.07.2001**

(51) Int Cl.:
E02B 7/00 (2006.01)

(86) International application number:
PCT/CZ2001/000042

(87) International publication number:
WO 2002/010519 (07.02.2002 Gazette 2002/06)

(54) **SEGMENT OF FLOOD-PROTECTION WALL BASED ON SPECIAL BAG FILLED WITH WATER**

SEGMENT FÜR HOCHWASSERSCHUTZWAND BASIERT AUF EINEM BESONDEREN MIT
WASSER GEFÜLLTEN SACK

SEGMENT DE MUR DE PROTECTION CONTRE LES INONDATIONS BASE SUR UN SAC SPECIAL
REMPLI D'EAU

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**

(30) Priority: **02.08.2000 CZ 20002812**

(43) Date of publication of application:
07.05.2003 Bulletin 2003/19

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(56) References cited:
**CH-A- 655 338 GB-A- 945 091
US-A- 5 713 699 US-A- 5 865 564**

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Description

Technical area

[0001] Invention concerns segment of flood-protection wall based on special bag filled with water. Walls built-up from individual segments mentioned are intended - as temporary barring and sealing elements - above all for quick protection separate objects against floods. They are usable in wide range of dangerous flood situations.

Actual technical state

[0002] At present various constructions of flood-protection bags and flood protection walls built-up from these bags are known. For example, there is group of bags filled with water, having its cross-section is created by on basis situated triangle. Cross section shape can be kept by external bar supporting structure or by internal partitions placed regularly in the bag. In this case covering of the bag is made of chemically resistant plastic, namely of low density polyethylene.

[0003] On principle similar flood-protection system is created by open bags (tanks) with trapezoidal cross section. Bags are supported by tough and quick mountable structure made of steel pipes and have surface sheet made of geo-fabric or polyvinylchloride coated fabric. These bags are filled by sand, soil or water (watertight design).

[0004] Triangular or trapezoidal cross section is a common disadvantage of above mentioned flood-protection walls. Triangular or trapezoidal cross section is necessary to be supported by some structure, internal partitions, etc. In cross section vertices strain can focus, too.

[0005] By virtue of these reasons it is useful to create domed shape of cross section which is defined by one or more mutual intersecting surfaces. Such bag conforms better to tonic conditions in water mass given by gravity and surface tension.

[0006] According to these reasons known flood-protection bags have domed shape when filled. For example one of bags has depressed ellipse surface sheet supported by internal longitudinal partition connecting upper and lower bag wall. Surface sheet is made of watertight polyester fabric coated by polyvinylchloride.

[0007] Another known flood-protection bag has surface sheet created by three mutual intersected convex surfaces ("trefoil" cross section). Also in this case shape of filled bag is kept by internal partitions connecting opposite sides of bag surface sheet. Bag surface sheet is made of geo-fabric (no detailed specification of design and composition).

[0008] As mentioned above flood-protection bags of domed design are advantageous, because the tonic strain of their surface is better. They also have design possibilities for higher mechanical resistance and durability than bags of other shapes of cross sections. But there is one lack of functional design: these bags are not

fully optimised as from point of view of functional design as from point of view of materials used for surface sheet production. Used materials with plastic coatings (especially polyvinylchloride) are not optimal in this way of application neither from point of view of possibility of immediate mechanical damage during handling with bags nor from point of view of long-term resistance during given flood situation. US-A-5 865 564 discloses a prior art water fillable bag.

Principle of invention

[0009] Segment of flood-protection wall based on special bag filled with water according to invention as defined in claim 1 contributes to elimination of above mentioned lacks of known designs. When filled the segment occupies (analogous to more sophisticated representatives of flood-protection bags) domed shape over its basis which is defined by at least one convex surface. Opposite parts of inner wall in bag cavity are connected by at least one stability partition.

[0010] Principle of invention lies in ratio of rectangular projection of segment width to rectangular projection of segment height is within 1.5 : 1 to 3.5 : 1. The segment has at least one filling neck and at least one vent neck in the top area; the segment has at least one draining neck in the foot area. The filling neck is provided with normal fire-hose connector. The segment surface sheet is made of plain weave fabric two-sided coated by elastomer compound based on EPDM rubber and butadiene-styrene rubber.

[0011] From point of view of connection separate segments to compact flood-protection wall it is advantageous to provide end areas of segment surface sheet with connecting fixtures containing metallic loopholes.

[0012] For easier handling It is advantageous when there are at least four metallic loopholes connected to each segment of flood-protection wall.

[0013] As fabric it is advantageous to use a plain weave fabric with tensile strength 1800 N to 2300 A (warpwise) and 2000 N to 2300 N (weftwise) having been determined on a sample 50 x 200 mm dimensions. It is possible that this fabric could be polyester fabric with square weight $140 \text{ g/m}^2 \pm 10\%$.

[0014] It is advantageous when compound for coatings of segment surface sheet made of plain weave fabric two-sided coated by elastomer compound based on EPDM rubber and butadiene-styrene rubber has tensile strength at least 10 MPa, elongation at least 400%, compression set 50% max., low temperatures resistance to -25°C and high temperatures resistance to 70°C.

[0015] It is advantageous when coatings of segment surface sheet are 1.2 to 1.4 mm thick.

[0016] Segment of flood-protection wall according to this invention is advantageous, because it joins together advantages of optimised segment bag design (domed shape with defined ratio width to height and with defined placing filling, draining and venting necks) and advan-

tages of optimised composition of materials of segment surface sheet. Plain weave fabric two-sided coated by elastomer compound based on EPDM rubber and butadiene-styrene rubber especially with more exact defined mechanical properties and in connection with above mentioned defined bag design ensures optimum handling and usable properties of the segment as well as in hard space and meteorological conditions. First of all this ensures meeting of priority requirement for reliable function of segments, or walls of them put together respectively, during the whole flood situation continues.

Resumption of pictures in drawings

[0017] For further explanation of invention principle there are drawings, where fig. 1 shows side view on simply domed segment according to invention, fig. 2 shows transverse section in place A in fig. 1, fig. 3 shows side view on doubly domed segment according to invention, fig. shows transverse section in place B in fig. 3.

Examples of invention design

Example No. 1

[0018] Segment 1 designed according to fig. 1 or fig. 2 respectively occupies when filled domed shape over its basis which is defined by one convex surface - cross section of "cob-loaf" shape. Ratio of rectangular projection of width s of segment 1 to rectangular projection of height v of segment 1 is within 2.15 : 1, length of segment could be 2 to 2.5 m. Segment 1 has one filling neck 3 and one vent neck 4 in the top area and at least one draining neck 5 in the foot area;

[0019] Segment surface sheet 2 is made of plain weave fabric two-sided coated by elastomer compound based on EPDM rubber and butadiene-styrene rubber.

[0020] Polyester fabric has square weight $140 \text{ g/m}^2 \pm 10\%$ and tensile strength 2294 N (warwise) and 2298 N (weftwise) having been determined on a sample 50 x 200 mm dimensions.

[0021] Coatings of segment surface sheet 2 are 1.29 mm thick. Compound based on EPDM rubber and butadiene-styrene rubber has tensile strength 11.5 MPa, , elongation 455%, compression set 45% max., low temperatures resistance to -25°C and high temperatures resistance to 70°C.

[0022] In bag cavity upper wall of surface sheet 2 of segment 1 is connected with opposite lower wall by stability partition 9.

[0023] End areas of segment surface sheet 2 are provided with connecting fixtures containing metallic loop-holes 6 for connecting adjoining segments with rope 7. There are carrier loop-holes 8 made of rubberised fabric fastened on surface sheet 2 by curing for to make easy handling with segment 1.

[0024] Segment 1 of flood-protection wall designed according to fig. 1 and fig. 2 is designated for to scale up

banks, to embank separate houses or bigger areas with integral flood-protection wall, to dam streets in towns (between houses) for to stop water from breaking into gateways of houses, etc. Segments 1 of this design can stand on free area without bearing on any wall.

Example No. 2

[0025] Segment 1 designed according to fig. 3 or fig. 4 respectively occupies when filled domed shape over its basis which is defined by two convex surfaces - cross section of "leaf" shape. Ratio of rectangular projection of width s of segment 1 to rectangular projection of height v of segment 1 is within 2.15 : 1, length of segment could be 2 to 5 m. Segment 1 has one filling neck 3 and one vent neck 4 in the top area and at least one draining neck 5 in the foot area;

[0026] Segment surface sheet 2 of segment 1 is made of plain weave fabric two-sided coated by elastomer compound based on EPDM rubber and butadiene-styrene rubber.

[0027] Polyester fabric has square weight $140 \text{ g/m}^2 \pm 10\%$ and tensile strength 2294 N (warwise) and 2298 N (weftwise) having been determined on a sample 50 x 200 mm dimensions.

[0028] Coatings of segment surface sheet 2 of segment 1 are 1.29 mm thick. Compound based on EPDM rubber and butadiene-styrene rubber has tensile strength 11.5 MPa, , elongation 455%, compression set 45% max., low temperatures resistance to -25°C and high temperatures resistance to 70°C.

[0029] In bag cavity upper wall of surface sheet 2 of segment 1 is connected with opposite lower wall by stability partition 9, side walls of surface sheet 2 of segment 1 are connected by horizontal stability partition 9

[0030] End areas of segment surface sheet 2 are provided with connecting fixtures containing metallic loop-holes 6 for connecting adjoining segments with rope 7. There are carrier loop-holes 8 made of rubberised fabric fastened on surface sheet 2 by curing for to make easy handling with segment 1.

[0031] Segment 1 of flood-protection wall designed according to fig. 3 and fig. 4 is designated above all for to stop water from breaking into doors, garage gates, low placed wells and air slots, separate cellar windows, etc. Segments 1 of this design must be supported or ensured alternatively. If necessary to use in free area, segments must be doubled and mutually gone on.

[0032] Using segments according to example 1 and example 2 respectively, separate segments are positioned on given place so that they lie on lower side with filling and venting necks upwards and with draining necks directed to water.

[0033] The best tightness is reached by positioning segments each to other so that they are in contact by lower edges of their side walls. The tighter they are connected, the better tightness is reached. If there is only longer segment available in given space, it can be "bent"

upwards and tightened by "stepping" in the corner.

[0034] It is possible to fill segments from any water source -miscellaneous pumps for river water or other sources, fire tanks or other ones, fire hydrants, water conduits, etc. Connecting with filling neck 3 is provided by fire-head "C". Emergency filling can be provided by thinner hose without connector. This hose is inserted through filling neck into the bag.

[0035] It is possible to fill several segments at the time (according to equipment available) or one by one segment. Using the second way it is recommended to insert next part under side wall of full segment. After filling segments are connected with ropes by means of metallic loopholes 6. If possible from point of view of environmental conditions it is good to tie at least outer ends of flood-protection wall to solid things (frames embedded in concrete, massive buildings, etc. that are presupposed not to be damaged by flood) or to subjects on uphill places.

[0036] Segments according to example No. 2 which are used separately are to be statically secured, e.g. tied to secured object. In order to ensure maximum tightening effect, it is necessary to place lower edge of segment exactly to tightened wall and during filling to check eventually correct position of lifting side walls.

[0037] Segments according to the invention are filled with water, not pressurized. Filling time (according to pump supply) is about 15 minutes in case of standard segment 5 metres long. As soon as the segment is full (it is not possible to stop outflowing water from venting neck 4 by lifting side walls), water inflow from the source will be stopped, hose will be disconnected and filling neck 3 and venting neck 4 will be closed with covers.

[0038] Flood-protection wall built-up from segments according to the invention is safe to water column of 0.8 meter high. In case of unruffled spilled water on lower reach of rivers and according to landform and subsoil it is possible to reach maximum secure height of 0.9 metres.

[0039] After flood exposure passed away, the flood-protection can be dismantled quickly. Draining necks of separate segments 5 and venting necks 4 (eventually also filling necks 3) will be opened and water will drain off. Separate segments will be released by unbinding ropes 7 and transported to stock or to next use.

Industry utilization

[0040] Segments according to the invention and flood-protection wall built-up of them are of use not only at floods or ominous floods (where sack of sand are used) but also in conventional situations, e.g. as damming up of parts of water streams - so called "pooling" during bed or bank reparations, etc.). Simple segments are not designated to positioning directly against the strong stream. In this case it is necessary to use doubled set.

[0041] For filling segments it is possible to use pumped water from rivers, fire tanks etc. by means normal fire connectors

[0042] Segments designed according to the invention are permanent resistant against drinking water, supply water and sewage water, which can be discharged into water flows in accordance with relevant legal regulations.

They are resistant against waste water washed out from sewers and septic tanks by floods. Depending on concentration segments are partially resistant against aggressive fluids and oil products. These media can be collected in segments, but for needful time only, e.g. during accidents. In this case it is necessary to empty segments as soon as possible and dispose after use (consider it to be single-purpose).

[0043] Flood-protection walls designed according to the invention are possible to be placed on any subsoil. It is recommended to place it especially on reinforced subsoil - concrete, pavement, bitumen, etc. If possible it is suitable to clean necessary area and remove sharp and similarly dangerous objects. If not necessary it is better not to place segments on slippery surface in order not to be displaced, or on sandy or gravel subsoil in order not to be undermined by water.

Claims

1. A segment of flood-protection wall comprising a water-fillable bag having domed shape over its basis when filled with water, the dome shape being defined defined by a sheet in the form of at least one convex surface when seen in transverse section of the segment, with opposite sections of the segment sheet inner wall being interconnected by at least one stabilizing partition (9) partitioning the bag cavity, wherein the ratio of the rectangular projection of segment width (s) to rectangular projection of its height (v) ranges between 1.5 : 1 to 3.5 : 1. that the segment (1) is provided with at least one filling neck (3) and at least one venting neck (4) in the top of its dome shaped area and at least one draining neck (5) in the foot area, with the filling neck being provided with a normal fire-hose connector and that the sheet (2) of the segment is made of plain weave fabric coated on both sides with an elastomer compound based on a blend ethylene-propylene-diene rubber and styrenebutadiene rubber.
2. The segment of the flood-protection wall according to Claim 1, in which its sheet (2) is provided with connecting fixtures comprising metal loopholes 6 in end areas.
3. The segment of the flood-protection wall according to Claim 1, in which at least four carrying handles (8) are connected to its sheet (2).
4. The segment of the flood-protection wall as claimed in Claim 1, **characterized in that** the plain weave fabric is having tensile strength, as determined on a

specimen 50 x 200 mm in size, of 1,800 N to 2,300 N in the warp direction and 2,000 N to 2,300 N in the weft direction.

5. The segment of the flood-protection wall as claimed in Claim 4, in which the plain weave fabric is a polyester fabric having mass per unit area of $140 \text{ g/m}^2 \pm 10\%$.
6. The segment of the flood-protection wall as claimed in Claim 1, in which the ethylene-propylene-diene rubber/styrene-butadiene rubber blend comprising the coats of the sheet (2) exhibits tensile strength of at least 10 MPa, elongation at break at least 400%, compression set 50% at maximum, low temperature resistance of down to -25°C and high temperature resistance of up to 70°C .
7. The segment of the flood-protection wall according to Claim 1, **characterized in that** the elastomer coats of the sheet (2) are 1.2 to 1.4 mm thick.

Patentansprüche

1. Segment für Hochwasserschutzwand basiert auf einem besonderen mit Wasser gefüllten Sack, der die Kuppelform über seinem Basis hat, wenn dieses Sack gefüllt mit Wasser ist, diese Kuppelform ist bestimmt mittels dem Mantel, der zumindest eine konvexe Oberfläche bildet, wobei die gegenüberliegenden Abschnitte der inneren Wall des Mantel des Segments durch den Hohlraum des Sacks miteinander mittels der Stabilisierungstrennwand gekuppelt sind, **dadurch gekennzeichnet, dass** das Verhältnis von dem Normalriss der Breite zu der Höhe des Segments (1) zwischen 1,5 : 1 und 3,5 : 1 liegt, und dass das Segment (1) auf der Gipfelpunkt der Kuppelform mit zumindest einem Füllstutzen (3) und zumindest einem Entlüftstutzen - Ablassstutzen (4) ausgerüstet ist, und dass das Segment (1) in dem Fußbereich mit zumindest einem Ablassstutzen (5) versehen ist, der Füllstutzen (3) mit der normalisierten Feuerlöschkupplung ausgerüstet ist, und dass der Mantel (2) des Segments (1) aus dem Gewebe der Leinwandbindung hergestellt ist, die beiderseitig mit der Mischung von einem Elastomer - Kautschukmischung versehen ist, diese Mischung auf der Basis des Äthylen - propylen - dien Kautschuk und des Styrol - Butadien Kautschuk gebildet ist.
2. Segment für Hochwasserschutzwand nach dem Anspruch 1, **dadurch gekennzeichnet, dass** der Mantel (2) in seinen Endflächen mit den Verbindungsanfassenden (6) versehen ist.
3. Segment für Hochwasserschutzwand nach dem Anspruch 1, **dadurch gekennzeichnet, dass** zumin-

dest vier Betätigungsaugen (8) zu dem Mantel (2) angeschlossen sind

4. Segment für Hochwasserschutzwand nach dem Anspruch 1, **dadurch gekennzeichnet, dass** die Zugfestigkeit des Gewebes, bestimmt bei dem Prüfungskörperchen von Größe 50 x 200 mm, zwischen 1800 N und 2300 N in der Ketterichtung und zwischen 2000 N und 2300 N in der Schussrichtung liegt.
5. Segment für Hochwasserschutzwand nach dem Anspruch 4, **dadurch gekennzeichnet, dass** als das Gewebe der Leinwandbindung das Polyestergewebe angewendet ist, das die Flächenmasse $140 \text{ g/m}^2 \pm 10\%$ hat.
6. Segment für Hochwasserschutzwand nach dem Anspruch 1, **dadurch gekennzeichnet, dass** die Elastomer - Kautschukmischung auf der Basis des Äthylen - propylen - dien Kautschuk und des Styrol - Butadien Kautschuk die Zugfestigkeit zumindest 10 MPa hat, die Dehnfähigkeit - zumindest 400% hat, die bleibende Druckverformung zuhöchst 50%, die Kältebeständigkeit bis -25°C und die Temperaturbeständigkeit bis $+70^\circ\text{C}$ hat.
7. Segment für Hochwasserschutzwand nach dem Anspruch 1, **dadurch gekennzeichnet, dass** die Elastomer - Kautschukschichten von dem Mantel (2) die Dicke von 1,2 zu 1,4 mm haben.

Revendications

1. Un segment de barrage anti-inondation composé d'un sac à eau présente, lorsqu'il est rempli, la forme d'un dôme au-dessus de sa base. La forme en dôme est définie par une paroi présentant au moins la forme d'une surface convexe lorsqu'elle est observée dans la section transversale du segment. La partie intérieure de la paroi est interconnectée avec les sections opposées du segment par au moins une cloison stabilisante (9) divisant la cavité du sac. Le rapport entre la largeur (s) du segment en projection rectangulaire et la hauteur (v) du segment en projection rectangulaire varie de 1,5:1 à 3,5:1. Le segment (1) est équipé d'au moins un orifice de remplissage (3) et d'au moins un orifice pour l'évacuation de l'air (4) au sommet de la surface en forme de dôme, et d'au moins un orifice de purge (5) à la base du segment. L'orifice de remplissage (3) est équipé d'un raccord pour tuyau à eau de pompier. La paroi (2) du segment est faite d'un tissu à armure toile enduit des deux côtés par un composé élastomère à base d'un mélange d'EPDM (terpolymère d'éthylène-propylène-diène) et de caoutchouc butadiène-styrène.

2. Un segment de barrage anti-inondation selon l'exigence 1 pour lequel la paroi (2) est équipée de parties fixes de liaison comportant des anneaux métalliques (6) aux extrémités. 5
3. Un segment de barrage anti-inondation selon l'exigence 1 dont la paroi (2) est équipée d'au moins quatre poignées de transport (8).
4. Un segment de barrage anti-inondation comme décrit dans l'exigence 1, **caractérisé par** un tissu à armure toile présente une résistance à la tension, déterminée sur un spécimen de taille 50 x 200 mm, allant de 1,800 N à 2,300 N dans la direction de la chaîne et allant de 2,000 N à 2,300 N dans la direction de la trame. 10 15
5. Un segment de barrage anti-inondation comme décrit dans l'exigence 4 pour lequel le tissu à armure toile est un tissu en polyester dont la masse par unité de surface est de $140 \text{ g/cm}^2 \pm 10\%$. 20
6. Un segment de barrage anti-inondation comme décrit dans l'exigence 1 pour lequel le composé à base d'EPDM (terpolymère d'éthylène propylène diène) et de caoutchouc butadiène styrène compris dans l'enduction de la paroi (2) présente une résistance à la tension d'au moins 10 MPa, une elongation à la rupture d'au moins 400%, une compression rémanente de 50% au maximum, une résistance à des températures faibles allant jusqu'à -25 °C et à des températures élevées allant jusqu'à 70 °C. 25 30
7. Un segment de barrage anti-inondation comme décrit dans l'exigence 1 est **caractérisé par** une épaisseur de l'enduction élastomère des parois (2) de 1.2 à 1.4 mm. 35

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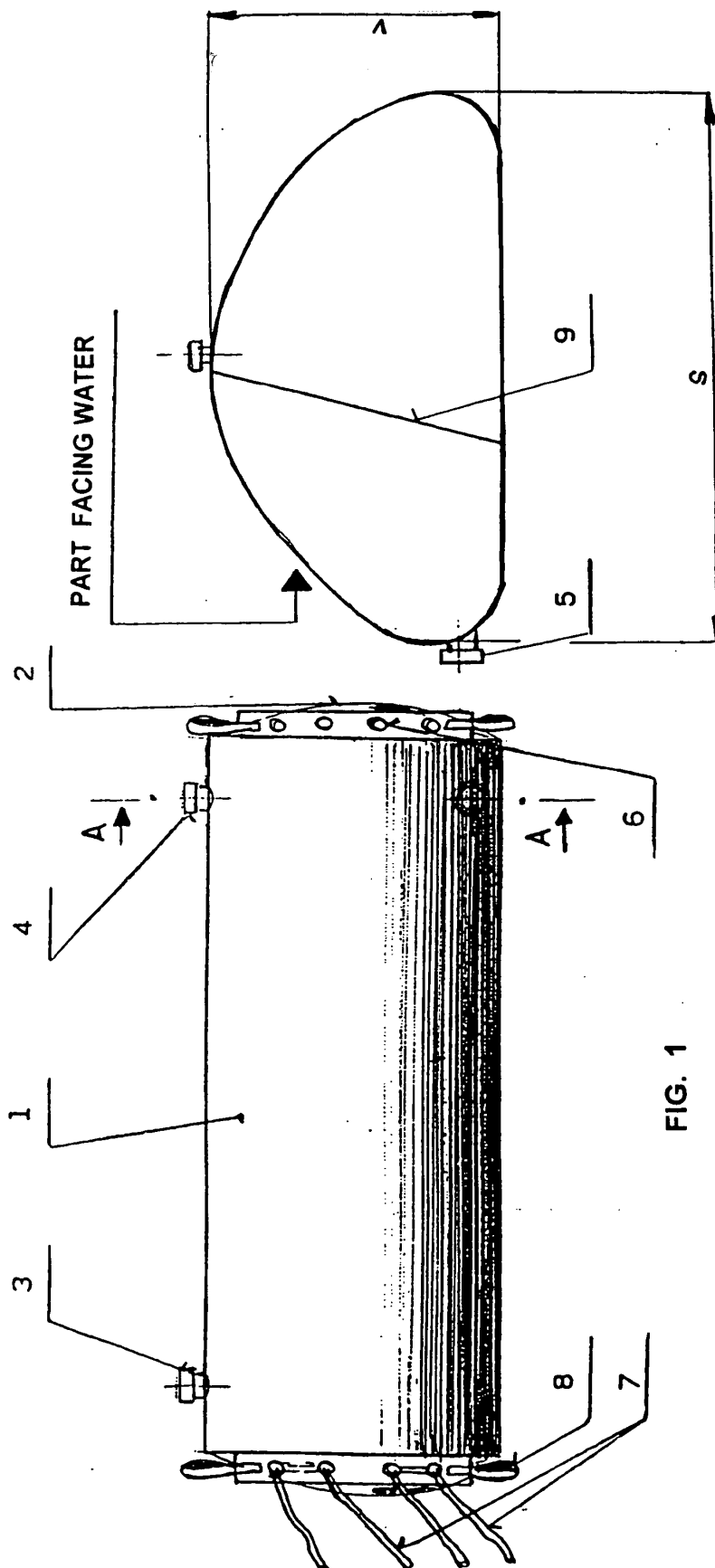


FIG. 2

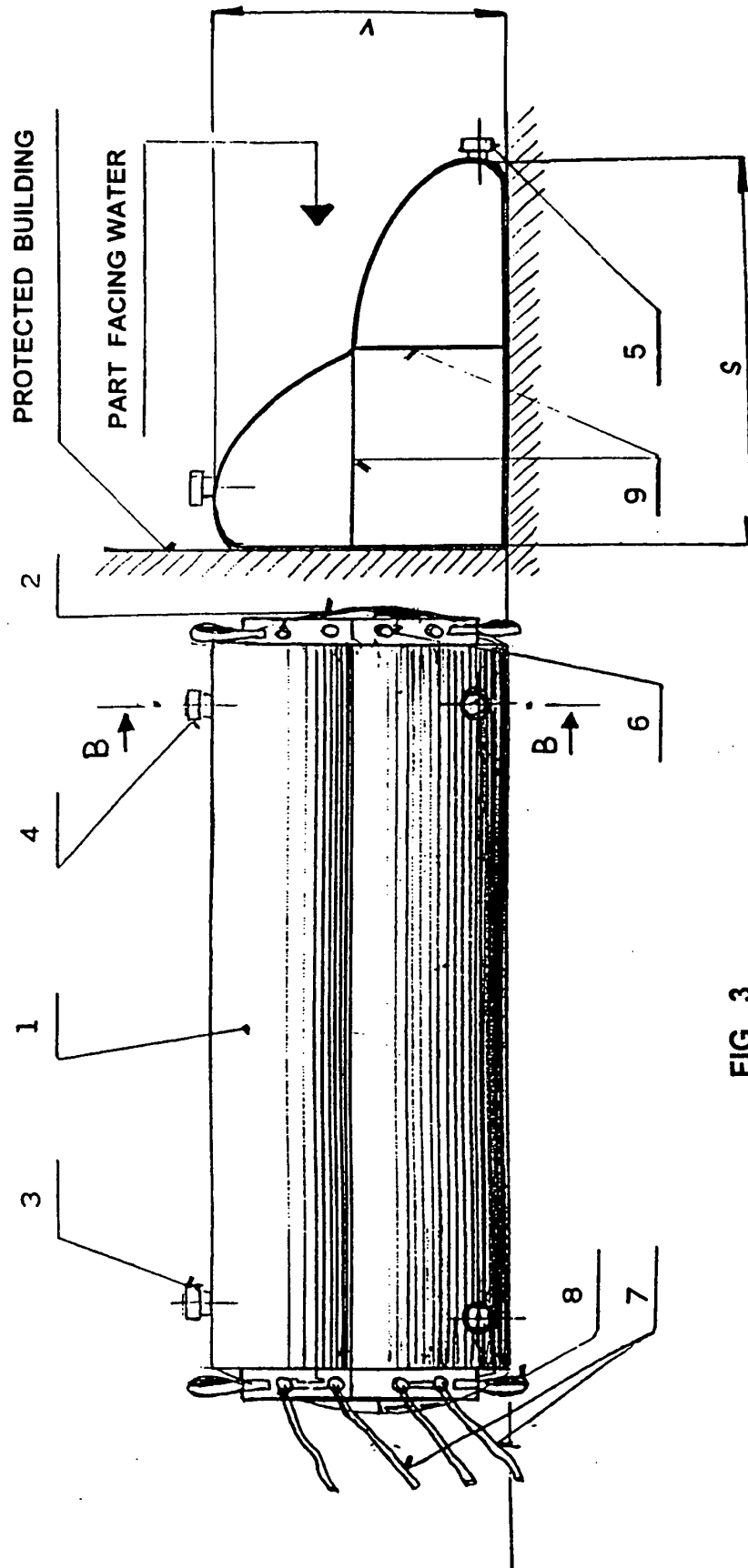


FIG. 4