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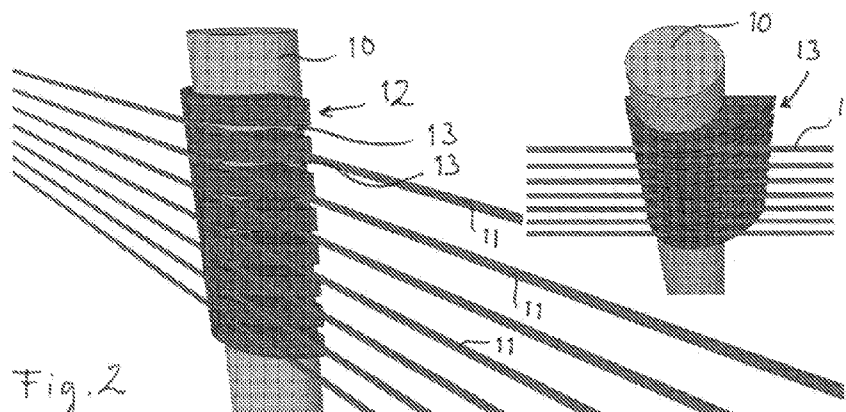
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DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
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(57) Abstract: The invention relates to a fender for use in a waterway, comprising posts that are connected to the waterway's bottom and guides that are connected to said posts and extending there between. Said guides comprise pre-stressed tensioning members. Suitable tensioning members may comprise cables, chains and bars. The construction is put under tensile load which reduces use of material in comparison to presently applied fenders. The construction is flexible.



Fender

5 The present invention relates to a fender according to the preamble of claim 1.

Such a fender is known in the art and is used as braking and guiding device. Fenders are applied at lock entrances, for allowing ships that are going to cross said lock, to fend and, option-
10 ally, to moor. A fender usually is part of a locking structure. Said structure comprises, as viewed from the lock, a locking entrance, and positioned before said entrance a guiding structure having a converging shape towards the locking entrance. The end of the guiding structure, positioned away from the locking entrance,
15 connects to the actual fender. Said fender usually consists of poles that are ground in the waterway's bottom, to which are connected horizontal guiding members. Ships are allowed to moor against said guiding members before they are allowed to enter the lock. Also, horizontal guiding members are used for slowing down
20 ships. Said guiding members usually are comprised of tubes or the like having a required strength and stiffness, a vertical frame comprising wood fender being connected thereto. Ships and vessels contact said wood fender by sailing or by mooring against it. As a consequence, high forces are applied on said fender.

25 A fender is of heavy construction and requires a large amount of material.

The present invention aims at providing an improved fender of the kind mentioned in the preamble.

30 The invention especially aims at providing a fender as mentioned above that has a lower weight.

The invention also aims at providing a fender that is comprised of less material.

The invention also aims at providing a fender that can be manufactured and located.

35 The invention especially aims at providing a fender that requires less maintenance and that can be carried out at lower costs.

The invention further aims at providing a fender that has less environmental impact.

So as to achieve at least one of the above mentioned goals, according to a first embodiment the invention provides a fender
5 comprising the features of claim 1. This fender had the advantage that it is made up of a smaller amount of material than the fenders used hitherto. As a result, the manufacturing costs are considerably less than that of the present fenders. Also, maintenance can be carried out more easily because it is possible to use mate-
10 rial that is less, or not at all, susceptible to weathering.

So as to prevent a ship contacting the tensioning members at a position said members are guided along the posts, cable guides comprising a recess for receiving a tensioning member have been provided at an outside surface of said posts, such that said re-
15 cess is deeper than the thickness of said tensioning member. Hence, the ship will contact the cable guide at the location of the post and the tensioning member will not be damaged.

In this respect, reference is made to JP60-144408 describing a buffer facility for underwater structure. The use of such con-
20 struction as a fender is not foreseen. Said structure is aimed at keeping away vessels by reversing impact forces and having the vessel move away from said buffer facility.

Furthermore, DE1024441 relates to a shock absorber for keeping away vessels. To this end, vertical ropes are positioned below
25 a quay. Said ropes protect the quay from impact forces. The ropes cannot serve as guiding members for vessels, ships and the like.

Finally, DE2158991 relates to a construction of a mooring construction for moving along with the water level.

Preferably, the tensioning members comprise at least one of
30 cables, beams and chains. Such construction elements can easily be constructed such that they have a life span of at least 50 years in corrosive conditions, like in or near the sea.

Hereafter, for ease of understanding, reference will be made to cables whereas tensioning members in general are meant. The in-
35 vention and the description are, however, in no way limited to the use of cables. The use or application of beams and tension members, as well as any other construction member that can be placed

under tensile load and that is suitable for use in the present invention, is covered by the scope of protection of the present invention.

In the present description, the term "cable" relates to a
5 construction element that has a larger length than thickness, especially a length that is sufficient for bridging the distance between two posts and having a thickness of maximally 10 cm, preferably maximally 7 cm. For example, both flexible cables, build up from strands and rods that are comprised of a single element and
10 combinations of elements, like chains, are comprised by the term "cable".

It has shown that the goals mentioned above are especially obtained because the construction members of the fender according to the present invention which take up the loads are substantially
15 put under tensile load. Tensile loaded members appear to have a substantially higher power- and load density than members that are put under bend load, as is general practice in fenders.

It has also shown that the present invention provides a more efficient braking (also called deceleration or slowing down) of
20 vessels than the present fenders. Such synergetic result is completely unexpected.

The cables can be provided with some strain, which as a consequence has the effect that the fender will bend less when contacted by a vessel. As is general practice in the art, the posts
25 may be flexible as well.

A fender that can be controlled and computed easily is obtained when said tensioning members extend in a horizontal direction and wherein said fender comprises a multiplicity of tensioning members at a mutually vertical distance of each other. In a
30 characterizing way, the most upper and most lower cable are positioned at a mutual distance of about 2.50 meter. The distance of the cables is preferably not larger than 0.50 meter, For example maximally 0.40 meter, so as to provide a sufficient degree of safety when a vessel only contacts the lower cables and the cables
35 that are positioned higher brush along the deck of the vessel. The distance between the cables is also determined by the class of vessel that will make use of the fender and, for that reason, may

vary widely. Also, the mutual distance will be made dependent on the fact whether the fender will be applied in a tidal environment. The fact if the fender will be applied as a floating body may also influence the distance and number of cables. The number
5 of cables is preferably at least six, more preferably at least eight.

The brushing along the deck of the cables, as mentioned above, can be prevented efficiently by mutually coupling said cables by means of stiffening members. This way, the mutual distance
10 of the cables can be kept substantially constant when a vessel touches and actually displaces only a few cables.

An especially effective operation is obtained when said stiffening members extend in a direction perpendicular to the cables. When the cables extend in a horizontal direction, said
15 stiffening members extend in a vertical direction.

It has furthermore shown that it may be advisable for the stiffening members to be positioned in a relative diagonal instead of perpendicular relationship with respect to the cables. Since the cables extend in a horizontal direction, the stiffening mem-
20 bers then extend in a diagonal direction.

The fender is positioned at a side of the waterway and has an approach side where vessels (or ships or the like) are located and a rear side positioned remotely from said approach side. As a consequence, said approach side is positioned (located) at the side
25 of the ships to be fended and moored. Preferably, the fender comprises a cover at the approach side. This ensures a protection of the cables which excludes wear and tear of said cables. The cover can be easily designed such that a life span at intended use of at least 50 years is obtained.

30 An especially effective protection is obtained wherein said cover is connected to said tensioning members.

It is furthermore preferred for the stiffening members and the cover to be mutually connected. For example, the stiffening members may be connected to the rear side of said cables whereas
35 the cover may be connected at the approach side. Locking said cables between the stiffening members and the cover, preferably by means of a clamping coupling, provides a construction that effi-

ciently transfers a force, exerted by a vessel on a few cables, to neighbouring cables.

Within the scope of the present invention, stiffening members may be connected diagonally to the cables, for example starting at
5 a lower most cable near a first post to an upper most cable at a subsequent post, said stiffening member being connected to each intermediate cable. Depending on the required stiffness further stiffening members may be connected to said cables in parallel to said first stiffening member. Preferably, said stiffening members
10 may be somewhat elastic. These stiffening members are tensile loaded as well.

For being able to accurately calculate the fender's stiffness, it is preferred for said posts to have been grounded in the waterway's bottom or to have been connected to foundation in the
15 waterway's bottom. This way, the posts have an exact defined position and as a consequence, any relocation or bending of said posts when being contacted by a vessel can be calculated easily.

When a fender is located in a waterway experiencing water level changes, it may be preferable for the posts to be connected
20 to foundation poles grounded in the waterway's bottom in a vertically movable fashion. For example, said posts, or more in particular the complete fender, may be maintained at a desired position with respect to the water level by connecting same to floaters. Also the posts, or similarly the complete fender, may be relocated
25 in an activated way, for example hydraulically or mechanically/electrically, so as to bring them in a desired position, depending on the water level.

The stiffening members may be comprised of beams, poles or cables. As a consequence, a relatively small construction can be
30 obtained. The stiffening members may be manufactured from synthetic resin, optionally comprising an internal reinforcement so as to obtain a desired stiffness.

The stiffening members also may be comprised of sheet-like, optionally laminated, members which yields an improved stiffness
35 across a larger surface of said cables.

Slowing down a vessel to some degree and maintaining a constant tension in the cables, independent the number of cables that

are contacted by said vessel and independent of the velocity said vessels impacts the fender, it is preferred for the fender to comprise a tensioning member for pre-stressing at least one tensioning member. When the vessel contacts the cable and relocates same, 5 the pre-stress value will be maintained constant, independent the extent to which the vessel relocates the cable.

It is especially preferred for the tensioning member to apply a continuous force on all cables.

A simple device can be obtained wherein said tensioning member 10 is comprised of a hydraulic, pneumatic or mechanic system.

The invention will now be explained further by means of a drawing. The drawing shows in:

Fig. 1 a schematic top view of a locking structure comprising a fender,

15 Fig. 2 a schematic view of guiding a cable along a post,

Fig. 3 an example of a tensioning member,

Fig. 4 a schematic view of the application of a stiffening member,

20 Fig. 5 a view of a cover in combination with a stiffening member, and

Fig. 6 a detailed view of a coupling of a cover and a stiffening member to a cable.

In the figures the same features have been denoted by the same reference numerals. However, for ease of understanding, not 25 all parts that are necessary for a practical embodiment of the fender according to the invention have been shown.

Fig. 1 shows a schematic top view of a locking structure 1 comprising two fenders 2. A lock 3 comprises lock entrances 4 extending away from said lock 3. Guiding structure 5 connects to 30 said lock entrance 4. In the embodiment as shown in Fig. 1, said guiding structure 5 is embodied as a number of posts 7 grounded in the waterway's bottom. Vessels that are to use lock 3 are guided both visually and physically by guiding structure 5 and locking entrance 4.

35 At the end of the guiding structures 5, directed away from the lock 3, a fender 2 connects. Said fender 2 extends between two terminal posts 8, 9. Between said terminal posts 8, 9 intermediate

posts 10 have been provided. Said terminal posts 8, 9 are stiff, whereas said intermediate posts 10 are somewhat flexible.

Between said terminal posts 8, 9 intermediate posts 10 have been provided and connected thereto a guide 11 has been provided. In the embodiment according to the present invention, this guide 11 is comprised of a series of cables 11 extending between said terminal posts, as shown in Fig. 2.

Fig. 2 shows a detailed view of cables 11 and more in particular the way guiding these along the intermediate posts 10. The intermediate posts 10, in Fig. 2 only a single intermediate post 10 has been shown, comprise a guiding member 12 connected to a post 10, said guiding member comprising at its outer circumferential surface a recess 13 in which cable 11 is received. The depth of this recess 13 is larger than the thickness of cable 11, such that cable 11 entirely fits within said recess 13. The cable guide 12 will ensure that there is no physical contact between said cable 11 and said ship when a ship contacts said cable guide 12, and as a consequence the cable will not be damaged by said ship and said intermediate post 10. Preferably, said cable 11 has been coupled in said recess in a clamping manner, so as to ensure the cable will not be able to leave said recess.

The view according to Fig. 2 is seen from terminal post 8 towards terminal post 9, that is a ship's sailing direction. The guide 12 outer surface's radius is, at the side of terminal post 8 larger than at the other side of said intermediate post 10. This ensures that an approaching ship that contacts cable 11, is moved away from post 10 towards the approaching side and will not end up at the rear side of said post 10. The enlarged radius furthermore ensures a limited bending of said cable 11 and prohibits defects. Cable 11 may move within said recess 13 in a longitudinal direction.

Fig. 3 shows an example of a tensioning member 14. Said tensioning member 14 provides a pre-tension on said cables 11. A weight 15 hangs from a lifting beam 16 that hinges around a pivot point that has been provided on terminal post 9. To a said lifting beam 16 a balance beam 18 has been rotatably or pivotally connected through a pivot point 20. To said balance beam 18 cables 11

have been connected. Tensioning member 14 ensures continuous pre-tensioning of said cables 11.

A ship contacting and displacing one or more cable 11, will have the pre-tensioning member 14 to rotate around axis 17 so as to have said cables move in the direction of arrow 20. Since all cables 11 are connected to beam 18, all cables will be displaced and moved, also if the ship only contacts one or a few cables, for example only the lower most cables.

The force exerted on the ship will increase with increasing displacement of cables 11 (and displacement of said (intermediate) posts 10) forming part of fender 2. Such also applies for the fenders presently applied in the art. What counts is that the force exerted on the cables does not exceed a maximally allowed value when a ship contacts the cables. This is obtained by applying a counter weight 15 combined with a balancing arm or lifting beam 16. Applying a tensioning force on cables 11 can also be obtained by a hydraulic cylinder on each cable, wherein all cylinders are connected to common rail system, but such yields an expensive system. An airbag, provided below water level, may be applied as well.

So as to ensure that the cables the ship does not contact, will be displaced as well, together with the cables that are contacted by said ship, a stiffening member 21 is provided. Fig. 4 shows a schematic view. Said stiffening member 21 is comprised of a member 22, connecting said cables 11. Said stiffening member 22 keeps together said cables 11, and as a consequence people or objects present on deck of said ship, will not be touched by said cables 11.

Fig. 5 and Fig. 6 both show further detailed views of examples of a set of cables 11, mutually connected by a stiffening member 11. A cover 24 for cables 11 has been provided as well. By providing such cover, a ship contacting the fender will not actually contact said cables 11 which might induce damage to said cables 11 by means of shear or deformation. Said cover 24 will have direct contact with said ship and guide same, as shown in Fig. 5 and Fig. 6. Said stiffening members 22 provide for an equal displacement of all cables 11.

As shown in Fig. 6 cable 11 is taken up by stiffening member 22 and cover 24. Cable 11 is clamped between said both parts. Said connection of guide 24 to member 22 is obtained by clamps, for example bolts 25 and nuts 26. For allowing the stiffness of said
5 stiffening members 22 to be adjusted, anchors 27 may be provided in members 22. By varying the number of anchors or the kind of material thereof, the required stiffness may be obtained. As mentioned above, elastic stiffening members may be coupled diagonally alongside cables 11 as well.

10 The pre-tensioning member provides a further equalisation of the force exerted on cables 11. The mechanical pre-tensioning member shown in Fig. 3 yields and, as a consequence, will exert a continuous force on said cables, irrespective of the degree of displacement by a ship. Optionally, a hydraulic or electro/-
15 mechanical system may be used for exerting a continuous force on said cables, irrespective of the degree of displacement of said cables by a ship.

Finally, fig. 7 shows a side view of a part of fender 2, comprising a post 10, as well as the cover 24 and a stiffening member
20 22. The water level has been identified as well. Arrows A-A denote the direction of the view according to Fig. 8. Fender 2 comprises a cover 24 and stiffening members 22 that have been connected to post 10 by means of a construction 28. For mooring a ship, mooring bollards 29 have been provided. Also, a floating tube 20 has been
25 shown, comprising a floater 31 that ensures the construction to float and maintain a horizontal positioning, as shown in Fig. 7. In Fig. 8, a footbridge 32 has been shown as well, floating on the water level.

The invention is not limited to the embodiments as described
30 above and as shown in the drawing. The invention is limited by the claims only.

The invention also embodies any combination of features and steps that have been mentioned above independently of each other.

C L A I M S

1. A fender for use in a waterway, comprising posts that are connected to the waterway's bottom and guides that are connected to said posts and extending there between, wherein said guides comprise pre-stressed tensioning members, **characterized in that** said
5 posts comprise cable guides at an outer surface thereof, said cable guides comprising a recess for receiving a tensioning member, such that said recess' depth is larger than the tensioning member's thickness.
- 10 2. A fender according to claim 1, wherein said posts are flexible.
3. A fender according to claim 1 or 2, wherein said tensioning members extend in a horizontal direction and wherein said fender comprises a multiplicity of tensioning members at a mutually vertical
15 tical distance of each other.
4. A fender according to claim 1, 2 or 3, wherein said tensioning members are mutually connected by means of stiffening members that have been connected to said tensioning members.
- 20 5. A fender according to claim 4, wherein said stiffening members extend in a vertical or diagonal direction.
6. A fender according to any of the preceding claims, wherein said
25 fender comprises an approach side positioned at the side of the ship to be fended, and wherein said fender comprises a cover at the approach side.
7. A fender according to claim 6, wherein said cover is connected
30 to said tensioning members.
8. A fender according to any of the preceding claims, wherein said stiffening members and said cover have been mutually connected.
- 35 9. A fender according to any of the preceding claims, wherein said

posts have been grounded in the waterway's bottom.

10. A fender according to any of the preceding claims, said posts
being connected to foundation poles grounded in the waterway's
5 bottom in a vertically movable fashion.

11. A fender according to any of the preceding claims, wherein
said stiffening members are comprised of beams, poles or cables.

10 12. A fender according to any of the preceding claims, wherein
said stiffening members are comprised of sheet-like or laminated
members.

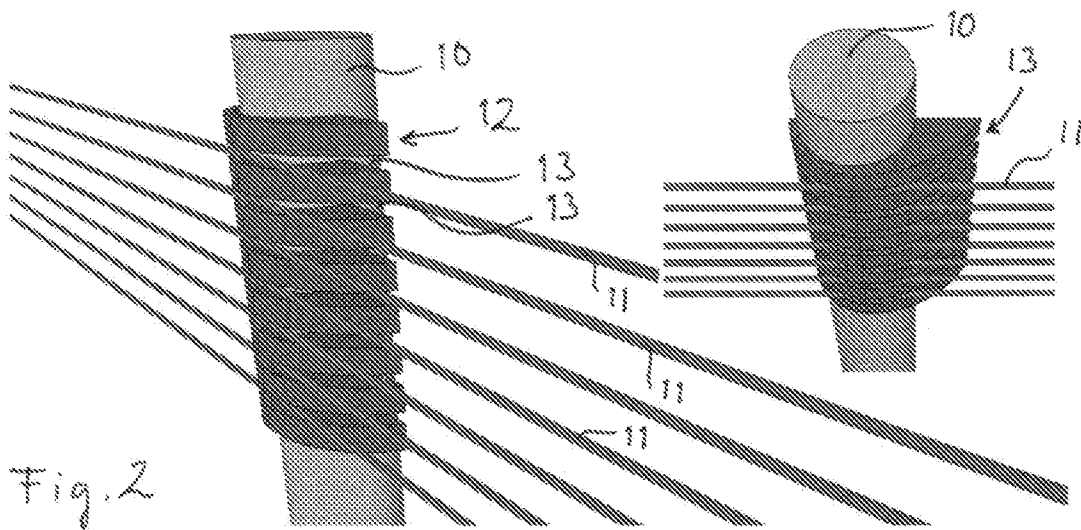
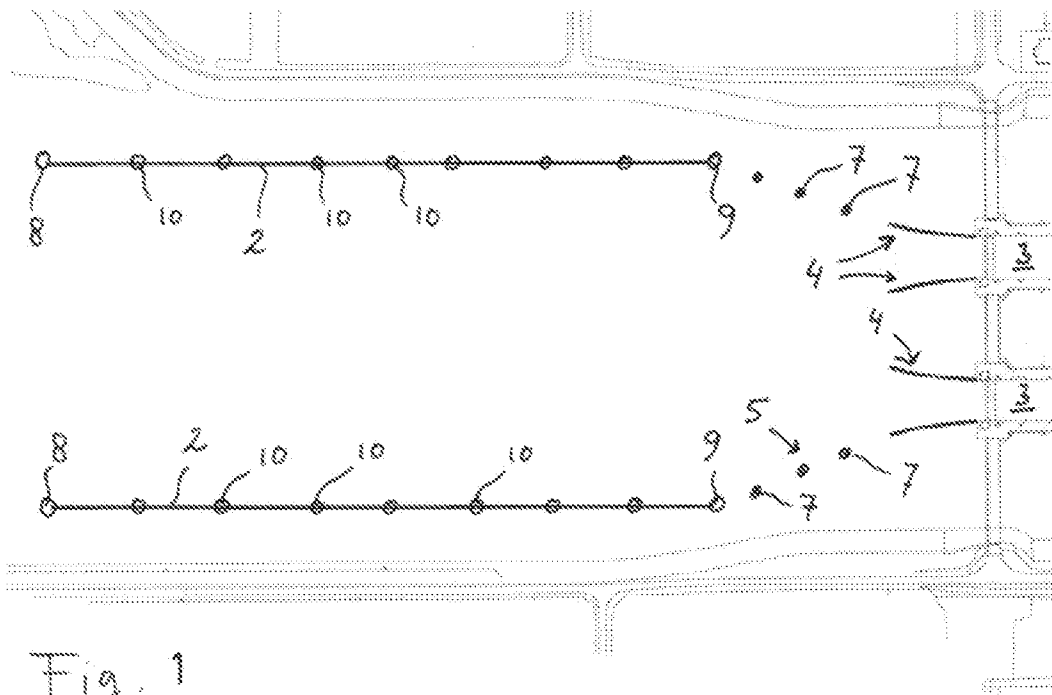
13. A fender according to any of the preceding claims, comprising
15 a tensioning member for pre-stressing at least one tensioning mem-
ber.

14. A fender according to any of the preceding claims, wherein
said tensioning member applies a continuous force on all tension-
20 ing members.

15. A fender according to any of the preceding claims, wherein
said tensioning member is comprised of a hydraulic, pneumatic or
mechanic system.

25

16. A fender according to any of the preceding claims, said ten-
sioning members comprising at least one of cables, beams or
chains.



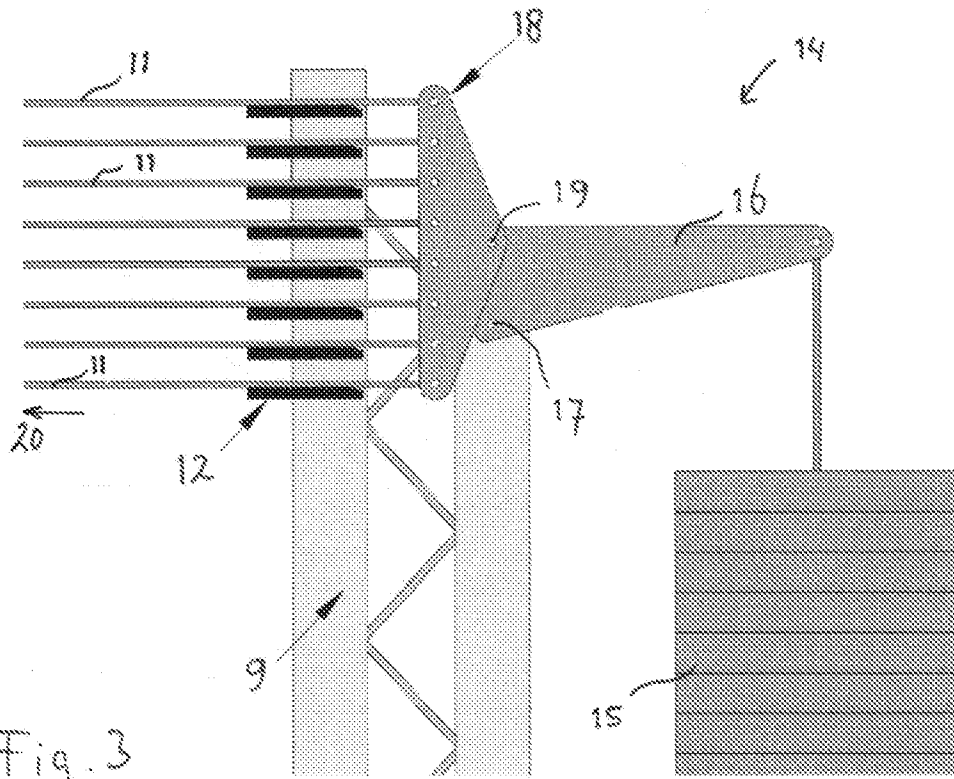


Fig. 3

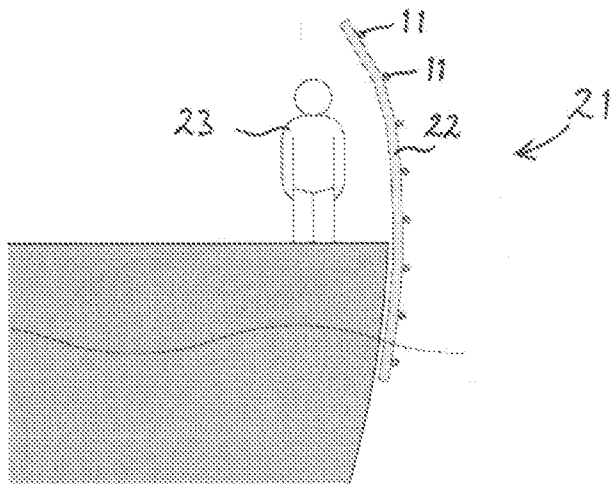


Fig. 4

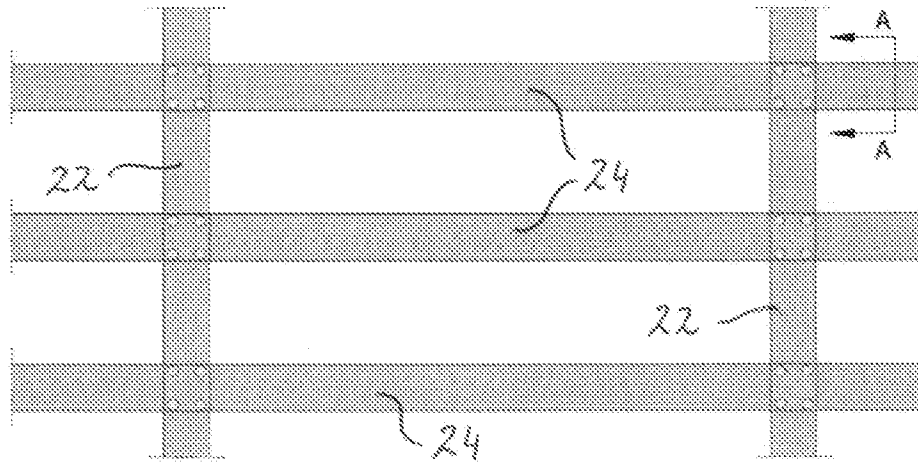


Fig. 5

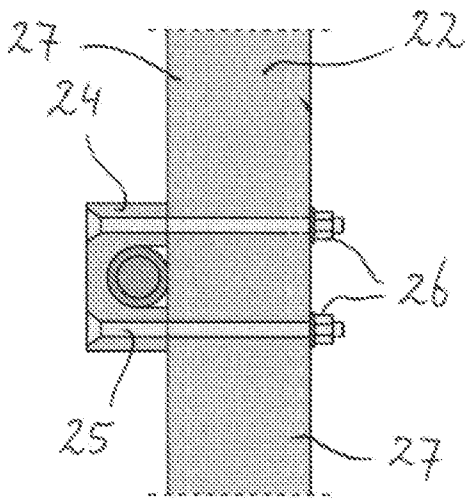


Fig. 6

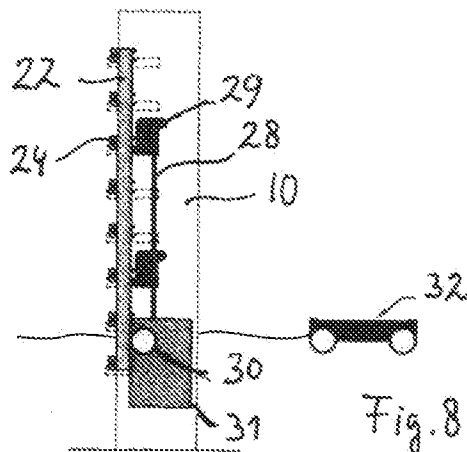


Fig. 8

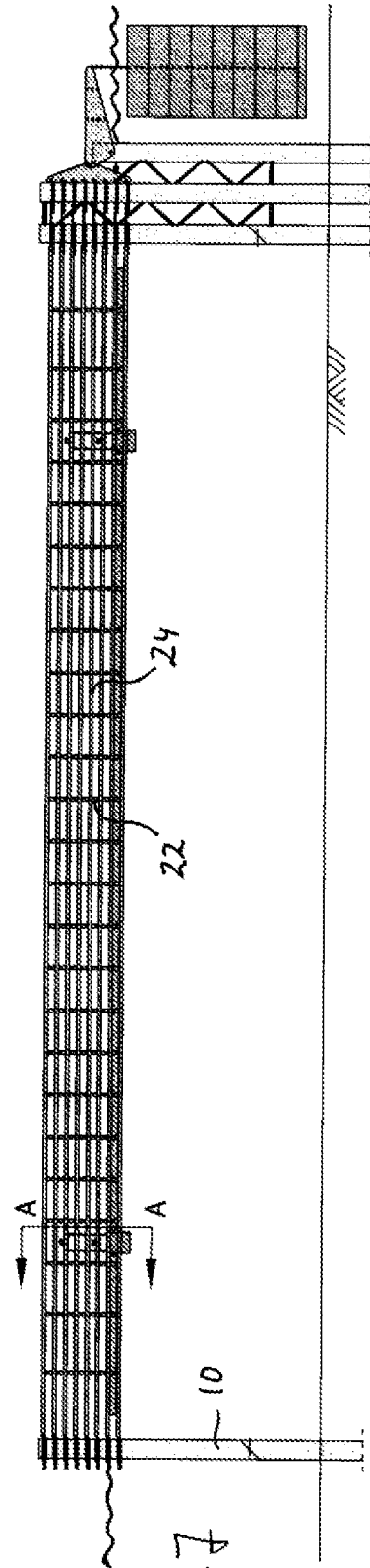


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2013/050478

A. CLASSIFICATION OF SUBJECT MATTER
 INV. E02B3/26
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 E02B F41H E02C E04H E01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP S57 147324 U (N/A) 16 September 1982 (1982-09-16) figures -----	1-16
X	JP H08 20932 A (MITSUBISHI HEAVY IND LTD) 23 January 1996 (1996-01-23) abstract; figures -----	1-16
X	GB 1 540 042 A (SEA TANK CO) 7 February 1979 (1979-02-07) page 2, line 87 - line 115; figure 5 -----	1,6,7,9, 10,13-16
A	US 3 975 916 A (WATSON BERT E) 24 August 1976 (1976-08-24) abstract; figures 1-2 -----	1
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>
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Date of the actual completion of the international search 27 September 2013	Date of mailing of the international search report 04/10/2013
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Lieber, Gabor
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INTERNATIONAL SEARCH REPORT

International application No

PCT/NL2013/050478

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 101 761 055 A (CHINA MERCHANTS CHONGQING COMM CHINA MERCHANTS CHONGQING COMM RES & DE) 30 June 2010 (2010-06-30) abstract; figures 1-2 -----	1-16
A	US 602 444 A (JAMES F. HAFNEY) 19 April 1898 (1898-04-19) the whole document -----	4,5,11, 12
X	JP S60 144408 A (HONSHU SHIKOKU RENRAKUKIYOU KO; YOKOHAMA RUBBER CO LTD) 30 July 1985 (1985-07-30) cited in the application abstract; figures -----	1-16
X	JP S63 96330 A (BRIDGESTONE CORP) 27 April 1988 (1988-04-27) abstract; figures 1-4 -----	1,3,6,7, 13-16
X	JP S57 147325 U (N/A) 16 September 1982 (1982-09-16) figures -----	1,3, 13-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/NL2013/050478

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
JP S57147324	U	16-09-1982	JP S6227529 Y2 JP S57147324 U	15-07-1987 16-09-1982

JP H0820932	A	23-01-1996	NONE	

GB 1540042	A	07-02-1979	FR 2358512 A1 GB 1540042 A	10-02-1978 07-02-1979

US 3975916	A	24-08-1976	NONE	

CN 101761055	A	30-06-2010	NONE	

US 602444	A	19-04-1898	NONE	

JP S60144408	A	30-07-1985	JP H0313363 B2 JP S60144408 A	22-02-1991 30-07-1985

JP S6396330	A	27-04-1988	NONE	

JP S57147325	U	16-09-1982	JP S602265 Y2 JP S57147325 U	22-01-1985 16-09-1982
