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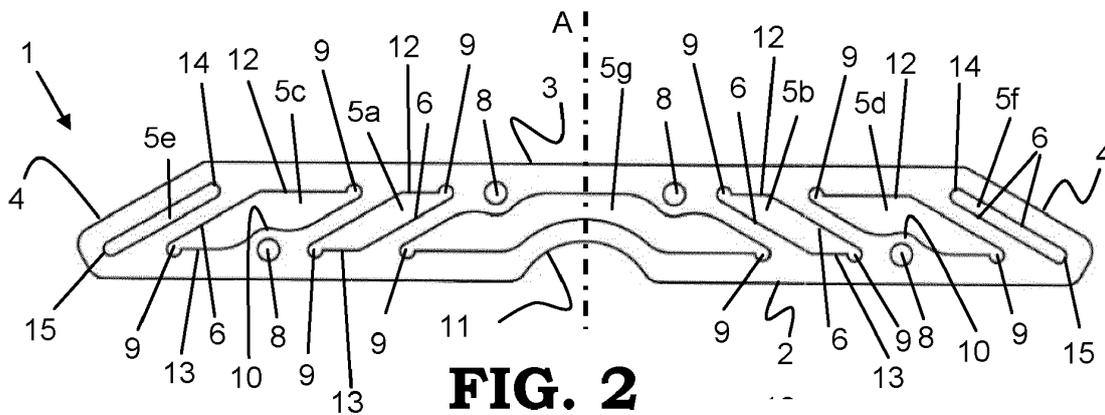
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(54) **Marine fender**

(57) The invention relates to a marine fender (1) which is designed to be removably suspended from a marine structure or a vessel by means of one or more lines and/or ropes, in which the fender (1) is provided with an inner and an outer continuous wall (2, 3) and one or more cavities (5a - 5g), in which the fender (1) comprises two closed outer side walls (4) which are arranged at an angle to the longitudinal direction of the fender (1)

and which each connect the inner wall (2) to the outer wall (3) and each delimit at least one closed cavity, and the inner wall (2) comprises an indentation which is configured in such a way that the outer side walls (4) and/or the intermediate side walls (6) which are arranged at an angle to the inner and outer wall (2) are prevented from bending and/or the fender is prevented from tearing if it is being compressed.



**FIG. 2**

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## Description

**[0001]** The invention relates to a marine fender which is designed to be removably suspended from a marine structure, such as a quay, a floating pontoon, a lock, etc., or a vessel by means of one or more lines and/or ropes.

**[0002]** The invention relates more specifically to such a marine fender which is provided with an inner continuous wall which is configured to rest at least partly against a wall of the marine structure or the vessel in the position of use of the fender and an outer continuous wall which is integral with the inner wall and is situated opposite the inner wall, and which is configured to rest at least partly against a wall of the vessel or the marine structure in the position of use of the fender. Furthermore, the fender comprises one or more cavities which are delimited laterally thereof by

- two outer side walls which are arranged at an angle to the longitudinal direction of the fender and which each connect the inner wall to the outer wall; or
- one outer side wall and one intermediate side wall arranged at an angle to the inner and outer wall; or
- two intermediate side walls.

**[0003]** Until now, car tyres have usually been used as buffers for vessels or marine structures. However, the use thereof is generally prohibited by law. A significant drawback of car tyres is that they sink and are a nuisance to vessels or locks, etc.

**[0004]** On the other hand, floating pieces of wood are used as buffers. However, the problem with these is that they are susceptible to splitting and they consequently have a short service life. In addition, they have to be wet for optimum performance.

**[0005]** Another solution is the use of fenders. Fenders are used for most types of ships to protect the ship and quayside, lock or another ship during mooring. Fenders are often left suspended, even when the vessel is not moving.

**[0006]** An example of such a fender is the fender which is marketed under the name "Tip-top fender", as illustrated in Figure 1. This fender (1) consists of an elongate body which is made from a resilient material. The elongate body in this case comprises an inner wall (2) and an outer wall (3) which are connected to each other, which are straight and which run parallel opposite one another. The Tip-top fender (1) has two open ends (5y) in its longitudinal direction. A drawback of this Tip-top fender is that these open ends (5y) always have to be directed towards the vessel in order to prevent the fender (1) from sticking or getting stuck to a part of a marine structure or a vessel. If these fenders (1) stick or get stuck, they will develop tears.

**[0007]** Another type of fenders which is to be attached to a marine structure is described, inter alia, in US 7,527,454 and US 3,949,697.

**[0008]** The fender as described in US 7,527,454 com-

prises an elongate body made from a resilient material of indeterminate length. This body is composed of a basal wall for installing the elongate body on the marine structure, in which case this basal wall has a basal installation surface which is dimensioned and designed to rest against the marine structure. Furthermore, this body comprises an outer wall which is integral with the basal wall, in which case transverse spaced-apart profiles are fitted between the outer and the basal wall. The outer wall extends laterally away from the basal wall in order to form an inner space between the outer and the basal wall. In this case, at least a part of the outer wall follows a circumferential configuration which is curved outwards. In this case, the inner space makes an inwardly directed curvature of the outer wall in response to the collision forces which are exerted on this outer wall. Furthermore, a web is provided inside the inner space and is integral with the basal wall and the outer wall. This web has a generally M-shaped lateral cross section. In this case, this M-shaped lateral cross section is composed of:

- a pair of lateral legs which are spaced apart transversely, with each leg extending laterally between a basal end which is integral with the basal wall and an apical end which is integral with the outer wall;
- an intermediary arm which extends from each apical end towards the basal wall, between the lateral legs, with each intermediary arm extending at an angle towards a corresponding lateral leg, so that the intermediary arm converges towards and is integrated with the basal wall intermediary the lateral legs.

**[0009]** In this case, this web forms an integrally reinforcing, energy-absorbing and energy-dissipating structure with an interior space for protection against damage by collision forces exerted on the outer wall.

**[0010]** US 3,949,697 describes such a marine fender assembly comprising first, second and third shock-absorbing parts and first, second and third supporting parts which are integral with these shock-absorbing parts.

**[0011]** The main drawback of the above-described fenders is that they have to be fastened to a marine structure, or optionally to a vessel, as a result of which a greater degree of installation is required and there is less flexibility regarding its use, both with respect to the marine structure itself, as such a fender cannot be moved from one marine structure to another in a simple manner, and with respect to the height which cannot be set in a simple manner in order to compensate for differences in height between vessels and differences in height between marine structures and vessels, for example due to the tides.

**[0012]** US 5,671,692 describes a buffer for a boat which is constructed specifically to provide protection where this is required for low freeboard boats with a minimum of rolling. This buffer comprises a substantially cylindrical body which is provided with first and second ends and a longitudinal axis. Furthermore, this buffer is provided with an ear portion which is integral with the body,

on its first end. This ear portion makes an angle of between 45 and 100 degrees, for example 90 degrees, with respect to the longitudinal axis. Both the body and the ear portion are made from a resilient material, for example a resilient plastic and are typically of a hollow design. The ear portion is provided with an opening which is sufficiently large to pass a rope through it in order to attach the buffer to a cleat or support on a boat or a quay. The contoured area between the ear portion and the body approximately corresponds to the gunwale of the low freeboard boat. The buffer may be attached to a boat or to a quay in order to protect the boat against hitting the quay.

**[0013]** The drawback of these buffers is that they can only be attached to the vessel or the marine structure at one point (e.g. with one line or rope), as a result of which these buffers will be displaced rather than compressed if the ship hits the quay, as a result of which the collisions are absorbed to a lesser degree and the ships and marine structures in question are less well protected and the buffers and ropes in question wear more quickly.

**[0014]** WO 9117320 describes a shock-absorbing device which is more specifically used as a marine buffer. This shock-absorbing device consists substantially of a polyurethane structure which is provided with a plurality of cavities in the outer surface of the device. The characteristics of the polyurethane material vary in layers between the outer and the inner surface of the device, with the hardest material being situated on the outer and the inner surface of the device, while a softer material is arranged between these surfaces.

**[0015]** Due to the fact that the outer surface comprises a large number of cavities, there is a significant risk that this buffer will become stuck to parts of marine structures or vessels. In addition, with these buffers, the rope which serves to attach the buffer to the vessel or the marine structure has to be passed through the central opening in the buffer, as a result of which the buffer will start to slide on the rope upon impact and will thus provide less protection.

**[0016]** A further drawback of the buffer as described in WO 9117320 is the fact that the outer side walls of the buffer are at right angles to the longitudinal direction, as a result of which this buffer runs a greater risk of becoming stuck in the direction of travel.

**[0017]** Consequently, there is a need for a marine fender in which the risk of it becoming damaged and/or largely losing its functionality by getting stuck or becoming caught behind a part of a marine structure or a vessel is reduced or even prevented completely.

**[0018]** To this end, the invention provides a marine fender according to the preamble of Claim 1, in which

- the outer side walls are closed and each delimit at least one closed cavity; and
- the inner wall comprises an indentation which is configured in such a way that the closed outer side walls and/or the intermediate side walls are prevented

from bending and/or the fender is prevented from tearing if it is being compressed.

**[0019]** Due to the fact that the outer side walls are closed and each delimit at least one closed cavity, it is necessary to provide an indentation in the inner wall in order to absorb the stress forces which act on the fender when the fender is being compressed. This indentation will distribute the stress forces in the fender in a controlled manner over the inner wall and over the rest of the fender when the latter is being compressed, so that the outer side walls and/or the intermediate side walls do not bend and/or the fender does not tear when it is being compressed.

**[0020]** By ensuring that the outer side walls are closed and each delimit at least one closed cavity, it is impossible for the fender to become stuck at the location of these outer side walls or to get caught behind parts of marine structures or vessels, as a result of which the risk of tearing of the fender is significantly reduced. In this way, a fender is obtained which has a longer service life than the known fenders.

**[0021]** In an advantageous embodiment of a marine fender according to the invention, the transition between each of the closed outer side walls and the inner wall and each of the closed outer side walls and the outer wall is round.

**[0022]** This ensures that the risk of the fender becoming stuck to parts of marine structures or vessels is minimized still further.

**[0023]** An additional drawback of the known Tip-top fender (1) is the fact that the ropes to removably attach this fender (1) to the marine structure or to removably attach the fender (1) have to be passed through a number of closed intermediate cavities (5x). If the fender (1) gets caught by one of its open ends (5y) or both open ends (5y) behind something, it is possible that the lines and/or ropes and the fender (1) are subjected to additional tension, as a result of which the lines and/or ropes will tear through the closed intermediate cavities (5x). In addition, the lines and/or ropes will wear more quickly due to the fact that they are repeatedly flattened and chafe in the cavities.

**[0024]** In a preferred embodiment of a marine fender according to the invention, this drawback is solved by providing the fender with one or more openings which are designed specifically for passing the one or more lines and/or ropes through in order to suspend the fender from the marine structure or the vessel.

**[0025]** In this case, the openings are preferably evenly distributed with respect to the vertical and the longitudinal direction of the fender.

**[0026]** In a preferred embodiment of a marine fender according to the invention, the inner and outer walls are designed to be substantially straight.

**[0027]** This also ensures that the fender is prevented from becoming stuck behind an uneven structure in the quay or the vessel.

**[0028]** In an advantageous embodiment of a marine fender according to the invention, the inner and outer walls run substantially parallel with respect to each other.

**[0029]** In a preferred embodiment of a marine fender according to the invention, the fender is mainly elongate.

**[0030]** In a first possible embodiment of a fender according to the invention, the fender comprises one closed cavity which is delimited on either side by a respective closed outer side wall which is arranged at an angle to the longitudinal direction of the fender.

**[0031]** More preferably, the closed outer side walls face each other. Most preferably, the closed outer side walls from the inner wall to the outer wall face each other.

**[0032]** In a second possible embodiment of a fender according to the invention, the fender comprises two closed cavities which are at least partly arranged next to one another in the longitudinal direction of the fender and are of essentially equal height, in which each of the cavities is delimited by a respective closed outer side wall and the cavities are separated from each other by a partition which is delimited on both sides thereof by a respective closed cavity.

**[0033]** In a third possible embodiment of a fender according to the invention, the fender is provided with at least three closed cavities which are at least partly arranged next to one another in the longitudinal direction of the fender and essentially have the same height, in which these at least three closed cavities comprise at least two outer cavities and one or more intermediate closed cavities, which are situated between the outer closed cavities, in which

- the outer closed cavities are delimited by a closed outer side wall and one intermediate side wall; and
- the one or more intermediate closed cavities are delimited by two said intermediate side walls.

**[0034]** By providing the fender with at least three cavities, as described above, a fender of sufficient resilience and flexibility is obtained which offers sufficient protection to a vessel and/or a marine structure.

**[0035]** More preferably:

- if the fender comprises one intermediate closed cavity, the intermediate side walls which are at an angle to the longitudinal direction of the fender and laterally delimit the intermediate closed cavity face each other, preferably from the inner wall towards the outer wall, and
- if the fender comprises several intermediate closed cavities, the closed cavities are divided into a first section of closed cavities and a second section of closed cavities which are separated by a central intermediate closed cavity, with the intermediate side walls of the first section of the closed cavities facing the intermediate side walls of the second section of the closed cavities, preferably from the inner wall towards the outer wall, and the intermediate side

walls which delimit the central intermediate closed cavity face each other, preferably from the inner wall towards the outer wall.

5 **[0036]** Directing outer side walls and/or intermediate side walls to face each other, preferably from the inner wall to the outer wall, solves the problem which is associated with the fact that the Tip-top fender (1) comprises one row of oblique intermediate cavities (5x) which are

10 all arranged parallel to each other and which all run in the same direction. The drawback of this is the fact that these fenders (1) can be used only in one direction of travel, i.e. the direction in which the fenders (1) are compressed between the marine structure and the vessel.

15 After having been used for a certain time, such fenders (1) no longer return to their original shape. In addition, even if the fender (1) is removably attached in such a manner that the open ends (5y) face the ship, these parallel cavities (5x) also always have to point from the front, against the vessel, to the back, away from the vessel, in the direction of travel. However, in practice, many sailors or captains do not know this, resulting in damage to the fender (1), the vessel or the marine structure.

20 **[0037]** A fender having outer side walls and/or intermediate side walls facing each other, as described above, has the advantage that, if the fender is attached in the correct manner, i.e. with the inner wall against the vessel, such a fender can be used in two directions of travel. Moreover, such a fender is sufficiently resilient to offer resistance to collision forces which may act upon it, while simultaneously absorbing and dissipating the energy of these forces.

25 **[0038]** It should be noted that providing a marine fender with outer side walls and/or intermediate side walls which face one another can not only be used for fenders having two closed outer side walls which are arranged at an angle to the longitudinal direction of the fender, each of which connects the inner wall to the outer wall and which each delimit at least one closed cavity, but can also be

30 used in a wider context.

**[0039]** Such a fender can be used in all cases where a fender which can be used in the two directions of travel is required.

**[0040]** In an advantageous embodiment of a fender according to the invention, the intermediate closed cavities, on their sides extending in the longitudinal direction of the fender, are delimited by a top and a bottom wall which extend essentially parallel to the inner and outer wall.

35 **[0041]** In a preferred embodiment of a marine fender according to the invention, the intermediate closed cavities comprise a reinforcing recess on at least two opposite corners.

40 **[0042]** The fender according to the invention is preferably designed to be symmetrical with respect to a vertical mirror plane.

45 **[0043]** In an advantageous embodiment of a fender according to the invention, the fender is made from a

partly recycled plastic.

**[0044]** Furthermore, the fender according to the invention preferably has a length of between 0.60 m and 1.60 m and preferably has a weight of less than 18 kg.

**[0045]** The invention will now be described further with reference to the drawings, in which:

- Fig. 1 shows a perspective top view of the 'tip-top' fender according to the prior art;
- Fig. 2 shows a top view of a preferred embodiment of a marine fender according to the invention; and
- Fig. 3 shows a perspective cross section of the marine fender as illustrated in Fig. 2.

**[0046]** A preferred embodiment of a marine fender (1) according to the invention as illustrated in Figure 2 consists of a preferably elongate body which is preferably made from a plastic, preferably a partly recycled plastic, and more preferably a partly recycled polyethylene. In this case, the requirement is that the fender (1) is sufficiently stiff to absorb collisions between vessels themselves and between vessels and marine structures, and is also sufficiently wear-resistant to be able to withstand friction and scraping between walls of vessels and marine structures, respectively.

**[0047]** The fender (1) is removably suspended from a marine structure or vessel by means of one or more lines and/or ropes (not illustrated in the figure). In the position of use of the fender (1), an inner continuous wall (2) of the fender (1) in this case rests against a wall of the marine structure or the vessel. This inner wall (2) is preferably designed to be substantially straight, except for the fact that an indentation (11) is provided, preferably in the central section of the inner wall (2). This indentation (11) is preferably designed as an inwardly curved edge.

**[0048]** Furthermore, the fender (1) is provided with an outer wall (3) which is shorter than the inner wall (2). This outer wall (3) is integral with the inner wall (2) and is connected thereto by means of two closed outer side walls (4) which preferably taper from the inner wall (2) to the outer wall (3). These closed outer side walls (4) are preferably arranged at an angle of 45° with respect to the inner and the outer wall (2, 3), respectively.

**[0049]** As can be seen in Figures 2 and 3, the transition between each of these closed outer side walls (4) and the inner wall (2), and the transition between each of these closed outer side walls (4) and the outer wall (3) are round.

**[0050]** In the position of use of the fender (1), the outer wall (3) is situated against the wall of the vessel when the inner wall (2) is attached to the wall of the marine structure, and is situated on the wall of the marine structure when the inner wall (2) is attached to the wall of the vessel. This outer wall (3) is preferably designed substantially straight. The inner and outer wall (2, 3) are preferably arranged parallel with respect to each other.

**[0051]** Although the inner and outer walls (2, 3) are preferably designed to be straight, it should be noted that

they may also be any other shape. Thus, for example, the inner and outer walls (2, 3) may be curved. The condition in this case is that the fender (1) has to be capable of absorbing many collisions and has to spring back to its original shape. In this case, a straight shape has the advantage that the fender (1) is prevented from becoming stuck to or getting caught behind a (projecting) part of or an uneven structure in the marine structure or the vessel.

**[0052]** Furthermore, the fender (1) according to the invention is provided with one or more closed cavities (5a - 5g).

**[0053]** In this case, it is possible to provide the fender (1) with one closed cavity (5g) which is delimited on both sides by respective closed outer side walls (4) which are placed at an angle to the longitudinal direction of the fender (1). This embodiment is not illustrated in the figures.

**[0054]** In this case, a second option is to provide the marine fender (1) with two closed cavities (for example 5c and 5d) of essentially equal height which are arranged at least partly next to each other in the longitudinal direction of the fender (1). This embodiment is not illustrated in the figures either. In this case, each of these two cavities (for example 5c and 5d) is delimited by a respective closed outer side wall (4). In addition, these two closed cavities (for example 5c and 5d) are separated from each other by a partition. This partition is then designed to be solid. This partition may then, for example, be made of a solid, partly recycled plastic.

**[0055]** However, in order to render the fender (1) even more flexible and resilient in order to offer improved protection for vessels and/or marine structures, the fender (1) preferably comprises at least three closed cavities (5a - 5g) of essentially equal height in the longitudinal direction of the fender (1) which are arranged at least partly next to each other. These at least three closed cavities (5a - 5g) comprise at least two outer cavities (5e, 5f) and one or more intermediate closed cavities (5a - 5d, 5g) which are situated between these two outer closed cavities (5e, 5f). In this case, the outer closed cavities (5e, 5f) are delimited by a closed outer side wall (4) and one intermediate side wall (6), respectively, in which case the intermediate side walls (6) of the outer cavities (5e, 5f) face each other, preferably from the inner to the outer wall (2, 3). At their sides, the intermediate closed cavities (5a - 5d and 5g) are delimited by respective intermediate side walls (6) which are arranged at an angle to the longitudinal direction of the fender (1).

**[0056]** If the fender (1) comprises one intermediate closed cavity (5g), the intermediate side walls (6) which are at an angle to the longitudinal direction of the fender (1) and laterally delimit the intermediate closed cavity (5g) face each other, preferably from the inner to the outer wall (2, 3).

**[0057]** If the fender (1) comprises several intermediate closed cavities (5a - 5d, 5g), the closed cavities (5a - 5g) are divided into a first section of closed cavities (5a, 5c, 5e) and a second section of closed cavities (5b, 5d, 5f) which are separated by an intermediate central closed

cavity (5g), in which case the intermediate side walls (6) of the first section of the closed cavities (5a, 5c, 5e) face the intermediate side walls (6) of the second section of the closed cavities (5b, 5d, 5f), preferably from the inner wall (2) to the outer wall (3), and the intermediate side walls (6) which delimit the intermediate central closed cavity (5g) face each other, preferably from the inner wall (2) to the outer wall (3). In this case, the intermediate side walls (6) have a width which renders the fender (1) sufficiently flexible and sufficiently shock-absorbent.

**[0058]** In addition, the intermediate closed cavities (5a - 5d), also on their side which runs along the longitudinal direction of the fender (1), are delimited by a preferably substantially straight top and bottom wall (12, 13) on which the intermediate side walls (6) are arranged at an angle, preferably at an angle of approximately 45°. These top and bottom walls (12, 13) are preferably arranged parallel to the inner and outer walls (2, 3). As can be seen in Figures 2 and 3, the outer cavities (5e and 5f) are narrower than the other cavities (5a - 5d) and have very narrow rounded top and bottom walls (12, 13). The top and bottom walls (14, 15) of these outer cavities (5a and 5f) are not arranged parallel to the inner and outer wall (2, 3), as these cavities (5a and 5f) are shorter and rounded. As can be seen in the figures, these are arranged at an angle with respect to these inner and outer walls (2, 3).

**[0059]** By arranging the closed outer side walls (4) and/or intermediate side walls (6) such that they face each other, preferably from the inner wall (2) to the outer wall (3), it becomes possible for a vessel from which this fender (1) is removably suspended to scrape against a marine structure, such as a quay or a lock wall, in both directions of travel, as the first section of cavity/cavities (5a, 5c, 5e) which absorb the first and heaviest impact, always point in the right direction. In the case of an impact, the outer wall (3) of the fender (1) will first be slowed down by the marine structure and be pulled backwards as the vessel is still moving forwards. The first cavity/cavities (5a, 5c, 5e) and (5b, 5d, 5f), respectively, will fold. At that point in time, the indentation (11) will perform its function and extend the inner wall (2). The second section of cavity/cavities (5b, 5d, 5f) and (5a, 5c, 5e), respectively, of the fender (1) will then provide additional resistance due to the fact that the second cavity/cavities (5b, 5d, 5f) and (5a, 5c, 5e), respectively, are in the other, "wrong" direction as the side wall(s) (6) of the second section of cavity/cavities (5b, 5d, 5f) and (5a, 5c, 5e), respectively, will be subjected to additional stress which will push open the fender (1) while the vessel wants to push against the marine structure and will thus want to flatten the fender (1), thus ensuring the final shock absorption. In this case, the risk of the second section of cavity/cavities (5b, 5d, 5f) and (5a, 5c, 5e), respectively, being folded in the wrong direction is small, as the greatest force has already been absorbed and the vessel is essentially stationary at that point in time.

**[0060]** As can be seen in Figures 2 and 3, the fender (1) according to the invention is preferably symmetrical

with respect to the vertical mirror plane (A).

**[0061]** A preferred embodiment of a fender (1) according to the invention as illustrated in Figures 2 and 3 comprises one row of closed cavities consisting of:

- 2 sets of 3 closed cavities (5a - 5f), with the intermediate side walls (6) of the first three cavities (5a, 5c, 5e) and the closed outer side wall (4) of the outer cavity (5e) being at an angle of essentially 45° with respect to the inner wall (2) and the intermediate side walls (6) of the second three cavities (5b, 5d, 5f) and the closed outer side wall (4) of the outer cavity (5f) being at an angle of essentially 45° with respect to the outer side wall (3); and
- a seventh central cavity (5g), the two opposite intermediate side walls (6) of which face each other, from the inner to the outer wall (2, 3).

**[0062]** The number of cavities (5a - 5g) and the shape of these cavities (5a - 5g), as illustrated in Figures 2 and 3, are chosen such that they

- take into account the stiffness of the plastic compound which was used to produce the fender (1);
- have a good shock absorbance;
- have good resistance so that they can also be used for larger ships and marine structures;
- have great resilience;
- have high ease of use (due to the possibility of using the fender in two directions of travel and preventing the fender from becoming stuck); and
- are chosen on the basis of the weight of the fender (1).

**[0063]** It should be noted that the fender (1) according to the invention could also comprise several rows of closed cavities (5a - 5g) (not illustrated in the figures). However, for ease of use, the fender (1) according to the invention preferably comprises only one row of closed cavities (5a - 5g).

**[0064]** Furthermore, the intermediate closed cavities (5a - 5d and 5g) comprise reinforcing recesses (9), preferably in two opposite corners. These reinforcing recesses (9) ensure that, when the cavities (5a - 5d and 5g) are flattened between two vessels or a vessel and a marine structure, the intermediate side walls (6) touch each other in a more efficient way, as a result of which the corners of the cavities (5a - 5d and 5g) will not start to tear. In addition, if lines and/or ropes were to be introduced into these cavities (5a - 5d and 5g) to suspend the fender (1) from the wall of the marine structure or the vessel, there is a greater risk of the fender (1) tearing and the line and/or the rope breaking, resulting in the fender (1) coming loose. The reinforcing recesses (9) reduce this risk. These reinforcing recesses (9) preferably have a round shape.

**[0065]** A better solution than passing lines and/or ropes through cavities (5a - 5g) which are flattened when ab-

sorbing shocks is to provide preferably 4 openings (8), evenly distributed along the fender (1), i.e. evenly distributed with respect to the height and the longitudinal direction of the fender (1), for passing ropes through and removably attaching the fender (1) to the marine structure or the vessel, as can be seen in Figures 2 and 3. At the locations where these openings (8) are arranged, the respective cavities, in this embodiment the cavities (5c, 5d and 5g), have a notch (10).

**[0066]** The fender (1) according to the invention typically has a length of between 0.60 m and 1.6 m. More preferably, a length of 1.392 m is chosen, on the one hand on the basis of the weight and the associated ease of use and, on the other hand, due to the fact that the ship's ribs (seams in the ship's wall) are 0.50 m apart and thus 2 ribs are always covered, as a result of which the ship's wall is always covered and protected. Another possibility is providing fenders (1) with a length of 0.75 m.

**[0067]** The fender (1) preferably has a thickness and a height of approximately 0.15 to 0.16 m. The height and thickness have to be chosen such that a balance is struck between the length, height and thickness, the ease of use, the stiffness and the flexibility (resilience) and the buoyancy of the fender (1).

**[0068]** Such a fender (1) according to the invention ideally weighs less than 18 kg. The weight has to be chosen such that a balance is struck between the length, the ease of use, the stiffness and the flexibility (resilience) and the buoyancy of the fender (1). In this case, the rule applies that the more lightweight the fender (1) is, the more user-friendly it becomes. In addition, the fender (1) also has to have a weight which meets the national labour laws.

**[0069]** Such a fender (1) according to the invention as described above is ideally suited to be used in inland navigation.

**[0070]** Although the present invention was illustrated with reference to specific embodiments, it will be clear to those skilled in the art that the invention is not limited to the details of the preceding illustrative embodiments, and that the present invention can be designed with various changes and modifications without departing from the area of application of the invention. The present embodiments therefore have to be regarded as being illustrative and non-restricting in all regards, with the area of application of the invention being described by the attached claims and not by the above description, and any changes which fall within the meaning and range of the claims are therefore incorporated herein. In other words, this includes any changes, variations or equivalents which fall within the area of application of the underlying basic principles and the essential attributes of which are claimed in the present patent application. In addition, the reader of this patent application will understand that the words "comprising" or "comprise" do not exclude other elements or steps, that the words "a(n)" do not exclude the plural, and that a single element can perform the functions of various ancillary means which are mentioned in

the claims. Any references in the claims should not be interpreted as a limitation of the claims in question. The terms "first", "second", "third", "a", "b", "c" and the like, when used in the description or in the claims, are used to distinguish between similar elements or steps and do not necessarily describe a sequential or chronological order. In the same way, the terms "top side", "bottom side", "above", "below" and the like are used for the benefit of the description and do not necessarily refer to relative positions. It should be understood that these terms are mutually interchangeable under the right circumstances and that embodiments of the invention can function according to the present invention in different sequences or orientations than described or illustrated above.

## Claims

1. Marine fender (1) which is designed to be removably suspended from a marine structure or a vessel by means of one or more lines and/or ropes, in which the fender (1) is provided with

- an inner continuous wall (2) which is configured to rest at least partly against a wall of the marine structure or the vessel in the position of use of the fender (1);

- an outer continuous wall (3) which is integral with the inner wall (2) and is situated opposite the inner wall (2), and which is configured to rest at least partly against a wall of the vessel or the marine structure in the position of use of the fender (1);

- one or more cavities (5a - 5g) which are delimited laterally thereof by:

- two outer side walls (4) which are arranged at an angle to the longitudinal direction of the fender (1) and which each connect the inner wall (2) to the outer wall (3); or
- one outer side wall (4) and one intermediate side wall (6) arranged at an angle to the inner and outer wall (2, 3); or
- two intermediate side walls (6);

## characterized in that

- the outer side walls (4) are closed and each delimit at least one closed cavity (5e, 5f, 5g); and  
 - the inner wall (2) comprises an indentation (11) which is configured in such a way that the closed outer side walls (4) and/or the intermediate side walls (6) are prevented from bending and/or the fender (1) is prevented from tearing if it is being compressed.

2. Marine fender (1) according to Claim 1, **character-**

ized in that the transition between each of the closed outer side walls (4) and the inner wall (2) and the transition between each of these closed outer side walls (4) and the outer wall (3) is round.

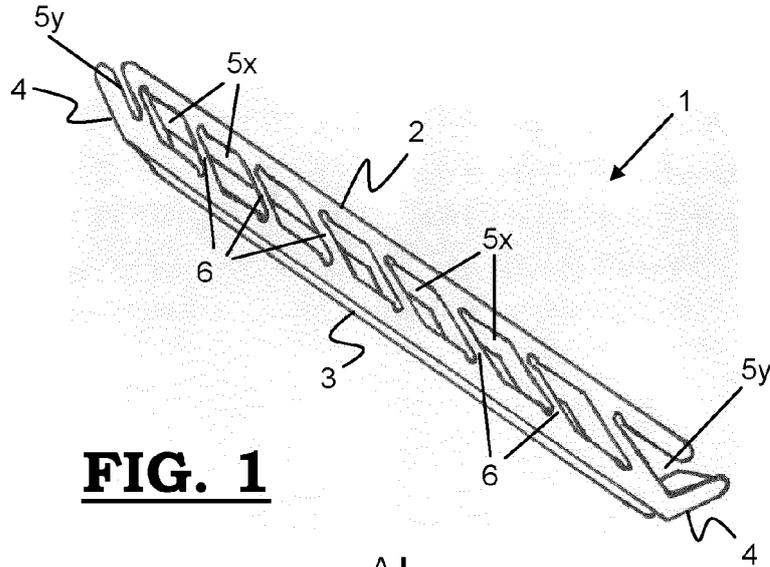
3. Marine fender (1) according to Claim 1 or 2, **characterized in that** the fender (1) comprises one or more openings (8) which are designed for passing the one or more lines and/or ropes through in order to suspend the fender (1) from the marine structure or the vessel.
4. Marine fender (1) according to Claim 3, **characterized in that** the openings (8) are evenly distributed with respect to the vertical and the longitudinal direction of the fender (1).
5. Marine fender (1) according to one of Claims 1 to 4, **characterized in that** the inner and outer walls (2, 3) are designed to be substantially straight.
6. Marine fender (1) according to one of Claims 1 to 5, **characterized in that** the inner and outer walls (2, 3) run substantially parallel with respect to each other.
7. Marine fender (1) according to one of Claims 1 to 6, **characterized in that** the fender (1) is mainly elongate.
8. Marine fender (1) according to one of Claims 1 to 7, **characterized in that** the fender (1) comprises one closed cavity (5g) which is delimited on either side by a respective closed outer side wall (4) which is arranged at an angle to the longitudinal direction of the fender (1).
9. Marine fender (1) according to Claim 8, **characterized in that** the closed outer side walls (4) face each other.
10. Marine fender (1) according to one of Claims 1 to 7, **characterized in that** the fender (1) comprises two closed cavities (5a - 5d) which are at least partly arranged next to one another in the longitudinal direction of the fender (1) and are of essentially equal height, in which
  - each of the cavities (5a - 5d) is delimited by a respective closed outer side wall (4); and
  - the cavities (5a - 5d) are separated from each other by a partition which is delimited on both sides thereof by a respective closed cavity (5a - 5d).
11. Marine fender (1) according to one of Claims 1 to 7, **characterized in that** the fender (1) comprises at least three closed cavities (5a - 5f) which are at least

partly arranged next to one another in the longitudinal direction of the fender (1) and essentially have the same height, in which these at least three closed cavities (5a - 5f) comprise at least two outer cavities (5e, 5f) and one or more intermediate closed cavities (5a - 5d), which are situated between the two outer closed cavities (5e, 5f), in which the outer closed cavities (5e, 5f) are delimited by a closed outer side wall (4) and one intermediate side wall (6), and the one or more intermediate closed cavities (5a - 5d, 5g) are delimited by two intermediate side walls (6).

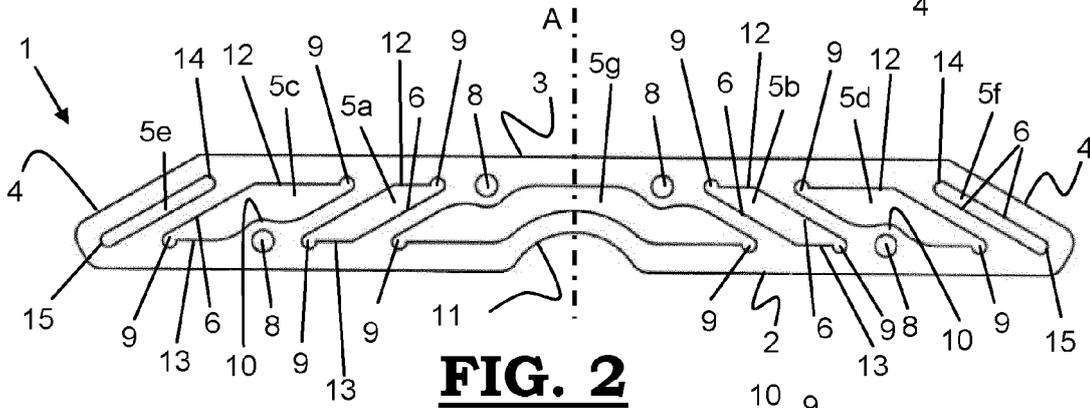
12. Marine fender (1) according to Claim 11, **characterized in that**

- if the fender (1) comprises one intermediate closed cavity (5g), the intermediate side walls (6) which are at an angle to the longitudinal direction of the fender (1) and laterally delimit the intermediate closed cavity (5g) face each other, and
- if the fender (1) comprises several intermediate closed cavities (5a - 5d, 5g), the closed cavities (5a - 5g) are divided into a first section of closed cavities (5a, 5c, 5e) and a second section of closed cavities (5b, 5d, 5f) which are separated by a central intermediate closed cavity (5g), with the intermediate side walls (6) of the first section of the closed cavities (5a, 5c, 5e) facing the intermediate side walls (6) of the second section of the closed cavities (5b, 5d, 5f) and the intermediate side walls which delimit the central intermediate closed cavity (5g) face each other.

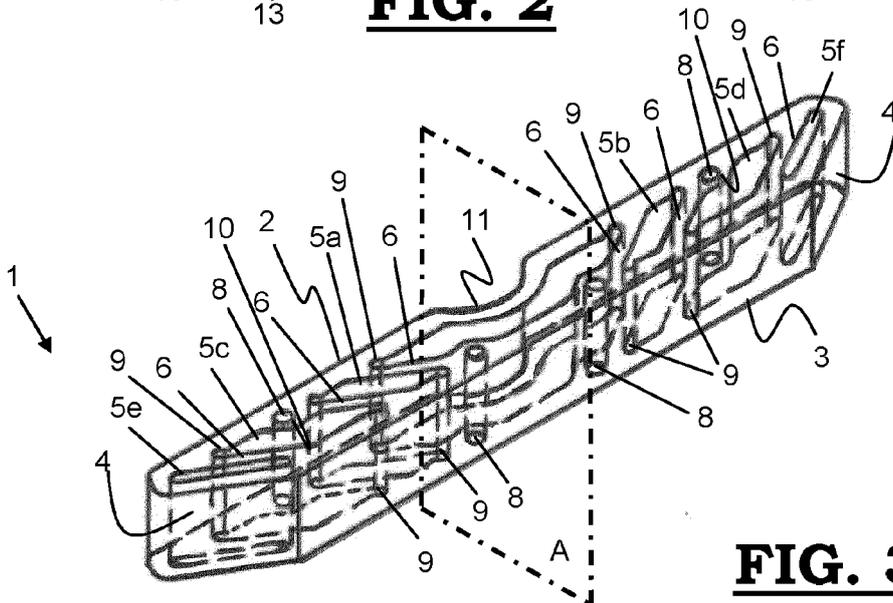
13. Marine fender (1) according to Claim 11 or 12, **characterized in that** the intermediate closed cavities (5a - 5d, 5g) comprise a reinforcing recess (9) on at least two opposite corners.
14. Marine fender (1) according to one of Claims 11 to 13, **characterized in that** the intermediate closed cavities (5a - 5d, 5g), on their sides extending in the longitudinal direction of the fender (1), are delimited by a top and a bottom wall (12, 13) which extend essentially parallel to the inner and outer wall (2, 3).
15. Marine fender (1) according to one of Claims 1 to 14, **characterized in that** the fender (1) the fender (1) is designed to be symmetrical with respect to a vertical mirror plane (A).
16. Marine fender (1) according to one of Claims 1 to 15, **characterized in that** the fender (1) is made from a partly recycled plastic.



**FIG. 1**



**FIG. 2**



**FIG. 3**



EUROPEAN SEARCH REPORT

Application Number  
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