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Stephenson, JR.

(54) **FENDER SYSTEM FOR VESSELS WHICH ALLOWS FENDERS TO SELF ADJUST**

(76) Inventor: **Samuel S. Stephenson, JR.**, Fort Lauderdale, FL (US)

Correspondence Address:
Darby & Darby (Formerly Michael J. Keller)
P.O. Box 770, Church Street Station
New York, NY 10008-0770 (US)

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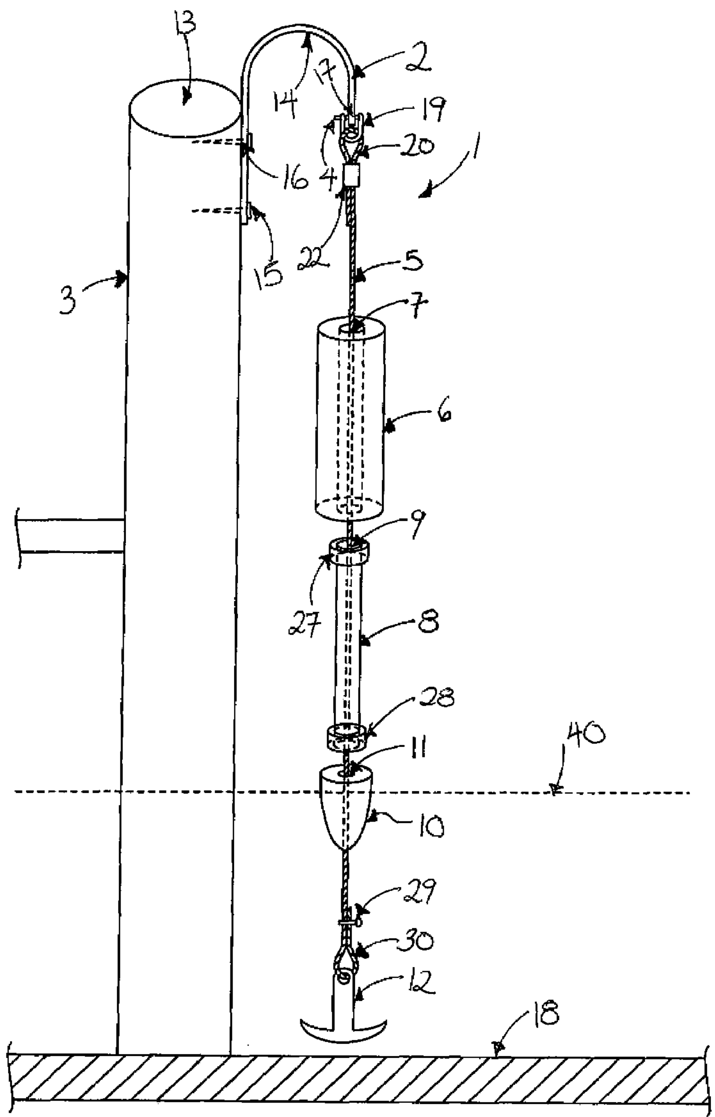
(57) **ABSTRACT**

The present invention provides a fender system that is applied to a dock piling or solid faced bulkhead in order to prevent damage to a marine vessel while the vessel is moored to a fixed or floating dock, or dock piling, or solid faced bulkhead. The fender is designed to uniquely rise and fall with the level of the tide such that the fender is always in the most suitable position for protecting the vessel's hull from coming into direct contact with the piling or bulkhead. Thus, this system is useful in waters in which there is a constant ebb and flow of the tide and is especially useful in areas experiencing a storm surge.



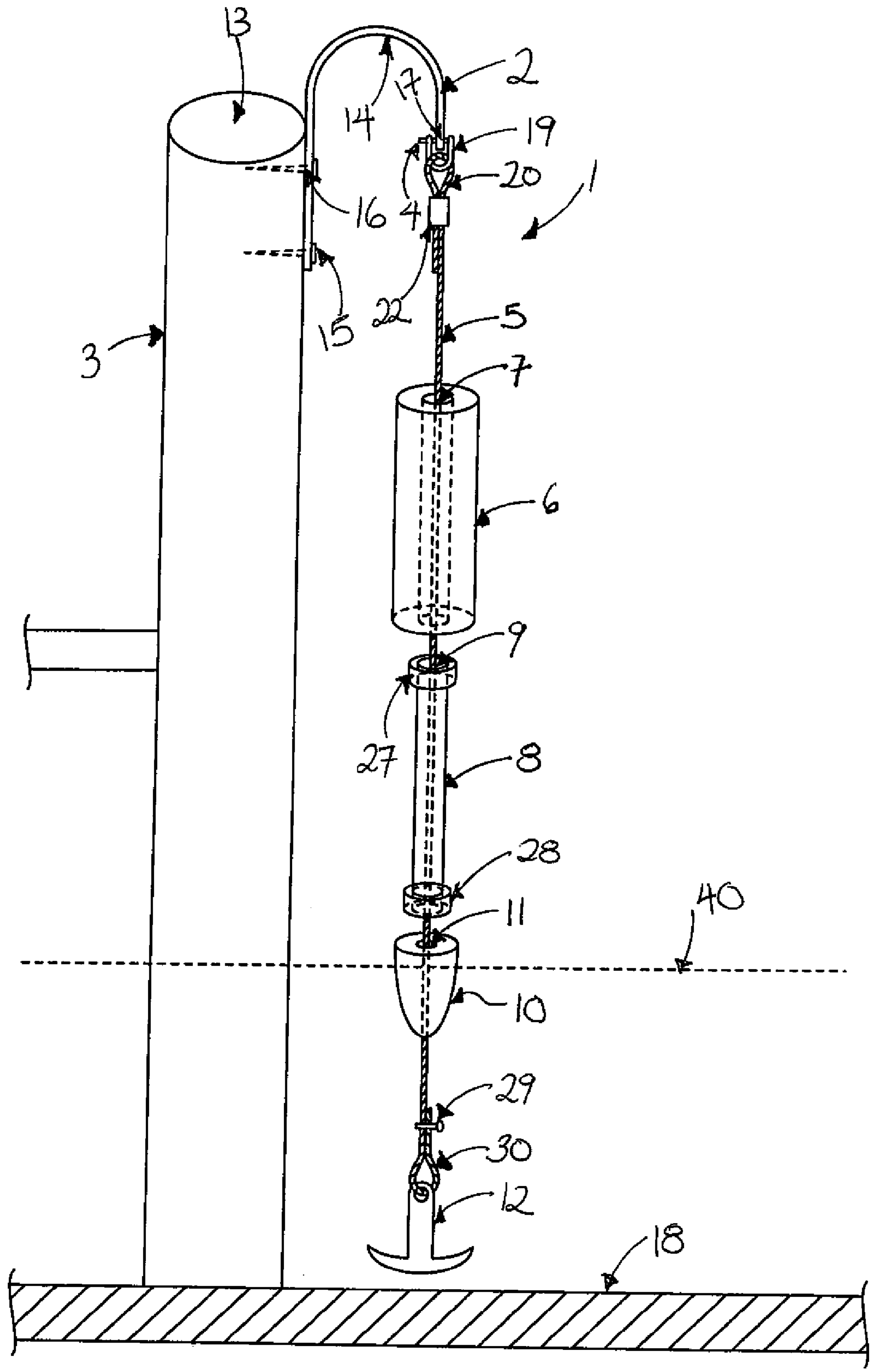


FIG. 1

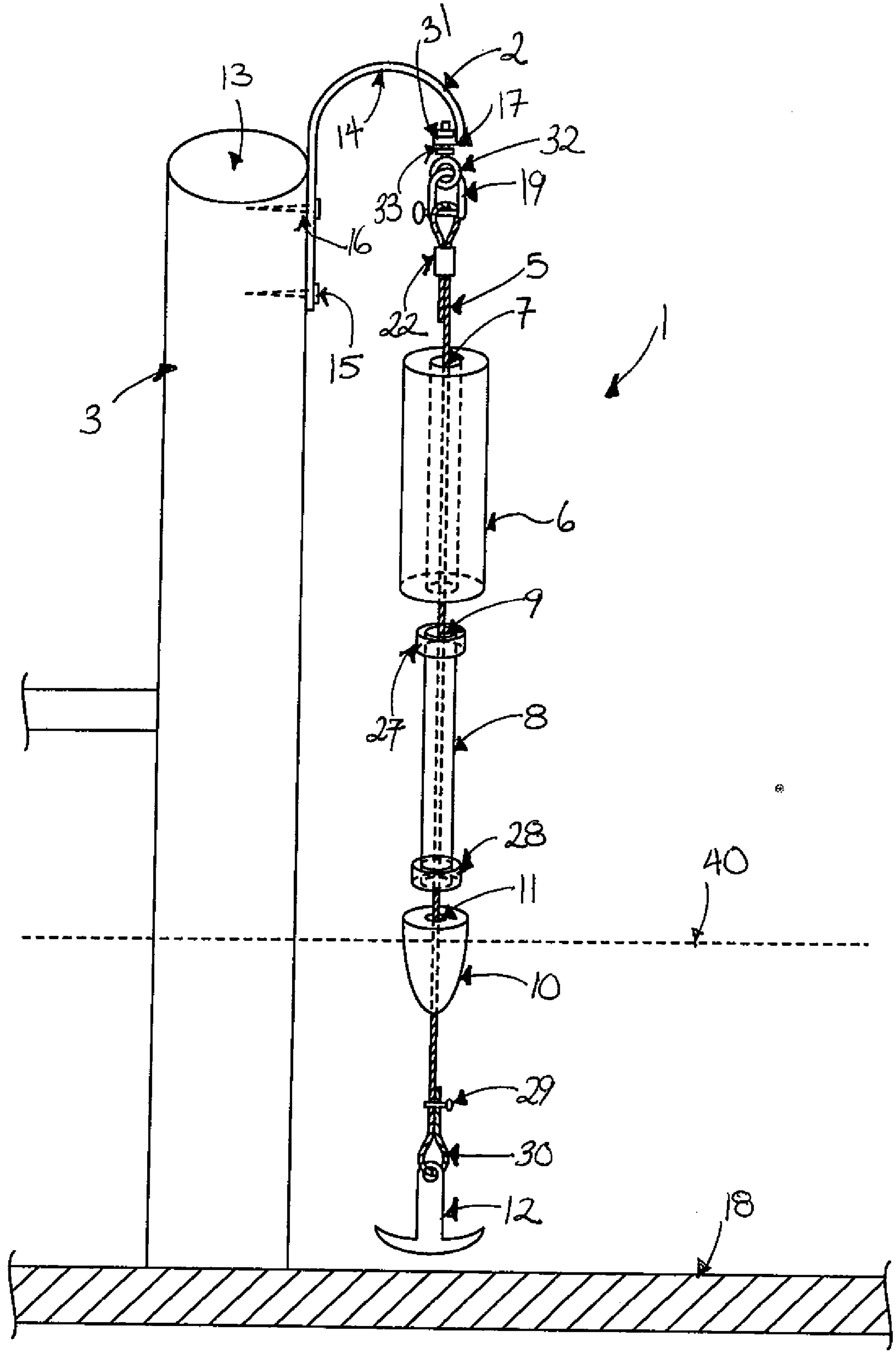


FIG. 2

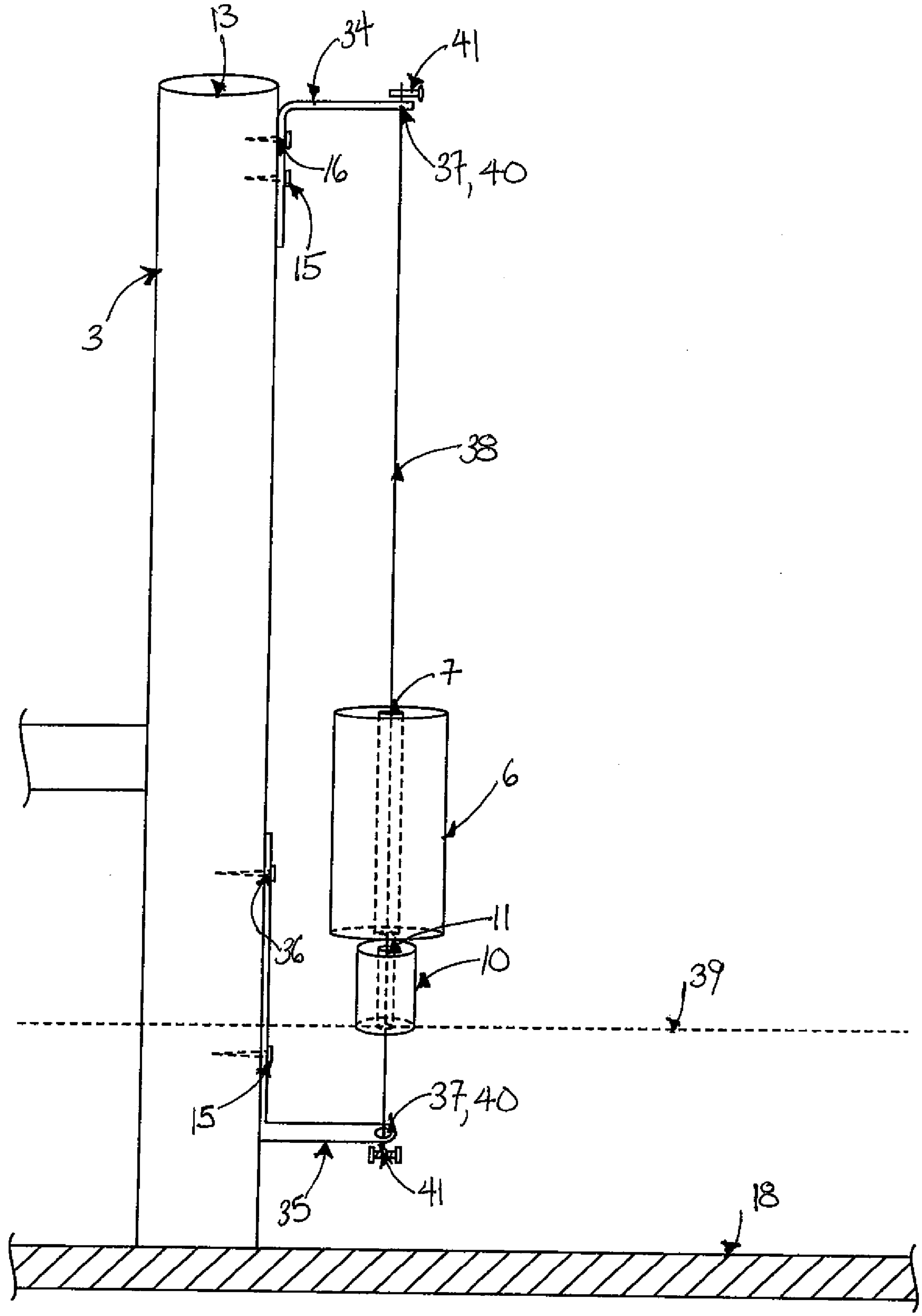


FIG. 3

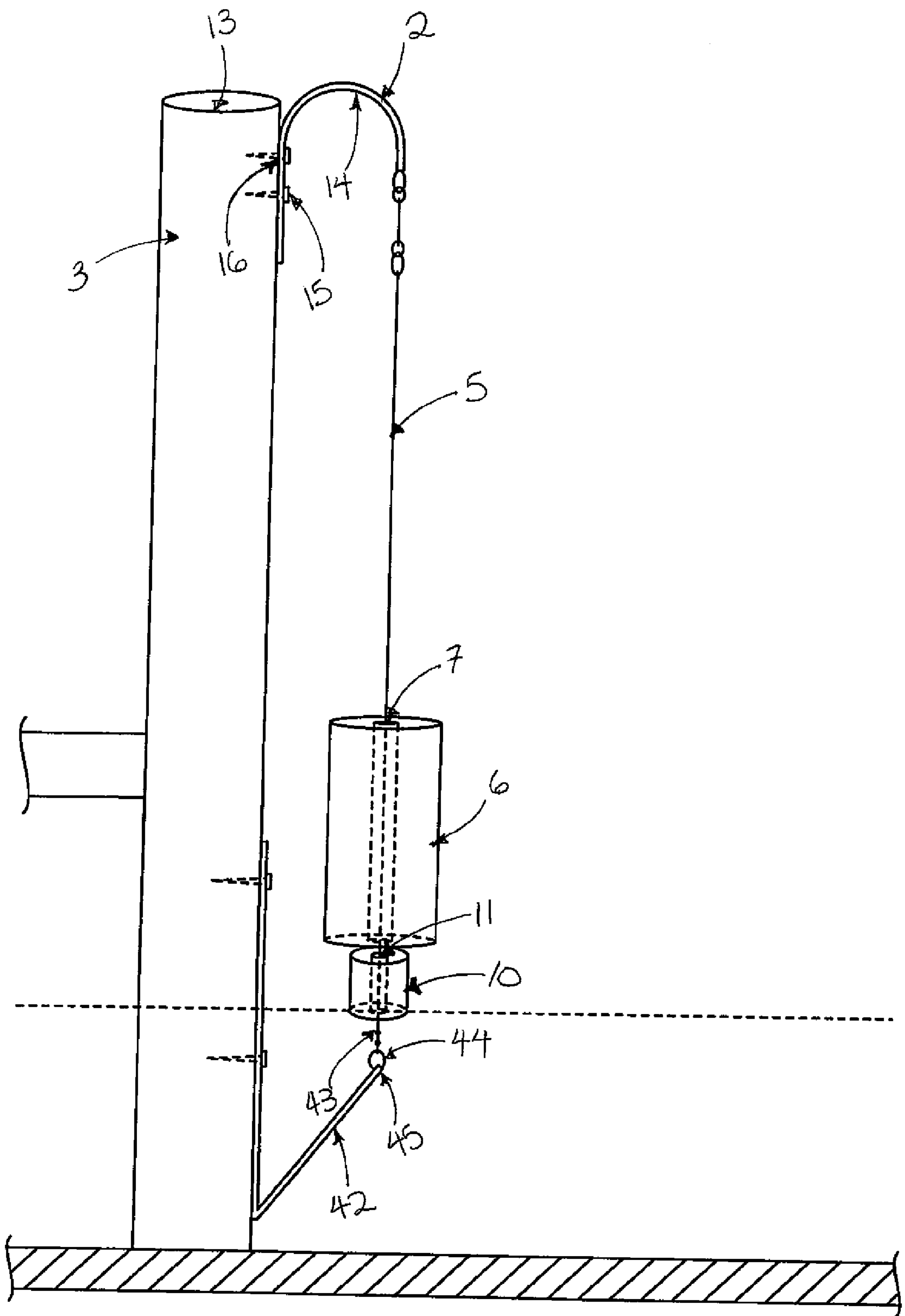


FIG. 4

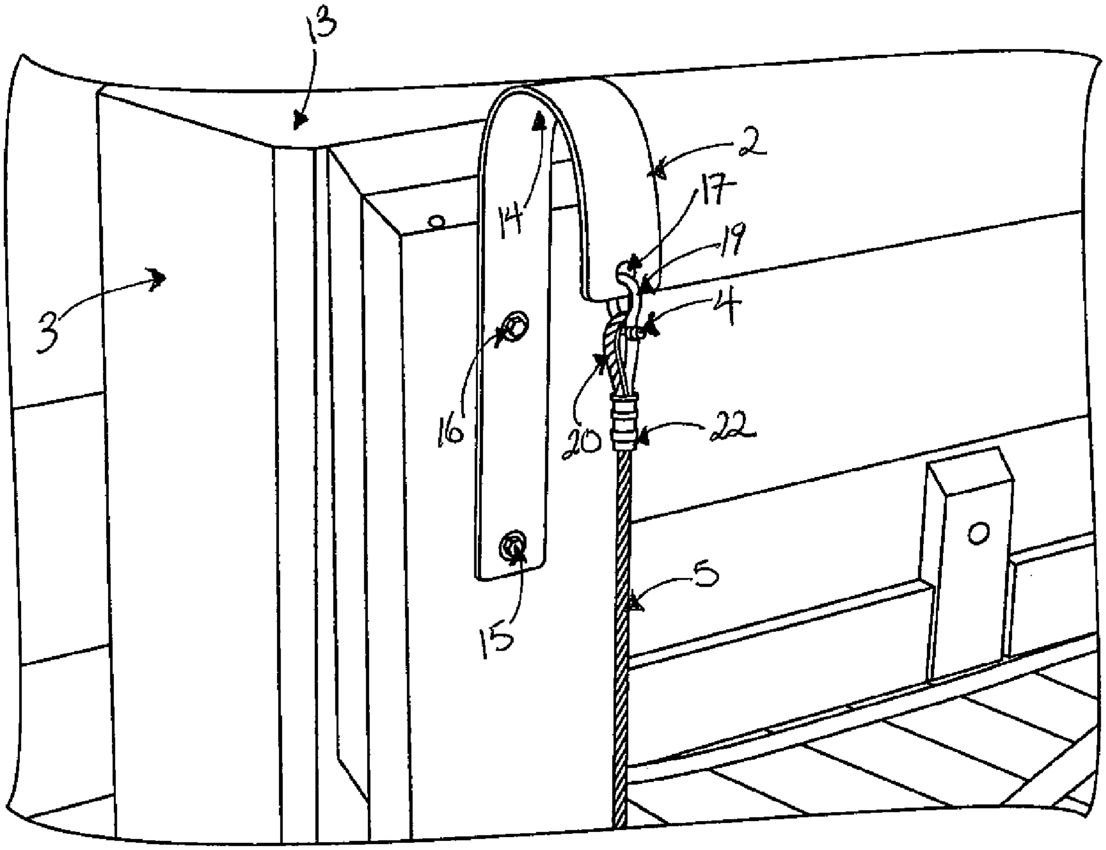


FIG. 5

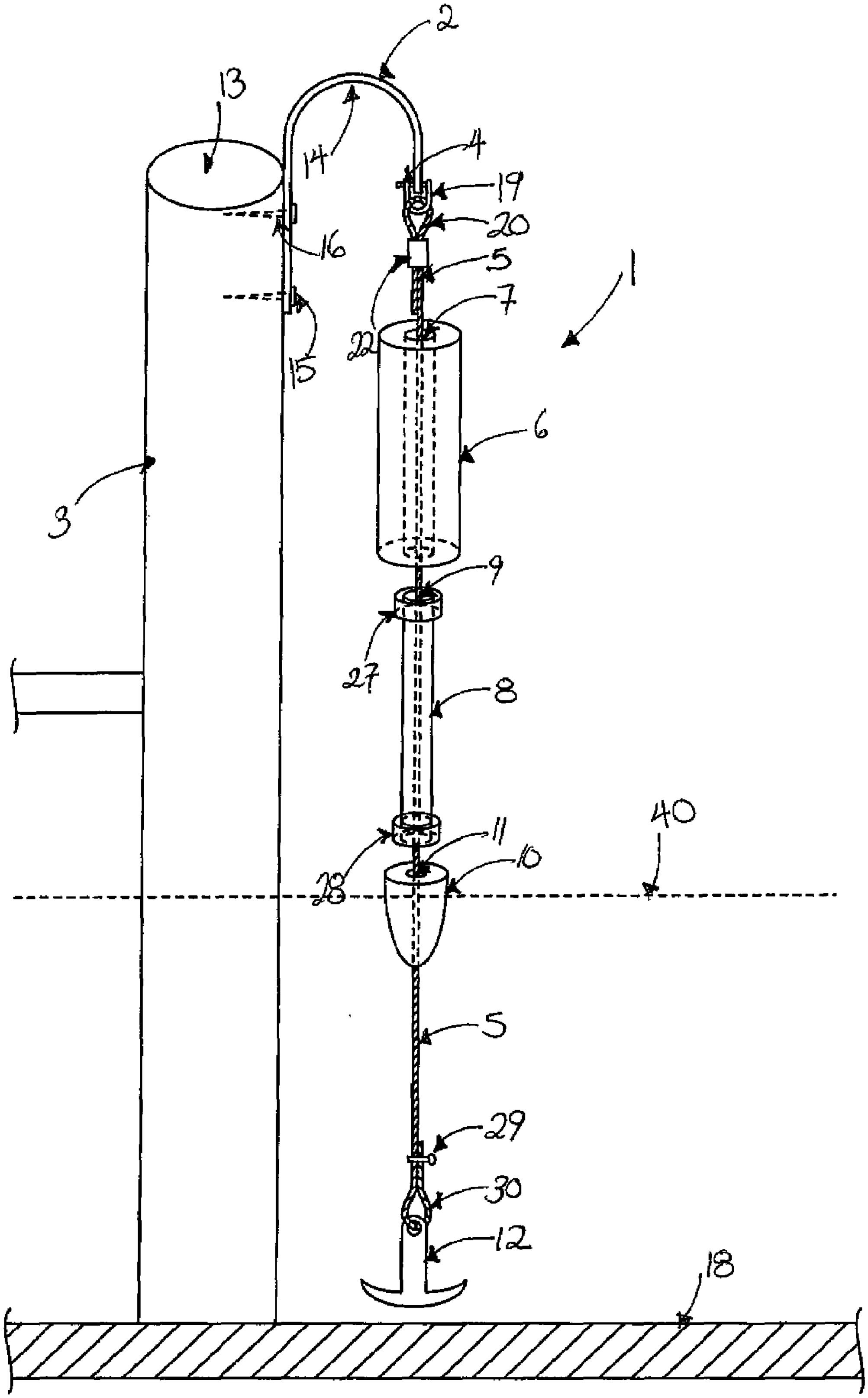


FIG. 6

FENDER SYSTEM FOR VESSELS WHICH ALLOWS FENDERS TO SELF ADJUST

PRIORITY CLAIM

[0001] This application claims priority to corresponding U.S. Provisional Application No. 61/001,055, filed on Oct. 31, 2007, the disclosure and contents of which are expressly incorporated herein by reference.

FIELD OF INVENTION

[0002] The present invention relates to a fender system that can be applied to a dock piling in order to prevent damage to a vessel whereby the fender uniquely rises and falls with the tide such that the fender is always in the most suitable position for protecting the vessel.

BACKGROUND OF THE INVENTION

[0003] With respect to commercial and recreational marine vessels, the vessels are regularly kept within a marina, harbor or port for a period of time while not being used alongside a dock area with a number of vertical dock pilings. Typically, the vessel is somehow attached or otherwise confined to the dock in order that the current and tide does not cause the vessel to stray from the dock area. As a result, the hull, transom or gunwale of the vessel routinely encounters the dock or dock piling each time the vessel pitches and rolls against the dock area due to the underlying current and rise and fall of the tide. Furthermore, in some instances, the vessel may even work itself under the dock if there is no structural barrier between the vessel and the dock. Therefore, a number of systems have been developed in order to protect the vessel's structure from being damaged by the dock pilings.

[0004] For example, bumpers have been applied to the vessel's railings and alongside the dock pilings themselves. The bumpers are typically made with rubber pads or strips. Unfortunately, the pads or strips are usually only capable of handling any rubbing engagement that occurs between a vessel and a piling, and cannot withstand the full force of an impact between the vessel and the dock piling. During a forceful impact, the pads or strips either do not have enough cushion to prevent any damage or are ripped away from their fastened position on the underlying vessel or piling structure rendering the bumpers ineffective and causing structural damage to the vessel or piling. In addition, the bumpers are unsightly when applied to a vessel or a piling thereby ruining the aesthetic appeal of the vessel or dock area. Packaging, cushions, carpeting and even corrugated cardboard have also been strapped to dock pilings with duct tape in an attempt to provide protection to the vessel. However, these solutions are only temporary as they degrade easily and quickly become unsightly.

[0005] In another example, fenders have been developed for mounting to and hanging over the waterside edge of the stem, fantail or gunwale of the vessel such that the fender acts as a physical buffer that prevents the vessel from coming into direct contact with the dock piling. A typical fender is in the form of a cylindrical, elongated tube, rounded at both ends or formed similar to a barrel, and is completely or partially filled with air, water or a cellular foam core to cushion and absorb the shock of the vessel bumping and banging against the dock piling. The fender typically has a line, such as a nylon cord or rope, at its upper end that is somehow attached or tied to the vessel. The fender simply hangs down from the gunwale to protect the sides of the vessel. However, in order to be effective, the fender must be suspended from the vessel at a precise length in order to be positioned such that the dock piling hits the vessel at the section that comes in contact with the fender. Therefore, the fender cannot just rely upon its buoyancy for placing it in the right place as the water level may not be where the vessel contacts with the dock. Determining the precise length of the fender is not a simple task and requires some trial and error, particularly when the level of the water is constantly rising and falling. Furthermore, because the fender is suspended from its top but is free-floating at its bottom such that there is little tension in the line, the fender can easily be errantly moved out of position and relies upon the vessel compressing the fender in place against the dock in order to keep it in position. Thus, a fender suspended from the vessel is completely useless in storm conditions. In some instances, the fender contains water or another substance that adds weight to the fender while still remaining buoyant. However, the inconvenience associated with locating the fender at a precise location under changing conditions still exists. In addition, although fenders are easily portable, the fender must be transported with the vessel during its entire voyage as unused cargo.

[0006] Therefore, there exists a need for a system of sufficient strength and cushion to absorb the full force impact between a vessel and a dock piling that is not difficult to correctly position and is permanently attached to the vessel or piling such that it cannot be easily moved out of the correct position.

[0007] In order to reduce the difficulty in attaching a suitable buffer to a vessel in the appropriate location and the undesirable added weight of applying a buffer to the vessel, systems have been developed for securing an existing inflatable fender or some other type of mooring device to a dock or pier rather than applying the fender or other device to the vessel. As a result, there is flexibility in receiving the impact of the vessel without the displacement of the fender or other device from its secured position.

[0008] For example, one system is comprised of an inflatable fender that is attached to a boat docking structure using at least two brackets that are secured to the boat docking structure on each side of the fender using screws. A strap is adjustably received by the two brackets and completely encircles the fender thereby securing the fender to the boat docking structure. In addition, the fender can have a center opening for running a line longitudinally through the fender whereby the line is attached to the boat docking structure using a hook or eyebolt to assist in securing the fender to the boat docking structure. Thus, upon impact of the boat with the fender, the fender cannot move relative to the boat docking structure. A series of these fenders can be applied vertically and/or horizontally in a linear fashion along the boat docking structure in order to cover the entire length wherein a vessel may come in contact with the boat docking structure.

[0009] In another example, rather than using readily available and conventional inflated fenders, one system employs a device having an extension arm that is attached to a dock in a fixed position. The extension arm is connected to one or more spring-loaded solid or air-filled rollers or wheels. The extension arm of the device is spaced from the dock in a manner so as to stand off a floating vessel using the solid or air-filled rollers while the vessel is tied to a stationary dock or piling. The spring-loaded rollers rotate against the vessel in order to allow the vessel to move with the vertical tide action, current and light wave or wave motion.

[0010] However, although these devices are attached permanently to the dock pilings such that the dock piling can receive the impact of the vessel without the displacement of the fender or other device from its secured position, none of these devices are capable of automatically changing position in response to the rise and fall of the water level. Therefore, these devices are not suitable for use in waters in which the water level is constantly changing. In order to protect the dock, a number of the fenders or other devices have to be installed up and down the dock area in series, which is highly unattractive particularly in recreational marinas. Furthermore, some of the fenders or other devices may need to be installed in places that, for a portion of the time, are under the water line in order to be prepared for events in which the water level drops significantly. This exposes the fenders or other devices and their means of attachment to the dock area to corrosion and to the growth of bacteria, barnacles and other damaging marine life. Accordingly, there exists a need for a fender-like system that is permanently attached to the dock side in order to maintain position and is capable of automatically adjusting in response to the rise and fall of the water level caused by the underlying current.

[0011] Devices with this automatic adjustment feature have been developed for mooring or otherwise confining a marine vessel to a dock area. For example, a self adjusting tidal mooring device has been developed for mounting onto mooring poles or pilings. The device includes one or more stainless steel vertical slide shafts that are mounted along the vertical length of the sides of the mooring pole or piling using stainless steel mounting plates. A polyethylene sliding block is affixed to the slide shaft such that it can be slide up and down the slide shaft. One end of a rope is secured to the sliding block while the other end of the rope is tied to the watercraft's cleats. The weight of the vertical slide block keeps tension on the rope. As the water level rises and falls, the sliding block moves up and down the vertical slide shaft allowing the watercraft to move vertically in the mooring slip but still remain securely positioned in relation to the dock.

[0012] In another example, a boat mooring apparatus, which has been developed for securing a boat to a vertical piling, includes a vertical elongated member that is mounted to the piling and has a longitudinal track along its length. A carriage is mounted such that it may slide within the track. A float support is secured to the carriage exterior at its upper end and is connected to a float on its lower end. The float is typically an air-filled cylinder that has sufficient buoyancy to float its own mass as well as that of the float support and the carriage. The float support transmits the tide forces acting on the float to the carriage in order to adjust the position of the carriage in response to changes in the tide. A line of suitable length and thickness for the boat to be moored is attached to a ring connected to the float support and is extended to moor the boat. As a result, the boat floats up and down with the float support and the strain on the mooring lines remains the same at all times.

[0013] However, none of these devices are capable of acting as a buffer between the vessel and the dock area because they do not provide an offset from the dock. These devices only operate to keep the vessel proximate to the dock area such that the vessel does not dangerously stray from the area.

[0014] Several systems exist for adjusting the length of the lines which suspend the fenders from either a source on the dock side or on the vessel side of the system in relation to the changes in tide. For example, a crane or derrick with suspended cables that are attached to a weighted fender can be used to manually hoist or lower the fender when desired. However, unlike the mooring devices describe above, each of these systems is not automatically responsive to the actual rise and fall of the water level as they require manual intervention in order to move the fender. Thus, there still exists a need for a fender-like system that is permanently attached to the dock side and is capable of automatically adjusting in response to the rise and fall of the water level and the underlying current.

SUMMARY OF THE INVENTION

[0015] The present invention provides a fender system that is applied to a dock piling in order to prevent damage to a marine vessel while the vessel is moored to a fixed or floating dock or dock piling. The fender is designed to uniquely rise and fall with the level of the tide such that the fender is always in the most suitable position for protecting the vessel's hull from coming into direct contact with the piling. Thus, this system is useful in waters in which there is a constant ebb and flow of the tide and is especially useful in areas experiencing a storm surge.

[0016] The present invention is affixed to a vertical dock piling or solid faced pier and is designed to allow the fender to rise and fall automatically with the tide all the way up to the top of the piling or solid face of pier in the event of a storm surge and all the way down to the lowest water point at the lowest tide. The fender not only rises and falls with the tide, but also stays in the proper location against the piling and the vessel's rub rail in order to be an effective fender at all stages of the tide. The present invention helps protect a vessel's hull from coming into direct contact with a piling at even the most extreme tides, thus reducing the chance of damaging the vessel or dock.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is a side view of a preferred embodiment of the fender system of the present invention depicted as being mounted to a vertical dock piling at low tide.

[0018] FIG. **2** is side view of a first alternative embodiment of the fender system of the present invention depicted as being mounted to a vertical dock piling.

[0019] FIG. **3** is a side view of a second alternative embodiment of the fender system of the present invention depicted as being mounted to a vertical dock piling.

[0020] FIG. **4** is a side view of a second preferred embodiment of the fender system of the present invention depicted as being mounted to a vertical dock piling.

[0021] FIG. **5** is a perspective view of the bracket of FIG. **1** as attached to a cable.

[0022] FIG. **6** is a side view of the embodiment of FIG. **1** depicted as being mounted to a vertical dock piling at high tide.

DETAILED DESCRIPTION OF THE INVENTION

[0023] For a better understanding of the present invention, reference may be made to the following detailed description taken in conjunction with the appended claims and the accompanying drawings.

[0024] Referring to FIG. **1**, the fender system **1** of the present invention is generally comprised of a bracket **2** that is affixed to a vertical dock piling **3**, a mechanical means **4** that attaches a cable **5** to the bracket **2**, a fender **6** with a vertical hole **7** for passage of the cable **5** there through, a pipe **8** just below the fender **6** having a vertical hole **9** for passage of the cable **5** there through, a float **10** for providing the buoyancy for the fender **6** and having a vertical hole **11** for passage of the cable **5**, and a weight **12** that is attached to the terminating end of the cable **5**.

[0025] In a preferred embodiment, the fender system **1** includes a bracket **2** that is attached at one end to a vertical dock piling **3** near the top **13** of the dock piling in order for the fender system **1** to operate along the entire length of the dock piling. The fender system of the present invention is designed to allow the fender to rise and fall automatically with the tide all the way to the top of the piling in the event of a storm or a hurricane. FIG. **1** depicts the present invention being used during a low tide condition. FIG. **6** depicts the embodiment of FIG. **1** being used during a high tide condition wherein the fender has risen to near the top of the piling and closer to the bracket **2**. Preferably, the bracket **2** is a flat bar that is composed of aluminum or stainless steel that has been bent into a 180° degree arc **14** in a bowed configuration that is curved downwards with respect to the water line **40**. The arc **14** prevents the bracket from harmfully puncturing a vessel should it somehow come into contact with the vessel. Also, by bending the bracket into an arc, the mechanical stresses placed upon the bracket are more evenly distributed along the entire length of the bracket rather than loading the stresses at the point where the bracket is attached to the piling. In addition, the arced bracket can more easily adapt to forces resulting from high winds and tumultuous water conditions. The end of the bracket **2** is preferably affixed directly to the dock piling **3** with two lag screws **15** that are threaded through two ¼" inch holes **16**.

[0026] As shown in detail in FIG. **5**, at the protruding end of the bracket **2** is a ½" inch hole **17** through which a sleeve **4** passes through the bracket **2**. This sleeve is preferably made of a non-corroding material, such as nylon, and is used to prevent corrosion between the metal bracket **2** and the metal shackle **19** that is further described below. A cable **5** is attached to the bracket **2** using the shackle **19** and a thimble **20**, whereby the shackle **19** is passed through the sleeve **4** and its bottom is passed through the thimble **20**. Preferably, the cable **5**, shackle **19** and thimble **20** are each composed of stainless steel metal. The thimble **20** is thereafter attached to a ¼" inch stainless steel cable **5** by a swage fitting **22**. Thus, the cable **5** is provided with a wide range of movement at the bracket **2** by the shackle **19**.

[0027] The cable **5** is inserted into and through a fender **6** whereby the fender **6** has a vertical hole **7** that runs longitudinally through its center such that the fender can slide freely up and down the length of the cable **5**. The fender can be any appropriate shape for the vessel it is protecting and made from any material which provides suitable impact cushioning between a vessel and the structure to which it is moored. In a most preferred embodiment, the fender is cylindrical in shape and made from a closed cell polystyrene or vinyl, in which case the vinyl is inflated for the cushioning affect and has a hole running longitudinally through the fender.

[0028] Just below the fender **6**, a hollow pipe **8** may be used in order to vary the height of the fender **6**. The pipe **8** has a vertical hole **9** through its center in order for the cable **5** to be inserted through the hole **9**. Preferably, the pipe **8** is made of polyvinyl chloride (PVC) and has a longitudinal slit the length of the pipe in order for the cable to be passed through. The slit would be sized to permit the pipe to fit over the cable. For example, where a ¼" inch cable is chosen, the slit would be approximately ¼" inches. The length of the pipe **8** is preferably dependent upon the height of the vessel's gunwale. The pipe should be sized such that the middle of the fender is positioned at the gunwale of the vessel. Furthermore, PVC end caps **27** and **28** may be placed at both ends of the pipe with a hole in the middle of the cap for the cable to pass through **8**. Alternatively, the end caps may be notched to allow passage over the cable. Below the pipe **8** is a float **10** that is composed of any suitable buoyant material and has a vertical hole **11** through which the cable **5** passes through. While the float can be made from any suitable non-marring buoyant material, the float **10** is preferably composed of a foam or plastic. In a preferred embodiment, the float is made out of polystyrene, closed cell foam, or Styrofoam and has the shape of a bullet in which there is a hole for the cable to pass through. The float provides the buoyancy for the fender **6** and prevents the fender **6** from coming into contact with the water line **40**. A weight **12** is attached to the terminating end of the cable **5** in order to provide tension in the cable **5** and to keep the entire fender system **1** in vertical alignment along the dock piling **3**. The weight **12** will maintain the positioning of the fender **6** in the presence of a strong underlying current that would typically drag the fender out of position. While any material of suitable mass and dimensions can be used, in one embodiment, the weight is a metal anchor that is attached to the cable **5** using a stainless steel wire clamp **29** and thimble **30**. The overall length of the cable **5** is dependent on the depth of the water as well as the desired location of the weight **12**. Preferably, the weight **12** is located **1'** foot off the sea floor **18**. It is understood that the term sea floor means the bottom of the waterway in which the dock or pier rests.

[0029] In an alternative embodiment, as shown in FIG. **2**, the fender system **1** does not include a sleeve. Rather, the shackle **19** is connected to the protruding end of the bracket **2** using an eye bolt **32** that passes through the hole **17** and is secured to the bracket **2** by one or more washers **31** and one or more nuts **33** on either side of the bracket **2**.

[0030] In another alternative embodiment, as shown in FIG. **3**, the fender system **1** could employ two or more stainless steel flat bar brackets (e.g. **34** and **35**), bent at a 90° degree angle, for attaching the fender **6** and a stainless steel rod or cable **38** to the piling **3**. Preferably, one bracket is mounted at the top of the piling **3** and a second bracket is mounted below the low water mark **39**. Each 90° degree bracket has two holes **16** and **36** for the lag screws **15** to secure the brackets to the piling **3**. In addition, each bracket has a hole **37** to allow a stainless steel rod or cable **38** to pass through. The stainless steel rod or cable **38** passes through the holes in the horizontal portion of the upper and lower brackets **34** and **35**. The rod or cable **38** is connected to the upper and lower brackets via a hole **40** drilled through the rod or cable **38** and a stainless steel screw and nut **41** are placed on the outermost ends of the rod or cable **38**. A fender **6** with a vertical hole **7** through its middle slides vertically up and down the rod or cable **38**. Below the fender **6** is a buoyant float **10** with a vertical hole **11** through the middle wherein the rod or cable **38** passes through the hole **11**. The float **10** keeps the fender **6** out of the water. Accordingly, due to the float **10**, the fender **6** automatically rises and falls with the tide and prevents the manual adjustment of the fender to keep the fender at the correct height. By attaching the rod or cable **38** to both the top and bottom brackets, the fender system **1** has a suitable strength for enduring severe storm and water conditions.

[0031] In a second preferred embodiment, as shown in FIG. 4, the bracket **2** of the fender system **1** is identical to the fender system described above and shown in FIG. **1** except that the terminating end of the cable **5** is not attached to a weight **12**. Rather, a 90° degree bracket **42** is mounted to the piling **3** below the low water mark **39**. The terminating end of cable **5** is attached to a hole **45** in the 90° degree bracket **42** using one or more stainless steel U-clamps **43** and a stainless steel shackle **44**. Thus, the bottom bracket **42** provides strength and stabilization to the fender system **1** of FIG. **1**.

[0032] All materials used in the construction of the present device should be selected for their ability to survive in a wet and/or salty environment. Materials that touch should be made from galvanically acceptable materials or should be made from non-corroding materials such as nylon. The term "galvanically acceptable" should be construed to mean that two or more different materials, when in contact, will not create unacceptable galvanic currents which lead to erosion of one or more of the materials. Such materials are known in the marine industry. Stainless steels such as type **316** are among the preferred galvanically acceptable materials. In instances where galvanically acceptable materials cannot be chosen, the present invention may need to be protected by the use of sacrificial anodes such as zinc, aluminum or magnesium as are known in the art.

[0033] In the foregoing description, the present invention has been described with reference to specific exemplary embodiments thereof. It will be apparent to those skilled in the art that a person understanding this invention may conceive of changes or other embodiments or variations, which utilize the principles of this invention without departing from the broader spirit and scope of the invention. The specification and drawings are, therefore, to be regarded in an illustrative rather than a restrictive sense. Accordingly, it is not intended that the invention be limited except as may be necessary in view of the appended claims.

I claim:

1. A fender system for a vessel, comprising:
- a bracket mounted to a vertical dock piling at a location above a water line;
- a fender;
- a vertical positioning means for positioning the fender and connecting the fender to the bracket;
- wherein the fender has means for attaching to the vertical positioning means; and
- a float device positioned below the fender wherein the float device engages the fender such that the float device causes the fender to automatically rise and fall in response to the changing level of the water line.

2. The fender system of claim **1** wherein the bracket is bent into a 180° degree arc that faces downwards towards the water line when mounted to the dock piling.

3. The fender system of claim **1** wherein the vertical positioning means is a cable or a rod.

4. The fender system of claim **3** wherein the means for attaching the fender to the vertical positioning means is a hole traversing the length of the fender such that the vertical positioning means can be inserted through the fender.

5. The fender system of claim **4** wherein the float device further comprises a hole traversing its length such that the vertical positioning means can be inserted through the float device.

6. The fender system of claim **5** wherein the float device causes the fender to slide along the vertical positioning means in response to the changing level of the water line.

7. The fender system of claim **1** further comprising a shackle for connecting the vertical positioning means to the bracket such that the vertical positioning means has a range of movement with respect to the bracket.

8. The fender system of claim **7** further comprising a sleeve interconnecting the vertical positioning means and the shackle wherein the sleeve is made of a non-corroding material or a galvanically acceptable material.

9. The fender system of claim **8** wherein the sleeve is comprised of nylon.

10. The fender system of claim **1** further comprising a weight wherein the vertical positioning means is connected to the weight at its terminating end such that the weight maintains the positioning and vertical alignment of the fender.

11. The fender system of claim **10** wherein the weight is located above the sea floor.

12. The fender system of claim **1** further comprising a hollow pipe having a ¼" inch cut traversing the entire length of the pipe and an end cap on each end of the pipe whereby each end cap has a ¼" inch diameter hole at its center wherein the pipe is positioned between the fender and the float device such that the pipe is used to alter the height of the fender along the vertical positioning means in relation to the water line.

13. The fender system of claim **1** wherein the float device is comprised of foam or plastic.

14. A fender system for a vessel, comprising:
- an upper bracket mounted to a vertical dock piling at a location above a water line;
- a lower bracket mounted to the vertical dock piling at a location below the water line;
- a fender;
- a vertical positioning means for positioning the fender and connecting the fender to the upper and lower brackets;
- wherein the fender has means for attaching to the vertical positioning means; and
- a float device positioned below the fender wherein the float device engages the fender such that the float device causes the fender to automatically rise and fall in response to the changing level of the water tide.

15. The fender system of claim **14** wherein the upper bracket is bent into a 180° degree arc that faces downwards towards the water line when mounted to the dock piling.

16. The fender system of claim **14** wherein the vertical positioning means is a cable or a rod.

17. The fender system of claim **16** wherein the means for attaching the fender to the vertical positioning means is a hole traversing the length of the fender such that the vertical positioning means can be inserted through the fender.

18. The fender system of claim **17** wherein the float device further comprises a hole traversing its length such that the vertical positioning means can be inserted through the float device.

19. The fender system of claim **18** wherein the float device causes the fender to slide along the vertical positioning means in response to the changing level of the water line.

20. The fender system of claim **14** further comprising a shackle for connecting the vertical positioning means to the bracket such that the vertical positioning means has a range of movement with respect to the bracket.

21. The fender system of claim **20** further comprising a sleeve interconnecting the vertical positioning means and the shackle wherein the sleeve is made of a non-corroding material or a galvanically acceptable material.

22. The fender system of claim **21** wherein the sleeve is comprised of nylon.

23. The fender system of claim **14** further comprising a hollow pipe that is positioned between the fender and the float device such that the hollow pipe is used to alter the height of the fender in relation to the water line.

24. The fender system of claim **14** wherein the float device is comprised of foam or plastic.

25. The fender system of claim **23** wherein the hollow pipe further comprises a longitudinal slit cut the entire length of the pipe with end caps on each end of the pipe.

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