Dec. 1, 1936. E. F. MAAS 2,062,919

MARINE FENDER

Filed Jan. 8, 1934 2 Sheets-Sheet 1

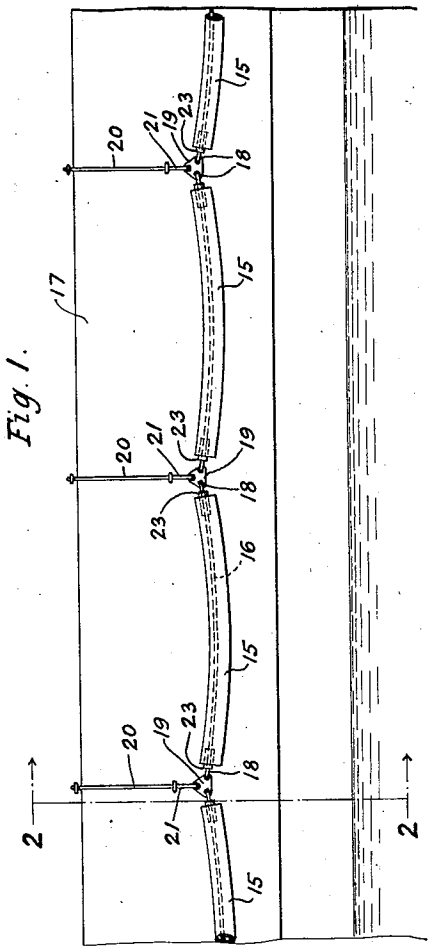


Fig. 1.

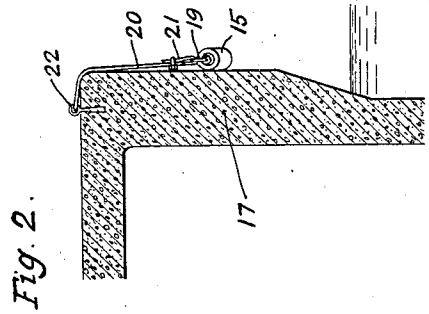


Fig. 2.

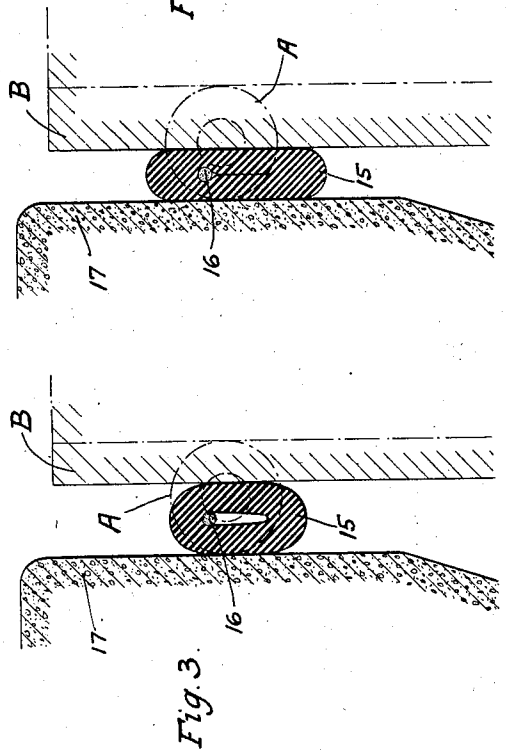


Fig. 4.

Fig. 3.

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MARINE FENDER

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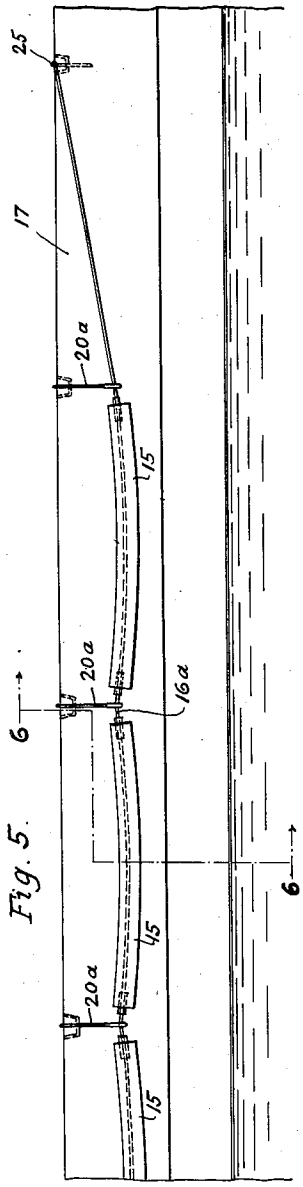


Fig. 5.

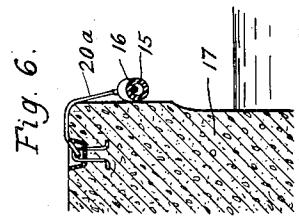


Fig. 6.

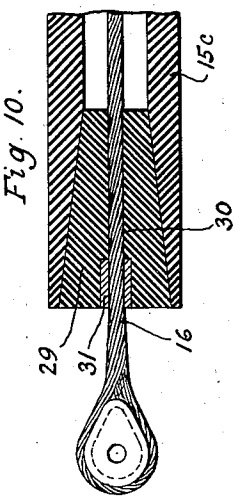


Fig. 10.

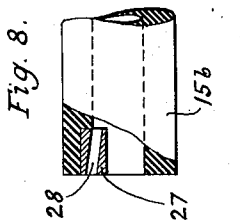


Fig. 8.

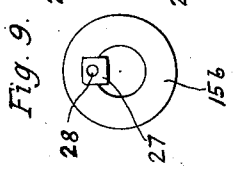


Fig. 9.

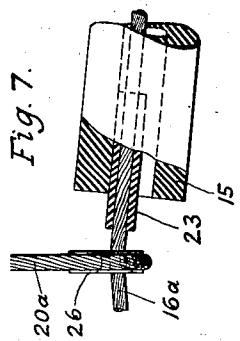


Fig. 7.

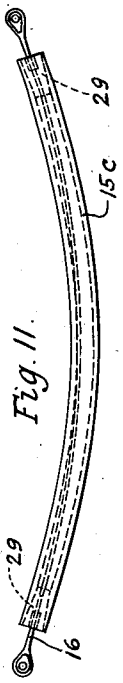


Fig. 11.

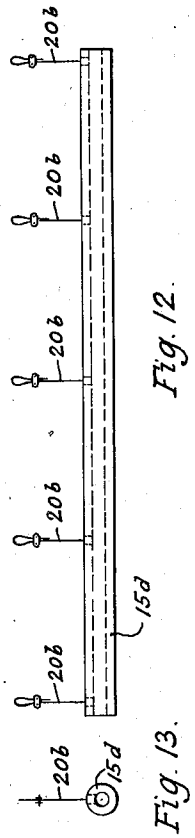


Fig. 12.

Fig. 13.

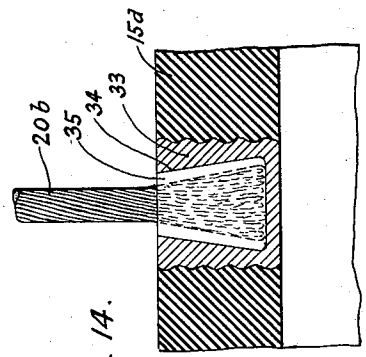


Fig. 14.

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UNITED STATES PATENT OFFICE

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MARINE FENDER

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Application January 8, 1934, Serial No. 705,749

6 Claims. (Cl. 114—219)

This invention relates to improvements in marine fenders and it has particular reference to such fenders for protecting the sides of ships from injury in the event of contact or collision with other marine structures such as piers, break-waters, canal locks and the like. Some of the matter disclosed herein is described and claimed in my divisional application Serial No. 106,205, filed October 17, 1936, for Ship fenders.

Prior to this invention several types of marine fenders have been proposed, but they have been objectionable for several reasons. Most of them have been too rigid and unyielding to give the necessary cushioning effects, and some have been too costly because of complicated structure and difficulty in applying. The present invention, however, overcomes the objectionable features of the prior art and provides a fender of extreme simplicity in construction and one which may be easily installed or applied.

An important object of the invention is to provide a marine fender which will be formed of cushioning material, preferably resilient rubber, and so arranged as to be flexible throughout at least the major portion of its length.

Another object is to provide a marine fender which will be not only formed of yieldable material, but which will be yieldably supported so as to be capable of complete bodily movement when necessary.

Another object is to provide such a fender which will be capable of movement both horizontally and vertically, and this without likelihood of the cushioning material being torn away from its supporting means.

The foregoing and other objects, features and advantages of the invention will be readily appreciated from the following description in conjunction with the accompanying drawings, wherein several forms of the invention have been shown by way of illustration, and wherein:

Fig. 1 is a fragmentary side-elevation of a pier equipped with one form of fender embodying the invention;

Fig. 2 is a vertical transverse sectional view on the line 2—2 of Fig. 1;

Figs. 3 and 4 are views similar to Fig. 2, but drawn on a larger scale and showing the cushioning material displaced under compression;

Fig. 5 is a fragmentary side view of a pier equipped with a modified form of the invention;

Fig. 6 is a vertical transverse sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a fragmentary view partly in section and partly in elevation and showing in greater detail the construction of the fender of Fig. 5;

Fig. 8 is a fragmentary view similar to Fig. 7 but showing another modification of the invention;

Fig. 9 is an end view of the fender member shown in Fig. 8;

Fig. 10 is a fragmentary longitudinal sectional view through still another modified form of the invention;

Fig. 11 is a complete side-elevation of one of the fender elements embodying the structure shown more clearly in Fig. 10;

Fig. 12 is a side elevation showing still another modification of the invention;

Fig. 13 is an end view of the structure shown in Fig. 12; and

Fig. 14 in a fragmentary sectional view on a larger scale and showing in detail the structure employed in the fender of Fig. 12.

Referring first to Figs. 1 to 4 inclusive, it will be seen that the novel fender comprises one or more tubular bodies 15 of resilient rubber, said bodies being relatively long in proportion to their diameters and being carried by a flexible supporting unit 16 which is suspended in any suitable manner at the side of a pier 17 or other marine structure. Each tubular body 15 may preferably be circular in cross-section when free of compression and of substantial dimensions, its outside diameter preferably being more than twice as much as its inside diameter, whereby to provide a wall thickness which will be capable of absorbing very substantial forces. In the illustrated embodiment there are shown a plurality of tubular members 15 arranged above the water line at the side of the pier 17, and the supporting unit 16 is shown as comprising a plurality of suitable lengths of flexible steel cable, each of such lengths of cable being threaded through one of the tubular members 15 and with its ends projecting outwardly therefrom. These steel cables are of considerably smaller diameter than the inside diameter of the rubber tubes with the result that said rubber tubes are loosely held and upon occasion are free to rotate with reference to the supporting means. The ends of the cables are looped at 18 for connection with metallic plates 19 which are arranged between each pair of cables to provide a unitary assembly. A plurality of flexible suspension members 20 are also employed, they preferably being formed of steel cable and having their lower ends looped and connected at 21 with the metallic plates 19, and having their upper ends connected at 22 to eye-bolts or other suitable fastening means provided at or

near the top of the pier. Adjacent their ends the cables which make up the supporting unit 16 are preferably covered by cushioning sleeves 23 whereby to prevent the tubes 15 from becoming chafed by the cable. These sleeves 23 may also be formed of rubber or other suitable non-metallic material and have a snug fit upon the cables.

The normal position and appearance of one of the tubular cushioning elements 15 is indicated in dot and dash lines A in Figs. 3 and 4, and the side of a ship is diagrammatically shown at B in the same views. From these views it will be clear that as the ship comes in contact with the tubular member 15 it tends to flatten the same to the point where the inside thereof is completely closed and thereafter continued pressure causes the rubber to spread. Of course the dimensions and proportions of the parts may be varied to suit different installations, but by way of illustration it is pointed out that in one such installation on a concrete pier used for heavy shipping, complete success was achieved by a fender wherein the tubular elements 15 were formed of 7 inch outside diameter and 3 inch inside diameter. The rubber of which these tubes were produced was suitably compounded for toughness and resiliency. In a fender of that size the tube 15 offers a resistance of substantially 1½ tons per foot of length before the center opening is entirely closed, and further it will safely resist a force of 50 tons per foot of length without damaging the rubber. The freedom of the tubes to rotate, and their flexible mountings are also important features because they allow the tubes to adjust themselves to different movements of the ship and thus prevent tearing of the rubber as would otherwise be possible if a fixed mounting were used.

It has been stated above that the main sections of the supporting unit 16 and the suspension members 20 are composed of steel cable, but it is to be understood that the invention is not limited in this respect, but that hemp rope, metal link chains, metallic rods, and other equivalents may be similarly employed if desired. Furthermore, the supporting unit 16 need not be made up of a plurality of sections as shown in Fig. 1, but in some cases this supporting unit may be composed of a single continuous flexible element 16*a* as shown in Figs. 5 and 7. The opposite ends of said flexible member 16*a* are secured to the pier 17 at suitable points, such as indicated at 25, and the flexible suspension members 20*a* are attached to the supporting member 16*a* at points between the successive tubular cushioning members 15. As best shown in Fig. 7, the lower end of each suspension member 20*a* may be provided with a metallic reinforcing bushing 26 about which the material is looped and afterward spliced.

For some purposes it might be desirable to have the supporting cable more definitely associated with the tubular shock-absorbing members, and in such case a structure such as is shown in Figs. 8 and 9 may be employed. In this form of the invention the tubular body 15*b* carries a metal block 27 in each of its ends, each of said blocks having an angularly directed opening 28 through which the supporting cable is threaded. These metal blocks 27 are partly embedded in the wall of the tubular member 15*b* and may preferably be molded in place and so arranged as to have a permanent bond with the engaging portions of the rubber.

Another modification is shown in Figs. 10 and 11, wherein the tubular body 15*c* formed of rubber or other resilient non-metallic material is provided in each of its ends with tapered plugs 29, which may also be formed of rubber and provided with central longitudinal bores 30 for passage of the flexible supporting cable 16. A substantially cylindrical metal bushing 31 is anchored in the outer end of each of the tapered plugs 29, said bushings being centrally bored in alignment with the bore 30 to accommodate the cable 16. In this construction the cushioning properties of the rubber are augmented by the air which is confined within each tubular member 15*c* so that this particular form of fender is, in fact, of the pneumatic type. Yet, it is suspended in such a way as to be bodily movable, and thus to possess the advantages of the previously described embodiments.

In some installations it might not be desirable to employ the longitudinally extending supporting member within the rubber cushioning tube, and in that event, a structure as shown in Figs. 12 to 14 inclusive may be employed. Here the cushioning tube 15*d* is provided in one of its side walls with a plurality of relatively spaced anchoring plugs 33 having their outer surfaces corrugated or otherwise roughened and molded in place, whereby to be well bonded. Each of these anchoring plugs 33 is formed with a dovetail socket 34 into which the lower end of a suspension cable 20*b* may be inserted and flared (see Fig. 14), and the remaining space filled with molten lead 35 holding the parts in assembled relation.

From the foregoing it will be understood that a novel marine fender has been provided which will be capable of absorbing shocks incident to the contacting of a pier by a ship and thus protecting the sides of the ship from injury. The construction is extremely simple and capable of being produced at relatively low cost as well as being capable of easy installation. The fenders need not necessarily be employed upon a fixed marine structure, but may be used to equal advantage when suspended at the side of a ship. and in this respect the term "marine structure" has been employed in the specification and claims in its broad significance to include either a fixed structure such as a pier or the like, or a movable structure such as a ship or equivalent. Furthermore, the fenders are not limited to use in a horizontal position, but may be suspended vertically or otherwise as desired. Obviously the invention may be modified in respect to details other than those specifically illustrated and described, and the right is herein reserved to make such changes as fall within the scope of the appended claims without departing from the spirit of the invention.

Having thus described the invention, what is claimed is:

1. In a marine fender, a flexible cable, a substantially horizontally arranged tubular body of rubber loosely strung on said cable for longitudinal sliding movement thereon, said body of rubber being of substantial proportions and having an inside diameter considerably greater than that of the cable, means in the ends of the tubular body to prevent chafing with the cable, and upwardly extending suspension means attached to the cable adjacent the ends of the tubular body.

2. A marine fender comprising a substantially horizontally arranged elongated tubular mem-

ber of resilient material having an internal opening for an air space freely communicating at its ends with the outer atmosphere, suspension means extending through said tubular member and extending upwardly from the ends thereof for suspending the same from a pier or the like, and a sleeve surrounding said suspension means within each end of said tubular member for preventing the former from chafing the latter, said sleeves having at least one side thereof spaced from the wall of said opening in said tubular member to permit the escape of air from the ends of said tubular member around said sleeve when the same is compressed through impact thereon.

3. A marine fender comprising a substantially horizontally arranged elongated tubular member of resilient material having an internal opening forming an air space freely communicating at its ends with the outer atmosphere, suspension means extending through said tubular member and extending upwardly from the ends thereof for suspending the same from a pier or the like, and a sleeve surrounding said suspension means within each end of said tubular members for preventing the former from chafing the latter, said sleeves being disposed eccentrically of the opening in said tubular member to space the same from the wall thereof, whereby to permit the escape of air from the ends of said tubular member when the same is compressed through impact thereon.

4. A marine fender comprising a substantially horizontally arranged elongated tubular member of resilient material having an internal opening forming an air space freely communicating at its ends with the outer atmosphere, suspension means extending through said tubular member for suspending the same from a pier or the like, and a metallic sleeve surrounding said suspension means and vulcanized within each end of said tubular member for preventing the former from chafing the latter, said sleeves having at least one side thereof spaced from the wall of said opening in said tubular member, and disposed eccentrically thereof to permit the escape of air from the ends of said tubular member when the same is compressed through impact thereon.

5. A device as set forth in claim 2 in which the sleeves have the axes of the openings therethrough extending at angles to the axis of said tubular member in a direction away from said latter axis toward the outer ends of the openings in said sleeves.

6. A device as set forth in claim 3 in which the sleeves have the axes of the openings therethrough extending at angles to the axis of said tubular member in a direction away from said latter axis toward the outer ends of the openings in said sleeves.

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