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Tedeschi, Jr.

[11] **3,906,732**

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[54] **SHIPSIDE OIL BARRIER SEAL**

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[52] **U.S. Cl.** ..... **61/1 F**

[51] **Int. Cl.²** **E02B 15/04**

[58] **Field of Search** ..... 61/1, 1 F; 210/DIG. 21, 210/242

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Primary Examiner—Dennis L. Taylor

[57] **ABSTRACT**

A pier mounted shipside oil barrier seal structure floating on the water surface for use between a generally fixed connection point floating on the water surface and a ship having a side surface. The structure comprises a floating shipside oil seal member vertically extended above and below the water level, having at its ship-contacting end a flexible elastic rubber-like vertically extended sealing element for contacting the ship side surface. It is mounted on the pier by a pair of transversely spaced supports slideably supporting it for transverse movement, the supports being arranged for free vertical movement of the floating oil seal member with the water level as it changes with respect to the pier and the ship side. Springs are connected between the oil seal member and the supports for urging the oil seal element into contact with the ship's side. It may also have a bendably collapsible portion collapsible upon horizontal movement of the ship side toward the fixed connection point.

14 Claims, 7 Drawing Figures

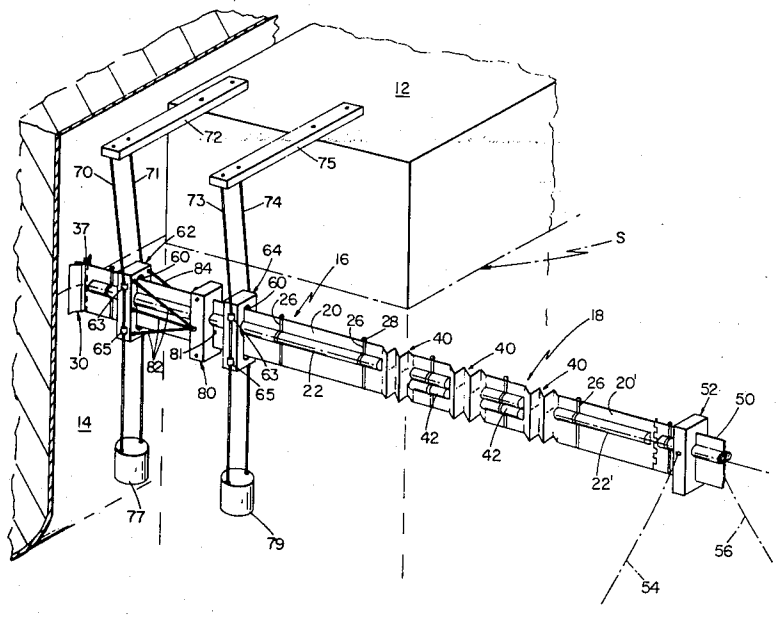


FIG 1

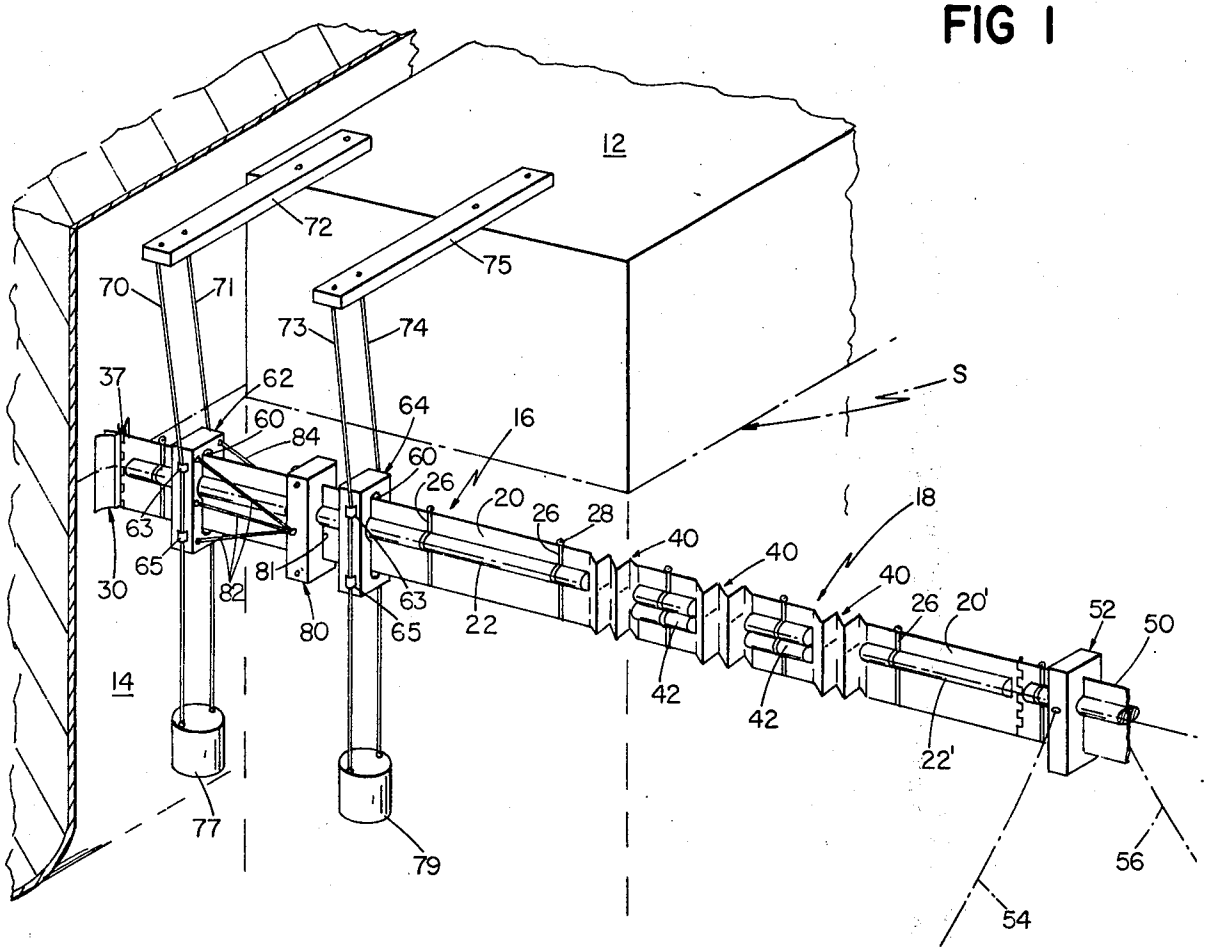
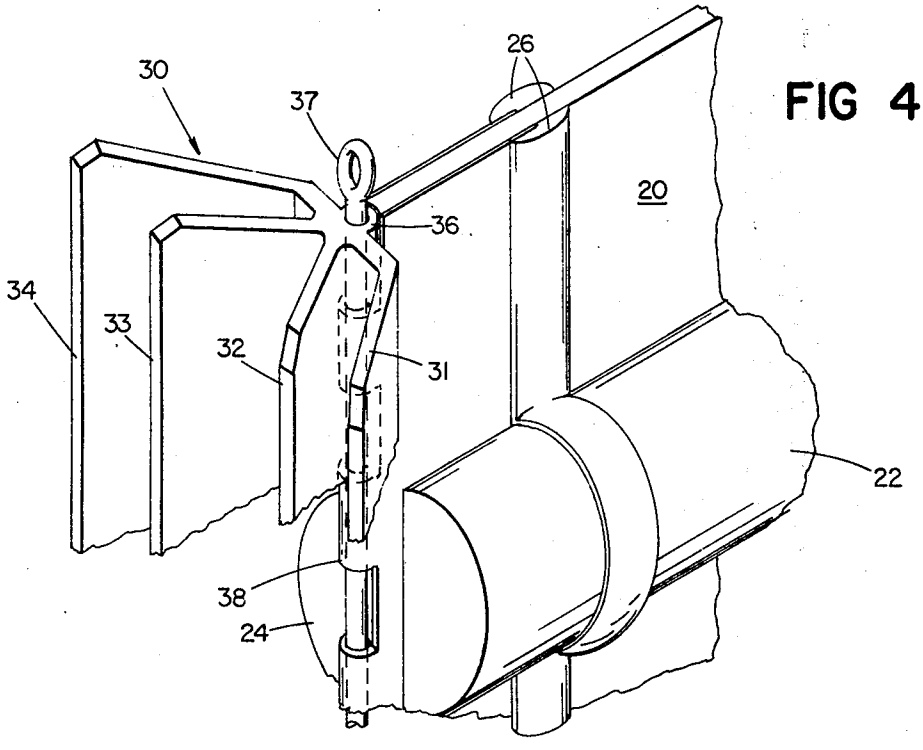

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FIG 4


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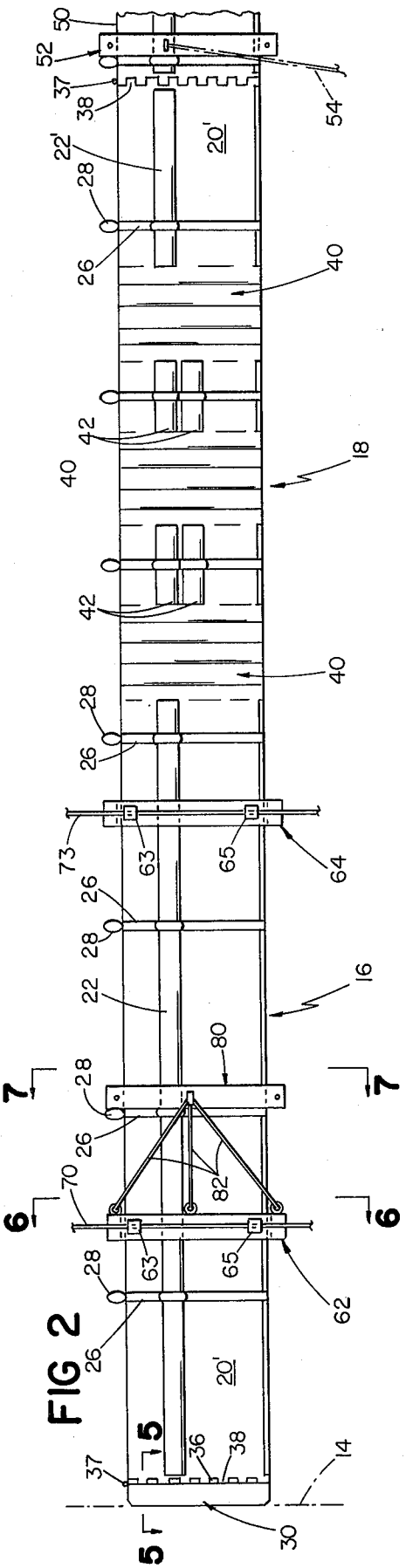


FIG 2

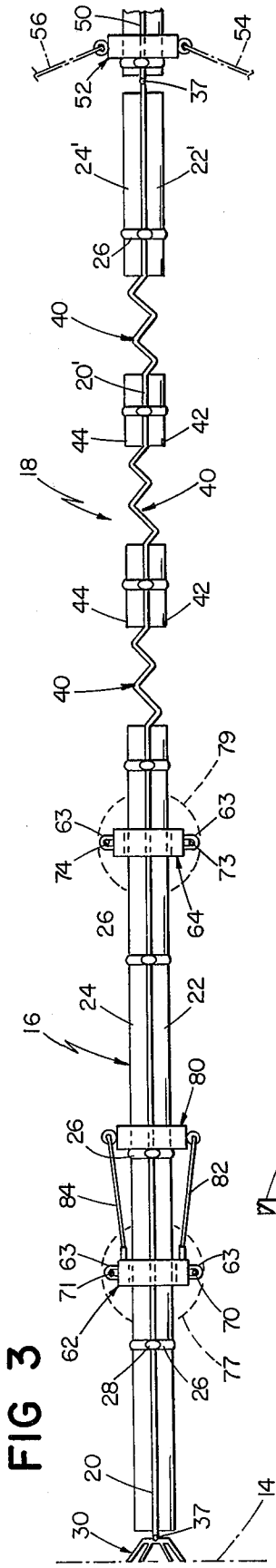


FIG 3

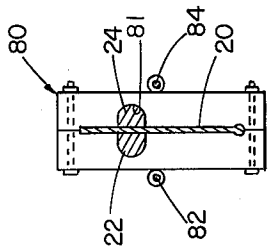


FIG 7

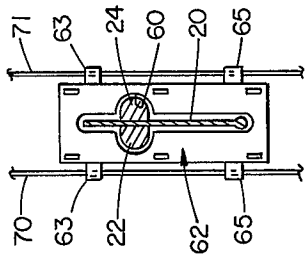


FIG 6

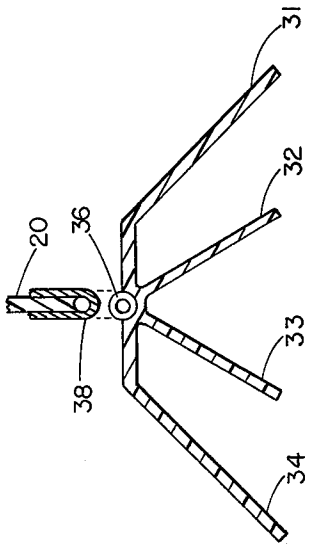


FIG 5

SHIPSIDE OIL BARRIER SEAL

This invention relates to oil booms and more particularly to a pier mounted, shipside sealing structure therefor.

In U.S. Pat. No. **3,818,708** is disclosed a floating oil barrier structure, together with devices for attaching it to connection points which allow it to move vertically with the rise and fall of the tide, while restraining it against movement in a horizontal direction on the surface of the water. Although these devices are entirely successful for the purpose for which they were designed, they do not solve the specific problem of providing an effective oil seal at the side of a ship tied to a fixed pier, wherein the ship not only moves vertically with respect both to the pier and the water surface but also moves horizontally with respect to the pier. The practical solution to the problem is made more difficult because of several factors among which are:

the necessity of allowing vertical movement of the ship side relatively both to the pier and the water surface which makes it difficult to utilize the ship as an attachment point; and

the necessity of allowing for horizontal movement of the ship relatively to the pier under the influence of wind and current without opposition from the oil barrier which, because of the great mass of the ship, would be destroyed if any attempt were made to use it to prevent such movement.

Accordingly, it is a major object of the invention to overcome these problems in such a manner as to provide a practical pier mounted shipside sealing structure.

The present invention accomplishes this by providing a pier mounted shipside oil barrier seal structure floating on the water surface for use with a ship having a side surface, the water level moving vertically with respect to the ship and the pier, and the ship moving horizontally with respect to the pier. It comprises a floating shipside oil seal member vertically extended above and below the water level and having at its end adjacent the ship side surface, at least one flexible, elastic, rubber-like, vertically extended sealing element for contacting the ship side surface, and pier mounting means mounting the oil seal member on the pier for vertical and horizontal movement relatively thereto. The mounting means includes a pair of transversely spaced support means slideably supporting the oil seal member at spaced positions therealong for transverse movement relatively to the ship side surface, the support means being mounted for vertical movement on the pier for free vertical movement of the floating oil seal member with the water level, as it changes with respect to the pier, and oil seal operating spring means connected between the oil seal member and the support means for urging the sealing element into contact with the ships side.

In certain of its more limited aspects, the invention includes support members surrounding the oil seal member providing a through channel for slideably supporting the oil seal member and a clamp member surrounding and mounted on the oil seal member at a location between the support members, the spring means being tension spring means connected between the clamp member and the one of the support members adjacent the free end of the oil seal member.

The support member guide means may also include a non-rigid flexible strand member adapted to be mounted at its upper end on the pier and having a weight at its lower end and a pair of vertically spaced strand guide means on each of the support members mounting the support members for vertical sliding movement along the strand member for non rigid support and limited horizontal movement of the oil seal member relatively to the pier. Stop means may also be mounted on the oil seal member between the one of the support members adjacent the free end and the free end itself to limit the maximum travel of the oil seal member relatively to the support members.

In another aspect of the invention, the floating shipside oil seal member may have at one end an extended relatively rigid portion and at the other end an extended readily bendably collapsible portion, said portions being sealably connected to one another. The rigid portion may comprise a vertical dam, preferably at least one-fourth inch thick, constructed of readily bendably collapsible solid material resiliently deformable in all directions, and have floats extended laterally from opposite sides of the dam below the top thereof, continuously along the length of the rigid portion to provide rigidity for the rigid portion. The bendably collapsible portion may comprise a vertical dam, preferably at least one-fourth inch thick, constructed of readily and easily bendably collapsible solid material resiliently deformable in all directions and have a plurality of individual floats extending laterally from opposite sides of said dam below the top thereof, these individual floats being longitudinally spaced a substantial distance from one another, providing unsupported dam portions therebetween, these unsupported dam portions between the floats being free to bend for longitudinal folding collapse of the bendably collapsible portion with horizontal movement of the ship side and the rigid portion toward a fixed connection point.

For the purpose of fully explaining the various objects and features of the invention, reference is now made to the following detailed description thereof, together with the accompanying drawings, wherein:

FIG. **1** is a somewhat diagrammatic perspective view of the pier mounted, shipside, sealing structure of the invention;

FIGS. **2** and **3** are, respectively, more detailed side and top views of the structure of FIG. **1**;

FIG. **4** is a detailed isometric view of the ship-side contacting end of the structure of FIG. **1**;

FIG. **5** is a cross-sectional view of the end of FIG. **4**; and

FIGS. **6** and **7** are end sectional views of the sealing structure of FIG. **1**, taken on lines **6—6** and **7—7** of FIGS. **2** and **3**.

Referring to the drawings, and particularly to FIG. **1** thereof, there is illustrated the oil barrier seal structure of the present invention mounted on a fixed finger pier **12** and floating on the water surface *S* in contact with the side surface **14** of a ship. It extends between the ship and a generally horizontally fixed connection point floating on the water surface, which, as shown, comprises a moored end of an oil barrier, such as is disclosed in said U.S. Pat. No. **3,818,708,** but also may comprise other types of horizontally fixed connection points, as also disclosed in said patent. The ship-contacting end of the oil barrier structure remains floating on the water surface, while the ship side moves

both vertically with respect to the water surface as the ship loads or discharges and horizontally under the influence of wind and current. The water level also moves vertically with respect to the pier as the tide rises and falls. Under all these circumstances, the ship-contacting end of the seal structure of the invention automatically remains in contact with the ship side to provide an effective oil barrier seal.

In general, the seal structure of the present invention comprises a floating shipside oil seal member, vertically extended above and below the water surface level (S), said member having at one end an extended relatively rigid portion, generally designated **16,** and at the other end an extended, readily bendably collapsible portion, generally designated **18,** said portions being sealably connected to one another as hereinafter more fully explained.

The rigid portion **16** may be as disclosed in said U.S. Pat. No. **3,818,708,** and comprises a vertical dam **20,** preferably at least one-fourth inch thick constructed of readily bendably collapsible solid material resiliently deformable in all directions, with side floats **22, 24** extending laterally from opposite sides of dam **20** below the top thereof. The floats **22, 24** extend continuously along the length of the dam **20** to provide rigidity for rigid portion **16.** Stiffening ribs **26** having lifting handles **28** are also provided.

The ship-contacting free end of rigid portion **16,** adjacent the ship side surface **14,** has a vertically extending sealing element, generally designated **30,** consisting of four flexible elastic rubber-like vertically extended sealing flaps **31, 32, 33** and **34** for contacting the ship side surface **14,** these flaps being connected at their base and there having a joiner element **36** connected to a similar joiner element **38** on rigid portion **16** to which it is connected by a pin **37** also as shown in said Patent.

The bendably collapsible portion **18** also comprises a vertical dam **20'**, preferably at least one-fourth inch thick, constructed of readily bendably collapsible solid material resiliently deformable in all directions, but, unlike rigid portion **16,** in addition to longer floats **22'** and **24'** at its ends has a plurality of short double floats **42** and **44** extending laterally from opposite sides of dam **20'**, respectively, below the top thereof. Short floats **42** and **44** are longitudinally spaced a substantial distance from one another, providing unsupported dam portions therebetween, so that the unsupported dam portions **40** between the floats **42, 44** are free to bend for longitudinal folding collapse of said bendably collapsible portion **18,** as illustrated in FIGS. **1–3.** The free end of the bendably collapsible portion **18** is connected by another end joiner element **38** and pin **37** to a fixed connecting point, herein illustrated as a barrier section **50** having a strongback **52** clamped thereon and moored by lines **54** and **56** to maintain it horizontally fixed on the water surface *S* as disclosed in said Patent. The vertical dams **20** and **20'** are preferably of substantially the same vertical dimension and the average longitudinal flotation of the floats is substantially the same in both the portions **16** and **18.**

For mounting the oil seal member rigid portion **16** on pier **12** for vertical and horizontal movement relatively thereto, the invention provides a pair of transversely spaced support members **62** and **64** surrounding the dam **20** and floats **22, 24** of rigid portion **16.** Members **62** and **64** have cruciform central openings **60,** providing a through channel with sufficient clearance for slideably supporting the dam **20** and floats **22, 24** of rigid portion **16** at spaced positions therealong for transverse movement relatively to pier **12.** Guides are provided for mounting support members **62** and **64** for vertical movement relatively to pier **12,** for free vertical movement of the rigid portion **16** of the floating oil seal member with the water level as it changes with respect to pier **12** with the rise and fall of the tide, as well as for providing an important degree of horizontal movement. These guides include two pairs of generally vertically extending non-rigid flexible strand members **70,** 71 and **73, 74,** associated with support members **62** and **64,** respectively, each pair being mounted at its upper end on pier **12** by beams **72** and **75,** respectively. The pairs of strands have weights **77, 79,** respectively, at their lower ends to maintain them in a generally vertical position while permitting their deflection under stress. Strand members **70, 71** and **73, 74** lead through pairs of vertically spaced strand guides **63, 65** on each side of each of said support members, mounting said support members for vertical sliding movement along the strand members for non-rigid support and limited horizontal movement of said floating seal structure relatively to said pier.

A clamp member **80** is provided surrounding and mounted on rigid portion **16** at a location between support members **62, 64,** said clamp member having a cruciform central opening **81** providing an interference fit to clamp dam **20** and floats **22** and **24** therewithin. Tension springs **82, 84,** in the form of elastic strands, are connected between said clamp member on each side thereof and the one of said support members adjacent the free end of rigid portion **16,** that is, support member **62,** for urging sealing element **30** into contact with said ship's side surface **14.**

A stop is also mounted on rigid portion **16** between support member **62** adjacent said free end and said free end itself to limit the maximum travel of rigid portion **16** relatively to support members **62** and **64,** said stop being effected by the rib **26** closest to the free end of rigid section **16.**

In operation, the tension springs continuously urge the free end sealing element **30** into sealing contact with the ship side while permitting both its vertical and horizontal movement. Strand members **70, 71, 73** and **74** permit the support members to move as the ship moves closer to the pier, and the bendably collapsible portion **18** at the same time collapses with horizontal movement of said ship side and rigid portion **16** toward said fixed connection point all to prevent damage to the seal structure by uniquely providing resiliency thereto, while maintaining its effectiveness as a shipside seal without the necessity of direct attachment to the side of the ship.

What is claimed is:

1. A pier mounted shipside oil barrier seal structure floating on the water surface for use with a ship having a side surface, the water level moving vertically with respect to said ship and said pier and said ship moving horizontally with respect to said pier

said structure comprising

a floating shipside oil seal member vertically extended above and below the water level and having at its free end adjacent the ship side surface at least one flexible elastic rubber-like vertically extended sealing element for contacting the ship side surface and

pier mounting means mounting said oil seal on said pier for vertical and horizontal movement relatively thereto

said mounting means including

a pair of transversely spaced support means slideably supporting said oil seal member at spaced positions therealong for transverse movement relatively to said ship side surface

said support means being mounted for vertical movement on said pier for free vertical movement of said floating oil seal member with the water level as it changes with respect to said pier and

oil seal operating spring means connected between said oil seal member and said support means for urging said oil seal element into contact with said ships side.

2. An oil barrier seal structure as claimed in claim **1** wherein

said support means includes support members surrounding said oil seal member providing a through channel for slideably supporting said oil seal member.

3. An oil barrier seal structure as claim in claim **2** further including

a clamp member surrounding and mounted on said oil seal member,

said spring means being tension spring means connected between said clamp member and the one of said support members adjacent the free end of said oil seal member.

4. An oil barrier seal structure as claimed in claim **3**, further including

support member guide means including

a non-rigid flexible strand member adapted to be mounted at its upper end on said pier and having a weight at its lower end and

a pair of vertically spaced strand guide means on each of said support members mounting said support members for vertical sliding movement along said strand member for non rigid support and limited horizontal movement of said oil seal member relatively to said pier.

5. A pier mounted shipside oil barrier seal structure floating on the water surface for use with a ship having a side surface, the water level moving vertically with respect to said ship and said pier, and said ship and seal structure moving horizontally with respect to said pier

said structure comprising

a floating shipside oil seal member vertically extended above and below the water level comprising

a vertical dam constructed of solid material resiliently deformable in all directions, and

floats extending laterally from opposite sides of said dam below the top thereof, said floats extending continuously along the length of said section

the free end of said oil seal member adjacent the shipside surface having at least one flexible elastic rubber-like vertically extended sealing element for contacting the ship side surface and

pier mounting means mounting said oil seal member on said pier for vertical and horizontal movement relatively thereto

said mounting means including

a pair of transversely spaced support members surrounding said oil seal member providing a through channel for slideably supporting said oil seal member at spaced positions therealong for transverse movement relatively to said ship side surface

support member guide means mounting said support members for vertical movement on said pier for free vertical movement of said floating oil seal member with the water level as it changes with respect to said pier

said support member guide means including

a non-rigid flexible strand member adapted to be mounted at its upper end on said pier and having a weight at its lower end and

a pair of vertically spaced strand guide means on each of said support members mounting said support members for vertical sliding movement along said strand member for non rigid support and limited horizontal movement of said oil seal member relatively to said pier

a clamp member surrounding and mounted on said oil seal member at a location adjacent one of said support members and

tension spring means connected between said clamp member and the one of said support members adjacent the free end of said oil seal member for urging said sealing element into contact with said ships side surface.

6. An oil barrier seal structure as claimed in claim **5** further including

stop means mounted on said oil seal member between the one of said support members adjacent said free end and said free end to limit the maximum travel of said oil seal member relatively to said support members.

7. A pier mounted shipside oil barrier seal structure floating on the water surface for use between a generally fixed connection point floating on the water surface and a ship having a side surface, the water level moving vertically with respect to said ship and said pier, and said ship and seal structure moving horizontally with respect to said pier and said fixed connection point

said structure comprising

a floating shipside oil seal member vertically extended above and below the water level

said member having at one end an extended relatively rigid portion and at the other end an extended readily bendably collapsible portion, said portions being sealably connected to one another

said rigid portion comprising

a vertical dam constructed of solid material and

floats extending laterally from opposite sides of said dam below the top thereof, said floats extending continuously along the length of said section to provide rigidity for said rigid portion and

said bendably collapsible portion comprising a vertical dam constructed of readily and easily bendably collapsible solid material resiliently deformable in all directions and

a plurality of individual floats extending laterally from opposite sides of said dam below the top thereof,

said individual floats being longitudinally spaced a substantial distance from one another providing unsupported dam portions therebetween said unsupported dam portions between said floats being free to bend for longitudinal folding collapse of said bendably collapsible portion

the free end of said rigid portion adjacent the shipside surface having at least one flexible elastic rubber-like vertically extended sealing element for contacting the shipside surface and

pier mounting means mounting said rigid portion on said pier for vertical and horizontal movement relatively thereto

said mounting means including

a pair of transversely spaced support means slideably supporting said rigid portion at spaced positions therealong for transverse movement relatively to said shipside

said support means being mounted for vertical movement on said pier for free vertical movement of said floating oil seal member with the water level as it changes with respect to said pier and

oil seal operating spring means connected between said oil seal member and said support means for urging said sealing element into contact with said shipsside

the free end of said bendably collapsible portion being connectible to said fixed connection point

said bendably collapsible portion bendably collapsing with horizontal movement of said shipside and said rigid portion toward said fixed connection point.

8. An oil barrier seal structure as claimed in claim **7** wherein

said vertical dam is of substantially the same vertical dimension in said portions and

the average longitudinal flotation of said floats is the same in said portions.

9. An oil barrier seal structure as claimed in claim **7** wherein

said support means includes support members surrounding said rigid portion providing a through channel for slidably supporting said rigid portion.

10. An oil barrier seal structure as claimed in claim **9** further including

a clamp member surrounding and mounted on said rigid portion at a location adjacent one of said support members,

said spring means being tension spring means connected between said clamp member and the one of said support members adjacent the free end of said rigid portion.

11. An oil barrier seal structure as claimed in claim **9** further including

stop means mounted on said rigid portion between the one of said support members adjacent said free end and said free end to limit the maximum travel of said rigid portion relatively to said support members.

12. An oil barrier seal structure as claimed in claim **9,** further including

support member guide means including

a non-rigid flexible strand member adapted to be mounted at its upper end on said pier and having a weight at its lower end and

a pair of vertically spaced strand guide means on each of said support members mounting said support members for vertical sliding movement along said strand member for non rigid support and limited horizontal movement of said rigid portion relatively to said pier.

13. A pier mounted shipside oil barrier seal structure floating on the water surface for use between a generally fixed connection point floating on the water surface and a ship having a side surface, the water level moving vertically with respect to said ship and said pier, and said ship and seal structure moving horizontally with respect to said pier and said fixed connection point

said structure comprising

a floating shipside oil seal member vertically extended above and below the water level

said member having at one end an extended relatively rigid portion and at the other end an extended readily bendably collapsible portion, said portions being sealably connected to one another

said rigid portion comprising

a vertical dam at least one-fourth inch thick constructed of readily bendably collapsible solid material resiliently deformable in all directions, and

floats extending laterally from opposite sides of said dam below the top thereof, said floats extending continuously along the length of said section to provide rigidity for said rigid portion and

said bendably collapsible portion comprising a vertical dam at least one-fourth inch thick constructed of readily bendably collapsible solid material resiliently deformable in all directions and

a plurality of floats extending laterally from opposite sides of said dam below the top thereof, said floats being longitudinally spaced a substantial distance from one another providing unsupported dam portions therebetween said dam portions between said floats being free to bend for longitudinal folding collapse of said bendably collapsible portion

said vertical dam being of substantially the same vertical dimension and the average longitudinal flotation of said floats being substantially the same in said portions

the free end of said rigid portion adjacent the shipside surface having at least one flexible elastic rubber-like vertically extended sealing element for contacting the shipside surface

pier mounting means mounting said rigid portion on said pier for vertical and horizontal movement relatively thereto

said mounting means including

a pair of transversely spaced support members surrounding said rigid portion providing a through channel for slideably supporting said rigid portion at spaced positions therealong for transverse movement relatively to said shipside surface

support member guide means mounting said support members for vertical movement on said pier for free vertical movement of said floating oil seal member with the water level as it changes with respect to said pier

said support member guide means including

a non-rigid flexible strand member adapted to be mounted at its upper end on said pier and having a weight at its lower end and

a pair of vertically spaced strand guide means on each of said support members mounting said support members for vertical sliding movement along said strand member for non-rigid support and limited horizontal movement of said seal structure relatively to said pier,

a clamp member surrounding and mounted on said rigid portion at a location between said support members, and

tension spring means connected between said clamp member and the one of said support members adjacent the free end of said rigid portion for urging said sealing element into contact with said ship-sside surface and

stop means mounted on said rigid portion between the one of said support members adjacent said free end and said free end to limit the maximum travel of said rigid portion relatively to said support members

the free end of said bendably collapsible portion being connectible to said connecting point

said bendably collapsible portion bendably collapsing with horizontal movement of said ship side and said rigid portion toward said fixed connection point.

14. An oil barrier seal structure as claimed in claim **13,** wherein

a said strand member and a pair of said strand guide means are provided on each of opposite sides of said support members.

* * * * *