United States Patent

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[45] Patented **Aug. 17, 1971**

[54] **DEVICE FOR CONFINING OIL RELEASED BY LEAKAGE DURING OFFSHORE OIL DRILLING OPERATIONS**
9 Claims, 9 Drawing Figs.

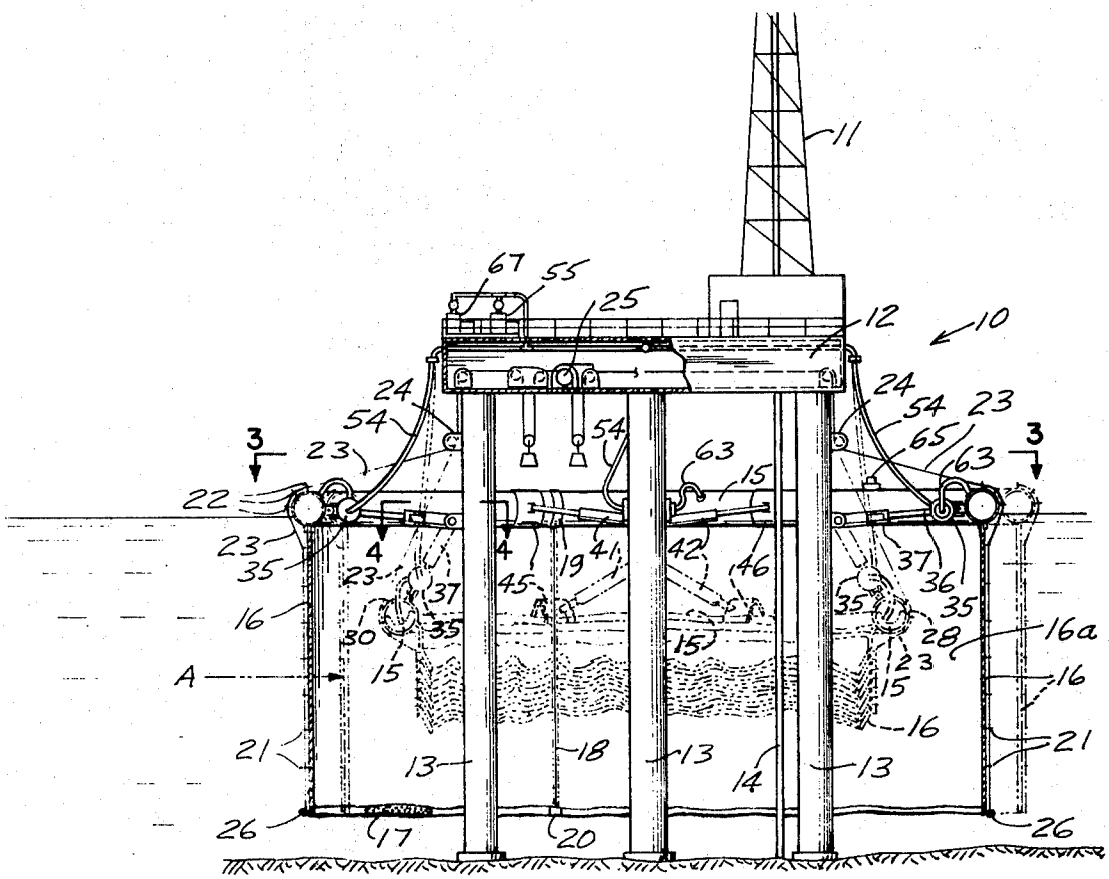
[52] **U.S. Cl.** **61/46,** 61/1, 61/5
[51] **Int. Cl.** **E02b 17/00,** E02b 15/04
[50] **Field of Search** 61/1, 5, 46, 46.5

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Primary Examiner—Jacob Shapiro
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ABSTRACT: A floatable tube and skirt assembly encircling an offshore oil drilling rig for collecting oil released by leakage during the drilling operation, and movable between an operative oil-confining position and an inoperative position in noninterfering relation to the drilling shaft. The tube is connected to the rig structure by telescopically extensible arms, there being (in one embodiment) a plurality of floatable lift canisters connected to said arms and tube, each canister having perforated walls and an inner inflatable bag, an air pump on the rig being connected to said canisters and said tube. When all the canister bags and the tube are deflated, they will sink to an inoperative position, pivotally guided inwardly to that position by said telescopic arms, said arms also serving to guide the tube into its operative floating position. A drawstring arrangement contracts the skirt into compact form against the tube, in noninterfering relation to the drilling shaft.



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SHEET 1 OF 2

FIG. 1

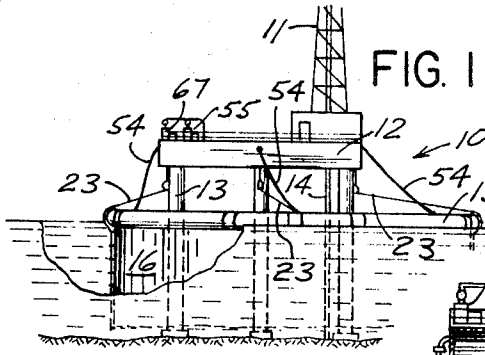


FIG. 2

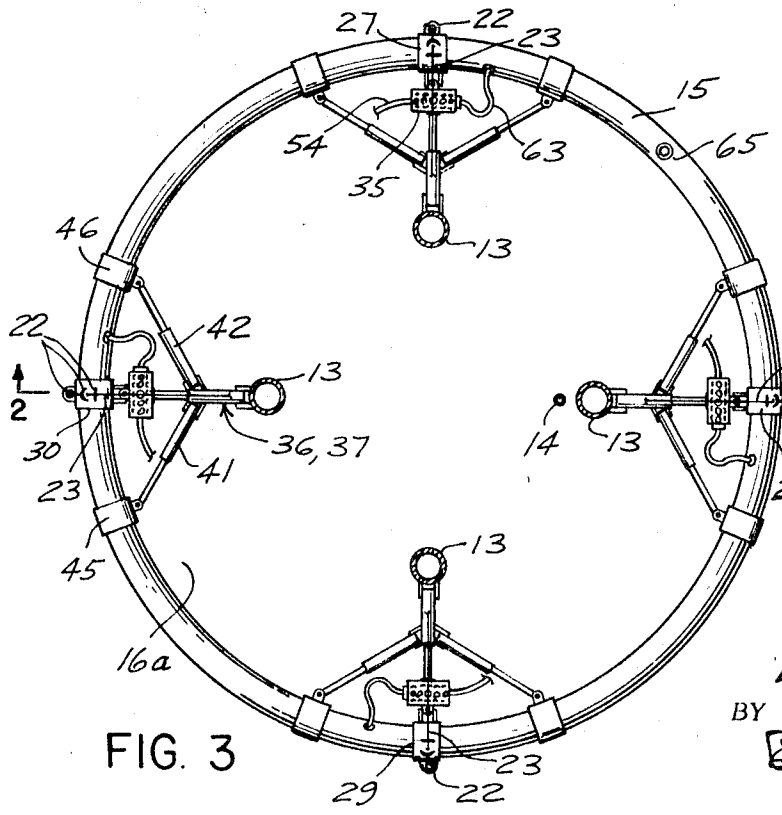


FIG. 3

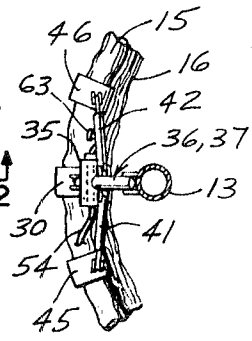


FIG. 4

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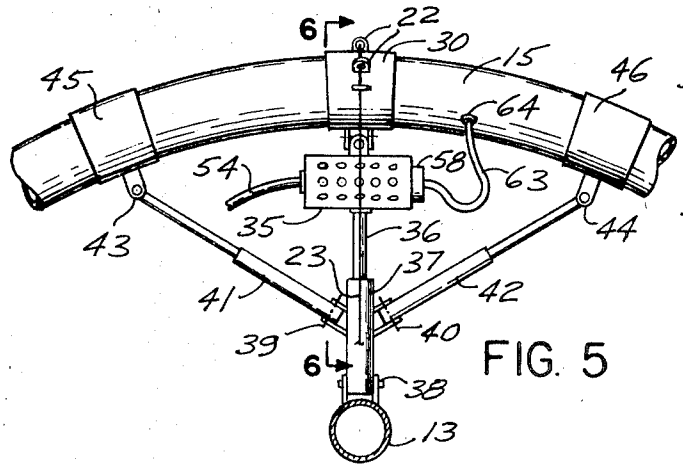


FIG. 5

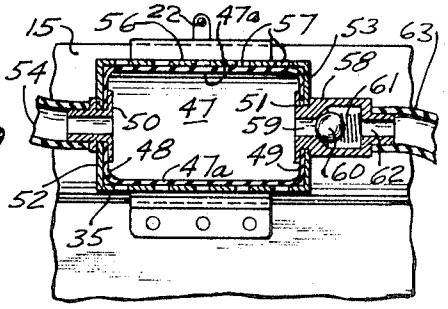


FIG. 7

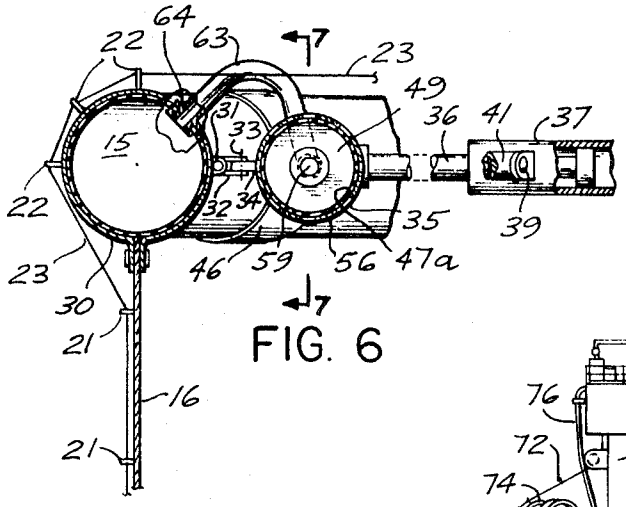


FIG. 6

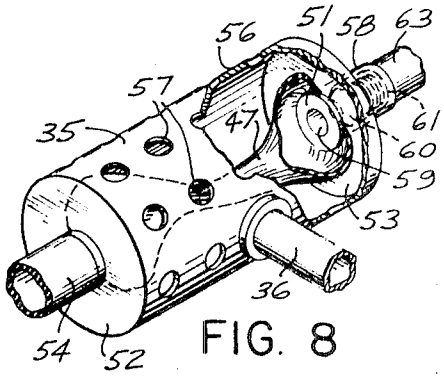


FIG. 8

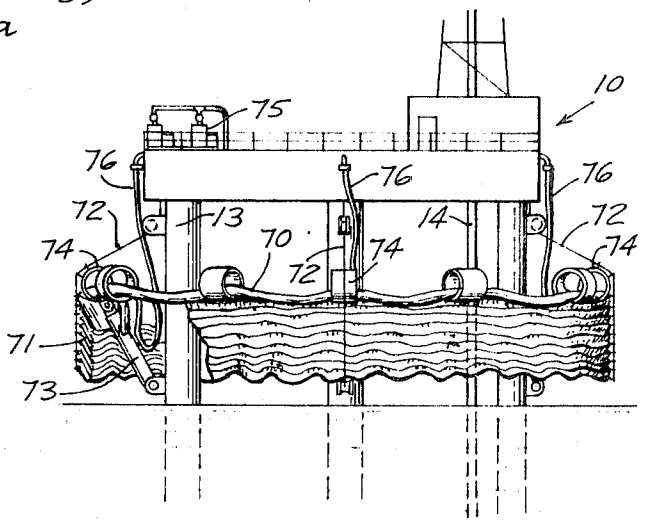


FIG. 9

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DEVICE FOR CONFINING OIL RELEASED BY LEAKAGE DURING OFFSHORE OIL DRILLING OPERATIONS

BACKGROUND OF THE INVENTION

1. The Field of the Invention

This invention relates to floatable means for collecting and confining oil released by leakage during offshore oil drilling operations.

2. The Known Art

There are various expedients for collecting and retaining floating material, such as the use of booms swept over water to collect floating oil and other material, and floatable tanks and the like for storing floating oil. While these methods adequately serve the purpose of trapping oil leaking from a ship, they are not suited for the special task of collecting and confining leaking oil from an offshore oil well during a drilling operation, especially where immediacy is of prime importance.

OBJECTIVES OF THE INVENTION

It is the main object of this invention to enable oil leaking from an offshore well during a drilling operation to be quickly and effectively collected and confined within a limited area for subsequent withdrawal. Further objects are the provision of means (1) to move the oil-confining device of this invention between an operative position in encircling relation to the drilling rig and an inoperative position, said device being in noninterfering relation to the drilling shaft in both its operative and inoperative positions; (2) to contract said device into compact form when in its inoperative position; (3) to effectively guide said device along predetermined paths between its said operative and inoperative positions; (4) to effect a yieldable connection of said device to the structure of the drilling rig, thereby to permit limited drifting of said device due to wind and water currents, and also to prevent sudden impact forces on the rig structure due to the action of wind and water currents on the device.

Other objects, features and advantages will appear from the drawings and the description hereinafter given.

SUMMARY OF THE INVENTION

The preferred embodiment of this invention comprises a floatable inflatable tube and weighted skirt depending therefrom, the assembly of tube and skirt encircling the entire oil offshore drilling rig to which it is operatively connected, or a selected portion of the rig structure containing the drill shaft. Disposed inwardly of the tube are a plurality of floatable lift canisters each pivotally connected to the tube, each of said canisters also having attached thereto a radially and inwardly extending telescopic arm pivotally connected to a structural part of the rig, such as a column supporting the rig platform. Said arms constitute the main lifting and guiding means for the tube during its movements between its operative and inoperative positions. There are also a pair of auxiliary telescopic arms flanking each of said main telescopic arms and pivotally connected to the arm and the tube.

Each canister has a perforated wall and an inner inflatable bag connected on one side thereof to air pump means on the rig and on the other side, through a spring-loaded one-way valve, to an adjacent part of the tube. When the bag is in deflated condition water enters the canister through said perforations, causing the canister to sink and urge the tube downwardly towards its submerged inoperative position. When the bag is inflated, the expanding bag forces the water out through the perforations, until the bag engages the inner walls of the canister, thereby blocking the perforations. Due to the inflated condition of the bags the canisters will rise to floating positions, urging the tube upwardly towards its floating operative position. When the bag is in its fully inflated condition, the said one-way valve, being preset, will open, and air from the said air pump means will enter the tube to inflate it. While being inflated the tube expands outwardly and moves upwardly—guided by the attached telescopic arms to its operative floating position.

The skirt is connected by a plurality of drawstrings to a winch on the rig platform, so that it can be operatively drawn into folded contracted condition while or before it is being moved to its submerged inoperative position, and released to permit it to fold to its operative position where it constitutes an oil-confining cylindrical wall.

In both its operative and inoperative positions, the assembly of tube and skirt is in encircling relation to the drill shaft, so that it never interferes with the operation of said shaft.

DESCRIPTIONS OF THE DRAWINGS

FIG. 1 is a fragmentary semischematic elevational view of an apparatus according to one embodiment of this invention for confining oil released by leakage during offshore oil well drilling, a portion of the water being removed for clarity.

FIG. 2 is a somewhat enlarged fragmentary elevational view of the rig of the apparatus of FIG. 1 shown encircled by the oil-confining device of this invention in its operative floating position, said device being shown by dot-dash lines in collapsed inoperative position, the said tube and skirt being shown as a section taken along line 2–2 of FIG. 3, the assembly of inflatable tube and depending skirt being shown by broken lines in a laterally shifted position.

FIG. 3 is a sectional plan of FIG. 2 taken substantially along line 3–3.

FIG. 4 is a fragmentary section of FIG. 2 taken substantially along line 4–4, showing a fragment of the tube and skirt in collapsed position.

FIG. 5 is an enlarged representation of a portion of FIG. 3.

FIG. 6 is a fragmentary section of FIG. 5 taken substantially along line 6–6.

FIG. 7 is a fragmentary section of FIG. 6 taken along line 7–7.

FIG. 8 is a perspective view of one of the floatable lifting canisters showing fragments of connected parts and showing the inner inflatable bag in collapsed position, a portion of the canister being removed for clarity.

FIG. 9 is a fragmentary elevational view of a modified form of the oil-confining device of this invention shown in operative relation to an offshore drilling rig, the inflated tube with its skirt being shown in collapsed inoperative position above the surface of the water.

DESCRIPTION OF PREFERRED EMBODIMENTS

In the form of this invention illustrated in FIGS. 1 to 8 inclusive, the offshore drilling rig **10** is shown in an offshore oil well drilling position, the rig containing the conventional derrick **11**, platform **12**, columns **13** and revolvable pipe shaft **14** attached at its lowermost point to a drilling bit not shown. The oil-confining device of this invention comprises the inflatable floatable tube **15** supporting the skirt **16** encircling the rig, the skirt being made of flexible or limp material and carrying at the bottom periphery the flexible weighted means **17**. In the particular embodiment illustrated, the said skirt and tube are separable along the vertical seam line **18**, bands **19** and **20** being applied, respectively, over the seamed edges of the tube **15** and bottom weighted periphery **17** of the said skirt **16** in known manner.

The said skirt **16** has a plurality of sets of vertically aligned loops **21**, and the tube **15** has a plurality of sets of correspondingly positioned loops **22** in spaced circumferential arrangement, there being a corresponding plurality of drawstrings **23** extending through said respective sets of loops **21** and **22**, around the respective pulleys **24** attached to adjacent columns **13**, and operatively connected to the winch **25** positioned on platform **12**. The lowermost end of each of said drawstrings is attached to respective hooks **26** at the weighted lower periphery **17** of the skirt, the arrangement being such that upon an operative lifting actuation of said winch **25** in known manner said skirt **16** can be drawn up by said

drawstrings into folded, contracted inoperative position, as indicated by the dot-dash lines in FIG. 2, and upon an operative releasing actuation of the winch the skirt will be released and enabled gravitationally to drop to its extended operative position, all in a manner to be fully hereinafter set forth.

Positioned at spaced intervals on said tube **15** are the bands **27**, **28**, **29** and **30**, these bands being so proportioned as to be in firm frictional engagement with the outer surface of said tube when the latter is in its fully inflated position, said bands being unattached to said tube, so that when the latter is in its operatively collapsed position, as illustrated in FIG. 4, the tube is loosely positioned within said respective bands. Pivotally attached at **31** to an inner portion of each of said bands is a short arm **32**, this being pivotally attached at **33** to the arm **34** affixed to the floatable canister **35**, preferably midpoint along its length, thereby providing a universal connection between said canister **35** and the corresponding band. Attached to said canister diametrically opposite to said arm **34** is the plunger **36** which extends into and is telescopically connected to the cylinder **37**, the latter being pivotally attached at **38** to the adjacent column **13**. The combination of plunger **36** and cylinder **37** constitutes an extensible main lifting and guiding arm extending radially inwardly of the tube and which, together with said floatable canister **35**, is effective in lifting and guiding the said floatable tube **15** from its inoperative dot-dash line position shown in FIG. **2** along a predetermined path upwardly and outwardly to its operative floating position upon the water. Pivotally attached at **39** and **40** at opposite sides of each of said cylinders **37** are the auxiliary telescopic lifting and guiding arms **41** and **42**, respectively, the outer ends of said auxiliary arms being pivotally attached at **43** and **44** to the auxiliary bands **45** and **46**, respectively, flanking the corresponding main band (such as **30** in FIG. **5**). The operative movement of the main telescopic arms **36**, **37**, which is along a path in a substantially vertical plane, will operatively carry along said auxiliary telescopic arms **41** and **42**, and since said main and said auxiliary arms are of extensible construction, their respective lengths will adjust themselves during their operative movements. In other words, when said floatable tube **15** is in its uppermost position as illustrated in full lines in FIGS. **2**, **3** and **5**, the said arms are extended to their full operative lengths; but when the collapsed tube and skirt are in their inoperative position illustrated by dot-dash lines in FIG. **2**, said arms are in their adjusted shortened positions for operatively supporting the assembly of tube and skirt in its said inoperative position.

Each said canister **35** contains therein the inflatable bag **47**, the opposite end walls **48** and **49** thereof being attached by fittings **50** and **51**, respectively, to the respective end walls **52** and **53** of the canister. The said fitting **50** is connected to the air line **54** leading to the air pump **55** mounted on platform **12**, the arrangement being such that the operation of said pump **55** will force air into the interior of the bag **47** to inflate it until the lateral wall **47***a* of the bag is in pressing contact with the lateral wall **56** of the canister **35**. Said lateral wall **56** contains a plurality of apertures **57** therein, the arrangement being such that when the said bag **47** is in its collapsed position, as indicated in FIG. **8**, water can enter the interior of the canister through said apertures but when the bag **47** is in its fully inflated position, it will block and close said apertures **57**. The said fitting **51** is connected to the preset spring-loaded one-way valve **58** which, in the form illustrated, comprises the port **59**, the ball valve **60**, the spring **61** and the outlet orifice **62**. Operatively connected to said orifice **62** is the flexible pipe **63** connected at **64** to the tube **15**. Each of said canisters **35** is operatively connected to said air pump **55** and to said tube **15**. The valve **58** is so preset that the ball **60** will yieldably seal the orifice **59** while the bag **47** is being expanded by the air from pump **55**.

While the bag is expanding, it is forcing water contained within the canister out through said apertures **57**. And when the lateral wall **47***a* of the bag **47** is fully expanded and is in firm pressing engagement with the lateral wall **56** of the canister, the canister will have acquired sufficient buoyancy to rise upwardly toward the surface. When a predetermined pressure within the bag is attained, the ball **60** of the valve **58** will be forces outwardly against the spring **61** to permit air to pass through the orifice **62** into pipe **63** and into the tube **15**, thereby inflating it. The lifting effect of the inflated canisters **35** and the inflated condition of the tube **15** causes the latter to rise to its operative floating position on the water. At this point air from the pump **15** can be shut off, either automatically or by manual manipulation, in known manner.

The device is now in operative position encircling the rig **10**, the interior **16***a* of the skirt **16** serving as a large chamber for receiving and confining any oil which may leak out of the well into the water. The oil will rise to an upper level, and can then be readily pumped out.

It is noteworthy that currents of wind or water will not interfere with the oil-confining function of this device, since the said telescopically adjustable arms will yield due to any wing or current pressure exerted against the tube or skirt. FIG. **2** illustrates a shifting of the tube-skirt assembly in the direction of arrow A, the shifted position being indicated by broken lines. It is also to be observed that the yieldable arms connecting the tube **15** to the columns **13** constitute a safety factor in that any sudden wind or current forces will to a considerable extend be absorbed by the telescopic arms, thereby preventing dangerous impacts against said columns.

When it is desired to retract the tube and skirt assembly, the air release valve **65** on the tube is opened—either manually or by any other known means—whereby air from the tube can be discharged therethrough. Each of said canisters **35**, besides being connected to said air pump **55**, is also connected through said pipe **54** to a suction pump **67** on the platform, whereby air can be withdrawn, in known manner, from said bag **47**, causing it to collapse and thereby to permit water to enter the canister through the apertures **57** as above described. Due to the weight of the water in the canisters, they will sink, exerting a downward force upon the tube **15** and thereby helping to expel the air therefrom. The weight of the deflated tube **15** together with the operative sinking of the water-filled canisters **35** will cause the tube and canister to become submerged, moving downwardly and inwardly due to the pivotal guiding action of said telescopic arms. During such action the winch **25** can be set into operation, drawing the skirt upwardly into its folded and contracted position, as hereinabove described.

The final position of the collapsed tube and skirt assembly is below the surface of the water, but still in encircling relation to the rig structure containing the drill shaft **14**, as clearly illustrated in FIG. **2**. It is particularly noteworthy that said drill shaft extends downwardly through the space **16***a* defined by the tube and skirt, so that there can never be any interference whatsoever with the drilling operation when the oil-confining apparatus is in its said inoperative position.

FIG. **9** illustrates a somewhat modified form of this invention in which the rig **10** is encircled by the oil-confining device containing the inflatable tube **70** and skirt **71**, the assembly being collapsible substantially as in the form above described. However, the winch (not shown) is connected to drawstrings **72** adapted to draw the tube-skirt assembly upwardly above the surface of the water into an inoperative position, there being extensible arms **73** directly pivotally connected to the bands **74** through which the said tube **70** extends. Upon an operative release of said drawstrings **72**, and by the inflation of the tube **70** by operatively pumping air therein from the air pump **75** through the pipes **76**, the tube will be lowered upon the surface of the water, and the skirt **71** will gravitationally fall to its operative position, substantially in the manner above described.

In the above description, the invention has been disclosed merely by way of example and in preferred manner; but obviously many variations and modifications may be made therein. It is to be understood, therefore, that the invention is not limited to any particular form or manner of practicing same.

I claim:

1. A device for confining oil released by leakage during offshore drilling operations comprising the combination of an oil well drilling rig having a drilling shaft and oil-confining means comprising a floatable inflatable tube and a skirt depending downwardly therefrom, said assembly of tube and skirt being in encircling relation to said drilling shaft and being attached to said rig, whereby the tube is in noninterfering relation to said drilling shaft, and yieldable means connecting said tube to said rig, said tube and skirt assembly being in encircling relation to a selected portion of said rig containing said drilling shaft, said yieldable connecting means comprising a plurality of separate members disposed inwardly of said tube, and having pivotal means attached to said tube and rig, respectively, said connecting means being of telescopic construction, whereby said tube and skirt assembly can have limited motion relative to said rig and its said drilling shaft.

2. A device for confining oil released by leakage during offshore drilling operations comprising the combination of an oil well drilling rig having a drilling shaft and oil-confining means comprising a floatable inflatable tube and a skirt depending downwardly therefrom, said assembly of tube and skirt being in encircling relation to said drilling shaft and being attached to said rig, whereby the tube is in noninterfering relation to said drilling shaft, and yieldable means connecting said tube to said rig, said skirt being of flexible material and being operatively movable between an extended operative position and a contracted folded position, said skirt in both of said positions being in encircling relation to said drilling shaft, and actuating means for moving said skirt between both of said positions, said tube and skirt assembly being movable between an operative floating position with said tube on the surface of the water and an inoperative nonfloating position with said tube in spaced relation to said surface, guiding and lifting means pivotally connecting said tube in said rig, said latter means having a plurality of extensible arms pivotally movable in a substantially vertical plane, thereby to guide said assembly of tube and skirt along a predetermined path between said operative and inoperative positions.

3. A device according to claim 2, the said inoperative position of said tube and skirt assembly being below the surface of said water.

4. A device according to claim 2, the said inoperative position of said tube and skirt assembly being above the surface of said water.

5. A device according to claim 2, said inflatable tube having thereon a plurality of bands in circumferential spaced relation, said bands being so proportioned as to be in firm frictional engagement with the outer surface of said tube when it is operatively inflated, and loosely positioned thereover when the tube is in its operatively collapsed position, said bands being pivotally attached to said respective extensible arms.

6. A device according to claim 5, said tube having thereon a plurality of pairs of auxiliary bands flanking said respective first-mentioned bands, each of said extensible arms having pivotally attached thereto at opposite sides thereof a pair of auxiliary arms, the latter being pivotally connected to corresponding ones of said auxiliary bands.

7. A device according to claim 2, said guiding and lifting means having a plurality of floatable lift canisters pivotally connected to said tube and to said extensible arms, each of said canisters having a perforated wall and an inner inflatable bag, air supply means for inflating said bag and said tube, said bag when in an operatively inflated position being in pressing engagement with said perforated wall to block the perforations thereof, whereby the canister with the inflated bag will be buoyant, said bag when in an operatively deflated position being in collapsed condition and out of engagement with said perforated wall, whereby water can enter said canister through said perforated wall to cause the canister to sink to an immersed position and thereby to urge said tube downwardly towards a submerged inoperative position.

8. A device according to claim 7, one portion of said bag being connected to one wall portion of the canister and to said air supply means, another portion of said bag being connected to another wall portion of said canister, and conduit means connecting said latter wall portion with said tube, said conduit means connecting said latter wall portion with said tube, said conduit means having therein a one-way valve operatively preset to open at a predetermined pressure within said bag, whereby when said pressure is operatively attained air will flow from said bag into said tube.

9. A device according to claim 7, and suction means operatively connected to said bag for operatively deflating it from an operatively inflated condition to its said collapsed condition.