United States Patent

[11] 3,631,679

[72] Inventor **Paul Fisch**
171 East 77th St., New York, N.Y. 10021

[21] Appl. No. **844,301**
[22] Filed **July 24, 1969**
[45] Patented **Jan. 4, 1972**

[54] **APPARATUS TO CONFINE AND RECOVER OIL SPILLAGE AT SEA**
14 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** ..... **61/1 F**
[51] **Int. Cl.** **E02b 15/04**
[50] **Field of Search** ..... 61/1, 1 F, 5, 6; 210/242; 114/5 T, 235.2 F; 128/DIG. 20

[56] **References Cited**

UNITED STATES PATENTS

2,397,957	4/1946	Freeman	114/235.2 F
3,332,415	7/1967	Ericson	128/DIG. 20
3,440,993	4/1969	Taylor, Jr. et al.	114/235.2 F
2,228,529	1/1941	Moeller	61/5 X
3,221,884	12/1965	Muller	61/1 F
3,494,132	2/1970	Logan	61/1 F

FOREIGN PATENTS

549,294	11/1942	Great Britain	128/DIG. 20

Primary Examiner—Peter M. Caun
Attorney—J. B. Felshin

ABSTRACT: The apparatus is a floating loop barrier which can be looped to surround a large water area covered with oil. The loop can be reduced so that the originally thin oil film which cannot escape, will gain more height so that it can be pumped out, separated from the water. The barrier is reduced by having one end passed through an eye at the other end and pulled by a boat. The barrier comprises a flexible steel cable or rope core surrounded by inflated sleeve sections attached in tandem. The barrier can be reeled onto a ship and the inflated sections separated from the rope. The sleeves are deflated and stored on the ship while the rope is wound on a drum for storage on the ship.

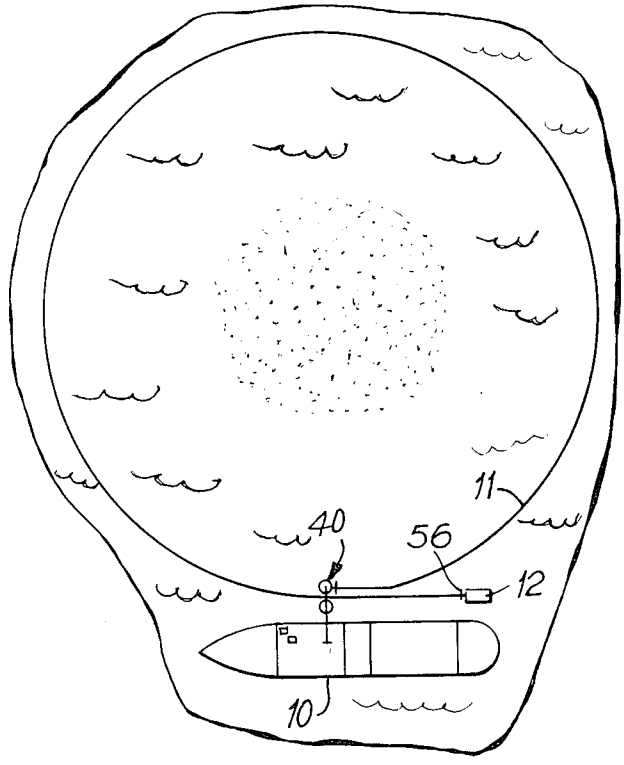


FIG. 1

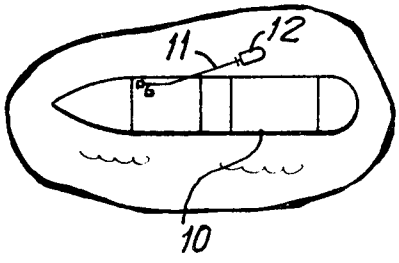


FIG. 2

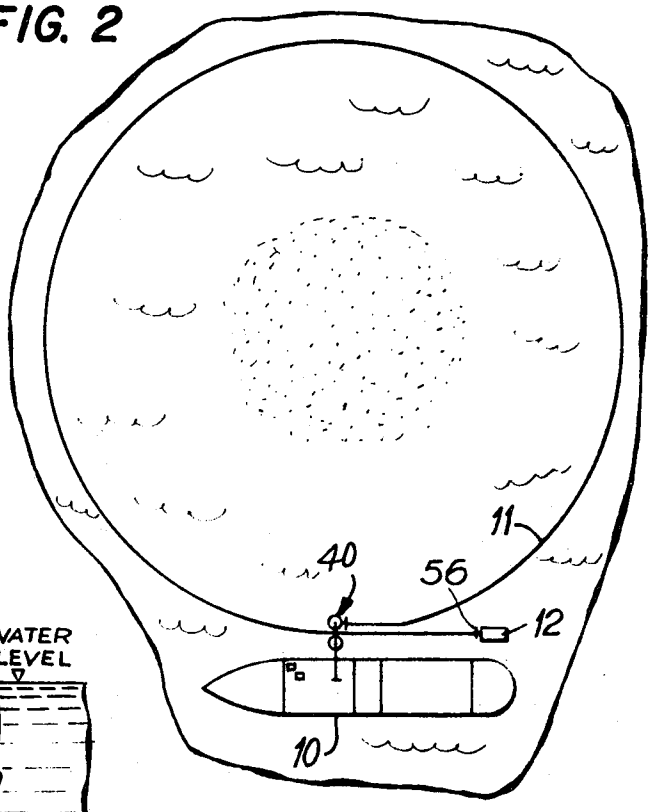


FIG. 3

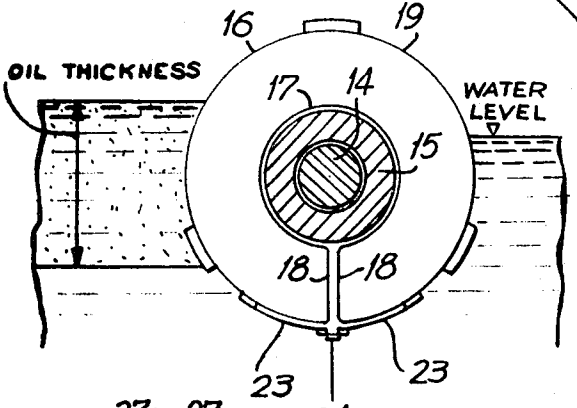


FIG. 4

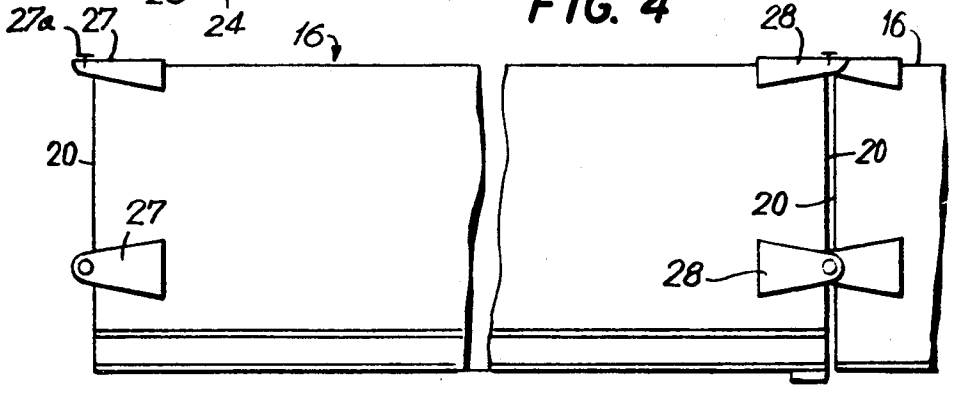
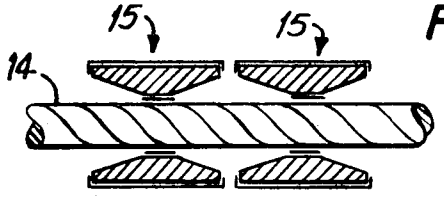


FIG. 5



INVENTOR
PAUL FISCH

BY
J. B. Felshin
ATTORNEY

FIG. 6

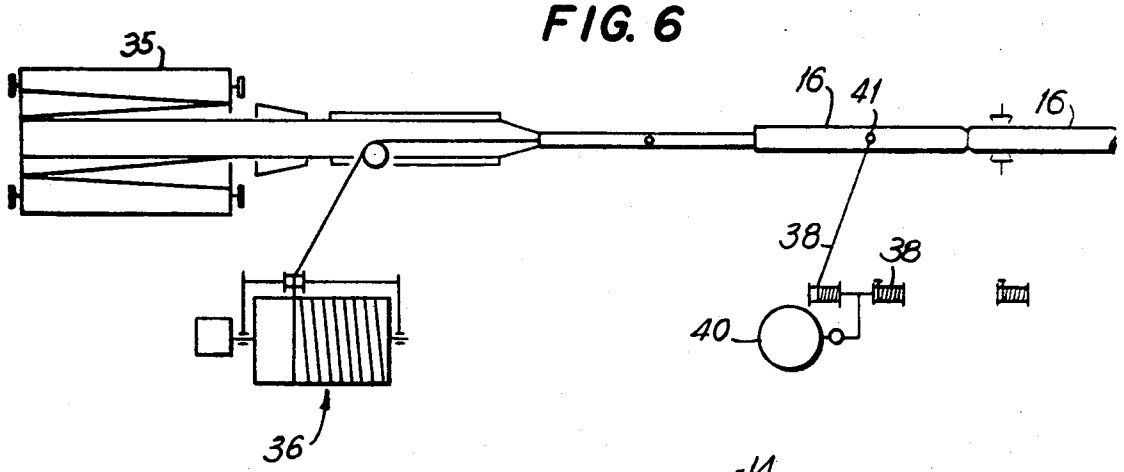


FIG. 7

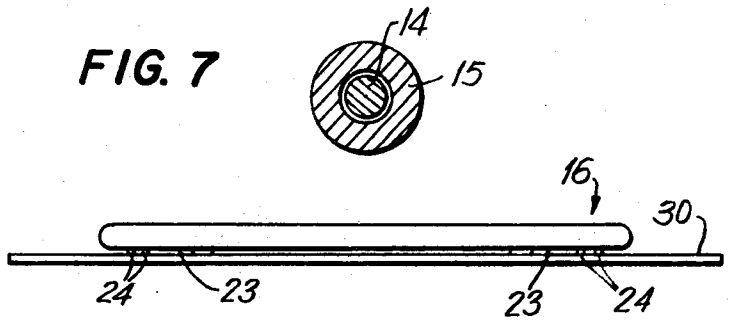
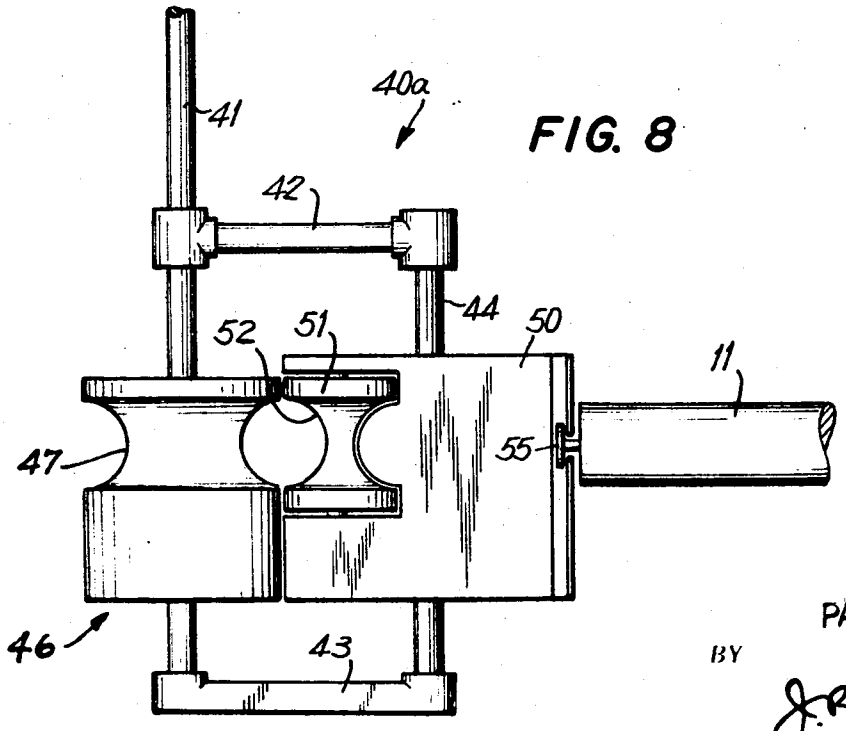


FIG. 8



INVENTOR
PAUL FISCH

BY

J. B. Felsher
ATTORNEY

APPARATUS TO CONFINE AND RECOVER OIL SPILLAGE AT SEA

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to apparatus for confining and recovery of oil spillage at sea, such as spillage in harbors of loading and destination; spillage in open water due to ship damage; or offshore drilling.

2. Description of the Prior Art

Presently means to prevent spillage are employed. Efforts have been made to dispense or destroy the oil, but not with any great measure of success.

SUMMARY OF THE INVENTION

Problem

The ever-increasing demand for oil created a tremendous transportation problem on account of the volumes and mileage involved. As more isolated and distant places will be acceptable as oil producers, the problem of oil delivery to the marketplaces will be more difficult. The maximum safety, due to the destructive nature of the product, has to be provided despite the increased magnitude and economical aspects of the operation. The companies involved are already making a tremendous effort to minimize or to prevent spillage during transportation, but the sheer dimensions of the undertaking makes it probable that some accidents will occur. Comparing the oil quantities transported to the small spillage which occurs, it is safe to conclude that safety measures have already reached their peaks. With any increase, of oil demand oil pollution will have to increase, too.

The basic problem is oil leakage, and according to the location where it occurs, there are several classifications of leakages.

Classification of Leakages

1. Spillage in the harbors of loading and of destination;
2. Spillage in open water, due to ship damage;
3. Offshore drilling.

The above problem classification indicates one of the requirements which is important to be considered if a good solution is to be obtained: the existence of large geographical distances between the occurrences. It is impractical to consider the effectiveness of an equipment stored at a central place, which would be rushed to geographically distant places where need may occur. The equipment must be readily available at any place of possible oil leakage, and that means the oil transport ship itself or the local Coast Guard vessels.

A second requirement for the equipment is derived from the effectiveness of presently enforced preventive methods. Except for spillage in the harbors, any other occurrence is extremely seldom. There is therefore large time intervals between oil spillages. Antispillage equipment must be in the inactive condition most of the time, and has to be designed for easy storage. It must receive little space, no need of attendance, and it must be readily available and easily applicable in the shortest notice.

Solution

According to the means by which the ill effects of oil pollution can be prevented, the solutions can be categorized as:

1. Dispersing or destroying the oil;
2. Containing it first, then recovering it.

Without going into the advantages and disadvantages of the two approaches, this design belongs to the second category. The construction is basically a floating barrier which due to its special design is strong enough to be spread rapidly over a large water area covered with oil. The barrier will then form a loop which—due to the strength and balance of the design—can be quickly reduced. The originally confined thin oil film, which cannot escape, will gain more and more height. As the oil thickens to about a 2-inch height, it can be pumped out separated from the water. FIGS. 1 and 2 show schematically

the ship, the barrier, and the boat which helps to form the loop, and pulls the barrier to diminish continuously the confined area. The total length of the barrier assumed to be 1 mile, would allow the recovery of approximately 100,000 pounds of oil.

The physical principles upon which this design is based are well known. Oil will not mix with water and it will float on the water surface. By confining a certain surface area of the water and reducing it without allowing leaks, the oil film will gain height. Although these principles are not new, the design described here has the merit of being able to fulfill with optimum efficiency, all the necessary requirements.

Because the equipment is placed on a ship and it has to be in the inactive condition most of the time, it is made out of standard, available, separate elements which are easily storeable. Its core is a long, standard steel rope, which is stored on a standard reel. The steel rope gives the design the necessary strength to be spread out and pulled by a boat with a speed which not only makes the oil collection effective, but also economical. Oil retention and flotation is achieved by inflatable elements which are connected to each other to form a hose the length of the steel rope. This hose of connected and inflatable elements is also easily storeable on the ship.

For deployment around an oil slick, the hose is simply wrapped around the steel rope and the elements are continuously inflated. In case of eventual damage, the inflatable elements are easily and individually replaceable.

The inflated, assembled design has to be strong and also oilproof. No soil should leak from the confined area into the open water, either above or below the barrier, or through any opening along the length of the barrier. This is fairly easy to obtain by a floating but resting barrier, however, it is difficult if the barrier is to be swept over the water surface with considerable speed during the collection phase. Our answer for this problem is the balanced design, which concentrates all the acting forces in the geometrical center of the barrier's cross section. For lack of any twisting movements on the barrier, the effective, oil-sealing cross section will remain the same even when it is sweeping the water surface. Consequently, effective and quick collection is possible.

The disassembly of the hose and the rope is as easy as the assembly and it is accomplished with the deflation of the elements as the first step.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic top plan view showing a carrier ship on which the apparatus embodying the invention is mounted and showing one end of the barrier attached to a pull boat;

FIG. 2 is a schematic top plan view showing the apparatus in use;

FIG. 3 is a transverse vertical cross section of the barrier in the sea;

FIG. 4 is a side elevational view of a portion of the barrier;

FIG. 5 is a longitudinal view of a piece of the barrier rope with weights thereon, shown in cross section;

FIG. 6 is a schematic view illustrating unwinding of the barrier and inflation of the inflatable cover sections, on the carrier ship;

FIG. 7 is a cross-sectional view illustrating a step in mounting an inflatable barrier section on the barrier rope; and

FIG. 8 is a partial vertical view illustrating the float for facilitating drawing the barrier noose.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to FIG. 1 of the drawing, 10 designates a carrier ship, and 11 designates a barrier being pulled off the ship by a pull boat 12.

The barrier comprises a flexible steel rope 14 (FIG. 5), on which ring weights 15 are slidably mounted. The weights 15 are threaded on the steel rope.

On the rope are inflatable hose or sleeve sections 16 attached together in tandem in the manner hereinafter ex-

plained, to form a hose. Each hose section **16** has an inner split cylindrical skin part **17** from which radial portions **18** extend outwardly. The outer ends of radial portions **18** are interconnected by an outer cylindrical part **19**. At the ends of each section **16** are end parts **20** to close the section.

Parts **17** surround the weighted members **15** and rope **14**. Each section **16** thus forms a cylindrical split chamber which may be filled with air for inflation, to float the rope on the sea.

Attached to part **19** of each section **16**, adjacent parts **18**, are flaps **23** carrying zippers or slider-actuated fasteners **24** to retain the section in closed condition on the rope.

Adjacent sections are attachable together in tandem by means of end tabs **27** at one end carrying fasteners **27***a* for attachment to tabs **28** at an opposite end of a next adjacent section. Any suitable fasteners may be employed for this purpose, such as snap fasteners or buttons or strap buckles.

On the carrier ship is a platform **30**. The flattened, deflated attached together sections **16** are placed on the platform **30** one at a time as shown in FIG. **7**, beneath the weighted rope **14**, with the flaps **23** on opposite sides of and longitudinally of the rope. The flaps may be lifted, wrapped around the rope and weights and zipped together by fasteners **24**. Then air may be supplied to the section to inflate it. Adjacent sections are attached together as the rope is let out or pulled by the pull boat **12**.

The carrier ship, as shown in FIG. **6**, may carry bins **35** to store the deflated and folded sections **16**. The rope is wound on a winch **36** and as it is pulled by the boat **12**, the attached together sections **16** may be wrapped and inflated. Air is supplied by air hoses **38** fed by air from a compressed air tank or compressor **40**. The ends of hoses **38** have quick connect valve **41** to connect to receive valves on the sections **16**. The valves are such as to remain engaged until an excessive pull on the feedline separates the hose from the inflated section.

For deflation, the valve on the section **16** will be connected to a counterpart on an open hose or line, allowing escape of air. Disconnection takes place again when the pull is excessive when reeling in the rope onto the ship.

To pull the barrier noose tighter to reduce the diameter thereof, there is shown in FIG. **8**, a float **40***a* comprising a vertical rod **41** which is attached to the carrier ship **10**. Attached to rod **41** is an upper horizontal member **42** and a lower horizontal member **43**. Members **42, 43** are interconnected by a rod **44** parallel to rod **41**.

Slidably mounted on rod **41**, and disposed between members **42, 43** is a hollow annular member **46** having an annular groove **47** of semicircular cross section. Slidable on rod **44** is a hollow member **50** rotatably mounting a rotor **51** having an annular groove **52** of semicircular cross section matching groove **47** to form a circular eye or opening through which the barrier may pass. One end of barrier **11** may be connected as by connector **55** to float member **50**. The barrier encircles the oil on the surface of the sea, then passes through eye or opening **47, 52** and is attached to boat **12** as at **56**, as shown in FIG. **2**.

RESUME

Design of the Barrier

1. The Elements

The best way to describe the design is to follow the illustrations.

FIG. **3** is the cross section of a, for example, 4-inch diameter, assembled and inflated barrier. The steel rope **14** is located in the center and serves the multiple purposes of giving the design strength, continuity, and the required weight. The illustration shows the conditions of flotation as it occurs when the collected oil reaches the intended maximum thickness of say 2 inches. That would leave 1.25-inch safety against spilling over the top and 0.75 inch on the bottom of the barrier. We can assume with certainty that the oil layer will follow the movements of the water, but the barrier will have a slight inertia in doing the same. The "safety zones" and the limitation of the maximum oil thickness will provide an oil-leakproof design despite the inertia.

On the right side of the barrier illustrated in FIG. **3** is the water level which keeps equilibrium with the oil layer. As it is shown, this specific configuration immerses say about 2.35 inches deep in the water. The weight which is necessary to achieve such a deep immersion could be provided by the use of a 1-inch O.D. steel rope. Such a rope, however, would have a strength far exceeding the requirements; it would be bulky to handle, and it would lack flexibility. Flexibility is needed to achieve a well-scaled design, not only at the closing point of the loop, but also along the entire barrier. If the barrier can easily follow the local water movements, over or underspill will be prevented and maximum efficiency of oil collection will be provided. The diameter of the steel rope is therefore determined by the required strength and the additional weight is supplied by concentric rings **15** allowing free bending of the rope. The rings and the rope constitute one element, the core of the barrier.

The inflatable part of the barrier **11** is a hose section **16** of say 12 feet long, closed at both ends and made out of impregnated, oil-repellent material. At two precisely calculated points on the periphery of the hose two flaps on strips **23** are sewn the entire length of the hose. Each strip has a zipper **24** at the free edge. While the hose is still deflated, it will be wrapped around the core (rope and rings), the zipper will be closed, and the hose will be then inflated. Because of the design, the inflated assembly will take the cross section of the desired 4-inch diameter circle. 12 feet for the length of the hose element has been chosen, attempting a maximum length while still providing for efficient replacement possibility in case of damage. To obtain quick assembly and easy storage, the hose elements are connected to each other by tabs **27, 28**, thereby forming a continuous band. The valves for inflation and deflation are of a quick connect type.

2. Storage

FIG. **6** shows schematically the arrangement needed to store the disassembled deflated elements of the barrier, the process of their assembly, and the inflation of the hose elements. The rope with the weight rings is wound around a standard drum of the type used in large fishing boats. It has a standard rope guide which helps to wind and unwind the rope in an orderly manner. The deflated, long band made out of connected hose elements is separately stored in a bin, which is only one of the storage possibilities for this purpose.

3. Assembly

The rope is wound out from the drum and the deflated hose is moved to a position which illustrated in a cross section view in FIG. **7**. Accordingly, the rope is in the upper position, and below it is the open flat deflated hose. This operation is performed by hand. After the first portion of the hose is wrapped around the rope and the slide of the zipper is engaged, the closing of the zipper will take care of the rest. After the total 12-foot length of the hose element is zipped, the operation of inflation can be performed.

4. Inflation

If the inflatable element were one continuous long hose, difficulties would arise in the wrapping around and in the zipping process as well as in that portion of the hose which is still in the storage bin. Further, the entire barrier would be useless in case of eventual local damage. Out of these considerations, the barrier is designed to be made of about 12-feet-long separately inflatable and mechanically connected units despite the resulting difficulties in the inflation and deflation operations. The design applies a quick connect valve on each hose segment, which opens automatically when mated with its counterpart. For the inflation phase the counterpart is on a feedline and the valves remain engaged until an excessive pull on the feedline separates them. Disengaged, both valves close automatically, preventing any leakage. For the deflation operation, the valve on the hose element will be connected to a counterpart which is on an open line, allowing escape of the

pressurized air during engagement. Disconnection will be achieved again by an excessive pull on the escape line. Inflation is illustrated in FIG. 6.

5. Disassembly

After the barrier is used and one of its ends is pulled back to the ship's deck, disassembly takes place in the reverse order of assembly. The rope storage drum is to energized to act as the barrier retrieval engine. As the barrier is pulled aboard, the air valves will be engaged consecutively to the escape lines, deflating one hose element after the other. Then the zipper is opened and the deflated hose will unwrap automatically from the steel rope. It is possible that some cleaning process may be needed before storage, although the inflatable hose is to be made water and oil repellent.

Operation

The assembled and inflated section of the barrier will be continuously lowered into the water, where one of its ends will be picked up by a boat. The connection to the boat is made in a manner such that the boat can pull the barrier without preventing it from floating freely in the water. After the barrier is lowered in its entire length, the boat will have described a full circle and returned to its initial point. One end of the barrier will be connected to a float FIG. 8, which itself is retained by the ship. The other end—which was pulled by the boat—will be slipped through an oil vial or eye **47**, **52** which is also part of the same float. At this point of operation the oil covering the encircled area is confined in a leakproof arrangement. Further pulling the barrier with the boat will raise the oil level in proportion to the decreasing encircled area. As the oil level exceeds say 1 inch, a suction hose can be lowered from the ship to scavenge the confined oil quantity.

After the salvage operation is completed at one location, the barrier can be pulled to a new spot or it can be retracted to the ship for storage. In the last case, the connections to the float shall be disconnected and the barrier hauled aboard.

It will now be understood that the inflatable part of the barrier comprises a series of connected but separable elements or separates air compartments. They can be interconnected. If air is lost in one, air will remain in others. Each defective or leaking section can be replaced.

This can be accomplished during wrapping.

Thus the barrier comprises two separable parts from which one assembly is built up. One part comprises inflatable elements continuously interconnected and wrapped around the second part which serves as a pulling and weighted element, and comprises a continuous rope covered by weighted rings. These two parts are separable for separate storage purposes.

The inflatable part serves as a barrier for oil. The steel rope element contributes strength, continuity and weight and to permit reeling it in. The two parts are united by wrapping and are secured with a zipper fastener.

There is an abutting relation between adjacent hose sections.

The weights could be lead.

The rope is wound with the weights. The ends of the rope have collars to prevent the weights from slipping off the rope.

It will thus be seen that there is provided an article in which the several objects of this invention are achieved, and which is well adapted to meet the conditions of practical use.

As possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings, is to be interpreted as illustrative only.

I claim:

1. A floating barrier comprising a flexible pull cable, and a flattened tubular inflatable hose wrapped in flattened condition around said cable with the cable being disposed outside of the interior of said tubular hose, and means to attach the longitudinal ends of the flattened wrapped hose to each other.

2. The combination of claim **1**, said cable comprising a steel rope.

3. The combination of claim **1**, and weighted rings on said cable and interposed between the cable and said wrapped around flattened hose.

4. The combination of claim **1**, said hose comprising inflatable tubular sections, and means to attach said sections together in tandem.

5. A floating barrier comprising a flexible pull cable, and an inflatable hose detachably attached longitudinally of said cable, a float, means to attach one end of said barrier to said float, said float having an eye and a portion of said barrier passing through said eye.

6. The combination of claim **5**, a ship, means to anchor said float to said ship, and a boat to which the other end of said barrier is attached so that said boat can pull said barrier through said eye.

7. The combination of claim **12**, each section having a pair of longitudinal flaps provided with slider actuated fasteners which can be fastened together in position surrounding said cable.

8. The combination of claim **7**, and weighted rings on said cable and disposed inside of said sections.

9. The combination of claim **8**, said cable comprising a steel rope.

10. A barrier floatable on the sea and comprising a flexible cable of material heavier than water and means to float said cable, surrounding said cable longitudinally thereof and comprising a member floatable on the water and extending above and below said cable and capable of floating said cable, said barrier comprising a noose which can be reduced in diameter by pulling one end of the barrier through an eye at the other end of the barrier.

11. The combination of claim **10**, said floating means comprising means removable from said cable for separate storage.

12. The combination of claim **10**, said floating means comprising a sealed, flexible inflatable sleeve means on the cable, removable therefrom for separate storage.

13. The combination of claim **12**, said sleeve means comprising a plurality of separate, sealed sleeve sections and means to detachably attach said sections to each other in tandem.

14. The combination of claim **13**, said cable comprising a steel rope, and weighted rings on said rope, said sleeve sections surrounding said weighted rings.

* * * * *