United States Patent

Bogosian

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[54] ELASTOMERIC OIL SLICK BOOM

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[51] **Int. Cl.** **E02b 15/04**
[58] **Field of Search** 61/1, 5; 210/83, 242, 523

[56] **References Cited**

UNITED STATES PATENTS

2,682,151	6/1954	Simpson et al.	61/1
3,146,598	8/1964	Smith	61/1
3,184,923	5/1965	Galving	61/54

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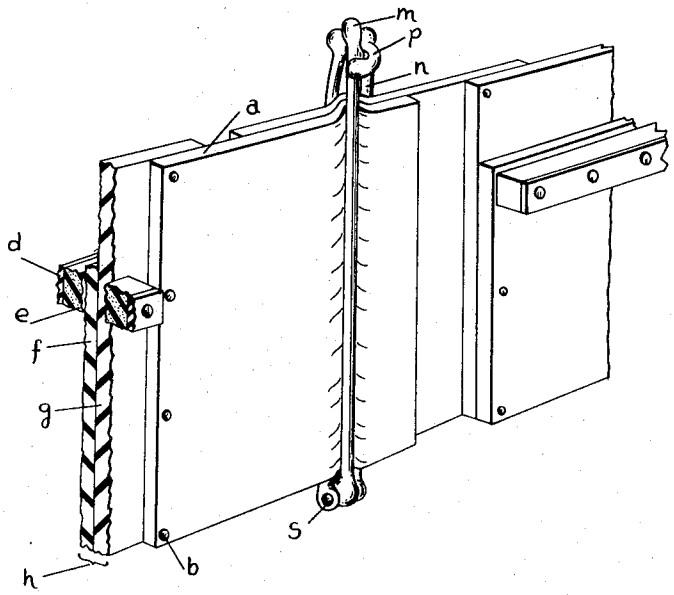
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[57] **ABSTRACT**

A buoyant barrier boom which preferably typically comprises a relatively rigid sheet of asbestos rubber of about 10 percent to about 20 percent styrene-butadiene rubber content by weight, having a closed cell sponge attached to both faces of the sheet in a position whereby at least two-thirds of the sheet is below water level when floated in water in an erect position substantially vertical to the surface of the water, the portion of the sheet located substantially below water level being laminated with an additional sheet of the rubber-asbestos material in order to provide any additional weight necessary to maintain the structure in an upright position, and in order possibly to provide additional strength, the sheet additionally having attached to each end of the boom a flexible compressed rubber sheet having about a 60 percent to about 70 percent content of styrene-butadiene rubber, each of the laminated sheets being about one-eight inch thick, the sponge material being partially enclosed by the rubber asbestos sheeting of a minor thickness to protect the sponge against abrasion, an achoring means for restraining the boom in a relatively fixed position in water, and a removable clamp for pinching together two flat and overlapped surfaces of the flexible compressed rubber sheet whereby two or more of the booms may be easily attached in series.

2 Claims, 2 Drawing Figures



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Fig. 1.

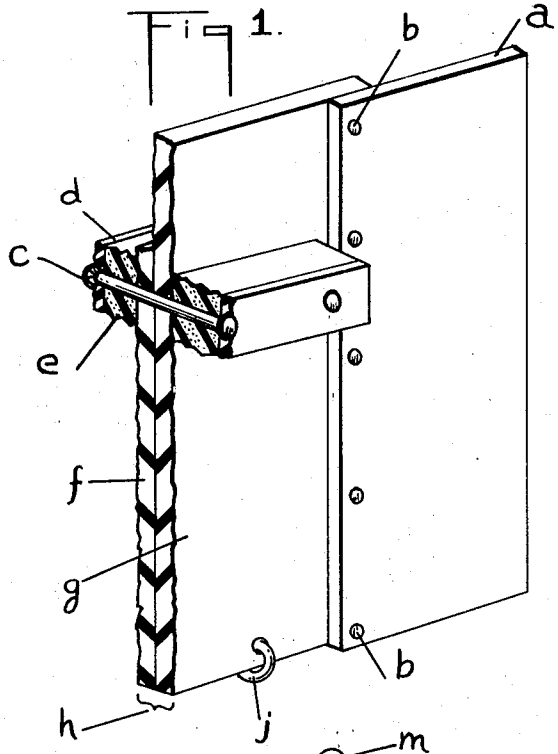
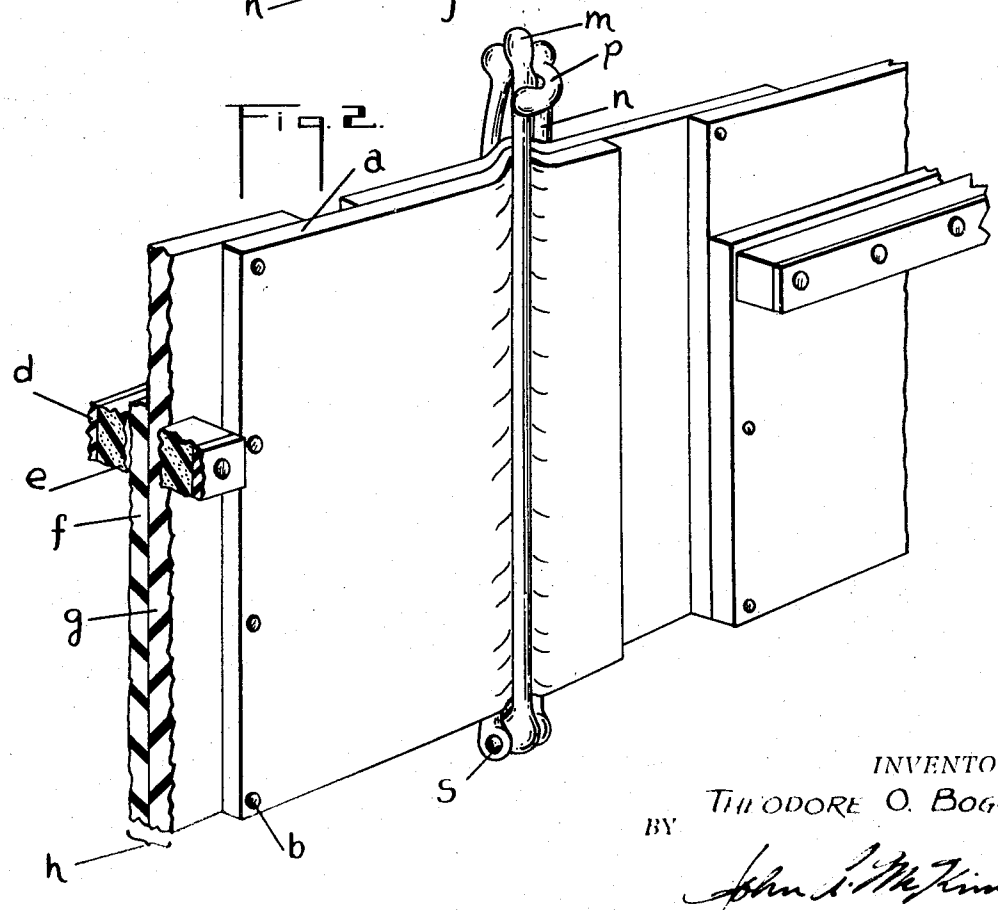


Fig. 2.



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ELASTOMERIC OIL SLICK BOOM

This invention is directed to the problem of providing an effective and efficient barrier to the movement of oil slicks on the surface of water, particularly sea water.

BACKGROUND

The magnitude of the problem toward which this invention is directed has recently been placed into sharper focus by the disasters of the oil tanker "Torrey Canyon" which broke in half off the coast of England, and the oil-carrying "Ocean Eagle" in San Juan Harbor, Puerto Rico. In each of these disasters, millions of dollars were expended in an effort to prevent contamination of beach and resort areas, and to prevent contamination of other waters and the marring of the hulls of other sea-going vessels. Also there was great concern over the fire hazards created by each of these disasters. In each of the above instances, all efforts to confine and to remove the oil from the surface of the water prior to the causing of damage of the type described above substantially failed and resulted in additional millions of dollars lost.

Although the disasters of the "Torrey Canyon" and the "Ocean Eagle" have served to focus public attention upon the magnitude of the problem, especially in the light of the ever-increasing size of oil-carrying tankers, the problem of oil contamination of sea water, of harbors, of beaches, and of streams is not a new problem. Accordingly, various means have been proposed in the past directed to confining and/or removing oil from the surface of water. In regard to the removal of oil from the surface of water, typical methods formerly proposed include the adding of a surface active agent to emulsify the oil and thereby bring about the precipitation of the oil which sinks to the bottom, a method of applying a synthetic rubber latex to the oil and thereafter coagulating the latex plus absorbed oil in the form of a rubber film which is subsequently collected from the surface of the water (see U.S. Pat. No. 3,265,616), the method of applying oil-absorbing materials such as hay, straw, ground bark, sawdust, bagasse, treated perlite, and shredded urethane foam. Another proposed method is the subjecting of the oil slick on the water to an agent which will congeal oil to a substantially stiff mass or gel that can be mechanically handled by physical means such as fine mesh nets or screens which will hold the congealed oil to allow water to drain through (see U.S. Pat. No. 3,198,731).

During each of the above-referred-to recent disasters of the "Torrey Canyon", and the "Ocean Eagle", most of the above proposed solutions to the problem were tried and proved to be unsatisfactory. For example, the use of detergents and other coagulating agents first of all required vigorous agitation of the water by the employment of multiple water hoses in order to emulsify the oil to cause it to sink to the bottom. Such a procedure proved to be time consuming, and expensive. But more importantly, it was soon recognized that it is undesirable to precipitate the oil to the bottom of the sea by the use of detergents because first of all the detergents kill marine life on the bottom which might be otherwise harvested or available for food, and secondly because the combination of detergents and oil

forms quicksand permitting the oil to penetrate and later return to the surface as a tar, whereby the problem has not been eliminated but merely delayed; moreover, the removal of tar from the surface of the water constitutes an even greater problem than the removal of the original oil. On the other hand, when any of the various particulated forms of materials such as treated-perlite, straw, talc, and the like were employed by spreading across the surface of the oil slick, the loose particulated materials initially absorbed oil to varying degrees, thereafter floated to the beach, washed up on the beach, and under the action of waves, heat, and rays from the sun, gave-up at least a major part of the formerly adsorbed oil thereby contaminating the beaches and the water adjacent the beaches. Accordingly, again the problem was not solved, but was merely delayed until the oil-laden particles reached the beach. Additionally, it was found that although by spreading talc on the beach, the beach was temporarily converted into a less-obnoxious beach, the talc subsequently adsorbed the oil beneath the talc and became darkened in color. Additionally, it was found that it is difficult if not impossible to efficiently remove these various oil-laden particles from the beach prior to the loss of oil from the particles. Also, sophisticated and expensive equipment is necessary in order to remove the oil-laden particles from the surface of the water either before or after the particles drift to the shore.

At the Puerto Rico disaster, in an effort to at least confine the oil to prevent it from spreading to the beach areas, the Puerto Rico Public Works was desperate in making efforts to appease the hotel and tourist trades. The Public Works made floating dams of wood as a harried attempt to contain the bay and keep the oil out; the wooden plank barriers proved unsatisfactory. The Public Works thereafter produced a dam made up of a 2 by 12 inch beam with a 2 by 6 inch beam nailed on the top and bottom, as a cross, connected with a rubber sheet, supported and made fast with steel cables. "Pacific-Murphy" booms appeared monstrous and were apparently scrapped on Catano Beach. Also employed were plastic booms made up of 10 foot lengths of 3 inch and 6 inch polystyrene logs with about a 6 inch coated fabric tail weighted on the edge extended in the water; this boom was effective solely in quiet waters and if the oil slick was merely relatively thin.

As became known to the general public as a result of wide newspaper coverage, the methods and materials employed substantially failed to prevent the oil from spreading; eventually the oil reached and damaged the beaches and personal property.

Initially the Public Officials at San Juan Harbor, Puerto Rico were selective in proposed solutions to their problems, placing a major emphasis on "cost" and "price". However, after repeated failures of various proposed devices and methods to contain (restrain) the oil, the Public Officials became desperate, and price was no longer an object to them.

Typical of various prior art floating barriers proposed in the past are the pontoons made of NEOPRENE coated polyester synthetic fabric, linked together to form a floating "oil boom", having an inflated diameter of 16 inches and standard 25 foot or 50 foot sections, employing ⅛ inch NEOPRENE having a

tensile strength of about 300 pounds per inch of width. Such booms have attached to the bottom of each pontoon a 22 inch-deep weighted skirt of the same material. In addition to the cost involved in "coating" materials with the NEOPRENE, and in addition to the susceptibility of pontoons being accidentally punctured such as by floating missiles, a pontoon barrier of this type is subject to the same problems as other conventional barriers that do not extend above the water-oil surface more than a few inches, and such flexible skirts have proven to be unsatisfactory against the swells and waves of typical harbor and/or sea action.

U.S. Pat. No. 3,221,884 is similarly directed to a metal plate or a flexible band of reinforced fabric, rubber, or the like, attached by metal struts to a large buoyant vacuum-pipe and suction nozzle for sucking-up oil from the water surface. The patent fails to discuss or recognize basic problems such as the degrading effect of sea water, waves, heat, oil, sunlight, oxidation, and the like on various barrier materials, insufficient strength, the required height and depth of satisfactory barriers and the critical weight maximum of the barrier when combined with disclosed pipe and suction nozzles, for example.

Similarly the barrier device of U.S. Pat. No. 3,184,923 is of complex structure, requires resistant fabric coatings, special pockets for barrier plates, employs wood or metal which would be subject to degradation, and in view of the foregoing factors would be expensive and cumbersome.

Some of the typical problems encountered which must be overcome to be of practical value as an oil barrier are as follow. The thickness of an oil slick may vary from a mere fraction of an inch up to a foot or more in thickness. Therefore the barrier must extend to a sufficient depth to avoid the passing of the oil beneath the barrier; the probability of this passing of oil is increased by the action of each of waves and swells of normal sea action or as caused by passing vessels, including large cargo ships and ocean liners. However, as the depth of the barrier increases, a larger float is required, and particularly a material of substantially greater strength is required which will withstand the great force of wave and swell action as well as withstand the bombardment by miscellaneous trash-missiles, for example including objects up to the size of telephone poles.

Another problem, which must be considered in conjunction with the problem of the preceding paragraph, arises from the fact that as a result of normal wave action, spray of the lighter oil portions readily passes over the conventional barriers, even though a barrier might restrain the major thickness of the oil slick; the lighter portions passing over the barrier proceed on the tide to mar the beach and to cause extensive property damage.

Another problem arises from the fact that many materials tend to sink and/or to disintegrate when they become saturated with oil and/or water. Oil in particular results in extensive degradation. Thus the material must remain afloat, and must be oil-resistant.

Another problem is that an oil barrier which might overcome some of the above and other problems would normally be highly expensive, complex, and too bulky to be of practical value in most instances.

In addition to situations such as the above-discussed disasters, there are everyday situations in harbors around the world in which oil is being taken-on or transferred from various ships, whereby there is a resulting oil pollution of the water, as well as oil pollution resulting from the normal operation of ships in the waterways and in the sea. In such situations, it is not practical to routinely employ sophisticated and expensive methods and/or equipment to avoid water pollution and damage to property.

The concern of various governments around the world with the problem discussed above is evidenced by the large number of Senators, Representatives, and other government officials of the United States who promptly visited the site of the disaster at Puerto Rico, as well as the fact that starting around the end of March, 1968, the Japanese government is conducting a joint experiment to test various oil-combating devices, the Swedish Coast Guard is setting up a nationwide system to combat oil slicks, with coordination centers at eight key coastal points, and the Italian government in initiating air surveillance of the Adriatic Sea as a part of the program to combat water pollution by oil.

THE OBJECTS

An object of this invention is a buoyant barrier boom having a high level of effectiveness and durability in the restraining of oil slicks on water.

Another object is a barrier boom meeting the above object and of a relatively uncomplicated structure.

Another object is a barrier boom meeting one or more of the above objects and easily assembled into large or into short lengths.

Another object is a barrier boom, a series of which may be easily made to assume and retain any desired configuration on the surface of the water.

Another object is a barrier boom which may be easily transported.

Another object is a barrier boom in which a series of such booms connected end to end may be stored in the water in either an accordion-like configuration or a spiral-like configuration, or any desired shape.

Another object is a barrier boom of materials sufficiently inexpensive to make available the boom to a large segment of the public-in-need at low cost.

Another object is a boom not subject to various of the problems discussed above.

Another object is a boom easily transportable and easily stored.

Another object is a boom having a means which is inexpensive and simple in structure for attaching two or more booms in series.

Another object is a process of using the novel boom as a barrier to oil.

Other objects become apparent from the preceding and following disclosure.

SUMMARY OF THE INVENTION

The invention is a buoyant barrier boom comprising a substantially rigid sheet-structure comprising a first sheet of a substantially oil-resistant synthetic composition and closed-cell foam composition attached to said sheet structure in a manner whereby said sheet-structure floats when placed in water in a substantially vertical position relative to said water's surface and whereby about one-eighth to about two-thirds of said first sheet extends above said water surface at least

about 0.5 foot and extends below said water's surface at least a sufficient depth to maintain said sheet in said substantially vertical position, said depth being at least about 1 foot. The invention also comprises a process of employing a boom of the type described above in water to restrain the flow of surface materials such as oil floating on the water.

FIGS. 1 and 2 illustrate a typical embodiment of this invention in which a rigid, strong oil-resistant rubber-asbestos sheeting has about one-third of the sheet extending above a level of a closed-cell sponge *e* arranged substantially horizontally with the top of the sheet-structure, and having about two-thirds of the sheet located at and below the level of the sponge and laminated to a second asbestos sheet reinforcing and/or adding weight, each of the laminated sheets being about one-eighth of an inch in thickness. Strip *d* is secured by bolt *c* through the laminate *h*. Brads *b* secure the flexible sheet *a* to the barrier sheets. Ring *j* is a convenient place to attach a guide line or anchor. In FIG. 2, levers *m* and *n* are hinged at *s* and fastened at *p*, with *n* nested in *m* to clamp the sandwiched flexible rubber sheets of two separate barrier booms, thereby attached in series.

In a preferred embodiment of the invention, the portion of the first sheet which extends from about water level to a depth below the water surface is laminated to a second sheet of oil-resistant synthetic composition, in order to give additional weight to facilitate maintaining the sheet in an upright position substantially vertical to the surface of the water. Additionally, such a sheet imparts a reinforcing action whereby the boom is better resistant to wave action, swell action, and bombardment by various missiles floating in the water. Also, such a reinforced sheet having improved rigidity nevertheless retains a certain degree of resiliency and thereby is not fragile. An advantage of the laminated sheet as opposed to mere greater thickness of a single sheet—which nevertheless is within the scope of this invention, is that normally the cost of producing thicker sheets becomes prohibitive and thereby makes a boom of the thicker sheets less practical and thereby less available for public use. This is especially true for a preferred embodiment of this invention in which at least the first sheet extending both above and beneath the surface is a "compressed" rubber sheet produced by a sheeter process in which an elastomeric composition in a suitable solvent is passed between two rolls, one of which is a cool roll and the other a hot roll sufficiently hot to evaporate the solvent (diluent) and thereby cause a sheet of "compressed" rubber to gradually build-up on the hot rolls to a predetermined thickness. For example, a preferred thickness for the sheet extending both above and below the surface of the water is about one-eighth of an inch; such a thickness is relatively inexpensive as contrasted to a compressed sheet of one-fourth inch. It is much more economically attractive and desirable for the public, to employ two separate sheets of about one-eighth inch thickness laminated together in order to obtain a preferred thickness having the weight necessary to maintain the sheet-structure in an erect position within the water.

It should be noted that another novel-aspect of the invention lies in the employment of synthetic sheets which are oil-resistant by virtue of the fact that merely a low percentage of the composition is of rubber, even though it is possible to employ an elastomer which normally would be considered to be a non-oil-resistant rubber. Accordingly, the term "oil-resistant" as employed in this disclosure refers to any composition which when exposed to oil over a reasonable period of time such as several weeks or months does not undergo a substantial amount of deterioration.

The employment of compressed rubber sheets constitutes a preferred embodiment of this invention primarily because of the improved rigidity and improved strength of such sheets as compared to non-compressed sheets made by other methods such as conventional methods known in the prior art. By the employment of compressed rubber sheets, this invention avoids the necessity of the prior art to coat rigid materials such as metal or wood and accordingly also avoids the problems of corrosion and deterioration of the metal or wood whenever the coating surface becomes accidentally broken or punctured. Also the problem of complex structure and of manufacturing such a structure is avoided.

However, it is within the scope of this invention to employ any synthetic material having oil resistance by virtue of either inherent oil-resistance when the synthetic material is employed at high percentages by weight of the total composition, or by virtue of the synthetic component being employed at a low percentage in combination with higher percentages of various fibrous materials such as nylon, polytetrafluoroethylene, rayon, wool, cotton, and preferably asbestos, for example. Similarly, additional weight may be imparted to the sheet-structure by the incorporation of various filler materials such as calcium carbonate (WHITING), barium sulfate (barytes), graphite, carbon black, silica sand, mica, talc, perlite, various clay materials, diatomaceous earth, and the like. For example, in a preferred embodiment of this invention, both the first sheet which extends above and below the surface of the water, as well as the second sheet laminated thereto are rubber-asbestos sheets of about one-eighth inch each. The second sheet, i.e., the sheet which extends solely substantially below the water surface and does not extend substantially above the water surface, is laminated to the first sheet.

In the embodiments of this invention which employ an elastomer which is inherently oil-resistant, as noted above it is not necessary to employ various fibrous materials except to the extent that is necessary in the non-compressed embodiments in order to impart the required rigidity and strength.

Accordingly, the oil-resistant synthetic composition of this invention typically includes those synthetics which inherently have a high resistance to oil-deterioration such as chloroprene rubber, the acrylonitrile (i.e. nitrile butadiene) rubbers (for example of the type described in copending, commonly assigned U.S. application Ser. No. 730,603), the fluoro elastomers (for example of the type described in the copending, commonly assigned U.S. application Ser. No. 506,283), and the like, as well as the synthetics which when employed with a sufficiently high fibrous content are oil resistant, such as typically polysulfide rubbers, vinyl resins such as polyvinylchloride, styrene-butadiene rubber, chlorobutyl rubbers, and the like.

The preferred compressed rubber sheeting of this invention may be produced by a process of the type such as described in U.S. Pat. No. 2,530,906. However, other embodiments of this invention typically may employ sheets having a composition such as that described in various patents such as U.S. Pat. Nos. 3,223,676, 2,052,603, 2,008,682, 2,813,084, and 1,569,182, for example. Each of these patent disclosures is incorporated by reference.

In the embodiments of this invention employing the elastomers which normally are not considered to be oil resistant, such as discussed above, the rubber content normally ranges from about 8 percent to about 50 percent by weight and the asbestos fibers normally range from about 15 percent to about 50 percent by weight of the rubber-asbestos sheet. In a preferred embodiment employing the synthetic materials normally considered not to be oil resistant, the rubber content normally ranges from about 10 percent to about 20 percent, and the asbestos content normally ranges from about 16 percent to about 85 percent, by weight.

The oil resistant synthetic sheets within the scope of this invention as noted above may include various filler materials. Normally, filler materials may range from zero up to about 30 percent or more. However, as the content of fibrous materials such as asbestos fibers increases, the percentage content by weight of fillers normally would decrease.

Also, various compounding materials may be included normally ranging from about 1 percent up to about 10 percent. Typical compounding materials include rubber compounding materials such as vulcanizing agents, vulcanizing accelerators, anti-oxidants, stabilizers, and the like.

The closed-cell foam composition, i.e. the closed-cell sponge composition, attached to the sheet-structure may be any conventional closed-cell sponge material, for example. Typical of sponge materials which may be employed within the scope of this invention are those disclosed for example in U.S. Pat. Nos.: 2,481,188; 2,779,754; 3,050,503; 3,110,709; 2,256,483; 2,440,800; 2,586,363; 2,592,763; 2,615,000; 2,630,425; 2,659,707; 2,723,255; 2,852,261; 2,852,497; 2,914,496; 2,982,759; 2,994,688; 3,001,964; 3,001,965; 3,026,294; and 2,960,482. However, as noted above, various other sponge materials may be employed.

In a preferred embodiment of this invention, whereby more of the above objects are obtained, it is preferred that the sponge have a density of about four to about 10 pounds per cubic foot, a temperature limit of about (minus) 40° F. to 200° F., a thermal stability of not more than about 4 percent shrinkage at 28 days, and a water adsorption of less than about 10 percent by weight. In a more preferred embodiment of this invention, the sponge material is substantially ozone resistant, has a substantially self-extinguishing fire-rating, has a density of about 5 to 7 pounds per cubic foot, a temperature limit ranging from at least as low as 0° F. up to about 220° F., and has a thermal stability not more than about 6 percent shrinkage at 220° F. for 28 days.

Although an oil-resistant sponge is preferred for the present invention, it is within the scope of this invention to employ a sponge which is non-oil-resistant enclosed within an oil-resistant fabric or oil-resistant rubber coating, for example. However, from the standpoint of economics and simplicity, the oil-resistant sponge is preferred.

Also in a preferred embodiment, at least the side portions of the sponge as it floats in the water, which would be exposed to bombardment and abrasion by the action of waves and missiles in the water, are protected by a tough layer of material such as a strip of rigid oil-resistant synthetic composition, for example a thin strip of rubber-asbestos sheeting of the general composition of the main barrier sheet of this invention.

The tough and rigid strip also serves as a convenient means for sandwiching and securing the sponge between the strip and the main sheet for example on each side of the main sheet, and having a typical securing means such as a bolt fastened to the rigid protective strip, extending through the sponge, through the main barrier sheet-structure, through the sponge on the opposite side of the barrier sheet-structure, and attached to a second opposite rigid protective strip. However, the strip and foam may each be attached adhesively to the sheet structure.

The closed-cell foam employed as a part of the barrier of this invention must be present in an amount to impart buoyancy to the barrier. Preferably it is attached to each of opposing faces of the barrier sheet-structure. The laminated portion of the barrier may start either below the area in which the sponge is located or substantially at the level of the sponge, whereby the sponge is on either side of the laminated sheet, or the laminated sheet may extend slightly above the area in which the sponge is located. However, in a preferred embodiment, the laminated sheet does not extend substantially above the water level nor above the sponge level, in order that the increased weight of the laminated portion may facilitate maintaining the sheet-structure in a position substantially vertical to the surface of the water in which it is floating. Normally the sponge is located at a point whereby at least about two-thirds of the sheet-structure, as measured from top to bottom, is substantially below the water surface. In a preferred embodiment, the sponge is arranged substantially parallel to the water surface.

In a preferred embodiment of this invention the barrier boom includes attached to each end of the sheet-structure a fastening means, preferably comprising a substantially flexible sheet of oil-resistant synthetic composition such as a rubber-composition sheet having about the same height above and depth below the water surface as the barrier sheet-structure, whereby several booms may be attached in series and whereby the attaching means prevents oil flow between the interconnected booms. Although various zipper or other clamping means may be employed such as various means conventional in the art, in a preferred embodiment of this invention, the clamping means provides a method for pinching together two opposing flat flexible surfaces, preferably by the employment of at least two opposing levers movably attached or fused together at one end of the levers, and having a means at the other end of the levers for fastening said other ends. Preferably the levers are sufficiently long to circumscribe at least a portion of the flexible sandwiched sheets and preferably the opposing faces of the levers are curved in a manner whereby when fastened, the op-

posing faces are substantially nested one in the other, with the two sandwiched sheets clamped therebetween.

In a preferred embodiment of this invention, each boom includes a means for attaching a restraining means for restraining the boom in a substantially fixed predetermined position in the water. Any suitable anchoring device or anchoring line may be employed.

A typical preferred embodiment of this invention comprises a rubber-asbestos sheet of about three feet in height of which about one foot extends above an oil-resistant sponge running substantially horizontally to the top of the sheet and sandwiched between a one-eighth inch thick layer of rubber-asbestos strip and the rubber-asbestos sheet on one side and sandwiched between another rubber-asbestos strip and a second rubber-asbestos sheet on the other side, which second sheet is laminated to that portion of the main rubber-asbestos sheet that extends from the level of the sponge for about 2 feet downward to the bottom of the sheet-structure. The two sheets are laminated adhesively but may include brads, and the sponge located on either side of the laminated sheets is adhesively adhered to each of the strips and to the laminated sheet-structure but may include a supplemental bolt extending from one strip through the sponge, through the laminated sheet, through the second sponge, and through the second strip of rubber-asbestos sheeting. At the bottom of the sheet is a ring extending through the bottom of the laminated sheets for attaching thereto to an anchoring chain. Each of the rubber-asbestos sheets is about one-eighth inch thick, whereby the laminated sheet is about one-fourth inch in thickness and whereby the non-laminated asbestos sheet extending above the surface of the water, i.e. above about the level of the horizontally extending sponge, is one-eighth inch thick. The rubber-asbestos sheets are compressed rubber having a rubber content of about 15 percent and an asbestos fiber content of about 80 percent, the remainder being various rubber compounding materials and filler materials. The adhesive by which the rubber-asbestos sheets are laminated is of any conventional adhesive composition, but preferably is a contact adhesive, and preferably is oil-resistant.

The above disclosure is intended to merely illustrate various embodiments of the invention, and is not intended to unduly limit the scope of this invention except to the extent expressly stated and to the extent that the appended claims are limited. Also, it is within the scope of this invention to use such equivalents and substitutes as would be obvious to a person of ordinary skill.

What I claim is:

1. A buoyant barrier boom for retaining oil on water comprising a relatively rigid barrier sheet of rubber containing fiber, said barrier sheet having a laminate construction in at least the lower approximate two-thirds portion thereof in the area to be located substantially below the surface of the water to provide additional weight and reinforcement to resist water movement, said barrier sheet having a buoyant closed cell foam body attached to both faces of the barrier sheet, said buoyant closed cell foam body being protected by a strip of rubber sheet containing fiber, said buoyant closed cell foam body being substantially horizontal to the top of the barrier sheet and intermediately located thereon approximately one-third from the top and two-thirds from the bottom of said barrier sheet whereby said barrier sheet will float in water in a substantially erect position substantially vertical to the surface of the water with approximately the upper one-third of the barrier sheet above the surface of the water and approximately two-thirds thereof below the surface of the water.

2. A buoyant barrier boom for retaining oil on water comprising a relatively rigid barrier sheet of rubber containing fiber, said barrier sheet having a laminate construction in at least the lower approximate two-thirds portion thereof in the area to be located substantially below the surface of the water to provide additional weight and reinforcement to resist water movement, said barrier sheet having a buoyant closed cell foam body attached to both faces of the barrier sheet substantially horizontal to the top of the barrier sheet and intermediately located thereon approximately one-third from the top and two-thirds from the bottom of said barrier sheet whereby said barrier sheet will float in water in a substantially erect position substantially vertical to the surface of the water with approximately the upper one-third of the barrier sheet above the surface of the water and approximately two-thirds thereof below the surface of the water, a flexible rubber sheet secured to each end of the relatively rigid barrier sheet for attaching one barrier sheet to another barrier sheet in series, said flexible rubber sheet being of approximately the same height as the barrier sheet whereby it extends substantially the same distance above and below the surface of the water, and the said barrier sheet being attached to another like sheet in series by means of a removable clamp comprising hinged levers with fastening means, pinching together overlapping portions of the flexible rubber sheet secured to the ends of the barrier sheets.

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