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J. T. HAZAK
METHODS AND MEANS FOR FACILITATING REMOVAL
OF OFFSHORE PLATFORM SUPPORTS FROM MUD

2,774,218

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4 Sheets-Sheet 1

Fig. 1.

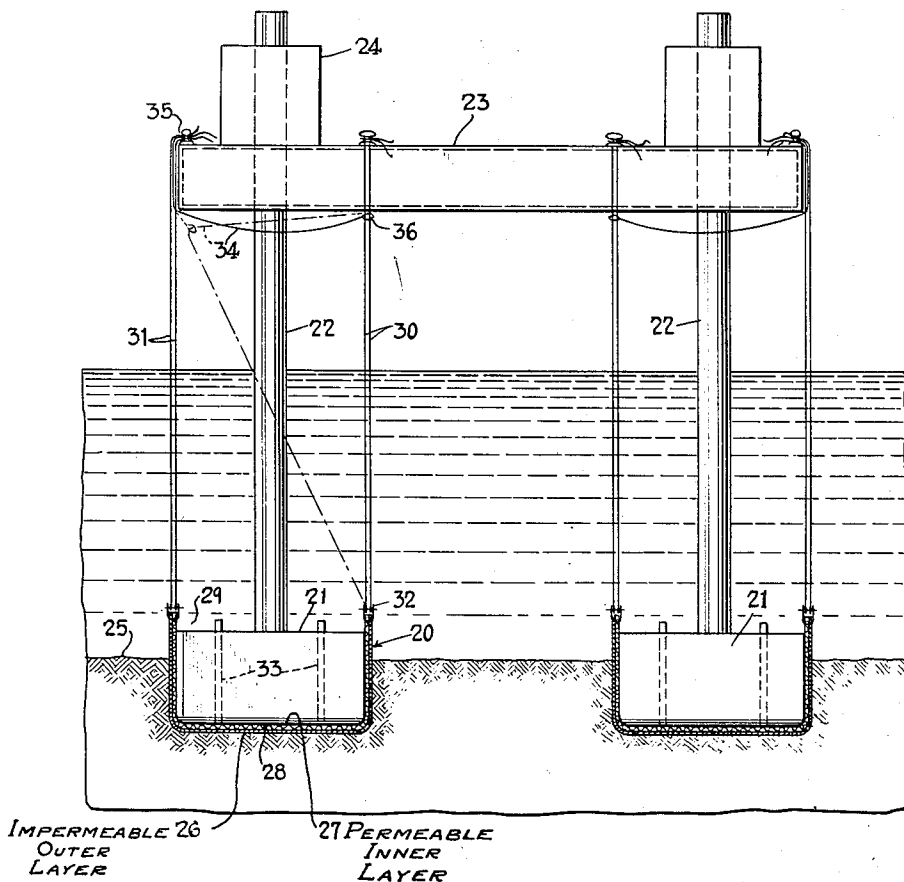


Fig. 2.

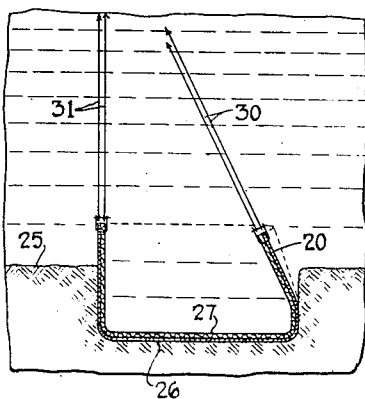
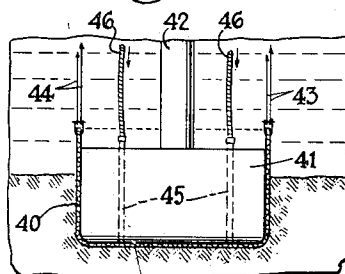


Fig. 2a.



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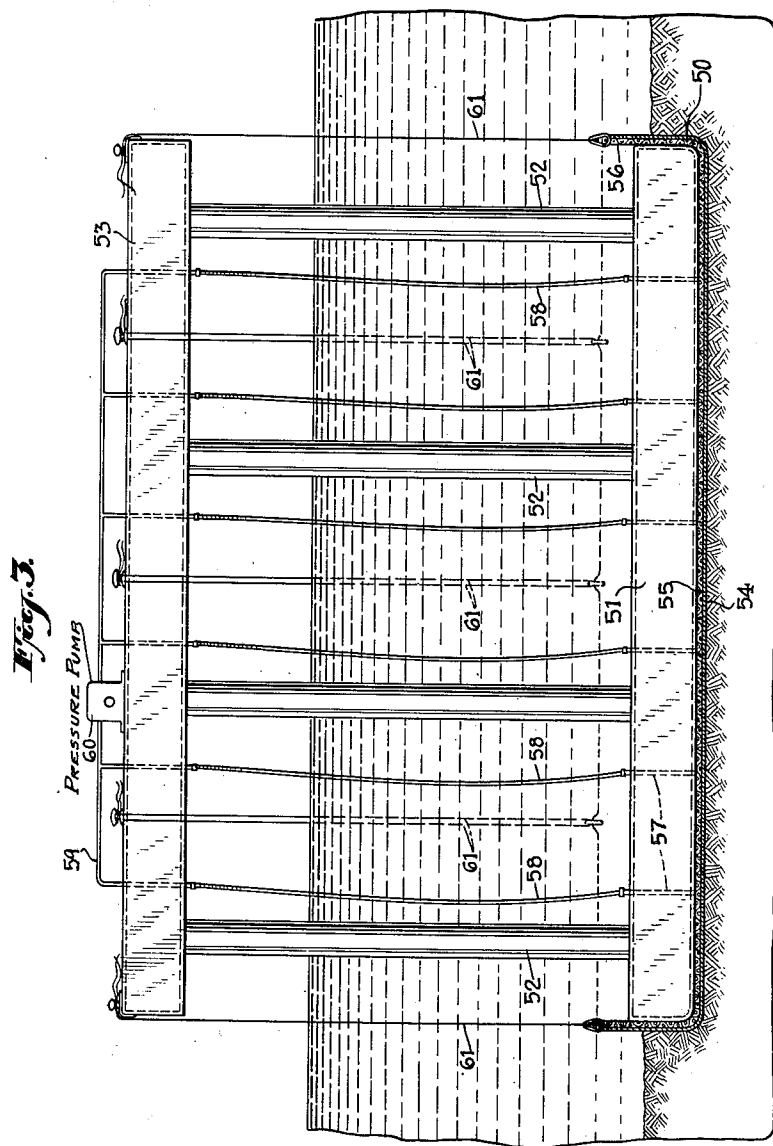
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Fig. 4.

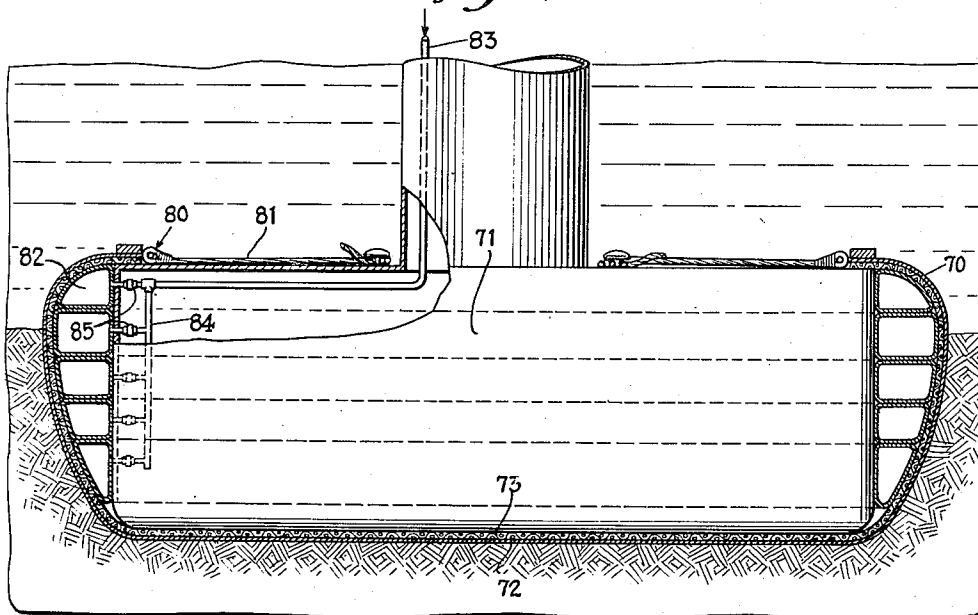
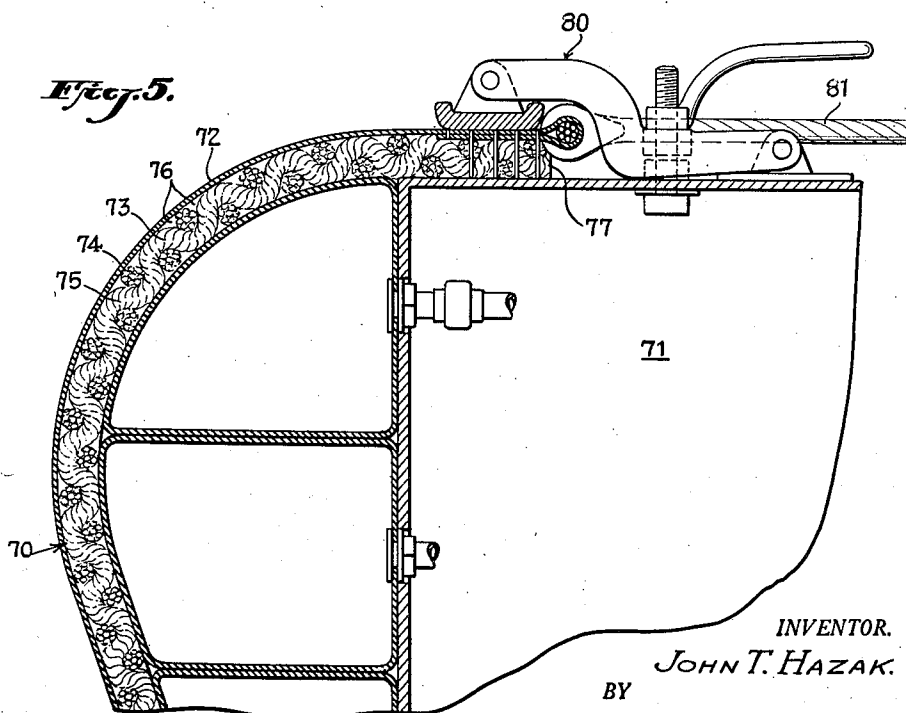


Fig. 5.



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Fig. 6.

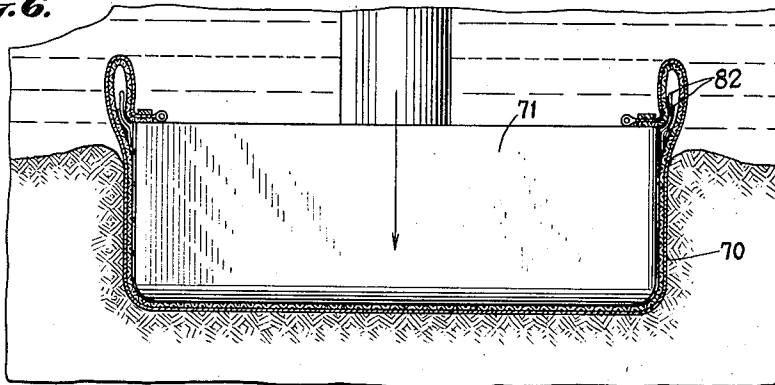


Fig. 7.

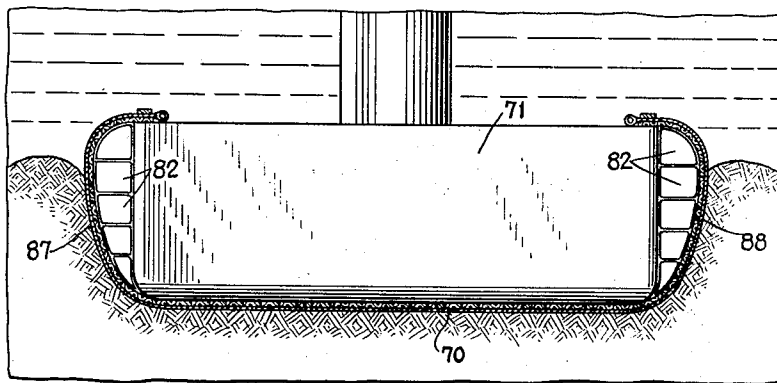
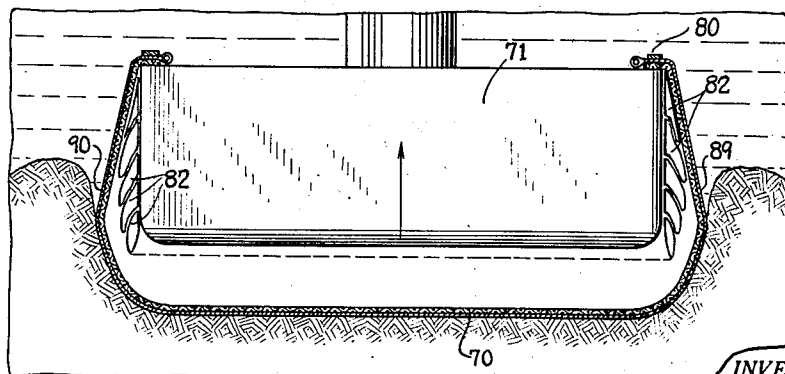


Fig. 8.



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METHODS AND MEANS FOR FACILITATING REMOVAL OF OFFSHORE PLATFORM SUPPORTS FROM MUD

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Application November 18, 1955, Serial No. 547,809

13 Claims. (Cl. 61—46.5)

This invention relates to mobile marine platforms of the type which are especially useful in offshore boring and drilling operations and, more particularly, to means and methods for facilitating removal of the supporting members of such platforms from the ocean floor when it is desired to move the platform from one offshore location to another.

Mobile marine platforms of the type which may be floated to the desired offshore location, securely anchored in operative position at such location for an indefinite length of time and then readily returned to a floating condition for transportation to another offshore location are attaining widespread commercial usage. Such platforms, while of many varied designs, in general, comprise a deck structure which is carried at the desired height above the water surface by means of supporting members, for example, spuds or piles, which extend downwardly into contact with the sea floor when the platform is in operative condition and are adapted to be raised out of contact therewith when it is desired to move the platform to a different location. Experience with heretofore known constructions has shown that such removal of the deck supported members out of contact with the sea bottom is oftentimes a difficult and at best a very time-consuming task. For example, in some platforms the deck is supported by a plurality of piles which are jacked down so as to penetrate into the sea bottom, and in this type of construction removal of these members requires a reverse jacking operation which is most time consuming. Such a time delay when changing offshore locations is, of course, an expensive item, and this is especially true when the platform is desired to be used to take exploratory borings at a large number of offshore locations, therefore requiring frequent change of position. In an effort to speed up this removal operation, enlargements have been provided at the base of the supporting members; for example, large area spud pads are secured to the lower ends of each spud member, thereby spreading the load carried by each spud over a relatively large area of sea bottom and hence preventing deep penetration of the same into the ocean floor. While such spud pads do succeed in preventing any substantial spud penetration, the pad itself will sink in varying degrees into the mud usually found on the sea floor, and thus a still serious problem of spud removal exists due to the great force of suction which is created between the undersurface of each pad and that mud. In another common type of mobile platform having an anchor barge connected to a plurality of supporting spuds or members, an equally great suctional force problem exists when it is attempted to raise the barge from the sea floor.

Various means and methods have heretofore been utilized in an attempt to break this suctional force. Thus hinged spud pads have been provided, mounted eccentrically of their spud, so that by pulling upward on the pad, the same will tend to tilt and thus permit air to

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enter at one edge and break the suction. Aside from inevitable operational difficulties of this type of device, the hinged construction thereof is costly and may be troublesome. It has also been proposed to break the suction by putting pipes down through the spud pads or anchor barge and then forcing fluid under pressure to the underside of these members in an attempt to equalize pressures above and below the same. Such pipes have proven unsuccessful because of the well known tendency of any such fluid under pressure to seek and escape by the path of least resistance. Thus, when fluid is forced through such pipes, instead of spreading out uniformly over the entire underside of the spud pad or barge, which would be necessary to equalize pressures as aforesaid, the same in actual practice will form a narrow channel or hole only in those portions where the mud is most loosely packed and, following that channel, will escape from beneath the member.

The instant invention overcomes these advantages of the prior art arrangement by providing over the bottom and preferably also the sides of the supporting member end enlargement, such as a spud pad or barge, a flexible covering which by design is impermeable to both mud and water in combination with means to introduce fluid under pressure substantially uniformly over the space between said cover and the underside of said pad or barge, thereby equalizing pressures above and below the pad or barge and breaking the suction force therebetween when it is desired to lift the pad or barge from the sea floor.

According to the method of the invention, such a flexible, mud and water impermeable cover is secured in place over the bottom and sides of the enlarged end portion of a platform deck supporting member, such as a spud pad or barge, prior to lowering that supporting member into engagement with the sea floor. Then when it is desired to lift the supporting member, fluid under pressure is introduced into the space between the underside of said enlarged portion and its cover, thereby equalizing pressures above and below said portion. The supporting member can then be raised, leaving the support end cover in place on the sea floor, and the cover then retrieved so as to permit re-use of the same.

According to one embodiment of the invention, this support end cover may comprise a sheet of flexible material having an impermeable outer layer designed to prevent passage of water or mud therethrough and a permeable inner layer designed to permit passage of fluid under pressure from the upper to the lower surface of the enlarged end portion of the supporting member.

According to another embodiment of the invention, the covering may comprise simply a layer of impermeable flexible material and in this embodiment conduit means, extending down to the undersurface of the enlarged end portion of the supporting member, provide means for introducing fluid under pressure to the space between said undersurface and covering.

The covering itself may be retrieved from the sea floor to permit re-use either by manual means such as lines secured at one end to said cover and at the other end to the deck itself or by the use of automatic means such as an inflatable means provided on the enlarged end portion of the supporting member itself as hereinafter described.

Further objects, features and advantages of the invention hereof will appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification and illustrate by way of example preferred embodiments of the invention.

In the drawings:

Fig. 1 is an elevational view partly in section showing

one embodiment of the support end cover of the invention secured in position on the spud pads of a mobile marine platform;

Fig. 2 is a vertical sectional view showing manually operable means for retrieving the support end cover from the ocean floor after lifting of its supporting member;

Fig. 2a is a fragmentary elevational view showing an alternative embodiment of the support end cover of the invention secured in position on a spud pad.

Fig. 3 is an elevational view showing a support end cover similar to the embodiment shown in Fig. 2 but having supplemental pressure equalizing means secured in position on an anchor barge of a mobile marine platform;

Fig. 4 is an enlarged fragmentary elevational view partly in section of a support end cover according to the invention secured to a spud pad and having automatic means for retrieving said cover after lifting of the spud pad;

Fig. 5 is an enlarged fragmentary sectional showing of a portion of the apparatus of Fig. 4;

Fig. 6 is a schematic view of the apparatus of Fig. 4 showing the relation of the support end cover to its spud pad upon lowering of said spud pad into position on the ocean floor;

Fig. 7 is a schematic view similar to Fig. 6 but showing the relative positioning of the support end cover to its spud pad just prior to removal of the latter; and

Fig. 8 is a schematic view similar to Fig. 7, but showing the relation of spud pad and end cover after the pad has begun its travel to the surface of the water.

Referring now in more detail to the drawings and particularly to Fig. 1 thereof, support end covers 20 according to one embodiment of the invention are there shown secured in operative position covering the bottom and sides of spud pads 21. These spud pads 21 are secured to the lower end of spuds or piles 22 which support the working deck 23 of a mobile marine platform. This mobile marine platform may, for example, be of the type disclosed in a copending Edward A. Smith application Serial No. 378,460, filed September 4, 1951, and may be provided with jacking means at 24 mounted on the deck and designed for jacking the supporting spuds with their enlarged pads up or down relative to the deck 23, and vice versa. The operation of this type platform will be substantially the same as that described in said copending application except that herein enlarged spud pads 21 have been secured to the lower ends of the spuds 22 in order to prevent deep penetration of those spuds into the mud. These spud pads may, for example, consist of hollow, rectangular, reinforced metal tank-like elements which are dimensioned so as to cover an area many times the cross-sectional area of the spud to which they are attached, thereby spreading out the load carried by that spud over a much larger area of ocean floor and hence preventing deep penetration. Of course, a spud pad as shown in Fig. 1 will penetrate to a slight degree into the mud 25 found on the ocean floor and as a result, suction forces will be created which must be overcome before the spud can be readily raised from the bottom.

According to the invention hereof, the support end cover 20 is flexible and comprises an impermeable outer layer or skin 26 which is suitably joined to a permeable inner layer 27. The impermeable outer layer 26 might, for example comprise a piece of canvas impregnated with a rubber or synthetic resin coating or any suitable fabric impregnated with a plastic coating so as to render the same impervious to the passage of water or mud. The inner permeable layer 27 constitutes in this embodiment the means to introduce fluid under pressure substantially uniformly over the space between the underside 28 of the spud pad 21 and the outer layer or skin 26 of the end cover. This inner layer 27 is designed so as to provide a plurality of small or minute passages extending throughout its dimensions which are capable of permitting the passage of water. Preferably, this layer may be formed

of fibrous material, for example, fiber glass for woven hemp or sisal fibers. As shown in Fig. 1 the upper extremities of this inner layer preferably extend above the upper surface of the spud pad 21 as at 29 and are therefore in constant communication with the water above the spud pad. Handling lines 30, 31 are suitably secured at one end, to the support end cover 20 as at 32 and at their other ends to the platform deck 23.

When it is desired to move the platform to another off-shore location, supporting spuds 22 may readily be raised from their position on the bottom shown in Fig. 1 as follows. After the deck 23 has been lowered to the surface of the water as described in the copending application mentioned above, jacking means 24 can be energized to lift the spud 22 from the bottom. Because of the presence of the end cover 20, no substantial suctional force will be encountered in opposition to the raising of this spud and its pad, for, as mentioned previously, the upper extremities of the cover's inner layer are constantly exposed to the water above pad 21, and therefore water under pressure will enter the pores or interstices between the fibers of this permeable member 27 and will travel downwardly and spread uniformly throughout the entire extent of said inner layer. Thus water under the same pressure which is prevalent at the top side of the spud pad 21 will be introduced substantially uniformly over the entire underside of this spud pad, thereby equalizing pressures above and below this member and thus eliminating the suction forces. In order to supplement this introduction of fluid under pressure to the underside of the spud pad 21, hollow pipes or conduits such as 33 may be provided extending from the top to the bottom of the pad, thereby insuring an ample flow of water to the lower portions of the permeable layer 27.

After the spud 22 and its pad have been lifted a suitable distance from the sea floor, the support end cover 20 may be retrieved by pulling upwardly upon lines such as 30 in the following manner. It will be, of course, evident that after removal of spud pad 21 a suction force will still exist between the underside of the cover's outer skin 26 and the mud, which force will preclude removal of the cover by pulling directly upwardly of lines 30 and 31. However, as shown in Fig. 1, a guide line 34 secured at one end to the platform deck as at 35 and extending under said platform and transversely thereof to a connection with the upper end of line 30 at 36 may be provided, then when it is desired to retrieve the end cover 20, by slacking off on the connection of line 30 to the platform deck and taking up on guide line 34, the line 30 may be moved to the angular position shown in Fig. 2 and when in this position by pulling thereon, the cover 20 may be gradually peeled from its engagement with the mud as shown at 37, thereby breaking the suction force gradually and permitting ultimate retrieving of the cover by raising the lines 30 and 31.

Turning now to Figure 2a, an alternative embodiment of the invention is there disclosed which comprises a support end cover 40, the same being formed of a layer or skin of water impermeable material such as rubber coated canvas or plastic impregnated cloth. This cover 40 is secured in operative position covering the bottom and sides of a spud pad 41 which is provided at the lower end of a spud 42, in the same manner as described in connection with the embodiment in Fig. 1. Similarly, handling lines 43 and 44 may be provided to retrieve the cover 40. However, in this embodiment in place of a permeable inner layer such as 27, supra, the means for introducing fluid under pressure to the underside of the spud pad 41 comprises one or more open ended tubes or pipes 45 which extend from the upper to the lower surface of the spud pad and whose upper ends are connected to flexible tubes or conduits 46 with the latter being connected to a source of fluid such as air or water under pressure. In this embodiment when it is desired to remove the spud and spud pad, the operation is identi-

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cal with that described in the embodiment in Fig. 1 except that just prior to such removal air or water under pressure is injected via lines 46 and conduits 45 to the underside of the spud pad 41. Because of the presence of the impermeable skin or cover 40 surrounding the undersurface of the spud pad, this fluid under pressure will not be permitted to escape along the path of least resistance as described above in connection with the prior art and hence will spread substantially uniformly over the entire undersurface of said spud pad, thereby equalizing pressure above and below the same and breaking the suctional forces.

In Fig. 3 there is shown a support end cover 50 secured in operative position to cover the bottom and sides of an anchor barge 51. Secured to this anchor barge 51 are a plurality of vertically extending supporting members such as piles or spuds 52 which carry at their upper ends the deck 53 of a mobile marine platform. Such an anchor barge type mobile platform may if desired be constructed to operate in accordance with the principles described in the copending application of John T. Hazak, Serial No. 449,998 filed August 16, 1954. Thus, initially, the barge is in the buoyant condition along with its deck 53 and supporting members 52 can be floated to the desired offshore location at which time barge 51, with its end cover 50 in position, is sunk to the ocean floor as shown in Fig. 3. When it is desired to remove such platform to a different location, the same suction force problem opposes lifting of this barge 51 as was the case in the spud pad design of Fig. 1. However, because of the inherent larger size of such an anchor barge the suctional force encountered is even greater. The end cover 50 as stated above may be identical in design to the cover 20 described in connection with Fig. 1, and comprise an impermeable outer layer or skin 54 and a permeable fibrous inner layer 55. Once again the upper extremities of this inner layer 55 are in continuous communication with the water above barge 51 as shown at 56, thereby permitting passage of this water under pressure throughout the entire area of the fibrous layer 55 and hence equalizing pressure above and below the anchor barge. Once again, if desired, supplemental means for introducing fluid under pressure onto the underside of this anchor barge and thus to the fibrous layer 55 may be provided; for example, a plurality of open-ended pipes 57, extending from the top to the bottom of the anchor barge, may be connected via hose or conduits 58 to a common leader 59 located on the platform deck 53. Then fluid such as air or water under pressure may be forced by a pump 60 through leader 59, conduits 58, and pipes 57 to the underside of the anchor barge, thereby insuring a substantially uniform spread of pressure fluid throughout the area of the underside of the barge. In this connection, it should be understood that in place of the pressure system 58, 59 and 60, the pipes 57 might simply be left open at their upper ends to the sea water as are pipes in Fig. 1. It should be further understood that a support end cover, comprising merely an impervious skin such as 40 in Fig. 2a could be employed with similar success on an anchor barge such as 51. Handling lines 61 may again be provided attached to the end cover 50 for retrieving the same after raising of the anchor barge.

Turning now to Figs. 4-8, means for retrieving the support end cover of the invention automatically with the removal of the supporting member are there illustrated. An end cover 70 according to the invention is there shown secured in operative position covering the bottom and sides of a spud pad 71. This cover 70 as shown is similar in make-up to the cover described in connection with Figs. 1 and 3 and comprises an impermeable outer layer 72 and a permeable inner layer 73. Referring for the moment to Fig. 5, the preferred construction of such a permeable inner layer 73 is there shown and as will be seen, it takes the form of a woven

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fibrous mat composed of a plurality of intertwining fibers 74, 75. As mentioned above, these could be either glass fiber or sisal or hemp fibers or the like. Such a construction, it will be noticed, provides a plurality of small voids or interstices 76 which extend throughout the entire area of the permeable inner layer, thereby permitting the flow of fluid under pressure therethrough. Again the upper extremities of this fibrous inner layer are exposed as at 77 to the water located above spud pad 71. Thus water under pressure will flow through the voids or interstices 76 of the permeable inner layer and spread over the entire undersurface of spud pad 71.

In order to provide for automatic retrieving of the support end cover 70, the upper extremities of said cover are secured by means of suitable clamps 80 and lines 81 to the upper surface of the spud pad 71. The cover itself is dimensioned so as to be large enough to permit a plurality of inflatable rings or tubes 82 to be inserted between the said cover and the sides of the spud pad. These rings or tubes are positioned so as to surround the sides of said spud pad and may be formed of any material which, though flexible, will not stretch substantially circumferentially in cross-section upon being subjected to internal fluid pressure. For inflating these tubes 82, conduit means 83 are provided extending downwardly from a source of pneumatic fluid under pressure on the deck of the platform and passing internally of the spud pad 71 to a leader 84 which connects through a plurality of branch lines 85 with the interiors of said tubes.

Turning to Figs. 6-8, the operation of this automatic cover retrieving means will be understood. As shown in Fig. 6, the spud pad 71 with its cover 70 clamped in operative position thereon is lowered to the ocean floor. As shown, the tubes or rings 82 are in the collapsed condition during this positioning of the pad. Then when it is desired to remove the pad, the rings 82 are first inflated as shown in Fig. 7, thereby forcing the mud laterally away from the sides of the spud pad as shown at 87, 88. The spud pad is then lifted from the sea floor in conventional manner. It will be obvious that because fluid under pressure has been introduced to the underside of this pad via permeable layer 73, as described above, there will be no suctional force existing between the same and the cover 70. Therefore, the spud pad can be raised to the position above the sea bottom as shown in Fig. 8. When this lifting of spud pad 71 commences, although the bottom of cover 70 will still be held by suction on the sea floor, its upper extremities being secured to the said pad by the clamps 80, an upward pull will be exerted thereon, which pull will tend to flatten the flexible inflatable tubes 82, thereby causing the cover 70 to gradually peel away from the mud as shown at 89-90. Once again this peeling action will gradually break the suctional forces involved and the cover will eventually be carried to the surface with the spud pad. It should be, of course, understood that while in connection with this automatic cover retrieving means the cover has been shown similar in construction to the embodiment in Figs. 1 and 3, supra, a cover constructed according to the embodiment of Fig. 2a could be employed. Furthermore, it should be understood that this automatic cover retrieving means could be employed with equal facility on an anchor barge such as 51 (Fig. 3).

Although certain particular embodiments of the invention are herein disclosed for purposes of explanation, various further modifications thereof, after study of this specification, will be apparent to those skilled in the art to which the invention pertains. Reference should accordingly be had to the appended claims in determining the scope of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. Apparatus for facilitating removal of the bottom end portion of a supporting member of a marine platform from contact with the mud on the ocean floor, which

comprises a support end cover formed of flexible, water impermeable material adapted to receive such end portion of said supporting member, in combination with means to introduce fluid under pressure substantially uniformly over the space between said end portion and said cover, thereby substantially eliminating any suction forces existing therebetween when such end portion is being raised from the mud.

2. Apparatus for facilitating removal of the bottom end portion of a supporting member of a marine platform from contact with the mud on the ocean floor, which comprises a support end cover formed of flexible, water impermeable material adapted to receive such end portion of said supporting member, in combination with means to introduce fluid under pressure substantially uniformly over the space between said end portion and said cover, thereby substantially eliminating any suction forces existing therebetween when such end portion is being raised from the mud, said means comprising a layer of water permeable material secured to said impermeable cover and adapted to be positioned between the latter and the supporting member.

3. Apparatus for facilitating removal of the bottom end portion of a supporting member of a marine platform from contact with the mud on the ocean floor, which comprises a support end cover formed of flexible, water impermeable material adapted to receive such end portion of said supporting member, in combination with means to introduce fluid under pressure substantially uniformly over the space between said end portion and said cover, thereby substantially eliminating any suction forces existing therebetween when such end portion is being raised from the mud, said means comprising conduit means extending through the end portion of said supporting member and adapted to deliver fluid under pressure to the underside thereof.

4. Apparatus for facilitating removal of the bottom end portion of a supporting member of a marine platform from contact with the mud on the ocean floor, which comprises a support end cover adapted to receive such end portion of said supporting member, said cover comprising an outer layer of water impermeable material and an inner layer of water permeable material, the extremities of said inner layer extending above said end portion so as to be in contact with the water thereabove.

5. Apparatus for facilitating removal of the bottom end portion of a supporting member of a marine platform from contact with the mud on the ocean floor, which comprises a support end cover adapted to receive such end portion of said supporting member, said cover comprising an outer layer of water impermeable material and an inner layer of water permeable material, the extremities of said inner layer extending above said end portion so as to be in contact with the water thereabove, and supplemental fluid pressure introducing conduit means extending to the underside of the end portion of said supporting member.

6. Apparatus for effecting ready removal of the enlarged end portion of a supporting member of a marine platform from contact with the mud on the ocean floor, which comprises a water impermeable support end cover adapted to receive such enlarged end portion of said supporting member in combination with fluid pressure delivering conduit means extending through said enlarged end portion and adapted to introduce fluid under pressure to the space between said end portion and said cover.

7. Apparatus for effecting ready removal of the enlarged end portion of a supporting member of a marine platform from contact with the ocean floor which comprises a support end cover adapted to receive said enlarged end portion and having a flexible water impermeable outer layer and a flexible water permeable fibrous inner layer having numerous small passageways extending therethrough adapted to permit the distribution there-through of fluid under pressure.

8. Apparatus for facilitating removal of the bottom end portion of a marine platform from contact with the mud on the ocean floor which comprises a support end cover formed of flexible water impermeable material adapted to receive such end portion of said supporting member, in combination with means to distribute fluid under pressure over the space between said end portion and said cover, thereby substantially eliminating any suction forces existing therebetween when such end portion is being raised from the mud, and handling line means secured at one end to said cover and adapted to be secured at the other end to said platform, whereby said cover may be retrieved from the ocean floor after the supporting member has been removed therefrom.

9. Apparatus for facilitating removal of the bottom end portion of a marine platform support from contact with the mud on the ocean floor which comprises a support end cover formed of flexible water impermeable material adapted to receive the end portion of said support and secured thereto, in combination with means to distribute fluid under pressure substantially uniformly over the space between said end portion and said cover, thereby substantially eliminating any suction forces existing therebetween when such end portion is being raised from the mud, and inflatable tube means positioned between said cover and the sides of said end portion adapted to provide for automatic retrieval of said cover as the supporting member is removed from the ocean floor.

10. A method of facilitating removal from the sea floor of the enlarged end portion of a supporting member of a marine platform which comprises securing a water impermeable cover around the bottom and sides of said enlarged end portion, introducing fluid under pressure to the space between said enlarged portion and its cover, thereby reducing the suction forces existing therebetween when such end portion is being raised from the mud, and raising said enlarged end portion from the sea floor while leaving the cover in place on the sea floor and then retrieving said cover.

11. A method of facilitating removal from the sea floor of the bottom end portion of a supporting member of a marine platform which comprises securing a water impermeable cover around the bottom and sides of said end portion, said cover having handling lines secured thereto, introducing fluid under pressure to the space between said end portion and its cover, thereby reducing any suction forces existing therebetween when such end portion is being raised from the mud, and raising said end portion from the sea floor while leaving the cover in place on the sea floor and then retrieving said cover by raising said handle lines.

12. A method of facilitating removal from the sea floor of the bottom end portion of a supporting member of a marine platform which comprises securing a water impermeable cover around the bottom and sides of said end portion, positioning inflatable tube means between said cover and the sides of said end portion, introducing fluid under pressure to the space between said end portion and said cover, inflating said tube means, and then raising said end portion from the sea floor, thereby automatically retrieving said cover from the sea floor.

13. A method of effecting ready removal of the bottom end portion of a marine platform supporting member from the sea floor which comprises positioning a water impermeable cover around the sides and bottom of said end portion prior to lowering said end portion to the sea floor, then lowering said end portion to the sea floor, introducing fluid under pressure between the underside of said end portion and said cover, thereby substantially equalizing pressures above and below said portion, raising said end portion from the sea floor and then retrieving said cover from the sea floor.