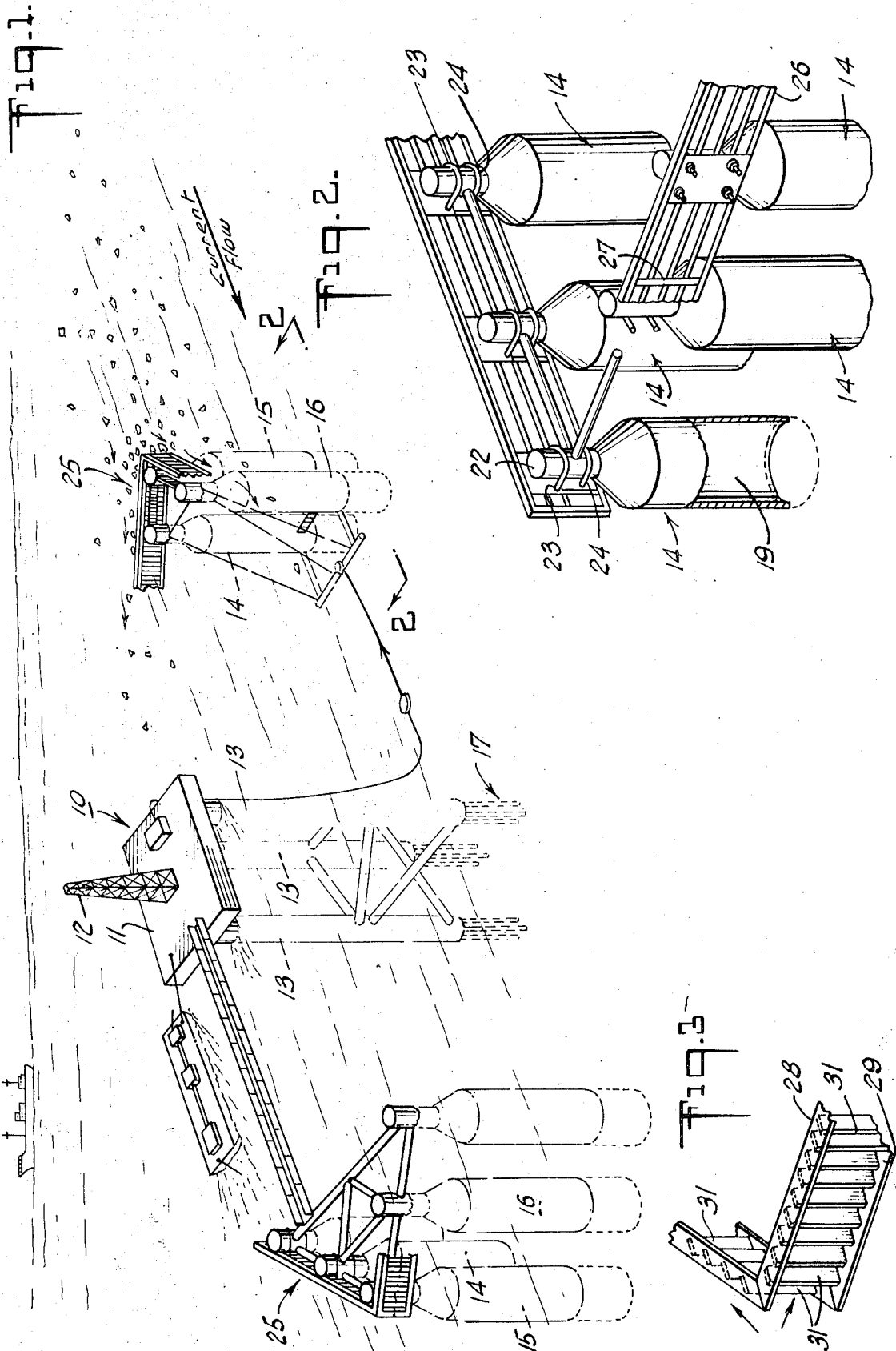


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OFFSHORE INSTALLATION

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3 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to an installation particularly for the drilling and subsequent production of an offshore oil well from an elevated marine platform. It relates further to means for conveniently storing crude oil on a provisional basis until subsequent transfer to a shore based refining or storage facility. The provisional storage means includes one or more tanks, imbedded in the ocean floor and so arranged remotely from the marine platform to protect the latter from environmental conditions inherent to the location.

BACKGROUND OF THE INVENTION

The use of offshore oil producing facilities is becoming more expensive every day. However the effective utilization of such facilities is often contingent on the conditions determined by the environmental surroundings in which the marine platform is situated. A satisfactory drilling and/or production platform must be adapted to perform effectively in shallow as well as deep water and in all extremes of water and weather conditions. One often vexing problem in any offshore installation is the adequate storage of crude oil as it is removed from the ground, where there is lacking any means for immediate transfer to the shore such as by way of a pipeline or the like. Such storage facilities should as a safety measure, be positioned remote from the platform. Secondly, the storage facility must, of necessity, be of sufficient capacity to hold a substantial volume of the crude oil until it is transferred by barge, tanker or other means.

It has been found both feasible and economically desirable to position such storage tanks under the water surface, and preferably on the ocean floor. When so located they are not only relatively safe from the action of severe tides and storm conditions, but they are also out of the way and require little except ordinary under water maintenance.

It can be appreciated that the type of offshore marine platform presently contemplated is subject to environmental abuse in varying degrees depending on the particular location. For example, the continuous changing tide in an offshore tideland installation results in the continuous movement of water against the platform support members whether the latter be of the floating or the sunken type. Such abuse of the support members can be at least partially overcome by use of coatings, and protective means carried on the member itself in the area affected most by the tide. However such measures under particularly severe environmental conditions are of minimal effect.

More specifically it has been experienced in offshore installations such as Alaska and other severely cold climates, that the operation can be greatly hampered, and production retarded if not completely stopped as a result of the extremely cold weather.

Many drilling platforms in use today are of the floating or floatable type, having suitable anchoring means to maintain them temporarily in position. The primary advantage deriving from this feature is that they might be

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readily detached from a moored spot and readily transferred to another location. However, since different locations can differ widely in prevalent climatic and weather conditions, in general there is often a problem of adapting the platform to a new location.

For example, an instance of an extremely severe weather environment is in the Gulf of Mexico which lies directly in the path of recurring tropical storms and hurricanes. On the other hand, Alaska the site of many offshore installations, experiences extremely cold weather, sudden violent wind storms and also extreme tides. In conjunction with the latter, and during the colder weather, the waters around Alaska are subject to freezing over, thus in the instance of tidal waters the ice tends to continuously move back and forth through the tidal areas. It has been realized by bitter experience that the erratic currents and floating ice in some offshore Alaskan locations has accounted for millions of dollars in lost time and equipment.

As a consequence, for offshore oil production to be economically warranted each location must be capable of operating continuously regardless of the adverse weather and environmental conditions imposed by the characteristics of the water and the surrounding areas.

It is, therefore, one object of the invention to provide an arrangement of equipment at an offshore oil drilling site that is both practical and economical as determined in view of the amount of oil produced. A further object is to provide a combined storage and protection means at an offshore well drilling site to more effectively utilize a platform either for drilling or for production purposes. A still further object is to provide means at an offshore location for protecting a raised platform and its submerged support members from extreme water currents and from floating objects which might forcibly contact the support members. Still another object of the invention is to provide a combination oil storage and platform protection means in the form of a barrier of deflecting elements disposed in the path of the prevailing current to protect the platform from damage which would ordinarily be imposed by such floating objects.

In accordance with the above delineated objectives, the invention in brief contemplates an oil producing facility installation positioned in a water mass and subject to adverse weather and tidal conditions. The installation includes a raised drilling and production platform anchored to and supported by the ocean floor in the path of usually severe currents and tide changes. The platform is supported on one or more legs which extend to the water mass substratum and normally enclose a plurality of well conductors or conduits for removing oil from the substratum.

Since such moving waters frequently carry relatively massive sheets of ice and other solid floating materials into contact with the platform support legs, means is provided to protect the latter. Storage means including a plurality of oil holding members is, therefore, disposed about the platform but spaced from the latter, serving the dual function of provisionally storing crude oil and also providing an outlying barrier for deflecting said ice and other floating objects. Positioning of the barrier arrangement spaced from the production platform also provides a form of mooring dolphin to facilitate the docking of small boats and barges at the platform without sustaining damage to either the boat or the platform.

DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a vertical elevation of an offshore oil drilling and/or producing installation including a drilling platform together with oil storage means spaced adjacently thereto. FIG. 2 is a segmentary, vertical elevation on an enlarged scale of a portion of the oil storage

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tanks shown in FIG. 1, and FIG. 3 is a segmentary view of an alternate form of barrier as shown supported by the storage tanks in FIG. 2.

Referring to the drawings, FIG. 1 illustrates a typical oil production site of the type contemplated, positioned in an offshore body of water, which for clarity, will be referred to as the ocean. Drilling and/or production platform 10 comprises a deck 11 which mounts derrick 12 and other equipment ancillary to a drilling operation. Support members 13 elevate deck 11 above the surface of the water, which members extend to and are fixed to the ocean floor by piles or similar means.

Storage means comprising tanks 14, 15 and 16 are positioned remote from the drilling platform. These tanks take the form of elongated, upright open lower end caissons, imbedded in the floor of the ocean, so arranged to provide the necessary provisional oil storage, and to provide a protective barrier to the raised platform and supports. The grouped tanks might be located on one or more sides of the platform and are placed to best function by deterring floating solid substances from contacting the platform supports. The caissons are most effective when disposed adjacent to but spaced apart from the platform and transverse to the water current flow.

Platform 10 comprises a plurality of support columns 13. However, this design is largely a matter of choice since the form of support, and the number of members functioning as such is contingent on the weight to be supported and the environment in which the platform is positioned. In this instance the respective columns 13 extend from the floor of the ocean to a position above the surface of the water.

The lower end of each column 13 is supported at the ocean floor in a manner to resist movement in response to the flow of under water currents, and waves at the surface. Following normal procedure, platform 10 is anchored in place by piles 17 driven through the respective supporting members and into the floor of the ocean. The piles are provided in a sufficient number to overcome any tendency of the column to adjust from its position, by either the force of water currents, or the wave conditions at the deck level.

Elongated columns 13 are preferably tubular, and of large enough diameter to accommodate a number of conductor pipes which extend from deck 11 into the ocean floor. Normally such conductors are integral with the well and extend downwardly into the ocean bottom for a predetermined distance. In the typical installation support columns 13 surround a plurality of wells which are numbered in accordance with the productivity of the particular location.

Under normal production conditions crude oil is drawn from the ocean substratum, and brought to the platform deck 11 for separation of various gaseous elements. The gas free crude is then conducted to the provisional storage facility, while the gas is disposed of by burning or other appropriate measure.

Normally, removed gas is discharged to the atmosphere or burned at a point remote from the installation to avoid the possibility of fire. For similar reasons the respective storage tanks are maintained remotely from the platform as well as from the gas burning facility. Burning facilities can even be provided at one or more of the tanks 14, 15 or 16.

The respective storage tanks 14, 15 and 16 in the present instance, are preferably positioned in groups both upstream and downstream of the platform. This presupposes that the tidal flow of water past the platform columns 13 follows the direction of the arrows as shown in the figure.

Each storage tank cluster or group illustrated by 14, 15 and 16, includes one or more, and preferably at least three elongated, upright units. Each tank or caisson in turn is characterized by an open lower end adapted to being imbedded into the floor of the ocean either by jet-

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ting, driving or by other methods needed to forcefully imbed the open end of the tank sufficiently deep to assure that the tank maintains a substantially upright position in spite of displacing forces.

The length of the respective tanks will be determinative on the depth of the water mass, soil conditions, and the particular area in which the tanks are located. Similarly, the tank outer dimensions will be sufficiently great to provide the unit with structural rigidity to withstand movement of the water both below and above the surface such that the tanks will remain liquid tight as well as stationary. The tank clusters may be made accessible to the platform by a light bridge, walkway, or similar structure 18 supported between platform 11 and at least one of the tanks. Such structure could serve the further purpose of supporting oil carrying lines as for example line 20 rather than having said lines submerged or lying in the ocean bottom. The usual valving and pumping means is provided in communication with the platform as by line 20 to pass a controlled flow of oil or water to the respective storage tanks as required. This permits the tanks to be controllably maintained in a full condition whether of oil, water, or a combination of the two.

Each tank cluster is positioned with the tank narrow upper ends protruding for a sufficient distance above the water surface to have said protruding end visible under all conditions of tide extremes or turbulent weather. The upper ends of the respective tanks are adapted to receive a structural framework and walkway which serves the function of unitizing the otherwise separated individual tanks thereby to better provide a barrier against ice or other flowing materials moving toward the supporting platform.

The respective tank clusters are so arranged to best provide maximum, and most effective protection for the partially submerged members 13. Thus, the tanks might be disposed in a line normal to the current flow. However, they can also be disposed in a line biased to the flow of the water to deflect ice or other floating materials to one side of platform 10. In still another effective arrangement the respective tanks are positioned in a triangular disposition so that deflected materials are displaced to either or both sides of the platform.

Referring to FIG. 2, each tank unit comprises essentially an elongated cylindrical caisson type body 19 which, when uprightly positioned, includes an open lower end defined by a relatively thin edge. Said lower edge is, when properly positioned, imbedded into the ocean substratum for a sufficient length depending on the composition or consistency of the substratum, to best assure the tank a relatively rigid stance. The upper edge of elongated body 19 terminates at a conical neck section 21. The upper end of the conical section is provided with a generally elongated cylindrical cap 22 which extends vertically above the water surface and connects at its lower end to the constricted aperture of said neck section 21.

The interior of body 19 may be partitioned and provided with suitable compartments each of which is interconnected with the above mentioned piping system. Body 19 may also comprise merely a shell-like structure into which water is introduced and maintained at a predetermined level until displaced by oil to be provisionally stored.

The diameter or vertical cross-section of said cap 22 is substantially less than the diameter or cross-section of the body 19. The primary reason for the minimal above surface exposure at the upper end of the tank is to minimize the bending moment applied to the tank as a result of water pressure acting against one side of the latter. Thus at the point of imbedment of each tank, the displacing force caused by either waves, prevailing currents or the like is relatively minimal in contrast to the same force as applied to the upper end of the tank which upper force is often supplemented by wind and changes in the water current.

The relatively thin, elongated cap 22 protrudes above the water surface, having the primary function of ripping or breaking up sheets of floating ice. The force induced into platform support members 13 by small pieces of floating ice is minimal in contrast to the force required to break up extensive sheets of solid ice. The breaking or dividing of the ice sheets is accomplished at least in part by the force of moving water hammering; the vertical heaving of the sheets against the barrier also tends to break up the mass.

A further desirable feature of the described storage tanks is that the latter by their nature are readily salvageable for use at a different oil facility. Thus, the respective tanks may be withdrawn from their imbedded positions in the substratum by means familiar in the trade such as jetting, or merely cutting them off at the ocean floor, such that the tanks can be either transported or floated from one location to another.

While the respective tanks will serve to achieve a desired function merely by their presence in the path of ice carrying current, the function might be supplemented by the addition of a fence or barrier supported on the respective end caps 22. In such an instance, and as shown in FIG. 2, each end cap 22 is provided with support means such as spaced brackets 23 and 24 carried on the cylindrical cap 22 and being adapted to removably receive a barrier or fence 25. Said barrier may assume a number of embodiments while effectively performing the function for which it was provided. For example, the fence is provided with a sufficient opening area to allow the free passage of water and small bodies of ice. On the other hand, the design of the fence must be such as to intercept, deflect and/or break up material of a relatively bulky nature such that the latter will be readily diverted to one or both sides of the platform legs.

As shown in FIG. 2, one embodiment of the barrier 25 is comprised of a number of interconnected horizontal and vertical structural members 26 and 27 respectively which, when considered as a whole, define a grid-like pattern. This fence may further be fabricated in individual sections to permit replacement of each section as the need arises due to excessive wear or damage as the result of contacting moving ice.

In still another embodiment of the barrier structure, shown in FIG. 3, upper and lower support members 28 and 29 position a plurality of vertically extending and spaced apart panels 31. The latter are so spaced to permit passage of water and small bodies of ice through the intermediate openings and yet direct movement of solid materials along the side thereof so that the material is permitted to float past the platform rather than contacting the support members 13.

Tanks 14, 15 and 16 serve the further purpose of being an effective mooring fender to protect the platform member from boat damage. Such damage has been found to be quite severe with the extremely strong currents which prevail in many areas, and the large boats, barges and other vessels which are used in offshore drilling and producing operations.

Obviously many modifications and variations of the invention, as hereinafter set forth, may be made without departing from the spirit and scope thereof and, therefore, only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. In an offshore oil producing facility disposed within a body of water having a penetrable substratum, and being exposed to prevailing water currents, said facility including; a platform having oil producing equipment thereon, at least one leg extending to the floor of said body of water and connected to said platform to support the latter above the water's surface, and conduit means communicating said oil producing equipment with a source of crude oil in said substratum, the improvement therein of oil storage means anchored into the floor of said body of water adjacent to said at least one support leg, and said conduit means further communicating said producing equipment with said oil storage means for transferring oil to the latter, said oil storage means including a plurality of said elongated caissons disposed adjacent one to the other, said caissons having opposed upper and lower ends, said lower end being imbedded into said penetrable substratum to define at least one liquid holding compartment in said caisson and to maintain the caisson in a substantially upright disposition, said liquid holding compartments in said caissons being communicated with a source of fluid immiscible with said oil for maintaining said at least one liquid holding compartment substantially full of fluid, and a cap extending from the upper end of each of said caissons beyond the surface of said water, said cap being formed with a lesser diameter than the diameter of said cylindrical caisson, and barrier means depending from the cap on said respective plurality of caissons to extend at least partially beneath the surface of said body of water.

2. In an offshore oil producing facility as defined in claim 1 wherein said barrier means includes a fence having openings formed therein to permit passage of water through said fence, the latter being arranged at an angle to the flow of water current whereby to deflect floating bodies away from said support leg.

3. In an offshore oil producing facility as defined in claim 1 wherein said barrier means includes a plurality of vertically arranged panels spaced apart a sufficient distance to permit passage of water therebetween while deflecting passage of floating bodies away from said support leg.

References Cited

UNITED STATES PATENTS

3,381,481	5/1968	Chamberlin et al.	61-46.5
3,396,544	8/1968	Manning	61-46
3,422,628	1/1969	McDonald	61-46

JACOB SHAPIRO, Primary Examiner

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61-1, 3, 4; 220-13