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(54) Title: METHOD AND SYSTEM FOR CAPTURING HYDROCARBONS FROM A LEAKING OILWELL AT A PREDETERMINED SEABED LOCATION

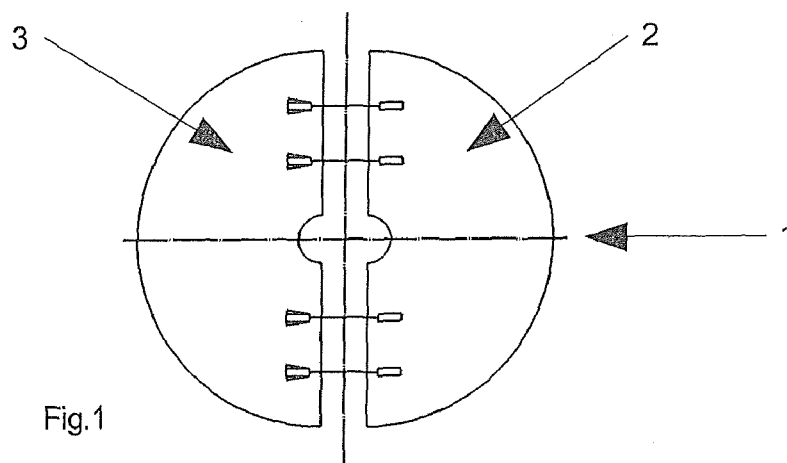


Fig. 1

(57) Abstract: Method and system for capturing hydrocarbons from a leaking oilwell at a predetermined seabed location, in which the steps are applied of: a. deploying a dome near the predetermined seabed location; b. moving the dome to the predetermined seabed location; c. capturing the hydrocarbons from the leaking oilwell into the dome; d. providing near the predetermined seabed location a predetermined number of anchor means around the leaking oilwell, which anchor means are equipped with pull wires, and e. attaching the pull wires to the dome for pulling the dome in position above the leaking oilwell. The dome is placed in position on top of a base plate which is placed on the predetermined seabed location prior to moving the dome to the predetermined seabed location.



Method and system for capturing hydrocarbons from a leaking oilwell at a predetermined seabed location

The invention relates to a method for capturing hydrocarbons from a leaking oilwell at a predetermined seabed location. The invention also relates to a system comprising a movable dome for placement at the predetermined seabed location and capturing the hydrocarbons from the leaking oilwell and to new subject matter which will be defined hereinafter.

Such a method and system are known from US-A-4,405,258. According to this prior art document a containment dome is used having an upper expanded domelike fluid impervious membrane, a fluid impervious hollow peripheral ring attached to the periphery of the membrane to provide a depending bag-like container and water drainage means located within the bag-like container for connection to pump conduit means. This known containment dome is only suitable for use in shallow water and is essentially developed for use in the Arctic. It is unsuitable however for use in deep-sea at levels unsuitable for diving. The known method and system is also unsuitable to collect the hydrocarbons of leaking oilwells in deep-sea and withstand the pressure levels that prevail at such deep sea levels which may be as high as 800 atmosphere.

US-A-3,981,154 discloses a method for capturing hydrocarbons from a leaking oilwell at a predetermined seabed location, which method comprises the steps of:

- a. providing near the predetermined seabed location a predetermined number of anchor means around the leaking oilwell;
- b. deploying a dome near the predetermined seabed location;
- c. moving the dome to the predetermined seabed location; and
- d. capturing the hydrocarbons into the dome.

It is one of the objects of the invention to provide a method and system which is capable to be used at shallow waters but also at deep-sea levels for the collection of hy-

drocarbons spilling out of a leaking oilwell.

It is a further object of the invention to put a stop to a leaking oilwell as quickly as possible to prevent environmental harm as much as possible.

5 It is still a further object of the invention to at least provide an alternative for existing methods and systems which may be used in a variety of circumstances to collect hydrocarbons from leaking underwater oilwells.

10 These objects and further advantages that may become apparent from the following disclosure are attained or promoted by the system, method, and novel devices according to one or more of the appended claims.

According to a first aspect the method of the invention further employs the steps of

15 e. arranging that the anchor means are equipped with pull wires, and

20 f. attaching the pull wires to the dome for pulling the dome in position above the leaking oilwell, wherein the dome is placed in position on top of a base plate which is separable from the dome and is placed on the predetermined seabed location prior to moving the dome to the predetermined seabed location.

25 The application of the anchor means and the pull wires enable an accurate positioning of the dome by maneuvering the dome from an initial position at the side of the leaking oilwell to avoid undesirable interference with the forcible stream of hydrocarbons coming out of said leaking oilwell. Further it enables that -as far as required- the dome then also can be of a construction capable to resist the pressures and forces that apply at deep-sea.

30 Preferably three anchor means are provided in the seabed forming a triangle surrounding the leaking oilwell. Providing three and no more than three anchor means is a reliable and precise way of defining the position at which the dome will be located.

35 Advantageously pull wires are employed that comprise first pull wires for transferring substantially vertical forces to the dome and second pull wires for transferring

substantially horizontal forces to the dome. The first pull wires and then effectively be used for maneuvering the dome in the action, whereas the second pull wires can be used for maneuvering the dome in the horizontal plane.

5 One of the novel and favorable aspects of the invention is that the dome is placed in position on top of a base plate which is separable from the dome and is placed on the predetermined seabed location prior to moving the dome to the predetermined seabed location. This promotes the reliability and accuracy of the placement of the dome, but is foremost
10 beneficial for enabling a closing off of the leaking oilwell after placement of the dome in position on top of the base plate .

Desirably a base plate is applied which is equipped
15 with an optionally closable slit to allow the base plate to be moved to the predetermined seabed location without interfering with the leaking oilwell. Preferably the base plate has a closable slit, which is closed after placement of the base plate at the predetermined seabed location. This is beneficial because it provides a solid base for the dome to be
20 lower to the seabed location to control the hydrocarbons flow from the oilwell.

For effective and accurate placement of the base plate it is preferable that the base plate is connected to
25 the pull wires of the anchor means for moving the base plate to the predetermined seabed location prior to placing the dome in position on top of the base plate. Advantageously then the base plate is pulled in position making use of the first pull wires in order to transfer horizontal forces to
30 the base plate.

Suitably the first pull wires are guided from the anchor points via the base plate to the dome at the time they are used for transferring substantially vertical forces to the dome for putting the dome on top of the base plate.

35 As already mentioned the invention also relates to a system for capturing hydrocarbons from a leaking oilwell at a predetermined seabed location, comprising a movable dome for placement at the predetermined seabed location and capturing

the hydrocarbons from the leaking oilwell. According to one of the aspects of the invention, this system further comprises a base plate that is placeable at the predetermined seabed location, and it has the feature that the dome snugly fits on top of the base plate.

For the purpose of effective and reliable placement of the dome on top of the base plate, the system is further embodied with a predetermined number of anchor means that are placeable in the predetermined seabed location around the leaking oilwell, and that said anchor means are provided with pull wires that are attachable to the base plate and/or the dome .

According to one of the further aspects of the invention it is preferable that the anchor means are embodied as suction piles having on top winches for the pull wires. At least some of the winches could also be placed elsewhere, for instance on the baseplate. It is remarked that suction piles as such are known from the prior art, see US2009/0052994, however they are normally used for a different purpose such as for the placement of a crane on top of the suction pile as taught by US2009/0052994 .

Preferably the pull wires comprise first pull wires for transferring during their use substantially horizontal forces to the base plate and/or vertical forces to the dome, and second pull wires for transferring substantially horizontal forces to the dome.

According to one of the other aspects of the invention, the system comprises a base plate having a closable slit, wherein in the open position of the slit the base plate is movable in position at the predetermined seabed location around the leaking oilwell without interfering with said leaking oilwell, and in the closed position of the slit the base plate circumferentially completely surrounds the leaking oilwell .

To promote the ease and effective placement of the base plate, the base plate is preferably provided with slides that during use rest on the seabed and that make it easier to move the base plate in a horizontal plane sliding across the

seabed to the predetermined seabed location of the leaking oilwell .

It is further preferable that the base plate has a centrally provided aperture which is arranged to pass therethrough a structural element of an oilwell.

Still another aspect of the invention is that the dome of the system is at its interior preferably provided with a flow diverter for hydrocarbons to reduce or counteract the abrasive effect of the high pressured oilflow coming out of the leaking oilwell.

To support the effective operation of the system to cease a continuing leaking oilwell, the dome is provided with a chemical injection system and/or a heating system. The chemical injection system is effective in combating hydrate formation within the dome, whereas the heating system is used for keeping the fluids in the chemical injection system from solidifying .

The invention is also embodied in the separate anchor means, baseplate, and dome that are used in the system and method of the invention.

The invention will hereinafter be further elucidated with reference to the drawing of some exemplary embodiments of the system of the invention and its parts, and with reference to a typical method of operation of the system according to the invention.

In the drawing:

-figures 1-4 show four different embodiments of the baseplate of the invention;

-figures 5 and 6 show a side view and top view respectively of a preferred embodiment of the baseplate of the invention;

-figures 7 and 8 show a side view and a detail view respectively of the dome of the invention;

-figures 9-13 show the system of the invention when used for executing the method of the invention.

Whenever in the figures the same reference numerals are applied, these reference numerals refer to the same or similar parts.

The baseplate

The function of the baseplate 1 is to form a solid base platform to which the dome (see figure 7, 8) can be fixed. The great advantage of installing the baseplate 1 first is that this can be done coming from the side and without dealing with the flow of hydrocarbons from the leaking oilwell since the baseplate 1 is intended to be installed below the blowout preventer (BOP) connector of the wellhead (to be discussed hereafter with reference to fig. 10, 11) .

There are several options to implement the baseplate 1 such that it can be positioned around the wellhead, coming from the side. It is preferable that eventually the baseplate 1 will wrap and close around the wellhead. At least four different options are feasible.

Option 1, see figure 1: Two halves 2, 3 are pulled together from both sides. An advantage is that the system can easily clamp around the wellhead with force. A disadvantage is that two separate parts 2, 3 have to be leveled and correctly positioned and that the two parts 2, 3 must close exactly parallel to each other.

Option 2, see figure 2: An opening is made into the half sphere 4 to provide a slit 5 to enable that the baseplate can slide around the wellhead. Once the baseplate 1 is in position a separate piece 6 is positioned over the slit 5 to close it off. Disadvantageous of this method is that there are two separate pieces 4, 6, and clamping to the wellhead with force is difficult.

Option 3, see figure 3: This system is comparable to option 1 except that on one side both plates 2, 3 are joined together with a hinge 7. The two half plates 2, 3 are pulled together hydraulically. An advantage over option 1 is that only the height of one plate 2, 3 must be correctly positioned. Comparable is that it can also clamp around the wellhead with force. A disadvantage is that the system has two

large moving halve plates 2, 3.

Option 4, see figure 4: This is the preferred option. The baseplate 1 is "opened" exposing a slit 5 by turning a part 8 of the baseplate 1 that is movable with respect to the remainder 9 of the baseplate 1 to an opposite side of the baseplate 1. The sliding mechanism that is used therefore can for instance comprise at least two rails over which the movable part 8 is pushed. This can be done by hydraulic pistons or by using a mechanical lever. Once the baseplate 1 is open it is pulled towards the wellhead. When it is positioned correctly the baseplate 1 is closed by rotating the movable part 8 back into its original position. A major advantage of this design is that the baseplate 1 is a one-piece design, making it easy to install and position, especially at an angle with respect to the wellhead.

A preferred embodiment of the baseplate in accordance with option 4 will now be further discussed with reference to figures 5 and 6.

The dome will be discussed hereinafter with reference to figures 7 and 8. First the correct steel "bit" is selected based on the dimensions and type of the wellhead at which the baseplate 1 is to be applied. The baseplate 1 comprises of two halves 8, 9. When closed it forms a steel base with a circular protrusion 10 in the center to wrap around the wellhead, see in particular the top view shown in figure 6. The hydraulic locking clamp to the wellhead is provided on the baseplate 1. One half is welded on the center of the part 9 which stands on legs 11. The other part is mounted onto the rotating part 8 of the baseplate 1. The baseplate 1 can be seen from the side with the bit in the center in Figure 5. The baseplate 1 is shown to be shaped conically to better deal with internal pressures. It has an upper diameter of around 8 meters and stands up to an estimated height of 3.25 meters. The weight is estimated at 39 t.

As elucidated above the baseplate 1 has a movable part 8 that can slide to another side of the baseplate 1 over

rails that allows opening (exposing a slit 5) and closing of the baseplate 1. The baseplate 1 is open when it is lowered to the seabottom, then it is pulled up against the wellhead and subsequently it is closed. To pull the baseplate 1 into position pull wires are connected from suction pile reels as will be discussed hereinafter with reference to figure 9. The baseplate 1 preferably stands on three hydraulically adjustable legs 11 which are standing on specially designed mud mat skis 12. The goal of these mud mats 12 is to distribute the force of the weight of the baseplate 1 over a larger area so the legs 11 do not sink away into the sea bottom, and to reduce the friction with the sea bottom when the baseplate 1 is being pulled into position.

The dome

The function of the dome is to receive the hydrocarbons from the leaking oilwell and offer a base on which to connect a new ram stack and connection system to a riser for bringing the hydrocarbons to sea water level.

The dome 13 as schematically shown as an example in figure 7 is a large 20 meter high steel cylindrical (diameter of 8m) construction. Its weight is estimated at around 190 t. It has a flange 14 on top to install a subsea riser connection system. It has pressure valves 15 around the flange 14 to make sure that the flow passing through can be controlled during the descent of the dome 13 to the seabottom, as well as during its installation on top of the baseplate 1. It also serves to release pressure during the capturing of the hydrocarbons. A special chemical injection system distributes chemicals evenly around the dome 13. The dome 13 is well insulated to prevent its temperature from dropping. It also has an electrical heating system which actively warms the fluids within the dome 13. The riser is to be connected on top of the dome 13 on the flange 14. To control the speed of the flow a floating capture vessel "pumps" the hydrocarbons up.

Preferably the dome 13 is provided with a sacrificial conical flow diverter 16 as shown in figure 8. This flow

diverter 16 is used to prevent severe erosion of the inside dome. This is specifically of interest for the top part of the dome 13. The top part of the dome 13 has vulnerable components including the pressure valves 15 and the riser connection system to be connected to the flange 14. Since the flow is most likely to exit the blowout preventer of the wellhead through a broken riser, the flow will be sprayed against these components at great velocities. The sacrificial conical flow diverter 16 decreases the impact of this effect by diverting the spout into various directions.

The anchor means

As an example of suitable anchor means figure 9 shows that three suction piles 17 have been installed in the proximity of a malfunctioning blowout preventer 18. The baseplate 1 is resting in the vicinity of the wellhead's blowout preventer 18 on the sea bottom prior to its placement around the wellhead. The suction piles 17', 17'', 17''' are provided with large reels carrying synthetic cables 19. For starting the positioning of the baseplate 1, the cables 19 are first connected to the baseplate 1 as seen in figure 9. As soon as the cables 19 are properly connected by remotely operated vehicles (ROV's), the two farthest reels on suction piles 17', 17'' start pulling the baseplate 1 into position. The movement of the baseplate 1 is assisted since it is standing on hydraulic legs (see the above description with reference to figure 5) which can rest on special ski like mud mats which allows the structure to be pulled over the seabottom more easily.

Moving and positioning the baseplate

In a scenario in which the baseplate 1 gets stuck on the sea bottom, air bags can be inflated to reduce the friction with the sea bottom or even partially lift the structure. Cables from the surface could also be or remain connected for this purpose to the baseplate.

About a quarter of the "bowl" shaped baseplate 1 is open or slides open prior to moving the baseplate 1 around

the wellhead as shown in figure 10, and then closes around the wellhead as soon as the baseplate 1 is in position, as is shown in figure 11. Hydraulic legs 11 adjust the height of the baseplate 1 accurately and a powerful gripper clamp is closed onto the wellhead.

Positioning the dome on the baseplate

Now that the baseplate 1 is stable once it is clamped to the wellhead, all the cables 19 are connected to the dome 13 which -as figure 12 shows- is dangling at a safe distance above the flow spraying from the wellhead's blowout preventer, and the pulling can begin. Horizontal forces are compensated for by one set of cables 19' running from winches 20 on top of the suction piles 17 directly to the dome 13. The vertical forces are set off by cables 19'' running from winches 20 on top of the suction piles 17 through the baseplate 1 up to the dome 13 and optionally to cables that may be suspended from a crane vessel at the sea surface. This is best shown in figure 13.

The dome 13 is pulled down until it connects to the baseplate 1. This represents a very critical moment because of pressure build up in the dome 13 and flow assurance issues that are known to the person skilled in the art.

There are pressure relief valves 15 on top of the dome 13 which can be used for maneuvering the dome 13 during its lowering and installation. The dome 13 is especially insulated to prevent the temperature in the dome 13 from dropping too much. Preferably the dome is heated and has chemicals injected to prevent hydrate formation.

On top the dome 13 has a provision for connecting same to a riser. As soon as the dome 13 is in position, the valves closing of the riser, which has already been put in place during the lowering of the dome 13, are opened. Slowly then the pressure relief valves 15 can be closed until all hydrocarbon flow is diverted from the dome via the riser connected to the dome towards a recovery vessel at the surface of the sea.

CLAIMS

1. Method for capturing hydrocarbons from a leaking oilwell at a predetermined seabed location, which method comprises the steps of:

5 a. providing near the predetermined seabed location a predetermined number of anchor means (17', 17'', 17''') around the leaking oilwell;

b. deploying a dome (13) near the predetermined seabed location;

10 c. moving the dome (13) to the predetermined seabed location;

d. capturing the hydrocarbons into the dome (13);

characterized in that the method further employs the steps of

15 e. arranging that the anchor means are equipped with pull wires (19', 19''); and

20 f. attaching the pull wires (19', 19'') to the dome (13) for pulling the dome in position above the leaking oilwell, wherein the dome (13) is placed in position on top of a base plate (1) which is separable from the dome (13) and is placed on the predetermined seabed location prior to moving the dome (13) to the predetermined seabed location.

25 2. Method according to claim 1, **characterized in that** three anchor means (17', 17'', 17''') are provided in the seabed forming a triangle surrounding the leaking oilwell.

30 3. Method according to claim 1 or 2, **characterized in that** pull wires (19', 19'') are employed that comprise first pull wires (19'') for transferring substantially vertical forces to the dome (13) and second pull wires (19') for transferring substantially horizontal forces to the dome (13) .

35 4. Method according to any one of claims 1-3, **characterized in that** the base plate (1) is equipped with an optionally closable slit to allow the base plate (1) to be moved to the predetermined seabed location without interfering with the leaking oilwell.

5. Method according to claim 4, **characterized in that** the base plate (1) has a closable slit (5), and said slit (5) is closed after placement of the base plate (1) at the predetermined seabed location.

5 6. Method according to any one of claims 1-5, **characterized in that** the base plate (1) is connected to the pull wires (19', 19'') of the anchor means (17', 17'', 17''') for moving the base plate (1) to the predetermined seabed location prior to placing the dome (13) in position on top of the
10 base plate (1).

7. Method according to any one of claims 3-7, **characterized in that** the base plate (1) is pulled in position making use of the first pull wires (19'') in order to transfer horizontal forces to the base plate (1).

15 8. Method according to claim 3 and 7, **characterized in that** the first pull wires (19'') are guided from the anchor means (17', 17'', 17''') via the base plate (1) to the dome (13) at the time they are used for transferring substantially vertical forces to the dome (13) for putting the dome
20 on top of the base plate (1).

9. System for capturing hydrocarbons from a leaking oilwell at a predetermined seabed location, comprising a movable dome (13) for placement at the predetermined seabed location and capturing the hydrocarbons from the leaking oilwell, **characterized in that** the system further comprises a
25 base plate (1) that is placeable at the predetermined seabed location, and that the dome (13) snugly fits on top of the base plate (1).

10. System according to claim 9, **characterized in that** the system is further embodied with a predetermined number of anchor means (17', 17'', 17''') that are placeable in the predetermined seabed location around the leaking oilwell, and that said anchor means (17', 17'', 17''') are provided with pull wires (19', 19'') that are attachable to the base
30 plate (1) and/or the dome (13).

11. System according to claim 10, **characterized in that** the anchor means are suction piles (17', 17'', 17''') having on top winches (20) for the pull wires (19', 19'').

12. System according to claim 9 or 10, **characterized in that** the pull wires (19', 19'') comprise first pull wires (19'') for transferring substantially horizontal forces to the base plate (1) and/or vertical forces to the dome (13),
5 and second pull wires (19') for transferring substantially horizontal forces to the dome (13) .

13. System according to any one of claims 9-12, **characterized in that** the base plate (1) has a closable slit (5), wherein in the open position of the slit (5) the base
10 plate (1) is movable in position at the predetermined seabed location around the leaking oilwell without interfering with said leaking oilwell, and in the closed position of the slit (5) the base plate (1) circumferentially surrounds the leaking oilwell .

14. System according to any one of claims 9-13, **characterized in that** the base plate (1) has slides (12) for resting at the seabed and promoting the horizontal movement of the base plate (1) sliding across the seabed to the predetermined seabed location of the leaking oilwell.

15. System according to any one of claims 9-14, **characterized in that** the base plate (1) has a centrally provided aperture (10) which is arranged to pass therethrough a structural element of an oilwell.

16. System according to any one of claims 9-15, **characterized in that** the dome (13) is provided at its interior with a hydrocarbons flow diverter (16) .

17. System according to any one of claims 9-16, **characterized in that** the dome (13) is provided with a chemical injection system and/or a heating system.

18. Anchor means, **characterized in that** these are embodied as suction piles (17', 17'', 17''') having on top winches (20) for pull wires (19', 19''), wherein the pull wires (19', 19'') comprise first pull wires (19'') for transferring substantially horizontal forces to a base plate (1)
35 and/or vertical forces to a dome (13), and second pull wires (19') for transferring substantially horizontal forces to a dome (13) .

19. Baseplate (1), **characterized in that** the base

plate has a closable slit (5), wherein in the open position of the slit the base plate (1) is movable in position at a predetermined seabed location around a leaking oilwell without interfering with said leaking oilwell, and in the closed position of the slit (5) the base plate (1) circumferentially completely surrounds the leaking oilwell.

20. Baseplate (1) according to claim 19, **characterized in that** it has slides (12) for resting at the seabed to promote the horizontal movement of the base plate (1) sliding across the seabed to a predetermined seabed location of a leaking oilwell.

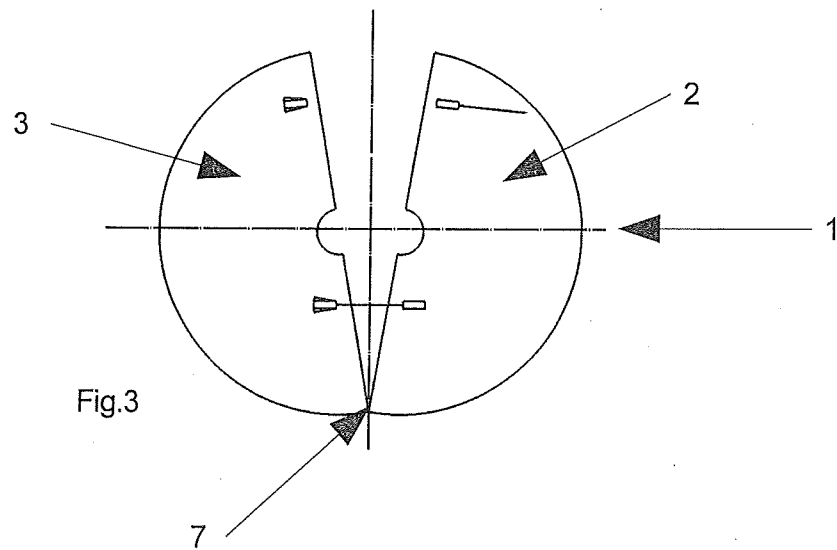
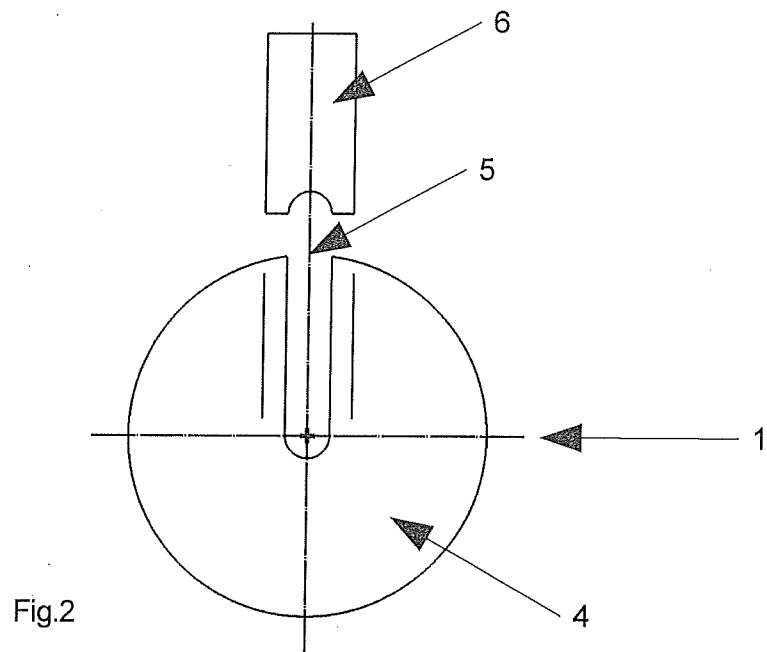
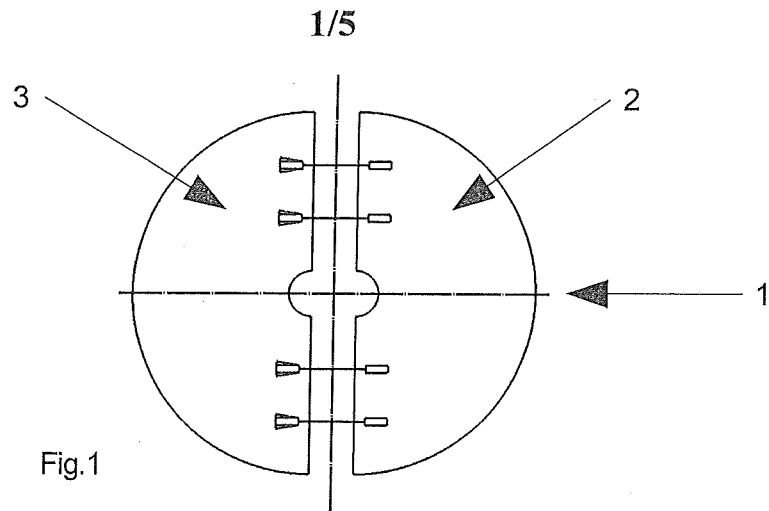
21. Baseplate (1) according to claim 19 or 20, **characterized in that** it has a centrally provided aperture (10) which is arranged to pass therethrough a structural element of an oilwell.

22. Dome (13), **characterized in that** it is provided at its interior with a flow diverter (16) for hydrocarbons.

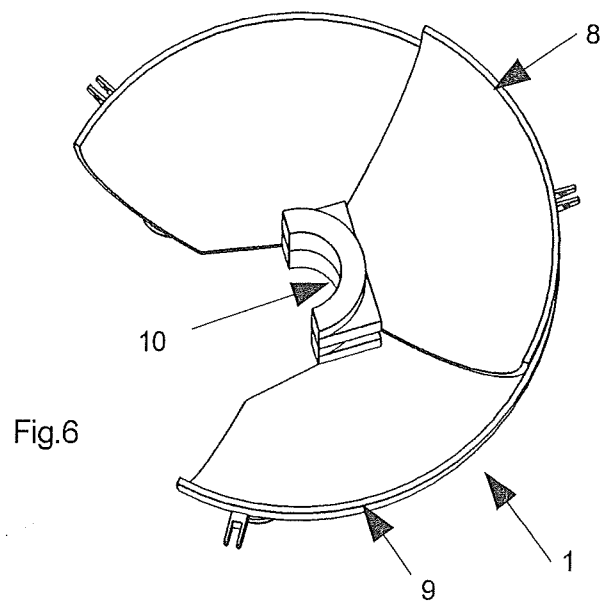
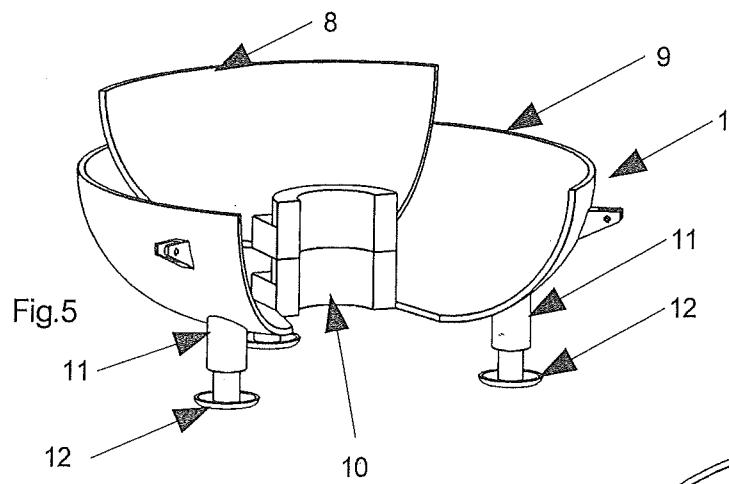
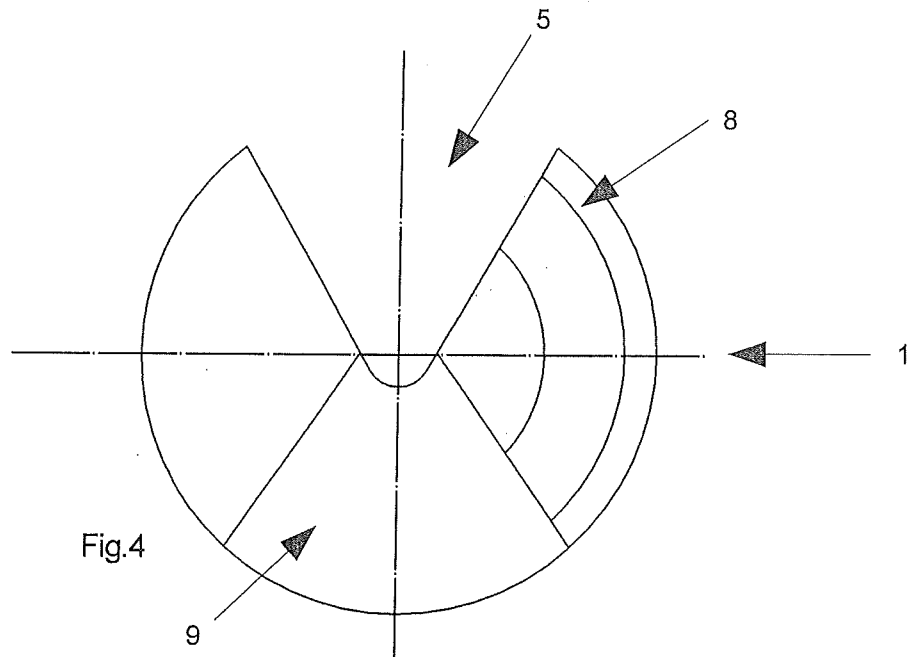
23. Dome (13) according to claim 22, **characterized in that** it is provided with a chemical injection system and/or a heating system.

24. Dome (13) according to claim 22 or 23, **characterized in that** it has pressure valves (15) around the flange (14) to release pressure during the capturing of the hydrocarbons, and to control the flow passing through during descent of the dome (13) to the seabottom and during its installation on top of the baseplate (1) .

25. Dome (13) according to any one of the previous claims 22-24, **characterized in that** it is connectable to a riser .



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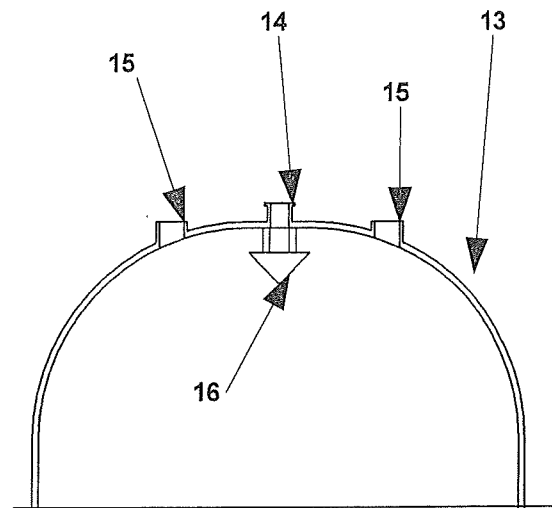
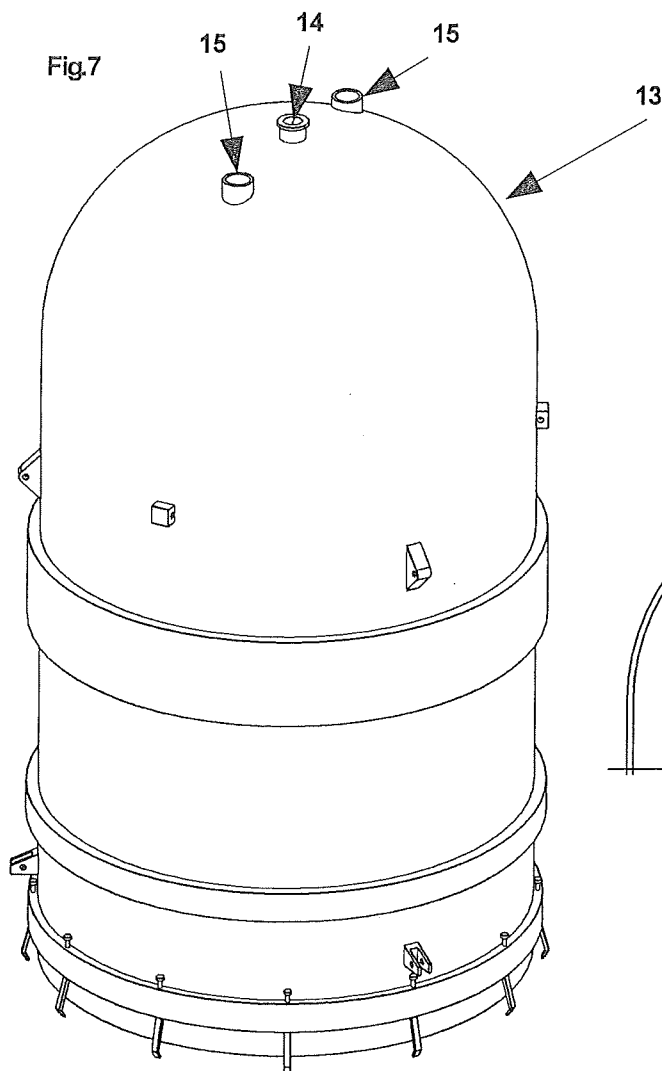
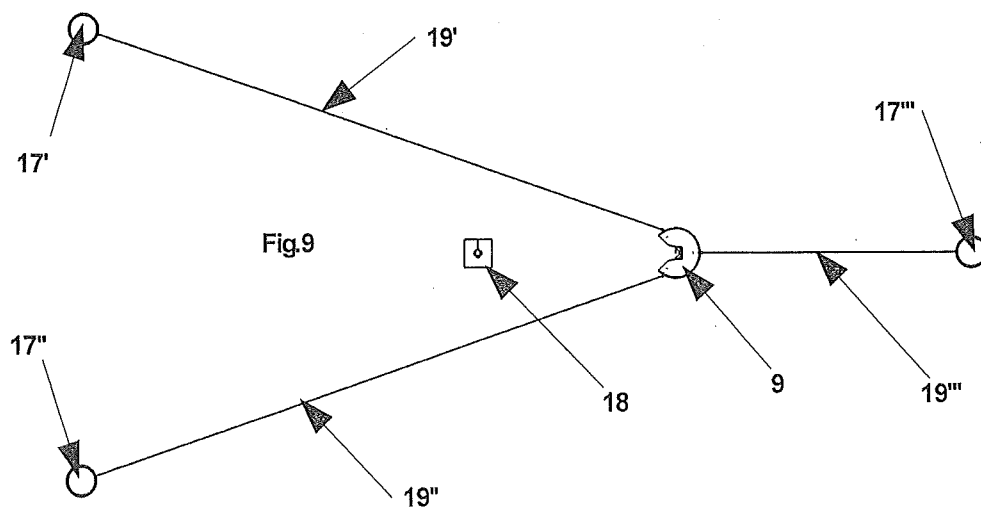


Fig.8



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Fig.10

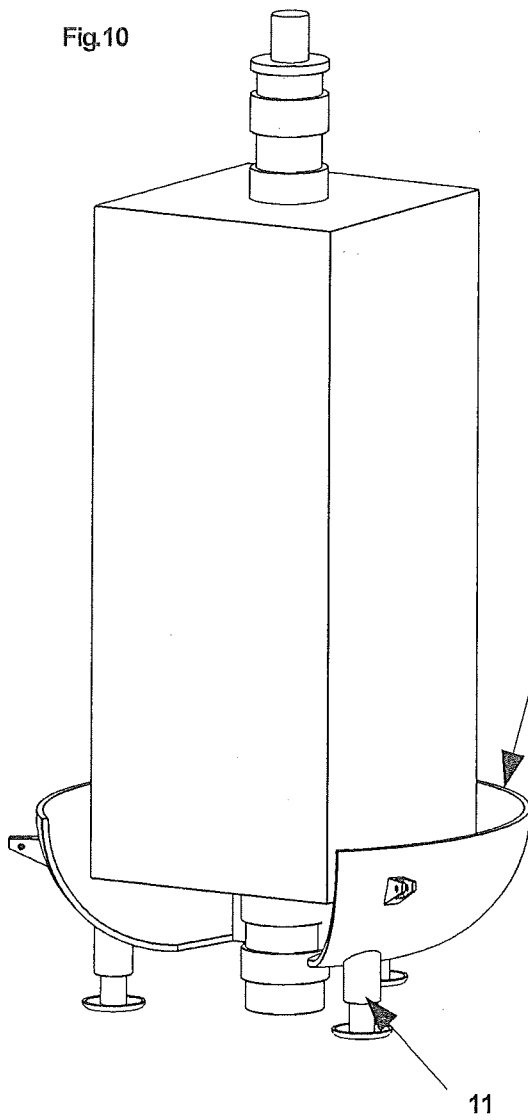


Fig.11

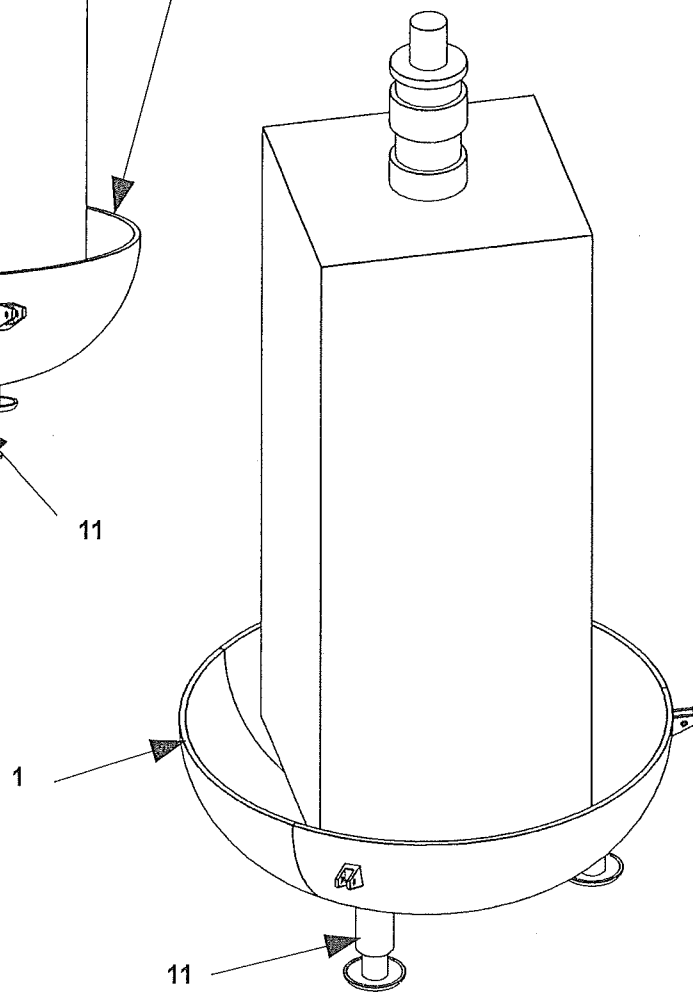


Fig.12

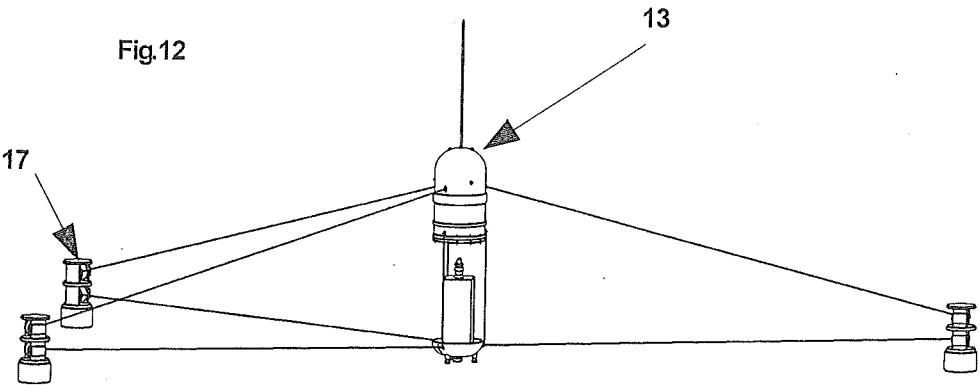
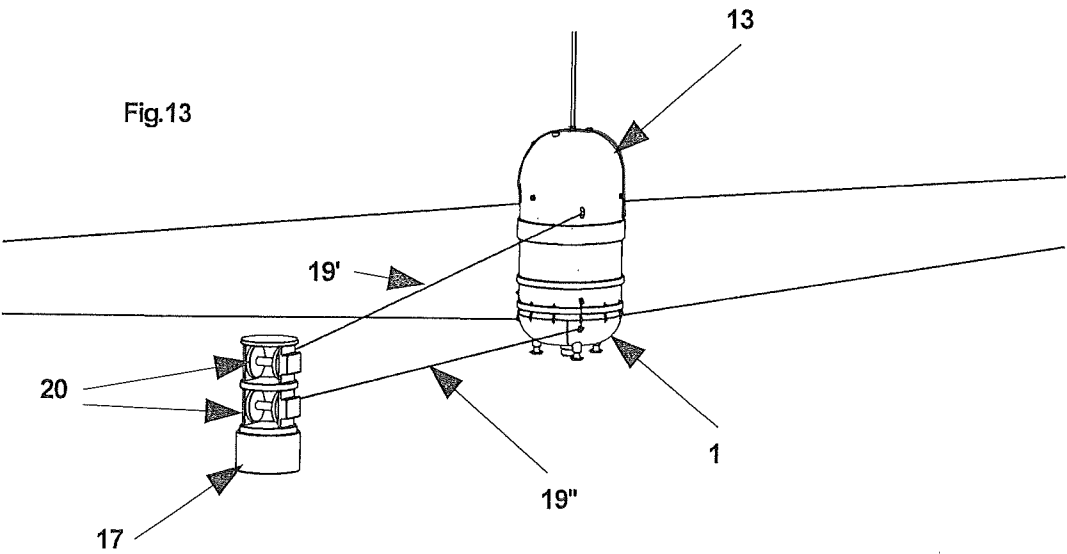


Fig.13



INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2012/050847

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B43/01
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 981 154 A (HIX JR CHARLES M) 21 September 1976 (1976-09-21)	18
A	column 2, line 3 - column 3, line 23; figures 1-3	1-17 , 19-25
Y	US 4 047 390 A (BOYCE II WILLIAM D) 13 September 1977 (1977-09-13)	18
A	column 3, line 40 - column 4, line 41; figures 3,7,10	1-17 , 19-25
X	US 3 851 487 A (LAMBERTSEN C) 3 December 1974 (1974-12-03) figure 1	22-25
A	US 3 610 194 A (SIEGEL GILBERT) 5 October 1971 (1971-10-05) the whole document	1-25
	-/-- -	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

29 January 2013

Date of mailing of the international search report

05/02/2013

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INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2012/050847

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 389 559 A (LOGAN CAMPBELL F) 25 June 1968 (1968-06-25) the whole document -----	1-25
A	US 4 405 258 A (O'ROURKE CAMERON [US] ET AL) 20 September 1983 (1983-09-20) cited in the application the whole document -----	1-25

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/NL2012/050847

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3981154	A	21-09-1976	NONE
US 4047390	A	13-09-1977	NONE
US 3851487	A	03-12-1974	NONE
US 3610194	A	05-10-1971	NONE
US 3389559	A	25-06-1968	NONE
US 4405258	A	20-09-1983	CA 1073224 AI 11-03- 1980 US 4405258 A 20-09- 1983