Nov. 14, 1967 C. E. WAKEFIELD, JR 3,352,356

METHOD FOR CONNECTING A FLOW LINE TO AN UNDERWATER WELL

Filed May 7, 1965 2 Sheets-Sheet 1

FIG. 1.

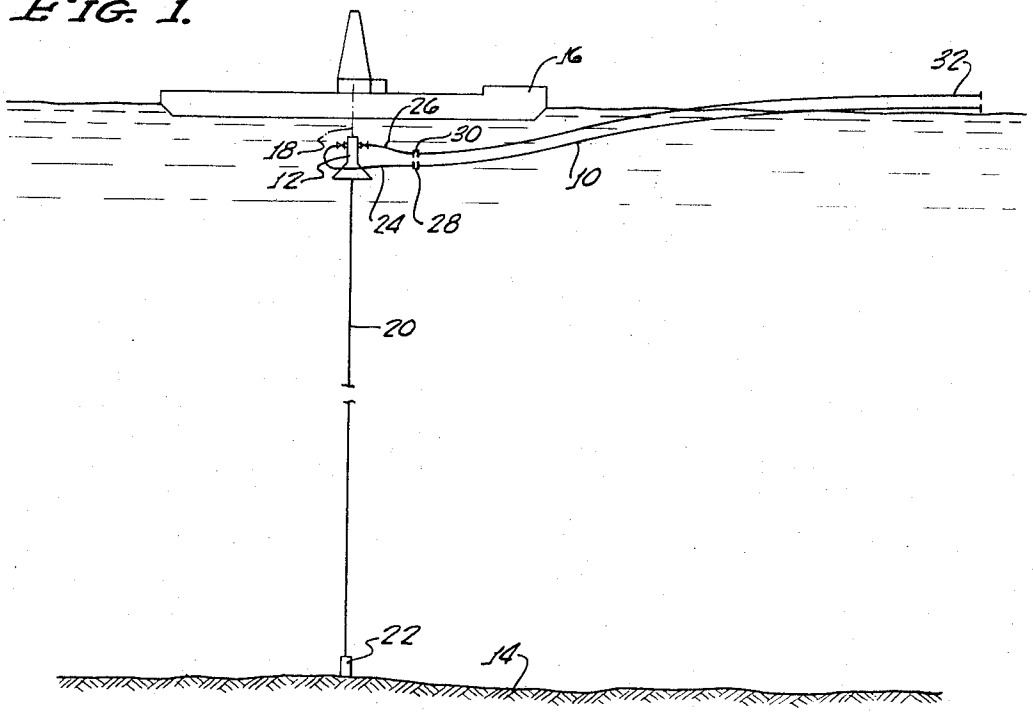
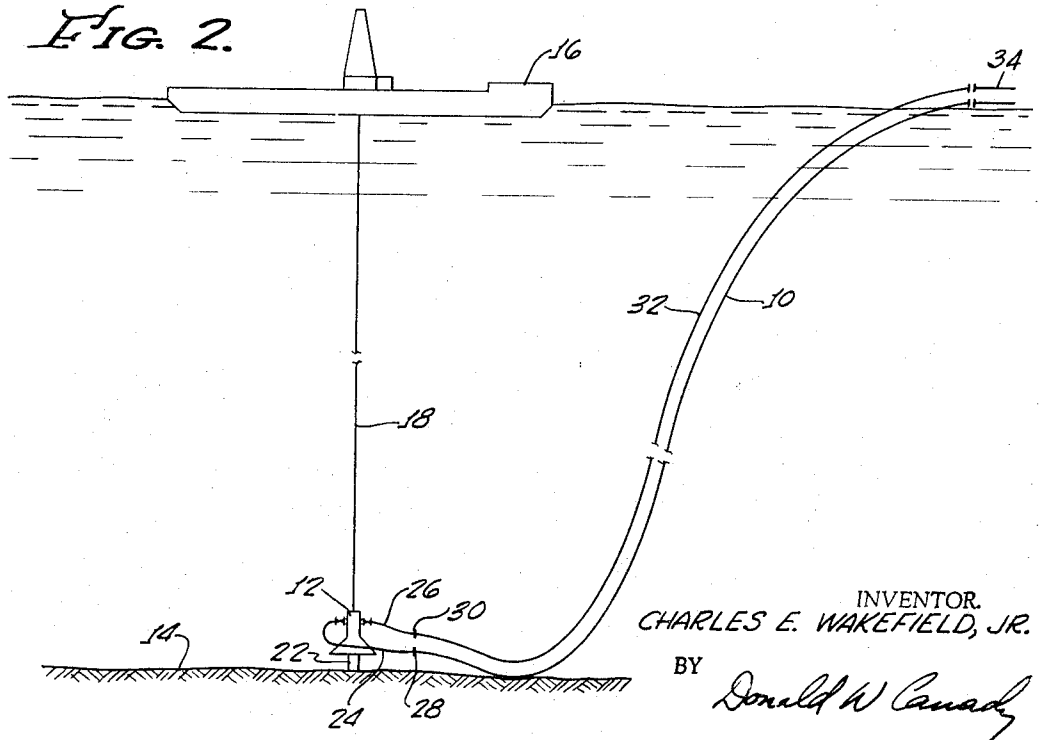


FIG. 2.



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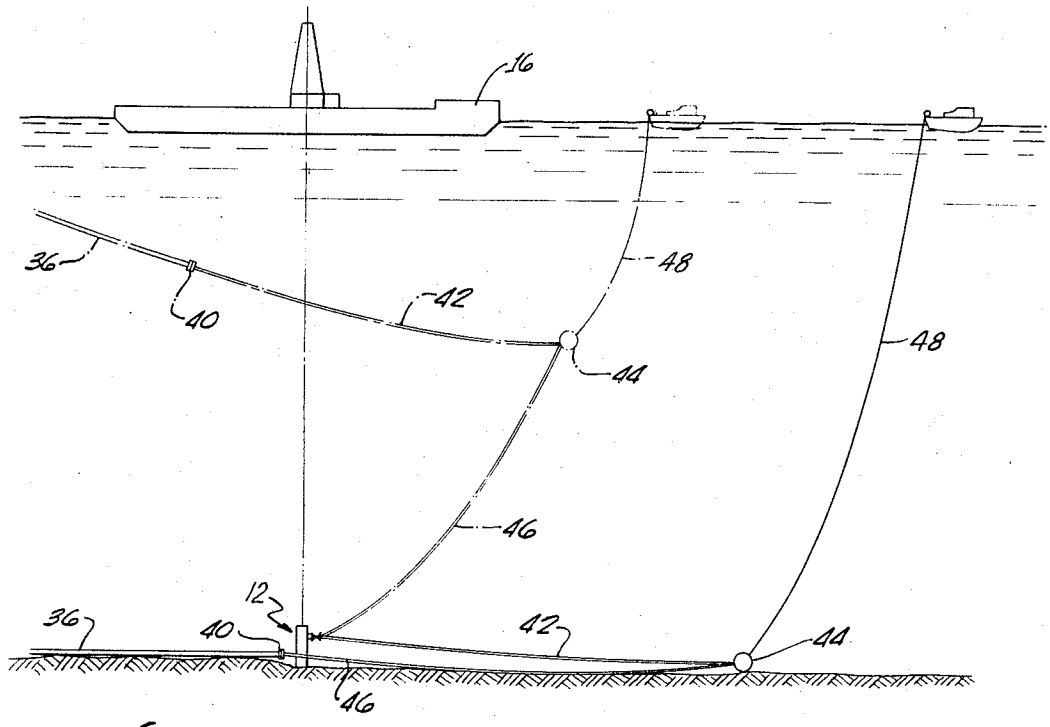


FIG. 3.

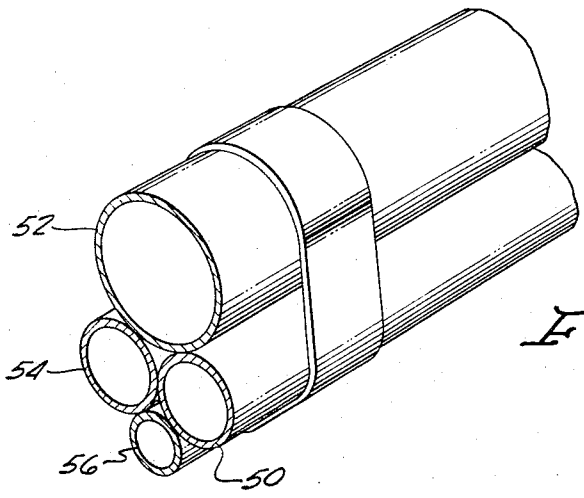


FIG. 4.

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METHOD FOR CONNECTING A FLOW LINE TO AN UNDERWATER WELL

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5 Claims. (Cl. 166—.5)

ABSTRACT OF THE DISCLOSURE

Method for connecting flow lines to a production head for lowering to an underwater well in which the flow lines are made floatable and connected to the production head at the surface of the water prior to lowering the production head to the well. This process provides easy moving of the flow lines to the production head and eliminates underwater or on-the-drilling-vessel handling of the flow lines. A swivel joint may also be provided in the flow lines and connected by cable to an above surface structure for convenience in raising and lowering the production head with the lines connected thereto.

My present invention relates to a method for connecting a flow line to an underwater wellhead located at an offshore location.

The drilling of a well into a formation underlying a body of water has led to the placement of well production equipment on the ocean floor, particularly in relatively deep water where it is not feasible to locate the production apparatus on a permanent drilling structure erected at the well site and extending from the ocean floor to the surface.

Oil and gas production from a well through a production head is transported to crude storage facilities through suitable flow lines. The flow line may include a plurality of pipes bundled together in order to provide separate lines for hydraulic or electrical control of the well production head, injection of fluids into the well, production of fluids from the well, etc. It has also been proposed to utilize in such flow line bundle a separate pipe for effecting buoyancy of the flow line. Such a bundle is shown in the Brown Patent No. 3,086,369 issued Apr. 23, 1963, which discloses floating the flow line bundle to a desired location and sinking the flow line by pumping ballast into a non-service pipe to weight the line sufficiently to cause the flow line bundle to sink to the ocean bottom.

The production flow lines must be connected to the well production head. When the production head is positioned on the ocean floor, it has heretofore been the practice for a diver to connect such flow line to the production head on the ocean bottom. In deeper water, however, because of the diver limitations at great depths, it is desirable to effect connection of the flow line to the production head without using a diver.

It is therefore an object of my present invention to provide a method for connecting a flow line to an underwater wellhead.

It is also an object of my present invention to provide a method for connecting a flow line to an underwater production head without using a diver.

It is a further object of my present invention to provide a method for connecting a floatable flow line to an underwater wellhead and later refloating the trailing end of said flow line for connection to additional flow line at the surface.

Another object of my present invention is to provide a method for connecting a flow line to an underwater production head which permits subsequent raising of the production head to the drilling barge.

Other objects and a more complete understanding of my present invention will become apparent from the following specification and the appended claims when taken in conjunction with the drawings, wherein;

FIG. 1 shows schematically a production head lowered from a barge floating on the body of water with the floating flow lines being connected thereto;

FIG. 2 shows the production head and the flow lines of FIG. 1 lowered to the ocean floor;

FIG. 3 shows an alternate method for connecting a flow line to an underwater production head;

FIG. 4 shows a cross section of a flow line bundle useful in accordance with my present invention.

Referring generally to the drawings, my present invention relates to a method for connecting a floatable flow line **10** with an underwater production head **12** by effecting a connection between the flow line and the production head while the flow line and, in the preferred method, the production head are located at or near the drilling barge before the production head has been lowered to the ocean floor and the floatable flow line sunk to the ocean floor **14**.

Referring now more particularly to the drawings, FIG. 1 shows a production head **12** suspended from the drilling barge **16** on drill pipe **18** with a stinger **20** extending from the production head into the drilling head **22** or other means for receiving the production head **12** at the well opening. The flow line **10** is rendered buoyant and pulled or floated, as with an auxiliary tug (not shown), to the well site and connected to flexible hoses **24** and **26** at connectors **28** and **38**. The production head may then be lowered to the ocean floor on drill pipe **18** with the stinger **20** maintaining contact with the opening in the production head **22**. As the production head **12** is lowered, the flow line **10** connected thereto is slowly filled with water through openings in the front end thereof, that is, the end nearest the production head **12**, so that the flow line and production head are simultaneously lowered to the ocean bottom. The production head **12** is latched to the drilling head **22** in accordance with the teachings of my copending application, Ser. No. 454,019, filed May 7, 1965, entitled, "Underwater Drilling Method."

The length of flow line **10** must be relatively long in order to prevent undue buckling of the flow line at the various pipe joints and connections, and to prevent bending of the pipe. The trailing end **32** may be maintained at the surface when the flow line **10** is connected to the production head by appropriate manipulation of the buoyancy of the flow line **10**, if, for example, additional length flow line **34** is to be connected to flow line **10** immediately. If the flow line **10** is sunk entirely with the wellhead, when it is later desired to add additional flow line **34**, the trailing end **32** of the flow line can be refloated to the surface so that an appropriate connection can be made to the additional flow line **34**, as best shown in FIG. 2.

The bending moment of the flow line should be such that the pipe is not damaged or buckled during connection and lowering to the ocean bottom and hence the curves in the flow line shown in FIG. 2 are somewhat exaggerated in order to conserve drawing space. The flow line **10** can be refloated, that is, the trailing end may be refloated by pumping air into the trailing end of the flow line thus displacing the water (or other ballast) from the flow line through the wellhead end of the flow line.

FIG. 3 shows an alternate method for connecting the flow line to an underwater wellhead in accordance with my present invention. The flow line **36** is floated to the area of the well **38** and is connected at its leading end **40** with a line **42** which is connected to a swivel joint **44**. The swivel joint **44** is also connected to the production head which may be already lowered to the ocean floor or may

be suspended under the drilling barge for connection to the flexible line **46**. Flexible lines **42** and **46** are connected, as previously stated, with a swivel joint which has a grapple eye to permit easy retrieving from the ocean bottom. The grapple eye may be connected to the surface through a cable **48**. The advantage of the alternate means shown in FIG. 3 is that the production head **12** can be more conveniently raised to the drilling barge without disconnecting the flow line **36** therefrom.

Thus, my present invention provides a convenient method for connecting a flow line to an underwater wellhead without using a diver to effect the connection. The flow line may consist of one or more pipes and, for example, as shown in FIG. 4, may consist of a flow pipe **50** with a floater line **52** which renders the flow line buoyant and which may be subsequently filled with water or a ballast material to effect sinking of the flow line. Additional lines **54** and **56** may be provided as, for example, an injection line and/or a control fluid line. The floater line **52** may be aluminum to serve as the anode to protect the steel lines **50**, **54** and **56** from electrochemical corrosion. Alternatively, a separate sacrificial anode may be provided according to well known prior art practices. Although a separate pipe is used to effect flotation of the device shown in the drawings, other flotation means may be utilized to effect the floating of the flow line without departing from the scope of my present invention.

Although my present invention has been described with respect to a preferred form of my present invention with a certain degree of particularity, it is to be understood that the scope of my invention should not be limited thereto, but should be afforded the full scope of the following claims.

I claim:

1. A method for connecting a flow line to a production head arranged and constructed for positioning at a well in a formation underlying a body of water, said production head being initially supported from a structure on said body of water, comprising the steps of:

floating on said body of water said flow line,

positioning one end of said floated flow line adjacent said production head,

operatively connecting said end of said flow line to said production head adjacent said structure, and

lowering said production head and said connected flow line end from said structure to said well.

2. The method of claim **1** including the step of: connecting the trailing end of said flow line at the surface of said body of water to additional sections of flow line.

3. The method of claim **1** including the steps of: refloating the trailing end of said flow line to the surface of said body of water and connecting said trailing end of said flow line to additional sections of flow line.

4. The method of claim **1** wherein the production head is lowered from said structure to said well while reducing the buoyancy of said flow line to permit said end of said flow line to sink to said well with said production head.

5. A process as defined in claim **1** wherein said flow line has a swivel joint therein and including the step of connecting said swivel joint to the surface through a weight bearing flexible means to assist in lowering of said production head to said well and in raising said production head from said well.

References Cited

UNITED STATES PATENTS

2,731,800	1/1956	Collins	61—72.4
3,086,590	4/1963	Jackson et al.	166—.6
3,291,210	12/1966	Johnstone et al.	166—.6

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