

[54] **METHOD OF GROUTING OFFSHORE STRUCTURE**

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61/54

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61/56.5, 50, 63, 53.64

[56] **References Cited**

UNITED STATES PATENTS

3,492,824	2/1970	Evans et al.	61/46.5
3,564,856	2/1971	Blount et al.	61/46
3,601,999	8/1971	Olsen et al.	61/46

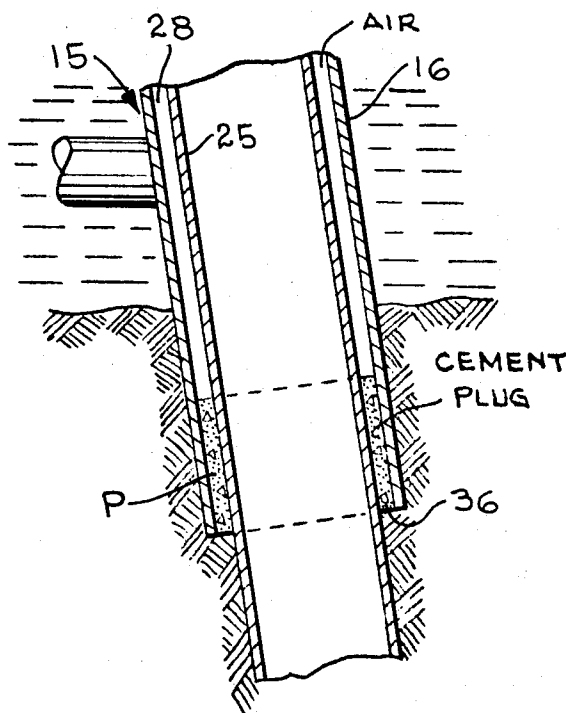
Primary Examiner—Jacob Shapiro

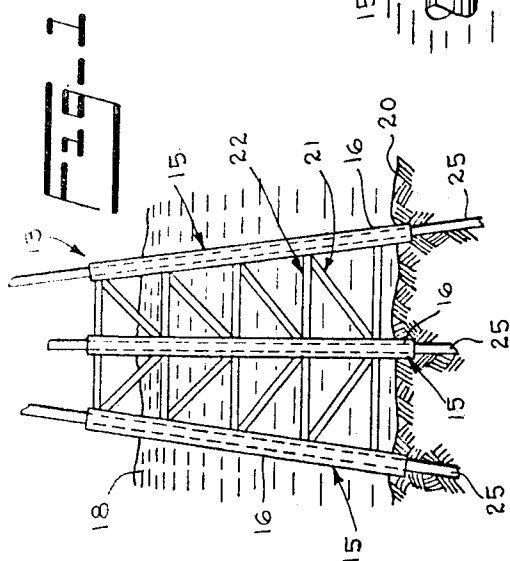
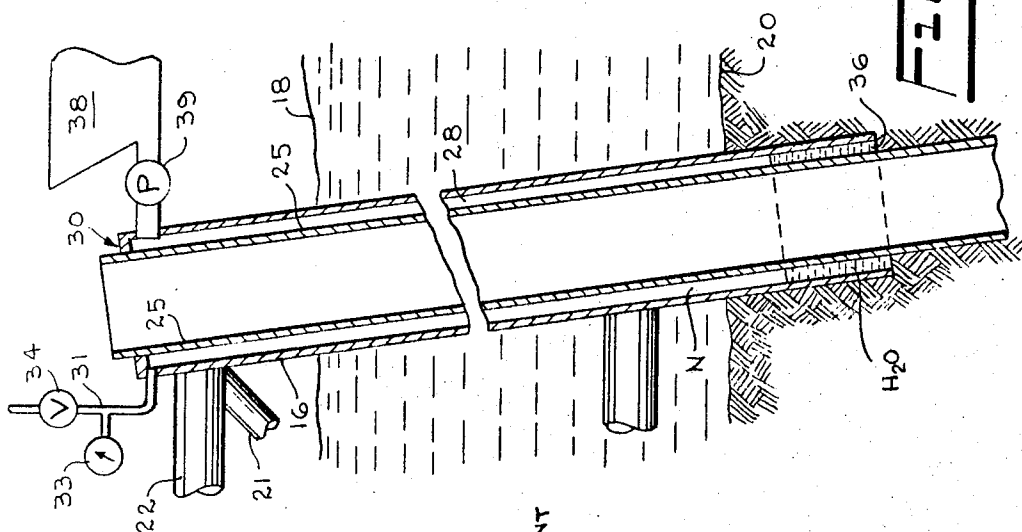
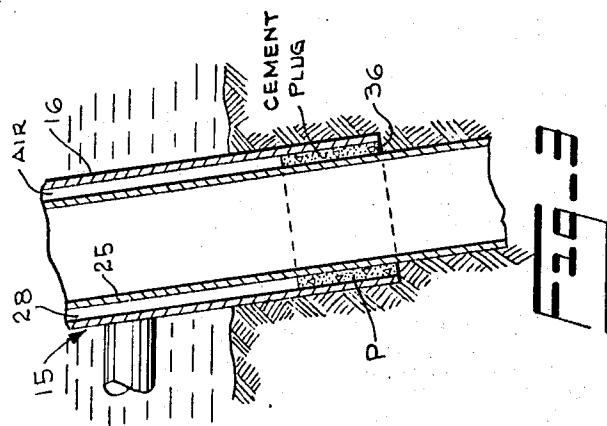
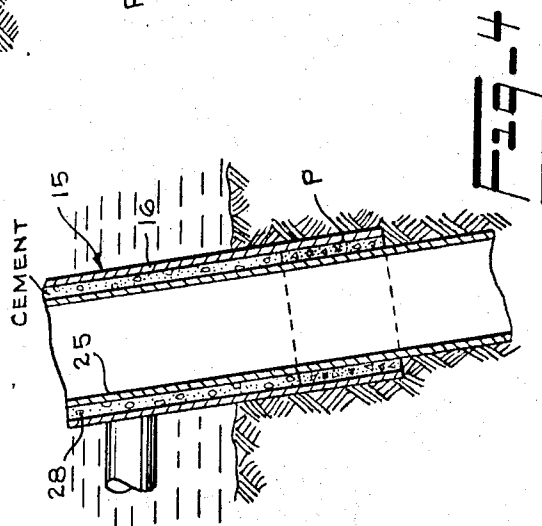
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[57] **ABSTRACT**

Compressed air or nitrogen is introduced into an annular space existing between the jacket and piling in the legs of an offshore structure, so that water is expelled from the annular space through the lower end of the jacket. Thereafter the air or nitrogen pressure in the annular space is relieved to permit a predetermined volume of water to reenter the lower end of the jacket and while maintaining the pressure in the annular space grouting material is injected thereinto to commingle with the predetermined water volume to form a plug at the lower end of the jacket. Thereafter the gas pressure is relieved from the column and additional grouting material is then inserted thereinto to fill the space between the plug and the upper end of the column.

1 Claim, 4 Drawing Figures





METHOD OF GROUTING OFFSHORE STRUCTURE

SUMMARY OF THE INVENTION

A reference which appears, in applicant's judgment, to be related to that of the present invention is illustrated in U.S. Pat. No. 3,601,999. However, in this patent, there is no arrangement for forming a plug at the lower end of a column, and under some circumstances this can be undesirable during the subsequent grouting operations.

The primary object of the present invention is to provide a method of grouting an annular space between the jacket and piling in the legs of an offshore structure wherein a plug is first formed adjacent the lower end of the jacket in the annular space, which permits the gas pressure to be relieved from the annular space and grouting material introduced into the annular space to fill such annular space between the plug and the upper end of the jacket and piling.

Other objects and advantages of the present invention will become more readily apparent from consideration of the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial elevational view showing a typical installation of an offshore structure on a seabed;

FIG. 2 is an enlarged vertical sectional view of one of the legs of the structure illustrating the method of first expelling the water from the space between the jacket of the piling and then permitting a predetermined volume of water to reenter the lower end of the jacket;

FIG. 3 is a fragmentary partial vertical sectional view of the lower end of the leg shown in FIG. 2 and illustrating a plug formed therein; and

FIG. 4 is a partial vertical sectional view showing additional grouting or cement in the annular space between the plug formed at the lower end thereof and extending upwardly in the annular space.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 of the drawings a base 13 is illustrated for a typical offshore structure commonly employed in oil and gas wells. It can be appreciated that a suitable superstructure or deck (not shown) is supported on the base 13 above the water level for accommodating various operations thereon. The base 13 includes a plurality of legs referred to generally at 15, the legs 15 each including a plurality of outer annular jackets 16 which extend downwardly from above the water line 18 and into the water covered area or seabed 20. The leg jackets 16 are secured together by any suitable bracing means such as that illustrated generally at 21 and 22.

Each leg 15 also includes a tubular piling 25 which is driven through each of the jackets 16 and into the seabed 20 a desired distance to provide stability for the structure. It will be noted that the piling 25 is smaller in diameter than the outer surrounding jackets 16 as shown in the drawings, and that the piling also extends from above the water line 18.

Because of the difference in diameter of the jackets 16 and piling 25 therein, there is formed an annular void or annular space 28 extending upwardly from the

seabed 20 and extends throughout the extent of the piling 25 and surrounding jacket 16.

In order to inhibit corrosive action internally of the space 28 on the jacket 16 and piling 25, and to provide additional stability and rigidity to the structure, it is desired to grout or cement such annular space and fill it with suitable grouting or cementing material.

Normally, after the piling 25 has been driven through the jacket 16 into the seabed 20, the upper end thereof is cut off and the space between the jacket 16 and piling 25 at the upper end thereof is closed off by any suitable closure arrangement referred to generally by the numeral 30.

A line 31 is connected to the upper end of the jacket 16 so as to communicate with the space 28 between the jacket 16 and piling 25 so that compressed air or nitrogen from a source (not shown) may be injected into the annular space 28. A suitable gauge 33 is provided in the conduit 31, and a suitable valve 34 is provided therein for controlling communication through the line 31 to the annular space 28.

Thereafter, the gas pressure may be increased to expel the water from the annular space 28 out through the lower end 36 of such annular space to insure that all of the water has been expelled therefrom.

The air pressure or nitrogen in the annular space 28 is then relieved by means of the valve 34 to permit reentry of fluid into the lower end 36 of the annular space 28 until it reaches a predetermined height, say for example, preferably approximately 10 feet. Any suitable means may be employed to determine the volume and height of the fluid permitted to reenter through the lower end 36 of the annular space 28 such as by way of example only a divers depth pressure gauge, or by observing the pressure on gauge 33 as the pressure is relieved through line 31.

While the predetermined height of water is maintained in the lower end of the annular space 28 as shown in FIG. 2 of the drawings, suitable quick setting grouting or cement material may be injected from a hopper 38 by means of the pump 39 into the annular space 28 above the water line so that it may commingle with the predetermined height of water in the lower end of the annular space and form a plug referred to as P in FIG. 3. The gas pressure is maintained on the annular space 28 to retain the predetermined height and volume of water as shown in FIG. 2 and as described, the grouting material sets to form a plug illustrated by the letter P in FIG. 3.

Thereafter, the air pressure or nitrogen pressure previously maintained in the annular space 28 may be relieved and additional grouting material injected into the annular space above the water line from hopper 38 to fill such annular space between the plug P and the upper end of the annular space.

The foregoing arrangement provides a method which enables a plug P first to be formed at the lower end 36 of the annular space 28 between the piling 25 and jacket 16 which permits the compressed gas pressure to be relieved from the remainder of the annular space before it is grouted and sets. Thus, compressed gas is not relied upon to maintain the integrity of the annular space 28 against reentry of water during grouting or cementing operations.

Also, the plug P will inhibit the excess flow of grouting or cementing material out the lower end 36 of the

annular space, as the remainder of the annular space is filled with the grouting material.

Since the remainder of the column from the plug P to the top of the annular space 28 is permitted to set under atmospheric pressure, a uniform bond between such grouting material and the interior walls of the jacket 16 and outer walls 25 of the piling 25 will be formed therebetween.

Additionally, the formation of the plug at the lower end 36 of the annular space 28 prior to injecting the balance of the grouting material therein inhibits leakage of fluid from the surrounding seabed and water covered area into the piling while the balance of the grouting material is injected and while it is setting.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

What is claimed is:

1. A method of grouting an offshore structure having at least one supporting leg including a tubular jacket extending downwardly from above the waterline to the seabed and a piling driven through said jacket into the seabed with an annular space existing between the inside of the jacket and the piling, said method compris-

ing the steps of:

- a. sealing the upper end of the jacket to the piling so as to close the annular space at the upper end of the jacket;
- b. introducing compressed gas into said annular space at a point adjacent the upper end of the jacket and above the waterline so as to expel water from said space through the lower end of the jacket;
- c. relieving the compressed gas from the annular space to accommodate the reentry of water through the lower end of the jacket until the water in the annular space at the lower end of the jacket reaches a predetermined height;
- d. introducing fluid grouting material into said annular space at a point adjacent the upper end of the jacket while simultaneously maintaining air pressure in the annular space to maintain the predetermined water level in the lower end of the jacket so as to form a plug in the annular space and seal off its lower end;
- e. thereafter releasing the compressed gas pressure from the annular space; and
- f. introducing additional fluid grouting material in the annular space adjacent the upper end of the jacket and permitting it to set to fill the annular space.

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