

PATENT SPECIFICATION

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(54) SUBMARINE PIPING SECTIONS

(71) I, JOSEPH BURRUS WEST, a citizen of the United States of America, of P.O. Box 8759, Beirut, Lebanon, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to piping sections for use in the construction of submarine piping strings and to a process for the production thereof.

In order to transfer oil or natural gas from a submarine well at which it is produced to a location on land, it has become conventional to employ submarine piping strings built up from individual sections which are assembled whilst they are continuously laid from a laying barge which travels over the intended route of the submarine pipeline. The individual sections of the piping string generally consist of a metal cylindrical section having a reinforced concrete jacket therearound. The purpose of the concrete jacket is to protect the piping section against damage due to impact of submarine objects and submarine earth movement and to ensure that the piping string is sufficiently weighted down to remain at the sea bed. A short length of metal piping generally protrudes from each end of the concrete jacket to allow welding to take place between the individual sections on the laying barge. The exposed metal join is jacketed with a field collar formed of concrete and produced in situ on the laying barge.

According to one aspect of this invention there is provided a piping section for use in the construction of a submarine piping string, comprising an inner metal pipe having disposed around its outer surface over substantially its entire length, a concrete jacket formed from one or more preformed concrete hollow cylindrical sections, with a set grout composition disposed between the jacket and the pipe.

According to a second aspect of the invention, there is provided a process for the production of a piping section for use in the construction of a submarine piping

string, comprising arranging an inner metal pipe with a jacket comprising a single preformed concrete hollow cylindrical section or a plurality of such sections contacting each other, with a space existing between the jacket and the inner metal pipe, filling said space with a grout composition and allowing the grout composition to set.

It has hitherto been the practice to form the concrete jacket of a piping section from a cement mixture applied to the outer surface of a metal pipe. Difficulty is frequently encountered with cement compositions when operating at temperatures below 5°C. Since much exploitation of oil and natural gas resources takes place in northern latitudes, it is to be expected that the ambient temperature will drop below such a value for substantial periods of the year effectively precluding the jacketing of the metal piping prior to loading onto a laying barge for submarine piping strings. By using concrete sections preformed during warmer periods of the year, it is now possible for the metal piping to be given the required concrete jacket at all times of the year.

The techniques hitherto available for jacketing the metal piping sections have generally allowed the use of such weak reinforcements as wire netting which has been wrapped around the metal piping when the cement composition is applied. A greater range of reinforcements is available when the concrete sections are formed in moulds prior to the disposition of the metal piping therein.

The number of preformed concrete hollow cylindrical sections used for each metal piping section will generally depend upon the dimensions of the inner metal pipe. Because of weight difficulties, it is proposed that with piping sections of relatively large diameter, in particular, for example of the order of 0.5 to 1.5 metre, the concrete jacket should be formed from a plurality of preformed concrete hollow cylindrical sections. In order to construct the jacketed piping section, the preformed concrete sections must be aligned and in contact with each other in end regions. They may abut, or, especially in the case of relatively thick cylindri-

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cal sections, overlap. In order that grout compositions should not be able to flow out of the joints between the individual sections as it is being supplied to the space between the concrete jacket and the metal piping, sealing gaskets such as O-rings are preferably seated in corresponding recesses in the contacting regions of adjacent concrete sections. The sealing gaskets are generally made of rubber or plastics material and provide a particularly tight seal owing to their compression under the weight of the concrete sections.

Prior to its use in the production of a piping section for use in the construction of a submarine piping string, the inner metal pipe is generally primed and then provided with a protective coating formed, for example of asphalt or some other bituminous material. When assembling the piping section, it is necessary to avoid damage to such a protective coating, and for this reason, it has been found practicable to first dispose horizontally the concrete jacket with the plurality of concrete sections, when used, already in alignment and in contact with each other. The inner metal pipe can then be passed through the inside of the concrete jacket with a small clearance, for example of the order of 1 centimetre without its protective coating being damaged. The inner metal pipe can be drawn through the concrete jacket on a suitably sized bottom wheel which takes its weight, with at least two spring loaded idler wheels maintaining the desired spacing from the concrete jacket being located at the sides of the inner pipe. These wheels can be provided on plugs inserted in the ends of the metal pipe so that the plugs can be withdrawn therefrom when the grout composition subsequently introduced into the space between the metal pipe and the concrete casing has set. In an alternative procedure, spring loaded roller bearings can be mounted on the periphery of the metal pipe to provide traction of the metal pipe through the concrete jacket, the roller bearings becoming compressed as they enter the concrete jacket.

The space between the concrete jacket and the inner metal pipe is then filled with a grout composition. Although in principle, this composition could be introduced into the spacing between the concrete jacket and the inner metal pipe at any position, it has been found particularly suitable for the grout composition to be introduced at the bottom of the spacing in order that air should not become entrapped in the lower regions of the spacing. The air is expelled upwardly by the grout composition and can be expelled through suitable apertures in the upper region of the concrete jacket. A small amount of grout composition is lost through the upper apertures, but the loss of grout

composition through these apertures gives an indication that the space is completely filled so that a further supply of grout composition to the lower reaches thereof can be stopped. Loss of grout composition from the ends of the spacing between the concrete jacket and the inner metal pipe can be prevented by provision of a temporary sealing collar over the end of the assembled jacket. The fitting of such a collar is assisted by the presence of a short end section of the inner metal pipe which is unjacketed to provide an exposed portion of metal for welding to a similar portion of another piping section in the construction of a piping string. The collar is removed when the grouting composition has set.

The grouting composition can be formed of a wet concrete or cement composition. Alternatively, it can be formed of a plastics material or of coal tar or asphalt. Since these latter materials are conventionally employed as protective coatings for the inner metal pipe when they are used as the grout composition it is possible to dispense with the provision of a protective coating on the inner metal piping before it is jacketed with the concrete section(s). Provided that the inner metal piping is primed in the usual way, it can be provided with its protective coating at the grouting stage. This procedure has the advantage that there is no risk of damage of the protective coating when the inner metal pipe is being provided with the concrete jacket.

For a better understanding of the invention, and to show how the same can be carried into effect, reference will now be made to the accompanying drawing which is an axial section through a piping section according to the present invention taken vertically through the piping section when it has been provided with the grout composition.

Referring to the drawing, the piping section comprises an inner steel pipe 1 around which are disposed three abutting preformed concrete hollow cylindrical sections 2, 3 and 4. Rubber O-rings 5 and 6 seated in corresponding recesses in the abutting faces of the concrete sections are provided as sealing means at the abutment interfaces between the concrete sections. A narrow gap between the concrete jacket sections and the steel piping which is generally of the order of 1 centimetre, which is exaggerated in the drawing for the sake of clarity, is filled with a grout composition 7. Diametrically opposed passages 8 and 9 are provided in the top and bottom parts of the individual concrete sections and are also filled with grout composition. Grout composition has been introduced into the gap through the lower passages 9 and air present therein has been expelled through the upper passages 8, all

of which passages are eventually plugged with grout composition. It is pointed out that it is not essential for each concrete section to be provided with a single pair of opposed passages. For example, if a single concrete section is employed, a plurality of passages in the top and bottom parts of the concrete sections can be provided, and if a plurality of concrete sections is provided, it is not necessary for passages to be preformed in each concrete section. In addition, it is not necessary for the top and bottom apertures to be equal in number or diametrically opposed.

15 A protective coating 10 is provided on the metal pipe 1.

WHAT I CLAIM IS:—

1. A piping section for use in the construction of a submarine piping string, comprising an inner metal pipe having disposed around its outer surface over substantially its entire length, a concrete jacket formed from one or more preformed concrete hollow cylindrical sections, with a set grout composition disposed between the jacket and the pipe.

2. A piping section as claimed in Claim 1, which has a diameter of from 0.5 to 1.5 metre and in which the concrete jacket is formed of a plurality of the preformed concrete hollow cylindrical sections.

3. A piping section as claimed in Claim 1 or 2, in which adjacent individual preformed concrete hollow cylindrical sections on a single said piping section, overlap.

4. A piping section as claimed in any one of the preceding claims, in which sealing gaskets are seated in corresponding recesses in contacting regions of adjacent concrete sections on a single said piping section.

5. A piping section as claimed in Claim 4, in which the sealing gasket is made of rubber or plastics material.

6. A piping section as claimed in Claim 4 or 5, in which the sealing gasket is an O-ring.

7. A piping section as claimed in any one of the preceding claims in which the set grout composition is formed of concrete, a cement composition, a plastics material, coal tar or asphalt.

8. A piping section for use in the construction of a submarine piping string, substantially as hereinbefore described with reference to and as shown in the accompanying drawing.

9. A process for the production of a piping section for use in the construction of a submarine piping string, comprising an inner metal pipe within a jacket comprising a single preformed concrete hollow cylindrical section or a plurality of such sections contacting each other, with a space existing between the jacket and the inner metal pipe,

filling said space with a grout composition and allowing the grout composition to set.

10. A process as claimed in Claim 9, in which the piping section has a diameter of from 0.5 to 1.5 metre, and the concrete jacket is formed from a plurality of the preformed concrete hollow cylindrical sections.

11. A process as claimed in Claim 9 or 10, in which the inner metal pipe is primed and provided with a protective coating before being placed within said jacket.

12. A process as claimed in Claim 11, in which the protective coating is formed of a bituminous material.

13. A process as claimed in any one of Claims 9 to 12, in which the concrete jacket is disposed horizontally with the plurality of concrete sections, when used, in contact with each other, and the inner metal pipe is drawn through the concrete jacket with a clearance therebetween and the concrete jacket.

14. A process as claimed in Claim 13, in which the inner metal pipe is drawn through the concrete jacket on a supporting bottom wheel, with at least two spring loaded idler wheels disposed on the periphery of the inner metal pipe maintaining the clearance with respect to the jacket.

15. A process as claimed in Claim 14, in which said wheels are provided on plugs inserted in the ends of the inner metal pipe and remain in said ends until the grout composition introduced into said space has set.

16. A process as claimed in Claim 13, in which the inner metal pipe is drawn through the concrete jacket on spring loaded roller bearings mounted on the periphery of the metal pipe, which roller bearings become compressed as they enter the concrete jacket.

17. A process as claimed in any one of Claims 9 to 16, in which the grout composition is introduced at the bottom of said space and air in the space is dispelled upwardly by the grout composition and out of one or more apertures in the upper part of the concrete jacket.

18. A process as claimed in Claim 17, in which the concrete jacket is provided with at least one pair of apertures therethrough in substantially diametrically opposed positions for admission of grout composition and expelling of air respectively.

19. A process as claimed in any one of Claims 9 to 18, in which a temporary sealing collar is placed over each end of the concrete jacket during admission and setting of the grout composition.

20. A process as claimed in any one of Claims 9 to 19, in which the grout composition is formed of a wet concrete or cement composition, a plastics material or coal tar or asphalt.

21. A process as claimed in any one of Claims 9 to 20, in which the concrete jacket



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5 of which passages are eventually plugged with grout composition. It is pointed out that it is not essential for each concrete section to be provided with a single pair of opposed passages. For example, if a single concrete section is employed, a plurality of passages in the top and bottom parts of the concrete sections can be provided, and if a plurality of concrete sections is provided, it is not necessary for passages to be preformed in each concrete section. In addition, it is not necessary for the top and bottom apertures to be equal in number or diametrically opposed.
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15 A protective coating 10 is provided on the metal pipe 1.

WHAT I CLAIM IS:—

20 1. A piping section for use in the construction of a submarine piping string, comprising an inner metal pipe having disposed around its outer surface over substantially its entire length, a concrete jacket formed from one or more preformed concrete hollow cylindrical sections, with a set grout composition disposed between the jacket and the pipe.

25 2. A piping section as claimed in Claim 1, which has a diameter of from 0.5 to 1.5 metre and in which the concrete jacket is formed of a plurality of the preformed concrete hollow cylindrical sections.

30 3. A piping section as claimed in Claim 1 or 2, in which adjacent individual preformed concrete hollow cylindrical sections on a single said piping section, overlap.

35 4. A piping section as claimed in any one of the preceding claims, in which sealing gaskets are seated in corresponding recesses in contacting regions of adjacent concrete sections on a single said piping section.

40 5. A piping section as claimed in Claim 4, in which the sealing gasket is made of rubber or plastics material.

45 6. A piping section as claimed in Claim 4 or 5, in which the sealing gasket is an O-ring.

50 7. A piping section as claimed in any one of the preceding claims in which the set grout composition is formed of concrete, a cement composition, a plastics material, coal tar or asphalt.

55 8. A piping section for use in the construction of a submarine piping string, substantially as hereinbefore described with reference to and as shown in the accompanying drawing.

60 9. A process for the production of a piping section for use in the construction of a submarine piping string, comprising an inner metal pipe within a jacket comprising a single preformed concrete hollow cylindrical section or a plurality of such sections contacting each other, with a space existing between the jacket and the inner metal pipe,

filling said space with a grout composition and allowing the grout composition to set.

10. A process as claimed in Claim 9, in which the piping section has a diameter of from 0.5 to 1.5 metre, and the concrete jacket is formed from a plurality of the preformed concrete hollow cylindrical sections. 70

11. A process as claimed in Claim 9 or 10, in which the inner metal pipe is primed and provided with a protective coating before being placed within said jacket. 75

12. A process as claimed in Claim 11, in which the protective coating is formed of a bituminous material.

13. A process as claimed in any one of Claims 9 to 12, in which the concrete jacket is disposed horizontally with the plurality of concrete sections, when used, in contact with each other, and the inner metal pipe is drawn through the concrete jacket with a clearance therebetween and the concrete jacket. 80
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14. A process as claimed in Claim 13, in which the inner metal pipe is drawn through the concrete jacket on a supporting bottom wheel, with at least two spring loaded idler wheels disposed on the periphery of the inner metal pipe maintaining the clearance with respect to the jacket. 90

15. A process as claimed in Claim 14, in which said wheels are provided on plugs inserted in the ends of the inner metal pipe and remain in said ends until the grout composition introduced into said space has set. 95

16. A process as claimed in Claim 13, in which the inner metal pipe is drawn through the concrete jacket on spring loaded roller bearings mounted on the periphery of the metal pipe, which roller bearings become compressed as they enter the concrete jacket. 100
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17. A process as claimed in any one of Claims 9 to 16, in which the grout composition is introduced at the bottom of said space and air in the space is dispelled upwardly by the grout composition and out of one or more apertures in the upper part of the concrete jacket. 110

18. A process as claimed in Claim 17, in which the concrete jacket is provided with at least one pair of apertures therethrough in substantially diametrically opposed positions for admission of grout composition and expelling of air respectively. 115

19. A process as claimed in any one of Claims 9 to 18, in which a temporary sealing collar is placed over each end of the concrete jacket during admission and setting of the grout composition. 120

20. A process as claimed in any one of Claims 9 to 19, in which the grout composition is formed of a wet concrete or cement composition, a plastics material or coal tar or asphalt. 125

21. A process as claimed in any one of Claims 9 to 20, in which the concrete jacket 130



is formed of a plurality of concrete hollow cylindrical sections, and a sealing gasket is provided in corresponding recesses in contacting regions of adjacent concrete sections.

- 5 22. A process as claimed in Claim 21, in which the sealing gasket is made of rubber or plastics material.

23. A process as claimed in Claim 21 or 22, in which the sealing gasket is an O-ring.

- 10 24. A process for the production of a piping section, substantially as hereinbefore described with respect to the accompanying drawing.

- 15 25. A piping section for use in the construction of a submarine piping string, whenever made by the process as claimed in any one of Claims 9 to 24.

26. A submarine piping string composed of piping sections as claimed in any one of Claims 1 to 8 and 25 joined together by welding exposed end parts of their inner metal pipes and providing a concrete field collar around the weld. 20

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