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PATENT SPECIFICATION (11) 1587334

1587334

(21) Application No. 19404/78 (22) Filed 12 May 1978 (19)
(31) Convention Application No. 796723 (32) Filed 13 May 1977 in
(33) United States of America (US)
(44) Complete Specification published 1 April 1981
(51) INT. CL.³ E02B 17/00
(52) Index at acceptance
E1H 602 B

(54) IMPROVEMENTS IN OR RELATING TO BRIDGE STRUCTURES

(71) We, RAYMOND INTERNATIONAL, INC., a Corporation organised and existing under the laws of the state of New Jersey, United States of America, of 2801 South Post Oak Road, Houston, Texas 77056, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to bridge structures, and is concerned with a bridge structure unit, a bridge structure member and a method of erecting a bridge structure.

Offshore oil drilling and/or producing operations conducted from an offshore platform often involve the liveration of excess amounts of natural gas which is frequently disposed of by being flared or burnt. For safety reasons, flaring must be conducted at a location remote from the offshore platform, because heat given off by the flaring operation could cause a fire hazard and/or damage the offshore platform and its personnel.

Accordingly, many different apparatuses have been proposed to enable such a flaring operation to be conducted at a location remote from a platform. One type of apparatus utilized in conjunction with offshore platforms for flaring excess gas is illustrated in U.S. Patents Nos. 2,894,269, 3,666,395 and 3,902,843, and involves the use of a submerged pipeline for conveying gas from an offshore platform to a flare structure which is anchored to the underwater surface. The gas flare apparatuses described in the foregoing Patents have some type of flexible connection between the gas flare and the lowermost portion of the structure in contact with the underwater surface, whereby the gas flare is subject to movement caused by wave action and ocean currents.

Many problems are encountered in using such apparatus particularly in conjunction with deep-water offshore installations. Because the pipeline is submerged, there are many problems associated with its maintenance and construction. For example, were the pipeline to develop any leaks, it would be necessary to use divers to repair the pipeline, making the cost of repair quite high. In addition, there are difficulties in initially determining whether or not the submerged pipeline has any leaks. Furthermore, a submerged pipeline is potentially subjected to large forces caused by water pressure, wave action, and/or ocean currents, and the pipeline must, therefore, be constructed to withstand such forces. Such construction may substantially increase the cost of the flare installation. Furthermore, because the gas flare apparatus is capable of movement, the pipeline may be subjected to tensional forces as the gas flare moves away from the offshore platform, this pulling the pipeline outwardly from the platform. This problem is believed to be particularly troublesome with respect to the apparatus disclosed in U.S. Patent No. 3,666,395 and could readily cause damage to the submerged pipeline.

Another approach that has been suggested involves supporting a gas flare line and a gas flare tip from a cantilevered structure attached to the offshore platform. An example of this approach is found in U.S. Patent No. 3,807,932. The structure disclosed in this Patent is utilized to support an apparatus for burning, or flaring, excess oil or gas produced in the course of drilling and/or testing offshore oil wells. The disadvantages of this approach are numerous.

If a large volume of excess gas is to be flared, the heat generated by the flaring operation requires that the flare tip be disposed a considerable distance from the offshore platform in order to avoid damage to the platform and/or personnel working thereon. Some installations presently in use require the flare tip to be located approximately 400 feet from the offshore platform. As is readily apparent, the construction of a cantilevered support for a gas flare line and gas flare tip having such a great length presents many problems. In addition to the great expense involved, constructing such a support under adverse weather conditions prevalent at deep-water offshore locations could present many problems in installing such a cantilever support. For example, U.S.

Patent No. 3,807,932 suggests that the cantilevered support is swung into place by a crane, or similar device, the cantilevered support being aligned with a support disposed on the offshore platform and then pinned to the off shore platform. Aligning a cantilevered support 400 feet in length such that it could be pinned to the offshore platform would be extremely difficult under the weather conditions prevalent at many deep-water offshore platform locations. For example, if the cantilevered support were to be lifted by a crane disposed under the offshore platform, great difficulty and expense would be encountered in attempting to align the cantilevered support with a support, such as a mounting bracket, disposed on the offshore platform owing to the fact that the centre of gravity of the cantilivered support would be located approximately 200 feet from the offshore platform. In order adequately to balance the cantilevered support such that the support would not tilt towards the ocean, the boom of a crane located upon the offshore platform would have a length in excess of 200 feet. Alternatively, if the crane were to be disposed upon a barge located at a location remote from the offshore platform, the crane would be subject to the slightest movement caused by wave or wind action upon the barge, making it extremely difficult to align the cantilevered support with its support disposed upon the offshore platform.

Another problem which could result when utilizing a cantilevered support for the gas flare line and gas flare tip could result from the fact that all the forces exerted upon the cantilevered support are borne by the support, for example a mounting bracket, disposed on the offshore platform. High wind and heavy sea conditions acting upon the end of a cantilevered support of substantial length could result in a mounting bracket being torn from an offshore platform, because the end of the cantilevered support remote from the offshore platform does not have any support beneath it for providing additional stabilization to the cantilevered support.

Accordingly, the art has sought provision of a bridge structure suitable for use in such conditions and in which the problems associated with the above discussed previously proposed arrangements are at least reduced.

In one aspect the present invention provides a bridge structure unit adapted to be disposed above a body of water, comprising an elongate bridge member including means for connecting one end thereof to an existing structure; at least one extensible support tower pivotably mounted to said bridge member, the or each support tower being adapted to be pivoted from a position of rest in which it extends in a plane substantially parallel to the longitudinal axis of said bridge member to a position of use in which it extends substantially perpendicularly to the longitudinal axis of said bridge member; and anchoring means for rigidly fixing the or each support tower to a surface underlying a body of water.

With the or each extensible support tower of such a bridge structure unit disposed in its position of rest, such a unit can readily be transported, for example towed to an offshore location adjacent to an existing structure such as an offshore production platform and erected to form a bridge structure by pivoting the or each support tower to its position of use, connecting said one end to the existing structure, extending the or each support tower and anchoring the or each support tower to the surface beneath the existing structure.

A gas flare line can conveniently be provided extending along the length of the bridge member of the thus formed bridge structure, enabling a flaring operation to be conducted at the end of the bridge structure remote from the existing structure.

The or each extensible support tower is preferably mounted to said bridge member at a location spaced from said one end thereof, desirably intermediate the ends of said bridge member. If two or more extensible support towers are used, the unit is provided with additional stability for a given length of bridge member.

The or each support tower conveniently includes a caisson having a jacking member telescopically mounted therein at its upper end and jacking means for extending the jacking member outwardly from the caisson.

The anchoring means for rigidly fixing the or each support tower desirably comprises an anchoring skirt that has a larger cross-sectional area than that of the caisson and that is fixedly secured to the lower end of the caisson, a plurality of pile sleeves being mounted upon the lower end of the support tower and extending through the anchoring skirt.

The jacking means preferably comprises a slip-type jack disposed within the caisson, with the jacking member extending through the jack. The jacking member may be further disposed within a sleeve located within the caisson, the jacking member desirably being adapted to be secured to the sleeve, for example by grouting.

The bridge member is conveniently provided with one or more releasable flotation tanks adapted to support the bridge member upon a body of water while it is being transported to a desired location. Further, the caisson may be provided with one or more valves adapted to be opened to flood the interior of the caisson to cause the support tower to pivot from its position of rest into its position of use.

A further aspect of the present invention provides a bridge structure member adapted to be disposed above a body of water and connected to an existing structure, comprising an elongate bridge member including means for connecting one end thereof to an existing structure; at least one extensible support tower mounted beneath and extending in a plane substantially perpendicular to the longitudinal axis of said bridge member; and anchoring means for rigidly fixing the or each support tower to a surface underlying a body of water.

In yet a further aspect of the present invention, there is provided a method of erecting a bridge structure above a body of water, comprising transporting to a location adjacent to an existing structure a bridge structure unit including an elongate horizontal bridge member having at least one extensible support tower pivotably mounted upon said bridge member, the or each support tower being initially disposed in a position of rest in which it extends in a plane substantially parallel to the longitudinal axis of said bridge member; pivoting the or each support tower to a position of use in which it extends substantially perpendicularly to the longitudinal axis of said bridge member, the lower end of the or each support tower being in spaced relationship with respect to a surface underlying said body of water; connecting one end of said bridge member to said existing structure; extending the or each support tower until the lower end thereof contacts the surface underlying said body of water; and rigidly fixing the or each support tower to the surface underlying said body of water.

The or each support tower is conveniently rigidly fixed to the surface underlying the body of water by driving piles into that surface and securing the support tower to the piles.

The support tower(s) may be extended until the bridge member is at least substantially parallel with a plane formed by an upper surface of the existing structure. Preferably, the or each support tower is extended until said one end of the bridge member that is connected to the existing structure is disposed lower than the other end of the bridge member.

The or each support tower conveniently includes a caisson having a jacking member telescopically mounted within the caisson at its upper end, the jacking member preferably being secured in position with the caisson after the bridge structure disposed in its final position in which it is desirably at least substantially parallel with a plane formed by an upper surface of the existing structure.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a side elevation of a bridge structure unit in accordance with the present invention, with the support tower thereof disposed in the position of rest;

Figure 2 is a top view of the unit of Figure 1;

Figure 3 is a further side elevation of the unit of Figure 1 with the support tower thereof disposed in the position of use;

Figure 4 is an enlarged scale cross-sectional view taken along line 4—4 of Figure 1;

Figure 5 is yet a further side elevation of the bridge structure unit of Figure 1; and

Figure 6 is an enlarged scale partial cross-sectional view of a portion of the unit shown in Figure 3.

The drawings illustrate a bridge structure unit 70 arranged for erection to produce a bridge structure an adapted to be disposed above a body of water 71. Unit 70 includs an elongate bridge member 72 and an extensible support tower 73 pivotably mounted upon the bridge member 72 by means of a pivotal connection 74, that is disposed beneath the elongate bridge member 72 intermediate the ends thereof. It should be readily apparent, however, that pivotal connection 74 could be disposed at other locations along the length of bridge member 72, including being disposed directly beneath one end 75 of bridge member 72 whereat a gas flare tip 104, to be hereinafter described, is intended to be located.

Support tower 73 includes anchoring means in the form of a plurality of pile sleeves 76 and an anchoring skirt 77 fixedly secured to the lower end of support tower 73. Support tower 73 further includes a plurality of pile guides 78 mounted about the circumferences of support tower 73 and aligned with the sleeves 76. The function of pile sleeve 76, anchoring skirt 77, and pile guides 78 will be hereinafter described in more detail in reference to Figure 5. Preferably, anchoring skirt 77 has a larger cross-sectional area than support tower 73. The use of anchoring skirt 77 is, however, optional depending upon the nature of the surface underlying body of water 71.

The bridge structure unit 70 is intended to be towed upon body of water 71 to an offshore location adjacent to an existing structure to be hereinafter described. To this end, elongate bridge member 72 is provided with releasably auxiliary flotation tanks 79. Two tow lines 80 are attached by connections 81 to the forward ends of two of the releasable flotation tanks 79 to permit connection of unit 70 to a towing strip (not shown).

Turning now to Figure 4, the details of the construction of elongate bridge member 72 will be described. Elongate bridge member 72 is constructed of three elongate tubular members 82 that extend along the length

thereof and are interconnected by a plurality of struts 83. Tubular members 82 and struts 83 may be manufactured from any suitable material, such as steel, and are large enough to withstand the forces that may be exerted by waves encountered during an ocean towing operation. The ends of tubular members 82 and srtuts 83 are sealed, providing the elongate bridge member 72 with at least partial bouyancy, releasable auxiliary flotation tanks 79 supplying any additional bouyancy required to keep the elongate bridge member 72 afloat during a towing operation.

Still referring to Figure 4, it can be seen that a plurality of struts 84 are disposed beneath bridge member 72, the struts 84 supporting pivotal connection 74, as best shown in Figures 1 and 6. A walkway 85 extends along the length of member 72 and is supported by a plurality of struts 83. A prefabricated gas flare line unit 86 and a prefabricated vent line unit 87 also extend along the length of bridge member 72, adjacent to walkway 85, the line units 86 and 87 being suitably secured to member 72.

Referring now to Figure 6, the construction of support tower 73 and pivotal connection 74 will be described. Extensibly support tower 73 includes a cylindrical caisson 85 which has a cylindrical jacking member 106 telescopically mounted therein. Jacking member 106 has a smaller diameter than caisson 85 and is concentrically mounted within te upper end of caisson 85. It should be readily apparent that although a cylindrical configuration is shown for caisson 85 and jacking member 106, any other suitable cross-sectional configuration, for example square, hexagonal, octagonal and so on, could be utilized.

Pivotal connection 74 includes a bracket 87 fixedly secured to the top of jacking member 106, a mating bracket 88 suspended beneath bridge member 72 by means of struts 84, and a suitable pin 89 passing through a conventional bushing (not shown) in brackets 87 and 88. Support tower 73 is thus pivotally secured to bridge member 72 and is adapted to be pivoted between a position of rest in which it extends in a plane substantially parallel to the longitudinal axis of bridge member 72, as shown in Figure 4 and in a solid lines in Figure 1, and a position of use in which it extends substantially perpendicularly to the longitudinal axis of the bridge member 72 as shown in Figures 3, 5 and 6. Support tower 73 is retained in its position of rest by means of one or more temporary connections (not shown), such as chains or ropes.

Still referring to Figure 6, the interior of caisson 85 is provided with a mounting plate 90 disposed in a plane substantially perpendicular to the longitudinal axis of caisson 85 and positioned towards the upper end of caisson 85. Disposed upon mounting plate 90 is jacking means 91 which is preferably a slip-type jack 92. The pistons (not shown) of jack 92 are preferably gas operated, a plurality of nitrogen gas bottles 93 being mounted within caisson 85 for supplying nitrogen gas to jack 92 via a feedline 94. Although any suitable jacking means may be utilized, it is preferred to use a slip-type jack of the construction disclosed in U.S. Patent No. 3,876,181. Jacking member 106 is concentrically mounted within jack 92 and additionally passes through an opening in mounting plate 90. A plurality of conventional packers 94 are disposed within a grout sleeve 95 which is concentrically disposed within the upper portion of caisson 85, with the packers 94 and grout sleeve 95 concentrically surrounding the upper portion of jacking member 106. After jacking member 106 has been extended outwardly to its final position, as to be hereinafter described, packers 94 are set into position and grout sleeve 95 is filled with a suitable grouting mixture that is capable of setting into a hardened state in an underwater location, whereby jacking member 106 is permanently grouted within caisson 85.

Support tower 73 may be constructed such that the interior is caisson 85 is air tight, support tower 73 thus being partially bouyant to facilitate further the transporting of the bridge structure unit 70 to a desired offshore location.

Preferably, the combined length of caisson 85 and anchoring skirt 77 is approximately equal to, or is slightly less than, the depth of water 71 at the installation location.

The manner in which the above described bridge structure unit 70 is used and erected to produce a bridge structure will now be described.

As previously mentioned, the bridge structure unit 70 is intended to be towed upon a body of water 71 to an offshore location. During the towing operation, the support tower 73 is located and retained in its position of rest, as previously described. After the bridge structure unit 70 has been transported to its intended location adjacent to an existing structure 96 (Figure 3), support tower 73 is pivoted about pivotal connection 74 and into its position of use, passing through the position shown in phantom lines in Figure 1. The pivoting is accomplished by releasing the temporary connections (not shown) and flooding the interior of caisson 85 by means of suitable flood valves 97 (Figure 3). The interior of caisson 85 is preferably flooded sequentially, beginning with the bottom of caisson 85. The top of the support tower 73 is held slightly below the surface of the body of water 71 as shown in Figure 3, by pivotal connection 74 and the bouancy of bridge member 72.

The structure 96 illustrated in Figure 3 is

an offshore production platform. It should be readily apparent, however, that existing structure 96 could also be, for example, an existing pier or a land formation adjacent a body of water. For such structures 96 the method and apparatus of the present invention could be utilized to provide either an extension to an existing pier or a bridge structure between two land formations disposed on either side of a body of water.

Referring to Figure 3, the offshore production platform 96 is provided with a conventional hoisting apparatus 98 which includes a power winch 99 which applies a lifting force to elongated bridge member 72 via hoisting line 100. Platform 96 is also provided with a semi-circular bridge support 101 that is adapted to mate with cooperating connector means 102 provided at one end of bridge member 72. The connecting means 102 may comprise, for example, hooks, pin connections, thrust bearings, or a plate structure that can be welded to bridge support 101.

Referring now to Figures 3 and 6, after the support tower 73 has been pivoted to its position of use, jack 92 is activated whereby jacking member 106 is extended outwardly with respect to caisson 85 until the anchoring skirt 77 at the lower end of support tower 73 is located in a spaced relationship with respect to surface 103 underlying body of water 71. Preferably, jack 92 is activated until anchoring skirt 77 just barely clears surface 103.

Hoisting line 100 is then passed from structure 96 and connected to the end of bridge member 72 that is provided with connecting means 102, and unit 70 is then winched towards structure 96 until connecting means 102 is disposed substantially beneath bridge support 101. A work boat (not shown) may assist winch 99 in pulling unit 70 towards structure 96. Additionally, the work boat may serve to ensure that bridge member 72 is properly aligned with bridge support 101, with the longitudinal axis of bridge member 72 substantially parallel to the longitudinal axis of bridge support 101. The support 101 and bridge member 72 do not, however, have to be precisely angularly aligned because bridge support 101 is semi-circular in configuration and can therefore accommodate a slight angular displacement of bridge member 72.

After bridge member 72 is properly aligned with bridge support 101, jack 92 is further activated to thrust support member 73 against or into surface 103 underlying body of water 71. Anchoring skirt 77, which may have a beveled surface (not shown) at its lower end, will serve to provide additional anchorage capability to jack 92 when support tower 73 is thrust into surface 103, particularly when surface 103 is a hard surface such as a rock formation. The end of bridge member 72 having connection means 102 is then hoisted by winch 99 until it is disposed above bridge support 101. Jack 92 is then activated to raise bridge member 72 out of water 71 whereby connection means 102 rests upon bridge support 101. After checking the positioning of bridge member 72 to ensure that the bridge member 72 is correctly disposed upon bridge support 101, support tower 73 is anchored to surface 103 underlying body of water 71 by means of a plurality of piles 104, as shown in Figure 5. Piles 104 may be driven using any conventional pile driving technique, for example pile driving operations may be conducted from a derrick barge (not shown). After piles 104 have been driven through pile sleeves 76 and anchoring skirt 77, piles 104 are secured within the pile sleeves 76 in any conventional manner, such as by grouting, in order to provide a stable foundation for support tower 73.

After the support tower 73 has been secured to surface 103, jack 92 is activated to cause further extension of jacking member 106 to bring bridge 72 to its final elevation, as shown in Figure 5. Jacking member 106 is extended until bridge member 72 is at least substantially parallel with the plane of the upper surface of the existing structure 96, in which position the end of the bridge member 72 which is connected to the existing structure 96 via connection means 102 may be disposed lower than the other end of bridge member 72, as shown in Figure 5. After the desired position of bridge member 72 has been reached, jacking member 106 is permanently secured within the sleeve 95, conveniently by grouting as described previously, or alternatively by other means, such as welding.

Alternatively, after bridge member 72 is properly aligned with bridge support 101 and while anchoring skirt 77 is still in a spaced relationship with surface 103, winch 99 may be activated to retract hoisting line 100 and raise one end of bridge member 72 until connection means 102 is disposed upon support 101. Connection means 102 then may be suitably affixed to support 101 or may be flexibly connected to support 101 via hoisting line 100. Jack 92 is then activated to thrust support member 73 against or into surface 103 and to raise bridge member 72 out of water 71 whereafter support tower 73 is anchored to surface 103 and jacking member 106 is secured within sleeve 95 as previously described.

A gas flare line 86′ is then provided, extending from platform 96 along the length of bridge member 72. In the presently described and illustrated embodiment, gas flare line 86′ is installed utilizing the prefabricated gas flare line unit 86 and gas vent line unit 87 which are included as a part of bridge member 72, as discussed above. Thus,

the end of the prefabricated gas flare line unit 86 adjacent to platform 96 is suitably connected to a section of gas flare line on platform 96, similar suitably connections being effected for the gas vent line unit 87. A gas flare tip 105 is then attached to the end of the gas flare line 86 remote from the platform 96, as shown in Figure 5. Alternatively, if bridge member 72 does not include a prefabricated gas flare line unit and gas vent line unit, a gas flare line 86' could be pulled from platform 96 onto and along bridge member 72 until the free end of the line 86' extended beyond the end of bridge member 72 and could then be fitted with a gas flare tip 105. In such circumstances, the bridge member 72 is conveniently provided with means for facilitating the installation of a gas flare line, for example a plurality of rollers disposed adjacent to walkway 85.

WHAT WE CLAIM IS:—

1. A bridge structure unit adapted to be disposed above a body of water, comprising an elongate bridge member including means for connecting one end thereof to an existing structure; at least one extensible support tower pivotably mounted to said bridge member, the or each support tower being adapted to be pivoted from a position of rest in which it extends in a plane substantially parallel to the longitudinal axis of said bridge member to a position of use in which it extends substantially perpendicularly to the longitudinal axis of said bridge member; and anchoring means for rigidly fixing the or each support tower to a surface underlying a body of water.

2. Apparatus according to claim 1, wherein the or each extensible support tower is mounted to said bridge member at a location spaced from said one end thereof.

3. Apparatus according to claim 2, wherein the or each extensible support tower is mounted to said bridge member at a location intermediate the ends thereof.

4. Apparatus according to claim 1, 2 or 3, wherein the or each support tower includes a caisson having a jacking member telescopically mounted at the upper end of said caisson, and jacking means for extending the jacking member outwardly with respect to the caisson.

5. Apparatus according to claim 4, wherein said jacking means comprises a slip-type jack disposed within said caisson and said jacking member extends through said jack.

6. Apparatus according to claim 4 or 5, wherein said jacking member extends through a sleeve located within the caisson and is adapted to be secured to said sleeve.

7. Apparatus according to claim 4, 5 or 6, wherein said caisson is provided with one or more valves adapted to be opened to flood the interior of said caisson to allow said support tower to pivot from its position of rest to its position of use.

8. Apparatus according to any one of the preceding claims, including a prefabricated gas flare line unit disposed upon said bridge member.

9. Apparatus according to claim 8, including a gas flare tip attached to one end of said gas flare line unit.

10. Apparatus according to any one of claims 1 to 7, wherein said bridge member includes means for installing a gas flare line.

11. Apparatus according to claim 10, including a plurality of rollers disposed upon said bridge member.

12. Apparatus according to any one of the preceding claims, wherein said bridge member is provided with one or more releasable flotation tanks adapted to assist in supporting said bridge structure unit upon a body of water during transportion to a desired location.

13. Apparatus according to any one of the preceding claims, wherein said anchoring means comprises an anchoring skirt fixedly secured to the lower end of the or each support tower, and a plurality of pile sleeves mounted upon the lower end portion of the or each support tower and extending through said anchoring skirt.

14. A bridge structure unit adapted to be disposed above a body of water, substantially as described with reference to, and as shown in the accompanying drawings.

15. A bridge structure member adapted to be disposed above a body of water and connected to an existing structure, comprising an elongate bridge member including means for connecting one end thereof to an existing structure; at least one extensible support tower mounted beneath and extending in a plane substantially perpendicular to the longitudinal axis of said bridge member; and anchoring means for rigidly fixing the or each support tower to a surface underlying a body of water.

16. Apparatus according to claim 15, wherein the or each extensible support tower is mounted to said bridge member at a location spaced from said one end therof.

17. Apparatus according to claim 16, wherein the or each extensible support tower is mounted to said bridge member at a location intermediate the ends thereof.

18. Apparatus according to claim 15, 16 or 17, wherein the or each support tower includes a caisson having a jacking member telescopically mounted at the upper end of the caisson, an upper portion of said jacking member being connected to the bridge member, and jacking means for extending the jacking member outwardly with respect to said caisson.

19. Apparatus according to claim 18,

the end of the prefabricated gas flare line unit 86 adjacent to platform 96 is suitably connected to a section of gas flare line on platform 96, similar suitably connections being effected for the gas vent line unit 87. A gas flare tip 105 is then attached to the end of the gas flare line 86 remote from the platform 96, as shown in Figure 5. Alternatively, if bridge member 72 does not include a prefabricated gas flare line unit and gas vent line unit, a gas flare line 86' could be pulled from platform 96 onto and along bridge member 72 until the free end of the line 86' extended beyond the end of bridge member 72 and could then be fitted with a gas flare tip 105. In such circumstances, the bridge member 72 is conveniently provided with means for facilitating the installation of a gas flare line, for example a plurality of rollers disposed adjacent to walkway 85.

WHAT WE CLAIM IS:—

1. A bridge structure unit adapted to be disposed above a body of water, comprising an elongate bridge member including means for connecting one end thereof to an existing structure; at least one extensible support tower pivotably mounted to said bridge member, the or each support tower being adapted to be pivoted from a position of rest in which it extends in a plane substantially parallel to the longitudinal axis of said bridge member to a position of use in which it extends substantially perpendicularly to the longitudinal axis of said bridge member; and anchoring means for rigidly fixing the or each support tower to a surface underlying a body of water.

2. Apparatus according to claim 1, wherein the or each extensible support tower is mounted to said bridge member at a location spaced from said one end thereof.

3. Apparatus according to claim 2, wherein the or each extensible support tower is mounted to said bridge member at a location intermediate the ends thereof.

4. Apparatus according to claim 1, 2 or 3, wherein the or each support tower includes a caisson having a jacking member telescopically mounted at the upper end of said caisson, and jacking means for extending the jacking member outwardly with respect to the caisson.

5. Apparatus according to claim 4, wherein said jacking means comprises a slip-type jack disposed within said caisson and said jacking member extends through said jack.

6. Apparatus according to claim 4 or 5, wherein said jacking member extends through a sleeve located within the caisson and is adapted to be secured to said sleeve.

7. Apparatus according to claim 4, 5 or 6, wherein said caisson is provided with one or more valves adapted to be opened to flood the interior of said caisson to allow said support tower to pivot from its position of rest to its position of use.

8. Apparatus according to any one of the preceding claims, including a prefabricated gas flare line unit disposed upon said bridge member.

9. Apparatus according to claim 8, including a gas flare tip attached to one end of said gas flare line unit.

10. Apparatus according to any one of claims 1 to 7, wherein said bridge member includes means for installing a gas flare line.

11. Apparatus according to claim 10, including a plurality of rollers disposed upon said bridge member.

12. Apparatus according to any one of the preceding claims, wherein said bridge member is provided with one or more releasable flotation tanks adapted to assist in supporting said bridge structure unit upon a body of water during transportion to a desired location.

13. Apparatus according to any one of the preceding claims, wherein said anchoring means comprises an anchoring skirt fixedly secured to the lower end of the or each support tower, and a plurality of pile sleeves mounted upon the lower end portion of the or each support tower and extending through said anchoring skirt.

14. A bridge structure unit adapted to be disposed above a body of water, substantially as described with reference to, and as shown in the accompanying drawings.

15. A bridge structure member adapted to be disposed above a body of water and connected to an existing structure, comprising an elongate bridge member including means for connecting one end thereof to an existing structure; at least one extensible support tower mounted beneath and extending in a plane substantially perpendicular to the longitudinal axis of said bridge member; and anchoring means for rigidly fixing the or each support tower to a surface underlying a body of water.

16. Apparatus according to claim 15, wherein the or each extensible support tower is mounted to said bridge member at a location spaced from said one end therof.

17. Apparatus according to claim 16, wherein the or each extensible support tower is mounted to said bridge member at a location intermediate the ends thereof.

18. Apparatus according to claim 15, 16 or 17, wherein the or each support tower includes a caisson having a jacking member telescopically mounted at the upper end of the caisson, an upper portion of said jacking member being connected to the bridge member, and jacking means for extending the jacking member outwardly with respect to said caisson.

19. Apparatus according to claim 18,

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wherein said jacking means comprises a slip-type jack disposed within said caisson and a portion of said jacking member extends through and is engaged by said jack.

20. Apparatus according to claim 18 or 19, wherein said jacking member extends through a sleeve located within the caisson and is adapted to be secured to said sleeve.

21. Apparatus according to claim 20, wherein the jacking member has been extended outwardly with respect to said caisson by a desired extent, and a lower portion of said jacking member is secured to said sleeve.

22. Apparatus according to claim 21, wherein said lower portion of said jacking member is secured within said sleeve by grouting.

23. Apparatus according to any one of claims 15 to 22, wherein said anchoring means comprises an anchoring skirt fixedly secured to the lower end of the or each support tower, and a plurality of pile sleeves mounted upon the lower end portion of the or each support tower and extending through said anchoring skirt.

24. Apparatus according to any one of claims 15 to 23, including a prefabricated gas flare line unit disposed upon said bridge member.

25. Apparatus according to claim 24, including a gas flare tip attached to one end of said gas flare line unit.

26. Apparatus according to any one of claims 15 to 23, wherein said bridge member includes means for installing a gas flare line.

27. Apparatus according to claim 26, including a plurality of rollers disposed upon said bridge member.

28. A bridge structure member adapted to be disposed above a body of water and connected to an existing structure, substantially as described with reference to, and as shown in the accompanying drawings.

29. A method of erecting a bridge structure above a body of water, comprising transporting to a location adjacent to an existing structure a bridge structure unit including an elongate horizontal bridge member having at least one extensible support tower pivotably mounted upon said bridge member, the or each support tower being initially disposed in a position of rest in which it extends in a plane substantially parallel to the longitudinal axis of said bridge member; pivoting the of each support tower to a position of use in which it extends substantially perpendicularly to the ongitudinal axis of said bridge member, the lower end of the or each support tower being in spaced relationship with respect to a surface underlying said body of water; connecting one end of said bridge member t said existing structure; extending the or each support tower until the lower end thereof contacts the surface underlying said body of water; and rigidly fixing the or each support tower to the surface underlying said body of water.

30. A method according to claim 29, wherein the or each support tower is pivoted to its position of use by flooding the support tower interior.

31. A method according to claim 29 or 30, including extending the or each support tower to a position in which the lower end thereof is located closely adjacent to the surface underlying said body of water prior to aligning said bridge member with a connecting support portion of the existing structure.

32. A method according to claim 29, 30 or 31, including extending the or each support tower until the lower end thereof contacts said surface prior to connecting said one end of the bridge member to said existing structure.

33. A method according to any one of claims 29 to 32, wherein said one end of the bridge member is raised into engagement with a connecting support portion of said existing structure by means of a winch disposed on said existing structure.

34. A method according to any one of claims 29 to 33, wherein said one end of the bridge member is connected to said existing structure by means of hooks, pins, thrust bearings or welding.

35. A method according to any one of claims 29 to 34, wherein the or each support tower is anchored to the surface underlying said body of water by driving piles into said surface and securing the support tower to said piles.

36. A method according to any one of claims 29 to 35, further including extending the or each support tower to a final position in which the bridge member is at least substantially parallel with an upper surface of the existing structure.

37. A method according to claim 36, wherein the or each support tower is extended to a final position in which the bridge member is inclined with said one end of the bridge member that is connected to the existing structure disposed lower than the other end of the bridge member.

38. A method according to claim 36 or 37, wherein the or each support tower is secured in said final position.

39. A method according to claim 38, wherein said support tower is secured in said final position by grouting.

40. A method according to any one of claims 29 to 39, wherein the or each support tower includes a caisson having a jacking member telescopically mounted at the upper end thereof, and jacking means for extending the jacking member outwardly with respect to the caisson, the hacking member being adapted to be secured in a desired position

with respect to the caisson.

41. A method according to any one of claims 29 to 40, wherein the or each support tower is mounted to said bridge member at a location spaced from said one end thereof.

42. A method according to claim 41, wherein the or each support tower is mounted to said bridge member at a location intermediate the ends thereof.

43. A method according to any one of claims 29 to 42, wherein a gas flare line and gas flare tip is installed on said bridge structure.

44. A method according to claim 43, wherein said bridge structure unit includes a prefabricated gas flare line unit that is connected to a gas flare line portion on said existing structure after the support tower is anchored to the surface underlying said body of water.

45. A method of erecting a bridge structure above a body of water, substantially as described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon) Ltd.—1981. Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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