

[54] **METHOD AND APPARATUS FOR LAYING A SUBMERGIBLE ELONGATE STRUCTURE**

[75] Inventors: **William R. Rochelle; Leif H. Smith,**
both of Houston, Tex.

[73] Assignee: **Brown & Root, Inc.,** Houston, Tex.

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[51] Int. Cl. **B63b 35/04, F16l 1/00**

[58] Field of Search **61/72.3, 72.1;**
226/195

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Primary Examiner—Jacob Shapiro

Attorney—James E. Cockfield

[57]

ABSTRACT

A method and apparatus for laying a submergible elongate structure upon the bed of a body of water including a floating vessel having a generally planar deck, a first cable tensioning system connected to the deck and selectively connectable to a submergible elongate structure for applying an approximately constant axial tension upon the submergible elongate structure when the barge is being advanced along a desired laying route, and a second cable tensioning system connected independently of the first cable tensioning system to the deck of the floating vessel and selectively connectable to the submergible elongate structure when the floating vessel is maintained in a generally nonadvancing mode with respect to the intended pipelaying route. A unitary submergible ramp is pivotally connected to the stern of the floating vessel and includes a plurality of vertically adjustable supporting rollers for supporting the submergible elongate structure within the body of water aft of the floating vessel.

11 Claims, 16 Drawing Figures

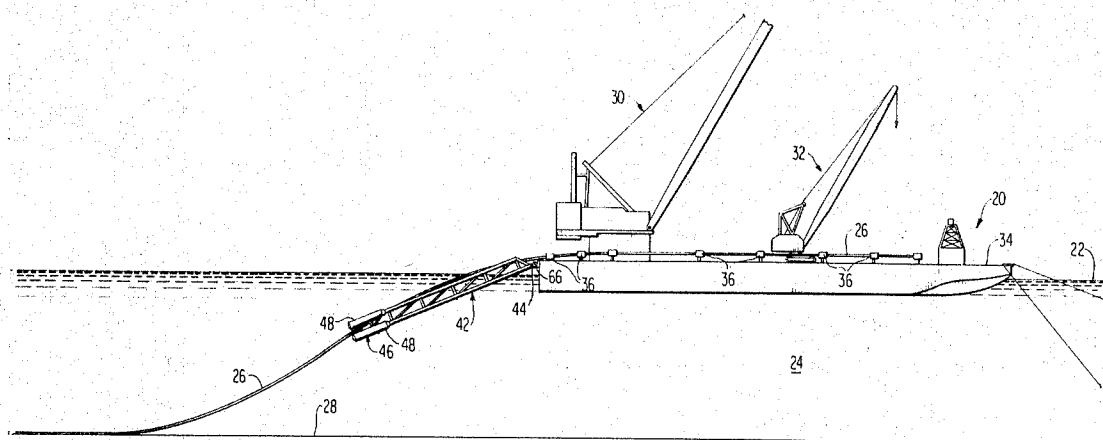


FIG. 1

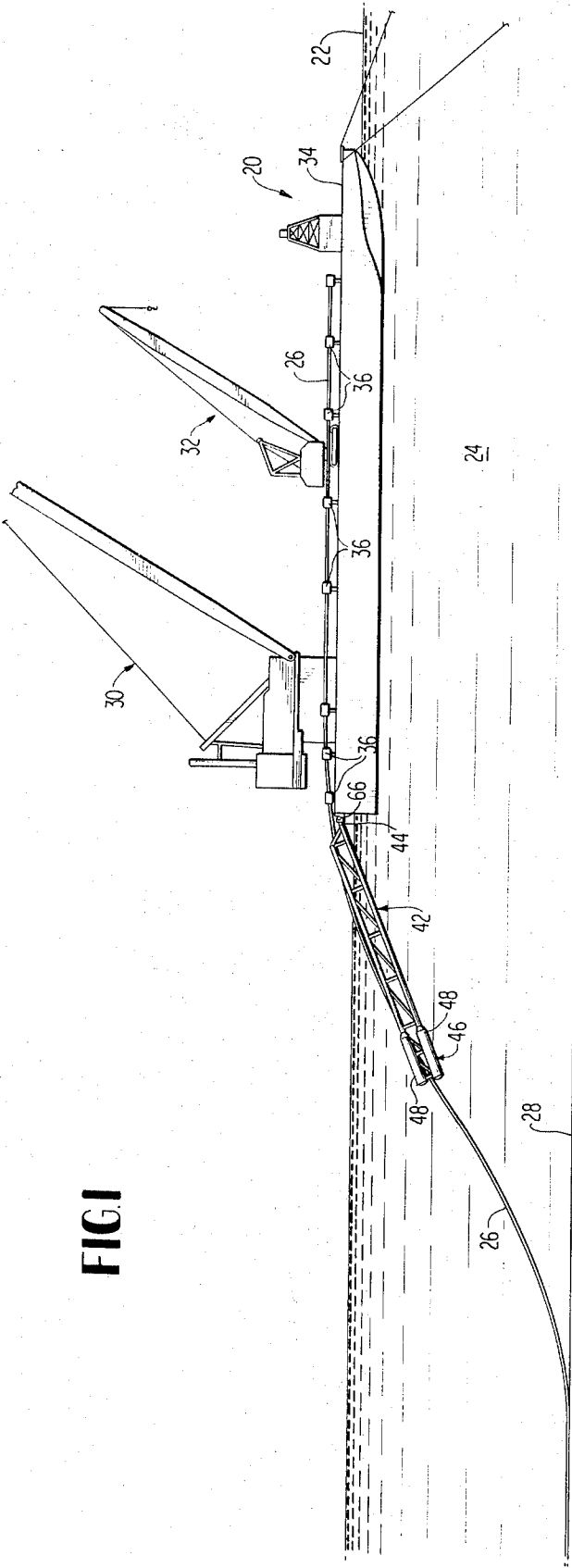
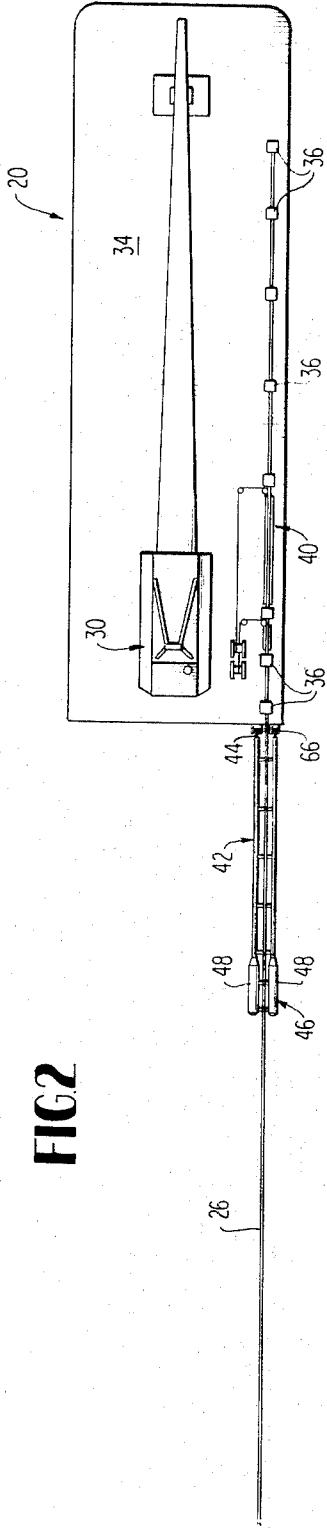


FIG. 2



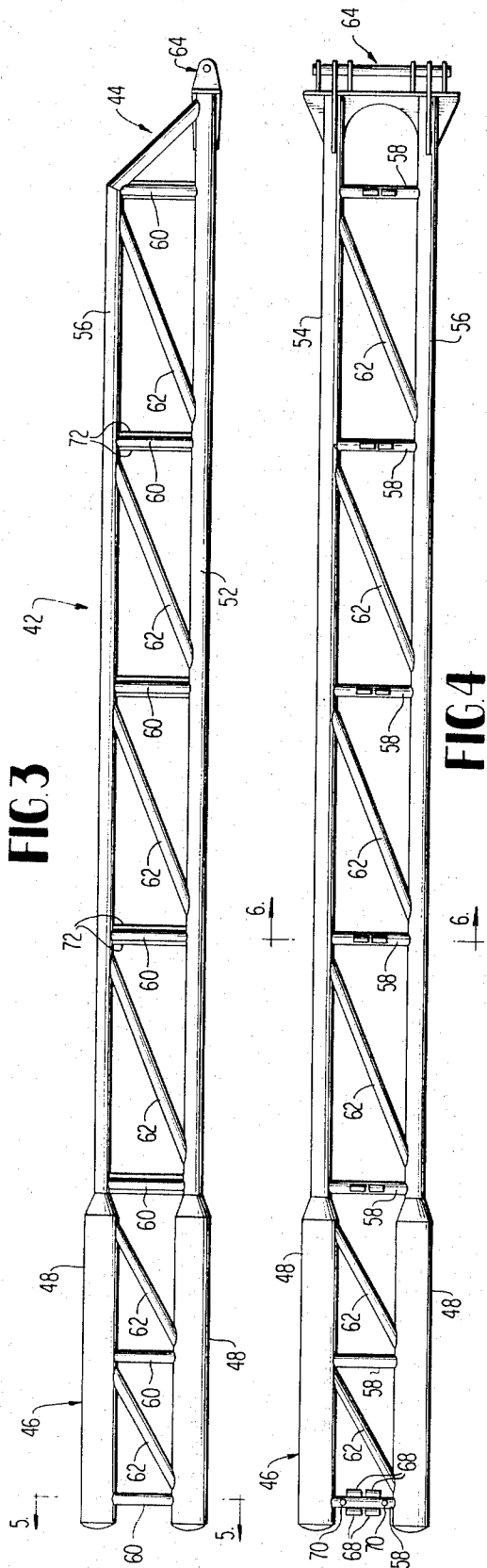
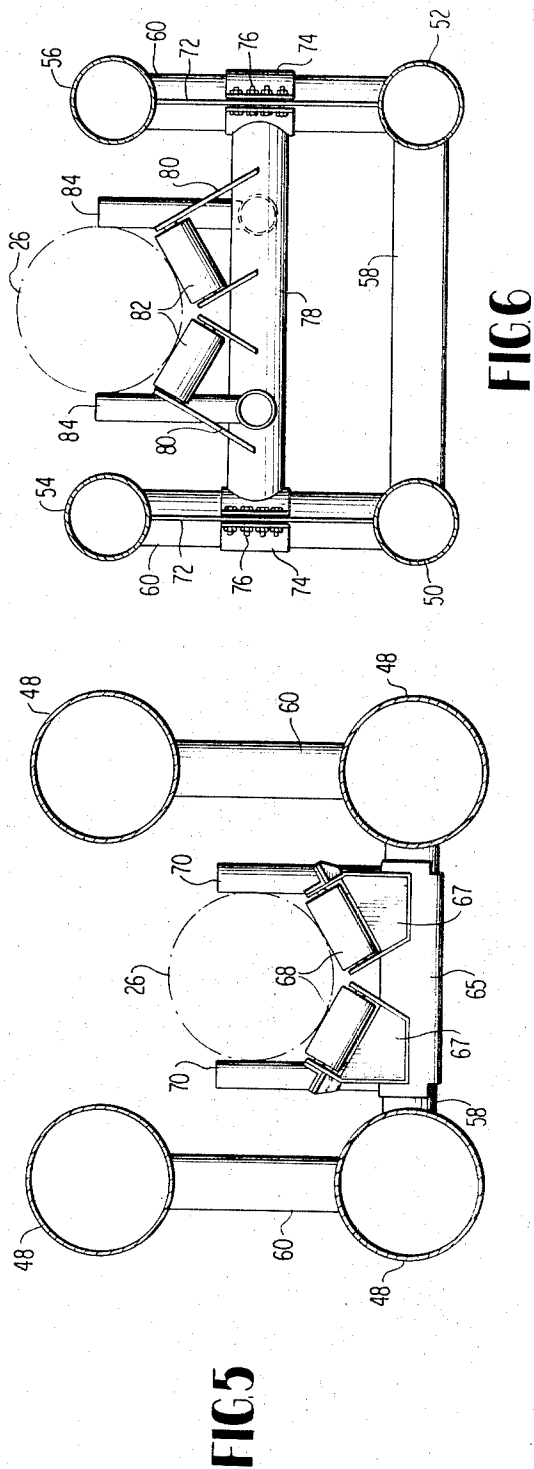


FIG 7

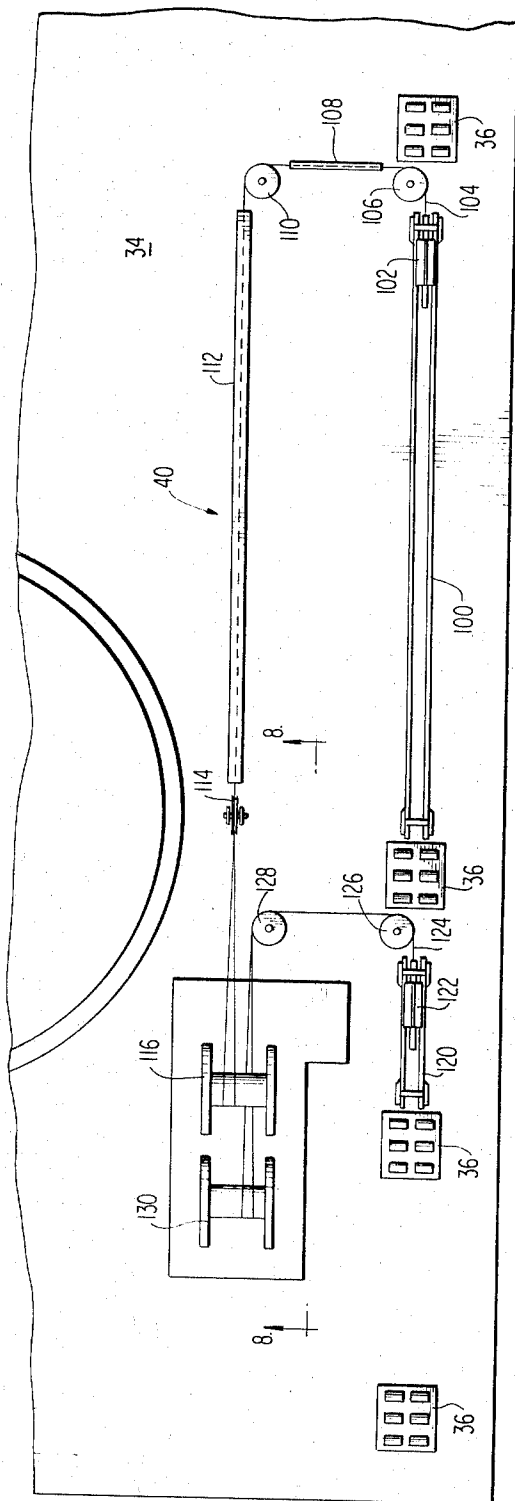
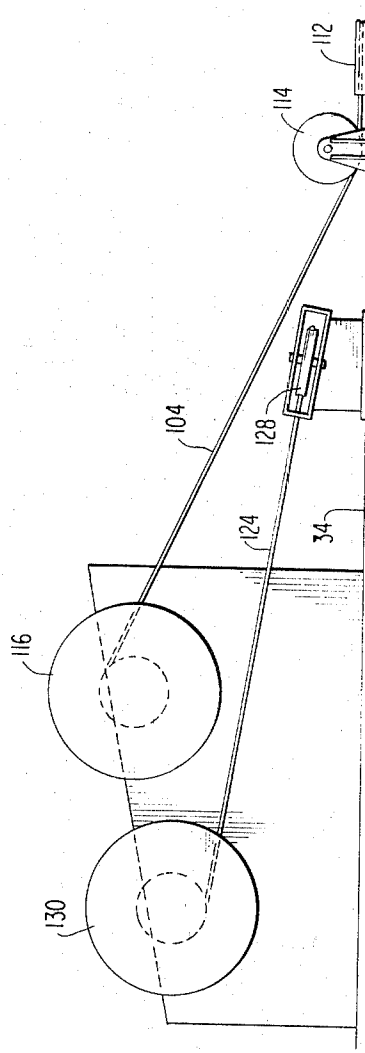


FIG 8

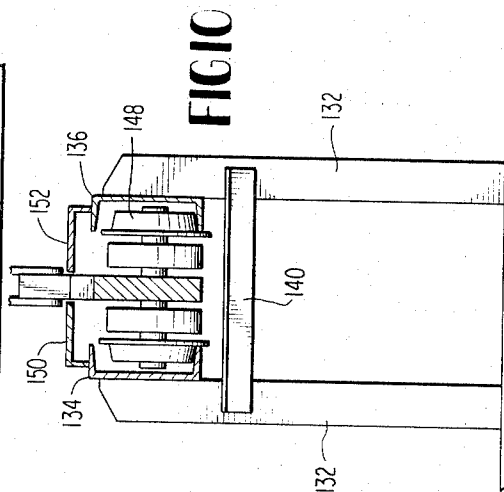
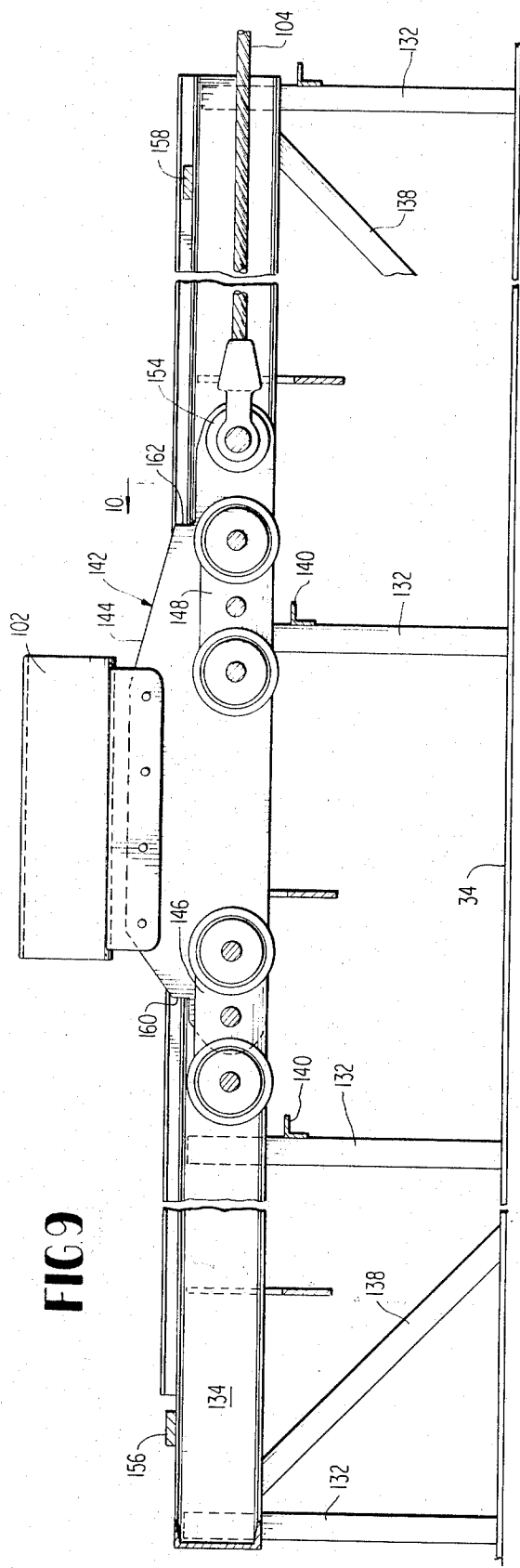
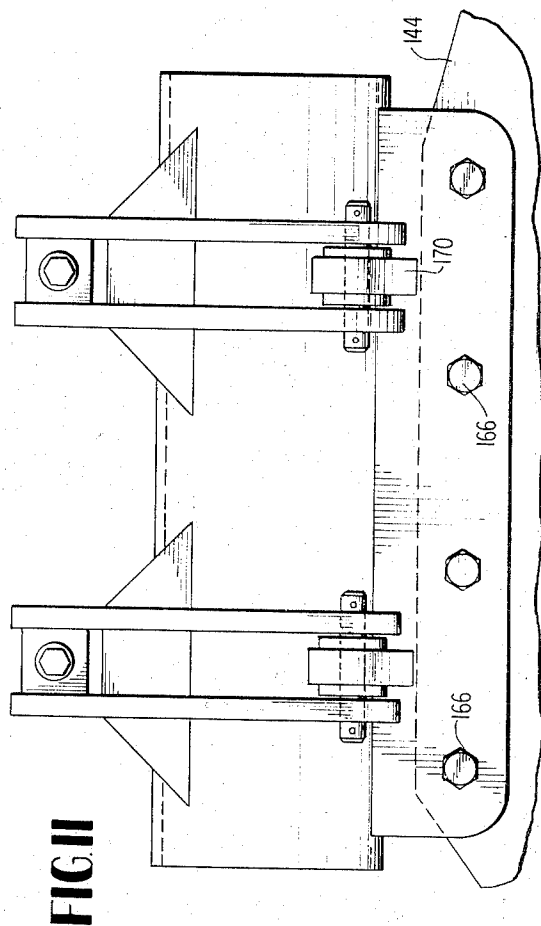
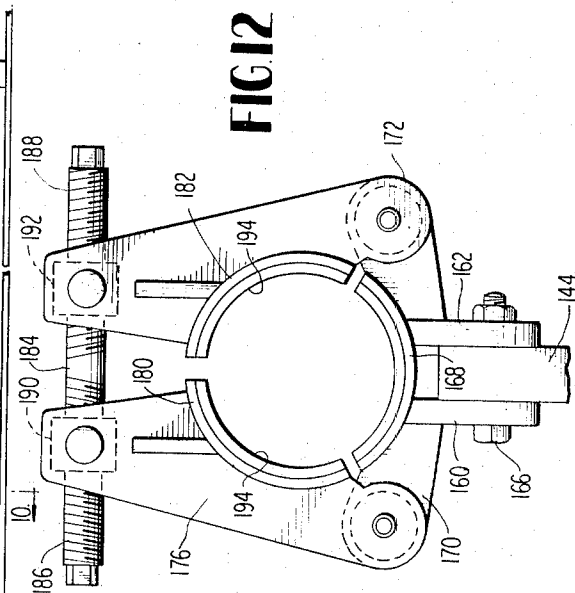


FIG 10



SHEET 5 OF 5

FIG 13

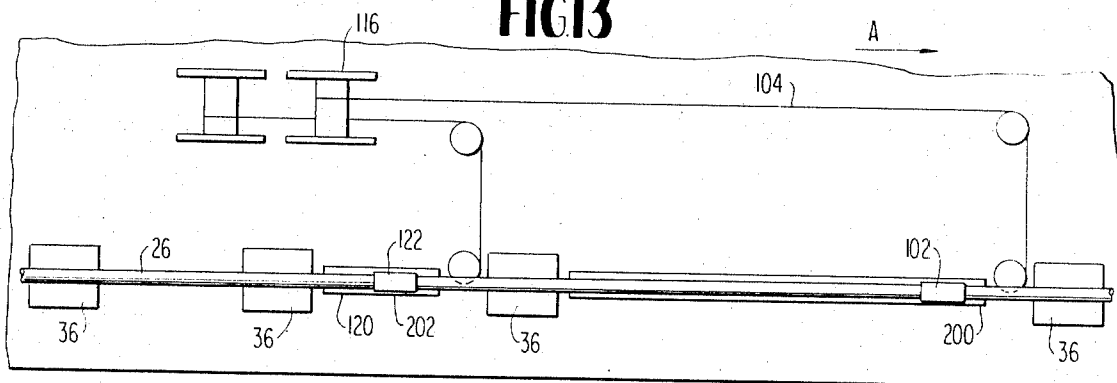


FIG 14

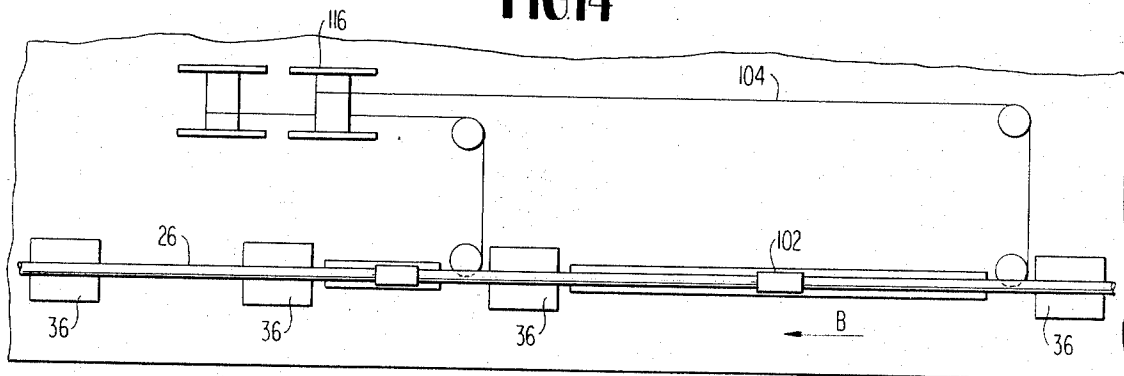


FIG 15

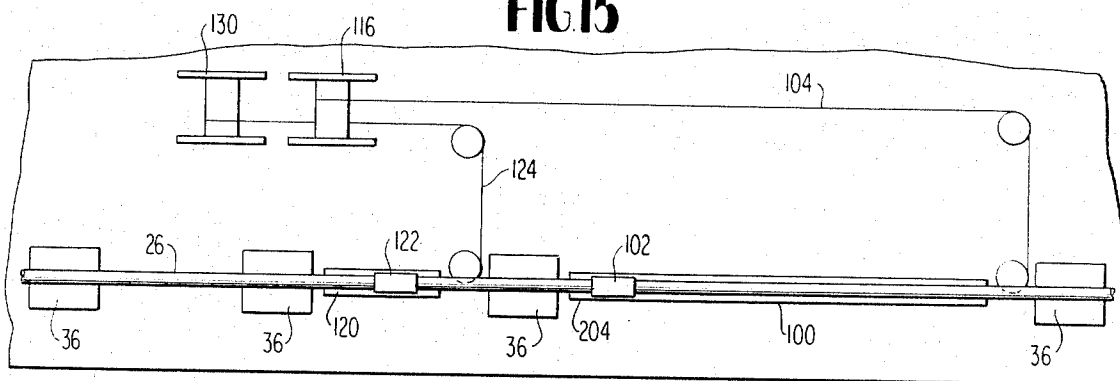
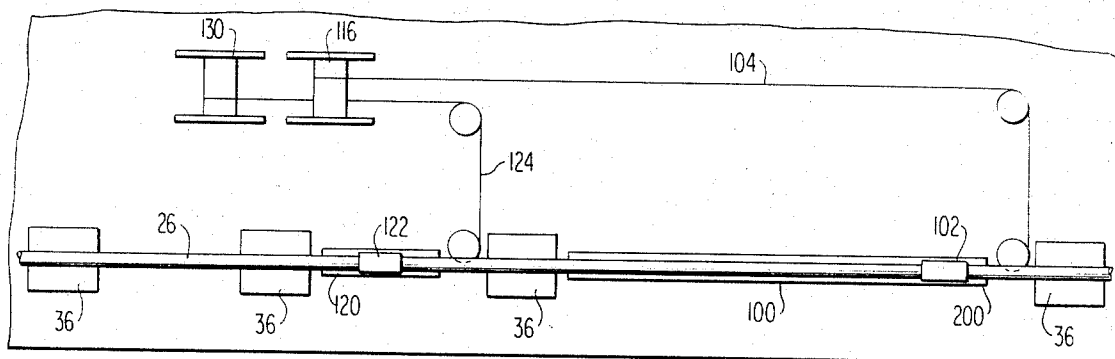


FIG 16



METHOD AND APPARATUS FOR LAYING A SUBMERGIBLE ELONGATE STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates to a method and apparatus for laying a submergible elongate structure upon the bed of a body of water. More particularly, the invention pertains to a method and apparatus for laying a submergible pipeline or the like upon a water bed.

With the discovery of large oil and natural gas deposits offshore and the subsequent successful drilling and production thereof, a problem arose in connection with the most economical means for transporting the crude petroleum and/or natural gas from a producing offshore site to a collection or transfer terminal. Often the most economical means for transporting oil and gas offshore has been to establish submerged pipelines between the producing and the collecting locations. In this connection U.S. Pat. No. 3,280,571 to Hauber et al.; Lawrence U.S. Pat. Nos. 3,390,532 and 3,487,648; Rochelle et al. U.S. Pat. No. 3,507,126 and Lochridge U.S. Pat. No. 3,606,759, all assigned to the assignee of the subject application, disclose highly effective methods and apparatus for laying pipelines upon the bed of a body of water.

The above noted and other previously known systems have been specifically designed for submergible pipelaying work. Pipelaying barges are typically designed with an inclined ramp along the starboard side thereof to provide a gradual transition of the pipeline from a generally horizontal posture to a generally sloping inclination within the body of water. Moreover, often relatively long and sometimes articulated ramp devices are connected to the barge stern to support the pipeline within the body of water intermediate the surface and the bed thereof, and thus minimize the possibility of the pipeline becoming overstressed. Still further in order to maintain an acceptable pipeline profile through the transition zone between the deck of the lay barge and the water bed frequently hydraulic tensioning systems are utilized to maintain an approximately constant axial tension upon the pipeline. In this connection, while wheel or track type tensioning units have been preferred, elaborate and relatively expensive piston and cylinder units have also been known.

While many of the above noted devices have achieved a singular degree of commercial application, in some instances it may be impractical to allocate such equipment to a particular job. More particularly stated, in new fields, such as might exist at remote locations, where drilling may occur in water of a few hundred feet, the economics of the then existent field development may preclude, from a sound management viewpoint, the utilization of a pipelaying barge which has been specifically and advantageously designed for deep water use. Moreover, it may be economically impractical to transport a barge which is specifically designed to lay pipeline to a remote location if only a short working duration is contemplated.

Therefore, it would be highly desirable to provide a method and apparatus for readily converting a standard derrick-construction barge having a generally planar deck to a pipelaying barge effective for laying pipeline in relatively shallow water. Further, it would be desirable to provide for such a transition with a minimum expenditure of time, effort and expense while utilizing conventional field equipment. Additionally, it would be

desirable to retain the advantageous operating characteristics of more sophisticated equipment.

OBJECTS AND SUMMARY OF THE INVENTION

It is a general object of the invention to provide a method and apparatus for laying submergible elongate structures which will obviate or minimize problems of the type previously described.

It is a particular object of the invention to provide a novel method and apparatus for laying submergible elongate structures in water at remote locations.

It is a further object of the invention to provide a novel method and apparatus for laying submergible elongate structures within a body of water by converting a conventional derrick-construction barge, on site, into a pipelaying barge in an efficient and economical manner.

It is another object of the invention to provide a novel method and apparatus for converting a conventional planar deck barge for laying a submergible elongate structure by the utilization of generally conventional equipment that may be typically found at a remote location with a minimum of time and effort while retaining the desirable operating characteristics of more sophisticated pipeline laying equipment.

It is still another object of the invention to provide a novel pipeline cable tensioning system utilizing two independent systems to provide reset and fail safe backup capability.

It is yet another object of the invention to provide a novel unitary pipeline supporting ramp which will accommodate a flexure of the pipeline through the ramp, thus eliminating the necessity of fashioning a ramp within the deck of a construction barge.

BRIEF SUMMARY

An apparatus suitable to accomplish at least some of the foregoing objects comprises a floating vessel having a generally planar deck and being operable to support a submergible elongate structure to be laid upon the bed of a body of water. A first cable tensioning system is connected to the deck of the floating vessel and is selectively connectable to the submergible elongate structure for applying an approximately constant axial tension upon the submergible elongate structure as the barge is advanced along a desired pipelaying route. A second cable tensioning system is connected to the deck of the floating vessel independently of the first cable tensioning system and is selectively connectable to the submergible elongate structure for applying an approximately constant axial tension upon the submergible structure while the barge is maintained in a generally stationary mode relative to the intended laying route.

In order to support the submergible elongate structure within the body of water at the stern of the floating vessel a unitary submergible ramp is pivotally connected to the stern of the floating vessel and includes a plurality of rollers for supporting the elongate structure along the length of the submergible ramp. The plurality of rollers are individually vertically adjustable so that a smooth transition may be achieved from the generally horizontal posture of the submergible elongate structure along the deck of the floating vessel to an inclined position of the submergible elongate structure as the structure descends within the body of water and onto the water bed.

THE DRAWINGS

Other objects and advantages of the present invention will become apparent from the following detailed description of a preferred embodiment thereof taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view of a converted derrick-construction barge operable for laying a submergible structure, such as a pipeline, upon the bed of a body of water;

FIG. 2 is a plan view of the converted pipelaying barge disclosed in FIG. 1;

FIG. 3 is a detailed side elevational view of a unitary ramp comprising one aspect of the subject invention;

FIG. 4 is a plan view of the unitary ramp;

FIG. 5 is a cross-sectional view of the submerged end of the ramp, taken along section line 5—5 in FIG. 3, and particularly discloses a non-adjustable roller and a lateral guide bracket combination mounted upon the unitary ramp;

FIG. 6 is a cross-sectional view of the unitary ramp, taken along section line 6—6 in FIG. 4, and discloses one of a plurality of vertically adjustable roller and lateral guide combinations which are spaced along the length of the unitary ramp structure;

FIG. 7 is a plan view of a cable tensioning system for providing an approximately constant axial tension on a submergible elongate structure as it is being laid from a floating vessel;

FIG. 8 is a partial cross-sectional view, taken along section line 8—8 in FIG. 7, and discloses a pair of generally constant tension winches for use in providing a generally constant axial tension on a submergible elongate structure as it is being laid;

FIG. 9 is a detailed side elevational view of an elongate rail system including a clamping assembly for connection to a submergible elongate structure to provide a continuous tension thereon as the structure is payed off of the stern of the floating vessel;

FIG. 10 is a cross-sectional view, taken along section line 10—10 in FIG. 9, and discloses a mounting relationship of a clamping assembly and rail combination;

FIG. 11 is a detailed side elevational view of a clamping assembly as generally shown in FIG. 9;

FIG. 12 is an end view of the clamping assembly disclosed in FIG. 11; and

FIGS. 13—16 comprise sequential schematic illustrations of a process for maintaining a generally constant axial tension upon an elongate structure as the structure is being laid from the deck of a converted derrick-construction barge.

DETAILED DESCRIPTION

Turning now to the drawings and in particular to FIGS. 1 and 2 thereof, there will be seen a marine vessel or barge 20 floating upon the surface 22 of a body of water 24. The barge 20 has been converted in a manner to be discussed in detail hereinafter to enable the barge to lay a submergible elongate structure, such as a pipeline 26, upon the bed 28 of the body of water.

The barge 20, before conversion, may comprise a standard derrick-construction barge which is typically provided with a pedestal crane 30. A track mounted crane 32 may also be disposed upon the barge and may be maneuvered about the generally planar deck 34 thereof as desired. For a more detailed illustrative example of a conventional derrick-construction barge to

which the subject invention may be applied, reference may be had to the derrick-construction barge, H. A. LINDSAY, owned and operated by Brown & Root, Inc., the assignee of the subject application.

In order to rapidly and economically convert the derrick-construction barge 20 into an effective pipelaying vessel a plurality of pipeline guide shoes 36 are mounted upon the deck in alignment along one edge thereof for slidably supporting a pipeline through make-up stations, not shown, and a constant tensioning cable system 40 comprising one structural aspect of the subject invention. The shoes 36 at the stern of the barge may be vertically adjustable to provide a gradual slope of the pipeline 26 as the pipeline descends into the body of water. For a more detailed description of pipeline guide shoes suitable for use with the subject invention, reference may be had to the previously noted Lawrence U.S. Pat. No. 3,390,532, and particularly to FIGS. 8 and 9 of the drawing, and columns 10, 11 and 12 of the specification. The disclosure of guide shoes as set forth in the relevant portions of the Lawrence patent are hereby incorporated by reference as though set forth at length.

In order to support and thus facilitate a gradual bending transition of the pipeline 26 from a horizontal posture along the deck of the converted barge into an inclined sloping posture within the body of water, a unitary ramp 42 is provided which is pivotally hitched at one end 44 to the stern of the barge 20. The free end 46 of the unitary ramp is designed to slopingly extend into the body of water. The free end, as will be more fully discussed hereinafter, is buoyantly supported by the provision of variable buoyancy pontoons 48.

Turning now to FIGS. 3—6 there will be seen detailed views of the subject unitary ramp 42 comprising a further structural aspect of the instant invention. More particularly, the unitary ramp is composed of a first pair 50 and 52 of elongate tubular legs which are generally coextensive and mutually parallel. A second pair of tubular legs 54 and 56 are also provided which are in like manner generally coextensive and mutually parallel. The first pair of legs 50 and 52 are interconnected by a plurality of normally extending transverse members 58 disposed at spaced locations along the length of the unitary ramp 42. Respective ones 50—54 and 52—56 of the elongate legs are also interconnected by a plurality of columns 60 also positioned at spaced locations along the length of the unitary ramp. In cross-section, as particularly illustrated in FIGS. 5 and 6, one of the transverse members 58 and a pair of corresponding columns 60, in conjunction with the longitudinally extending legs, form a generally U-shaped cradling structure for supporting a submergible elongate structure such as a pipeline, as particularly illustrated in FIGS. 1 and 2. To provide structural rigidity, the pairs of the tubular legs 50—54, 50—52 and 52—56 are also interconnected by a plurality of sloping struts 62.

At one end 44 of the unitary ramp a mounting bracket 64 is affixed to the legs 50 and 52. The mounting bracket 64 may be readily connected to a conventional hitch 66 mounted upon the stern of the barge 20.

At the free end 46 of the unitary ramp each of the tubular legs may be enlarged to form variable buoyancy pontoons 48, as previously mentioned. The pontoons 48 may be in direct fluid communication with the remainder of the ramp legs or preferably a bulkhead, not shown, may be provided across the initial enlarged por-

tion, and a valving and actuation means, also not shown, may be connected to each of the pontoons 48 to provide a capability for varying the bouyancy thereof and thus selectively control the angle of inclination assumed by the ramp within the water 24.

In order to slidably guide the pipeline 26 longitudinally through the unitary support ramp 42 the transverse bracket 58 at the free end 46 of the unitary ramp has coupled thereto a mounting collar 64 which carries a plurality of pivotal roller brackets 67. A pipeline engaging roller 68 is mounted for rotation within each of the brackets 67. The rollers 68 are mutually inclined to cradle the pipeline as it extends within the ramp.

In order to guide and maintain the pipeline 26 upon the cradle rollers 68, normally extending guide posts 70 are fixedly connected to the mounting collar 65 at the outer extremities of the rollers 68. Thus, a pipeline 26, such as shown in phantom in FIG. 5, will be generally centrally aligned within the unitary ramp at the free end 46 thereof.

As noted in FIG. 1, in order to promote a smooth bending profile and additionally provide firm support at spaced intervals along the length of the ramp, a plurality of vertically adjustable roller guide combinations are mounted along the length of the ramp. In this connection, note FIG. 6, each of the upright columns 60 is provided with adjustment rails 72 which longitudinally extend along the exterior thereof and are fashioned with a plurality of vertically spaced apertures. An opposing C-clamp 74 is mounted upon each of the columns 60 and includes flanges interconnected by threaded fasteners 76 which may be extended through the apertures in the guide rails 72. The C-clamps 74 may thus be fixedly attached at desired positions along the columns 60. A transverse arm 78 extends between the clamps 74 and carries roller mounts 80. Rollers 82 are slopingly disposed for rotation within the mounts 80 to cradle a pipeline 26 thereupon for translation along the ramp 42, as previously noted.

In order to minimize the possibility of misalignment of the pipeline 26 upon the supporting rollers 82, a pair of spaced guide bars 84 are also connected to the transverse arm 78 and normally extend with respect thereto to bracket and maintain the pipeline in a generally centrally disposed posture within the unitary ramp 42.

While the unitary ramp structure which extends into the body of water is suitable for supporting the pipeline 26 in the transition zone at the end of the barge, it will be appreciated by those skilled in the art that the inclined pipeline 26 will tend to roll off of the vessel unless it is constrained in some manner. Moreover, in order to control bending stress being created in the sag bend region 27 of the pipeline 26, it has been found to be highly desirable to maintain an axial tension within the pipeline 26 as it is being laid. In order to provide this generally constant axial tension in a reliable and economic manner at remote locations where conversion of a derrick-construction barge to a laying barge is necessary, reference may be had to FIG. 7 wherein the previously mentioned cable tensioning system 40 is disclosed.

A plurality of pipeline guide shoes 36 are mounted in alignment upon the deck 34 of the barge to be converted. Positioned in alignment between adjacent guide shoes 36 is a first longitudinally extending rail system 100 which serves to support for translation thereupon a pipe clamping assembly 102. Connected to the pipe

clamping assembly 102 is a wire rope 104 which is guided around a sheave 106 and passes beneath a split pipe cover 108 to a second sheave 110 beneath another split pipe protector 112 under a sheave 114 and up to a generally constant tension winch 116 mounted upon the barge deck. The sheaves 106, 110 and 114 serve to guide the wire rope in a generally U-shaped manner and thus permit a compact arrangement of the cable tensioning system. The split pipe protectors 108 and 112 serve to enclose the wire rope 104 along the barge deck 34 and thus minimize the possibility of the line becoming fouled. Therefore, the pipe clamping assembly 102 is free to translate along the rail 100 between adjacent shoes 36 under a generally constant axial tension provided via wire rope 104 by the deck winch 116.

A second cable tensioning unit is positioned downstream of the first cable tensioning unit and includes a longitudinally extending guide rail 120 positioned in alignment with adjacent shoes 36 between the rail 100 and the unitary ramp 42. A pipe clamping assembly 122 is mounted for translation upon the rail 120. A flexible wire rope 124 is connected to the translatable pipe clamping assembly 122 and is guided around a pair of sheaves 126 and 128 to a constant tension winch 130 mounted upon the deck 34 of the barge for operation independently of the deck winch 116. Therefore, the pipe clamping assembly 122 is free to translate along rail 120 between adjacent shoes 36 under generally constant tension provided via wire rope 124 from the constant tension winch 130.

Turning now to FIGS. 9 and 10, there will be seen a rail system suitable for use as either rail 100 or 120. More particularly, a plurality of upright posts 132, which may be fashioned from channel iron or the like, are mounted upon the barge deck 34 and extend to an elevation so that a pipe clamping assembly 102 or 122 will be in coaxial alignment with a pipe supported upon shoes 36. The posts 132 support an opposing pair of U-channel rails 134 and 136 which extend generally parallel to the deck surface 34. In order to provide structural rigidity to the rail support system, struts 138 are intermittently connected between the rails and the deck and the posts 132 are horizontally interconnected by L-channel braces 140.

The pipe clamping assembly 102 or 122 is supported along the rails 134 and 136 by a running assembly 142 which includes a central body member 144 mounted between spaced sets of railway trucks 146 and 148, respectively. In order to perform the dual function of guiding the body 144 and providing a cover for the under-running railway trucks 146 and 148, L-shaped members 150 and 152 are mounted upon an upper surface of rails 134 and 136, respectively, and mutually extend together to provide a slot in which the body 144 may travel along the rail structure. A wire rope 104 is pivotally connected to one end of the assembly 142, as at 154. The rope in turn is connected to a constant tension winch, as previously described.

Maximum limits of travel of the running assembly 142 are maintained by the provision of horizontally extending stop bars 156 and 158 mounted across the rails 134 and 136 at the remote ends thereof. The stop bars serve to abut against compatible surfaces 160 and 162, respectively, fashioned within the running assembly 142 to limit travel of the running assembly.

Turning now particularly to FIGS. 11 and 12, there will be seen detailed side and end views of a pipe

clamping assembly suitable for use with the subject invention. More particularly, a pair of spaced parallel mounting plates 160 and 162 are dimensioned to intimately engage the body member 144 of the running assembly. A plurality of threaded fasteners 166 serve to extend through the mounting plates and the body member 144 to releasably and thus interchangeably connect the pipe clamping assembly to the running assembly.

Fixedly connected to the mounting plates 160 and 162 is a first arcuate pipeline bearing segment 168 which is approximately in cross section one-third of the arc of a circle. Interconnecting the mounting plate 160 and one portion of the arcuate segment 168 is a hinge 170. In a similar manner interconnecting the mounting plate 162 and another portion of the arcuate portion 168 is a hinge assembly 172. Mounted upon the hinge plates 170 and 172 are pivotal bracket assemblies 176 and 178, respectively. The pivotal brackets 176 and 178 have fixedly mounted thereto arcuate segments 180 and 182 which, like the base segment 168, are each composed of an arc of approximately one-third of a circle.

The hinge mountings 176 and 178 are mutually pivotally movable toward or away from each other by the provision of a shaft 184 having left-handed threads 186 on one end thereof and right-handed threads 188 on an opposite end thereof. The shaft 184 extends through internally threaded mountings 190 and 192, respectively, which in turn are pivotally connected to the brackets 176 and 178. The shaft 184 is further provided at the ends thereof with wrench flats to receive in driving communication the head of a socket wrench or the like to enable an operator to open and to close the pipe clamping assembly.

The segments 168, 180 and 182 may be fabricated from a longitudinal split pipe and are selected to correspond in size to the pipe to be laid. In order to facilitate frictional engagement of the pipe clamping assembly with a pipe extending therethrough, each of the arcuate segments 168, 180 and 182 are laminated with a liner such as bonded rubber neoprene or the like 194.

While the description thus far has been directed to a single pivotal hinge assembly, it will be appreciated by those skilled in the art that more than one hinge assembly may be conveniently utilized with each pipe clamping assembly. In this connection, two longitudinally spaced hinge brackets are illustrated in FIG. 11. Both brackets are identical in structure and function as previously described.

METHOD OF OPERATION

Turning now to FIGS. 13-16, there will be seen in a sequential schematic array a process of utilizing the subject cable tensioning system for maintaining an approximately constant axial tension upon a pipeline as it is being laid.

More particularly, a pipeline 26 is made up on board the floating vessel and is supported upon a plurality of axially aligned shoes 36 as illustrated in FIG. 13. In order to maintain an approximately constant axial tension upon the pipeline, and thus enhance the profile characteristics thereof, the pipe clamping assembly 102 is intimately tightened around the pipeline at a first end 200 of the guide rail 100. The pipe clamping assembly 122 is maintained in a non-engagement posture in approximately the center 202 of the guide rail 120.

Axial tension is applied to the pipe by actuation of the constant tension winch 116 and wire rope 104 which is connected to the clamping assembly 102 as previously described. Under such conditions, the barge lays away along a desired pipelaying route in a direction from left to right as viewed in FIG. 13 and as indicated by arrow A so that the pipeline 26 relative to the barge 20 is payed off of the stern.

By reference to FIG. 14 this relative motion is reflected in the fact that pipe clamping assembly 102 which is fixedly connected to the pipeline 26 has moved from right to left or in the direction of arrow B with respect to the barge as wire rope 104 is payed out under constant tension from winch 116.

Still further, movement of the barge along the desired laying route, as illustrated in FIG. 15, will translate the pipe clamping assembly 102 to another end 204 of the rail 100. At this point, in time, in order to continue to lay the pipeline, it will be necessary to reset the clamping assembly 102 at the first end 200 of the rail 100. In order to provide for this resetting function without losing the approximately constant tension on the pipeline, the clamping assembly 122 is actuated into firm gripping engagement with the surface of the pipeline 26 to thereby transmit an axial tension to the pipeline by the provision of the constant tension winch 130 acting through wire rope 124. Once clamping assembly 122 is firmly engaged with the pipeline, the clamping assembly 102 may be released and the tension in line 104 will automatically translate the assembly from left to right as viewed in FIG. 15 back to the first end 200 of the rail 100. During this resetting of the pipe clamping assembly 102, the barge is maintained in an approximately stationary posture with respect to the intended pipe laying route.

It has been found, however, that notwithstanding the intention of remaining stationary, wave action and the like will produce a pitching motion of the barge. In order to maintain an approximately constant axial tension on the pipeline therefore the clamping assembly 122 must be free to translate and in this connection, as previously described, the clamping assembly 122 is mounted for translation under constant tension upon rail assembly 120.

Once the pipe clamping assembly 102 is reattached to the pipeline 26 at the first end 200 of the rail 100, the pipeline clamping assembly 122 may be released and constant axial tension will be maintained upon the pipeline by the provision of winch 116 as previously discussed.

The above described steps of clamping and unclamping are repeated in an ambulatory manner as the pipeline is laid along a desired route.

SUMMARY OF THE MAJOR ADVANTAGES

It will be appreciated that the above described method and apparatus provides a convenient and ready means of converting a standard derrick-construction barge to a pipelaying barge with a minimum amount of time and effort, while the desirable operating characteristics of ramp support plus axial tension of more sophisticated equipment are maintained.

Further, the subject method and apparatus provides a means for laying pipeline without the utilization of complicated and expensive hydraulic systems which would be difficult or impractical to fabricate in the field.

Still further, the subject system provides a smooth bend of the pipeline at the inflection point between horizontal and inclined postures at the stern of the barge without reshaping the deck structure of the converted barge.

Another significant advantage of the invention is the provision of a unitary ramp structure which is capable of firmly supporting a curved portion of a pipeline while maintaining the pipeline in general axial alignment with respect to the ramp.

Further, a significant advantage of the present invention pertains to the exclusive utilization of independent cable tensioning systems which provide a reset capability and fail safe backup capability.

Although the invention has been described in connection with preferred embodiments and methods, it will be appreciated by those skilled in the art that additions, deletions, modifications and substitutions, or other changes not specifically described, may be made which will fall within the purview of the appended claims.

What is claimed is:

1. An apparatus for laying a submergible elongate structure upon the bed of a body of water comprising: a floating vessel having a generally planar deck; means connected to said deck for supporting a submergible elongate structure to be laid for translation along said deck; first cable tensioning means connected to said deck and selectively connectable to a submergible elongate structure to be laid for applying an approximately constant axial tension upon the submergible elongate structure while said floating vessel is being advanced along a desired laying route including, a first approximately constant tension winch mounted upon the deck of said floating vessel; a first pair of spaced rails extending along and generally parallel to the deck of said floating vessel; a running assembly supported upon said rails; a selectively actuatable clamping assembly supported for translation along said rails by said running assembly; second cable tensioning means connected to said deck and selectively connectable to a submergible elongate structure for applying an approximately constant axial tension upon the submergible elongate structure supported upon said floating vessel deck while said floating vessel is maintained in a generally stationary posture with respect to the desired laying route; and a unitary submergible ramp pivotally connected to the stern of said floating vessel for supporting between said floating vessel and the bed of the body of water a portion of the submergible elongate structure to be laid, said unitary submergible ramp including a plurality of pontoon members to buoyantly support said submergible elongate structure, and a plurality of selective vertically adjustable support rollers spaced along the length thereof to accommodate flexure of a submergible elongate structure during the laying operation.
2. An apparatus for laying a submergible elongate structure upon the bed of a body of water as defined in claim 1 and further comprising: a plurality of guide posts connected to said unitary submergible ramp adjacent to said support rollers

for maintaining a submergible elongate structure positioned upon said support rollers.

3. An apparatus for laying a submergible elongate structure upon the bed of a body of water as defined in claim 1 wherein said second cable tensioning means comprises:

- a second approximately constant tension winch mounted upon the deck of said floating vessel;
- a second pair of spaced rails extending along and generally parallel to the deck of said floating vessel and in alignment with said first pair of spaced rails;
- a running assembly supported upon said second pair of spaced rails;
- a selectively actuatable clamping assembly supported for translation along said second pair of rails by said running assembly; and
- a flexible cable connected between said second constant tension winch and said running assembly.

4. An apparatus for laying a submergible elongate structure upon the bed of a body of water as defined in claim 3 wherein:

- said first and second pair of spaced rails are in axial alignment with said unitary submergible ramp; and
- said second pair of spaced rails is positioned intermediate said first pair of spaced rails and said unitary submergible ramp.

5. An apparatus for laying a submergible elongate structure upon the bed of a body of water comprising:

- a floating vessel having a generally planar deck;
- means connected to said deck for supporting a submergible elongate structure to be laid for translation along said deck;
- first cable tensioning means connected to said deck and selectively connectable to a submergible elongate structure to be laid for applying an approximately constant axial tension upon the submergible elongate structure while said floating vessel is being advanced along a desired laying route, including a first approximately constant tension winch mounted upon the deck of said floating vessel, a first pair of spaced rails extending along and generally parallel to the deck of said floating vessel, a running assembly supported upon said rails, a selectively actuatable clamping assembly supported for translation along said rails by said carrying assembly, and
- a flexible cable connected between said first approximately constant tension winch and said running assembly;

- second cable tensioning means connected to said deck independently of said first cable tensioning means and selectively connectable to a submergible elongate structure for applying an approximately constant axial tension upon the submergible elongate structure supported upon said floating vessel deck while said floating vessel is maintained in a generally stationary posture with respect to the desired laying route, and

- a second approximately constant tension winch mounted upon the deck of said floating vessel,
- a second pair of spaced rails extending along and generally parallel to the deck of said floating vessel and in alignment with said first pair of spaced rails,
- a running assembly supported upon said second pair of spaced rails,

a selectively actuatable clamping assembly supported for translation along said second pair of rails by said running assembly, and
 a flexible cable connected between said second constant tension winch and said running assembly;
 a unitary submergible ramp pivotally connected to the stern of said floating vessel for supporting between said floating vessel and the bed of the body of water a portion of the submergible elongate structure to be laid.
 6. An apparatus for laying a submergible elongate structure upon the bed of a body of water comprising:
 a floating vessel having a generally planar deck;
 means connected to said deck for supporting a submergible elongate structure to be laid for translation along said deck;
 first cable tensioning means connected to said deck and selectively connectable to a submergible elongate structure to be laid for applying an approximately constant axial tension upon the submergible elongate structure while said floating vessel is being advanced along a desired laying route, including
 a first approximately constant tension winch mounted upon the deck of said floating vessel,
 a first pair of spaced rails extending along and generally parallel to the deck of said floating vessel,
 a running assembly supported upon said rails,
 a selectively actuatable clamping assembly supported for translation along said rails by said carrying assembly, and
 a flexible cable connected between said first approximately constant tension winch and said running assembly;
 second cable tensioning means connected to said deck and selectively connectable to a submergible elongate structure for applying an approximately constant axial tension upon the submergible elongate structure supported upon said floating vessel deck while said floating vessel is maintained in a generally stationary posture with respect to the desired laying route, and
 a second approximately constant tension winch mounted upon the deck of said floating vessel,
 a second pair of spaced rails extending along and generally parallel to the deck of said floating vessel and in alignment with said first pair of spaced rails,
 a running assembly supported upon said second pair of spaced rails,
 a selectively actuatable clamping assembly supported for translation along said second pair of rails by said running assembly, and
 a flexible cable connected between said second constant tension winch and said running assembly;
 a unitary submergible ramp pivotally connected to the stern of said floating vessel for supporting between said floating vessel and the bed of a body of water a portion of the submergible elongate structure to be laid, said unitary submergible ramp including,
 a first pair of generally coextensive, mutually parallel pontoons legs, wherein
 each of said first pair of pontoon legs is fashioned with an enlarged section at a first end thereof;

transverse members extending between and interconnecting said first pair of pontoon legs at spaced intervals along the length thereof;
 means connected at the second end of said first pair of pontoon legs for connecting said first pair of pontoon legs to the stern of said floating vessel;
 a second pair of coextensive, mutually parallel pontoon legs, wherein
 each of said second pair of pontoon legs is fashioned with an enlarged section at a first end thereof;
 a plurality of normally extending columns interconnecting corresponding ones of said first and second pair of pontoon legs along the length thereof to form at spaced intervals along the length of said first and second pair of legs a generally U-shaped structure, in cross section, having the sides thereof formed by corresponding ones of said plurality of columns and the bottom thereof formed by one of said transverse member;
 a pair of supporting rollers having mutually inclined axes to cradle therebetween a submergible elongate means to be laid upon the water bed, said rollers being fixedly mounted upon the transverse member interconnecting said first pair of pontoons at the first end thereof;
 a transverse bridge member normally extending between corresponding ones of each of said columns spaced along the length of said pontoon legs and mounted for selective adjustment with respect thereto; and
 a pair of supporting rollers having mutually inclined axes to cradle therebetween a submergible elongate means to be laid upon the bed of a body of water, said pair of rollers being fixedly mounted upon each transverse member along the length of said first pair of pontoon legs.
 7. A method for laying a submergible elongate structure upon the bed of a body of water comprising:
 supporting the submergible elongate structure at the surface of the body of water upon a floating vessel having a generally planar deck;
 advancing the floating vessel along a desired laying route;
 maintaining an approximately constant axial tension on the submergible elongate structure while the floating vessel is being advanced along the desired laying route by tensioning the submergible elongate structure by a cable tensioning system connected to the deck of the floating vessel and selectively connectable to the submergible elongate structure said step of maintaining axial tension on the elongate structure when the vessel is being advanced including the steps of,
 actuating a first selectively actuatable clamping assembly into frictional engagement with the submergible elongate structure to be laid upon the bed of a body of water at a first end of a first pair of spaced rails;
 paying out a flexible cable under constant tension from a first approximately constant tension winch which as the floating vessel proceeds along a laying route and the selectively actuatable clamping assembly travels to a second end of the first pair of spaced rails and the pipeline is payed off of the stern of the floating vessel; and

resetting the selectively actuatable clamping assembly upon the submergible elongate structure at the first end of the first pair of spaced rails; maintaining an approximately constant axial tension on the submergible elongate structure when the floating vessel is in a stationary mode with respect to the intended laying route by a cable tensioning system connected to the deck of said floating vessel and selectively connectable to the submergible elongate structure; and supporting the submergible elongate structure within the body of water aft of the floating vessel by a unitary submergible ramp pivotally connected to the stern of the floating vessel, including the step of: positioning a plurality of selectively vertically adjustable support rollers at spaced locations along the unitary submergible ramp to accommodate for flexure of a submergible structure during the laying operation.

8. A method for laying a submergible elongate structure upon the bed of a body of water as defined in claim 7 wherein said step of maintaining an axial tension on the elongate structure when the floating vessel is stationary includes the step of:

actuating a second selectively actuatable clamping assembly into friction engagement with the submergible elongate structure for constant tension translation along a second pair of rails when the first selectively actuatable clamping assembly supported for translation along the first pair of rails reaches the second end thereof to maintain a constant tension upon the submergible elongate means while the first selectively actuatable clamping assembly connected to the first pair of rails is repositioned at the first end thereof.

9. A method for converting a conventional derrick-construction barge to a barge for laying a submergible elongate structure upon the bed of a body of water comprising the steps of:

connecting a first cable tensioning means to deck of the barge for selective attachment to a submergible elongate structure to be laid for applying an approximately constant axial tension upon a submergible elongate structure while the barge is being advanced along a desired laying route, said step of connecting a first cable tensioning means for applying axial tension while the barge is being advanced includes the step of,

providing a first approximately constant tension winch mounted upon the deck of the floating vessel;

providing a first pair of spaced rails extending along and generally parallel to the deck of the floating vessel;

providing a running assembly supported upon the

rails;

providing a selectively actuatable clamping assembly supported for translation along the rails by a running assembly; and

providing a flexible cable connected between the first approximately constant tension winch and the running assembly;

connecting a second cable tensioning means to the deck of the barge for selective attachment to a submergible elongate structure to be laid for applying an approximately constant axial tension upon the submergible elongate structure while the barge is maintained in a generally stationary posture with respect to the desired laying route; and

providing a unitary submergible ramp pivotally connectable to the stern of the barge for supporting between the barge and the bed of the body of water a portion of the submergible elongate structure to be laid, including the step of

providing a plurality of selective vertically adjustable support rollers spaced along the length of the unitary submergible ramp to accommodate flexure of the submergible elongate structure during the laying operation.

10. A method for converting a conventional derrick-construction barge to a barge for laying a submergible elongate structure upon the bed of a body of water as defined in claim 9 wherein said step of providing a unitary ramp includes the step of:

providing a plurality of guide posts adjacent to each of the support rollers for maintaining the submergible elongate structure positioned upon the support rollers during the laying operation.

11. A method for converting a conventional derrick-construction barge to a barge for laying a submergible elongate structure upon the bed of a body of water as defined in claim 15 wherein said step of connecting a second cable tensioning means to the deck of the barge for applying axial tension while the barge is generally stationary comprises:

providing a second approximately constant tension winch mounted upon the deck of the barge;

providing a second pair of spaced rails extending along and generally parallel to the deck of the barge and in alignment with the first pair of spaced rails;

providing a running assembly supported upon the second pair of spaced rails;

providing a selectively actuatable clamping assembly supported for translation along the second pair of rails by the running assembly; and

providing a flexible cable connected between the second constant tension winch and the running assembly.

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