

- [54] **POSITIONING APPARATUS**
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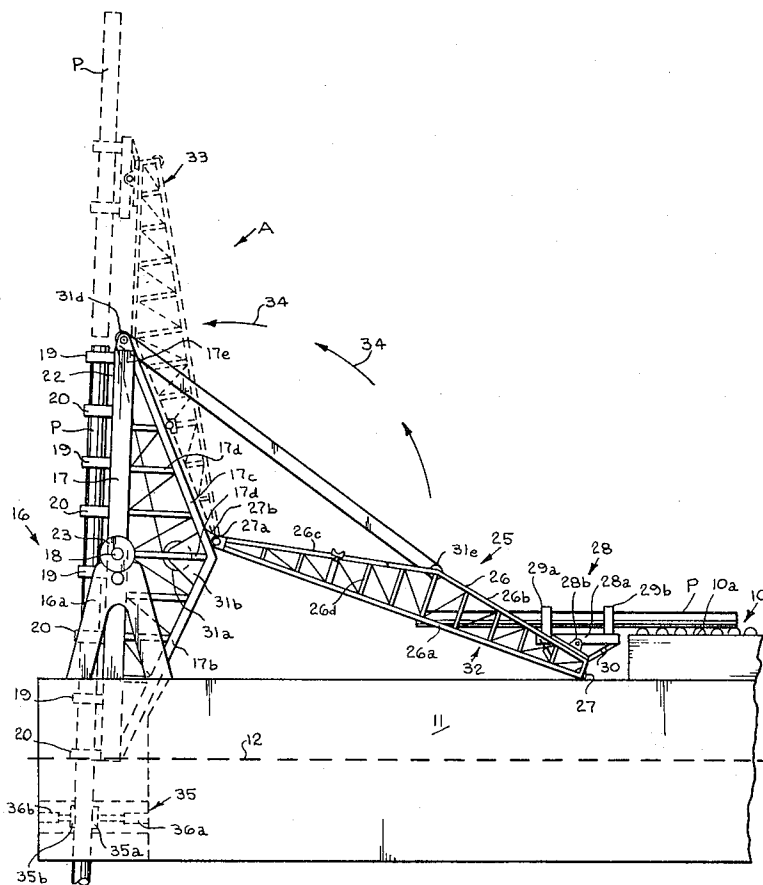
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[57] ABSTRACT

Apparatus for transferring a tubular member such as a pipe from a storage area such as an oil well drilling platform or barge to a submerged position at least partly underwater for the purpose of driving pile, laying pipe or other related uses.

13 Claims, 6 Drawing Figures



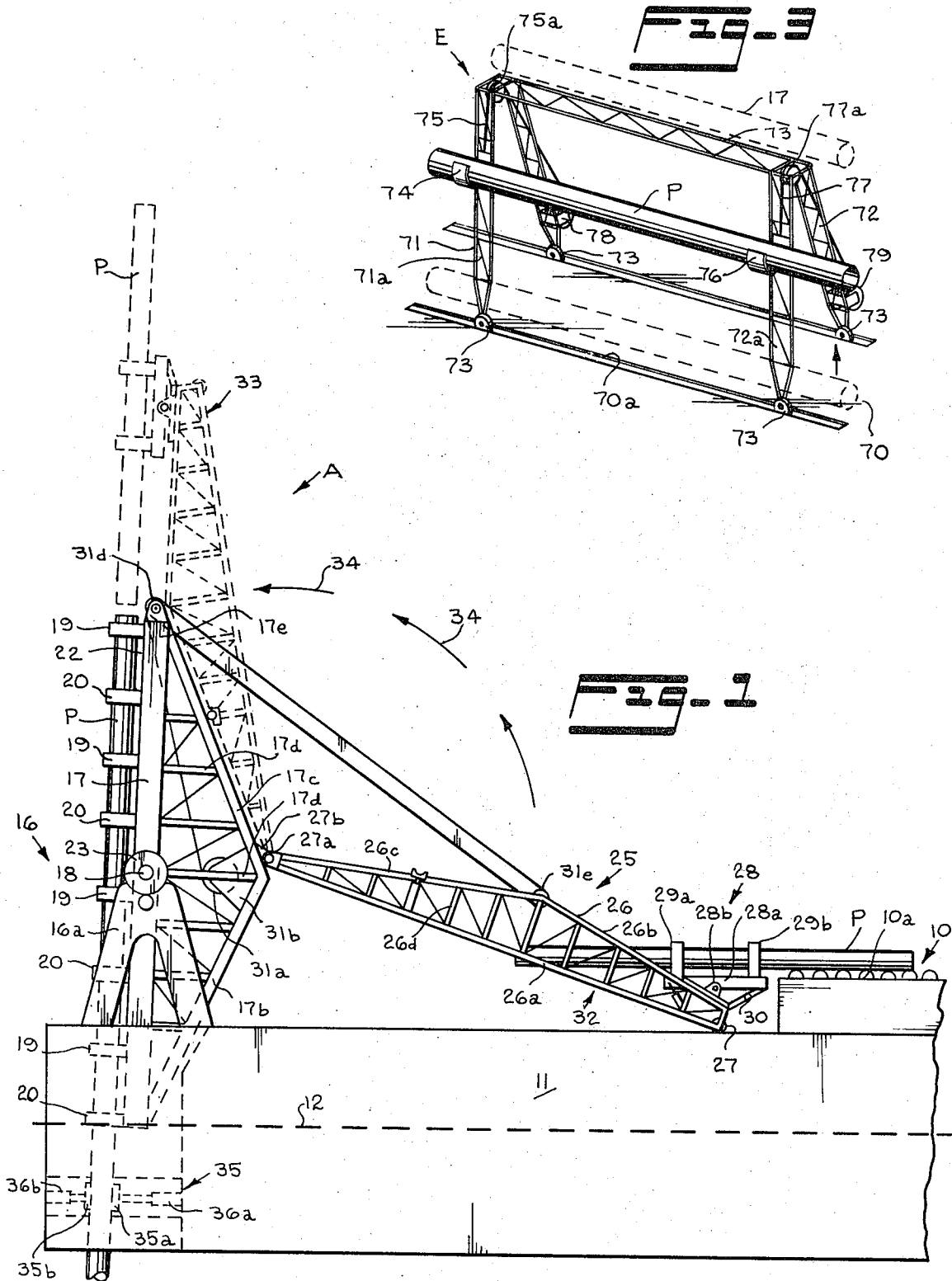
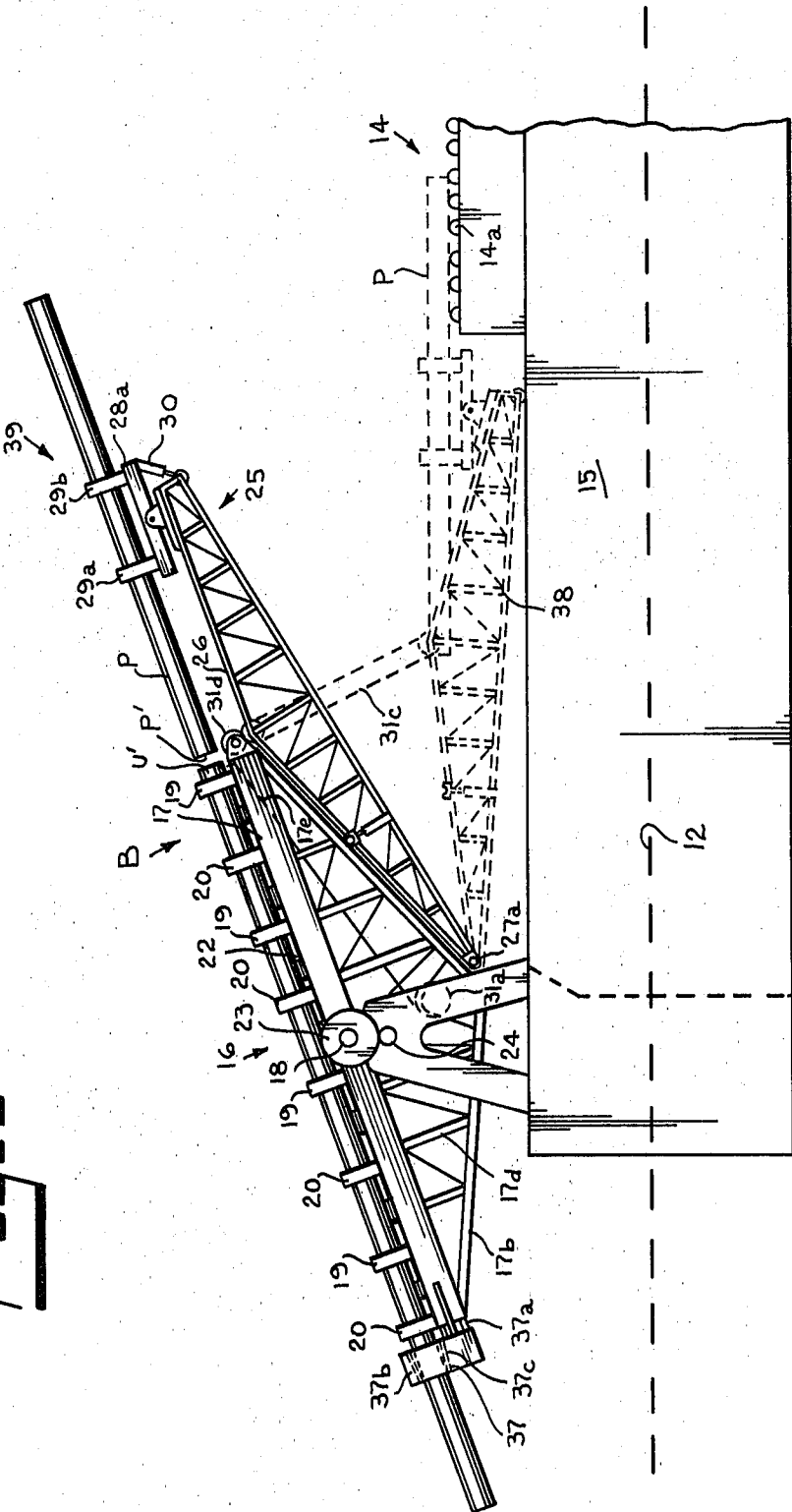


Fig. 2



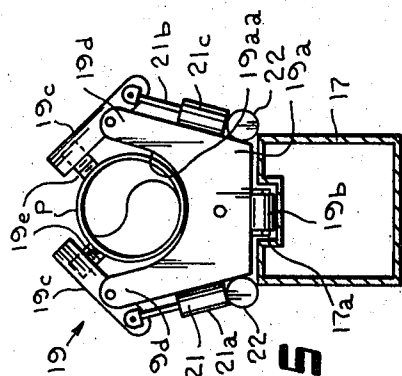


Fig. 5

Fig. 4

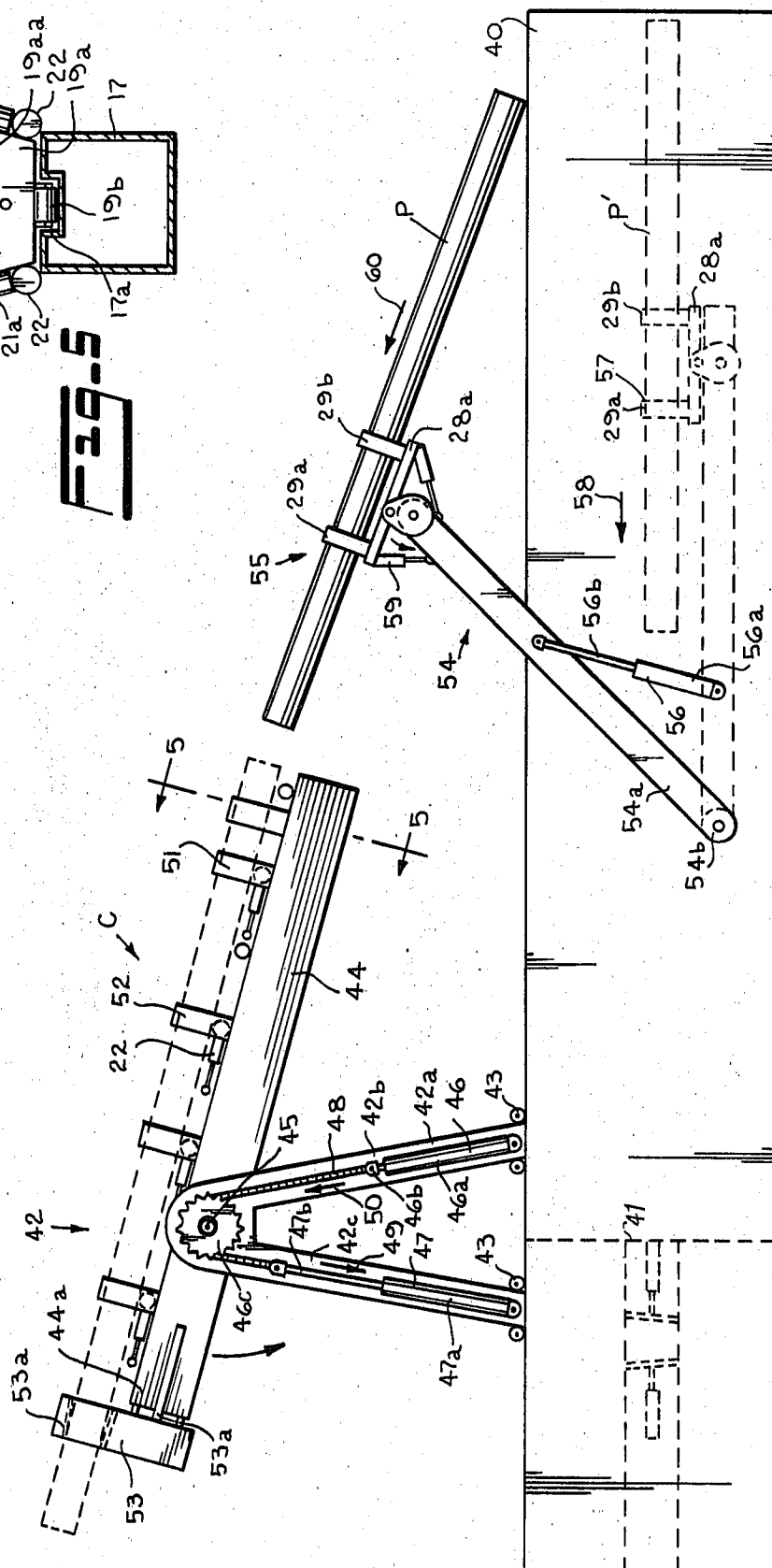
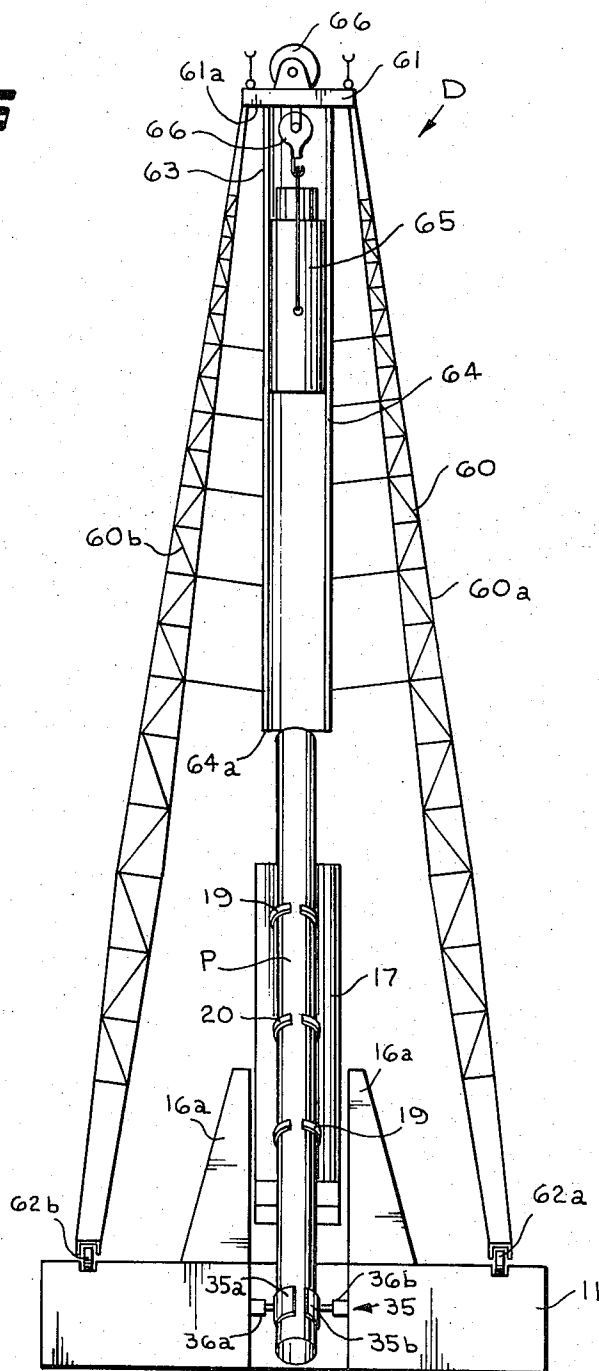


Fig. 5



POSITIONING APPARATUS

BACKGROUND OF THE INVENTION

The field of this invention is apparatus for moving and positioning tubular members such as pipe or the like.

In offshore oil well drilling operations, the drilling platform is positioned at the desired location and one or more legs of this drilling platform are extended downwardly to the bottom. When the body of water is particularly deep and the sea quite rough, it may be necessary to further secure the position of the platform by driving a cluster of piles about each platform leg. The piles may be very long, extremely heavy sections of pipe which must be lowered down to the ocean floor one at a time and welded or otherwise attached together to form a supporting column if the depth is greater than the length of a single pipe section. After the column extends from the platform to the ocean floor, pile driving equipment may be used to drive the column into the bottom. One of the very difficult problems encountered in driving such piles is handling the extremely long, heavy pipe sections that must be moved to an almost vertical position from a storage position.

Another problem with positioning very heavy pipe lengths is found in laying large pipelines on the ocean floor. In laying pipe, the individual very heavy pipe sections are held at an acute angle while connected to the pipeline and then lowered into the ocean.

SUMMARY OF THE INVENTION

It is an object of this invention to provide new and improved apparatus for positioning an elongated member such as a pipe for movement from stored position on a platform or barge to a submerged position at least partly underwater.

It is another object of this invention to safely move and exactly position extremely long and heavy lengths of pipe for movement to a submerged position.

It is a further object of this invention to move a plurality of pipe lengths from a stored position aboard a platform or barge to a submerged position and to connect two or more of such pipe lengths together to form a column extending from the bottom of the body of water to the surface and thereafter to drive the column into the bottom in order to provide a support pile.

In the preferred embodiment of this invention the positioning apparatus includes pipe positioner means mounted on a platform or barge for moving pipe to a release position wherein the pipe can be released to be lowered to a submerged position. A load means is operably attached to or associated with the platform and positioning means in order to move pipe from a stored position to a transfer position in which the pipe is transferred to the positioner means. The positioner means includes a tower having pivotally mounted thereon a pipe track with a plurality of pipe clamp assemblies which are adapted to receive a pipe length. The pipe track is pivotally movable by hydraulic power means or gear means between a transfer position in which pipe is moved into the plurality of clamp assemblies and the release position in which the pipe is released for movement to a submerged position.

In another embodiment of this invention, the load means may include laterally spaced towers having elevators mounted thereon for moving a pipe length up-

wardly and onto the pipe track of the positioner means. And, in a further embodiment of this invention, the load means may include a pivotal arm which is pivotally mounted to the platform and is capable of receiving a pipe length and pivoting upwardly with said pipe length to a transfer position in which the pipe length is pulled onto the elongated track of the pipe positioner means.

After one or more pipe lengths have been positioned to form a pile column extending from the bottom upwardly above the surface of the water, pile driving means is provided on the platform for movement into position to drive the pile column downwardly into the bottom so that the pile column can provide support such as for a leg of a drilling platform.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially schematic view in elevation illustrating the positioning apparatus of a preferred embodiment for positioning pipe or other tubular members for pile driving;

FIG. 2 is a partially schematic view in elevation illustrating another embodiment of this invention wherein individual pipe lengths are positioned for connection with an underwater pipe line;

FIG. 3 is a partially schematic, isometric view of the elevator lift of an alternate embodiment of this invention;

FIG. 4 is a partially schematic view in elevation of an alternate embodiment of the pipe positioner apparatus for positioning pipes either for forming piles underwater or for laying underwater pipeline;

FIG. 5 is a sectional view taken along 5—5 of FIG. 4 illustrating the pivotal clamp assemblies utilized in this invention; and

FIG. 6 is an elevational view of pile driving apparatus utilized in combination with the pipe positioner apparatus of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the letter A generally designates apparatus A for transferring pipe P from a storage area generally designated as 10 on a platform 11 to a submerged position at least partly under the surface 12 of a body of water. In FIG. 2, apparatus generally designated B is provided for moving a pipe length P from a storage area 14 on a barge 15 to a pipe laying position for laying a pipeline under the surface 12 of a body of water. The apparatus A and B of the embodiments of FIGS. 1 and 2, respectively, are basically similar in structure and like numbers and elements will be used throughout to describe similar structures.

Referring again to FIG. 1, a rock-over tower means generally designated as 16 includes spaced inverted V-shaped towers or support frames 16a which are mounted onto the platform 11, which may be a floating drilling platform. An elongated, enclosed channel or track 17 is pivotally mounted onto tower support 16a by the journalled pin assembly 18, which is journalled into the spaced tower support 16a. Referring to FIG. 5, the elongated channel 17 includes an U-shaped track portion or elongated recess 17a which is adapted to receive a plurality of axially mounted clamp assemblies 19 and 20.

The clamp assemblies 19 and 20 are spaced along the elongated channel 17 and are basically identical in structure. For the purpose of explanation, the clamp

assembly 19 illustrated in FIG. 5 will be described in detail, it should be understood that this description of the clamp assembly 19 fully applies to the clamp assembly 20. The clamp assembly 19 of FIG. 5 includes a U-shaped support plate 19a having a roller 19b mounted to the bottom thereof. The roller 19b is positioned within the U-shaped track portion of the elongated channel 17. Jaw arms 19c are pivotally mounted onto legs 19d of the support plate 19a and include pipe engaging elements 19e which are pivoted into frictional engagement with a pipe length P. The jaw arms 19c are movable into and out of engagement with a pipe length P by hydraulic power assemblies 21. The hydraulic power assemblies 21 include cylinder portions 21a attached to the support plate 19a and piston and rod portions 21b which extend into pivotal connection with the jaw arms 19c. By hydraulic operation of the power cylinder assemblies 21, the jaw arms are movable between positions in and out of engagement with the pipe length P. The generally U-shaped support plate 19a has a curved recess 19a formed between support legs 19d to receive the pipe P.

The roller 19b mounts the U-shaped support plate 19a for longitudinal or axial movement along the elongated channel 17. The axial movement of clamp assembly 19 is controlled by hydraulic cylinder power assemblies 22 which are illustrated schematically in FIG. 5. The power assemblies 22 are hydraulic rams which are attached to the elongated channel 17 and to the U-shaped support plate 19a in order to move the entire clamp assembly 19 longitudinally of the elongated track portion 17a for a limited distance. The limited distance is controlled by the length of the hydraulic cylinder of the power ram 22 as is well known in the art. The clamp assemblies 19 and 20 cooperate to move a pipe length P along the elongated channel 17 in a manner that is well known in the art.

The elongated channel 17 is supported by connected beams 17b and 17c which cooperate with the channel 17 to form a triangularly-shaped frame which is supported by a plurality of connecting supports 17d.

A gear wheel 23 is mounted onto the channel 17 for rotation therewith about pivotal connecting pin assembly 18 and a gear drive assembly 24 is mounted onto tower 16a and includes a driving gear engaging the gear wheel 23 whereby rotation of the driving gear causes rotation of the channel 17. The drive gear assembly 24 may be powered by any suitable means such as hydraulic motors or internal combustion motors as desired. Utilizing the drive gear assembly 24 the elongated channel 17 is movable to practically any angular position.

A load means generally designated as 25 is operably connected to the rock-over tower means 16 and is movable between the pipe pick-up position designated by number 32 (illustrated in solid lines in FIG. 1) and the pipe transfer position designated by number 33 (illustrated in imaginary lines in FIG. 1). The load means 25 includes a triangularly-shaped load frame 26 which is formed of beams 26a, 26b and 26c which are welded or otherwise attached in a generally triangular shaped and supported in such shape or configuration by supporting members 26d. The load frame 26 has a roller 27 rollably mounted at one end thereof. The load frame 26 is pivotally connected to beam 17c of the frame for channel 17. This pivotal connection is made by any suitable means which will provide the necessary strength to sup-

port pivotal movement of the load frame 26 to and from the platform 11. The pivotal connection may be provided by a pin 27a which extends between supports 27b mounted onto frame beam 17c.

A pipe receiving means generally designated as 28 is pivotally mounted onto the load frame 26 in order to receive a pipe length P and align the pipe length P with the elongated channel 17 of the rock-over tower means 16. The pipe receiver means 28 includes a base 28a pivotally attached to load frame beam 26b by a pivotal connection 28b. Pivotally movable, spaced jaws 29a and 29b are mounted onto the base 28a. The jaws 29a and 29b may be of any suitable structure including a structure similar to that of the axial movable clamping assemblies 19 and 20. Thus the jaws 29a and 29b may be opened to receive a pipe length P and there after closed to hold the pipe length P in position while the load means 25 moves upwardly in the direction of arrow 34 to position the pipe length P in alignment with the elongated channel 17 of the rock-over means 16. The pivotal movement of the base 28a with respect to the load frame 26 is controlled by hydraulically operated piston and rod combination 30 which is pivotally connected to load frame beam 26b and to pipe receiving base 28a. The hydraulic cylinder assembly, which of course, is powered hydraulically, may be utilized to pivot base 28a and thus the pipe length P mounted in the jaws 29a and 29b to practically any desired angular position.

A lift means generally designated as 31 is operably mounted on the channel frame beams 17b and 17c and extends into lifting engagement with the load frame 26 for moving the load means 25 between the pipe pick-up position, which is designated 32 and the pipe transfer position, which is designated 33, in FIG. 1. The lift means 31 is a winch drive which includes a winch reel 31a mounted on supports 31b which are connected to channel frame beams 17b and 17c. A cable 31c is wound onto the winch reel 31a and extends over a rotatably mounted pulley assembly 31d that is attached to end 17e of elongated channel 17. The cable 31c extends over a second pulley 31e, which is rotatably mounted onto the load frame 26 at the point of connection of load frame beams 26b and 216c. The cable 31c extends about the pulley assembly 31e and is fixedly attached to end 17e of the elongated channel 17. Suitable power means (not shown) are provided for winding the winch reel 31a such that the entire load means 25 can be moved between the pipe pick-up position at 32 and the pipe transfer position at 33 in FIG. 1.

In operation and use of the apparatus A, the platform 11, which may be a floating drilling platform, is moved to a desired position and, one or more platform legs are jacked or otherwise moved downwardly to the ocean floor. Due to the extreme depth of the water in some areas offshore, it is necessary to provide a cluster of piles about one or more of the platform legs. The apparatus A of the preferred embodiment of this invention is provided for transferring pipe lengths P from the storage area on the platform 11 to a submerged position at least partly below the water line 12. With the load means 25 in the pipe pick-up position designated as 32, the jaws 29a and 29b are opened and a pipe length P is moved along conveyor rollers 10a into the jaws 29a and 29b of the pipe receiving means 28. The winch reel 31a is then rotated in a counter-clockwise direction in order to wind up the cable 31c thereby

causing the load frame 26 with the pipe length P mounted thereon to pivot about the pivotal connection 27a and move upwardly in the direction of arrows 34 to the substantially vertical, pipe pick-up position 33. If necessary, hydraulic power assemblies 30 are actuated to pivot the pipe length P on base 28a until the pipe length P is aligned with the axis of the elongated channel 17 and the pipe clamp assemblies 19 and 20 mounted thereon. It is to be noted that the pivotally mounted pipe receiving base 28a is positioned substantially horizontally with the load frame 26 in the pipe pick-up position (with roller 27 on the floor of the platform 11) in order to receive the pipe length P which has been stored in a horizontal position.

With the pipe P and the load means 26 itself in the pipe transfer position designated as 33, the pipe clamp assemblies 19 and 20 are utilized in a well-known manner to move the pipe P onto the elongated channel 17. Briefly, this movement of the pipe length P axially with respect to the channel 17 onto the channel 17 is accomplished in the following manner. Pipe clamp assemblies 19 are opened in order to receive the pipe length P at least partially onto the elongated channel 17. Thereafter, the pipe clamp assemblies 19 are closed and the pipe clamp assemblies 20 are opened and the pipe clamp assemblies 19 are moved axially to move the pipe length P further onto the elongated channel 17. The alternate opening and closing of the clamp assemblies 19 and 20, with the closed clamp assembly set moving the pipe length P axially onto the elongated channel 17, is continued until the pipe is moved entirely onto the channel 17. In this position, the pipe length P is ready to be released for movement to a submerged position at least partly below the water line 12. It might be mentioned that if the pipe length P, which is now mounted onto the elongated channel 17, is not in exactly the proper position for release, that the gear drive assembly as schematically represented at 24 may be actuated to rotate gear wheel 23 thereby rotating the elongated channel 17 and pipe length L mounted there until the desired angular position is obtained.

The platform 11 includes a hydraulically actuated pipe slip assembly generally designated as 35 which cooperates with the pipe clamp assemblies 19 and 20 to control the movement of the pipe length L downwardly to a submerged position. The hydraulic slip assembly 35 includes slips 35a and 35b which are hydraulically controlled by hydraulic cylinder assemblies 36a and 36b, respectively. Thus, in order for the pipe length L mounted in the pipe clamp assemblies 19 and 20 to be positioned for release to a submerged position, it is necessary that the lower end of the pipe length P be aligned for lowering between the hydraulically controlled platform slips 35a and 35b.

The pipe length P is gradually released downwardly from the substantially vertical position through the platform slip assembly 35 by means of the pipe clamp assemblies 19 and 20. The pipe clamp assemblies 19 and 20 cooperate to move the pipe length P downwardly through the pipe slip assembly 35 in a well-known manner. For example, one of the sets of pipe clamp assemblies such as 19 are loosened and the other set of pipe clamp assemblies 20 are hydraulically actuated to move axially with the pipe length P attached thereto and axially moved therewith. Then, the pipe clamp assemblies 19 are locked into engagement with the pipe length L and the clamp assemblies 20 are loos-

ened and the pipe length L is again moved through a certain distance, which is determined by the size and stroke of the hydraulic power rams 22. This alternate locking of the clamp assemblies 19 or 20 against the pipe length L and axial movement thereof gradually releases the pipe length L into the water below the water line 12.

It is entirely possible that the situation will arise where the depth of the water below the drilling platform 11 may be greater than one or more pipe lengths P. In this case, a second pipe length P is moved from the storage area 10 upwardly to the transfer position 33 for the load means 25 and is transferred onto the elongated channel 17 of the rock-over tower means 16. The second pipe length P is then rotated with the elongated channel 17 until it is in position for release downwardly through the platform slip assembly 35. The pipe length P is then released downwardly until it comes into engagement with the already submerged first pipe length P. The pipe lengths are then welded or otherwise attached to form a pile column. Whenever sufficient lengths of pipe have been aligned and welded or otherwise attached to each other to form a column which extends above the water line 12, the pile driving apparatus of FIG. 6 is then utilized to drive the pile column into the ocean floor. This operation can be repeated until a cluster of piles surrounds the platform leg thereby supporting the platform firmly in spite of the tremendous depth of the water and high seas.

The pipe laying apparatus B of FIG. 2 is basically similar in structure to the pipe transferring and positioning apparatus A of FIG. 1 and operates in the following manner. The entire apparatus B is mounted onto a barge 15 or the oil well drilling platform 11. In the pipe laying apparatus B, a slip assembly 37 is mounted on the lower end of the elongated channel 17 by supports 37a; the slips are schematically represented at 37b and 37c and are used to support that portion designated as U of an underwater pipeline which has already been fabricated. The underwater pipe line U extends downwardly into the ocean and to the bottom thereof. The apparatus B may be utilized to lay an underwater pipeline utilizing extremely long, extremely heavy pipe lengths P which are moved from a substantially horizontal position in the barge storage area 14 to the sloped or inclined position of the rock-over tower means 16 as illustrated in FIG. 2 in the following manner. The load means 25 is moved or lowered to the pipe pick-up position which may be designated as 38 and is illustrated in broken lines in FIG. 2. In the pipe pick-up position 38, a pipe length p can be moved over storage area rollers 14a onto the pipe receiving base 28a and the pipe jaws 29a and 29b are then moved into gripping engagement with the pipe length P. Thereafter, the winch reel 31a is rotated in a counter-clockwise direction to wind the cable 31c thereon thereby lifting the entire load means 25, which includes the load frame 26 and the pipe receiving means 28 with the pipe length P mounted thereon, upwardly to the pipe transfer position of FIG. 2, which may be designated by the number 39 and is illustrated in solid lines. With the load frame 26 of the load means 25 in the pipe transfer position 29, the angular position or angle of inclination of the pipe length P mounted in jaws 29a and 29b can be adjusted by operation of hydraulic cylinder assembly 30.

With the pipe length P aligned with that portion of the underwater pipeline U which is being held by the

pipe clamp assemblies 19 and 20, the pipe length P may be released slightly by jaws 29a and 29b until end P' of the pipe length P abuts end U' of the already fabricated pipeline U. Then, the abutting ends U' and P' may be welded together. Thereafter, the axially mounted pipe clamp assemblies 19 and 20 are alternately actuated to lower more of the underwater pipeline U under the water until the now connected pipe length P is being held within the clamp assemblies 19 and 20. The load means 25 is then ready to be moved downwardly to the pick-up position 38 in order to receive another pipe length P for movement upwardly to the transfer position 39 in alignment with that portion of the pipeline U which is being held and supported within clamp assemblies 19 and 20 mounted on the elongated channel 17.

The pipe positioner apparatus B of FIG. 2 has been described in operation such that the pipe length P is welded to the already fabricated portion of the underwater pipeline U being held by the rock-over tower means 16 prior to release of the pipe length P by the jaws 29a and 29b. It should be understood that it is within the scope of this invention to make the weld or other connection between the end U' of the already fabricated pipeline U and the pipe length P at some other point. For example, end U' of the underwater pipeline U may be supported only by some portion of the clamping assemblies 19 and 20 or the pipeline may only be supported by the slip assembly 37. In either event, it would be necessary to release the pipe length P from the transfer position 39 and move the pipe length P onto the elongated channel 17 until end P' thereof abuts end U' of the pipeline. Then, the weld or other connection between the already fabricated pipeline U and the new pipe length P is made and the clamping assemblies 19 and 20 gradually release the newly added pipe length P downwardly to a lower position along elongated track 17 so that another new pipe length P can be received from the load means 25. It is further noted that the angular position or slope of the portion of the underwater pipeline U being held by the clamping assemblies 19 and 20 is quite adjustable just as the angular position of the pipe length P being held in jaws 29a and 29b of the load means 25 is entirely adjustable.

Referring to FIG. 4, apparatus generally designated as C is provided for positioning a pipe length P for movement downwardly to a submerged position in a manner similar to FIG. 1. The pipe positioner C is mounted on a platform 40, which may be a drilling platform, and is utilized to move pipe lengths P from the horizontal position of the pipe length P' to a substantially vertical position in alignment with the platform pipe slip assembly 41. A rock-over tower means 42 includes laterally spaced, inverted V-shaped towers 42a. The towers 42a (only one of which being shown in FIG. 4) are mounted for rolling movement along the platform 40 by any suitable means such as roller assemblies 43. An elongated channel 44 identical to the elongated channel 17 is mounted for pivotal movement with respect to the towers 42a by a pin assembly 45. A sprocket gear 46c is mounted for rotation with pin assembly 45 and with elongated channel 44. A hydraulic ram 46 is pivotally mounted onto leg 42b of the towers 42a and a hydraulic ram 47 is mounted onto leg 42c of towers 42a. The ram 46 includes a cylinder portion 46a which is pivotally mounted to tower leg 42b and a piston and rod combination 46b. Similarly, the ram 47 in-

cludes a cylinder 47a pivotally attached to leg 42c and a piston and rod combination 47b. The piston and rod combinations 47b and 46b are connected to a chain drive 48 which extends over and into operative engagement with the gear teeth on the sprocket wheel 46c. In this manner, the coordinated movement of the piston and rod combination 47b in the direction of arrow 49 and movement of the piston and rod combinations 46b and 47b of the rams 46 and 47, respectively, is accomplished by utilization of any suitable hydraulic fluid power source (not shown). A plurality of pipe clamp assemblies 51 and 52, which are identical to the axially mounted pipe clamp assemblies such as 19 in FIG. 5, are mounted for axial movement along the elongated channel 44. A pipe slip assembly 53 is mounted on supports 53a at end 44a of the elongated channel 44. Slips 53a of the slip assembly are movable into and out of engagement with a pipe length P by any suitable means such as hydraulic cylinders.

A lift means generally designated as 54 is mounted onto the platform 40 in order to move a pipe length from the horizontal position of the pipe length P' upwardly off of the platform 40 to a transfer position generally designated by the number 55. The lift means 54 includes an arm 54a pivotally mounted at 54b to the platform 40 for pivotal movement between the horizontal position illustrated in broken lines and the transfer position 55. Arm 54a is movable between such positions by means of a hydraulic power cylinder assembly 56 which includes cylinder 56a pivotally attached to the platform 40 and piston rod 56b pivotally attached to the arm 54a. By the use of hydraulic fluid under pressure, the lift arm 54 is pivoted upwardly in a counter-clockwise direction to the transfer position 55, which is shown in solid lines. A pipe receiving means generally designated at 57 is mounted onto the lift arm 54 and is identical to the pipe receiving means 28 of the apparatus A and B; therefore, like numbers and letters will be used to describe like parts. With the lift arm 54a in the position shown in broken lines, the jaws 29a and 29b of the pipe receiving means 57 are open to allow the pipe length P' to be moved horizontally in the direction of the arrow 58 onto the pipe receiving jaws 29a and 29b. Then the jaws 29a and 29b, which are well-known in the art, are closed. The lift means 54 is now ready to move the pipe length P' to the transfer position generally illustrated by the number 55. Movement of the lift arm 54a is accomplished by actuation of the hydraulic power assemblies 56 thereby causing the lift arm 54a to be moved upwardly, rotating in a counter-clockwise manner to the position designated at 55. The pipe length P being held by the jaw members 29a and 29b in the transfer position is then aligned with the elongated channel 44 of the rock-over tower means 42. Angular alignment of the pipe length P being held by the jaws 29a and 29b is accomplished by actuation of hydraulic power cylinder assemblies such as 59 which are attached between the lift arm 54a and pipe receiving base 28a. In this manner, the position of the pipe length P is angularly adjusted such that the pipe length P being held in the transfer position 55 is aligned to be moved into the elongated channel 44. Movement of the pipe length P from the transfer position 55 onto the elongated channel 44 is accomplished by utilizing the axially mounted, pipe clamp assemblies 51 and 52 to pull the pipe length P in the direction of arrow 60 onto the elongated channel 44 in a well-known manner.

After the pipe length P is positioned onto the elongated channel 44 as shown in broken lines in FIG. 4, the power rams 46 and 47 are activated to rotate the elongated channel 44 in a counter-clockwise direction to a position wherein the pipe length P being held by the pipe clamp assemblies 51 and 52 is aligned with platform slip assembly 41. In the substantially vertical position for the pipe length P being held by the clamp assemblies 51 and 52, the pipe length L is ready to be gradually released by alternate operation of the pipe clamp assemblies 51 and 52 and lowered through the platform pipe slips 41 to a submerged position in the water in a manner similar to that described with respect to the apparatus A of FIG. 1. By utilizing the apparatus C of FIG. 4, pipe lengths P can move from a storage position on the platform 40 to a submerged position partly or completely below a body of water. And, the apparatus C can be used in a manner similar to the apparatus of FIG. 1 to drive a plurality of pile columns about a leg (not shown) of the platform 40.

The pile driving apparatus generally designated as D of FIG. 6 is utilized to drive pile columns into the bottom of the ocean after such pile columns have been set by either the apparatus A or the apparatus C. The pile driving apparatus D includes an inverted V-shaped mast structure 60 that includes structural legs 60a and 60b which converge to a roof plate 61. The mast legs 60a and 60b have rollers 62 mounted on the bottom thereof such that the entire apparatus D is movable along the platform 11. A pile driving mechanism generally designated as 63 includes a guide sleeve 64 which is attached to the underside 61a of the roof plate 61 and extends downwardly such that lower end 64a thereof is only slightly above the upper end of the pipe P in the substantially vertical release position illustrated in real lines in FIG. 1. A pile driving hammer 65 is mounted within the sleeve 64 and is moved upwardly and downwardly in hammering strokes by any suitable power means such as 66, which may be a diesel operated or steam operated motor/winch means for pulling the hammer 65 to the top of the sleeve 64 so that it may be released downwardly to drive a pipe length P (or a pile column, not shown) downwardly to the ocean floor. The exact power source for the operation of the pile drive hammer 65 will not be described in further detail since such power sources are very well known in the art and any suitable power source may be utilized to operate the pile driving hammer 65. Of course, the pile driving apparatus D of FIG. 6 can be utilized to drive a pipe length held by the apparatus C of FIG. 4. When a pipe length P has been used to form a pile driving column utilizing the apparatus of FIG. 4, the mast 60 mounted on the platform 40 is rolled into position above the pipe length held by the clamping assemblies 51 and 52 of the rock-over tower means 42 and the pile driving apparatus D is used as previously discussed.

Various load means have been disclosed for loading a pipe length L by moving such pipe length from a platform loading area. For example, in the embodiment of the apparatus A illustrated in FIG. 1, the load means 25 raises a pipe length P from the platform storage area 10a upwardly to a substantially vertical position as shown in broken lines from which the pipe length P is transferred onto the elongated channel 17 of the rock-over tower 16. Similarly, in FIG. 2 the load means 25 is utilized to move the pipe length P from the barge storage area 14 upwardly to the inclined position illus-

trated in real lines and defined by the number 39. In FIG. 4, the load means 54 is provided for raising a pipe length from the horizontal position of pipe length P' upwardly to the pipe transfer position generally designated by the number 55, which is in alignment with the elongated channel 44 of the rock-over tower means 42. Of course, as described herein, from the transfer position above the platform or barge, the pipe length P is moved onto the rotatably mounted elongated channel (17 for apparatus A and B and 44 for apparatus C).

In an alternate embodiment of this invention illustrated in FIG. 3, apparatus E is provided for lifting a pipe length P upwardly from the deck of a platform or barge 70 and onto either the elongated channel 17 of apparatus A and B or the elongated channel 44 of apparatus C. The apparatus E is an elevator means and includes laterally spaced inverted V-shaped support structures 71 and 72 which are interconnected by beam structure 73. The entire elevator means E is mounted for rolling movement along the deck of the platform or barge 70 by means of rollers 73 attached to each of the legs such as 71a of the support structures. The platform or barge 70 may have tracks 70a in the deck thereof to receive the rollers and guide the entire elevator means during movement along the deck.

An arcuately shaped hook 74 is mounted for sliding movement upwardly and downwardly of the leg 71a of the support structure 71 by means of cable 75. Similarly, another arcuately shaped hook 76 is mounted for movement upwardly and downwardly of leg 72a of support structure 72 by means of cable 77. The cable 75 extends over a pulley arrangement 75a at the apex of support structure 71 and downwardly into operative engagement with a winch drive system 78. Similarly, the cable 77 extends over a pulley arrangement 77a and into operative engagement with a winch drive system 79. Coordinated winding and unwinding of the cables such as 75 onto the winch power system such as 78 will cause the slidably mounted, arcuately shaped hooks 74 and 76 to move upwardly and downwardly of the support structures 71 and 72. In operation and use of the elevator means E, the arcuately shaped hooks 74 and 76 are lowered to the bottom of the support structures 71 and 72 and a pipe length P is moved onto the hooks. The winch drive systems 78 and 79 are then activated to wind up cables 75 and 77, respectively, in coordinated movement thereby lifting the pipe length P upwardly. The pipe length P actually continues upwardly movement until it actually goes over the pulley systems 75a and 77a and rolls onto the rock-over tower means of apparatus A, B or C. Of course, in order for the elevator means E to work properly, the rock-over tower means, such as the rock-over tower means 16 of the apparatus A, must be positioned such that the elongated channel 17 is adjacent the support structures 71 and 72 and in position to receive the pipe P as it is pulled over the apex pulley arrangements 75a and 77a. The elevator means E may be used as a substitute for the various load means for the apparatus A, B or C as desired or as conditions necessitate.

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

It should be understood that the apparatus of the various embodiments of this invention have been disclosed as being usable for transferring extremely long, extremely heavy pieces of pipe for use either in laying pipe underwater or in driving pile columns. Therefore, the movement of such very large and heavy pieces of pipe will require exercise of engineering skill in choosing materials and sizes of materials to support the extremely long, heavy pipe lengths. It is within the scope of this invention to use any suitable material of any suitable size which will provide the structures and perform the functions described herein. It is further within the scope of this invention to use the elevator means E with any of the apparatus A, B, or C. Further, the rock-over tower means 42 of apparatus C for pivoting a pipe length may be utilized instead of the rock-over tower means 16 for the apparatus A or B. Conversely, the rock-over tower means 16 of the apparatus A may be used in the apparatus C of FIG. 4 in cooperation with the lift means 54 illustrated therein. Further, any other combination of the various elements of this invention is considered within the scope of this invention so long as pipe lengths P are moved from a stored position (which may be substantially horizontal) to an inclined or substantially vertical position.

It should be further understood that the pipe lengths P have been disclosed as being rotated by the various rock-over tower means such as the rock-over tower 16 in the apparatus A to rather specific angular positions with respect to the horizontal or the water line 12; it is within the scope of this invention to utilize the rock-over means such as 16 of the apparatus A to move a pipe length P to any angular position desired.

The various apparatus of the various embodiments of this invention have been disclosed as being used to move pipe lengths L. As previously mentioned, it is within the scope of this invention to move not only tubular members such as pipe lengths, but also to move any elongated member which cannot be efficiently and safely handled by the more conventional and known types of transfer equipment.

I claim:

1. Apparatus for positioning piles and laying pipe by transferring a tubular member such as pipe from a platform or other support area to a submerged position at least partly underwater, comprising:

a platform;

a pipe positioner means including support frame means mounted on said platform and track means mounted with said support frame means for receiving and positioning pipe for movement to said submerged position;

load means mounted on said platform for loading pipe onto said pipe positioner means;

said load means being pivotally movable between a pipe pick-up position in which pipe is picked-up and a transfer position in which pipe is transferred onto said pipe positioner means;

said load means including pipe receiving and alignment means for receiving pipe with said load means in said pick-up position and pivoting pipe with respect to said load means to align the pipe with said pipe positioner means for loading said pipe onto said pipe positioner means with said load means in said transfer position; and

pipe release means for releasing the pipe from said pipe positioner means for movement of said pipe to said submerged position.

2. The structure set forth in claim 1, further including:

transfer means for transferring said pipe from said load means in said transfer position to said pipe positioner means.

3. The structure set forth in claim 2, wherein:

said load means includes a load frame;

connection means for pivotally connecting said load frame to said pipe positioner means; and

lift means for pivoting said load frame between said pipe pick-up position and said pipe transfer position.

4. The structure set forth in claim 1, wherein said pipe positioner means includes:

means for pivoting said pipe from a transfer position, in which said pipe is transferred from said load means, to a release position, from which said pipe is releasable for movement to said submerged position.

5. The structure set forth in claim 4, wherein:

said pipe positioner in said release position holds said pipe in a substantially vertical position for movement to said submerged position.

6. The structure set forth in claim 1, wherein said load means includes:

a load frame having mounted thereon pipe receiving means;

connection means pivotally connecting said load frame to said support frame of said pipe positioner; lift means for pivoting said load frame between a pipe pick-up position and a pipe transfer position.

7. The structure set forth in claim 6, wherein:

said lift means includes a winch assembly operatively connected with said pipe track and with said load frame for pulling said load frame to said pipe transfer position.

8. The structure set forth in claim 1, wherein said load means includes:

laterally spaced towers;

elevator means mounted with said towers for raising said pipe from a stored position onto said pipe positioner means.

9. The structure set forth in claim 1, wherein said load means includes:

a lift arm pivotally mounted on said platform; and power means for moving said lift arm to a raised position.

10. The structure set forth in claim 1, wherein said pipe positioner means includes:

a. a support frame mounted on said platform;

b. a pipe track mounted with said support frame for receiving pipe;

c. pivot means mounting said pipe track for pivotal movement; and

d. said pivot means including adjusting and holding means mounted with said pipe track for adjusting said pipe track to any desired angular position between a substantially horizontal position and a vertical position and for firmly holding said pipe track in said desired position.

11. The structure set forth in claim 10, wherein:

said adjusting and holding means includes gear means mounted with said pipe track and said support frame for rotating said pipe track.

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12. The structure set forth in claim 10, wherein:
 said adjusting and holding means includes a sprocket
 wheel means attached with said pipe track and a
 hydraulically operated chain assembly operatively
 engaging said sprocket wheel means for rotating 5
 same.

13. The structure set forth in claim 10, wherein said

pipe release means includes:
 a plurality of pipe jaws; and
 axial means mounting said jaws on said pipe track for
 axial movement with respect thereto for moving
 pipe along said pipe track.

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