Nov. 8, 1960 M. H. PARKS 2,959,016

OFFSHORE APPARATUS AND METHOD OF INSTALLING SAME

Filed Oct. 21, 1957 2 Sheets-Sheet 1

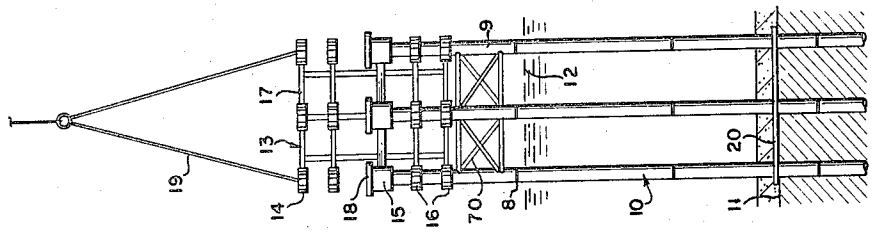


FIG. 5.

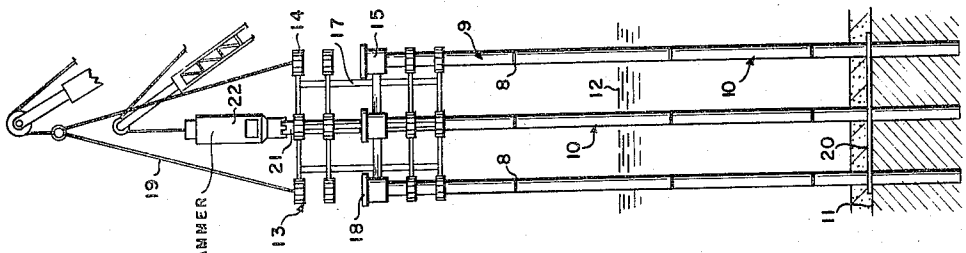


FIG. 4.

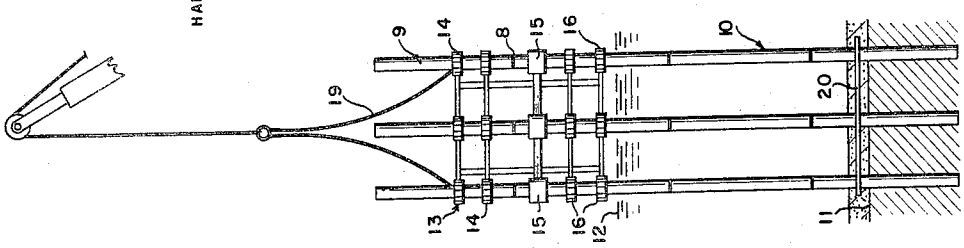


FIG. 3.

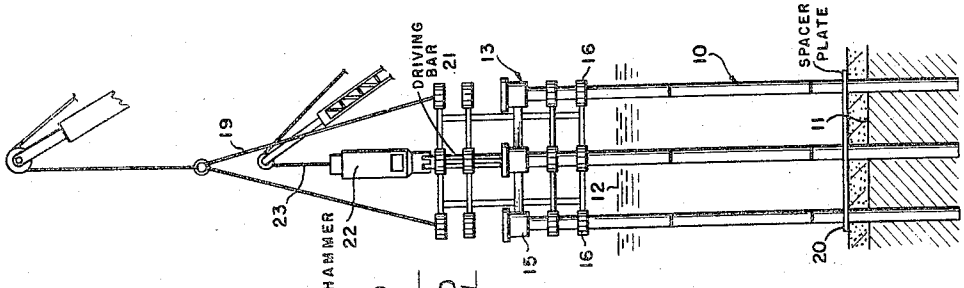


FIG. 2.

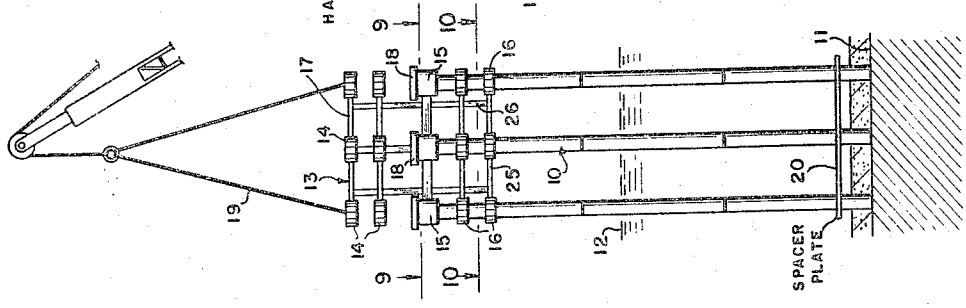


FIG. 1.

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OFFSHORE APPARATUS AND METHOD OF INSTALLING SAME

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FIG. 9.

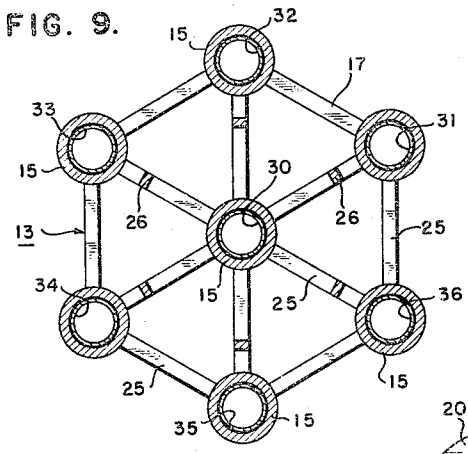
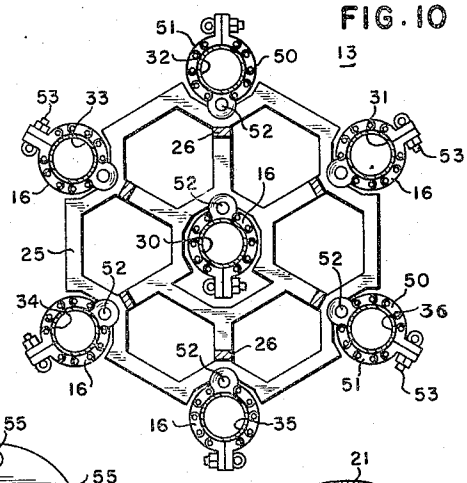


FIG. 10



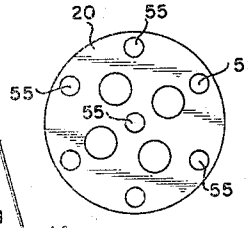


FIG. 12.

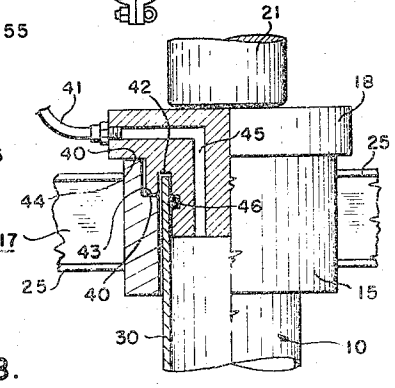


FIG. 11.

FIG. 6.

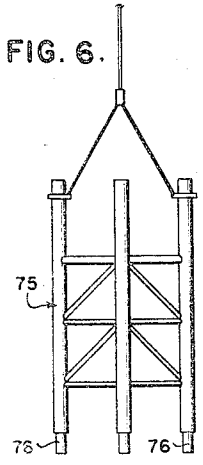


FIG. 7.

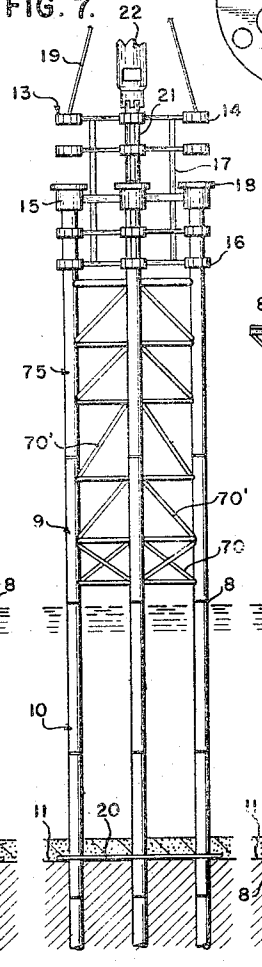
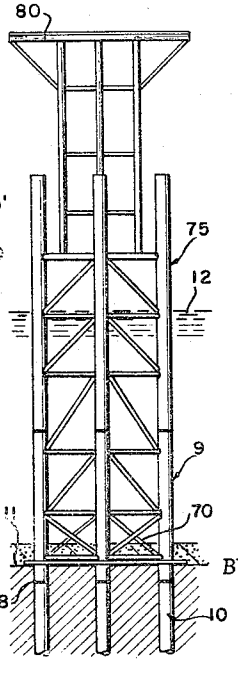
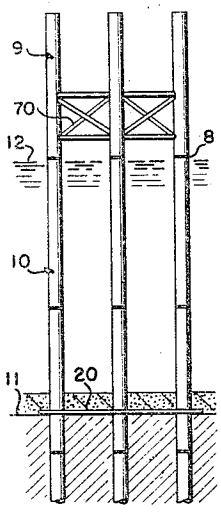


FIG. 8.





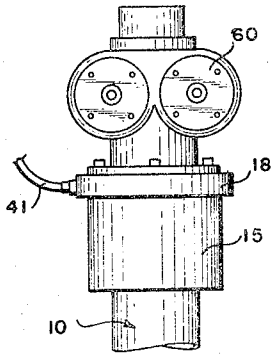


FIG. 13.

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OFFSHORE APPARATUS AND METHOD OF INSTALLING SAME

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14 Claims. (Cl. 61—63)

This invention concerns well drilling installations and particularly marine well drilling installations.

The invention is especially concerned with apparatus and method for setting multiple self-supporting tubular members or pipes, which members may serve as surface casing strings for supporting drilling well heads or as support for a drilling platform for drilling and servicing wells or as both casing strings and a drilling platform support.

Surface casing and platform legs are normally separate and distinct pipes. Thus, this invention saves the expense of purchasing surface casing and obviates the effort of driving individually the surface casing for wells to be drilled. Also, in the template-type construction the platform legs are concentric pipes. This invention saves one set of the two concentric legs.

The invention, in brief, provides apparatus for setting a plurality of spaced-apart, vertically extending tubular members which includes lower clamping means adapted to grip the tubular members; driving means adapted to engage the tubular members; upper guide clamping means adapted to align the tubular members; a frame interconnecting said lower clamping means, driving means and upper clamping means; and means operatively connecting with the driving means adapted to drive the tubular members downwardly. The invention also contemplates employing washing means for flowing fluid down the tubular members and out the lower open ends thereof.

The invention also encompasses a method for installing offshore structure comprising the steps of positioning initial sections of a plurality of horizontally spaced, vertically extending hollow tubular members adjacent the earth, driving said initial sections of tubular members into the earth simultaneously, attaching intermediate sections of a plurality of horizontally spaced, vertically extending hollow tubular members to said initial sections of tubular members, driving said intermediate sections of tubular members downwardly until the lower ends of said initial sections of tubular members have reached a selected or predetermined depth in the earth, attaching final sections of a plurality of horizontally spaced, vertically extending hollow tubular members to said intermediate sections of tubular members, said final sections of tubular members being provided with interconnecting bracing means and then driving said final sections of tubular members downwardly until the lower ends of said final sections of tubular members are arranged adjacent the earth. The intermediate sections may be omitted if the initial sections reach the selected or predetermined depth. Also, the number of intermediate sections used will depend upon the depth of penetration desired.

While driving the tubular members downwardly fluid may be washed down the interiors of the tubular members and out the lower ends of the initial sections of tubular members in order to minimize the driving effort.

Thus, an object of this invention is to provide method and apparatus for setting multiple self-supporting tubular members.

This and other objects of the invention will be apparent from the following description taken in conjunction with the drawings wherein:

Fig. 1 is a vertical view of the apparatus of the invention positioned in one stage of the method of installation;

Figs. 2 through 8 are views similar to Fig. 1 illustrating subsequent stages of the method of installation;

Fig. 9 is a view taken on lines 9—9 of Fig. 1;

Fig. 10 is a view taken on lines 10—10 of Fig. 1;

Fig. 11 is a vertical view, partly in section, of a driving head and connected apparatus;

Fig. 12 is a plan view of a spacer element; and

Fig. 13 is a vertical view of a driving means connected to a driving head.

In Fig. 1 is shown a cluster of tubular members generally designated **10**, the lower ends of which are positioned adjacent land **11** underlying a body of water, designated **12**. A driving assembly, generally designated **13**, and including upper clamps **14**, drive heads **15**, and lower clamps **16** connected together by means of framework **17** is arranged adjacent the upper ends of the tubular members. Each of the drive heads **15** is provided with a drive and wash flange **18**. A sling **19** connects driving assembly **13** to a winch or other type hoisting means, not shown. A spacer plate **20** is arranged on the tubular members **10**, adjacent their lower ends.

As seen more clearly in Figs. 9 and 10 the cluster of tubular members **10** includes a center tubular member **30** radially spaced from a plurality of surrounding, circumferentially spaced tubular members **31** through **36** inclusive. Each of the tubular members has associated therewith a drive head **15** and a pair of upper clamps **14** and a pair of lower clamps **16** (Figs. 1 to 8).

As seen in Fig. 2, a driving bar **21** is arranged in the clamps **14** which are aligned with the center tubular member **30**. Driving bar **21** engages the drive flange **18** of the drive head **15** associated therewith and embracing tubular member **30**. A reciprocating hammer such as a steam hammer **22** or other suitable driving means is connected to driving bar **21**. Hammer **22** is connected by means of cable **23** to a winch or other suitable supporting and hoisting means, not shown.

Frame **17** includes horizontal braces **25** and vertical braces **26** which serve to inter-connect the clamps and driving heads into a unit (Figs. 1 to 8). It will be understood that although other structural bracing such as diagonal bracing is desirable it has been omitted for reasons of clarity.

The drive head **15** associated with tubular member **30** is seen more clearly in Fig. 11 and, as shown, is cylindrically configured and formed to provide a shoulder **40** adjacent the upper end thereof. Drive flange **18** is also cylindrically configured and formed to provide a recessed portion **42** and shoulders **43** and **44**. A tubular member such as center tubular member **30** is arranged in the recess **42**; shoulder **43** engages with shoulder **40**; and shoulder **44** engages with the upper surface of the drive head when the drive flange, drive head, and tubular member are in operative position. Driving bar **21** engages the upper surface of drive flange **18**. Drive flange **18** is also formed to provide a conduit or passageway **45** which passageway fluidly communicates a conduit **41** connected to the exterior of drive flange **18** and the interior of the tubular member when the drive flange is arranged on the drive head **15** and tubular member **30**. Each of the various driving flanges is provided with such a fluid introduction means. Each of the conduits **41** is connected to a source of fluid pressure such as a pump, not shown. Also, a sealing means such as O-ring seal **46** is arranged on drive flange **18** and is adapted

to seal off the annulus between drive flange 18 and the interior surface of the tubular member 30, as shown.

As seen more clearly in Fig. 10, clamps 16 are arranged in the same configuration as drive heads 15. Any desired type clamps may be used. Essentially each clamp comprises semi-cylindrical members 50, 51 provided with pipe gripping surfaces, hinged as at 52 to the framework 17 and adapted to be locked together by means of the bolt assembly 53. Upper clamps 14 are constructed the same as and are aligned with lower clamps 16.

Spacer plate 20 is seen more clearly in Fig. 12 and as shown constitutes a circular plate provided with a plurality of openings 55 through which the tubular members 10 are adapted to extend. The spacer plate 20 serves to keep the lower ends of the tubular member aligned with and spaced the same as the upper ends held in the driving assembly 13.

It is to be noted that clamps 14 and clamps 16 are shown in vertically aligned pairs. Although two sets or groups of clamps 14 and clamps 16 are shown, any number may be used. Also, although the cluster of tubular members 10 is shown as in a pattern of 7, any number greater than one may be used.

Instead of a pile driver, described supra, other type driving means may be employed. For example, in Fig. 13 is shown a vibrator assembly 60 secured directly to flange 18. The vibrator assembly 60 may be of the type wherein contra-rotating eccentric fly wheels are mounted in bearings attached by springs to drive flange 18. Because the fly wheels are contra-rotating, the horizontal components of the force exerted cancel and the vertical forces add. The vibrating assembly 60 includes a variable speed electric motor or other variable speed power source.

For a detailed account of the operation of the invention reference is made to Figs. 1 through 8. A cluster, designated 10, of seven tubular members (Fig. 9 and Fig. 10) of even lengths are assembled in driving assembly 13 in a horizontal position either at the well situs or at a shore installation. The proper desired spacing between the lower ends of tubular members is maintained by means of a spacer plate 20. Spacer plate 20 may be tack welded to one or more of the tubular members so that it may be jarred loose and slide along the tubular members as they are driven downwardly when the driving operation commences. These tubular members may constitute the lower sections of surface casings to be installed. The individual tubular members may be welded together to form any desired length. In Fig. 1 three lengths are shown. Sling 19 is then secured to frame 17 and driving assembly 13 and attached tubular members then are picked up by means of the sling 19 and the hoisting mechanism and placed on bottom adjacent the earth 11 underlying water 12 (Fig. 1). Either before or after positioning of the tubular members on the bottom, driving assembly 13 is manipulated to position driving heads 15 adjacent the upper ends of the tubular members 30 through 36, inclusive. Lower clamps 16 are then clamped to the tubular members and the driving flanges 18 are arranged on the individual tubular members and driving heads 15, as illustrated for a single tubular member in Fig. 11. Spacer plate 20 may be made sufficiently large so that it will remain at the mud line or earth line and serve as a guide for the initial sections of tubular members and for the sections that are to follow (Figs. 1 to 8).

Driving bar 21 is then positioned through the set of guides 14 associated therewith to adjacent the top of the center drive flange 18. The cluster of tubular members 10 is driven downwardly until the upper ends thereof are located just above the water level, as seen in Fig. 2. To add new sections of casing or tubular members, drive flanges 18 are removed from drive heads 15 and the entire driving assembly is lowered on the tubular members until the upper ends of these lower sections of tubular members protrude above drive heads 15. Clamps 16 are then set on the tubular members and sling 19 is slacked off, as seen in Fig. 3. New sections of even lengths of tubular members or casings 9 are then placed through the upper clamps 14 until the new and the previously set tubular members 10 abut. These sections are then welded together, as indicated at 8 in Fig. 3.

Lower clamps 16 are then loosened and the driving assembly is raised to the driving position as shown in Fig. 1; that is, it is raised until drive heads 15 are positioned adjacent the upper ends of the new sections of tubular members or casings 9. Drive flanges 18 are then replaced onto the driving heads 15 and tubular members. Driving bar 21 and pile driver 22 are then repositioned to engage driving bar 21 and center drive flange 18, as seen in Fig. 4.

The driving bar and hammer then are actuated to drive the tubular members downwardly to a new position, wherein driving assembly 13 is again located just above water level as seen in Fig. 5. This operation is repeated with new sections of tubular members until a predetermined penetration is reached. Then before driving assembly 13 is removed, the tubular members last added are braced by supports or struts 70. This bracing is made in order to insure that the upper ends of the tubular members maintain proper positioning. Hammer 22 and attached driving bar 21 are then removed. Flanges 18 and driving assembly 13 are also removed and an entire section of pre-braced tubular members or casings 75 is then joined to the uppermost tubular members 9 as seen in Fig. 6. Guide or alignment sleeves 76 are provided on the lower ends of tubular members 75 in order to facilitate positioning of tubular members 75 onto tubular members 9. Any desired type of alignment device may be used to facilitate alignment of the new sections of tubular members 75 with the uppermost of the previously driven tubular members. The two sections of tubular members are then welded together. Additional bracing such as 70' (Fig. 7) may then be added if desired. The upper ends of the tubular members 75 are free of bracing in order to permit resetting of driving assembly 13. The braced section 75 is of predetermined length in order to provide bracing for the tubular members from the earth 11 to above sea level (Fig. 8). As seen in Fig. 7, driving assembly 13 then is replaced on the braced cluster of tubular members 75, drive flanges 18 are replaced and pile driver 22 and driving bar 21 are repositioned on the center drive flange. The tubular members are then driven deeper into the subsurface and, as seen in Fig. 8, after reaching a predetermined depth, a drilling or workover platform 80 is positioned on the uppermost cluster of tubular members.

During the driving operations, fluid such as water, drilling mud, air, etc. from a suitable source is injected through conduits 41 and passageways 45 in the drive flanges 18 to the interior of the tubular members. The injection of the fluid into the interiors of the tubular members provides a washing or lubricating effect as the fluid passes out the lower ends of the tubular members and up their outer sides or surfaces. The lubricating effect is calculated to be sufficient to make only a minimum driving effort necessary and yet to cause only a minimum disturbance of the sediments into which the tubular members are forced.

Platform structure 80 may be used as the main drilling structure or the platform may be employed for servicing the various wells provided by the cluster of casings. Thus, with respect to the drilling of sulphur wells, for example, the platform may be constructed on the cluster of surface casings, which platform may be used for supporting the hot water and air and sulphur manifolds for mining service.

In the event that the multiple tubular members are unable to penetrate to the desired depth in unison, drive flanges 18 are removed and the unitary driving assembly

slipped down until the tops of the tubular members protrude well above it. Then an individual driving assembly and a driving flange are installed on each of the individual tubular members, other than the one or ones first driven to refusal when operating in unison, and each tubular member is washed and driven or vibrated to a final depth. In this type of operation, the last braced section of tubular members may be welded to the upper ends of the previously driven tubular members; however, the cluster of tubular members should be driven no deeper thereafter. Alternatively, the final or last braced section may be provided with tubular members sufficiently large to slip over the tubular sections already driven. By telescoping the tubular members in this manner a double-leg effect from the mud line upward is obtained.

Although driving bar **21** and hammer **22** are shown and described herein as being applied to the center driving head **15** connected to center tubular member **30**, this apparatus may be connected to any one or more of the heads **15**.

Having fully described the method, apparatus, and objects of my invention, I claim:

1. Apparatus for setting a plurality of spaced-apart tubular members comprising a driving assembly including upper and lower sets of clamp means and a set of drive heads arranged therebetween; each of said upper and lower sets of clamp means comprising a plurality of horizontally spaced clamps, said set of drive heads comprising a plurality of horizontally spaced drive heads; said upper set of clamp means, said set of drive heads and said lower set of clamp means being arranged in vertically spaced relationship; each clamp of said upper set of clamp means being vertically aligned with a drive head of said set of drive heads and a clamp of said lower set of clamp means; each of said lower clamps being adapted to grip separately a different tubular member, each of said drive heads being adapted to be positioned upon a different tubular member and each of said upper clamps being adapted to align separately a different tubular member; a frame interconnecting said upper and lower sets of clamp means and said set of drive heads, a drive flange arranged on each of said drive heads, a driving bar arranged on at least one of said drive flanges whereby driving means may be applied to said driving bar for driving said tubular members downwardly, each of said drive flanges being formed to provide a passage adapted to fluidly communicate the interior of said tubular member and the exterior of said drive head, and means connected to said drive flanges adapted to transmit fluid to said passages.

2. Apparatus as recited in claim 1 wherein said driving bar extends through one of said upper clamps.

3. Apparatus as recited in claim 2 wherein the upper and lower sets of clamp means are comprised of a central clamp and a plurality of circumferential clamps secured to the central clamp by means of radial members.

4. Apparatus for setting a plurality of spaced-apart tubular members comprising a driving assembly including a set of clamp means and a set of drive heads; said set of clamp means comprising a plurality of horizontally spaced clamps and said set of drive heads comprising a plurality of horizontally spaced drive heads; each clamp being in vertically spaced relationship below and aligned with one of said drive heads; bracing means interconnecting said set of clamp means and said set of drive heads; said clamps being adapted to grip said tubular members and said drive heads being adapted to be positioned upon said tubular members; and a drive flange arranged on each of said driving heads whereby driving means may be applied to at least one of said driving heads for driving said tubular members downwardly; each of said drive flanges being provided with a passage adapted to fluidly communicate the interior of said tubular member and the exterior of said drive head; and means connected to said drive flanges adapted to transmit fluid to said passages.

5. Apparatus as recited in claim 4 wherein said set of clamp means is comprised of a central clamp and a plurality of circumferential clamps secured to the central clamp by means of radial members.

6. Apparatus for setting a plurality of spaced-apart tubular members comprising a driving assembly including a plurality of lower clamping means adapted to clamp onto said tubular members; a plurality of driving heads arranged above said lower clamping means adapted to be positioned upon the upper ends of said tubular members; a plurality of upper clamping means arranged above said drive heads; said upper and lower clamping means and said driving heads being vertically aligned; bracing means interconnecting said upper and lower clamping means and said driving heads; said upper clamping means being adapted to guide said tubular members, a driving bar extending through at least one of said upper clamping means and connecting with said driving head aligned therewith whereby driving means may be applied to said driving bar for driving said tubular members downwardly simultaneously, said driving bar resting on the driving head vertically aligned therewith.

7. Apparatus for setting a plurality of spaced-apart tubular members comprising a driving assembly including a plurality of clamping means horizontally spaced from each other and a plurality of drive heads also horizontally spaced from each other; each drive head being aligned with and arranged above one of said clamps; bracing means interconnecting said clamps and drive heads, said clamps being adapted to clamp separately each of said tubular members and said drive heads being adapted to be positioned upon said tubular members whereby driving means may be applied to at least one of said drive heads for driving said tubular members downwardly simultaneously.

8. A method for installing an offshore structure utilizing a driving assembly including spaced-apart guide means, drive means, and clamping means, said guide means comprising a plurality of spaced-apart guides, said drive means comprising a plurality of spaced-apart drive heads and said clamping means comprising a plurality of spaced-apart clamps, each guide being aligned with a drive head and a clamp comprising inserting a tubular member of a first section of tubular members in each clamp and drive head aligned therewith, clamping each clamp to the tubular member extending therethrough, then positioning the other end of each of said first section of tubular members adjacent the earth such that the tubular members are spaced substantially horizontally from each other and extend substantially vertically from the earth to above the water, said guide means being above said drive means and said drive means being above said clamping means, driving said first set of tubular members into the earth simultaneously while maintaining said horizontal spacing between the tubular members, releasing said clamping means, lowering said driving assembly on said first set of tubular members until the uppermost ends of said tubular members are positioned between the clamping means and drive means, positioning a tubular member of a second set of tubular members through each guide, attaching each of said second section of tubular members to the tubular member of the first section of tubular members aligned therewith, raising said driving assembly to position said drive means adjacent the uppermost ends of said second section of tubular members, clamping said driving assembly to said second section of tubular members, driving said first and said second sections of tubular members downwardly simultaneously while maintaining the horizontal spacing between the tubular members, releasing the clamping means and removing the driving assembly from said second set of tubular members, attaching a tubular member of a third section of tubular members to each one of said second section of tubular members while main-

taining by bracing means the horizontal spacing between the upper ends of each of said tubular members of the second section of tubular members, the third section of tubular members being provided with interconnecting spacing means, repositioning said driving assembly on said third section of tubular members so that the driving heads are aligned with the uppermost ends of the third section of tubular members, clamping said driving assembly to said third section of tubular members such that the drive means is positioned adjacent the uppermost end of said third section of tubular members and then driving said first, second, and third sections of tubular members downwardly until the lower end of the braced portion of said third section of tubular members is arranged adjacent the earth underlying the water.

9. A method as recited in claim 8 including the step of attaching a platform to the upper ends of the third section of tubular members following the step of driving the tubular members downwardly until the lower end of the braced portion of the third section of tubular members is arranged adjacent the earth underlying the water.

10. A method as recited in claim 9 including flowing into the upper ends of each of said uppermost tubular members and out the lower ends of each of said lowermost tubular members to provide a lubricating effect during the driving steps.

11. A method for installing a drilling site utilizing a driving assembly including spaced-apart drive means and clamping means, said clamping means comprising a plurality of spaced-apart clamps, said drive means comprising a plurality of spaced-apart drive heads, each clamp being aligned with a drive head comprising inserting a tubular member of a first section of tubular members in each clamp and drive head aligned therewith, clamping each clamp to the tubular member extending therethrough, then positioning the other end of each tubular member adjacent the earth such that the tubular members are spaced substantially horizontally from each other and extend substantially vertically from the earth to above the water, said drive means being above said clamping means, driving each tubular member of the first section of tubular members into the earth simultaneously while maintaining the horizontal spacing between the tubular members, releasing the clamping means, lowering said driving assembly until the uppermost ends of said tubular members extend above said drive heads, attaching a tubular member of a second section of tubular members to a tubular member of said first section of tubular members, raising the driving assembly until the drive means is arranged at the uppermost ends of the tubular members of the second section of tubular members, clamping the driving assembly to the second section of tubular members, driving said first and second sections of tubular members downwardly simultaneously while maintaining the horizontal spacing between the tubular members, releasing the clamping means and removing the driving assembly, attaching a tubular member of a third section of tubular members to each one of said second section of tubular members, the third section of tubular members being provided with interconnecting bracing means, attaching the driving assembly to the third section of tubular members adjacent the upper ends thereof, and then driving the first, second and third sections of tubular members downwardly until the lower end of the braced portion of the tubular members is arranged adjacent the earth underlying the water.

12. A method as recited in claim 11 including the step of attaching a platform to the upper ends of the third section of tubular members after driving said tubular members downwardly until the lower end of the braced portion of the third section of tubular members is arranged adjacent the earth underlying the water.

13. A method as recited in claim 12 including flowing fluid into the upper ends of the uppermost tubular members and out the lower ends of the lowermost tubular members during the driving steps.

14. A method as recited in claim 13 including telescoping said third section of tubular members over said second sections of tubular members to obtain a double-leg effect from the earth upwardly.

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