Dec. 7, 1965 D. DE VRIES ETAL 3,221,817

MARINE CONDUCTOR PIPE ASSEMBLY

Filed Sept. 13, 1962 6 Sheets-Sheet 1

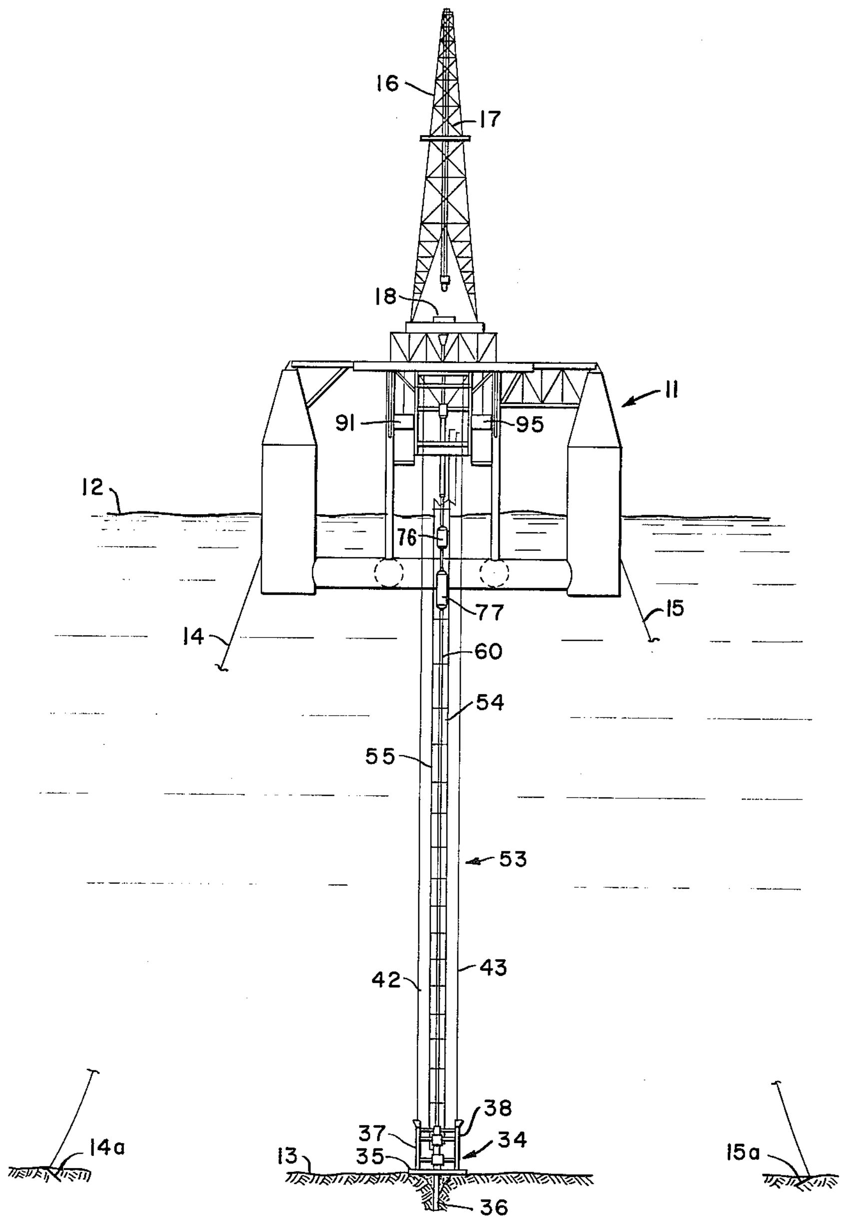

FIG. 1

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MARINE CONDUCTOR PIPE ASSEMBLY

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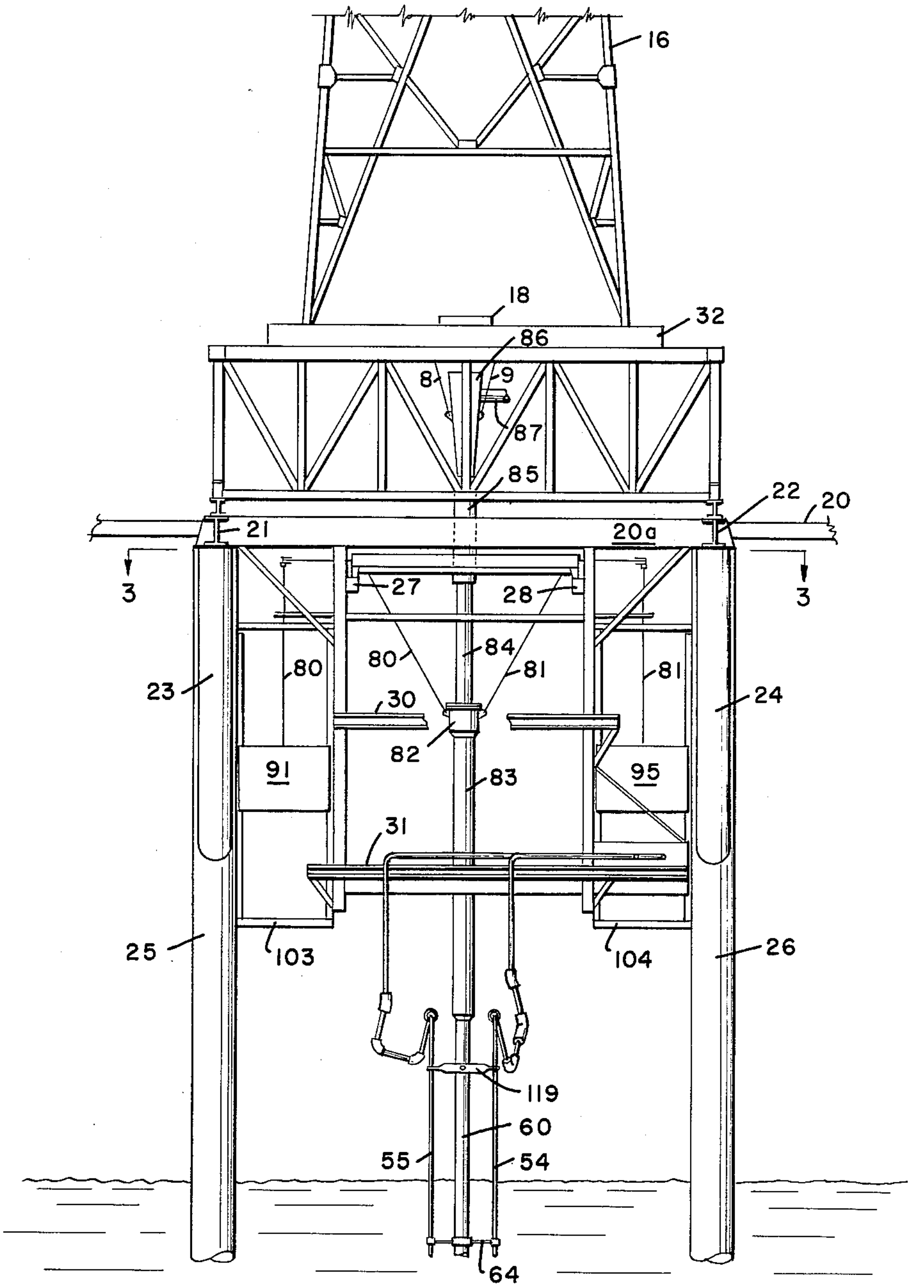

FIG. 2

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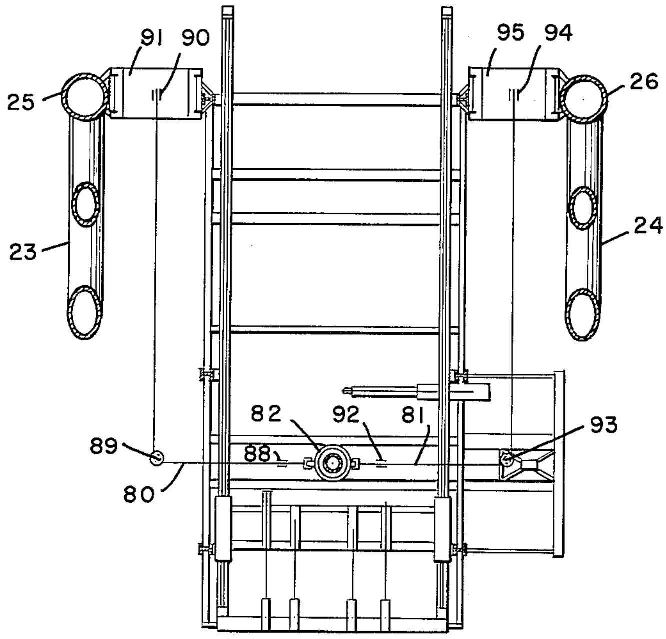

FIG. 3

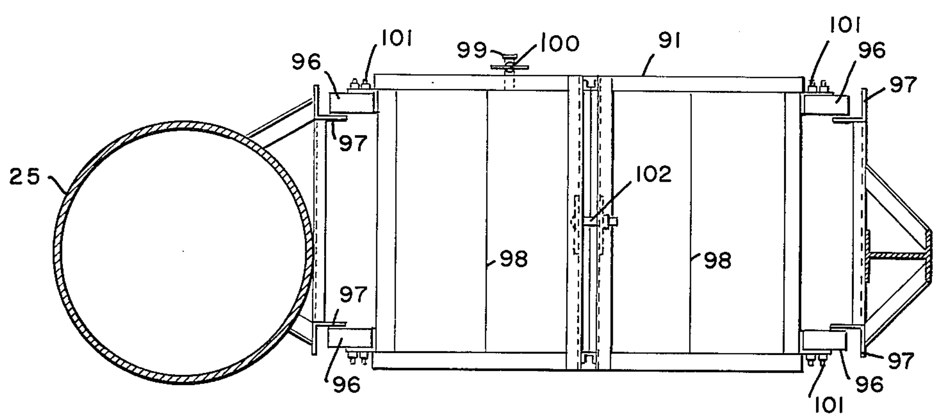

FIG. 5

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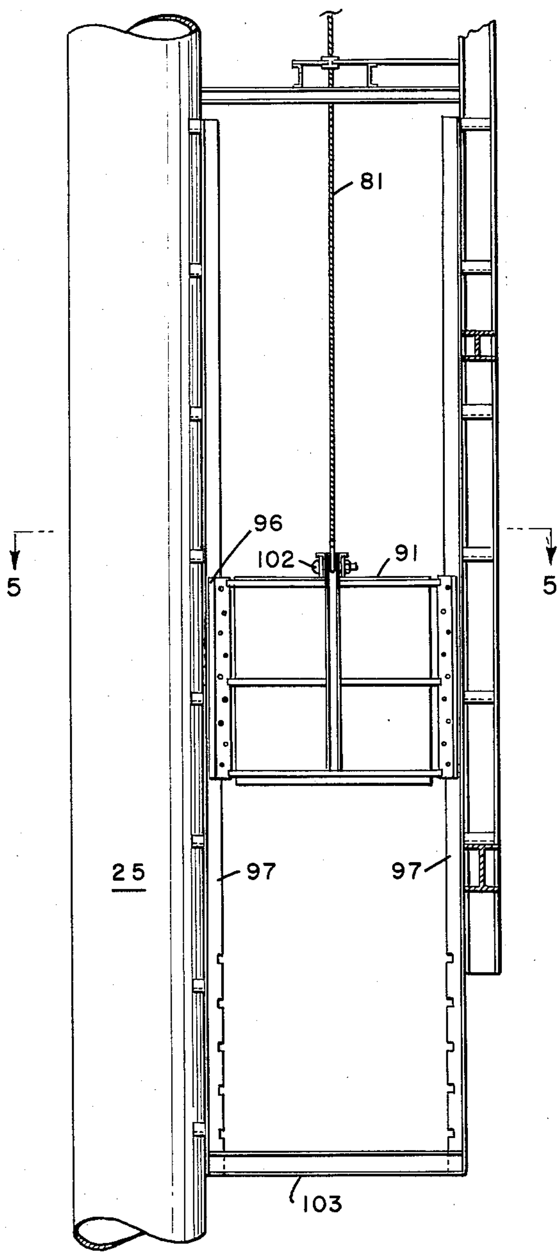

FIG. 4

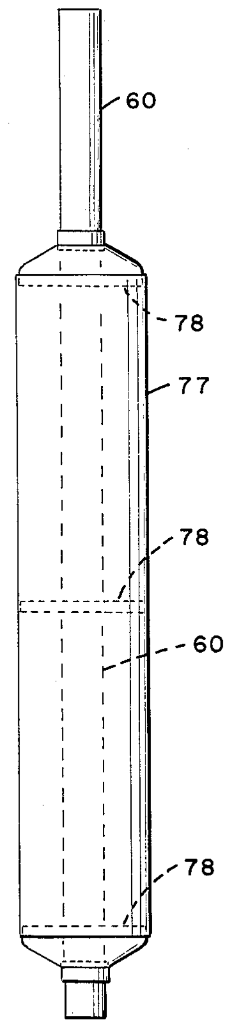

FIG. 6

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MARINE CONDUCTOR PIPE ASSEMBLY

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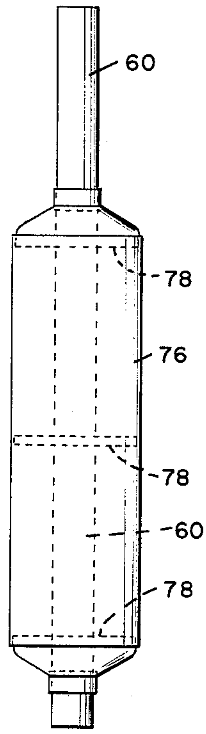

FIG. 7

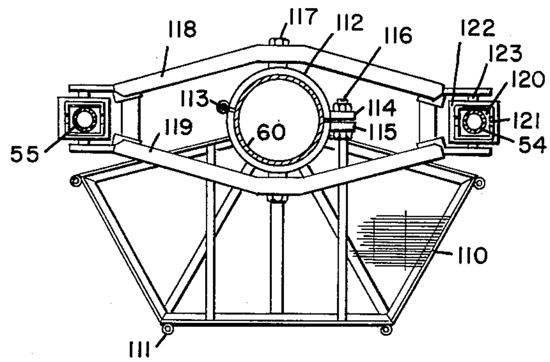

FIG. 9

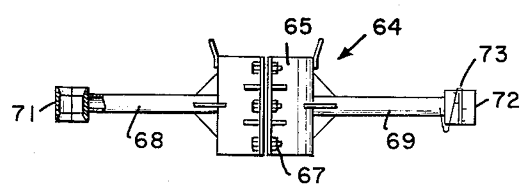

FIG. 10

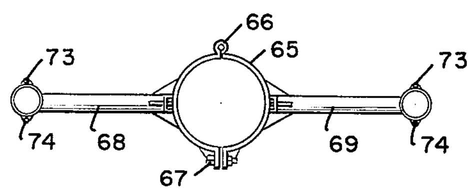

FIG. 11

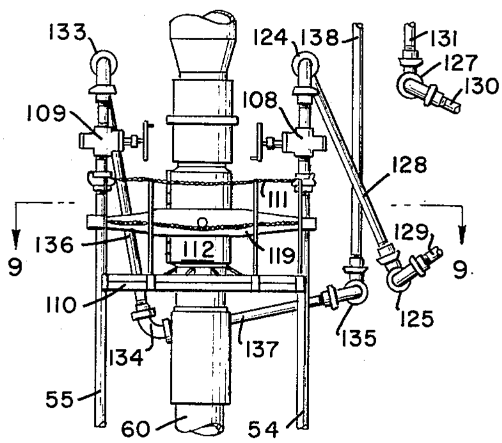

FIG. 8

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MARINE CONDUCTOR PIPE ASSEMBLY

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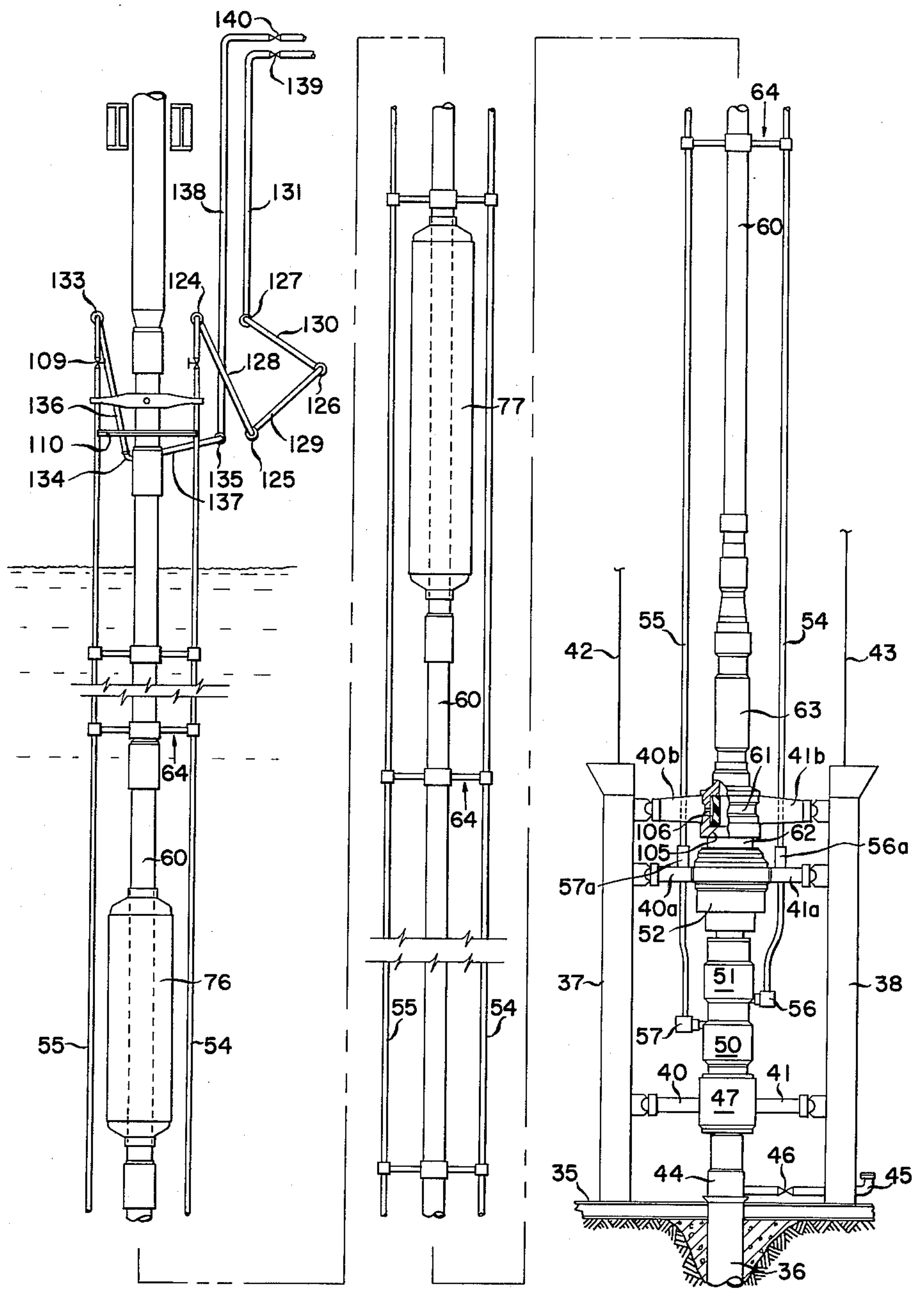

FIG. 12A FIG. 12B FIG. 12C

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MARINE CONDUCTOR PIPE ASSEMBLY

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Filed Sept. 13, 1962, Ser. No. 223,396
7 Claims. (Cl. 166—66.5)

This invention relates to apparatus for use in drilling, completing and working-over operations in oil and gas wells at offshore locations, and pertains more particularly to apparatus adapted to provide full-flow fluid communication between a vessel at the surface of a body of water and a wellhead assembly positioned on the ocean floor or at a substantial depth below the surface of the water.

In an attempt to locate new oil fields, an increasing amount of well drilling has been conducted at offshore locations, such for example, as off the coast of Louisiana, Texas and California. As a general rule, the strings of casing in a well, together with the tubing strings or string, extend to a point above the surface of the water where they are closed in a conventional manner that is used on land wells, with a conventional wellhead assembly being attached to the top of the casing. Recently, methods and apparatus have been developed for drilling and completing wells wherein both the well casinghead, and subsequently the wellhead assembly and casing closure device, are located under water at a depth sufficient to allow ships to pass over them. Preferably, the casinghead and the wellhead closure assemblies are located close to the ocean floor. In order to install well drilling equipment underwater at depths greater than the shallow depth at which a diver can easily operate, it has been necessary to design entirely new equipment for this purpose.

Wells drilled in deep water are generally drilled from vessels of varying designs commonly known as drilling barges, vessels or platforms. Deepwater wells are generally drilled by one of two methods. In one method the string of drill pipe extends downwardly from the drilling barge to the drilling wellhead assembly on the ocean floor which is closed at the top by a circulation head with a flexible hose running from the circulation head back to the surface and to the drilling barge so that drilling fluid may be circulated down the drill pipe, through the drill bit, and thence upwardly on the outside of the drill pipe, out the circulation head and up the flexible hose to the barge again. In the second method, a large-diameter pipe known as a marine conductor pipe is put together and arranged to extend from the drilling wellhead assembly on the ocean floor to the barge on the surface of the water. In the latter method, the drill pipe rotates within the conductor pipe with drilling fluid being circulated down through the drill pipe, through the bit at the bottom thereof, up the outside of the drill pipe and thence upwardly through the annular space between the conductor pipe and the drill pipe, returning to the barge in the conventional way. The present invention is concerned with apparatus to be used in the second method described hereinabove.

One of the problems in drilling underwater wells from floating barges is that of providing suitable means for suspending and/or securing a marine conductor pipe assembly in movable relationship to the drilling barge so that the barge is free to move up and down with the movement of the water while the marine conductor pipe assembly is fixed against vertical movement while being arranged to be moved laterally in any direction. Some of the presently designed marine conductor pipe assemblies have been provided with buoyancy tanks supplying a positive buoyancy to the marine conductor pipe assembly so that the assembly is vertically positioned in the water with its lower end locked to an underwater wellhead. A marine conductor pipe or assembly of positive buoyancy has certain drawbacks in that, in the event that the connection between the lower end of the conductor pipe and the wellhead is broken, the conductor pipe would shoot upwardly in the water underneath or adjacent the barge and possibly damage the floating drilling barge or rupture some of its buoyancy tanks.

It is therefore a primary object of the present invention to provide apparatus for supporting a marine conductor pipe assembly adjacent to a barge without the possibility existing of the marine conductor pipe breaking loose from an underwater wellhead and/or the barge and damaging the barge.

A further object of the present invention is to provide apparatus independent of the barge for supporting the major portion or weight of a marine conductor pipe assembly while the rest of the assembly is supported by the barge itself.

Another object of the present invention is to provide weight-supporting apparatus on a floating drilling barge which may be readily adjusted to support a portion of the weight of a marine conductor pipe assembly as the weight of the portion varies due to changes in drilling operations, such for example, as due to a change in the weight of the drilling mud being circulated through the assembly.

Still another object of the present invention is to provide a marine conductor pipe assembly including apparatus for controlling and/or killing a well from a point above the surface of the water when emergency conditions are encountered in the drilling of a well.

A further object of the present invention is to provide a marine conductor pipe assembly with sufficient flexibility whereby in rough weather a drilling vessel or barge may move several degrees in any direction off the center line of a well that is being drilled without rupturing the marine conductor pipe assembly.

These and other objects of this invention will be understood from the following description taken with reference to the drawings wherein:

FIGURE 1 is a diagrammatic view taken in longitudinal projection illustrating a floating drilling vessel positioned at the surface of the ocean with an underwater wellhead assembly positioned on the ocean floor;

FIGURE 2 is a diagrammatic view taken in longitudinal projection and in enlarged detail of the lower portion of the drill rig and the upper portion of the marine conductor pipe assembly shown in FIGURE 1;

FIGURE 3 is a cross-sectional view taken along the line 3—3 of FIGURE 2;

FIGURE 4 is a longitudinal view taken in enlarged detail of one of the counterweights or ballast tanks of FIGURE 2;

FIGURE 5 is a cross-sectional view taken along the line 5—5 of FIGURE 4;

FIGURE 6 is a longitudinal view in enlarged detail of one of the buoyancy tanks surrounding the marine conductor pipe of FIGURE 1;

FIGURE 7 is a longitudinal view of the other buoyancy tank shown in FIGURE 1;

FIGURE 8 is a longitudinal view illustrating the manner in which the upper ends of auxiliary pipes running along the outside of the marine conductor pipe are secured thereto;

FIGURE 9 is a cross-sectional view taken along the line 9—9 of FIGURE 8;

FIGURE 10 is a view taken in partial cross section of one form of a pipe guide and support member by which auxiliary pipes may be secured to the marine conductor pipe of the present invention;

FIGURE 11 is a plan view of the apparatus in FIGURE 10; and,

FIGURES 12A, 12B and 12C are longitudinal views adapted to be arranged end to end to show in enlarged detail the marine conductor pipe assembly of the present invention as it is positioned on a wellhead of the ocean floor.

Referring to FIGURE 1 of the drawing, a drilling barge or platform is generally represented by numeral **11**. The drilling barge or platform **11** is of any suitable type preferably one, as illustrated, floating at the surface of a body of water **12** and substantially fixedly positioned over a preselected drilling location by suitable barge positioning means or by being anchored to the ocean floor **13** by suitable anchors **14***a* and **15***a* connected to the anchor lines **14** and **15**. Equipment of this type may be used when carrying on well drilling operations in water depths varying from about 100 to 1500 feet or more. The drilling barge is equipped with a suitable derrick **16** as well as other auxiliary equipment needed during the drilling of a well such as a hoist system **17**, rotary table **18**, etc. The derrick **16** may be positioned over a drilling slot or well which extends vertically through the barge in a conventional manner. When using the equipment of the present invention the slot of the barge may be centrally located or extend in from one edge. However, drilling operations may be carried out over the side of the barge or vessel without the use of a slot, as from a portion of the deck of the barge which is cantilevered out over one end, as is the case in the barge in FIGURE 1.

As shown in FIGURE 2, a portion of the barge deck **20** is cantilvered toward the viewer on support beams **21** and **22** which are supported by diagonal braces **23** and **24** from vertical support members **25** and **26** of the barge. Suspended beneath the cantilevered portion **20***a* of the barge deck **20** is a craneway made up of tracks **27** and **28**, and intermediate deck **30** and a spider deck **31**. The decks **20***a*, **30** and **31** are all positioned below the derrick **16** which is provided with an elevated rig floor or operating platform **32**.

A typical underwater wellhead structure, generally represented by numeral **34** in FIGURE 1, is illustrated as comprising a base member **35** which is positioned on the ocean floor **13** and fixedly secured to a conductor pipe or a large diameter well casing **36** which extends down into a well which has been previously drilled, and is preferably cemented therein. Thus, the base structure or member **35** is rigidly secured to the ocean floor in order to support two or more vertically-extending guide columns **37** and **38** (FIGURE 12C) adapted to receive and guide therein guide arms **40** and **41**, **40***a* and **41***a*, and **40***b* and **41***b* which are arranged to slide along vertically extending guide cables **42** and **43**. The lower ends of the guide cables **42** and **43** are anchored to the base structure **35** within the guide columns **37** and **38**, while extending upwardly through the water to the drilling barge **11** where they are preferably secured to constant tension hoists (not shown). If desired, a single guide cable extending between the base structure **35** and the vessel **11** may be employed to position a piece of equipment on the wellhead. Generally, a guide system having at least three guide cables is preferred. However, it is to be noted that wellhead equipment could be lowered from the vessel **11** down to the wellhead by methods other than using the guide cable system illustrated.

Centrally positioned above the base member **35** and fixedly secured thereto, or to the conductor pipe **36**, is a well casinghead unit **44** which may be provided with a cement circulation or fluid return line **45** which may be selectively closed by a remotely operated valve **46**. The guide arms **40** and **41** are illustrated as being connected to a wellhead connector unit **47** which may be hydraulically or electrically actuated to connect to the top of the casinghead **44** in a manner described in copending patent application Serial No. 105,068, filed April 24, 1961. In the above-identified patent application, a wellhead connector **47** is provided with a self-contained electro-hydraulic operating unit which is provided with operating power from an electrical transmission line (not shown) running to the barge **11** at the surface. Alternatively, the wellhead connector could be hydraulically operated by means of a pressure fluid line (not shown) running to the barge **11**.

During the drilling of a well, one or more blowout preventers are connected coaxially above the wellhead connector **47**. In FIGURE 12C a series of three blowout preventers **50**, **51**, and **52** are illustrated as being fixedly secured together and forming a unitary package with the wellhead connector **47**, which package is adapted to be lowered onto the casinghead **44** in any suitable manner. Preferably, the combined blowout preventers **50**, **51** and **52** and the wellhead connector **47** are run together into position on the top of the well by being lowered through the water from the drilling vessel **11** by means of a pipe string (not shown), commonly known as a running string, with the lower end of the running string being connected to the uppermost blowout preventer **52** by any suitable coupling or connector which may be similar in form to the wellhead connector **47**. During drilling operations the running string is replaced by a larger diameter pipe known as a marine conductor pipe and is represented generally in the drawing by numeral **53**.

The various wellhead components, such for example as the wellhead connector **47** and blowout preventers **50**, **51** and **52** may be either hydraulically, pneumatically, or electrically actuatable but are preferably actuatable with each unit being provided with an electro-hydraulic operator unit as described in copending patent application Serial No. 105,068, filed April 24, 1961. Alternatively, the blowout preventers **50**, **51** and **52** could be provided with pressure hoses (not shown) which would extend up through the water to the drilling barge **11**.

In addition, the drilling assembly stack of blowout preventers **50**, **51** and **52** on the top of the wellhead connector **47** is provided with one or preferably two small diameter conduits which will be termed hereinbelow as choke and kill lines **54** and **55**, respectively. The choke and kill lines **54** and **55** are employed to provide means for establishing fluid communication between the drilling vessel **11** and the well during drilling operations after one or more of the blowout preventers **51** and **52** have been closed during an emergency. The choke and kill lines **54** and **55** are provided with remotely actuatable valves **56** and **57**, respectively, which are actuated through pressure hoses or electrical transmission lines (not shown) which extend to the surface. Since these valves and the blowout preventers and the wellhead connector **47** do not form an essential part of the present invention and are described in detail in the above-identified copending application, they will not be further described here.

A marine conductor pipe assembly is employed in drilling underwater wells in order to establish unrestricted communication with the well in a manner shown and described in U.S. Patent 2,606,003, which was issued August 5, 1952, to J. M. McNeill. The marine conductor pipe is of sufficient diameter that a drill pipe and drill bit at the lower end of the drill pipe can be run down through the marine conductor so as to bore into the ocean floor. Thus, the annular space between a drill pipe and the inner wall of a marine conductor pipe forms a full flow passage for return of fluid to the drilling barge together with cuttings removed from the bottom of the well by the bit. Drilling mud would be pumped entirely in the conventional way by means of a pump from the barge down the drill string (not shown), out the drill bit, up the space outside the drill pipe in the well to the wellhead on the ocean floor, and thence upwardly through the casinghead, blowout preventers and up through the marine conductor **53** outside the drill pipe to the barge **11**.

The marine conductor pipe assembly, generally represented by numeral **53** in FIGURE 1, is shown in FIGURES 12A, 12B and 12C in greater detail, FIGURE 12B representing an upward extension of FIGURE 12C and FIGURE 12A representing an upward extension of FIGURE 12B. It is to be understood however that the overall length of the marine conductor pipe assembly may vary from 100 to 1500 feet or more while the width of the assembly need not become any greater. In order to facilitate handling of the marine conductor pipe assembly of the present invention on a drilling vessel, and to aid in the assemblying or construction of the marine conductor pipe so that it extends from the drilling vessel **11** (FIGURE 1) to the uppermost blowout preventer **52** of the drilling stack (FIGURE 12C), the marine conductor pipe assembly **53** is made up in a number of sections, the pipe sections generally being from 10 to 40 feet long.

The lowermost section of the marine conductor pipe assembly comprises a large diameter pipe **60** having fixedly secured to its lower end a landing head or pipe connector **61** of a size and having a bore to fit telescopically onto and to make a sealing engagement with a landing mandrel **62** which is fixedly secured at its lower end to the uppermost blowout preventer **52**, and extends upwardly and coaxially therefrom. If desired, a pipe joint locator **63** may be provided in the conductor pipe assembly above the landing head **61**.

Extending upwardly along the large-diameter conductor pipe **60** are at least one and preferably two small-diameter pipes which in this case are extensions of the choke and kill lines **54** and **55**, respectively. It is to be understood that these small-diameter pipes **54** and **55** are also made up from short pipe sections which are coupled together in any suitable manner, as by screw threads or other couplings, it being preferred that the coupled joints are flush on the outside with the connectors or tool joints having the same outside diameter as that of the pipe. The choke and kill lines **54** and **55** are aligned with the marine conductor pipe **60** by means of a series of guide and support arms or brackets generally represented in FIGURES 12A, 12B and 12C by numeral **64**. One form of a suitable guide and support arm **64** is shown in FIGURES 10 and 11. As illustrated, the pipe support bracket **64** comprises a short section of large-diameter pipe which is split longitudinally and hinged at **66** while being connectible on the opposite side by bolts **67**. The internal diameter of the pipe section **65** is equal to the outside diameter of the marine conductor pipe **60** and serves in the way of a clamp. A pair of diametrically-positioned arms **68** and **69** extend outwardly from the pipe section **65** with small-diameter pipe guides **71** and **72** being fixedly secured, as by welding to the ends of the arms **68** and **69**. The pipe guides **71** and **72** consist of short sections of small-diameter pipe slightly larger than the choke and kill lines **54** and **55** so that the pipe guides **71** and **72** are able to slide up and down the pipes **54** and **55** when engaged around them. For ease in attaching the pipe guides to the choke and kill lines, the pipe guides **71** and **72** also may consist of split pipe sections provided with hinge pins **73**, and connector pins **74**. Any suitable spacing may be employed between the support arms **64**. Generally, a support arm or bracket **64** is positioned above each tool joint or every other tool joint of the marine conductor pipe **60**, depending upon the length of the pipe sections of the marine conductor pipe.

As shown in FIGURE 1 and FIGURES 12A and B, the marine conductor pipe **60** is provided with a buoyancy member or chamber in the form of one or more concentrically arranged buoyancy tanks **76** and **77** which, for ease of handling, are preferably no greater in length than one section of the marine conductor pipe **60**. As shown in FIGURES 6 and 7, the tanks **77** and **76** may be provided with internal reinforcing members **78**. The number and size of the buoyancy tanks **76** and **77** to be used would naturally depend upon the weight of the marine conductor pipe **60** and the choke and kill lines **54** and **55** to be supported. The weight of these elements **54**, **55** and **60** in turn depends upon the depth of the water at which a well is being drilled as well as the size of these elements and the material of which they are made. Whatever amount of weight exists to be supported by these buoyancy tanks, it is extremely important, in accordance with the teachings of the present invention, that the buoyancy tanks together with the marine conductor pipe assembly to which they are attached have a negative buoyancy. That is, in the event that the marine conductor pipe assembly broke loose at the blowout preventers, the buoyancy tanks **76** and **77** would not have sufficient flotation capacity to cause the marine conductor pipe to float to the surface thus obviating any chance of the marine conductor pipe assembly damaging the drilling vessel. It is preferred, however, that the combined buoyancy tanks and conductor pipe assembly have only a slightly negative buoyancy. Thus, the buoyancy tanks are preferably designed so as to support the major portion of the weight of the marine conductor pipe assembly below them.

The remaining weight portion of the marine conductor pipe assembly is supported at the vessel by means of suitable cables **80** and **81** which are fixedly secured at one end to the upper movable end **82** of the conductor pipe **60**. In the particular arrangement of equipment shown the upper end **82** of the conductor pipe **60** is provided with a telescopic joint in the form of a section, say 25 feet long, of large-diameter pipe **83** in which a smaller-diameter pipe **84** is mounted for sliding vertical movement through a seal (not shown) carried in the upper end **82** of the conductor pipe. The upper end of the small diameter pipe **84** may be provided with a bumper section **85** and a bell nipple **86** from which a side conduit **87** allows mud to flow to suitable mud tanks (not shown). The bell nipple **86** is concentrically positioned beneath the rotary table **18** and is supported in place together with the small-diameter pipe portion of the telescopic sub by means of support chains or cables **8** and **9**.

As shown in FIGURES 2 and 3 the cables **80** and **81** which extend from the upper end **82** of the telescopic joint section **8**, are lead over suitable sheaves or pulleys. Thus, cable **80** passes over sheaves **88**, **89** and **90** with the opposite end of the cable being connected to a counterweight **91**. Cable **81** in turn passes over sheaves **92**, **93** and **94** and the lower end of the cable is secured to the top of counterweight **95**. Cables **80** and **81** may each actually represent a number of parallel cables, depending on the loads imposed.

A preferred form of counterweight is shown in FIGURES 4 and 5 of the drawing as comprising a pair of open-topped tanks, each tank or counterweight **91** (FIGURE 5) being provided with lateral movement-limiting means in the form of vertically-arranged oak runners **96** on opposite ends of the tank **95**, the runners being adapted to slide vertically along angle-iron guide rails **97** which form an elevator shaft (FIGURE 4) in which the counterweight tank **95** rises and falls as the drilling vessel **11** and support member **25** rises and falls with the motion of the water, thus enabling a constant tension to be maintained by cables **80** and **81** on the top of the marine conductor pipe assembly to support that portion of the weight thereof that is not supported by the buoyancy tanks **76** and **77**. The contact surface of the oak runners **96** is kept heavily greased at all times. The counterweight tank **91** (FIGURE 5) is provided with one or more vertical baffle plates **98** to reduce the movement of the water laterally in the tanks while the bottom of the plates **98** are provided with openings therethrough (not shown) so that the level of water in the tank **91** can equalize after filling. Each tank is also provided with a suitable drain port **99** and shut-off valve **100**. The oak runners are secured to the outside of the tank **91** by suitable bolts **101** and are replaceable when worn. The end of the cable **81** is secured to the top center of the tank by bolt **102** (FIGURE 4). The vertical length of the elevator rails **97** may be in the order of 20 feet or more depending upon the estimated rise and fall of the drilling vessel **11** and hence the movement of the counterweight tanks **91** and **95** during drilling operations. Horizontal cross members **103** and **104** are provided at the lower end of the vertical elevator guide rails **97** so that the counterweights **91** and **95** can be positioned thereon when not in use and when disconnected from the marine conductor pipe assembly. The amount of tension being applied to the counterweight cables **80** and **81** by the counterweights **91** and **95** can be readily adjusted by adding more water to the counterweight tanks **91** and **95** or draining it therefrom. Additional weight may be obtained by the use of a weighted fluid instead of water.

In FIGURE 12C one form of a landing head **61** is shown as being provided with an outwardly flaring skirt **105** at its lower end to facilitate engagement with the upper end of the leading mandrel **62** when the former is lowered onto the latter. A suitable seal **106** is carried within the landing head **61** and is employed between the landing head **61** of the marine conductor pipe assembly and the landing mandrel **62** on the top of the blowout preventer **52**. While a static seal could be employed in some cases, the sealing element **106** is preferably arranged within the landing head **61** so that it can be expanded inwardly against the landing mandrel **62** to form a fluidtight seal thereagainst. Alternatively, the landing head **61** may be provided with locking dogs (not shown) and take the form of the wellhead connector **47**. The inner surface of the skirt **105** of the landing head **61** preferably forms a landing shoulder for resting in weight-supporting engagement on the top of the seating surface of the mandrel **62**. It is to be understood that only a slight amount of weight is supported by the wellhead assembly. In so doing, the marine conductor string will remain seated on mandrel when the hydraulic connecting means fail. As described hereinabove, the major portion of the weight of the marine conductor pipe assembly is supported by the buoyancy tanks with the rest of the weight of the marine conductor pipe assembly being supported by the counterweights **91** and **95**.

Returning to the choke and kill lines **54** and **55**, the lower ends thereof may be secured to extentions to the valves **56** and **57** in a suitable manner by any connector means well known to the art, as by safety joints **56*a*** and **57*a***. Preferably, the connectors are of the type that may be disengaged remotely. The choke and kill lines **54** and **55** are mounted in spaced relationship to the marine conductor pipe **60** so that they are positioned outside the buoyancy tanks **76** and **77**, as shown in FIGURES 12A and 12B, rather than having them pass through the tanks if the lines **54** and **55** were arranged closer to the conductor pipe **60**. In the event that the choke and kill lines pass through the buoyancy tanks **76** and **77**, it would be necessary to put sleeves longitudinally thorugh the tanks which were of a larger internal diameter than the outside diameter of the choke and kill lines **54** and **55** so that the choke and kill lines would be permitted to move vertically relative to the conductor pipe **60** and the buoyancy tanks **76** and **77** as the conductor pipe was subjected to bending stresses during drilling operations.

The connections at the top of the choke and kill lines **54** and **55** are shown in FIGURE 8 and FIGURE 12A. In order to contain well pressures the choke and kill lines are preferably made of rigid material of a strength sufficient to withstand any well pressures encountered during drilling operations. Although the choke and kill lines **54** and **55** are provided with shut-off valves

56 and **57** at the wellhead which may be remotely closed by an operator on the drilling vessel **11**, these valves may be subject to failure or their conrtol lines may become ruptured. Thus, for emergency purposes the choke and kill lines **54** and **55** are provided with shut-off valves **108** and **109** near the top thereof and at least above the water surface so that these valves may be closed manually, if necessary. To enable an operator to close these valves **108** and **109** a small platform **110** having a hand rail **111** is secured to the bottom of an attachment collar **112**. As shown in FIGURE 9 the attachment collar comprises a split pipe section being hinged at **113** and being provided with suitable connector means, such for example as flanges **114** and **115** which are secured together by bolts **116**, so as to fixedly secure the collar **112** to the upper end of the conductor pipe **60**. The collar **112** is also provided with a horizontally-disposed pivot pin **117** which pivotally secures a pair of yoke arms **118** and **119** to the collar **112**. The choke and kill lines are preferably supported by means of gimbal-mounted slips or any other suitable means of vertical support in the outer ends of the yoke arms **118** and **119**. Thus, the choke line **54** (FIGURE 9) is vertically supported and held down in a block **120** which is pivotally secured by a pivot pin **121** to a surrounding frame **122** which is in turn pivotally secured to the outer ends of the yoke arms **118** and **119** by means of pivot pin **123** which is arranged with its axis in a direction normal to the axis of the pivot pin **121**, both pivot pins **121** and **123** lying in a horizontal plane. It will be seen that as the drilling vessel **11** (FIGURE 1) moves off the vertical line of the well to cause the marine conductor pipe assembly to bend, the choke and kill lines **54** and **55** bend and the support yoke arms **118** and **119** (FIGURE 9) will adjust themselves to eliminate introduction of any additional stresses into the kill and choke lines **54** and **55** due to this condition.

In order to compensate for the rise and fall motion of the vessel, with wave action, relative to the upper end of the choke and kill lines **54** and **55**, the choke and kill lines **54** and **55** are provided above their shut-off valves **108** and **109** with flexible pipe line sections of any suitable type. As shown in FIGURES 8 and 12A the choke line is provided with flexible couplings **124**, **125**, **126** and **127** which interconnect pipe line sections **128**, **129**, **130** and **131**. In turn, the kill line **55** is provided with flexible couplings **133**, **134** and **135** which interconnect pipe lines **136**, **137** and **138**. The upper ends of pipe lines **131** and **138** are provided with shut off valves **139** and **140** which are part of a more or less conventional manifold. It is to be understood that the apparatus of the present invention may be modified in many ways while still forming an operative combination. Thus, for example the choke line **54** may be eliminated, it being sufficient in some cases that a single line extend from the drilling vessel **11** to the wellhead below at least some of the blowout preventers whereby a heavy fluid can be injected into the well in order to kill the well or to control the pressure therein in abnormally high pressure oil fields.

It will be seen that the apparatus of the present invention provides a simple marine conductor pipe assembly adapted to be readily installed or to be disconnected and withdrawn when the vessel is to move to another location. The apparatus also provides means for suitably supporting one or more rigid small-diameter pipes adjacent a large-diameter marine conductor pipe with the combination of pipes being buoyantly supported to a large extent by buoyancy chambers. It is to be understood however that the entire marine conductor pipe assembly is to have a negative buoyancy under operating conditions so that there is no danger at any time of the entire assembly breaking loose from the wellhead at the ocean floor and floating to the surface in a manner so as to endanger or damage the floating vessel **11**. This is especially important since the stability and buoyancy of the drilling vessel **11** may depend upon a relatively thin-skinned or buoyancy chambers which could be readily punctured by a buoyant marine conductor pipe assembly shooting to the surface. At the same time the apparatus of the present invention provides unique counterweights which are readily adjustable as to support capacity for maintaining constant tension on the upper portion of the marine conductor pipe assembly.

We claim as our invention:

1. Apparatus for drilling, completing and working over an underwater well, said apparatus comprising

operational platform means positioned above the surface of a body of water,

a well base positioned below the surface of the water and including substantially vertical well base pipe means having a lower portion thereof fixedly anchored to the formation below said body of water and a portion extending upwardly above said formation,

marine conductor means connectible at its lower end to the upper end of said well base pipe means with the upper end of said conductor pipe extending above the surface of the water in the vicinity of said operational platform means,

buoyancy tank means secured to said marine conductor means below the surface of the water and having sufficient buoyancy to support a major portion of the weight of said marine conductor means, and

weight support means operatively secured to said marine conductor means near the upper end thereof and to said platform means for supporting that portion of the weight of said marine conductor means unsupported by said buoyancy tank means,

a vertically-extending tubular member of said well base in communication with said well base pipe means,

a wellhead connector carried at the lower end of said marine conductor means connectible to said tubular member,

small-diameter rigid conduit means extending from said operational platform means to said well base,

conduit connector means securing the lower end of said conduit means to said well base in communication with the bore of said well base pipe means,

and valve means in said conduit means near the upper end thereof and above the surface of said body of water.

2. The apparatus of claim **1** including connector means securing said conduit means to said marine conductor means at spaced intervals therealong.

3. The apparatus of claim **2** wherein said connector means are fixedly secured to said marine conductor means and slidably secured to said conduit means to permit differential vertical movement of said conduit means relative to said conductor means when they are moved laterally.

4. The apparatus of claim **2** wherein said connector means are fixedly secured to said conduit means and slidably secured to said conductor means.

5. The apparatus of claim **1** including flexible pipe means in said small-diameter conduit means above the valve means therein above the surface of the body of water.

6. The apparatus of claim **2** wherein the uppermost connector means comprises movable yoke means, horizontal means securing said yoke means to the marine

conductor means near the upper end thereof, and gimbal means securing said movable yoke means to said conduit means.

7. Apparatus for drilling, completing and working over an underwater well, said apparatus comprising

(a) operational platform means positioned above the surface of a body of water on a vessel,

(b) a well base positioned below the surface of the water and including substantially vertical well base pipe means having a lower portion thereof fixedly anchored to the formation below said body of water and a portion extending upwardly above said formation,

(c) marine conductor means connectible at its lower end to the upper end of said well base pipe means with the upper end of said conductor pipe extending above the surface of the water in the vicinity of said operational platform means,

(d) buoyancy tank means secured to said marine conductor means below the surface of the water and having sufficient buoyancy to support a major portion of the weight of said marine conductor means,

(e) weight support means operatively secured to said marine conductor means near the upper end thereof and to said platform means for supporting that portion of the weight of said marine conductor means unsupported by said buoyancy tank means,

(f) said weight means carried by said vessel and arranged for substantially free vertical movement, sheave means secured to said vessel at a fixed level above the uppermost position of said weight means, cable means having one end thereof secured to said marine conductor means, said cable means passing operatively over said sheave means with the other end of the cable means secured to said weight means, said weight means being free to move up and down as the vessel rises and falls due to wave action,

(g) movement-limiting means positioned in contact with said movable weight means for confining the movement of said weight means along a selected path,

(h) said movement-limiting means comprising substantially vertically-extending rigid elongated members of a length at least equal to the maximum vertical movement of said weight means and arranged in contact with said weight means to prevent any substantial lateral movement thereof, and

(i) said weight means comprising variable weight tank means adapted to contain weighting material.

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