United States Patent

Brown

[15] **3,696,864**

[45] **Oct. 10, 1972**

[54] **UNDERSEA RISER STRUCTURE**

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[73] Assignee: **Subsea Equipment Associates Limited,** Hamilton, Bermuda

[22] Filed: **Oct. 24, 1969**

[21] Appl. No.: **869,078**

[52] **U.S. Cl.** **166/.5**

[51] **Int. Cl.** **E21b 33/035**

[58] **Field of Search** ..... 166/.5, .6; 175/7

[56] **References Cited**

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3,308,881	3/1967	Chan et al.	175/7
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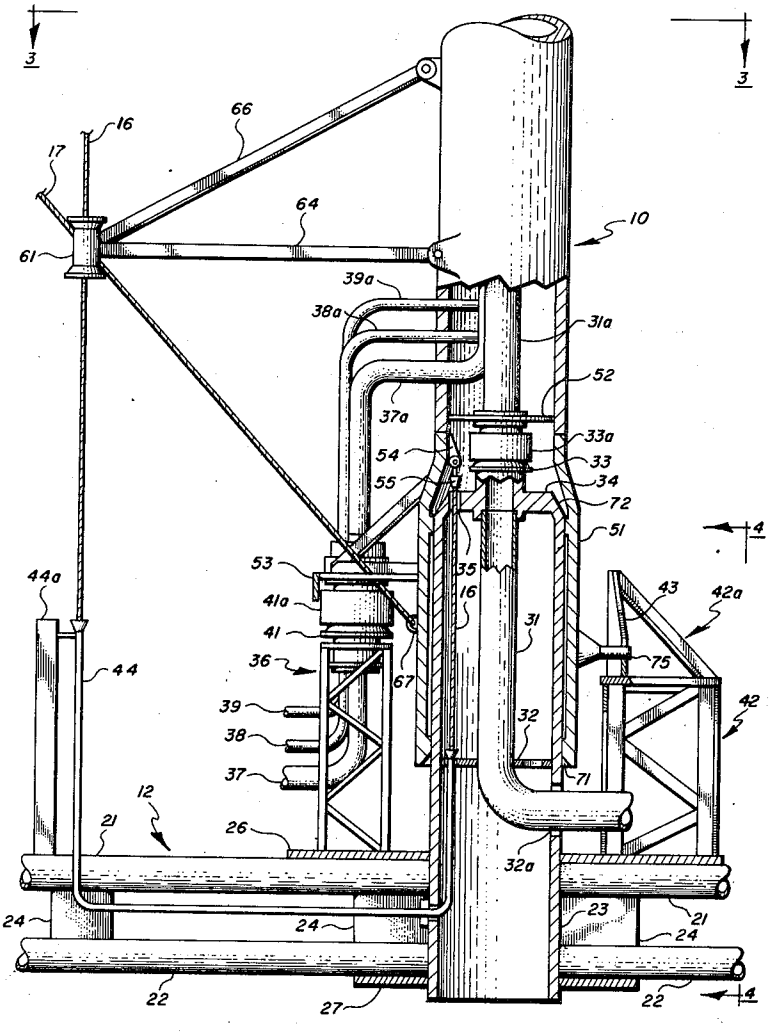
Primary Examiner—James A. Leppink

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[57] **ABSTRACT**

A means, which allows a multipipe riser to be remotely connected to a base located on the ocean floor from a floating vessel, has, formed on the base, a fixed rigid vertical post and, formed on the riser, a column at the lower end thereof which column mates with the post. A pulldown line is threaded through a suitable structure on the base from a surface vessel and attached to the column on the riser so that the column can be pulled down over the post by pulling on the line. Since various pipes in the riser need to communicate with specific pipes in the base, the riser and base have means for rotating the riser on a vertical axis as the column engages the post to orient azimuthally the riser to the base.

6 Claims, 5 Drawing Figures



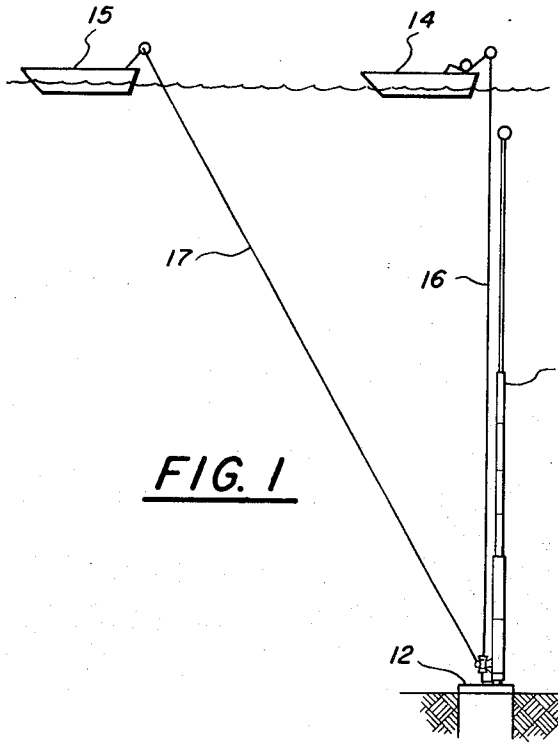


FIG. 1

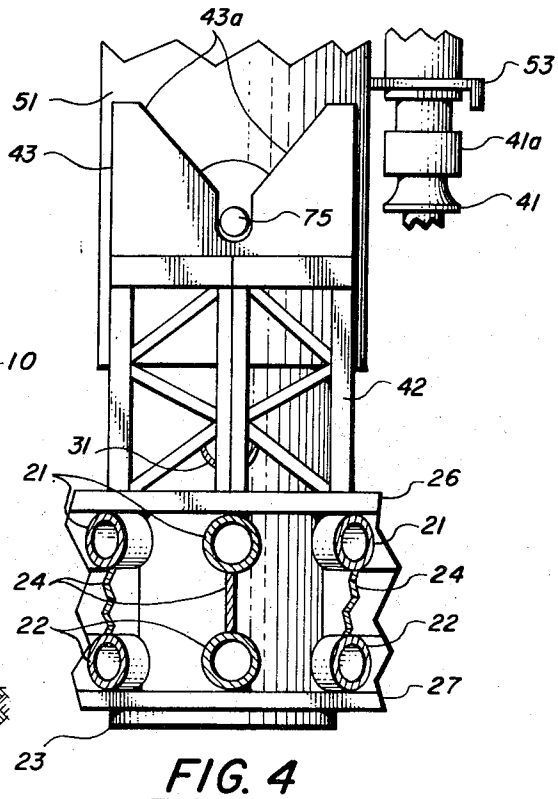


FIG. 4

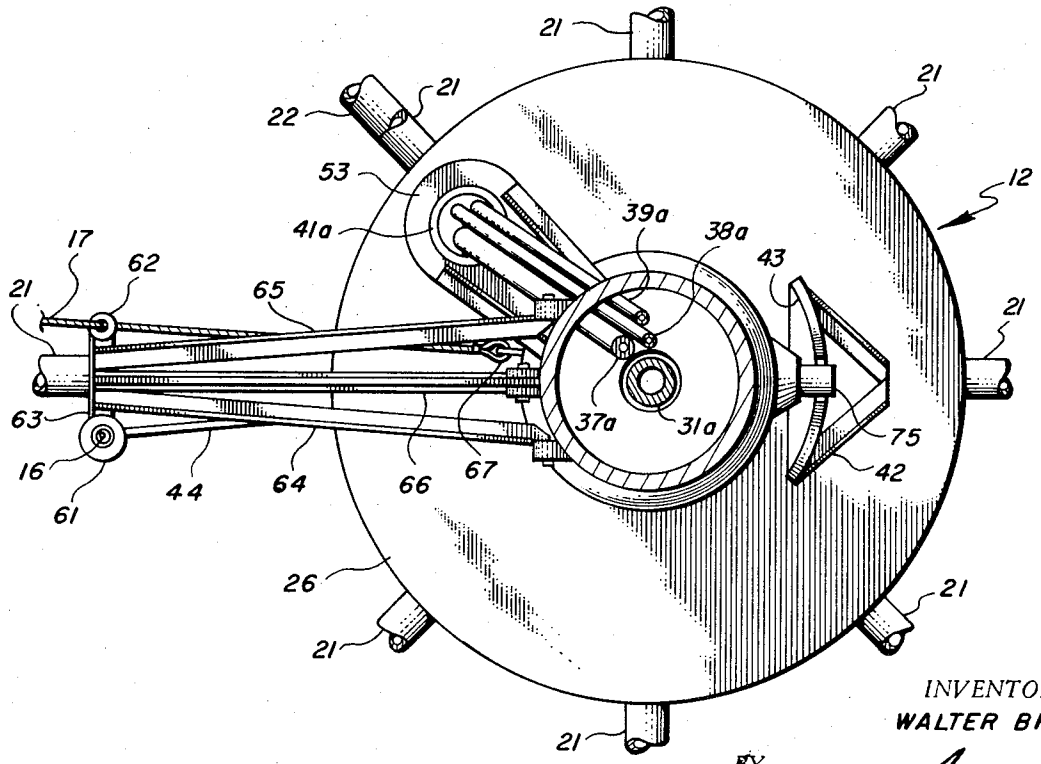


FIG. 3

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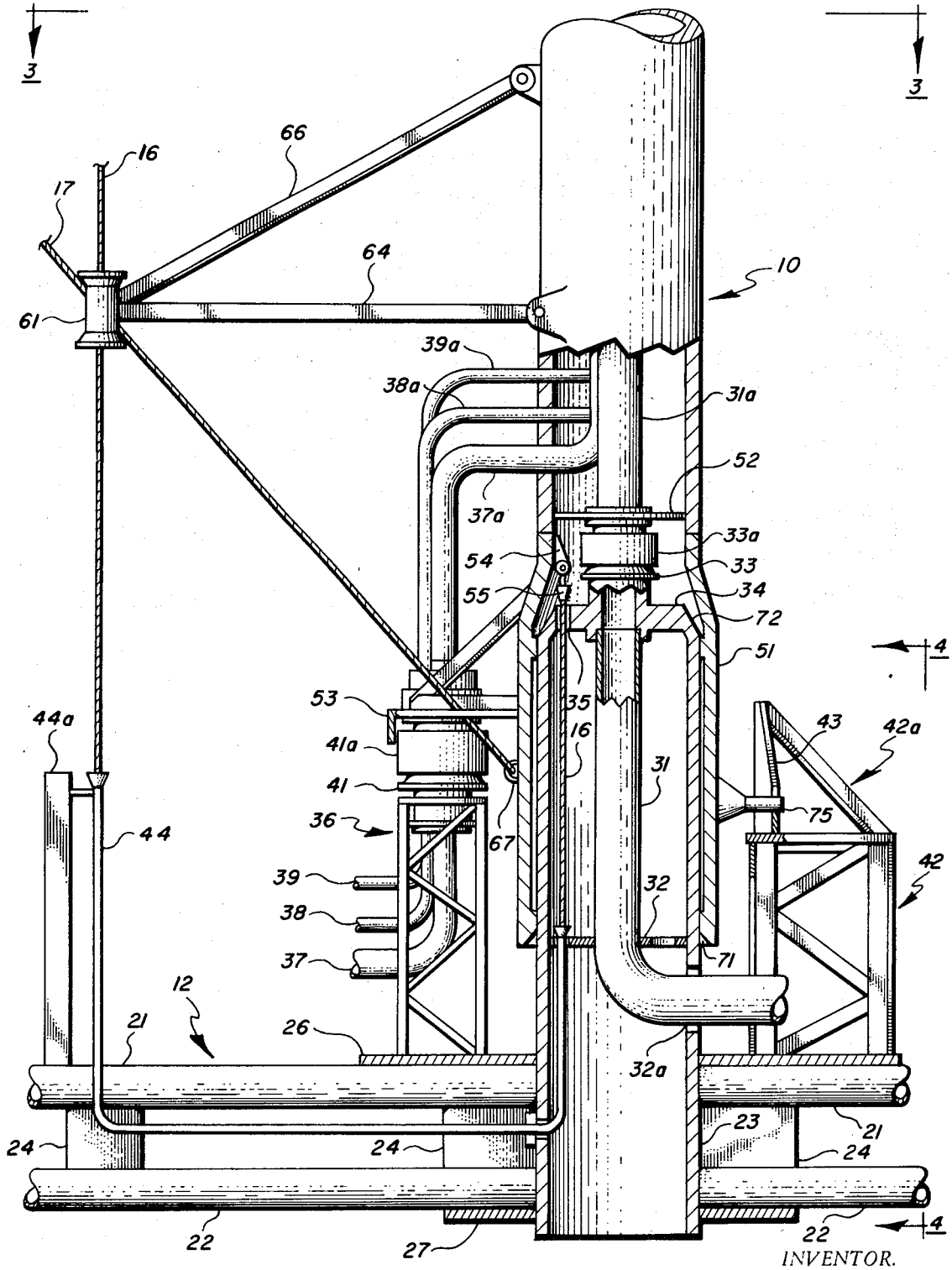


FIG. 2

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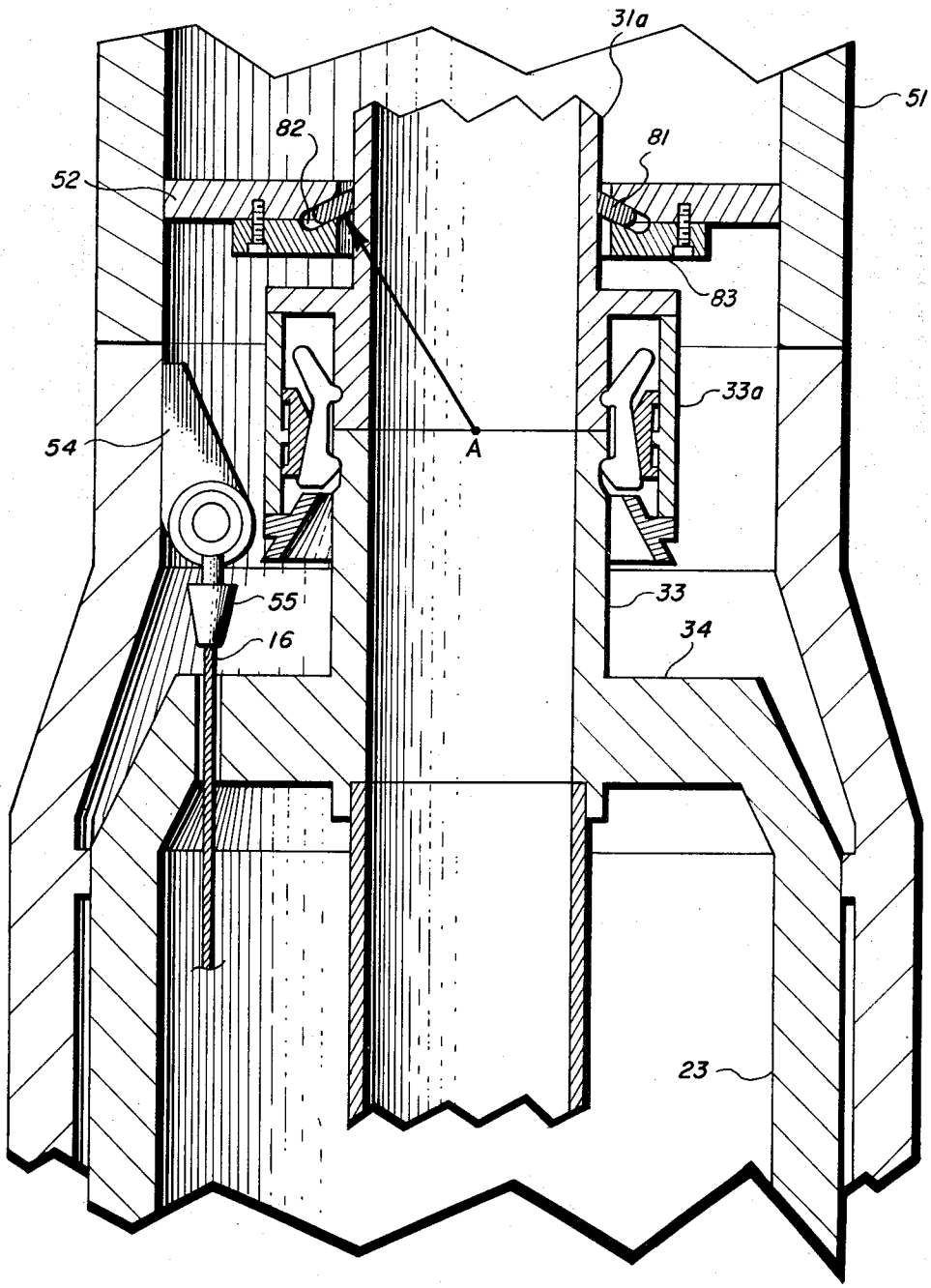


FIG. 5

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UNDERSEA RISER STRUCTURE

FIELD OF THE INVENTION

This invention relates to the art of connecting a riser to an underwater structure and more particularly to the art of connecting the two remotely from the surface of the water.

BACKGROUND

One method of producing oil and gas from deep sea wells is described in the U.S. Pat. No. 3,366,173. The oil and gas, from a plurality of wells, are fed to the centrally located satellite located on the ocean floor. A riser delivers the oil and gas to the surface and feeds electrical power and water to the satellite as required. Normally, subassemblies of the system are made on land and dropped to the ocean floor where they are assembled by divers if the water is not too deep. In deep water, submarines with suitable manipulators are used. The capabilities of these manipulators are limited besides being expensive to operate.

Therefore an object of this invention is to provide a riser and an ocean base wherein the riser can be connected to the base from a surface vessel with the minimal use of or, preferably, without the use of submarines or divers.

Another object of this invention is to provide a means for aligning remotely the various pipes of a multiple riser with respective pipes in the base.

These and other objects and features of advantage will become apparent from the following description when taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic illustration of the overall operation of connecting the riser to an ocean base from the surface of the ocean;

FIG. 2 is an enlarged partial sectional elevation of a portion of the base and riser shown in FIG. 1;

FIG. 3 is a view taken on line 3—3 of FIG. 2 showing a plan of a portion of the base and riser;

FIG. 4 is a view taken on line 4—4 of FIG. 2 showing a side elevation of a portion of the base and riser; and

FIG. 5 is a further enlarged section of the base and riser in elevation.

DESCRIPTION OF THE DRAWINGS

Referring to the drawings and to FIG. 1 in particular, there is shown the preferred method of connecting a riser **10** to a base or foundation **12**. Two floating barges **14** and **15** are utilized to make the connection with the aid of pull down and guidelines made of wire rope **16** and **17**, that are connected between the respective barges and the riser **10** as shown in FIG. **2** and will be described hereinafter.

Referring to FIGS. **2** and **3**, the base **12** has radially extending pipes **21** and **22** disposed one over the other as shown in FIG. **2**. The pipes **21** and **22** extend radially from a center post **23**. The pipes **21** and **22** and post **23** form an integral unit. For example, each pipe **21** is braced to a respective pipe **22** disposed below by gusset plates **24**. An annular platform plate **26** is welded over the pipes **21** and to the center post **23** while another annular plate **27** is welded to pipes **22** and also to post **23** to provide further stiffness and strength. The base **12** is fixed to the ocean floor by tying down the free ends of

pipes **21** and **22** by suitable means such as piling, (not shown). Axially disposed within post **23** is a main pipe **31** which has a 90° bend and protrudes through an opening **32a** in the post **23** to a place of use. The main pipe **31** is supported by, for example, an aperture disk **32** at the lower end and its upper end is fixed to a suitably male coupling **33** which is mounted on an inwardly extending flange **34** on the post **23**. On platform plate **26** is disposed a fixture **36** which supports the ends of, for example, three pipes **37**, **38** and **39**. The ends terminate in a suitable male coupling **41** of the type described in a copending U.S. Pat. Application Ser. No. 837,083, filed June 25, 1969, and assigned to the same assignee as this application. Another fixture **42** is also disposed on plate **26** which fixture **42** supports an asmuth alignment means **42a** to be described hereinafter. The base **12** also includes a J-shaped cable guide tube **44** which has one end located within the post **23** and the other end located outside the post **23**. Tube **44** is suitably fixed to the base **12**, for example, by welds. A suitable aperture **35** is formed in flange **34** on post **23** through which passes the rope **16** that is also threaded through tube **44**.

The riser **10** has a rigid tubular column **51** which slides over the center post **23** onto the base. Column **51** encloses, for example, pipes **31***a*, **37***a*, **38***a* and **39***a*. Pipe **31***a* is preferably centrally located and has its lower end supported within an apertured disk **52** so that some lateral movement is provided between the pipe **31***a* and column **51**, as will be explained hereinafter. On the end of pipe **31***a* is disposed a suitable female coupling **33***a* that engages in a standard manner to male coupling **33**. Pipes **37***a*, **38***a* and **39***a* extend down the column **51**, bend and preferably pass through the wall of the column **51**. The pipes bend downward and terminate within a female coupling **41***a* that engages the male coupling **41**. Coupling **41***a* is attached to column **51** by a suitable structure **53**. On the internal wall surface of column **51** is disposed a lug **54** having an eyelet through which a rope socket **55** is attached. Rope socket **55** is fixed to the end of the wire rope **16**. Rope **17** is attached to the outer surface of column **51** through an eyelet **67**. In addition, guide sleeves **61** and **62** (FIG. **3**) for wire ropes **16** and **17**, respectively, are attached to column **51** by, for example, angle steel beams **63**, **64** and **65** and a tee steel beam **66**.

METHOD OF ASSEMBLY

The base **12** has been installed on the ocean floor by some suitable means which is not part of this invention, with the center post **23** extending substantially vertically. Wire rope **16** has been threaded through J-shaped pipe **44** by means which form no part of this invention. The riser **10** was in an initial floating position on the surface of the ocean with the rope socket **55** attached to lug **54**. In addition, wire rope **16** has been also threaded through guide sleeve **61** and wire rope **17** has been threaded through guide sleeve **62** and fixed to eyelet **67**. Through suitable winches on barge **14**, wire rope **16** is hauled into the barge causing the column **51** to be pulled to the ocean floor. Meantime wire rope **17** is payed out from floating barge **15** at a rate to stabilize the descent of the riser. When the column **51** is over the center post **23** a tapered conical portion **71** on the

lower end of the column **51** and a tapered conical portion **72** on the upper end of the post function to aid the alignment of the column **51** over the posts **23**. To align the two in the azimuthal position in order that pipes **37**, **38** and **39** can be connected to pipes **37a**, **38a** and **39**, respectively, column **51** has fixed to its outside surface a radially extended lug **75** which engages the alignment plate **43** fixed to fixture **42**. Referring to FIG. **4** the radially extended lug **75** on the column engages the sloping edges **43***a* on plates **43** causing the lug to be guided into a slot formed in the plate **43** and in turn rotates the column **51**. When the lug **75** is located just above a slot, coupling **41***a* is located above coupling **41** and coupling **33***a* is located above coupling **33**. Now the male portions of the coupling can slip into the female portions of the couplings as column **51** is further lowered over the center posts **23** by pulling on wire rope **16**. To further insure that each female portion of the couplings is aligned with each male portion of the couplings each female portion is made to move laterally slightly with respect to the column **51**. This lateral motion is provided as shown in FIG. **5** by providing play between the parts. For example, pipe **31***a* has mounted thereto a spherical shaped flange **81** as shown. The radius of curvature of this flange is such that its center is at a point A, located axially on pipe **31***a* at the end thereof. This flange is disposed within a spherically shaped recess **82** formed by an annular washer **83** bolted to the apertured disk **52**. The washer and disk are so shaped as to form the recess **82** when the two are bolted together. This same structure can be adapted to fixture **53** to provide spherical motion relative to the female coupling **41***a*. The couplings are secured remotely in the same manner as described in the abovementioned copending patent application.

With the present disclosure in view modification of the invention will appear to those skilled in the art. Accordingly the invention is not limited to the exact details of the illustrated preferred embodiment but includes all such modifications and variations coming within the scope of the invention as defined in the claims.

What is claimed is:

1. An undersea riser structure in an ocean comprising:

a base fixed to the ocean floor;

a vertically disposed hollow rigid post fixed to said base;

a plurality of fluid conducting pipes fixed to said base;

a riser that is attached to said base and rises towards the surface of the ocean;

a rigid tubular column fixed to the lower end of said riser for sliding over said post;

a plurality of fluid conducting pipes carried by said risers;

a J-shaped tube fixed to said base with one end disposed within said post and the other end disposed outside of said post;

a wire rope threaded through said J-shaped tube and having one end extending to the ocean surface and the other end connected to the interior of said tubular columns to allow the column to slip over said post as said rope is pulled at the surface; and

first and second means for rotating the riser on a vertical axis as said riser is being lowered to said base so that said pipes in said riser are aligned with preselected pipes in said base before the respective pipes come in contact, said first means is disposed on said risers, while said second means is disposed on said base.

2. The structure of claim **1** wherein:

said fourth means includes a lug protruding radially from said column;

said fifth means includes an alignment plate disposed on said base spaced from said post and oriented substantially normal to a radius extending from the axis of said post; and

said alignment plate having a V-slot for engaging said lug as said riser is being lowered.

3. The structure of claim **2** wherein:

a guide sleeve is disposed on said riser, radially spaced from said column for each of said wire ropes.

4. The structure of claim **1** wherein:

said first means includes a lug protruding radially from said column;

said second means includes an alignment plate disposed on said base spaced from said post and oriented substantially normal to a radius extending from the axis of said post; and

said alignment plate having a V-slot for engaging said lug as said riser is being lowered.

5. The structure of claim **4** wherein:

a guide sleeve is disposed on said riser, radially spaced from said column for each of said wire ropes.

6. An undersea base structure which is capable of being attached to a riser, said base structure comprising:

a foundation fixed to the sea floor;

a plurality of fluid conducting pipes fixed to said foundation;

a vertically disposed hollow post fixed to said foundation;

a vertically disposed hollow post fixed to said foundation and disposed to engage said riser;

second means on said foundation disposed to engage said riser to rotate said riser on a vertical axis to a preselected aximuthal position; and

a J-shaped tube disposed on said foundation and having one end disposed within said post and having the other end disposed outside of said post, said shaped tube being adapted to engage a wire rope in sliding relationship.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,696,864 Dated October 10, 1972

Inventor(s) Walter Brown

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 56 (Claim 6, line 17):

Before "shaped" insert --- J- ---

Signed and sealed this 24th day of April 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents