Oct. 6, 1970 R. P. VINCENT 3,531,941

METHOD OF FORMING A RISER FOR MARINE PIPELINE

Filed May 5, 1969 5 Sheets-Sheet 1

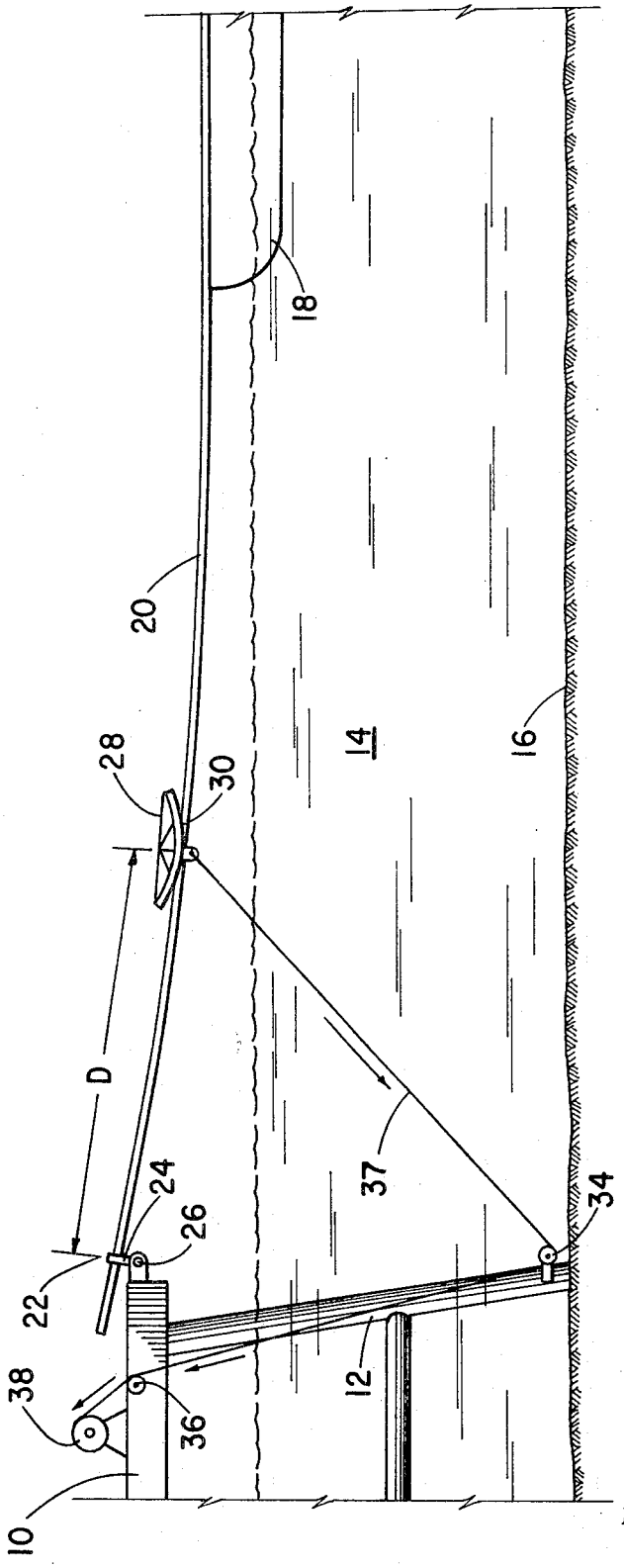


FIG. 1

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METHOD OF FORMING A RISER FOR MARINE PIPELINE

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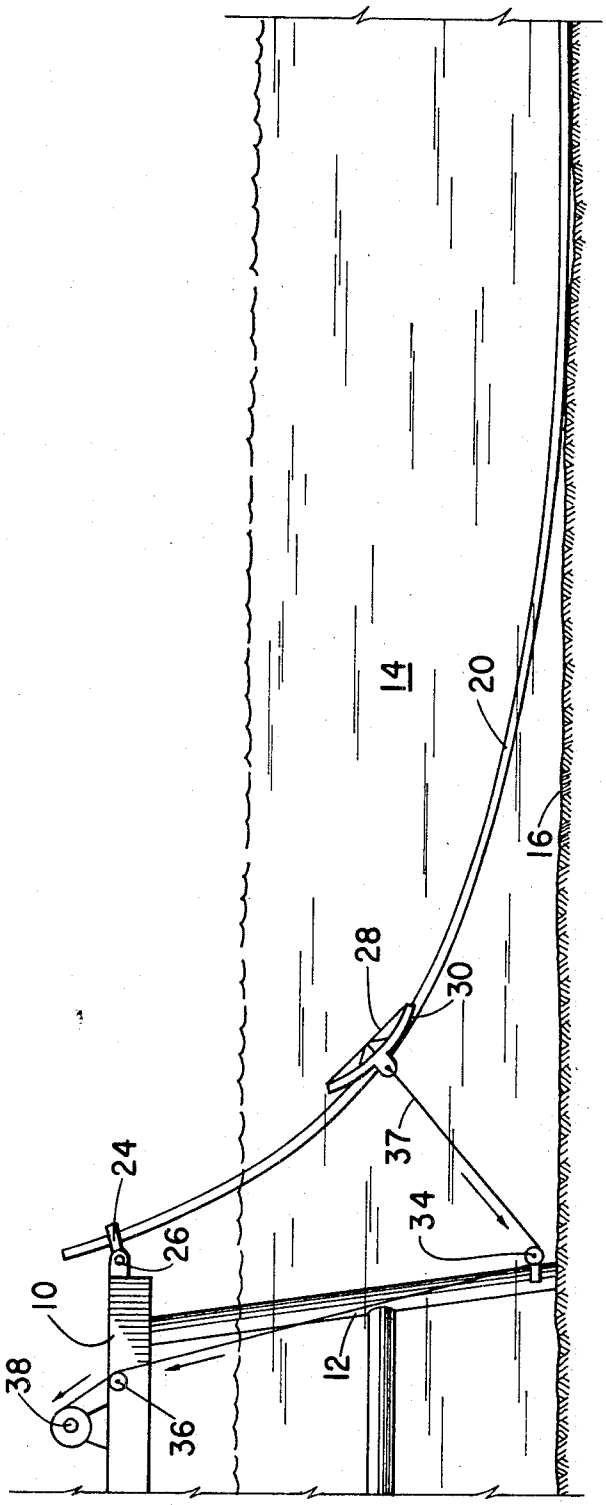


FIG. 2

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METHOD OF FORMING A RISER FOR MARINE PIPELINE

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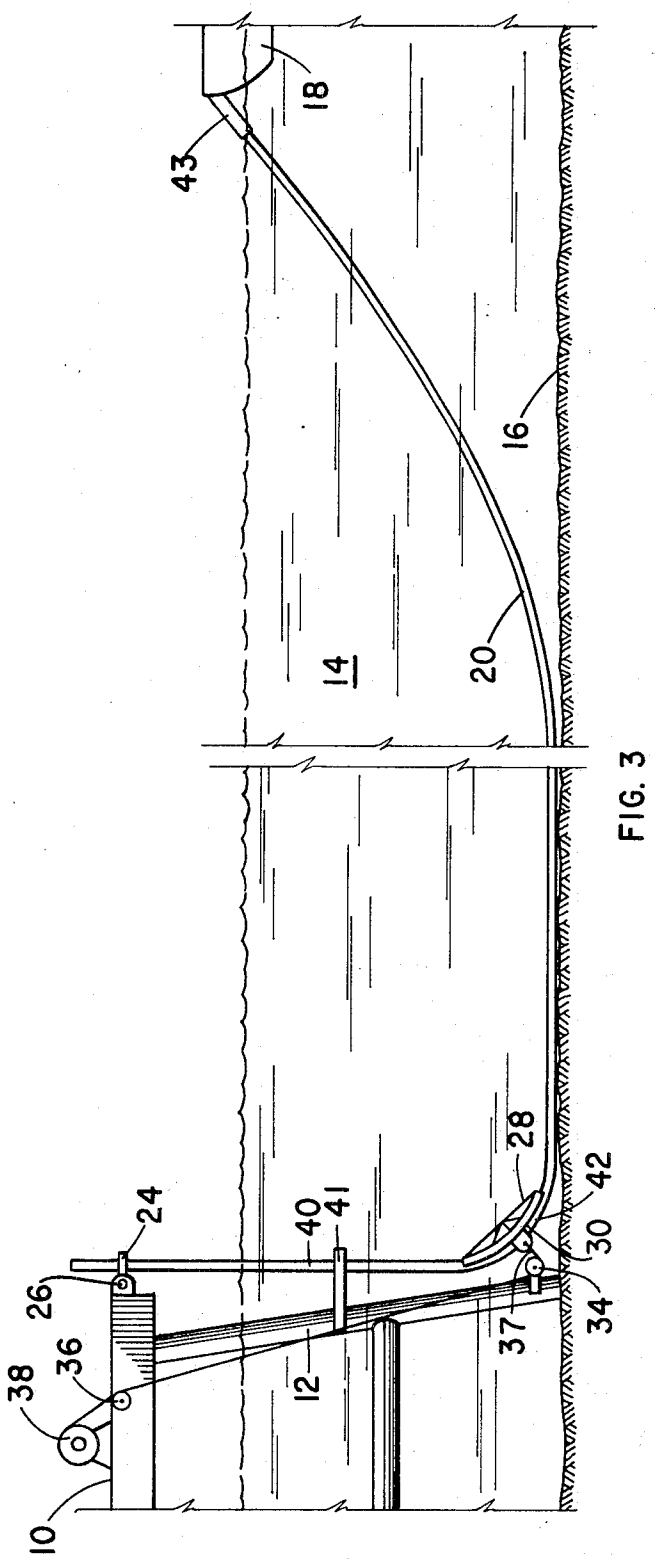


FIG. 3

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METHOD OF FORMING A RISER FOR MARINE PIPELINE

Filed May 5, 1969 5 Sheets-Sheet 4

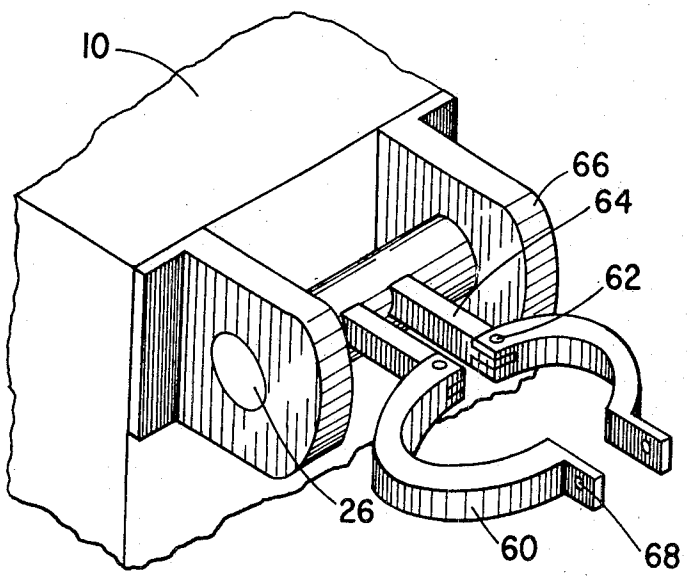


FIG. 4

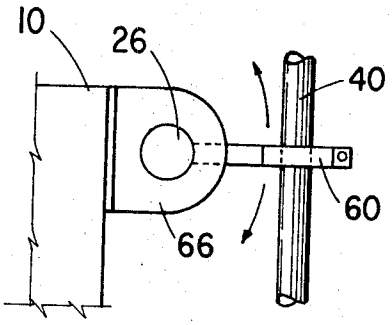


FIG. 5

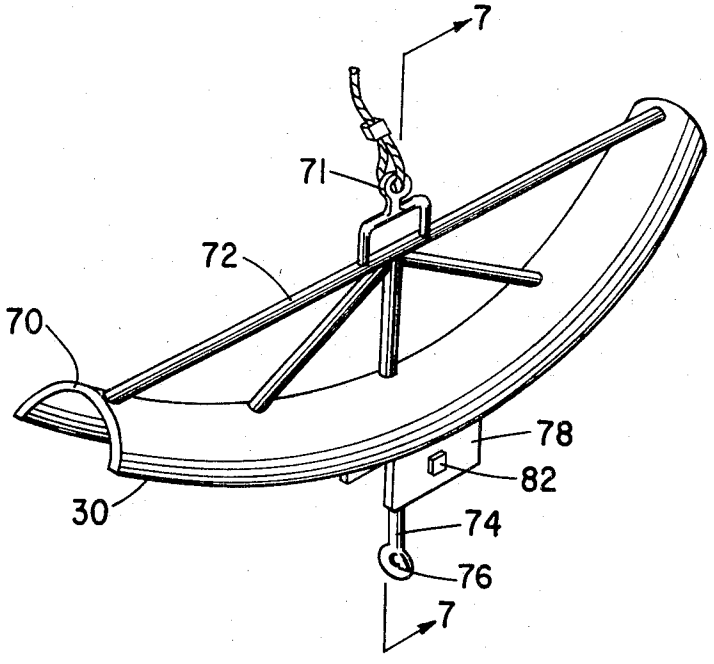


FIG. 6

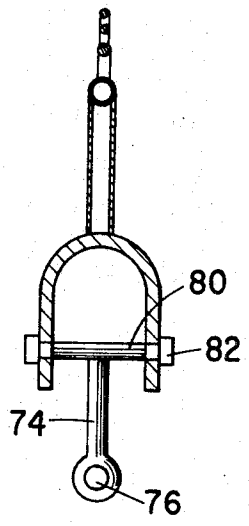


FIG. 7

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METHOD OF FORMING A RISER FOR MARINE PIPELINE

Filed May 5, 1969 5 Sheets-Sheet 5

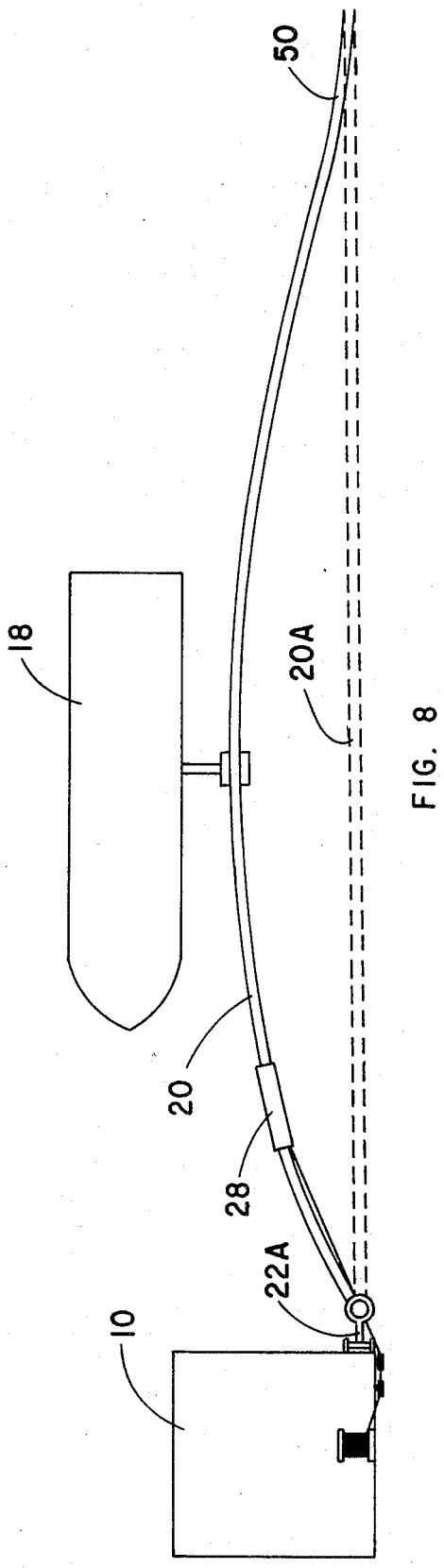


FIG. 8

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United States Patent Office

3,531,941

Patented Oct. 6, 1970

3,531,941

METHOD OF FORMING A RISER FOR MARINE PIPELINE

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Filed May 5, 1969, Ser. No. 822,532
Int. Cl. F16l 1/00; B21d 11/04
U.S. Cl. 61—72.3 4 Claims

ABSTRACT OF THE DISCLOSURE

This concerns a method of making a riser from a subsea line to the flow system on the deck of a platform set above the body of water. The end of the pipeline is pivotally supported on the top of the platform. A bending structure is placed on the pipeline at a distance from the top of the platform about equal to the height of the platform from the bottom of the body of water. The pipeline is pulled by exerting force on the bending structure so that the point on the pipe where the bending structure was attached is forcibly positioned adjacent the lower end of one of the support legs of the platform.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to the laying of pipelines on the bottom of the body of water. It relates especially to the forming of a riser from such pipeline to the top of a platform supported above the body of water by legs extending to the bottom.

Setting of the invention

Recently, the drilling of oil and gas wells has been extended into water-covered areas such as the Gulf of Mexico. In relatively shallow water, e.g., about 400 feet or less, these wells are usually drilled from fixed platforms. A common type of fixed platform is one which supports a drilling structure or producing facility above the surface of the water by long columns of pipe which extend from the platform into the bottom of a body of water. Sometimes these wells are completed on the bottom of the body of water, i.e., the well head is adjacent the bottom, and sometimes they are completed on top of a drilling platform. In either event, the produced oil or gas must be transported to land or to another platform where it may be loaded on a transport vessel. A more frequent way of transporting this oil and gas is by laying pipelines along the bottom of the body of water. If the well is completed by having the well head on top of the platform, then this well head must be connected to the pipeline. One of the most critical links in the offshore pipeline system is the vertical segment of pipe or riser which connects the well head on the platform to the pipeline on the ocean floor. For shallow water, less than about 100 feet, the conventional riser has ordinarily consisted of an L-shaped pipe welded to the section of pipe to be laid on the bottom and the assembly is the set into place alongside the platform by a large crane. The crane operates cooperatively with a lay barge and stinger to lower the line and the L-shaped connection to the bottom progressively as additional joints are added to the vertical leg of the riser. The riser is subsequently clamped at intervals to the platform leg by divers.

Other techniques for installing the riser pipe include the J tube method and the bending shoe concept. In each of these methods, the J tube or the bending shoe method, the J tube and the shoe are each installed in the lower end of the platform. In the J tube concept, a J-shaped

conduit with an inside diameter several inches larger than the pipeline O.D. is constructed as an integral part of the platform prior to the platform being installed. The cable is fastened to the surface of the platform through the J tube and connected to a special pulling nose welded on the pipeline. The end of the line is positioned on bottom in alignment with the bell-shaped mouth of the J tube. The pipe is then forced or pulled through the conduit around the bend and to the surface of the platform. The bending shoe concept is slightly different. There, the shoe having a specified curvature is fixed to the bottom of the platform. This bending shoe is used as a fulcrum and curvature limiting device for bending the pipeline in place along one of the legs of the platform.

While these various methods of installing the riser have been used with success, none are fully satisfactory. For example, the J tube concept and the bending shoe concept each require considerable additional structure permanently fixed on the platform. Insofar as setting the riser in deeper water, it is desirable to have a system in which less equipment can be left permanently attached to the drilling platform. My present invention provides such a system.

SUMMARY OF THE INVENTION

This is a method of forming a riser pipe from a pipeline laid along the bottom of a body of water to the top of a platform set in such body of water. One end of the pipeline is pivotally supported at the top of the platform. The other end of the pipeline is connected to a barge. A bending structure is placed on the pipeline at a distance from the pivot point which is about equal to the height of the platform from the bottom of the body of water. The bending structure includes an arcuate section which has a radius sufficiently large so as to prevent buckling of the pipe when force is applied thereto. This bending structure is placed on top and attached to the pipe. A cable extends from the bending structure to a pulley which has previously been attached to the bottom of one of the legs of the platform. The cable extends up to a winch on the surface. The winch takes up on the cable, pulling the structure down toward the pulley. As this structure is pulled downwardly it causes the pipe to bend along the shape of the structure. One end of the "bend" leads into a vertical section which goes to the top of the pipe, and the other end leads into the pipeline which is laid along the bottom of the body of water.

Various objects and a better understanding of the invention will become apparent from the description which follows when taken in conjunction with the drawings.

DRAWINGS

FIG. 1 illustrates a pipeline supported between a floating lay barge and a platform with bending structure attached;

FIG. 2 is similar to FIG. 1 except that the pipeline has been bent about one-half of the distance to its ultimate position;

FIG. 3 illustrates the pipeline after it has been bent to form a riser section alongside the platform;

FIG. 4 illustrates a pivot at the top of the platform for the pipe;

FIG. 5 is a side view of the apparatus of FIG. 4 with pipe inserted in the clamping means;

FIG. 6 illustrates an enlarged view of a preferred bending structure;

FIG. 7 is a view taken along the line 7—7 of FIG. 6; and

FIG. 8 illustrates a planned view of the barge, platform and pipeline for explaining the operations when the pipeline and riser are being laid toward the platform.

Attention is first directed to FIG. 1 which illustrates a platform riser pipeline connection device. Shown thereon is a portion of platform **10** having leg **12** which extends through a body of water **14** into the bottom **16**. Floating on the body of water is a barge **18**. Barge **18** can be any conventional pipeline laying barge for use in laying pipeline in water-covered areas and can be equipped with whatever equipment may be needed for laying pipe. Extending from barge **18** to the deck of platform **10** is a section of pipe **20**. It is desired that this pipe **20** be laid along the bottom **16**, and a portion of the pipe will form the vertical section of the riser along leg **12** as shown in FIG. 3.

At point **22**, pipe **20** is hinged to platform **10**. This can comprise a clamp means **24** having shaft **26** which is fixed to platform **10**. The clamp then can rotate about axis **26**. FIG. 4 is an enlarged view of the clamp. The clamp for the pipe includes jaws **60** which are connected by pivots **62** to arm **64** which is attached to horizontal shaft **26**. Jaws **60** can be sized to closely fit pipe **40** and when bolted together by bolts through holes **68**, securely fastens the pipe to the jaws. If it is desired that the pipe be able to slip through the jaws **60**, the jaws can, of course, be made sufficiently large to permit this. Shaft **26** is supported from platform **10** by support members **66**.

Mounted on pipe **20** is a bending structure **28**. This structure is positioned along the pipe from pivot **22** a distance D which is approximately the distance from pivot **24** to the bottom of the body of water. One takes into account whether the pipeline is to be laid beneath the bottom in a trench which may be dug and also the expected curvature of the pipe around structure **28**. This is all simple mathematics and will not be gone into in detail. Structure **28** has a curved surface **30** which has a radius R which is sufficient to prevent buckling of the pipe as the bending structure is forced downwardly. The bending structure **28** is preferably fixed to pipe **20** by a releasable clamp. End **70** shows that the curved portion **30** is shaped to receive the pipe to be bent. Bracing **72** is provided to give the structure rigidity. Means are provided for attaching a pulling cable to the main bending structure **30**. This includes members **78**, shaft **80** extending between the two members, end members **82** for holding shaft **80** in position, arm **74** attached to shaft **80** and eyelet **76** at the end of arm **74**. Shaft **80** can be an explosive bolt so that the bending structure can be released from the pipe and cable. A line **71** can extend from the bending structure to the surface so that such structure can be readily recovered.

I will now discuss the means for pulling the bending structure down toward the base of the platform **10**. On the base of platform **10** is a pulley **34**. This is the only structure in addition to the pipeline which is required to be attached to the platform and left in place after the riser has been established in position. A cable **37** extends from eyelet **76** from member **74** of bending structure **28** downwardly about pulley **34** and up alongside leg **12** of the platform over a second pulley **36** to a winch **38**.

In operation the pipeline is either laid toward the platform **10** or laid away from it, that is, by beginning at the platform. I shall first discuss the laying procedure for laying the pipeline **20** beginning from the platform and proceeding outwardly. In this case, barge **18** is used to lay the pipeline from the top of deck **20** outwardly. The end of the pipe is secured by clamp **24** on the platform. Then, sufficient length of pipe is laid so that distance D is satisfied as described above. Then bending structure **28** is attached to the pipeline at the proper position. The cable **37** has previously been threaded down through pulley **34**, for example, when pulley **34** was installed.

Pulling bending structure **29** downwardly by cable **37**, I provide adequate length of line **20** between bending structure **28** and barge **18** so that there is sufficient length of pipeline to follow good pipeline laying practice for the particular depth of water **14**. The lay barge **18** can move backwards to accommodate the extra pipe for making the bend.

We are now ready to proceed with bending of pipeline **20** to form the desired riser pipe. This is accomplished merely by taking up on winch **38** the pull the bending structure **28** down first into an intermediate position, as shown in FIG. 2. It is seen that a part of the pipe is resting on the sea floor. Additional pulling on cable **37** pulls the pipe into the position shown in FIG. 3. There, one can readily see that a portion **40** of the pipe **20** is essentially a vertical section along leg **12**. Section **40** curves through portion **42** into the remaining portion of pipe **20**. It will ordinarily be necessary to either connect additional lengths of pipe to the pipe on barge **18** as we draw structure **28** downwardly toward pulley **34** or drive the barge **18** back toward the platform to provide for this additional length of pipe required for the bending procedure in forming the riser section. After the pipe has been bent as shown in FIG. 3, the bending structure **28** is released such as by exploding shaft **80** so that the bending structure can be recovered by a line connected by eyelet **71** and used on subsequent jobs. Cable **37** can be severed from eyelet **76** in any of a number of ways so that the cable can be recovered. Thus, all that is left on the platform in addition to the platform itself is sheave **34**.

We shall now consider the procedure for laying a pipeline and riser when we are coming into the platform. That is, the pipeline has been laid starting at a point far removed from the platform. Basically, the only difference is that we must use a little different way in providing the extra length of pipe which will be consumed by the bend of the pipe after it is bent. Turning to FIG. 8, we see a planned view having platform **10**, pipe **20** and bending structure between the platform **10** and barge **18**. After the pipe is connected to the platform we wish it to have a straight line indicated by dotted lines **20A**. The pipeline section **20** between platform **10** and some point **50** is curved from line **20A** providing the required additional length of pipe required for the "riser" portion of the pipe. It is easy to calculate the distance of pipe **20A** from point **50** to the platform point **22A**. It is known the horizontal distance from the point **50** to the platform; it is also known what the vertical section of pipe **40** is, as shown in FIG. 3, and the curved section **42**. I simply make a mark on pipe **20** at point **50** and add sufficient lengths of pipe so that a length that the pipe in its uncurved position from point **50** to point **22A** as indicated by line **20** in FIG. 8 is equivalent to the calculated length. We then attach bending structure **28** to pipe **20** and bend the pipe into place as described above in connection with FIGS. 1, 2 and 3. In this process the pipe **20** is supported from barge **18** by a crane, not shown. As the pipe bending structure **28** is pulled downwardly, the pipe is gently fed from barge **18** to rest on the bottom of the body of water. This prevents the cable from having to drag the pipe **20** laterally across the bottom which might require considerable horsepower. After the riser is in position I prefer to clamp section **40** of FIG. 3 to the leg **12** by clamps **41**.

The above embodiments have been described with a certain amount of detail. However, it is to be understood that various modifications can be made therefrom without departing from the spirit or scope of the invention.

I claim:

1. A method of forming a riser pipe extending from the surface of a platform set in a body of water to a pipeline laid along the bottom of said body which comprises:

supporting a pipeline from the top of said platform at one end and to a barge on the other end;

placing a bending structure on said pipeline at a position a distance from the top of said platform about equal to the height of said platform from said bottom, said bending structure including an arcuate structure

having a radius sufficient to prevent buckling of the pipe when force is applied thereto;

pulling said structure down toward the base of said platform whereby said pipeline extends vertically downwardly from the top of said platform and curves into the horizontal pipe at the bottom of said body of water.

2. A method as defined in claim 1 including the step of fixing said bending structure to said pipeline at said position.

3. A method as defined in claim 1 including the step of pivotally connecting said pipeline to the upper end of said platform prior to pulling said bending structure to the base thereof.

4. A method as defined in claim 1 including the steps

of pivotally connecting one end of said pipeline to said upper end of said platform, and

maintaining said pipe in tension while said bending structure is pulled downwardly.

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JACOB SHAPIRO, Primary Examiner

U.S. Cl. X.R.

72—318