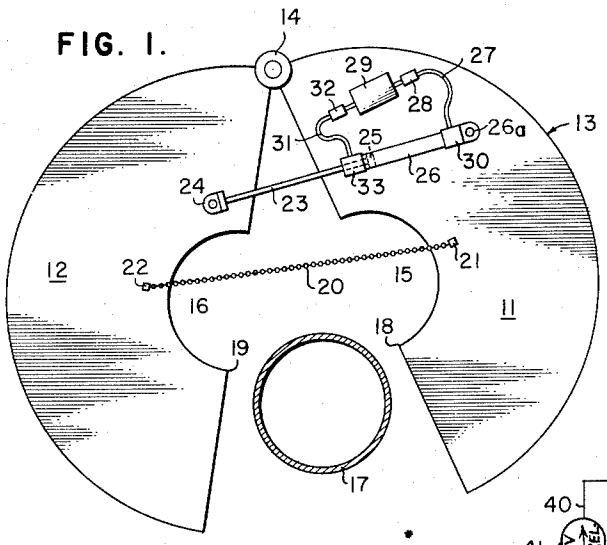
Nov. 3, 1959 R. P. KNAPP 2,910,834

POSITIONING OF CYLINDRICAL ELEMENTS

Filed Feb. 18, 1957

FIG. 1.



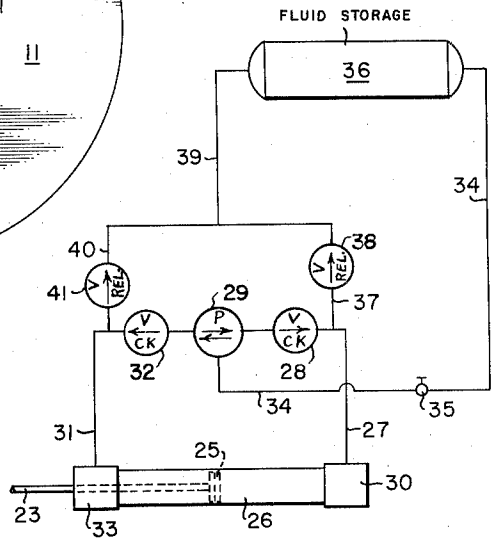
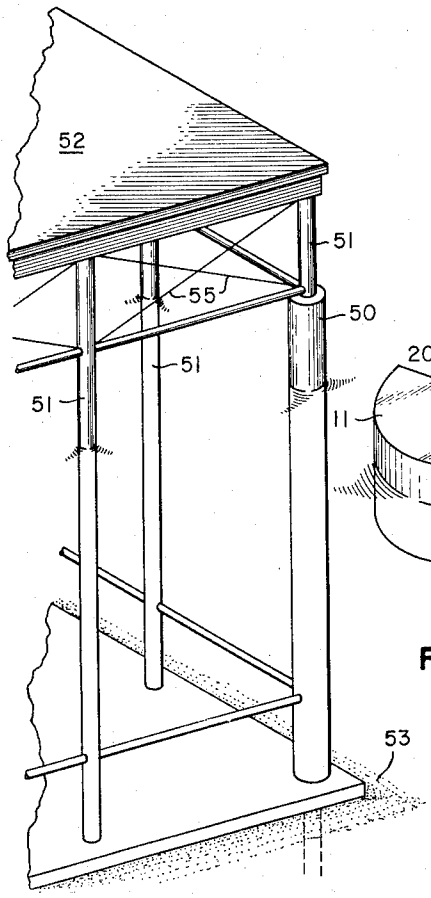


FIG. 2.



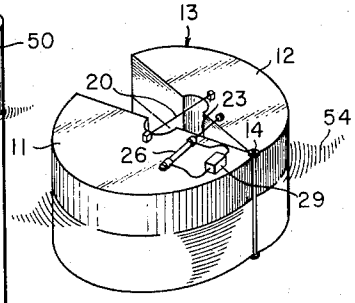


FIG. 3.

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POSITIONING OF CYLINDRICAL ELEMENTS

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9 Claims. (Cl. 61—46.5)

The present invention is directed to apparatus for positioning a first cylinder around a second cylinder. More particularly, the invention is directed to apparatus for enclosing a smaller cylinder by a larger cylinder. In its more specific aspects, the invention is concerned with the placement of a cylindrical pontoon element around a cylindrical column.

The present invention may be briefly described as apparatus for enclosing a smaller cylinder by a larger cylinder. The larger cylinder has two hingedly connected segments and has an axial cylindrical opening of a size sufficient for receiving the smaller cylinder. Flexible means interconnect the two segments across the opening and the flexible means is of a length sufficient to restrain and to provide limited movement apart of the segments. A piston arm is pivotally attached to one of the segments and carries a piston on the free end which is arranged slidably in a piston cylinder on the other segment. A hydraulic pumping means is connected to each end of the piston cylinder for introducing hydraulic fluid to the piston cylinder. Means are connected to the piston cylinder for releasing hydraulic fluid on exceeding a predetermined pressure.

The larger cylinder is releasably placed around the smaller cylinder on moving one of the cylinders relative to the other cylinder so that the smaller cylinder contacts the flexible means and causes pressure in excess of the predetermined pressure to be exerted on the hydraulic fluid releasing means.

The flexible means may suitably be a metal chain, a wire rope or a fiber rope or a metal cable and the like. The flexible means may comprise articulated sections which will allow relative movement.

The hydraulic pumping means of the present invention is suitably provided with a check valve which prevents flow back into the hydraulic pumping means.

The present invention will be further illustrated by reference to the drawing in which:

Fig. 1 is a top plan view of the structure of the present invention showing the enclosure of a smaller cylinder by a larger cylinder;

Fig. 2 is a diagrammatic flow sheet showing the piston cylinder and the hydraulic pumping means and auxiliary equipment of Fig. 1; and

Fig. 3 is a perspective view of the arrangement of the smaller cylinder within the confines of the larger cylinder.

Referring now to the drawing in which identical numerals will be employed to designate identical parts and particularly to Fig. 1, numerals **11** and **12** designate identical size segments of a cylinder generally designated by the numeral **13** which are hingedly connected by hinging means **14**. The segments **11** and **12** define semicircular openings **15** and **16** of a size sufficient to receive and enclose a smaller cylinder **17**. The segments **11** and **12** are provided with entrance corners **18** and **19**. Extending across the openings **15** and **16** is a flexible member, such as a chain **20** which is connected to segment **11** by connecting means **21** and to segment **12** by connecting

means **22**. A piston arm **23** is pivotally connected to segment **12** by means **24** which may be a suitable bearing member and carries a piston **25** which is slidably arranged in a piston cylinder **26** pivotally connected to the segment **11** by the bearing member **26***a*.

A conduit **27** provided with a check valve **28** connects pump **29** with a first end **30** of the cylinder **26** while a conduit **31** provided with a check valve **32** connects the second end **33** of the cylinder **26** with the pump **29**. The pump **29** is conventional and may be operated by an electrical motor, a steam engine, or an internal combustion engine, and the like.

As shown more clearly in Fig. 2, the pump **29** is connected by a suction line **34** provided with a valve **35** to a hydraulic fluid storage vessel **36**. Pump **29** is shown arranged on the segment **11** and is suitably attached thereon. Vessel **36** may also be arranged on segment **11** or may be arranged on a work boat or on the platform **52** or other structure as desired. Conduit **27** also interconnects with the storage vessel **36** by way of line **37** provided with a pressure relief valve **38** through a manifold **39**. Conduit **31** also connects to hydraulic storage vessel **36** by way of line **40** containing pressure relief valve **41**.

Referring now to Fig. 3, it will be seen that the cylinder **13** defined by the segments **11** and **12** comprises a buoyant vessel which is designed to be placed around a buoyant column **50** enclosing a piling **51** which supports a platform **52** which, in turn, is designed to support a drilling structure for drilling a well in the sea bottom **53** for a marine or offshore location. Column **50** may be buoyant as described but also may be constructed to be non-buoyant or may be alternately buoyant or non-buoyant by flooding with or exhausting water as ballast. It will be noted that the platform **52** is arranged above the level of water **54**.

The piling **51** is suitably cross-braced by cross-bracing **55** to provide rigidity and support.

In employing the device of the present invention, especially with reference to the showing of Fig. 3, the segmented cylinder **13** is forced into its open position by the hydraulic cylinder **26** through pressure applied by the pumping means **29**. This pressure will hold the segmented cylinder **13** in the open position and the flexible restraining means **20** limits the amount of opening of the segments **11** and **12** to that required for placement of the segmented cylinder **13** about the cylinder **17** or the cylindrical column **50** of Fig. 3. The amount of opening may be limited by other mechanical means, such as stops on the hydraulic cylinder **26** as may be desired.

The pumping means is provided with a suitable hydraulic fluid reservoir, such as **36**, and pressure relief valves **38** and **41** as has been described so that a constant pressure may be maintained on either ends **30** or **33** of the hydraulic cylinder **26**. This pressure provides a constant force holding the cylinder **13** in an open or closed position. When a smaller cylinder such as **17** or **50** enters the opening of the segmented cylinder **13** or the segmented cylinder **13** is placed around a smaller cylinder, such as **17** or **50**, one of the cylinders moves toward the hinge **14** until the flexible means **20** is contacted. Additional movement relative to the smaller cylinder **17** or **50** toward the hinge **14** increases the tension in the flexible means **20** and this tension increases until the flexible means **20** exerts a greater closing force and moment on the open segmented cylinder **13** than the opening force and moment of the hydraulic cylinder **26**. When the tension on the flexible means **20** overcomes the opening force of the hydraulic cylinder **26**, one of the pressure relief valves in the hydraulic system permits flow of the hydraulic fluid from the cylinder **26** to the reservoir **36** and the segmented cylinder **13** closes.

The location and length of the flexible member **20** may be suitably adjusted to the relative size of the smaller cylinder such as **17** or **50**. Likewise, the opening in the segmented cylinder **13** may suitably be adjusted so that the distance between the corners **18** and **19** of the opening in the segmented cylinder **13** will be greater than the diameter of the smaller cylinder, such as **17** or **50**, when its axis of revolution passes and less than the diameter of the smaller cylinder, such as **17** or **50** after its axis of revolution has passed inboard of the corners **18** and **19**.

As the smaller cylinder **17** or **50** passes inboard of the corners **18** and **19**, increasing tension in the flexible means **20**, closes the segmented cylinder **13** and the distance between the corners **18** and **19** becomes less than that of the small cylinder, such as **17** or **50**. Complete closure of the segmented cylinder **13** may then be accomplished by reversing the action of the double acting hydraulic cylinder **26** and piston **25**. Similarly, an external force available on the smaller cylinder, such as **50**, or on the larger cylinder, such as **13**, may cause a force toward the hinge **14** while pressure is released from the hydraulic system including the pump **29** and its attendant conduits and check and pressure release valves causing pressure to be supplied to the hydraulic cylinder **26** or the hydraulic fluid may be forced through one of the pressure relief valves back to the reservoir **36** if the tension on the flexible means is not prohibitive and the available external force is adequate.

Reversal of the action of the double acting hydraulic cylinder **26** is the preferable method for closing the segmented cylinder **13** since external force is then not required and since the hydraulic system then locks the smaller diameter cylinder, such as **50**, within the opening of the segmented cylinder **13**.

In providing a segmented cylinder **13** around a smaller cylinder, such as **50**, as illustrated in Fig. 3, external force may be exerted on the cylinder **13**, which is buoyant and movable, by a suitable powered vessel, such as a tug boat, and the like.

The present invention is of advantage and utility in that a means is provided for placing and locking a larger cylinder around a smaller cylinder with one of the cylinders moving relative to the other cylinder. This is quite advantageous and useful in offshore marine operations where it is desirable to provide auxiliary buoyancy to a buoyant structure or to remove or decrease buoyancy of a buoyant or non-buoyant structure.

The natural and objects of the present invention having been comp'etely described and illustrated, what I wish to claim as new and useful and to secure by Letters Patent is:

1. Apparatus for enclosing a smaller vertically arranged cylinder in a body of water comprising a larger cylinder forming a buoyant vessel, the larger cylinder comprising two hingedly connected segments and having an axial cylindrical opening of a size sufficient for receiving said smaller cylinder, said cylindrical vessel possessing sufficient buoyancy to provide buoyancy for said smaller cylinder flexible means interconnecting said segments across said opening of a length sufficient to restrain and provide limited movement apart of said segments, a piston arm pivotally attached at one end to one of said segments and carrying a piston on a free end, its piston cylinder on and pivotally connected to the other segment, said piston being slidably arranged in said piston cylinder, hydraulic pumping means connected to each end of said piston cylinder for introducing hydraulic fluid to said piston cylinder and thereby moving said segments relative to each other into open and closed positions, and means connected to said piston cylinder for releasing hydraulic fluid therefrom on exceeding a predetermined pressure, said larger cylinder being releasably placed around the smaller cylinder on moving one of said cylinders in said body of water relative to the other cylinder

such that the smaller cylinder contacts said flexible means and causes pressure in excess of the predetermined pressure to be exerted on said hydraulic fluid releasing means by said flexible means closing said segments and forcing the piston arm and piston cylinder together.

2. Apparatus in accordance with claim 1 in which the flexible means is a chain.

3. Apparatus in accordance with claim 1 in which the flexible means is a cable.

4. Apparatus in accordance with claim 1 in which the flexible means is a wire rope.

5. Apparatus in accordance with claim 1 in which the hydraulic pumping means is provided with a check valve and in which the hydraulic fluid releasing means is a pressure relief valve.

6. Apparatus for enclosing a smaller vertically arranged cylinder in a body of water comprising a larger cylinder forming a buoyant vessel, the larger cylinder comprising two hingedly connected segments and having an axial cylindrical opening of a size sufficient for receiving said smaller cylinder, said cylindrical vessel possessing sufficient buoyancy to provide buoyancy for said smaller cylinder, flexible means interconnecting said segments across said opening of a length sufficient to restrain and provide limited movement apart of said segments, a piston arm pivotally attached at one end to one of said segments and carrying a piston on a free end, its piston cylinder on and pivotally connected to the other segment, said piston being slidably arranged in said piston cylinder, hydraulic pumping means, conduit means connecting each end of said piston cylinder to said hydraulic pumping means for introducing hydraulic fluid to said piston cylinder and thereby moving said segments relative to each other into open and closed positions, and means connected to said conduit means for releasing hydraulic fluid therefrom on exceeding a predetermined pressure, said larger cylinder being releasably placed around the smaller cylinder on moving one of said cylinders in said body of water relative to the other cylinder such that the smaller cylinder contacts said flexible means and causes pressure in excess of the predetermined pressure to be exerted on said hydraulic fluid releasing means by said flexible means closing said segments and forcing the piston arm and piston cylinder together.

7. Apparatus for enclosing a smaller vertically arranged cylinder in a body of water comprising a larger cylinder forming a buoyant vessel, the larger cylinder comprising two hingedly connected segments and having an axial cylindrical opening of a size sufficient for receiving said smaller cylinder, said cylindrical vessel possessing sufficient buoyancy to provide buoyancy for said smaller cylinder flexible means interconnecting said segments across said opening of a length sufficient to restrain and provide limited movement apart of said segments, a piston arm pivotally attached at one end to one of said segments and carrying a piston on a free end, its piston cylinder on and pivotally connected to the other segment, said piston being slidably arranged in said piston cylinder, hydraulic pumping means on one of said segments, conduit means connecting each end of said piston cylinder to said hydraulic pumping means for introducing hydraulic fluid to said piston cylinder and thereby moving said segments relative to each other into open and closed positions, and means connected to said conduit means for releasing hydraulic fluid therefrom on exceeding a predetermined pressure, said larger cylinder being releasably placed around the smaller cylinder on moving one of said cylinders in said body of water relative to the other cylinder such that the smaller cylinder contacts said flexible means and causes pressure in excess of the predetermined pressure to be exerted on said hydraulic fluid releasing means by said flexible means closing said segments and forcing the piston arm and piston cylinder together, said conduit means also being provided with a check valve preventing flow of said hydraulic fluid back

to said hydraulic pumping means on release of hydraulic fluid by said hydraulic fluid releasing means.

8. Apparatus for enclosing a smaller vertically arranged cylinder in a body of water comprising a larger cylinder forming a buoyant vessel, the larger cylinder comprising two hingedly connected segments and having an axial cylindrical opening of a size sufficient for receiving said smaller cylinder, said cylindrical vessel possessing sufficient buoyancy to provide buoyancy for said smaller cylinder, flexible means interconnecting said segments across said opening of a length sufficient to restrain and provide limited movement apart of said segments, a piston arm pivotally attached at one end to one of said segments and carrying a piston on a free end, its piston cylinder on and pivotally connected to the other segment, said piston being slidably arranged in said piston cylinder, hydraulic pumping means on one of said segments, a reservoir vessel for hydraulic fluid, first conduit means interconnecting each end of said piston cylinder to said hydraulic pumping means for introducing hydraulic fluid to said piston cylinder and thereby moving said segments relative to each other into open and closed positions, second conduit means interconnecting said reservoir vessel and said hydraulic pumping means, and means connected to said first conduit means for releasing hydraulic fluid therefrom on exceeding a predetermined pressure, said larger cylinder being releasably placed around the smaller cylinder on moving said larger cylinders in said body of water relative to the other cylinder such that the smaller cylinder contacts said flexible means and causes pressure in excess of the predetermined pressure to be exerted on said hydraulic fluid releasing means by said flexible means closing said segment and forcing the piston arm and piston cylinder together, said conduit means also being provided with a check valve preventing flow of said hydraulic fluid back to said

hydraulic pumping means on release of hydraulic fluid by said hydraulic fluid releasing means.

9. Apparatus for enclosing a smaller vertically arranged cylinder in a body of water comprising a larger cylinder forming a buoyant vessel, the larger cylinder comprising two hingedly connected segments and having an axial cylindrical opening of a size sufficient for receiving said smaller cylinder, said cylindrical vessel possessing sufficient buoyancy to provide buoyancy for said smaller cylinder flexible means interconnecting said segments across said opening of a length sufficient to restrain and provide limited movement apart of said segments, hydraulic means attached to said segments pivotally interconnecting said segments for opening and closing said segments and thereby moving said segments relative to each other into open and closed positions, and means connected to said hydraulic means for releasing hydraulic fluid from said hydraulic means on exceeding a predetermined pressure, said larger cylinder being releasably placed around the smaller cylinder on moving one of said cylinders in said body of water relative to the other cylinder such that the smaller cylinder contacts said flexible means and causes pressure in excess of the predetermined pressure to be exerted on said hydraulic fluid releasing means by said flexible means closing said segments.

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