March 24, 1959 F. C. JACOBS 2,878,649

RETRACTABLE BEARING SHOES FOR CAISSONS

Filed May 19, 1954 2 Sheets-Sheet 1

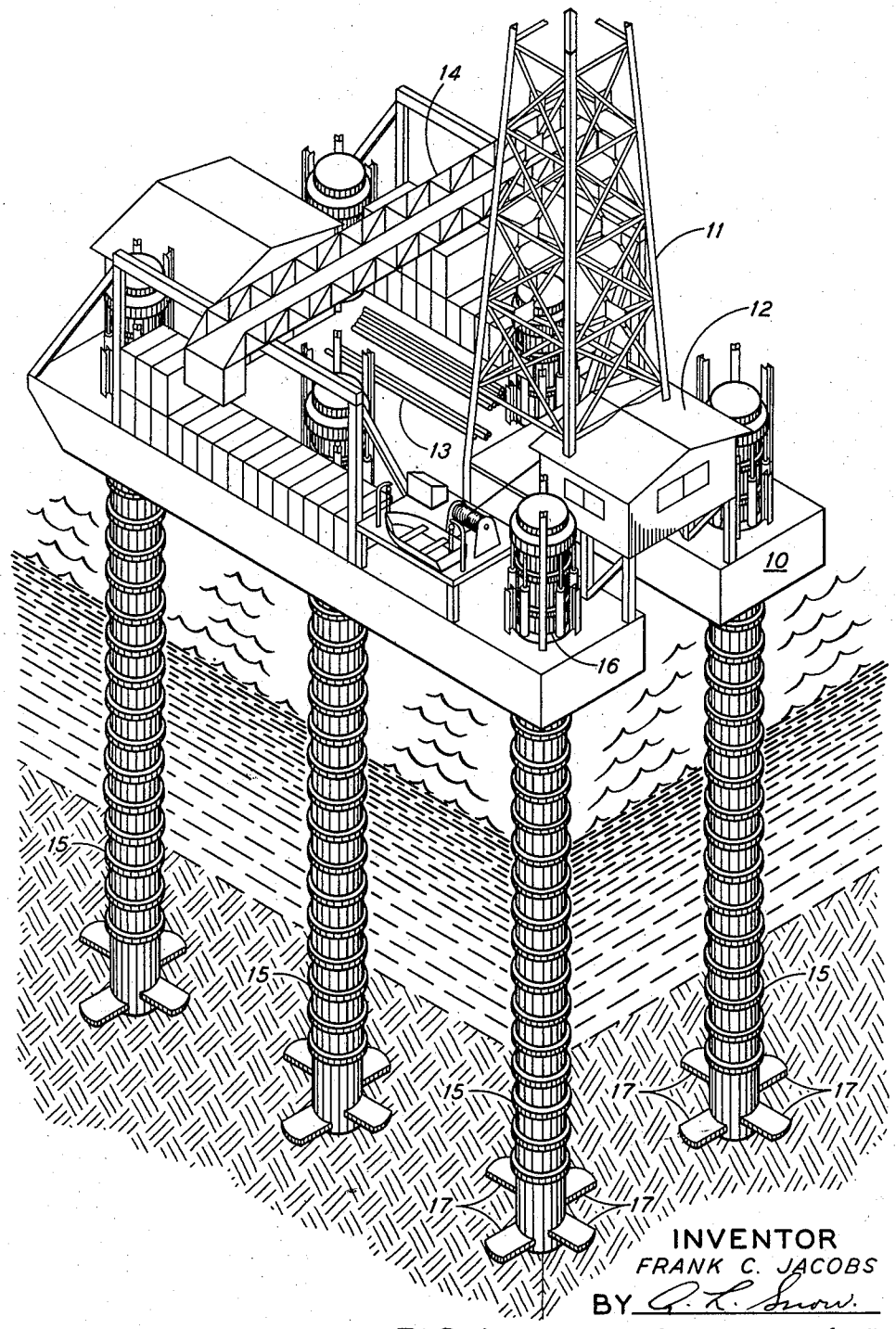


FIG. 1

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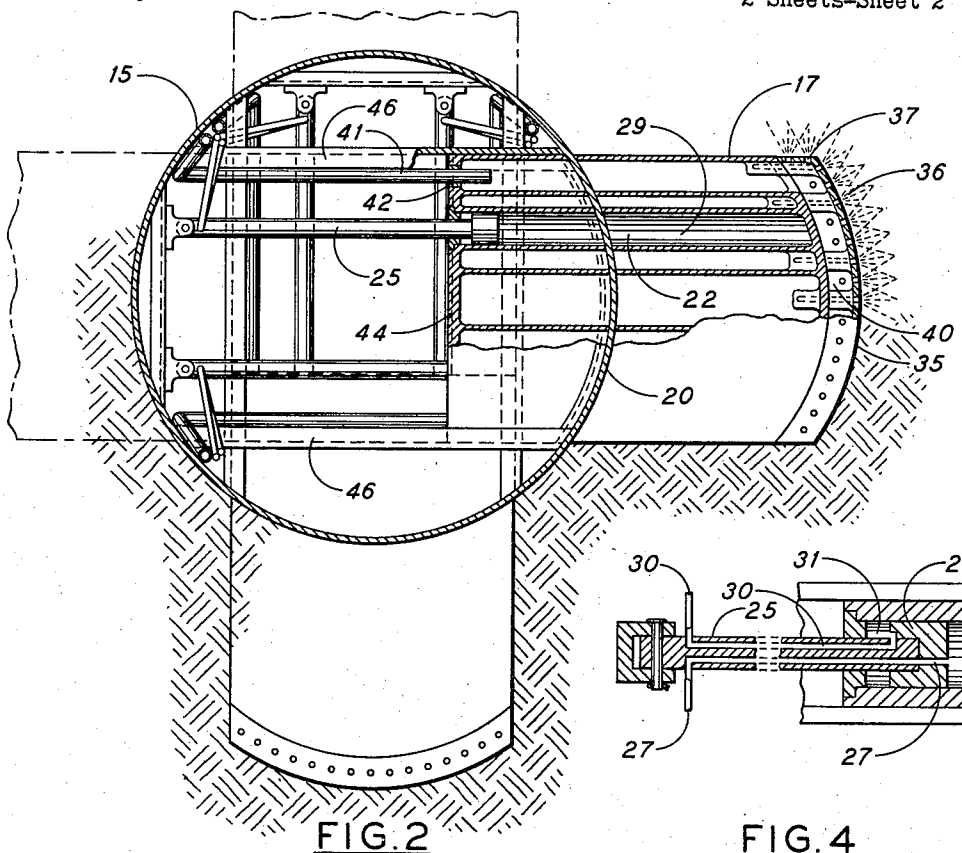


FIG. 2

FIG. 4

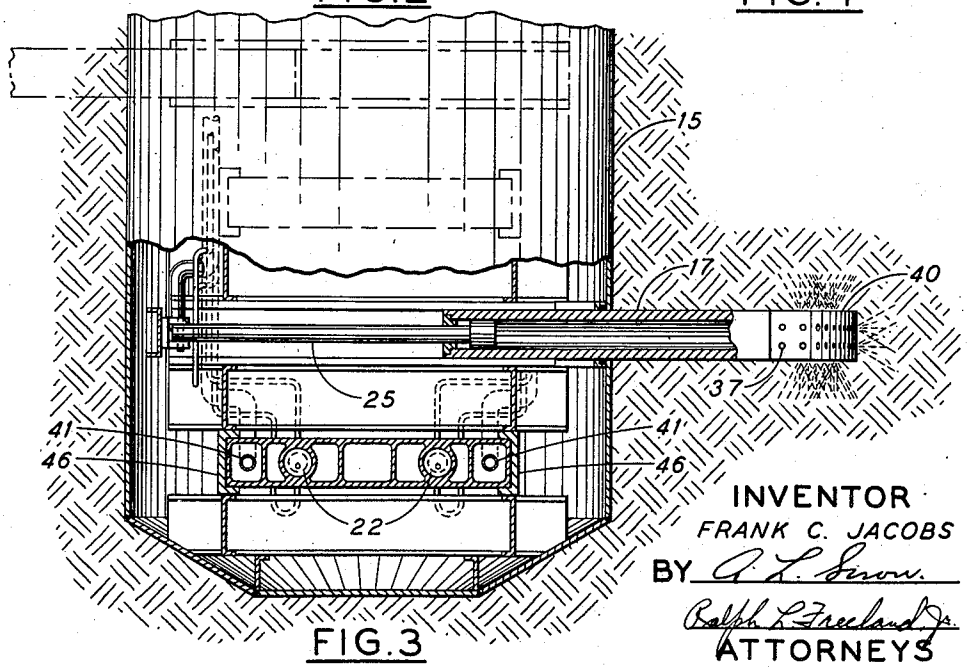


FIG. 3

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RETRACTABLE BEARING SHOES FOR CAISSONS

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Application May 19, 1954, Serial No. 430,882

2 Claims. (Cl. 61—46.5)

The present invention relates to a method of and apparatus for establishing a portable marine foundation of the caisson type, more particularly relates to a method of and apparatus for increasing the load-carrying capacity of a caisson in an unstable foundation bed to support an offshore drilling structure, and has for an object the provision of a structure adapted for deep water drilling which may be stabilized in an unstable foundation bed by providing laterally-extending, supporting shoes adapted to be extended and retracted within the over-all dimensions of the caisson.

In the drilling of oil wells in offshore locations where the water depth is from a few feet up to about 100 feet and the bottom is unstable, it has been found extremely difficult to provide a portable marine foundation which may be floated to the drilling location and then extended sufficiently deep into the unstable bottom, with a sufficient length of the caisson extending above water, to permit a drilling deck to be placed above wave height under storm conditions. The primary difficulty has been that the caissons or piles upon which the structure is supported must be driven into the unconsolidated bottom to the "refusal" point. That is, the piles are driven until they will not go deeper under a predetermined load. Such "refusal" point in many instances is so deep, with previously-known forms of equipment, that the depth of water in which drilling may be done has either been seriously restricted, due to the length and weight of the caissons, or the entire structure rendered non-portable after erection.

In accordance with the present invention, there is provided a method of stabilizing a caisson, adapted to support a structure above abnormal wave heights and capable of supporting the complete drilling structure on an unstable bottom, without undue lengthening of the caisson. In a preferred form of apparatus for carrying out the present method, a plurality of retractable plate, or shoe, members adapted to form spread footings for said caisson are spaced equally around the periphery of the caisson and held in a retracted position both during the lowering of the caisson into engagement with the underwater bottom and during the further vertical loading of the caisson to obtain lateral stability for said caisson in the underwater foundation material. Further in accordance with the invention, the retractable shoes may be forced outwardly into the foundation material to provide a greatly increased load-carrying area adjacent the lower part of the caisson, after the desired depth of the underwater formation has been penetrated. Jetting means may be provided for the laterally-extendible shoe members to assist in the extension thereof into the unstable media forming the foundation bed. Following the drilling of a well from a platform supported by caissons having the spread-footing shoes, the shoes may be retracted within the confines of the caisson periphery to permit the caisson to be withdrawn from bottom and again supported on a floatable structure for movement to another drilling site.

Further objects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings.

In the drawings:

Fig. 1 is an offshore drilling structure adapted to be supported upon caissons provided in accordance with the present invention with load-carrying, retractable shoe members, with said members being illustrated in their extended position.

Fig. 2 is a top plan view of the lower end of the caissons illustrated in Fig. 1, further illustrating a preferred form of the invention.

Fig. 3 is a side elevation of the lower end of a caisson, partially broken away, to illustrate the operating mechanism for the retractable shoes.

Fig. 4 is a detailed view of the hydraulic connections for the ram means employed in extending and retracting the shoe members.

Referring now to the drawings and in particular to Fig. 1, there is illustrated a floatable drilling foundation identified as barge **10**, capable of supporting an entire drilling structure, including derrick **11**, power drilling equipment indicated generally as **12**, drill pipe **13**, and hoisting equipment **14**. The barge **10** is adapted to float the complete drill rig to a desired drilling site. After floatable foundation **10** has arrived at its intended site, a plurality of caissons indicated generally as **15**, normally supported by the floating structure during the moving operation, are dropped downwardly through the wells **16** in the barge hull until the lower portion thereof engages the underwater bottom.

In the present embodiment, caisson members **15** are adapted to be jacked downwardly into the unstable bottom to a sufficient degree to provide lateral stability for the barge hull and to bring the hull above the surface of the water a sufficient distance so that the lower portion of the hull will not be within the normal range of waves at the drilling location. This distance is, of course, quite variable depending upon the total weight of the platform and the load-carrying capacity of the bottom.

Since the total weight of the entire drilling structure progressively increases as the depth of the well drilled from the foundation is increased, due to the addition of several tons of drill pipe which is supported by the structure, there is presented a serious problem in maintaining the height of the structure with caissons of even quite large diameter where the underwater bottom is not well consolidated. In accordance with the present invention, the load-carrying ability of these caissons upon which the drilling structure is supported is greatly increased by the provision of a plurality of laterally extendible and retractable bearing shoes **17**, which are adapted to be forced outwardly into the unstable bottom from the lower end of the caissons **15**.

An indicated, bearing shoes **17** are normally positioned within the caisson during the lowering thereof into the bottom and then may be extended to a desired degree to provide load support so that barge **10** may be raised above the water level and the barge totally supported on caissons **15**. Thus, shoes **17** provide a greatly expanded bearing load area adjacent the bottom of the caisson so that upon increasing the weight supported on drill barge **10** by the addition of drilling mud, drill pipe, and other load to the barge, the caissons need not be increased in length and correspondingly increased in weight. This latter advantage of the bearing shoe **17** is of particular importance when it is considered that the caissons may have a diameter as great as 15 feet and that the lineal weight of such caissons may be as much as a thousand pounds per foot of length.

It will be readily understood that the portability of the entire structure depends upon the lineal length of the caissons being held to a minimum. In accordance with

the present invention, it will be seen that the expansible bearing shoes 17 at the lower end of each of the caissons 15 may more than double the bearing load area of each caisson and accordingly reduce the square foot loading on the unstable bottom, wherein the caisson is positioned.

As particularly illustrated in Fig. 2, the bearing shoes 17 are adapted to pass through window openings 20, which may be positioned around the periphery of caisson 15. In the present embodiment, four shoes may be located as illustrated, each being positioned at 90 degrees around the periphery of caisson 15 and staggered at successive levels around the lower end of caisson 15. By this arrangement the bearing shoes may have a maximum area so that, when retracted, they are fully enclosed within caisson 15 and, when expanded outwardly into the underwater bottom, will provide a maximum bearing area.

Shoe 17 may be hydraulically extended and retracted by the hydraulic ram means, indicated generally as 22. In the present embodiment, a pair of these hydraulic ram means 22 is provided for each of the bearing shoes 17. Further, to increase the bearing area of shoes 17, ram means 22 is operated by hydraulic connections being made thereto through the connecting rods 25. This construction is particularly illustrated in Fig. 4, in which it will be observed that the inlet conduit 27 passes through the head of piston means 28 to feed, or withdraw, hydraulic fluid from the forward end of chamber 29, formed integrally with the bearing shoe 17. Fluid conduit means 30 may be connected to the rear portion 31 of chamber 29 through the side of connecting rod 25, immediately behind piston 28.

While not illustrated in detail, it will of course be understood that control valve means for regulating the flow direction of fluid through condits 27 and 30 may be selectively operated to permit the extension or retraction of any of the bearing shoes 17, independently of the other shoes, or to operate simultaneously all of the shoes. Indicating means, such as lights, operated in response to the portion of the individual shoes, may be provided adjacent the control valve means.

In the extension of bearing shoes 17 to increase the load-carrying capacity of caissons 15, jetting means are provided adjacent the leading edge 35 of bearing shoe 17, as well as along the upper and lower surfaces of the shoe. These jetting means are indicated generally as 36, and comprise a plurality of nozzles 37 formed in the leading edge 35 of shoe 17 and along the upper and lower surface to communicate with a chamber or header 40, to which the fluid is supplied under pressure by conduit 41 adapted to pass slidably through a shaft seal 42 at the rear edge 44 of the bearing shoe 17. The jetting means may also be employed to assist in retraction of shoes 17 by relieving the suction between said shoe and the formation after drilling. As illustrated, each of the bearing shoes 17 is further guided in its retraction and extension by guide rails 46 lying along the opposite sides of load-carrying shoes 17.

While the load-supporting or bearing shoes 17 have been illustrated as relatively flat members extendible, in a generally radial direction, outwardly from caisson 15, it will be understood that these extendible members may be varied considerably in their configuration without departing from the invention. Such laterally-extendible members, independent of their exact configuration, will, of course, provide stability for the caissons and permit said caissons to be shortened considerably while at the same time retaining their load-carrying function to support a fully-portable marine foundation. Accordingly, it will be seen that there has been provided a novel method of establishing a caisson-supported, portable foundation which may be entirely self-contained and which may be readily moved from one drilling site to another, without construction or reconstruction at either location.

While various modifications and changes in the method and the preferred form of apparatus for carrying out that method may be made without departing from the present invention, all such modifications and changes which fall within the scope of the appended claims are intended to be included therein.

I claim:

1. A retractable bearing shoe for a caisson footing comprising a shoe element having upper and lower walls forming respectively upper and lower planar surfaces extending transversely of the longitudinal axis of the caisson and slidably mounted on the caisson for extension through an opening in a peripheral wall thereof and retraction within said caisson, and end wall on said shoe element connecting said upper and lower walls, said end wall conforming in shape with the peripheral wall of said caisson to provide a continuous outer surface for said caisson when said shoe element is retracted, a first chamber formed within said shoe element and adjacent the said end wall thereof, jetting nozzles formed through the said walls of said shoe element and communicating with said first chamber, a conduit for jetting fluid supported by said caisson in fixed relationship thereto, a second chamber in said shoe element for receiving said conduit in telescopic relationship and communicating with said first chamber, a sealing means between the walls of said second chamber and said conduit to permit said conduit to slide relatively into and out of said second chamber in a fluid-tight relationship, a cylinder formed within said shoe element, a piston slidably mounted in said cylinder, a connecting rod connecting said piston to said caisson, means to introduce a pressure fluid alternately into each end of said cylinder to move said shoe element relative to said caisson, and means to introduce a jetting fluid into said conduit.

2. A retractable bearing shoe for a caisson footing comprising a shoe element having upper and lower walls forming respectively upper and lower planar surfaces extending transversely of the longitudinal axis of the caisson and slidably mounted on the caisson for extension and retraction in a plane transverse to the longitudinal axis thereof, an end wall on said shoe element connecting said upper and lower walls and disposed adjacent the outer peripheral wall of said caisson when said shoe element is retracted within said caisson, a chamber formed within said shoe element and adjacent the said end wall thereof, jetting nozzles formed through the said walls of said shoe element and communicating with said chamber, means to introduce a jetting fluid under pressure into said chamber while said shoe element is moved relative to said caisson, a cylinder formed within said shoe element, a piston slidably mounted in said cylinder, a connecting rod having one end connected to said piston and the other end connected to said caisson, a fluid conduit extending through said piston rod and communicating with one end of said cylinder, a second fluid conduit extending through said piston rod and communicating with the other end of said cylinder, and means to introduce a pressurized fluid alternately through said fluid conduits to extend said shoe element outwardly of the peripheral wall of said caisson and to retract said shoe element within said caisson.

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