United States Patent [19]

Mercier et al.

[11] **3,817,412**

[45] **June 18, 1974**

[54] **METHOD OF CONNECTING UNDERWATER INSTALLATIONS**

[75] Inventors: **Bernard M. Mercier**, St. Maur; **Francisco De A. M. Serrano**, Paris, both of France

[73] Assignee: **Subsea Equipment Associates Limited (SEAL)**

[22] Filed: **Oct. 20, 1972**

[21] Appl. No.: **299,551**

[30] **Foreign Application Priority Data**

Oct. 21, 1971 France 71.37808

[52] **U.S. Cl.** ..... **214/152**, 114/0.5 D, 212/3, 214/2.5, 214/13

[51] **Int. Cl.** **E21b 3/00**

[58] **Field of Search** ..... 214/12, 13, 14, 15 R, 15 E, 214/152, 2.5; 114/0.5 D; 29/428, 464, 468, 469; 212/3

[56] **References Cited**

UNITED STATES PATENTS

3,368,509	2/1968	Knight, Jr. et al.	114/0.5 D
3,422,971	1/1969	Wright	214/15 R
3,463,247	8/1969	Klein	214/2.5 X

FOREIGN PATENTS OR APPLICATIONS

1,124,425	7/1956	France	214/2.5

Primary Examiner—Frank E. Werner

Attorney, Agent, or Firm—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

A ship is provided with a through-hull well extending from the upper deck 3 through the main deck 2 to the ship's bottom. A derrick 4 is positioned on the upper deck above the well. To assemble a multi-unit load for lowering to the sea bottom, a sliding platform 10 at the main deck level is moved over the well opening. A sliding crane just below the upper deck then transports a first load unit from a storage area adjacent the well to the platform. The crane is then withdrawn, the load unit is restrained against lateral movement in vertical guides, and is raised up into the derrick. Additional load units are delivered in this manner to the platform and coupled to the unit(s) above it to produce the final load. The platform is then slid back from the well opening and the load is lowered by the derrick to the sea bottom.

3 Claims, 16 Drawing Figures

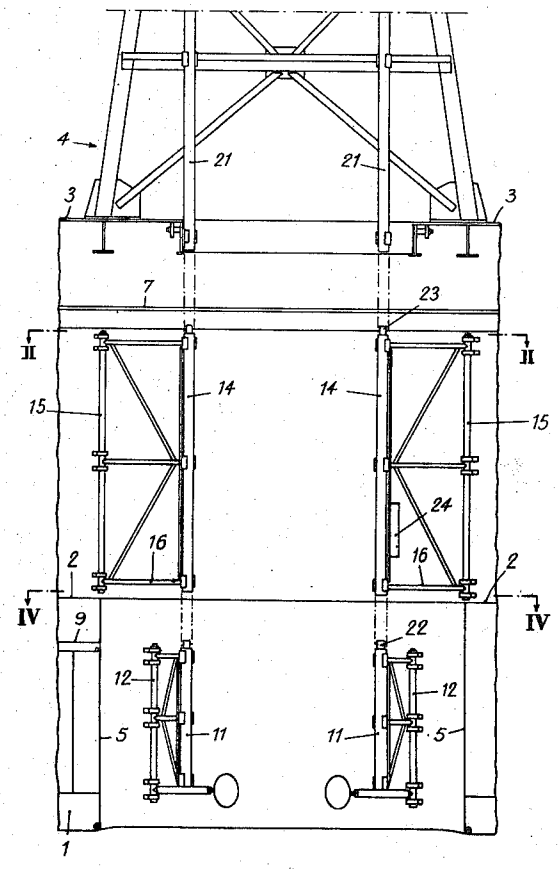


FIG. 1

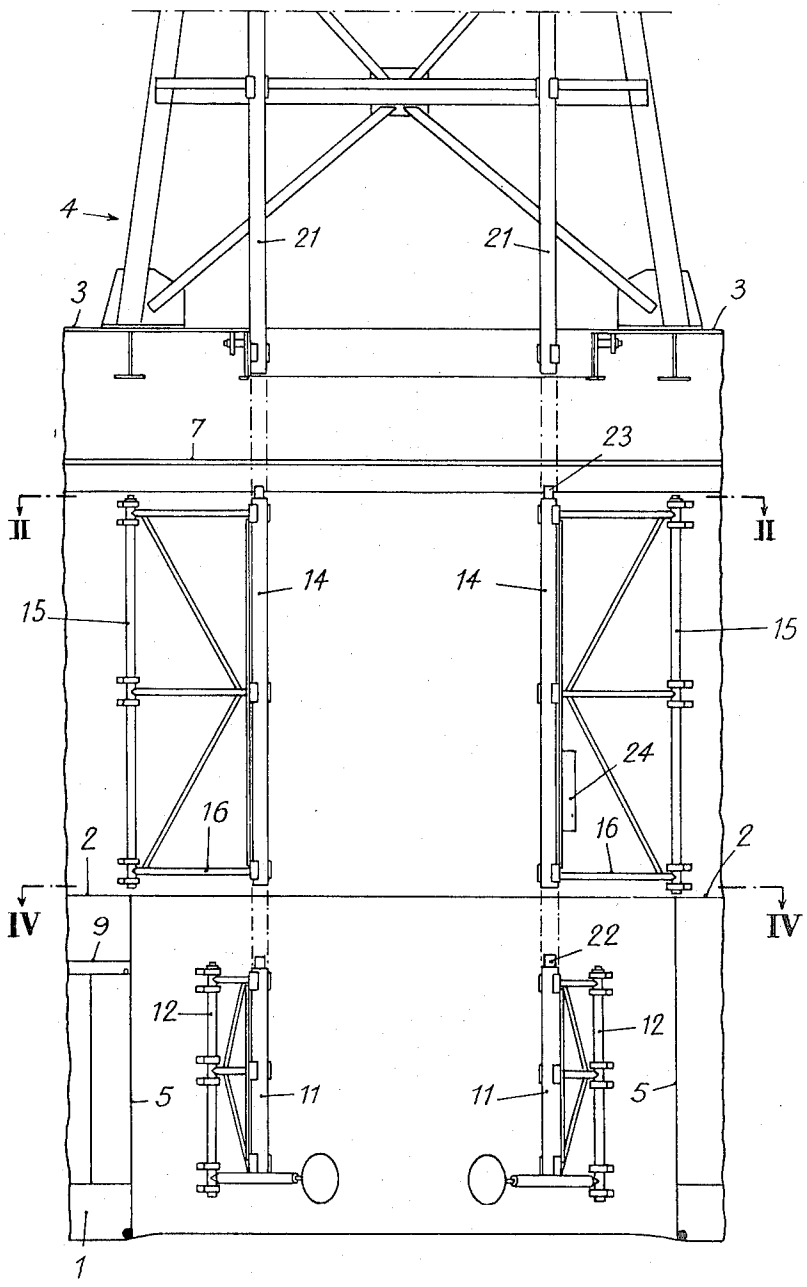


FIG. 2

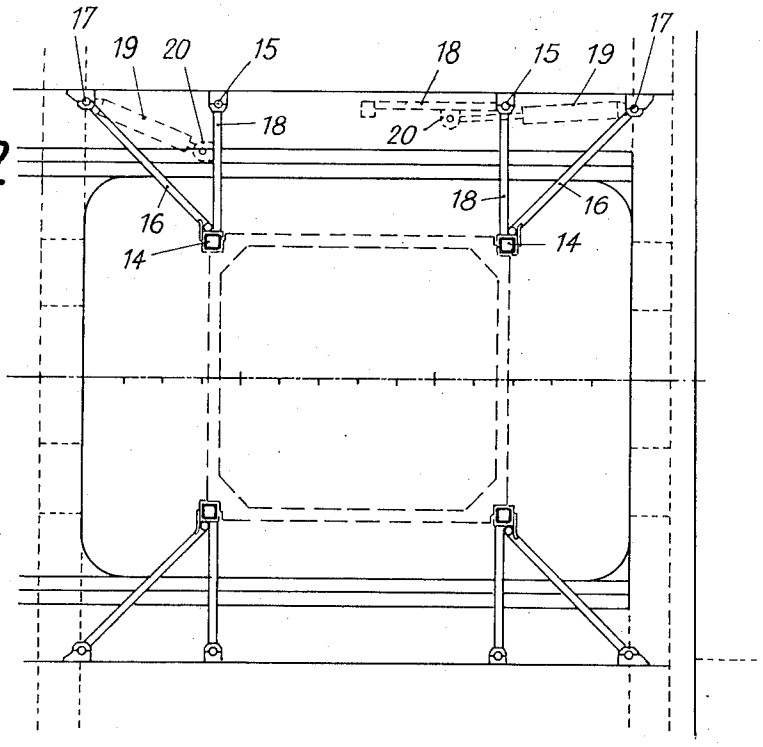

17
19
20
15
18
15
19
17
18
20
18
16
16
14
14

FIG. 4

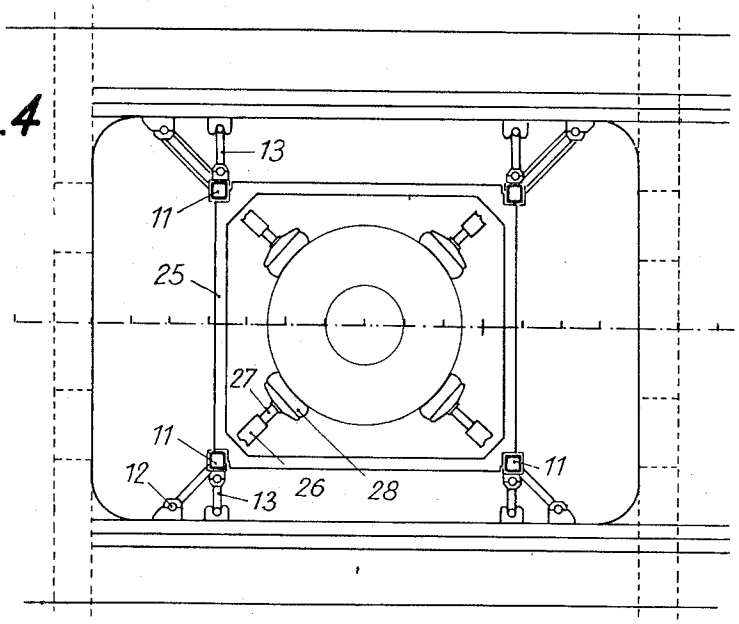

13
11
25
27
11
12
13
26
28
11

FIG. 3

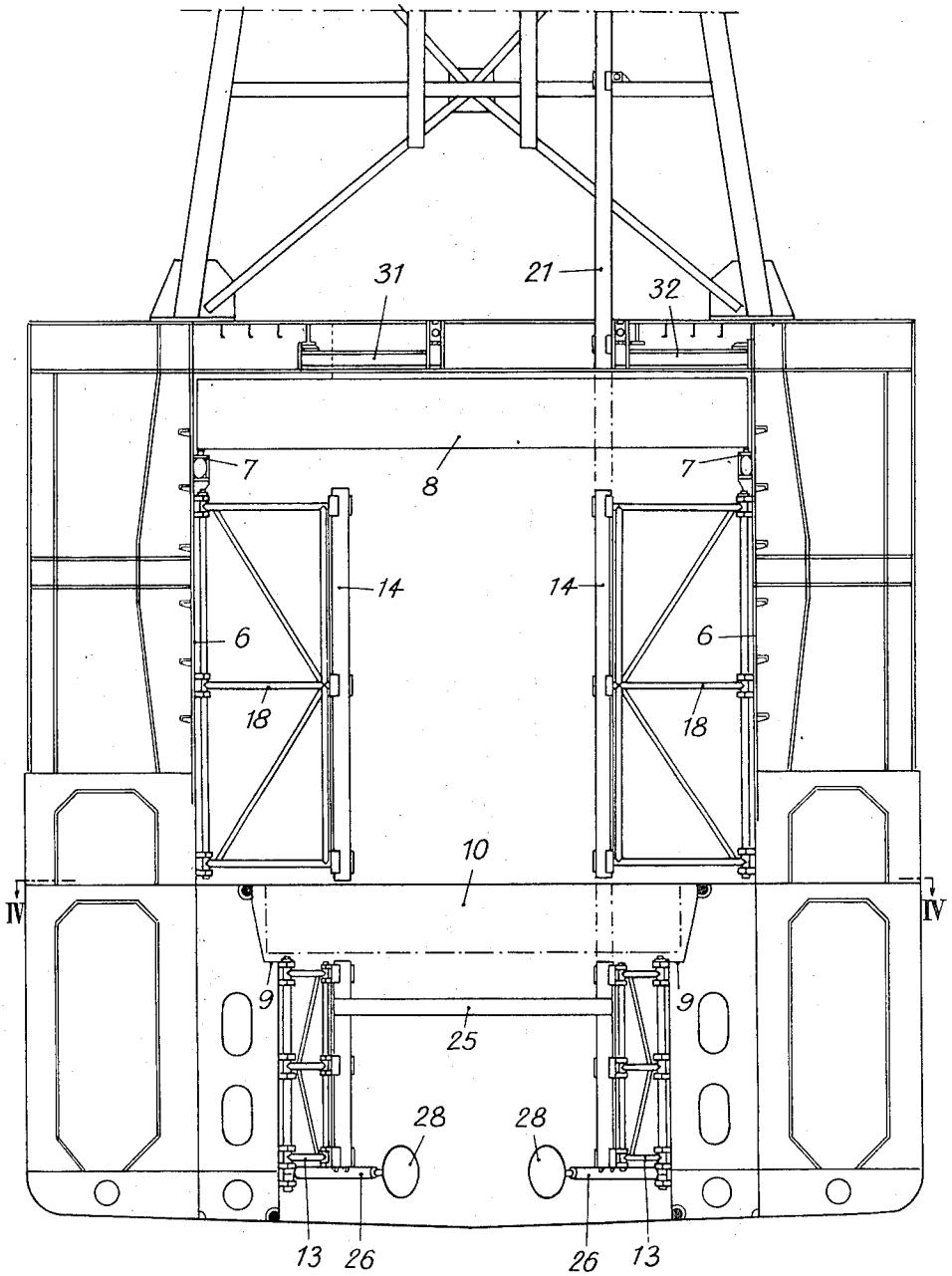


FIG. 5

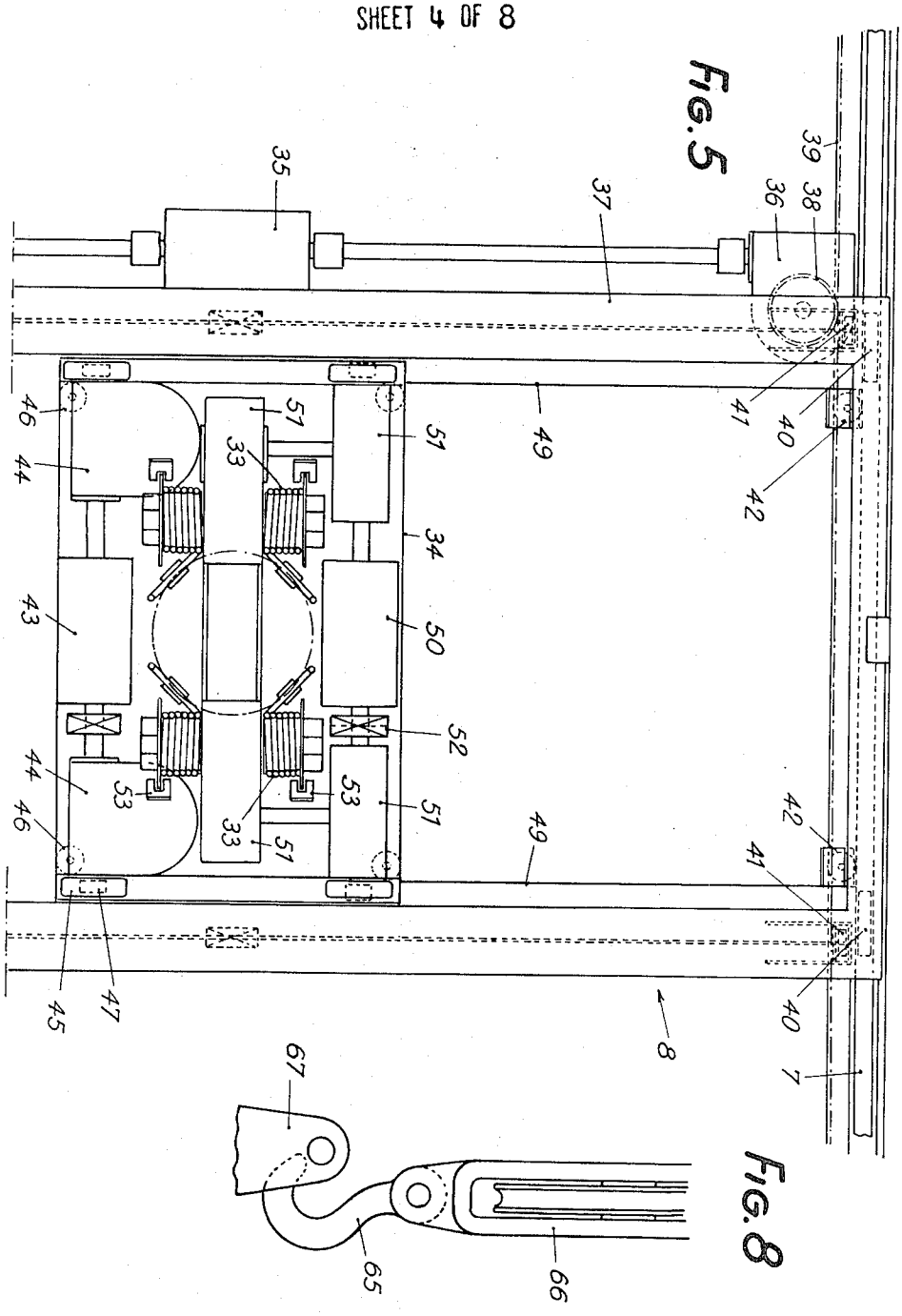


FIG. 8

FIG. 6

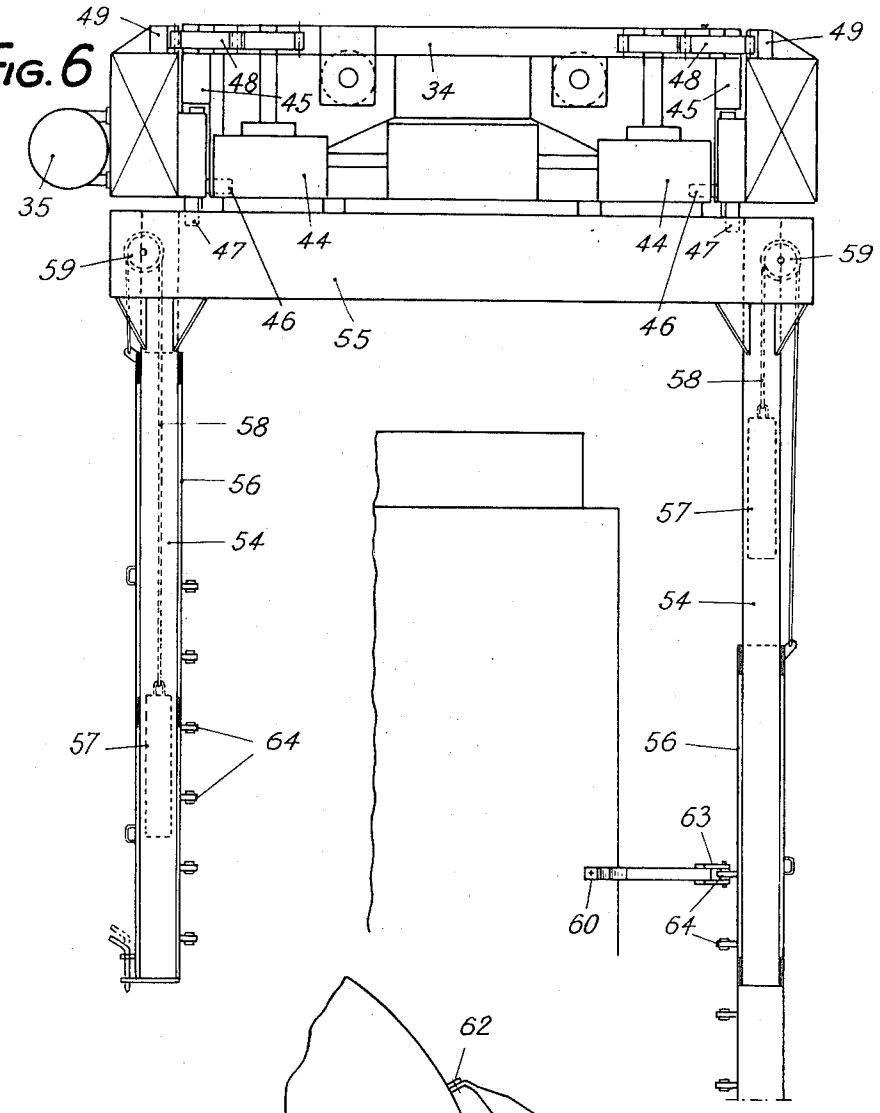


FIG. 7

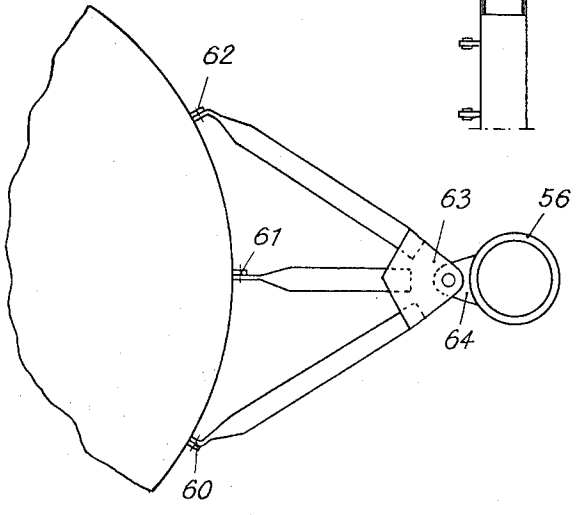


FIG. 9

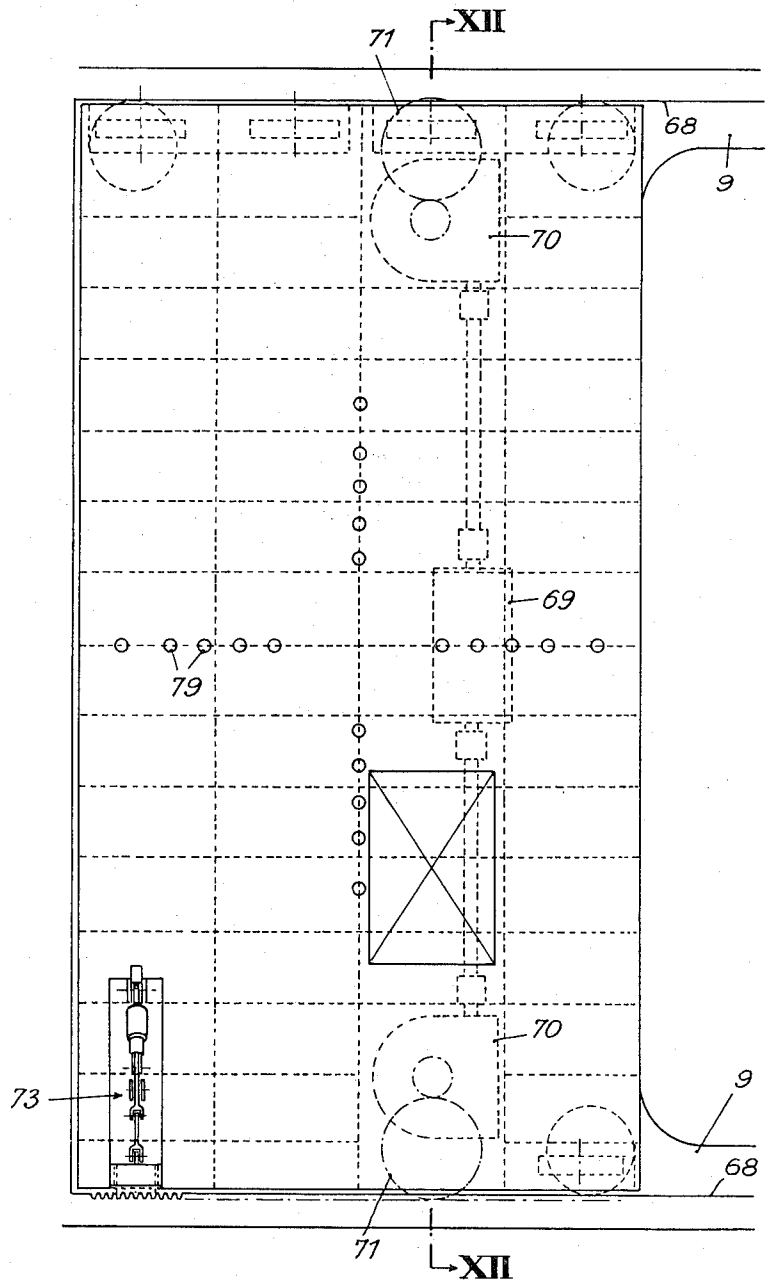


FIG. 13

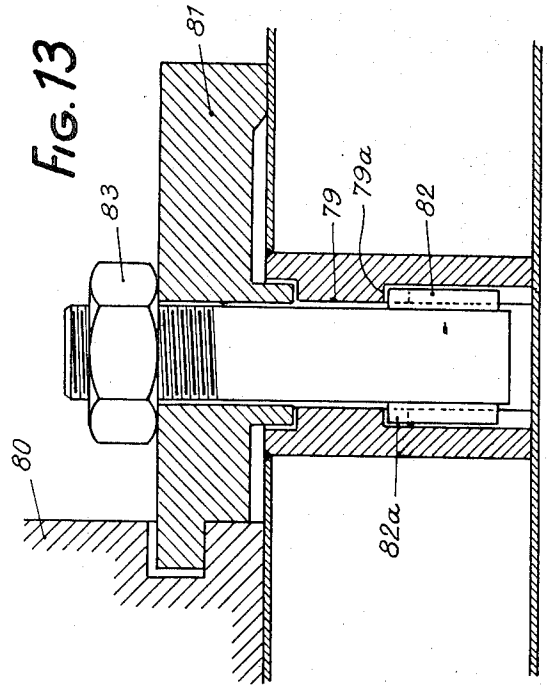


FIG. 10

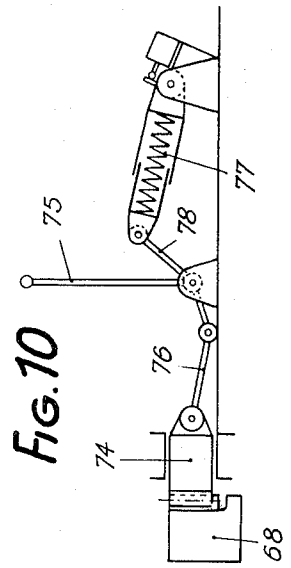


FIG. 11

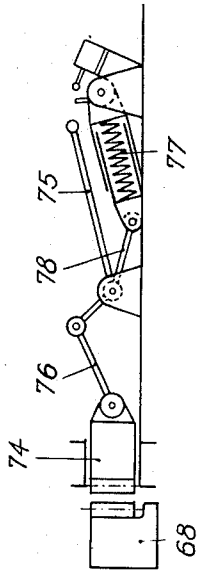


FIG. 12

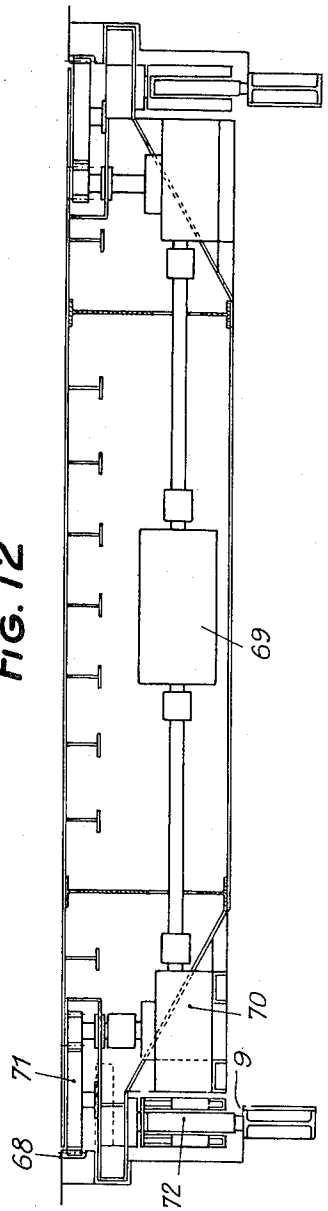


FIG. 14

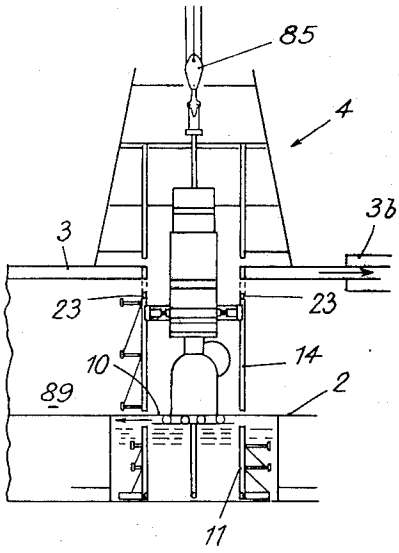


FIG. 15

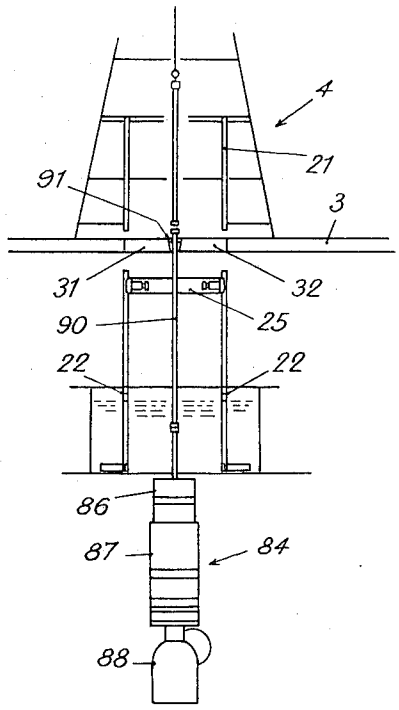
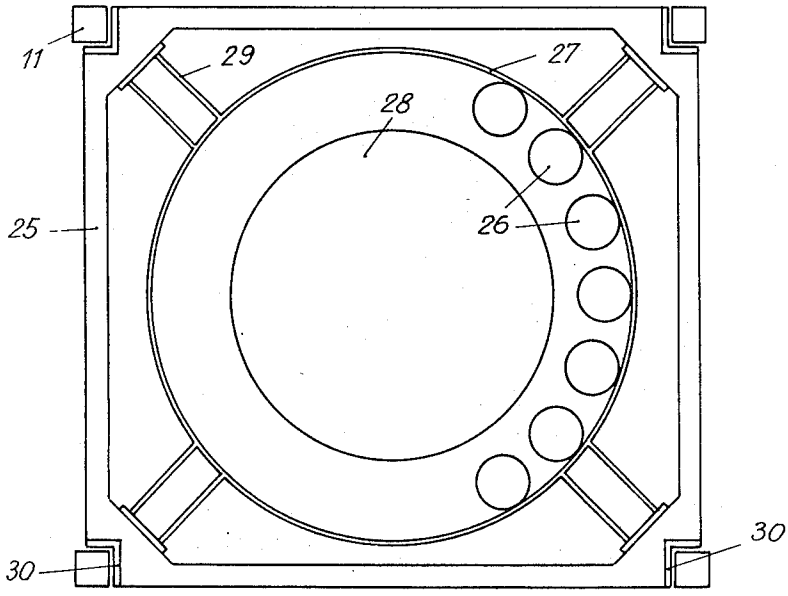


FIG. 16



METHOD OF CONNECTING UNDERWATER INSTALLATIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method and apparatus connecting up with underwater installations, such as an oil well, from a vessel or a drilling platform.

2. Description of the Prior Art

Various vessels are already known, capable of being employed for connecting up with oil wells, but these vessels are specially adapted for drilling and not for setting heavy equipment in place. Vessels can also be specially designed for a particular method of setting the underwater installation in place or of controlling the working of a well, but these vessels are very costly and do not enable the control of installations at depths exceeding **50** meters. As for fixed surface platforms comprising only a derrick and a well, none of them enable, in spite of heavy hoisting equipment, the rapid and easy placement of an underwater installation in deep water, this operation necessitating the transport, handling and precise setting in place of heavy and bulky units.

Moreover, the displacement of heavy loads on board ship cannot be carried out without special precautions since the surface vessel is subjected to pitching, rolling or yawing movements caused by ground swells and waves. In spite of the precautions taken, the heavy strains to which the hoisting equipment would be subjected during variations in acceleration of the loads prevent its use in the event of even small variations in the trim and list of the vessel. Furthermore, since heavy hoads cannot be raised and left free to shift laterally because of the obvious dangers incurred, the problem of handling heavy loads of 10 to 100 tons, for example, prohibits any work of setting in place or connecting up with underwater installations from being done as soon as significant pitching, rolling or yawing movements of the vessel appear.

SUMMARY OF THE INVENTION

According to the present invention there is provided a method of unloading an underwater apparatus from an installation on the water surface, whether subjected or not to the action of ground swells and waves, and comprising a deck carrying a derrick, a well straight below the latter and opening into a storage area below the deck, a platform capable of supporting and attaching the said loads positionable across the well, and load transport means in the storage area, the method comprising making a load fast with the transport means, transporting the load to the platform when the platform spans the well, making the load fast with the platform, disengaging the load from the transport means, which is moved back into the storage area, positioning lateral guide means in contact with the load connecting the load to the hoisting means of the derrick and disengaging it from the platform, drawing the platform back out of the well, and lowering the load down the well while guiding it laterally.

Such a method presents the advantages of being able to be easily applied to any ship, and in particular to any ship and drilling platform, of effecting permanent immobilization of the load being transported relative to its support in spite of movements of the surface installation, of being cheap from the customary means capable of being employed, and of enabling the assembly together of bulky loads above the installation well, even in the case of relatively reduced dimensions in the height of the ship.

In fact it is sufficient when hooking the first load onto the hoisting means of the derrick to bring this upwards above the well to be able to repeat the same maneuver as has just been described, and then to assemble the new load resting on the platform with the load carried by the derrick. It goes without saying that this method enables the assembly of any number of loads before the lowering of the whole unit produced.

The lateral guidance of the load in the well may be effected by surrounding it with a movable frame which is attached to the load at the level of its center of gravity and which is made to slide on vertical retractable guides.

The advantage of this method is in enabling the easy transport of heavy loads of any shape through the well in spite of the trim and list of the ship, the retractable guides enabling the passing of the load and its carrying means to the junction between the well and the store.

According to the invention there is further provided a system for effecting the above defined method of this invention which comprises a storage area, a well extending downward from through the storage area and a deck over the storage area carrying a derrick straight above the well, and a movable platform capable of adopting at least two positions:

one spanning the well to receive these loads, the other displaced from the well to permit passage of loads to the well, the platform having means for attaching loads thereto.

Such a system may be easily installed on drilling ships since these include a main deck through which the well passes.

The deck carrying the derrick may include a staging opening at right angles to the derrick, the latter having guide means in extension of the well guides.

This arrangement therefore enables the vertical assembly of a number of loads straight above the well, while, when the staging is in the closed position, allowing the use of any suitable means for screwing connecting tubes to the load or to the assembly of loads which are to be lowered to the seabed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a longitudinal section of the connecting-up system according to the invention on board a drilling ship, the fore and aft portions of which have been removed;

FIG. **2** shows a section along the line II—II in FIG. **1**;

FIG. **3** shows a transverse section of the coupling-up system;

FIG. **4** shows the section along the line IV—IV in FIG. **1**;

FIG. **5** shows a plan view of the bridge crane and its crab;

FIG. **6** shows an elevation of the bridge crane;

FIG. **7** shows a section of the device for attaching the load to the crab of the bridge crane, along the line VII—VII in FIG. **6**;

FIG. **8** shows an elevation of a load-retaining ear and a hook of the hoisting tackle of the bridge crane crab;

FIG. **9** shows a plan view of the platform;

FIGS. 10 and 11 show two diagrammatic views of the platform locking device in the locked and unlocked positions;

FIG. 12 shows a section along the line XII—XII in FIG. 9;

FIG. 13 shows a detail of the device for attaching the load to the platform;

FIG. 14 shows a diagrammatic view of the system showing the loads assembled on the platform;

FIG. 15 shows a diagrammatic view of the system in the course of lowering the loads; and

FIG. 16 shows a diagrammatic plan view of a collar for retaining the loads in the course of their vertical displacement.

Although the following description refers to a system mounted on a drilling ship, it will be understood that this system can be mounted on any suitable installation, such as a drilling platform, for example. It has therefore been considered unnecessary to show the whole drilling ship. The zone of the ship serving as the storage area can have any suitable dimensions. In the example shown, this zone is bounded by staging 2 of the main deck and an upper deck 3 on which is a derrick 4. This zone extends both fore and aft from a well, bounded laterally in its lower portion by bulkheads 5 and by bulkheads 6, FIG. 3, in its upper portion. In fact the zone might possibly extend only aft or only forward. A first horizontal rollway shown diagrammatically at 7 carries a bridge crane, shown diagrammatically at 8, FIG. 3. A second rollway 9 carries a working platform shown diagrammatically at 10.

The lower portion of the well contains vertical guides 11, FIGS. 1, 3 and 4, mounted on retractable frames swinging about mountings 12; arms 13 controlled by jacks (not shown), but like jacks 19 shown in FIG. 2, ensure locking of the frames when the guides 11 are in the working position.

Guides 14, FIGS. 1 to 3, likewise mounted on retractable frames 18 rotatable about mountings 15, provide guidance of loads in the upper portion of the well. Arms 16 swinging on mountings 17 ensure locking of the guides in the working position.

The arms 16 can be replaced by jacks 19 hinged to ears 20 and shown in dotted lines, FIG. 2, in the working position and in the parked or retracted position.

Upwardly retractable guides 21 in extension of the guides 14 provide guidance for loads in the interior of the derrick.

The guides 14 are movable vertically and can lift to connect with the guides 21 by means of spigots 23.

The guides 14 can be lowered to connect with the guides 11 by means of spigots 22. According to one variation, instead of slidable guides 14, guides fixed on their frames can be provided and independent retractable connections can be provided ensuring continuity of vertical guidance of loads in the course of their passing from the lower portion of the well to the upper portion and thence to the interior of the derrick, when the platform 10 and the bridge crane 8 are out of the well. The sliding guides 14 can be controlled by any device, motor or manual, and are balanced by means of a counterweight. The control device can be of any suitable kind known in the art and accordingly has been shown diagrammatically at 24.

The derrick can also be equipped with slidable guides 21 capable of connecting with the guides 14, the guides 14 or 21 having at their ends spigots or any other means facilitating the joining up.

In order to avoid any swinging to and fro of the loads in the course of their passing through the well and the derrick, a retaining collar 25 has been provided for, having any sort of device for laterally retaining the load being transported. By way of example the collar can be provided with jacks similar to those indicated by 26, the rods 27 of which have at their ends pads 28, such jacks 26 being provided to prevent impacts of the load against the hull of the ship at the end of the well. The pads 28 can be of any suitable type.

The retaining collar 25, as shown in FIG. 16, can, as an alternative to jacks, be provided instead with inflatable bolsters 26*a* preferably having walls of reinforced rubber. These bolsters 26*a* are distributed around a circle on a collar 27*a* fixed to the collar 25 by parts 29. The bolsters 26*a* are independently inflatable with water to ensure the centering of the load being transported. Thus the load and the collar 25 are made fast with one another, the latter sliding on the guides 11, 14 and 21 by shoes 30.

The passing of the load into the derrick is effected through a retractable staging, FIG. 3, composed of panels 31 and 32.

According to a preferred embodiment of the invention the axis of the well coincides with the axis of the platform and that of the supporting cables of the derrick tackle.

The bridge crane 8 servicing the storage area and the well is shown partially in plan in FIG. 5. Four winches 33 mounted on the crab 34 enable the loads to be raised by means of hooks 65, FIG. 8, attached to cables wound around the drums of the winches after passing over sheaves 66. The points of attachment of the cables to the crab constituting the fixed points of the tackle are adjustable and have elastic suspension devices. This arrangement enables the tensions in the cables to be equalized and the height of the hooks to be adjusted to the same level, thus facilitating the hooking on of the load by sling lugs 67.

The transfer movements of the crane in the longitudinal direction are effected by means of the motor 35, reduction gears 36 at each end of the gantry 37, driving pinions 38 and racks 39. The crane rests on the rollways 7 by means of supporting rollers 40, vertical and horizontal retention rollers 41 and 42 ensuring stability of the crane.

The motor 43 provides transfer of the crab across the crane by means of reducing gears 44, pinions, and racks 49. Supporting rollers 45 and horizontal and vertical retention rollers 46 and 47 ensure stability of the crab.

The drive of the drums of the winches 33 is effected by a motor 50 and reduction gears 51. A solenoid brake 52 controls the drive, and emergency brakes 53 enable rapid stopping of the hoist winches 33.

Two columns 54 arranged under the gantry 55 and integral with the crab 34, enable lateral retention of the loads being transported. The loads are restrained against any lateral movement by at least one of the columns. The latter are provided with sheaths 56 attached to counterweights 57 by means of cables 58 and pulleys 59. Attachment of the loads is effected by means of single detachable ears or multiple ones as shown in FIG. 7 at 60, 61, 62, these ears being integral with a support 63 that is attached to one of the ears 64 integral with

the sleeves **56.** The level of the sleeve is adjusted so that the fixing ear in use is practically at the level of the center of gravity of the load. An excellent immobilization of the load is thus obtained. It goes without saying that the method of attachment of the support **63** to the ears **64** can be of any kind and that the means shown are given only by way of example.

The rolling platform **10,** FIGS. **9** and **12,** is located in the floor of the store. The rollway **9** and racks **68** enable its displacement up to the front of the wall. Transfer motor **69** drives, through reducing gears **70,** driving pinions **71** engaging the racks **68.** Supporting rollers **72** roll on the way **9.**

Locking devices **73** shown in the locking position in FIG. **10** and the unlocking position in FIG. **11** keep the platform in the required position. A comb **74** is operated for this purpose to come into engagement with or disengage itself from the rack **68** by a lever **75** articulated to a link **76** and to a spring guide **77** by means of a cranked lever **78.**

Attachment points **79** more easily seen in FIG. **13** enable immobilization of a load **80** being transported by means of claws **81** held by means of bolts, projections **82***a* on which bear against stops **79***a* when a nut **83** tightens the claw **81.**

The system which has just been described enables the method of the invention to be illustrated. If the diagrammatic FIGS. **14** and **15** are referred to, a unit **84** is seen to be already assembled and suspended on the collar of hoisting tackle **85** of the derrick **4.**

Suppose the unit **84** is composed of three loads: **86, 87** and **88.** These loads are stored originally in zone **89** enclosed in the given example between the upper deck **3** and the main deck **2.** The platform **10** having been brought into the well, and the crab of the bridge crane into a position enabling hooking-on of the load **86,** the latter is attached to one ear of the sheath whose height is adjusted so that the ear is at the level of the center of gravity of the load. Then the crane is moved up to the well in order to deposit the load on the platform **10** and moved away again after fixing the load to the platform. If the guide rails **14** are not already out they are locked in the working position after the load has been enclosed in the retaining collar **25.** Having raised the sliding guides **14** and centered them on the spigots **23** to establish continuity with the guides **21,** the load is hooked onto the tackle **85** and the load **86** held by the collar **25** is raised into the derrick. The guides **14** are then lowered to enable the bridge crane to pass by again, which is employed as before to deposit the load **87** on the platform. After withdrawal of the crane the load **86** is lowered onto the load **87** in order to fix them to one another. Possibly the retaining collar **25** is moved to attach it preferably at the level of the center of gravity of the unit so composed. The same operation as before is performed to assemble the load **88** with the previous unit, then the platform **10** is brought back into the storage area and the unit **84** is lowered after having previously lowered the guides **14,** centering by the spigots **22** on the guides **11** in order to guide the unit as far as the end of the lower part of the passage at the bottom of the well. The retaining collar **25** can then be raised again as indicated in FIG. **15** and the opening panels **31, 32** can be closed again and employed with any sort of clamping device **91** for connecting pipes **90** to the unit that is being lowered to the seabed.

This method thus enables very heavy loads to be lowered and cumbersome loads to be transported after assembly in the well, which could neither be assembled in a storage area on the main deck of a ship of average tonnage nor easily erected underwater.

What is claimed is:

1. A method of unloading an underwater apparatus from an installation on the water surface subjected to the action of ground swell and waves and comprising a deck carrying a derrick, a well straight below the derrick and opening into a storage area below the deck, a platform capable of supporting and attaching loads positionable across the well, and load transport means in the storage area, the method comprising: making a load fast with the transport means, transporting the load to the platform when the platform spans the well, making the load fast with the platform, disengaging the load from the transport means, moving the transport means back into the storage area, positioning lateral guide means in contact with the load, connecting the load to hoisting means of the derrick, disengaging the load from the platform, drawing the platform back out of the well, and lowering the load down the well while guiding it laterally.

2. A method as in claim **1,** in which a frame is positioned around the load at the level of the center of gravity of the load and which is positioned by vertical guides during lowering.

3. A method as in claim **2,** in which the vertical guides are displaced away from the load during the application of the frame to the load.

* * * * *