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(54) **SHIPBORNE TRUSS COMBINED IN-SITU TESTING PLATFORM**

(57) A shipborne truss combined in-situ testing platform comprising: a truss load bearing frame (400), formed by vertically connecting a plurality of truss modules (410) in series; an operation platform (200), fixed at an upper end of the truss load bearing frame (400), a machine frame seat (204) used for installing an in-situ testing device (201) being disposed on the operation platform (200); a drive shoe (500) fixed at a lower end of the truss load bearing frame (400), the bottom of the drive shoe (500) being provided with shoe teeth (503); a catheter (600), successively penetrating the operation platform (200), the truss load bearing frame (400), and the drive shoe (500) along an up-down direction; and a centering device (300), comprising a plurality of soft ropes (302), one end of the soft rope (302) being connected to the upper end of the truss load bearing frame (400) or the operation platform (200).

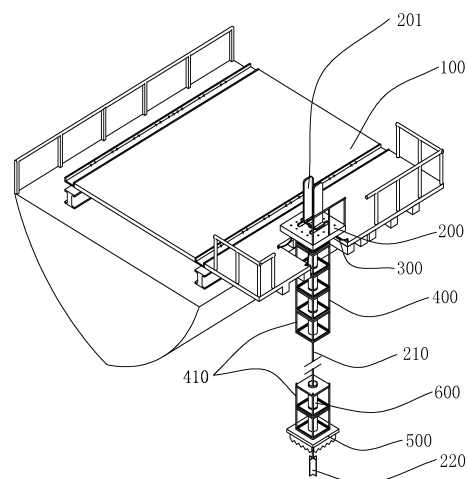


FIG. 1

Description

Background of the Present Invention

Field of Invention

[0001] The present invention relates to an operation platform for nearshore geotechnical engineering investigation, which ensures normal proceeding of conventional in-situ testing projects, e.g., marine static sounding, vane shear test, etc., and particularly belongs to a field test foundation platform for rock property of water area.

Description of Related Arts

[0002] An in-situ test of soil-rock mass refers to field testing rock layers by adopting an in-situ tester at the scene of the geotechnical engineering investigation, to obtain geotechnical parameters such as an intensity index of soil layer of shallow foundation, which is safer, more economic and reliable than the current conventional mode of drilling, sampling and laboratory test, and thus is of great significance and wide application value in the marine traffic engineering. As for some great marine traffic engineering, such as revetment, flood control, land reclamation and the like, especially as for overseas projects, it more and more depends on the field in-situ test project to obtain geotechnical parameters of subsoil, e.g. in-situ solidification, permeation, modulus, sensitivity, shear strength, etc., as well as to divide soil layers, distinguish soil property, determine bearing capacity of the subsoil and design parameters of a construction, etc. since the in-situ test is quick, intuitive, continuous, and no need for field exploration and sampling, the obtained index is more representative and reliability, and thus the in-situ test has become an indispensable exploration method in the engineering exploration.

[0003] The most commonly used in-situ tests in the project include static penetration test, vane shear test, etc. Currently, onshore in-situ testing techniques have been well developed, while the in-situ testing technique of water area of nearshore project unable to be widely popularized and applied since it requires a safe and static platform to perform offshore in-situ test (on sea), but the existing technologies adopt pile foundation and elevation typed platform to implement the in-situ test, which are subject to expensive cost constraint.

[0004] There is a kind of solution in the existing technology, that is, a Chinese utility model patent, with a patent number of 20042002020.4, has disclosed a water area in-situ testing bottom suction platform, where the overall platform is installed in advance, and then is hoisted by a crane of a mother vessel, such that the platform is set upright in water, which is approximate to land area static state platform effect. However, it is subject to operating water depth, space of the platform and loading effects, particularly that conventional measures, e.g., borehole cleaning of complex soil layers, partition of running casing, etc., are difficult to resolve.

[0005] The applicant has disclosed a platform system in a specification of a Chinese patent application for invention with a patent number of CN101643110A. The invention provides a simple, low-cost shipborne exploration platform system, which has triple drilling elevating capacity and 4~6 anchors of cross distribution for berthing, for underwater geotechnical engineering exploration, misering and sampling, so that the exploring work can be proceeded normally under various environmental conditions. However, when influencing by wind, wave, surge, flood-ebb fluctuations, etc., the shipborne exploration platform is waggled up and down, left and right, so that the in-situ testing project, which has to be located in a static operating platform, is difficult to proceed.

[0006] With the continuously expanding of engineering scale of offshore, longshore hydraulic structure, bridge, wharf, tunnel and the like, the geotechnical engineering investigation is more and more dependent on the geotechnical parameters provided by the in-situ test, therefore, it is urgently required for a operation platform of low-cost, high safe, easy in installation, fast in moving, and capable of withstanding wind, wave, tide and surge, so that to guarantee the normal proceeding of water in-situ test.

[0007] In the foregoing testing platform, it is capable to install an in-situ testing device used in various land areas, to facilitate the seaborne (waterborne) in-situ test. There are various types of such kind of in-situ testing device in the existing technology, e.g., a Chinese utility model patent with a patent number of CN201738295U has disclosed a static sounding probe, and a patent with a patent number of CN201622217U has disclosed a shear strength in-situ tester for deep sea soupground.

Summary of the Present Invention

[0008] The technology to be solved in the present invention is to provide a shipborne truss combined in-situ testing platform, which forms a static operating platform isolated from a dynamic shipborne exploration platform, thereby extending the mature land area in-situ testing technique to a nearshore waters.

[0009] In order to solve the foregoing technical problem, the present invention adopts the following technical solution: a shipborne truss combined in-situ testing platform comprises the following parts: a truss load bearing frame, formed by

vertically connecting a plurality of truss modules; an operation platform, fixed at an upper end of the truss load bearing frame; a machine frame seat used for installing an in-situ testing device being disposed on the operation platform; a drive shoe, fixed at a lower end of the truss load bearing frame, the bottom of the drive shoe being provided with shoe teeth; a catheter, successively penetrating the operation platform, the truss load bearing frame and the drive shoe along an up-down direction; and a centering device, comprising a plurality of soft ropes, one end of the soft rope being connected to the upper end of the truss load bearing frame or the operation platform.

[0010] Preferably, a bottom surface of the operation platform is vertically fixed with a plurality of pulley shafts, and the pulley shaft is provided with a pulley, one end of the soft rope is connected with the pulley.

[0011] Further, the pulley is provided with a pulley ring, one end of the soft rope is provided with a quick hook, and the quick hook is hooked to the pulley ring.

[0012] Preferably, it further comprises a shipborne exploration platform, the operation platform is above a top surface of the shipborne exploration platform, the shipborne exploration platform is fixed with a plurality of anchor piles, and the other ends of the plurality of soft ropes are respectively twined to the anchor piles.

[0013] Further, the shipborne exploration platform is provided with an exploration equipment having a drilling machine and a drilling tower.

[0014] Preferably, the truss module is of cuboid frame structure welded together by a transverse beam, a vertical beam, an upper frame plate and a lower frame plate, the truss module is also welded with a lifting lug.

[0015] Further, the vertical beam is a hollow column, the lower frame plate is provided with a location hole at the position corresponding with a lower end of the vertical beam, the upper frame plate is welded with a location pin at the position corresponding with an upper end of the vertical beam.

[0016] Further, the catheter is formed by a plurality of catheter sections sealed by couplings, a downmost catheter section is an underground catheter, and the underground catheter is welded to the drive shoe, a lower end of the underground catheter is provided with catheter teeth, each truss module is inside welded with a catheter section.

[0017] Further, the truss module and the operation platform, the truss module and the drive shoe, as well as two adjacent truss modules are detachable connected by bolts.

[0018] Preferably, the drive shoe comprises a bearing plate and a shoe rack, the shoe rack is downward stretched from a bottom surface of the bearing plate, the shoe teeth are located at a lower end of the shoe rack.

[0019] The present invention has the following beneficial effects:

(1) The in-situ testing platform of the present invention is erected at one side of the shipborne exploration platform, and is isolated with the shipborne exploration platform, and connectable with the shipborne exploration platform by a soft rope; when performing in-situ test, the in-situ testing platform may not be affected by the shaking of the shipborne exploration platform, so as to form a dual-platform operation mode of dynamic and static, thereby greatly decreasing the cost of exploration on water.

(2) The in-situ testing platform of the present invention is inside provided with a catheter, so that a protective layer is formed between the static operation platform and sludge surface of seabed (or riverbed), which prevents the drill pipe from being curved by the force of torrents during the in-situ test, and ensures the accuracy of the in-situ test data.

(3) The in-situ testing platform of the present invention adopts a modular construction, which is low-cost, easy in storage and transportation; each module is field assembled, with the result that the disassembly is easy, and there is no need of ancillary support equipments such as other ships, floating crane and the like.

(4) The present invention realizes a sharing of various exploration resource of the dual-platform, so that various kinds of in-situ test projects may be carried out in limited static operation platform space, and the in-situ test is ensured to be normally preformed under various depth of water, test depths as well as complicated work conditions.

(5) In the in-situ testing platform of the present invention, the truss load bearing frame and the drive shoe offer counter-force and twisting force for the static sounding test and the vane shear test, to satisfy the in-situ test requirement of various complicated holes and deep holes of strata in the marine traffic engineering.

(6) The present invention fully demonstrates a novel designing scheme of a shipborne static platform for achieving the in-situ test of nearshore water area.

Brief Description of the Drawings

[0020]

Figure 1 is a whole structural diagram of a shipborne truss combined in-situ testing platform in accordance with the present invention.

Figure 2 is a connection diagram of an operation platform and a centering device in accordance with the present invention.

Figure 3 is a structural exploded diagram of a truss module in accordance with the present invention.

Figure 4 is a structural exploded diagram of a catheter in accordance with the present invention.

Figure 5 is a structural diagram of a drive shoe part in accordance with the present invention.

Figure 6 is assembling and disassembling diagrams of a truss load bearing frame in accordance with the present invention.

[0021] In figures:

100 shipborne exploration mobile platform;	200 operation platform;	201 in-situ testing device;
202 handrail;	203 machine frame connecting hole;	204 machine frame seat;
210 drill pipe;	220 detection device;	300 centering device;
301 anchor pile;	302 soft rope;	303 pulley ring;
304 pulley;	305 pulley shaft;	400 truss load bearing frame;
401 connecting hole;	402 upper frame plate;	403 location pin;
404 lifting lug;	405 vertical beam;	406 location hole;
407 transverse beam;	408 lower frame plate;	409 bolt;
410 truss module;	415 walking beam;	418 lifting rope;
500 drive shoe;	501 bearing plate;	502 shoe rack;
503 shoe tooth;	600 catheter;	601 catheter section;
602 coupling;	603 sealing ring;	604 groove;
605 underground catheter;		606 catheter tooth

Detailed Description of the Preferred Embodiments

[0022] The present invention is further illustrated by combining with the specific embodiments, and persons skilled in the art may clearly understand other advantages and efficacies of the present invention.

[0023] It should be noted that the form, the scale, the size and the like shown in the drawings attached in this specification are all simply used to match with the content exposed by the specification for the skilled in the art understanding and reading, but not used to limit qualifications when the invention may be implemented. The change or the adjustment of the relative relation should also be seen as the scope of the invention when there is no substantial alteration in the technical content.

[0024] As shown in figure 1, a shipborne truss combined in-situ testing platform is erectable at one side of a shipborne exploration platform 100, and the shipborne exploration platform 100 may be provided with exploration equipments, e.g., a drilling machine and a drill tower, etc., and capable of geotechnical coring and sampling of underwater exploration. The testing platform comprises a truss load bearing frame 400, formed by vertically series connecting a plurality of truss modules 410; an upper end of the truss load bearing frame 400 is fixed with an operation platform 200, for installing an in-situ testing device 201, and for carrying out various in-situ tests; the operation platform 200 is slightly above a top surface of the shipborne exploration platform 100, a lower end of the truss load bearing frame 400 is fixed with a drive shoe 500, which is capable of inserting into a surface layer of sludge of seabed (or riverbed); a catheter 600 successively penetrates the operation platform 200, the truss load bearing frame 400 and the drive shoe 500 along an up-down direction; a drill pipe 210 and a detection device 220 of the in-situ testing device 201 enable to insert into the ground below the seabed (or riverbed) by the catheter 600, to perform the in-situ test. In order to guarantee that the truss load bearing frame 400 and the catheter 600 enable to perpendicular with the seabed (or riverbed), the present invention is also provided with a centering device 300, which comprises a plurality of soft ropes, and one end of the soft rope is connected with an upper end of the truss load bearing frame 400, or the operation platform 200.

[0025] As shown in figure 2, the operation platform 200 is provided with a machine frame seat 204, and the machine frame seat 204 is connected with the machine frame connecting hole 203 of the operation platform 200, so that the in-situ testing device 201 is fixed to the operation platform 200; around the operation platform 200 is surrounded with 1~4 handrails 202, to ensure the security of operating workers. The machine frame connecting hole 203 is distributed and arranged at the operation platform, for installing various types of in-situ testing devices, such as a static sounding instrument, a vane borer and the like. The machine frame connecting hole 203 is designed according to a size of the machine frame seat of a commonly used in-situ testing device, and different machine frame seat 204 corresponds with a machine frame connecting hole 203 at different position.

[0026] Refer to figure 2, in a preferable embodiment of the present invention, the centering device 300 comprises anchor piles 301, soft ropes 302, pulley rings 303, pulleys 304 and pulley shafts 305, where the four pulley shafts 305 are respectively vertically fixed at a bottom of the operation platform 200, and are respectively located in the forth and back, left and right directions; accordingly, the four anchor piles 301 are fixed to the shipborne exploration mobile platform

100 along the four directions. The pulley 304 is rotatably arranged at the pulley shaft 305, and the pulley 304 is provided with a pulley ring 303; one end of each of the four soft ropes 302 is provided with a quick hook, and the quick hook is hooked to the pulley ring 303, while the other end of the soft rope 302 twines around the anchor pile 301. The soft rope 302 refers to a rope having a certain flexibility and capability of bearing tension, and can be made of fibrous material or metal material.

[0027] As shown in figure 3, the truss modules 410 are of standard size with a unified size, and each truss module 410 of cuboid frame structure welded together by a transverse beam 407, a vertical beam 405, an upper frame plate 402 and a lower frame plate 408, the truss module is also welded with a lifting lug 404. The vertical beam 405 is a hollow column, the lower frame plate 408 is provided with four location holes 406 at the position corresponding with a lower end of the vertical beam 405, the upper frame plate 402 is welded with four location pins 403 at the position corresponding with an upper end of the vertical beam 405; when assembling two upper-lower adjacent truss modules, the location pin 403 penetrates into the location hole 406 of another truss module, so that the two adjacent truss modules are aligned and positioned; after that, the bolt 409 penetrates into the connection holes 401 of the upper frame plate 402 and the lower frame plate 408, so that the two adjacent truss modules are connected together. The truss module and the operation platform, the truss module and the drive shoe, as well as truss modules therebetween are detachable connected by bolts.

[0028] As shown in figure 3 and figure 4, the catheter is formed by a plurality of catheter sections 601 sealed by couplings 602, and inside each truss module 410 is welded a catheter section 601, inside the coupling 602 is provided a groove 604, inside the groove 604 is provided with a sealing ring 603, by which the two adjacent catheter sections 601 can be sealingly connected.

[0029] As shown in figure 1 and figure 5, a downmost catheter section forming the catheter is an underground catheter 605, and the underground catheter 605 is welded to the drive shoe 500; a lower end of the underground catheter 605 is provided with catheter teeth 606. The above catheter section 601 and the underground catheter 605 are interconnected, to form a long catheter 600; the whole catheter 600 extends to a sludge surface of seabed (or riverbed) from the operation platform, thereby preventing the drill pipe 210 from being curved by the force of torrents during the in-situ test, and preventing the influence on the test data. As for complex terrain, such as sand layer and gravel layer, it is required for slurry to clear hole and dado, while since the catheter 600 is sealed, the circulation of slurry is guaranteed.

[0030] As shown in figure 5, the drive shoe 500 comprises a bearing plate 501 and a shoe rack 502, the shoe rack 502 is downward stretched from a bottom surface of the bearing plate 501, a lower end of the shoe rack 502 is provided with shoe teeth 503. The bearing plate 501 is used for contacting with the sludge surface of seabed (or riverbed), to provide support for the in-situ testing platform. The four shoe racks 502 at the bottom of the bearing plate 501 are circled to form a rectangle, which may provide anti-torsion for the vane shear test. The truss module connecting with the drive shoe 500 may adopts a weighting truss module, which adopts a thicken upper frame plate, lower frame plate and transverse beam, and also may provide appropriate counter-force for the in-situ cone penetration of complex soil layer and deep hole.

[0031] Hereinafter, the installation and application method of the shipborne truss combined in-situ testing platform of the present invention will be illustrated.

[0032] As shown in figure 1 and figure 6, after an exploration operation ship is field anchored, the drive shoe 500 starts to connect and fix to the truss module 410 on the shipborne exploration platform 100 according to the in-situ testing project and the underground depth; then the truss modules 410 are lifted to one side of the shipborne exploration platform 100 and assembled successively according to the depth of water. During the assembling process, a lifting rope 418 is hooked with a lifting hug 404, and lifts a truss module 410, which will be lay down till aligning with the location pin 403 of the truss module 410 below, then the bolt 409 penetrates the connection holes of the upper frame plate and the lower frame plate, and screws and connects with a nut. Lift several integrated truss modules 410, remove the supporting walking beam 415, then lay down the truss modules 410, and reinsert the supporting walking beam 415, and repeat the foregoing process until the in-situ testing platform is installed.

[0033] During the installation process, the in-situ testing platform is erected in the slurry surface of the seabed (or riverbed), and has to keep the vertical state; when it inclines and requires for adjustment, the in-situ testing platform is adjusted by veer and haul of each soft rope 302, to keep in a vertical state. After the in-situ testing platform is installed in place to perform the in-situ test, loosen the soft rope 302, make another end of the soft rope 302 twine the four anchor piles 301 of the shipborne exploration platform 100, so that the in-situ testing platform is isolated with the shipborne exploration platform 100 and is in a static state, and the whole in-situ testing platform is in a controlled state.

[0034] When performing the static penetration test, the in-situ testing platform should take a counter-force design into consideration, i.e., self-weight of the platform, buoyancy in water and influence of wave, and several weighting truss modules may be added to form the in-situ testing platform as required.

[0035] The present invention adopts a modular design, and is low-cost, convenient in installation, easy in storage and transportation, and can be recycled. According to the depth of water in the field, one can determine the number of truss modules required for the in-situ testing platform, assemble and install in the operation field, so as to quickly form the shipborne truss combined in-situ testing platform. The invention substantially realizes that several in-situ testing holes

can be accomplished in a one-time assembly. Together with the shipborne exploration platform, the invention forms a dual-platform operation mode of dynamic and static, thereby achieving a sharing of various exploration resource, and greatly decreasing the cost of exploration on water; and the in-situ test is ensured to be normally preformed under various depth of water, test depths as well as complicated work conditions.

Claims

1. A shipborne truss combined in-situ testing platform, comprising the following parts:

a truss load bearing frame (400), formed by vertically connecting a plurality of truss modules (410);
 an operation platform (200), fixed at an upper end of the truss load bearing frame (400); a machine frame seat (204) used for installing an in-situ testing device (201) being disposed on the operation platform (200);
 a drive shoe (500), fixed at a lower end of the truss load bearing frame (400), the bottom of the drive shoe (500) being provided with shoe teeth (503);
 a catheter (600), successively penetrating the operation platform (200), the truss load bearing frame (400) and the drive shoe (500) along an up-down direction;
 a centering device (300), comprising a plurality of soft ropes (302), one end of the soft rope (302) being connected to the upper end of the truss load bearing frame (400) or the operation platform (200).

2. The in-situ testing platform according to claim 1, **characterized in that**, a bottom surface of the operation platform (200) is vertically fixed with a plurality of pulley shafts (305), and the pulley shaft (305) is provided with a pulley (304), one end of the soft rope (302) is connected with the pulley (304).

3. The in-situ testing platform according to claim 2, **characterized in that**, the pulley (304) is provided with a pulley ring (303), one end of the soft rope (302) is provided with a quick hook, and the quick hook is hooked to the pulley ring (303).

4. The in-situ testing platform according to claim 1, **characterized in that**, it further comprises a shipborne exploration platform (100), the operation platform (200) is above a top surface of the shipborne exploration platform (100), the shipborne exploration platform (100) is fixed with a plurality of anchor piles (301), and the other ends of the plurality of soft ropes (302) are respectively twined to the anchor piles (301).

5. The in-situ testing platform according to claim 4, **characterized in that**, the shipborne exploration platform (100) is provided with an exploration equipment having a drilling machine and a drilling tower.

6. The in-situ testing platform according to claim 1, **characterized in that**, the truss module (410) is of cuboid frame structure welded together by a transverse beam (407), a vertical beam (405), an upper frame plate (402) and a lower frame plate (408), the truss module (410) is also welded with a lifting lug (404).

7. The in-situ testing platform according to claim 6, **characterized in that**, the vertical beam (405) is a hollow column, the lower frame plate (408) is provided with a location hole (406) at the position corresponding with a lower end of the vertical beam (405), the upper frame plate (402) is welded with a location pin (403) at the position corresponding with an upper end of the vertical beam (405).

8. The in-situ testing platform according to claim 6, **characterized in that**, the catheter (600) is formed by a plurality of catheter sections (601) sealed by couplings (602), a downmost catheter section is an underground catheter (605), and the underground catheter (605) is welded to the drive shoe (500), a lower end of the underground catheter (605) is provided with catheter teeth (606), each truss module (410) is inside welded with a catheter section (601).

9. The in-situ testing platform according to claim 6, **characterized in that**, the truss module (410) and the operation platform (200), the truss module (410) and the drive shoe (500), as well as two adjacent truss modules (410) are detachable connected by bolts (409).

10. The in-situ testing platform according to claim 1, **characterized in that**, the drive shoe (500) comprises a bearing plate (501) and a shoe rack (502), the shoe rack (502) is downward stretched from a bottom surface of the bearing plate (501), the shoe teeth (503) are located at a lower end of the shoe rack (502).

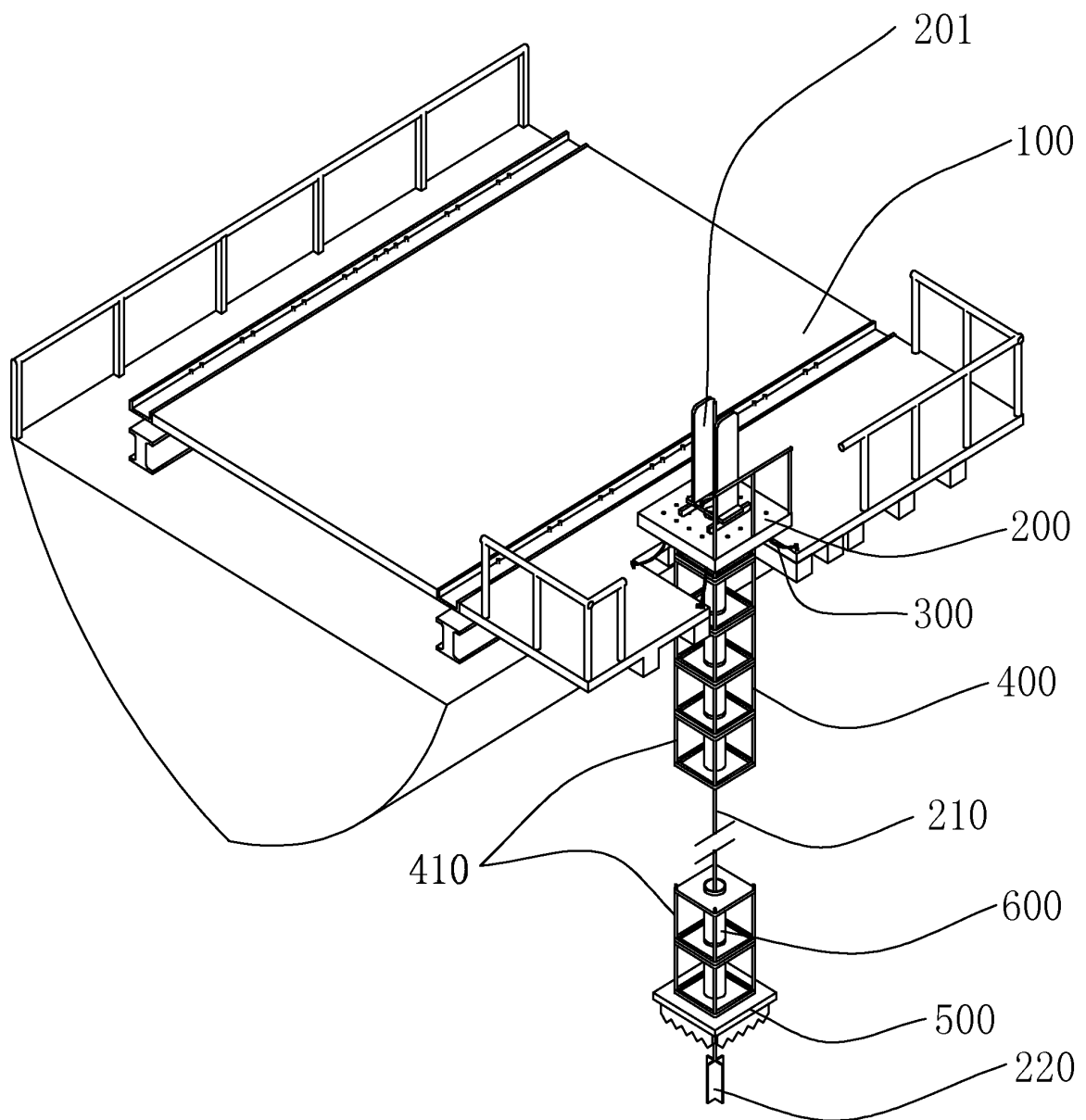


FIG. 1

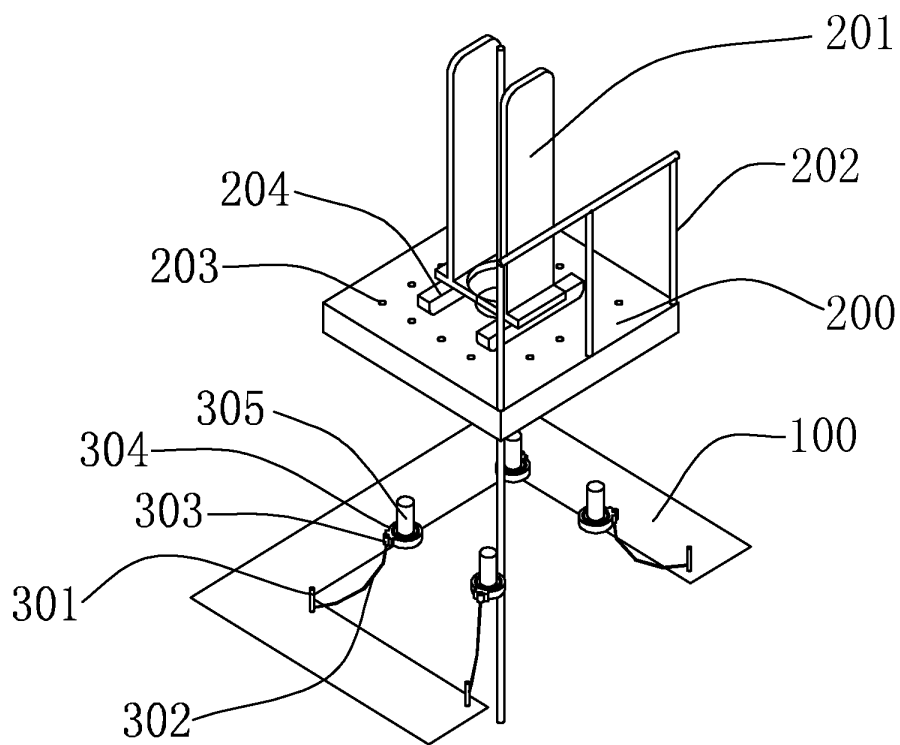


FIG. 2

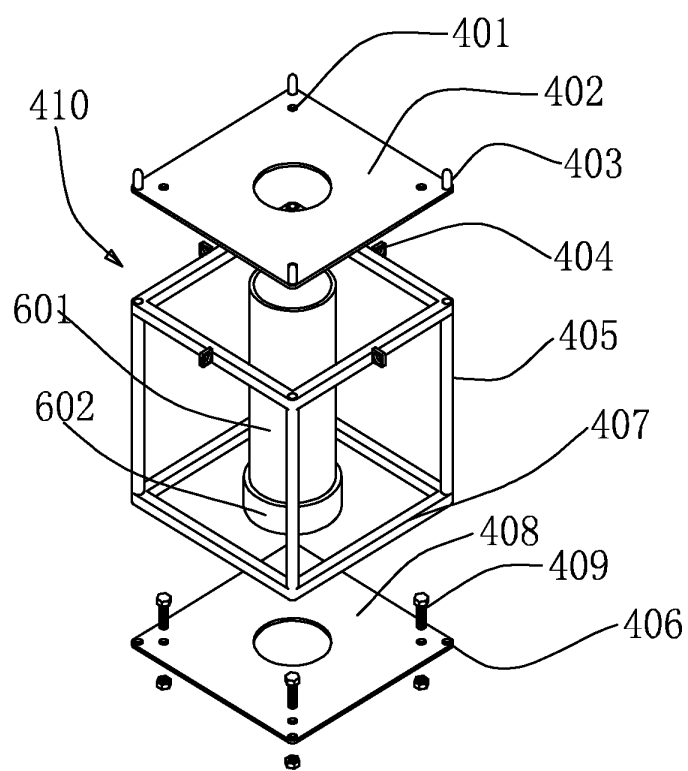


FIG. 3

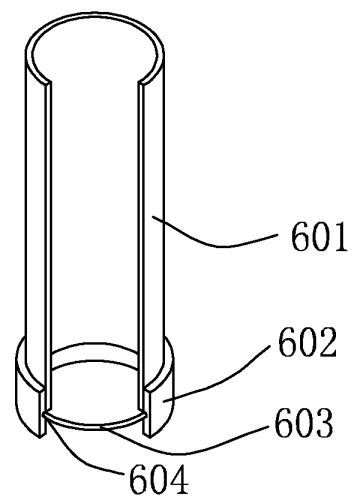


FIG. 4

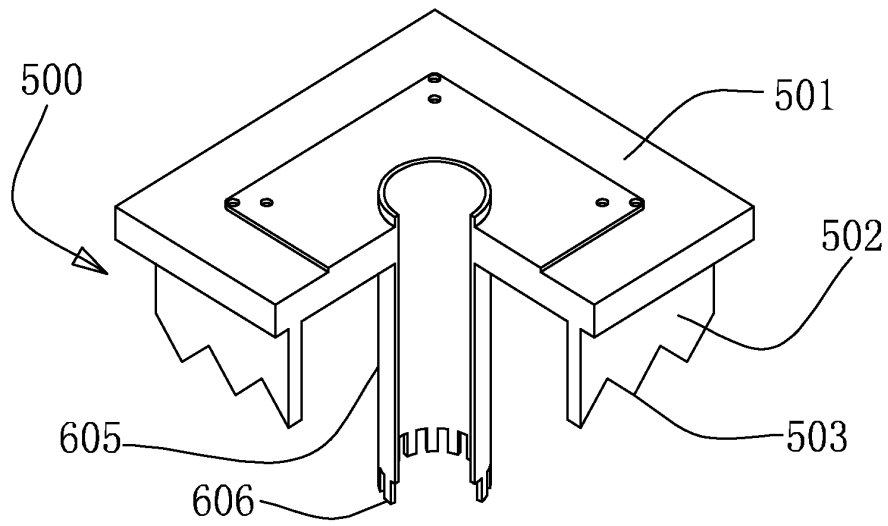


FIG. 5

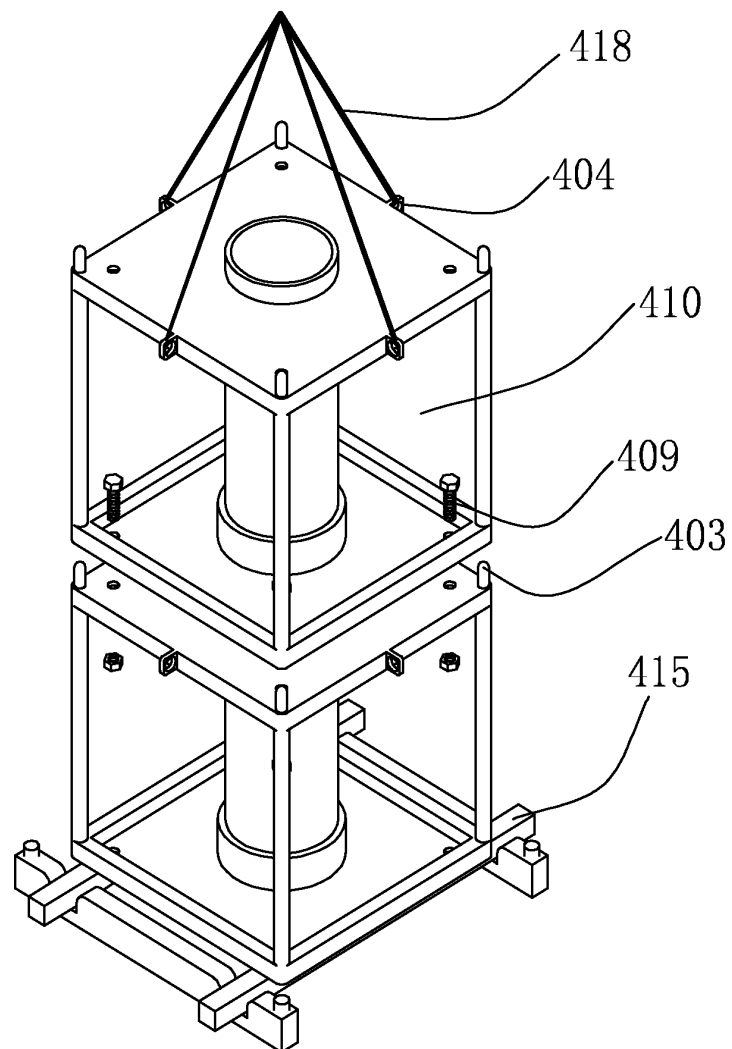


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/087102

A. CLASSIFICATION OF SUBJECT MATTER

E02D 1/00 (2006.01) i; B63B 35/44 (2006.01) i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E02D 1; B63B 35; E21B 49

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CPRSABS; VEN: CCCC THIRD HARBOR, NIU Jianding, CHENG Limin, TANG Zhongqing, CHENG Zekun, CAI Hongbo, HU Jianping, WANG Nianxi, ZHANG Cheng, XU Wei, submarine, tube, level, floor, testing, survey+, test, plate, water, e02d, vane, cone, exploration, b63b, measur+, in, investigat+, deck, surface, pipe, pile, fram+, vessel, reconnaissance, VST, guiding, flatform, underwater, girder, marine, conduct, checkout, plain, flatbase, penetration, table, sea, gallery, situ, truss, shear, grillage, prov+, shoe, terrace, platform, submersed, flat, guide, conduit, ocean, stage

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 101643110 A (CCCC THIRD HARBOR CONSULTANTS CO., LTD.) 10 February 2010 (10.02.2010) claims 1-10 and figure 1	1-10
A	CN 201633890 U (CHINA NAT ADMINISTRATION COAL GEOLOGY HY) 17 November 2010 (17.11.2010) the whole document	1-10
A	CN 201512098 U (CHINA WATER NORTHEASTERN INVESTIGATION D) 23 June 2010 (23.06.2010) the whole document	1-10
A	JP 2008223378 A (SHIMIZU CONSTRUCTION CO LTD) 25 September 2008 (25.09.2008) the whole document	1-10
A	JP 2010242369 A (KAJIMA CORP et al.) 28 October 2010 (28.10.2010) the whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex

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Date of the actual completion of the international search 23 April 2014	Date of mailing of the international search report 26 May 2014
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer YAN, Junxia Telephone No. (86-10) 62084950

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