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(54) **TOP LOADED BIDIRECTIONAL TESTING SYSTEM AND METHOD OF USING THE SAME**

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See application file for complete search history.

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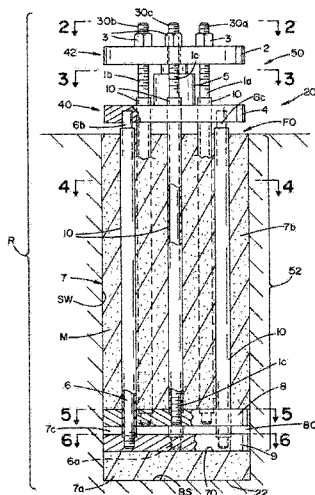
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(57) **ABSTRACT**

A testing system for load test measuring a shaft resistance and a base resistance having first and second operating units with the first operating unit having a bottom loading plate, a base bearing plate and base mobilizer bars operably joined thereto; the second operating unit having a top loading plate, a shaft bearing plate and shaft mobilizer bars operably joining them together wherein the first and second operating units can move relative to one another; the system having a loading sources producing a test load between the top and bottom loading plates to move them apart wherein the shaft bearing plate that is positioned below a foundation element produces an upward compressive force test load on the foundation element to test shaft resistance and the base bearing plate that is positioned between the shaft bearing plate and the bottom surface of the foundation opening produces a downward compressive force test load on the bottom surface to test base resistance.

**26 Claims, 15 Drawing Sheets**



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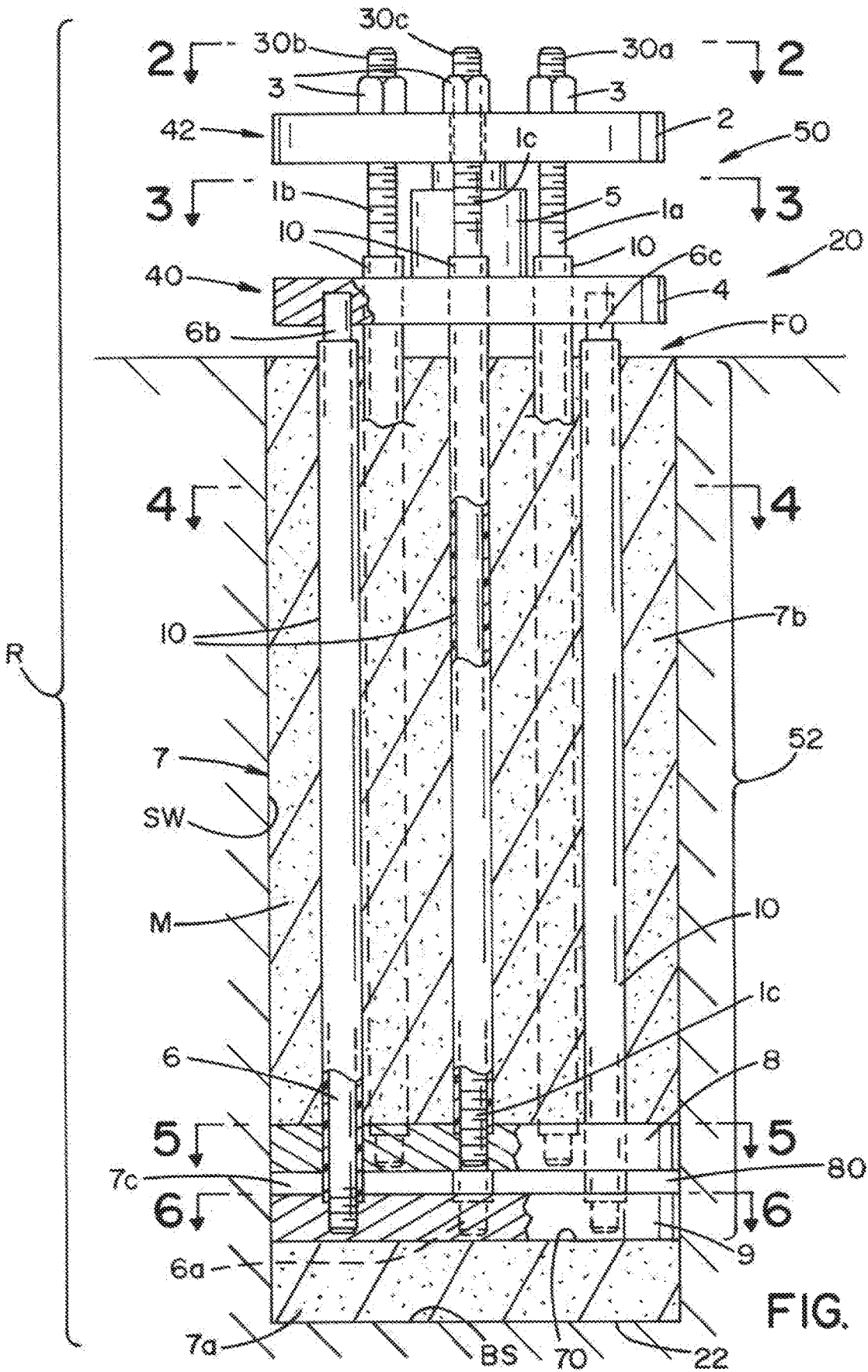
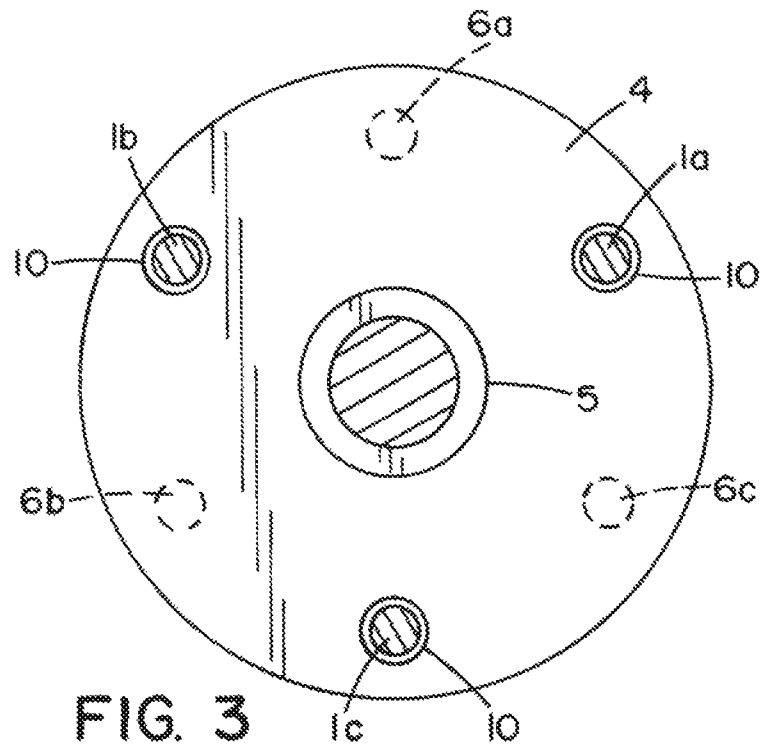
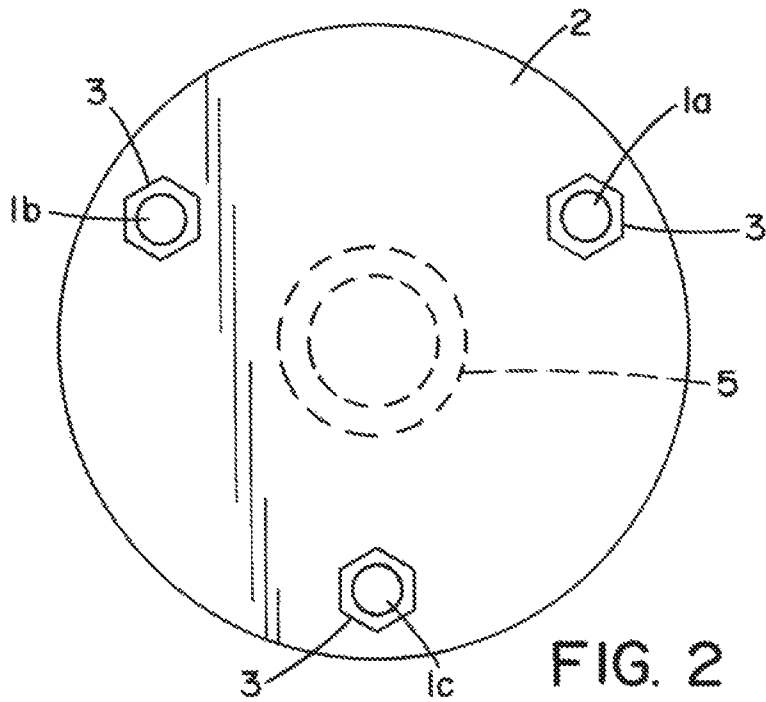
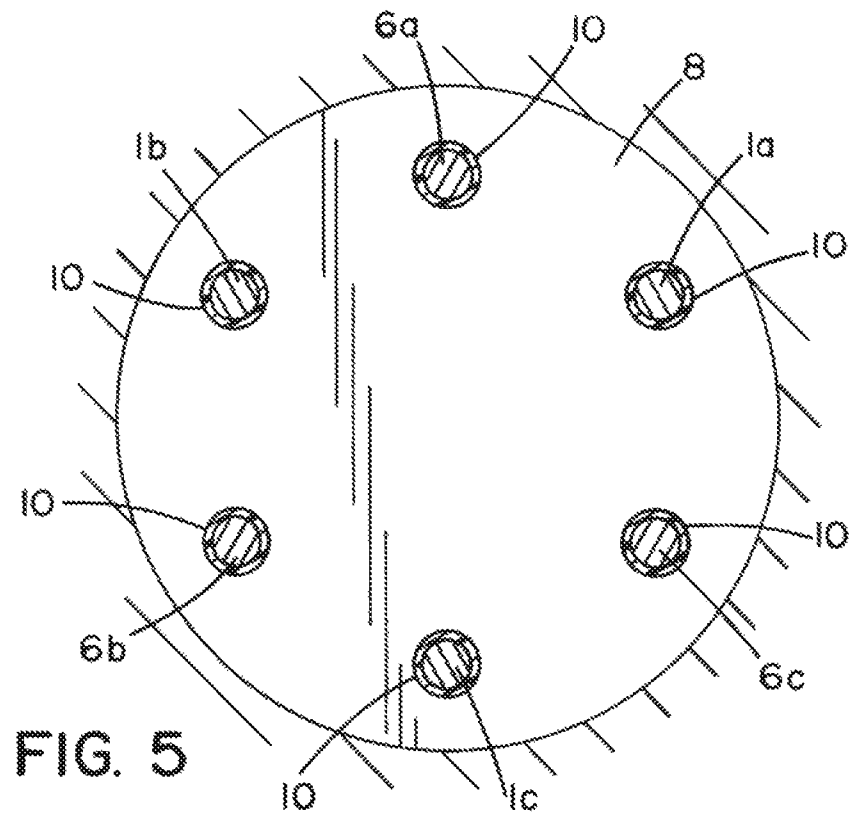
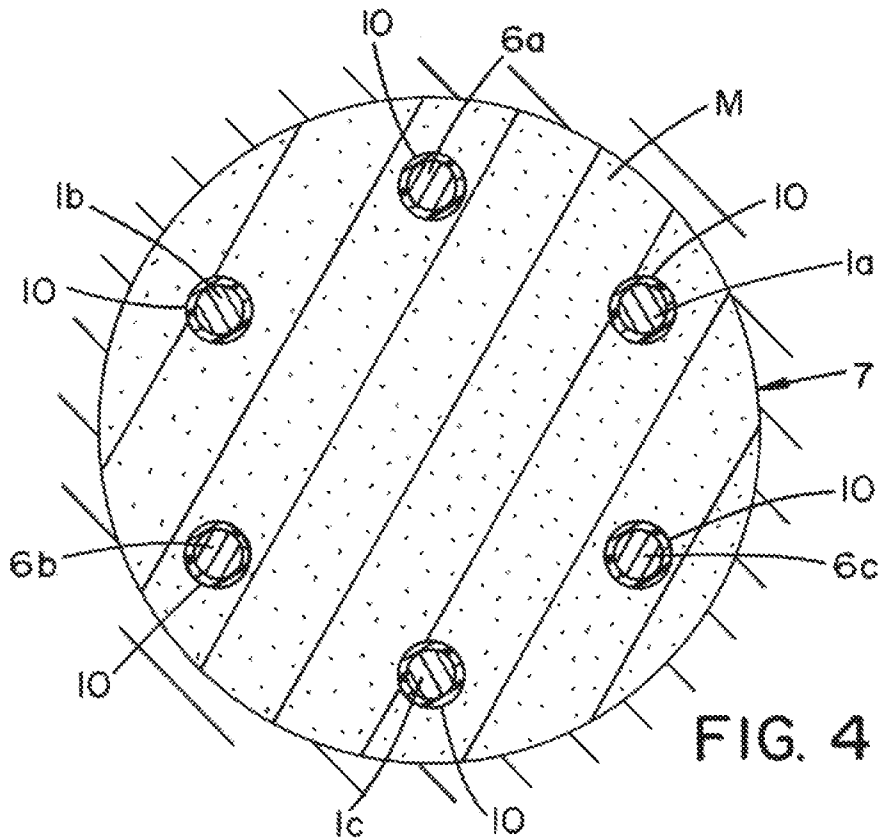


FIG. 1





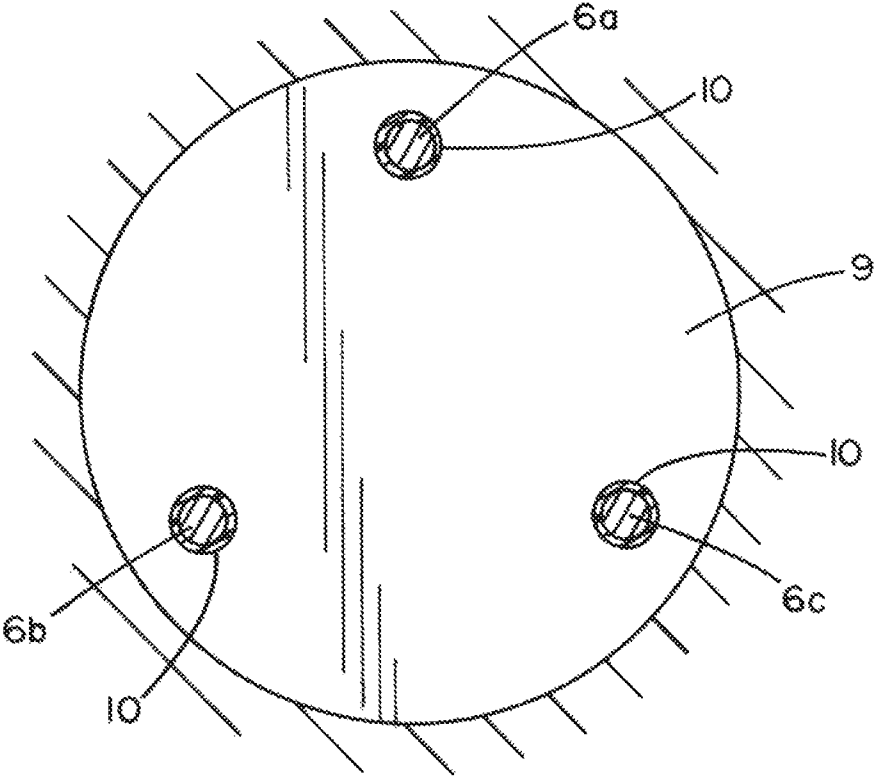


FIG. 6

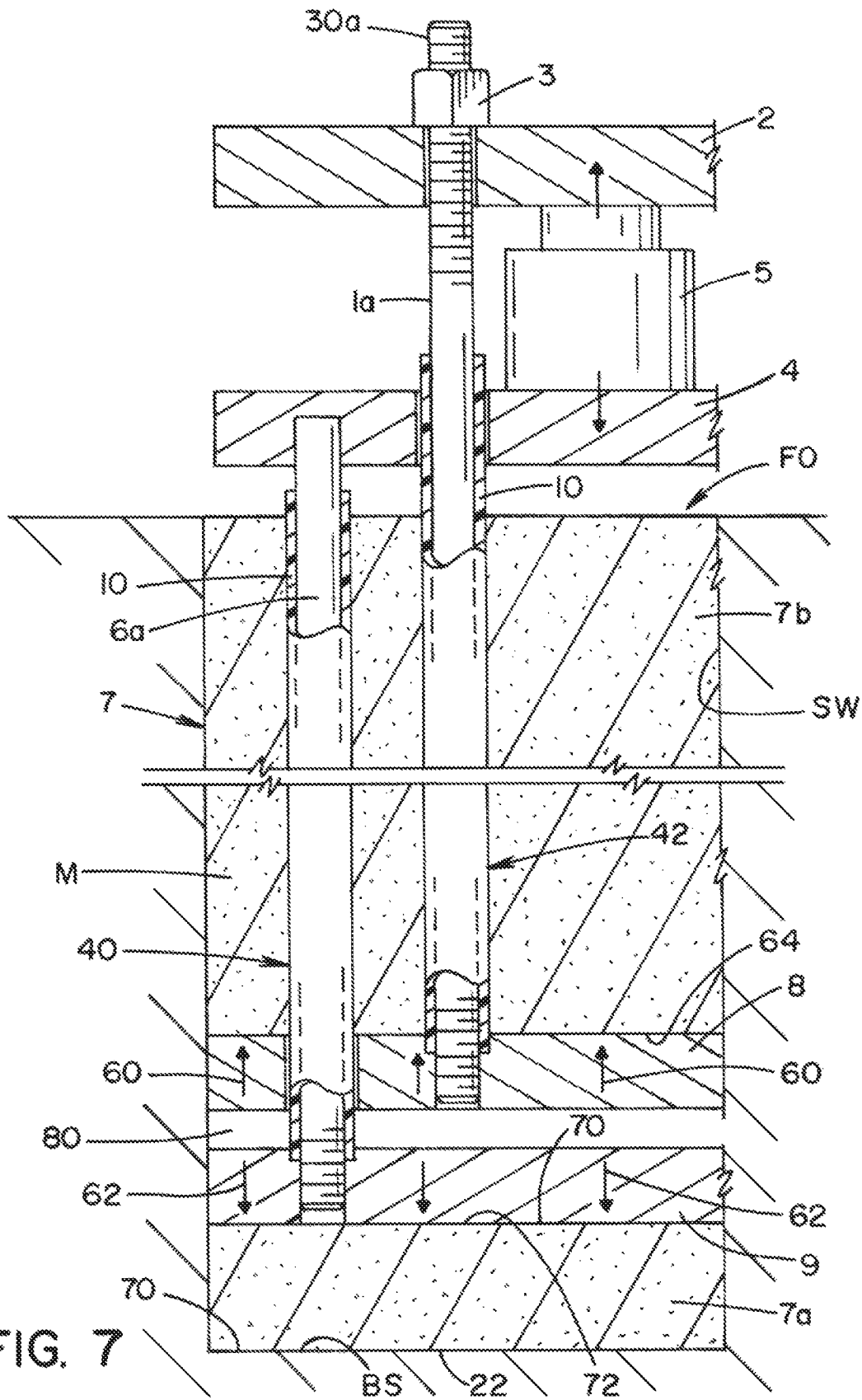
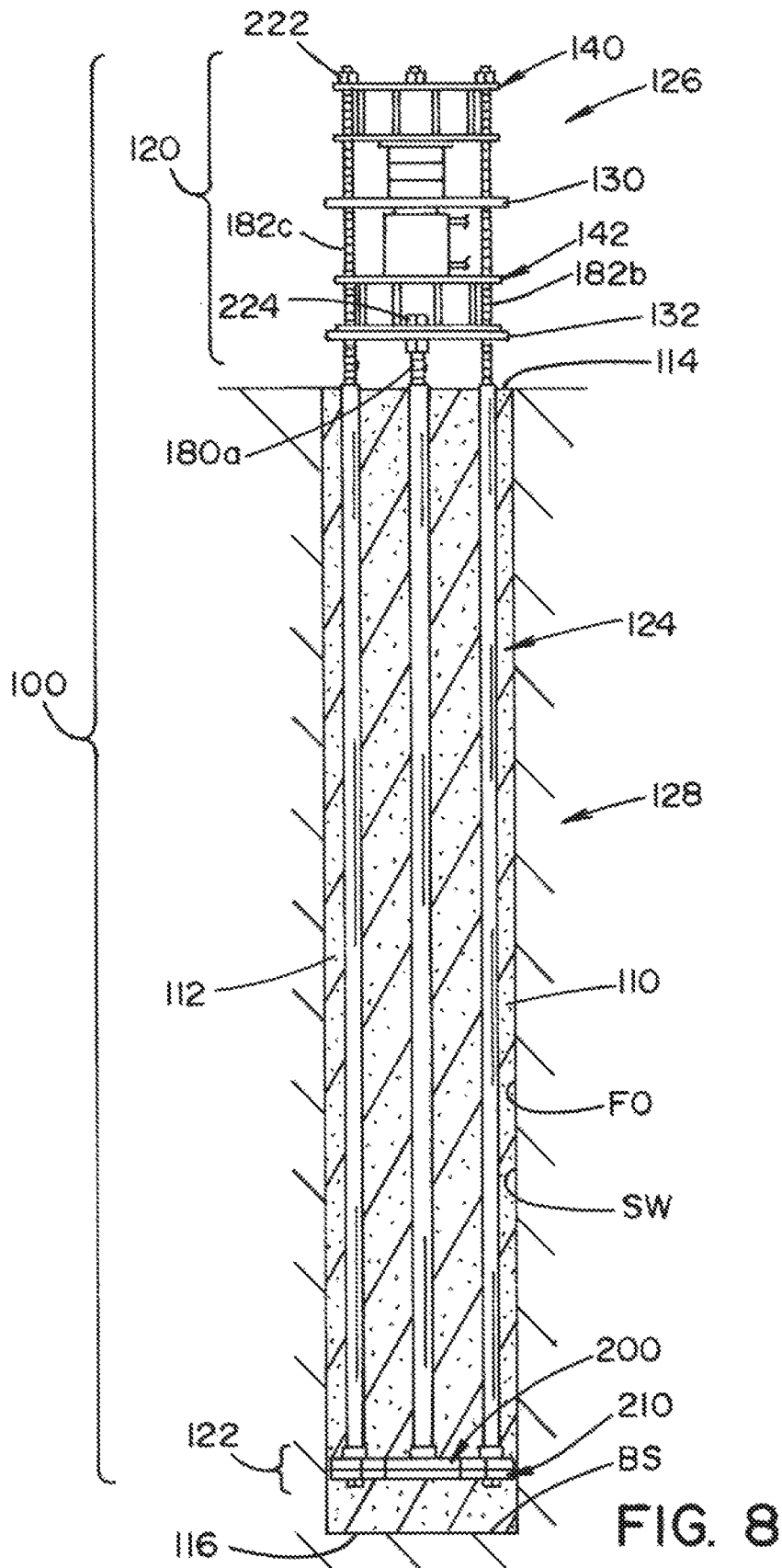


FIG. 7





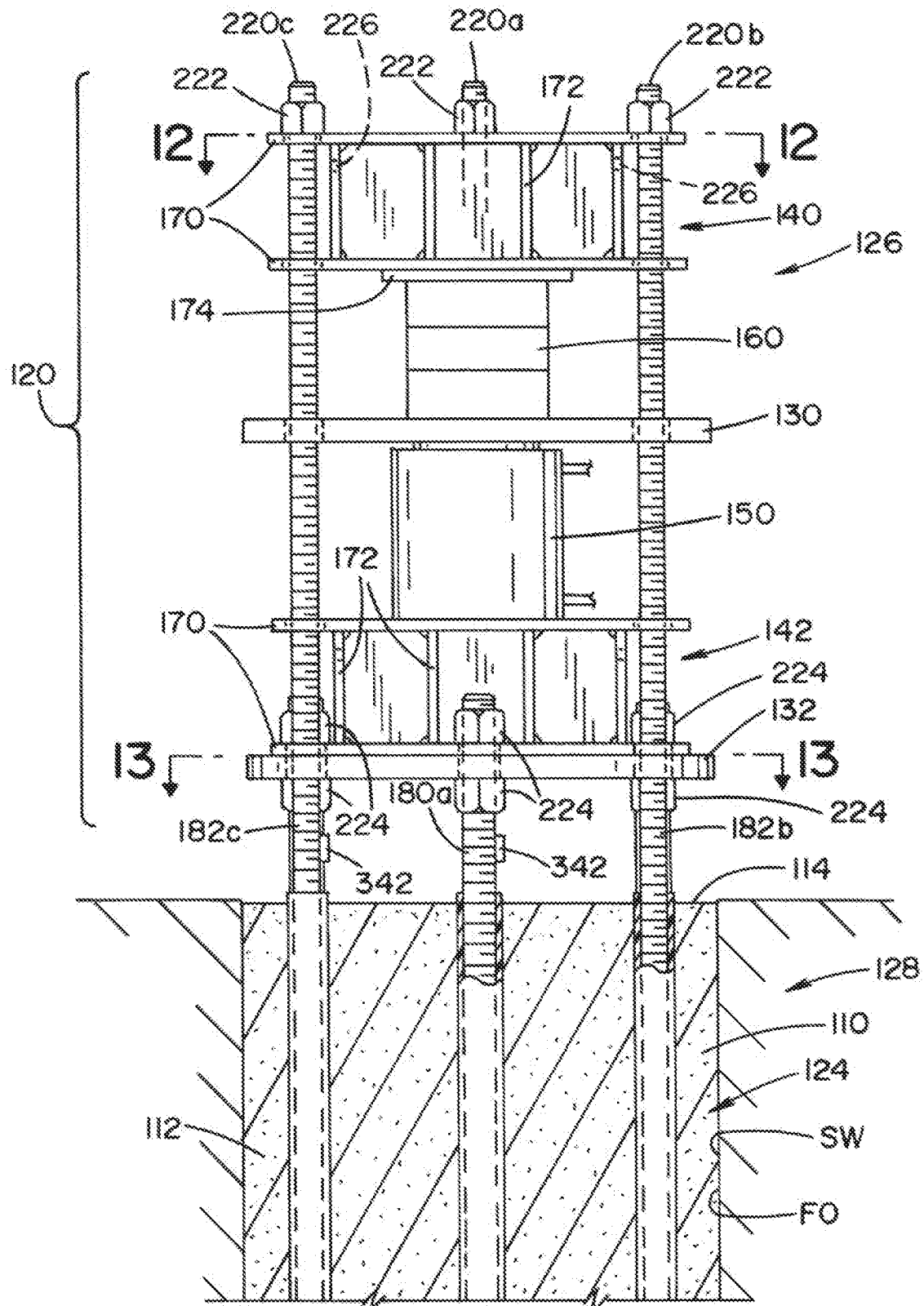


FIG. 9

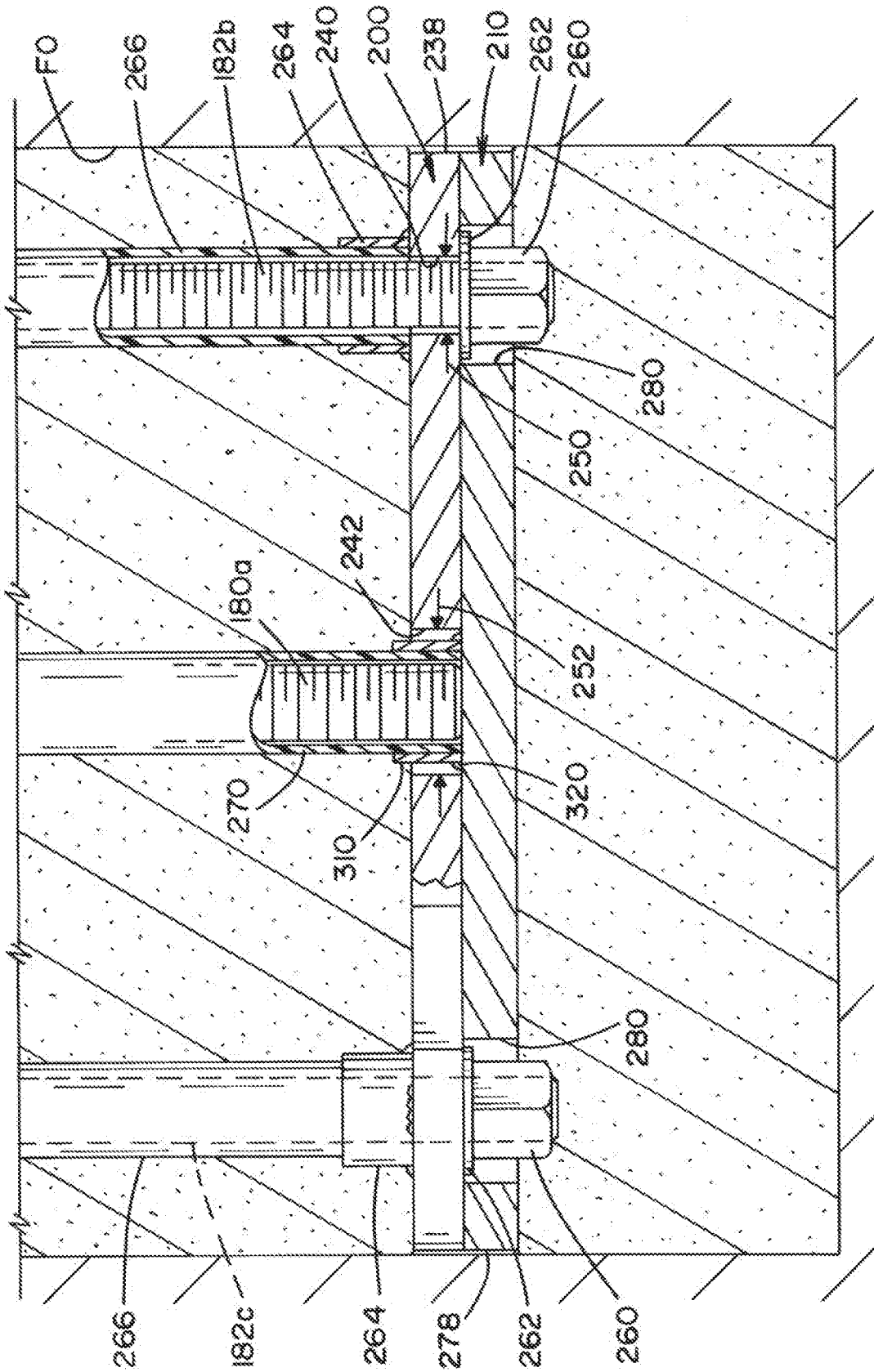


FIG. 10

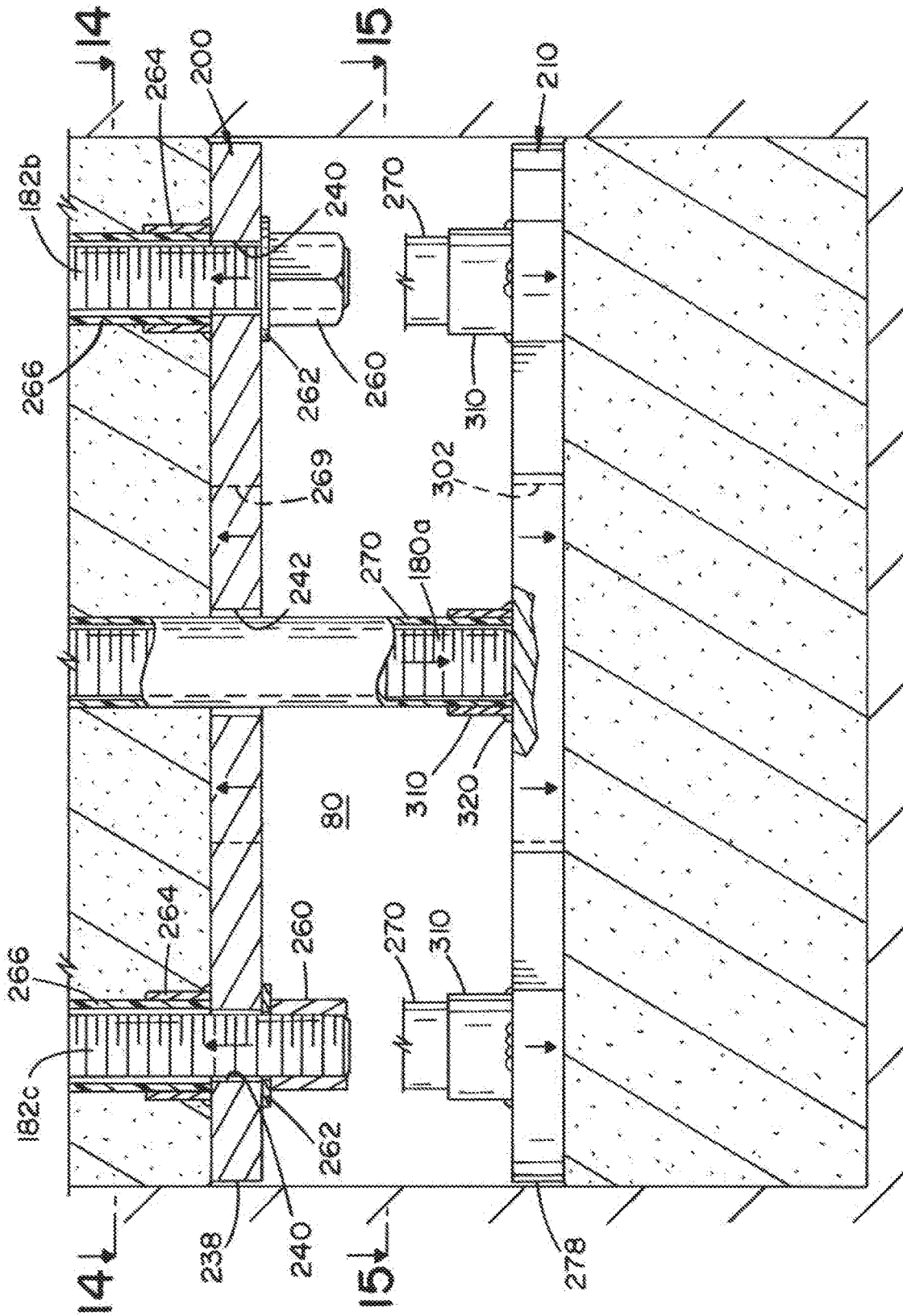


FIG. II

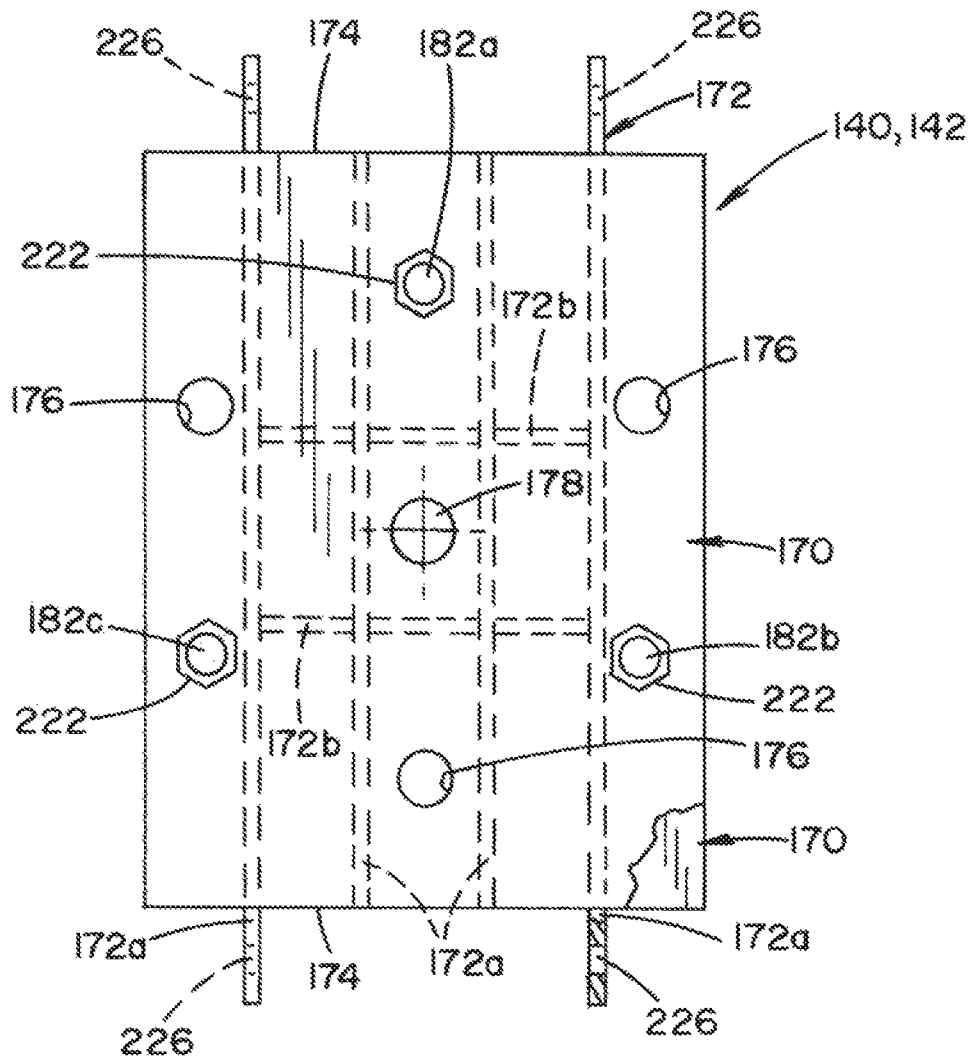


FIG. 12

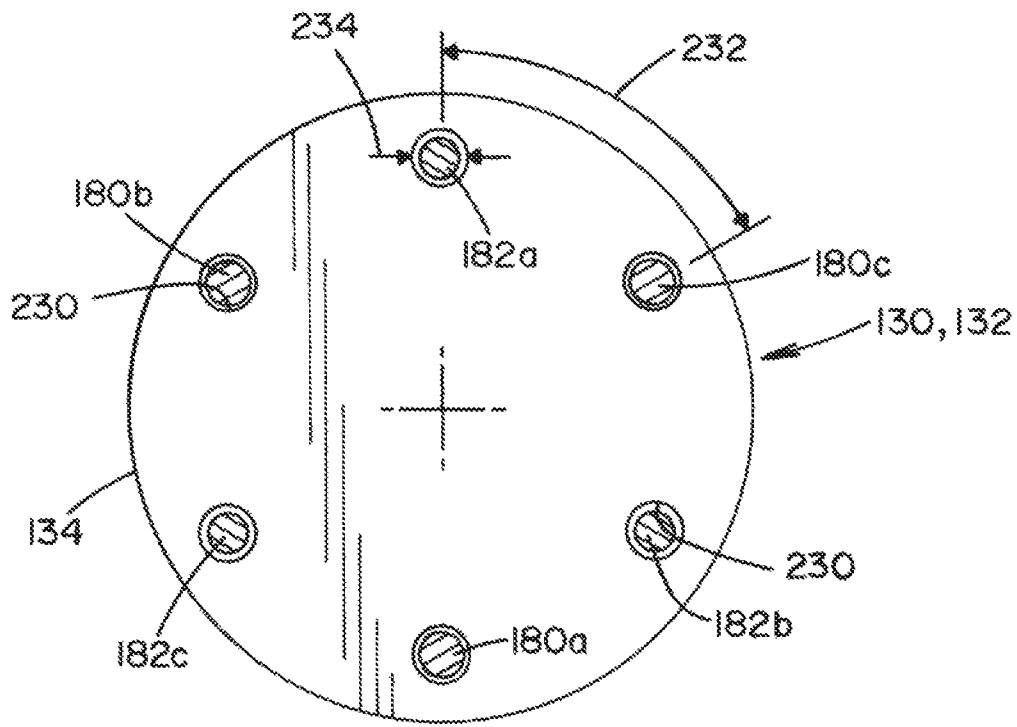


FIG. 13

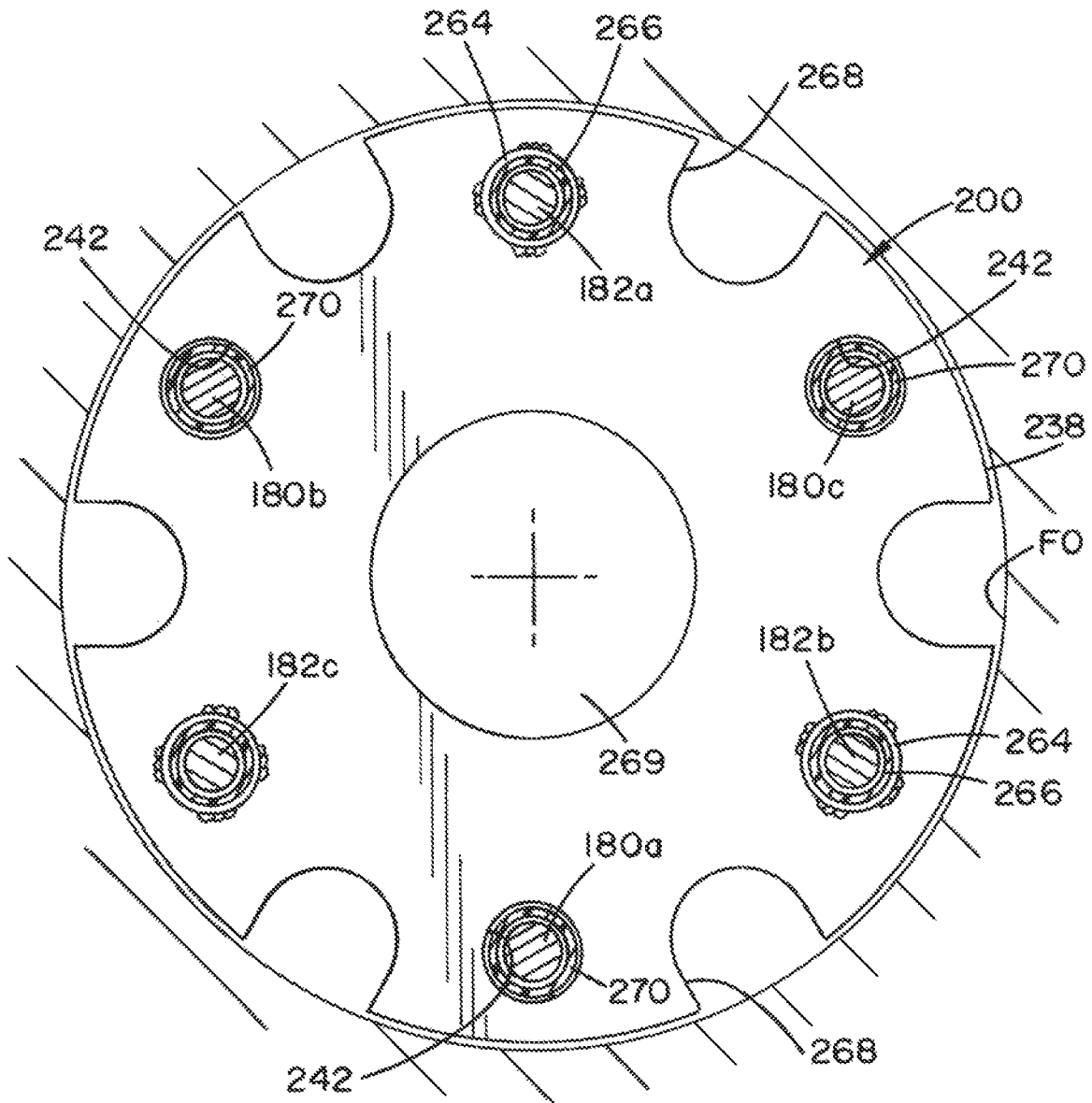


FIG. 14

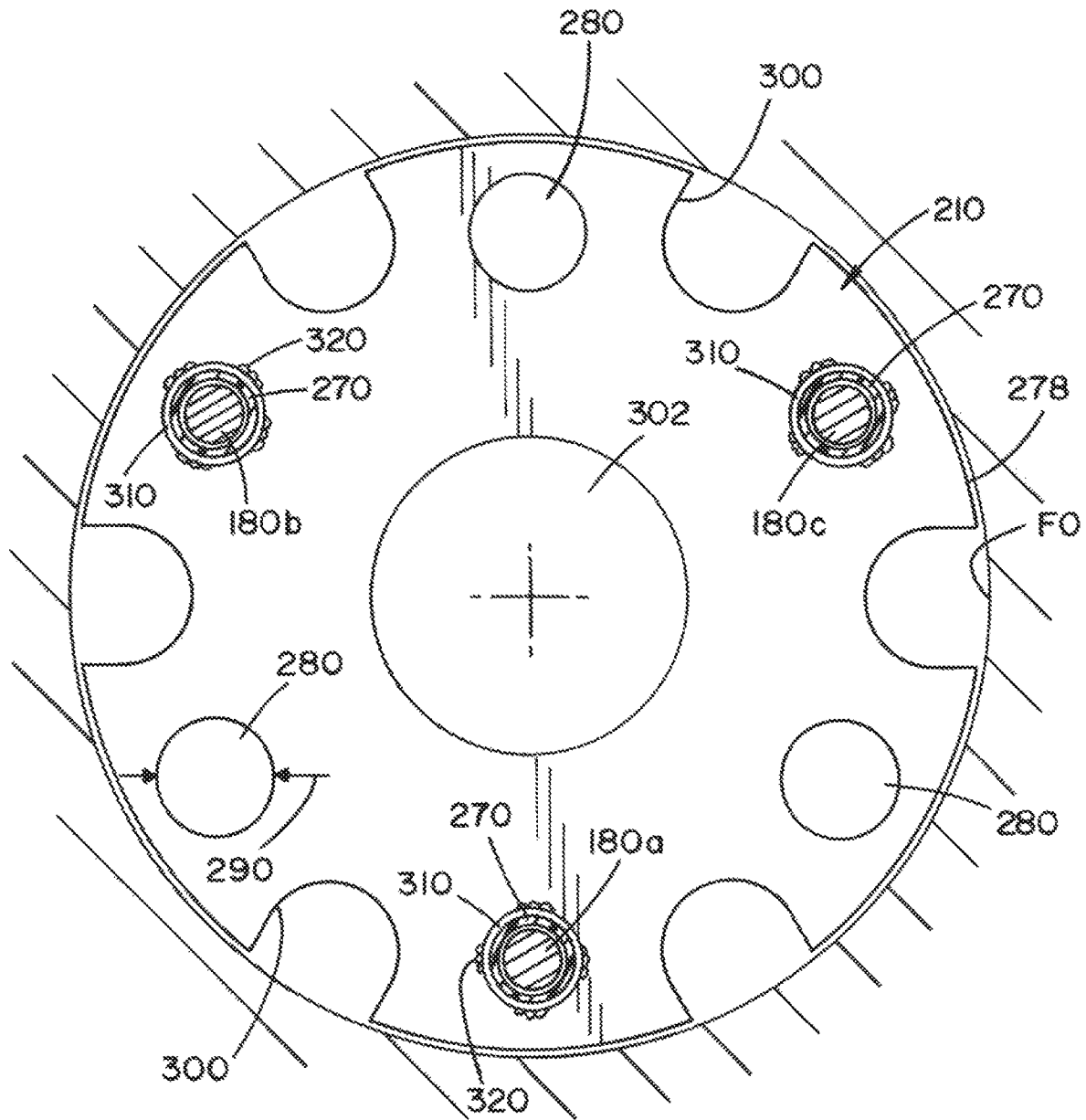


FIG. 15

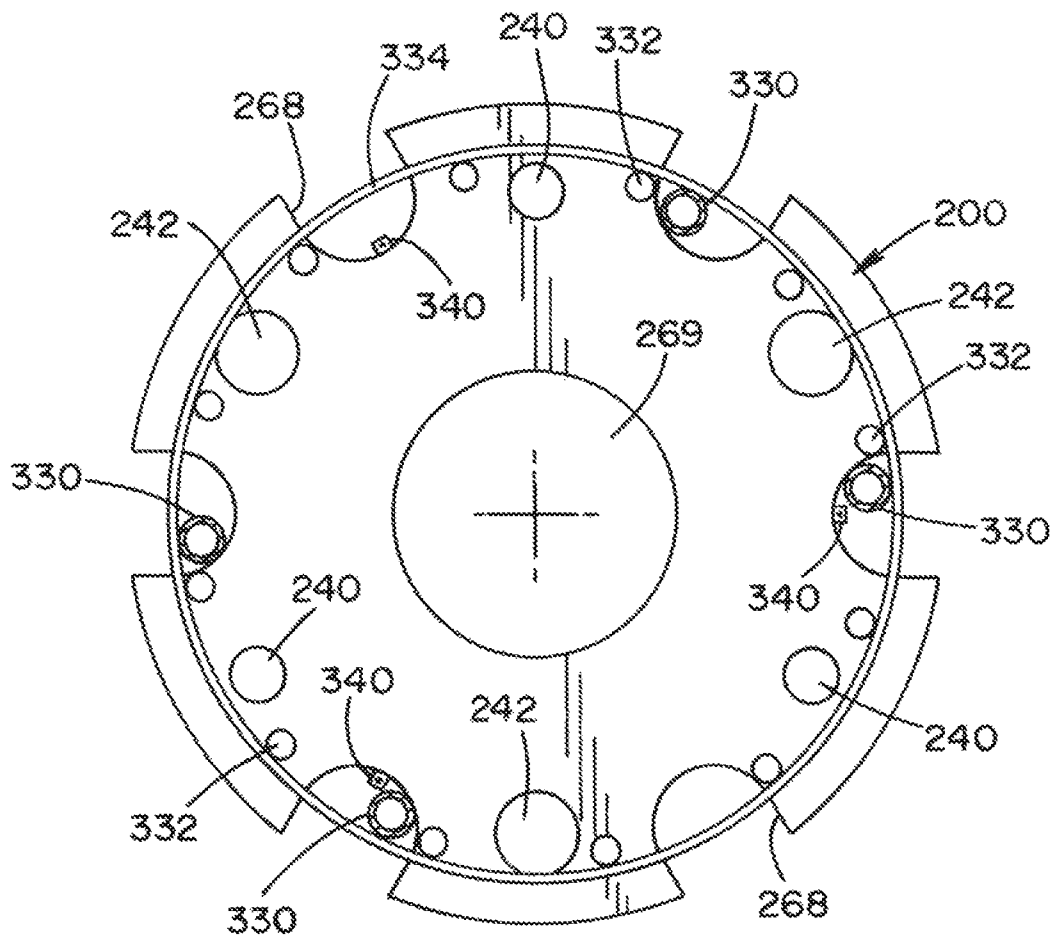


FIG. 16



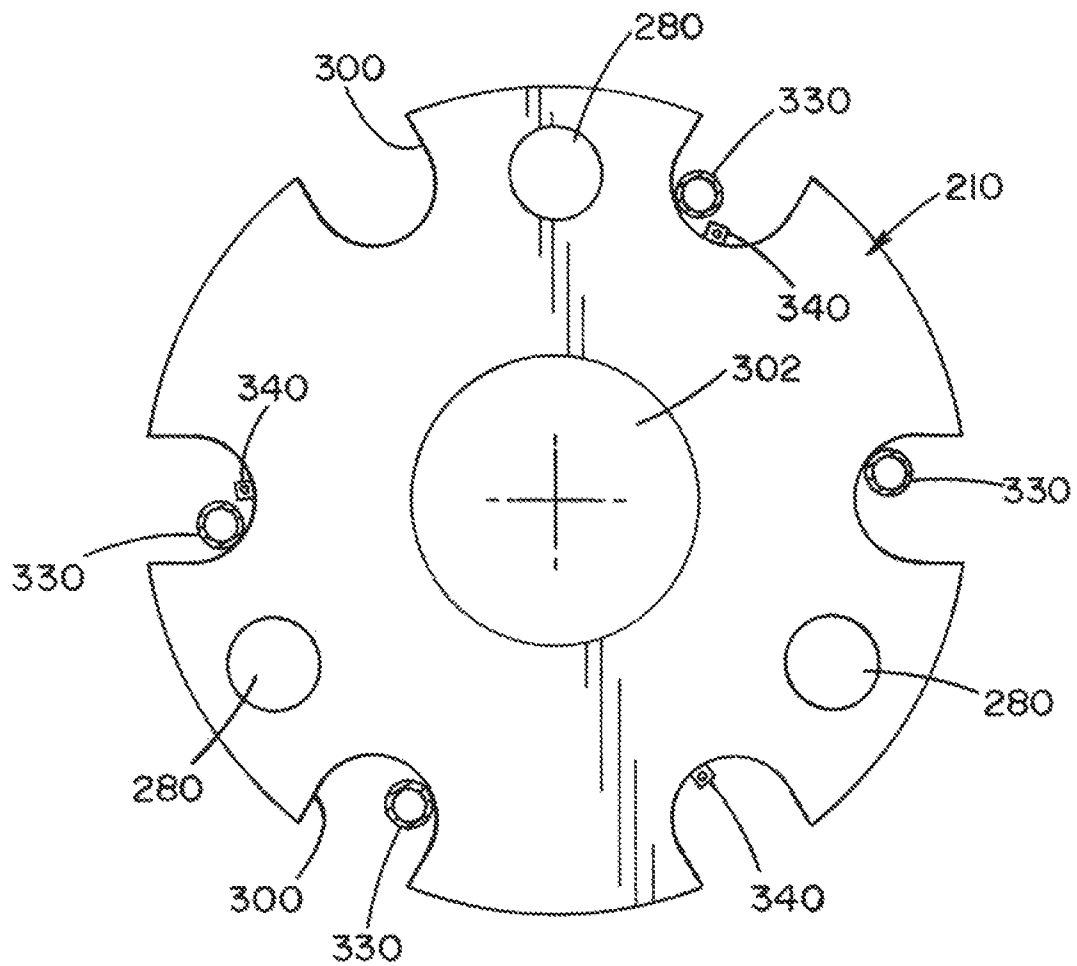


FIG. 17

**TOP LOADED BIDIRECTIONAL TESTING  
SYSTEM AND METHOD OF USING THE  
SAME**

This application claims priority to provisional patent application Ser. No. 62/909,601 filed on Oct. 2, 2019, which is incorporated by reference herein.

The invention of this application relates to a load application apparatus and method that can perform a full-scale load test to measure both base resistance and shaft resistance of any structural and non-structural element classified as a deep foundation including but not limited to driven piles, drilled shafts, displacement piles, continuous flight auger piles, auger cast in place piles, or classified as any load transferring element including but not limited to vibro replacement columns, vibro concrete columns, controlled modulus columns, and rigid inclusions hereinafter collectively referred to as "foundation(s)". Furthermore, the invention in this application relates to an embedded apparatus and method of determining base and shaft resistance independently through a full-scale load test without the need to embed a jack assembly within the foundation or construct any type of reaction system built at the top of the foundation.

BACKGROUND OF THE INVENTION

Load testing systems and apparatuses have been used in the construction industry for a number of years. These systems and apparatuses include a wide range of devices and monitoring instrumentation used for variety of reasons. This includes devices that are used in connection with the load testing of supporting structures such as foundations that are used to support the weight of superstructures including but not limited to bridges, industrial structures, commercial buildings, retaining walls and embankments. As can be appreciated, it is important to assess that a supporting structure, such as a foundation, has been properly designed and installed to perform as required during its service life.

Primarily, foundation static load testing can be classified into three types of testing: (1) Conventional Top-Down Static Load Test ("TDSLTL"), (2) Bi-Directional Static Load Test ("BDSLTL"), and (3) non-conventional Static Load Test

Conventional Top-Down Static Load Test  
("TDSLTL")

In the TDSLTL arrangement, axial compression loads are applied to the foundation from the top where the loading apparatus reacts against a reaction system built at the top of the foundation. The most common reaction system used in a TDSLTL is beam-based reaction system consisting of a main reaction beam supported by secondary or junior beams. Although TDSLTL is a suitable test for foundation, limitations on the structural capacity of the reaction system limits the use of the test. Other noticeable limitations are the difficulty of transferring loads to deeper depths and a potentially highly dangerous work environment when high reaction loads are in use. Considering modern foundation types and elements and their significantly increased diameter and length, the TDSLTL arrangement becomes insufficient for testing a foundation for higher loads.

Bi-Directional Static Load Test ("BDSLTL")

The BDSLTL is performed by applying loads to the foundation in two directions using an embedded jack assembly comprised of one or more expandable hydraulic jack(s)

placed between an upper and lower plate and cast within the foundation. Originally, the BDSLTL was known in the art as the Osterberg test because of the use of a specially designed loading device called the Osterberg cell ("O-Cell") as presented by Osterberg J. O. in the U.S. Pat. No. 5,576,494 to Osterberg, which is incorporated by reference into this application. During the O-Cell test, pressure is applied to the O-Cell, which theroretically creates an equal upward and downward force inside the foundation. This test makes it possible to evaluate the foundation base resistance and the foundation shaft resistance separately. The main advantage of the BDSLTL using the O-Cell test is that it makes it possible to test the foundation with half of the jack load compared to a TDSLTL.

The BDSLTL has the advantage of providing higher loads and the ability of safely testing larger diameter foundations since loads are applied internally from within. However, like any other test, the BDSLTL also presents some limitations. One of the limitations is the cost associated with the one-time-use sacrificial hydraulic jack. Since the jack assembly becomes part of the foundation, the jack assembly is sacrificial and unrecoverable which significantly impacts the test cost.

Another limitation to consider is the test setup workability. Since hydraulic lines and the jack assembly are all embedded within the foundation, any slight damage to the lines or the Jack assembly itself during the construction process could significantly impact the load test. Finally, for foundations with potentially large displacement requirements at the base, the installed jack may not have enough stroke to reach the required resistance.

Non-Conventional Static Load Test

A non-conventional static load test method primarily applicable to bored piles was first presented by Cernak (1985) in patent CS216409, proposing the separation between the base and shaft resistance using a reaction system built at the top and within the bored pile. The proposed mechanism consisted of the anchored frame pulling the bored pile upwards (such as in a tension test) by reacting against the bored pile base throughout a center strut. The major and most significant limitation of this test is the reduction of the ratio of lateral strain over linear strain also known as the Poisson's ratio. As the bored pile is pulled upwards, a reduction in the diameter is created for which the shaft resistance is not comparable to scenarios where axial compression loads are applied to the bored pile. Additionally, even in the presence of sufficient upward soil resistance, the foundation may not have the necessary structural strength to counteract the required base load. The Cernak Patent No. CS216409 is hereby incorporated by reference into this application.

Another non-conventional load testing method with specific application to driven piles was patented by Kyung-Han An et al. (1994), U.S. Pat. No. 5,282,701, describing a self-repulsive force applied to the driven pile to measure base and shaft resistances in two separate testing stages. The test is performed by driving a hollow steel pile with a cone-shaped end member abutted to the lower-end of the test pile. Loads are applied from the top of the foundation to the cone-shaped end member through a load-transferring pipe while pulling the exterior pipe out of the ground. The Kyung-Han An U.S. Pat. No. 5,282,701 is hereby incorporated by reference into this application.

All of the documents and materials referenced above are hereby incorporated by reference into this application in their entirety.

#### SUMMARY OF THE INVENTION

Applicant has developed its own load testing apparatus and method for testing the geomaterial resistance surrounding and underlying the foundation that overcomes the many shortcomings in the prior art systems. This system is incorporated by reference into this specification wherein details on Applicant's Top Loaded Bidirectional Test ("TLBT") apparatus and method are shown in the drawings attached hereto. The invention relates to a test where loads are transferred to the foundation using two stacked steel plates within the foundation. Depending on the magnitude of the geotechnical resistance, the plates may be located at the foundation base or higher up in the foundation. The lower steel plate transfers the load to the base or a lower foundation portion, while the upper steel plate pushes an upper foundation portion upwards. In this test method, all loading sources are located at the top of the foundation without the need of beam-based reactions or any other constructed reaction system. Furthermore, loads are transferred to the testing apparatus presented in this invention, which will apply bidirectional loads to the foundation without the need of embedded jacks. Therefore, the risk of damaged or inoperable hydraulic lines and hydraulic jacks during the construction process is eliminated. Moreover, the risk of hydraulic fluid spills within the subsurface strata is eliminated. In addition, the apparatus related to this invention, creates a compressive force applied to the foundation which provides advantage over other testing systems where the foundation is pulled upward (similar to a tension test) creating a reduction in the Poisson's ratio which consequently does not properly determine the shaft resistance. Also, the test can be applied to a foundation with limited tensile strength. Another advantage is that the spread between the two loading plates can easily be adjusted when the soil underneath or along the sides of the foundation requires a large displacement to reach the test load. Furthermore, the unlimited displacement capability of the application related to this invention, allows for virtually unlimited additional loading cycles even after grouting the space or void between the two stacked plates.

In greater detail, the invention of this application relates to an embedded load application apparatus and method that can perform a full-scale load test measuring the shaft resistance and base resistance without embedding a jack assembly within the foundation. Furthermore, the invention of this application relates to an embedded load application apparatus and method for determining the foundation shaft resistance and base resistance without the use of any beam-based reaction system or any other constructed reaction system at the foundation top. Moreover, the system of this application tests the foundation by way of compressive forces and not tensile forces, and has unlimited displacement capabilities.

More particularly, the testing apparatus of this invention includes an expandable jack or loading source ("Jack") located at the foundation top with one or more top loading plate(s) or assemblies (hereinafter collectively referred to as top plate(s)), one or more bottom loading plate(s) or assemblies (hereinafter collectively referred to as bottom plate(s)), one or more base mobilizer bar(s), one or more shaft mobilizer bar(s), one or more shaft bearing plate(s), and one or more base bearing plate(s). The shaft mobilizer bar(s) are

connected to the top plate(s) above the Jack, passing through the bottom plate(s), and connected to the shaft bearing plate(s). The base mobilizer bar(s) are connected to the bottom plate(s) passing through the shaft bearing plate(s) and then connected to the base bearing plate(s). To provide free movement during the test, all shaft mobilizer bar(s) and/or base mobilizer bar(s) can be installed as an insertion through sacrificial tubes.

The testing apparatus of this invention is divided into two segments. Segment two is installed first within the foundation in the preferred embodiment and includes the shaft mobilizer bar(s), base mobilizer bar(s), shaft bearing plate(s), base bearing plate(s), and their surrounding sacrificial tubes. The shaft mobilizer bar(s) and base mobilizer bar(s) are inserted inside these sacrificial tubes before or after foundation installation. The shaft mobilizer bar(s) are screwed or pushed-in into the shaft bearing plate(s) and the base mobilizer bar(s) rest on the base bearing plate(s). The shaft mobilizer bar(s) and base mobilizer bar(s) can be removed from segment two after the test, making them reusable. Alternatively, shaft mobilizer bar(s) and base mobilizer bar(s) can be left in-place for additional structural reinforcement. Also the bars could be post-tensioned for additional structural (bending) strength of the foundation element.

Segment one is connected to segment two after the foundation is installed. Segment one includes the reusable Jack, top loading plate(s), and the bottom loading plate(s).

The testing description of this invention is defined as follows: as the Jack is pressurized, it pushes upwards reacting against the top loading plate(s). The jack load is directly transferred to the base bearing plate(s) by way of the bottom loading plate(s) and base mobilizer bar(s). The shaft mobilizer bar(s) are pulled upwards as the Jack is loading and reacting against the top loading plate(s). This consequently pulls the shaft bearing plate(s) upward resulting in upward compression forces applied to the foundation. Measurements associated with the base bearing plate(s) displacements and applied loads will define the foundation base resistance, whereas, measurements associated with the shaft bearing plate(s) displacements and applied loads will define the foundation shaft resistance. Strain measurements using strain gages on the shaft mobilizer bar(s) and/or the base mobilizer bar(s) provide a check of internal bar forces and jack loads. Moreover, and particularly, loads transferred to the shaft bearing plate(s), by way of the shaft mobilizer bar(s), can alternatively or additionally be monitored using load cells located between the shaft bearing plate(s) and the shaft mobilizer bar(s). Furthermore, Loads transferred to the base bearing plate(s), by way of the base mobilizer bar(s), can alternatively or additionally be monitored using load cells located between the base bearing plate(s) and the base mobilizer bar(s).

These and other objects, aspects, features and advantages of the invention will become apparent to those skilled in the art upon a reading of the Detailed Description of the invention set forth below taken together with the drawings which will be described in the next section.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention may take physical form in certain parts and arrangement of parts, a preferred embodiment of which will be described in detail and illustrated in the accompanying drawings which form a part hereof and wherein:

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FIG. 1 is a partially sectioned elevational view of a testing arrangement and apparatus according to the certain aspects of the present invention;

FIG. 2 is a plan view taken along line 2-2 in FIG. 1;

FIG. 3 is a sectional view taken along line 3-3 in FIG. 1;

FIG. 4 is a sectional view taken along line 4-4 in FIG. 1;

FIG. 5 is a sectional view taken along line 5-5 in FIG. 1;

FIG. 6 is a sectional view taken along line 6-6 in FIG. 1;

FIG. 7 is an enlarged sectional view of the load testing apparatus shown in FIG. 1;

FIG. 8 is an elevational view of another set of embodiments showing another testing arrangement and apparatus according to the certain other aspects of the present invention;

FIG. 9 is an elevational view showing a top portion of the testing arrangement and apparatus shown in FIG. 8;

FIG. 10 is an elevational view showing a bottom portion of the testing arrangement and apparatus shown in FIG. 8 that is shown in a closed position;

FIG. 11 is an elevational view showing the bottom portion of the testing arrangement and apparatus shown in FIG. 8 that is shown in an expanded position;

FIG. 12 is a plan view of a load transfer assembly shown in FIG. 8;

FIG. 13 is a plan view of a loading plate shown in FIG. 8;

FIG. 14 is a plan view of a shaft bearing plate shown in FIG. 8;

FIG. 15 is a plan view of a base bearing plate shown in FIG. 8;

FIG. 16 is a plan view of the shaft bearing plate shown in FIG. 8 that shows yet further embodiments; and,

FIG. 17 is a plan view of a base bearing plate shown in FIG. 8 that shows yet further embodiments.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings wherein the showings are for the purpose of illustrating preferred and alternative embodiments of the invention only and not for the purpose of limiting the same, FIGS. 1-7 show a Top Loaded Bidirectional Test system R that includes, but is not limited to the following primary components:

Number	Description
1	SMB- Shaft Mobilizer Bar(s)
2	TLP- Top Loading Plate(s)
3	SMB- TLP Connection(s)
4	BLP- Bottom Loading Plate
5	Loading Source(s)
6	BMB- Base Mobilizer Bar(s)
7	Foundation Element
8	SBP- Shaft Bearing Plate (s)
9	BBP- Base Bearing Plate(s)
10	ST- Sacrificial Tube(s)

In greater detail, system R can perform a full-scale load test measuring the shaft resistance and base resistance without embedding a jack assembly within a foundation element 7. System R relates to an embedded load application apparatus and method for determining the foundation element's shaft resistance and base resistance without the use of any embedded hydraulic jack or beam-based reaction system or any other constructed reaction system at a foundation top extent 20.

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In greater detail, foundation element 7 extends into a foundation opening FO wherein foundation opening FO includes one or more sidewalls SW and a bottom surface BS. Foundation element FO can include one or more foundational structures 7a-c and overall extends between foundation top extent 20 and a foundation bottom extent 22, which will be discuss more below. As is shown in the figures as an example, foundation element 7 can include a first foundation element 7a and a second foundation element 7b, but this is not required, and more than two foundation elements could be utilized without detracting from the invention of this application. For example, the foundation element can include a foundation element 7c between shaft bearing plate 8 and base bearing plate 9.

System R includes one or more expandable jacks or loading sources 5, which can be any type of load source known in the art. Loading source 5 is located at or near foundation top extent 20 with at least one top loading plate 2 positioned above loading source 5. The system further includes at least one bottom loading plate 4 positioned below loading source 5. Plates 2 and 4 can have a wide range of configurations without detracting from the invention of this application wherein the figures are not to be interpreted to limit the invention. In the embodiment shown, system R further includes at least one base mobilizer bar 6 and at least one shaft mobilizer bar 1. System R further includes at least one shaft bearing plate 8 and at least one base bearing plate 9. While plates 8 and 9 are shown to have a circular configuration, these plates can include a wide range of configuration and/or construction formats without detracting from the invention of this application. As will be discussed more below, plates 2, 4, 8 and/or 9 can also include a wide range of features and/or configurations without detracting from the invention of this application. For example, plates 8 and/or 9 can include a central opening that can be configured and sized to allow a tremie pipe, which is used to fill foundation opening FO with material, to pass by the plate(s). Moreover, plates 8 and/or 9 can include other openings and/or edge cutouts that can allow the foundation material to more freely pass by and around the plate(s) to fully engulf the plate(s) in foundation opening FO with material. As will also be discussed more below, the openings and/or cutouts also can be used for the attachment and/or use of sensors for any purpose including, but not limited to, monitoring the testing activities, monitor forces, monitor displacement and/or monitoring the curing of the foundation material. Moreover, they can be used to allow the system to work with other structural materials and systems such as structural rebar.

As is shown in the illustrated embodiments in these figures, system R can include three shaft mobilizer bars 1a-1c and three base mobilizer bars 6a-6c, but the invention of this application is not limited to the illustrated three bar configurations nor is it limited to the exact locations of the bars in the plates that are shown in the figures. Moreover, larger foundational elements could include more bars and smaller foundation elements could include less bars.

Shaft mobilizer bars 1a-1c are joined between top loading plate 2 that is above source or jack 5 and shaft bearing plate 8 wherein shaft mobilizer bars 1a-1c have shaft bar top ends 30a-30c that are fixed relative to top loading plate 2 by any means known in the art. As is shown, connectors 3 can be used to secure top ends 30a-30c on the opposite side of plate 2 as source 5. Connectors 3 can be any type of fastening device or system including, but not limited to, nuts, other types of threaded fasteners, locking pins, press fitted fittings, and/or welded arrangements. Shaft mobilizing bars 1a-1c are also fixed relative to shaft bearing plate 8. Again, as can

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be appreciated, any method of attaching the bars relative to the plates can be used without detracting from the invention of this application. Shaft mobilizer bars **1a-1c** are configured to pass through bottom loading plate **4** thereby allowing bars **1a-1c** to connect top loading plate **2** to shaft bearing plate **8** and move relative to bottom loading plate **4**.

Base mobilizing bars **6a-6c** are joined between bottom loading plate **4** and base bearing plate **9**. Again, base mobilizing bars are operably fixed relative to these plates and can be secured thereto by any means known in the art including, but not limited to, fasteners, press fitting, threading, and/or welding. However, in that base mobilizing bars **6a-6c** only push against the base mobilizing bars and the bottom loading plate, they do not need to be fastened thereto. Base mobilizing bars **6a-6c** are configured to pass through shaft bearing plate **8** thereby allowing bars **6a-6c** to connect bottom loading plate **4** to base bearing plate **9** and to move relative to shaft bearing plate **8**.

In that base mobilizing bars **6a-6c** are configured to pass through shaft bearing plate **8**; base mobilizer bars **6a-6c**, bottom loading plate **4**, and base bearing plate **9** operate as a first operating unit **40**. Similarly, in that shaft mobilizer bars **1a-1c** are configured to pass through bottom loading plate **4**; shaft mobilizing bars **1a-1c**, top loading plate **2**, and shaft bearing plate **8** operate as a second operating unit **42** that is configured to move relative to first operating unit **40**.

To improve the freedom of movement in operating units **40** and **42**, shaft mobilizer bars **1a-1c** can be inserted through sacrificial tubes **10** and/or base mobilizing bars **6a-6c** can be inserted through sacrificial tubes **10**. Any type of sacrificial tubes and/or bars can be used without detracting from the invention of this application, which includes, but is not limited to PVC tubing. Moreover, sacrificial tubes **10** can be secured relative to shaft bearing plate **8** and/or base bearing plate **9**, respectively, wherein the sacrificial tubes can be used to lower shaft bearing plate **8** and/or base bearing plate **9** into the foundation opening as the system is being operably assembled within the foundation opening. As a result, base mobilizing bars **6a-6c** can be operably joined to base bearing plate **9** of first operating unit **40** by merely resting against base bearing plate **9**. This allows mobilizing bars **6a-6c** to be easily removed after testing.

The testing apparatus of this invention also can be divided into a first segment **50** and a second segment **52**. First segment **50** can include the major components that are outside of the foundation element during testing. In this respect, first segment **50** can include, but is not limited to, one or more sources or jacks **5**, top loading plate **2** and bottom loading plate **4**. In that the components of first segment **50** are outside of the foundation element, they are reusable. Second segment **52** can include the major components that are inside of the foundation element during testing. In this respect, second segment **52** can include, but is not limited to, shaft mobilizing bars **1a-1c**, base mobilizing bars **6a-6c**, shaft bearing plate **8** and base bearing plate **9**. Moreover, second segment **52** can include sacrificial tubes **10** if they are used in the system.

In one set of embodiments, second segment **52** can be installed first within the foundation opening. The bars can be inserted inside the sacrificial tubes before and/or after foundation installation. Shaft mobilizing bars **1a-1c** are secured relative to shaft bearing plate **8** by any method known in the art that includes, but is not limited to, threading the bars into a threaded openings in the shaft bearing plate, press fitting the bars into the plate, welding the bars to the plate and/or using fasteners to secure the bars to the plate wherein the fasteners can be fastened to the plate by any means known

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in the art including welding fasteners to the plate. Moreover, the “bars” referenced in this application can be any structural object or objects that can transfer the needed forces between the plates. Base mobilizing bars **6a-6c** can be configured to rest on base bearing plate **9**. Moreover, according to certain embodiments, shaft mobilizing bars **1a-1c** and/or base mobilizing bars **6a-6c** can be configured to be removable from second segment **52** after the test, which makes them also reusable. In other embodiments, shaft mobilizing bars **1a-1c** and/or base mobilizing bars **6a-6c** can be configured to be left in-place.

First segment **50** can be connected to second segment **52** after the foundation is installed. In that the components of first segment **50** are outside of the foundation element, they are also reusable.

An example testing description and/or method of this application is as follows:

Second segment **52** is positioned in the foundation opening wherein second segment **52** can be assembled at the jobsite and/or can be assembled, at least in part, as the second segment is positioned in the foundation opening;

Any number of sensor arrangements can be positioned on and/or around second segment **52** to measure forces, displacement, stress, strain and/or any other operational factors associated with the test. In that sensors and sensor arrangements for measuring these kinds of data are known in the industry, these are not disclosed in detail herein in the interest of brevity;

Material **M** is poured into the foundation opening to form foundation element **7** (or **7b**) and is allowed to cure;

In at least one set of embodiments where the base bearing plate **9** is not directly located at the foundation base and it is not in direct contact with the geomaterial or bottom surface **BO** at the foundation base, a portion of the foundation opening can be filled with material **M** and/or any other suitable material before second segment **52** is positioned in the foundation opening to produce a lower foundation element **7a** as is shown in the illustrated embodiments. Base bearing plate **9** then rests on the top of lower foundation element **7a**;

First segment **50** is joined relative to second segment **52** and above foundation element **7**;

Loading source **5** is pressurized wherein source **5** pushes downwardly against bottom loading plate **4** and first operating unit **40** that includes, base mobilizing bars **6a-6c**, bottom loading plate **4** and base bearing plate **9**;

Similarly, pressurizing loading source **5** pushes upwardly against top loading plate **2** and second operating unit **42** that includes, shaft mobilizing bars **1a-1c**, top loading plate **2**, and shaft bearing plate **8**.

The load from loading source **5** is directly transferred to base bearing plate **9** by way of bottom loading plate **4** and base mobilizer bars **6a-6c**;

Shaft mobilizing bars **1a-1c** are pulled upwards as source **5** is loaded and reacts against top loading plate **2**. This consequently pulls shaft bearing plate **8** upwardly resulting in an upward compression forces **60** that are applied to a bottom surface **64** of foundation Element **7** (or **7b**). This also pushes base bearing plate downwardly in a downward compression force **62** that is applied to a bottom surface **70**. Again, bottom surface **70** can be any bottom surface including a bottom extent of the foundation opening **BS** and/or a top extent **72** of lower foundation element **7a** as is shown in the illustrated embodiments.

Measurements associated with the test can be taken during and/or after the test.

These measurements can include, but are not limited to, measuring the displacement of base bearing plate **9** and applied loads of base bearing plate **9**, which will define the foundation base resistance. This can also include taking measurements associated with shaft bearing plate **8** wherein displacements and applied loads will define the foundation shaft resistance. Strain measurements using strain gages on shaft bearing plate **8** and/or shaft base plate **9** can provide a check of internal bar forces and source **5** loads. Moreover, loads transferred to shaft bearing plate **8** by means of the shaft mobilizer bar **1a-1c** can alternatively or additionally be monitored using load cells located between the shaft base plate and the shaft mobilizing bar(s). Yet even further, loads transferred to base bearing plate **9** by means of base mobilizer bar can alternatively and/or additionally be monitored using load cells located between the base bearing plate and the based mobilizing bar(s). All of which is accomplished while foundation elements **7** and **7a** are fully in compression.

According to yet other embodiments, the foundation element can also be used as a structural load bearing member after the test. In this set of embodiments, once the test(s) are completed, shaft mobilizing bars **1a-1c** and base mobilizing bars **6a-6c** can be removed and sacrificial tubes **10** can be filled with material, such as the grout used for the foundation element. Moreover, sacrificial tubes can be used as one or more flow paths to fill void **80** that is between base bearing plate **9** and shaft bearing plate **8**. In one set of embodiments, the flow path(s) can be formed from the sacrificial tubes that rest against base bearing plate **9**. High pressure filling techniques can be used to fill these opening to ensure the usability of the structural member. Additionally or alternatively, the shaft mobilizer bars **6a-6c** can be used as inlets for the injection of any suitable material including, but not limited to, grout used for the foundation element. Alternatively, shaft mobilizer bar(s) and base mobilizer bar(s) can be left in-place for additional structural reinforcement. Depending upon the base mobilizing bars to base bearing plate connection, post-test foundation reuse under tension and bending loads is possible. Also the bars could be post-tensioned for additional structural (bending) strength of the foundation element.

FIGS. **8-17** show a Top Loaded Bidirectional Test system **100** that shows yet other aspects of the present invention. As with system **R**, system **100** can perform a full-scale load test measuring the shaft resistance and base resistance without embedding a jack assembly within the foundation element. Moreover, system **100** can perform the methods described above wherein this description will not be repeated in the interest of brevity.

Again, the foundation element can be any foundation element and can have a wide range of dimension without detracting from the invention of this application. This set of embodiments show a foundation element **110** that extends into a foundation opening **FO** wherein foundation opening **FO** includes one or more sidewalls **SW** and a bottom surface **BS**. Foundation element **FO** can include one or more foundational structures or elements **112** as is described above wherein overall the one or more foundation structures extends between foundation top extent **114** and a foundation bottom extent **116**.

System **100** includes a top portion **120** and a bottom portion **122** with one or more bars or rods **124** extending therebetween, which will be discussed more below. Top portion **120** can form a first segment **126** and bottom portion **122** and/or rods **124** can form a second segment **128**. Top portion **120** and/or first segment **126** can include the major

components that are outside of the foundation element during testing while bottom portion **122**, rods **124** and/or second segment **128** can include the major components that are within the foundation, but where a portion of the bars can extend from the foundation and/or be removable.

In greater detail, top portion **120** has a top loading plate **130** and a bottom loading plate **132**. Top portion can further include one or more load transfer assemblies. In the embodiment shown, top portion **120** includes an upper load transfer assembly **140** and a lower transfer assembly **142**. Throughout the application, reference to plates, such as plate **130** and plate **132**, equally applies to an assembly structure, such as assemblies **140** and **142** without detracting from the invention of this application. Top portion further includes one or more jacks or loading sources **150**, which can be any type of load source known in the art. In the embodiment shown, loading source **150** is between top loading plate **130** and bottom loading plate **132**. The top portion can further include sensors that can include, but is not limited to, one or more load cells **160**. Load cell **160** can include a hemispherical bearing. The upper and lower transfer assemblies can include upper and lower plates **170** with cross members **172**. Top portion can further include one or more load cell plates **174** to further even out and/or spread out the forces applied thereto.

The plurality of bars **124** can include any number of bars without detracting from the invention of this application. As can be appreciated, the number of bars can be based on the size of the foundation element wherein the system includes at least one base mobilizer bar **180** and at least one shaft mobilizer bar **182**. As is shown, system **100** includes three base mobilizer bars **180a-c** and three shaft mobilizer bars **182a-c**. System **100** further includes at least one shaft bearing plate **200** and at least one base bearing plate **210**. While plates **200** and **210** are shown to have a circular configuration, these plates can include a wide range of configuration and/or construction formats without detracting from the invention of this application including multi-component plate assemblies even though they will be referred to as "plates" throughout the application. As will be discussed more below, these plates can also include shapes and/or features to allow for the filling of material into foundation opening **FO**, the flow of the material around and past the plates during the filling, use with structural material such as structural rebar, improve performance, monitor performance and/or to allow the use of sensors and/or movement control features. Moreover, the system can include shapes and/or features to allow for the filling of material into foundation opening **FO**, the flow of the material around and past the system during the filling, use with structural material such as structural rebar, improve performance, monitor performance and/or to allow the use of sensors and/or movement control features along with other foundation elements including, but not limited to, structural rebar.

Shaft mobilizer bars **182a-c** are joined between top loading plate **130** and/or upper load transfer assembly **140** that is/are above source or jack **150** and shaft bearing plate **200** wherein shaft mobilizer bars **182a-c** have shaft bar top ends **220a-c** that are fixed relative to top loading plate **130** and/or upper load transfer assembly **140** by any means known in the art. As is shown, connectors **222** can be used to secure top ends **220a-c** relative to plate **170**. Connectors **222** can be any type of fastening device or system including, but not limited to, nuts, other types of threaded fasteners, locking pins, press fitted fittings, and/or welded arrangements. Shaft mobilizing bars **182a-c** are also fixed relative to shaft bearing plate **200**.

Again, and as can be appreciated, any method of attaching the bars relative to the plates can be used without detracting from the invention of this application wherein one such type will be discussed below in greater detail. Shaft mobilizer bars **182a-c** are configured to pass through bottom loading plate **132** and/or lower transfer assembly **142** thereby allowing bars **182** to connect top loading plate **130** and/or upper load transfer assembly **140** to shaft bearing plate **200** and to allow bars **182** to move relative to bottom loading plate **132**.

Base mobilizing bars **180a-c** are joined between bottom loading plate **132** and/or lower transfer assembly **142** and base bearing plate **210**. Again, base mobilizing bars **180a-c** are operably fixed relative to these plates and can be secured thereto by any means known in the art including, but not limited to, fasteners, press fitting, threading, and/or welding. As is shown, fasteners **224** are used wherein the fasteners can be on both sides of the plate to fixably secure the plate to the rods. However, in that base mobilizing bars **180a-c** are in compression, they technically do not require attachment to the plates. However, a connection between bars **180** and base bear plate **210** can be used to help lower portion **122** into the foundation opening and/or the plates can be temporarily fixed relative to one another for the lowering and positioning steps. Base mobilizing bars **180a-c** are configured to pass through shaft bearing plate **200** thereby allowing bars **180a-c** to connect bottom loading plate **132** to base bearing plate **210** and to move relative to shaft bearing plate **200** as is discussed above in greater detail.

With special reference to FIG. **13**, plates **130** and **132** includes openings **230**. In that system **100** is a six bar system, plates **130** and **132** can include six opening **230**. In this set of embodiments openings are spaced near an outer edge **134** of plates **130** and **132**. Moreover, openings **230** can have the same diameter without detracting from the invention wherein the diameter can be such that both bars **180** and **182** can pass therethrough. Fasteners, as described above and below in greater detail, can be used to fix the respective bars to the respective plates. Opening **230**, in this six bar system, can be circumferentially spaced from one another at an angle **232**. Angle **232** can be about 60 degrees. Opening **230** have a diameter **234** that can be 3.5 inches.

With special reference to FIG. **12**, upper load transfer assembly **140** and lower transfer assembly **142** include plates **170** and can include a plurality of cross members **172**. Plates **170** can have a wide range of configurations without detracting from the invention. As is shown, plate **170** has a square or rectangular configuration. Cross members **172** can utilize a wide range of support patterns without detracting from the invention of this application. As is shown, cross members **172** include members **172a** that extended across at least a substantial portion of plate **170**. As is shown, members **172a** can extend over an edge **174** of plate **170** and they can include openings, or the like, **226** that can be used to allow assembly **120** and/or system **100** to be lifted, such as being lifted by a crane. In addition, cross members **172** can include members **172b** that extend between members **172a**. Plates **170** also includes openings **176** for the passage of bars **180** and **182** wherein members **172** can be spaced from these openings. Plate **170** can further include one or more openings **178** that can be used for a wide range of purposes.

With special reference to FIGS. **10**, **11** and **14**, shaft bearing plate **200** is shown. As noted above, shaft bearing plate **200** can have a circular configuration with an outer edge **238**, but this is not required. In this embodiments, shaft bearing plate **200** includes openings **240** and **242** spaced inwardly from edge **238**. Openings **240** have a diameter **250** and openings **242** have a diameter **252** wherein, in this

embodiment, diameter **250** is smaller than diameter **252**. Openings **240** are for securing bars **182** relative to plate **200** whereas bigger openings **242** are to allow bars **180** to pass through plate **200** and move relative to plate **200**.

Bars **182** are joined relative to plate **200** to allow bars **182** to pull plate **200** upwardly during testing wherein plate **200** pushes against an upper portion of the foundation element. As is shown in these figures, rods or bars **182** are fixed related to plate **200** by extending through openings **240**. Bars **182** can be threaded bars wherein they can be secured relative to plate **200** by hex nuts **260** positioned below plate **200**, which can be fastened to the plate. One or more washers **262** can also be utilized. Bars **182** can be a Grade 75 #18 threaded bar. Nuts **260** can also be a Grade 75 #18 threaded nut. The connection between plate **200** and rods **182** can also include an upper steel pipes **264** to increase rigidity. In addition, PVC pipe material **266** can be used to separate rods **182** from the foundation material. Moreover, shims can be positioned between steel pipes **264** and PVC pipe material **266** to strengthen the connection and/or support between the steel pipe and the rods and/or to maintain the PCV pipe relative to the plate. Upper steel pipes **264** can be a 3.5 inch SCH **40** steel pipe for the increase rigidity and can help to lower the assembly into the foundation opening. As with nuts **260**, pipes **264** can be secured to plate **200** by any means including, but not limited to welding the pipe to the plate. In addition, PVC pipe material **266** can be utilized to separate the bars from the foundation material. Again, plate **200** can also include other shapes and/or features to improve performance and/or to monitor performance. This can include one or more edge cut outs **268** that extend inwardly from plate edge **238**, which will be discussed more below. Cut outs **268** can include a circular configuration as is shown, but this is not required and these cut outs can be equally spaced about the plate. As is shown in this embodiment, plate **200** can include six cutouts that are spaced between the bar openings wherein they can be equally spaced about the plate. Plate **200** can also include one or more central openings **269** and/or other internal openings, pockets, extensions and/or features without detracting from the invention of this application. Central opening **269** can be used to allow a tremie pipe, which is used to fill foundation opening FO with material, to pass by the plate(s). Central opening **269** and cutouts **268** also can allow the foundation material to more freely pass by and around the plate(s) to fully engulf the plate(s) in foundation opening FO with material. As will be discussed more below, openings and cutouts can be used for the attachment and/or use of sensors for any purpose including, but not limited to, monitoring the testing activities, monitor forces, monitor displacement and/or monitoring the curing of the foundation material. Moreover, they can be used to allow the system to work with other structural materials and systems such as structural rebar.

Moreover, openings **242** are sized to allow rods **180** to extend through openings **242** of plate **200**. In that rods **180** are to move relative to plate **200**, openings **242** are large enough to allow generally resistance free passage through the plate. As with rods **182**, rods **180** can be threaded rods or bars. In the embodiment shown, rods **180** are Grade 75 #20 threaded bars. In addition, PVC pipe material **270** can be used to separate rods **180** from the foundation material and PVC pipe **270** can also pass through opening **242**.

With special reference to FIGS. **10**, **11** and **15**, base bearing plate **210** is shown. As noted above, base bearing plate **210** can have a circular configuration with an outer edge **278**. In this set of embodiments, base bearing plate **210** includes openings **280**. While in this set of embodiments,

base bearing plate **210** only includes openings in alignment with bars **182**, plate **210** can include additional openings that are in alignment with bars **180** to allow different securing techniques to secure bars **180** relative to the plate, such as those discussed above. Openings **280** have a diameter **290** wherein opening diameter **290** of holes **280** can be sized to allow bars **182**, hex nut **260** and/or washer **262** to pass through plate **210** and move relative to plate **210**; especially when the system is in the closed condition as is shown in FIG. **10** wherein the plates can be sandwiched together. Again, plate **210** can also include other shapes and/or features to improve performance and/or to monitor performance. This can include one or more edge cut outs **300**. Cut outs **300** can include a circular configuration as is shown, but this is not required, and these cut outs can be equally spaced about the plate. As is shown in this embodiment, plate **210** can include six cutouts that are spaced between the bars. The plate can further include a central opening **302** and/or other internal openings, pockets, extensions and/or features without detracting from the invention of this application. Again, central opening **302** can be used to allow a tremie pipe to pass plate **210** when filing foundation opening FO with material. Moreover, central opening **302** and cutouts **300** also can allow the foundation material to more freely pass by and around the plate(s) to fully engulf the plate(s) in the borehole. As will be discussed more below, these also can be used for the attachments of sensors for any purpose including, but not limited to, monitoring the testing activities, monitor forces, monitor displacement and/or monitoring the curing of the foundation material. Moreover, they can be used to allow the system to work in connection with structural rebar, which also will be discussed more below. Yet even further, plates can be sized and positioned such that edges **238** and **278** are at least near side wall(s) SW such that plates **200** and **210** push against a substantial portion of the foundation element(s), which balances the forces applied thereto. Moreover, this allows movement of the plates without having to first fracture a substantial portion of the foundation element. This forms a first foundation element and a second foundation element on either sides of plates **200** and **210**.

Bars **180** are joined, held relative to and/or rest against plate **210** to allow the plate to be lowered into the borehole and to allow bars **180** to push plate **210** downwardly during testing. As is shown, rods or bars **180** engage plate **210** to allow them to push the plate downwardly in the foundation opening. This can include bars **180** being fixed to the plate and/or resting against the plate wherein gravity maintains the bar in an operating position until the test is performed. This also can include a pocket (not shown) in plate **210**, a threaded opening in the plate and/or a threaded fastener joined to the plate as is referenced above. As is shown, plate **210** can include pipes **310** wherein bars **180** can extend into pipes **310**. Pipes **310** can be fixed relative to plate **210** by any means known in the art including, but not limited to, welding the pipes to the plate at one or more weld joints **320**. Moreover, pipes **310** and/or bars **182** could be threaded into a plate opening (not shown) and/or a nut below the plate (also not shown). Again, Rods or bars **180** also can be threaded bar wherein they can be secured relative to plate **210** by threaded engagement with pipes **310**. Again, PVC pipe material **270** can be used to separate rods **180** from the foundation material. In order to lower plate **210** into the borehole, bars **182** can be utilized to hold the plate(s). In that the lowering process only requires the support of the weight of plate **210** to prevent it from falling from the assembled structure, this connection can be temporary and/or of limited

strength. Then, during testing, bars **182** push against plate **210** wherein a strong connection therebetween is not needed for most testing. However, if an additional pull test is desired for plate **210**, a more secure attachment between plate **210** and bars **182** can be created and this can include a threaded connection therebetween referenced above. In one set of embodiments, bars **182** can be secured relative to plate **210** by fixing shims between bars **182** and pipes **310**. Yet even further, plate **210** can be secured for lowering the system into the borehole by affixing plate **210** relative to plate **200**. This can include, but is not limited to, an adhesive connection between the plates or the like. Then, this affixed connection would be easily broken when the test load are applied to the system.

Again, the systems of this application can include a wide range of sensing devices wherein many of these are incorporated by reference into this application. With special reference to FIGS. **16** and **17**, shown are some of these additional features. In this respect, the systems can include one or more steel pipes **330** that align with cut outs **268** and **300** of plates **200** and **210**, respectively and can be used for access to the testing zone at or near plates **200** and **210**. As is shown, there are four pipes **330** in this set of embodiments. In addition, the systems can include the use of additional rebar **332** and an outer reinforcement spiral or helical **334**. The systems can further include one or more displacement measuring devices to measure displacements corresponding to the shaft bearing plate and the base bearing plate during the test. This can include, but is not limited to telltale measuring systems **340** to measure the displacement of the plates.

The methods and steps discussed above with reference to System R also apply to system **100** wherein they are not repeated in the interest of brevity.

#### Further Invention Statements

1. Base bearing plate(s) **9**, **210** can be used without instrumentation or instrumented with specialized wired or wireless monitoring instrumentation to measure strain within the base bearing plate(s) **9**, **210**.
2. Shaft bearing plate(s) **8**, **200** can be used without instrumentation or instrumented with specialized wired or wireless electronic or mechanical instrumentation to measure strain within the shaft bearing plate(s) **8**, **200**.
3. The shaft mobilizer bar(s) **1**, **182** can be solid bars or flexible steel cables connected to the shaft bearing plate(s) **8**, **200** by any means of connection or passed through or underneath the plate in a U-shape arrangement.
4. The interface between the shaft bearing plate(s) **8**, **200** and/or the base bearing plate(s) **9**, **210** can be instrumented with specialized wired or wireless electronic or mechanical displacement monitoring device(s) to monitor the separation between the shaft bearing plate (s) **8**, **200** and the base bearing plate(s) **9**, **210**.
5. The separation between the shaft bearing plate(s) **8**, **200** and/or the base bearing plate(s) **9**, **210** can be monitored with the use of telltales **340** installed on the shaft bearing plate(s) **8**, **200** and/or the base bearing plate(s) **9**, **210**.
6. The separation between the shaft bearing plate(s) **8**, **200** and the base bearing plate(s) **9**, **210** can be monitored through wired or wireless electronic or mechanical displacement monitoring instrumentation installed on shaft mobilizer bar(s) **1**, **182** and/or base mobilizer bar(s) **6**, **180** at the surface.



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7. Loads transferred to the shaft bearing plate(s) **8, 200** by the means of the shaft mobilizer bar(s) **1, 182** can be monitored using load cells **160** and/or one or more load cells located between the shaft bearing plate(s) **8, 200** and the shaft mobilizer bar(s) **1, 182**.
8. Loads transferred to the shaft bearing plate(s) **8, 200** by the means of the shaft mobilizer bar(s) **1, 182** can be monitored using strain gages **342** located along the shaft mobilizer bar(s) **1, 182** and/or nearby the shaft bearing plate(s) **8, 200**.
9. Loads transferred to the base bearing plate(s) **9, 210** by the means of the base mobilizer bar(s) **6, 180** can be monitored using load cells located between the base bearing plate(s) **9, 210** and the base mobilizer bar(s) **6, 180**.
10. Loads transferred to the base bearing plate(s) **9, 210** by the means of the base mobilizer bar(s) **6, 180** can be monitored using strain gages **342** located along the base mobilizer bar(s) **6, 180** and/or nearby the base bearing plate(s) **9, 210**.
11. Loads and/or displacements can be monitored automatically and/or manually. Furthermore, loads can be automatically regulated according to a prescribed protocol using feedback control technology.
12. The connection between shaft mobilizer bar(s) **1, 182** and/or the shaft bearing plate(s) **8, 200**, can be threaded, welded and/or push-in connection and/or other means known in the art.
13. The connection between base mobilizer bar(s) **6, 180** and the base bearing plate(s) **9, 210**, can be threaded, welded or push-in connection and/or other means known in the art. Moreover, a secured connection between base mobilizer bar(s) **6, 180** and the base bearing plate(s) **9, 210** is not required in that the bars can merely rest against the plate.
14. The connection between base mobilizer bar(s) **6, 180** and the base bearing plate(s) **9, 210**, can be a right-hand thread system.
15. The connection between shaft mobilizer bar(s) **1, 182** and the shaft bearing plate(s) **8, 200**, can be a right-hand thread system.
16. The loads applied during the load testing can be applied manually and/or through an Automated Load Testing monitoring and load application system.
17. The loading source can be a single loading device mounted individually on each shaft mobilizer bar **1, 182**, and/or each base mobilizer bar **6, 180**.
18. The shaft mobilizer bar(s) **1, 182** and/or the base mobilizer bar(s) **6, 180** can be combined into a concentric system where base mobilizer bar(s) **6, 180** is installed inside the shaft mobilizer bar(s) **1, 182** and/or further installed inside a sacrificial tube. One or more concentric system can be used to perform the testing description of this invention.
19. To avoid collapse of the soils between plates **8, 200 & 9, 210** in void **80**, the systems can include optional automatic pressure injection of a fluid to be solidified and/or become part of the foundation element to properly maintain the continuous load transfer.
20. To avoid soil intrusion between plates **8, 200 & 9, 210** in void **80** during testing, the application related to this invention can include an optional, expandable sleeve or diaphragm in void **80** between shaft bearing plate(s) **8, 200** and base bearing plate(s) **9, 210**.
21. To assess potential deformation of plates **8, 200, 9, 210**, optional tilt measurements can be made atop plates **8** and **200** and below plates **9** and **210**.

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While considerable emphasis has been placed on the preferred embodiments of the invention illustrated and described herein, it will be appreciated that other embodiments, and equivalences thereof, can be made and that many changes can be made in the preferred embodiments without departing from the principles of the invention. Furthermore, the embodiments described above can be combined to form yet other embodiments of the invention of this application. Accordingly, it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the invention and not as a limitation.

The invention claimed is:

**1.** A testing system for load test measuring a shaft resistance and a base resistance of a foundation element without embedding a jack assembly within the foundation element, the foundation element extending in a foundation opening wherein the foundation opening includes one or more sidewalls and a bottom surface, the at least one foundation element having a top extent and a bottom extent; the testing system comprising:

at least one loading sources positioned above an associated top extent of an associated foundation element wherein the associated foundation element extends into an associated foundation opening that includes at least one associated sidewall and an associated bottom surface;

a first operating unit including at least one bottom loading plate positioned below the loading source, at least one base bearing plate facing the associated bottom surface of the associated foundation opening and at least one base mobilizer bar; the at least one base mobilizer bar operably joining the at least one bottom loading plate and the at least one base bearing plate wherein movement of the at least one bottom loading plate results in movement of the first operating unit as a whole;

a second operating unit including at least one top loading plate positioned above the loading source, at least one shaft bearing plate that is positioned above the at least one base bearing plate within the associated foundation opening and at least one shaft mobilizer bar operably joining the at least one top loading plate and the at least one shaft bearing plate wherein movement of the at least one top loading plate results in movement of the second operating unit as a whole;

the at least one bottom loading plate having a bottom loading plate shape allowing the at least one shaft mobilizer bar to extend past the at least one bottom loading plate and move relative to the at least one bottom loading plate and the at least one shaft bearing plate having a shaft bearing plate shape allowing the at least one base mobilizer bar to extend past the least one shaft bearing plate and move relative to the at least one shaft bearing plate wherein the first and second operating units can move relative to one another;

the at least one shaft bearing plate being positioned below the associated foundation element and the at least one base bearing plate being positioned between the at least one shaft bearing plate and the associated bottom surface of the associated foundation opening wherein a test load produced by the at least one loading sources urges the at least one top loading plate away from the at least one bottom loading plate thereby producing an upward force against the associated foundation element and a downward force toward the associated bottom surface.

**2.** The testing system according to claim **1**, wherein the associated foundation element is a first associated founda-

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tion element and there being a second associated foundation element, the second associated foundation element extending between the at least one base bearing plate and the associated bottom surface of the associated foundation opening, the at least one shaft bearing plate and the at least one base bearing plate being between the first and second associated foundation elements.

3. The testing system according to claim 2, wherein there is a plate void between the at least one shaft bearing plate and the at least one base bearing plate, the system further including a fluid flow path between the associated top extent of the associated foundation element and the plate void to allow an associated foundation material to be pumped into the plate void to form a third associated foundation element.

4. The testing system according to claim 3, wherein the at least one shaft bearing plate is a single unified plate that forms a separation between the associated first associated foundation element from the plate void.

5. The testing system according to claim 3, wherein the system further includes a tube extending from at least one of the at least one shaft bearing plate and the at least one base bearing plate to the associated top extent of the associated foundation, the tube forming the fluid flow path.

6. The testing system according to claim 1, wherein the system further includes sacrificial tubes extending from the at least one shaft bearing plate to the associated top extent of the associated foundation, the at least one shaft mobilizer bar each extending through one of the sacrificial tubes.

7. The testing system according to claim 6, wherein the at least one shaft mobilizer bar are selectively attachable and detachable from the at least one shaft bearing plate, the at least one shaft bearing plate being spaced from the at least one base bearing plate forming a plate void therebetween, the sacrificial tubes forming a fluid flow path to allow an associated foundation material to be pumped into the plate void.

8. The testing system according to claim 1, wherein the system further includes sacrificial tubes extending through the foundation element and to the associated top extent of the associated foundation, the at least one base mobilizer bar each extending through one of the sacrificial tubes.

9. The testing system according to claim 8, wherein the at least one base mobilizer bar are selectively attachable and detachable from the at least one base bearing plate, the at least one base bearing plate being spaced from the at least one shaft bearing plate forming a plate void therebetween, the sacrificial tubes forming a fluid flow path to allow an associated foundation material to be pumped into the plate void.

10. The testing system according to claim 1, wherein the at least one shaft bearing plate is a single unified shaft bearing plate and the at least one base bearing plate is a single unified base bearing plate.

11. The testing system according to claim 10, wherein the single unified shaft bearing plate has a circular configuration and has a plate diameter similar to an associate foundation opening diameter.

12. The testing system according to claim 1, wherein at least one of the bottom loading plate shape includes at least one opening and each of the at least one shaft mobilizer bar extending through one of the at least one opening, and the shaft bearing plate shape includes at least one opening and each of the at least one base mobilizer bar extending through one of the at least one opening.

13. The testing system according to claim 1, wherein the shaft bearing plate shape includes at least one edge cutout and a central opening and the base bearing plate shape

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includes at least one edge cutout and a central opening, the at least one edge cutouts and the central openings allowing the associated material foundation material to move past and around the plates to engulf the plates in the foundation material.

14. The testing system according to claim 13, wherein the associated foundation element is a first associated foundation element and there being a second foundation element, the second foundation element being between the at least one base bearing plate and the associated bottom surface of the associated foundation opening and being at least one of separate and separable from the associated first foundation element, the at least one shaft bearing plate and the at least one base bearing plate being between the first and second associated foundation elements.

15. The testing system according to claim 14, wherein there is a plate void between the at least one shaft bearing plate and the at least one base bearing plate, the system further including a fluid flow path between the associated top extent of the associated foundation and the plate void to allow an associated foundation material to be pumped into the plate void to form a third associated foundation element between the first and second foundation elements.

16. The testing system according to claim 15, wherein the system further includes sacrificial tubes extending from at least one of the at least one shaft bearing plate and the at least one base bearing plate to the associated top extent of the associated foundation, the sacrificial tube forming the fluid flow path.

17. The testing system according to claim 16, wherein the at least one shaft bearing plate is a single unified plate that forms a separation between the associated first associated foundation element from the plate void.

18. The testing system according to claim 1, wherein the at least one base mobilizer bar includes a plurality of base mobilizer bars and/or the at least one shaft mobilizer bar includes a plurality of shaft mobilizer bars.

19. A method of load test measuring a shaft resistance and a base resistance of a foundation element without embedding a jack assembly within the foundation element, the foundation element extending in a foundation opening wherein the foundation opening includes one or more sidewalls and a bottom surface, the at least one foundation element having a top extent and a bottom extent; the method comprising the steps of:

providing a first operating unit that includes at least one base bearing plate and at least one base mobilizer bar fixed relative to the at least one base bearing plate;

providing a second operating unit that includes at least one shaft bearing plate and at least one shaft mobilizer bar fixed relative to the at least one shaft bearing plate; lowering the first and second operating units into the foundation opening;

filling the foundation opening with a foundation material; allowing the foundational material to cure to form at least one foundation element;

securing at least one bottom loading plate relative to the at least one base mobilizer bar wherein the at least one base mobilizer bar join the at least one bottom loading plate and the at least one base bearing plate wherein movement of the at least one bottom loading plate results in movement of the first operating unit as a whole;

securing at least one top loading plate relative to the at least one shaft mobilizer bar wherein the at least one shaft mobilizer bar join the at least one top loading plate and the at least one shaft bearing plate wherein

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movement of the at least one top loading plate results in movement of the second operating unit as a whole; providing at least one loading sources positioned between the at least one top loading plate and the at least one bottom loading plate and above the top extent of the foundation opening; 5

applying a test load with the at least one loading sources to urge the at least one top loading plate away from the at least one bottom loading plate thereby producing an upward force against the foundation element and a downward force on the associated bottom surface. 10

20. The method according to claim 19, further including the steps of measuring at least one of the test load and the movement of the foundation element.

21. The method according to claim 19, wherein a plate void is formed after the applying step between the at least one shaft bearing plate and the at least one base bearing plate, at least one of the first and second operating units including one or more sacrificial tubes and the sacrificial tubes forming a fluid flow path between the top extent of the foundation element and the plate void, the method further including the step of filing the plate void with foundation material after the applying step. 15 20

22. The method according to claim 19, wherein the first and second operating units are lowered into the foundation opening together. 25

23. The method according to claim 22, wherein the at least one base bearing plate is temporality secured relative to the at least one shaft bearing plate for the lowering step.

24. A method of load test measuring a shaft resistance and a base resistance of a foundation element without embedding a jack assembly within the foundation element, the foundation element extending in a foundation opening wherein the foundation opening includes one or more side-walls and a bottom surface, the at least one foundation element having a top extent and a bottom extent; the method comprising the steps of: 30 35

- providing a first operating unit that includes at least one base bearing plate and at least one base sacrificial tube fixed relative to the at least one base bearing plate; 40
- providing a second operating unit includes at least one shaft bearing plate and at least one shaft sacrificial tube fixed relative to the at least one shaft bearing plate;
- lowering the first and second operating units into the foundation opening; 45
- filing the foundation opening with a foundation material;

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allowing the foundational material to cure to form a foundation element;

extending a base mobilizer bar through each of the at least one base sacrificial tube wherein the base mobilizer bar is operably joined to the at least one base bearing plate and extending a shaft mobilizer bar through each of the at least one shaft sacrificial tube and operably positioning the shaft mobilizer bar relative to the at least one shaft bearing plate

securing at least one bottom loading plate relative to the base mobilizer bar wherein the base mobilizer bar joins the at least one bottom loading plate and the at least one base bearing plate wherein movement of the at least one bottom loading plate results in movement of the first operating unit; 15

securing at least one top loading plate relative to the shaft mobilizer bar wherein the shaft mobilizer bar joins the at least one top loading plate and the at least one shaft bearing plate wherein movement of the at least one top loading plate results in movement of the second operating unit; 20

providing at least one loading source positioned between the at least one top loading plate and the at least one bottom loading plate and above the top extent of the foundation opening; 25

applying a test load with the at least one loading sources to urge the at least one top loading plate away from the at least one bottom loading plate thereby producing an upward force against the foundation element and a downward force on the associated bottom surface.

25. The method according to claim 24, further including the step of removing at least one of the base mobilizer bar and the shaft mobilizer bar to form a fluid flow path between the top extent of the foundation element and a plate void between the at least one base bearing plate at least one shaft bearing plate, and filing the plate void with foundation material after the applying step. 30 35

26. The method according to claim 19, wherein the filling of the foundation opening is a second filling step and the method further including a first filling step of filling the foundation opening with a first portion of foundation material and a first curing step before the lowering step for the first and second operating units that are lowered into the foundation opening; the second filling step filling the foundation opening above the at least one shaft bearing plate. 40 45

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