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White

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[54] **VIBRATORY SYSTEMS FOR DRIVING ELONGATE MEMBERS INTO THE EARTH IN INACCESSIBLE AREAS**

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[51] **Int. Cl.**^{6} **E21B 7/24**

[52] **U.S. Cl.** **173/189**; 173/49; 173/193

[58] **Field of Search** 173/49, 39, 42, 173/44, 186, 187, 188, 189, 191, 193; 405/231, 232

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Primary Examiner—Scott A. Smith
Attorney, Agent, or Firm—Michael R. Schacht; Hughes & Schacht, P.S.

[57] **ABSTRACT**

A system for allowing elongate members such as piles, caissons, and casings to be driven into the earth at inaccessible locations. The system comprises a structural assembly having a support assembly and a bracing assembly. The structural assembly is arranged on a ground engaging assembly. The bracing assembly engages the caisson as it is being driven to make sure that it is plumb as it is being driven and when it is subsequently in the earth. The ground engaging assembly is adjustable to alter the orientation of the structural assembly to maintain the caisson in a plumb orientation. The bracing assembly comprises a guide portion and an extension portion. The extension portion may be retracted and extended relative to the support assembly. The system employs a conventional vibratory hammer to drive the elongate member. The system may also include a helicopter to lift the various components and the elongate member to the desired location.

21 Claims, 9 Drawing Sheets

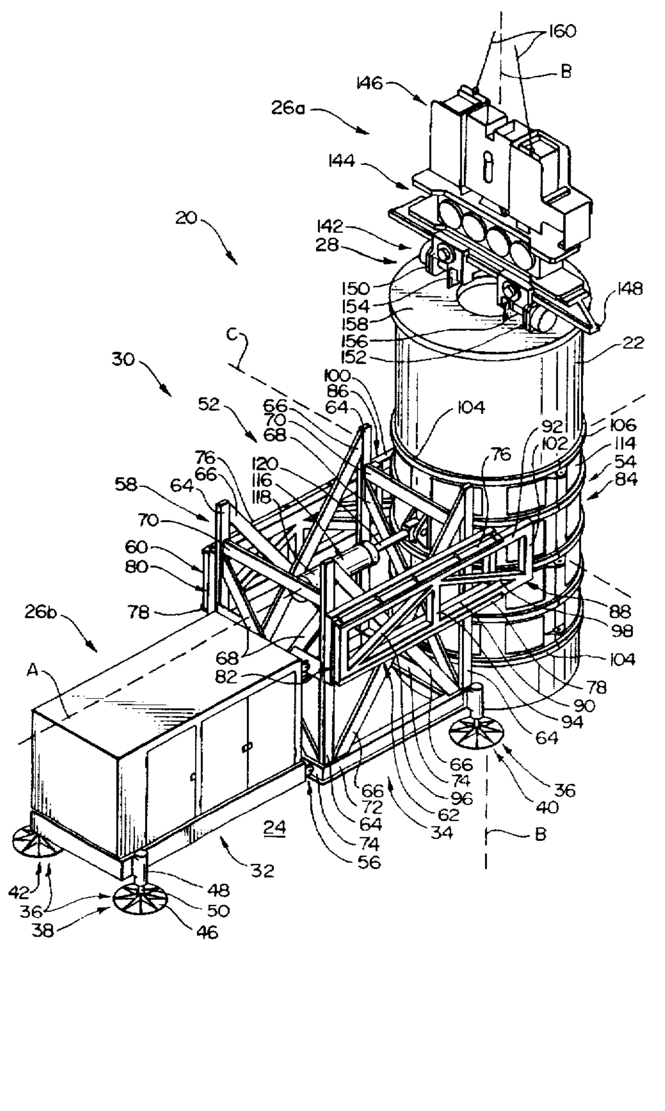

FIG. 1

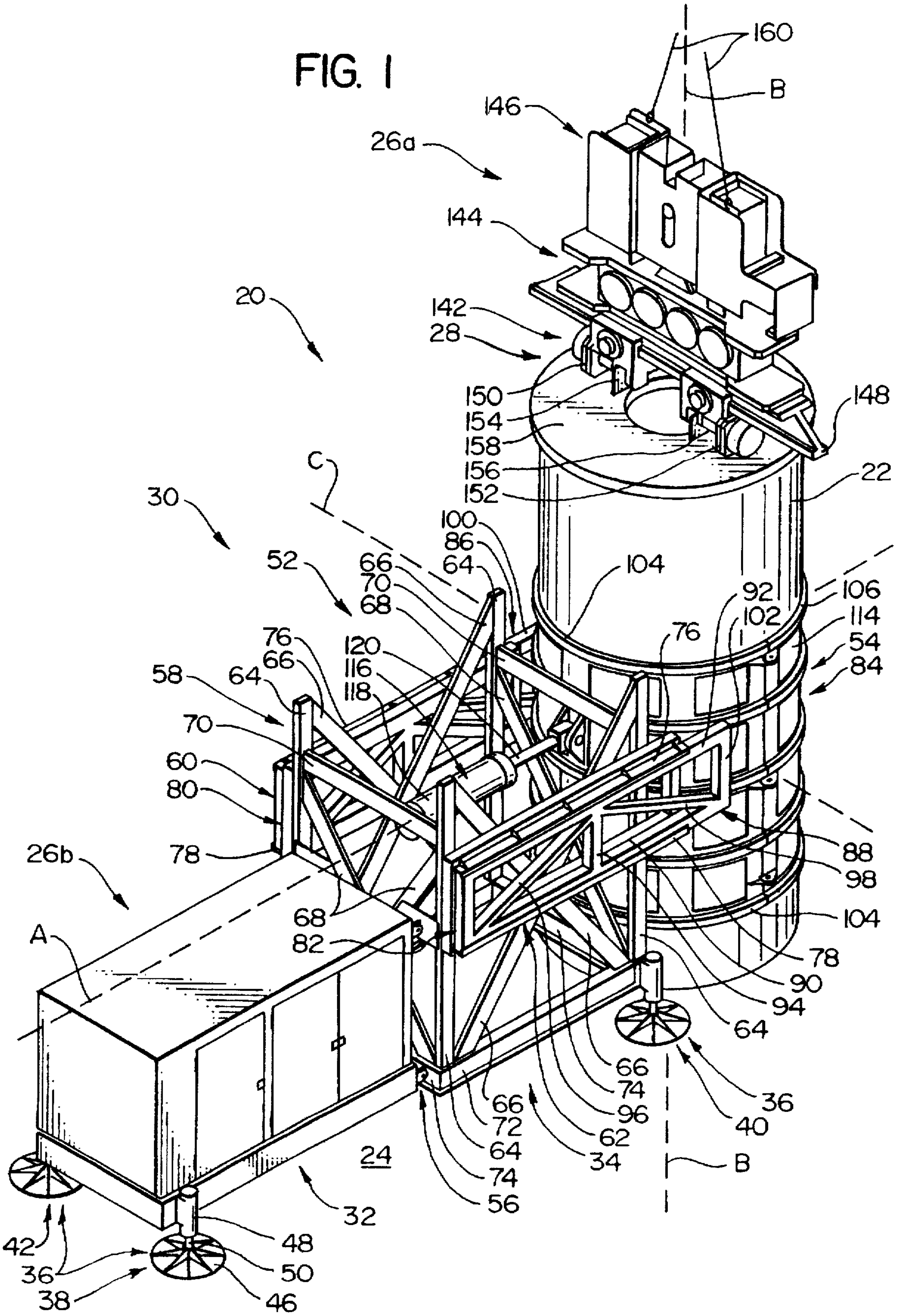
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FIG. 2A

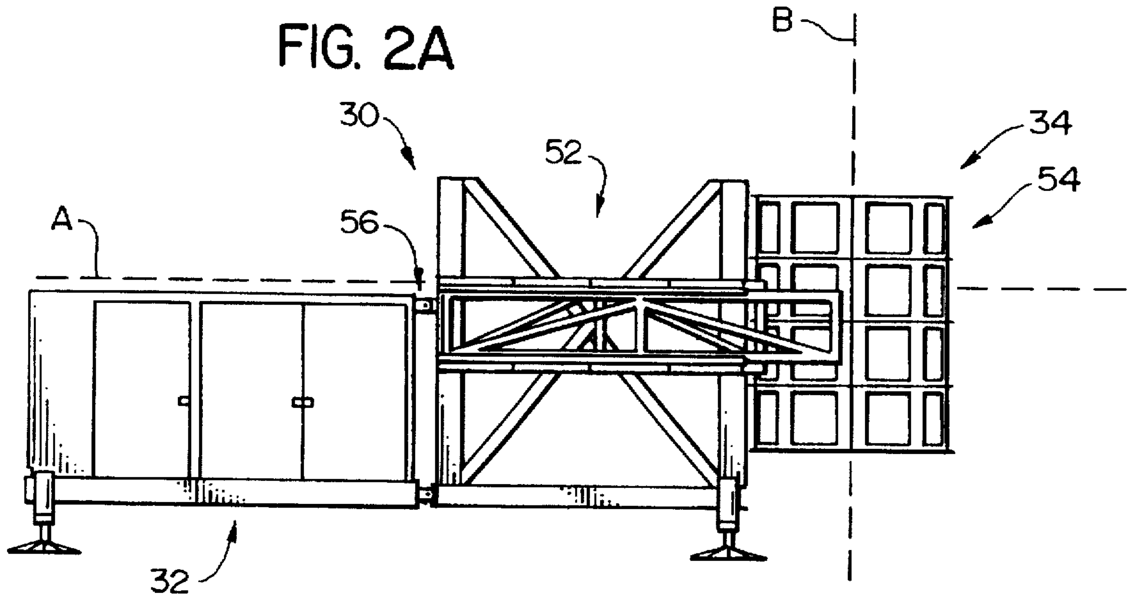


FIG. 2B

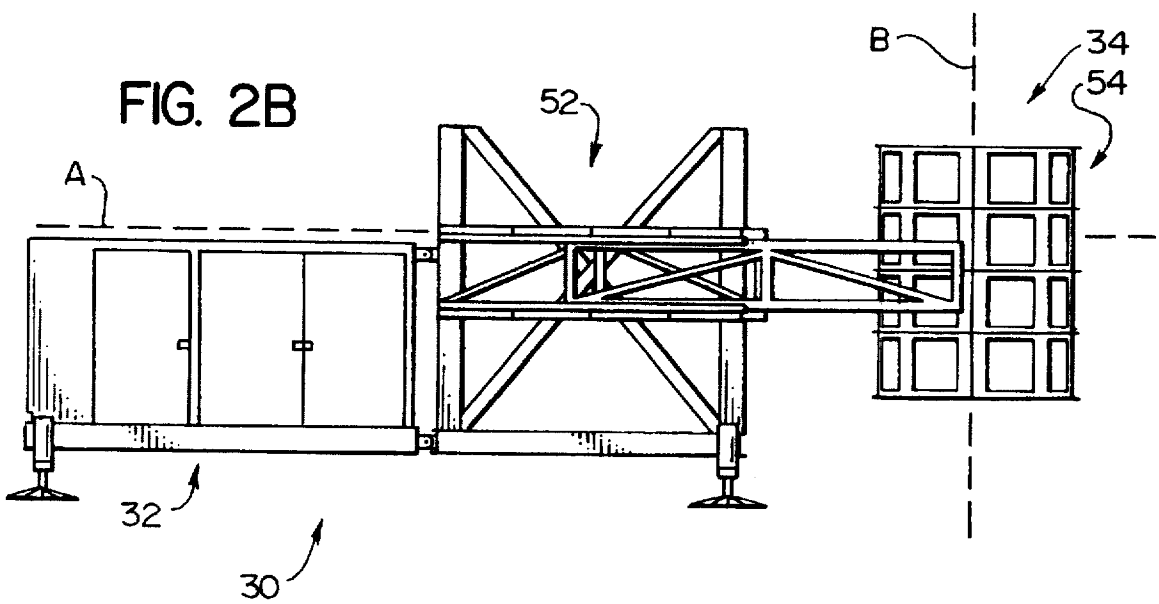


FIG. 3A

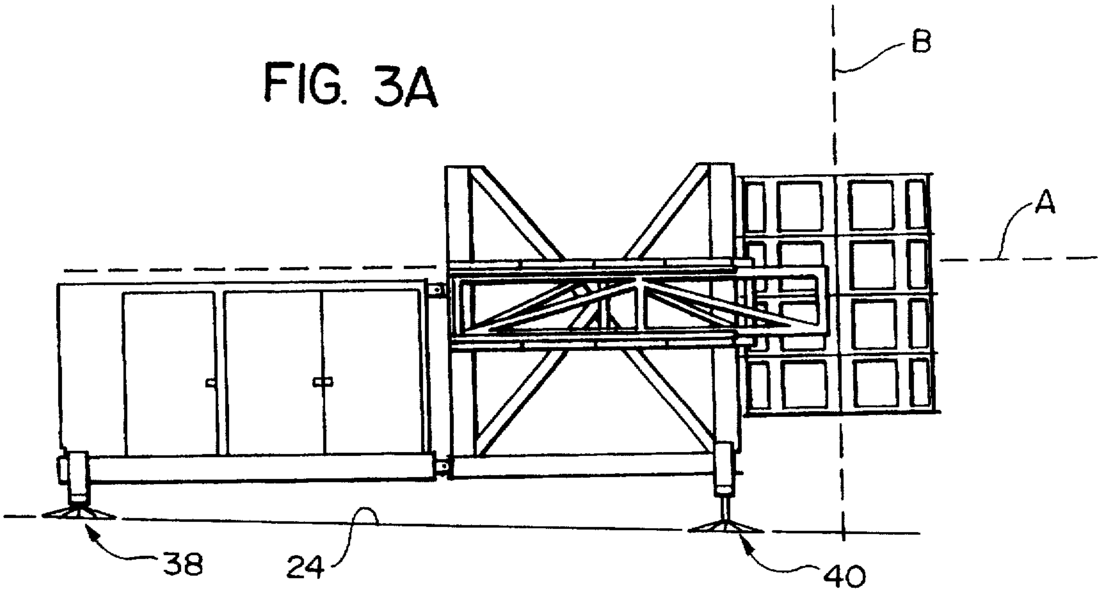


FIG. 3B

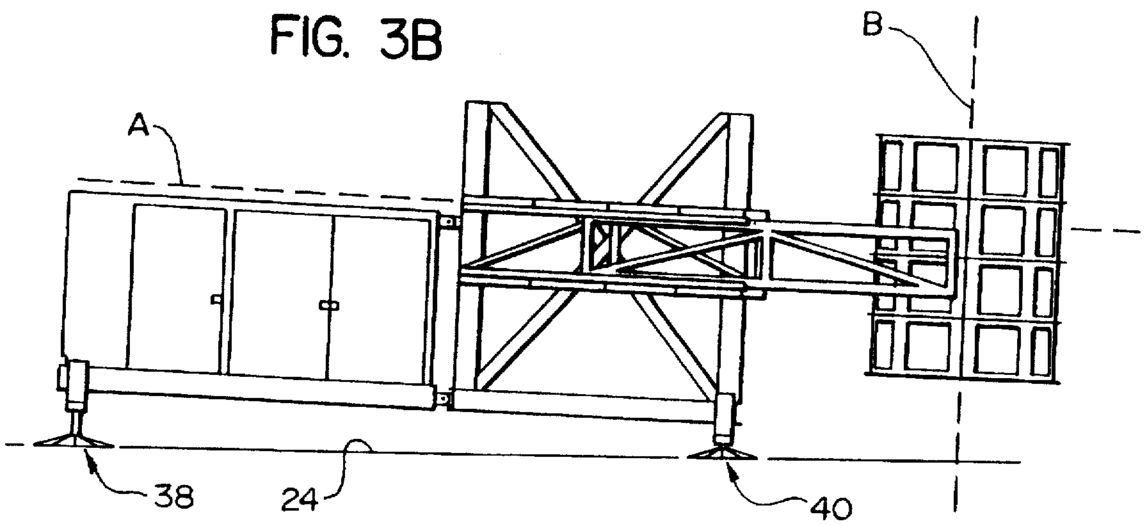


FIG. 4A

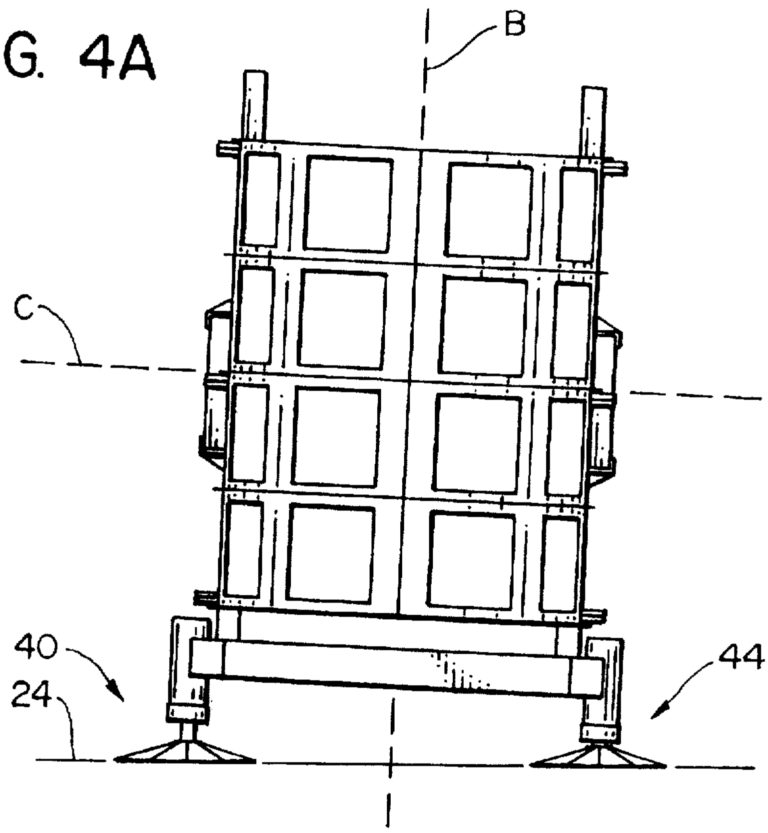


FIG. 4B

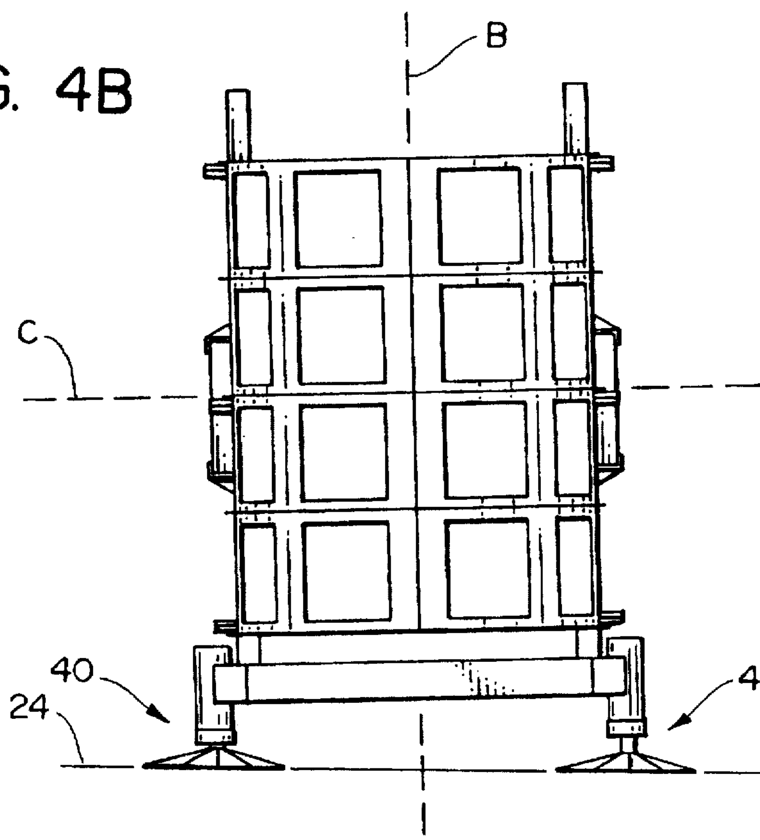


FIG. 5A

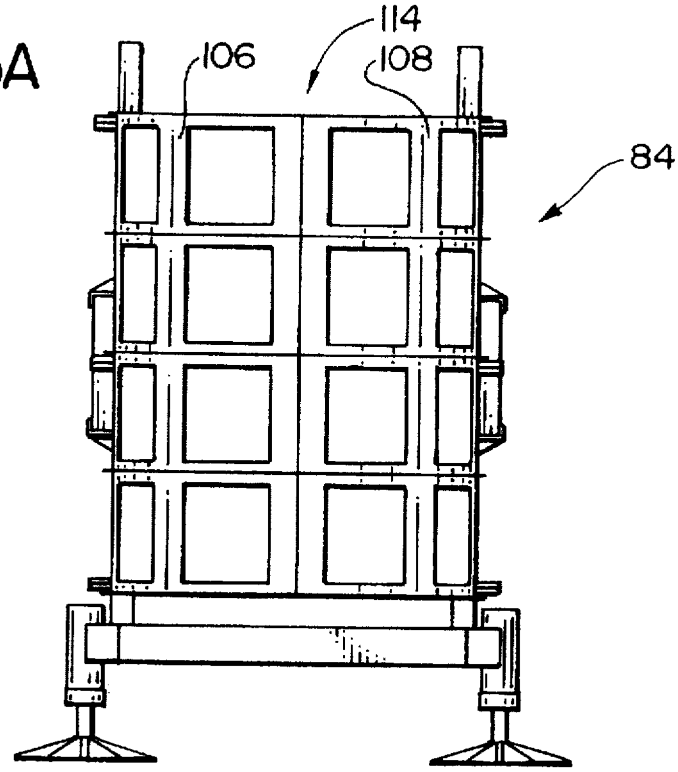


FIG. 5B

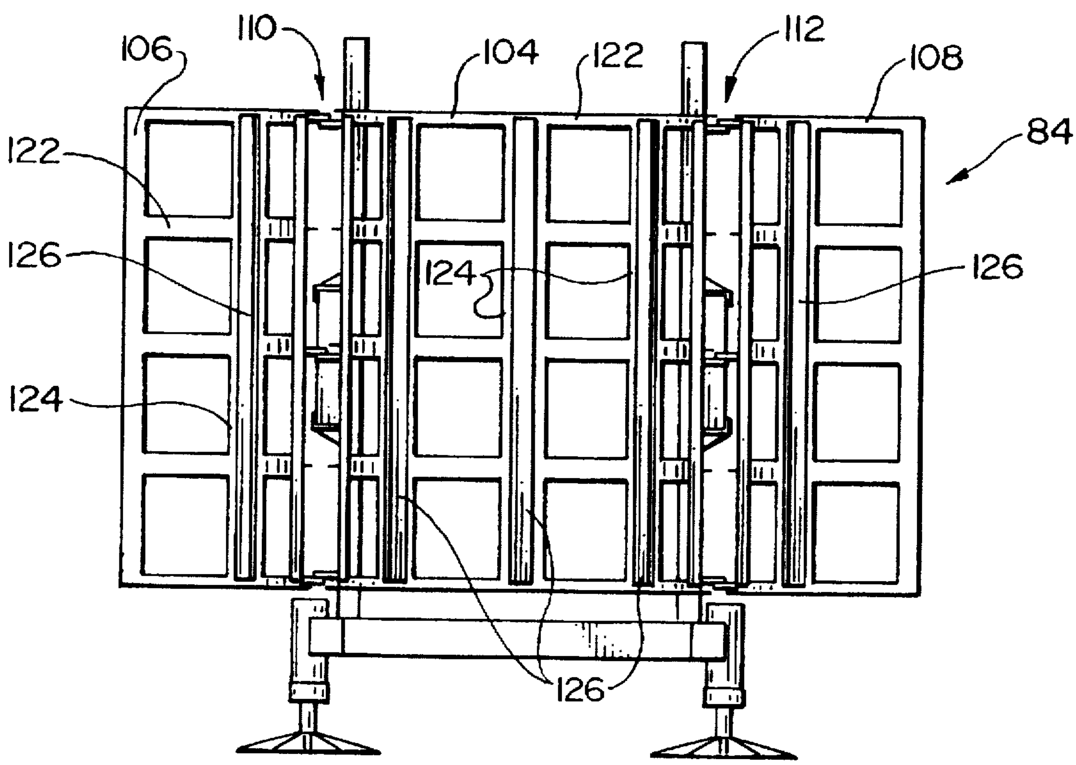


FIG. 6

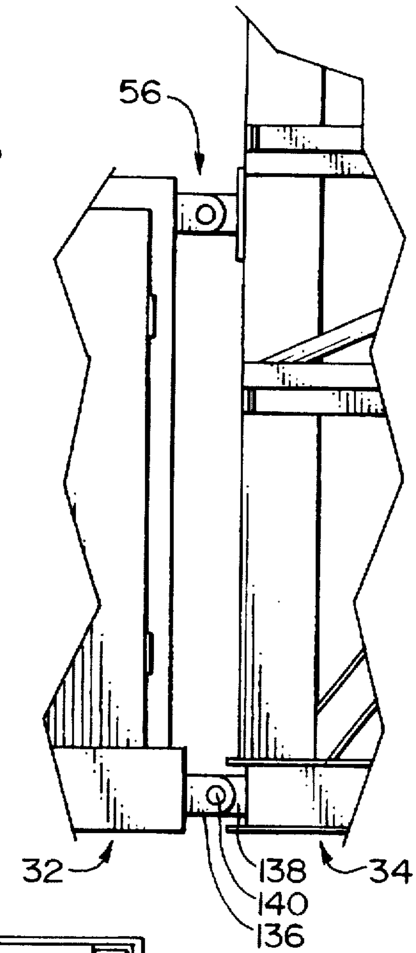


FIG. 7

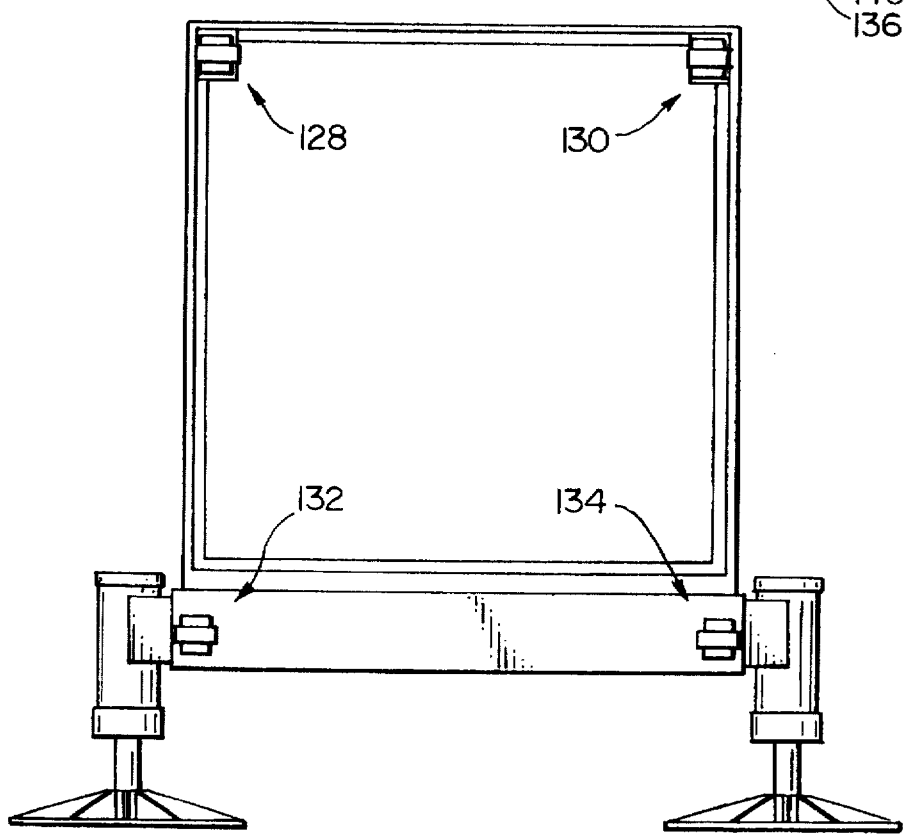


FIG. 8A

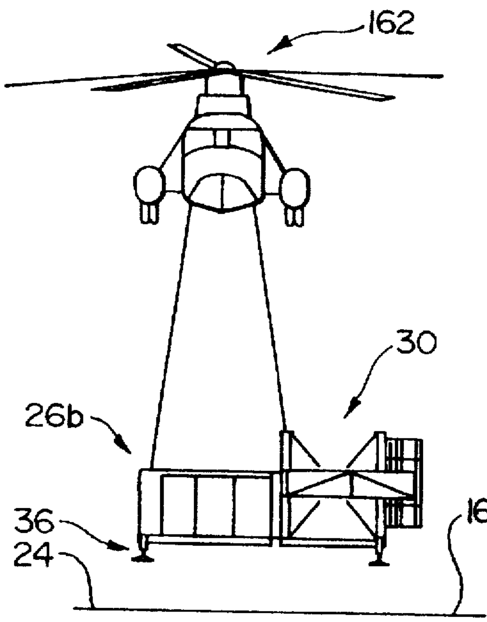


FIG. 8B

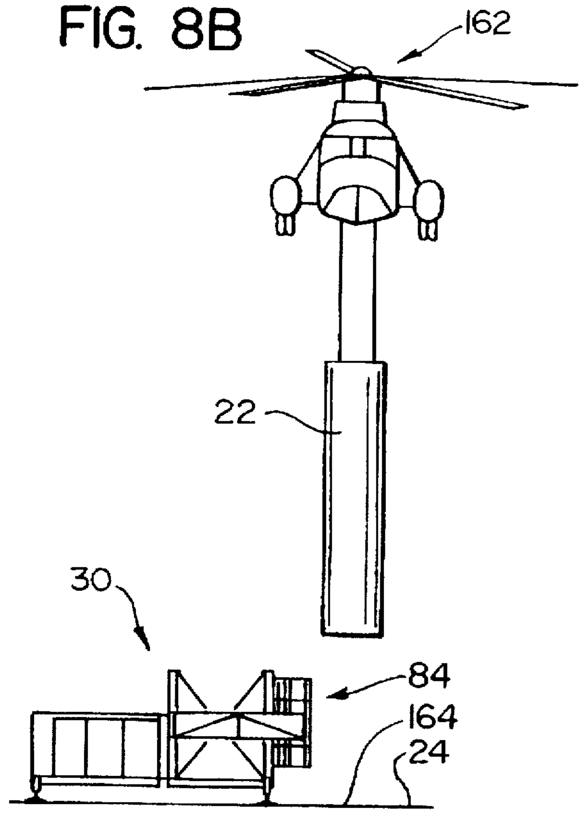


FIG. 8C

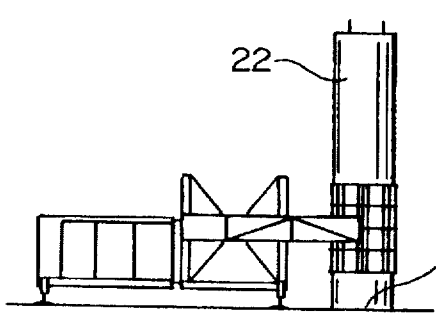


FIG. 8D

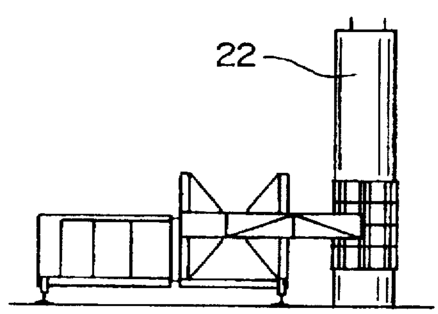


FIG. 8E

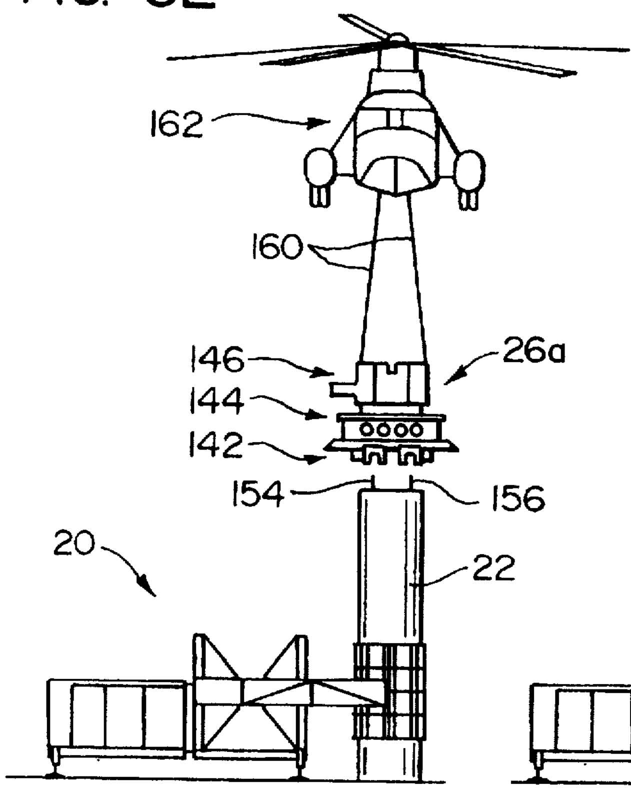


FIG. 8F

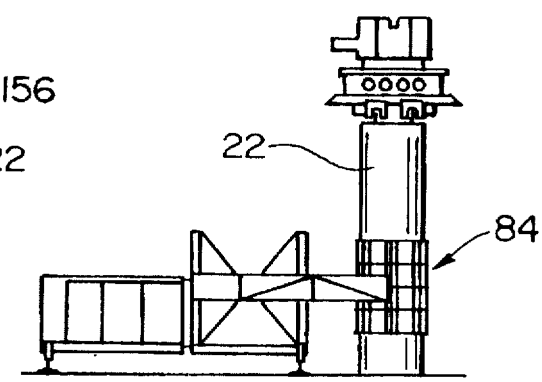


FIG. 8G

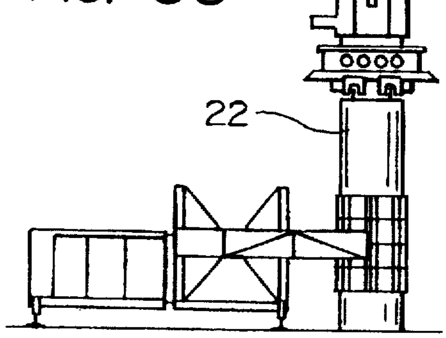


FIG. 8H

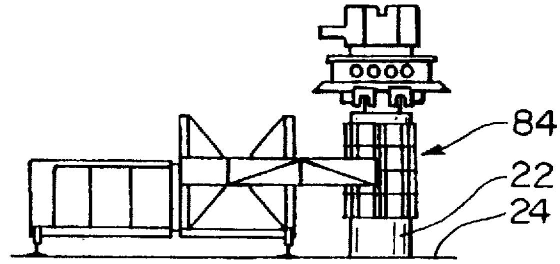


FIG. 8I

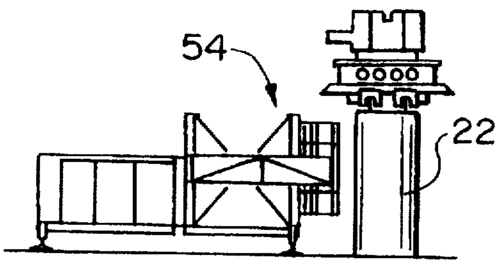


FIG. 8J

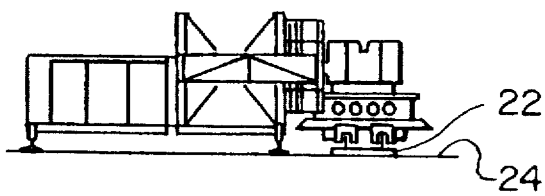


FIG. 8K

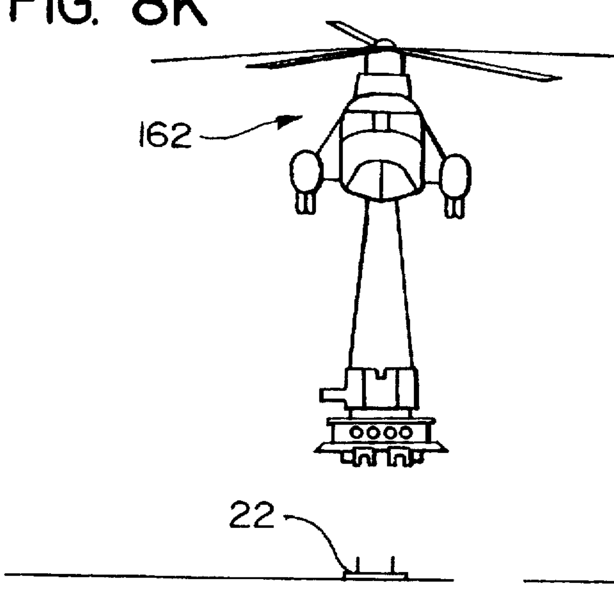
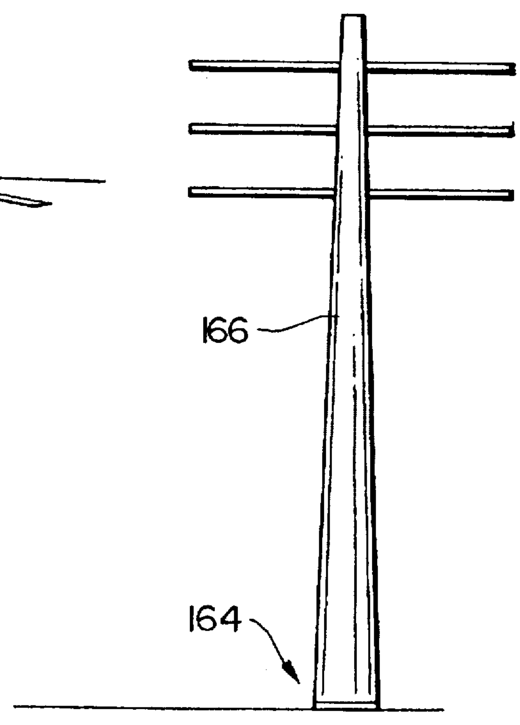


FIG. 8L



VIBRATORY SYSTEMS FOR DRIVING ELONGATE MEMBERS INTO THE EARTH IN INACCESSIBLE AREAS

TECHNICAL FIELD

The present invention relates to vibratory systems for driving elongate members into the earth and, more particularly, to such vibratory systems that allow elongate members to be driven at locations that are inaccessible because they are remote and/or sensitive.

BACKGROUND OF THE INVENTION

In the construction industry, it is often necessary to insert elongate members into the earth. Such elongate members may be solid piles or hollow, generally cylindrical bodies referred to as caissons or, in the context of drilling, as casings.

Such elongate members are driven into the earth for many reasons. Piles are often driven into lake or river beds as part of a pier structure or the like. Caissons are often inserted into the earth during new construction as part of a foundation for a structure. Casings are employed when drilling a hole to prevent the earth from collapsing into the hole as it is drilled.

In this application, the term "caisson" will be used to refer to any elongate member that is driven into the earth, including traditional caissons, solid piles, and casings used in drilling operations.

To insert a caisson into the earth, a large driving force must be applied thereto. Often, vibratory devices are employed to introduce a vibratory force along the axis of the caisson during the driving process. The combination of a static driving force with a dynamic vibratory force is usually sufficient to overcome the earth's resistance and allow the caisson to be inserted therein.

Normally, the vibratory device is incorporated into a vibratory system including a crane for suspending the vibratory device, a suppresser for preventing vibratory forces from being transmitted to the crane, a power pack for providing hydraulic power to the vibratory device, and a clamping system adapted to connect the vibratory device to the particular elongate member being driven. The weight of the vibratory device, suppresser, and clamping system create the static driving force required.

In certain situations, the caisson must be driven in a location that is relatively inaccessible to the entire vibratory system as described above. In particular, the use of such systems may be impractical or expensive if the caisson is be driven in a location not serviced by road or in an environmentally sensitive area.

In the case of a remote location, a road or the like may be constructed to allow the vibratory system to be trucked to the remote location. This approach yields satisfactory results in many situations but can be expensive because of the road work involved. When a caisson is to be driven in environmentally sensitive areas such as wetlands or the like, governmental regulations may preclude the building of a road to allow trucks to transport the remote location. Or if such a road may be constructed, the road must later be removed and the area returned to its original condition. This process is usually very expensive.

One approach that has been employed in remote locations is to use a helicopter to transport the vibratory system and caisson to the remote location. The power pack is brought in first, after which the caisson and vibratory device are brought in. The power pack is connected to the vibratory device and operated to drive the caisson into the earth.

The use of a helicopter obviates the need to construct and/or remove an access road. But, without a crane, it is difficult to keep the vibratory device plumb as it is driven into the earth. The helicopter may be used for this purpose, but helicopters are not particularly suited for this type of work and are normally quite expensive.

The need thus exists for a system for driving caissons into the earth at inaccessible locations without the need to construct an access road and in a manner that allows the caisson to kept plumb as it is driven into the earth without use of a helicopter.

OBJECTS OF THE INVENTION

From the foregoing, it should be clear that one primary object of the present invention is to provide an improved vibratory system for driving piles at inaccessible, remote, or sensitive locations.

A further object of the invention is to provide a vibratory system having a favorable combination of the following characteristics:

(a) obviates the need to construct a road to reach the location at which the caisson is to be inserted into the earth;

(b) allows the use of standard power packs, vibratory devices, and clamping assemblies;

(c) allows the caisson to maintained in a plumb orientation as it is driven and/or returned to plumb if necessary;

(d) is relatively inexpensive to operate;

As will become clear from the following detailed discussion, these and other objects are achieved by the caisson driving system of the present invention.

SUMMARY OF THE INVENTION

The present invention is a system for driving elongate members such as piles or the like in a desired location that is relatively inaccessible. The system of the present invention basically comprises a vibratory apparatus, a structural assembly, and a ground engaging assembly. The structural assembly comprises a support portion and a bracing portion. The ground engaging assembly spaces the structural assembly from the ground adjacent to the desired location. The bracing portion of the structural assembly engages the elongate member being driven to keep the elongate member in a plum orientation.

The ground engaging assembly may be made extensible or movable to change the orientation of the structural assembly relative to the earth. The bracing assembly can be adapted to engage the elongate member such that, as the orientation of the structural assembly is changed, the direction of the axis of the elongate member relative to the earth is changed. Thus, if the elongate member is not vertical, it can be moved back into a vertical position by operation of the ground engaging assembly. In this case, the ground engaging assembly may comprise a plurality of pneumatic jacks extending between the structural assembly and the ground.

The bracing assembly may comprise a fixed portion, an extension portion, and a pneumatic cylinder. The fixed portion is rigidly attached to the support portion. The pneumatic cylinder is arranged to extend and retract the extension portion relative to the fixed portion. The bracing member may thus be moved into and out of position adjacent to the elongate member and can be used to force the elongate member into a vertical position in some situations.

The bracing assembly may also comprise a cage assembly adapted to surround the caisson. The cage assembly would preferably comprise one or more gate portions that may be opened to allow the elongate member to be placed into and removed from a cage chamber defined by the cage assembly.

The vibratory apparatus conventionally comprises a vibratory portion and a power pack portion connected by hydraulic hoses. The power pack portion of the vibratory apparatus may be mounted onto or formed as an integral part of the support portion for ease of transportation and use.

The present invention may be embodied in a method comprising the steps of transporting the structural assembly with the power pack portion to the desired location by helicopter, transporting the elongate member and vibratory portion to the location by helicopter, and supporting the elongate member as it is driven using the structural assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of vibratory system **20** of the present invention;

FIGS. 2A and 2B depict extension and retraction of the cage assembly of the present invention;

FIGS. 3A, 3B, 4A, and 4B depict the use of ground engaging jack assemblies to change the orientation of the caisson being supported by the present invention;

FIGS. 5A and 5B depict the opened and closed position of the gate assembly of the present invention;

FIGS. 6 and 7 show details of the connecting assembly of the system of the present invention;

FIGS. 8A–8L depict the method of using the system **20**.

DETAILED DESCRIPTION

Referring now to the drawing, depicted at **20** in FIG. **1** is a caisson driving system constructed in accordance with, and embodying, the principles of the present invention. The system **20** is adapted to drive a caisson **22** into the earth **24**.

The system **20** basically comprises a vibratory system **26** including a vibratory portion **26**a and a power portion **26***b*, a clamp assembly for fixing the vibratory portion **26***a* of the vibratory system **26** onto the caisson **22**, and a structural assembly **30**. The structural assembly **30** comprises a support assembly **32** and a bracing assembly **34**. A ground engaging assembly **36** spaces the structural assembly **30** from the earth **24**.

The bracing assembly **34** is adapted to engage the caisson **22**. As the vibratory system **26** applies vibratory forces to the caisson **22** to drive the caisson **22** into the earth **24**, the structural assembly **30** maintains the caisson **22** in a desired orientation with respect to the earth **24** as these vibratory forces are applied thereto.

The ground engaging assembly **36** forms an adjusting means that allows a position of the structural assembly **30** relative to the earth **24** to be adjusted or altered. In particular, the ground engaging assembly **36** comprises first through fourth jack assemblies **38**, **40**, and **42** (FIGS. 4A and 4B). These jack assemblies **38**–**44** are identical and each comprises a ground plate **46** adapted to engage the ground **24**, a cylinder **48** rigidly fastened to the structural assembly **30**, and a piston **50** connected between the cylinder **48** and the ground plate **46**. By introducing hydraulic fluid into the cylinder **48**, the piston **50** is forced out of the cylinder **48** to effectively lengthen the jack assemblies **38**–**44**. By allowing hydraulic fluid to flow out of the cylinders **48**, the length of these jack assemblies **38**–**44** can effectively be shortened.

The effect of these jack assemblies **38**–**44** is shown in FIGS. 3A, 3B, 4A, and 4B. To help explain these figures, shown in FIGS. 1, 3A, 3B, 4A, and 4B are a longitudinal axis A, vertical axis B, and lateral axis C of the system **20**. The vertical axis B also corresponds to the longitudinal axis of the caisson **22**. The caisson **22** is driven along the vertical axis B.

Referring now to FIGS. 3A and 3B, it can be seen that the angles between the longitudinal axis A and vertical axis B are different from FIG. 3A than from FIG. 3B. This change in angles is accomplished by a change in effective length of jacks **38**–**44**. In particular, the overall length of the jack assembly **38** is shorter in FIG. 3A than in FIG. 3B. Conversely, the overall length of jack assembly **40** is longer in FIG. 3A than in FIG. 3B.

A similar change in the angles between the lateral axis C and the vertical axis B may be obtained as shown in FIGS. 4A and 4B. The jack assembly **40** in FIG. 4A is longer than in FIG. 4B, while the jack assembly **44** is longer in FIG. 4B than in 4A.

By comparing FIGS. 3A, 3B, 4A, and 4B, one can see that the angle of the vertical axis B with respect to the ground **24** can be significantly changed by operation of the jack assemblies **38**–**44**. Thus, the jack assemblies **38**–**44** can be employed to plumb the vertical axis B and thus the caisson **22** in contact with the bracing assembly **34**.

Referring now to FIGS. 2A and 2B, these figures show that the bracing assembly comprises a guide assembly **52** and an extension assembly **54**. The guide assembly **52** is securely attached to the support assembly **32** by connecting assembly **56**. The guide assembly **52** slideably engages the extension assembly **54** such that the extension assembly can move away and towards the guide assembly **52** (and thus the support assembly **32**) along the longitudinal axis A. In particular, the extension assembly **54** is shown in its retracted position in FIG. 2A and in its extended position in FIG. 2B.

A comparison of FIGS. 2A and 2B shows that the vertical axis B is spaced further from the support assembly **32** in the extended position than in the retracted position. This feature of the present invention can be used to plumb the vertical axis B and, as will be explained in further detail below, to facilitate driving of the caisson **22** completely into the earth **24**.

The guide assembly **52** basically comprises a structural frame **58**, first side rails **60**, and second side rails **62**. The structural frame **58** comprises four corner posts **64**, four side braces **66**, internal braces **68**, two upper horizontal braces **70**, two side horizontal braces **72**, and two internal horizontal braces **74**. These members **66**–**74** are connected in a manner that creates a rigid, stable, box-like structure appropriate for bearing the loads encountered while plumbing and driving the caisson **22**.

The side rails **60** and **62** are attached in parallel on opposing sides of the frame structure **58**. Each of the rails **60** and **62** comprises an upper rail member **76** and a lower rail member **78**. The rail members **76** and **78** define channels **80** and **82**.

The extension assembly **54** comprises a cage assembly **84** adapted to encircle the caisson **22** and first and second channel assemblies **86** and **88** are adapted to be received within the channels **80** and **82**, respectively. The channel assemblies **86** and **88** are rectangular in overall configuration and slightly larger in the direction of the longitudinal axis A than the channels **80** and **82**. Each of the rail members **86** and **88** is identical and comprises upper and lower rigid members **90** and **92**, a center post **94**, and angle braces **96** and **98**. These members are dimensioned and assembled in a manner appropriate for bearing the loads encountered while plumbing and driving the caisson **22**. Distal ends **100** and **102** of these channel assemblies **86** and **88** are rigidly connected to the cage assembly **84**.

Referring now to FIGS. **5A** and **5B**, the cage assembly **84** comprises a fixed portion **104** securely attached to the distal ends **100** and **102** of the channel assemblies **86** and **88** and first and second gate members **106** and **108** rotatably attached to the fixed member **104** by hinge assemblies **110** and **112**. The gate members **106** and **108** may thus rotate between a closed position as shown in FIG. **5A** and an open position as shown in FIG. **5B**.

In the closed position shown in FIGS. **1** and **5A**, the gate members **104**, **106**, and **108** define a gate chamber **114** sized and dimensioned to encircle a portion of the caisson **22**. The ability of the gate members **106** and **108** to move into the open position shown in FIG. **5B** allows the caisson **22** to be placed into the gate chamber **114** by displacing the extension assembly **54** relative to the caisson **22** rather than by moving the caisson **22** into the chamber **114**.

To accomplish the movement of the extension assembly **54** between the retracted and extended position shown in FIGS. **2A** and **2B**, a hydraulic assembly **116** is provided assembly hydraulic assembly **116** comprises a cylinder **118** securely attached to the frame structure **58** and a piston member rigidly connected to the fixed cage member **104**. By introducing pressurized hydraulic fluid into appropriate chambers in the cylinder **116**, the piston member **120** can be forced into or out of the cylinder **118**. Because the hydraulic assembly **116** is connected as described above between the frame structure **58** and the fixed gate member **104**, the hydraulic assembly **116** moves the extension assembly **54** between the retracted and extended positions shown in FIGS. **2A** and **2B**.

Referring now for a moment back to FIG. **5B**, it can be seen that the cage members **104**, **106**, and **108** comprise a rigid, ladder-like structure including a series of vertical members **122** and horizontal members **124**. Mounted on the inside of each of the vertical members **124** are pad members **126**. The pad members **126** are made of a somewhat resilient material that will reduce the likelihood that engagement of the members **104**, **106**, and **108** with the caisson **22** will result in damage to the caisson. The exemplary pads **126** are made of wood, but any resilient material may be used that has a somewhat slick surface that will not impede passage of the caisson **22** through the cage chamber **114**.

Referring now to FIGS. **6** and **7**, depicted therein in more detail is the connecting assembly **56** employed to connect the support assembly **32** to the bracing assembly **34** to form the structural assembly **30**. The connecting assembly **56** connects the assemblies **32** and **34** at four points identified by reference characters **128**, **130**, **132**, and **134**. At each of these locations, a first flange **136** extends from the support assembly and a second flange **138** extends from the bracing assembly **34**. A hole is formed in each of these flanges **136** and **138** that is adapted to snugly receive a pin **140**. By aligning the holes in the flanges **136** and **138** and inserting the pin **140**, relative movement along any of the axes A, B, and C described above is prevented. By providing four attachment points and spacing these points such that the longitudinal axes of these pins do not all lie in the same line, a rigid connection is formed between the assemblies **32** and **34**.

As briefly described above, the vibratory system **26** comprises a vibratory portion **26*a*** and a power portion **26*b***. The power portion **26*b*** may be a conventional power pack that is placed into a separate rigid frame forming the support assembly **32** or may be an integral part of this assembly **32**. In the exemplary system **20**, the power pack portion **26*b*** of the vibratory system **26** is integrally formed as part of the support assembly **32**.

The vibratory portion **26*a*** comprises a clamping assembly **142**, a vibratory assembly **144**, and a suppresser assembly **146**.

The clamping assembly **142** comprises a beam member **148** from which clamps **150** and **152** are suspended. These clamps **150** and **152** rigidly engage flanges **154** and **156** rigidly welded to an upper end wall **168** of the caisson **22**.

The vibratory assembly **144** comprises eccentrically mounted weights that are rotated to generate vertical vibratory forces in a conventional manner. The vibratory assembly **144** is rigidly connected to the beam **148**.

The suppresser assembly **146** is rigidly connected to the vibratory assembly **144**. Cables **160** are attached to the suppresser assembly **146** to allow the vibratory portion **26*a*** to be suspended from a helicopter or the like. The suppresser assembly **146** is configured to absorb the vibratory forces generated by the vibratory assembly **144** and prevent these forces from being transmitted to the cables **160**.

The power pack portion **26*b*** of the vibratory system **26** supplies hydraulic fluid appropriate for operating the jacks **38–44**, the hydraulic assemblies **116**, the clamping assembly **142**, and the vibratory assembly **144**. Ordinarily, the power pack portion **26*b*** comprises a motor (not shown) to make the vibratory system **26** self-contained.

Referring now to FIGS. **8A–8L**, the method of using the system **20** will be described in further detail.

Referring initially to FIG. **8A**, a helicopter **162** is used to transport the structural assembly **30**, power pack portion **26*b***, and a ground engaging assembly **36** to a desired location of the earth **24** represented by reference character **164**.

As shown in FIG. **8B**, the helicopter **162** is then used to bring the caisson **22** to the desired location **164**. Between the steps shown in FIGS. **8B** and **8C**, the cage assembly **84** is placed around the caisson **22** as described above.

FIG. **8C** shows the caisson **22** located at the desired location **164** with the cage assembly **84** in its closed position with the caisson **22** within the cage chamber **114**. At this point, the caisson **22** is slightly out of plumb, or vertical alignment, and cannot be driven straight into the earth. Accordingly, between FIGS. **8C** and **8D** the jacks **38–44** and/or hydraulic assembly **116** are operated as necessary to plumb the caisson **22** as shown in FIG. **8D**. Importantly, the helicopter **162** need not be used in this operation.

Referring now to FIG. **8D**, that figure depicts the helicopter **162** placing the vibratory portion **26*a*** of the vibratory system **26** on to the flanges **154** and **156** located on the upper end of the caisson **22**. The clamping assembly **142** is used to fix the vibratory device **144** on to the flanges **154** and **156**. The connection between the power pack portion **26*b*** and the vibratory portion **26*a*** is made and the vibratory assembly **144** is energized to begin driving the caisson **22**.

After the pile has been driven a short distance as shown in FIG. **8F**, is becomes slightly out of plumb. At this point, the jacks **38–44** and hydraulic assembly **116** are again operated to make the caisson **22** plumb as shown in FIG. **8G**.

The vibratory device is then operated to drive the caisson **22** to a position where it is partially inserted as shown in

FIG. 8H. At this point, the cage assembly **84** is in the way and prevents the caisson **22** from being completely driven into the earth **24**.

Accordingly, as shown in FIG. **8I**, the cage assembly **84** is placed in its open position and the hydraulic assembly **16** operated so that the extension assembly **54** is placed in the retracted position as shown in FIG. **8I**. The caisson **22** has been driven far enough that it does not need to be braced in order to maintain it in a plumb configuration.

The vibratory device **144** is then operated again to drive the caisson **22** completely into the earth **24** as shown in FIG. **8J**. The helicopter **162** is then used to remove the system **20**, leaving only the upper end of the caisson **22** exposed. The helicopter **162** then may be used to bring in a power pole **166** which is attached to the caisson **22** at the desired location **164**. Because the caisson **22** is plumb, the power pole **166** will be substantially vertical as shown in FIG. **8L**.

From the foregoing, it can be seen that system **20** and method of using this system **20** do not require the construction of roads to the desired location **164** and minimizes the use of the helicopter **162**. The system **20** and method described herein are thus appropriate for use in locations where the building of a road to the desired location **164** is either impossible or impractical for one reason or another.

The above described embodiment is therefore to be considered in all respects illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than the foregoing description. All changes that come within the meaning and scope of the claims are intended to be embraced therein.

What is claimed is:

1. A system for driving an elongate member to a desired position in the earth comprising:

vibratory means for generating a vibratory force;

clamp means for fixing at least a portion of the vibratory means to an upper end of the elongate member such that the vibratory means are supported solely by the elongate member;

a structural assembly comprising a support assembly and a bracing assembly; and

a ground engaging assembly for spacing the structural assembly from the earth; wherein

the bracing assembly initially engages a lower end of the elongate member and solely supports the elongate member and the vibratory means clamped thereto in a desired orientation as the vibratory means applies vibratory forces to the elongate member;

the bracing assembly engages the elongate member such that the vibratory forces move the elongate member into the earth and the earth begins to support the elongate member in the desired orientation;

the bracing assembly is disengaged from the elongate member when the earth is capable of solely supporting the elongate member and the vibratory means; and

after the bracing assembly is disengaged from the elongate member, the vibratory means completes driving the elongate member into the earth to the desired position.

2. A system as recited in claim **1**, in which the ground engaging assembly comprises adjusting means for moving the structural assembly relative to the ground to move the elongate member into the desired orientation.

3. A system as recited in claim **2**, in which the adjusting means comprises at least one jack means for changing a position of the structural assembly relative to the ground.

4. A system as recited in claim **3**, in which the adjusting means comprises a plurality of jack means each connected between one of a plurality of points on the structural assembly and the ground such that a distance between the plurality of points on the structural assembly and the ground may be changed to change the orientation of the structural assembly relative to the ground.

5. A system as recited in claim **1**, in which the bracing assembly comprises a guide assembly and an extension assembly, where the guide assembly attaches the extension assembly to the support assembly such that the extension assembly may move relative to the support assembly along a first axis but not along second and third axes orthogonal to each other and the first axis.

6. A system as recited in claim **5**, further comprising hydraulic means for displacing the extension assembly along the first axis relative to the support assembly.

7. A system as recited in claim **1**, in which the bracing assembly comprises a cage assembly adapted to surround a section of the elongate member.

8. A system as recited in claim **7**, in which the cage assembly comprises a gate portion movable between a closed position and an open position.

9. A system as recited in claim **1**, further comprising means for displacing at least a portion of the bracing assembly along a first axis relative to the support assembly.

10. A system as recited in claim **1**, in which the vibratory means comprises a power pack portion and a vibratory portion, where the power pack portion is supported by the support assembly.

11. A system as recited in claim **1**, further comprising a connecting assembly for securely attaching the bracing assembly onto the support assembly.

12. A system as recited in claim **11**, in which the connecting assembly further comprises:

a plurality of first flange members each defining a first pin opening, where the first flange members are rigidly attached to one of the structural assembly and the support assembly;

a plurality of second flange members each defining a second pin opening, where the second flange members are rigidly attached to the other of the structural assembly and the support assembly; and

a plurality of pins each sized and dimensioned to be snugly received within the first and second pin openings; wherein

each of the first flange members is associated with one of the second flange members; and

when the pins extend into the associated pairs of flange members, the axes of the pins are arranged such that movement between the structural assembly and the fixed portion of the support assembly is prevented.

13. A system as recited in claim **12**, in which four pins are provided, and axes of two of the pins lie on a first line and axes of the remaining two pins lie on a second line spaced from the first line.

14. A system for driving an elongate member to a desired position in the earth, comprising:

vibratory means for generating a vibratory force;

clamp means for fixing at least a portion of the vibratory means to an upper end of the elongate member such that the elongate member solely supports the vibratory means;

a support assembly;

a bracing assembly adapted to engage the elongate member;

a connecting assembly adapted to mount the bracing assembly onto the support assembly to form a structural assembly, where the connecting assembly moves the bracing assembly relative to the support assembly; and

leveling means for moving the support assembly relative to the ground; wherein

when the bracing assembly engages the elongate member, the structural assembly initially engages a lower portion of the elongate member and completely supports the elongate member with the vibratory device attached thereto;

the connecting assembly and leveling means move the bracing assembly to maintain the elongate member in a desired orientation as the elongate member is driven into the ground;

the vibratory means drives the elongate member into the ground with the structural assembly supporting the elongate member and vibratory means in the desired orientation; and

when the ground is capable of supporting the elongate member and vibratory means in the desired orientation, the bracing assembly is disengaged from the elongate member and the vibratory means drives the elongate member into the desired position.

15. A system as recited in claim **14**, in which the leveling means comprises at least one jack means for changing an orientation of the structural assembly relative to the ground.

16. A system as recited in claim **15**, in which the leveling means comprises a plurality of jack means each connected between one of a plurality of points on the structural assembly and the ground such that a distance between the plurality of points on the structural assembly and the ground may be changed to change the orientation of the structural assembly relative to the ground.

17. A system as recited in claim **14**, in which the bracing assembly comprises a guide assembly and an extension assembly, where the guide assembly attaches the extension assembly to the support assembly such that the engaging assembly may move along a first axis relative to the support assembly but not along second and third axes orthogonal to each other and the first axis.

18. A system as recited in claim **17**, further comprising hydraulic means for displacing the extension assembly along the first axis relative to the support assembly.

19. A system as recited in claim **14**, in which the bracing assembly comprises a gate portion movable between a closed position and an open position.

20. A system for driving an elongate member into the earth, comprising:

vibratory means for generating a vibratory force;

clamp means for fixing at least a portion of the vibratory means to the elongate member;

a structural assembly comprising a support assembly and a bracing assembly;

a ground engaging assembly for spacing the structural assembly from the earth; and

a connecting assembly for securely attaching the bracing assembly onto the support assembly wherein

the bracing assembly engages the elongate member to maintain the elongate member in a desired orientation as the vibratory forces are applied thereto; and

the connecting assembly further comprises:

a plurality of first flange members each defining a first pin opening, where the first flange members are rigidly attached to one of the structural assembly and the support assembly;

a plurality of second flange members each defining a second pin opening, where the second flange members are rigidly attached to the other of the structural assembly and the support assembly; and

a plurality of pins each sized and dimensioned to be snugly received within the first and second pin openings; wherein

each of the first flange members is associated with one of the second flange members; and

when the pins extend into the associated pairs of flange members, the axes of the pins are arranged such that movement between the structural assembly and the fixed portion of the support assembly is prevented.

21. A system as recited in claim **20**, in which four pins are provided, and axes of two of the pins lie on a first line and axes of the remaining two pins lie on a second line spaced from the first line.

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