No. 863,614. PATENTED AUG. 20, 1907.

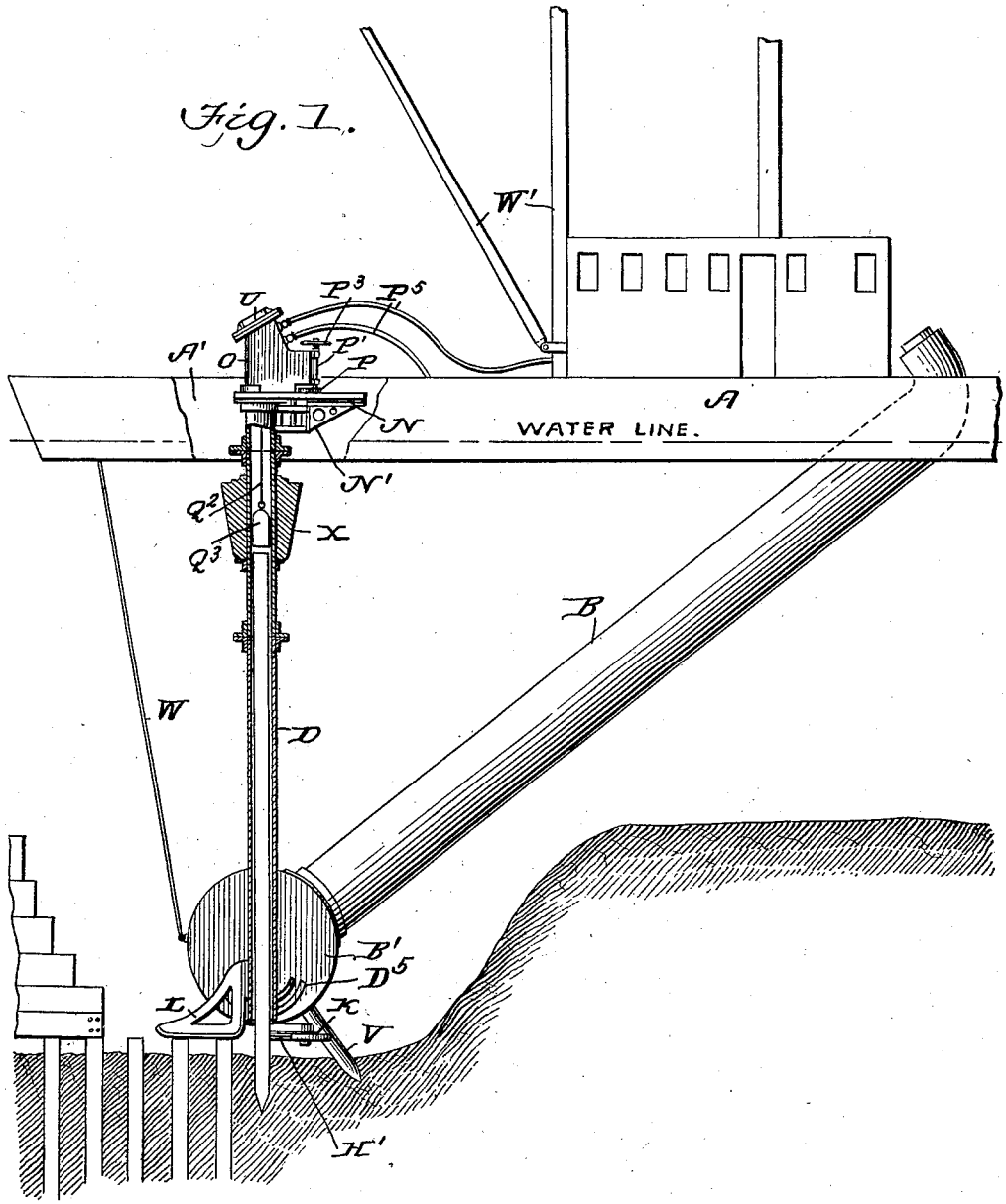
S. LAKE.

APPARATUS FOR DRIVING PILES UNDER WATER.

APPLICATION FILED MAR. 22, 1907.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses
M. D. Blondell
M. Hildebrand

Inventor
Simon Lake.
by
Wm. P. Sinnett
Attorney

THE NORRIS PETERS CO., WASHINGTON, D. C.

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4 SHEETS—SHEET 2.

Fig. 2.

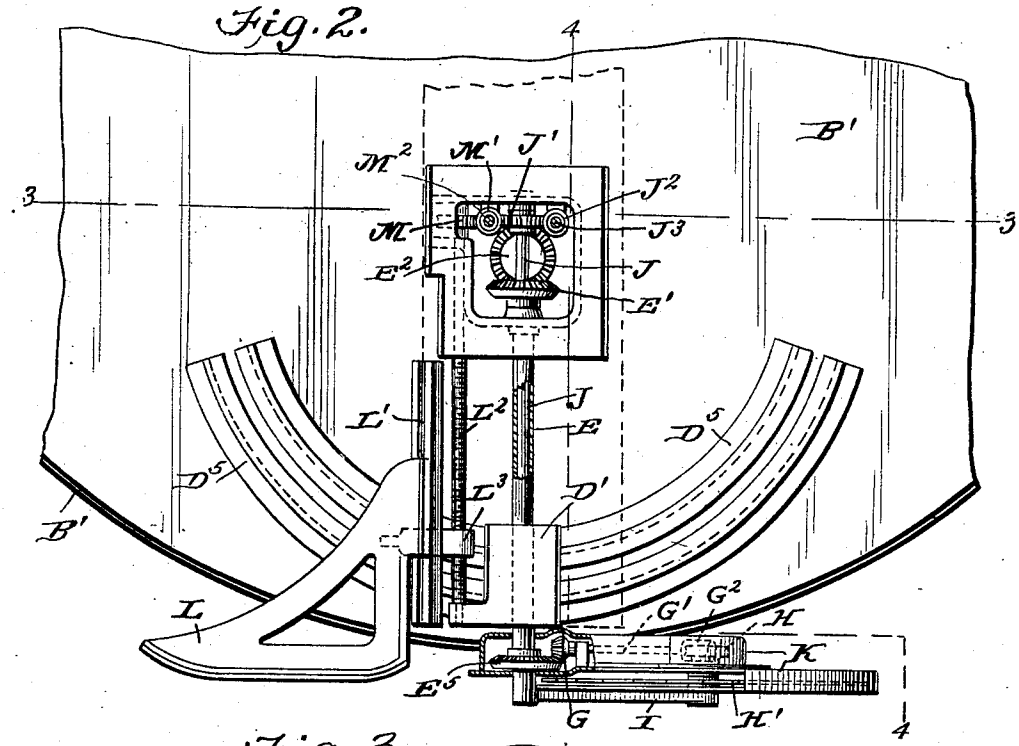
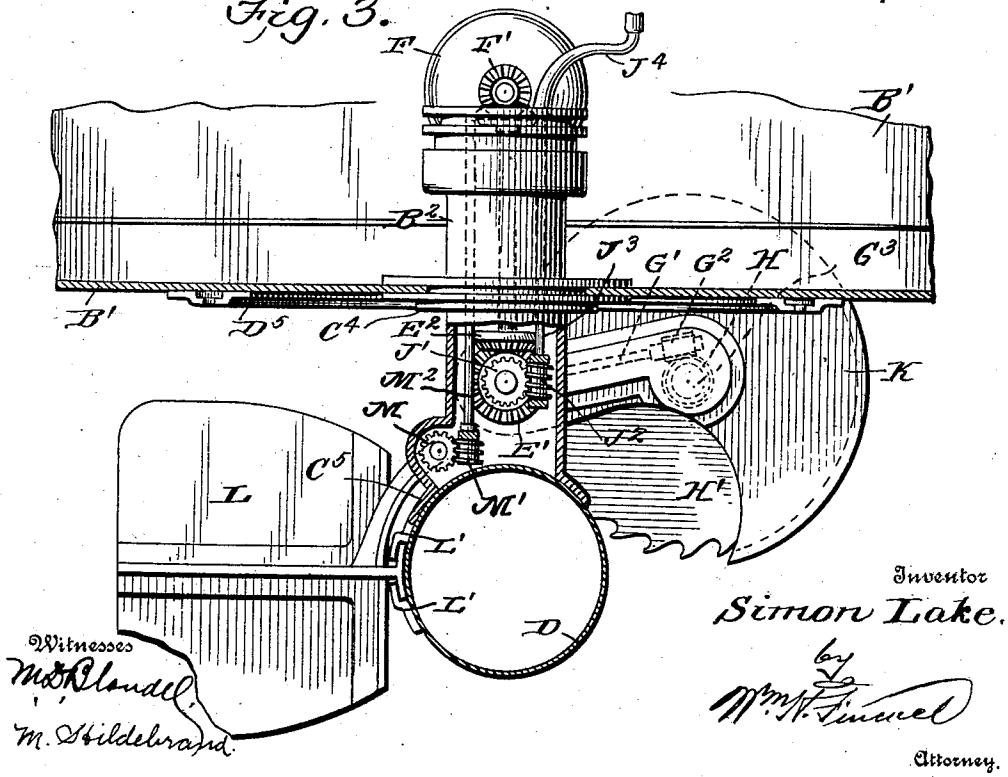


Fig. 3.



Witnesses
M. O. Blondell.
M. Hildebrand.

Inventor
Simon Lake.
by
Wm. H. Sinnel
Attorney.

THE NORRIS PETERS CO., WASHINGTON, D. C.

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4 SHEETS—SHEET 3.

Fig. 4.

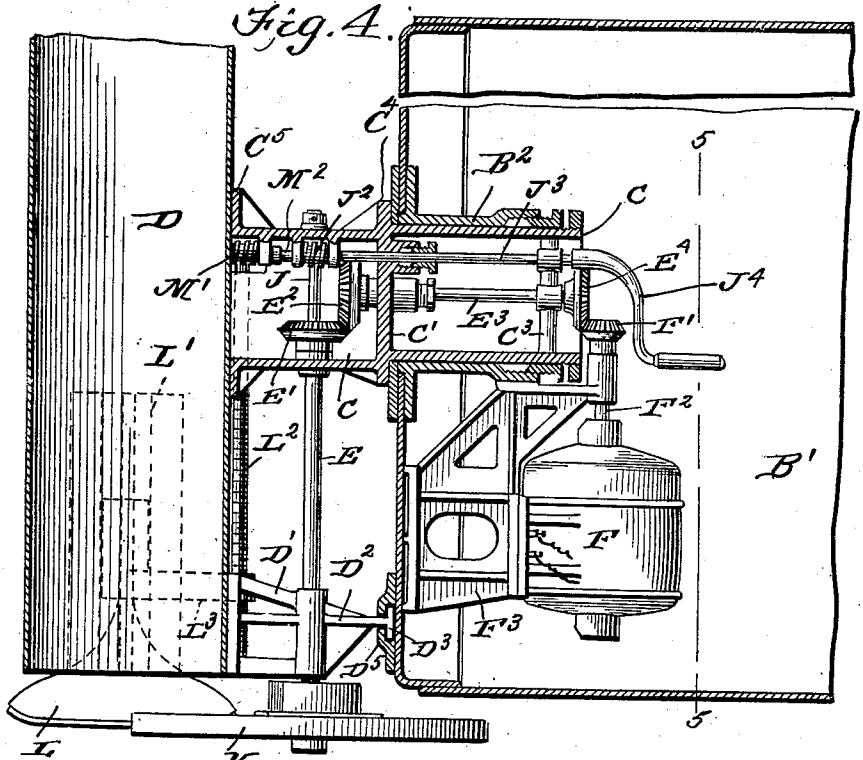
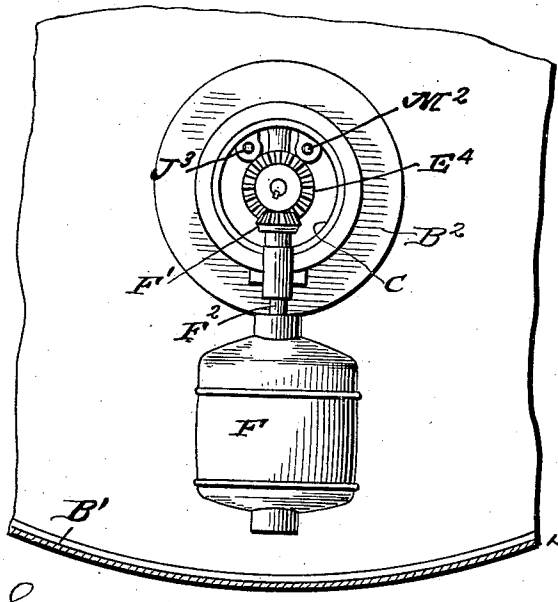


Fig. 5.



Witnesses

M. D. Blondell.

M. Hildebrand.

Inventor

Simon Lake

by

Wm. W. Tuttle

Attorney

THE NORRIS PETERS CO., WASHINGTON, D. C.

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4 SHEETS—SHEET 4.

Fig. 6.

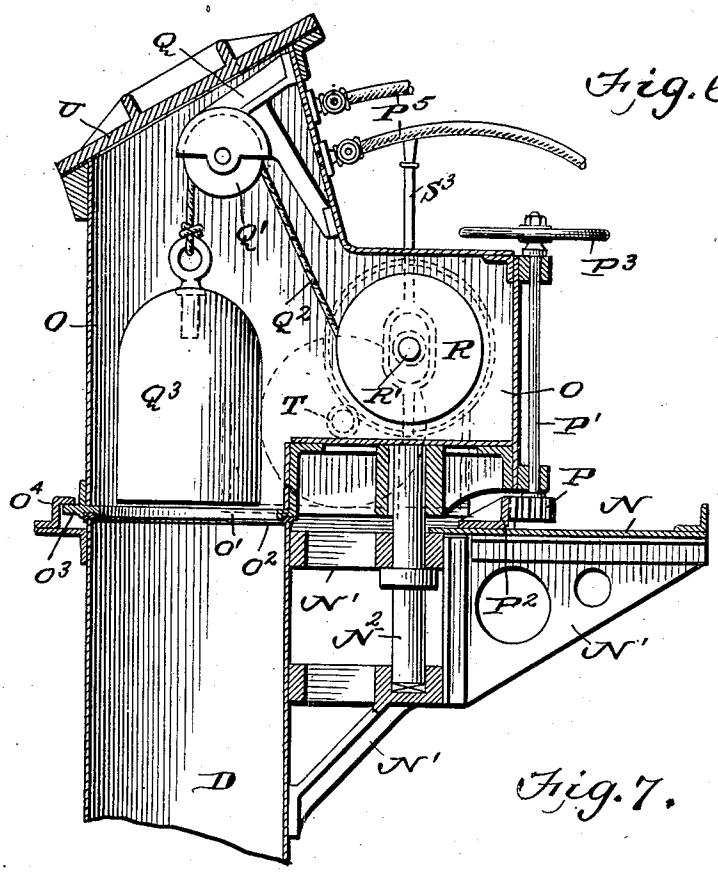
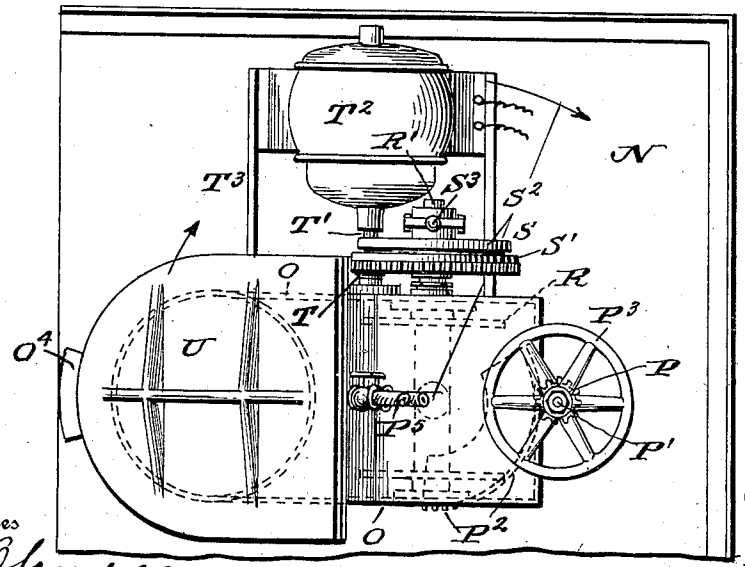


Fig. 7.



Witnesses
M. D. Blondell.
M. Hildebrand.

Inventor
Simon Lake.
by
Wm. H. Sinnett
Attorney

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

SIMON LAKE, OF BERLIN, GERMANY.

APPARATUS FOR DRIVING PILES UNDER WATER.

No. 863,614. Specification of Letters Patent. Patented Aug. 20, 1907.

Application filed March 22, 1907. Serial No. 363,944.

To all whom it may concern:

Be it known that I, SIMON LAKE, a citizen of the United States, at present residing at 23 Friedrich Wilhelm strasse, Berlin, Germany, have invented a certain new and useful Improved Apparatus for Driving Piles Under Water, of which the following is a full, clear, and exact description.

The object of this invention is to provide a pile driver particularly adapted for use in driving piles in comparatively deep waters or in the presence of heavy currents, for use in connection with the building of foundations for piers, lighthouses, breakwaters and various other subaqueous constructions.

Another object of the invention is to provide an apparatus whereby the piles may be easily handled, guided, and driven in place, the upper or protruding ends cut off, when necessary, so that the upper ends of the piles will be in substantially the same horizontal plane, and the delivery of the severed ends to the surface of the water, where they may be easily removed.

A further object is to provide, a device capable of ready adjustment so that the piles may be driven at any particular place relative to the adjacent pile or piles.

Another object is to provide an arrangement that will act as a guide in cutting the piles at any particular point and to support and steady the device as a whole when the piles are being set or otherwise operated upon.

With these objects in view, the invention comprises certain combinations and arrangement of parts set forth in the following specification and pointed out in the claims.

In the accompanying drawings, illustrating the invention, in the several figures of which like parts are similarly designated, Figure 1 is a sectional elevation illustrating a practical application of my invention. Fig. 2 is a vertical sectional elevation, on a larger scale, of a portion of the working chamber, illustrating the means for operating the saw-blade and shoe carried by the guide tube; the said tube being shown only in dotted lines. Fig. 3 is a top plan view, partly in section, drawn on the line 3 3 of Fig. 2. Fig. 4 is a detail vertical section drawn on the line 4 4 of Fig. 2. Fig. 5 is a detail elevation of the saw-operating mechanism looking from the line 5 5 of Fig. 4. Fig. 6 is a vertical section drawn through the upper end of the guide tube and movable housing that is normally held upon the upper end of the tube, and Fig. 7 is a detail plan of the same.

A designates a surface vessel, such as a barge, scow or other structure, constructed with a well A′, extending nearly the entire length of the vessel. B is a semi-submergible vessel held at one end in one end of the well A′ by yielding supports, not shown. The lower end of the vessel B is constructed with a working compartment or chamber B′, that forms a working space for an operator, and this chamber B′ is designed to normally rest adjacent to the water-bed when the device is in operation.

Secured to one side of the working chamber and extending therethrough is a hub B^2, Figs. 3 and 4, the greater portion of whose length extends within the working chamber, and journaled in the hub is a hollow trunnion or spindle C, having a partition C′ to prevent ingress of water to the working chamber. The trunnion is provided with a post C^3 and also with a central peripheral flange C^4, which bears against the side of the working chamber, and at its outer end is a flange C^5 to provide a connection for a guide tube D, adapted for the reception and guidance of the piles to be driven. Connected to the lower end of the tube D is a bracket D′, in which is journaled the lower end of a hollow shaft E, the upper end of which extends through the lower side of the trunnion and carries a beveled gear E′, which meshes with a similar gear E^2, held upon the outer end of a shaft E^3, extending longitudinally through the trunnion and journaled at one end in the partition C′, and at its opposite end in the post C^3. To the extreme inner end of the shaft is connected a beveled gear E^4, meshing with a pinion F′, held upon the shaft F^2 of an electric motor F, the current wires to which extend from a dynamo (not shown) on the surface vessel.

The motor F and its shaft F^2 are supported within the working chamber by a bracket F^3, preferably secured to and extending from the vertical wall of the said chamber, and this bracket is connected to the hub B^2 and forms a support therefor.

The lower end of the hollow shaft E carries a beveled gear E^5, (shown most clearly in Fig. 2) meshing with a pinion G on the inner end of a shaft G′, whose opposite end carries a worm G^2 meshing with a worm wheel H on a short shaft G^3 journaled in a bracket arm I, extending from and held fast to the lower end of a spindle J that extends through the hollow shaft E and projects beyond the lower end thereof.

The shaft of the worm wheel H carries a circular saw-blade H′, and the said blade, shaft G′, gear E^5, and pinion G are all covered by a suitable casing K, to protect them from rocks and mud of the water-bed. The shaft G′ is journaled in bearings formed in the casing.

To the upper end of the spindle J is secured a worm-wheel J′, meshing with a worm J^2, carried by a shaft J^3, extending longitudinally in the trunnion or spindle and journaled in suitable supports provided therefor. The said shaft extends through the partition C′, and to its extreme inner end is connected a crank handle J^4, by which the shaft is manually operated, and it will be readily understood that when the crank is revolved, motion will be imparted to the spindle and the saw moved towards, or away from, the pile held within the guide tube.

The saw-blade is arranged some distance below the lower end of the guide tube, so that it may be worked freely across the lower end of the said tube.

The bracket D′, is formed with an extension D^2, which terminates at its outer end in a T head D^3, which fits and travels within a segmental guide or race-way D^5, secured upon the side of the casing and acts as a brace to steady the movement of the guide tube when the latter is adjusted, as is necessary when the semi-submergible tube B is raised or lowered, as, for instance, when piles are driven in different depths of water and also when the tube B is shifted by the movement of the surface vessel through the action of the tide.

L, designates a shoe adjustably supported in brackets L′, held upon one side, and at the lower end of the guide tube D, the said shoe being adjusted vertically within the guides by a threaded spindle L^2 journaled at its lower end in an extension of the bracket D′, and at its opposite end in a lateral extension formed at the outer end of the hollow trunnion or spindle C. The spindle L^2 works through a threaded aperture in an arm L^3, extending from the shoe L. Upon the end of the spindle within the trunnion is held a worm wheel M, which meshes with a worm M′, held upon the shaft M^2, extending through the trunnion, and this shaft is, squared at its inner end to receive a crank handle, like crank-handle J^4, or that crank-handle itself.

It will be readily apparent that by revolving the shaft M^2, the shoe will be raised or lowered as conditions of the work require.

The shoe L is designed to rest upon the last-driven pile or piles when the succeeding pile is being driven or otherwise operated upon, and acts as a support for the semi-submergible vessel and guide tube, and also as a guide to facilitate the sawing off of the piles on a horizontal line. It will be apparent that by raising or lowering the shoe the piles may be cut off at different heights or distances from the bed of the water.

The guide tube D, extends upwardly from the working end or chamber of the semi-submergible vessel in a vertical line above the surface of the water, and works freely within the well of the surface vessel. Any suitable guide rods or supports may be employed for holding the tube in this position.

To the upper end of the tube is secured, by brackets N′, a working platform N, from which projects vertically, a pintle N^2, upon which is journaled a housing O, that is designed to swing horizontally upon the pintle into and out of alinement with the guide tube D. The housing is moved to either position by a pinion P, held upon a shaft P′, journaled to the side of the housing, and which engages a segmental rack P^2, secured to the floor of the platform. A hand wheel P^3, is connected to the upper end of the shaft by which the shaft and pinion are revolved, the revolution of the shaft in one direction or the other, causing the free end of the housing to be swung into position upon the tube, or away from the tube, as desired.

The housing is made air tight, and at its lower end is provided with a flanged ring O′, having a suitable packing O^2, which engages the upper end of the tube and forms an air tight joint when in position upon the tube. The flanged ring O′, is provided with an extension O^3, which engages a keeper O^4, extending from the platform, and serves as a lock to hold the housing firmly in position upon the tube.

Air supply pipes P^5, are connected to the housing and extend from suitable pumps (not shown) located upon the surface vessel.

Within the housing is held a bracket Q, carrying a pulley Q′, the periphery of which is in vertical alinement with the center of the guide tube when the housing is in position upon the tube, and operating over the pulley is a cable Q^2, carrying at one end a drop hammer Q^3, and having its opposite end wound upon a drum R, held upon a shaft R′, journaled in an extension of the housing. One end of the shaft extends through one side of the housing and also through a stuffing box surrounding the shaft, and loosely held upon the inner surface of the extended end is one member S′, of a friction clutch S. The opposite member, or section S^2, of the clutch is keyed upon the outer end of the shaft and movable into and out of engagement with the member S, by a hand lever S^3, in the usual way. The periphery of the member S′, is provided with gear teeth, meshing with a pinion T, held upon a shaft T′, of an electric motor T^2, which is supported by brackets T^3, extending from the side of the housing, and moves therewith. This motor, like the motor F, is connected by current wires with a dynamo (not shown) on the surface vessel.

The housing is provided with a hatch and covering U, by which access may be had thereto.

A spur V, is connected to the lower side of the working chamber, which is designed to penetrate the water bed and hold the lower end of the semi-submergible vessel in position, and prevents its accidental movement, which might be caused by the buffeting of the surface vessel by the sea.

In operation, the semi-submergible vessel with the guide tube is lowered into the water at the point at which the piles are to be driven, and is first supported at a proper distance from the waterbed by a cable W, extending from the surface vessel and connected to the lower end or working chamber of the semi-submergible vessel. The housing is then swung clear of the guide tube D, and a pile lowered into the tube by a suitable crane or derrick, a portion of which is illustrated at W′ in Fig. 1 of the drawings. The housing is then adjusted in position upon the tube forming an air-tight compartment. Air is then admitted through the pipes P^5, which drives the water out of the tube and allows the pile to drop down against the water-bed into which it penetrates by reason of its own weight. It will, of course, be understood that during this operation the drop hammer is held in an elevated position, but immediately after the pile has been lowered the drop hammer is alternately lowered and raised by operating the clutch S, which rapidly drives the pile into position. It will be seen that the hammer operates freely in the air within the tube and is not hampered or impeded in its work by water.

When the pile has been driven to the proper point the tube and working chamber B′ are raised to the proper height by the cable W, the saw-blade is then set in motion and thrown into engagement with the upper end of the pile (through the medium of the crank handle J^4 and parts operated thereby), and the upper

end of the pile will be quickly sawed off. The housing is then swung clear of the guide tube, which releases the air pressure and by the in-rushing waters the severed end of the pile is brought up to the top of the tube, where it may be easily removed.

The semi-submergible vessel and guide tube are then shifted to adjust the lower end of the tube to the point where the next pile is to be driven, and in this position the shoe L, is allowed to rest upon the pile previously driven, and acts as a guide and support for the semi-submergible vessel and guide tube. The operations of placing the successive piles driving them and cutting off and removing their ends are carried on in the manner previously described, until the work is complete.

It will be seen that the shoe not only acts as a support but also as a guide to regulate the cutting off of the piles, and when it is desired to cut all the piles upon a horizontal line, the shoe is adjusted so that its lower surface will be on a horizontal line with the saw-blade, which avoids further adjustment of the parts when the subsequent pile is to be sawed off.

From the foregoing it will be apparent that by use of my device the operation of setting and driving the piles can be rapidly and easily accomplished.

In practice I propose to make the guide tube in sections to adapt it to varying depths of water, and I also may employ a float or other form of buoyant, as shown at X in Fig. 1 of the drawing to assist in sustaining the tube in a vertical position, the said float being attached to the tube in any suitable manner. When the surface vessel is transported to any considerable distance the semi-submergible vessel B is raised and allowed to rest within the well of the surface vessel, in which position the guide tube D will be swung upon its pivot or trunnion to a horizontal position with respect to the semi-submergible vessel to which it might be secured in any suitable manner, or it may be held in a suspended position within the well of the surface vessel.

Claims.

1. A device of the kind described, comprising a guide tube, a housing detachably connected thereto, a drop hammer supported within the housing and operable within the tube, and means for controlling the movement of the hammer.

2. A device of the kind described, comprising a guide tube, a housing detachably connected thereto and forming an air tight compartment at the upper end of the tube when in position thereon, and which communicates with the tube, a drop hammer supported within the housing and operable within the tube, means controlling the operation of the hammer, and compressed air pipes connected to the housing.

3. Apparatus for driving piles under water, having a tube for placing the piles, an air-tight housing, means to move said housing into and out of communication with said tube, said housing having an air-tight connection with the tube when in position thereon, a drop hammer supported within the housing and operable within the tube, means for lifting and releasing the hammer, and compressed air supply pipes connected to the housing.

4. A device of the kind described, comprising a guide tube, an air tight housing journaled at the upper end of the tube and adapted for connection therewith, said housing having an air tight connection with the tube when in position thereon, air supply pipes connected to the housing, means for moving the housing into and out of position upon the tube, a drop hammer supported within the housing and operable within the tube, means for lifting the hammer and also means for releasing the lifting means to permit the hammer to drop.

5. A device of the kind described, comprising a guide tube, a platform connected thereto, an air tight housing pivotally held upon the platform and adapted for connection with the tube, means for shifting the position of the housing, a drop hammer supported within the housing and operable within the tube when the said housing is in position thereon, means for lifting the said drop hammer and also means for releasing the hammer.

6. A device of the kind described, comprising a guide tube, a platform connected thereto at its upper end, and having an air tight housing pivotally supported thereon which is adapted for engagement with the guide tube, a drop hammer supported within the housing and operable within the tube, a segmental rack connected to the platform, a shaft journaled to the housing, said shaft having a pinion at one end for engagement with the rack and a hand wheel at the opposite end.

7. A device of the kind described, comprising a guide tube, a platform connected thereto, an air tight housing pivotally supported upon the platform and adapted to be positioned upon the tube, means for shifting the position of the housing into and out of engagement with the said tube, a pulley supported within the housing, a lifting drum journaled within the housing and having a cable wound thereon which operates over the said pulley, and having a drop hammer or weight at its free end which operates within the tube, a motor operatively connected to the drum, and a clutch interposed in the connection and operated as specified.

8. Apparatus for driving piles under water, having a guide tube for placing the piles, a platform supported by the tube at its upper end, a pintle projecting from said platform, an air-tight housing mounted upon the pintle and adapted to be moved into and out of alinement with the said tube, said housing having a packing ring which engages the end of the tube to provide an air-tight joint, a rack carried by the platform, a shaft journaled in the housing and having a pinion for engagement with the rack whereby said housing may be shifted into and out of position with relation to the tube, air supply pipes connected to the housing for displacing water from the tube, a drop hammer operable within the tube, a cable connected to the drop hammer, a drum around which the cable is wound, a motor operatively connected to the drum, and means interposed in the connection for releasing the drum to permit the hammer to drop within the tube.

9. A device of the kind described, comprising a semi-submergible vessel, a guide tube pivotally connected thereto, a housing held adjacent the tube and detachably connected therewith, and a drop hammer supported in the housing and operable within the tube when the said housing is in position thereon.

10. A device of the kind described, comprising a semi-submergible vessel having a trunnion journaled therein and extending therefrom, a guide tube secured to the trunnion and projecting upwardly therefrom in a vertical position, a housing held adjacent the upper end of the tube and movable into and out of position therewith, means controlling the said movement, and a drop hammer supported within the housing and operable within the tube.

11. A device of the kind described, comprising a semi-submergible vessel, a guide tube pivotally connected thereto and adapted for holding and guiding a pile to be driven, a housing arranged at the upper end of the tube, a drop hammer carried by the housing for driving the pile, a saw held adjacent to the lower end of the tube, means for revolving the saw, and also means for moving the saw into engagement with the pile and for returning the saw to its normal position.

12. A device of the kind described, comprising a semi-submergible vessel, a guide tube pivotally connected thereto and adapted for holding and guiding a pile, a housing arranged adjacent to the upper end of the tube and adapted to be moved into engagement therewith, a drop hammer carried by the housing and operable within the tube for driving the pile, a saw blade held adjacent to the lower end of the tube for engagement with the pile, and a guide shoe carried by and adjacent to the lower end of the tube, all for the purpose specified.

13. A device of the kind described, comprising a semi-submergible vessel, a guide tube pivotally connected there-

to and extending upwardly therefrom, said tube being adapted to hold and guide a pile, an air tight housing supported by and at the upper end of the tube, said housing being adapted for movement into and out of engagement with the tube, and forming when in engagement therewith an air tight compartment, compressed air supply pipes connected to the housing, a drop hammer carried by the housing and operable within the tube, means controlling the movement of the hammer, a saw-blade arranged adjacent to the lower end of the tube and adapted for engagement with the pile, a guide shoe adjustably carried by, and at the lower end of the tube, and means for raising and lowering the shoe.

14. A device of the kind described, comprising a semi-submergible vessel, a guide tube pivotally connected thereto, a platform arranged at the upper end of the tube, an air tight housing pivotally supported by the platform, means for moving the housing into position upon the tube, a winding drum and pulley arranged within the housing, a cable wound upon the drum and operating over the pulley and having a drop hammer at its free end, means carried by the housing for revolving the drum to elevate the hammer and also means for releasing the drum to permit the hammer to drop, and a guide shoe adjustably supported by and at the lower end of the tube, and means for adjusting the said shoe.

15. A device of the kind described, comprising a semi-submergible vessel, a guide tube pivotally connected thereto, a platform arranged at the upper end of the tube and connected therewith, an air tight housing mounted upon the platform, a winding drum and pulley journaled within the housing, a clutch carried upon the shaft of the drum, said clutch having one section provided with gear teeth, a motor supported upon a bracket extending from the housing and having its shaft provided with a pinion which engages the said gear teeth, a lever connected to the clutch, a guide shoe adjustably held at the lower end of the tube, and a saw-blade also arranged adjacent to the lower end of the tube and means for moving the blade into engagement with the pile and also means for operating the blade.

16. A device of the kind described, comprising a semi-submergible vessel, a guide tube for holding a pile and pivotally connected to said vessel, a housing supported by and at the upper end of the tube, and having a drop hammer operable within the tube, a saw-blade arranged adjacent to the lower end of the tube, means operable from within the said vessel for operating the blade, and also means operable from within the vessel for moving the blade into engagement with the pile.

17. A device of the kind described, comprising a semi-submergible vessel, a guide tube for holding a pile and pivotally connected to said vessel, a housing supported by and at the upper end of the tube and having a drop hammer which is operable within the tube, a saw-blade arranged adjacent to the lower end of the tube, means controlled within the said vessel for operating the blade, and also means controlled within the vessel for moving the blade into engagement with the pile, and a guide shoe arranged at and carried by the lower end of the tube, and means operable from within the vessel for adjusting the shoe.

18. A device of the kind described, comprising a semi-submergible vessel having a hollow trunnion revolubly held thereto, a guide tube for holding and guiding a pile and connected to the trunnion, a guide or race-way arranged upon the semi-submergible vessel, a bracket having a journal bearing connected to the guide tube, said bracket also having a head which operates in the said guide or race-way, a hollow shaft journaled in the bearing of the bracket and extending into the trunnion and having its upper end provided with a gear, a shaft journaled in the trunnion and having a gear at its outer end for engagement with the gear of the said hollow shaft, and a gear at its inner end, a motor held within the vessel and having its shaft provided with a pinion which meshes with the last mentioned gear, a spindle held within the hollow shaft and having a bracket at its lower end, a shaft journaled in the bracket and carrying a saw-blade, a casing surrounding the saw and the gear at the lower end of the spindle, a shaft supported by the casing and having a gear at one end which meshes with the gear at the lower end of the spindle and a worm at its opposite end which engages with a worm wheel of the saw-shaft, and means for turning the spindle to adjust the saw into the path of the guide tube for engagement with the pile.

19. A device of the kind described, comprising a semi-submergible vessel, a trunnion journaled in the vessel and projecting therefrom, a guide tube secured to the trunnion, said tube being adapted for holding and guiding a pile to be driven, a housing supported by and at the upper end of the tube, a drop hammer supported within the housing and operable within the tube, a guide shoe adjustably connected to the lower end of the tube, an arm extending from the shoe and having a threaded bore, a threaded spindle operating through the bore and journaled at its lower end in a bracket carried by the tube and in the trunnion at its upper end, a worm wheel arranged upon the upper end of the spindle and a shaft journaled in the trunnion and having a worm at one end which meshes with the said worm wheel and having its opposite end squared to receive a crank handle for the purpose specified.

20. A device of the kind described, comprising a semi-submergible vessel whose lower end terminates in a working chamber, a spindle journaled in the side of the chamber, a guide tube connected to the outer end of the spindle and adapted for holding and guiding a pile to be driven, a housing supported at the upper end of the tube and having a drop hammer operable within the tube, a bracket secured to the lower end of the tube, a hollow shaft journaled in the bracket and having gears at each end, a shaft having a gear meshing with the gear at the upper end of the hollow shaft and means for operating the said shaft, a spindle having a bracket arm at its lower end, a shaft journaled in the arm and having a saw-blade and worm wheel, a shaft having a pinion at one end which meshes with the pinion upon the lower end of the hollow shaft, and a worm which meshes with the worm gear of the saw shaft, a worm wheel held upon the upper end of the spindle, a shaft journaled in the trunnion and having a worm at one end which engages with the said worm wheel and having its opposite end squared to receive a crank handle.

In testimony whereof I have hereunto set my hand this 9th day of March A. D. 1907.

SIMON LAKE.

Witnesses:
M. D. BLONDEL,
HENRY HASPER.