No. 712,002. Patented Oct. 28, 1902.

R. G. PACKARD.

SUBMARINE ROCK DRILLING AND BLASTING APPARATUS.

(Application filed Feb. 5, 1901. Renewed Apr. 11, 1902.)

(No Model.) 5 Sheets—Sheet 1.

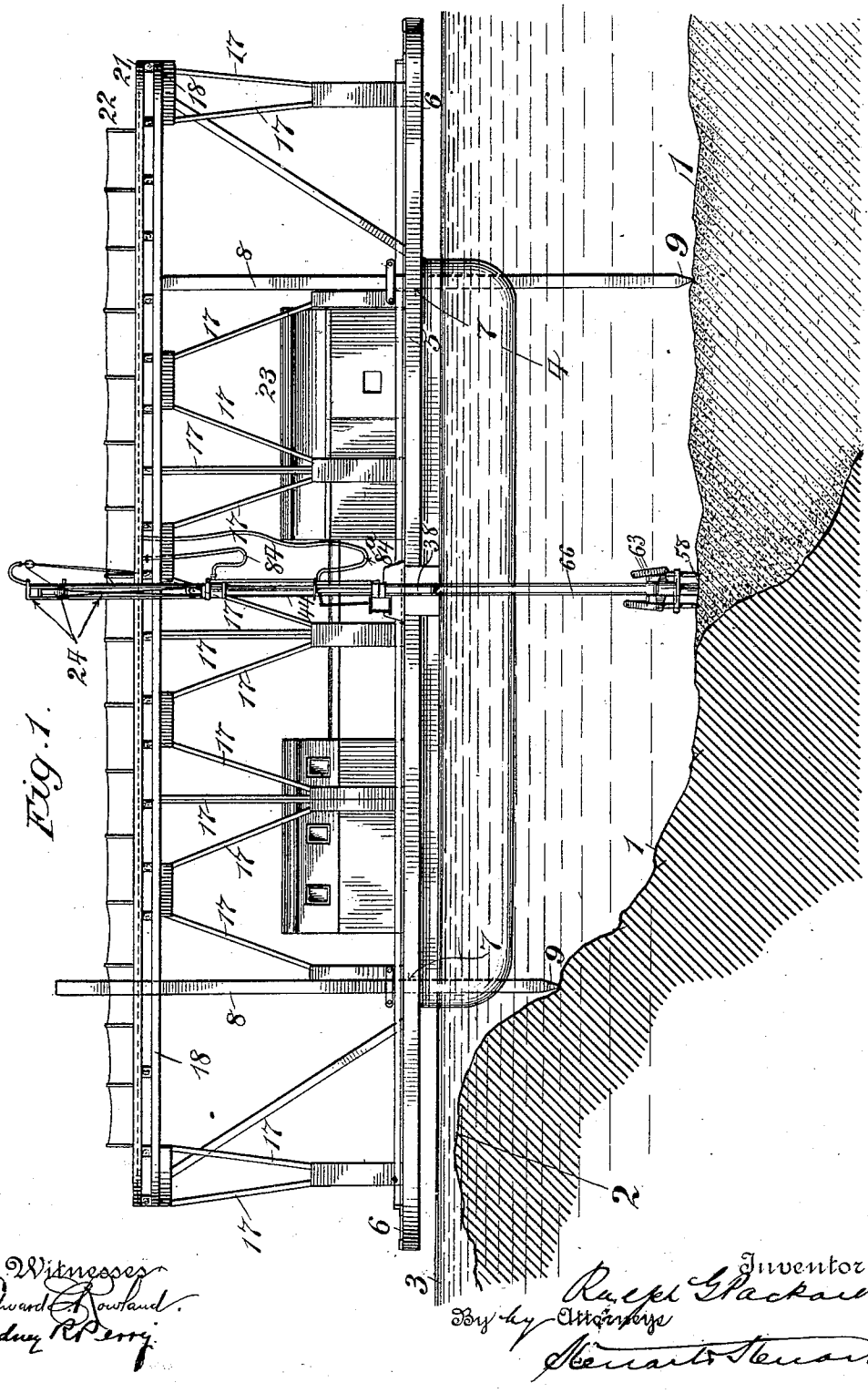


Fig. 1.

Witnesses
Edward Rowland.
Sidney R. Berry.

Inventor
Rufus G. Packard
By his Attorneys
Merriam & Stewart

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(No Model.) 5 Sheets—Sheet 2.

Fig. 3.

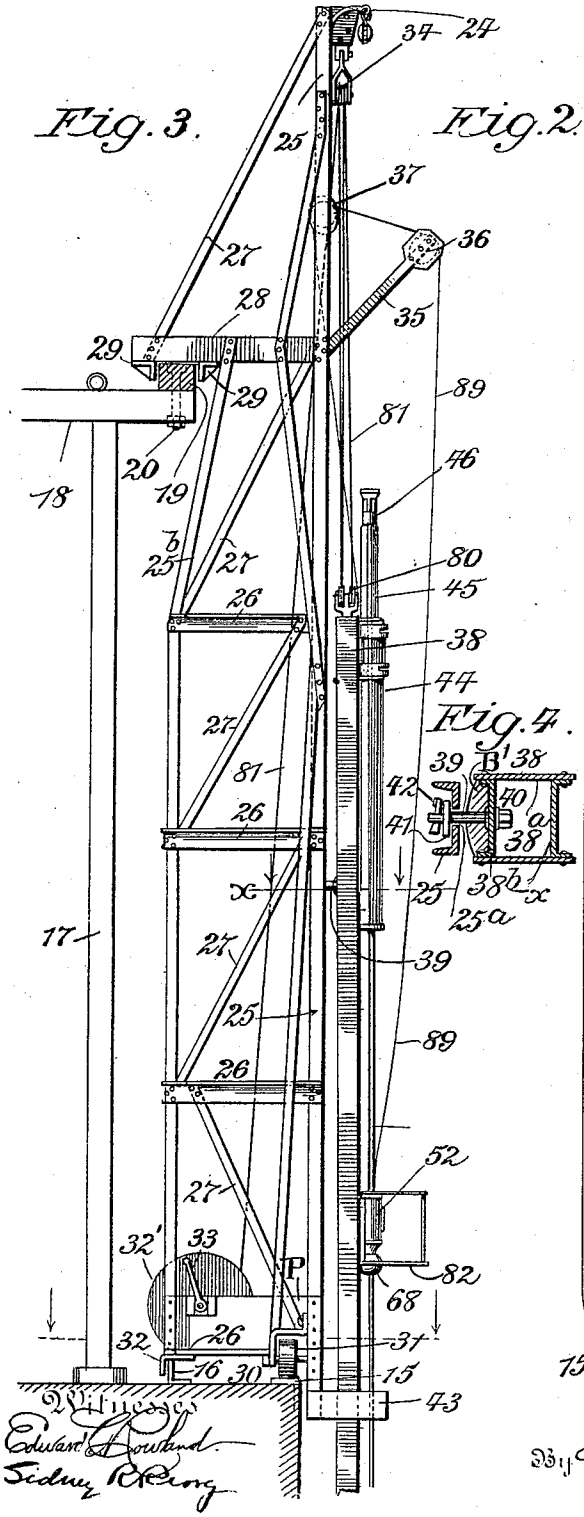


Fig. 2.

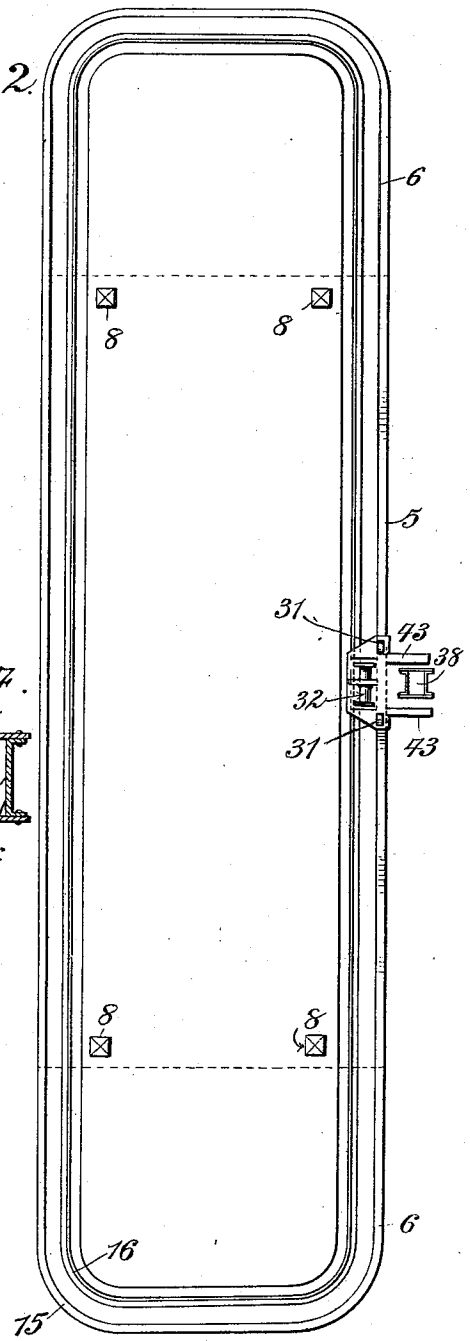


Fig. 4.

Witnesses:
Edward Rowland
Sidney R. Ellis

Inventor
Ralph G. Packard
By Chas. Attorneys
Stewart & Stewart

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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(No Model.) 5 Sheets—Sheet 3.

Fig. 5.

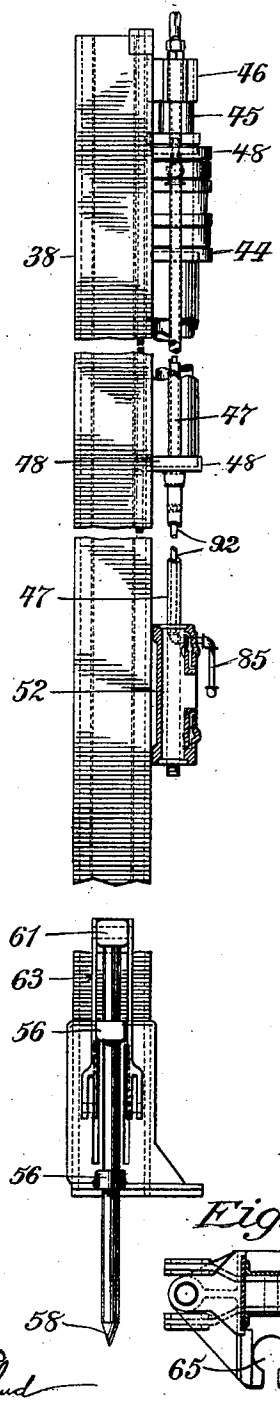


Fig. 6.

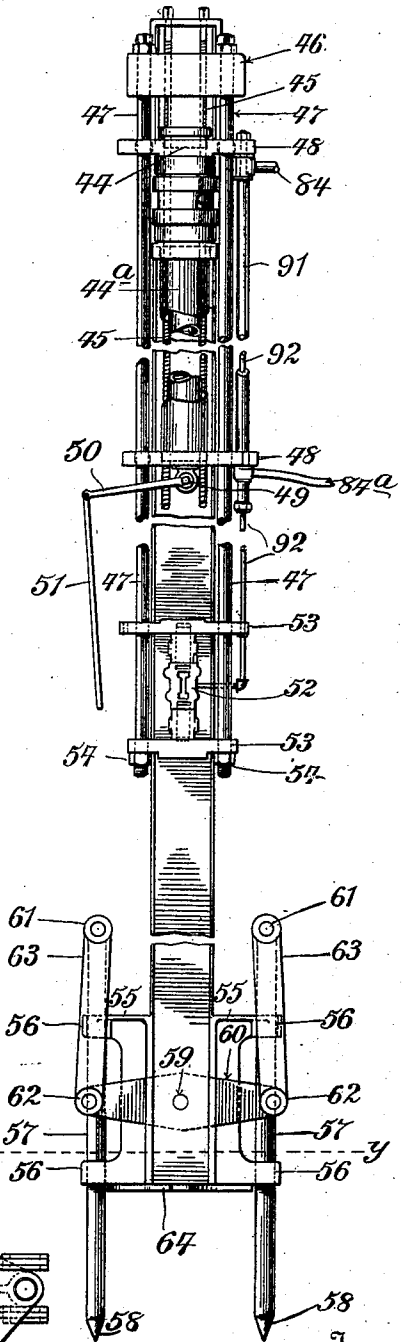
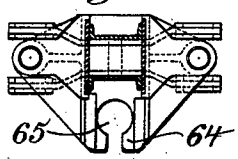


Fig. 7.



Witnesses
Edward L. Rowland
Sidney R. Perry

Inventor
Ralph G. Packard
By his Attorneys
Stewart & Stewart

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 712,002. Patented Oct. 28, 1902.

R. G. PACKARD.

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(Application filed Feb. 5, 1901. Renewed Apr. 11, 1902.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 8.

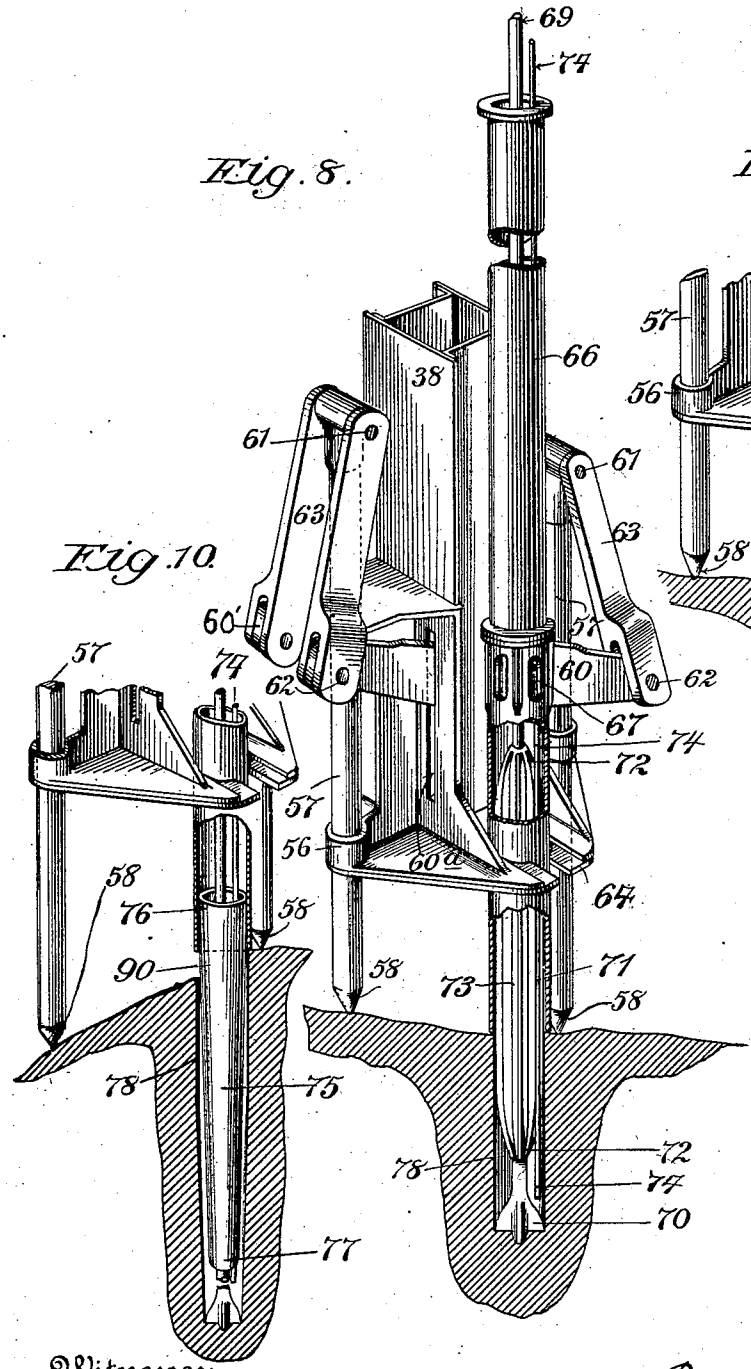


Fig. 9.

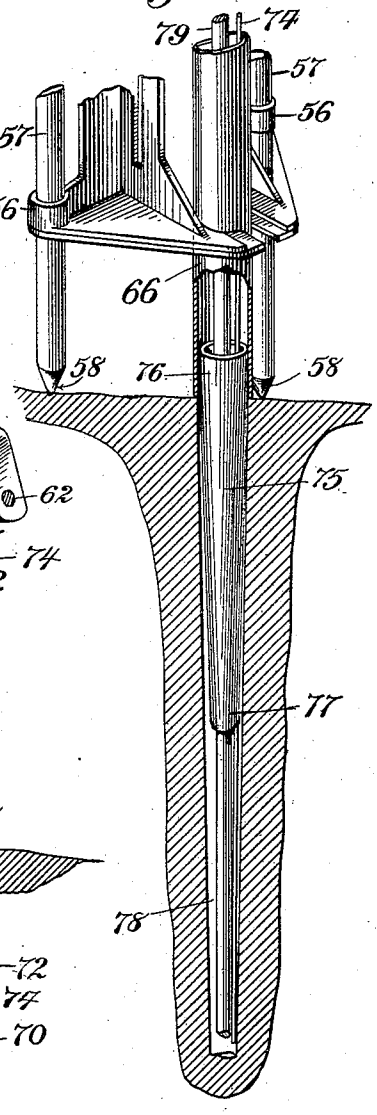


Fig. 10.

Witnesses:
Edward L. Rowland.
Sidney R. Parry.

Inventor
Rasper G. Packard
By their Attorneys
Merwin & Stewart

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 712,002. Patented Oct. 28, 1902.

R. G. PACKARD.

SUBMARINE ROCK DRILLING AND BLASTING APPARATUS.

(Application filed Feb. 5, 1901. Renewed Apr. 11, 1902.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 11

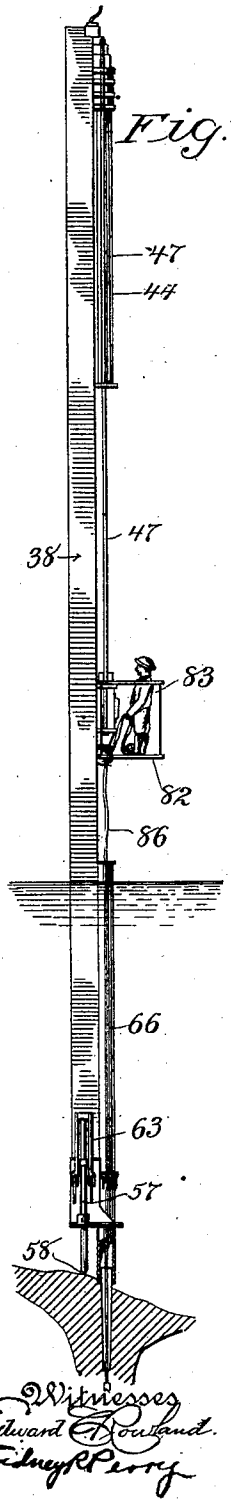


Fig. 12.

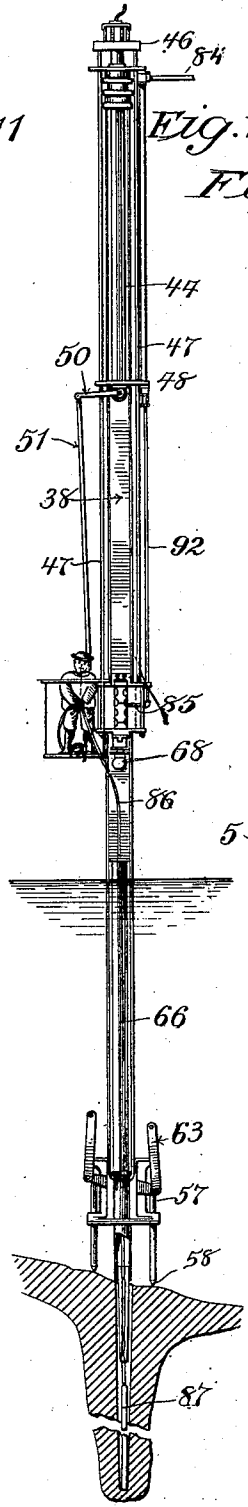


Fig. 13

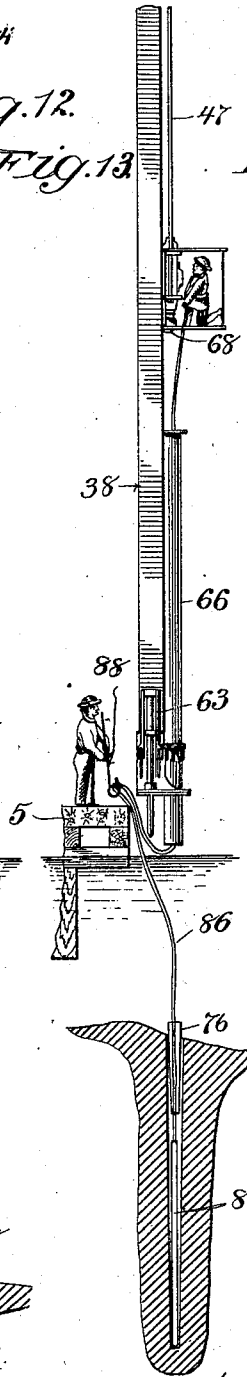
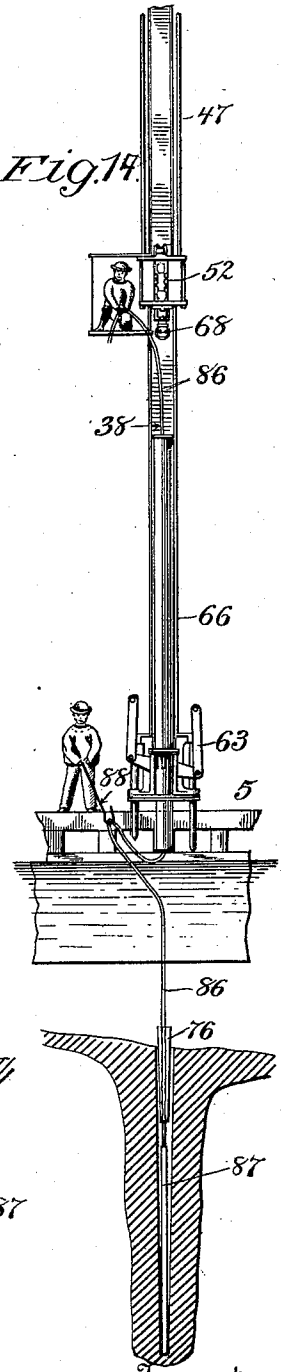


Fig. 14



Witnesses
Edward Boutard.
Sidney R. Perry

Inventor
Ralph G. Packard
By his Attorneys
Stewart & Stewart

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

RALPH G. PACKARD, OF MORRISTOWN, NEW JERSEY.

SUBMARINE ROCK DRILLING AND BLASTING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 712,002, dated October 28, 1902.

Application filed February 5, 1901. Renewed April 11, 1902. Serial No. 102,465. (No model.)

To all whom it may concern:

Be it known that I, RALPH G. PACKARD, a citizen of the United States of America, and a resident of Morristown, State of New Jersey, have invented certain new and useful Improvements in Submarine Rock Drilling and Blasting Apparatus, of which the following is a specification.

My invention relates to an improvement in submarine rock drilling and blasting apparatus.

I have illustrated my invention in the accompanying drawings, in which I have designated the parts by numerals and letters, referring to like parts by like characters.

Figure 1 is a side elevation of my apparatus, showing the float in the water over a rock-bed. Fig. 2 is a plan view of the deck of the float. Fig. 3 is a side elevation of a traveling crane, one or more of which may be mounted to travel around the deck of the float. Fig. 4 is a partial horizontal section of Fig. 3, taken on the line xx. Fig. 5 is an elevation of the column 38 shown in Fig. 3, with the motor drilling and hoisting apparatus mounted thereon. Fig. 6 is a front elevation of Fig. 5. Fig. 7 is a horizontal section taken on the line $y\ y$ of Fig. 6. Figs. 8, 9, and 10 are perspective views showing the apparatus for supporting the column and guiding the drill apparatus hereinafter to be described. Figs. 11, 12, 13, and 14 show the column and accompanying apparatus in its several positions, all being in elevation.

I will now describe my apparatus in detail.

1 is a submarine base or bottom of a river or other body of water.

2 is a ledge of rock over which the water is too shallow to permit the float to navigate.

3 is a figurative representation of water.

4 is a float or barge of any desired form capable of sufficient displacement to carry the mechanism hereinafter described. 5 is a deck for said float, and 6 6 are platforms or extensions of the deck 5, adapted to overhang a ledge of rock, such as 2, where it would be impossible for the float to navigate or float.

7 represents four vertical apertures passing through the floating structure, and 8 represents four restraining posts or "spuds," adapted to move freely within the aperture 7, by means of which the float may be permanently anchored in any convenient position. I provide suitable means for raising and lowering these restraining-spuds; but I deem it unnecessary to illustrate or describe such means. It will be understood that when the spuds are permitted to drop to the bottom their steel-pointed ends 9 will find lodgment in the bottom, and the float may rise or fall with the tide or waves without materially disturbing their position, and they prevent any large horizontal motions of the float. When the rock is smooth, the spuds are reciprocated vertically until the steel point shall have drilled a hole into the rock sufficient to prevent a horizontal motion.

Referring to Fig. 2, 15 is a marginal track run around the deck 5 and extension 6, and 16 is an angle-iron secured in like manner to said deck. These may be seen in section in Fig. 3.

Referring again to Fig. 1, 17 represents upright supports carrying a platform 18. (Seen also in Fig. 3.) Mounted on this platform 18 is a guide-rail 19, secured to the platform by the bolt 20. 21 is a platform, and 22 a railing. 23 is a house mounted on the deck 5, adapted to contain the boilers and engine necessary to operate the device.

I have designated the whole of the traveling crane now to be described by the numeral 24, the same being constructed as follows: The vertical beams 25, 25^b, and 27 and the cross-beams 26 make up its general structure, approximately rectangular in horizontal section. The vertical angle-iron beam 25, as shown in section in Fig. 4, forms a vertical slot 25^a, the use of which will be described later.

28 represents two cross-beams, and 29 29 are angle-irons secured to the cross-beams 28, adapted to fit over the guide-beam 19.

30 is one of two brackets secured to the bottom plate of the carriage. 31 31 are friction-wheels mounted in said brackets.

32 is an angle-iron secured to the bottom plate of the carriage 26, the latter overhanging the retaining-track 16.

32′ is a drum mounted at the base of the carriage 24 and serving as means to operate the tackle hereinafter to be described.

33 is a crank for controlling a friction-clutch of the drum, which is operated by power.

34 is a block carried at the top of the crane, and 35 is an arm secured to the crane carrying the block 36.

37 is a block near the top of the carriage for hoisting the drill-shaft mounted on the upright 25, the latter blocks being adapted to guide the tackle hereinafter to be described.

The crane last described is used mainly to raise and lower the column upon which is mounted the drill-operating mechanism. I have indicated this column generally by the numeral 38. It is preferably formed of four plates secured together, as 38^a 38^a and 38^b 38^b. The column last described is guided and flexibly held in a vertical position by the eyebolt 39, secured to the plate 38^b by a double-eye jaw and pin, the eyebolt passing through the vertical slot 25^a between the uprights 25 and 25^b. 41 is a guide-plate run on said bolt 39, and 42 is a pin locking said plate.

B′ is a radial buffer-block and distance-piece, which prevents column 38 from approaching the uprights 25 and 25^a and 28, and the column is thereby, while resting upon the surface of the rock below, practically a steady platform from which to operate the drill mechanism and makes a stable foundation for pulling drills out of holes when jammed by pieces of rock. Plates 43 and 43 project horizontally from apron P. The column 38 stands between them when lowered and standing upon the bottom, the lowering being done by placing removable chocks between said plates and said column 38 to keep the column nearly vertical when lowered. When lowered upon the rock, these chocks are then removed, and there is then such a clear space around the column that none of the motions of the boat have any appreciable effect upon column 38 or upon the manipulations of the drill mechanism or upon its operation. As before described, column 38 then becomes and is a steady platform, having no connection to the boat except the one flexible joint attachment 39 near its top.

The drill-operating mechanism I have indicated generally by the numeral 52. This mechanism may be of any of the well-known forms of drill mechanism—as, for instance, a rand-drill; but I deem it unnecessary to illustrate or describe the same in detail, as the structure is well understood. This drill mechanism 52 is secured to the ends of the connecting-rods 47 by the cross-heads 53 53, secured by the bolts 54 54. All this drill mechanism 52 is mounted to move in ways up and down the column 38. I deem it unnecessary to illustrate these ways. It will be understood that by the operation of the motor 44 the drill-operating mechanism 52 will be raised and lowered at the pleasure of the operator.

55 55 are brackets secured to the lower end of the column 38, said brackets having vertical guides or sleeves 56 56, adapted to receive and guide vertical pins 57, which are sharp-pointed at their lower ends, as at 58.

59 is a pin mounted in the end of the column 38, and 60 and 60′ are rock-beams centrally journaled on said pin-shaft 59.

61 represents pins mounted at the upper ends of the vertical pins 57, and 62 represents pins mounted at the ends of the rock-beams 60 60′.

63 represents connecting-links between the pins 61 and 62. It will therefore be seen that by this construction any uneven pressure exerted upon one of the pins which is not exerted upon the other will cause the rock-beam to tilt and bring the other pin into operative position until the pressure on each is equally balanced.

64 is a plate mounted on the base of the brackets 55 and having a circular hole 65 therein to receive the pipe 66. 66 is a pipe or tube adapted to pass through said aperture 65. Guide-pipe 66 is guided vertically by circular hole of plate 65 and guide 65^a above, so as to adjust itself automatically upon the surface of the rock when column 38 is lowered and remains constantly in contact with the rock when the drilling is in progress and is free to follow the drill into the hole as it is drilled as far as its diameter will permit and making a joint between 66 and the rock and excluding sand or other such material from entering the drilled hole.

67 represents vent-apertures in the pipe 66, through which apertures the cuttings produced by drilling are forced out into the water surrounding the guide-pipe 66.

The drilling apparatus 52 is provided with an adjustable socket 68, adapted to receive and clamp one end of the drill-shaft.

69 is a drill-shaft, and 70 is the head of the drill.

71 is a corrugated sleeve pointed at either end, as at 72 72, and having the corrugation 73.

74 is a small water-pipe.

75 is a funnel having a large end 76 and a small end 77.

By 78 I indicate the hole in the rock as drilled.

79 is a stick run through the pipe 66 and funnel 75 to the bottom of the drilled hole, the purposes of which will be hereinafter described.

80 is a block secured to the column 38.

81 is a tackle run between the blocks 34 and 80 and the drum 32′.

82 is a platform carried by the drill and moving with it, upon which the operator 83 stands in the manipulation of the device.

84 is a flexible connection between a source of pressure or power on the float and the drill-operating mechanism 52. This connection is made through the pipes 91 and 92, which form together a sliding connection to the pipe 85, and thence to the drill-operating mechanism 52.

84ª is a flexible connection to the motor from a source of power.

In Figs. 11 to 14 I have illustrated the manner in which the blast is placed in position and discharged. In these figures, 86 represents the electrical connection, and 87 the cartridge to which the electrical connection is made. 88 is a hook by means of which the operator on the float withdraws the conducting-wires from beneath the guide-pipe 66 when the column 38 has been raised preparatory to blasting, and 89 represents tackle run over the pulleys 36 and 37, by which the drill and other apparatus which must be raised and lowered in the operation of the device are operated either by hand or by power.

Having described the structure of my device, I will now proceed to trace the operation thereof. The object that I have in view is to provide means by which I may with precision and accuracy drill and blast holes in rock under water, especially in strong currents in tidal waters and exposed to waves from boats and storms and without the delays and expenses in such waters which arise from use of divers, and to accomplish this end with approximately the same facility and rapidity and freedom from interruption as is and might be done upon the land I first provide means by which I may with accuracy establish and maintain my drilling apparatus in a nearly-fixed position with reference to the point at which I desire to introduce the drill and the blast. The first necessary requirement, therefore, is to provide a float suitable to carry the necessary power and apparatus and means to anchor the same quickly and securely in a position from which the drilling operation may be performed. I may accomplish this result of anchoring by any suitable means. I prefer to employ four or more vertical spuds, as 8, passing through certain suitable vertical apertures in or connected to the float, and to provide means for raising and lowering said spuds, so that when the spuds are dropped to the bottom they find lodgment in the submarine base and serve as an anchorage for the float. The spuds being supported vertically by the float and yet able to loosely run through the apertures in the float permit the float to rise and fall with the tide, but will prevent large lateral movements of the float. Having projecting sharp steel points, they can be used as drills to make holes for their points in smooth rocks. I have found in some cases that the rock is so near the surface of the water as to prohibit a near approach of the float to the rock. To overcome this difficulty, I have provided my float with the overhanging platforms 6, which I use in bringing the apparatus into position over a ledge of rock, as 2 in Fig. 1.

It will be understood as I proceed with the description of the operation of my device that in a case where I desire to drill into a ledge such as that last described I may bring my crane and drilling apparatus around to the end of this platform 6 or to any part thereof and operate the drilling apparatus under water which would be too shallow for navigation.

I have discovered in the operation of drilling devices where the drill is mounted on a float and operates from the float directly to the point where the drilling is to be accomplished that great difficulty is encountered in maintaining the float in a sufficiently fixed position by reason of the variation of the tides and currents, so as to accomplish the drilling operation with success and accuracy, the slightest motion of the boat jamming the drills and causing numerous delays. To overcome this difficulty, I have constructed my present apparatus so that the drilling apparatus and its operating mechanism are mounted on a vertical column, which I permanently anchor on the submarine base or bottom, said column being flexibly connected with the float by a vertically-sliding and swiveled connection, so that both the horizontal and vertical motion of the float will not interfere with the relative position of the column with reference to the bottom, the column pivoted at a point near the bottom and the sliding and pivoting connection between the column, and the float being near the top end of the column. Thus it will be seen that a considerable movement of the column at the point where it makes contact with the float will be reduced to a minimum at the rock. The merit of this basic conception being clearly understood, the coöperation of the several parts which go to make up the whole structure will be readily comprehended.

I will first describe the crane. An elevation of this crane is shown in Fig. 3, where it will be seen that I have mounted the crane on the deck 5, and I have hung the same to a superstructure formed of the uprights 17 and the horizontal retaining-beam 18. In Fig. 2 I have shown a plan of the deck, where it will be seen that I have provided an annular track 15 and a retaining angle-iron 16, which are intended to coöperate with the roller 31, the angle-iron 32 and the retaining-beam 19 coöperating with the angle-irons 29. Thus it will be seen that I may move the crane completely around the deck of the float and its overhanging platform, and by this means I am able to bring my drilling apparatus into any position within those limitations without moving the float. This crane is intended for the purpose of raising and lowering the column in a nearly vertical position and conveying the same to any point where it is desired to drill the rock. This is accomplished by the blocks and tackle 34, 80, and 81 and the drum 32'. As heretofore stated, the column and the crane are connected by the eyebolt 39. The uprights 25 of the crane are provided with a vertical slot in which the eyebolt 39 moves, this bolt being secured to the column 38. Hence it will be understood that when the column is resting

on the bottom and the tackle 81 is released the eyebolt or pin 39 will hold the column in a nearly vertical position, which will not be affected by the rise and fall of the tide or the swaying or pitching of the float, for the reason that the bolt will slide and pivot in the ways 25^a. The means by which I permanently anchor the column at its lower end, so that it will maintain a fixed position with reference to the bottom, may be described as follows: It will be readily understood that if the column was simply armed with a sharp lower end it might be found difficult to find lodgment for this pointed end with precision, for the reason that in some instances, as illustrated in Fig. 12, the surface of the bottom may be inclined or irregular and one point will be liable to slip and twist laterally on the base or bottom by turning on its axis. I therefore provide the mechanism illustrated in perspective in Fig. 8 and in side and front views in Figs. 5 and 6. I secure this device to the end of the column. The structure has already been described. It will be readily understood that when the column is lowered should the surface of the bottom be inclined away from the horizontal plane in any direction first one of the pins 57 will engage the bottom and be driven up, thus tilting the rock-beams 60 and driving the other pin 57 down until both pins are brought in contact with the bottom, thus providing a firm anchorage for the column. This structure also has another function—to wit, that of providing a pivotal bearing for the beams. This is found in the pin-shaft 59 and rock-beams 60. It will be understood that the column 38 may rock on this shaft 59 without disturbing the position of the pins, and it will be again observed that if the column 38 was simply armed with one rigidly-attached point at its base the movement of said column (by reason of its contact with the float) or pressure of the currents upon it would tend to work it horizontally and rotate it about its vertical axis and away from its original position, thus jamming the drill-shaft in the driled hole and losing the hole when the drill is withdrawn, whereas in the present structure all these difficulties are avoided. It will be readily understood that I may also so pivot the beam at this point as to give it a universal movement; but the structure here shown I deem sufficient to illustrate my invention in this connection. I mount on this column 38 all of my drill-operating mechanisms, so that it will be readily understood that when the column is lowered to the bottom and finds its permanent anchorage all of said drill-operating mechanisms will be in a fixed position with reference to the rock to be drilled, and from this permanent base I may proceed continuously and with precision and accuracy to carry on the operation of drilling into the rock, all the manipulations being performed above water. For the purposes of my present invention it is not material what form of drill-operating mechanism I employ. I may mount any form of drill or drill-operating mechanism on this vertical column without departing from this feature of my invention; but I have devised and constructed a certain combination of apparatus which I prefer to mount on this column, and I will now proceed to describe the drill-operating mechanism and the operation thereof.

The ordinary drill-operating mechanism, such as the Rand drill, has but a limited length of stroke and motion, and in order to have it work effectively the drill-cylinder must be moved with great accuracy. If therefore a Rand drill were secured to the column 38, it is necessary to keep the drill-cylinder in such a position that a full stroke is always obtained, and it is also necessary to change the drill-bar as the depth of the hole increases. To provide for these necessary manipulations, therefore, I find it expedient to control the position of my drill-operating mechanism by a suitable motor, by means of which I am able to move the drill-operating mechanism upward or downward, according to the position that I desire it to occupy while drilling. It has sufficient power to pull the drill loose when jammed, and it withdraws the bar from the hole when it needs to be sharpened. This motor I have indicated generally as 44, and the drill-operating mechanism I have indicated generally as 52. The motor consists in this case simply of a cylinder secured to the column 38, having a piston, the said piston being connected by suitable connecting-rods to the drill-operating mechanism 52. This drill-operating mechanism and motor 52 I prefer to mount in ways on the face of the column 38, so that they will move vertically. The motor in this case is a hydraulic motor controlled by pressure coming from a source of power on the float and connected to the motor by a flexible connection, as 84^a. The flow of liquid to the motor is controlled by the hand of the operator. When the operator desires to raise the drill-operating mechanism 52, he introduces pressure into the cylinder 44^a, thus driving the piston up and raising the drill in like manner. He then opens the valve to let the liquid out of the cylinder and in so doing lowers the drill. It will be readily seen from this description that both the upward and downward motions of the drill-bar and its motor are coincident with the piston of the hydraulic motor and that with properly-designed mechanism the operator can from his platform feed the drill downward, as it cuts with ease and great accuracy, and, as frequently happens, withdraw the drill mechanism upward with a force of many tons when the drill shall be jammed in the drilled hole. It will also be understood as illustrating the value of column 38 that these great strains which become necessary to withdraw the drill-bars when jammed in their holes is transmitted direct to the rock itself and does not cause any additional strain upon the boat or upon

the crane by which the column 38 is hoisted and moved. I may for this purpose, of course, employ any form of motor to raise and lower the drill; but the form indicated is the one that I prefer in this case.

In the operation of drilling under water it is important that communication should be established from above the surface of the water to the point against which the drilling is to be directed and to protect the drill-shaft from pressure of strong currents. I establish this connection by the pipe or tube 66, the latter being guided by passing through the aperture 65 of the plate 64 and guide 66^a and finding its lodgment on the surface of the rock. This pipe is arranged to slide easily upon the column 38 and adjust itself automatically to surface of rock when column 38 is lowered and will follow the drill-bar into the hole as far as its diameter permits. The points 57 adjust themselves to the surface of the rock when the column 38 is lowered on the base below.

The next step in the operation is that of drilling the hole. I have found that one of the difficulties in successfully drilling a vertical hole under the conditions nominated, where it is necessary to use a drill having a long shaft, is that the drill will cut irregularly to the end that the hole will not be central with the inclosing pipe and will not be vertical or straight. This I can overcome by providing a suitable guide for the drill at the point where it enters the rock. This guide I have provided in the form of a longitudinally-corrugated sleeve or jig, such as 71, having pointed ends 72 with corrugations 73. This jig is run on the shaft of the drill. Before it is secured to the drill-operating mechanism it is permitted to drop over the drill-bar against the drill-head. The drilling operation is then commenced, and as the drill enters the hole the guide 71 wedges into the hole near to its top, for the reason that it is made of slightly greater diameter than the cutting-head of the drill. The drill is then guided permanently from this base until it has reached a considerable depth, under which it is not so necessary that it should be thus guided.

In the operation of drilling it is necessary to force water to the point of drilling for purposes which are well understood in the art—that is to say, to remove the debris and cuttings. To accomplish this end in the last-described operation, I introduce through the pipe 66 a small pipe 74, passing the same through one of the corrugations 73 of the guide 71 to the point of drilling, and during the operation of drilling I force water through this pipe to the point where the drill is operating. The water thus forced down makes a strong upward current in the pipe 66, and this current finds an outlet through the apertures 67, said apertures being above the sand-line—that is to say, about the depth of the sand covering the rock. Thus it will be seen that the debris is continuously removed from the point of drilling. I then remove the drill and slip off the jig 71 from the drill-shaft.

I have discovered in the operation of my device that it happens in some cases where the surface of the rock is out of the horizontal plane or the drilled hole at the surface of the rock is irregular—that is, not truly circular—that the pipe 66 will not enter the hole sufficiently to close on all sides, but will leave an opening on one side thereof, as shown in Fig. 10, leaving an aperture 90, through which the mud and sand on the surface of the rock may flow into the drill-hole. I find it necessary, therefore, to provide means to close this aperture, so that the surrounding stratum of sand and gravel cannot flow into the drilled hole. To accomplish this result, I provide the funnel 75, the large end of which, 76, fits closely the tube 66 and tapers to a diameter smaller than that of the drilled end 77. When the operation described in the last paragraph is performed, this funnel 76 is introduced by sliding down over a drill-shaft which has been inserted after use of jig 75 has been withdrawn. Its use on this individual hole has ceased. Falling through the pipe as it is guided to the hole by the drill-shaft and being smaller than the top part of the hole in the rock it falls into it until stopped by its taper, and thus closes out all the nearby sand and gravel, and the process of drilling is then resumed. The operation of drilling is continued as heretofore described. The water is pumped through the small pipe 74 to the point of drilling and passes up through the funnel 71 and the pipe 66 and out of the apertures 67, carrying with it the cutting debris.

When I have completed the drilling operation, I find that it is sometimes necessary to cleanse the hole of debris, and to accomplish this result after I have removed the drill I introduce through the tube 66 and funnel 71 the rod 79, together with the pipe 74, carrying the same together to the base of the drill-hole to be retained there a sufficient time to wash out of the drilled hole all of the debris, leaving the hole free. The function of the rod is to increase the velocity of the outward current by means of the rod's size and displacement and by means of this higher velocity remove the heavy sand. I then withdraw the rod 79 and pipe 74, and I am now in position to introduce the cartridge with which the blast is to be made. One of the difficulties involved in placing the cartridge in position is that of ascertaining accurately as to whether the cartridge has reached the bottom of the drill-hole. To make sure of the position of the cartridge in the hole, I first drop in the rod 79 and note the depth of the hole from a fixed point on the column or to surface of the water. To the cartridge is connected electrical wires, by which it is discharged. I therefore mark on these electrical connections a point corresponding to the

measured distance last ascertained with a measurement-rod. I then drop the cartridge into the hole, and if these measurements correspond I know that the cartridge has reached the base of the hole. In Figs. 11 to 14 I have indicated the operation of dropping the cartridge into the drill-hole. After the charge of explosive is at the bottom of the drilled hole I then tamp the hole, introducing sand therein and jamming it down. I then raise the column 38 with all of its connecting apparatus by the operation of the drum 32′ and tackle 31. The wires are withdrawn from the guide-pipe with the hook-bar, and the mark attached to them is again compared with the former point of reference to know if the operation of raising the column has disturbed the dynamite, and if not it is discharged by electrical current through the wires. Thus it will be seen that from the first to the last operation of drilling the hole and charging the same I maintain the whole apparatus in a permanent and certain position—first over the point to be drilled and last over the hole to be blasted—and I may in this way drill a series of holes in accurate alinement either with the operation of one of these blasting mechanisms or an aggregation of the same.

What I claim is—

1. In a submarine drilling apparatus, a float suitably anchored in combination with a column connected with said float by a flexible and sliding connection and resting in a substantially vertical position on the bottom with a drill-operating mechanism mounted on said column and means to operate the same, substantially as described.

2. In a submarine drilling apparatus, a float suitably anchored in combination with a column connected with said float by a suitable flexible and sliding connection, with means to raise and lower said column in a substantially vertical position and a drill-operating mechanism mounted on said column to operate the same, substantially as described.

3. In a submarine drilling apparatus, a float suitably anchored in combination with a column connected with said float by a flexible and sliding connection and resting in a substantially vertical position on the bottom with a drill-operating mechanism mounted on said column, all of the operating mechanism to move parallel with the axis of said column and means to raise and lower said drill-operating mechanism, substantially as described.

4. In a submarine drilling apparatus, a float suitably anchored in combination with a column connected with said float by suitable flexible and sliding connections with means to raise and lower said column in a vertical position and a drill-operating mechanism mounted on said beam to move parallel with its axis and means also mounted on said column to raise and lower said drill-operating mechanism, substantially as described.

5. In a submarine drilling apparatus a float suitably anchored in combination with a column connected with said float by a suitable flexible and sliding connection with means to raise and lower said column in a vertical position; a motor mounted on said column adapted to raise and lower a drill-operating mechanism; a drill-operating mechanism mounted on said column to move in ways parallel with the axis of the column; a connection between said motor and drill-operating mechanism to control the position of the drill with reference to the rock, and also to raise and lower the whole drill mechanism, the motor and drill mechanism operating coincident with each other, substantially as described.

6. In a submarine apparatus, a float suitably anchored in combination with a column connected with said float by a suitable flexible and sliding connection with means to raise and lower said column in a vertical position, with a drill-operating mechanism mounted on said column to move in ways parallel with the axis of said column; a motor mounted on said column in a stationary position, said motor being connected with the drill mechanism to move the same up and down, and also arranged to feed the drill down when cutting, and by reversing the motion of said motor to withdraw the drill away from contact with the material being acted upon; the movements of the motor and the drill being coincident, substantially as described.

7. In a submarine drilling apparatus, a float suitably anchored and carrying a crane in combination with a column connected with said crane by a flexible and vertical sliding connection; means to move said column in a vertical position by said crane, with suitable drill-operating mechanism mounted on said column to move axially of the column, and means mounted on the column to move the said drill-operating mechanism, substantially as described.

8. In a submarine drilling apparatus, a float suitably anchored and carrying a crane or cranes in combination with a column, and means operating in connection with said crane to raise and lower said column in a vertical position, and means when the column is lowered to the bottom to cause the same to retain a fixed position on the bottom, and means to support the column vertically while it is resting on the bottom consisting of flexible and vertically-sliding connections between the column and the crane; a motor mounted on the column and a drill-operating mechanism mounted on the column to move in ways vertically and means for controlling said motor to move said drill-operating mechanism in said ways vertically, substantially as described.

9. In a submarine drilling apparatus, a float suitably anchored and carrying a crane in combination with a column, means to raise and lower said column in a vertical position by means of said crane; rocking beam or beams centrally pivoted at the lower end of the column and two pins mounted to move

vertically at the end of the beams, said pins being connected by suitable links to the ends of said beams; vertical ways on the crane adapted to coöperate with a fixed stud on the column; a motor mounted on the column to move in suitable vertical ways, and means for controlling said motor to move said drill-operating mechanism in said ways, substantially as described.

10. In a submarine drilling apparatus, a float suitably anchored and carrying a crane in combination with a column; means to raise and lower said column in a vertical position by means of said crane, the column being pivotally connected at its lower end to a centrally-pivoted rock-beam, and carrying also two pins mounted to move vertically, said pins being connected by suitable links to either ends of said rock-beams; vertical ways in the crane adapted to coöperate with a fixed stud on the beam; a motor consisting of a cylinder and piston with suitable valves mounted on said column, and a drill-operating mechanism mounted to move vertically in ways on said column; suitable connections between the piston of said motor and the drill-operating mechanism, substantially as described.

11. In a submarine drilling apparatus, a float upon which is mounted a platform and an upright frame, said platform and ways extending substantially around the float, in combination with a movable crane supported by the platform and frame, and mounted to move in ways along the platform and frame, whereby the drill may be operated from substantially any point on the sides of the float, substantially as described.

12. In a submarine drilling apparatus, a float carrying a platform and supporting-frame, the platform and frame each being provided with annular retaining-flanges and tracks in combination with a crane having rollers and retaining-flanges and being mounted to move on said tracks and flanges, substantially as described.

13. In a submarine drilling apparatus, a float carrying a platform and supporting-frame, the platform and frame each being provided with annular retaining-flanges and tracks in combination with a crane having rollers and retaining-flanges and being mounted to move on said tracks and flanges with vertical apertures through the float and retaining beams or spuds, adapted to pass through the same and rest on the bottom to hold the float in position, substantially as described.

14. In a submarine apparatus wherein it is desired to maintain a column or pillar in a fixed position on a submarine base or bottom, the following mechanism in combination, a column vertically supported and being pivotally connected at its lower end with the center of a rock-beam; two pins suitably mounted to move in ways on either side of said beam with link connections between the upper ends of said pins and the ends of said rock-beam, substantially as described.

15. In a submarine apparatus wherein it is desired to maintain a column or pillar in a fixed position on a submarine base or bottom, the following mechanism in combination, a column pivoted at one end to the center of a rock-beam, two pins suitably mounted in sleeves on either side of said column at the same end, to move parallel with the axis of the column and link connections between the upper ends of the pins and the ends of the rock-beam respectively, with means to maintain the column or pillar in a substantially vertical position, substantially as described.

16. In a submarine drill mechanism, a drill in combination with a sleeve run on the drill-shaft, said sleeve having a conical end and of a size to wedge centrally in the drilled hole, said sleeve being also corrugated longitudinally, substantially as described.

17. In a submarine drill mechanism, a drill in combination with a sleeve run on the drill-shaft, said sleeve having a conical end and of a size to wedge centrally in the drilled hole, said sleeve being also corrugated longitudinally, and a pipe passing through one of the said corrugations by means of which water may be forced to the drilling-point and out of the drilled hole through the other corrugations, substantially as described.

18. In a submarine drill mechanism, a tube and means to support the same in a suitable position resting on the bottom in combination with a drill and a guide-sleeve run on the drill-shaft, said sleeve having a conical end and of a size to wedge centrally in the drilled hole, said sleeve being also longitudinally corrugated, substantially as described.

19. In a submarine drill mechanism, a tube and means to support the same in a suitable position resting on the bottom in combination with a drill and a guide-sleeve run on the drill-shaft, said sleeve having a conical end and of a size to wedge centrally in the drilled hole, said sleeve being also longitudinally corrugated and a pipe passing through one of said corrugations, by means of which water may be forced to the drilling-point and out of the drilled hole through the other corrugations, said tube being also provided with apertures above the mud-line out of which the water thus forced in may escape and carry therewith the particles of rock as the same are broken by the drill, substantially as described.

Signed by me at New York, in the county and State of New York, this 12th day of January, 1901.

RALPH G. PACKARD.

Witnesses:
PAUL BONYNGE,
SIDNEY R. PERRY.