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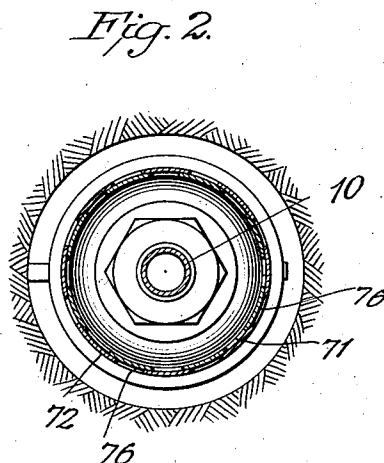
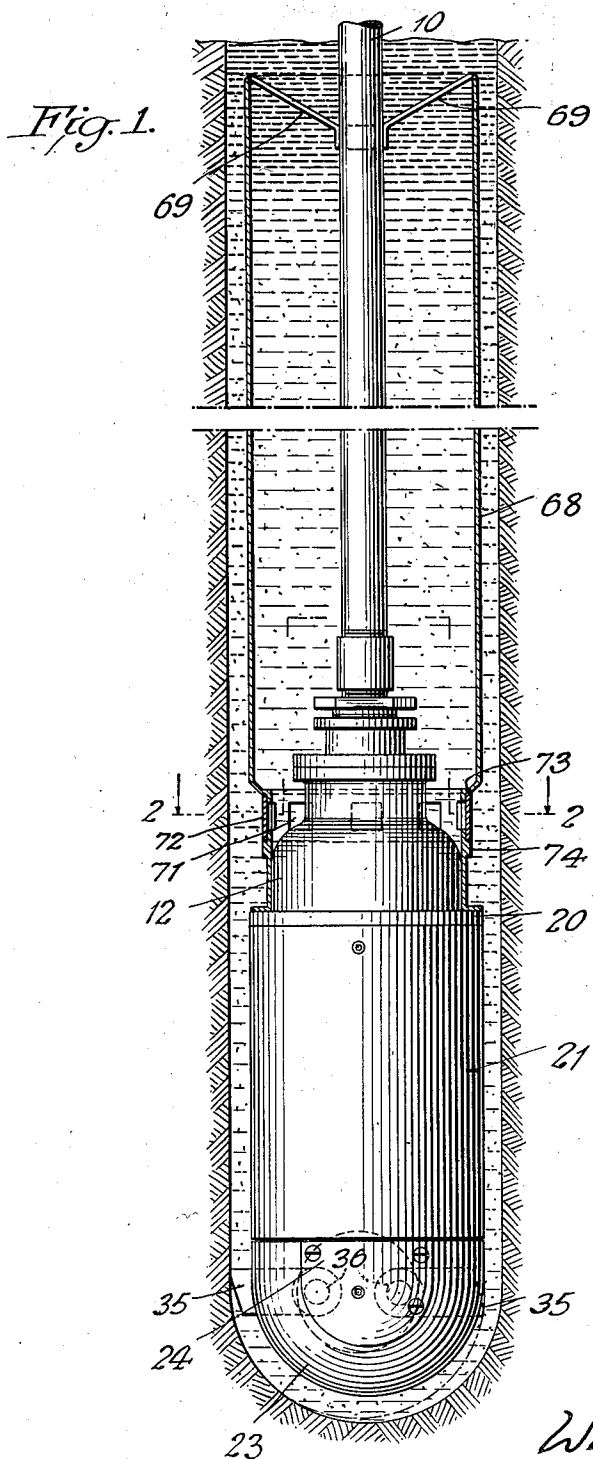
J. K. HENCKEN

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EARTH BORING MACHINE

Filed June 16, 1928

3 Sheets-Sheet 1



INVENTOR.

John K. Hencken
BY
Williams, Rich & Loomis
ATTORNEYS.

April 8, 1930.

J. K. HENCKEN

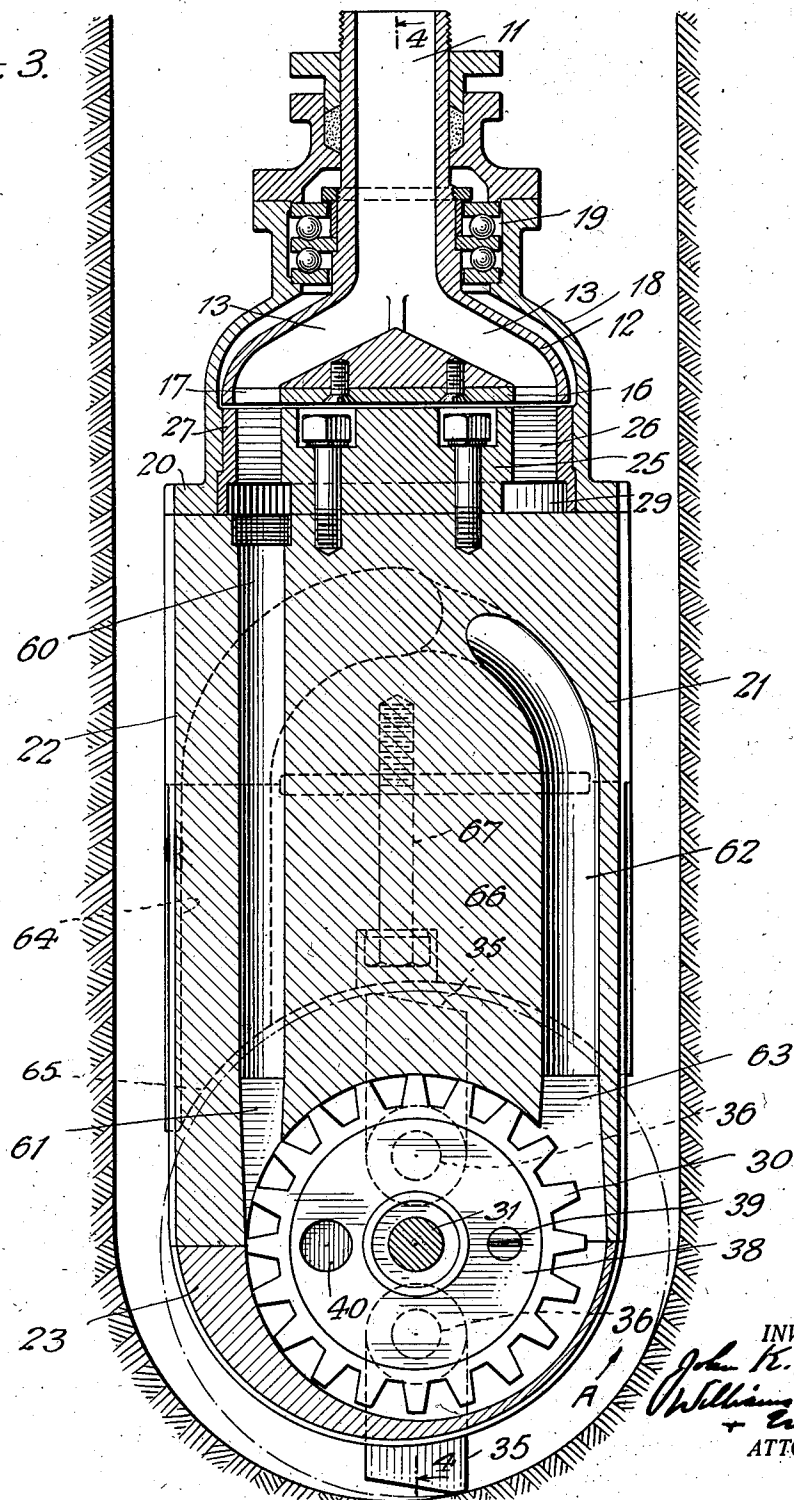
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3 Sheets-Sheet 2

Fig. 3.



INVENTOR.

John K. Hencken
 Williams, Rich
 & Ensey
 ATTORNEYS.

April 8, 1930.

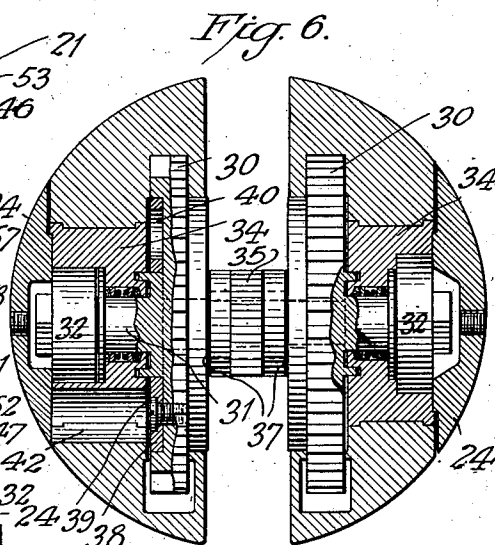
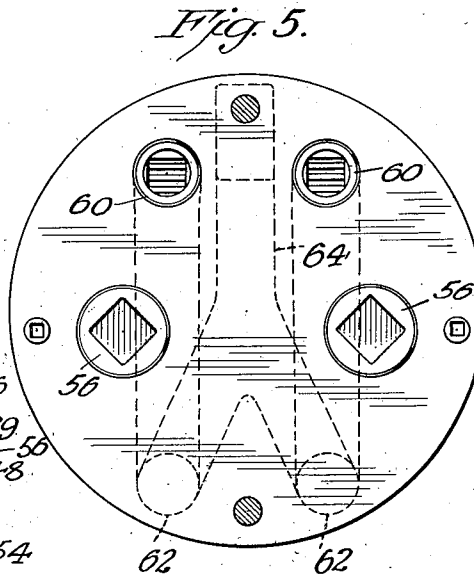
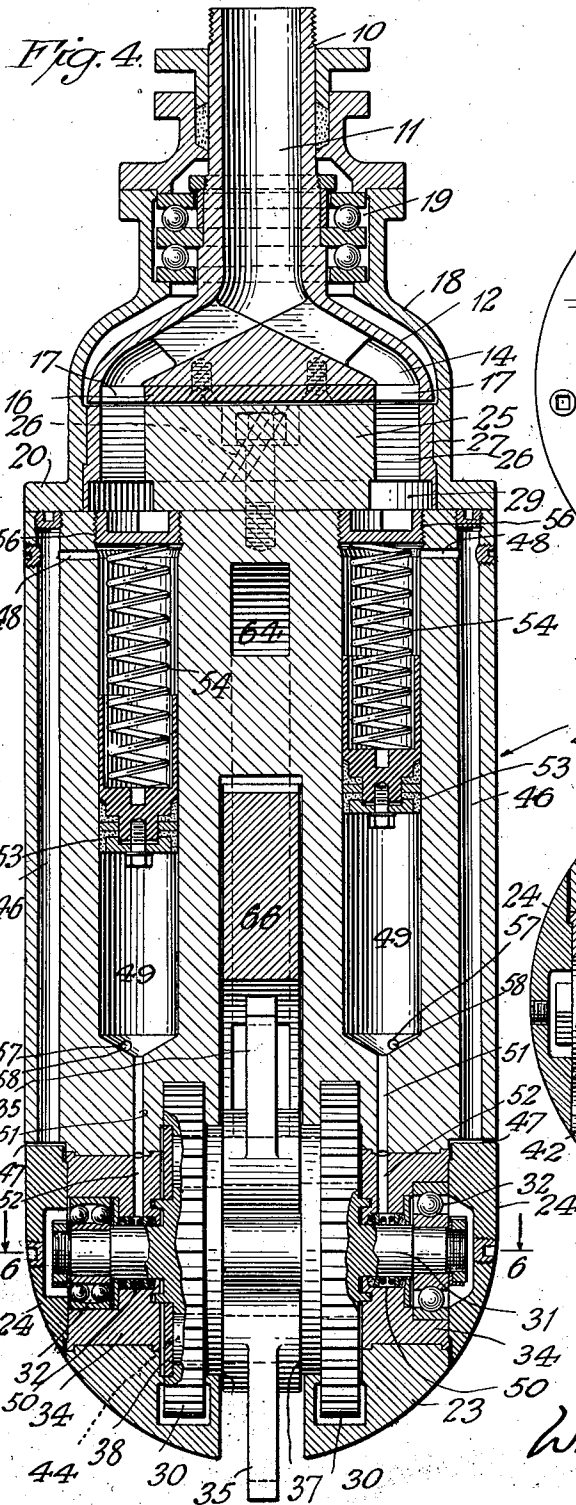
J. K. HENCKEN

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EARTH BORING MACHINE

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3 Sheets-Sheet 3



INVENTOR.
John K. Hencken
BY
Williams, Rich & Evans
ATTORNEYS.

UNITED STATES PATENT OFFICE

JOHN K. HENCKEN, OF BROOKLYN, NEW YORK

EARTH-BORING MACHINE

Application filed June 16, 1928. Serial No. 285,839.

This invention relates to earth boring machines and has particular reference to machines especially adapted for use in drilling deep wells such as oil, artesian and other wells.

An important object of the invention is to provide a machine of the character mentioned by which drilling operations may be expeditiously performed and by which accuracy and perpendicularity of the wells may be insured.

Another object of the invention is to provide a simple and effective means by which the loosened material at the bottom of the well may be easily removed therefrom as the drilling operation progresses.

A further object of the invention is to provide a generally improved machine of the character mentioned which is strong, durable, economic in operation and reliable in use.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings in which Figure 1 is a view partly in elevation and partly in section of the machine in operating position at the bottom of a well; Figure 2 is a horizontal sectional view taken on the line 2-2 of Figure 1; Figure 3 is a central vertical sectional view, taken at right angles to the horizontal axis of rotation of the hammer or digging elements, with the machine turned through an arc of 180° with respect to its position shown in Figure 1 and with the material-receiving bucket removed; Figure 4 is a central vertical sectional view taken on the line 4-4 of Figure 3, certain elements of the impact delivering unit being shown in elevation; Figure 5 is a plan view of the body portion of the machine with the upper turbine and its cap member removed; and Figure 6 is a sectional view taken on the line 6-6 of Figure 4, certain elements of the impact delivering unit being shown in plan.

Referring to the drawings, the numeral 10 indicates a depending support adapted to be lowered into an excavation such as a well as the boring or drilling thereof progresses. This support is provided with a central longitudinal passage 11, through which a suitable

fluid, such as water under pressure, may be delivered to the apparatus, herein shown, to serve as a propelling medium as will hereinafter be described. The depending support 10 is provided at its lower end with a header 12, which is formed with a plurality of diverging passages 13, all of which communicate with the passage 11 and with an annular channel 14 formed in the lower part of the header. To the solid portion of the header 12, which is surrounded by the annular channel 14 is secured a stator member or plate 16, having formed therein a plurality of ports 17 which communicate with the channel 14. Over the header 12 is arranged a rotatable cap 18, which is journaled upon the depending support 10 and is so suspended therefrom, through the use of a suitable ball or other anti-friction bearing 19, as to permit the cap 18 to freely rotate with respect to the header 12.

The cap 18 is provided at its lower end with an outwardly projecting peripheral flange 20 to which is bolted a depending head 21, comprising a body portion 22, an end portion 23, and side plates 24. To the upper end of the body portion 22 is secured a rotor 25 which together with stator member 16 associated with the header 12 serves as a fluid motor of the turbine type adapted to be acted upon and operated by fluid pressure received from the passage 11 of the depending support 10, whereby rotation of the head 21 about a vertical axis is effected. The rotor 25 is provided with a plurality of radially disposed blades 26, to the outer ends of which is secured an annular ring 27, which conforms to the contour of the adjacent inner wall of the cap 18 and forms with the central hub portion of the rotor 25 an annular channel 29 located adjacent the upper end of the body portion 22 of the head 21, the annular channel 29 being adapted to receive the fluid actuating medium after having exerted its influence upon the blades 26 of the rotor 25.

Within the lower end of the head 21 is mounted an impact delivering unit which includes a pair of turbine rotors 30. These rotors 30 are secured to a horizontally disposed shaft 31, opposite ends of which are mounted

in ball bearings 32 housed within bearing blocks 34 suitably mounted within the end portion 23 of the head 21, the bearings being protected from grit, dirt and other foreign matter, encountered during a well drilling operation, by the side plates 24 which are suitably secured to the end portion 23 adjacent opposite ends of the shaft 31.

Between the rotors 30 are located a plurality of impact-delivering hammers 35, which are of such a length as to project an appreciable distance beyond the peripheral surface of the head 21 as they are rotated about the axis of the rotors 30 with which they are adapted to revolve. These hammers 35 are pivotally mounted upon pins 36 carried within suitable openings formed in the rotors 30 parallel to their common axis of rotation, the pins being held against end-wise movement toward the right, as viewed in Figure 4, by reason of the fact that their corresponding ends are provided with shoulders 37 which abut the inner face of the rotor 30 appearing at the right in that figure. For preventing endwise movement of the pins 36 in an opposite direction, the rotor 30, appearing at the left in Figure 4, is provided with a locking ring 38 which is connected to the rotor 30 appearing at the left in Figure 4 and is held normally against movement with respect thereto by suitable securing means such as a screw 39. In order to enable the pins 36 to be easily removed when it is desired to replace the hammers 35, the locking ring 38 is provided with an opening 40 which is normally positioned out of alignment with each of the pins 36. By removing the screw 39, the locking ring 38 may be so rotated with respect to the rotor 30 to which such ring is secured as to bring the opening 40 into registration with either of the pins 36, access to the screw 39 being had through a registering opening 42 formed in the adjacent bearing block 34. As shown in Figure 6, access is had to this opening 42 by removal of the adjacent side plate 24. Upon removal of this side plate, and aligning the opening 40 with the opening 42 and with the pin 36 to be removed, a suitable screw threaded instrument, not shown, may be inserted through the openings 42 and 40 and screwed into a screw threaded opening 44 formed in the end of the pin 36, whereupon the pin may be easily withdrawn as will be readily understood. In order to remove the other pin 36, the locking ring 38 is rotated about the axis of the rotors 30 until the opening 40 is brought into registration with such remaining pin 36 whereupon that pin may be similarly withdrawn. Removal of the pins 36 enables replacement of the hammers 35 to be readily made, after which the locking flange 38 is secured, by the screw 39, to its rotor 30 in such a position as to maintain the opening 40 out of registration with each of the pins 36, and the side

plate 24, is attached, effectively covering up the opening 42.

In the case of deep wells having a large head of water therein, considerable hydrostatic pressure is encountered. In order to equalize the hydrostatic pressure in the vicinity of the bearings of the shaft 31 and thereby make possible the maintenance of proper lubrication of such bearings, a pair of pressure transmitting conduits 46 are provided in the body portion 22 which open exteriorly of the head 21, through relatively narrow ports 47 intermediate the body portion 22 and the side plates 24, and communicate through passages 48 with the upper ends of grease chambers 49 which communicate with stuffing boxes 50 through which opposite ends of the shaft 31 project, communication of the grease chambers with the stuffing boxes being afforded through registering ducts 51 and 52 formed respectively in the body portion 22 and bearing blocks 34. The grease chambers 49 are provided with floating pistons 53, which are normally urged downwardly by compression springs 54, arranged over the pistons 53 and abutting against screw threaded plugs 56 screwed into the upper screw threaded ends of the chambers 49. The grease chambers 49 may be charged with lubricant by a suitable instrument, such as a grease gun, through charging openings 57 which are formed in the body portion 22 and communicate with the grease chambers 49 at their respective lower ends, the openings 57 being normally closed by removable screw threaded plugs 58. In charging the chambers 49 with lubricant, the pistons 53 are displaced, thereby compressing the springs 54 so that they exert sufficient influence upon the pistons 53 to cause them to move downwardly along the walls of the chamber 49 as the lubricant is gradually consumed within the stuffing boxes 50 with which the grease chambers communicate. From the preceding description it will be readily appreciated that since the grease chambers 49 at one side of their respective pistons 53 communicate with the stuffing boxes 50 and since such grease chambers at the opposite sides of their respective pistons communicate with the outside of the head 21, a pressure is set up in the vicinity of the parts to be lubricated equal to the hydrostatic pressure encountered when operating under a head of water, with the result that unobstructed transmission of lubricant from the chambers 49 to the shaft 31 is permitted.

The body portion 22 is provided with a pair of conduits 60 which lead from the annular channel 29, adjacent the rotor 25 at the upper end of the head 21, to the respective intake ports 61 of the rotors 30 at the lower end of the head so that fluid pressure, from the turbine at the upper end of the head 21 composed of the stator and rotor members 16 and 25,

63 of the rotors 30, such fluid passes through the passages 62 into the conduit 64 from which it is directed onto the outer ends of the hammers 35 as they pass the outlet end of the conduit 64, whereby rotation of the hammers about the axis of the shaft 31 is augmented as will be readily understood. As the escaping fluid leaves the conduit 64 it is directed downwardly and in the general direction of the cutting and breaking action of the hammers and assists that action and carries the loosened material away from the bottom of the well and upwardly between the wall of the well and the peripheral surfaces of the head 21 and bucket 68, respectively. At the top of the bucket 68 the rate of flow of the liquid in an upward direction is substantially diminished with the result that practically all except the slimes of the solid material sinks into the bucket 68. As the digging operation progresses, the support 10 is lowered until the bucket 68 is filled or substantially filled, whereupon the machine is withdrawn by lifting the support 10 and the contents of the bucket are discharged by opening the valve ring 72. The proper time for withdrawing the machine may be readily calculated, since the volumetric capacity of the bucket 68 is known and the amount of material loosened by the hammers 35 for each unit of depth that the machine is lowered is readily ascertainable.

While only one form of the invention has been herein shown and described, it will be understood that various modifications and changes may be resorted to without departing from the spirit of the invention or the scope of the following claims.

What is claimed is:

1. In an earth boring machine, an impact delivering unit comprising a rotatable member having an impact delivering element pivotally connected thereto, means for actuating said rotatable element whereby said impact delivering hammer is rotated about the axis of said rotatable member, and actuating means for bodily moving said unit about a perpendicular axis.

2. In an earth boring machine, an impact delivering unit comprising a motor having a rotatable member adapted for rotation about a horizontal axis, and a plurality of impact delivering hammers pivotally connected to said rotatable member and adapted to be moved therewith about its axis of rotation, and actuating means for rotating said unit about a vertical axis.

3. In an earth boring machine, an impact delivering unit comprising a pair of rotors connected together and adapted for rotation about a horizontal axis, an impact delivering hammer pivotally connected to said rotors and adapted to be rotated thereby about said horizontal axis, and actuating means for rotating said unit about a vertical axis.

4. In an earth boring machine, a head, a pair of fluid actuated rotors journaled in said head and adapted for rotation about the common horizontal axis, a plurality of impact delivering hammers pivotally connected to said rotors and adapted to move therewith about the common axis thereof, and fluid actuated means for bodily moving said rotors together with said hammers about a vertical axis.

5. In an earth boring machine, a head, a fluid motor associated with said head for rotating the same about a perpendicular axis, a fluid motor having a rotatable member journaled in said head for rotation about a horizontal axis and having its intake side communicating with the delivery side of the first mentioned fluid motor whereby the exhausted fluid from the first named motor is utilized as a propelling medium for the second named motor, an impact hammer connected to the rotatable member of the second named motor and adapted to be rotated about said horizontal axis.

6. In an earth boring machine, a head, a fluid motor associated with said head for rotating the same about a perpendicular axis, a fluid motor having a rotatable member journaled in said head for rotation about a horizontal axis and having its intake side communicating with the delivery side of the first mentioned fluid motor whereby the exhausted fluid from the first named motor is utilized as a propelling medium for the second named motor, an impact hammer connected to the rotatable member of the second named motor and adapted to be rotated about said horizontal axis, and means for utilizing the spent fluid from the second named motor to remove material from the bottom of a well out of the path of said impact delivering hammer.

7. In an earth boring machine, a fluid motor having relatively rotatable turbine members, a depending stationary support having one of said turbine members associated therewith, a rotatable head journaled upon and supported by said depending support and having the other of said turbine members associated therewith, means for directing fluid pressure into said fluid motor for rotating said head about a vertical axis, an impact delivering hammer mounted at the lower end of said head for rotation about a horizontal axis, and a fluid motor for rotating said hammer about said horizontal axis, and means for maintaining communication between the outlet of the first named motor and the inlet of the second named motor whereby the actuating medium of the first named motor is utilized as the actuating medium of the second named motor.

8. In an earth boring machine, a fluid motor having relatively rotatable turbine members, a depending stationary support

respectively, may be utilized as the propelling medium for the rotors 30. The body portion 22 is also formed with a pair of outlet conduits 62 which lead from the outlet ports 63 of the rotors 30 upwardly through the body portion 22 to the upper end thereof, at which point they come together, thus forming a single conduit 64 which leads across the body portion 22 and then extends downwardly, as shown in Figures 4 and 5, through a removable insert 66 held in place by the screw 67 and located centrally of the body portion 22 at a point directly above the path of travel of the hammers 35. The outlet end of the conduit 64 terminates in a port 65 so arranged that the fluid from the rotors 30 is directed down upon the outer ends of the hammers 35 as they rotate in the direction of the arrow A of Figure 3, with the result that such energy as is possessed by the fluid at the time it issues from the port 65 of the conduit 64 is utilized to further facilitate rotation of the hammers 35 about the axis of the shaft 31, and additionally the fluid is discharged in the general direction of the cutting and breaking action of the hammers and assists this action and in the removal of the debris from this action. It is deemed advisable that the port 65 of the conduit 64 be in proximity to the circle described by the outer ends of the hammers 35 as they are rotated about the axis of the shaft 31, and for that reason the insert 66 is made removable so that different sizes of such inserts may be employed, depending upon the length of the hammers employed.

Since the shaft 31 is off-set with respect to the axis of the head 21, as will be clearly seen from Figure 3, shorter hammers 35 than would be necessary were the shaft 31 centrally located, may be employed to provide a given clearance between the peripheral surface of the head 21 and the wall of the well. The clearance, however, between the wall of the well and the peripheral surface of the head 21 is relatively slight, inasmuch as it is desirable to maintain a substantial rate of flow of fluid from the discharge passage 64 upward along the wall of the well to carry upward the loosened material from the bottom of the wall as it is displaced or severed by the hammers 35.

Upon the peripheral flange 20, at the lower end of the cap 18, is mounted an upwardly projecting cylindrical bucket 68, the upper end of which is open and is held in a fixed relation to the depending support 10 by a plurality of inwardly and downwardly projecting braces 69 which engage the depending support and are suitably connected thereto. The lower end of the bucket 68 is provided with a plurality of discharge openings 71 which may be closed by a valve ring 72 rotatably mounted intermediate a shoulder 73 formed in the wall of the bucket and a collar

74 secured to the lower end of the bucket. This valve ring 72 is provided with a plurality of openings 76 which are adapted to register with the openings 71 upon rotation of the valve ring, the spacing of the openings 71 with respect to each other and of the openings 76 with respect to each other being such that the solid portions of the valve ring 72 intermediate the opening 76 thereof overlie the openings 71 when the valve ring 72 is positioned as shown in Figure 2. The openings 76 are closed when the boring machine is in the well.

It will be noted that the diameter of the bucket 68 is equal to the diameter of the head 21 and that the space afforded between the wall of the well and the peripheral surface of the bucket 68 is the same as the space intermediate the wall of the well and the peripheral surface of the head 21, with the result that the rate of flow of the fluid discharged from the discharge passage 64 is maintained uniform as such fluid rises from the bottom of the well to the top of the bucket 68. As the fluid passes from the space afforded between the wall of the well and the bucket 68 into the bore of the well above the top of the bucket, the rate of the flow of the liquid is materially decreased, with the result that the heavy particles which are carried from the bottom of the well upwardly can no longer be suspended in and carried by the upwardly moving liquid and are therefore allowed to fall into the open end of the bucket 68 where they are collected.

In operation, the machine is located over the point at which it is desired to drill the well and there suitably suspended by the support 10, which is held so as to resist rotation, whereupon a suitable fluid, such as water under pressure, is admitted to the passage 11 therein. The fluid pressure is directed from the passage 11 into and through the turbine at the upper end of the head 21, thereby causing the head to rotate on the bearings 19 about a vertical axis. The fluid pressure, as it leaves the turbine at the upper end of the head 21, is directed through the conduit 60 to the rotors 30 of the turbines in the lower end of the head, thereby causing the hammers 35 to rotate in the direction of the arrow A, as shown in Figure 3, about the horizontal axis of the shaft 31 at high speed. Inasmuch as the head 21 rotates about a vertical axis while the hammers 35 are rotating about a horizontal axis, a series of impacts are delivered by the hammers to the material to be removed in such a manner as to produce a round hole in the earth of sufficient diameter to readily receive the body portion 22 of the head 21, leaving a substantial clearance between the peripheral surface of the body portion 22 and the wall of the well as shown in Figures 1, 2 and 3. As the propelling fluid passes from the outlet ports

having one of said turbine members associated therewith, a rotatable head journaled upon and supported by said depending support and having the other of said turbine members associated therewith, means for directing fluid pressure into said fluid motor for rotating said head about a vertical axis, an impact delivering hammer mounted at the lower end of said head for rotation about a horizontal axis, and a fluid motor for rotating said hammer about said horizontal axis, and means for maintaining communication between the outlet of the first named motor and the inlet of the second named motor whereby the actuating medium of the first named motor is utilized as the actuating medium of the second named motor, and means for utilizing the actuating fluid from the second named motor for removing material from the bottom of a well out of the path of said hammer.

9. In an earth boring machine, a fluid motor having relatively rotatable turbine members, a depending stationary support having a fluid passage adapted to deliver fluid pressure to said motor and having one of said turbine members associated therewith, a rotatable head journaled upon and depending from said support and having the other of said turbine members connected therewith and cooperating with one of said turbine members for rotating said head about a vertical axis, said head also having a fluid conduit leading from the outlet side of said motor, a second motor having a rotatable member journaled in the lower end of said head for rotation about a horizontal axis and having its inlet side in communication with said conduit whereby the discharge fluid from the first named motor is utilized as the propelling medium of the second named motor, and a plurality of impact delivering hammers connected with the rotatable member of the second motor for rotation about said horizontal axis.

10. In an earth boring machine, a fluid motor having relatively rotatable turbine members, a depending stationary support having a fluid passage adapted to deliver fluid pressure to said motor and having one of said turbine members associated therewith, a rotatable head journaled upon and depending from said support and having the other of said turbine members connected therewith and cooperating with one of said turbine members for rotating said head about a vertical axis, said head also having a fluid conduit leading from the outlet side of said motor, a second motor having a rotatable member journaled in the lower end of said head for rotation about a horizontal axis and having its inlet side in communication with said conduit whereby the discharge fluid from the first named motor is utilized as the propelling medium of the second named mo-

tor, and a plurality of impact delivering hammers connected with the rotatable member of the second motor for rotation about said horizontal axis, a material receiving bucket carried by said head at the upper end thereof and having its upper end open, and means for utilizing the discharge fluid from the second named motor to float the displaced material at the bottom of the well out of the path of said hammers and upwardly along the wall of a well and into said bucket.

11. In an earth boring machine, a fluid motor having relatively rotatable turbine members, a depending stationary support having a fluid passage adapted to deliver fluid pressure to said motor and having one of said turbine members associated therewith, a rotatable head journaled upon and depending from said support and having the other of said turbine members connected therewith and cooperating with one of said turbine members for rotating said head about a vertical axis, said head also having a fluid conduit leading from the outlet side of said motor, a second motor having a rotatable member journaled in the lower end of said head for rotation about a horizontal axis and having its inlet side in communication with said conduit whereby the discharge fluid from the first named motor is utilized as the propelling medium of the second named motor, and a plurality of impact delivering hammers connected with the rotatable member of the second motor for rotation about said horizontal axis, a material receiving bucket carried by said head at the upper end thereof and having its upper end open, and means for utilizing the discharge fluid from the second named motor to float the displaced material at the bottom of the well out of the path of said hammers and upwardly along the wall of a well and into said bucket, and valve means at the lower end of said bucket for discharging the contents thereof.

In testimony whereof, I have affixed my signature to this specification.

JOHN K. HENCKEN.