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HYDROGEN PEROXIDE DRILLING TOOL

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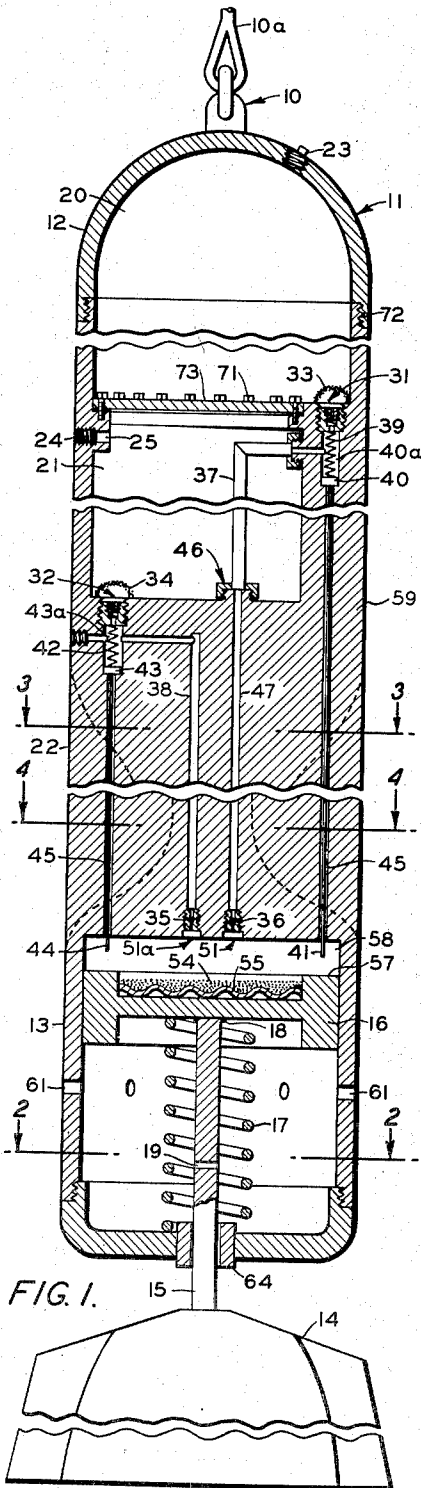


FIG. 1.

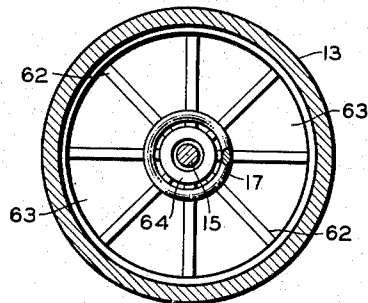


FIG. 2.

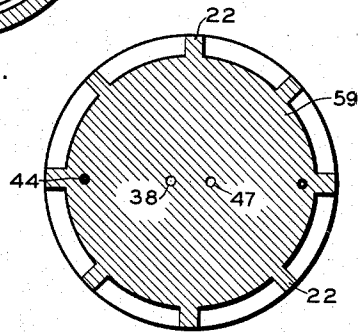


FIG. 3.

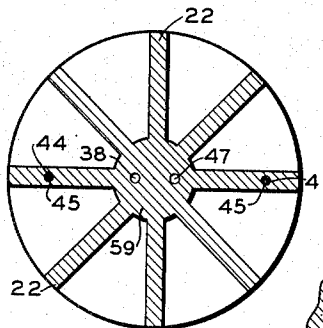


FIG. 4.

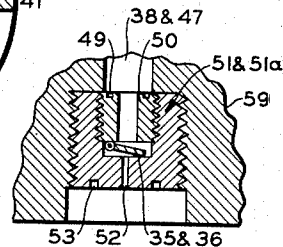


FIG. 5.

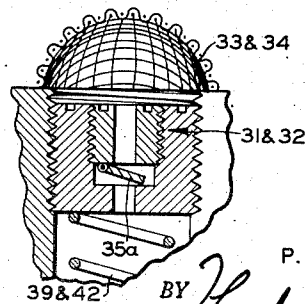


FIG. 6.

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HYDROGEN PEROXIDE DRILLING TOOL

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8 Claims. (Cl. 255-4.4)

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This invention relates to a well-drilling apparatus and method of operation. In one specific aspect, it relates to a self-contained and unitary well-drilling apparatus. In another aspect, it relates to a well-drilling apparatus which is completely self-contained, including a source of driving power.

Well-drilling apparatus of the prior art is powered from the surface of the ground. In electrically operated well-drilling apparatus, the lead wires for carrying electricity to the apparatus must extend from the apparatus to the surface of the ground. In rotary drilling apparatus, tubing extends the entire distance from the drilling bit to the surface of the ground, and this entire length of tubing is rotated from an above ground source of power. Cable tools drills are suspended and operate from an above ground source of power. Drilling apparatus powered by flow of fluids must have provision for transmission of fluid from a compressor or pump at the surface to the drilling apparatus at the bottom of the well. Some apparatus also includes provision for the return of the fluid exhausted from the drill to the surface of the ground for either disposal or reuse.

I have devised an apparatus in which a fluid or fluids are stored, and this fluid, or fluids, operates a motor which in turn actuates the actual drilling bit. This entire apparatus is a relatively small and completely self-sufficient mechanism which may be lowered into the well by a cable. The drilling mechanism then operates to drill the well in a manner entirely independent from any source of power extending to the surface of the ground.

An object of my invention is to provide a well drilling apparatus the operation of which is independent from surface equipment.

Another object of my invention is to provide a well drilling apparatus which contains its own driving fuel and motor.

Still another object of my invention is to provide a well drilling apparatus which is unitary and self-contained as regards motor and fuel for powering the motor.

Still other objects and advantages of my invention will be apparent upon reading the following disclosure, which taken with the attached drawing and claims, forms a part of this specification.

In the drawing, Figure 1 is a longitudinal view, partly in section and partly in elevation, of one embodiment of my well-drilling apparatus. Figure 2 is a cross-sectional view taken on the line

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2-2 of Figure 1. Figure 3 is a cross-sectional view taken on the line 3-3 of Figure 1. Figure 4 is a cross-sectional view taken on the line 4-4 of Figure 1. Figure 5 is a cross-sectional view of one piece of apparatus of Figure 1. Figure 6 is a cross-sectional view of an assembly of apparatus parts illustrated in Figure 1.

Broadly speaking, my drilling apparatus consists of a drilling bit fastened to one end of a piston rod with a piston on the other end. A reservoir is provided for storing a supply of such a power liquid as hydrogen peroxide. Means is provided for admitting small quantities of hydrogen peroxide from its reservoir to an expansion cylinder. A quantity of catalyst adapted to decompose hydrogen peroxide into its component parts is provided on the piston head. Since the decomposition temperature of hydrogen peroxide is relatively high at the time of decomposition, the decomposition products are in the gaseous state and under the conditions of temperature and pressure existing in the cylinder, tremendous pressures are exerted against the head of the piston. This pressure then causes the piston to move and its movement is transmitted directly through the piston rod to the drill bit. At the point near the bottom of the stroke exhaust ports in the side wall of the cylinder are opened and the power fluid is expelled. The piston and drill bit are moved upward and at a point near the top of the stroke peroxide injection apparatus operates to inject a new charge of hydrogen peroxide into the decomposition chamber or cylinder. In this disclosure by the use of such a term as "the piston and drill bit move upward" the meaning intended is that the upward movement of the piston is with respect to its containing cylinder 53 regardless of whether it is the piston or the cylinder which is doing the actual moving. Downward movement of the piston is also with respect to the cylinder 53. The length of time of continuous operation of this apparatus without recharging peroxide is, of course, dependent upon the size of the storage tank. In deep wells when time and energy are expended in raising apparatus out of or lowering apparatus into the well, my drilling apparatus may be provided with a relatively large peroxide supply tank. My apparatus may be used in drilling operations in which cable tool type of drilling may be used.

When hydrogen peroxide is decomposed into water vapor and oxygen, a tremendous amount of energy is released. Hydrogen peroxide may be decomposed in the presence of certain catalysts by admitting small amounts of hydrogen peroxide

into a chamber in which is disposed a hydrogen peroxide decomposition catalyst. I am able to control the release of energy and adapt this energy to useful purposes. Such a catalyst as finely-divided silver and finely-divided platinum may be used. The release of energy can then be controlled by regulating the rate of flow of hydrogen peroxide to the catalyst.

Referring now to the apparatus and specifically to Figure 1, the apparatus consists of a self-contained source of power, a motor, and a drilling mechanism referred to in the figure by reference numeral 11. A drill-raising and lowering mechanism 10 includes a cable 10a which extends from the top of the apparatus to the surface of the ground. An upper housing 12 is the side wall for chambers 20 and 21 while the lower housing 13 is the wall for the power cylinder 58. The chamber 20 is a vessel in which is stored the supply of hydrogen peroxide fuel for the operation of the drill. Chamber 21 is a vessel in which any other fluid such as a hydrocarbon oil may be stored, in case a combustible fuel is used in conjunction with the hydrogen peroxide. A plate 13 is held firmly in place by some cap screws 71 and this plate serves as a partition separating chambers 20 from 21. Threads 72 provide one means for construction and assembly of the top portion of my apparatus. The cylinder 58 is a decomposition chamber or cylinder in which the hydrogen peroxide decomposes to water vapor and oxygen. A piston 16 is provided in this chamber 58 for transforming the energy of the decomposing hydrogen peroxide into mechanical energy. To the bottom of this piston is attached a shaft or rod 15 and to the bottom end of which is attached a drill bit 14. On the top of the piston is provided a quantity of catalyst 54. This catalyst may be disposed directly on the surface of the piston, if desired, or it may be disposed on the surface of a supporting material 55. This corrugated support metal is provided so that the upper surface of the piston will not become overheated and also so that expansion or contraction due to temperature changes will not destroy this portion of the mechanism. When a charge of peroxide is decomposed, the force of the gases pushes the piston 16 downward and forces the drill bit 14 against the earth formation to be drilled. When the top surface of the piston 57 reaches the exhaust ports 61, the water vapor and oxygen pass from within the chamber and a spring 17 then operates to raise the piston on its compression stroke. The apparatus is then in position for another charge of peroxide to be admitted to the chamber. When the upper surface 57 of the piston 16 approaches the top of its stroke, a pin or push rod 41 is contacted, and this rod extends vertically to a small cylinder 40a. To the upper end of this rod and in the cylinder is attached a small piston 40. The small chamber in which is disposed the piston 40 is the peroxide feed chamber and through previous operation this chamber is full of hydrogen peroxide. When the piston 40 rises, some hydrogen peroxide is forced from this chamber and flows through a line 37, a line 47, and through a check valve-orifice member assembly 51. This orifice member assembly 51 is illustrated in detail in Figure 5 of the drawing. This member contains a small, more or less capillary, conduit 52 and some small holes 53. The holes 53 are for the accommodation of a wrench for screwing the member 51 into position at the bottom end of the conduit 47. A check valve 35, 36 prevents

back flow of fluid. The check valve 35, 36 is hinged to the bottom of a plug 50 in such a manner that fluid can flow from line 38, 47 through capillary 52, but not in the reverse direction. In the top of the plug 50 are holes 49 for assembly of this plug. When the peroxide is forced by the piston 40 through the orifice member 51, the peroxide is squirted onto the surface of the catalyst 54 on the head of the piston. When the peroxide contacts the catalyst, decomposition into steam and gaseous oxygen is immediate and the pressure exerted by this decomposition is, of course, dependent upon the concentration of the peroxide solution and upon the amount of hydrogen peroxide liquid injected into the chamber 58. Since pressure is developed in the chamber 58, the piston 16 starts on its downward stroke with the result that the drill bit 14 is forced downward against the earth formation at the bottom of the drill hole. At the bottom of the stroke of the piston, the gases of decomposition are vented through the ports 61 and when this pressure is vented, the spring 17 operates in conjunction with the weight of the apparatus body to raise the piston again to contact the lower end of the push rod 41 and to introduce a new charge of peroxide into the decomposition chamber. The check valve 35 is intended to permit flow of peroxide from the tank 20 through conduits 37, 47, and through the orifice 51. This check valve is further intended not to permit the flow of fluid backward through these conduits even at the pressure obtained within the chamber 58. At the bottom of the peroxide tank 20 is disposed a check valve assembly 31 which is illustrated on an enlarged scale in Figure 6. In this figure the check valve assembly is shown as a longitudinal section on an enlarged scale. In this assembly a check valve 35a is intended to permit flow of peroxide from the chamber 20 into the chamber 40a, containing piston 40 but is further intended not to permit the flow of peroxide from the chamber 40a into the reservoir 20. The top surface 57 of the piston pushes the push rod 41 and piston 40 upward to inject a charge of peroxide into the cylinder 58. A compression spring 39 is intended to push the piston 40 and its push rod 41 downward and during this downward movement, liquid peroxide is drawn from the chamber 20 into the cylinder 40a containing piston 40. A screen 33 is provided for preventing the passage of any solid material from chamber 20 into the check valve assembly 31. In the embodiment illustrated in Figure 1, element 37 is a tube passing through chamber 21, and this tube is attached by coupling assembly 46 to the conduit 47. This conduit 47 passes through a solid metal member 59.

This metal member 59 is relatively long in order to give weight to my drilling apparatus. Since the decomposition of hydrogen peroxide is accomplished by the evolution of large quantities of heat, the metal member 59 is provided with fins 22 for heat exchange purposes with the liquid contents of the well. The fins may be seen upon inspection of Figures 1, 3, and 4.

While my drilling apparatus is on the surface of the ground and being made ready for use, the plug 23 is removed from the top of the upper housing 12 and the space 20 is filled with liquid hydrogen peroxide. The plug 23 is inserted in its normal position and tightened so that the hydrogen peroxide will be retained in the vessel 20 to the exclusion of other fluids. The drill bit 14 is pulled downward by hand to compress the spring 17 to

such an extent that the hole 19 in the shaft 15 is downward and outside of the bushing assembly 64. A small shear pin is inserted through the opening 19 in such a manner that upon release of the drill bit 14, the pin holds the piston at a point near the bottom of its stroke so that the top surface 57 of the piston will not touch the push rod 41. In this manner, hydrogen peroxide is not admitted to the chamber 58. The assembly is then ready for lowering into the drill hole. When the drill bit 14 touches the bottom of the hole, the weight of the apparatus shears the pin in hole 19 and permits the upward movement of the piston 16. This upward movement of the piston 16 is caused by the operation of the compression spring 17 with the weight of the apparatus and its liquid contents. This combined effect causes the surface 57 of the piston to push against the end of the push rod 41 which injects a charge of peroxide onto the surface of the catalyst 54. The apparatus is then in operation. The decomposing peroxide pushes the piston with its attached parts downward in such a manner that the drill bit 14 strikes the formation in the bottom of the hole and as soon as the piston passes the exhaust ports 61, pressure from the cylinder is released and the piston passes upwardly to inject a new charge of peroxide. This operation is repeated very rapidly and the net result is a very vigorous pounding of the drill bit 14 against the rock formation.

In the embodiment of my invention as explained above, the drilling operation is powered only by the use of hydrogen peroxide and the chamber 21 and the injection apparatus extending from the floor of this chamber to the peroxide decomposition chamber may be omitted. However, when it is desired to supplement the effect of the decomposing peroxide by the use of a combustible hydrocarbon, these apparatus parts just mentioned are used. Chamber 21 is a storage chamber for such a hydrocarbon oil as a kerosene distillate or gas-oil type of fuel. This oil is charged into the vessel 21 through opening 25. After the charge of oil is added, plug 24 is inserted in its proper position to exclude all foreign materials. A check valve plug assembly 32 is positioned in the floor of this chamber 21 in a manner similar to the positioning of the check valve plug assembly 31 in the floor of the chamber 20. For the injection of hydrocarbon fuel, the downward movement of a piston 43 in cylinder 43a occasioned by a compression spring 42 draws hydrocarbon through the check valve plug assembly 32 into the cylinder 43a. When the surface 57 of the piston 16 pushes against the bottom of the push rod 44, the piston 43 rises to force a quantity of the oil through a check valve 36, conduit 38, through orifice 51A into the chamber 58. The orifice member inserted into the outlet end of the conduit 38 is exactly like the orifice in the outlet end of the conduit 47, both orifices may be represented by Figure 5. The check valve 36 is intended to prevent the back flow of fluid through the conduit 38, while check valve in the assembly 32 is intended to prevent the flow of oil from the cylinder 43a into the storage chamber 21. To prevent passage of foreign material from the chamber 21 into the check valve plug assembly 32, a screen 34 is provided, as illustrated. The check valves 35, 36 and 35A are hinged as shown.

Conduits 45 are provided, as shown, for the push rods 41 and 44. These conduits 45 are made sufficiently large that the push rods may be moved easily and without banging or sticking, and yet

not to permit leakage of any undesired material therethrough.

Since my drilling apparatus is usually submerged in water or other liquid in the bottom of the well, this liquid will be drawn in or expelled out through the exhaust ports 61 at such times when the piston 16 is above these ports. Radial members 62 in the bottom of the housing 13 are provided so that open spaces 63 between them will permit additional free flow of fluids into and out of the space beneath the piston.

The piston rod 15 may be attached to the underside of the piston in any manner desired, for example, by a weld 18.

In the operation of this apparatus when using hydrocarbon fuel in conjunction with the peroxide, the piston at the top of its stroke pushes push rods 41 and 44 to inject a charge of hydrocarbon oil and a charge of peroxide simultaneously into the chamber 58. When the peroxide is sprayed against the catalyst, oxygen and water vapor are evolved at a relatively high temperature and under these conditions, the oxygen immediately combines with the hydrocarbon which burns with explosive force. Under these conditions, the piston is forced downward and the drill bit 14 performs its desired function. At the bottom end of the stroke, the piston passes the exhaust ports 61 and combustion gases are vented. Then as the piston again rises and touches the push rods 41 and 44, new charges of oil and peroxide are admitted.

When the apparatus is charged with a fresh charge of peroxide and a charge of oil before lowering into the well, the shear pin is inserted through hole 19 in the shaft 15 in a manner hereinbefore described. When the apparatus is lowered into the well and the bit 14 hits against the bottom of the well, the shear pin is sheared off and the apparatus is automatically in operation.

I prefer to employ relatively concentrated forms of hydrogen peroxide. At present it is possible to purchase 98 per cent hydrogen peroxide, the other 2 per cent consisting of water and various well-known materials which inhibit the decomposition of the peroxide. I find, however, that valuable results can be obtained as long as the solution employed contains at least 70 per cent by weight of hydrogen peroxide. Seventy per cent hydrogen peroxide can release about 4,000 times its volume of hot steam and gaseous oxygen when suitably contacted with a catalyst, and the 98 per cent peroxide will evolve even larger volumes of gas. The injection of the peroxide into the decomposition chamber 58 is closely controlled by the injection apparatus described above.

The above-described drilling apparatus is given for illustrative purposes and should not be regarded as limiting the invention, the scope of which is set forth in the following claims.

Having described my invention, I claim:

1. An earth boring drill for drilling deep wells comprising, in combination, a body member having a fluid-tight reservoir attached at its upper end, a quantity of hydrogen peroxide power liquid in said reservoir, a cylinder attached to the lower end of said body member, a conduit leading from said reservoir to said cylinder, an exhaust port in the wall of said cylinder, said body member, reservoir and cylinder being disposed along a common axis and being adapted to be lowered into a well, a reciprocating pump in said conduit for pumping liquid from said reservoir to said cylinder, a reciprocating piston disposed operatively in said cylinder, a catalyst

mounted on the head of said piston, said catalyst being adapted to promote decomposition of hydrogen peroxide, an earth boring means secured to and actuated by said piston mounted to move relative to said cylinder, said boring means being disposed to extend into boring relation with the earth formation, a pushpin for actuating said reciprocating pump, said pushpin being actuated by said reciprocating piston and a compression spring biasing said reciprocating piston to the top of said cylinder for actuating said pushpin.

2. An earth boring drill for drilling deep wells comprising, in combination, a body member having a fluid-tight reservoir attached at its upper end, a quantity of hydrogen peroxide power liquid in said reservoir, a cylinder attached to the lower end of said body member, a conduit leading from said reservoir to said cylinder, an exhaust vent in the wall of said cylinder, said body member, reservoir and cylinder being disposed along a common axis and being adapted to be lowered into a well, a reciprocating pump in said conduit for pumping liquid from said reservoir to said cylinder, a reciprocating spring biased piston disposed operatively in said cylinder, a catalyst mounted on the head of said spring biased piston, said catalyst being adapted to promote decomposition of hydrogen peroxide, an earth boring means secured to and actuated by said spring biased piston mounted to move relative to said cylinder, said boring means being disposed to extend into boring relation with the earth formation, a pushpin for actuating said reciprocating pump, said pushpin being actuated by said spring biased piston and said spring of said spring biased piston biasing said piston at the upper end of its stroke to actuate said pushpins.

3. An earth boring drill for drilling deep wells comprising, in combination, a body member having a fluid-tight reservoir attached at its upper end, a quantity of hydrogen peroxide power liquid in said reservoir, a cylinder attached to the lower end of said body member, a conduit leading from said reservoir to said cylinder, an exhaust vent in the wall of said cylinder, said body member, reservoir and cylinder being disposed along a common axis and being adapted to be lowered into a well, a reciprocating pump in said conduit for pumping liquid from said reservoir to said cylinder, said reciprocating pump comprising a spring loaded first piston attached to one end of a pushpin and the other end of said pushpin extending through said body member into said cylinder, a reciprocating spring biased piston disposed operatively in said cylinder, a catalyst mounted on the head of said spring biased piston, said catalyst being adapted to promote decomposition of hydrogen peroxide, an earth boring means secured to and actuated by said spring biased piston mounted to move relative to said cylinder, said boring means being disposed to extend into boring relation with the earth formation, said spring biased piston being so disposed with respect to said other end of said pushpin that said second piston contacts said pushpin at a point near the upper end of the piston stroke to actuate said reciprocating pump means, and said spring of said spring biased piston biasing said piston at the upper end of its stroke to actuate said pump.

4. An earth boring drill for drilling deep wells comprising, in combination, a body member having a pair of fluid-tight reservoirs attached at its upper end and a cylinder attached at its lower end, a quantity of hydrogen peroxide in one of

said reservoirs, a quantity of hydrocarbon fuel in the other of said reservoirs, a first conduit leading from one of said reservoirs to said cylinder, a second conduit leading from the other of said reservoirs to said cylinder, an exhaust vent in the wall of said cylinder, said reservoirs, body member and cylinder, being disposed along a common axis and being adapted to be lowered into a well, a first reciprocating pump in said first conduit for pumping liquid from one of said reservoirs to said cylinder, a second reciprocating pump in said second conduit for pumping liquid from said other reservoir to said cylinder, a reciprocating piston disposed operatively in said cylinder, a catalyst mounted on the head of said piston, said catalyst being adapted to promote decomposition of hydrogen peroxide, an earth boring means secured to and actuated by said piston mounted to move relative to said cylinder, said boring means being disposed to extend into boring relation with the earth formation, a first pushpin for actuating said first pump, a second pushpin for actuating said second pump, said pushpins being actuated by said reciprocating piston, and a compression spring biasing said reciprocating piston to the top of said cylinder for actuating said pushpins.

5. An earth boring drill for drilling deep wells comprising, in combination, a body member having a pair of fluid-tight reservoirs attached at its upper end and a cylinder attached at its lower end, a quantity of hydrogen peroxide in one of said reservoirs, a quantity of hydrocarbon fuel in the other of said reservoirs, a first conduit leading from one of said reservoirs to said cylinder, a second conduit leading from the other of said reservoirs to said cylinder, an exhaust vent in the wall of said cylinder, said reservoirs, body member and cylinder being disposed along a common axis and being adapted to be lowered into a well, a first reciprocating pump in said first conduit for pumping liquid from said one reservoir to said cylinder, a second reciprocating pump in said second conduit for pumping liquid from said other reservoir to said cylinder, a reciprocating spring biased piston disposed operatively in said cylinder, a catalyst mounted on the head of said spring biased piston, said catalyst being adapted to promote decomposition of hydrogen peroxide, an earth boring means secured to and actuated by said spring biased piston mounted to move relative to said cylinder, said boring means being disposed to extend into boring relation with the earth formation, a first pushpin for actuating said first pump, a second pushpin for actuating said second pump, said pushpins being actuated by said reciprocating piston, said spring of said spring biased piston biasing said piston at the upper end of its stroke to actuate said pushpins.

6. An earth boring drill for drilling deep wells comprising, in combination, a body member having a pair of fluid-tight reservoirs attached at its upper end and a cylinder attached at its lower end, a quantity of hydrogen peroxide in one of said reservoirs, a quantity of hydrocarbon fuel in the other of said reservoirs, a first conduit connecting one of said reservoirs with said cylinder, a second conduit connecting the other reservoir with said cylinder, an exhaust vent in the wall of said cylinder, said reservoirs, body member and cylinder being disposed along a common axis and being adapted to be lowered into a well, a first reciprocating pump in said first conduit for pumping liquid from said one reservoir to said

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cylinder, a second reciprocating pump in said second conduit for pumping liquid from said other reservoir to said cylinder, each of said reciprocating pumps comprising a spring loaded piston attached at one end of separate pushpins and the other end of said pushpins extending through said body member into said cylinder, a reciprocating spring biased piston disposed operatively in said cylinder, a catalyst mounted on the head of said spring biased piston, said catalyst being adapted to promote decomposition of hydrogen peroxide, an earth boring means secured to and actuated by said spring biased piston mounted to move relative to said cylinder, said boring means being disposed to extend into boring relation with the earth formation, said spring of said spring biased piston biasing said piston at the upper end of its stroke and said spring biased piston being so disposed with respect to said other end of said pushpins that said spring biased piston contacts said pushpins at a point near the upper end of its stroke to actuate said first and second reciprocating pumps.

7. An advancing motor earth boring drill comprising in combination a housing, means for lowering and supporting said housing adjacent the bottom of an earth bore, a tank secured to said housing for containing catalytically decomposable fuel, an expansible chamber internal combustion motor comprising a cylinder and a piston member reciprocable in said cylinder, one of said cylinder and piston members being secured to said housing and the other member having a

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drill bit secured thereto, a catalyst member positioned on one of said cylinder and piston members in said expansible chamber of said motor adapted to decompose said fuel, means adapted and disposed to bias said piston relative to said cylinders to reduce the volume of said expansible chamber and to be overcome by gas pressure therein due to said decomposition of said fuel, and means to inject fuel from said tank into said chamber into contact with said catalyst when said piston reduces the volume of said chamber to a predetermined value.

8. The combination of claim 7 in which the fuel is hydrogen peroxide.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
431,131	Webber	July 1, 1890
1,430,473	Stoll	Sept. 26, 1922
2,035,350	Stoll	Mar. 24, 1936

FOREIGN PATENTS

Number	Country	Date
12,076	Germany	Apr. 29, 1881
354,393	Germany	June 29, 1922
76,268	Austria	Apr. 25, 1919

OTHER REFERENCES

Industrial Bulletin of Arthur D. Little, Inc., No. 220, Apr. 1946.