

[54] **LASER BEAM DRILL**
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 [58] Field of Search **175/11, 15, 16, 257; 299/14**

3,500,942 3/1970 Smith..... 175/16
 3,539,221 11/1970 Gladstone..... 175/16 X
 3,693,718 9/1972 Stout..... 175/16

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[57] **ABSTRACT**

A method of drilling for subterranean fluid with a laser beam comprising positioning a laser beam generator in a wellhole electrically connected to an inhole voltage generator actuated by drilling mud or other liquid passing through a laser beam housing connected to the drill string. A reflecting crystal for the laser beam is positioned within the laser beam housing to reflect the beam preferably in elliptical pattern across the formation to be penetrated.

5 Claims, 2 Drawing Figures

[56] **References Cited**
UNITED STATES PATENTS
 3,036,645 5/1962 Rowley 175/16 X
 3,461,964 8/1969 Venghiattis 175/16 X
 3,493,060 2/1970 Van Dyk 175/16

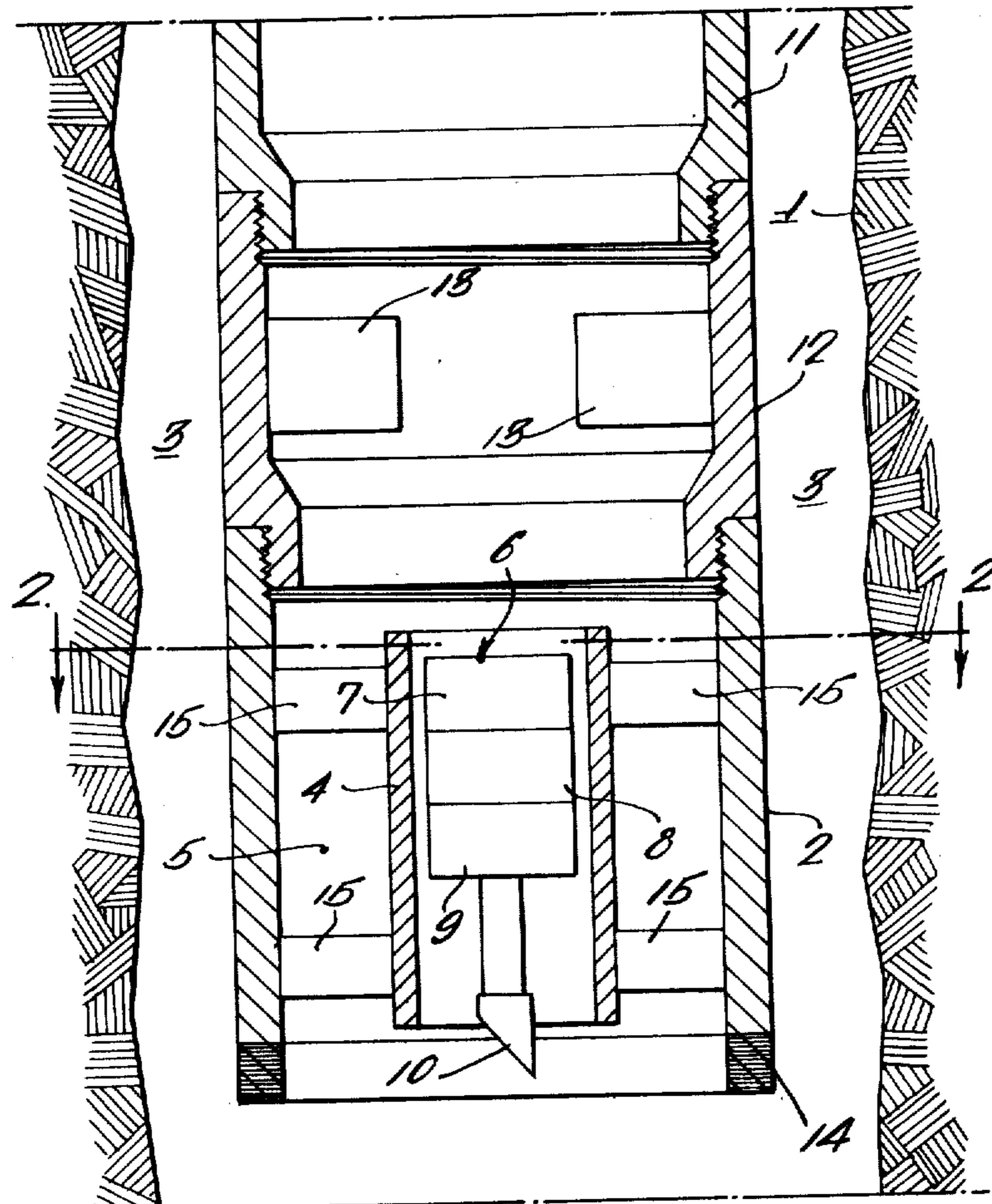


FIG. 1.

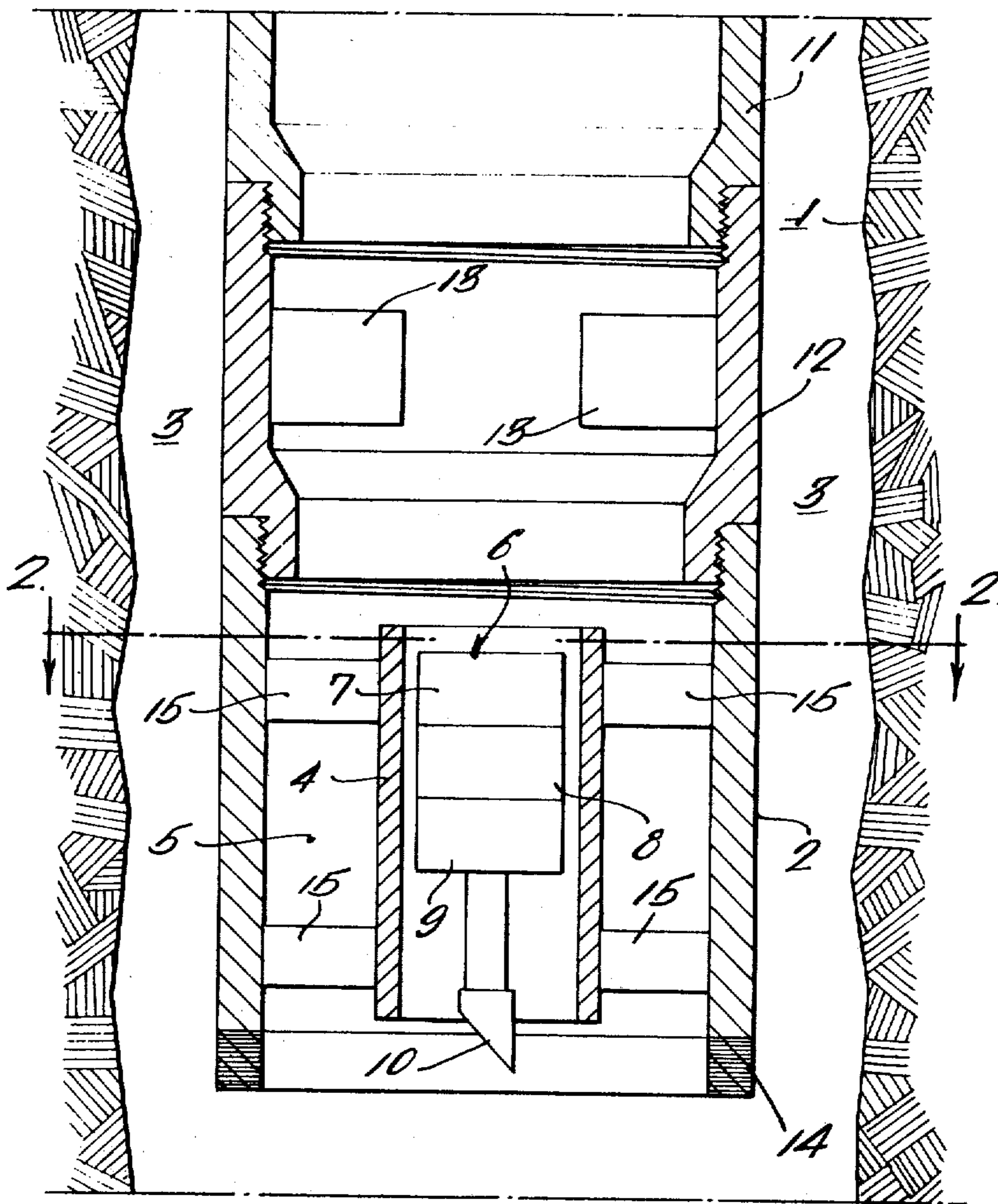
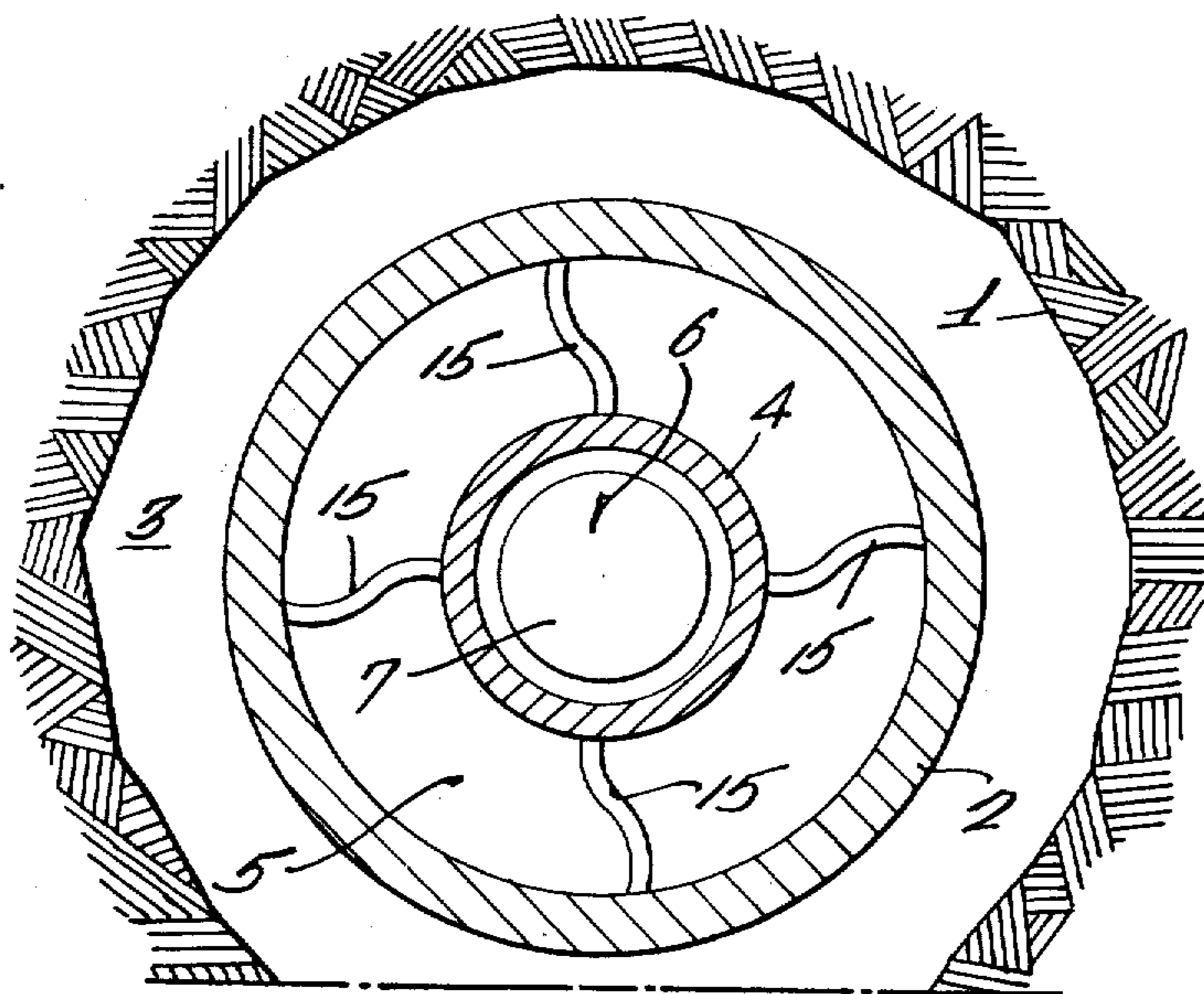


FIG. 2.



LASER BEAM DRILL

BACKGROUND OF THE INVENTION

1. Field of the Invention.

This invention relates to a method for recovering subterranean fluids from underground formations through a borehole. More particularly this invention relates to the use of laser technology for boring into subterranean formations, and more particularly this invention relates to replacing the drilling heads normally used in drilling for underground fluids with a laser beam arrangement comprising a voltage generator actuated by the flow of drilling fluids through a drill pipe or collar in a wellhole and a laser beam generator which draws its power from a voltage generator, both positioned in an inhole laser beam housing and electrically connected.

2. The Prior Art.

Removal of petroleum fluids from subterranean formations is usually accomplished through rotary drilling techniques. In the actual drilling or boring of holes with this technique, there are required a cutting tool or bit, a rotary motion of the tool, and means for maintaining pressure on the bit while the material is being cut, usually accomplished with a string of drill collars, also a medium for removing the material displaced by the bit or cuttings. This material, sometimes referred to as drilling mud or circulating fluid, must be circulated in volume and velocity through the holes of the bit so that it not only cleans the bit but it cleans the bottom of the hole flushing it of cuttings and hard formations. The circulating fluid must have a downward velocity sufficient to clean the formation and an upward velocity sufficient to remove the cuttings from the hole. Also the fluid must be readily pumpable.

Use of lasers to penetrate underground formations has been discussed in U.S. Pat. No. 3,693,718 issued to Daniel W. Stoudt, Sept. 26, 1972. This patent along with prior apparatus and methods utilizing laser beam energy is limited in that the laser beam generator are mounted by a frame assembly above the ground surface in alignment with the borehole communicating with a subterranean cavity from which recovery of oil and gas reserves is desired. Another disadvantage of these types of systems is that they cannot be used easily with the present multiple or single head systems now being used to recover subterranean fluids, especially in offshore applications. These types of systems often use radially extending boreholes from one main or mother borehole and a surface laser beam generator cannot follow the pattern with these bores without undue use of energy.

Overcoming this drawback in the prior art is one of the main objectives of the present invention.

SUMMARY OF THE INVENTION

An improved laser beam method has now been found where in a self-contained unit, containing therein a voltage generator actuated by the flow of drilling fluids, a laser beam generator electrically connected to said voltage generator, and a beam reflecting crystal, for reflection of the laser beam generated by said laser beam generator across the face of the formation within the borehole which is being drilled, is positioned in a laser beam housing which in turn is positioned where would otherwise be positioned a conventional rotary bit on the end of a drill string to replace this conventional rotary drilling bit, which is now used in most subterra-

nean drilling techniques. Also the flow of drilling mud already present therein is utilized to pass over the self-contained unit and drive the generator therein so that in-situ powered generation and laser beam generation are accomplished.

The advantages of this system are that the laser beam drilling techniques can be used in wellholes which veer from a straight line pattern.

Other advantages to be gained from such a system are that the equipment costs can be greatly decreased since the size of the laser beam generator need not be as powerful when its positioned in the borehole as it need be when its positioned on the surface. This also results in less energy cost.

Further, this laser beam system can be attached to a drill collar or drill string by making the connection on the upper most section of the laser beam housing to match the connection on the end of the existing drill string. It is also envisioned that the drill collar can be replaced with a drill pipe during the drilling operation since maintaining a pressure on a bit is no longer necessary.

These and other advantages will be more readily determinable upon review of the description of the drawing and of the preferred embodiment which follows.

DESCRIPTION OF THE DRAWINGS AND THE PREFERRED EMBODIMENT

FIG. 1 is a vertical cross section of an existing wellhole wherein the self-contained unit of this invention is connected to an existing drill pipe.

FIG. 2 is a downward facing across sectional drawing of lines 2—2 of FIG. 1.

Shown in FIG. 1 is existing wellhole, 1, penetrated by a drill pipe connected at its lower most end to a laser beam housing assembly, 2. Also shown in a vane sub 12 which can be connected between the drill pipe, 11, and laser beam housing, 2, which contains radially spaced vanes, 13, around the inner circumference which directs the flow of mud around the laser beam housing. An annular space, 3, is defined between the wall of said wellhole and the wall of the said laser beam housing. Within said laser beam housing, 2, is contained a laser beam drill positioner, 4, with an annulus, 5, being finned, 15, between the inner circumference of the laser beam housing, 2, and the outer circumference of the laser beam drill positioner, 4, all within said wellhole, 1. Where, in the prior art is positioned a rotary bit, is now positioned in a self-contained laser beam assembly, 6, containing a voltage generator, 7, a laser beam generator 8, both of the conventional configured and commercially available, a gear box, 9, rotatably connected to said generator and a beam deflecting crystal, 10, rotatably connected to said gear box. The gear box is arranged in such a way so as to provide an elliptical motion of the beam reflected by said reflecting crystal over and cross the face of the formation to be drilled. Further, the gearbox is arranged to allow a path for the laser beam from general 8 to deflecting crystal 10. The drilling mud traveling downward through the drill pipe is directed in a rotational flow pattern via the vanes in the previously described vane sub section and this rotary motion of the mud drives the turbine blades of the voltage generator. In actual operation drilling mud flows down the annulus between the laser beam housing, 2, and the laser beam drill positioner, 4, passing over the generator thereby turning

said generator and producing power. This drilling mud then flows to the bottom of the wellhole wherein it picks up cuttings which would previously have been made from a rotary drill, which are now the result of laser drilling, and carries these cuttings along its path in the annulus between the drill collar or drill pipe and the wall of the well-hole, with sufficient upward velocity to carry the mud and the cuttings of said drilling to the surface wherein conventional separation means are used to remove the cuttings from said mud and return the mud down in the drill collar or drill pipe as previously discussed. The lower most circumference of the laser beam housing, 2, is hardened at location 14 so as to more readily withstand the erosion which is caused by the mud and entrained cuttings which flow around it. Another liquid (water) can be substituted for drilling mud when the laser is used to replace a rotary bit. The laser assembly section is positioned where a conventional bit would have previously been positioned and the power for said laser assembly is derived from the energy contained in the flow of drilling mud past the voltage generator. The entire system is self-contained and removable which allows removal without pulling the entire drill string out of the wellhole. This results in saving of time and money. The self-contained unit can snap into the laser beam housing by conventional methods. One conventional method is the positioning of spherical bearings around the outer circumference of the self-contained unit and semi-spherical indentations around the inner circumference of the laser beam drill positioner corresponding in radial position to said bearings so that once the bearing meet the indentations a snapping and locking in of the self-contained unit is achieved. For the sake of simplicity and due to the conventionality of such a system, it is not pictured in the drawing. It is also envisioned that the gear box which rotates beam deflecting crystal can be driven by the mud passing in the annulus between the laser beam positioner and the laser beam housing rather than being driven by the power or rotation derived from the voltage generator.

It will be understood that various changes may be

made in the form and arrangement of the elements used in the method illustrated herein without departing from the spirit of the present invention or from the scope of the annexed claims. For example, the path of the beam across the formation can be other than elliptical and the advantages of the system can still be achieved or modifications in the flow of liquid to drive the generator can be made without the parting of the scope of the combination claimed herein.

The invention claimed is:

1. A method for recovering liquid reserves from a subterranean formation through a borehole containing a drill string comprising
 - a. attaching a laser beam housing to the lower most section of the drill string,
 - b. positioning in said laser beam housing a self-contained and removable laser beam drill positioner,
 - c. positioning within said laser beam drill positioner a voltage generator and a laser beam generator electrically connected to and deriving its power from said voltage generator,
 - d. activating said voltage generator by drilling fluid passing through the drill pipe and
 - e. positioning a rotating beam reflecting crystal within the laser beam drill positioner whereby a beam projected from the laser beam generator is reflected across the face of the formation being drilled.
2. The method of claim 1 wherein the drilling mud is directed in a rotational flow pattern by vanes positioned upstream of the laser beam housing.
3. The method of claim 2 wherein the reflecting crystal rotation is actuated by the flow of drilling fluid.
4. The method of claim 2 wherein the reflecting crystal rotation is actuated by the power derived from the voltage generator.
5. The method of claim 2 wherein the rotation of the reflecting crystal provides an elliptical path for the laser beam across the face of the formation being drilled.

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