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(54) Abstract Title

**Bore hole clearing apparatus**

(57) Apparatus for removing debris from a bore hole, comprises a housing 36, and a cylindrical electric motor 21, coupled coaxially to a direct drive pump 22. The housing includes a debris entry port, into which the debris is induced to flow, as the inside of the housing is maintained at a pressure lower than the outside pressure. The electric motor may have a central bore 32, through which material pumped by the pump can pass. The apparatus may include a head 39, rotatable by the motor for engagement with the debris deposits in the bore hole. Where the pump is a direct drive worm pump, the head may be directly attached to the worm of the pump. In one embodiment, the housing extends along the whole length of the motor and pump, with the apparatus including a port (Fig 2, 49) settable to allow debris to be pumped into the housing from either end. Debris collection means may be included for isolating any debris pumped by the pump from the bore hole, and could be a pipe (Fig 2, 24') extending from the bore hole head to the motor and pump, or a compartment 23 attached to the motor and having a filter 40, through which fluid may pass, but which traps debris.

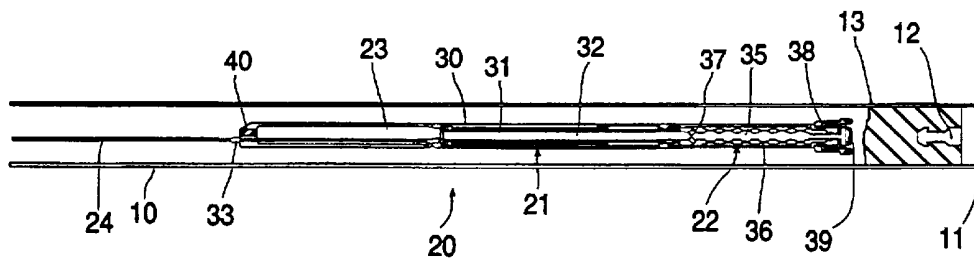


Fig. 1

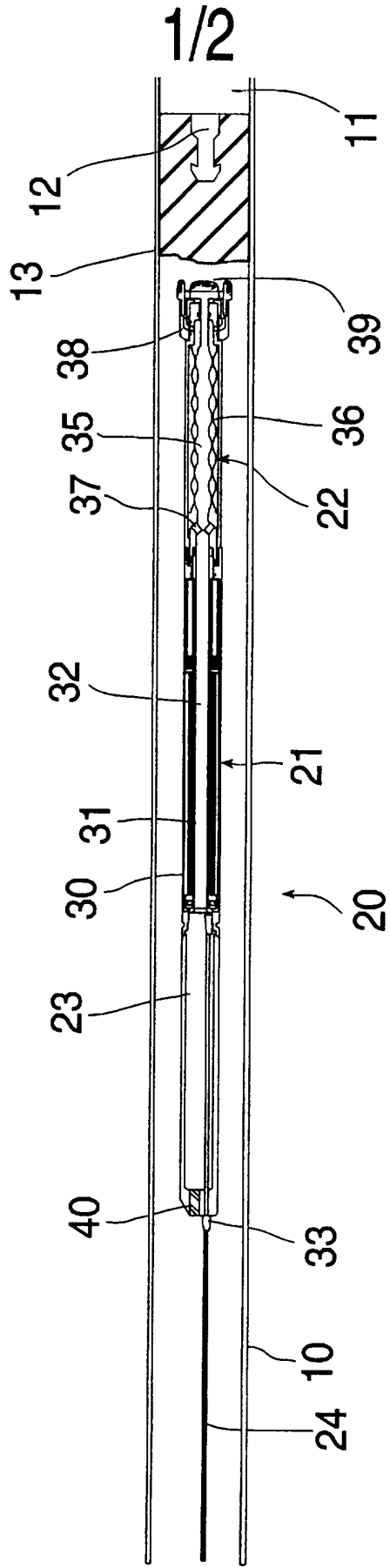
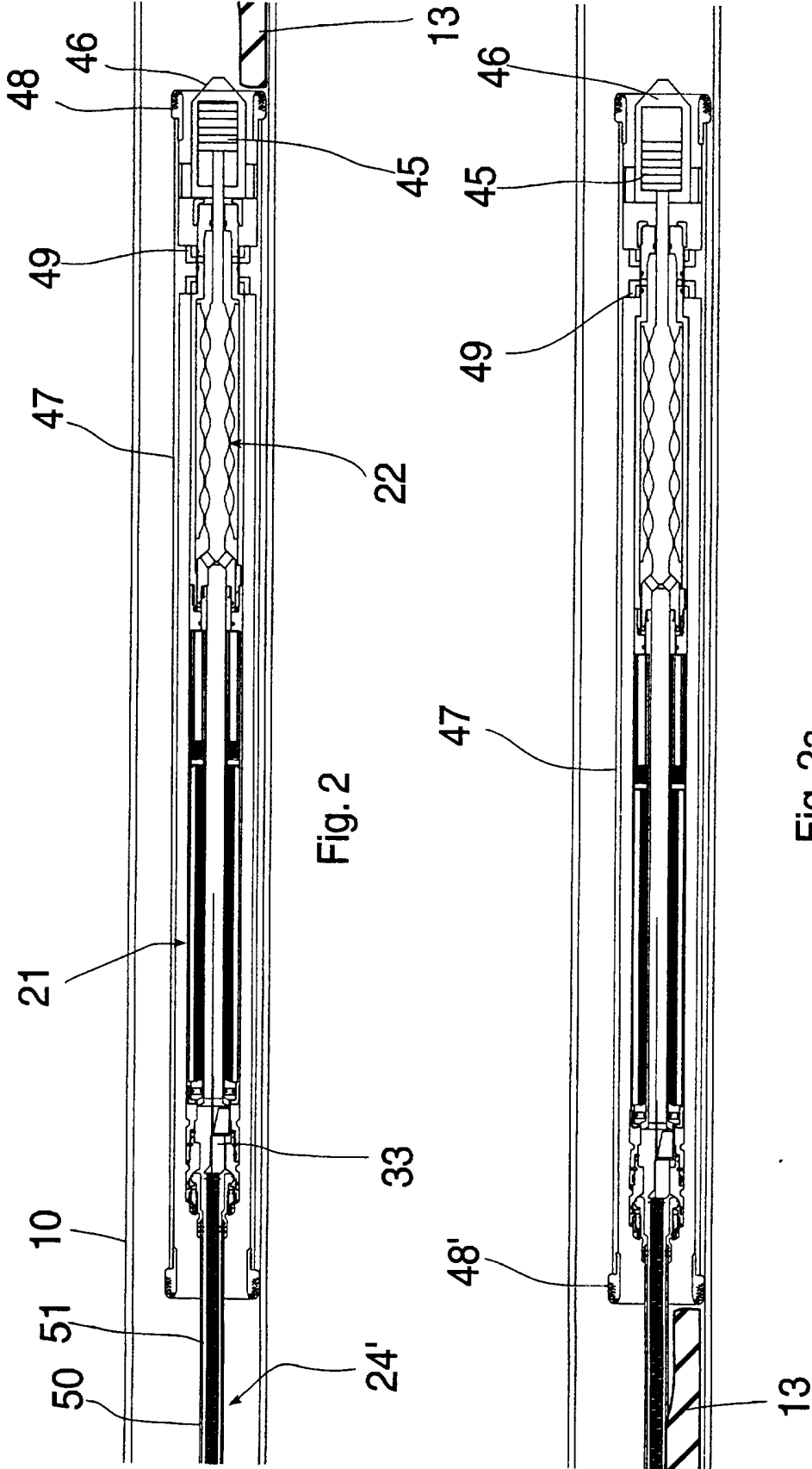


Fig. 1



Bore Hole Clearing

5 The present invention relates to the clearing of tubes and bores, and particularly oil well and like bore holes.

In the drilling and operation of oil wells, a considerable amount of apparatus is often placed down the bore holes. (Although the term "down" is used,  
10 some bore holes may have considerable lengths which are far from vertical, and may be substantially horizontal.) There can be considerable flows of material through the bore hole, such as mud used for driving drill heads, and wires or pipes may be passed through the bore hole. Further, the bore hole may pass through friable strata which may be eroded. All these matters can  
15 result in the accumulation of detritus, which will here be termed "mud", in the bore hole; its consistency may of course vary widely. The mud may be deposited along the length of the bore hole, or on top of a piece of apparatus in the bore hole.

20 It is often desirable or necessary to clear a bore hole of such mud. Present techniques for such clearing are relatively primitive. Some form of scraper or similar mechanical device may be lowered into the bore hole in an attempt to loosen compacted mud, and some form of bucket or similar mechanical device may similarly be lowered into the bore hole in an attempt  
25 to capture particles or pieces of mud and pull them up to the surface.

The general object of the present invention is to provide an improved technique for clearing bore holes of mud.

According to one aspect, the invention comprises using an electric motor coupled to a pump to remove mud from a bore hole.

- 5 According to another aspect, the invention provides apparatus for clearing a bore hole or the like of debris, comprising a housing, and a cylindrical electric motor coupled coaxially to a direct drive pump, the housing including a debris entry port into which the debris is induced to flow into the housing and wherein the inside of the housing is maintained at a  
10 pressure which is lower than the outside pressure.

Preferably the apparatus includes debris collection means for effectively isolating any debris pumped by the pump from the bore hole.

- 15 The electric motor preferably has a central passage through which material pumped by the pump can pass.

The apparatus preferably has a head rotatable by the motor for engagement with debris deposits in the bore hole. The head may be directly attached to  
20 the worm of the pump where the pump is a direct drive worm pump, or the head may comprise a tubular housing around the motor and/or pump. In the latter case, the housing may extend along the whole length of the motor and pump, with the apparatus including a port settable to allow debris to be pumped into the housing from either end.

25

The debris collection means may be a compartment attached to the motor and having a filter through which fluid may pass but which traps debris.

Alternatively, the debris collection means may be a pipe (of the type known as a coiled pipe) extending from the bore hole head to the motor and pump.

Two bore hole mud clearing apparatuses embodying the invention will now  
5 be described, by way of example, with reference to the drawings, in which:

Fig. 1 is a longitudinal section through the first apparatus;

Fig. 2 is a longitudinal section through the second apparatus; and  
10

Fig. 2A is a longitudinal section through the second apparatus in a second configuration.

Referring to Fig. 1, this shows a bore hole 10 in which a piece of apparatus  
15 11 has become detached. This piece of apparatus has a coupling element or fish 12, which is intended to allow the apparatus 11 to be grasped and so pulled out of the bore hole. This fish has become covered by mud 13, and it is necessary to remove this mud before the fish can be reached and grasped.

20

The bore hole 10 also contains a bore hole mud clearing apparatus 20, which comprises three main components; a motor 21, a pump 22, and a mud collection chamber 23. This apparatus is linked to the bore hole head by means of a wire 24, which supports the apparatus mechanically (so that it  
25 can be pulled out of the bore hole) and also carries an electric power cable to the apparatus.

The motor 21 is a cylindrical electric motor comprising an outer stator 30 and an inner rotor 31 which has a cylindrical passage 32 along its length. The motor is powered from the power carried through the wire 24 via a connector 33.

5

The pump 22 is a direct drive worm pump. A worm 35 is connected to the motor rotor 32, and a housing 36 is connected to the motor stator 31. Ports 37 provide a passage between the pump and the bore 32 through the motor. A head housing 38 is mounted on the end of the pump housing 36, and a  
10 head rotor 39 is mounted on the end of the pump worm 35.

The other end of the motor bore 32 communicates directly with the mud collection chamber 23, which has a filter 40 which retains mud but allows liquid to escape.

15

In use, the motor 21 drives the pump 22 to suck up the mud 13 (the whole of the bore being filled with a suitable liquid acting as a carrier). The head 39 rotates against the mud, helping to loosen pieces from the body of mud. The pieces of mud sucked up are passed through the bore 32 through the  
20 motor and are collected in the mud collection chamber 23.

Referring now to Fig. 2, a second bore hole mud clearing apparatus is shown. This apparatus is connected to the bore hole head by means of a coiled tube 24'(so termed because it is a tube and the part not in the hole is  
25 retained in the form of a large coil at the bore hole head). This coiled tube 24' is hollow, and carries the electric power cable to the apparatus.

As before, this apparatus comprises a motor 21 and a pump 22. The motor and pump are, in this apparatus, enclosed within a tubular housing 47, which has a nose 46 attached to its front end. The pump rotor has attached to it a coupling element 45 which is contained within the housing nose 46 as shown. This nose is filled with viscous oil, so that the tubular housing will rotate with the motor and pump, though at slower speed. The housing terminates in an annular head 48, which rotates against the mud, helping to loosen pieces from the body of mud. The pieces of mud are sucked away from the mass of mud 13 through the tubular housing 47, around the nose 46 and through ports 49 into the pump.

From the pump 22, the sucked up fluid with pieces of mud are passed through the passage 32 of the motor 21. at the other end of the motor, the passage is connected to the centre of the coiled tube 24', through which the sucked up fluid with the pieces of mud passes to the bore hole head.

In the Fig. 2 configuration, the apparatus is being pushed forward along the bore hole to clear mud from in front of it. Fig. 2A shows an alternative configuration of the apparatus, in which it has been passed down the bore hole and is being pulled back out. In this configuration, it clears mud lying between it and the well head.

The position of the motor and pump relative to the tubular housing 47 is determined by the relationship between the nose 46 at the front end of the housing and the coupling element 45 attached to the pump rotor. When the apparatus is being pushed into the bore hole, the relative position of these elements 45 and 46 is as shown in Fig. 2. When the apparatus is being pulled out of the bore hole, the coupling element 45 moves to the other end



of the interior of the nose 46, as shown in Fig. 2A. This results in the ports 49 being closed and ports 49' being opened.

5 The pump now sucks from the other end of the housing 47 (the left hand end as seen in the drawings). The housing 47 rotates in the same way in both configurations of the apparatus, and has a second annular head 48' at its left hand end. In the Fig. 2A configuration, this head 48' rotates against the mud in the bore above the apparatus, ie between the apparatus and the bore hole head. As a result, the apparatus acts to clear mud from the bore  
10 as it is being drawn out of the bore hole, as well as when it is being lowered into the bore hole (ie in the Fig. 2 configuration).

The rotating nose 46 may also be provided with a helical auger, so that the  
15 as the nose rotates, the auger moves the mud, assisting the action of the pump.

Referring back to the embodiment shown in figure 1, the apparatus may be hung upon a length of coiled tubing rather than the wire 24, that is, in a similar fashion to the embodiment shown in figure 2. The filter 40 may be  
20 dispensed with, and the outlet instead connected to the coiled tubing. Provided that the coiled tubing and the power cable are chosen so that there is sufficient bore available, the mud and debris may then be pumped to the surface through the coiled tubing.

## Claims

- 5    1     A method of removing debris from a bore hole by using an electric motor coupled to a pump.
- 2     Apparatus for clearing a bore hole or the like of debris, comprising a housing, and a cylindrical electric motor coupled coaxially to a direct drive  
10 pump, the housing including a debris entry port into which the debris is induced to flow into the housing and wherein the inside of the housing is maintained at a pressure which is lower than the outside pressure.
- 3     Apparatus according to claim 2 wherein the apparatus includes  
15 debris collection means for effectively isolating any debris pumped by the pump from the bore hole.
- 4     Apparatus according to either of claims 2 or 3 wherein the electric motor has a central bore through which material pumped by the pump can  
20 pass.
- 5     Apparatus according to any of claims 2 to 4 including a head rotatable by the motor for engagement with debris deposits in the bore hole.
- 25 6     Apparatus according to claim 5 wherein the pump is a direct drive worm pump, and the head is directly attached to the worm of the pump.

7 Apparatus according to either of claims 5 or 6 wherein the head comprises a tubular housing around the motor and/or pump.

8 Apparatus according to claim 7 wherein the housing extends along  
5 the whole length of the motor and pump, with the apparatus including a port settable to allow debris to be pumped into the housing from either end.

9 Apparatus according to any one of claims 2 to 8 wherein the debris  
10 collection means is a compartment attached to the motor and having a filter through which fluid may pass but which traps debris.

10 Apparatus according to any of claims 2 to 9 wherein the debris  
collection means is a pipe extending from the bore hole head to the motor  
and pump.

15

11 A method or apparatus of clearing a bore hole or the like of debris substantially as herein described and illustrated.



Application No: GB 9913998.2  
Claims searched: 1-11

Examiner: Richard Collins  
Date of search: 28 June 1999

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.Q): E1F FGL FLC

Int CI (Ed.6): E21B 21/00, 37/00.

Other: Online WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	US 5230388 A (Cherrington Corporation) column 5, line 37 to column 6, line 12, and claim 1.	1-3,5,10

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.