(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 248 615**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87304811.0**

(22) Date of filing: **01.06.87**

(51) Int. Cl.⁴: **E21B 25/00** , E21B 25/12 , E21B 10/00 , E21B 10/02 , E21B 17/00 , E21B 21/00

(30) Priority: **04.06.86 GB 8613582**

(43) Date of publication of application: **09.12.87 Bulletin 87/50**

(84) Designated Contracting States: **AT BE CH DE ES FR GB GR IT LI LU NL SE**

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(54) Improvements in drilling apparatus.

(57) Drilling apparatus is coated on selected surfaces with PTFE.

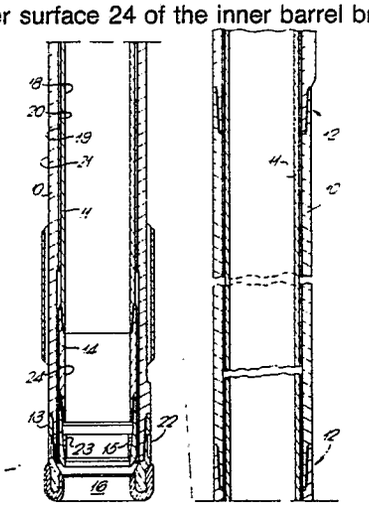
In the drawing is shown an example of the application of the invention to a core barrel assembly.

An outer core barrel 10 and an inner core barrel 11 are shown which are normally in sections.

At the lower end of the outer core barrel there is attached a core catcher sub 13. At the lower end of the inner barrel 11 is attached an inner barrel breaker sub 14 and below that a core catcher 15. A core bit 16 is attached to the lower end of the outer barrel.

Parts are shown coated with PTFE by thick lines, e.g. the inner surface 18 of the inner barrel 11, the outer surface 19 of the inner barrel and the inner surface 20 of the outer barrel 10.

The outer surface 21 of outer barrel 10 may also be coated for example, and the surface 22 of the drill bit, the inner surface 23 of the core catcher and the inner surface 24 of the inner barrel breaker sub.



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IMPROVEMENTS IN DRILLING APPARATUS

This invention relates to improvements in drilling apparatus.

An object of the invention is to provide improved and more reliable drilling apparatus which overcomes a number of problems which currently occur in the use of such apparatus. Drilling apparatus is used in a broad sense to cover equipment such as drilling and coring bits, stabilisers, core barrels including inner and outer barrels, bearings and bearing housings, core catchers, core catcher and core barrel substitutes (subs), core barrel extension pieces, junction pieces, drill collars, down hole motors, reamers and substitutes, drill pipe and oil well piping and tubing generally, including oil well production tubing.

In accordance with the present invention drilling apparatus is coated with a layer of a fluoropolymer such as polytetrafluoroethylene, commonly known as PTFE.

We now give some examples of the use and importance of the present invention. In core drilling a core of rock is cut by a bit rotating on an outer barrel and the core passes into a non-rotating inner barrel. When the core barrel is lifted from the drill hole the core is retained by a core catcher.

The core as it is cut enters the inner barrel through the core catcher. Depending upon the type of rock employed, difficulty may be experienced by the rock core jamming in the mouth of the inner core barrel or core catcher sub or in the core catcher due to the friction between the rock core and the steel inner tube or core catcher or due to the inner core barrel rotating when in contact with the core. When the rock core "jams", high pressure may develop in the circulating fluid and lack of penetration or regrinding (or re-cutting) of the rock core will occur. The core barrel must then be removed from the drill hole prematurely and the core removed from the barrel before coring can be recommenced.

Depending upon the type of rock employed, difficulty may be experienced in removing the rock core from the inner core barrel after the core barrel has been lifted from the drill hole as some rock formations swell when cut and the high friction set up between the rock core and the steel inner tube freezes the rock in the inner core barrel. The normal method of removing the core from the inner core barrel is by gravity or by pumping out the core hydraulically with the use of a piston.

One attempt to overcome this problem has been to replace the inner core barrel with a fibreglass tube. However, fibreglass tubes are weak and subject to shock and thermal damage in the drill hole.

By coating the inner barrel surface, particularly the inner surface of the inner barrel, with fluoropolymer the coefficient of friction between the rock core and the steel inner barrel is reduced thus allowing the core to freely enter the inner barrel and to be removed without "freezing".

Another problem arises in the annular area between the outside of the non-rotating inner barrel and the inside of the rotating outer barrel. This annular area acts as a passage through which all the drill hole circulating medium passes. A medium may for instance be oil-based mud or water based mud. There is a point when circulating high viscosity drill hole medium or high volumes causes the inner barrel to rotate which results in poor core recovery. The reason why the inner barrel rotates within the outer barrel is the hydraulic coupling effect which may occur between the inner and outer barrels. In addition to the hydraulic coupling effect there may in fact be a physical or mechanical coupling due to bending and flexing of the outer barrel in some conditions locking the inner barrel to the outer barrel. Since the inner barrel is normally not required to rotate and the outer barrel is, this can cause jamming of the core in the bit and inner core barrel and, consequently, a disastrous hold up in the drilling operation while the whole barrel is removed so as to remove the jammed core.

In accordance with the present invention the outer surface of the inner barrel and the inner surface of the outer barrel are coated with a fluoropolymer. The reduced friction from the coated surface allows higher viscosity fluids and higher volumes of fluid to be used without resulting in the inner barrel rotating.

Preferably the coating of fluoropolymer is a PTFE coating and it is preferably in the form of either a single coat of 18 - 20 microns thickness or two coats each of 5 - 12 microns in thickness.

Other parts may be coated such as a drill bit carrier or parts of the drill bit itself, or the core catcher sub and other tubes, pipes, collars, sleeves, etc. which are used in the drilling equipment and are liable to come into contact either with the core or with the drilling medium.

In the accompanying drawing is shown an example of the application of the invention to a core barrel assembly. The core barrel assembly is shown sectioned and is shown in two parts for convenience of illustration, the chain dotted line indicating that the parts were in fact joined in practice.

The apparatus shown in the drawing comprises an outer core barrel I0 and an inner core barrel II which are normally in sections. One complete section is shown and the joints I2 between each section and the next upper section is also shown.

At the lower end of the outer core barrel there is attached a core catcher sub I3. At the lower end of the inner barrel II is attached an inner barrel breaker sub I4 and below that a core catcher I5. A core bit I6 is attached to the lower end of the outer barrel.

Various parts of this assembly are shown as coated with PTFE by means of thick lines such as the inner surface I8 of the inner barrel II, the outer surface I9 of the inner barrel and the inner surface 20 of the outer barrel I0.

The outer surface 2I of outer barrel I0 may also be coated as may various other parts such as the outer surface 22 of the drill bit, the inner surface 23 of the core catcher and the inner surface 24 of the inner barrel breaker sub.

In fact any surface may be coated which is liable to be contacted either by a core or by drilling medium.

By use of this invention, it is possible to remove cores from a core barrel with minimum effort and to avoid freezing of the core in the barrel. It is also possible to avoid hydraulic locks and mechanical locks between the rotating outer core barrel and the stationary inner core barrel and thus avoid the core jamming and the necessity of having to remove the whole string in order to free such core jams.

Another important application of the present invention is to oil well production tubing. Oil well production tubing is susceptible to a build-up of salts which stick particularly to the interior surface of the production tubing. The tubing is therefore coated, in accordance with the invention, on its interior surface at least, with a layer of PTFE which substantially reduces the build-up of salts.

Claims

I. Drilling apparatus characterised by being coated with a layer of a fluoropolymer.

2. Drilling apparatus according to claim I characterised in that the fluoropolymer is polytetrafluorethylene (PTFE).

3. Drilling apparatus according to claim I or claim 2 characterised by being selected from drilling and coring bits, stabilisers inner and outer core barrels, bearings, bearing housings, core catchers, core barrel substitutes, core barrel extension pieces, junction pieces, drill collars, down hole motors, reamers, drill pipes, oil well piping and tubing and oil well production tubing.

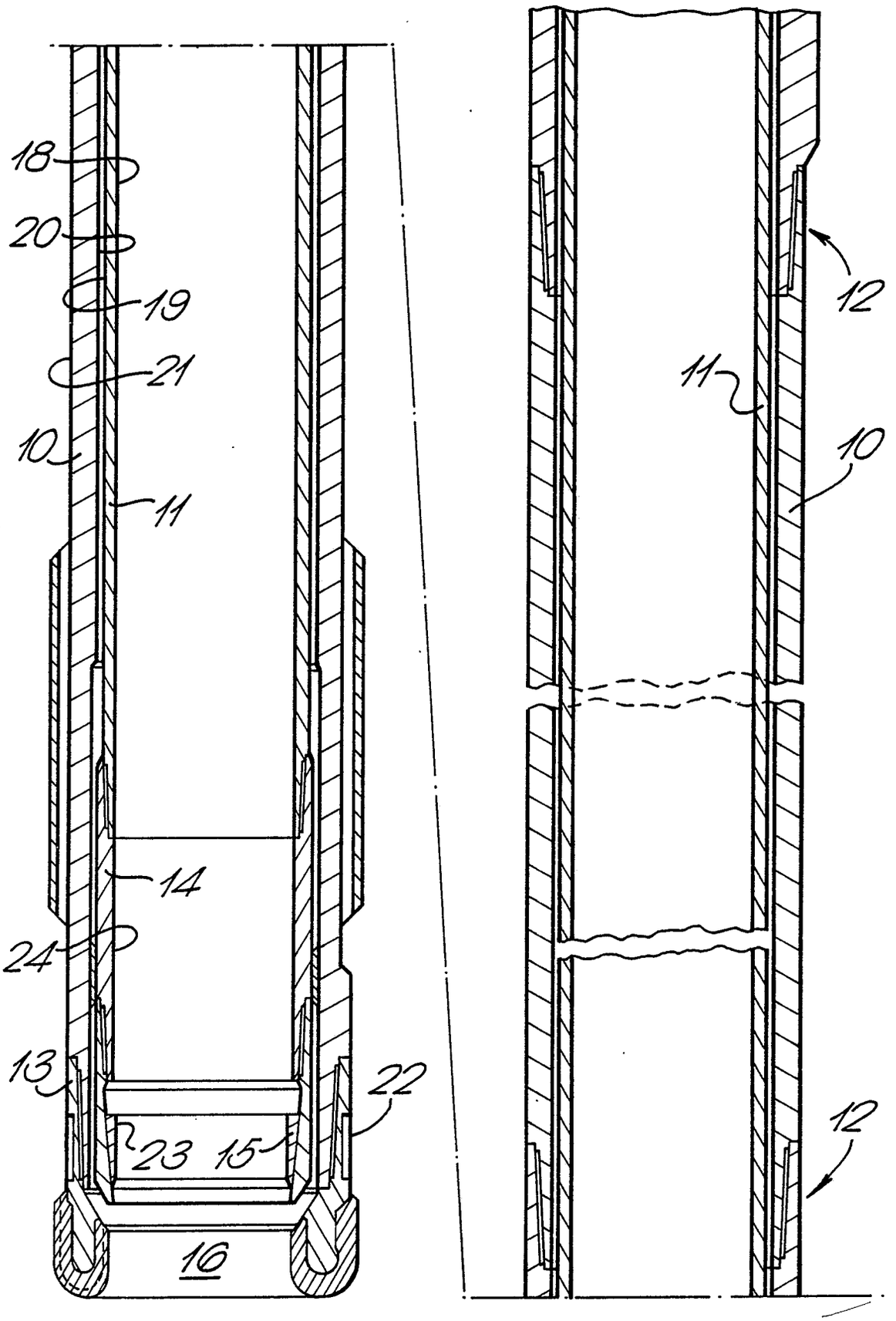
4. An inner core barrel (II) having an inner surface (I8) characterised by said inner surface being coated with a fluoropolymer.

5. A core barrel assembly comprising an outer barrel (I0) having an inner surface (20) and an inner barrel (II) having an outer surface (I9) characterised by both of said surfaces (I9, 20) being coated with a fluoropolymer.

6. A core barrel assembly according to claim 5 characterised in that the inner core barrel (II) has an inner surface (I8) which is also coated with a fluoropolymer.

7. A core barrel assembly according to claim 5 or claim 6 characterised in that said fluoropolymer is PTFE.

8. Oil well production tubing characterised by having an inner surface coated with a fluoropolymer.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