A dynamic damper for installation in a drill string (1), the purpose of which damper is to reduce the risk of jamming the drill bit (5), thereby avoiding damages in the event of unwanted extreme oscillations and rotational speed of the drill string caused by uncontrolled release of torsional energy in the drill string when the drill string suddenly breaks free of the jam. For this purpose, the damper is constructed from an outer and an inner string section (11) and (12), supported concentrically and interconnected through a helical threaded connection (10), so that relative rotation between the sections caused by torque (8) will give an axial movement that lifts and loosens the drill bit from the bottom of the hole in critical jamming situations. The spring (9) maintains the outer string section in an axial position against the shoulder (22). A hydraulic damping effect on the axial movements is achieved by oil volumes (16) and (17) being interconnected through narrow bores (18). Logging of the damping function is carried out by sensor (20), which registers and stores data to be read when the damper is retrieved to the surface.
DYNAMIC DAMPER FOR USE IN A DRILL STRING

This invention regards a dynamic damping device for use in a drill string, designed especially for use when drilling for hydrocarbons in sedimentary rocks.

Known dynamic dampers are extensively used to dampen oscillations that arise in mechanical constructions subjected to variable loads. In a drill string having a length of several thousand metres, oscillations can arise as a result of variations in the torque along the drill string.

Variations in torque may be due to different frictional conditions along the string and drilling through formations of different hardness, causing the moment on the drill bit to vary. Such uncontrollable variations in torque will in turn generate oscillations that exert great forces and vibrations on the drill string, in particular when the oscillations resonate with the natural oscillations of the drill string.
The use of more modern and more powerful rotary machines over the last years has resulted in the drill string now being subjected to considerably greater strain, with a consequent increase in the risk of damage caused by uncontrolled oscillations and vibrations.

A particular problem arises when the drill bit hits a formation that is difficult to penetrate, and jams. The drill string is turned by torque from the drilling machine on the surface, and the string builds up energy which is released when the drill suddenly breaks loose. All the stored energy is released through uncontrolled rotation, and the lower part of the drill string may reach extreme rotational speeds that can cause damage to the drilling equipment. Today's controlled drilling systems include a lot of electromechanical equipment that is especially susceptible to damage when subjected to this type of strain.

In relation to prior art, the object of the invention is to provide a solution that reduces the risk of the drill bit getting jammed, and of accumulated energy stored as torque in the drill string being released in the form of uncontrolled rotation.

This is achieved in accordance with the invention, by a dynamic damper being installed in the drill string, above the measuring equipment used for directional control. This damper consists of an inner cylindrical string section with threads that connect this to the upper section of the drill string, which in turn is connected to the rotary machine on the
surface. An outer cylindrical string section is supported concentrically in the inner string section and connected to a lower section of the drill string towards the drill bit, through a threaded connection. The outer and inner string sections are engaged through a spiral trapezoidal threaded connection, so that relative rotation between the string sections will cause a relative axial movement between the two parts. A spring is disposed between the outer and inner string sections and pre-tensioned, so that axial movement between the outer and inner string sections occurs only when axial force and moment or a combination of these exceed a predetermined value. Externally of the outer string section there is provided a cylindrical jacket connected to the inner string section through a threaded connection, such that the jacket protects the outer and inner string sections while at the same time constituting a limitation for the axial movement between the outer and inner string sections.

Between the outer and inner string sections there are two volumes filled with oil and interconnected in a manner such that axial movement will cause forced displacement of liquid from one volume to the next through narrow passages. This has an intended dynamic damping effect on the movement.

When the present invention is installed in a drill string, torque caused by incipient locking of the drill bit will effect relative rotation between the outer and inner string sections when the moment exceeds a selected spring tension. This will result in an axial movement that lifts and loosens the drill bit from the bottom. When the drill bit comes
loose, the moment is reduced and the spring will again push
the drill bit towards the bottom of the borehole, thus
generating torque resistance that prevents the accumulated
torque in the drill string from "spinning" out of control.

The invention will now be explained in greater detail in
connection with the description of an embodiment and with
reference to the enclosed drawings, in which:

Figure 1 is a system overview with a dynamic damper installed
in the drill string;

Figure 2 shows a section through the outer string section;
and

Figure 3 shows a section through the outer and inner string
sections.

In the drawings, reference number 1 denotes a known drill
string where the dynamic damper has been installed and is
referred to by reference number 2. The instrumentation
section for directional control 3 is installed in an
extension of the damper, towards the drill bit, while the
extension of part 3 holds stabilizers nibs 4 and drill bit 5.

The torque and the axial force transferred to the damper are
indicated by reference numbers 8 and 9. The end piece 6
attached to the drill string with a threaded connection
transfers the forces to an inner string section 12.
The inner and outer string sections are engaged through helical threads 10, such that relative rotation of these parts will entail relative axial movement between the parts. A torsional spring 9 stops against the end piece 6 on the inner string section 12 and against the outer string section 11. The spring forces the outer string section 11 to stop against the shoulder 22 of outer jacket 21. Thus the outer string section 11 will be pre-tensioned between the spring 9 and the shoulder 22 in a manner such that the torque 8 combined with axial force 7 must exceed a given value before relative torsion between the outer and inner string sections will occur, causing the intended axial movement between these sections.

The cavity formed between the two string sections and the jacket 21 is filled with oil that is kept in place with respect to the surroundings by means of seals 13 and 14. Volume 17 and volume 16 around the spring 9 are interconnected through narrow bores 18, so as to bring about an intended damping effect on the axial movement.

A central bore 19 for drill mud passes through the inner and outer string sections.

In order to log the performance of the damper, a sensor 20 is provided to register and record data on oil pressure and spring force from the spring 9. These data can then be read when the drill string is retrieved, and will give information about the performance of the damper.
Claims

1. A dynamic damper for use in a drill string (1), preferably of the type used when drilling for oil and gas in sedimentary rocks, wherein the damper (2) is designed to counteract jamming of the drill bit during drilling, through imparting axial movement to the drill bit (5) when the torque in the drill string 1 exceeds a specified value, characterized in that the damper (2) consists of outer and inner cylindrical string sections (11) and (12) supported concentrically relative to each other and connected through a helical threaded connection (10), and positioned axially with respect to each other with the spring (9) and impact against the shoulder (22).

2. A dynamic damper according to Claim 1, characterized in that bores (18) are provided between two oil volumes (16) and (17) for hydraulic damping of relative axial movement between the outer and inner string sections (11) and (12).

3. A dynamic damper according to Claims 1 and 2, characterized in that a sensor (20) is provided for logging of operational data.
**INTERNATIONAL SEARCH REPORT**

**PCT/NO 03/00121**

### A. CLASSIFICATION OF SUBJECT MATTER

**IPC7:** E21B 17/07

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC7:** E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**SE, DK, FI, NO classes as above**

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**EPO-INTERNAL**

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.  

See patent family annex.

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Date of the actual completion of the international search: 14 October 2003

Date of mailing of the international search report: 16-10-2003

Name and mailing address of the ISA/Swedish Patent Office:
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# INTERNATIONAL SEARCH REPORT

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