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(54) **DRILL BIT FOR PERCUSSIVE ROCK DRILLING**

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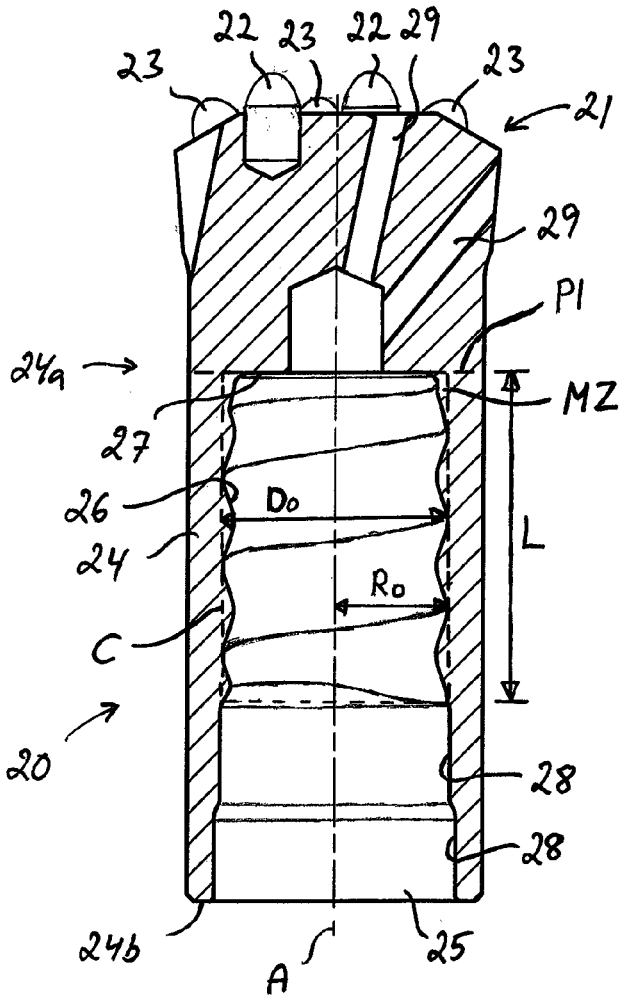
(57) **ABSTRACT**

The invention relates to a drill bit (**20**) for percussive rock drilling, which comprises: —a drill head (**21**); —a skirt (**24**), which has a first end and an opposite second end, the skirt being connected to the drill head at said first end; —a recess (**25**) extending axially through the skirt from the second end of the skirt towards the first end thereof, the recess being provided with an internal, cylindrical female thread (**26**); and—an impact surface (**27**) at the bottom of the recess. Every cross-section of the recess (**25**) between the impact surface and the part of the recess where the female thread has its full thread profile has a cross-sectional area which is smaller than the cross-sectional area of a cross-section of the recess at the part of the recess where the female thread has its full thread profile.



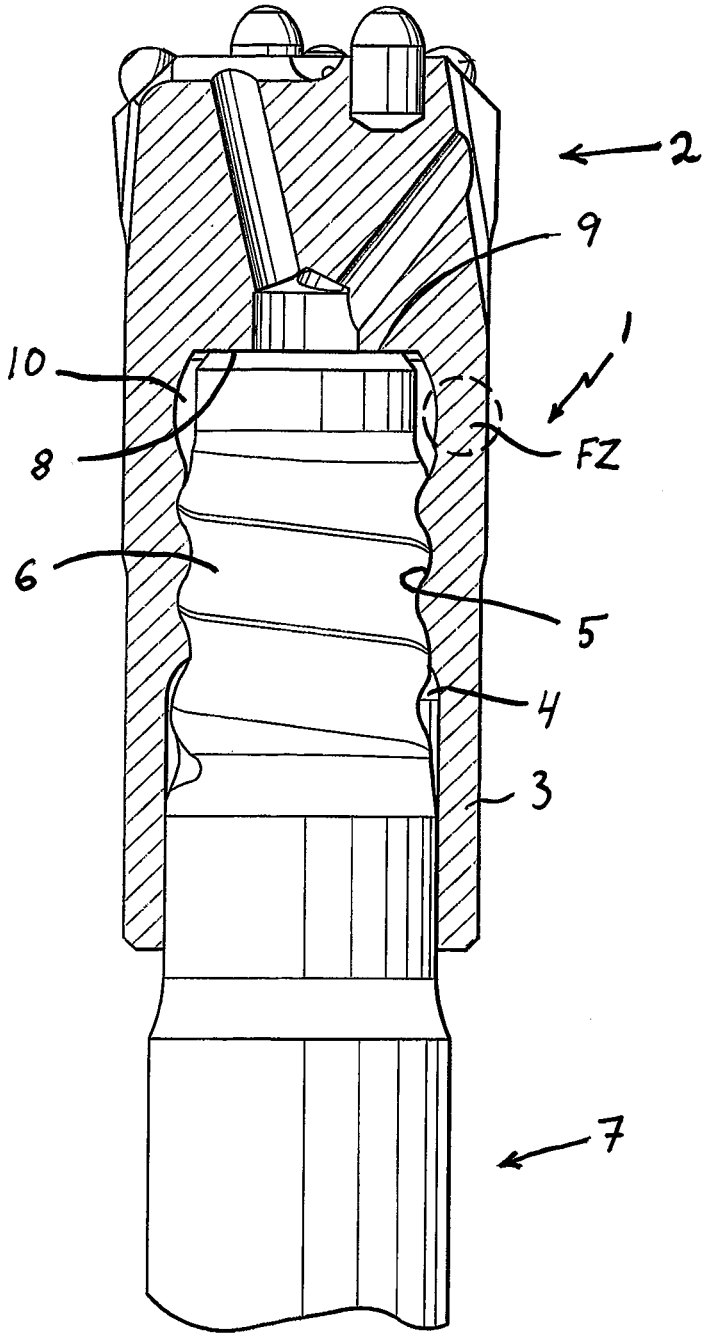


Fig 1

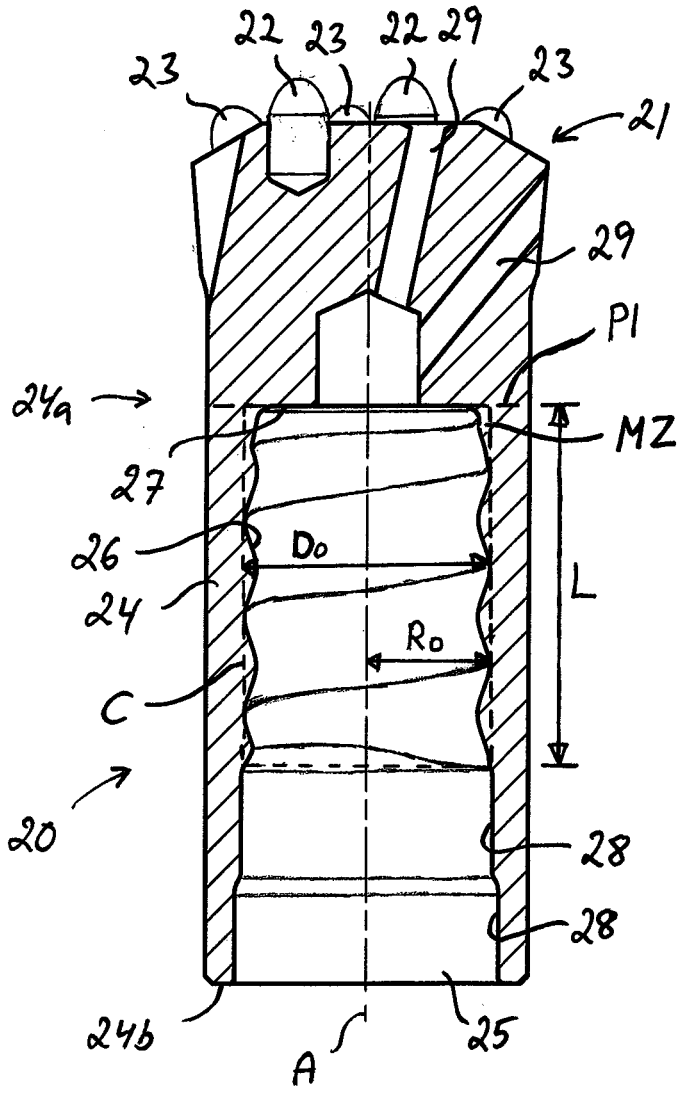


Fig 2

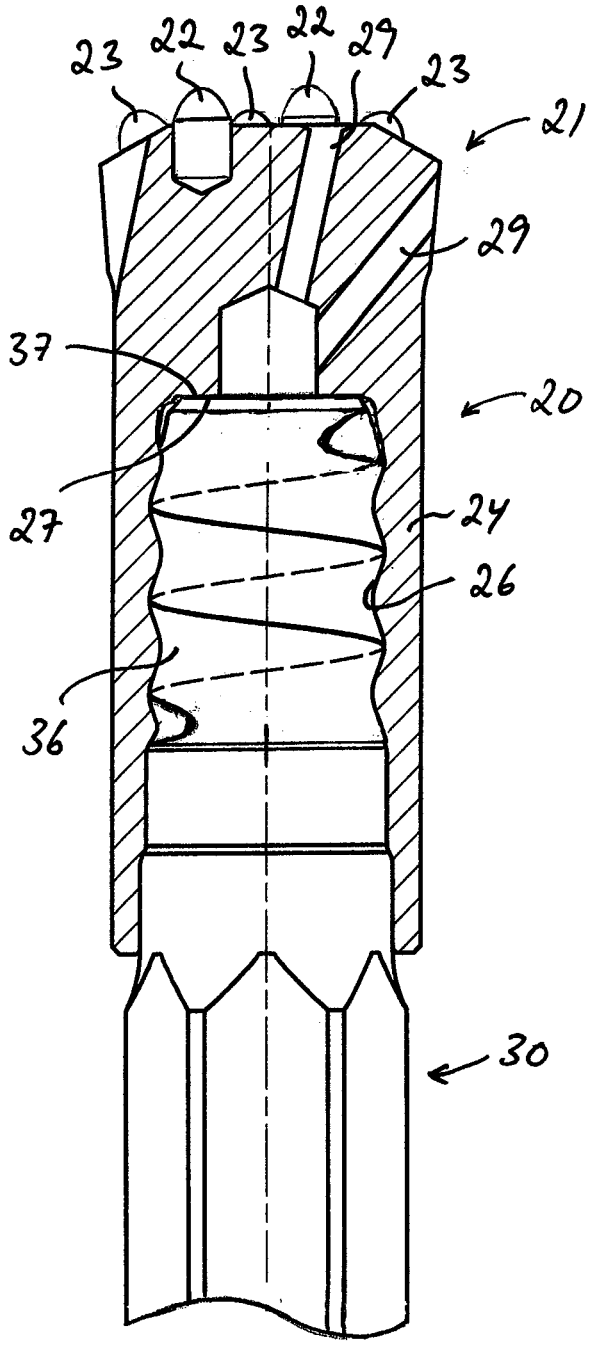


Fig 3

DRILL BIT FOR PERCUSSIVE ROCK DRILLING

FIELD OF THE INVENTION AND PRIOR ART

[0001] The present invention relates to a drill bit for percussive rock drilling according to the preamble of claim **1**.

[0002] A previously known drill bit for percussive rock drilling configured in accordance with the preamble of claim **1** is illustrated in FIG. **1**. A drill bit of this type is for instance disclosed in WO 2004/003334 A1 (and US 2002/074797, US 2008/304904 or WO 01/38685). This known drill bit **1** comprises:

[0003] a drill head **2**;

[0004] a skirt **3**;

[0005] a recess **4** extending axially through the skirt **3** from the rear end of the skirt towards the drill head **2**, the recess being provided with an internal female thread **5** for connection to a corresponding external male thread **6** of a drill rod **7** and; and

[0006] an impact surface **8** for abutment against an end surface **9** of a drill rod, this impact surface **8** being formed at the bottom of the recess **4** and extending perpendicularly to the longitudinal axis of the drill bit.

[0007] The part of the recess **4** between the inner end of the female thread **5** and the impact surface **8** is wider than the female thread so as to provide a thread clearance **10** at the inner end of the female thread.

[0008] Each of U.S. Pat. No. 3,258,077A and U.S. Pat. No. 3,258,284 A discloses a drill bit having a shoulder abutment. JP 8 151885 A, on which the preamble of claim **1** is based, discloses a drill bit with locally increased diameter of the drill bit in the vicinity of the impact surface.

SUMMARY OF THE INVENTION

[0009] The object of the present invention is to achieve a further development of a drill bit of the above-mentioned type so as to provide a drill bit which is improved in at least some aspects.

[0010] According to the invention, this object is achieved by a drill bit having the features defined in claim **1**.

[0011] The drill bit of the present invention comprises:

[0012] a drill head;

[0013] a skirt, which has a first end and an opposite second end, the skirt being connected to the drill head at said first end;

[0014] a recess extending axially through the skirt from the second end of the skirt towards the first end thereof, the recess being provided with an internal, cylindrical female thread for connection to a corresponding external, cylindrical male thread of a drill rod; and

[0015] an impact surface for abutment against an end surface of a drill rod, this impact surface being formed at the bottom of the recess and extending perpendicularly to the longitudinal axis of the drill bit. According to the invention, every cross-section of the recess between the impact surface and the part of the recess where the female thread has its full thread profile has a cross-sectional area which is smaller than the cross-sectional area of a cross-section of the recess at the part of the recess where the female thread has its full thread profile. Thus, the drill bit of the present invention lacks a widened thread clearance between the inner end of the female thread and the impact surface. Such a thread clearance will give a reduced thickness of the skirt wall in the part of the skirt wall surrounding the thread clearance as compared to the part of the skirt wall surrounding the female thread. Such a part of the skirt wall with reduced wall thickness, and consequently reduced cross-sectional area of the skirt wall, will constitute a weakened part or fracture zone FZ (see FIG. **1**) at the drill bit. The present invention is based on the realization that the strength of the drill bit can be improved by dispensing with a thread clearance between the inner end of the female thread and the impact surface. The strength improvement has been measured to 18% for a drill bit according to the present invention as compared to a corresponding drill bit according the above-mentioned prior art. Without such a thread clearance, the recess of the drill bit can be formed in such a manner that every cross-section of the recess between the impact surface and the part of the recess where the female thread has its full thread profile has a cross-sectional area which is smaller than the cross-sectional area of a cross-section of the recess at the part of the recess where the female thread has its full thread profile. Hereby, no point of reduced strength is introduced in the part of the skirt extending between the impact surface and the female thread.

[0016] In this description and the subsequent claims, the expression "cross-section of the recess" refers to a section across the recess perpendicularly to the longitudinal axis of the drill bit.

[0017] Further advantages as well as advantageous features of the drill bit according to the invention will appear from the following description and the dependent claims.

BRIEF DESCRIPTION OF THE DRAWING

[0018] With reference to the appended drawing, a specific description of preferred embodiments of the invention cited as examples follows below. In the drawings:

[0019] FIG. **1** is a partly cut lateral view of a drill bit according to prior art connected to a drill rod,

[0020] FIG. **2** is a partly cut lateral view of a drill bit according to an embodiment of the present invention, and

[0021] FIG. **3** is a partly cut lateral view of the drill bit according to FIG. **2** connected to a drill rod.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0022] A drill bit **20** for percussive rock drilling according to an embodiment of the present invention is illustrated in FIGS. **2** and **3**. This drill bit **20** comprises a drill head **21**, which is provided with rock cutting members **22**, **23** at its front end. In the illustrated embodiment, the rock cutting members are constituted by cemented carbide inserts in the form of front buttons **22** and peripheral buttons **23**. At its rear end, the drill head **21** is connected to a skirt **24**. The drill head **21** and the skirt **24** are formed in one piece of a suitable metallic material, such as for instance steel.

[0023] The skirt **24** has a first end **24***a*, through which the skirt is connected to the drill head **21**, and an opposite second end **24***b*. A recess **25** extends axially through the skirt **24** from the second end **24***b* of the skirt towards the first end **24***a* thereof. This recess **25** is provided with an internal, cylindrical female thread **26** for connection to a corresponding external, cylindrical male thread **36** provided at an end of a drill rod

30. The female and male threads may be of any conventional thread form, such as rope threads or trapezoidal threads. The thread form shown in the figures is a rope thread. An impact surface **27** for abutment against an end surface **37** of a drill rod **30** is formed at the bottom of the recess **25**. This impact surface **27** extends perpendicularly to the longitudinal axis A of the drill bit **20**. The recess **25** is suitably provided with one or more unthreaded cylindrical surfaces **28** between the outer end of the female rope thread **26** and the second end **24***b* of the skirt **24**, as illustrated in FIGS. **2** and **3**. The recess **25** is in fluid communication with the front end of the drill head **21** through a number of flush channels **29** extending through the drill head. When the drill bit **20** is connected to a drill rod **30** with the female thread **26** of the drill bit in engagement with the male thread **36** of the drill rod and with the impact surface **27** of the drill bit in abutment against the end surface **37** of the drill rod (as illustrated in FIG. **3**), the flush channels **29** of the drill bit are in fluid communication with a flush channel (not shown) which extends axially through the drill rod along the centre axis thereof.

[0024] Every cross-section of the recess **25** along the part of the recess where the thread **26** has its full thread profile has one and the same cross-sectional area. The expression "full thread profile" can be defined as the profile which is present along a majority of the entire thread length.

[0025] No thread clearance is provided in the recess **25** between the inner end of the female thread **26** and the impact surface **27**, and every cross-section of the recess **25** between the impact surface **27** and the part of the recess where the female thread **26** has its full thread profile has a cross-sectional area which is smaller than the cross-sectional area of a cross-section of the recess **25** at said part of the recess where the female thread **26** has its full thread profile.

[0026] The recess **25** has its smallest cross-sectional area at its bottom and the impact surface **27** defines the smallest radial cross-sectional area of the recess **25**. Thus, the area of the impact surface **27** is smaller than the cross-sectional area of any cross-section of the recess **25** between the impact surface **27** and the second end **24***b* of the skirt **24**.

[0027] It can also be seen in FIG. **2** that the cross-sectional area of the recess **25** is gradually reduced from the inner end of the female thread **26** to the impact surface **27**. The radial cross-sectional area of the recess **25** continuously increases along the recess from the impact surface **27** all the way on to the part of the recess where the female thread **26** has its full thread profile. The axial distance between the impact surface **27** and the inner end of the part of the recess where the female thread **26** has its full thread profile is preferably 8-12 mm, which implies that the part of the recess where the female thread **26** has its full thread profile begins 8-12 mm from the impact surface **27** as seen in the axial direction.

[0028] The radial distance Ro from the longitudinal axis A of the drill bit **20** to the deepest point of the thread bottom of the female thread **26**, i.e. the largest radius of the female thread, is preferably equal to or smaller than 18.5 mm at the part of the recess where the female thread has its full thread profile.

[0029] Preferably, the female thread **26** has 2.8-3.2 thread turns with full thread profile.

[0030] An imaginary cylinder C is illustrated in broken lines in FIG. **2**. This imaginary cylinder C has such a diameter Do that its envelope surface touches the deepest point of the thread bottom of the female thread along the part of the recess where the female thread **26** has its full thread profile. Thus, $Do=2\cdot Ro$.

[0031] The diameter Do of said imaginary cylinder C is preferably equal to or smaller than 37 mm, while fulfilling the following condition:

$$1.3 \leqq L/Do \leqq 1.6$$

where L is the axial distance from the impact surface **27** to the outer end of the part of the recess where the female thread **26** has its full thread profile.

[0032] An annular material zone MZ is formed between a cross-sectional plane P**1** extending through the impact surface **27** and the envelope surface of the above-mentioned imaginary cylinder C. The annular material zone MZ forms an area at a certain axial cross-section that tapers towards where the female thread has its full thread profile.

[0033] The drill bit **20** is to be used for percussive rock drilling with the drill bit **20** connected to a top hammer device through one or more drill rods **30**.

[0034] With the drill bit **20** according to the present invention, it will be possible to provide a longer female thread **26**, and thereby a longer contact surface between the female thread **26** of the drill bit **20** and the corresponding male thread **36** of the drill rod **30**, as compared to a drill bit according to the above-mentioned prior art, without increasing the axial distance L from the impact surface **27** to the outer end of the part of the recess where the female thread **26** has its full thread profile. Furthermore, there will be better possibilities to alter the space for cuttings removal while maintaining the skirt sufficiently strong, or to increase the strength of the skirt **24**, due to the fact that the wall of the skirt **24** can be designed without having to take into account any fracture zone at the inner end of the skirt. The presently claimed drill bit i.a. solves the problem of weak skirts, i.e. by increasing the wall thickness without affecting the outside of the drill bit.

[0035] It should be noted that the female thread **26** of the drill bit according to the present invention is a cylindrical thread and not the type of conical thread used in drill pipes or drill tubes for rotary oil drilling.

[0036] The invention is of course not in any way restricted to the embodiment described above. On the contrary, many possibilities to modifications thereof will be apparent to a person with ordinary skill in the art without departing from the basic idea of the invention such as defined in the appended claims.

[0037] The disclosures in European patent application No. 10161383.4, from which this application claims priority, are incorporated herein by reference.

1. A drill bit for percussive rock drilling comprising:

a drill head;

a skirt having a first end and an opposite second end, the skirt being connected to the drill head at said first end;

a recess extending axially through the skirt from the second end of the skirt towards the first end thereof, the recess being provided with an internal, cylindrical female thread for connection to a corresponding external, cylindrical male thread of a drill rod; and

an impact surface for abutment against an end surface of a drill rod, said impact surface being formed at the bottom of the recess and extending perpendicularly to a longitudinal axis of the drill bit, every cross-section of the recess between the impact surface and the part of the recess where the female thread has its full thread profile

has a cross-sectional area which is smaller than the cross-sectional area of a cross-section of the recess at the part of the recess where the female thread has its full thread profile.

2. A drill bit according to claim **1**, wherein the impact surface defines the smallest radial cross-sectional area of the recess.

3. A drill bit according to claim **1**, wherein the radial cross-sectional area of the recess continuously increases along the recess from the impact surface all the way on to the part of the recess where the female thread has its full thread profile.

4. A drill bit according to claim **1**, wherein an annular material zone is formed between a cross-sectional plane containing the impact surface and the envelope surface of an imaginary cylinder which has such a diameter that its envelope surface touches the deepest point of the thread bottom of the female thread along the part of the recess where the female thread has its full thread profile.

5. A drill bit according to claim **4**, wherein the diameter of said imaginary cylinder is equal to or smaller than 37 mm, while fulfilling the following condition:

$$1.3<L/Do<1.6$$

where Do is the diameter of the imaginary cylinder and L is the axial distance from the impact surface to the outer end of the part of the recess where the female thread has its full thread profile.

6. A drill bit according to claim **5**, wherein the axial distance between the impact surface and the inner end of the part of the recess where the female thread has its full thread profile is 8 to 12 mm.

7. A drill bit according to claim **1**, wherein the radial distance from the longitudinal axis of the drill bit to a deepest point of the thread bottom of the female thread is equal to or smaller than 18.5 mm at the part of the recess where the female thread has its full thread profile.

8. A drill bit according to claim **1**, wherein the number of thread turns with full thread profile of the female thread is 2.8 to 3.2 mm.

9. A drill bit according to claim **1**, wherein the recess is provided with at least one unthreaded cylindrical surface between the female thread and said second end of the skirt.

10. A drill bit according to claim **1**, wherein rock cutting members in the form of front buttons and peripheral buttons are provided at the front end of the drill head.

11. A drill bit according to claim **1**, wherein the recess is in fluid communication with the front end of the drill head through one or more flush channels extending through the drill head.

12. A drill bit according to claim **1**, wherein the female thread is a rope thread or a trapezoidal thread.

13. A drill bit according to claim **1**, wherein the drill bit is connected to a top hammer device for percussive rock drilling through one or more drill rods.

14. A drill bit according claim **1**, wherein the female thread is a trapezoidal thread.

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