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(54) THREAD CLEARANCE

(57) A female portion to form part of a thread joint for a percussive drilling tool comprising a mounting sleeve having an axial end, wherein the mounting sleeve surrounds an internal cavity having an axial inner wall at the opposing end of the mounting sleeve compared to the axial end; wherein the mounting sleeve has at least one substantially cylindrical internally threaded section having a length L_1, a thread entrance towards the axial end and a thread exit towards the axial inner wall; a thread clearance section positioned between the axial inner wall and the thread exit having a length L_2 and a diameter D_1; a guiding section positioned between the thread entrance and the axial end of the sleeve having a length, L_3; characterized in that: 0 mm < L_3-L_2 < 12 mm.

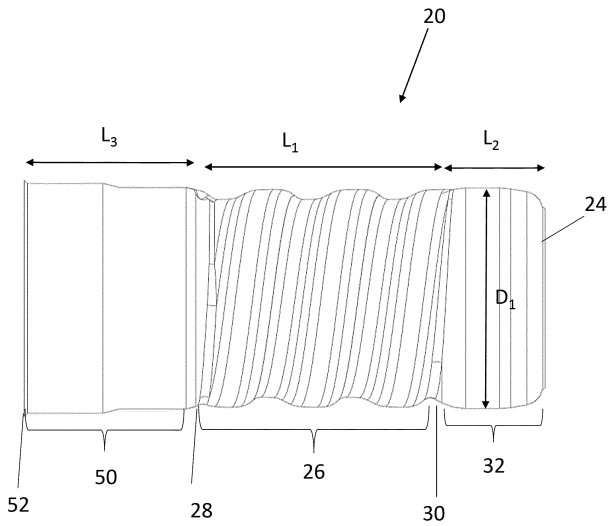

Fig. 5

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Description

Technical field

[0001] The present invention relates to a female portion to form part of a thread joint for a percussive drilling tool, especially for, although not exclusively for drill bits and drill rods.

Background

[0002] Percussion drilling is used to create a long borehole via a plurality of elongate drill string rods coupled together end-to-end by interconnected male and female threads. Alternatively, a drill bit may be connected to a single rod. The well-established technique breaks rock by hammering impacts transferred from the rock drill bit to the rock at the bottom of the borehole. The rock drill bit is mounted at one end of the drill string via a male thread on the endmost drill string rod to a female thread on the drill bit. Typically, the energy required to break the rock is generated by a hydraulically driven piston that contacts the end of the drill string (via a shank adaptor) to create a stress (or shock) wave that propagates through the drill string to a drill bit. Conventional threaded joints are described in US 4,332,502; US 4,398,756; US 4,687,368 and DE 2800887.

[0003] Threaded joints in the percussive drilling tool, such as those between drill string rods and between the endmost drill string rod and the drill bit are subjected to bending forces during drilling from the stress waves that propagate the drill string. These bending moments fatigue the threaded joints and lead to breakage within the threaded portion of the joint. Eventually the stress will cause the threaded joint to get worn out and eventually fail.

[0004] Therefore, it is desirable to reduce the stress in the threaded joint to improve the performance of the percussive drilling tool and reduce the risk of the failure in the threaded joint. One solution to reducing stresses in the threaded joint is to increase the diameter of the male thread, however the problem with this is that it weakens the female part of the threaded joint meaning it is more likely to break. Consequently, the problem to be solved is how to decrease stress in the threaded joint to therefore increase their lifetime.

Summary

[0005] It is an objective of this invention to provide a novel and improved design for threaded joints for percussive drilling tools. The objective is achieved by providing a female portion to form part of a thread joint for a percussive drilling tool comprising: a mounting sleeve having an axial end, wherein the mounting sleeve surrounds an internal cavity having an axial inner wall at the opposing end of the mounting sleeve compared to the axial end; wherein the mounting sleeve has at least one substantially cylindrical internally threaded section having a length L_1, a thread entrance towards the axial end and a thread exit towards the axial inner wall; a thread clearance section positioned between the axial inner wall and the thread exit having a length L_2 and a diameter D_1; a guiding section positioned between the thread entrance and the axial end of the sleeve having a length, L_3; characterized in that: 0 mm < L_3-L_2 < 12 mm. More preferably, 5 mm < L_3-L_2 <11.5 mm, even more preferably 7 mm< L_3-L_2 <11.1 mm.

[0006] Advantageously, this reduces the stress in the female portion of the threaded joint, meaning the risk of breakages in the female portion is decreased. Furthermore, if the stress in the female portion is increased then the diameter of the male threaded part can be increased which improves the performance of the percussive drilling tool.

[0007] Preferably, L_1 is between 25-56 mm, more preferably between 30-45 mm. Preferably, the total length of the female thread (L1 + L2 + L3) is between 70 to 86 mm. Advantageously, this is the most optimal length of threaded section for increased performance.

[0008] Preferably, $L_2/L_1 > 0.01x\ D_1$. Advantageously, by increasing the ratio of the length of the thread clearance area compared to the length of the threaded section means that the stress in thread clearance area decreases.

[0009] Preferably, $L_2 / L_1 > 26\%$, more preferably $L_2 / L_1 > 32\%$. Advantageously, increasing the ratio of the length of the thread clearance area compared to the length of the threaded section means that the stress in thread clearance area decreases.

[0010] Preferably, $L_2 / L_1 < 65\%$, more preferably <50%. Advantageously, this provides sufficient length in the threaded section to achieve a secure threaded connection.

[0011] Preferably, $L_2 / D_1 > 30\%$, more preferably $L_1 / D_1 > 38\%$. Advantageously, increasing the ratio of the length of the thread clearance area compared to the diameter of the threaded section means that the stress in thread clearance area decreases. Therefore, the diameter of the thread clearance and female thread can be increased and consequently so can the diameter of the male part, which leads to increased performance of the male part and less risk of skirt failures in the female part.

[0012] Preferably, $L_2 / D_1 < 65\%$, more preferably < 50%. Advantageously, this enables a secure threaded connection.

[0013] In one embodiment, the female portion is a drill bit. In an alternative embodiment, the female portion is a female

end of a drill string rod.

Brief description of the drawing

[0014] A specific implementation of the present invention will now be described, by way of example only, and with reference to the accompanying drawings:

Figure 1: Perspective view of a percussive drilling tool having one male and one female end.
Figure 2: Perspective view of a drill rod having two male ends.
Figure 3: Cross section of the female end of a drill rod.
Figure 4: Cross section of a drill bit.
Figure 5: Cross section of an internal profile of the cavity of the female portion to form part of a thread joint for a percussive drilling tool.

Detailed description

[0015] Figure 1 shows a percussive drilling tool 2 whereby a drill rod 4 is threadedly coupled to a drill bit 6 of conventional design. The percussive drilling tool 2 is especially used for top hammer drilling. Shockwaves generated by a surface piston (not shown) are translated through the mated surfaces from the drill rod 4 to the drill bit 6. The drill rod 4 comprises an axially extending main length section 8 that is terminated at one end by a male end 10 and at a second opposite end by a female end 12 having a longitudinal axis 14. The drill rod 4 is capable of being coupled end-to-end with other further drill rods to form a drill string (not shown) via another thread joint. Figure 2 shows that alternatively the drill bit 6 may be connected to a single drill rod 4 having two male ends 10.

[0016] Figure 3 shows a cross section of the female end 12 of the drill rod 4 having a mounting sleeve 18 and an internal cavity 20, which is a hollow space, for receiving the male end 10 of the drill rod.

[0017] Figure 4 shows a cross section of the drill bit 6 comprising an axially forwardmost drill head 16 of convention design for example comprising a rock crushing means, most typically this is a plurality of wear resistant cutting buttons projecting axially forward from the drill head (not shown); a mounting sleeve 18 that comprises an axially extending internal cavity 20 for receiving the male end 10 of the drill rod 4.

[0018] The present invention relates to a special design for a female portion 22 that forms part of a thread joint for a percussive drilling tool 2. The female portion 22 could be either the female end 12 on the drill rod 4 or the drill bit 6.

[0019] Figure 5 shows a cross section of an internal profile of the cavity 20 of the female portion 22, in other words figure 5 is an enlargement of the interior of figure 3 or figure 4. The cavity 20 has an axial inner wall 24 for abutment with a male end 10 of a drill rod 4. Further, the cavity 20 has at least one substantially cylindrical internally threaded section 26 having a thread entrance 28 at the axially opposite end compared to the axial inner wall 24 and a thread exit 30 nearer to the axial inner wall 24. The threaded section 26 has a length, L_1, which is defined as the length between the thread entrance 28 and the thread exit 30. The cavity 20 of the female portion 22 also has a thread clearance section 32 positioned between the axial inner wall 24 and the threaded section 26. The thread clearance section 32 is circumferential concave recess. The thread clearance section 32 has a length, L_2, which is defined as the length between the thread exit 30 and the axial inner wall 24. The thread clearance section has a diameter, D_1. There is a guiding section 50 on the opposing end of the threaded section 26 compared to the thread clearance section 32 for guiding the male end 10 of the rod 4 into the correct position. The guiding section 50 has a length, L_3, which is defined as the length between the thread entrance 28 and an axial end 52 of the sleeve 18. The guiding section 50 can either be a constant diameter across the whole of the guiding section 50 or it could optionally be stepped so that it has at least two different diameters.

[0020] Compared to conventional designs the ratio L_2 compared to L_1 and / or L_3 has been increased.

[0021] L_3- L_2 for female portions 22 according to the present invention is <12 mm, more preferably <11.5 mm, even more preferably <11 mm. L_3 - L_2 for female portions 22 according to the present invention is >0 mm, more preferably >5 mm, even more preferably >7 mm. In one embodiment L_1 is between 25-56 mm, more preferably between 30-45 mm.

[0022] In one embodiment L2/L1>0.01x D_1.

[0023] In one embodiment L_2 / L_1 > 26%, more preferably >32%.

[0024] In one embodiment L_2 / L_1 <65%, more preferably <50%.

[0025] In one embodiment L_2 / D_1 > 30%, more preferably >38%.

[0026] In one embodiment L_2 / D_1 < 65%, more preferably <50%.

[0027] Preferably, the female portion 22 is used for forming a thread joint 34 for a percussive drilling tool 2 wherein there is a bottom contact, as opposed to a shoulder contact, between female portion 22 and the male end 10 of the adjoining rod. In other words, there is contact between the axial inner wall 24 on the female portion and the male end 10 of the adjoining rod 4.

[0028] Software simulation programming with bending force added to the female portion 22 of inventive and non-

inventive female portions was performed. Table 1 shows a summary of stress measurements for prior art and inventive female portions 22, it can clearly be seen that the stress in the region of the thread clearance is lower for the inventive samples.

Table 1: Summary of stress measurements

Example	D_1 (mm)	L_3-L_2 (mm)	Stress (MPa) in the region of the thread clearance on the female portion of a threaded joint.
1 (prior art)	33.1	12.7	305
2 (invention)	33.1	11.0	290
3 (prior art)	36.5	14.3	300
4 (invention)	36.5	10.5	275

Claims

1. A female portion (22) to form part of a thread joint (34) for a percussive drilling tool (2) comprising:

a mounting sleeve (18) having an axial end (52), wherein the mounting sleeve (18) surrounds an internal cavity (20) having an axial inner wall (24) at the opposing end of the mounting sleeve (18) compared to the axial end (52); wherein the mounting sleeve (18) has at least one substantially cylindrical internally threaded section (26) having a length L_1, a thread entrance (28) towards the axial end (52) and a thread exit (30) towards the axial inner wall (24);
a thread clearance section (32) positioned between the axial inner wall (24) and the thread exit (30) having a length L_2 and a diameter D_1;
a guiding section (50) positioned between the thread entrance (28) and the axial end (52) of the sleeve (18) having a length, L_3;
characterized in that:
0 mm < L_3-L_2 < 12 mm.

2. The female portion (22) according to claim 1, wherein L_1 is between 25-56 mm.

3. The female portion (22) according to claim 1 or claim 2, wherein L_2/L_1>0.01x D_1.

4. The female portion (22) according to any of the previous claims, wherein L_2 / L_1 > 26%.

5. The female portion (22) according to any of the previous claims, wherein L_2 / L_1 <65%.

6. The female portion (22) according to any of the previous claims, wherein L_2 / D_1 > 30%.

7. The female portion (22) according to any of the previous claims, wherein L_2 / D_1 < 65%.

8. The female portion (22) according to any of the previous claims wherein the female portion (22) is part of a drill bit (6).

9. The female portion (22) according to any of the previous claims wherein the female portion (22) is a female end (12) of a drill string rod (4).

10. A drill string rod comprising a female portion (22) according to any of claims 1-7.

11. A drill bit comprising a female portion (22) according to any of claims 1-7.

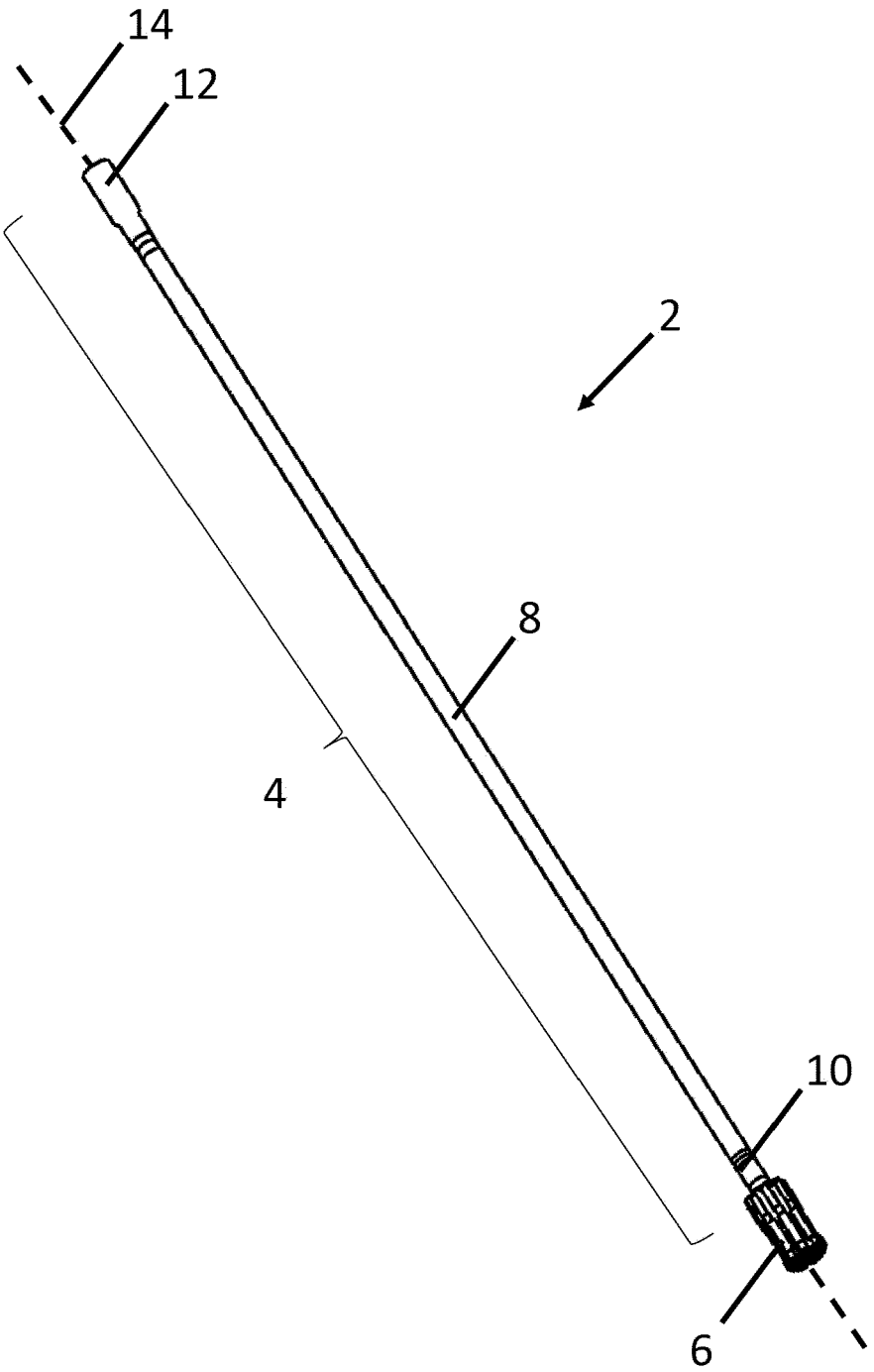

Fig. 1

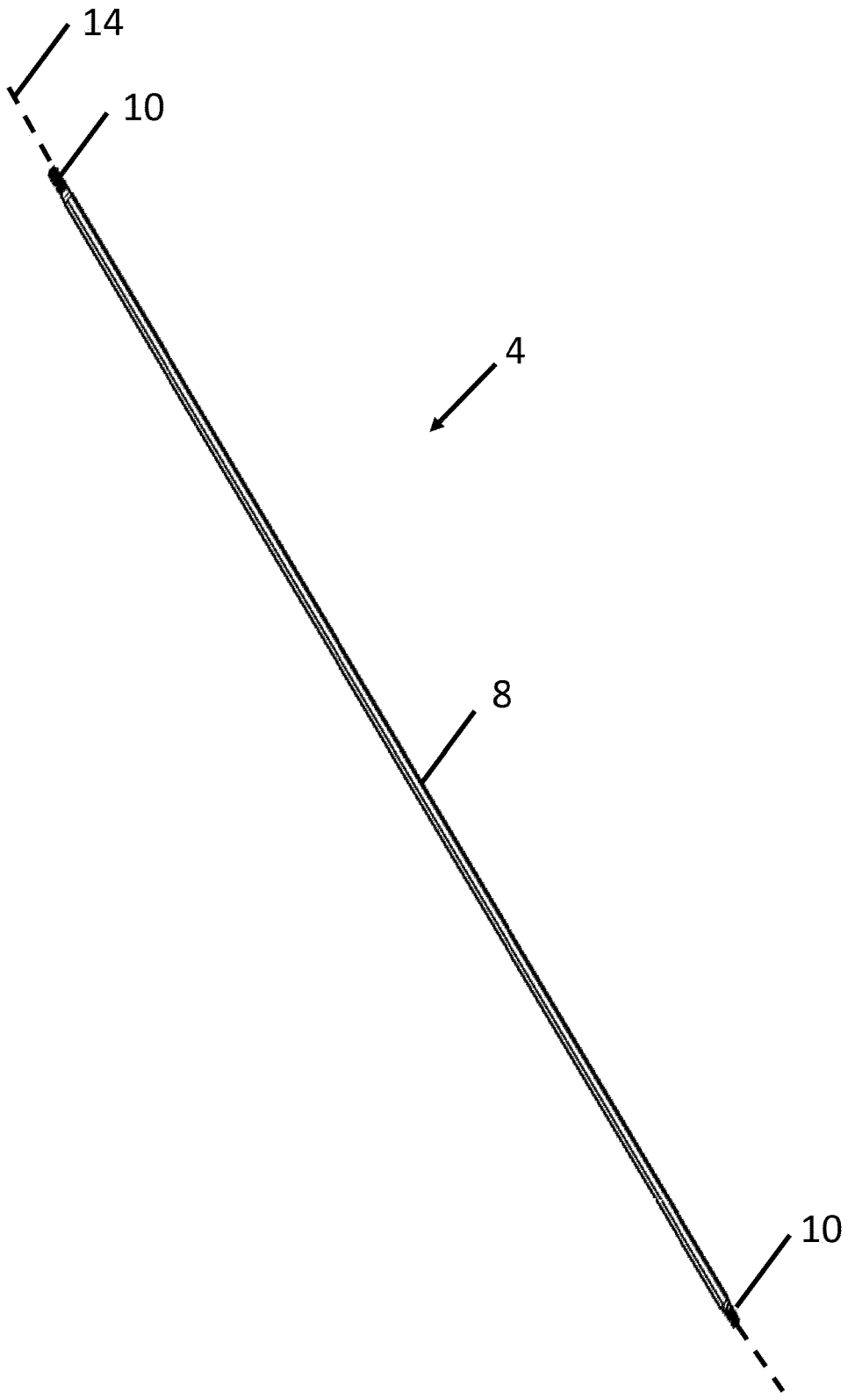

Fig. 2

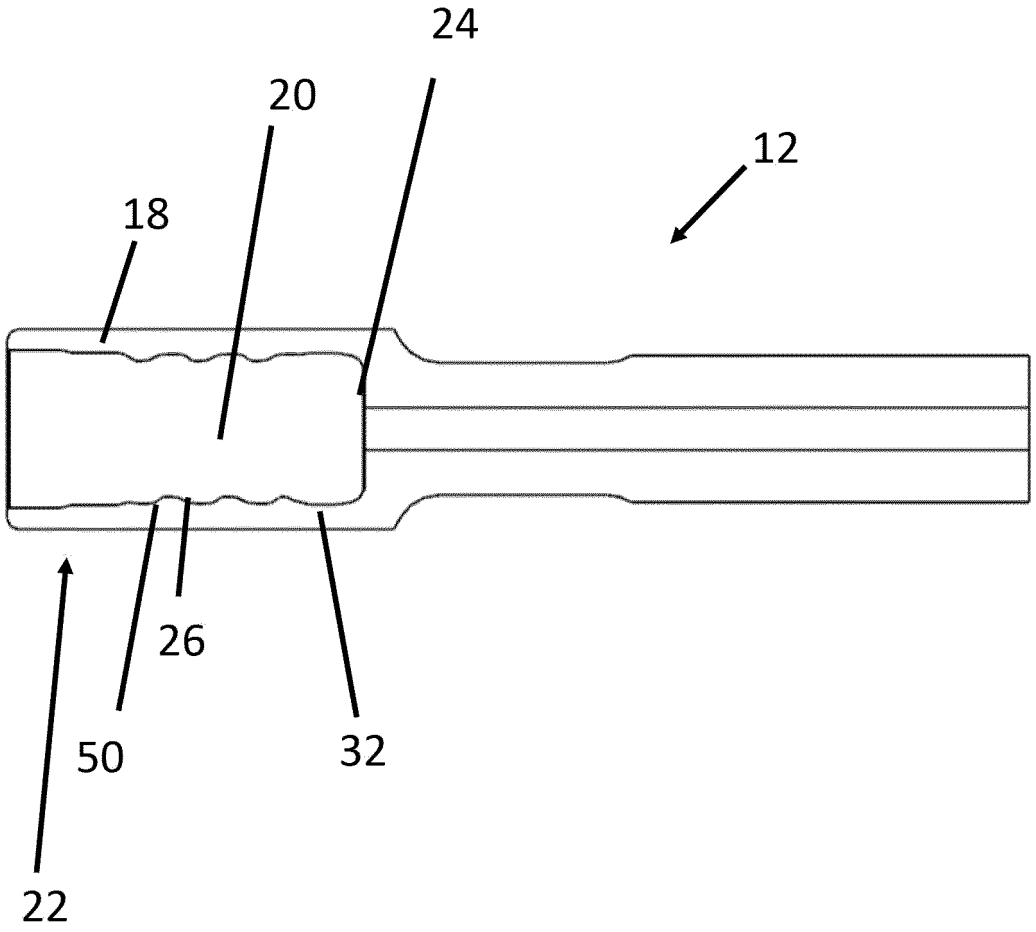

Fig. 3

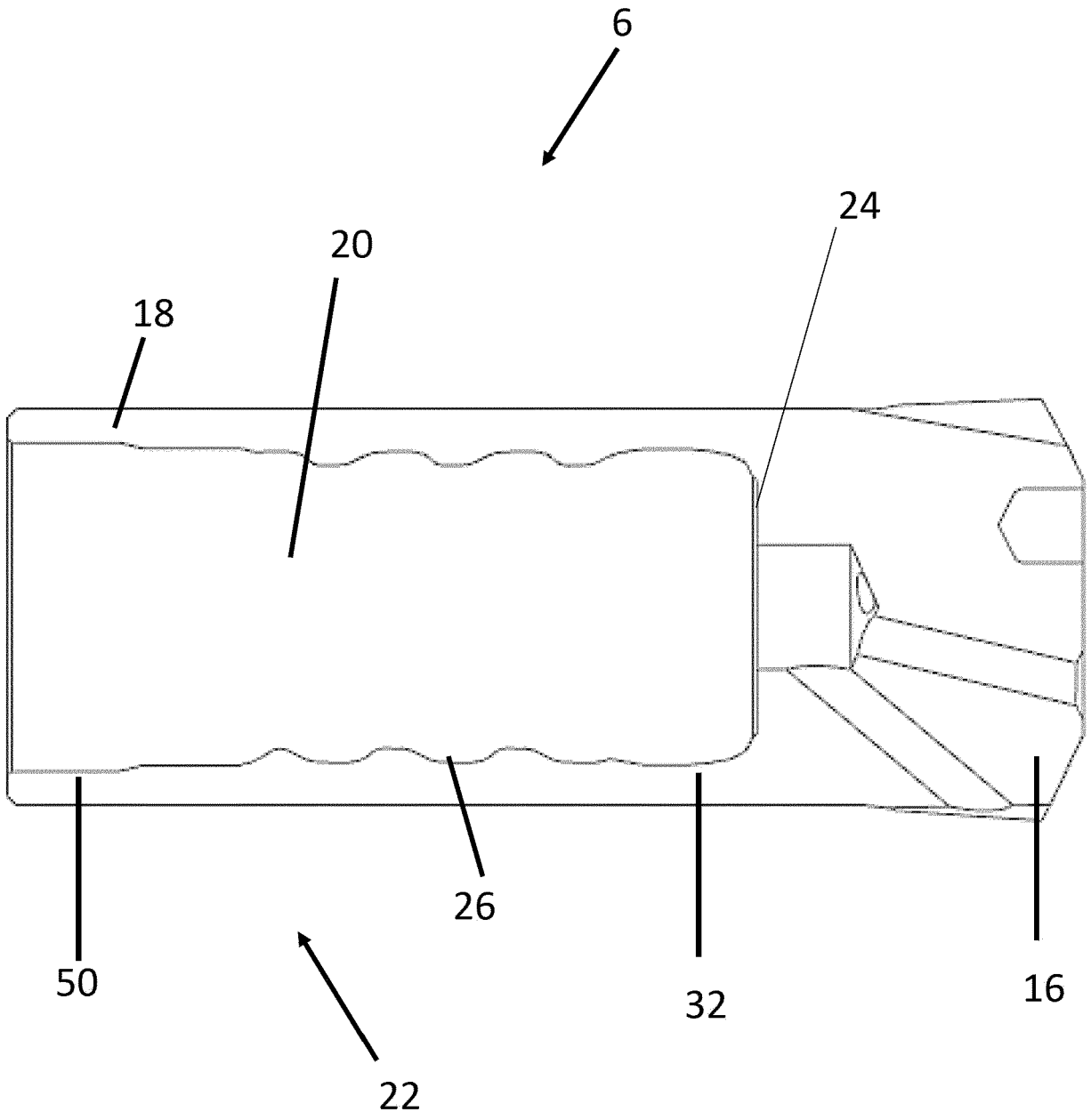

Fig. 4

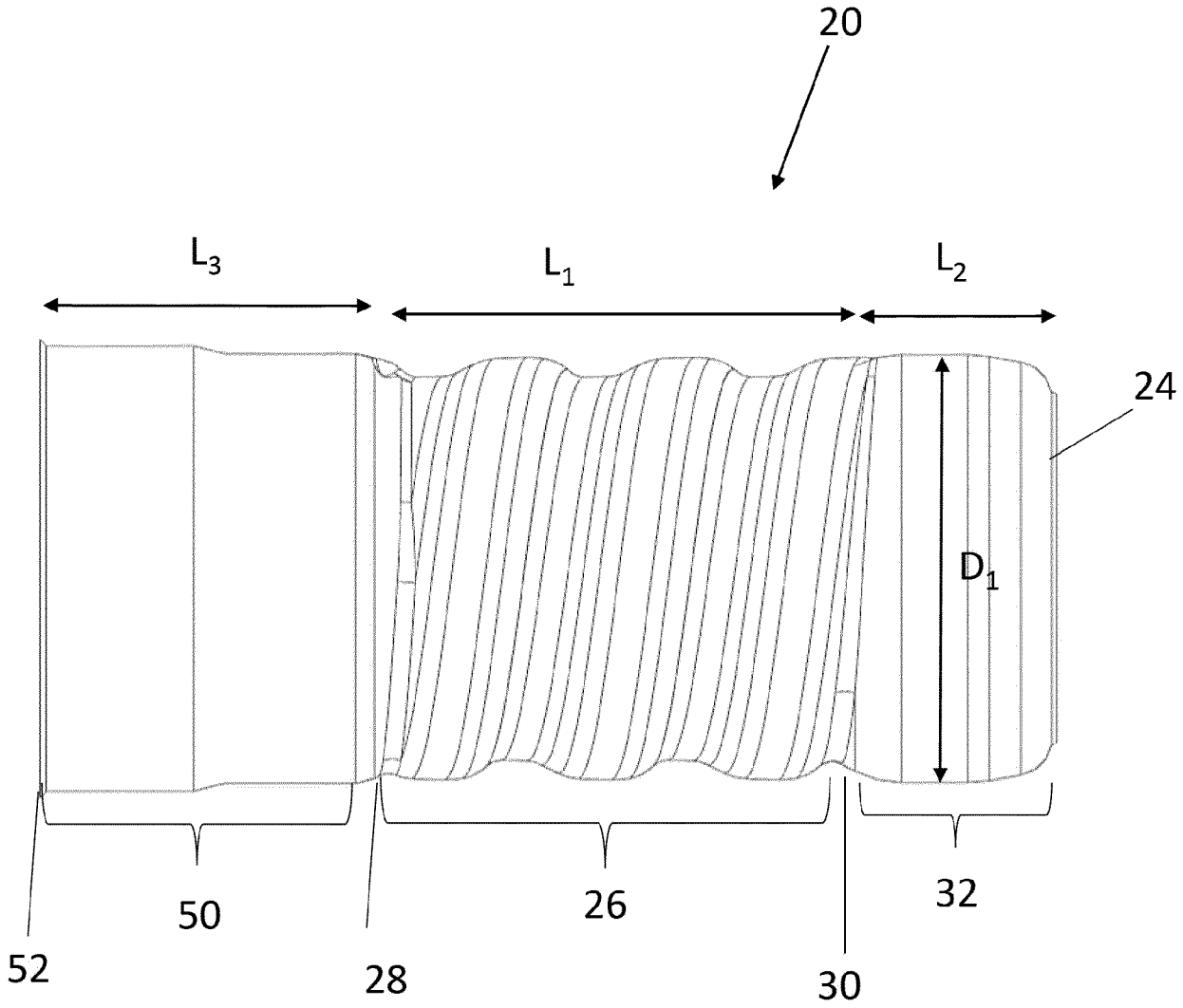

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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