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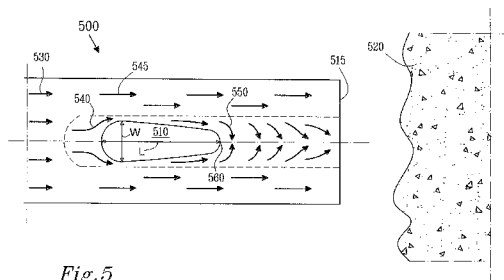


Fig. 5

(57) Abstract: The invention pertains to a neck adaptor at a drilling device for rock drilling. The neck adaptor is cylindrical and comprises an envelope surface, a front end surface, a central axial passage which orifices at the front end surface, and a radial side-flushing hole which extends from the central axial passage and orifices in the envelope surface. The side-flushing hole has an oblong cross-section which extends along a mid axis from a front end of the cross-section of the side-flushing hole to a rear end of the cross-section of the side-flushing hole. The mid axis is substantially parallel with the central axial passage. The front end faces the front end surface of the neck adaptor. The cross-section of the side-flushing hole is wing profile shaped. The cross-section is divided up into two cross-section parts perpendicular against the mid axis, so that each of the two cross-section parts has substantially the same length of the mid axis. The two cross-section parts comprise a front cross-section part comprising the front end of the cross-section of the side-flushing hole, which front cross-section part has a front cross-section area, and a rear cross-section part comprising the rear end of the cross-section of the side-flushing hole, which rear cross-section part has a rear cross-section area. The front cross-section area is formed to be smaller than the rear cross-section area.



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## NECK ADAPTER WITH SIDE-FLUSHING HOLE

### TECHNICAL FIELD

The present invention concerns a neck adaptor for a drill for rock drilling, as well as a drilling device comprising a neck adaptor. In particular, the invention concerns the formation of side-flushing holes in a neck adaptor.

### BACKGROUND OF THE INVENTION

A typical rock drill comprises a number of drilling rods which have been joined together to form a drill string. One end of the drill string culminates in a drill head which drills into the rock as it cuts and rotates. The other end of the drilling rod is coupled to a driving device via a neck adaptor. In use, the drill string cuts and rotates by means of the driving device.

In order that drilling may be carried out effectively when drilling stone, it is necessary that the bottom of the drill hole is kept clean and that drill cuttings are carried away from the drill hole. This is done by a flushing medium, e.g. water or air, being flushed from a flush adaptor via a flush head in through a radial hole, to a central hole in the neck adaptor, and further through a central hole in the drill string and out through the drill head to the bottom of the drill hole. Drill cuttings mixed with the flushing medium are then forced out of the drill hole between the drilling rod and the walls of the drill hole.

Previously, round drilled side-flushing holes were used to enter the flushing medium in a radial direction to the central hole of the neck adaptor and the drill string. Several such side-flushing holes were in general required to achieve a large enough flow area in the side-flushing hole. Often breaks occurred across the holes where the cross section area of the neck adaptors was smallest. To solve the problem, neck adaptors with one single milled elongated side-flushing hole are used today instead of several round side-flushing holes. This is shown for example in SE432460.

When water flushing is used, cavitation damages often appear in the end portions of the flushing holes. Shock waves that arise by percussion drilling makes the neck adaptor to quickly move a short distance in axial link, a so called shock wave movement. This results in problems in that cavitation bubbles are formed due to the water not being able to keep up with the fast acceleration which means a sideways movement compared with its radial flow direction. When the cavitation bubbles collapse, this takes place in the front and the rear portions of the flushing hole due to that the shock wave movement takes place in both

directions, a primary wave due to a piston slap and a secondary wave a little bit later due to a rock reflection in the other direction. This causes local damages which easily initiates a break in the neck adaptor as the strain is so high. The problem is particularly noticeable when drilling is performed at high impact frequencies. In this document, the word "front" refers to the portion of the flushing hole that is closest to the rock that is drilled in at drilling, and the "rear" the portion of the flushing hole that is furthest away from the rock that is drilled in at drilling.

## SUMMARY OF THE INVENTION

The aim of the present invention is to provide a neck adaptor with improved structural strength.

This aim is achieved by a neck adaptor of a drilling device for rock drilling. The neck adaptor is cylindrical and comprises an envelope surface, a front end surface, a central axial passage which orifices at the front end surface, and a radial side-flushing hole which extends from the central axial passage and orifices in the envelope surface. The side-flushing hole has an elongated cross-section which extends along a mid axis from a front end of the cross-section of the side-flushing hole to a rear end of the cross-section of the side-flushing hole. The mid axis is substantially parallel to the central axial passage. The front end faces the front end surface of the neck adaptor. The cross-section of the side-flushing hole is wing profile shaped. The wing profile shaped cross-section is divided into two cross-section parts perpendicular to the mid axis, so that each of the two cross-section parts has substantially equally long parts of the mid axis. The two cross-section parts comprise a front cross-section part comprising the front end of the cross-section of the side-flushing hole, which front cross-section part has a front cross-section area, and a rear cross-section part comprising the rear end of the cross-section of the side-flushing hole, which rear cross-section part has a rear cross-section area. The wing profile shaped cross-section is formed so that the front cross-section area is smaller than the rear cross-section area.

As the cross-section of the side-flushing hole is wing profile shaped and the wing profile shaped cross-section is formed so that the front cross-section area is smaller than the rear cross-section area, the shock wave passage around the side-flushing hole in the neck adaptor is facilitated at percussion drilling, minimal harmful tensile stress around the side-

flushing hole is formed. This means that the structural strength of the neck adaptor is improved.

An advantage of the present invention is that it is simple to manufacture.

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Another advantage with the present invention is that it renders a formation of the cross-section of the side-flushing hole possible so that a large flow area is obtained for the flushing medium.

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An advantage with an embodiment according to the present invention is that more cavitation bubbles implode before they reach the area around the sensitive front and also the rear end of the cross-section of the side-flushing hole in the neck adaptor.

#### BRIEF DESCRIPTION OF THE DRAWINGS

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Figure 1 is a schematic side view of a drilling device for rock drilling.

Figure 2 is a schematic view which shows an axial cross-section of a neck adaptor according to the present invention.

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Figure 3 is a schematic view which shows a three dimensional view of a neck adaptor according to the present invention.

Figure 4 is a schematic view which shows a radial cross-section of a side-flushing hole in a neck adaptor according to prior art.

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Figure 5 is a schematic view which shows a radial cross-section of a side-flushing hole in a neck adaptor according to the present invention.

Figure 6 is a schematic view which shows a radial cross-section of a side-flushing hole in a neck adaptor according to an embodiment of the present invention.

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Figure 7 is a schematic view which shows a radial cross-section of a side-flushing hole in a neck adaptor according to yet another embodiment of the present invention.

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Figure 8 is a schematic view which shows a radial cross-section of a side-flushing hole in a neck adaptor according to yet an embodiment of the present invention.

5 Figure 9 is a schematic view which shows a radial cross-section of a side-flushing hole in a neck adaptor according to yet another embodiment of the present invention.

Figure 10 is a schematic view which shows a radial cross-section of a side-flushing hole in a neck adaptor according to yet another embodiment of the present invention.

10 Figure 11 is a schematic view which shows a radial cross-section of a side-flushing hole in a neck adaptor according to yet another embodiment of the present invention.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

15 A number of embodiments according to the invention will now be described with reference to the figures. The present invention is not limited to these embodiments. Other variants, equivalents and modifications may be used. Therefore, these embodiments shall not be interpreted as limiting the scope of the present invention, which scope is defined by the accompanied claims.

20 **Figure 1** shows a device for rock drilling 10. The rock drilling device 10 comprises a drilling machine 20, a number of drilling rods 30, which have been joined together forming a drill string 40. One end of the drill string culminates in a drill head 50 which drills into the rock 52 as it cuts and rotates and thereby forms a drill hole 55. The other end of the drill string 40 is  
25 coupled to the drilling machine 20 via a neck adaptor 60. The drill string cuts, with to-and-fro movements, and rotates in use, driven by the drilling machine 20.

To remove drill cuttings from the bottom of the drill hole 55, the drilling machine comprises a flushing device 70. A flushing medium, for example water or air, is flushed with a device  
30 for flushing medium supply 80 in via the flushing device 70 into a central axial passage in the neck adaptor 60 and further out through a central hole in the drill string 40 and out through the drill head 50 to the bottom of the drill hole 55. The drill cuttings mixed with the rinsing medium are then forced out through the drill hole 55 between the drill string and the walls of the drill hole.

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**Figure 2** shows a schematic cross-section of the neck adaptor 60 seen from the side and **Figure 3** shows a schematic three dimensional and transparent sketch of the neck adaptor 60. The neck adaptor 60 is cylindrical and comprises an envelope surface 110, a front end surface 115 and the central axial passage 120 which orifices at the front end surface 115.

5 The front end surface 115 is adapted to connect the central axial passage 120 to the central hole in the drill string 40, for example by thread assembly of the drill string 40 with the front portion of the neck adaptor 60. The neck adaptor 60 also comprises a radial side-flushing hole 130 which extends from the central axial passage 120 and orifices in the envelope surface 110. A flushing medium is flushed in through the side-flushing hole 130, the arrow  
10 140 shows the movement of the flushing medium through the side flushing-hole 130. When a shock wave spreads, after a while the neck adaptor 60 is moved, i.e. each cross-section of the neck adaptor 60 quickly along a short distance 150, a so called shock wave movement 150 in axial direction along the central axis 160 of the neck adaptor 60. The shock wave movement is normally in the order of magnitude of 1 mm. The dashed line in  
15 Figure 2 shows the neck adaptor 60 in the position before it has moved the short distance 150, the distance is herein drawn in exaggerated perspective for a better view. The neck adaptor 60 is made of a suitable material, preferably of steel.

A part of the inventiveness of the present invention lies in analyzing and understanding the  
20 problem. The cavitation bubbles especially have a tendency to gather at the front portion of the flushing hole and implode there, the number of damages is also the largest at the front portion. To analyze the problem by looking at the tension picture in the neck adaptor, in **Figure 4** it is shown a cross-section of a known neck adaptor 400 comprising a central axis 405. The neck adaptor 400 has a side-flushing hole with a conventional oblong cross-  
25 section 410 which extends along a mid axis 415, which mid axis is parallel with the central axis 405 of the neck adaptor 400. The cross-section 410 of the side-flushing hole has a length L along its mid axis and a breadth w which partly is constant and partly varies along the mid axis 415 of the cross-section of the side-flushing hole. The maximal breadth of the cross-section 410 of the side-flushing hole is W. The cross-section 410 of the side-flushing  
30 hole is terminated with the radius  $R = W/2$ . The rock 420 which is to be drilled is shown to the right in Figure 4, which means that the drill and the neck adaptor 400 cuts in that direction at percussion drilling in the rock 420, i.e. to the right in Figure 4. The shock wave movement which is formed at percussion drilling moves the neck adaptor 400 in the same direction, i.e. to the right in Figure 4.

The shock wave gives rise to a tension flow in the neck adaptor material. The arrows, among others the arrows 430, 440 and 450 in the neck adaptor 400, represent size and direction of the tension flow in the neck adaptor 400 at a shock wave movement.

- 5  $\sigma = F / [1]$  where  $\sigma$  is the tension,  $F$  is the power in the cutting and  $A$  is the area, i.e. the cross-section of the neck adaptor 400.

$\sigma = E * \epsilon$  [2] where  $E$  is the coefficient of elasticity of the material that the neck adaptor 60 is manufactured of and  $\epsilon$  is the stretch of the material.

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The propagation velocity  $c$  of the shock wave in the neck adaptor may be calculated from the equation  $c^2 = E/\rho$  [3] where  $\rho$  is the density of the material that the neck adaptor 60 is manufactured by. The propagation velocity  $c$  of the shock wave in the neck adaptor 60 if it is made out of steel is  $\approx 5100$  m/s.

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The duration of the shock wave is in the size range of a few tenths of a millisecond. The shock wave causes the neck adaptor 400 to compress which causes a tension field in the neck adaptor 400, see equation [2]. A quite good way to the left of the side-flushing hole 410 the tensions are compressive stresses that are homogenous over the whole cross-

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section of the neck adaptor, see for example arrow 430. Closer to the left side of the side-flushing hole 410, the tension flow is forced to round the side-flushing hole 410, see for example arrow 440. There the cross-section area of the neck adaptor 400 decreases and thereby the compressive stress  $\sigma$  increases, see equation [1] and arrow 445. Increased

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compressive stress most often do not lead to any major problem, and is therefore not so harmful. To the right of the side-flushing hole 410, the cross-section of the neck adaptor increases and the stress  $\sigma$  decreases again, see equation [1]. During a transitional distance, similar to the eddies formed behind for example a sailing boat which travels

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through the water, "tension eddies" are formed locally closest after the side-flushing hole 410, i.e. closest to the right of the side-flushing hole 410, which is due to that the cross-section area of the neck adaptor 400 increases very abrupt to the right of the side-flushing hole 410. This in turn depends on that the oblong cross-section of the side-flushing hole 410 has an abrupt termination against the side of the rock, i.e. the side-flushing hole 410 that is oblong has along a large mid section of its length  $L$  a constant breadth  $W$ , but the breadth  $W$  decreases greatly during a very short part of the length  $L$ . These tension eddies

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mean that the compressive stresses changes into tensile stress, which is shown in Figure 4

by that the arrows bend off in the opposite direction, see for example arrow 450. I.e. compressive stress means that the stress arrow is directed to the right in Figure 4 and tensile stress means that the stress arrow points to the left in Figure 4. Tensile stress means a larger risk for damage to the neck adaptor, especially if the area is already  
5 weakened by cavitation damages. This may also be described as that the material particles to the right of the side-flushing hole 410 cannot obtain any push by particles to the left as there are holes there, instead they are pulled with the shock wave movement by their "neighboring particles" above, below and to the right. Tension from the surrounding particles of course gives a tensile stress in the neck adaptor material. As water has no  
10 tensile strength, in the boat metaphor water eddies instead of tensile stress is formed.

To improve the strength of the neck adaptor, the cross-section of the side-flushing hole in the neck adaptor should be formed so that the "eddy formation" is minimized, i.e. so that as little tensile stress as possible arises. One way to achieve this is to form the cross-section  
15 of the side-flushing hole so that it is wing profile shaped, with reference to the passage of the shock wave in the material of the neck adaptor around the cross-section of the side-flushing hole. As tension from the surrounding particles provides a tensile stress in the material of the neck adaptor similar to an eddy formation in the water behind a boat according to the discussion in the above, special care should be taken to the formation of  
20 the "stern" of the hole. This facilitates the shock wave passage in the material of the neck adaptor around the side-flushing hole. With a wing profile is meant a streamline shape, formed like the cross-section of a wing which is blunter against the flow and pointier with the flow. **Figure 5** shows a cross-section of a neck adaptor 60 which comprises the side-flushing hole 130 with a wing profile shaped cross-section 510, according to the present  
25 invention. The neck adaptor 60 comprises a front portion 515 which at drilling is faced against the rock 520 which is to be drilled into. The rock 520 which is to be drilled into is accordingly shown to the right in Figure 5, which means that the drill and the neck adaptor 60 cuts in that direction at percussion drilling in the rock 520, i.e. to the right in Figure 5. The shock wave movement which is formed at cutting at drilling, moves the neck adaptor in  
30 the same direction, i.e. to the right in Figure 5. The shock wave gives, as mentioned in the above, rise to a tension flow in the steel. The arrows, among others the arrows 530, 540, 545 and 550 in the neck adaptor 60 represents the tension flow in the neck adaptor 60 at a shock wave passage.

By forming the cross-section 510 of the side-flushing hole in a wing profile shape, on the side of the maximal breadth  $W$  of the cross-section 510 which faces the rock 520, i.e. with a long and narrowing form with a pointier termination, i.e. with a smaller radius than  $W/2$  by way of termination, the zone with tension eddies with accompanying tensile stresses will become smaller, see the area to the right of the cross-section 510 of the side-flushing hole, for example the arrow 550. In the discussion with the boat metaphor, the rock side of the cross-section 510 of the side-flushing hole corresponds to the stern. When the side-flushing hole 130 has a wing profile shaped cross-section 510, the increase of the cross-section area of the neck adaptors to the right of the maximal breadth  $W$  of the flushing hole is not so abrupt, which means that the compressive stress may decrease in a controlled manner along the side-flushing hole 130, which in its turn provides a considerably less formation of tension eddies/tensile stress, compared to the conventional neck adaptor 400. This is favorable for the strength of the neck adaptor 60. To facilitate the manufacture of the side-flushing hole 130, it is advantageous if the cross-section 510 of the side-flushing hole 130 is rounded and not too pointy in its outermost end 550 which faces the rock. This means that the cross-section of the neck adaptor 60 certainly will increase abruptly on the side of the front end 560 of the cross-section 510 of the side-flushing hole which faces the rock, but even if the increase is abrupt, it is not very large. In the zone after, i.e. to the right of the narrowing form of the wing profile shaped cross-section 510 of the side-flushing hole 130, is no longer the same high compressive stress level remaining as in the known neck adaptor in Figure 4, thereby the damaging tensile stresses are much reduced. Testing of a neck adaptor with this wing profile shape shows that the damages are considerably reduced.

The cross-section 510 of the wing profile shaped side-flushing hole is shown in **Figure 6** and may be described in the following manner. The cross-section 510 is oblong and extends along a mid axis 610 from the front end 560 of the cross-section 510 which faces the front portion (515 in Figure 5) of the neck adaptor 60 against the side of the rock, to a rear end 630 of the cross-section 510 which faces away from the side of the rock. The mid axis 610 of the cross-section of the side-flushing hole is substantially parallel with the central axial passage 120 which is shown in Figure 3. The cross-section 510 of the side flushing hole has a length  $L$  along its mid axis and a breadth  $w$  which for example may be partly constant and partly vary along the mid axis 610 of the cross-section of the side-flushing hole. In a descriptive model of the cross-section 510 of the side-flushing hole, the cross-section 510 is divided into two cross-section parts, perpendicular against the mid axis 610 so that each of the two cross-section parts has substantially the same length of the mid

axis 610. The cross-section 510 may also be divided up into more than two cross-section parts, such as in embodiments later on in this document. The at least two parts comprise a front cross-section part 640 and a rear cross-section part 650. The front cross-section part 640 comprises the front end 560 of the cross-section 510 of the side-flushing hole, and the rear cross-section part 650 comprises the rear end 630 of the cross-section 510 of the side hole. The front cross-section part 640 has a front cross-section area 660, and the rear cross-section part 650 has a rear cross-section area 670. The wing profile shaped cross-section 510 is shaped so that the front cross-section area 660 is smaller than the rear cross-section area 670, i.e. so that the front cross-section area 660 is pointier in the direction towards the rock and the rear cross-section area 670 is blunter in the direction away from the rock.

The wing profile shaped cross-section 510 of the side-flushing hole may be manufactured in a variety of different embodiments. The cross-section 510 of the side-flushing hole has a length  $L$  which extends along the mid axis 610 of the cross-section of the side-flushing hole and a breadth  $w$  which is perpendicular towards the length  $L$  and which entirely or partly varies along the length  $L$ . In some embodiments, such as in the example that is shown in Figure 6, the length  $L$  is more than or twice as long as the maximal breadth  $W$  in the broadest position along the length  $L$ . This is advantageous as it gives low tension concentrations around the side-flushing hole as well as a large flow area for the flushing medium if the long length can be allowed with reference to the surrounding construction.

Some embodiments, such as for example the one that is shown in **Figure 7**, may have a side-flushing hole which has a wing profile shaped cross-section 510 with a short length  $L$ , for example a length  $L$  which is less than twice as long as the breadth  $w$  in the broadest position along the length  $L$ . If a short side-flushing hole is desirable, this form is advantageous as it gives the cross-section 510 of the side-flushing hole a large flow area for the flushing medium, despite a side-flushing hole with small axial extension.

Among some embodiments, such as for example the one shown in **Figure 6**, **Figure 7** and **Figure 8** the breadth  $w$  of the wing profile shaped cross-section 510 of the side-flushing hole gradually decreases during a large part of the length  $L$  of the cross-section 510 of the side-flushing hole on the side which comprises the front end 560, for example during more than half of the length  $L$  of the cross-section 510 of the side-flushing hole, which gives a very favorable tension position with very little eddy formation, i.e. very little tensile stress.

The wing profile shaped cross-section 510 of the side-flushing hole may, to describe some embodiments in a simple manner, such as for example the one's which are shown in **Figure 7, Figure 8, Figure 9, Figure 10 and Figure 11**, comprise a mid section M along the mid axis 610 of the cross-section 510 of the side-flushing hole. The mid section M extends along the length L of the cross-section 510 of the side-flushing hole from a front point 710 at a distance from the front end 560 to a rear end 720 at a distance from the rear end 630.

The breadth  $w$  of the mid section is in some embodiments formed so that it gradually decreases along the mid section M the closer to the front end 560 it gets, from a first breadth  $w_1$  at the rear point 720 along the mid axis 610 of the cross-section of the side-flushing hole to a second breadth  $w_2$  at the front point 710, where the second breadth  $w_2$  is less than the first breadth  $w_1$ .

In some embodiments, the decreasing breadth from  $w_1$  to  $w_2$  along the mid section M, is convexly formed such as for example the embodiment which is shown in **Figure 7**. Such a performance of a side-flushing hole 130 provides the advantage of relatively low tension concentrations around the side flushing hole while still providing a large flow area for the flushing medium.

In some embodiments, the decreasing breadth from  $w_1$  to  $w_2$  along the mid section M, is rectilinearly formed, such as for example the embodiment shown in **Figure 8**. That is an advantage, as a side-flushing hole 130 with such a performance is simple to manufacture.

In some embodiments, the decreasing breadth from  $w_1$  to  $w_2$  along the mid section M, is concavely formed, such as for example the embodiment which is shown in **Figure 9**. Such a performance of a side-flushing hole 130 provides the advantage that a larger part of the arisen cavitation bubbles easier bumps into the inside of the side-flushing hole 130, as the inside diverges inwards into the side-flushing hole 130. When the cavitation bubbles bumps against an inner wall, the probability that they will implode due to the bump before they reach the furthest end 560 of the cross-section of the side-flushing hole will increase. Thereby the risk for damage further decreases at the area of the neck adaptor 60 around the sensitive front end of the cross-section 510 of the side-flushing hole.

The mid section M is in some other embodiments, such as for example the embodiments that are shown in **Figure 10** and **Figure 11**, formed so that the breadth  $w$  is constant  $W$  along the mid section M from the rear point 720 along the mid axis 610 of the cross-section of the side-flushing hole to the front point 710. To accomplish the cross-section 510 of the side-flushing hole in such a manner provides the advantage that it is simple to manufacture and it also gives a large flow area for the flushing medium.

The cross-section 510 of the side-flushing hole may, to describe some embodiments, such as for example the one's that are shown in **Figure 10** and **Figure 11**, in a simple manner comprise a **front section F** along the mid axis 610 of the cross-section of the side-flushing hole. The front section F extends along the length  $L$  of the cross-section of the side-flushing hole from the front point 710 to the front end 560.

As the cross-section 510 of the side-flushing hole is wing profile shaped, the breadth  $w$  of the front section is in all embodiments formed so that it successively decreases with caution along the front section F the closer to the front end 560 that it gets, from a third breadth  $w_3$  at the front point 710 along the mid axis (610) of the cross-section of the side-flushing hole to a forth breadth  $w_4$  at the front end 560, which forth breadth  $w_4$  is zero and is therefore not visible in the Figures 10 and 11. The forth breadth  $w_2$  is consequently smaller than the third breadth  $w_3$ .

In some embodiments, the decreasing breadth from  $w_3$  to  $w_4$  along to the front section F, is convexly formed, such as for example the one shown in **Figure 10**. Such a performance of a side-flushing hole 130 provides the advantage of a large flow area for the flushing medium.

In some embodiments, the decreasing breadth from  $w_3$  to  $w_4$  along the front section F, is rectilinearly formed, such as for example the one shown in **Figure 11**. Such a performance of a side-flushing hole 130 provides the advantage of a simple manufacture.

The decreasing breadth from  $w_3$  to  $w_4$  along the front section F may also be concavely formed (not shown).

The cross-section 510 of the side-flushing hole may, to describe some embodiments, such as for example the one's that are shown in **Figure 11**, in a simple manner comprise a rear

section B along the mid axis 610 of the cross-section of the side-flushing hole, with a length  $L_B$ . The rear section B extends along the length L of the cross-section 510 of the side-flushing hole from the rear point 720 to the rear end 630. It is advantageous to also consider the stress waves that spread in the other direction, i.e. in the direction away from the rock 420, due to that as a consequence, the original stress waves at least partly may be reflected against the rock. In that case, it is the rear section B which is the "stern of the boat". Still, it is valid that the front cross-section area is smaller than the rear cross-section area, as it is most advantageous in the normal bearing case which occurs at every piston slap. It is hence advantageous to form the rear section B so that it does not terminate too abruptly, for example by forming the rear section B so that its length  $L_B$  is larger than half of the breadth W of the cross-section 510 of the side-flushing hole, i.e.  $L_B$  is larger than  $W/2$ .

The mid-axis of the side-flushing hole 130 may be perpendicular against the central axis 160 of the neck adaptor or angled forward or backwards along the central axis 160 of the neck adaptor in an angle which preferably is between  $45^\circ$  and  $90^\circ$  forward or backwards. To decrease the cavitation further, the edges of the radial side-flushing hole 130 are in some embodiments formed in an angle so that the cross-section 510 of the side-flushing hole is larger or smaller at its orifice on the envelope surface 110 than at the connection of the central axial passage 120.

In the above discussion it has only been referred to figures that show that the cross-section 510 of the side-flushing hole is symmetrical with reference to the mid axis 610, but the present invention also comprises the alternative that the cross-section 510 is asymmetrical with reference to the mid axis 610.

**CLAIMS**

1. Neck adaptor (60) at a drilling device for rock drilling, which neck adaptor (60) is cylindrical and comprises an envelope surface (110), a front end surface (115), a central axial passage (120) which orifices at the front end surface (110), and a radial side-flushing hole (130) which extends from the central axial passage (120) and orifices in the envelope surface (110), which side-flushing hole (60) has an oblong cross-section (510) which extends along a mid axis (610) from a front end (560) of the cross-section (510) of the side-flushing hole to a rear end (630) of the cross-section (510) of the side-flushing hole, which mid axis (610) is substantially parallel to the central axial passage (120), and wherein the front end (560) faces the front end surface (115) of the neck adaptor,

**characterized in**

that the cross-section 510 is wing profile shaped,

that the wing profile shaped cross-section (510) is divided into two cross-section parts perpendicular to the mid axis (610), so that each of the two cross-section parts has substantially the same length of the mid axis (610), which two cross-section parts comprise

a front cross-section part (640) comprising the front end (560) of the cross-section (510) of the side-flushing hole, which front cross-section part (640) has a front cross-section area (660), and

a rear cross-section part (650) comprising the rear end (630) of the cross-section (510) of the side-flushing hole, which rear cross-section part (650) has a rear cross-section area (670), and

that the wing profile shaped cross-section (510) is formed so that the front cross-section area (660) is smaller than the rear cross-section area (670).

2. Neck adaptor according to claim 1, wherein the cross-section (510) of the side-flushing hole comprises a length (L) which extends along the mid axis (610) of the cross-section of the side-flushing hole, and a breadth (w) which is perpendicular to the length (L) and which partly varies along the length (L), and wherein the length (L) is more than or twice as long as the breadth (w) of the broadest position along the length (L).

3. Neck adaptor (60) according to claim 1, wherein the cross-section (510) of the side-flushing hole comprises a length (L) which extends along the mid axis (610) of the cross-section of the side-flushing hole, and a breadth (w) which is perpendicular to the length (L), and which partly varies along the length (L), and where the length (L) is less than twice as long as the breadth (w) of the broadest position along the length (L).
4. Neck adaptor (60) according to any of claims 2-3, wherein the breadth (w) of the cross-section (510) of the side-flushing holes gradually decreases along a part of the length (L) of the cross-section of the side-flushing hole on the side of the length (L) which comprises the front end (560).
5. Neck adaptor (60) according to claim 4, wherein the breadth (w) of the cross-section (510) of the side-flushing hole gradually decreases along more than half of the part of the length (L) of the cross-section (510) of the side-flushing hole.
6. Neck adaptor (60) according to any of claims 1-5, wherein the cross-section (510) of the side-flushing hole comprises a mid section (M) along the mid axis (610) of the cross-section of the side-flushing hole, which mid section (M) extends along the length (L) of the cross-section (510) of the side-flushing hole from a front point (710) at a distance from the front end (560) which corresponds to the radius of curvature in the front end of the cross-section of the side-flushing hole, to a rear point (720) at a distance from the rear end (630) which corresponds to the radius of curvature in the rear end of the cross-section of the side-flushing hole.
7. Neck adaptor (60) according to claim 6, wherein the breadth (w) of the cross-section (510) of the side-flushing hole at the mid section (M) is formed so that the breadth (w) gradually decreases along the mid section (M) the closer to the front end (560) the breadth (w) is, from a first breadth ( $w_1$ ) at the rear point (720) along the mid axis (610) of the cross-section of the side-flushing hole to a second breadth ( $w_2$ ) at the front point (710), where the second breadth ( $w_2$ ) is smaller than the first breadth ( $w_1$ ).
8. Neck adaptor (60) according to claim 7, wherein the decreasing breadth ( $w_1$ - $w_2$ ) along the mid section (M) is convexly formed.

9. Neck adaptor (60) according to claim 7, wherein the decreasing breadth ( $w_1-w_2$ ) along the mid section (M) is rectilinearly formed.

5 10. Neck adaptor (60) according to claim 7, wherein the decreasing breadth ( $w_1-w_2$ ) along the mid section (M) is concavely formed.

10 11. Neck adaptor (60) according to claim 6, wherein the breadth (w) of the mid section is formed so that the breadth (w) is constant along the mid section (M) from the rear point (720) along the mid axis (610) of the cross-section of the side-flushing hole to the front point (710).

15 12. Neck adaptor (60) according to any of claims 1-5, wherein the cross-section (510) of the side-flushing hole comprises a mid section (M) along the mid axis (610) of the cross-section of the side-flushing hole, which mid section (M) extends along the length (L) of the cross-section (510) of the side-flushing hole from a front point (710) at a distance from the front end (560) which corresponds to a third of the length (L) of the cross-section of the side-flushing hole to a rear point (720) at a distance from the rear end (630) which corresponds to the radius of curvature in the rear end of the cross-section of the side-flushing hole, and wherein the cross-section (510) of the side-flushing hole comprises a front section (F) along the mid axis (610) of the cross-section of the side-flushing hole, which front section (F) extends along the length (L) of the cross-section of the side-flushing hole from the front point (710) to a point just before the front end (560).

25 13. Neck adaptor (60) according to claim 12, wherein the breadth (w) of the cross-section of the side-flushing hole in the front section (F) is formed so that the breadth (w) gradually decreases along the mid axis (610) of the front section (F) of the cross-section of the side-flushing hole, the closer to the point just before the front end (560) the breadth (w) comes, from a third breadth ( $w_3$ ) at the front point (710) along the mid axis (610) of the cross-section of the side-flushing hole right up to a forth breadth ( $w_4$ ) at the point just before the front end (560), where the forth breadth ( $w_4$ ) is smaller than the third breadth ( $w_3$ ).

14. Neck adaptor (60) according to claim 13, wherein the decreasing breadth ( $w_3-w_4$ ) along the front section (F) is convexly formed.

15. Neck adaptor (60) according to claim 13, wherein the decreasing breadth ( $w_3-w_4$ ) along the front section (F) is rectilinearly formed.

16. Neck adaptor (60) according to claim 13, wherein the decreasing breadth ( $w_3-w_4$ ) along the front section (F) is concavely formed.

17. Neck adaptor (60) according to any of claims 1-16, wherein the cross-section (510) of the side-flushing hole comprises a rear section (B) along the mid axis (610) of the cross-section of the side-flushing hole, with a length ( $L_B$ ), where the rear section (B) extends along the length (L) of the cross-section (510) of the side-flushing hole from the rear point (720) to the rear end (630), and where the rear section is formed with a length ( $L_B$ ) which is larger than half of the breadth (W) of the cross-section of the side-flushing hole.

18. Neck adaptor (60) according to any of claims 1-17, wherein the edges of the radial side-flushing hole (130) are formed so that the cross-section (510) of the side-flushing hole is larger at its orifice on the envelope surface (110) than at the connection to the central axial passage (120).

19. Neck adaptor (60) according to any of claims 1-18, wherein a mid axis in the side-flushing hole 130 has an angle against the central axis (160) of the neck adaptor (60) which is between  $45^\circ$  and  $90^\circ$  forwards or backwards along the central axis (160) of the neck adaptor.

20. Drilling device (10) for rock drilling, which drilling device (10) is characterized by that it comprises a neck adaptor (60) according to any of claims 1-19.

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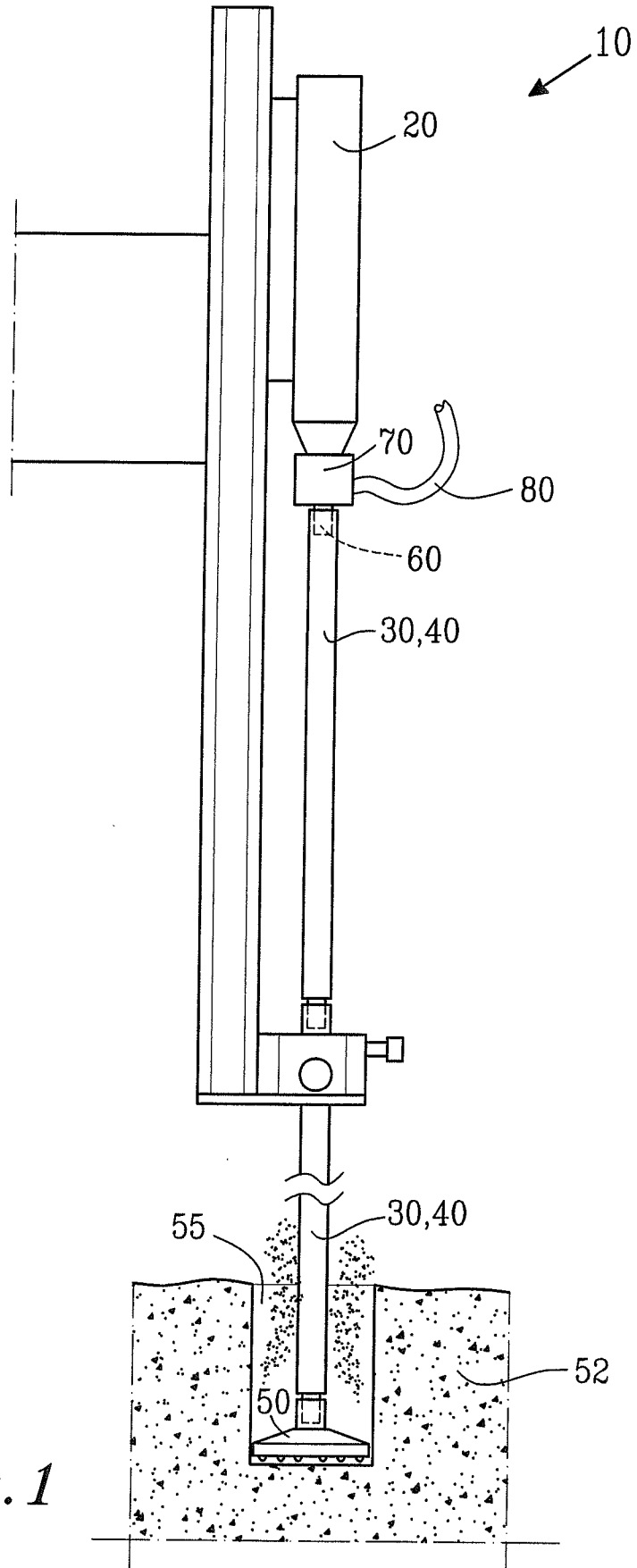
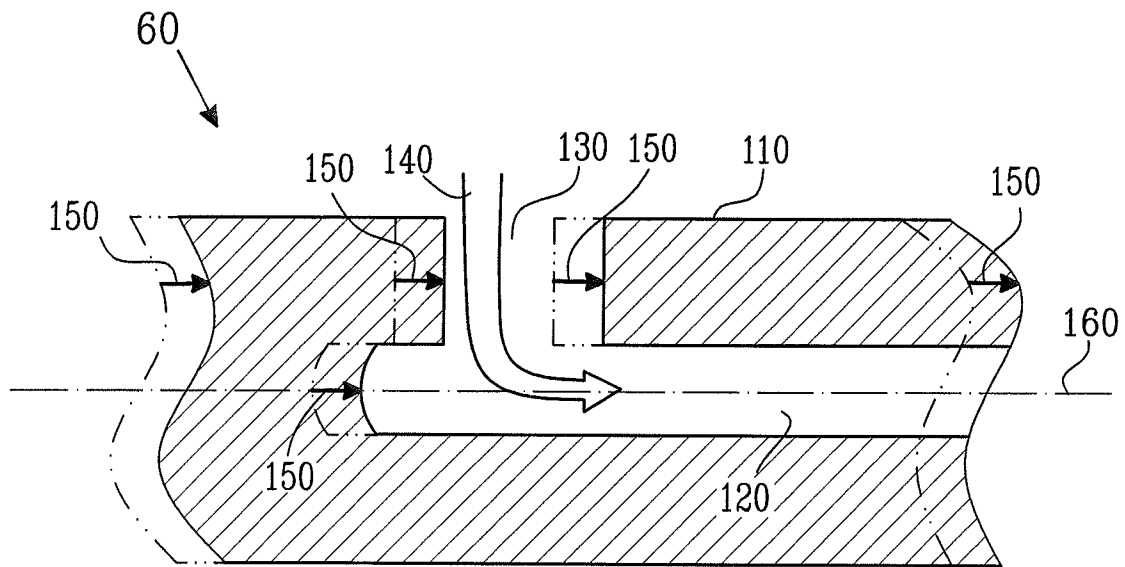
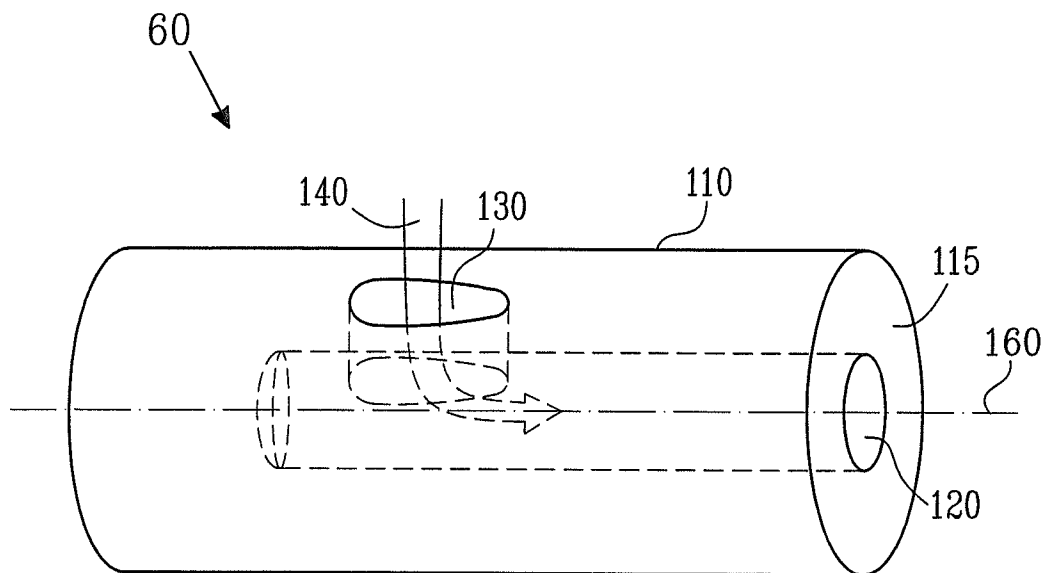
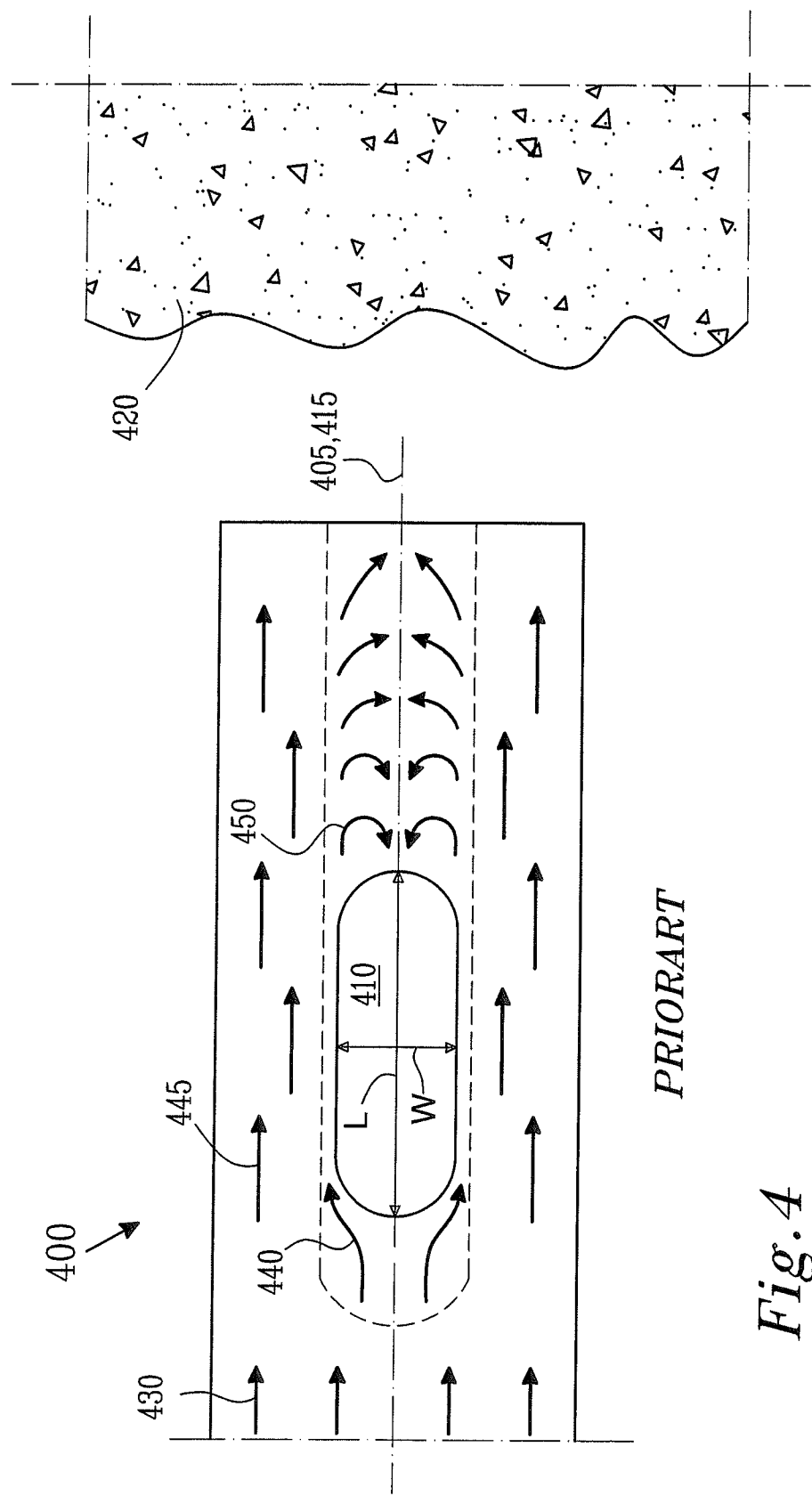


*Fig. 1*

*Fig. 2**Fig. 3*



*PRIORART*

*Fig. 4*

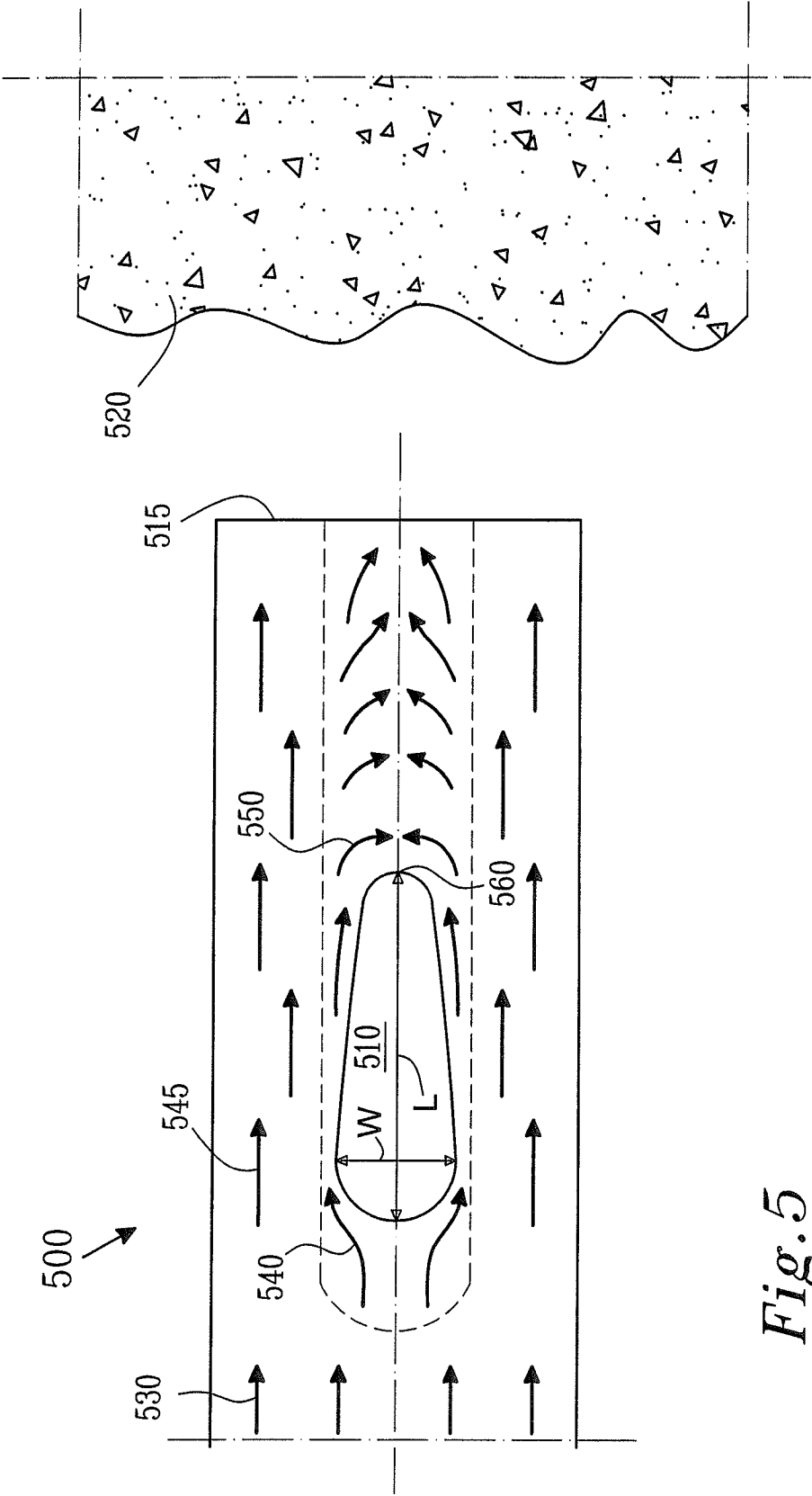
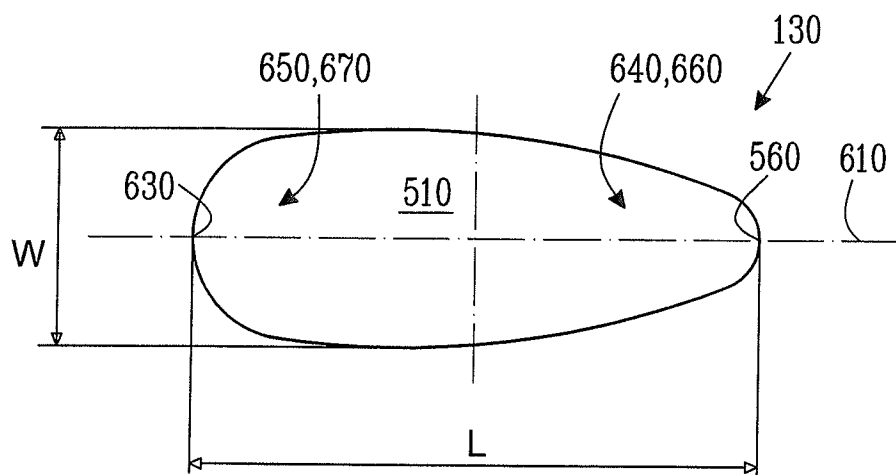
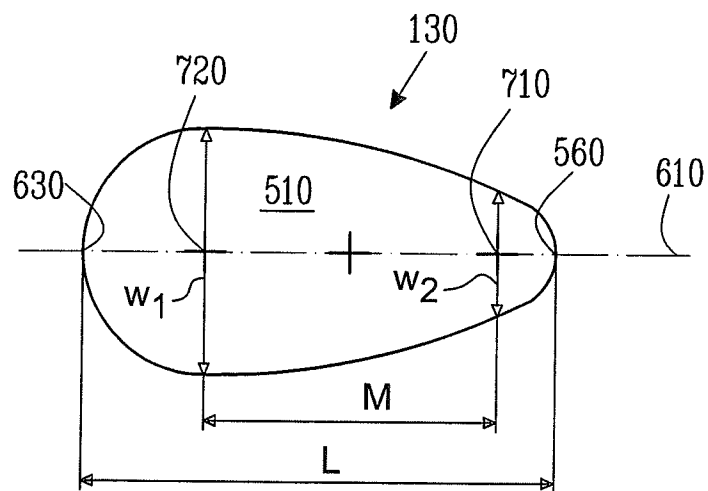
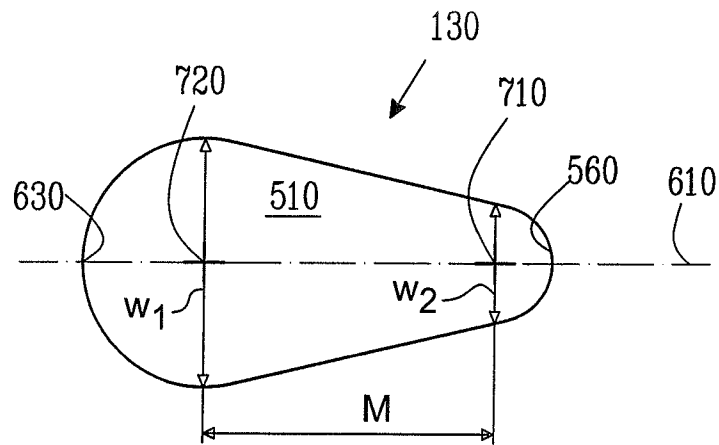
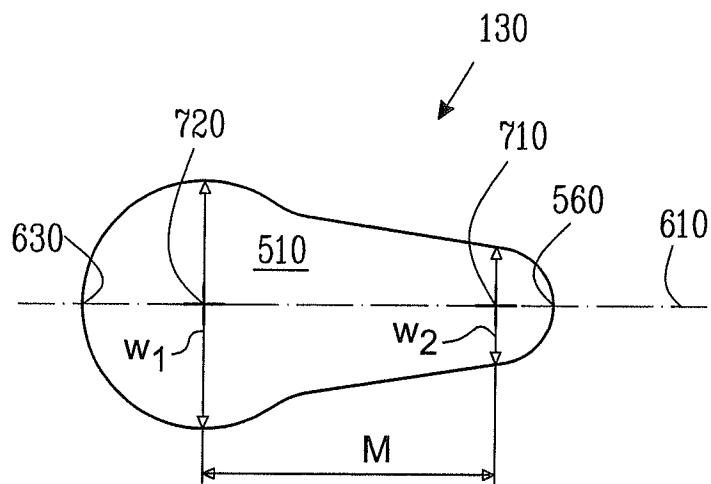


Fig. 5

*Fig. 6**Fig. 7*

*Fig. 8**Fig. 9*

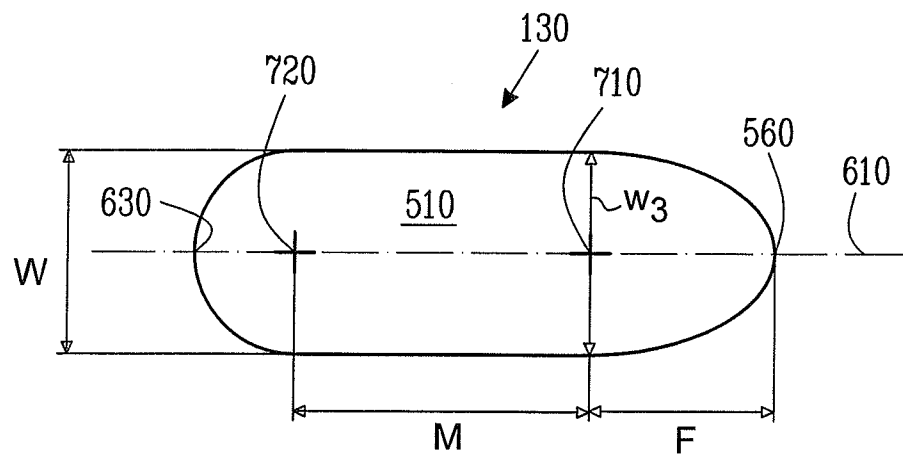


*Fig. 10*

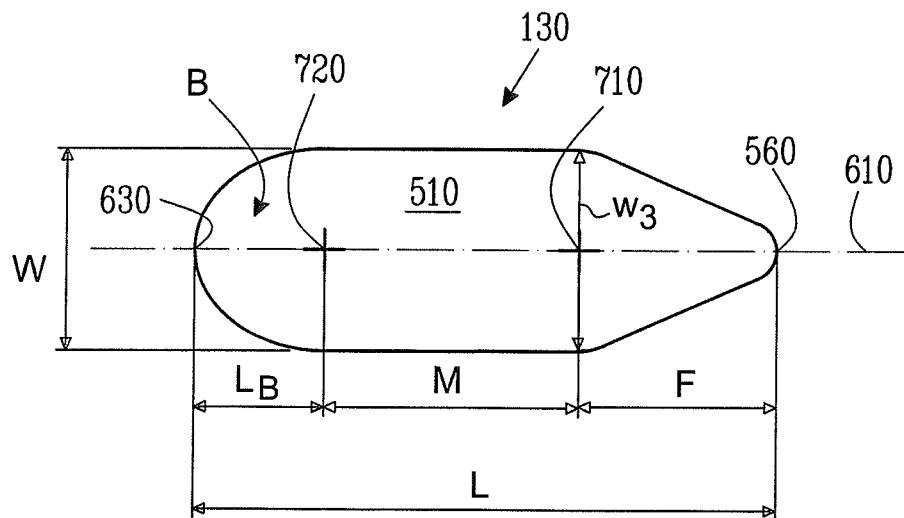


*Fig. 11*

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2008/050431

## A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: E21B, B25D

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, WPI DATA, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages    | Relevant to claim No. |
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| A         | SE 432460 B (FAGERSTA AB), 2 April 1984<br>(02.04.1984)<br>--<br>-----                | 1-20                  |

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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**International patent classification (IPC)****E21B 17/00** (2006.01)**B25D 17/22** (2006.01)**E21B 21/00** (2006.01)**Download your patent documents at [www.prv.se](http://www.prv.se)**

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Cited literature, if any, will be enclosed in paper form.

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

28/06/2008

International application No.

PCT/SE2008/050431

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