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(54) **A CASING PIPE, A CASING PIPE ARRANGEMENT, A CASING SHOE, A TOOL ARRANGEMENT HAVING A CASING SHOE, AND A DRILL ARRANGEMENT**

(57) The disclosure relates to a casing pipe with a first and a second attachment means being friction welded to the rest of the casing pipe. An outermost groove element (2a) of the first attachment co-operates with an innermost shoulder (3a) element of the second attachment means, while an innermost groove element (2c) of the first attachment means co-operates with an outermost shoulder (3c) element of the second attachment means. The groove elements (2a, 2b, 2c) on a first end portion have effective dimensions (Da, Db, Dc) which decrease towards the respective side end. The shoulder elements (3a, 3b, 3c) on a second end portion have effective dimensions (Da, Db, Dc) which increase towards respective side end. The grooves and shoulders may be provided as an opposite arrangement. A casing pipe with two first or second attachment means, and a drill arrangement are also disclosed.

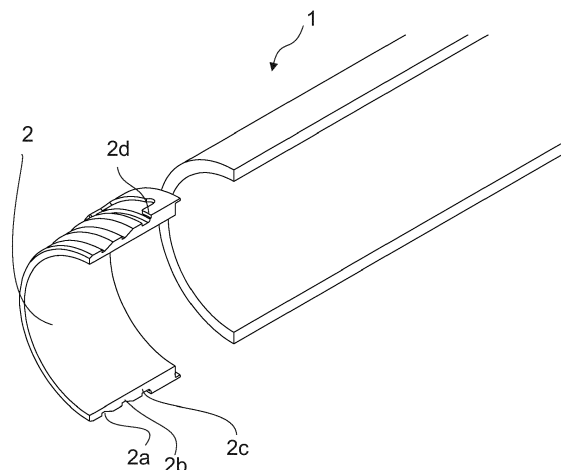


Fig. 6a

Description

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates to a casing pipe and a casing pipe arrangement used in drilling. The present disclosure further concerns a corresponding casing shoes and an arrangement having a casing shoe, and a drill arrangement.

BACKGROUND OF THE DISCLOSURE

[0002] It generally known to use casing pipes in drilling for various purposes. For example, a casing pipe may be arranged to enhance the structural integrity of the drill hole, thus enabling the drill string and drill tools to be removed from the drill hole. A casing pipe may also be used as a casing for inserting piping or tubing into the drill hole after the drilling, or for injecting grout into the hole.

[0003] Commonly, casing pipes are made of iron or steel. Consequently, such casing pipes are generally attached one after another by welding. Although a strong joint is provided, welding is rather time consuming and drilling operations have to be interrupted during the welding operation. Another drawback of the conventional casing pipes is that they are very heavy, which contributes to difficulties relating to handling the casing pipes as well as to increased transportation and handling costs, particularly, if the drilling site is located at a remote destination.

[0004] U.S. Patent publication 4,779,902 discloses an arrangement in which polyolefin casing pipes are connected to each other with corresponding grooves and ribs. However, in order to ensure a reliable connection, multiple such respective grooves and ribs have to be provided. Consequently, in order to attach two such pipes, the outermost ribs have to be pushed past the innermost grooves in order for the subsequent casing pipe to be fully inserted. Such a construction poses difficulties on dimensioning the grooves and ribs with respect to the capability to deform of the casing pipe material while striving to maintain a required rigidity of the casing pipe. Furthermore, as most ribs / grooves undergo several deformation cycles when the such casing pipes are attached, the risk of the casing pipe cracking, or residual tension leading to subsequent failure, is increased

BRIEF DESCRIPTION OF THE DISCLOSURE

[0005] The basic idea of the present disclosure is the concept of providing a casing tube by attaching an end portion having attachment means to the rest of the casing tube. This enables the end portion to be formed and manufactured to withstand the mechanical stresses which the attachment means have to bear, while the rest of the tubular casing of the casing pipe, subject to less strict requirements, can be manufactured separately from the

end portion using, for example, a smaller material thickness than what would be dictated if the end portions would be formed on the tubular casing of the casing pipe.

[0006] Suitably, the end portion is attached to the casing pipe by friction welding, more suitably by spin welding. In friction welding, two objects of are moved with respect to each while being simultaneously pushed towards each other. The pressure and the movement generates sufficient friction to heat the objects such that their abutting surfaces partially melt and eventually fuse together. Spin welding is a specific application of friction welding, where the movement between the two objects is a rotation movements. Spin welding is particularly suitable for both rotationally symmetric objects such as tubes, and for plastic materials, i.e. thermoplastic materials.

[0007] Moreover, the disclosure carries the concept of providing a first attachment means and a second attachment means being correspondingly tapered. Subsequently, corresponding groove and/or shoulder elements can be arranged on the first and second attachment means in such a way that each groove/shoulder element only needs to temporarily deform in order interlock with its respective shoulder / groove element. In other words, for example when inserting a first end portion into a second end portion for attaching subsequent casing pipes, the leading shoulder element does not need to be pushed over the grooves preceding the trailing groove element.

[0008] Consequently, each respective groove/shoulder element is dimensioned with respect to the tapering such that an interlocking attachment is only formed with its respective shoulder / groove element.

[0009] The concepts of the disclosure provide mutual advantages, particularly when the casing pipe is made of a plastics material, where specific problems are faced. Particularly, they both contribute to providing a more reliable connection between casing pipes while enabling less material to be used for the casing pipe.

[0010] As discussed earlier, the constructions according to the prior art are prone to structural failure. However, increasing the material thickness of the casing tube to withstand the stresses faced by the attachment means would lead to an unnecessarily large material thickness on the tubular casing of the casing pipe, thus rendering the whole of the casing pipe economically unattractable.

[0011] The solution according to the present disclosure provides a more reliable connection between casing pipes, as the attachments means encounter smaller stresses during attachment as they undergo only a single deformation cycle when attaching consecutive casing pipes. Respectively, the end portion may be dimensioned for a smaller material thickness as compared to that of more conventional arrangements. Moreover, the manufacturing the end portion having the attachment means separately, and attaching it to the rest of the casing pipe thereafter enables a sufficient material thickness to be used at the end portions, while not having to provide the rest of the casing pipe with an unnecessarily strong material thickness.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 illustrates a cross sectional view of two casing pipes according to an aspect of the description being attached one after another

Fig. 2 illustrates a cross sectional view of an alternative casing pipe according to an aspect of the description

Fig. 3 illustrates a partial cross sectional view of an alternative casing pipe according to an aspect of the description

Fig. 4 illustrates a drill arrangement according to an aspect of the description

Fig. 5 illustrates a drill arrangement equipped with damping means according to an aspect of the description

Fig. 6A and Fig. 6B illustrate a casing pipe and an end portion separately and after being attached, respectively

Fig. 7 illustrates a drill arrangement in which a casing pipe has not yet been attached to a drill bit equipped with a casing shoe.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0013] Figure 1 illustrates a cross-sectional view of a drill arrangement according to an aspect of the description. A casing pipe 1, particularly a first end portion 2 thereof is shown as connected to a second end portion 3 of another similar casing pipe 1. The outer surface of the first end portion 2 is effectively tapered such that it narrows towards said first end. Correspondingly, the inner surface of the second end portion 3 is effectively tapered such that it expands towards said second end. In this context, the phrasing effectively tapered means that the general dimension increases or decreases towards an end. In other words, an effectively tapered end portion may comprise sections at which the dimension locally remains constant or even increases.

[0014] The first end portion 2 comprises an outermost groove element 2a, an intermediate groove element 2b, and an innermost groove element 2c. Respectively, the second end portion 3 comprises an outermost shoulder element 3c, an intermediate shoulder element 3b, and an innermost shoulder element 3a. In this context, the outermost groove element 2a or shoulder element 3c, is an element being closest to its respective end, and respectively, an innermost groove element 2c or shoulder element 3a is an element being furthest from its respective end.

[0015] The outermost groove element 2a of the first end portion is arranged as complementary with the innermost shoulder element 3c of the second end portion 3 so as to form interlocking shapes with each other. The innermost groove element 2c of the first end portion is arranged as complementary with the outermost shoulder element 3c of the second end portion 3 so as to form interlocking shapes with each other. The intermediate groove element 2c of the first end portion is arranged as complementary with the intermediate shoulder element 3c of the second end portion 3 so as to form interlocking shapes with each other.

[0016] Each respective groove element and its respective shoulder element complementary with each other has their own specific effective dimension, That is, in the case of Fig. 1, the inner diameter of the outermost groove element 2a on the first end portion 2 shares its effective dimension with the innermost shoulder element 3c of the second end portion, namely both the outer diameter of the outermost groove element 2a and the inner diameter of the innermost shoulder element 3c have an effective dimension of D_a . The outer diameter of the innermost groove element 2c and the inner diameter of the outermost shoulder element 3a have a shared effective dimension of D_c . The outer diameter of the intermediate groove element 2b and the inner diameter of the intermediate shoulder element 3b have a shared effective dimension of D_b .

[0017] For facilitating the insertion of the first end portion 2 into a second end portion, the effective dimensions D_a , D_b , D_c on the first end portion are arranged to decrease towards the respective end of the first end portion 2. Correspondingly, the effective dimensions D_c , D_b , D_a on the second end portion are arranged to increase towards the respective end of the second end portion 3.

[0018] Fig. 2 illustrates an alternative embodiment according to an aspect of the description. In this embodiment a casing pipe 1' has a first end portion 2 equipped with first attachment means at both of its ends.

[0019] Fig. 3 illustrates an alternative embodiment according to an aspect of the description. In this embodiment a casing pipe 1'' has a second end portion 3 equipped with second attachment means at both of its ends.

[0020] Fig. 4 illustrates a casing pipe assembly comprising casing shoe 4 coupling a drill tool 7 with a casing pipe 1.

[0021] The casing shoe 4 has a tubular casing extending between a tool end portion 5 and a pipe end portion 6.

[0022] The pipe end portion 6 is equipped with attachment means substantially corresponding to the second attachment means of Fig. 1 and Fig. 3. Particularly, an innermost shoulder element 6a, an intermediate shoulder element 6b, and an outermost shoulder element 6c are provided on the inner surface of the casing on the pipe end portion 6. The pipe end portion 6 is further equipped with an abutting surface 6d for abutting the end of the casing pipe 1. The abutting surface 6d is provided

as an annular surface on the inside of the casing. As can be seen more clearly from Detail A of Fig. 4 the abutting surface 6d is slightly inclined from a vertical to the longitudinal axis of the arrangement. Particularly, the abutting surface 6d is inclined towards the pipe end portion 6 in direction in an inward direction.

[0023] The pipe end portion 6 and the tool end portion 5 are connected to each other in a radially and axially fixed manner, while permitting rotational movement therebetween. The coupling between the pipe end portion 6 and the tool end portion 5 is provided with an annular groove 6e on the outside of the pipe end portion, and correspondingly with an annular shoulder 5b on the inside of the tool end portion 5.

[0024] Furthermore, the tool end portion 5 of the casing shoe 4 is connected to a drill tool 7, particularly a ring bit, in a radially and axially fixed manner while permitting rotational movement therebetween. The coupling between the tool 7 and the tool end portion 5 is provided with an annular shoulder 5a on the inside of the tool end portion 5, and correspondingly, an annular groove 7a on the outer circumference of the drill tool 7.

[0025] Fig. 5 illustrates the casing pipe arrangement of Fig. 4 further equipped with damping means 8. The purpose of the damping means is to dampen drilling impact forces carried on to the casing pipe 1 by the casing shoe 4. During drilling, a percussive force may be exerted on to the drill tool 7 for penetrating the ground material. The groove 7a on the drill tool 7 and the shoulder 5a on the tool end portion 5 of casing shoe 4, are arranged to provide an axial motion clearance for enabling the percussive motion of the drill tool, while allowing the drill tool 7 to pull the casing pipe 1 via the casing shoe 4. However, in some circumstances, the casing pipe 1 may drag behind in the drill hole. That is, a substantial force is needed to advance the casing pipe 1. In such cases, the impact forces transferred by the casing shoe 4 might cause failure of the shoulder elements 6a, 6b, 6c or groove elements 2a, 2b, 2c. Thus, the arrangement of Fig. 5 is equipped with a damping means 8 for alleviating the harshness of the impacts. A damping means 8 is provided as an annular element of elastic material between the surfaces of the groove 7a on the drill tool

[0026] 7 and the shoulder 5a on the tool end portion 5 of the casing shoe 4, that abut each other when the drill tool 7 is pushed further by the percussive drilling forces. Similarly, a further damping means 8 may be provided between the tool end portion 5 and the pipe end portion 6 of the casing shoe, i.e. as an annular element of elastic material between the surfaces of the groove 6e on the pipe end portion end portion 6 and the shoulder 5b on the tool end portion 5 of the casing shoe 4, that abut each other when the drill tool 7 is pushed further by the percussive drilling forces.

[0027] Fig. 6A and Fig. 6B, illustrate a casing pipe 1 and an end portion 2 thereof being provided before and after being attached to each other, respectively. The first end portion 2 is equipped with attachment means 2a, 2b,

2c being provided as grooves, and 2d being provided as a lug.

[0028] Fig. 7 illustrates a drill arrangement in which a casing pipe 1 has not yet been attached to a drill bit 7 equipped with a casing shoe 4. The casing shoe 4 has been attached to the drill bit, in this case a ring bit 7. Moreover, the casing shoe 4 provided as two-part form, the portions of which 5 6 being rotationally disengaged with each other allowing rotational movement therebetween. The casing pipe 1 side portion of the casing shoe 4 is equipped with pockets 4a.

[0029] The first end portion 2 has attachment means 2a, 2b, 2c being provided as grooves, and 2d being provided as a lug. The attachment means 2a, 2b, 2c are to be receivable within the casing pipe 1 side portion 6 of the casing shoe 4 for radially and axially fixing the casing pipe 1 to the casing shoe 4.

[0030] The lug 2d is to be receivable within the pocket 4a for locking the casing pipe 1 to the casing shoe 4 in a rotational manner.

[0031] According to first aspect of the description, a casing pipe 1 for drilling is provided. The casing pipe 1 has a tubular casing extending between a first end portion 2 and a second end portion 3 thereof. The first end portion 2 is equipped first attachment means 2a, 2b, 2c, and respectively, the second end portion 3 is equipped with second attachment means 3a, 3b, 3c, for attaching casing pipes 1 one after another.

[0032] Particularly, the first attachment means comprises, on an outer surface of the casing, an outermost groove element 2a and an innermost groove element 2c. Respectively, the second attachment means comprises, on an inner surface of the casing, an innermost shoulder element 3a and an outermost shoulder element 3c. The outermost groove element 2a of the first attachment means is arranged to co-operate with the innermost shoulder 3a element of the second attachment means, so as to form interlocking shapes with each other for attaching consecutive casing pipes to each other. Respectively, the innermost groove element 2c of the first attachment means is arranged to co-operate with the outermost shoulder 3c element of the second attachment means, so as to form interlocking shapes with each other for attaching consecutive casing pipes to each other.

[0033] It should be understood, that the first attachment means could naturally be implemented with shoulder elements instead of groove elements, in which case the second attachment means would be implemented with groove elements instead of shoulder elements.

[0034] At least the first attachment means, the second attachment means, or both have a structural elasticity enabling temporary deformation permitting the shoulder elements 3a, 3b, 3c to be inserted into the respective groove 2a, 2b, 2c elements. Such structural elasticity may be provided, for example, by manufacturing the first, second, or both, attachment means from a suitable material, such as a plastics material. Preferably, the whole casing pipe 1 is made of the same material. An alternative

way of producing such structural elasticity is providing one or more axial slits extending through the casing, thus providing an intermittent circumference at the location of first, second, or both,

[0035] Furthermore, effective dimensions Da, Db, Dc of the groove elements 2a, 2b, 2c on the first end portion 2 decreases towards its respective end, and correspondingly, the effective dimensions Da, Db, Dc of the shoulder elements 3a, 3b, 3c on the second end portion 3 increase towards its respective end.

[0036] At least one, preferably both of the first end portion 2 and second end portion 3 are attached to the tubular casing of the casing pipe 1 by friction welding, most preferably by spin welding. That is, at least one, preferably both end portions 2, 3 are formed separately, and subsequently attached to the rest of the casing pipe. Preferably, either or both of the end portions 2, 3 are formed from a portion of a pipe having a larger material thickness than that of the rest of the tubular casing of the casing pipe 1.

[0037] According to a second aspect of the description an alternative casing pipe 1' is provided. The casing pipe 1' according to the second aspect differs from the casing pipe 1 according to the first aspect by two identical first end portions 2, each provided with first attachment means. Hence, a casing pipe 1' according to the second aspect has a tubular casing extending between two identical first end portions 2. Both of the first end portions 2 are each equipped with a first attachment means for attaching the casing pipe with a second attachment means. The second attachment means may be a part of another casing pipe 1, 1" or a casing shoe 4, for example.

[0038] The first attachment means comprises, on an outer surface of the casing, at least an outermost complimentary groove element 2a and an innermost complimentary groove element 2c.

[0039] Preferably, the second attachment means referred to comprises, on an inner surface of a casing, at least an innermost complimentary shoulder element 3a, 6a and an outermost complimentary shoulder element 3c, 6c.

[0040] The outermost groove element 2a of the first attachment means is arranged to co-operate with said innermost shoulder 3a, 6a element of the second attachment means, so as to form interlocking shapes with each other, suitably for attaching consecutive casing pipes to each other, and respectively,

[0041] The innermost groove element 2c of the first attachment means is arranged to co-operate with said outermost shoulder 3c, 6c element of the second attachment means, so as to form interlocking shapes with each other, suitably for attaching consecutive casing pipes to each other;

[0042] Preferably, at least the first attachment means, at least the second attachment means, or both, have a structural elasticity enabling temporary deformation permitting the shoulder elements to be inserted into the respective groove elements

[0043] The effective dimensions Da, Db, Dc of the groove elements on both of the first end portions 2 decrease towards their respective ends.

[0044] It should be understood, that the first attachment means could naturally be implemented with shoulder elements instead of groove elements, in which case the second attachment means would be implemented with groove elements instead of shoulder elements.

[0045] Either, or preferably both first end portions 2 are attached to the tubular casing of the casing pipe 1' by friction welding, most preferably by spin welding. That is, at least one, preferably both first portions 2, are formed separately, and subsequently attached to the rest of the casing pipe 1'. Preferably, either or both of the end portions 2 are formed from a portion of a pipe having a larger material thickness than that of the rest of the tubular casing of the casing pipe 1. According to a third aspect of the description an alternative casing pipe 1" is provided. The casing pipe 1" according to the third aspect differs from the casing pipe 1 according to the first aspect by having two identical second end portions 3, both provided second attachment means. Hence, a casing pipe 1" according to the third aspect has a tubular casing extending between two identical second end portions 3, wherein both of the second end portions 3 are each equipped with a second attachment means for attaching such casing pipes to a first attachment means. The second attachment means may be a part of another casing pipe 1, 1' or a casing shoe, for example.

[0046] Preferably, the first attachment means referred to comprises, on an outer surface of a casing, at least an outermost complimentary groove element 2a and an innermost complimentary groove element 2c.

[0047] The second attachment means comprises, on an inner surface of the casing, at least an innermost complimentary shoulder 3a element and an outermost complimentary shoulder 3c element.

[0048] The innermost shoulder element 3a of the second attachment means is arranged to co-operate with an outermost groove element 2a of the first attachment means, so as to form interlocking shapes with each other, suitably for attaching consecutive casing pipes to each other.

[0049] Respectively, said outermost shoulder element 3c of the second attachment means is arranged to co-operate with an innermost groove element 2c of the first attachment means, so as to form interlocking shapes with each other, suitably for attaching consecutive casing pipes to each other.

[0050] Preferably, at least the first attachment means, at least the second attachment means, or both, have a structural elasticity enabling temporary deformation permitting the shoulder elements to be inserted into the respective groove elements.

[0051] The effective dimensions Da, Db, Dc of the shoulder elements on both second end portions 3 increase towards their respective ends.

[0052] It should be understood, that the second attach-

ment means could naturally be implemented with groove elements instead of shoulder elements, in which case the first attachment means would be implemented with shoulder elements instead of groove elements.

[0053] Either, or preferably both second end portions 3 are attached to the tubular casing of the casing pipe 1" by friction welding, most preferably by spin welding. That is, at least one, preferably both first portions 3, are formed separately, and subsequently attached to the rest of the casing pipe 1". Preferably, either or both of the end portions 3 are formed from a portion of a pipe having a larger material thickness than that of the rest of the tubular casing of the casing pipe 1".

[0054] The casing pipes 1', 1" according to the second and third aspects may be connected to each other in a casing string, which may be formed by using casing pipes according to the second and third aspect alternately.

[0055] According to a fourth aspect of the description, the first attachment means further comprises, on an outer surface of its casing, at least an axially extending lug 2d or pocket. Respectively, the second attachment means further comprises, on an inner surface of its casing, an axially extending pocket or lug.

[0056] The lug and pocket being arranged to co-operate with each other such as to form interlocking shapes for preventing consecutive casing pipes 1, 1', 1" from rotating about their longitudinal axis with respect to each other. That is, when consecutive casing pipes 1, 1', 1" having such a lug and pocket construction are attached to each other, the lug 2d is received in the pocket, thus preventing the consecutive casing pipes from being rotated about their longitudinal axis with respect to each other. Consequently, the respective attachment means are prevented from rotating with respect to each other. This also contributes to providing a more reliable connection between the casing pipes, as any possible rotation between the respective attachment means may damage the shoulder and groove elements. This advantage is particularly prominent where plastic casing pipes are used, as plastic is more easily damaged.

[0057] According to a fifth aspect of the description, the first attachment means further comprise at least one intermediate groove element 2b, and the second attachment means further comprise at least one intermediate shoulder element 3c. The at least one intermediate groove element 2b of the first attachment means is arranged to co-operate with the at least one intermediate shoulder element 3c of the second attachment means, so as to form interlocking shapes with each other for attaching consecutive casing pipes to each other.

[0058] Naturally, multiple intermediate groove elements may be provided to the first attachment means, whereas multiple intermediate shoulder elements may be provided to the second attachment means. In other words, the total amount of corresponding grooves and shoulders is not restricted. Again, it should be noted, that the first attachment means could be implemented with shoulder elements, in which case the second attachment

means should be implemented with groove elements.

[0059] According to a sixth aspect of the description, at least one of the shoulder elements 3a, 3b, 3c is an annular ring radially protruding from, and tangentially extending around the circumference of the outer surface of the casing. Respectively at least one of the groove elements 2a, 2b, 2c is an annular recess radially protruding into, and tangentially extending around the circumference of the inner surface of the casing. It should be noted, that although the shoulder elements and groove elements are preferably mutually of the same type, their dimensioning may vary between each other. For example, some of the corresponding groove elements and shoulder elements may have a different width or height with respect to the other groove elements and shoulder elements.

[0060] According to a seventh aspect of the description, the casing pipe 1, 1', 1" is made of a plastics material. Plastic materials are generally light compared to conventional materials from which casing pipes are manufactured. Moreover, most plastics naturally provide a suitable structural elasticity, i.e. capability to temporarily deform. For example, thermoplastics, such as polyolefins, particularly polyethylene and polypropylene have been discovered to be suitable plastics for producing a casing pipe according to the description. For example, a casing pipe 1, 1', 1" may be formed from a PE100 pipe material.

[0061] According to an eighth aspect of the description the first end portion 2, the second end portion 3, or both, have an increased casing material thickness with respect to the rest of the casing pipe 1, 1', 1". Increasing the material thickness of either end portion 2, 3 increases the strength of the coupling formed by the attachment means. Furthermore, this enables groove elements 2a, 2b, 2c and / or shoulder elements 3a, 3b, 3c to be formed even into a casing having a material thickness between the end portions too thin for forming such forms. This contributes to material costs savings and overall weight reduction, as the thickness of the casing between the end portions, constituting most of the weight of the casing pipe, can be reduced.

[0062] The material thickness of either end portion 2, 3 may be increased in several different ways. Most suitably, the material thickness may be increased by providing an upset.

Alternatively, a sleeve or a bushing may be provided

[0063] According to a ninth aspect of the description a casing pipe 1, 1', 1" is equipped with an abutting surface provided at the first attachment means, the second attachments means, or both.

[0064] The purpose of the abutting surface is to prevent the first and second attachment means from being pushed past each other by acting as a stopper. Preferably, the abutting surface is inclined, suitably so as to guide any possible deformation of a casing pipe, being coupled with another casing pipe, towards the casing of the other

casing pipe. In other words, the abutting surface may guide any possible deformation to a direction in which the casing of the other casing pipe will provide additional support for the casing pipe. That is, preferably the abutting surface is inclined so as to prevent either of, or both, successive casing pipes from deforming away from each other.

[0065] Should the abutting surface be provided at the first attaching means, the abutting surface is preferably arranged as an annular surface on the outside of the casing of a casing pipe 1, 1', preferably inclined towards its respective end in a direction outward from the casing.

[0066] Should the abutting surface be provided at the second attaching means, the abutting surface 6d is preferably arranged as an annular surface on the inside of the casing of a casing pipe 1, 1", preferably inclined towards its respective end in a direction inward from the casing.

[0067] According to a tenth aspect of the description, a casing pipe arrangement is provided. The casing pipe arrangement comprises two or more of the casing pipes 1, 1', 1" according to any of the aspects discussed above. In the arrangement, the casing pipes 1, 1', 1", are attached one after another such that first attachment means of a subsequent casing pipe is inserted into second attachment means of a preceding casing pipe.

[0068] According to an eleventh aspect of the description a casing shoe 4 is provided. Particularly, the casing shoe 4 is provided with attachment means corresponding to either the first attachment means or second attachment means of a casing pipe 1, 1', 1" according to any of the aspects discussed above. Thus a casing shoe 4 has a tubular casing extending between a tool end portion 5 and a pipe end portion 6. The tool end portion 5 is preferably arranged for being coupled with a drilling tool, whereas the pipe end portion is arranged for being coupled with a casing pipe.

[0069] Preferably, the casing shoe 4 is equipped at least one axially extending lug or pocket 4a arranged to correspond with a pocket or lug 2d of a casing pipe 1, 1', 1", respectively. That is, the lug or pocket being arranged to co-operate with a pocket or lug of casing pipe 1, 1', 1" such as to form interlocking shapes for preventing consecutive casing pipes 1, 1', 1" from rotating about its longitudinal axis with respect to the casing shoe 4, particularly the portion of which the casing pipe 1, 1', 1" is connected to. That is, when a casing shoe 4 and a casing pipe 1, 1', 1" having such a lug and pocket construction are attached to each other, the lug 2d is received in the pocket 4a, thus preventing the casing pipe from being rotated about its longitudinal axis with respect to the portion of the casing shoe to which the casing pipes is attached. As mutual rotation between the casing shoe 4 and the casing pipe 1, 1', 1" is prevented, the respective shoulder and groove elements also remain stationary with respect to each other. This also contributes to providing a more reliable connection between the casing pipe and the casing shoe, as any possible rotation between the respective attachment means may damage

the shoulder and groove elements. This advantage is particularly prominent where plastic casing pipes are used, as plastic is more easily damaged.

[0070] The pipe end portion 6 may be equipped with first attachment means, for attaching the casing shoe 4 to a second attachment means of a casing pipe 1, 1". The first attachment means comprise, on an outer surface of the casing, at least an outermost complimentary shoulder element or groove element and an innermost complimentary shoulder element or groove element.

[0071] Alternatively, and preferably, the pipe end portion 6 is equipped with second attachment means for attaching the casing shoe 4 to a first attachment means of a casing pipe 1, 1'. The second attachment means comprise, on an inner surface of the casing, at least an innermost complimentary groove element or shoulder 6a element and an outermost complimentary groove element or shoulder 6c element.

[0072] If the pipe end portion 6 is equipped with first attachment means, the outermost shoulder element or groove element of said first attachment means is arranged to co-operate with an innermost groove element or shoulder 3a element of a second attachment means on a casing pipe 1, 1", so as to form interlocking shapes with each other. The innermost shoulder element or groove element of said first attachment means would correspondingly be arranged to co-operate with an outermost groove element or shoulder 3c element of the second attachment means, so as to form interlocking shapes with each other.

[0073] If the pipe end portion 6 is equipped with second attachment means, the outermost shoulder element 6c or groove element of said second attachment means is arranged to co-operate with an innermost groove element 2c or shoulder element of a first attachment means on a casing pipe 1, 1', so as to form interlocking shapes with each other. The innermost shoulder element 6a or groove element of the second attachment means would correspondingly be arranged to co-operate with said outermost groove element 2a or shoulder element of the first attachment means on a casing pipe 1, 1', so as to form interlocking shapes with each other.

[0074] Preferably at least the first attachment means, at least the second attachment means, or both, have a structural elasticity enabling temporary deformation permitting the shoulder elements to be inserted into the respective groove elements.

[0075] The pipe end portion 6, having either first or second attachment means may additionally be provided with an intermediate shoulder element 6b, or groove element, corresponding to that of the respective attachment means of a casing pipe 1, 1', 1" to be joined.

[0076] If the pipe end portion 6 is equipped with first attachment means, the effective dimensions Da, Db, Dc of the groove elements or the shoulder elements on the first attachment means on the casing shoe decrease towards the pipe end portion side.

[0077] If the pipe end portion 6 is equipped with second

attachment means, the effective dimensions Da, Db, Dc of the groove elements or the shoulder elements on the second attachment means on the casing shoe 4 increase towards the pipe end portion 6 side end.

[0078] According to a twelfth aspect of the description, the casing shoe 4 as discussed in connection with the preceding aspect is further arranged to provide a rotational decoupling.

[0079] The tool end portion 5 is axially and radially connectable to a drill tool 7 allowing rotational movement therebetween. Suitably, this is provided by arranging a complementary shoulder element 5a and a groove element 7a on the tool end portion 5 of the casing shoe and on the drill tool 7, respectively. Naturally, the groove and shoulder elements may be arranged the other way round.

[0080] The pipe end portion 6 is axially and radially connectable to the tool end portion 5 allowing rotational movement therebetween. Suitably, this is provided by arranging a complementary shoulder element 5b and a groove element 6e on the tool end portion 5 of the casing shoe and on the pipe end portion of the casing shoe 4, respectively. Naturally, the groove and shoulder elements may be arranged the other way round.

[0081] Such a casing shoe 4 enables a casing pipe 1, 1', 1" to be coupled with drill tool axially and radially, while being rotationally disconnected from the drill tool at least between the pipe end portion 6 and the tool end portion 5 of the casing shoe 4, and respectively, between tool end portion 5 of the casing shoe 4 and the drill tool 7.

[0082] This is particularly advantageous, as connections between subsequent casing pipes 1 do not generally tolerate rotation as well as conventional welded joints. This is particularly prominent when the first attachment means, the second attachment means, or both are made from a plastic material. Moreover, conventional casing shoes are rotationally disconnected from the drill tool at only one point, namely the outer periphery of the drill tool. Should this rotational joint get clogged, a part of the torsional moment of the drill tool 7 is transferred onwards to the casing shoe 4. The casing shoe 4, preferably made of metal, such as steel, will in turn transfer a part of the torsional moment to the casing pipe 1, 1', 1", which will eventually become damaged, at least if made of a plastics material.

[0083] The casing pipe discussed in the above aspect provides a casing shoe disconnecting the casing pipe from the drill tool at two separate locations, enabling thus a more reliable joint to be formed.

[0084] According to a thirteenth aspect of the description, the casing shoe 4 as discussed in connection with any of the preceding aspects is further equipped with an abutting surface 6d. The purpose of the abutting surface 6d is to prevent the first and second attachment means from being pushed past each other by acting as a stopper. Preferably, the abutting surface 6d is inclined so as to guide any possible deformation of a casing pipe 1, 1', 1" being coupled with the casing shoe 4 towards the casing of the casing shoe. In other words, the abutting sur-

face may guide any possible deformation to a direction in which the casing of the casing shoe will provide additional support for the casing pipe. That is, preferably the abutting surface 6d is inclined so as to prevent the casing pipe 1, 1', 1", pipe end portion 6, or both, from deforming away from each other.

[0085] Should the pipe end portion 6 of the casing shoe 4 be equipped with first attaching means, the abutting surface 6d is preferably arranged as an annular surface on the outside of the casing, preferably inclined towards the pipe end portion 6 side end, in a direction outward from the casing.

[0086] Should the pipe end portion 6 of the casing shoe 4 be equipped with second attaching means, the abutting surface 6d is preferably arranged as an annular surface on the inside of the casing, preferably inclined towards the pipe end portion 6 side end, in a direction inward from the casing.

[0087] According to a fourteenth aspect of the invention, a casing shoe 4 according to any of the preceding casing shoe aspects, as discussed above, is provided with an intermediate portion. The purpose of the intermediate portion is to provide a rotational decoupling between the tool end portion 5 and the pipe end portion 6 of the casing shoe. If the tool end portion 5 and the pipe end portion 6 of the casing shoe are already rotationally decoupled with respect to each other, an intermediate portion may be provided for enabling further rotational decoupling between the tool end portion 5 and the pipe end portion 6. Naturally, the casing shoe 4 may be provided with more than one intermediate portions for providing further rotational decoupling.

[0088] In other words, the tool end portion 5 and the pipe end portion 6 may be connected to each other via one or more intermediate portions axially and radially connectable between the tool end portion 5 and the pipe end portion 5, between the tool end portion 5 and another intermediate portion, between the pipe end portion and another intermediate portion, between two other intermediate portions, or any combination thereof.

[0089] According to a fifteenth aspect of the description, a tool arrangement is provided. The tool arrangement comprises a casing shoe 4 as discussed in connection with any of the preceding aspects. The tool end portion 5 of the casing shoe 4 is attached to drill tool 7 in an axially and radially fixed manner, while allowing rotational movement between the drill tool 7 and the tool end portion 5. Preferably, but not necessarily, the drill tool 7 is a ring bit.

[0090] According to a sixteenth aspect of the description, the tool arrangement, as discussed above in connection with the preceding aspect, is equipped with a damping means 8 for damping impact forces from the drill tool 7 transmitted to the casing pipe 1, 1', 1" via the casing shoe 4. Preferably, the damping means 8 are arranged between the complementary shoulder element 5a on the tool end portion 5 of the casing shoe 4 and the respective groove element 7a on the drill tool. Alterna-

tively, or additionally, a further damping means 8 may be arranged between the complementary shoulder element 5b on the tool end portion 5 of the casing shoe 4 and respective the groove element 6e on the pipe end portion 6 of the casing shoe 4. Naturally, such damping means 8 may be arranged in corresponding manner should the groove elements and shoulder elements be arranged other way round.

[0091] Particularly, the damping means are preferably arranged between surface of the respective groove and shoulder elements that abut each other when the drill tool 7 is pushed further by the percussive drilling forces. Suitably annular damping means 8 of elastic material are used, such as O-rings made from an elastomer material

[0092] According to a seventeenth aspect of the description a drill arrangement is provided. The drill arrangement comprises at least one casing pipe according to any of the casing pipe aspects discussed above. The drill arrangement comprises a drill tool 7 attached to the casing pipe, preferably via a casing shoe, in an axially and radially fixed manner, while allowing rotational movement between the drill tool 7 and the casing pipe. Preferably, but not necessarily, the drill tool 7 is a ring bit.

[0093] Suitably, the drill arrangement comprises casing pipe 1, 1', 1" according to any of the casing pipe aspects discussed above and a casing shoe according to any of the casing shoe aspects discussed above. Preferably, the casing pipe 1, 1', 1" is attached to the pipe end portion of the casing shoe 4. The drill arrangement may additionally comprise a drill tool 7, in which case the drill tool is preferably attached to the tool end portion 5 of the casing shoe in an axially and radially fixed manner, while allowing rotational movement between the drill tool 7 and the tool end portion 5. Preferably, but not necessarily, the drill tool 7 is a ring bit.

[0094] The aspects of the present description have been found to be particularly suitable in well drilling of, for example, water wells and thermal wells, where a casing pipe is commonly used for protection against impurities from the surroundings in addition to its primary function of supporting the drill hole. The load bearing properties of a casing pipe in such a use is not generally a significant factor. This, in turn, enables the use of casing pipes having the needed elastic and resilient properties required for the attachment means discussed above.

Claims

1. A casing pipe (1) for drilling, said casing (1) pipe having a tubular casing extending between a first end portion (2) and a second end portion (3), wherein the first and second end portions are equipped with a first and a second attachment means, respectively, for attaching such casing pipes one after another, wherein:

the first attachment means comprises, on an

outer surface of the casing, at least an outermost complimentary shoulder element or groove element (2a) and an innermost complimentary shoulder element or groove element (2c), and respectively,

the second attachment means comprises, on an inner surface of the casing, at least an innermost complimentary groove element or shoulder (3a) element and an outermost complimentary groove element or shoulder (3c) element, wherein

said outermost shoulder element or groove element (2a) of the first attachment means is arranged to cooperate with said innermost groove element or shoulder (3a) element of the second attachment means, so as to form interlocking shapes with each other for attaching consecutive casing pipes to each other, and respectively,

said innermost shoulder element or groove element (2c) of the first attachment means is arranged to cooperate with said outermost groove element or shoulder (3c) element of the second attachment means, so as to form interlocking shapes with each other for attaching consecutive casing pipes to each other;

at least the first attachment means, at least the second attachment means, or both, have a structural elasticity enabling temporary deformation permitting the shoulder elements to be inserted into the respective groove elements;

the groove elements (2a, 2b, 2c) or the shoulder elements on the first end portion have effective dimensions (Da, Db, Dc) which decrease towards the first end portion side end, and correspondingly, the groove elements or the shoulder elements (3a, 3b, 3c) on the second end portion have effective dimensions (Da, Db, Dc) which increase towards the second end portion side end,

characterized in that the first end portion (2), second end portion (3), or both are attached to the tubular casing of the casing pipe (1) by friction welding, most preferably by spin welding.

2. A casing pipe (1') for drilling, said casing pipe (1') having a tubular casing extending between two identical first end portions, each equipped with a first attachment means, for attaching the casing pipe with a second attachment means, wherein:

the first attachment means comprises, on an outer surface of the casing, at least an outermost complimentary shoulder element or groove element (2a) and an innermost complimentary shoulder element or groove element (2c), wherein

said outermost shoulder element or groove element

(2a) of the first attachment means is arranged to co-operate with an innermost groove element or shoulder (3a) element of an second attachment means, so as to form interlocking shapes with each other, and respectively,

said innermost shoulder element or groove element (2c) of the first attachment means is arranged to co-operate with an outermost groove element or shoulder (3c) element of an second attachment means, so as to form interlocking shapes with each other, and

the groove elements (2a, 2b, 2c) or the shoulder elements on the first end portions have effective dimensions (Da, Db, Dc) decreasing towards their respective ends,

characterized in that either or both first end portions (2) are attached to the tubular casing of the casing pipe (1) by friction welding, preferably spin welding.

3. A casing pipe (1'') for drilling, said casing pipe (1'') having a tubular casing extending between two identical second end portions, each equipped with a second attachment means for attaching the casing pipes to a first attachment means, wherein:

the second attachment means comprises, on an inner surface of the casing, at least an innermost complimentary groove element or shoulder (3a) element and an outermost complimentary groove element or shoulder (3c) element, wherein

said outermost shoulder element (3c) or groove element of the second attachment means is arranged to co-operate with an innermost groove element (2c) or shoulder element of a first attachment means, so as to form interlocking shapes with each other, and respectively,

said innermost shoulder element (3a) or groove element of the second attachment means is arranged to co-operate with said outermost groove element (2a) or shoulder element of a first attachment means, so as to form interlocking shapes with each other, and

the of the groove elements or the shoulder elements (3a, 3b, 3c) on the second end portion have effective dimensions (Da, Db, Dc) increasing towards their respective ends

characterized in that either or both second end portions (3) are attached to the tubular casing of the casing pipe (1) by friction welding, preferably spin welding.

4. The casing pipe (1, 1', 1'') according to any of the Claims 1-3, **characterized in that** at least one of the first attachment means further comprises, on an outer surface of its casing, at least an axially extending lug (2d) or pocket, and/or respectively, at least one

of the second attachment means further comprises, on an inner surface of its casing, an axially extending pocket or lug,

said lug and pocket being arranged to co-operate with each other such as to form interlocking shapes for preventing consecutive casing pipes from rotating about their longitudinal axis with respect to each other

5. The casing pipe (1, 1', 1'') according to any of the Claims 1-4, **characterized in that** the first attachment means further comprises at least one intermediate groove element (2b) or shoulder element, and the second attachment means further comprise at least one intermediate shoulder element (3b) or groove element, wherein the at least one intermediate groove element (2b) or shoulder element of the first attachment means is arranged to co-operate with the at least one intermediate shoulder element (3b) or groove element of the second attachment means, so as to form interlocking shapes with each other for attaching consecutive casing pipes (1, 1', 1'') to each other.

6. The casing pipe (1, 1', 1'') according to any of the Claim 1-5, **characterized in that:**

at least one of the shoulder elements (3a, 3b, 3c) is an annular ring radially protruding from, and tangentially extending around the circumference of the outer surface of the casing, and, respectively, **in that**

at least one of the groove elements (2a, 2b, 2c) is an annular recess radially protruding into, and tangentially extending around the circumference of the inner surface of the casing.

7. The casing pipe (1, 1', 1'') according to any of the Claims 1-6, **characterized in that** the casing pipe (1, 1', 1'') is made of a plastics material, preferably of polyethylene, polypropylene or polyolefin
8. The casing pipe (1, 1', 1'') according to any of the Claim 1-7, **characterized in that** the first end portion (2), the second end portion (3), or both, have an increased casing material thickness with respect to the rest of the casing pipe (1, 1', 1'').
9. The casing pipe (1, 1', 1'') according to any of the Claims 1-8, **characterized in that** the first attachment means, the second attachment means, or both comprise an abutting surface arranged to act as a stopper for preventing the first and second attachment means from being pushed past each other, said abutting surface being preferably inclined so as to prevent either of, or both, successive casing pipes from deforming away from each other.

10. A casing pipe arrangement, **characterized by** comprising two or more casing pipes (1, 1', 1'') according to any of the preceding Claims 1-9, such that said casing pipes are attached one after another such that first attachment means of a subsequent casing pipe is inserted into second attachment means of a preceding casing pipe. 5
11. A drill arrangement, **characterized by** comprising at least one casing pipe (1, 1', 1'') according to any of the preceding Claims 1-9, the drill arrangement comprising a drill tool (7) attached to the casing pipe, preferably via a casing shoe (4), in an axially and radially fixed manner, while allowing rotational movement between the drill tool (7) and the casing pipe (1, 1', 1'') 10 15

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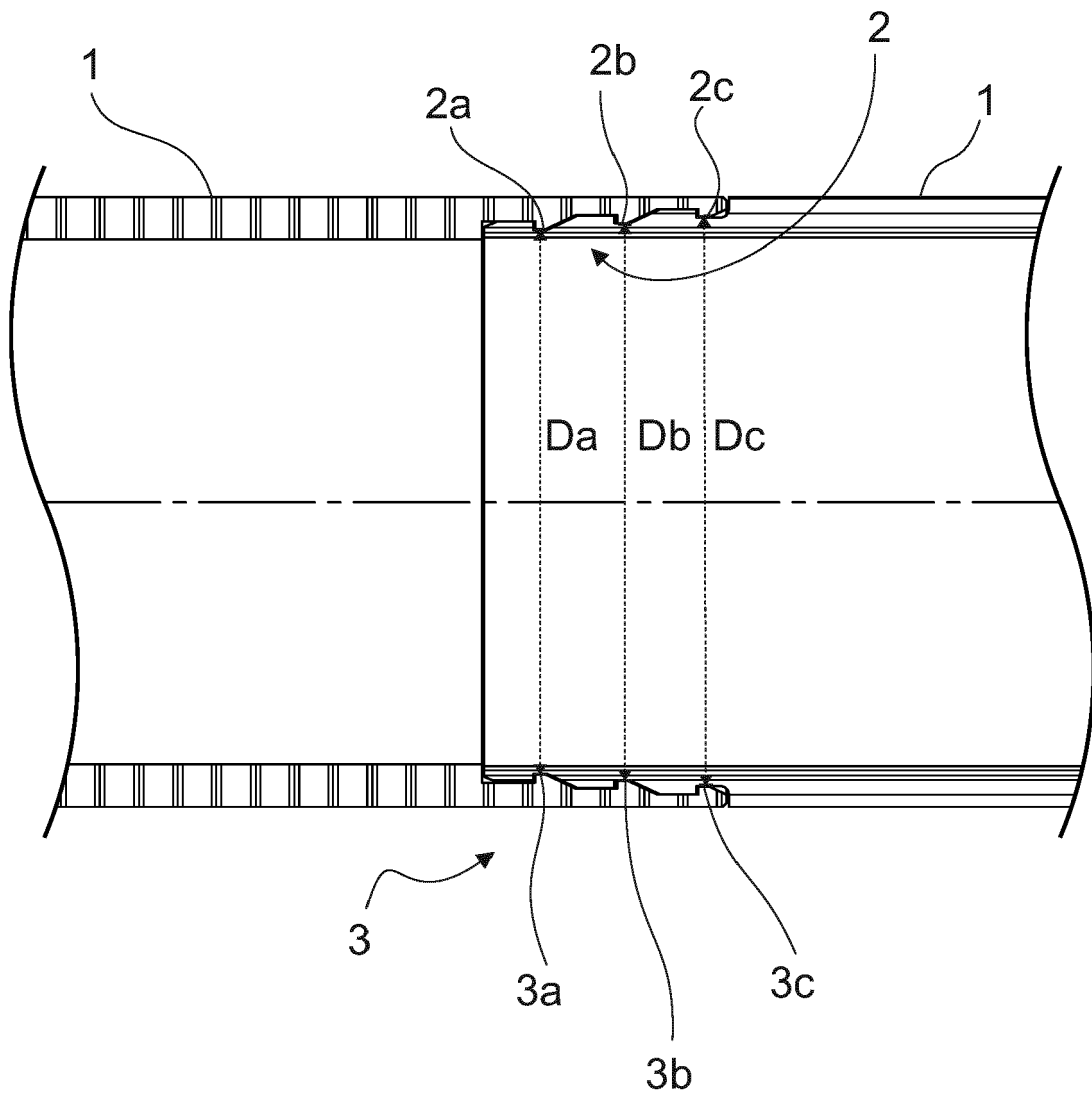


Fig. 1

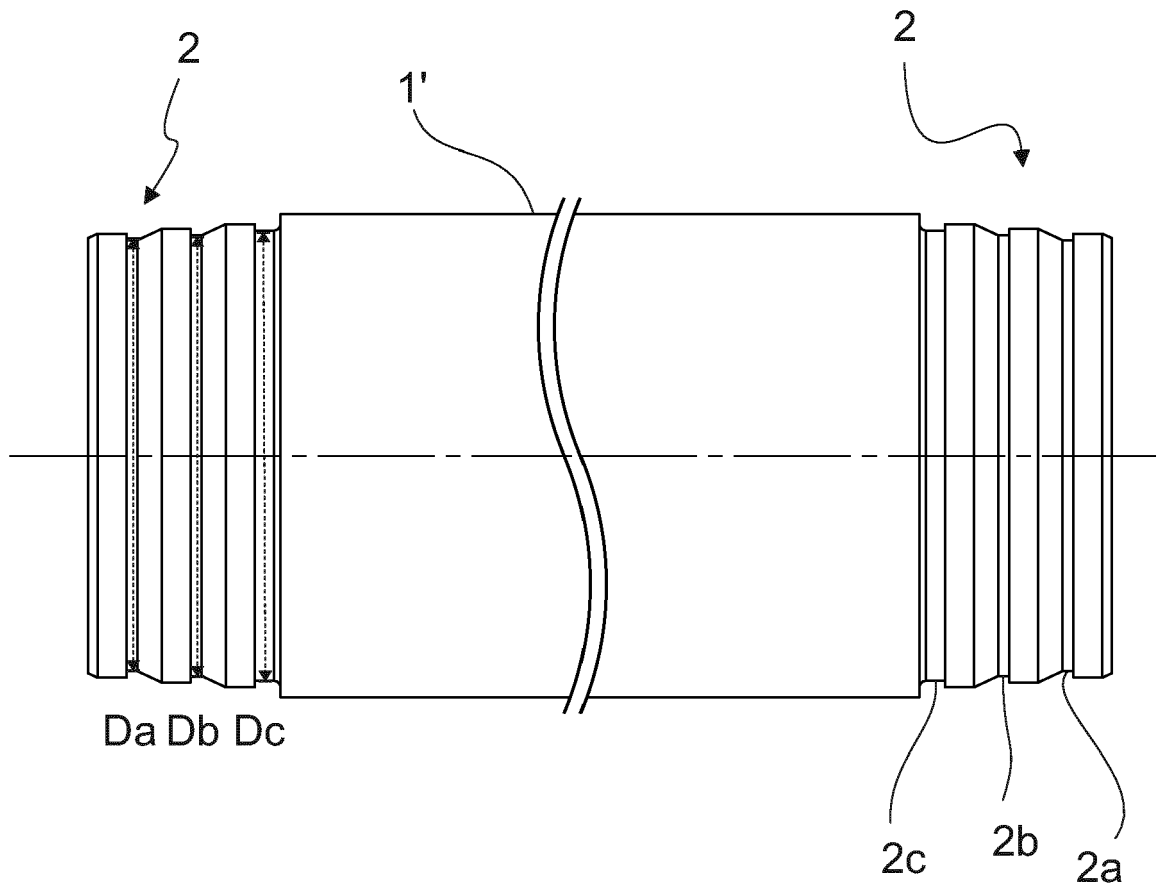


Fig. 2

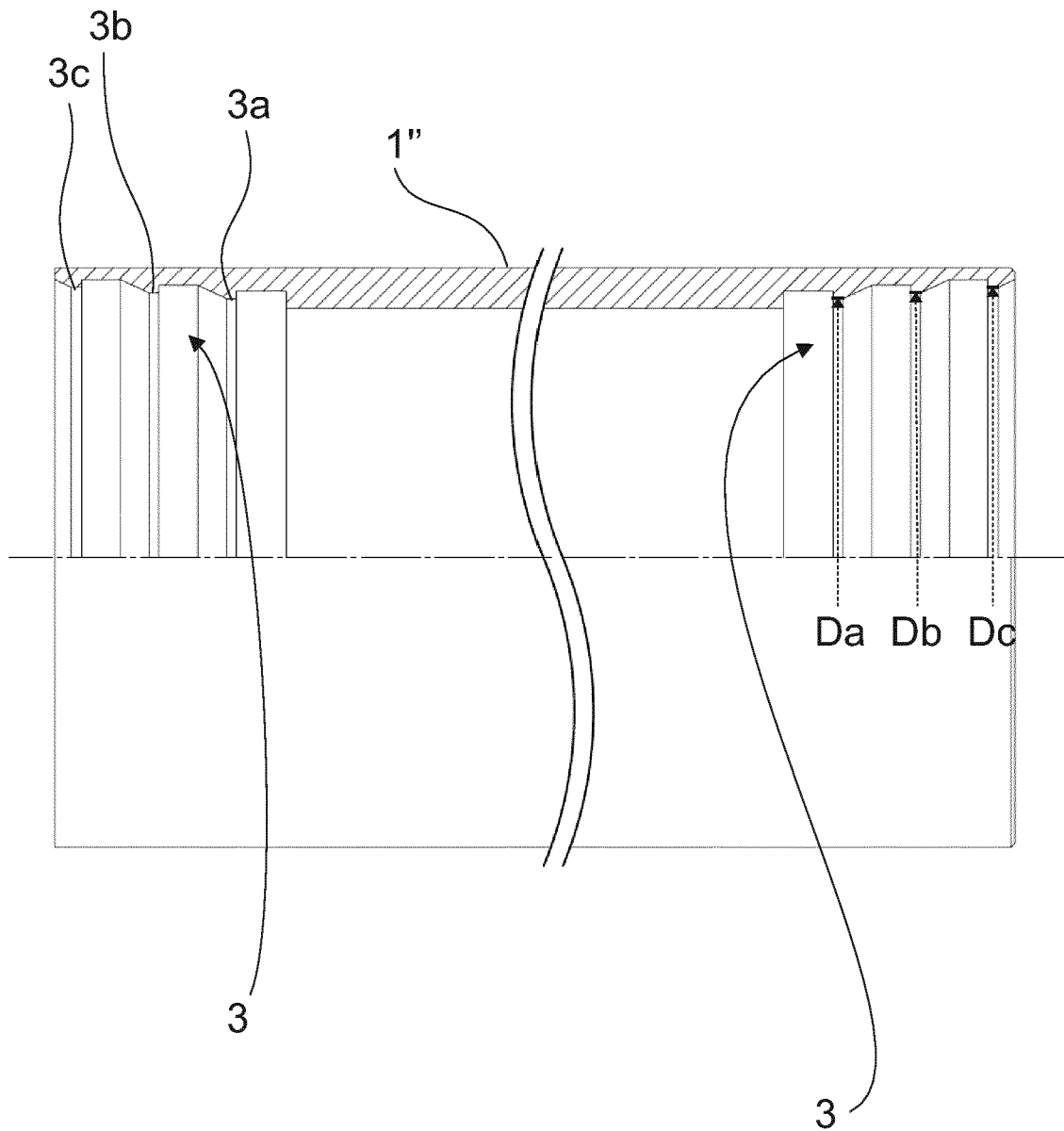
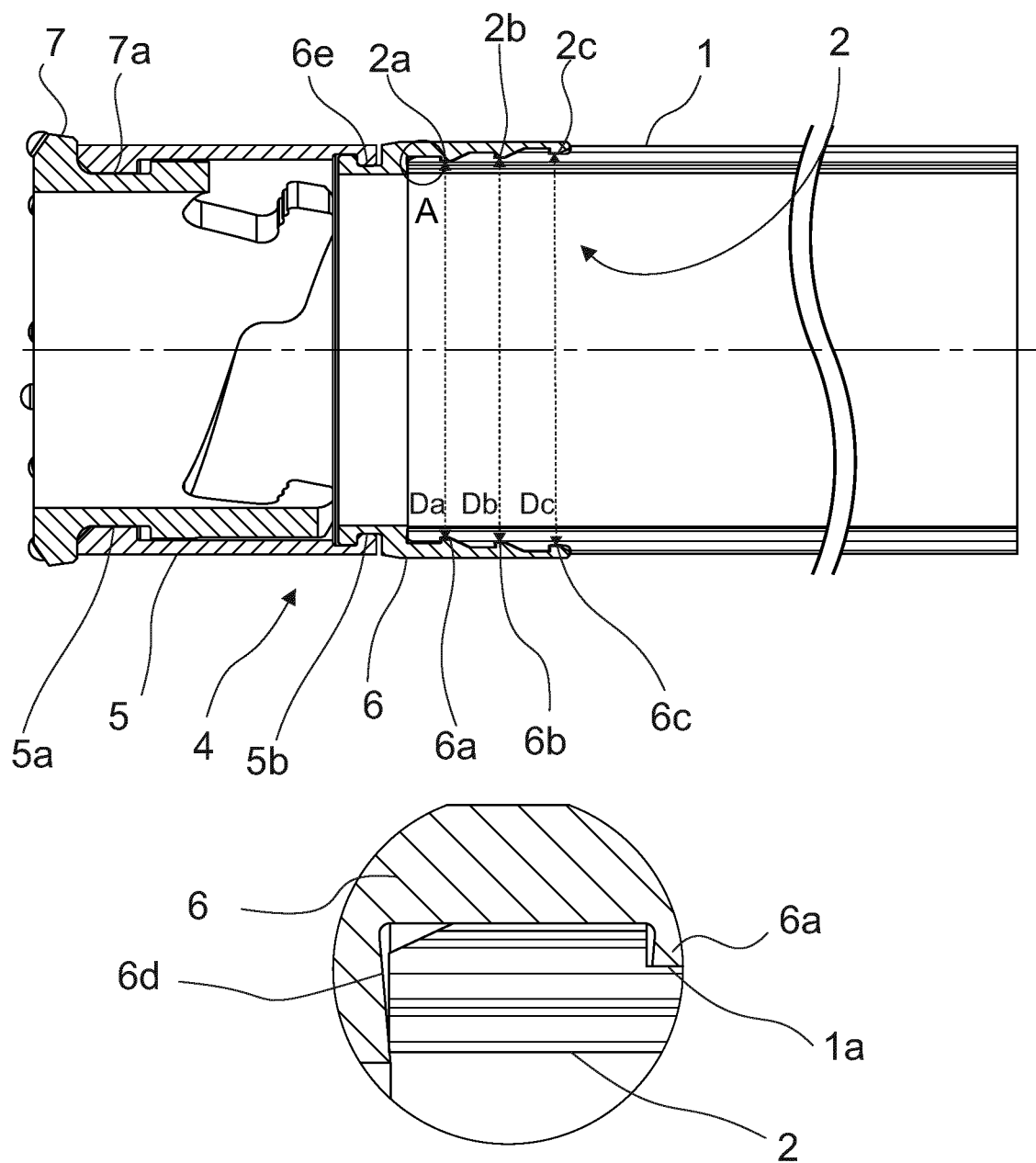


Fig. 3



DETAIL A

Fig. 4

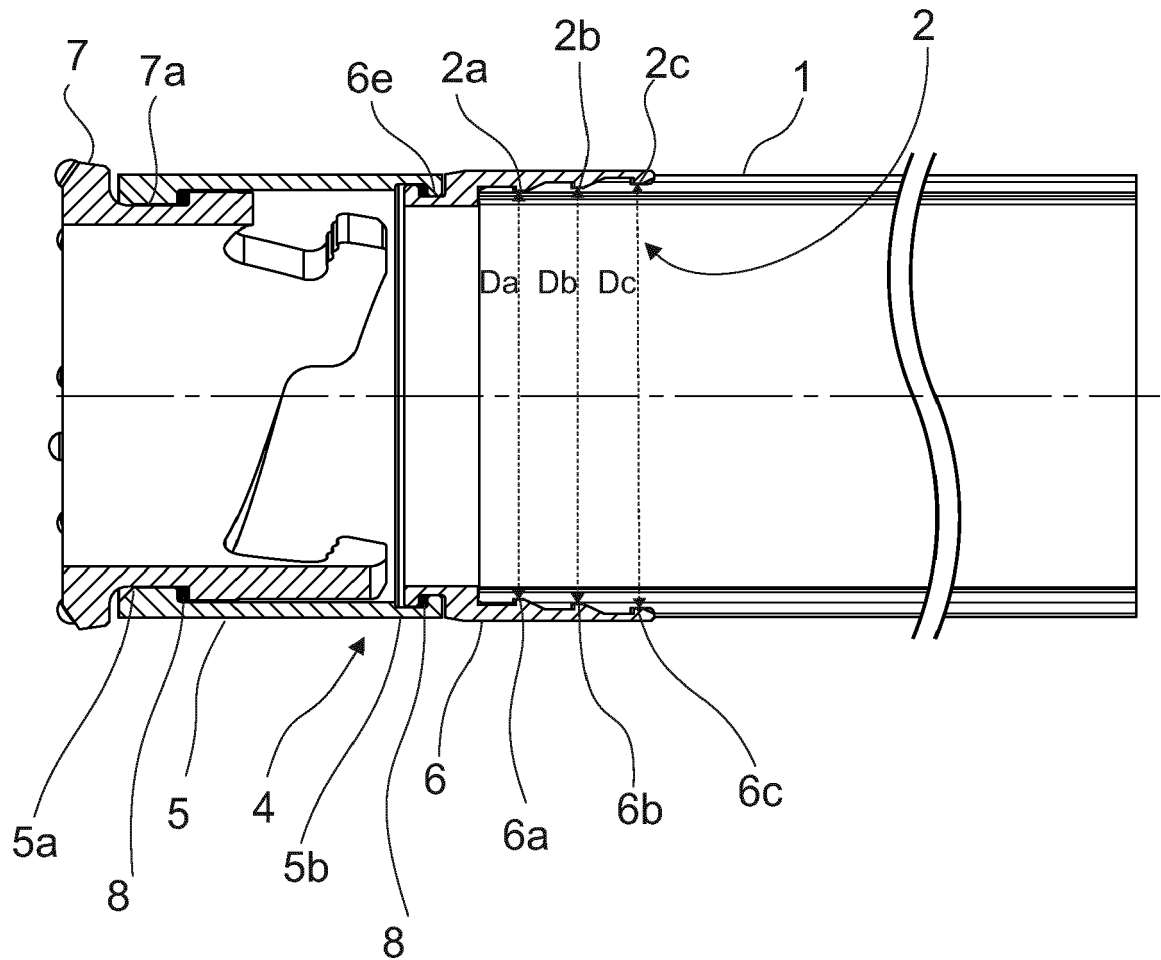


Fig. 5

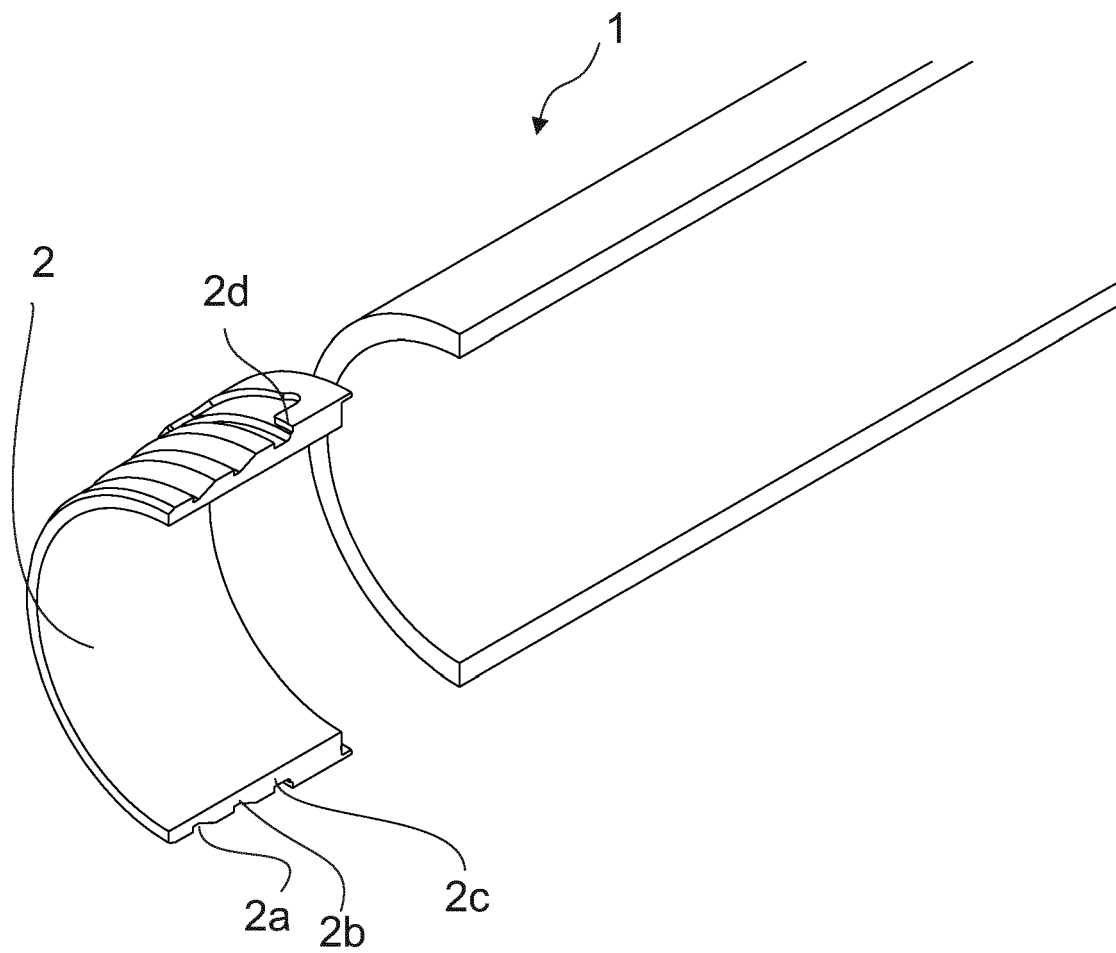


Fig. 6a

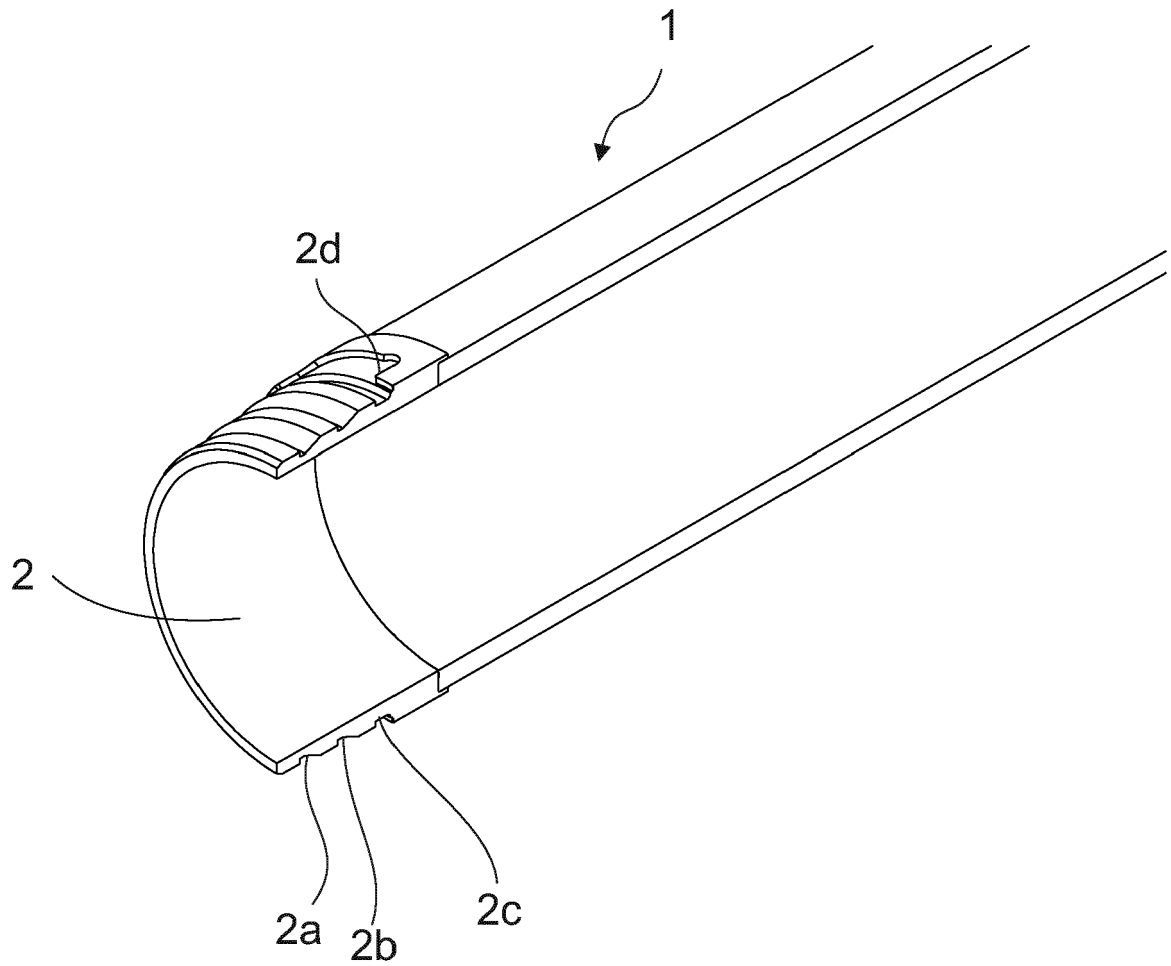


Fig. 6b

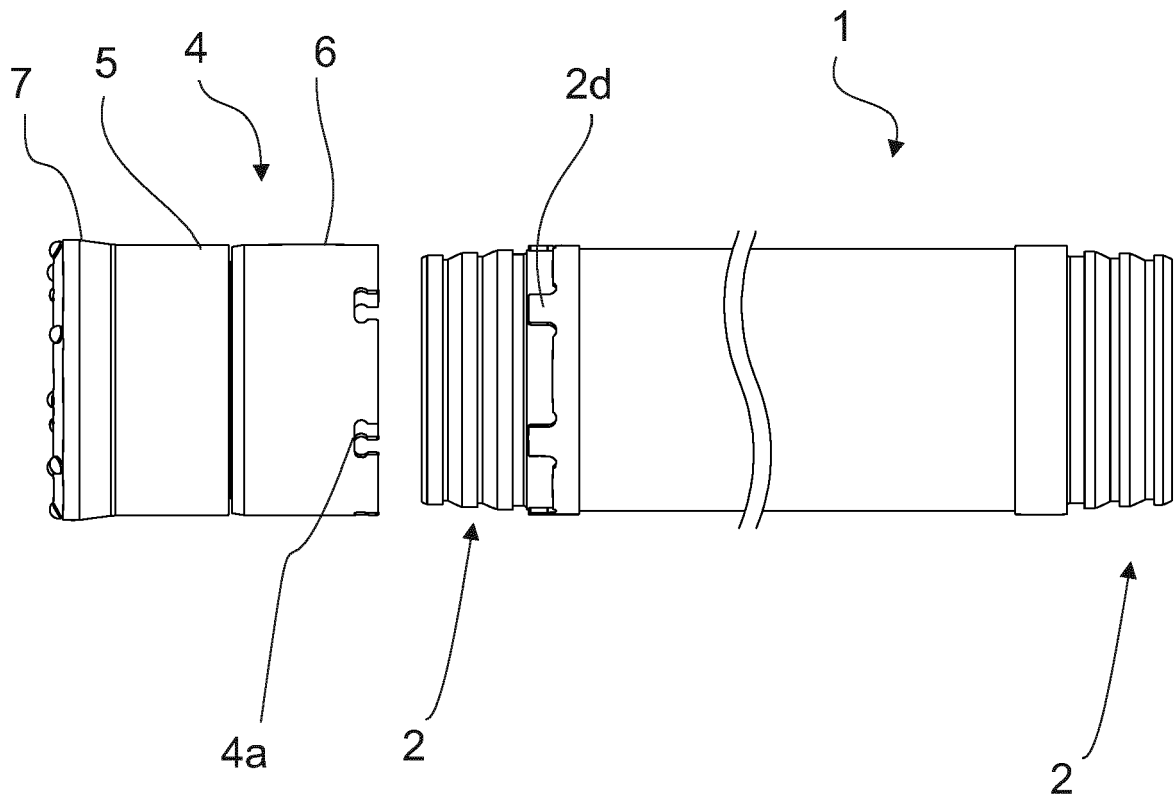


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 16 20 6335

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 2010/308577 A1 (CHIN DAVID [US]) 9 December 2010 (2010-12-09) * abstract * * figures 1-4 * * paragraph [0025] - paragraph [0027] * * paragraph [0030] - paragraph [0034] * * paragraph [0062] * * paragraph [0068] *	1-6,8-11 7	INV. E21B17/046 F16L47/00
X A	GB 1 421 530 A (PRYOR T G) 21 January 1976 (1976-01-21) * abstract * * figure 1 * * page 1, line 38 - page 2, line 2 *	1-3,7 4-6,8-11	
A	WO 99/43974 A1 (GRANT PRIDECO INC [US]) 2 September 1999 (1999-09-02) * abstract * * figures 1,10-16 * * page 7, line 11 - page 9, line 11 * * page 11, line 22 - page 12, line 10 *	1-11	
			TECHNICAL FIELDS SEARCHED (IPC)
			E21B F16L
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 27 June 2017	Examiner Hustedt, Bernhard
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 20 6335

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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27-06-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010308577 A1	09-12-2010	US 2010308577 A1	09-12-2010
		US 2014143998 A1	29-05-2014
GB 1421530 A	21-01-1976	NONE	
WO 9943974 A1	02-09-1999	AR 014652 A1	28-03-2001
		AT 322640 T	15-04-2006
		AU 759456 B2	17-04-2003
		CA 2322441 A1	02-09-1999
		DE 69930731 T2	12-04-2007
		EP 1056968 A1	06-12-2000
		MX PA00008442 A	30-08-2002
		US 6042153 A	28-03-2000
		US 6273474 B1	14-08-2001
		WO 9943974 A1	02-09-1999

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4779902 A [0004]