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(54) **DOWNHOLE TOOL PROTECTOR APPARATUS AND METHOD**

BOHRLOCHWERKZEUGSCHUTZVORRICHTUNG UND VERFAHREN

APPAREIL ET PROCÉDÉ DE PROTECTION D'OUTIL DE FOND

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Description

[0001] The present invention relates to a downhole tool protector apparatus and method and more particularly but not exclusively relates to a method of and apparatus for protecting a drill bit particularly during transportation or storage when not in use.

[0002] US 4,733,789 discloses a shipping containers for transporting drill bits, comprising two separable and telescoping components. Drilling wells for oil and gas involves making up a Bottom Hole Assembly (BHA), which is an assortment of drilling tools screwed and torqued together to make up a drill string on a drilling rig. However, this assembly and disassembly of drilling tools that make up the drill string is time consuming and most wells require multiple BHAs (4 - 20+) before completion which add considerable cost to any drilling campaign because every hour of rig time can cost an operator from £8,000 - £16,000 at August 2008 rates. Therefore the cost associated with such a make-up/break-out of a BHA can run from £192,000 - £2 million (depending upon the amount of BHAs required and the rig rate) per well.

[0003] An essential element of each BHA is the drill bit. Such drill bits are actually relatively fragile and are prone to damage if dropped or accidentally struck by other pieces of machinery but such drill bits are also very expensive (each drill bit costing from £5,000 - £150,000 each). Consequently, it is very important to protect the drill bits during transportation and storage whilst they are not in use. Conventionally, drill bits would be hung upside down within a breaker plate whilst in transportation and/or storage. The breaker plate is essentially C-shaped with an opening on one side such that the upper end of the drill bit can be inserted into the open side of the C-shaped breaker plate until the drill bit sits in the middle of the breaker plate and a gate is closed across the open side thereof such that the gate locks the drill bit in the breaker plate. The drill bit is vertically secured to the breaker plate by means of a pair of straight edged slots being formed on opposite sides of the substantially cylindrical outer housing of the drill bit, where the straight edged slots accept the straight edged sides of the aperture formed in the breaker plate (the width of the aperture formed in the breaker plate being just slightly larger than the width of the drill bit at the height having the straight edged slots) such that the drill bit is prevented from rotating with respect to the breaker plate whilst being held therein. The breaker plate is crucial in the making up of a BHA in that, when offshore on a drilling rig, the breaker plate and drill bit are lowered onto the drill rig floor and into a rotary table provided therein such that the breaker plate is then fixed to the drilling rotary table. The rest of the BHA, typically a large motor such as a mud motor, is conventionally then swung above the upper end of the drill bit and the large motor is threaded onto an upper most thread of the drill bit and can be torqued onto the drill bit using manual rig tongs such that the connection between the mud motor and the drill bit is "made up". The breaker plate therefore holds the drill bit tight such that the motor can be torqued onto the upstanding threaded pin or threaded box of the drill bit.

[0004] The drill bit as described above is held in the breaker plate and dangles down there from during storage or transportation. Furthermore, in order to further protect the drill bit, the breaker plate in turn is mounted to the upper open end of a box termed a "bit box", the upper open end having four upstanding pins at each corner and said pins are threaded through four corresponding holes provided at each corner of the breaker plate such that the breaker plate essentially forms the uppermost side of the bit box and the bit dangles down from the breaker plate within the interior of the bit box. In the case of some designs of bits, transportation is in the form of cardboard or wooden boxes due to no breaker straight edged slots being present on the drill bit.

[0005] Such a conventional method of transporting and storing drill bits and making up BHAs on drilling rigs has a number of problems and disadvantages associated therewith. Firstly, making up the drill bit into the rest of the BHA on the drilling rig is expensive because of the cost of running a drill rig, particularly an offshore rig, and therefore anything that can be done to reduce the time involved in making up a BHA on a drill rig is advantageous. Furthermore, torqueing up the drill bit to the motor with manual rig tongs is dangerous, particularly because of the weight of the drill bit and the large motor.

[0006] It would be highly desirable to be able to make up the drill bit and the motor onshore and transport the combined drill bit and motor offshore already made up to one another. However, bit boxes for protecting the drill bit require the breaker plate to be in place around the drill bit. Unfortunately, it would be very dangerous to transport a drill bit plus large motor with a breaker plate attached there between because of the weight of the bit box and the breaker plate in particular - these are typically in the region of 25-100 kg and because a combined drill bit and large motor would by necessity have to be transported horizontally, conventional breaker plates would be very dangerous to be transported in that configuration because the person on the drilling rig would suffer a serious likelihood of injury if they tried to remove a breaker plate when it is arranged in a vertical plane around the neck of a drill bit lying horizontally or there is the potential of dropping either or both of the drill bit and breaker plate due to a lack of secure holding points.

[0007] It is therefore an object of the present invention to overcome one or more of the above described disadvantages of conventional bit boxes and methods of transporting and storing drill bits.

[0008] Furthermore, other tools included in the BHA and further up the drill string such as rotary steerable tools, reamers, milling tools, melon mills and the like are also high value and it would be desirable to protect them during transportation and storage when not in use. Such other tools are provided with connections at each end such that they

may be included in the drill string.

[0009] According to a first aspect of the present invention there is provided an oil, gas or water borehole drill bit protector apparatus comprising:-

5 two protector portions adapted to be placed around and/or adapted to envelope at least a drilling portion of the drill bit; the protector portions being hinged together by a hinge mechanism the hinge being provided by one or more straps and the protector portions comprising an aperture through which a connection portion of the drill bit projects in use According to the first aspect of the present invention there is also provided

10 A method of protecting a drill bit comprising:-

providing a protector apparatus according to the first aspect of the invention,
placing the one or more protector portions around and/or enveloping the drilling portion of the drill bit; and
15 hinging the protector portions closed around the drilling portion of the drill bit such that the connection portion of the drill bit projects through the aperture of the one or more protector portions.

[0010] Preferably, the protector apparatus according to the first aspects of the present invention the portions are substantially semi-circular in internal cross section and closed around a drill bit or downhole tool provide a generally circular internal diameter.

20 **[0011]** Typically, the hinge mechanism may be integrally formed with the two portions such that the protector apparatus is moulded or otherwise formed as a one piece component or may be formed by a separate hinge member such that the hinge member connects the said two portions. The said two portions typically comprise respective longitudinal axes with the hinge mechanism being provided along one longitudinal edge of the respective two portions.

25 **[0012]** Preferably, the protector apparatus further comprises a locking mechanism to lock the two or more portions together preferably about the drill bit or downhole tool. Typically, the locking mechanism is provided at, on or along the other longitudinal edge of the respective two portions such that the locking mechanism is formed on the opposite longitudinal edge of the two portions from the hinge mechanism.

30 **[0013]** The hinge member and the locking mechanism are provided by a strapping arrangement such as by one or more straps which firstly connect the two portions together and secondly can be connected to one another to form the locking mechanism. More preferably, the one or more straps are embedded within the two portions such that a middle portion of the one or more straps forms the hinge member and the ends of the one or more straps can be connected together to form the locking mechanism.

35 **[0014]** Preferably, the two portions of the protector apparatus according to the first aspect of the invention when brought together provide a generally cylindrical inner bore having a closed lowermost in use end and an in use upper most end having a means to prevent movement occurring between the protector apparatus and the drill bit. Preferably the said in use uppermost end further comprises the aperture through which the connection portion of the drill bit projects in use. Preferably, the means to prevent movement occurring comprise shoulder portions adapted to abut with a portion of the drill bit which may be shoulder portions of the drill bit, such that the aperture in the in use uppermost end is a smaller diameter than the upper most in use end of the drilling portion of the drill bit such that the shoulder portions of the protector apparatus hang off the shoulder portions of the drill bit.

40 **[0015]** A gap or annulus between the outer surface of the drilling portion of the drill bit or downhole tool and the inner bore of the protector apparatus of the respective first and second aspect may be filled by a packing material wherein said packing material may be any suitable type of packing such as foam, rubber, neoprene, injected foam, sponge foam, an inflatable member such as air bags, or fluid filled bags or other suitable type of packing material such that the respective drill bit is securely held in the respective bit box.

[0016] According to a second aspect of the present invention there is provided a method of transporting an oil gas or water borehole drill bit to a drilling rig comprising the steps of:-

50 a) providing a protector apparatus according to the first aspect of the invention, making up a connection between the drill bit and a motor or other portion of a BHA;

c) hinging the protector apparatus closed around the drill bit either before step b) or after step b); and

55 d) transporting the drill bit and motor or other portion of BHA made up together and the protector apparatus to the drilling rig.

[0017] Typically, the connection between the drill bit and the motor or other portion of BHA is made up in a make up/break out facility on land and is subsequently transported to a drilling rig offshore. The made up drill bit and motor or

other portion of BHA and the protector apparatus may be stored on or in close proximity to the drilling rig until such a time that the made up drill bit and rest of BHA is required to drill a borehole, at which point it may be connected to the lower most end of a drill string, the protector apparatus removed by unlocking the locking mechanism and the drill bit may be run into the borehole.

[0018] Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 (a) is a cross section side view of a first example of a bit box, and is shown as housing a drill bit;

Fig. 1 (b) shows an end view (bottom end) of the bit box of Fig. 1 (a);

Fig. 1 (c) shows a plan view of the bit box of Fig. 1 (b) but in an open configuration;

Fig. 1 (d) is a close up view of one possible example of a locking mechanism for locking the bit box of Fig. 1 (b);

Fig. 1 (e) is a side view of locking strip for insertion into the locking mechanism of Fig. 1 (d);

Fig. 2(a) is cross-sectional side view of the bit box of Fig. 1 (a) but without the drill bit or packing elements for clarity;

Fig. 2(b) is a bottom end view of the bit box of Fig. 2(a);

Fig. 2(c) is a cross-sectional plan view of the bit box of Fig. 2(b) but in an open configuration;

Fig. 3(a) is a cross-sectional side view of a second example of bit box, shown in a closed configuration, and being provided in a first (largest) size (design 1) which is suitable for use with a drill bit ranging from 12 ¼ inch diameter to 17 ½ inch diameter drill bits;

Fig. 3(b) is a side view of the bit box of Fig. 3(a) but in an open configuration;

Fig. 3(c) is a plan view of the uppermost end of the bit box of Fig. 3(a) but in an open configuration;

Fig. 3(d) is a perspective view of the bit box of Fig. 3(a) but in an open configuration;

Fig. 3(e) is a plan view of the bit box of Fig. 3(c);

Fig. 4(a) is a smaller size version (design 2) of the bit box of Fig. 3(a), again shown in a closed configuration, where design 2 is suitable for housing a smaller drill bit ranging from 8 ½ inch to 12 ¼ inch diameter;

Fig. 4(b) is a side view of the bit box of Fig. 4(a) but in an open configuration;

Fig. 4(c) is a plan view of the uppermost end of the bit box of Fig. 4(a) but in an open configuration;

Fig. 4(d) is a perspective view of the bit box of Fig. 4(a) but in an open configuration;

Fig. 4(e) is a plan view of the bit box of Fig. 4(c);

Fig. 5(a) is a yet smaller size version (design 3) of the bit box of Fig. 3(a), again shown in a closed configuration, where design 3 is suitable for housing a drill bit ranging from 6 1/8th inch to 8 ½ inch diameter;

Fig. 5(b) is a side view of the bit box of Fig. 5(a) but in an open configuration;

Fig. 5(c) is a plan view of the uppermost end of the bit box of Fig. 5(a) but in an open configuration;

Fig. 5(d) is a perspective view of the bit box of Fig. 5(a) but in an open configuration;

Fig. 5(e) is a plan view of the bit box of Fig. 5(c);

Fig. 6(a) is a smallest size version (design 4) of the bit box of Fig. 3(a), again shown in a closed configuration, where design 4 is suitable for housing a 2 7/8th inch outer diameter drill bit to a 6 inch drill bit;

Fig. 6(b) is a side view of the bit box of Fig. 6(a) but in an open configuration;

Fig. 6(c) is a plan view of the uppermost end of the bit box of Fig. 6(a) but in an open configuration;

Fig. 6(d) is a perspective view of the bit box of Fig. 6(a) but in an open configuration;

Fig. 6(e) is a plan view of the bit box of Fig. 6(c);

Fig. 7(a) is a perspective view of an embodiment of a bit box according to one aspect of the present invention in a closed configuration;

Fig. 7(b) is a perspective cross sectional view of the bit box of Fig 7(a);

Fig. 7(c) is a side elevation of the bit box of Fig. 7(a) in an open configuration;

Fig. 7(d) is a plan view of the bit box of Fig 7(a);

Fig. 7(e) is a cross sectional view on the line A-A through a half of the bit box of Fig. 7(d);

Fig. 7(f) is a top elevation of the bit box of Fig. 7(a), and

Fig. 7(g) is an end elevation of the bit box of Fig. 7(a).

[0019] Fig. 1 (a) shows a cross-sectional side view of a bit box 10 for safely and securely housing and thereby protecting a drill bit 12. The bit box 10 is shown in Fig. 1(b) in the closed configuration and in Fig. 1 (c) in the open configuration as comprising a generally cylindrical housing having a cylindrical main inner bore with a substantially cylindrical outer surface although it should be noted that, although the inner circumference of the bit box 10 is preferably cylindrical to suit the generally cylindrical outer circumference of most drill bits, the outer surface may be any suitable shape such as square, hexagonal, pentagonal etc.

[0020] The bit box 10 is suitable for housing substantially any conventional drill bit used in the oil & gas exploration industry such as the five main types of drill bits, these being:-

- a) Polycrystalline Diamond Compact (PDC);
- b) Tri Cone bits;
- c) Impregnated Diamond bits (Impreg);
- d) Two Cone bits; and
- e) Mono cone bits.

[0021] The bit box 10 as shown in Fig. 1(c) is preferably provided in more than one main piece such that they can be brought close to and closed around the drill bit in order that it at least partially envelopes and preferably completely envelopes the relatively fragile cutting elements of the drill bit. Most preferably, the bit box 10 is provided in two semi-circular halves 10A, 10B connected by a hinge 18. The hinge may be formed as shown in Fig. 1(c) as an integral part of the bit box 10 or could be provided by a suitable knuckle joint arrangement where each semi-circular half 10A, 10B is a separate component and is provided with alternating and interlockable circular bores through which a rod can be threaded and then secured to keep the two halves hinged to one another.

[0022] These arrangements however are not claimed.

[0023] The two halves can be placed around a drill bit to be protected such that the two halves are closed about the hinge 18 such that the opposing edges 20A, 20B opposite the hinge 18 come together to form a locking mechanism 20. As can be seen in Fig. 1 (a) the gap between the outer surface of the drill bit and inner circumference of the bit box 10 is filled with a suitable filling material such as rubber or neoprene packing 14 or another suitable type of packing such as foam, injected foam, sponge foam, inflatable air bags, or fluid filled bags or other suitable type of packing material such that the drill bit is securely held in the bit box 10. In certain circumstances, the packing material such as sponge foam etc could be specifically designed to match the outer circumference of the drill bit to minimise any possible movement of the drill bit relative to the bit box 10.

[0024] Locking mechanism 20 as shown in Fig. 1(b) is locked by inserting a locking strip 22 along its length but again the locking mechanism could be provided by a number of alternating bores that interlock to form a long bore and into which a locking pin can be inserted along the entire length c of the bit box 10 such that the bit box 10 is selectively locked in the closed position as shown in Fig. 1(a) and Fig. 1(b). However it should be noted that the locking mechanism 20 could take any other suitable configuration or arrangement that provides a suitable locking mechanism. As shown in Fig. 1 (a) when the bit box 10 is in the locked configuration, its in use lowermost end 24 is completely closed whereas its uppermost end 26 comprises a central aperture 16 formed therein but also comprises a shoulder portion 17. The central aperture 16 allows the threaded pin 12P of the drill bit 12 to project therethrough whilst the shoulder portion 17 extends over and around the upper shoulder portions 12S of the drill bit and thus the shoulder portion 17 of the bit box 10 ensures that the bit box 10 cannot be pulled off the drill bit 12 as long as the locking mechanism 20 remains locked. Nevertheless, the aperture 16 allows the threaded pin 12B to project therethrough and thus allows the threaded pin 12P to be threaded to for instance a large motor or another tool that forms the next lowermost component in a BHA. Thus, the bit box 10 provides the possibility of protecting the drill bit 12 in a safe manner without requiring a breaker plate nor a conventional drill bit cage whilst the drill bit 12 is connected to the rest of the BHA.

[0025] The bit box 10 is preferably formed from a lightweight but strong material such as a plastics material and a preferred plastics material is polypropylene. The bit box 10 being formed from plastics material provides several advantages including relatively lightweight but also provides the big advantage that it can be drilled out of the borehole by the drill bit if the bit box 10 is accidentally dropped down the borehole whilst being removed from the drill bit and thus provides embodiments of the present invention with a further advantage over the prior art substantially metal drill bit box cages which could not be drilled out if portions of them were accidentally dropped down the borehole.

[0026] The bit box 10 as shown in Fig. 1(a)-1(d) further comprises longitudinally extending indents or grooves in the outer surface to provide strength and support to the bit box 10. However, such indents 28 are not essential.

[0027] The bit box 10 can be provided in four sizes to fit the vast majority of drill bit sizes and these are follows:-

Design and suitable drill bit sizes	Length of bit box C	Inner Diameter of bit box B	Diameter of aperture A
Design 1 - suitable for 12¼" to 17½" OD drill bits	45cm	51cm	25cm
Design 2 - suitable for 8½" to 12¼" OD drill bits	65cm	38cm	22cm
Design 3 - suitable for 6⅝" to 8½" OD drill bits	45cm	28cm	17cm

(continued)

Design and suitable drill bit sizes	Length of bit box C	Inner Diameter of bit box B	Diameter of aperture A
Design 4 - suitable for 2 $\frac{7}{8}$ " to 6" OD drill bits	45cm	22cm	13cm

[0028] Fig. 3(a) shows another example of a bit box 100 which is similar in many respects to the first example 10 and has the same sizes of length and diameter as design 1. The example of bit box 200 as shown in Fig. 4(a) is most similar to the embodiment 100 shown in Fig. 3(a) except that the example of bit box 200 of Fig. 4(a) has the same length C, outer diameter B and aperture diameter A as design 2. Moreover, the example of bit box 300 shown in Fig. 5(a) is most similar to the example 100 shown in Fig. 3(a) except that the example of bit box 300 of Fig. 5(a) has the same length C, outer diameter B and aperture diameter A as design 3. Furthermore, the example of bit box 400 shown in Fig. 6(a) is most similar to the example 100 shown in Fig. 3(a) except that the example of bit box 400 of Fig. 6(a) has the same length C, outer diameter B and aperture diameter A as design 4.

[0029] The examples of bit boxes 10, 100, 200, 300, 400 described above provide the great advantage that they can be attached around a drill bit and secured either before or after the drill bit is made up or torqued up to the whole or part of a BHA in a workshop or other suitable location anywhere on land and, because the bit boxes 10, 100, 200, 300, 400 are very lightweight and because of the other features they comprise, the bit 12, rest of BHA (not shown) and bit boxes 10, 100, 200, 300, 400 can all be transported offshore to an offshore drilling rig already connected together thus increasing safety and reducing time and therefore cost offshore (because there is no longer a requirement to make up a connection between the motor or lower portion of BHA and drill bit offshore). Furthermore, the bit boxes 10, 100, 200, 300, 400 can quickly and safely be removed from around the bit 12 just before the made up BHA is run into the borehole. Furthermore, if the bit box 10, 100, 200, 300, 400 is accidentally dropped down the hole when this is being removed from the bit 12, it can be easily drilled out because it is preferably formed of drillable materials, which is preferably plastic. Furthermore, no heavy breaker plate is required to be used offshore to hold the bit steady in the rotary table whilst the rest of the BHA is made up onto the bit 12.

[0030] Preferably, a snare or tether loop formed from a wire (not shown) is provided to provide a backup means of attaching the bit box 10, 100, 200, 300, 400 to the bit 10 in order to further reduce the chances of dropping the bit box 10, 100, 200, 300, 400 down the hole. Suitable holes are formed in each of the halves 10A, 10B and the snare or tether wire is threaded through the said holes and a variable diameter snare loop is formed at the other end which can be placed around the drill string/rest of BHA and fastened thereto such that when the time comes to remove the bit box 10 from enveloping the bit 10, the snare or tether still connects the bit box 10 to the drill string/rest of BHA until it is also disconnected from the drill string/rest of BHA.

[0031] Furthermore, the hinge 18 and/or locking mechanism 20 is modified and a preferred embodiment of bit box comprises one or more elongate flexible straps (not shown) such as nylon or other suitable flexible rope type straps to form the hinge 18 and/or locking mechanism 20. In such an embodiment, one or more (and two are preferred) flexible straps are embedded within the semi-circular halves 10A, 10B during manufacture/moulding such that the one or more straps are integral with the semi-circular halves 10A, 10B and are located just under the outer surface and extend around the circumference of the semi-circular halves 10A, 10B such that when the semi-circular halves 10A, 10B are brought together around the bit 12, the approximate mid-point of the strap(s) form the hinge 18 and the two ends of each strap project out of the opposing edges 20A, 20B such that the two ends of each strap can be tied together to form an alternative locking mechanism. In such an embodiment it is preferred that one of the ends of each strap is provided with a buckle (not shown) such as a cam buckle through which the other end of the strap can be passed in order to tighten the two semi-circular halves 10A, 10B around the bit 12. This also aids an operator to release the locking mechanism 20 when the time comes to remove the bit box 10 from the bit 12. Most preferably, there are two or three straps equispaced along the longitudinal axis of the bit box 10 and which are located just under the outer surface and extend around the circumference of the semi-circular halves 10A, 10B. Preferably, the strap(s) are embedded in the two semi-circular halves 10A, 10B during moulding of the bit box 10 such that the plastics or other suitable material of the two semi-circular halves 10A, 10B hardens around the strap(s) in order to increase the strength therebetween but in other embodiments the straps could be otherwise fastened to the two semi-circular halves 10A, 10B with suitable fixing means such as screws or bolts or the like.

[0032] Figs 7(a) to 7(g) show a claimed embodiment of bit box 700 similar to that described above in which the hinge 18 is formed by the straps. In this embodiment a channel 750 and more preferably two channels is/are formed through the two halves of the bit box 700 to receive the straps. The position of the channel(s) may be marked on the bit box during manufacture/moulding and then formed by a routing procedure to remove the necessary material to provide a pathway for the strap(s) close to the surface of the bit box. The strap(s) is/are then fed through the channel(s) such that

the approximate mid-point of the strap(s) form/forms the hinge. The strap(s) may be secured in position within the channel(s) by forcing an adhesive or foam or other setting material into the channel(s) such that the material sets within the channel(s) to prevent the strap(s) from being pulled out of the channel(s). The channel(s) are shown on one size only of bit box but could be incorporated into any of the embodiments described herein.

[0033] A recess 760 is provided in the side of each half of the bit box. The recess may be formed during manufacture/moulding and provides a hand hold for ease of carrying the bit box. The bit boxes 10, 100, 200, 300 or 400 can also be modified to include such a hand hold.

[0034] Furthermore, the bit boxes 10, 100, 200, 300, 400 can be further modified by providing an aperture on their lower end (such that the lower end is no longer closed off) to provide a downhole tool protector (not shown) such that the downhole tool protector can be used to protect other valuable and/or fragile tools used in the BHA and further up the drill string such as rotary steerable tools, reamers, milling tools, melon mills and the like during transportation and storage when not in use. These modified bit boxes however are not claimed.

[0035] As will be appreciated by those skilled in the art, such downhole tools are provided with suitable connections (such as OCTG pin and box screwthreaded connections) at each end such that they may be included in the drill string and the downhole tool protector therefore has an aperture at each end. The lowermost aperture, when the downhole protector is in the locked configuration, provides its lowermost end with a central aperture formed therein that surrounds the lowermost connection or tubular section of the downhole tool and also thereby provides the lowermost end of the downhole tool protector with a shoulder portion that is supported on and thereby protects the lowermost end of the valuable and/or fragile portion of the downhole tool such as the reamer blades on a reamer. Furthermore, the uppermost end of the downhole tool protector also comprises a central aperture formed therein and a shoulder portion that is similar to the uppermost end of the bit box 10. Consequently, the upper central aperture allows the threaded pin or uppermost tubular portion of the downhole tool to project therethrough whilst the uppermost shoulder portion extends over and around the upper shoulder portion of the valuable and/or fragile portion of the downhole tool and thus the upper and lower shoulder portions of the downhole tool protector ensure that the downhole tool protector cannot be pulled off the downhole tool as long as the locking mechanism remains locked. Nevertheless, the upper and lower apertures allow the respective upper and lower connections of the downhole tool to project therethrough and thus allow the upper and lower connections to be inserted into the BHA or rest of drill string.

[0036] Further modifications and improvements may be made to the embodiments hereinbefore described without departing from the scope of the invention. For instance, the bit boxes and downhole tool protectors hereinbefore described could be formed from suitable other materials such as any one of or a combination of fibre glass, Kevlar™, carbon fibre, polyurethane or any other suitable material having the protective properties of relatively lightweight, strong, durable and preferably also being drillable in the unlikely event that they are dropped downhole.

Claims

1. An oil, gas or water borehole drill bit protector apparatus (10) comprising:-

two protector portions (10A, 10B) adapted to be placed around and/or adapted to envelope at least a drilling portion of the drill bit and comprising an aperture (16) through which a connection portion of the drill bit projects in use, **characterized in that** the protector portions are hinged together by a hinge mechanism (18) the hinge being provided by one or more straps.

2. A protector apparatus according to claim 1, wherein the portions (10A, 10B) are semi-circular in internal cross section and when closed around a drill bit provide a generally circular internal diameter.

3. A protector apparatus according to any of claims 1 or 2, wherein the two portions comprise respective longitudinal axes with the hinge mechanism being provided along one longitudinal edge of the respective two portions.

4. A protector apparatus according to any of claims 1-3, wherein the protector apparatus further comprises a locking mechanism (20) to lock the two portions together.

5. A protector apparatus according to claim 4, wherein the locking mechanism is provided at, on or along the other longitudinal edge of the respective two portions

6. A protector apparatus according to claim 5, wherein the locking mechanism is formed on the opposite longitudinal edge of the two portions from the hinge mechanism.

7. A protector apparatus according to any of claims 4-6, wherein the the locking mechanism is provided by the one or more straps.
- 5 8. A protector apparatus according to claim 7, wherein the one or more straps are embedded within the two portions such that a middle portion of the one or more straps forms the hinge member and the ends of the one or more straps can be connected together to form the locking mechanism.
9. A protector apparatus according to any of the preceding claims wherein the two portions of the protector apparatus when brought together provide a generally cylindrical inner bore having a closed lowermost in use end and an in use upper most end having a means to prevent movement occurring between the protector apparatus and the drill bit.
- 10 10. A protector apparatus according to claim 9, wherein the means to prevent movement occurring comprise shoulder portions adapted to abut with a portion of the drill bit.
- 15 11. A method of protecting a drill bit comprising:-providing a protector apparatus according to any of claims 1-10, placing the two protector portions around and/or enveloping the drilling portion of the drill bit; and hinging the protector portions closed around the drilling portion of the drill bit such that the connection portion of the drill bit projects through the aperture of the one or more protector portions.
- 20 12. A method of transporting an oil gas or water borehole drill bit to a drilling rig comprising the steps of:-
 - a) providing a protector apparatus according any of claims 1-10,
 - b) up a connection between the drill bit and a motor or other portion of a BHA;
 - c) hinging the protector apparatus closed around the drill bit either before step b) or after step b); and
 - 25 d) transporting the drill bit and motor or other portion of BHA made up together and the protector apparatus to the drilling rig.

Patentansprüche

- 30 1. Eine Öl-, Gas- oder Wasserbohrlochbohrmeißel-Schutzvorrichtung (10), die Folgendes beinhaltet:

zwei Schutzabschnitte (10A, 10B), die zum Platzieren um mindestens einen Bohrabschnitt des Bohrmeißels herum angepasst sind und/oder zum Umhüllen mindestens eines Bohrabschnitts des Bohrmeißels angepasst sind, und eine Öffnung (16) beinhalten, durch die im Einsatz ein Verbindungsabschnitt des Bohrmeißels vorsteht, **dadurch gekennzeichnet, dass** die Schutzabschnitte durch einen Gelenkmechanismus (18) miteinander gelenkig verbunden sind, wobei das Gelenk durch einen oder mehrere Riemen bereitgestellt ist.
- 35 2. Schutzvorrichtung gemäß Anspruch 1, wobei die Abschnitte (10A, 10B) im Innenquerschnitt halbkreisförmig sind und, wenn sie um einen Bohrmeißel herum geschlossen sind, einen im Allgemeinen kreisförmigen Innendurchmesser bereitstellen.
- 40 3. Schutzvorrichtung gemäß einem der Ansprüche 1 oder 2, wobei die zwei Abschnitte jeweilige Längsachsen beinhalten, wobei der Gelenkmechanismus entlang einer Längskante der jeweiligen zwei Abschnitte bereitgestellt ist.
- 45 4. Schutzvorrichtung gemäß einem der Ansprüche 1-3, wobei die Schutzvorrichtung ferner einen Verriegelungsmechanismus (20) beinhaltet, um die zwei Abschnitte miteinander zu verriegeln.
- 50 5. Schutzvorrichtung gemäß Anspruch 4, wobei der Verriegelungsmechanismus an, auf oder entlang der anderen Längskante der jeweiligen zwei Abschnitte bereitgestellt ist.
6. Schutzvorrichtung gemäß Anspruch 5, wobei der Verriegelungsmechanismus an der gegenüberliegenden Längskante der zwei Abschnitte von dem Gelenkmechanismus gebildet ist.
- 55 7. Schutzvorrichtung gemäß einem der Ansprüche 4-6, wobei der Verriegelungsmechanismus durch den einen oder die mehreren Riemen bereitgestellt ist.
8. Schutzvorrichtung gemäß Anspruch 7, wobei der eine oder die mehreren Riemen in den zwei Abschnitten eingebettet

ist/sind, so dass ein mittlerer Abschnitt des einen oder der mehreren Riemen das Gelenkelement bildet und die Enden des einen oder der mehreren Riemen miteinander verbunden werden können, um den Verriegelungsmechanismus zu bilden.

- 5 9. Schutzvorrichtung gemäß einem der vorhergehenden Ansprüche, wobei die zwei Abschnitte der Schutzvorrichtung, wenn sie zusammengebracht werden, eine im Allgemeinen zylindrische Innenbohrung mit einem im Einsatz geschlossenen untersten Ende und einem im Einsatz am weitesten oben liegenden Ende mit einem Mittel zum Verhindern, dass eine Bewegung zwischen der Schutzvorrichtung und dem Bohrmeißel vorkommt, bereitstellen.
- 10 10. Schutzvorrichtung gemäß Anspruch 9, wobei das Mittel zum Verhindern, dass eine Bewegung vorkommt, Schulterabschnitte beinhaltet, die so angepasst sind, dass sie an einen Abschnitt des Bohrmeißels anstoßen.
11. Ein Verfahren zum Schützen eines Bohrmeißels, das Folgendes beinhaltet:
15 Bereitstellen einer Schutzvorrichtung gemäß einem der Ansprüche 1-10, Platzieren der zwei Schutzvorrichtungen um den Bohrabschnitt des Bohrmeißels und/oder so, dass sie diesen umhüllen; und
gelenkiges Verbinden der Schutzabschnitte, die um den Bohrabschnitt des Bohrmeißels herum geschlossen sind, so dass der Verbindungsabschnitt des Bohrmeißels durch die Öffnung des einen oder der mehreren Schutzabschnitte vorsteht.
20
12. Ein Verfahren zum Transportieren eines Öl-, Gas- oder Wasserbohrlochbohrmeißels zu einer Bohranlage, das die folgenden Schritte beinhaltet:
25 a) Bereitstellen einer Schutzvorrichtung gemäß einem der Ansprüche 1-10,
b) Herstellen einer Verbindung zwischen dem Bohrmeißel und einem Motor oder einem anderen Abschnitt eines Bohrlochsohlensystems (BHA, Bottom Hole Assembly);
c) gelenkiges Verbinden der Schutzvorrichtung, die um den Bohrmeißel herum geschlossen ist, entweder vor Schritt b) oder nach Schritt b); und
30 d) Transportieren des Bohrmeißels und des Motors oder des anderen Abschnitts des BHA, die zusammengesetzt sind, und der Schutzvorrichtung zu der Bohranlage.

Revendications

- 35 1. Un appareil de protection de trépan pour trou de forage de pétrole, de gaz ou d'eau (10) comprenant :-
deux parties de protection (10A, 10B) conçues pour être placées autour et/ou conçues pour envelopper au moins une partie de forage du trépan et comprenant un orifice (16) par lequel une partie de raccordement du trépan dépasse lors de l'utilisation, **caractérisé en ce que** les parties de protection sont articulées l'une à l'autre
40 au moyen d'un mécanisme formant charnière (18), la charnière consistant en une ou plusieurs brides.
2. Un appareil de protection selon la revendication 1, dans lequel les parties (10A, 10B) sont semi-circulaires en coupe transversale interne et, lorsqu'elles sont refermées autour d'un trépan, assurent un diamètre interne généralement circulaire.
45
3. Un appareil de protection selon n'importe lesquelles des revendications 1 et 2, dans lequel les deux parties comprennent des axes longitudinaux respectifs, le mécanisme formant charnière étant prévu le long d'un bord longitudinal des deux parties respectives.
- 50 4. Un appareil de protection selon n'importe lesquelles des revendications 1 à 3, dans lequel l'appareil de protection comprend en sus un mécanisme de verrouillage (20) pour verrouiller les deux parties ensemble.
5. Un appareil de protection selon la revendication 4, dans lequel le mécanisme de verrouillage est prévu au niveau de, sur ou le long de l'autre bord longitudinal des deux parties respectives.
55
6. Un appareil de protection selon la revendication 5, dans lequel le mécanisme de verrouillage est formé sur le bord longitudinal opposé des deux parties par rapport au mécanisme formant charnière.

7. Un appareil de protection selon n'importe lesquelles des revendications 4 à 6, dans lequel le mécanisme de verrouillage consiste en ces une ou plusieurs brides.

8. Un appareil de protection selon la revendication 7, dans lequel ces une ou plusieurs brides sont intégrées à l'intérieur des deux parties de sorte qu'une partie médiane de ces une ou plusieurs brides forme l'élément charnière et les extrémités de ces une ou plusieurs brides peuvent être raccordées les unes aux autres pour former le mécanisme de verrouillage.

9. Un appareil de protection selon n'importe lesquelles des revendications précédentes dans lequel les deux parties de l'appareil de protection, lorsqu'elles sont ramenées l'une vers l'autre, assurent un alésage interne généralement cylindrique présentant une extrémité, qui lors de l'utilisation est la plus basse, fermée et une extrémité la plus haute lors de l'utilisation possédant un moyen pour empêcher qu'un déplacement se produise entre l'appareil de protection et le trépan.

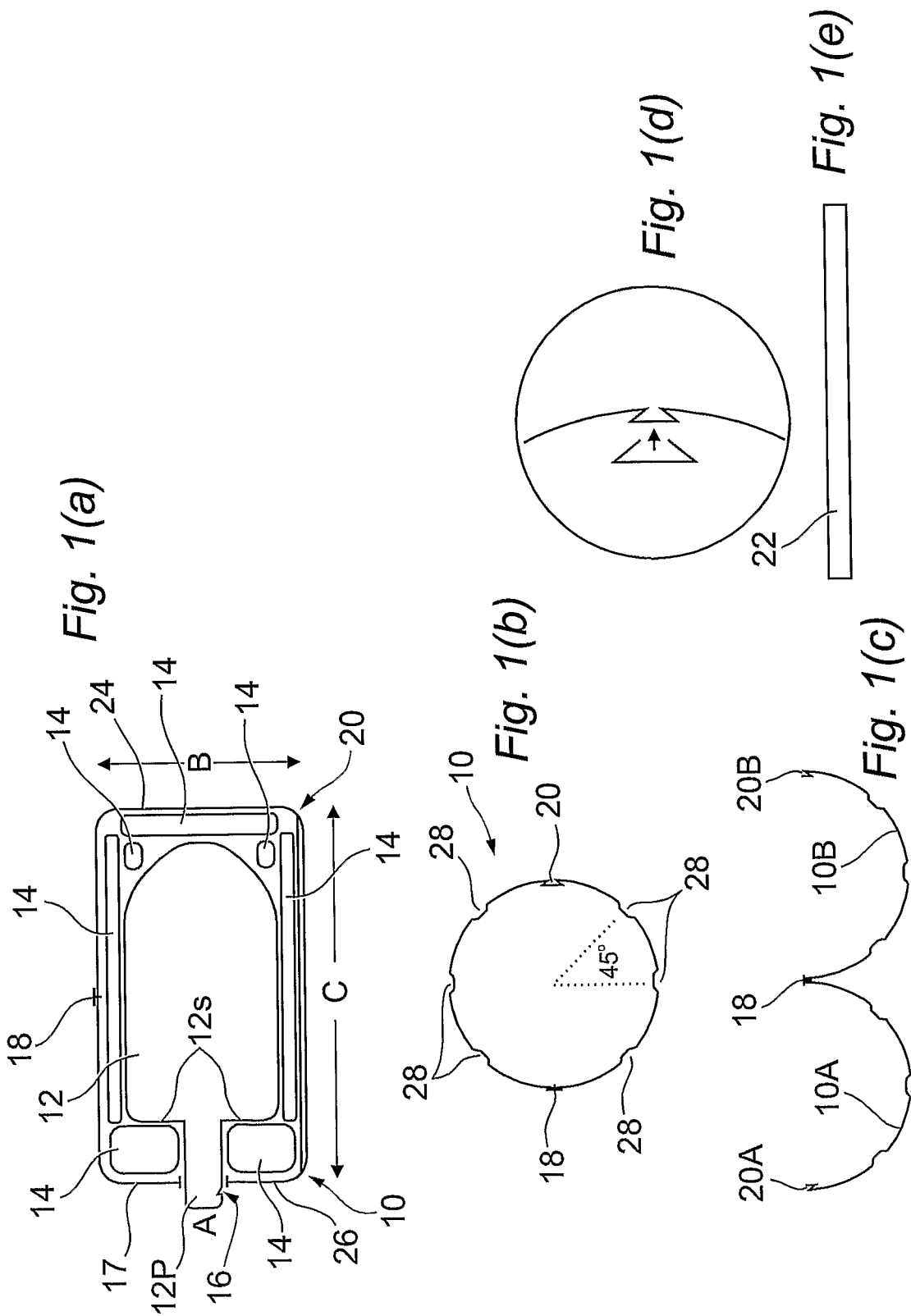
10. Un appareil de protection selon la revendication 9, dans lequel le moyen pour empêcher qu'un déplacement se produise comprend des parties à épaulement conçues pour se mettre en aboutement avec une partie du trépan.

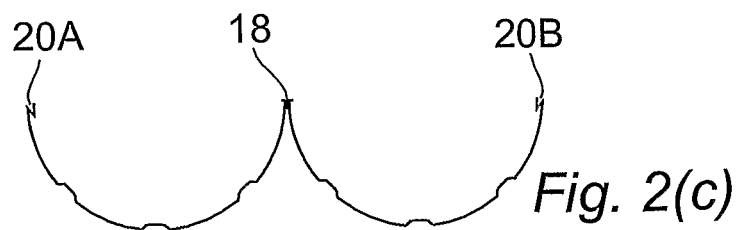
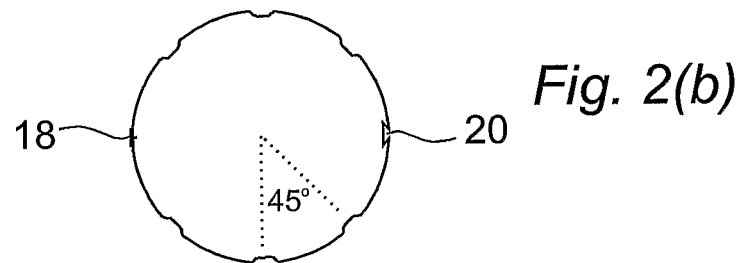
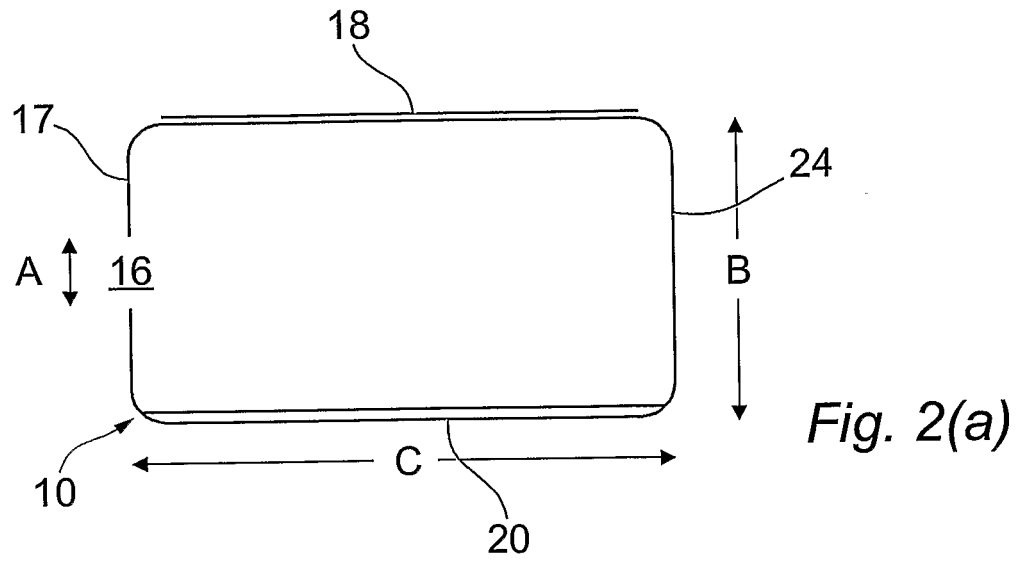
11. Une méthode pour protéger un trépan comprenant :-

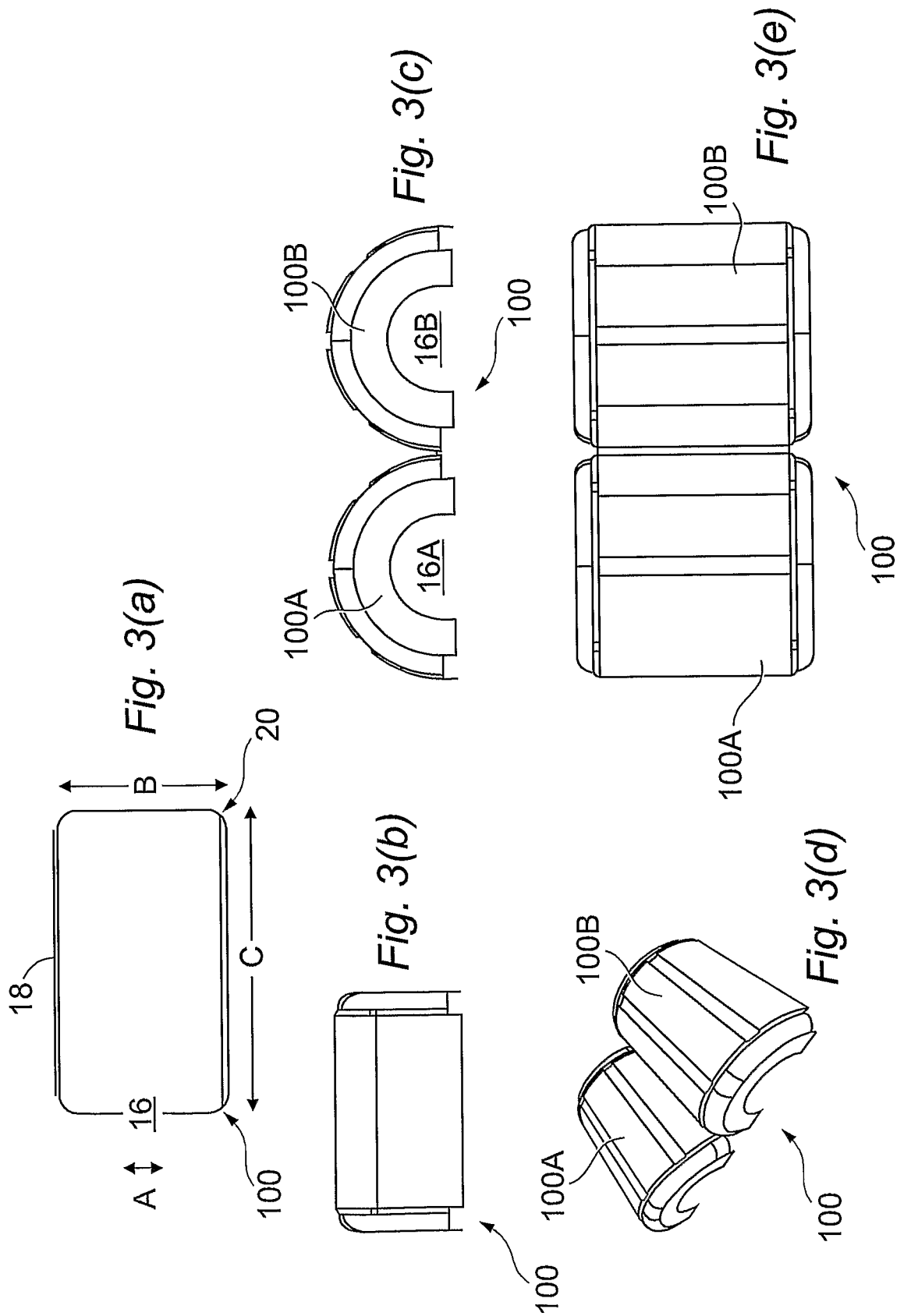
le fait de procurer un appareil de protection selon n'importe lesquelles des revendications 1 à 10 ;
le fait de placer les deux parties de protection autour de et/ou d'envelopper la partie de forage du trépan ; et
le fait de refermer, en faisant jouer la charnière, les parties de protection autour de la partie de forage du trépan de sorte que la partie de raccordement du trépan dépasse par l'orifice de ces une ou plusieurs parties de protection.

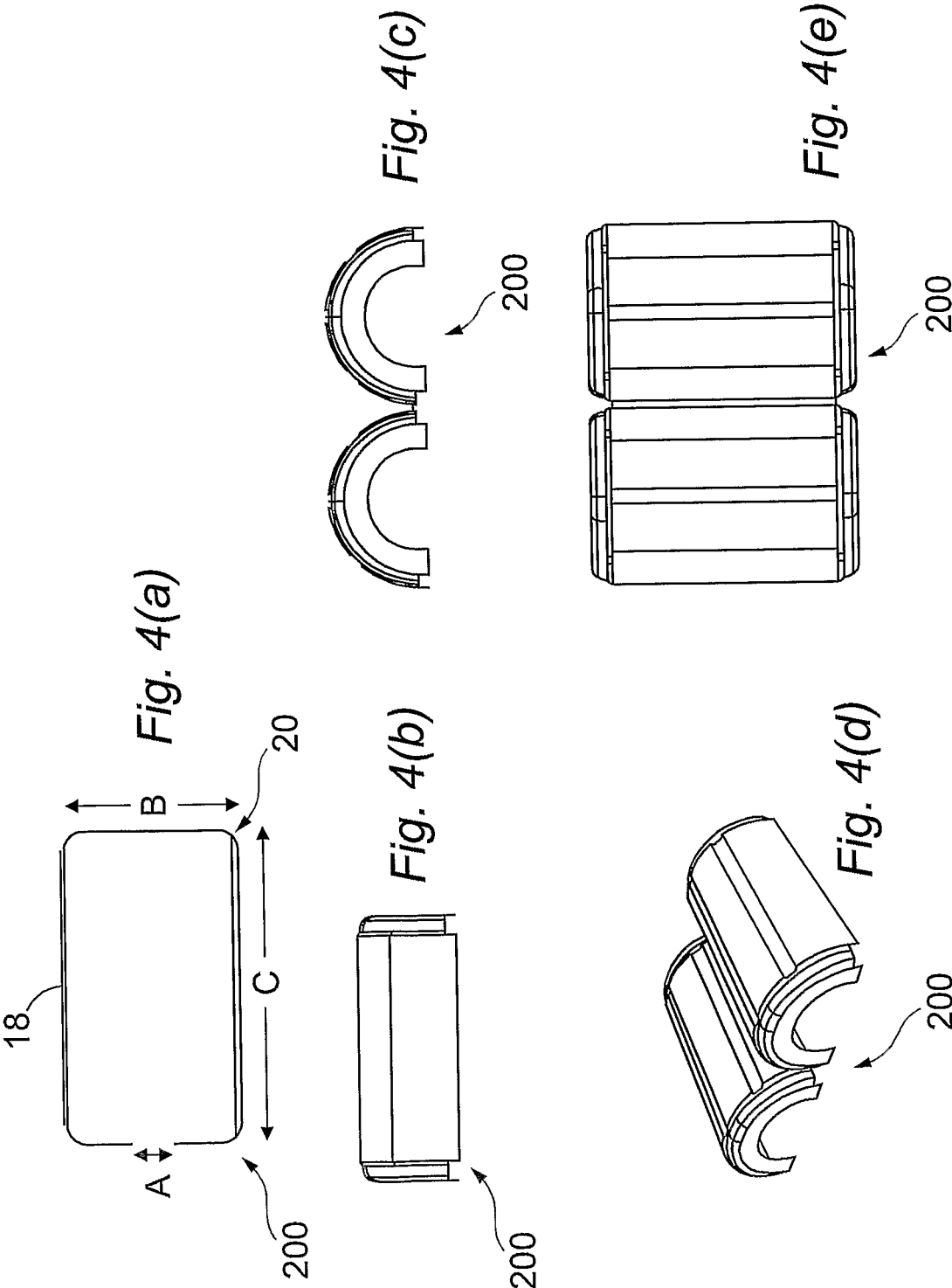
12. Une méthode pour transporter un trépan pour trou de forage de pétrole, de gaz ou d'eau vers une installation de forage comprenant les étapes consistant à :-

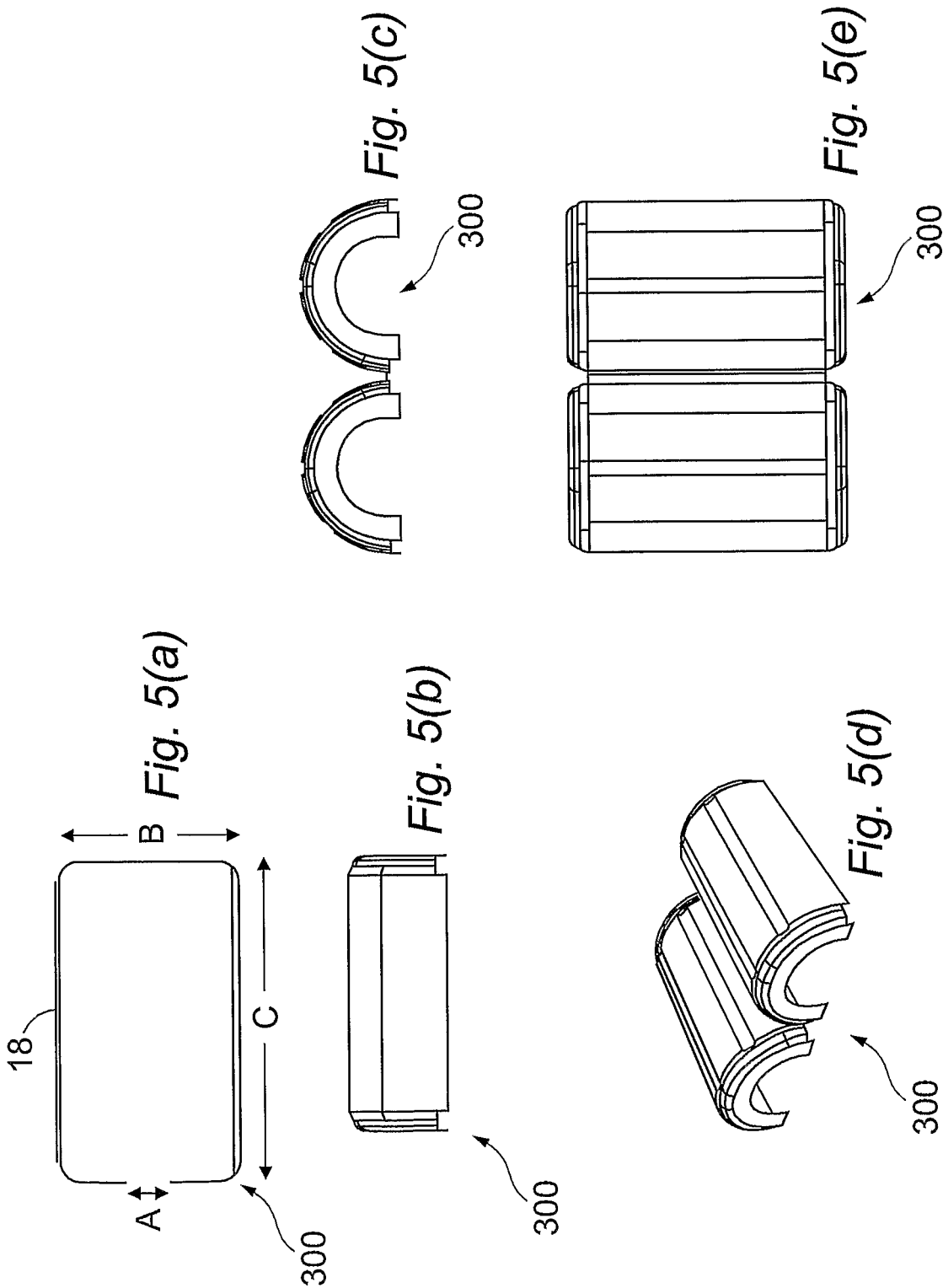
a) procurer un appareil de protection selon n'importe lesquelles des revendications 1 à 10 ;
b) monter un raccordement entre le trépan et un moteur ou une autre partie d'un BHA (assemblage de fond de puits) ;
c) refermer, en faisant jouer la charnière, l'appareil de protection autour du trépan soit avant l'étape b), soit après l'étape b) ; et
d) transporter le trépan et le moteur ou autre partie du BHA montés ensemble et l'appareil de protection vers l'installation de forage.

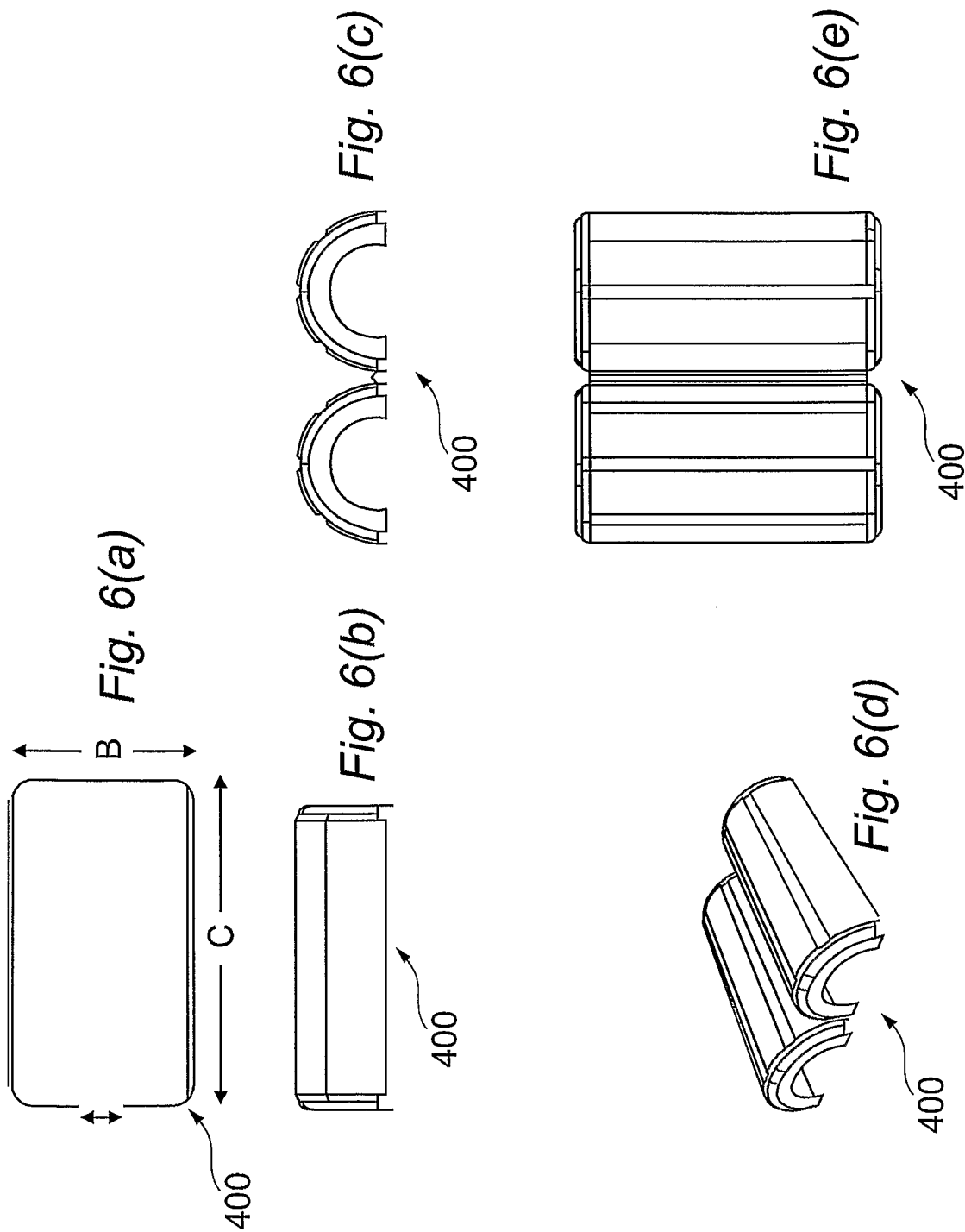


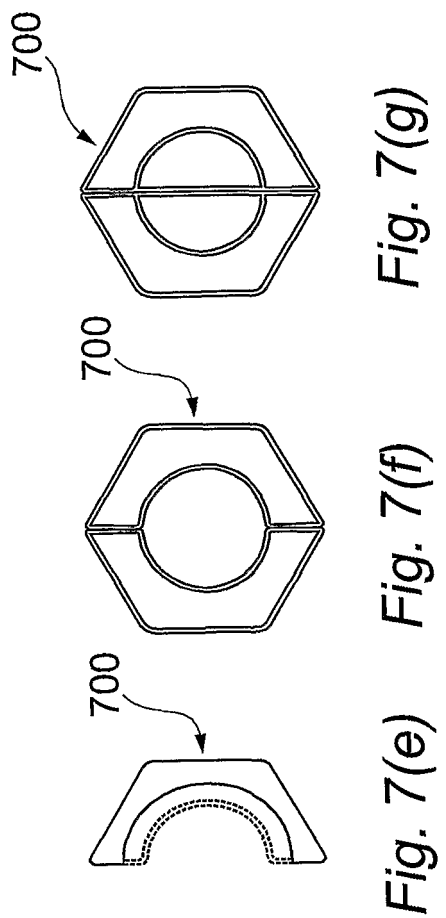
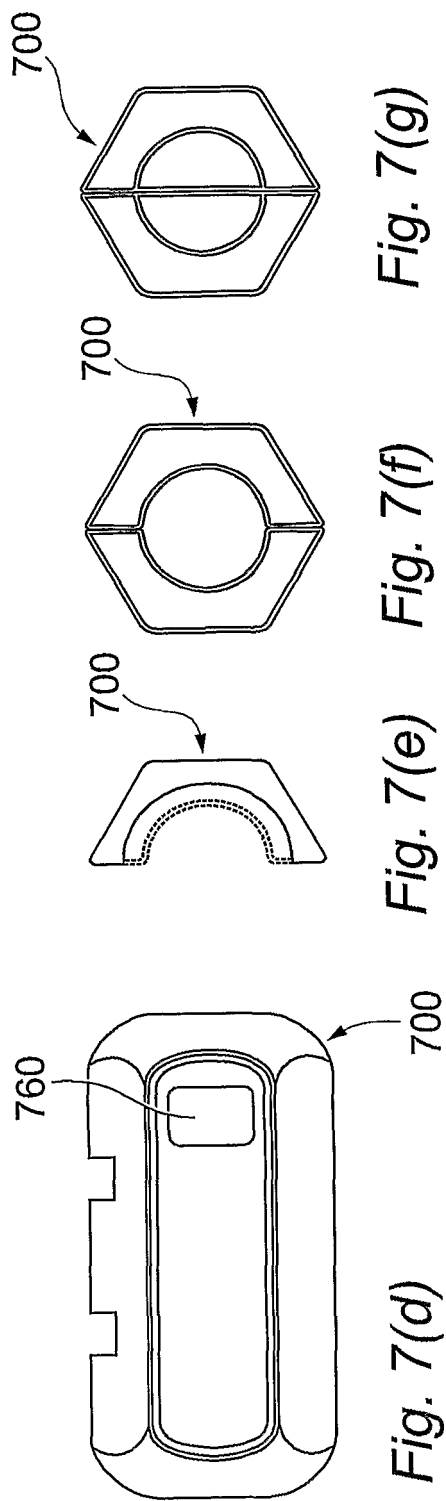
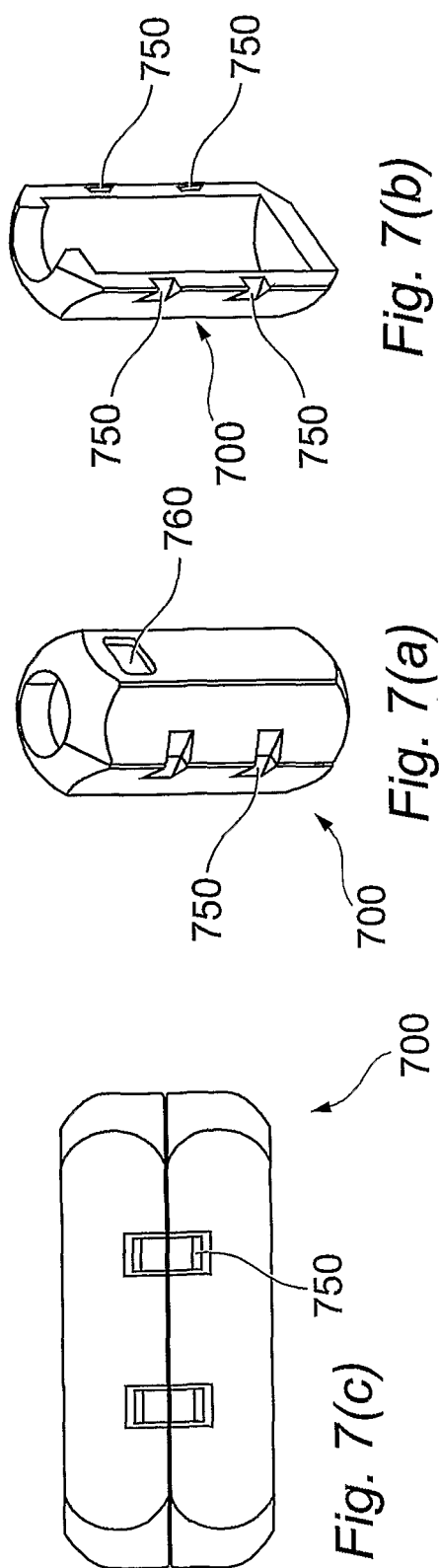












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