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(54) **Down-the-hole drill.**

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Down-the-hole drill.

This invention relates to a down-the-hole drill comprising a bit having a shank surrounded by a casing of the drill, a head formed integrally with the shank and protruding beyond the casing of the drill and a shoulder between the head and the shank, a first cavity being formed in the bit and extending to the face of the head for conveying flushing fluid from the interior of the drill to the exterior, and at least one second cavity for conveying flushing fluid extending axially between the shank and the casing to the lower end of the casing.

In out-of-the-hole drilling technology, it is known to provide second cavities terminating above the face and including a floor for upwardly deflecting flushing fluid conveyed through the cavity, as it leaves the cavity, in combination with a first cavity extending to the face of the head. Drills of this type with various configurations of flushing passages are shown for example in DE—B—1238864, CA—A—871004, GB—A—107148, CH—A—321023, AU—A—450556 and FR—A—200434. Of these specifications, the British, Swiss and Australian specifications disclose the upward direction of flushing air.

However, a common disadvantage of all these specifications is that the bit is unduly weakened by the presence of multiple flushing fluid passages in the bit. In down-the-hole drilling it is important that the bit should be as strong and tough as possible to resist the greater stresses that arise, when compared with an out-of-the-hole bit.

US—A—3225841 deals with a down-the-hole bit which has a lateral passage for flushing fluid. This bit is however weakened by the presence of a large internal cavity and by a lateral passage through the wall of the bit.

US—A—3991834 also refers to a down-the-hole bit. This known down-the-hole bit is of the kind as described in the first paragraph of the description. In this bit there is an exhaust passage for flushing fluid which extends axially between the shank and the casing of the drill, ends at the end of the casing and leads into the space between the drill and the hole. With this drill there is however no provision for upwardly deflecting flushed fluid conveyed through the cavity as the fluid leaves the cavity.

It is an object of the present invention to construct a down-the-hole drill in which some of the flushing fluid passed down the drill is directed upwardly as it leaves the drill, so as to draw fluid and debris from the face of the drill up the hole, and to achieve this object without weakening the bit.

This object has been achieved by the invention, in a drill of the type set forth at the beginning of the specification, in that one or more grooves are formed in the shoulder of the bit, the or each groove communicating with a

respective second cavity, the or each groove extending from the outside to the inside of the shoulder and having a floor for upwardly deflecting flushing fluid conveyed through the groove as the fluid leaves the groove.

It is preferred to have the floor of the groove where it leaves the bit, making an included angle not greater than 90° with the axis of the shank of the bit.

The first and the second cavities preferably extend independently of each other in the bit.

There may be a plurality of second cavities terminating above the face of the bit.

The first cavity may be a groove formed in the exterior surface of the bit, where it extends along the shank of the bit. The first cavity may also include a bore extending through at least a part of the bit, this bore being the only bore for flushing fluid in the bit.

The invention is particularly, but not exclusively, suitable for button bits, where the existence of the buttons allows a freer flow of fluid at the bit face than occurs in blade-type bits.

The flow of flushing fluid to the face of the bit is preferably less than the flow of fluid deflected up the hole. For example the flow to the face of the bit may be only 25% of the total flow of flushing fluid.

In the drawings:

Figure 1 is a simplified fragmentary longitudinal section through the lower end of a down-the-hole drill fitted with a bit of the invention;

Figure 2 is an underplan view of the bit of Figure 1;

Figure 3 is a view similar to Figure 1 of a further embodiment of the invention;

Figure 4 is a view of the bit of Figure 3, similar to the view of Figure 2; and

Figure 5 is a semi-section of the bit of Figures 4 and 5 showing a longitudinal flushing groove in it.

In Figure 1, a pneumatic down-the-hole drill includes a casing 10 having a lower end into which is fitted a bit 12 of the invention seen only fragmentarily. The bit 12 has a shank 14 and a head 16. The upper part of the shank is conventional as regards the manner in which it is supported in the casing 10. The face 18 of the bit is adapted to carry a series of buttons fixed in blind holes 20, the buttons being removed for the sake of simplicity. The arrangements for imparting percussive force to the bit and for rotating the drill assembly in the hole are conventional.

The shank 14 has an internal bore 22 which extends axially from the upper tip of the bit and merges near the head 16 with an oblique bore 24 having a mouth 26 in the face 18.

The casing 10 of the drill includes an internal longitudinal groove 28 which extends along the

full length of the shank 14 and which carries flushing air. It terminates at the end of the casing 10, where the flushing air is directed into a groove or channel 30 formed in the material of the bit 12 in the surface abutting the lower edge of the casing 10 and so shaped as to deflect the air arriving from the groove 28 outwards into the hole and upwards in it, thus back up the hole. The groove 30 shown, which leaves the drill at right angles to its vertical axis, is suitable for this purpose. The passages 22, 24, 28 and 30 are so sized in relation to the air supply in the drill that somewhat less than half the air flow, and preferably about 25%, arrives at the face of the bit through the bores 22, 24, the remainder being directed through the passage 28 and deflected by the groove 30 up the hole. The result is that a low pressure area is created in the hole at the level of the groove 30, and air and rock chips from below are drawn upwards into this zone and from it blown out of the hole. The effect is to reduce turbulence and to allow a steadier and more controlled flow of air across the face of the bit. The removal of chips is thus more effective in the face area.

In the version of Figures 3—5, a drill casing 110 is fitted with a bit 112 that includes a shank 114 and a head 116. The head 116 has a face 118 with buttons (not shown) fixed in holes 120.

The drill casing 110 has on one side an internal groove 122 which at its lower end joins a bore 124 formed obliquely in the material of the head of the bit and ends in a mouth 126 in the face 118. There is no axial bore in the shank of the bit, but a longitudinal groove 128 on its side surface registers with the groove 122 in the wall of the casing 110 of the drill to form a passage of approximately the same cross-sectional area as the bore 124. Thus flushing air in the interior of the drill is conveyed through the passage defined by the grooves 122, 128 into the bore 124 and finally emerges in the drill hole through the mouth 126, where it has a flushing action.

As is best seen in Figures 4 and 5, the shank 114 of the bit 112 is provided, at 90° angular displacement round the axis of the shank from the bore 124, with a further groove 130 which extends the full length of the shank and joins a deflection groove 132 formed in the head of the bit. The groove 130 registers with a suitably shaped groove (not illustrated) in the inner surface of the casing 110 so that a further passage down the shank is created for air which passes out of the drill assembly through the deflection groove 132 and passes up the hole, creating a low pressure area below it to attract upwards air and rock chips.

The combined action of the air stream directed into the floor of the hole and that deflected upwards from the floor of the groove 132 is much as was described in relation to the embodiment of Figures 1 and 2.

Note that in both the embodiments men-

tioned above the flushing cavity extending to the face of the bit is completely independent of the cavity supplying flushing air to the exterior of the bit above the face. This arrangement naturally calls for the air supply in the mechanism of the drill body above the bit to be divided into two streams.

Among further variants (not illustrated) of the invention is one in which the air supply to the face of the bit is delivered not through a bore but through a groove in the external surface of the bit, the groove following the general outline of the bit and terminating an off-centre zone in the face. The second cavity may in this case be a bore in the bit but is preferably a further groove in the shank, conveniently one which registers with another groove formed in the casing, and terminating in a transverse extension such as the grooves 30 or 132 illustrated.

In another variant there is not one but a plurality of cavities supplying flushing fluid from the interior of the drill to points on the periphery of the bit above the face for deflection up the hole to create a low-pressure zone drawing chips from below.

In preliminary trials of drills of the invention under practical operating conditions it has been found that erosion and wear of the bit have been substantially reduced, in some cases increasing the life of the bit by more than 20% compared to comparable known bits.

It would seem that the chief advantage of the invention is that it improves the control which can be exerted of the flushing action at the face by reducing or eliminating turbulence and closed air circuits, the venturi effect explained above being a secondary advantage.

Claims

1. A down-the-hole drill comprising a bit having a shank (14; 114) surrounded by a casing (10; 110) of the drill, a head (16; 116) formed integrally with the shank and protruding beyond the casing of the drill, and a shoulder between the head and the shank, a first cavity (22, 24; 122, 128, 124) being formed in the bit and extending to the face (18; 118) of the head (16; 116) for conveying flushing fluid from the interior of the drill to the exterior, and at least one second cavity (28; 130) for conveying flushing fluid extending axially between the shank (14) and the casing (10; 110) to the lower end of the casing, characterised in that one or more grooves (30; 132) are formed in the shoulder of the bit, the or each groove (30; 132) communicating with a respective second cavity (28; 130), the or each groove (30; 132) extending from the outside to the inside of the shoulder and having a floor for upwardly deflecting flushing fluid conveyed through the groove as the fluid leaves the groove.

2. A drill as claimed in Claim 1; characterised in that the floor of the or each groove (30; 132), where it leaves the bit, makes an included

angle not greater than 90° with the axis of the shank (14; 114) above the or each groove (30; 132).

3. A drill as claimed in any preceding claim, characterised in that the first cavity (22, 24; 122, 128, 124) and the or each second cavity (28; 130) extend independently of each other.

4. A drill as claimed in any preceding claim, characterised in that there is a plurality of grooves (30; 132) terminating above the face (18; 118).

5. A drill as claimed in any preceding claim, characterised in that the first cavity (122, 128, 124), where it extends along the shank (114) of the bit, is a groove (128) formed in the exterior surface of the bit.

6. A drill as claimed in any preceding claim, in which the first cavity (22, 24; 122, 128, 124) includes a bore (24; 124) extending through at least a part of the bit, which bore is the only bore for flushing fluid in the bit.

7. A drill as claimed in any preceding claim, characterised in that the bit is a button bit.

8. A drill as claimed in any preceding claim, characterised in that the first cavity (22, 24; 122, 128, 124) is adapted to convey approximately one half or less of the flushing fluid to the face (18; 118).

9. A drill as claimed in Claim 8, characterised in that the first cavity (22, 24; 122, 128, 124) is adapted to convey approximately 25% of the flushing fluid to the face.

10. A drill as claimed in any preceding claim, characterised in that the second cavities (28) are grooves in the inner wall of the casing (10).

Revendications

1. Marteau perforateur dans le trou comprenant un trépan ayant une tige (14; 114) entourée par une enveloppe (10; 110) du marteau, une tête (16; 116) formée d'un bloc avec la tige et dépassant au-delà de l'enveloppe du marteau, et un épaulement entre la tête et la tige, un première cavité (22, 24; 122, 128, 124) étant formée dans le trépan et s'étendant vers la face (18; 118) de la tête (16; 116) pour transporter du fluide de rinçage depuis l'intérieur du marteau vers l'extérieur, et au moins une seconde cavité (28; 130) pour transporter du fluide de rinçage, s'étendant axialement entre la tige (14) et l'enveloppe (10; 110) vers l'extrémité inférieure de l'enveloppe, caractérisé en ce qu'une ou plusieurs rainures (30; 132) sont formées dans l'épaulement du trépan, la rainure ou chaque rainure (30; 132) communiquant avec une seconde cavité respective (28; 130), la rainure ou chaque rainure (30; 132) s'étendant depuis l'extérieur vers l'intérieur de l'épaulement et ayant un plancher pour faire dévier vers le haut le fluide de rinçage transporté à travers la rainure à mesure que ce fluide la quitte.

2. Marteau selon la revendication 1, caractérisé en ce que le plancher de la rainure ou de

chaque rainure (30; 132) forme, là où il quitte le trépan, un angle inclus qui n'est pas supérieur à 90° avec l'axe de la tige (14; 114) au-dessus de la rainure ou de chaque rainure (30; 132).

3. Marteau selon l'une quelconque des revendications précédentes, caractérisé en ce que la première cavité (22, 24; 122, 128, 124) et la seconde cavité ou chaque seconde cavité (28; 130) s'étendent indépendamment l'une de l'autre.

4. Marteau selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il y a une pluralité de rainures (30; 132) se terminant au-dessus de la face (18; 118).

5. Marteau selon l'une des revendications précédentes, caractérisé en ce que la première cavité (122, 128, 124), à l'endroit où elle s'étend le long de la tige (114) du trépan; est une rainure (128) formée dans la surface externe du trépan.

6. Marteau selon l'une des revendications précédentes, dans lequel la première cavité (22, 24; 122, 128, 124) comprend un alésage (24; 124) s'étendant à travers au moins une partie du trépan, cet alésage étant le seul alésage destiné au fluide de rinçage dans le trépan.

7. Marteau selon l'une des revendications précédentes, caractérisé en ce que le trépan est un trépan à pastilles.

8. Marteau selon l'une des revendications précédentes, caractérisé en ce que la première cavité (22, 24; 122, 128, 124) est prévue pour transporter approximativement une moitié ou moins du fluide de rinçage vers la face (18; 118).

9. Marteau selon la revendication 18, caractérisé en ce que la première cavité (22, 24; 122, 128, 124) est prévue pour transporter approximativement 25 % du fluide de rinçage vers la face.

10. Marteau selon l'une quelconque des revendications précédentes, caractérisé en ce que les secondes cavités (28) sont des rainures dans la paroi interne de l'enveloppe (10).

Patentansprüche

1. In das Bohrloch einwandernder Versenkhammer mit einem Bohrwerkzeug, das einen von einem Gehäuse (10; 110) des Versenkhammers umgebenden Schaft (14; 114), einen einstückig mit dem Schaft ausgebildeten und über das Gehäuse des Versenkhammers vorragenden Kopf (16; 116) und eine Schulter zwischen Kopf und Schaft aufweist, wobei zur Leitung von Spülfluid vom Inneren des Versenkhammers zur äußeren Umgebung in dem Bohrwerkzeug eine sich zur Frontfläche (18; 118) des Kopfes (16; 116) erstreckende erste Höhlung (22, 24; 122, 128, 124), sowie wenigstens eine sich axial zwischen dem Schaft (14) und dem Gehäuse (10; 110) zum unteren Ende des Gehäuses erstreckende zweite Höhlung (28; 130) zur Leitung von Spülfluid ausgebildet sind, dadurch gekennzeichnet, daß

eine Rinne oder mehrere Rinnen (30; 132) in der Schulter des Bohrwerkzeugs gebildet sind, wobei jede Rinne (30; 132) mit jeweils einer zweiten Höhlung (28; 130) kommuniziert, und wobei die oder jede Rinne (30; 132) sich von der Außenseite zum Innenbereich der Schulter erstreckt und einen Boden zur Umlenkung des durch die Rinne geförderten Fluids nach oben beim Verlassen der Rinne aufweist.

2. Versenkhammer nach Anspruch 1, dadurch gekennzeichnet, daß der Boden der Rinne oder jeder Rinne (30; 132) am Austritt aus dem Bohrwerkzeug einen Winkel von nicht größer als 90° mit der Achse des Bohrwerkzeugs (14; 114) oberhalb der oder jeder Rinne (30; 132) einschließt.

3. Versenkhammer nach irgendeinem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die erste Höhlung (22, 24; 122, 128, 124) und die oder jede zweite Höhlung (28; 130) unabhängig voneinander verlaufen.

4. Versenkhammer nach irgendeinem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß eine Vielzahl von oberhalb der Frontfläche (18; 118) endenden Rinnen (30; 132) vorhanden ist.

5. Versenkhammer nach irgendeinem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die erste Höhlung (122, 128, 124) im Bereich ihrer Erstreckung entlang des

Schaftes (114) des Bohrwerkzeugs als Rinne (128) in der Außenfläche des Bohrwerkzeugs ausgebildet ist.

6. Versenkhammer nach irgendeinem der vorhergehenden Ansprüche, in welchem die erste Höhlung (22, 24; 122, 128, 124) eine sich durch wenigstens einen Teil des Bohrwerkzeugs erstreckende Bohrung (24; 124) umfaßt, welche die einzige Bohrung zum Einspülen von Fluid in das Bohrwerkzeug ist.

7. Versenkhammer nach irgendeinem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Bohrwerkzeug als Bohrmeißel mit knopfartigen Vorsprüngen an der Frontfläche ausgebildet ist.

8. Versenkhammer nach irgendeinem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die erste Höhlung (22, 24; 122, 128, 124) zur Zuführung von annähernd der Hälfte oder wenigstens des Spülfluids zu der Frontfläche (18; 118) geeignet ausgebildet ist.

9. Versenkhammer nach Anspruch 8, dadurch gekennzeichnet, daß die erste Höhlung (22, 24; 122, 128, 124) zur Zuführung von annähernd 25 % des Spülfluids zu der Frontfläche geeignet ausgebildet ist.

10. Versenkhammer nach irgendeinem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die zweiten Höhlungen (28) Rillen in der Innenwand des Gehäuses (10) sind.

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Fig. 1

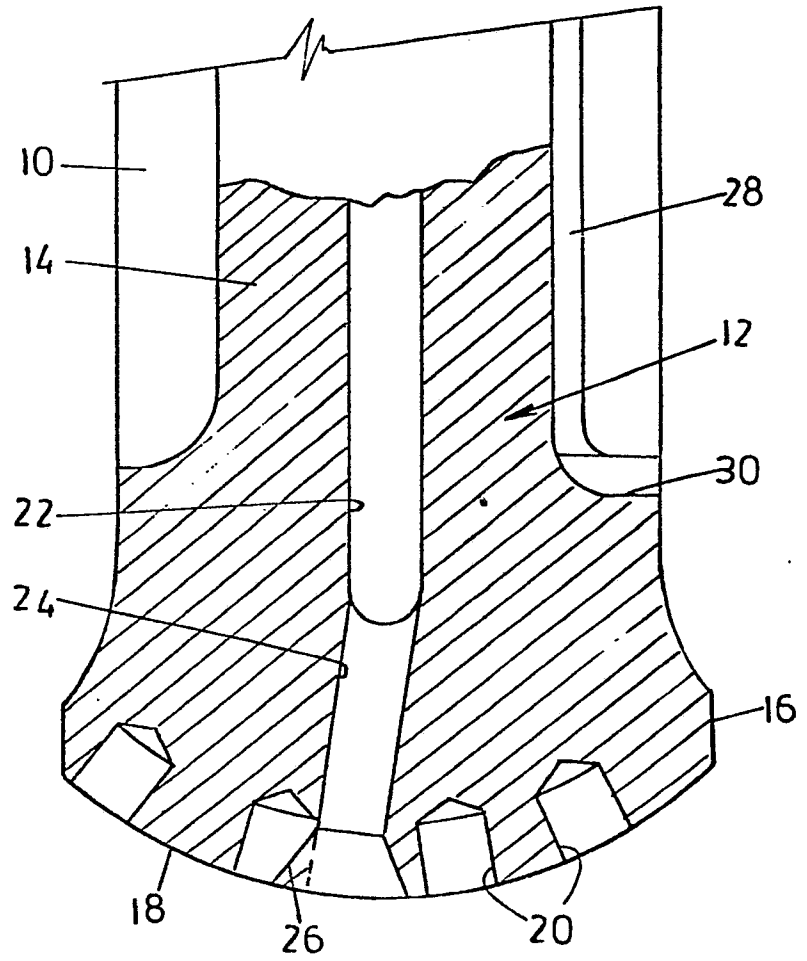
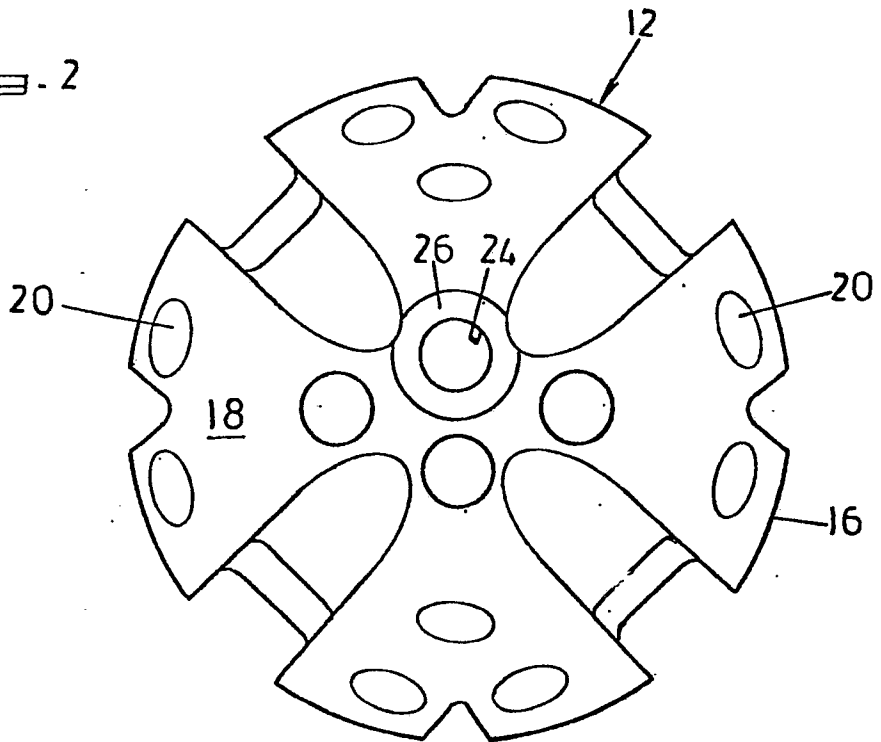


Fig. 2



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Fig. 3

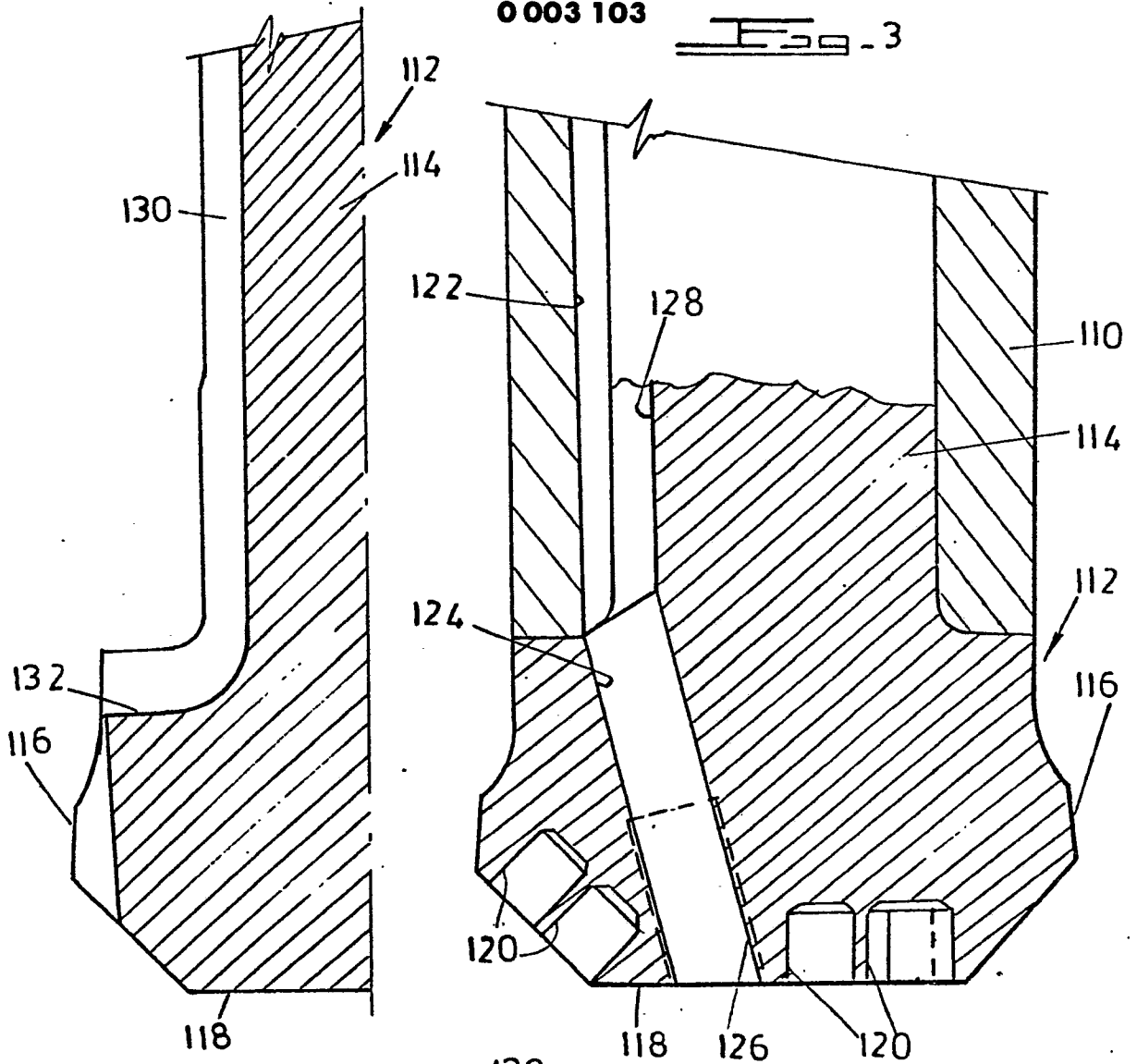


Fig. 5

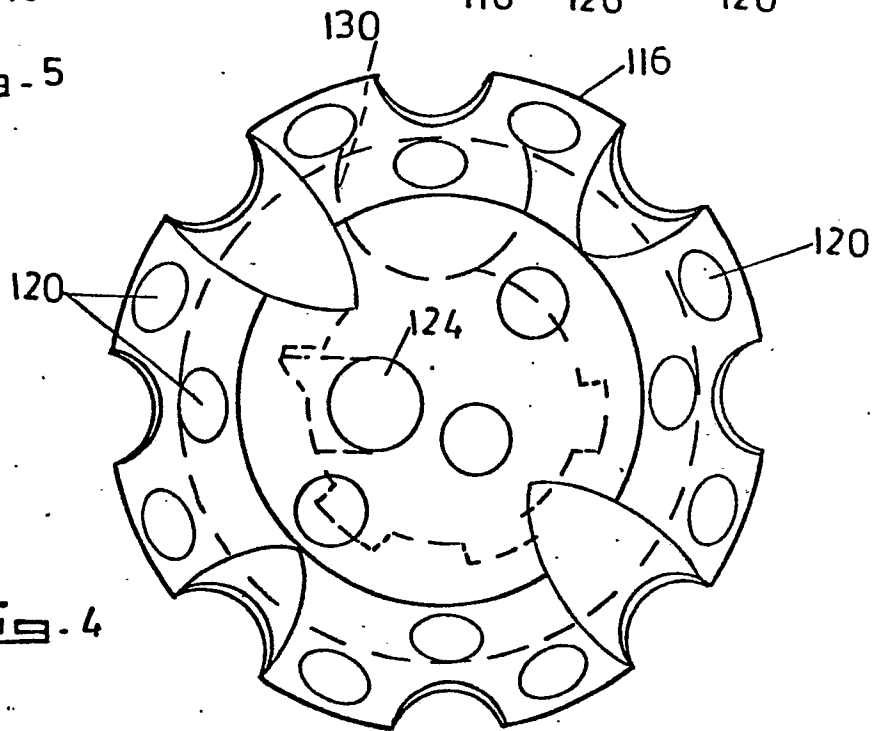


Fig. 4