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(54) **CUTTER HEAD FOR DREDGING GROUND, CUTTER SUCTION DREDGER PROVIDED WITH SUCH A CUTTER HEAD AND USE OF THE CUTTER HEAD FOR DREDGING GROUND**

SCHNEIDKOPF ZUM AUSBAGGERN VON ERDE, SAUGBAGGER AUSGESTATTET MIT SOLCH EINEM SCHNEIDKOPF UND BENUTZUNG DIESES SCHNEIDKOPFS ZUM AUSBAGGERN VON ERDE

TÊTE DE COUPE POUR LE DRAGAGE DE SOL, DRAGUE ASPIRANTE POURVUE D'UNE TELLE TÊTE ET UTILISATION DE CETTE TÊTE DE COUPE POUR LE DRAGAGE DE SOL

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(73) Proprietor: **Dredging International N.V.**
2070 Zwijndrecht (BE)

(72) Inventor: **TACK, Bruno**
B9960 Assenede (BE)

(74) Representative: **Brouwer, Hendrik Rogier et al**
Arnold & Siedsma
Bezuidenhoutseweg 57
2594 AC Den Haag (NL)

(56) References cited:
WO-A-2005/035884
WO-A1-2005/035884
DE-A1- 3 107 939
DE-A1-102005 051 450
GB-A- 2 032 492
JP-A- 2 128 027
NL-A- 7 415 416
NL-A- 8 104 969
US-A- 4 319 415
US-A- 4 319 415
US-A- 4 365 427
US-A- 4 403 428
US-A- 4 470 210
US-A- 4 488 608
US-A- 4 575 156
US-A- 4 986 011
US-A1- 2002 104 238

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Description

[0001] The invention relates to a cutter head for dredging ground under the water surface, this cutter head being suitable for attachment to the ladder of a cutter suction dredger and for being moved over the ground therewith in a lateral sweeping movement. The invention also relates to a cutter suction dredger provided with such a cutter head, and to the use of the cutter head for dredging ground, in particular relatively hard ground.

[0002] A cutter head of the type described in the preamble is for instance known from NL-1031253. The known cutter head is a revolving body which is rotatable around a central axis and formed by a base ring and a hub placed at a distance therefrom and concentrically thereto, between which extend a number of support arms provided with cutting tools. The known cutting tools are bit-like, which means that they comprise a flattened part at their free outer end, with the end surface of which they make contact with the ground over a determined linear distance. For a good cutting action the cutting tools must be first to come into contact with the ground during rotation of the known cutter head. The cutting tools are therefore situated on a leading part of the support arms as seen in the direction of rotation of the cutter head.

[0003] The cutter head is applied in combination with a cutter suction dredger (also referred to as cutter dredger). A cutter suction dredger comprises a vessel anchored in the ground by means of so-called spud posts. Owing to this anchoring the reaction forces occurring during dredging can be absorbed and transmitted to the ground. Attached to the ladder of the cutter suction dredger is a suction conduit which is connected to the cutter head and along which the dredged ground is removed. During dredging the cutter head is set into rotation and with ladder and suction conduit lowered into the water at a generally oblique angle until it touches the ground. The cutter head is dragged through the ground by hauling the ladder alternately from port side to starboard side using winches. Because the cutter head rotates about the axis of the cutter head - the line connecting the centres of rotation of the base ring and the hub - the end surfaces of the cutting tools strike the ground with great force under the weight of the cutter head, ladder and suction conduit. Via passage openings between the support arms the hereby formed fragments are suctioned up and discharged by the suction conduit. A whole ground surface can be dredged by moving the cutter suction dredger over a determined distance at a time and repeating the above stated sweeping movement.

[0004] US-A-4 319 415 discloses a cutter head for a cutter. The cutter head comprises a revolving body that is rotatable around an axis of revolution and which is formed by a base ring and a hub located at a distance thereof, between which a number of support arms extend. The support arms are provided with teeth holders for cutting teeth. The teeth holders have a T-shaped profile with which they can be releasably attached to the support arms.

[0005] WO 2005/035884 A describes a robotic manipulator for removing a worn tooth from a dredger cutter head, and for replacing the removed tooth with a new tooth. The manipulator is installed on a dredger vessel. The disclosed cutter heads are of the usual type including, about 5 support arms carrying about 8 teeth each.

[0006] GB-A-2 032 492 discloses a cutter head comprising a central hub onto which at least one spiral-helical web is mounted. The web is provided with an array of cutter bits spaced along the web and projecting therefrom such that in use successive bits on the same web cut deeper than a previous bit

[0007] NL.A.8 104 969 discloses a conventional cutter head for a cutter suction dredger, the cutter head comprising the usual amount of 5 support arms with about 8 teeth attached to it.

[0008] US-A-4 470 210 discloses an adapter for a cutter head. The adapter is rotatable around a longitudinal and a transverse axis, such that the optimum cutting angle of the cutting teeth can be adjusted.

[0009] US-A-4 986 011 discloses a cutting tooth for a cutter dredger that may be attached to a support arm of a cutter head by clamping part of it in an adapter making use of an intermittent flexible element.

[0010] The known cutter head has the drawback that relatively hard ground, such as for instance rock, defined in the context of the present application as ground with an Unconfined Compressive Strength (UCS) of at least 50 MPa, either cannot be dredged or can only be dredged with limited efficiency. The UCS is a concept known to the skilled person and represents the compressive strength of a ground mass, the side walls of which are not supported during compression. Efficiency is understood in the context of this application to mean the volume of ground dredged per unit of time and unit of power.

[0011] The present invention has for its object to provide a cutter head for a cutter suction dredger which, in addition to other advantages, can dredge ground surfaces more efficiently and which makes it particularly possible to dredge relatively hard types of ground with an increased efficiency relative to the known cutter head.

[0012] According to the invention there is provided for this purpose a cutter head which comprises a revolving body which is rotatable around a central axis and which is formed by a base ring and a hub placed at a distance therefrom, between which extend a number of support arms provided with cutting tools, wherein the cutter head comprises at least 100 cutting tools, which cutting tools are axisymmetrical at least at their free outer end, and preferably along their entire length, thereby allowing free rotation around their longitudinal axis. It has been found that, by providing inter alia the support arms of the cutter head with cutting tools that are axisymmetrical at the soil contact side thereof, relatively hard ground in particular, such as for instance rock, can be dredged with an increased efficiency relative to the known cutter head. The axisymmetry of the cutting tools has been found to have

a favourable effect on the breaking of the ground, and particularly relatively hard ground.

[0013] The known cutting tools are relatively wide at their free outer end to be able to withstand the great forces to which they are subjected during the dredging. The weight of the underwater components of the cutter suction dredger is after all distributed over the contact surface area between the cutting tools and the ground. By giving the known cutting tool a relatively wide free outer end this contact surface area is relatively large, whereby the force transmitted to the ground is distributed over a relatively large surface area. The average pressure on the contact surface is thus kept limited, whereby breaking of the cutting tools is prevented.

[0014] Because the cutting tools according to the invention are axisymmetrical at least at their free outer end, and come into contact with the ground with this part, the cutting tools already penetrate the ground at relatively low forces. The pressure exerted locally on the ground is moreover relatively high, whereby the ground, and particularly relatively hard ground, is crushed effectively.

[0015] It should be mentioned that US-A-4 488 608 describes a rotary stone-cutting head for cutting dry rock and the like, the cutting head carrying conical cutting tools, a part of which comprise a hardened (Tungsten carbide) insert. The tools having the inserts are placed in a somewhat retracted position vis-a-vis the other cutter tools to avoid early breakage when coming in contact with an irregular rock surface.

[0016] DE 10 2005 051450 A1 discloses an axisymmetrical cutting tool that can be rotated freely around its axis of rotation symmetry in a case, whereas US-A-4 575 156 relates to a similar axisymmetrical cutting tool for use in coal mining. Both documents do not suggest using such tools in underwater dredging.

[0017] A preferred embodiment of the cutter head has the feature that the cutting tools are rotation-symmetrical, and are more preferably of conical form. Such a geometry allows higher average pressures to be transmitted to the ground than is possible with the known cutting tool. A further advantage of the cutting tool according to the invention, and particularly the conical preferred variant, is that, owing to its shape, it takes up less space than the known cutting tool. It hereby becomes possible to provide the cutter head with a large number of cutting tools, and this has been found advantageous for the dredging efficiency of the cutter head. For the same reason the passage openings which are present between the support arms of the cutter head and along which the dredged ground is discharged can likewise be smaller than is the case in the known cutter head. This is because the cutting tools according to the invention obstruct the passage less. The number of support arms can hereby also increase.

[0018] According to another preferred embodiment of the invention, the cutting tools comprise a substantially cylindrical shank part with a reduced diameter with respect to a conical top part. The cutting tool according to this embodiment is arranged with its cylindrical shank part in coupling means, provided on the arms of the cutter head. The coupling means preferably comprise a block socket with a central bore in which the cylindrical shank part is inserted for ready rotation. In this embodiment, the conical part will protrude outside the block socket over an active length, which is relatively short in comparison with the total length of the cutting tool. This has the advantage that much larger forces can be withstood than with the state of the art cutting teeth. The block socket moreover effectively supports the cutting tool against bending deformations. In a preferred embodiment the cutting tools have a length protruding outside its holder lying between 10 and 500 mm, more preferably between 20 and 250 mm, and most preferably between 50 and 150 mm.

[0019] In a particularly preferred embodiment, the cutting tool is arranged, preferably in its socket, such that it can be rotated freely or at least readily around its axis of rotation-symmetry. This is possible due to the fact that the cutting tools are rotation-symmetric. Allowing free or ready rotation of the tools during operation reduces the risk for breakage and also self-sharpens the soil-contacting tip of the cutting tools by friction with the soil. The useful life of the cutting tools is hereby extended and precious time is saved in not having to replace broken or blunt cutting tools frequently.

[0020] The conical part of the cutting tool is preferably provided with a hardened tip at the outer end which comes into contact with the soil. The tip may for instance be made of carbide.

[0021] In another preferred embodiment the cutter head according to the invention is characterized in that the top part of the conical cutting tools has a radius of curvature of a maximum of 500 mm, more preferably of a maximum of 350 mm, still more preferably of a maximum of 100 mm, and most preferably of a maximum of 50 mm. Yet another preferred variant comprises conical cutting tools, the top part of which has a radius of curvature lying between 1 and 100 mm, and more preferably between 5 and 80 mm. In yet another preferred variant the cutting tools comprise a holder in which a conical hard metal insert is received.

[0022] A preferred embodiment of the cutter head according to the invention has the feature that the cutter head comprises at least 5 support arms, more preferably at least 10 support arms, and most preferably at least 15 support arms. It is even possible for the cutter head to comprise a revolving surface provided with passage openings between the base ring and the hub. The part of the revolving surface lying between the openings then forms the 'support arms' of the cutter head. Another option is to provide the cutter head with axially running support arms on which are mounted transverse arms running in the peripheral direction.

[0023] The number of cutting tools can be varied within broad limits, wherein it is advantageous if the number of cutting tools is as high as possible. In a preferred em-

bodiment the cutter head according to the invention comprises at least 140 cutting tools, and most preferably at least 180 cutting tools. The cutting tools can here be distributed regularly, but also irregularly, over the revolving surface of the cutter head. The number of cutting tools per support arm preferably comprises at least 10 cutting tools, more preferably at least 15 cutting tools, still more preferably at least 20 cutting tools, and most preferably at least 25 cutting tools.

[0024] The cutter head according to the invention cuts the ground in a fundamentally different manner than the known cutter head. Where the known cutter head strikes large fragments out of the ground with great force, the cutter head according to the invention will break off much smaller pieces of ground. Owing to the greater number of cutting tools in the direction of rotation of the cutter head the ground is moreover cut in more rapid succession. This operation is found to result in a higher efficiency, particularly in harder grounds.

[0025] It has further been found advantageous for the support arms to comprise a first series of cutting tools on a leading part as seen in the direction of rotation of the cutter head, and at least one support arm comprises a second series of cutting tools on a part facing away from the central axis. Although it is unusual to provide a part of a support arm facing away from the central axis with cutting tools, an improved efficiency is obtained. It has been found, surprisingly, that the connection of the cutting tools to the part of the support arm facing away from the central axis is sufficiently strong to transmit to the support arm the forces resulting from the cutting tools striking against particularly hard ground such as rock. More cutting tools can in this way be placed on a single support arm than according to the prior art. This provides advantages, particularly in the dredging of relatively hard ground.

[0026] In an advantageous embodiment the cutting tools of the first series on a support arm are offset relative to the cutting tools of the second series. This further increases the efficiency of the dredging process. Because the cutting tools are offset, an increased working area of the cutting tools is obtained. This is because cutting tools of the second series are not obstructed by cutting tools of the first series.

[0027] In yet another embodiment the support arms have a length, and the cutting tools are located on either side of the middle of the support arms along a maximum of 80% of the length of the support arm. The absence of cutting tools close to the outer ends of the support arms is not found to adversely affect the efficiency of the cutter head, while owing to this measure the construction of the cutter becomes simpler and therefore cheaper. On the other hand, the presence of cutting tools close to the hub of the cutter head is advantageous for the progression of the cutter head.

[0028] The cutting tools can be formed integrally with the support arms of the cutter head. Another method is to connect them directly to the support arms, for instance by welding cutting tools embodied substantially in steel to support arms manufactured substantially from steel, this resulting in a strong connection. The cutting tools can particularly be connected to the support arms via coupling means. Cutting tools can hereby be replaced easily, which may be necessary as a result of wear or damage. It is advantageous here to connect the coupling means themselves integrally with the support arms, such as by making use of a welded connection.

[0029] In a preferred embodiment of the cutter head according to the invention the support arms of the cutter head are provided with guides on which the coupling means and/or the cutting tools are displaceably mounted. A suitable guide comprises for instance a guide rail over which the coupling means and/or the cutting tools can slide. The present preferred variant has the advantage that the coupling means and/or the cutting tools can be displaced easily. The intermediate distance between the cutting tools can thus be adjusted in simple manner depending on the properties, and in particular the hardness, of the ground.

[0030] The invention also relates to the use of a cutter head according to the present invention for cutting into ground parts a ground with an Unconfined Compressive Strength (UCS) of between 50-200 MPa, preferably between 60-150 MPa and most preferably 80-100 MPa. For the advantages of the use of the cutter head reference is made to the advantages already stated above of the cutter head according to the present invention.

[0031] The invention also relates to a cutter suction dredger provided with a cutter head according to the present invention. With a cutter suction dredger provided with a cutter head according to the present invention ground, and in particular relatively hard ground, i.e. a ground with a UCS of more than 50 MPa, can be dredged with an improved efficiency.

[0032] The invention will now be further elucidated with reference to the following figures and description of preferred embodiments, without the invention otherwise being limited thereto. The figures are not necessarily drawn to scale. In the figures:

Figure 1. is a schematic side view of a part of a cutter suction dredger with a ladder attached thereto and provided with a cutter head according to the invention;

Figure 2 is a perspective view of a cutter head according to the invention;

Figure 3 is a side view of a detail of a cutting tool according to the invention;

Figure 4 is a side view of a detail of a cutting tool according to another embodiment of the invention; and

Figure 5 is a side view of a detail of a cutting tool according to still another embodiment of the invention.

[0033] Figure 1 shows a cutter suction dredger 1 on

which a ladder 2 is mounted pivotally around a horizontal shaft 3. Ladder 2 is provided with a suction pipe 4 which can suction up the loosened ground parts to a level above water surface 100, after which they are discharged. Ladder 2 is hauled over the ground surface 9 for dredging or breaking by means of a winch 5 which is arranged on the deck of cutter suction dredger 1 and is provided with a number of swing winches (not shown) and ladder winch 8. Ladder 2 is provided on the outer end thereof with a cutter head 10 according to the invention. Cutter head 10 can be lowered under water by means of the ladder winch cables 8 and moved during use over ground surface 9 in a reciprocating, sweeping movement from the port side to the starboard side of cutter suction dredger 1 and back. In order to be able to absorb the forces generated here on the ground surface, cutter suction dredger 1 is anchored in the ground by means of a spud post 101. Figure 1 shows the left-hand (starboard) spud post in unanchored position and the right-hand (port side) spud post in anchored position.

[0034] Referring to figure 2, cutter head 10 according to the invention comprises a revolving body 11 which can be set into rotation around its rotation axis 12 by means of drive means (not shown). Rotation axis 12 herein coincides with the central axis of cutter head 10. In the shown embodiment revolving body 11 is set into rotation in clockwise direction R as seen from the bridge. Support arms 15 extend spirally between a base ring 13 and a hub 14 located at a distance from base ring 13, these support arms 15 being connected to base ring 13 and hub 14. Support arms 15 are here arcuate, wherein the convex sides are directed in the rotation direction R. Base ring 13, hub 14 and support arms 15 are manufactured substantially from steel. This not only makes cutter head 10 strong but also gives cutter head 10 a great weight, whereby during dredging the cutter head 10 is urged in the direction of the ground for dredging under the influence of the gravitational force. Support arms 15 are herein placed regularly round the periphery of cutter head 10. Passage openings 16 are located between support arms 15. Coupling means 17 manufactured substantially from steel are welded to a leading edge 15a of support arms 15 relative to the rotation direction of cutter head 10 for the purpose of coupling a first series of cutting tools to support arms 15. Coupling means 17 likewise manufactured substantially from steel are welded to the edge 15b of support arms 15 facing away from the central axis of cutter head 10 for the purpose of coupling a second series of cutting tools 20 to support arms 15. Coupling means 17 are oriented such that the front side or striking side of cutting tools 20 of the first and second series are directed in rotation direction R.

[0035] Referring to figure 3, an embodiment of a cutting tool 20 is shown. The shown cutting tool 20 with overall length 27 comprises a substantially cylindrical part 22 with diameter 25, and a conical second part 23. Cutting tool 20 can be arranged with cylindrical part 22 in an above described coupling means 17 of cutter head 1, for instance by means of a snap connection 220. A permanent connection is also possible, or other form of releasable connection. In the situation where cutting tool 20 is arranged in coupling means 17, conical part 23 will protrude outside the coupling means or holder 17 over an active length 26. Conical part 23 of cutting tool 20 is provided with a hardened tip 28 at the outer end which comes into contact with the soil. The appropriate radius of curvature of the tops of cutting tools 20 depends on, among other factors, the properties of the ground and on the specific design of the cutter head, but preferably lies between 1 and 100 mm. A suitable overall length 27 of a cutting tool 20 preferably amounts to between 20 and 400 mm. Suitable transverse dimensions 25 preferably amount to between 10 and 100 mm. In a preferred embodiment the cutting tools 20 have a length 26 protruding outside holder 17 lying between 10 and 500 mm, more preferably between 20 and 250 mm, and most preferably between 50 and 150 mm.

[0036] As shown in figures 4 and 5, the cutting tool 20 is preferably coupled to the support arms 15 through coupling means 17 in the form of a block socket with a central bore 170 in which the cylindrical shank part 22 of a cutting tool 20 is inserted for ready rotation. In the embodiment of figure 4, the conical part 23 with the carbide tip 28 protrudes outside the block socket over an active length that is relatively short in comparison with the total length of the cutting tool 20. The block socket 17 supports the cutting tool 20 against bending deformations and allows to transfer large compressive forces in the axial direction 171 of the cutting tool 20. The cutting tool 20 is inserted into the central bore 170 from the left until the snap connection 220 engages a corresponding annular groove 221 in the socket. In the engaged state, the cutting tool 20 is free to rotate around the axis 171 in the central bore 170, due to the fact that the cutting tool 20 is rotation-symmetric. This rotation may be hindered somewhat by frictional forces between the outer surface of the shank part 22 and the inner surface of the central bore 170, or between the contact surfaces of socket and conical part 23, but is essential a free rotation.

[0037] Another embodiment shown in figure 5, uses a separate holding ring 172 with a slot 173 such that it may be made smaller by compressing it. Once engaged with a corresponding annular groove 221 (as in the embodiment shown in figure 4) it expands and leaves the outer surface of the shank part 22 free to rotate. Locking of the cutting tool 20 in the axial direction 171 is accomplished by engagement of the rear part 222 of cutting tool 20 against the annular ring 172.

[0038] A cutter head according to the invention is particularly suitable for breaking relatively hard ground, is self-sharpening and has an extended service life.

Claims

1. Cutter head (10) for dredging ground under the water

surface, comprising a revolving body (11) which is rotatable around a central axis and which is formed by a base ring (13) and a hub (14) placed at a distance therefrom, between which extend a number of support arms (15) provided with cutting tools (20), between which support arms (15) passage openings (16) are present for discharge of the dredged ground, **characterized in that** the cutter head comprises at least 100 cutting tools, which cutting tools (20) are axisymmetrical at least at their free outer end.

2. Cutter head (10) as claimed in claim 1, **characterized in that** the cutting tools (20) are arranged on the support arms (15) such that they can be rotated freely around their axis of rotation symmetry.

3. Cutter head (10) as claimed in claim 1 or 2, **characterized in that** the cutting tools (20) are conical.

4. Cutter head (10) as claimed in any of the foregoing claims, **characterized in that** the top part of the conical cutting tools (20) has at the free outer end a radius of curvature of a maximum of 50 mm.

5. Cutter head (10) as claimed in any of the foregoing claims, **characterized in that** the cutter head (10} comprises at least 10 support arms (15).

6. Cutter head (10) as claimed in any of the foregoing claims, **characterized in that** a support arm (15) comprises at least 20 cutting tools (20).

7. Cutter head (10) as claimed in any of the foregoing claims, **characterized in that** the cutting tools (20) are oriented relative to the support arms (15) such that during rotation of the cutter head through the ground they strike substantially perpendicularly of the ground surface.

8. Cutter head (10) as claimed in any of the foregoing claims, **characterized in that** a support arm (15) comprises a first series of cutting tools (20) on a leading part (15a) thereof as seen in the direction of rotation of the cutter head (10), and that the support arm (15) comprises a second series of cutting tools (20) on a part (15b) facing away from the central axis.

9. Cutter head (10) as claimed in claim 8, **characterized in that** on the same support arm (15) the cutting tools (20) of the first series are disposed offset relative to the cutting tools (20) of the second series.

10. Cutter head (I 0) as claimed in any of the foregoing claims, **characterized in that** the cutting tools (20) are connected to the support arms (15) via coupling means (17).

11. Cutter head (10) as claimed in claim 10, **characterized in that** the support arms (15) of the cutter head are provided with guides on which the coupling means (17) and/or the cutting tools (20) are displaceably mounted.

12. Use of a cutter head (10) as claimed in any of the foregoing claims for dredging ground a ground with an Unconfined Compressive Strength (UCS) of at least 50 MPa, preferably at least 60 MPa and most preferably at least 80 MPa.

13. Cutter suction dredger (1) provided with a cutter head (10) as claimed in any of the claims 1-11.

Patentansprüche

1. Schneidkopf (10) zum Ausbaggern von Erdboden unter der Wasseroberfläche, der einen Drehkörper (11) aufweist, der um eine zentrale Achse drehbar ist und der von einem Basisring (13) und einer in einer Entfernung davon angebrachten Nabe (14) gebildet wird, zwischen denen sich eine Reihe von Tragarmen (15) erstreckt, die über Schneidewerkzeuge (20) verfügen, wobei zwischen den Tragarmen (15) Durchgangsöffnungen (16) vorhanden sind, um den ausgebaggerten Erdboden abzuführen, **dadurch gekennzeichnet, dass** der Schneidkopf mindestens 100 Schneidewerkzeuge aufweist, wobei die Schneidewerkzeuge (20) mindestens an ihrem freien Außenende achsensymmetrisch sind.

2. Schneidkopf (10) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schneidewerkzeuge (20) so auf den Tragarmen (15) angeordnet sind, dass sie frei um ihre Rotationssymmetrieachse gedreht werden können.

3. Schneidkopf (10) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Schneidewerkzeuge (20) konisch sind.

4. Schneidkopf (10) nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** der obere Teil der konischen Schneidewerkzeuge (20) an dem freien Außenende einen Krümmungsradius von höchstens 50 mm aufweist.

5. Schneidkopf (10) nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** der Schneidkopf (10) mindestens 10 Tragarme (15) aufweist.

6. Schneidkopf (10) nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Tragarm (15) mindestens 20 Schneidewerkzeuge (20) aufweist.

7. Schneidkopf (10) nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die Schneidewerkzeuge (20) so relativ zu den Tragarmen (15) ausgerichtet sind, dass sie während der Rotation des Schneidkopfs durch den Erdboden im Wesentlichen senkrecht zur Bodenfläche zugreifen.

8. Schneidkopf (10) nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Tragarm (15) aus der Rotationsrichtung des Schneidkopfs (10) aus gesehen eine erste Reihe von Schneidewerkzeugen (20) auf einem führenden Teil (15a) von diesem aufweist, und dass der Tragarm (15) eine zweite Reihe von Schneidewerkzeugen (20) auf einem von der Mittelachse abgewendeten Teil (15b) aufweist.

9. Schneidkopf (10) nach Anspruch 8, **dadurch gekennzeichnet, dass** die Schneidewerkzeuge (20) der ersten Reihe auf demselben Tragarm (15) versetzt zu den Schneidewerkzeugen (20) der zweiten Reihe angeordnet sind.

10. Schneidkopf (10) nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die Schneidewerkzeuge (20) über Verbindungsmittel (17) mit den Tragarmen (15) verbunden sind.

11. Schneidkopf (10) nach Anspruch 10, **dadurch gekennzeichnet, dass** die Tragarme (15) des Schneidkopfs mit Führungen versehen sind, auf denen die Verbindungsmittel (17) und/oder die Schneidewerkzeuge verschiebbar angebracht sind.

12. Verwendung eines Schneidkopfs (10) nach einem der vorstehenden Ansprüche zum Ausbaggern von Erdboden mit einer einaxialen Druckfestigkeit (UCS, Unconfined Compressive Strength) von mindestens 50 MPa, vorzugsweise mindestens 60 MPa und besonders bevorzugt mindestens 80 MPa.

13. Schneidkopfbagger (1) mit einem Schneidkopf (10) nach einem der Ansprüche 1 bis 11.

Revendications

1. Désagrégateur (10) pour draguer le sol sous la surface de l'eau, comprenant un corps tournant (11) qui est rotatif autour d'un axe central et qui est formé par un socle annulaire (13) et un moyeu (14) placé à une certaine distance de celui-ci, entre lesquels s'étendent un certain nombre de bras de support (15) pourvus d'outils de coupe (20), bras de support (15) entre lesquels des ouvertures de passage (16) sont présentes pour évacuer les terres draguées, **caractérisé en ce que** le désagrégateur comprend au moins 100 outils de coupe, lesquels outils de coupe (20) sont axisymétriques au moins à leur extrémité extérieure libre.

2. Désagrégateur (10) selon la revendication 1, **caractérisé en ce que** les outils de coupe (20) sont agencés sur les bras de support (15) de telle sorte qu'ils puissent tourner librement autour de leur axe de symétrie de rotation.

3. Désagrégateur (10) selon la revendication 1 ou 2, **caractérisé en ce que** les outils de coupe (20) sont coniques.

4. Désagrégateur (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la partie supérieure des outils de coupe (20) coniques présente à l'extrémité extérieure libre un rayon de courbure de 50 mm au maximum.

5. Désagrégateur (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le désagrégateur (10) comprend au moins 10 bras de support (15).

6. Désagrégateur (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un bras de support (15) comprend au moins 20 outils de coupe (20).

7. Désagrégateur (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les outils de coupe (20) sont orientés par rapport aux bras de support (15) de telle sorte que, pendant la rotation du désagrégateur dans le sol, ils frappent sensiblement à la perpendiculaire de la surface du sol.

8. Désagrégateur (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un bras de support (15) comprend une première série d'outils de coupe (20) sur une partie avant (15a) de celui-ci quand on regarde dans le sens de rotation du désagrégateur (10) et **en ce que** le bras de support (15) comprend une seconde série d'outils de coupe (20) sur une partie (15b) opposée à l'axe central.

9. Désagrégateur (10) selon la revendication 8, **caractérisé en ce que**, sur le même bras de support (15), les outils de coupe (20) de la première série sont disposés décalés par rapport aux outils de coupe (20) de la seconde série.

10. Désagrégateur (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les outils de coupe (20) sont reliés aux bras de support (15) par des moyens de couplage (17).

11. Désagrégateur (10) selon la revendication 10, **caractérisé en ce que** les bras de support (15) du désagrégateur sont pourvus de guides sur lesquels les moyens de couplage (17) et/ou les outils de coupe (20) sont montés déplaçables.

12. Utilisation d'un désagrégateur (10) selon l'une quelconque des revendications précédentes pour draguer un sol présentant une résistance à la compression simple (UCS) d'au moins 50 MPa, de préférence d'au moins 60 MPa et, de manière particulièrement préférée, d'au moins 80 MPa.

13. Drague suceuse à désagrégateur (1) dotée d'un désagrégateur (10) selon l'une quelconque des revendications 1-11.

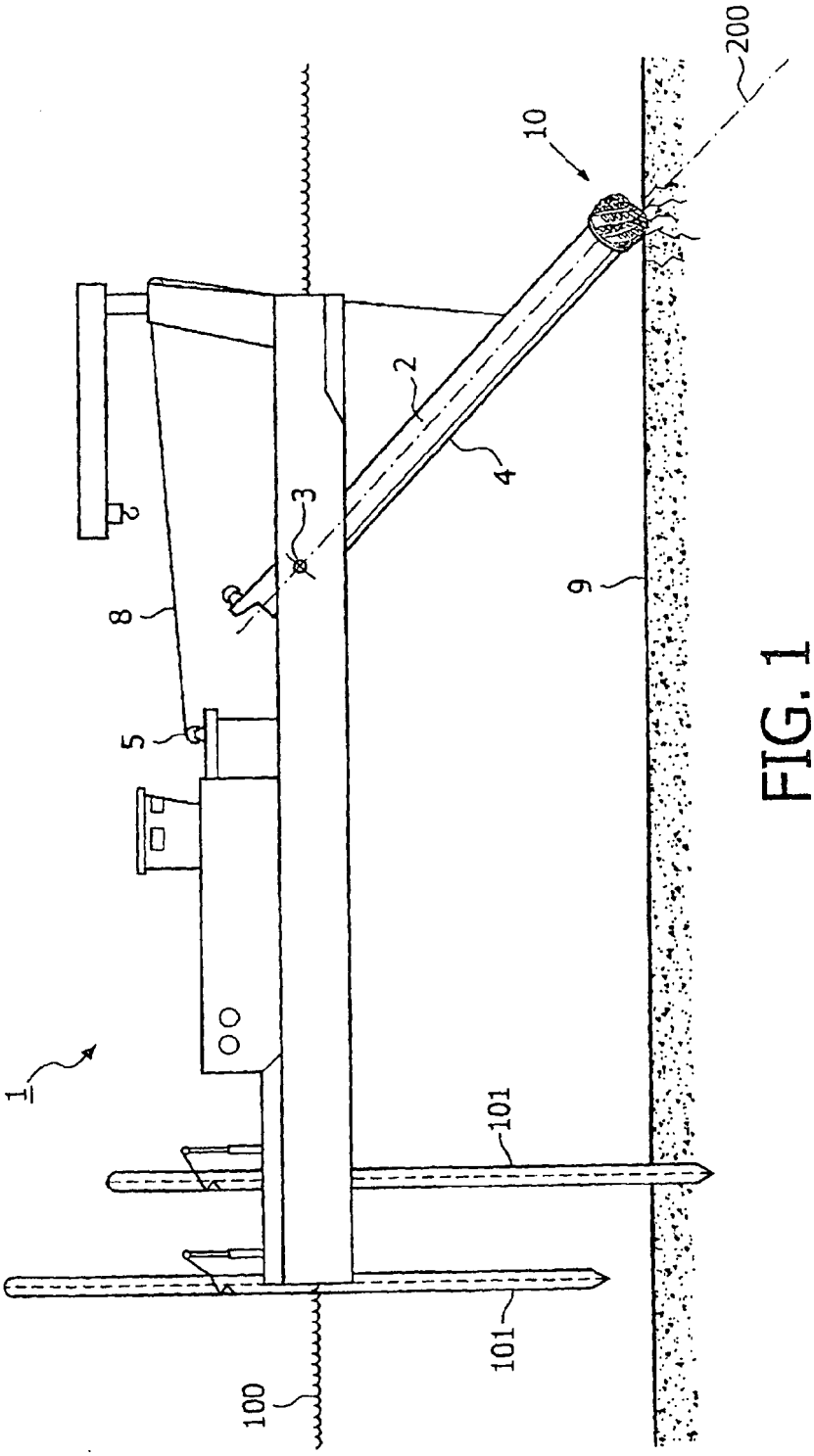
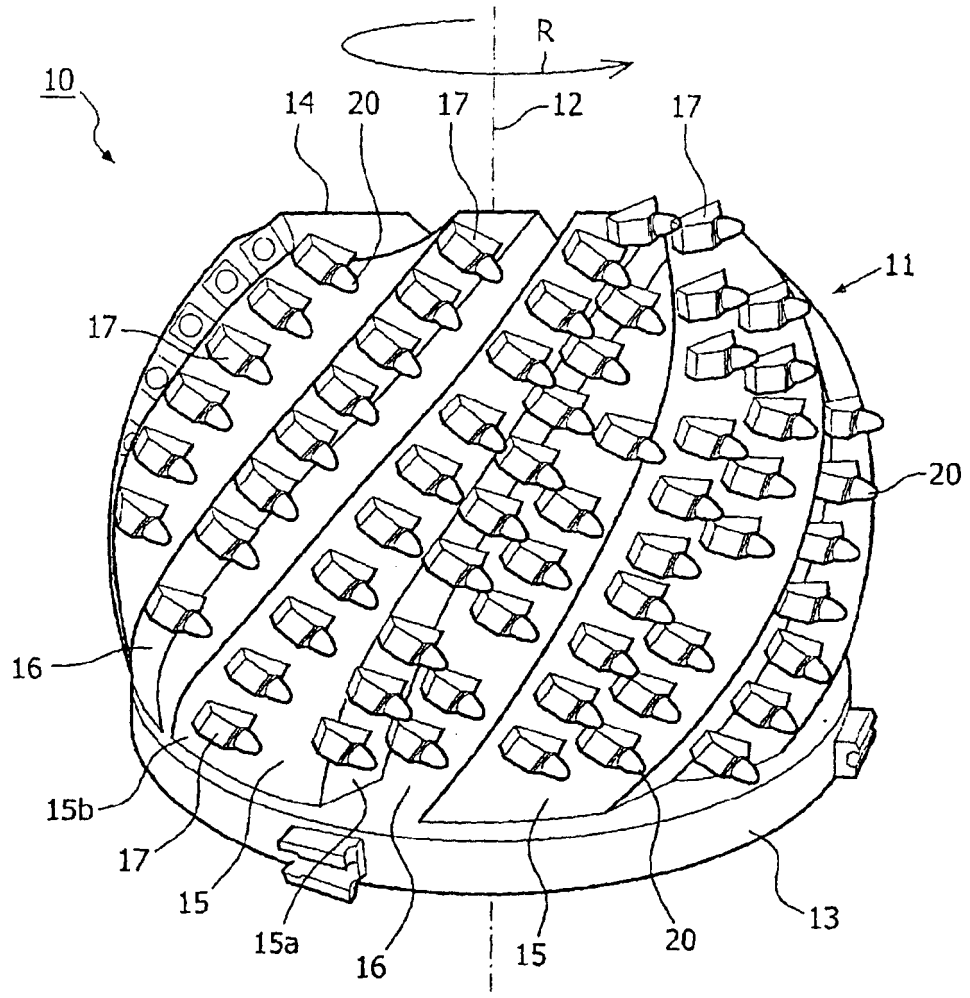


FIG. 1


R
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20
16
15b
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15
15a
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20
13

FIG. 2

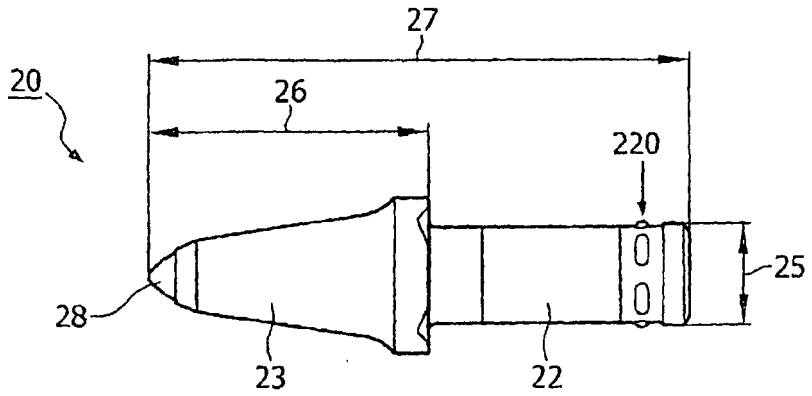
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FIG. 3

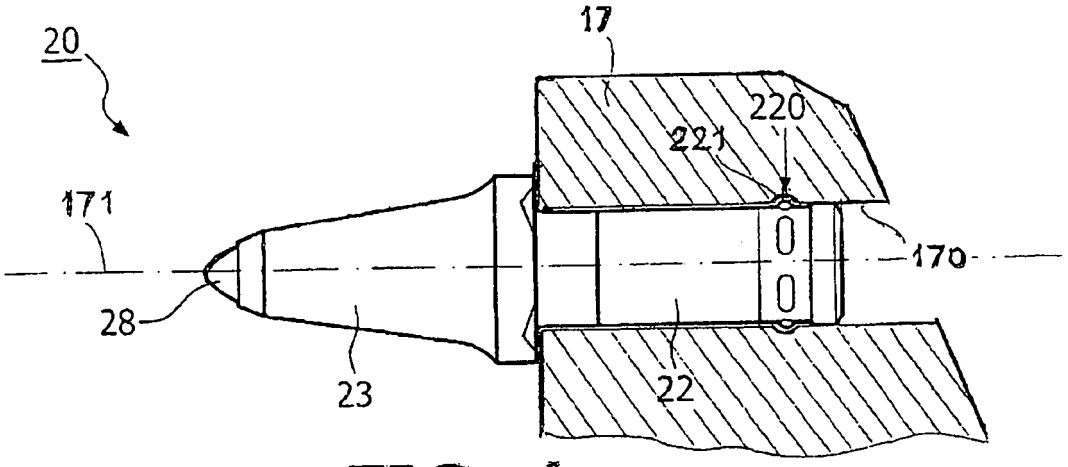
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FIG. 4

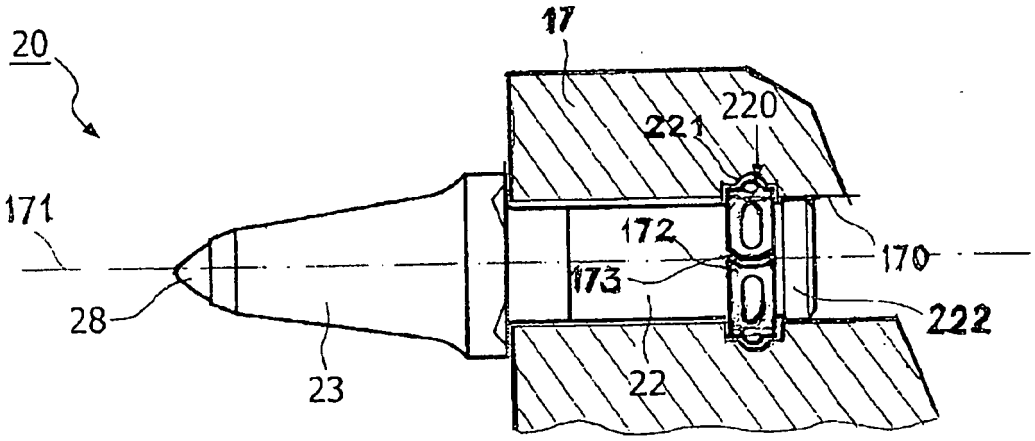
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FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- NL 1031253 **[0002]**
- US 4319415 A **[0004]**
- WO 2005035884 A **[0005]**
- GB 2032492 A **[0006]**
- NL 8104969 A **[0007]**
- US 4470210 A **[0008]**
- US 4986011 A **[0009]**
- US 4488608 A **[0015]**
- DE 102005051450 A1 **[0016]**
- US 4575156 A **[0016]**