

WEARING-PART SYSTEM

TECHNICAL FIELD

- 5 The present invention relates to a wearing-part system which comprises a wearing-part holder and a wearing part. Wherein the wearing part comprises a tooth portion that is detachably arranged on and in relation to the wearing-part holder, which tooth portion is in the form of an
- 10 exchangeable wear and/or replacement part.

BACKGROUND OF THE INVENTION, PROBLEM AREA AND PRIOR ART

- 15 Various types of devices for dredging, such as dredgers, bucket dredgers or other types of machines intended to excavate or otherwise work or move material or sediment, mainly under water, usually use teeth or another replaceable wearing part or tool mounted on the cutter
- 20 head, the bucket or the apparatus that is used to work or move the material. For machinery designed to work the material or sediment using teeth, wear in most cases occurs on the teeth with which the machinery is equipped. The teeth are designed to be able to be replaced after they
- 25 have become worn, and the teeth are designed to work or clear in different ways the material or sediment that is to be worked by the machinery.

- A wearing part such as a tooth is mounted on the machinery,
- 30 such as a cutter head on a dredger, for example by a screw joint or cotter joint. Various types of thermal assembly, such as welding or shrink-fitting, are other known assembly methods. The tooth can be mounted on a wearing-part holder or tool holder and replaced on a continuous basis. Forces
- 35 acting on the wearing part, or the tool, affect the wearing-part holder and, after a considerable period of use, the wearing-part holder may also need to be changed.

Traditionally, the wearing-part holder is welded to the cutter head or is mounted thereon using another thermal joining technique. However, it is also conceivable that the wearing-part holder is mounted using a screw joint, cotter
5 joint or other mechanical method of assembly. It may also be that the tooth is mounted directly on the cutter head.

Cutter heads for dredgers are arranged with wear-parts arranged with a separating distance from each other on,
10 generally helical, elongated blades protruding from a central body attached to a central, rotating hub. The blades suitably extend in a helical line from the hub at the forward end of the body and rearward in the feed direction of the tool to the rear end of the rotating body
15 comprising a back ring, holding the blades together, where also a suction device is arranged for removal of the loosened earthen mass through the interspace between the blades.

20 The wearing-part system which comprises a wearing-part holder and a wearing part comprises a forward located wear-part in the form of a replaceable tooth portion with a point, cutting point, and comprising a rear leg for mounting in a specially designed groove at a rear,
25 stationary wearing-part holder. To achieve a dynamic yet reliable attachment of the replaceable tooth point to the holder, the connection parts also comprise a connection system common to the parts and with a detachable locking mechanism. Every such connection system has a distinctively
30 characteristic geometry, comprising the surfaces and the form of the legs and grooves named above adapted to minimizing wear to the wearing-part and the wearing-part holder until, due to inevitable wear by machining the material or sediment, the wear-part must be replaced.

35 Such commercial tooth systems are designed to absorb loads from the use of the tool through specially designed and

mutually interactive contact zones, which are arranged along the joint between the connection parts defined by the leg and groove. Each contact zone comprises at least two mutually opposing and interacting contact surfaces arranged one on each connection part and arranged at a given angle to the line of axial symmetry of said joint. When these contact surfaces are placed mainly perpendicular to said axial line of symmetry Y, i.e., essentially in the cross vertical plane, the further insertion of the tooth part on the holder part is stopped completely, why these surfaces are also hereafter referred to as stop surfaces.

However, it is to be understood that when the dredger is used, i.e., when the tool is used, there are not only active loads that are parallel to the connection geometry along with a longitudinal plane of symmetry, but also loads that deviate from the longitudinal plane of symmetry. Essentially, every active load, F , thus, comprises in part a shearing force component, or the cutting force, F_c , that acts essentially from the front parallel to the work surface and axially placed in relation to the said joint, in part a normal force component F_n that acts essentially from above, perpendicular to the work surface and in part a transverse force component F_p that acts from the side, essentially parallel to the work surface and more perpendicular in relation to said tooth part's protrusion beyond the common joint of the connection parts.

The position terms used below such as rear, forward, lower, upper, vertical, transverse or horizontal surfaces, etc., can consequently be inferred from the definitions, as stated above, of said forces and the mutual relationship of the connection parts, as well as their relations and positions relative to the work surface.

The new concept for a tooth system, as stated in the present patent application, comprises a number of

characteristics, which characteristics alone or in combination are unique in comparison with the presently available tooth systems and which characteristics afford advantageous solutions to a number of problems that can
5 arise with known tooth systems.

A number of these problems are summarized below.

The interconnection between the wearing part and the
10 wearing-part holder is important wherein a too wide degree of play between the wearing part and the wearing-part holder develop problems with movement between the wearing part and the wearing-part holder, also known as hammering, that is, said parts are powerfully impacted against one
15 another during the use of the tool. This hammering causes considerable increase in wear. Those tooth systems that instead have all too narrow degree of play, that is have a too small gap between the wearing part and the wearing-part holder, develop the problem of the wearing part becoming
20 difficult to remove from the wearing-part holder.

Tooth systems designed for dredging encounter their greatest, and thus, as regards the tooth system design, most often the gravest loads when breaking hard rock. This
25 is due to the very large normal loads F_n that impact essentially perpendicularly to the rock, as when breaking rock. The known tooth systems, by prior art, thus usually obtain disadvantageous wear damage along the joint between component connection parts of the tooth system, as these
30 lack the required capacity to withstand such F_n loads.

Known tooth systems normally have holder contact surfaces, along the sides of the joint, with high degree of strength, regarding the normal force, F_n , acting essentially axially
35 along the tooth point that is, the normal forces impacting more or less vertically against the working surface and that are usually absorbed by stop surfaces arranged

somewhere along the impact zone between the wearing-part holder and the wearing part, but that are also transferred as friction forces axially along the axial symmetry axis of the wearing part to the contact surfaces along the

5 essentially longitudinal sides along the joint of the wearing part system. However, the same does not apply to corresponding transverse forces F_p that essentially impact parallel with the breaking surface and, thus, more perpendicular to the axial symmetry axis of the wearing

10 part. These transverse forces, F_p , and those moment forces resulting from them are also essentially absorbed by the contact surfaces along the joint of the wearing-part system but said contact surfaces usually have significantly lower strength against such transverse (F_p) and resultant forces.

15 Patent document WO 2012/006664 A1 discloses an excavation tooth assembly comprising a first tooth member comprising a body having a cavity incorporating two or more channels and a second tooth member comprising a body and two or more

20 coupling portions extending from the body, wherein when the first and second tooth members are in an assembled condition, each coupling portion is separately received in respective ones of the channels; and a locking arrangement for locking the first and second tooth members in their

25 assembled condition.

Patent document EP 1997967 A1 discloses a tooth system for use in an dredging or mining device, comprising a tooth and an adapter onto which the tooth is mounted in a detachable

30 fashion, said tooth comprising a longitudinally extending tooth web, a longitudinally extending tooth base and a longitudinally extending tooth head at a distance from the tooth base, a longitudinally extending undercut cavity being defined between the adapter base and the adapter

35 head, and at least one pair of correspondingly shaped facing zones of the adapter and the tooth comprises a stepped configuration.

Patent document WO 2005/005737 A1 discloses a tooth system for a tool for earth moving machinery, which tooth system is of the type embodying a holder located on the tool and a front tooth portion that is detachably arranged on and in relation to the holder, the tool embodies a rear leg and the holder embodies a cavity designed to receive the leg in interaction with the tooth portion and thereby achieve a unified joint for assimilation of occurring loads (F_n , F_c , F_p) via a predetermined connection geometry embodying special, opposite, wherein the components of the tooth system have a multi-armed, preferably cruciform, cross section comprising at least four projection arms and at least four grooves each that interact with each projecting arm.

An important object of the present invention is to achieve a new and improved wearing-part system for a dredger, which tooth system essentially reduces or wholly eliminates problems relating to limited free cutting. Known systems are sensitive to wear due to soil sliding against the outside of the adapter that could result in that the adapters are weakened due to material wear when too much steel is worn away from the adapter.

Another object of the present invention is to achieve a new and improved wearing-part system for a dredger, which tooth system essentially optimizing the ratio between strength and weight.

Another object of the present invention relates to improving the handling of the reaction forces, or the perpendicular forces, F_p , that are unpredictable in their nature since these forces does depend on the material that is worked and other circumstance due to the actual use of the system.

Another object of the present invention is to achieve a new and improved wearing-part system for a dredger, which tooth system reduces the wear on the contact surfaces and/or between the different connection parts and that the contact surfaces is possible to rebuild by the use of liners, where the wear is caused by hammering and/or caused by too large surface loads on the joint between the wearing-part holder and the wearing-part.

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- 10 Another object of the present invention is to achieve a new and improved wearing-part system, which wearing-part system essentially reduces or wholly eliminates the problem with disadvantageously large wear damage along the joint between the connection parts of the wearing-part system due to the
- 15 very large loads arising during, e.g., the breaking of hard rock mass.

Further objects of the present invention are to achieve a new and improved wear-part system whose joint affords great strength with regard to the normal forces, F_n , and to the cutting forces, F_c .

The invention intends to solve the problems describe above through the development of a wear-part system with an improved interconnection between the wearing-part holder and the wearing part, designed with an easily releasable lock to fix a tooth/wearing part to a wearing-part holder securely, simply, and permanently and a new design of the wearing-part to reduce material and to improve the performance of the wearing-part.

OBJECT AND FEATURES OF THE INVENTION

An object of the present invention is to provide the technical field with a wearing-part systems having improved
5 interconnection between the wearing-part holder and the wearing part, designed with an easily releasable lock to fix a tooth/wearing part to a wearing-part holder securely, simply, and permanently and a new design of the wearing
10 part to reduce material and to improve the performance of the wearing-part.

By arranging the centreline of coupling part of the wearing part in line with the tip of the tooth it is possible to reduce material from the wearing part and the wearing-part
15 holder since less material is used for strengthening, or otherwise, improving the strength of the wearing part and/or the wearing-part holder.

Since the wearing part is possible to arrange in the centre
20 recess of the wearing-part holder an improved connection between the wearing part and the wearing-part holder is achieved with less material used in the wearing part and/or the wearing-part holder leading to that free cutting is improved and thus potential wear on the outside of the
25 wearing-part holder is reduced and/or completely eliminated.

By arranging the end of the coupling part of the wearing part to a fully symmetrical or a near fully symmetrical
30 geometry the cross section could be shaped as an I-beam creating an improved ratio between strength and weight of the wearing part in relation to known systems.

By arranging contact surfaces between the wear part and the
35 wear-part holder the reaction forces, F_p is handled in a more efficient way than in known systems.

Other objects of the invention are described in more detail in the detailed description of the invention.

The invention relates to a wearing part for a dredger
5 arranged to fit a wearing-part holder, where the wearing
part comprises a longitudinally extending rear leg, and a
longitudinally extending head, said rear leg and head have
a central extension in head flanges with respect to the
centreline L-L of the wearing part of the wearing part,
10 wherein the rear leg and the head are essentially arranged
on a straight centreline L-L, and that the attachment plane
of the wearing part and the wearing-part holder and the
centre line L-L is arranged with an attachment angle α
preferably in the range between 35 degrees to 53 degrees.

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According to further aspects of the improved wearing-part
holder, provision is made as follows:

that the attachment plane of the wearing part and the
20 wearing-part holder and the centre line L-L is arranged
with an attachment angle α more preferable in the range of
40 degrees to 48 degrees and most preferably 44 degrees.

that a hook is extending from the wearing part.

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that the head flanges are arranged with a width Y-Y that
equal to or larger than the width of the wearing part
holder, X-X.

30 that liners could be arranged between a first contact
surface, a second contact surface, a third contact surface,
a fourth contact surface, a fifth contact surface, a sixth
contact surface, a seventh contact surface, a eighth contact
surface, a ninth contact surface and a stop surface
35 arranged on the wearing part and the corresponding surfaces
of the wearing-part holder.

that a liner comprising a bottom part, a first side part and a second side part is arranged in the wearing-part holder.

- 5 that the stop surface arranged on the rear leg of the wearing part is substantially flat.

The invention also relates to a wearing-part holder for a dredger arranged with a recess adapted for arranging a rear
10 leg of a wearing part characterized by that the recess is arranged with a contact surfaces adapted to face a first contact surface, a second contact surface, a third contact surface, a fourth contact surface, a fifth contact surface, a sixth contact surface, a seventh contact surface, a eight
15 contact surface, a ninth contact surface and a stop surface arranged on the rear leg of the wearing part.

The invention also relates to a wearing-part system comprising a wearing-part holder, a wearing part, and a
20 lock.

According to further aspects of the improved wearing-part system, provision is made as follows:

- 25 a lock comprising a threaded rod is arranged on a catch, where an elastomer is arranged with a through-hole through which the threaded rod runs; a mounting nut which is arranged on the threaded rod, where a first washer is arranged between the elastomer and the mounting nut, and a
30 second washer is arranged between the elastomer and the wearing-part holder.

BRIEF DESCRIPTION OF FIGURES

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The invention is described in more detail below with reference to the attached figures, in which:

Fig. 1 shows the components in a wearing-part system according to an embodiment of the invention.

5 Fig. 2 shows a wearing-part system in an assembled state in a view from the rear according to an embodiment of the invention.

10 Fig. 3 shows a wearing-part system in an assembled state in a view from above according to an embodiment of the invention.

15 Fig. 4 shows the components of a wearing-part system in a view from the side according to an embodiment of the invention.

20 Fig. 5a shows a wearing-part system in an assembled state in a view from the side with marked section surfaces according to an embodiment of the invention.

Fig. 5b shows section surfaces in an assembled wearing-part system according to an embodiment of the invention.

25 Fig. 6 shows the section surface of the wearing-part system in an assembled state in position F-F revealing the wearing parts position in the wearing-part holder according to an embodiment of the invention.

30 Fig. 7 shows the wearing part of a wearing-part system in a view from the side according to an embodiment of the invention.

35 Fig. 8a shows the forces acting on the wearing part in a view from the side according to an embodiment of the invention.

Fig. 8b shows the forces acting on the wearing part in a view from the behind according to an embodiment of the invention.

- 5 Fig. 9 shows a wearing-part system in an assembled state in a view from above according to an embodiment of the invention.

- Fig. 10 shows different angles of the wearing part in a view from the side according to an embodiment of the invention.

- Fig. 11 shows the components in a wearing-part system comprising liners according to an embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

- 20 Figure 1 shows the components included in a wearing-part system 1 according to one of the embodiments. A wearing part 3, or another form of tool or tooth, is arranged or mounted on a wearing-part holder 4, also referred to as holder, tool holder or adapter. The wearing part 3 can also
- 25 be mounted directly on the cutter head or the apparatus using the wearing part, in which case the wearing-part holder 4 is a part of the cutter head or the apparatus. The wearing part comprises a longitudinally extending head 9 that is the actual contact point towards the material or
- 30 sediment that is worked or moved by the dredger. The wearing part 3 is mounted with a lock 2 which locks the wearing part 3 to the wearing-part holder 4. When the wearing part 3 is a tooth, the tooth 3 will be changed when the degree of wear is such that the tooth 3 needs to be
- 35 replaced. When the wearing part 3 is replaced, it is important that the replacement of the wearing part 3 is easy to carry out and that locking is such that the wearing

part is permanently retained on the wearing-part holder 4 and that the replacement is safe to carry out. Traditionally, different types of locking methods have been used, for example different types of wedges or welded joints. The lock 2 shown in Figure 1 consists of a catch 10 which is arranged to a hook 5 arranged on the wearing part 3. The placement of the hook 5 on the wearing part 3 improves the characteristics of the wearing part 3 and the wearing-part holder 4 with regards to free cutting since the material used in the wearing part 3 and the wearing-part holder 4 is reduced. The catch 10 retains the wearing part 3 on the wearing-part holder 4. The lock 2 is arranged in a lock holder 6 on the wearing-part holder 4. The lock also includes a threaded rod 11, not shown in the image, which is preferably designed as one piece together with the catch 10. Moreover, an elastomer 12 is included, which is preferably designed as a cylinder with a through-hole through which the threaded rod 11 runs. The elastomer 12 is preferably made of an elastically deformable material such as an elastomer, such as rubber, or in the form of a soft metal. A mounting nut 13 is arranged on the threaded rod 11. Moreover, a first washer 14 is arranged between the elastomer and the mounting nut 13 and a second washer 15 is arranged between the elastomer 12 and the wearing-part holder 4. When the wearing part 3 is placed on the wearing-part holder 4, the rear leg 7 formed on the wearing-part 3 fits into a recess 8 formed on the wearing-part holder 4, and, when the rear leg 7 is fully inserted into the recess 8, the lock 2 is placed in the lock holder 6, or, the lock 2 is already placed in the lock holder 6, so that the catch 10 is arranged to the hook 5 of the wearing part 3. By rotating the mounting nut 13, the wearing part 3 can be locked to the wearing-part holder 4. The wearing part 3 is arranged with head flanges 31, 32 extending from the wearing part, in the figure the flange 32 is not shown.

Figure 2 shows an assembled wearing-part system 1. A wearing part 3 is mounted on a wearing-part holder 4. The lock 2 is tightened, which means that the elastomer 12, not shown in the figure, is compressed or otherwise loaded to achieve a tightening effect for retaining the wearing part 3 on the wearing-part holder 4.

Figure 3 shows a further view of an assembled wearing-part system 1. A wearing part 3 is mounted on a wearing-part holder 4. Lock 2 is designed to fix or retain a wearing part 3 on a wearing-part holder 4. Retaining or being retained means that the wearing part 3 is mounted on or arranged on the wearing-part holder 4 in a permanent manner. Initially, the wearing part 3 is almost fixed to the wearing-part holder 4, but as wear occurs, the wearing part 3 can be arranged more loosely, or with some play, in relation to the wearing-part holder 4. Regardless of whether the wearing part 3 is fixed or somewhat moveably arranged on the wearing-part holder 4, the wearing part 3 will not come off or otherwise be removed from the wearing-part holder 4, thus the wearing part 3 is retained on the wearing-part holder 4. In figure 3 the width, X-X, of the wearing-part holder 4 and the width, Y-Y of the flanges of the wearing part 3 are illustrated. If the width of the flanges, Y-Y, is equal to or larger than the width of the wearing-part holder 4, X-X, the wearing-part holder 4 is protected from wear during dredging since sediment is directed away, by the flanges arranged on the wearing part 3, from the wearing-part holder 4.

Figure 4 shows a view of a wearing-part system 1 not yet assembled, where the wearing part 3, the wearing-part holder 4 and the lock 2 are separate from each other. The rear leg 7 of the wearing-part 3 is formed with four sections, a first section 20, adjacent the outer end portion of the rear leg 7, a second section 30, a third section 40 and a fourth section 50. Where the second

section 30 is arranged between the first section 20 and the third section 40. And where the third section 40 is arranged between the second section 30 and the fourth section 50. The first section 20 mainly has a stopping function and a contacting function against the wearing-part holder 4. The second section 30 mainly have a contacting function for handling the normal force component, F_n , between the wearing part 3 and the wearing-part holder 4. The third section 40 mainly have a function for accomplish an additional, secondary, contact surface for handling the normal forces, F_n , after wear of the wearing part 3 and/or wear of the wearing-part holder 4. The fifth section 50 mainly have a contacting function for handling the cutting force component, F_c , between the wearing part 3 and the wearing-part holder 4. The lock 2 is arrangeable in a lock holder 6 on the wearing-part holder 4. The lock also includes a threaded rod 11 which is preferably designed as one piece together with the catch 10. Moreover, an elastomer 12 is included, which is preferably designed as a cylinder with a through-hole through which the threaded rod 11 runs. The elastomer 12 is preferably made of an elastically deformable material such as an elastomer, such as rubber, or in the form of a soft metal like a spring. A mounting nut 13 is arranged on the threaded rod 11. Moreover, a first washer 14 is arranged between the elastomer and the mounting nut 13 and a second washer 15 is arranged between the elastomer 12 and the wearing-part holder 4. The rear leg 7 of the wearing part 3 is arranged to fit into a recess 8 of the wearing-part holder 4. The wearing part 3 also comprises a longitudinally extending head 9.

Figure 5a shows a wearing-part system 1 in an assembled state in a view from the side with marked section surfaces. The section surface B-B is at the position where the stop surface 23 of the first section 20 of the wearing part 3 meets the inner bearing surface of the wearing-part holder

4. The section surface C-C is at a position on the second section 30. The section surface D-D is at a position on the third section 40. The section surface E-E is at a position on the fourth section 50. The section F-F is a position of the longitudinal interconnection between the wearing part 3 and the wearing-part holder 4 shown in figure 6. Figure 5a also discloses the attachment plane G-G, that is the plane to where the wearing part 3 is arranged to the wearing-part holder 4. The attachments plane is used as a reference for defining the angles of the wearing part 3. When the wearing part 3 is worn the head 9 is reduced and the tip, the wear plane, is parallel to the attachment plane. The wear plane is thus constantly approaching the attachment plane when the wearing part 3 is worn and at a specific point, before wear occurs on the wearing-part holder 4, the wearing part 3 is exchanged.

Figure 5b shows the section surfaces in a wearing-part system 1 at the different positions described above. The section surfaces B-B, C-C, D-D and E-E are shown in the figures. The wearing-part holder 4 meets the wearing part 3 with a stop surface or a bearing surface. The other surfaces of the wearing-part holder 4 that do not contact the wearing part 3 are referred to as clearance surfaces. Therefore, the surfaces arranged on the wearing-part holder 4 are of the type stop surface, bearing surface or clearance surface. The cross-section B-B of the first section 20 shows that the wearing part 3 is arranged with contact to the wearing-part-holder 4 in all directions. The cross-section C-C of the second section 30 shows that the wearing part 3 is arranged as an I-beam with two contact surfaces and two clearance surfaces. The cross-section D-D of the third section 40 shows that the wearing part 3 is arranged as an I-beam with four clearance surfaces. If/when the wearing-part holder 4 is worn the I-beam of the wearing part 3 at the D-D cross section is able to move further into the wearing-part holder 4 to accomplish an additional

contact surface for handling the normal forces, F_n . The cross-section E-E of the fourth section 50 shows that the wearing part 3 is arranged in a format resembling a T-beam.

5 Figure 6 shows a wearing-part system 1 where the wearing part 3 is arranged in the wearing-part holder 4 for position F-F as shown in figure 5a. The first section 20 is formed with a first contact surface 21 and a second contact surface 22 and a first stop surface 23 which is formed in
10 the nose or the rear leg 7 of the wearing part 3. The second section 30 and the third section 40 does not have any primary contact surface for the specific position of the section F-F, instead all surfaces are clearance surfaces. The fourth section 50 is formed with a third
15 contact surface 51 and a fourth contact surface 52.

Figure 7 shows the wearing part 3 in a perspective view from the side. The first contact surface 21 of the second section 30 is shown and a corresponding second contact
20 surface 22 is arranged on the opposite side of the second section 30 not shown in the figure. The third contact surface 51 of the fourth section 50 is shown and a corresponding fourth contact surface 52 is arranged on the opposite side of the fourth section 50 not shown in the
25 figure. The first contact surface 21 and the second contact surface 22 arranged on the second section 30 and the third contact surface 51 and the fourth contact surface 52 arranged on the fourth section 50 are jointly arranged to handle the perpendicular force, F_p , acting on the
30 wearing part 3. The fifth contact surface 53 of the fourth section 50 is shown and a corresponding sixth contact surface 54 is arranged on the opposite side of the fourth section 50 not shown in the figure. A seventh contact surface 24 is arranged on the second section 30. The fifth
35 contact surface 53 and the sixth contact surface 54 arranged on the fourth section 50 together with seventh contact surface 24 arranged on the second section 30 are

jointly arranged to handle the cutting force, F_c , acting on the wearing part 3. An eight contact surface 55 is arranged on the fourth section 50. A ninth contact surface 25 is arranged on the second section 30. The eight contact
5 surface 55 arranged on the fourth section 50 together with ninth contact surface 25 arranged on the second section 30 are jointly arranged to handle the normal force, F_n , acting on the wearing part 3. For all contact surfaces described above, arranged on the wearing part 3, corresponding
10 contact surfaces are arranged on the wearing-part holder 4. A stop surface 23 is arranged on the first section 20 on the wearing part 3 to handle the combined forces of the normal force, F_n , and the cutting force, F_c . Surface 56 discloses a secondary contact surface arranged on the third
15 section 40 for handling the normal force, F_n .

Figure 8a shows the wearing part 3 in a view from the side indicating the forces acting on the wearing part. Wherein the cutting force, F_c , and the normal force, F_n , are
20 indicated.

Figure 8b shows the wearing part 3 in a view from behind indicating the forces acting on the wearing part. Wherein the perpendicular force, F_p , is indicated potentially
25 acting, depending on how the wearing part 3, and thus the dredger, is arranged towards the soil.

Figure 9 shows the centre line L-L for a wearing-part system 1. The centre line L-L runs in the longitudinal
30 direction of the wearing part 3 and the wearing-part holder 4.

Figure 10 shows the attachment angle α of the wearing part 3. The attachment angle is the angle between the attachment
35 plane of the wearing part 3 arrangement to the wearing-part holder 4 and the centre line L-L. The attachment plane is the plane to where the wearing part 3 is arranged to the

wearing-part holder 4, i.e. the plane where the lock 2 is arranged and where the eight contact surface 55 of the wearing part 3 contacts the wearing-part holder 4. For some conventional wearing-part systems the attachment angle is 0
5 degrees, i.e. the rear leg 7 and the head 9 are arranged with an angle between the rear leg 7 and the head 9. The attachment angle α is preferably in the range between 35 degrees to 53 degrees, and more preferable in the range of 40 degrees to 48 degrees and most preferably 44 degrees.
10 The engagement angle β is the angle between the attachment plane and the main direction of the normal force, F_n , to the tip of the wearing part 3 and is preferably in the range between 90 degrees to 110 degrees, and more preferable in the range of 95 degrees to 105 degrees and
15 most preferably 100 degrees. The head angle γ is the angle between the head 9 and the main direction of the normal force, F_n , to the tip of the wearing part 3 and is preferably in the range between 14 degrees to 26 degrees, and more preferable in the range of 17 degrees to 23
20 degrees and most preferably 20 degrees. The orthogonal contact angle δ is the angle between the head 9 and the main direction of the cutting force, F_c , to the tip of the wearing part 3 and is preferably in the range between 104 degrees to 116 degrees, and more preferable in the range of
25 107 degrees to 113 degrees and most preferably 110 degrees. The contact angle ε is the angle between the attachment plane and the main direction of the cutting force, F_c , to the tip of the wearing part, the infestation direction, and is preferably in the range between 6 degrees to 14 degrees,
30 and more preferable in the range of 8 degrees to 12 degrees and most preferably 10 degrees.

Figure 11 shows the wearing-part system comprising a wearing part 3 arranged in a wearing-part holder 4 wherein
35 a liner 60 is arranged in the wearing-part holder 4. The liner 60 comprises a bottom part 61 a first side part 62 and a second side part 63. The first side part 62 and the

second side part 63 are arranged with mounting devices in the form of threaded bolts that arrange the liner 60 in the wearing-part holder 4. The liner 60 could be arranged as three separate parts, a bottom part 61 a first side part 62
5 and a second side part 63, but could also be arranged in the form of a single liner comprising a bottom part 61 a first side part 62 and a second side part 63,

10 DESCRIPTION OF FUNCTION

When a wearing part 3, for example a tooth for dredging, is arranged, for example mounted, on a wearing-part holder 4, the catch 10 of the lock 2 can be arranged to the hook 5 of
15 the wearing part 3. In the following description of function, the term wearing part is used to describe the invention. However, any wearing part or tooth or dredging tooth can be used in a corresponding manner. For example, a wearing part can be an end board protection, a cutting
20 blade protection, a loading tooth, an excavating tooth, a ripper, a deep pocket tooth or a bucket tooth.

When a wearing part 3 is arranged on the wearing-part holder 4, the rear leg 7 of the wearing part 3 meets a
25 recess 8 arranged on the wearing-part holder 4. The wearing part 3 is arranged on the wearing-part holder 4 so that the recess 8 of the wearing-part holder 3 meets the rear leg 7 of the wearing part 3, where the rear leg 7 comprises the first section 20, the second section 30 and the third
30 section 40 of the wearing part 3.

The contact surfaces, the first contact surface 21, second contact surface 22, third contact surface 51, fourth contact surface 52, fifth contact surface 53, sixth contact
35 surface 54, seventh contact surface 24, eighth contact surface 55, and the ninth contact surface 25 arranged to meet the forces applied to the wearing part 3 when the

- wearing part is used for dredging or other work. When the wearing part 3 meets the material being worked, the main part of the forces during work will, from the wearing part 3, from the fourth contact surface 52 and the fifth contact surface 53, meet the corresponding primary contact surfaces, on the wearing-part holder 4. Therefore, it is relevant that the fourth contact surface 52, fifth contact surface 53 and the corresponding surfaces of the wearing-part holder 4 are relatively large in order to establish a large contact surface between the wearing part 3 and the wearing-part holder 4 to enable transmission of forces from the wearing part 3 to the wearing-part holder 4. Moreover, the stop surfaces, such as the first stop surface 23, are arranged to define the correct position between the wearing part 3 and the wearing-part holder 4. Other surfaces, clearance surfaces, are arranged to enable installation and removal, such as mounting and dismantling, of the wearing part 3 on/from the wearing-part holder 4.
- 20 The wearing part is arranged with head flanges 31, 32 arranged to protect the wearing-part holder 4 from wear due to soil sliding against the outside of the wearing-part holder 4 that could result in that the wearing-part holder 4 is weakened due to material wear when too much steel is worn away from the adapter. The head flanges 31, 32 are thus arranged with a width Y-Y that is equal to or larger than the width of the wearing-part holder 4, X-X.

- According to a preferred embodiment, when the wearing part 3 is worn and needs replacing, the lock 2 is dismantled by loosening and moving the mounting nut 13 on the threaded rod 11 so that the elastomer 12 is released. When the mounting nut 13 is moved to a position so that the lock 2 can be released, the lock is lifted out of the lock holder 6 and the catch 10 can be moved out of the hook 5. Then the wearing part 3 can be removed from the wearing-part holder 4. The lock 2 can then be reused to mount a new wearing

part 3 on a wearing-part holder 4 again. If the elastomer 12 has lost its resilience, the mounting nut 13 can be fully removed, after which the first washer 14, the elastomer 12 and the second washer 15 are removed from the threaded rod. Then the second washer 15, a new elastomer 12 and the first washer 14 are refitted, after which the mounting nut 13 is threaded again on the threaded rod 11.

10 ILLUSTRATIVE EMBODIMENT

An example of an embodiment of the wearing-part system 1 consists of a lock 2, where the lock 2 is arranged between a wearing part 3 and a wearing-part holder 4 and locks the wearing part 3 to the wearing-part holder 4. Each apparatus or tool, for example a cutter head, has a plurality of wearing-part systems 1 mounted on the apparatus. According to an embodiment, the wearing-part holders 4 are arranged, by welding or other mechanical means, onto the cutter head and can be dismantled from the cutter head if the wearing-part holder 4 needs replacing. The wearing-part system 1, and thus the locking system 2, can be adapted to all sizes of wearing parts 3 and to all types of applications of teeth, excavating teeth, wearing-part systems and tools. The teeth can be replaced continuously by the operator of the dredger in a safe and simple manner.

ALTERNATIVE EMBODIMENTS

30

In an alternative embodiment, other devices can be used to lock the wearing part 3 to the wearing-part holder 4, for example various forms of cotter joints or other variants of screw joints.

CLAIMS

1. Wearing part (3) for a dredger arranged to fit a wearing-part holder (4), where the wearing part (3)
5 comprises a longitudinally extending rear leg (7), and a longitudinally extending head (9), said rear leg (7) and head (9) have a central extension in head flanges (31, 32) with respect to the centreline L-L of the wearing part (3) of the
10 wearing part (3), **characterized by** that the rear leg (7) and the head (9) are essentially arranged on a straight centreline L-L, and that the attachment plane of the wearing part (3) and the wearing-part holder (4) and the centre line L-L is
15 arranged with an attachment angle α preferably in the range between 35 degrees to 53 degrees
2. Wearing part (3) for a dredger arranged to fit a wearing-part holder (4) according to claim 1,
20 **characterized by** that the attachment plane of the wearing part (3) and the wearing-part holder (4) and the centre line L-L is arranged with an attachment angle α more preferable in the range of 40 degrees to 48 degrees and most preferably 44
25 degrees.
3. Wearing part (3) for a dredger arranged to fit a wearing-part holder (4) according to any of the previous claims, **characterized by** that a hook (5)
30 is extending from the wearing part (3).
4. Wearing part (3) for a dredger arranged to fit a wearing-part holder (4) according to any of the previous claims, **characterized by** that the head
35 flanges (31,32) are arranged with a width Y-Y that equal to or larger than the width of the wearing-part holder (4), X-X.

5. Wearing part (3) for a dredger arranged to fit a wearing-part holder (4) according to any of the previous claims, **characterized by** that liners could be arranged between a first contact surface (21), a second contact surface (22), a third contact surface (51), a fourth contact surface (52), a fifth contact surface (53), a sixth contact surface (54), a seventh contact surface (24), a eighth contact surface (55), a ninth contact surface (25) and a stop surface (23) arranged on the wearing part (3) and the corresponding surfaces of the wearing-part holder (4).
6. Wearing part (3) for a dredger arranged to fit a wearing-part holder (4) according to claim 5, **characterized by** that a liner (60) comprising a bottom part (61), a first side part (62) and a second side part (63) is arranged in the wearing-part holder (4).
7. Wearing part (3) for a dredger arranged to fit a wearing-part holder (4) according to claim 5, **characterized by** that the stop surface (23) arranged on the rear leg (7) of the wearing part (3) is substantially flat.
8. Wearing-part holder (4) for a dredger arranged with a recess (8) adapted for arranging a rear leg (7) of a wearing part (3) **characterized by** that the recess (8) is arranged with contact surfaces adapted to face a first contact surface (21), a second contact surface (22), a third contact surface (51), a fourth contact surface (52), a fifth contact surface (53), a sixth contact surface (54), a seventh contact surface (24), a eighth contact surface (55), a ninth contact surface (25)

and a stop surface (23) arranged on the rear leg (7) of the wearing part (3).

- 5 9. Wearing-part system (1) comprising a wearing-part holder (4) according to claim 8, a wearing part (3) according to any of claims 1 - 7, and a lock (2).
- 10 10. Wearing-part system (1) according to Claim 9, where a lock (2) comprising a threaded rod (11) is arranged on a catch (10), where an elastomer (12) is arranged with a through-hole through which the threaded rod (11) runs; a mounting nut (13) which is arranged on the threaded rod (11), where a first washer (14) is arranged between the elastomer (12) and the mounting nut (13), and a second washer is arranged (15) between the elastomer (12) and the wearing-part holder (4).