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BLADE CARRIER FOR COMMINUTING DEVICES

Description

The invention relates to a comminution device, comprising a toothed element which can be fastened onto a comminution roller and at least one knife.

Such knife bodies are known. They are used in comminution devices, especially in waste comminution devices for waste processing or the like. For a wide variety of comminution tasks, a wide variety of knives are required. The knives also differ in their shape and the material from which they are made according to which material must be comminuted. Various technical solutions are known for an exchanging of the knife.

Thus, it is known to form the knife carrier according to the required knife shape. This requires a knife carrier exchange when switching to other knives. Since the wear on the knives and on the knife carriers is very high, this regularly causes difficulties. The efforts for a conversion are high and cause high costs.

It is also known to provide respective knife carriers for the rollers for use with different knives and to exchange the rollers for modified comminution tasks. This variant is very expensive.

It is also known to provide roller segments on roller bodies and equip same with knife carriers. The respective roller segments are to be exchanged for a change in the comminution task. Again, this exchange incurs very high expenses.

A cutting tooth for a comminution machine is known from the document DE 200 21 216 U1 in which a comminution machine is at least partially fastened to a milling tooth holder in a form-fitting manner.

A multi-part comminution hammer for organic waste materials is known from the document G 94 02 062.0 in which the cutting part is connected in a form fit and positive fit manner via a screw or clamp connection with a holder.

A comminution device for industrial waste is known from document EP 1 304 169 A2 in which comminution tools are provided on a comminution roller. Again, the knives are connected in a form fit and positive fit manner to a knife carrier.

The document WO 94/14540 relates to a comminution disc for a comminution roller of a comminution device, having a base body, and having at least one tearing tooth, wherein an undercut recess is provided in the region of each tearing tooth, in which a replaceable cutting insert with a cutting edge facing the direction of rotation is fixed in working position.

The disadvantages described above are given in the same way in the solutions known from the specifications.

The object of the invention is therefore to provide a comminution device which simplifies the exchange of the knives when changing the comminution task and which enables lower expenditures and minimises the wear on the knife.

The object of the invention is obtained with a comminution device consisting of a toothed element which can be secured to a comminution roller or the like and at least one knife, wherein the knife can be arranged in a form-fitting manner on the toothed element, wherein a knife receptacle is provided on the toothed element, and wherein the knife receptacle is configured as a recess and has a J shape when viewed from the side, characterised in that the recess is wedge-shaped or conical, preferably extending outwards, such that recess surfaces are formed. Several advantages are obtained simultaneously due to the design of the knife carrier as a toothed element that receives a knife in a form-fitting manner.

For example, the effort for a knife exchange is greatly facilitated and thus reduced. The knives can be inserted in the toothed element and removed again in a very simple manner. At the same time, a centring of the knife on the toothed element is provided as well due to the form-fitting arrangement in the recess. The use of different knives is now given according to the invention. It is only necessary to correspondingly form the form-fitting connection of the knife and the toothed element. The blades themselves can be formed in various designs from the form and the material. An exchange of the toothed element itself or an exchange of the rollers or roller segments, as described in the prior

art, is no longer necessary. Thus, the use of the comminution device itself becomes substantially more variable and cheaper. The wear and the life of the knife and the toothed element is increased to a considerable extent because the knife is now supported in the recess on the recessed surfaces, since it is formed to correspond thereto.

The variant of the form-fitting attachment of the knife offers the advantage of an additional attachment option for the knife. Since the knives are regularly exposed to very high stresses, additional reliability is created with this attachment.

A comminution device according to the invention is preferably characterised in that the knife is releasably fixedly arranged on the toothed element. The releasably fixed arrangement provides further advantages, in particular with regard to the operating convenience.

According to the invention, it has also been found that it can be advantageous if a knife receptacle is provided into which at least a part of the knife can be inserted. Thus, all applicable knife shapes are dependent on the shape of the knife receptacle. However, a change of the knife is greatly facilitated and the change time is shortened.

It can be advantageous if the knife receptacle is arranged at the front end of the toothed element in the cutting direction. Of course, it is also possible to provide other locations on the toothed element for the arrangement of the knife receptacle. However, the arrangement as described above has also proven favourable for the design of the individual types of knives.

According to one variant of the invention, the knife receptacle is formed as a recess and has the shape of a J from a side view. The J shape has the advantage that it is easy to insert the knife into the knife receptacle. The J shape ensures the form fitting with self-adjustment in a very impressive manner.

A further optimisation of the adjustment and the form fitting is achieved according to one development of the invention in that the recess has a lug at the front end as seen in the cutting direction.

Advantageously, the lug of the recess is thus formed roller-shaped.

A comminution device, as described above, is preferably characterised in that the recess is wedge-shaped or conical, preferably formed to run outwards, in such a way that recessed surfaces are formed. These surfaces provide further optimisation of the centring behaviour of the knife when the knife has corresponding surfaces.

Another preferred aspect of the comminution device according to the invention is specified in that a part of the toothed element is formed as a supporting element. This part also serves to centre the knife, but in particular also serves the better load distribution of forces acting on the knife during the cutting or comminution process.

It is also advantageous if wedge-shaped or conically outward-extending support surfaces are provided on the side facing the knife of the supporting element. These support surfaces also serve to improve the self-adjustment of the knife when inserting to the other, but on the other hand also the optimisation of the load distribution.

One embodiment of the comminution device according to the invention therefore provides that the toothed element and the knife have a mutually corresponding shape. The resulting advantages have already been described.

According to one development of the invention, it is provided that the toothed element is fastened on or to the comminution roller of the comminution device by welding. However, the invention is not limited to welding as a mounting option. Rather, it is possible to arrange the toothed element on the comminution roller with a variety of fastening means or methods. Examples that can be named include screw, wedge, spring, and groove connections or the like.

According to a further variant, the invention is characterised in that the toothed element can be arranged on the comminution roller, and in particular can be arranged to be angularly offset from one another on the comminution roller. The angularly offset arrangement offers several advantages. For example, the load distribution during comminution is optimised and the option is created to arrange the toothed elements in a spiral on the roller, whereby optimal comminution productivity is positively influenced.

One aspect of the invention is according to a development characterised in that the toothed element has a centring device for centring on the roller on the underside or on the

side facing the comminution roller.

A comminution device, as described above, is further preferably characterised in that the centring device of the toothed element is formed as a groove or spring which interacts with a spring or groove provided on the comminution roller in a corresponding and form-fitting manner. Thus, the attachment and or fixing of the toothed element is greatly simplified. The adjustment of the toothed element on the roller body of the comminution roller is automatic. Even if welding is subsequently carried out, no alignment or realignment is required.

According to the invention, it is furthermore preferably provided that toothed elements and knives have fastening means by means of which they can be firmly connected to one another in a releasable manner.

It is also advantageous if the fastening means is specified by at least one screw connection which is guided by bores in the toothed element and in the knife. It has proved to be particularly advantageous to provide nuts counter to the cutting direction to simplify a later release. If a threaded bore is used for the screw connection, it may cause difficulties in releasing the connection by preventing the screw from turning in the thread. In such a case, a rear protruding nut can be forced open or is very easy to remove by separating by welding or cutting, for example.

According to one preferred variant for the fastening means, the bore has a diameter of 23 cm into which a matching screw can be inserted.

It has also been found that it is favourable if the toothed element and/or the knife were obtained from metal, preferably as a cast element. This considerably simplifies the production of such elements. Also, different shapes can be easily realised.

It is also advantageous if the side surfaces of the toothed element run out obliquely upwards, taper off, or run out to the outer radius. This has a favourable effect on the cutting behaviour.

It is also preferably provided that the toothed element is formed to be narrower in the direction opposite to the cutting direction than at the cutting edge.

A further development of the comminution device according to the invention provides that the outer radius of the toothed element intersects with the outer radius of the comminution roller at the side thereof, facing away from the knife receiving side.

This radius is preferably adaptable to different tooth heights. This means that, when using different teeth with altered tooth heights, the radius is adjusted accordingly to obtain the favourable cutting and supporting properties of the tooth.

The comminution device according to the invention is also provided as a design such that the knife receptacle is formed such that knives with different knife shapes, for example triangular, rectangular, or polygonal knives, can be used or fastened.

It is also advantageous if the knife is formed as a tooth. According to the invention, the tooth has a blade and is concave on the side facing the cutting direction.

Also, according to one advantageous variant of the invention, the tooth is provided, on the side facing away from the toothed element, with a radius which preferably intersects the radius of the roller or of the roller body.

One development of the comminution device provides that a support region is provided on the tooth, which is supported on the supporting element of the toothed element. As already described, this leads to an improvement in the self-alignment of the tooth on the toothed element.

Also provided on the support region of the tooth are conical or wedge-shaped extending support surfaces which interact with the support surfaces of the toothed element.

Preferably, the tooth is wider than the toothed element formed such that a clearance results. This reduces the wear on the toothed element and improves the overall cutting behaviour.

A further development of the invention provides that the tooth on the sides facing the toothed element is formed so as to correspond to the recess surfaces and the support surfaces in a conical or wedge-like manner such that self-centring occurs owing to the form fitting when the tooth is secured. The effect of this variant has already been

described above.

A comminution device, as described above, according to a development of the solution according to the invention is characterised in that two sides facing the toothed element and oriented downward to the recess are formed as recess mating surfaces, and the inclination of these surfaces corresponds to those of the recessed surfaces. This ensures self-centring in this region.

It is further provided according to the invention that two horizontally-oriented sides facing the toothed element are formed as support mating surfaces and the inclination of these surfaces corresponds to that of the support surfaces. This ensures that a form-fitting and self-centring connection is also obtained in the region of the support surfaces.

According to one development, another means that serves both the self-centring and the better support of the forces exerted on the tooth is by two of the sides facing the attachment surfaces acting as attachment mating surfaces. Also, the attachment mating surfaces have an inclination corresponding to that of the attachment surfaces and therefore also serve the support and self-centring in this region.

According to the invention, it has been found to be advantageous if the size of the tooth is variable. In particular, the height between the tip of the blade and the outer radius of the comminution roller is measured. The size of the tooth is then selectable based on different comminution tasks. This means that comminution rollers with different teeth are made available, or in the case of larger comminution orders, the teeth on the comminution roller itself can be exchanged. The height of the teeth is then adapted to the respective comminution task. The height of the tooth is preferably between 100 mm and 200 mm.

Of course, it is also provided according to the invention that the tooth has a mounted blade, which is preferably formed from hard metal. The service life of such teeth is significantly longer than that of normal materials, such as cast iron or tool steel.

It is also favourable if the tooth has at least one hardened region on the edges thereof facing the cutting direction.

The hardened region(s) are obtained, for example, by hard-facing or welding.

Another aspect of the invention is characterised in that the tooth is formed in two parts. The two-part tooth is preferably formed by a first cutting body and a second cutting body.

In this case, the first cutting body is flat or planar on the side facing the second cutting body.

One development is characterised in that the second cutting body is plate-shaped and provided with an opening which, in the installed state, comprises the lug of the toothed element.

The second cutting body of the two-part tooth is preferably formed as a changing plate, which according to one advantageous development has a thickness of 20 mm. The changing plate has the shape of a triangle which can be set up substantially horizontally on one of the edges and which is preferably flattened on the upper side in the installed position. The flattening is done such that the changing plate then has a trapezoidal shape. Of course, other flattening options according to the invention are encompassed by this variant of the invention. Thus, it is possible, for example, to form the flattening to be round, preferably concave. Of course, a convex rounding of the changing plate in its upper tip portion is provided as well according to one embodiment.

According to one embodiment, a comminution device as described above is characterised by a plurality of knife carriers which are arranged on the comminution roller, in particular offset from one another.

The invention will be further described by means of exemplary embodiments.

In the drawings:

Fig. 1 shows a three-dimensional representation of an embodiment of a toothed element according to the invention,

Fig. 2 shows a side view of the toothed element of Fig. 1,

Fig. 3 shows a three-dimensional representation of a variant of a knife formed as a tooth,

Fig. 4 shows a cut-away side view of Fig. 3,

Fig. 5 shows a variant of Fig. 3,

Fig. 6 shows a further view of the tooth according to Fig. 3.

Figs. 7a and b show different views of an embodiment for a tooth according to the invention,

Figs. 8a-eshow different views of a variant of an embodiment with a two-part tooth,

Figs. 9 and 10 show variants of toothed elements with differently shaped teeth.

Fig. 1 shows a three-dimensional view of an embodiment of a toothed element 1 according to the invention. It is designed to be mountable on a comminution roller (not shown) of a comminution device. At the side thereof facing in the cutting direction, there is located a knife receptacle 3. The knife receptacle 3 is formed as a recess 4 and has a J shape. Thus, the simplest embodiment of the invention has a form-fitting connection between the knife receptacle 3 and a knife 2 (not shown here) usable therein. The knife receptacle 3 has, on the outwardly facing sides thereof, recess surfaces 4/1, 4/2, which are formed to be wedge-shaped running outward. According to one variant (not shown), the invention can also be realised with inwardly extending recess surfaces. A lug 7 is provided at the front outwardly running end of the recess which effects a further optimisation of the form-fitting connection, but also a distribution of the received loads. Support surfaces 5/1, 5/2 are attached in the rear upper part of the recess 4, which during the cutting process effects a support of the knife 2 on the supporting element 5 as part of the toothed element 1. These support surfaces 5/1, 5/2 are wedge-shaped or conical running outward. The supporting element 5 has on the upper side thereof bearing surfaces 8/1, 8/2, 8/3 on which the tooth 2 rests in the inserted position. All surfaces are wedge-shaped or tapered outward. The form-fitting attachment of the knife 2 additionally provided in or on the toothed element 1 can be accomplished by means of fastening means (not shown), e.g., a screw. It is then passed through the bore 8. The part of the toothed element 1 facing away from the cutting direction bears the reference symbol 6.

There, a centring device in the form of a groove can be seen. This serves to centre and/or

fix the toothed element 1 on the comminution roller, which then has corresponding means, for example a spring, on which the toothed element 1 is mounted.

Fig. 2 shows a side view of the toothed element 1 according to Fig. 1. This is for better understanding. All features and reference symbols are used in the same way as described in Fig. 1, so that a repeated presentation is omitted.

Fig. 3 shows a three-dimensional representation of a variant of a knife 2 formed as a tooth 9. The tooth 9 has a blade 10 in the cutting direction, which is mounted in the variant shown. This offers the possibility, for example, of mounting harder and more resistant material there, such as carbide. Of course, the tooth 9 can be obtained from a whole body of a material and the blade or other parts of the tooth 9 are hardened. According to one development of the invention, the mounted material can be affixed there, for example, by hard-facing or deposit welding. The tooth 9 is formed concave on the side 11 facing the cutting direction. Hardened regions 14 are located at the edges or sides. These regions can also be produced, for example, by hard-facing or deposit welding. The bore 8 serves to receive the fastening means (not shown). On the side 12 facing away from the blade 10, the radius is chosen so that it intersects with the radius of the roller body of the comminution roller (not shown). At the end of the radius, there is located the support region 13 which in the inserted form interacts with the supporting element 5 of the toothed element 1. The tooth 9 runs upwards slightly wedge-shaped, but is overall a little wider than the toothed element formed, whereby a clearance is formed.

Fig. 4 is a cut-away side view of Fig. 3, which serves for a better understanding of the presented embodiment of the invention.

Fig. 5 is a bottom view of the tooth 9 of Fig. 3. Here the surfaces 17/1, 17/2 of the tooth 9 interact with the recess surfaces 4/1, 4/2, which can be seen with the surfaces 15/1 and 15/2 interacting with the support surfaces 5/1, 5/2 and the surfaces 13/1 and 13/2, mountable on the attachment surfaces 8/1, 8/2.

Fig. 6 is a further view of the tooth 9 according to Fig. 3. The reference symbols are identical to those already described and denote the same features.

Figs. 7a and 7b show various views of an embodiment for a tooth according to the

invention. In the selected exemplary embodiment, it is provided that the bore 8 has a diameter of 23 mm. The tooth in turn with the reference symbol 9 is indicated only schematically. The tooth has a width of 41.7 mm at the upper edge thereof, which is the blade 10 for the tooth 9. The opening for the fastening screw or the hexagon provided therefore has a width of 34 mm. In the lower region, where the recess mating surfaces 17/1 and 17/2 are indicated schematically, the inner side facing the recess 4 has a width of 30 mm. The two different angles for limiting the support surfaces are 62° and 140° . The height of the opening corresponding to the lug 7 is 49.5 mm. The width of this opening is 60 mm and the total width of the tooth is given to be 86 mm. This embodiment represents a preferred variant of the invention. However, the invention is not limited to these dimensions. Rather, other variants are possible. However, the variant presented here has proven to be very practical in the testing of the solution according to the invention.

Fig. 7b shows a side view of the section along the line A—A according to Fig. 7a. The reference symbols used in this figure have been used in the same way for features already presented. Not yet presented were the angles chosen for this preferred variant or radii of the individual surfaces of the tooth according to the invention. The radius at the blade 10 of the tooth 9 in its upper region and on the outer edge is 82.5 mm. The tooth is concave so the inner radius in this region is 84.59 mm. The radius which interacts correspondingly with the lug 7 is 17.5 mm in the embodiment shown and the centre point is at a distance of 32 mm from the lower edge. The lower surfaces of the tooth 9 insertable into the recess 4 have a radius of 35 mm in the outer region and of 24.8 mm in the inner region and of 24 mm in the upward-facing portion of the lower curve. The angle between the support surface 13 and the rear portion of the tooth on which the counter support surface 15/2 is located is 83° for the inner region, and 80° for the outer region.

Figs. 8a to 8e show different views of a very advantageous further variant for one embodiment of the invention with a two-part tooth 9. Fig. 8a shows a three-dimensional representation of a tooth 9, which is fastened onto a toothed element 1 by means of an unspecified fastening screw. The tooth 9 is formed in the illustrated embodiment by a first cutting body 9/1 and a second cutting body 9/2. The cutting body 9/2 is formed to be plate-shaped as a changing plate 101. The side of the first cutting body pointing to the second cutting body is formed to be flat. The second cutting body 9/2 is formed as a plate or disk-shaped and has a triangular shape with an upper flattening. Thus, the second cutting body 9/2 has a trapezoidal shape. For the implementation of the lug 7, the second

cutting body 9/2 is excluded so that it includes the lug 7 in the installed state. The bearing surfaces 8/1, 8/2, 8/3 over which the first cutting body 9/1 is supported are easily seen in the representation according to Fig. 8a.

Figures 8b and 8c show the embodiment described above in a three-dimensional representation in one case, and in a cut-away view in the other. Here, however, only the first cutting body 9/1 is shown. The angle dimensions and radii selected in the representation of Fig. 8c correspond to a further advantageous variant for the described embodiment of a two-part tooth 9.

Fig. 8d shows a further view which shows further dimensions of the embodiment. Of particular significance are the lower width of 117.7 mm, the width of the lower opening 71, and the angle specified there for the selected embodiment. It is, of course, advantageous that these angle indications always comprise the same amount, especially in the inner region, to ensure that the different teeth can be mounted on the toothed element 1 of the knife carrier according to the invention, which is always the same. All other dimensions and angles can be made variable according to the invention.

Fig. 8e shows the second cutting body 9/2 or this cutting body in a design as a changing plate 101.

Figs. 9 and 10 relate to a further embodiment of the invention. All previously proposed reference symbols are reused in the same way. The difference between these two embodiments lies in the fact that teeth 9 with different heights and thus with a different radius 12 are mounted on the toothed element 1.

Knivholder til findelingsanordninger

Patentkrav

1. Findelingsanordning bestående af et tandlegeme (1), som kan fastgøres på en findelingsvalse eller lignende, og mindst én kniv (2), hvor kniven (2) kan anbringes således, at den går i indgreb med tandlegemet (1), hvor der på tandlegemet (1) er tilvejebragt et knivoptag (3), og hvor knivoptaget (3) er udformet som udsparring (4) og set fra siden har form som et J, **kendetegnet ved**, at udsparringen (4) er udformet kileformet eller konisk, foretrukket skrånende udad, således at der opstår udsparringsflader (4/1, 4/2).
2. Findelingsanordning ifølge krav 1, **kendetegnet ved**, at udsparringen (4) ved den set i skæreretningen forreste ende har en næse (7), og/eller at udsparringens (4) næse (7) er udformet cylinderformet.
3. Findelingsanordning ifølge et af kravene 1 eller 2, **kendetegnet ved**, at en del af tandlegemet (1) er udformet som støttelegeme (5), og at der på den side af støttelegemet (5), der vender mod en isat kniv (2), er tilvejebragt kileformede eller koniske støtteflader (5/1, 5/2), der skråner udad.
4. Findelingsanordning ifølge et af de foregående krav, **kendetegnet ved**, at tandlegemet (1) på undersiden henholdsvis på den side, der vender mod en findelingsvalse, har en centreringsanordning til centrering på findelingsvalsen, hvor centreringsanordningen på tandlegemet (1) foretrukket er udført som not eller fer, der samvirker korresponderende og formsluttende med en fer eller not, der er tilvejebragt på findelingsvalsen.
5. Findelingsanordning ifølge et af de foregående krav, **kendetegnet ved**, at tandlegemet (1) sideflader skråner opad, tilspidses henholdsvis skråner hen mod den ydre radius, og/eller at tandlegemet (1) i retningen modsat af skæreretningen er udformet smallere end på skærekanten.
6. Findelingsanordning ifølge et af de foregående krav, **kendetegnet ved**, at tandlegemet (1) ydre radius på den side, der vender væk fra knivoptaget (3), skærer en findelingsvalses ydre radius.
7. Findelingsanordning ifølge et af de foregående krav, **kendetegnet ved**, at kniven (2) er udformet som en tand (9), og/eller at tanden (9) har et skær (10) og på den side (11), der vender i skæreretningen, er udformet konkavt.
8. Findelingsanordning ifølge et af de foregående krav, **kendetegnet ved**, at tanden

- (9) på den side (12), der vender væk fra tandlegemet, har en radius, der foretrukket skærer en findelingsvalsens henholdsvis eller valselegemets radius.
9. Findelingsanordning ifølge krav 7 eller 8, **kendetegnet ved**, at der på tanden (9) er tilvejebragt et støtteområde (13) til afstøtning på et støttelegeme (5) på tandlegemet (1), og/eller at der på støtteområdet (13) er tilvejebragt afstøtningsflader (13/1, 13/2), der forløber konisk henholdsvis kileformet.
10. Findelingsanordning ifølge et af kravene 7 til 9, **kendetegnet ved**, at tanden (9) på de sider, der vender mod tandlegemet (1), er udformet konisk henholdsvis kileformet svarende til udsparringsfladerne (4/1, 4/2) og støttefladerne (5/1, 5/2), således at der sker en automatisk centrering som følge af den formluttende forbindelse, når tanden (9) fastgøres.
11. Findelingsanordning ifølge et af de foregående krav, **kendetegnet ved**, at to sider, der vender mod tandlegemet (1) og er orienteret nedad mod udsparringen (4), er udformet som udsparringsmodflader (17/1, 17/2), og disse fladers hældning korresponderer med udsparringsfladernes (4/1, 4/2) hældning.
12. Findelingsanordning ifølge et af de foregående krav, **kendetegnet ved**, at to sider, der vender mod tandlegemet (1) og er orienteret horisontalt, er udformet som støttemodflader (15/1, 15/2), og disse fladers hældning korresponderer med støttefladernes (5/1, 5/2) hældning.
13. Findelingsanordning ifølge et af kravene 7 til 12, **kendetegnet ved**, at tanden (9) har et påsat skær (10), der fortrinsvis er fremstillet af hårdmetal, og/eller at tanden (9) på kanterne, der vender i skæreretningen, har mindst ét hærdet område (14).
14. Findelingsanordning ifølge et af kravene 7 til 13, **kendetegnet ved**, at tanden (9) er udformet todelt af et første skærelegeme (9/1) og et andet skærelegeme (9/2).
15. Findelingsanordning ifølge krav 14, **kendetegnet ved**, at det første tandlegeme (9/1) på den side, der vender mod det andet skærelegeme (9/2), er fladt henholdsvis plant.
16. Findelingsanordning ifølge krav 14 eller 15, **kendetegnet ved**, at det andet skærelegeme (9/2) er pladeformet og/eller er forsynet med en åbning (71), som i indbygget tilstand omfatter tandlegemets (1) næse (7).
17. Findelingsanordning ifølge et af kravene 14 til 16, **kendetegnet ved**, at det andet skærelegeme (9/2) er udformet som en vekselpatte (101), hvor vekselplassen (101) foretrukket har en tykkelse på 20 mm, og/eller vekselplassen (101) har form af en trekant, som foretrukket er affladet på oversiden i indbygget position, således at vekselplassen (101) er trapezformet.

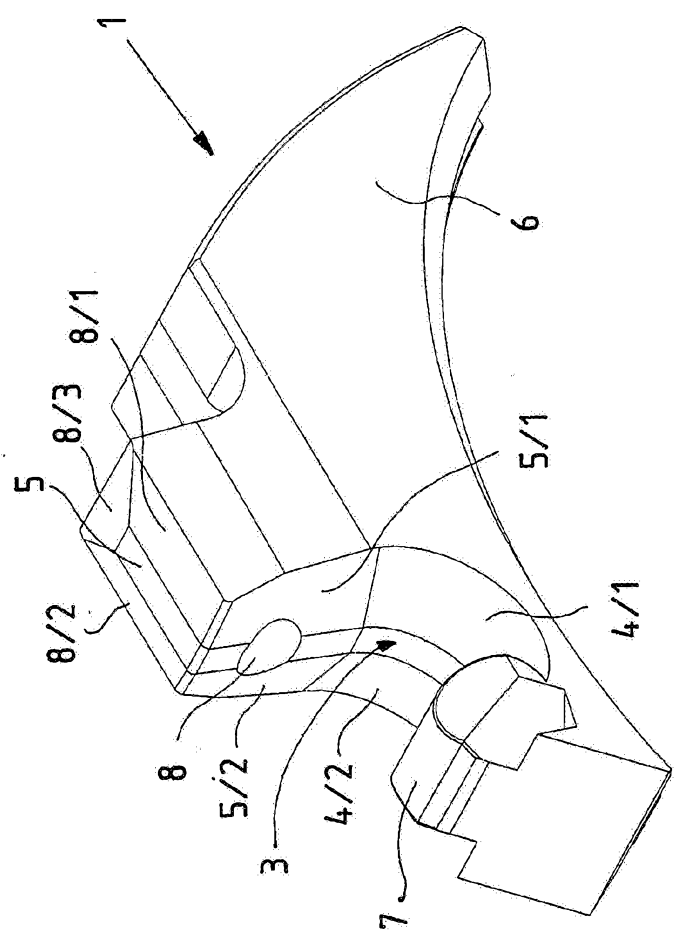


Fig.1

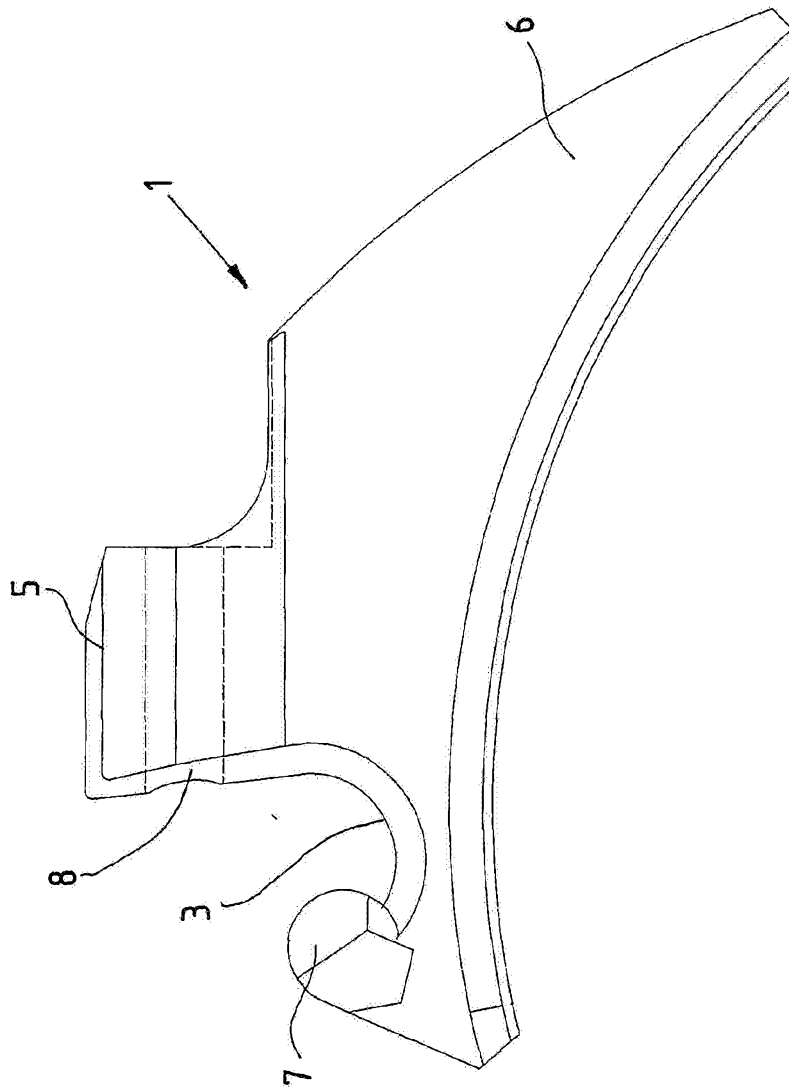


Fig.2

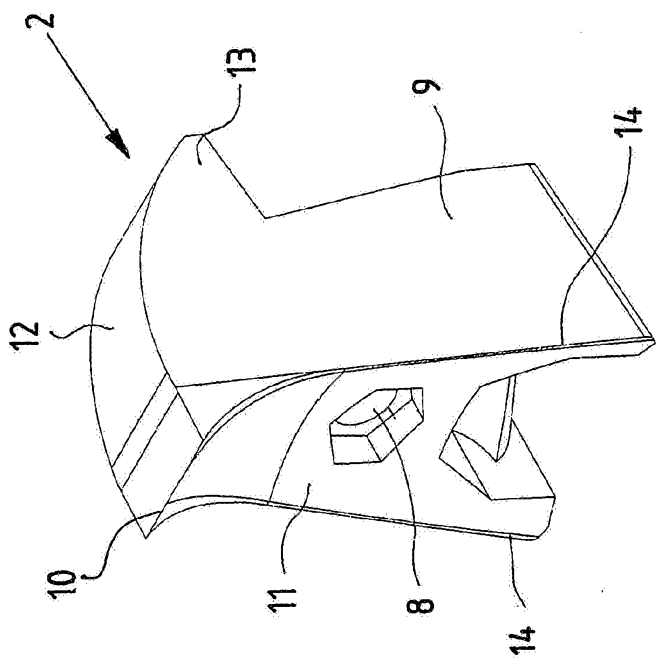


Fig. 3

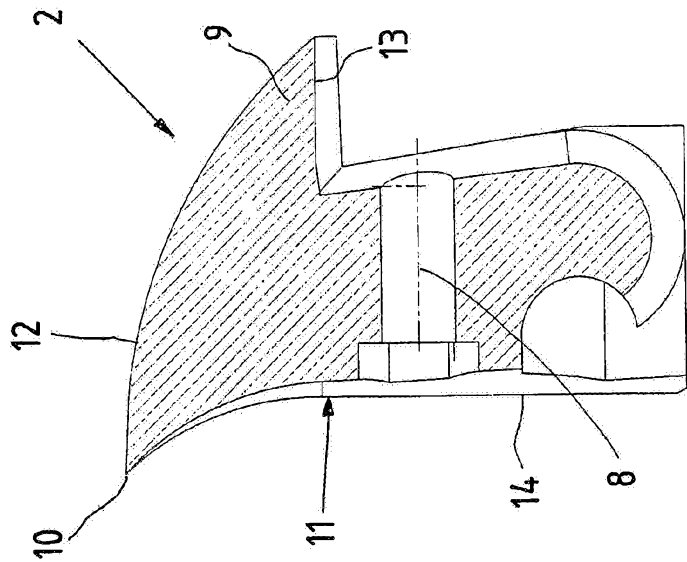


Fig. 4

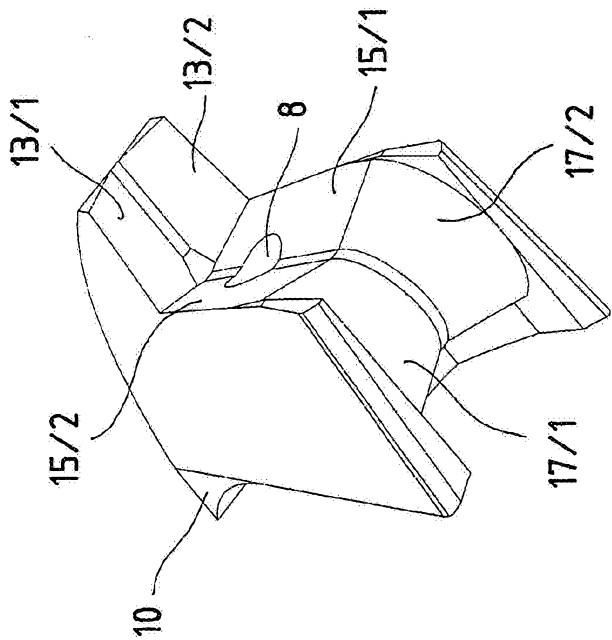


Fig.5

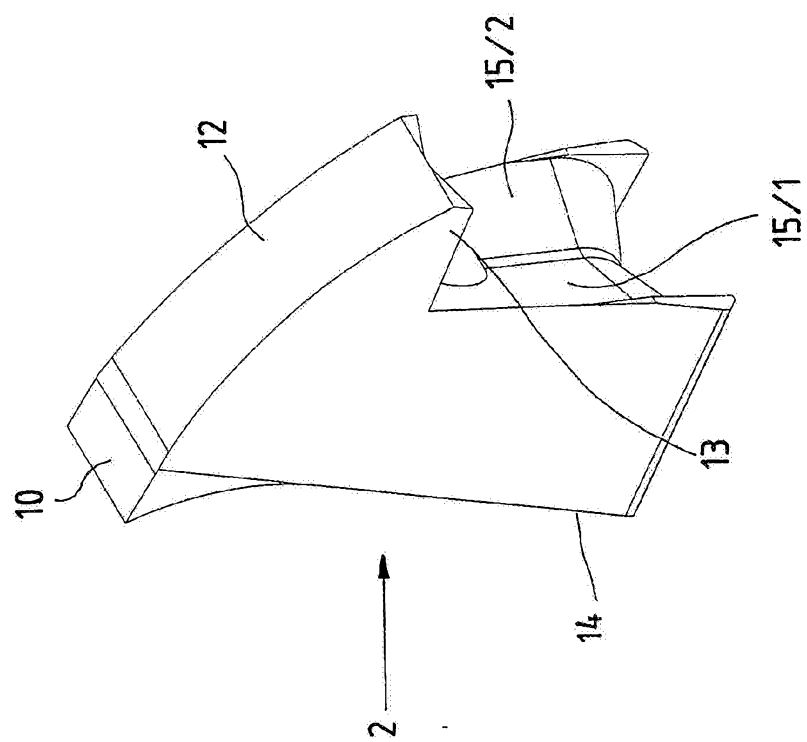


Fig.6

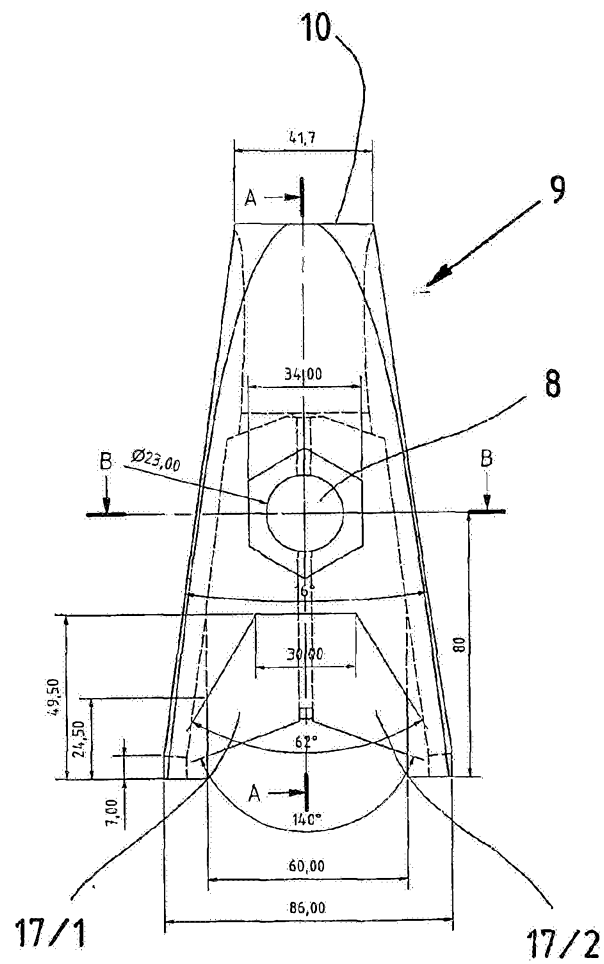


Fig.7a

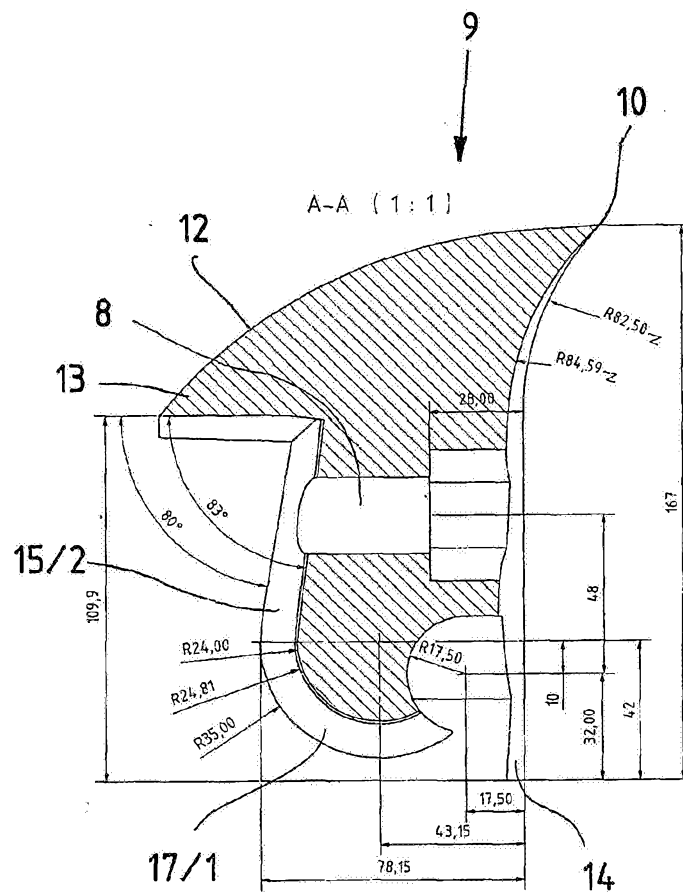


Fig.7b

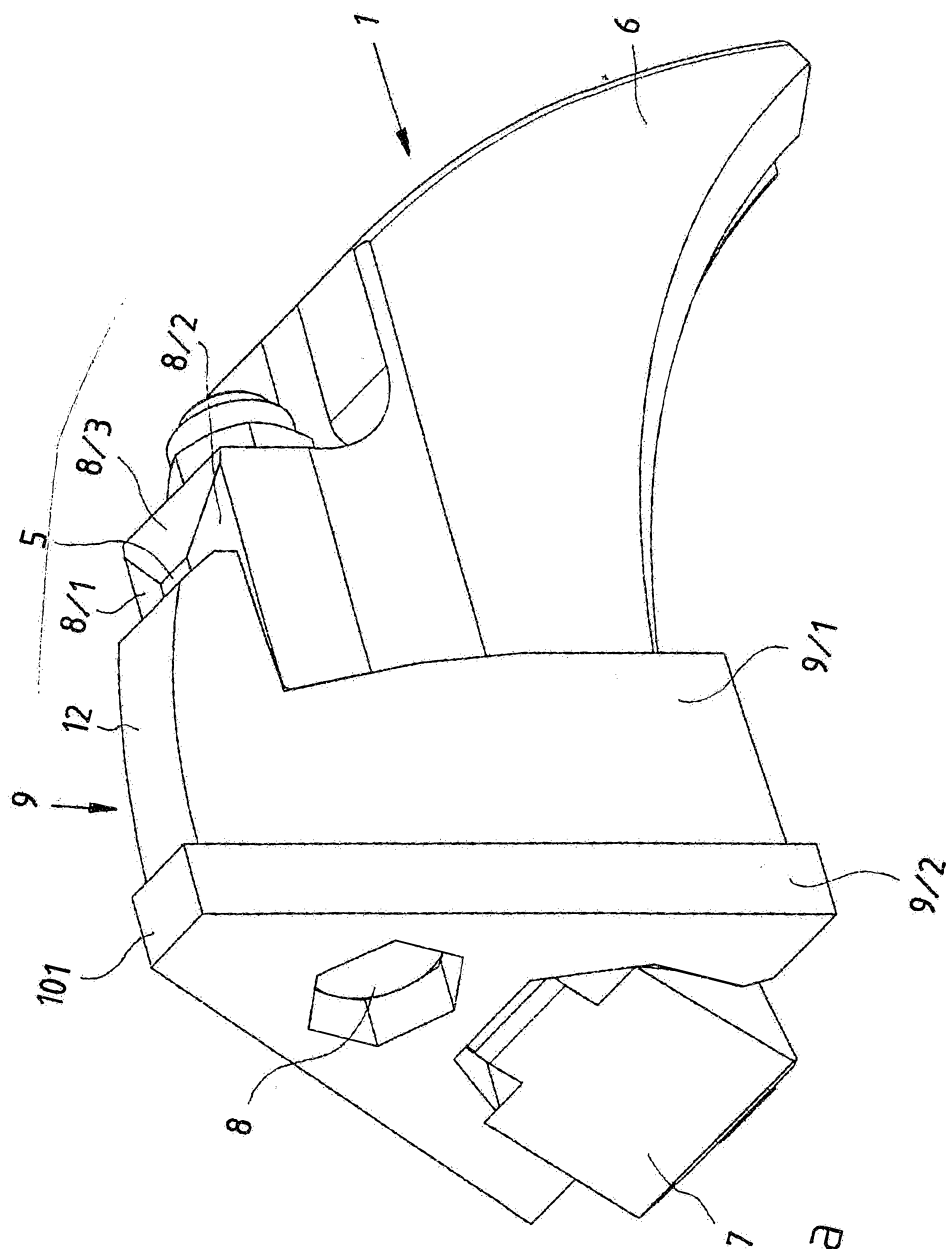
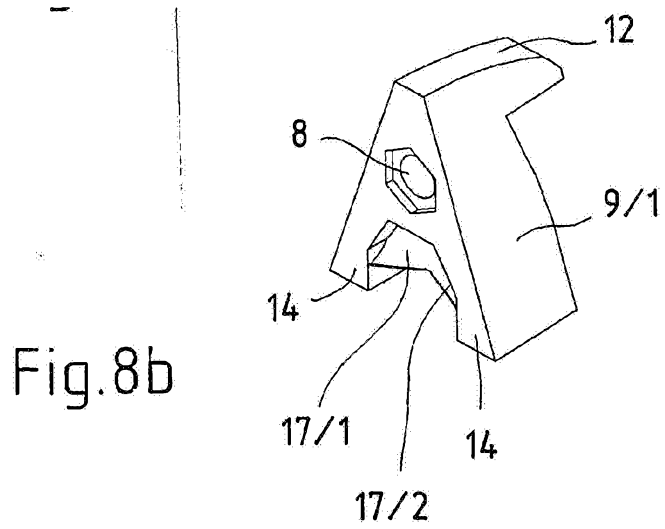
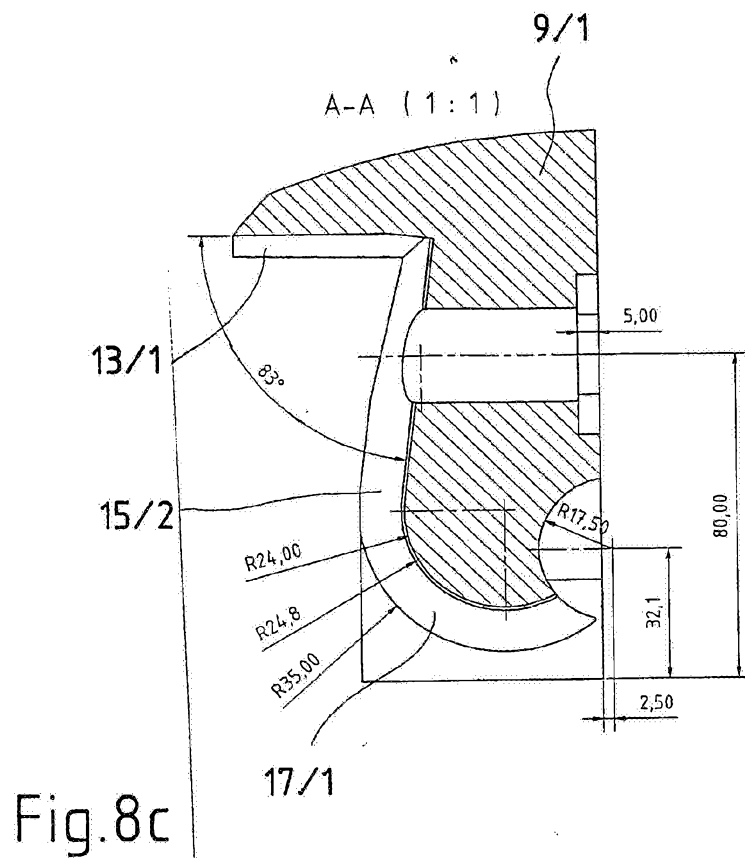


Fig. 8a



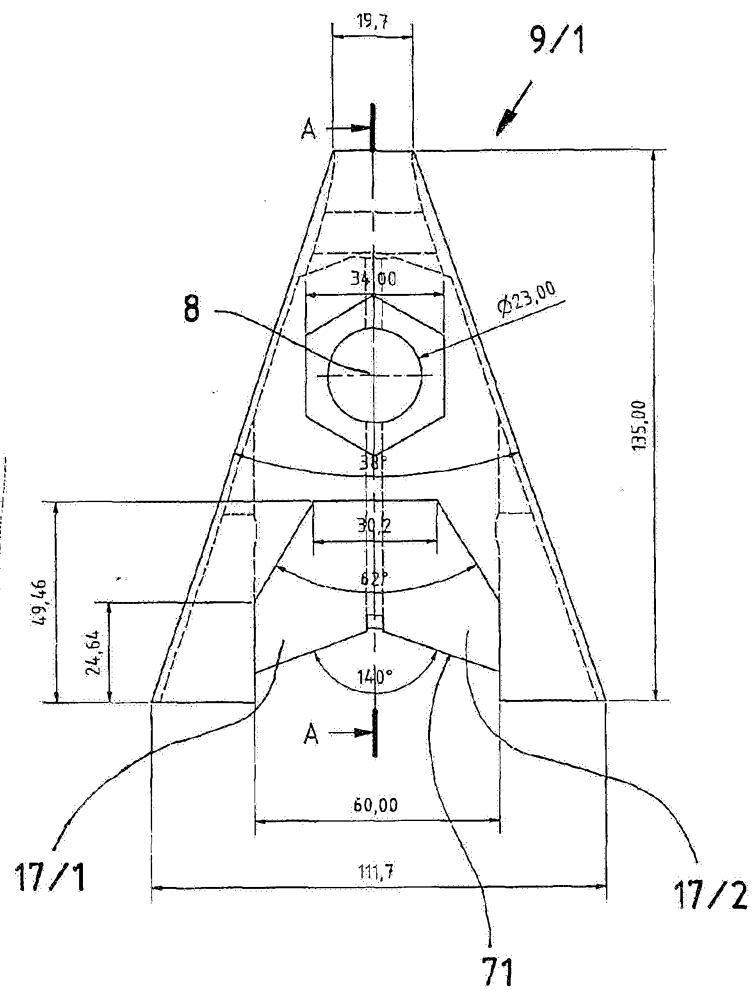


Fig.8d

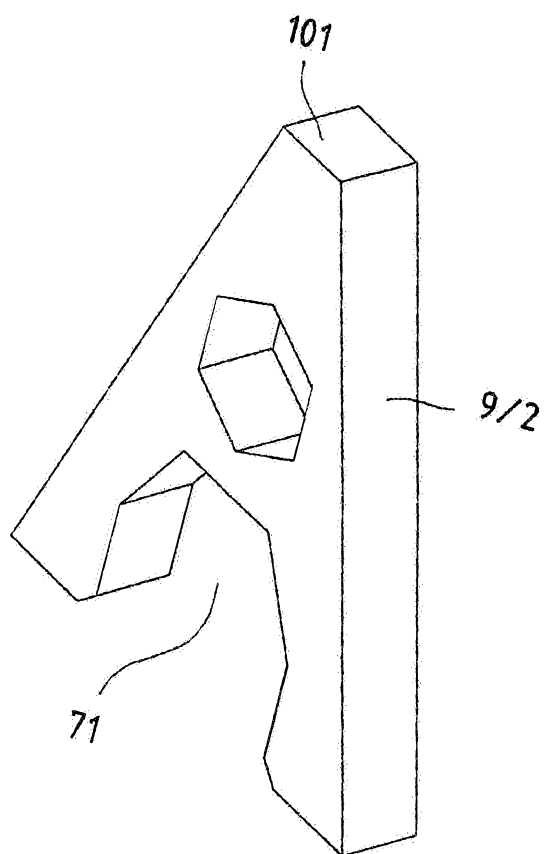


Fig.8e

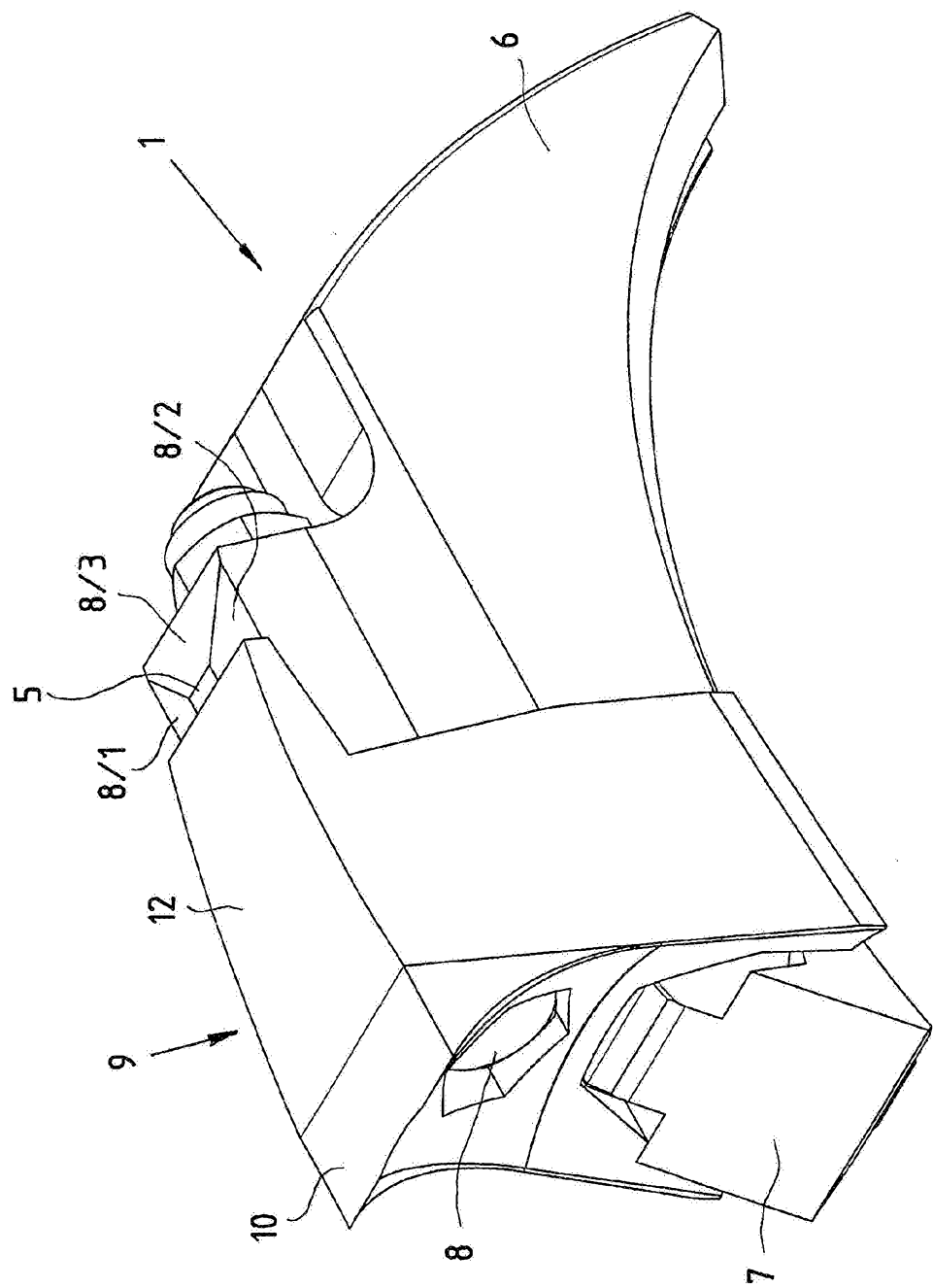


Fig.9

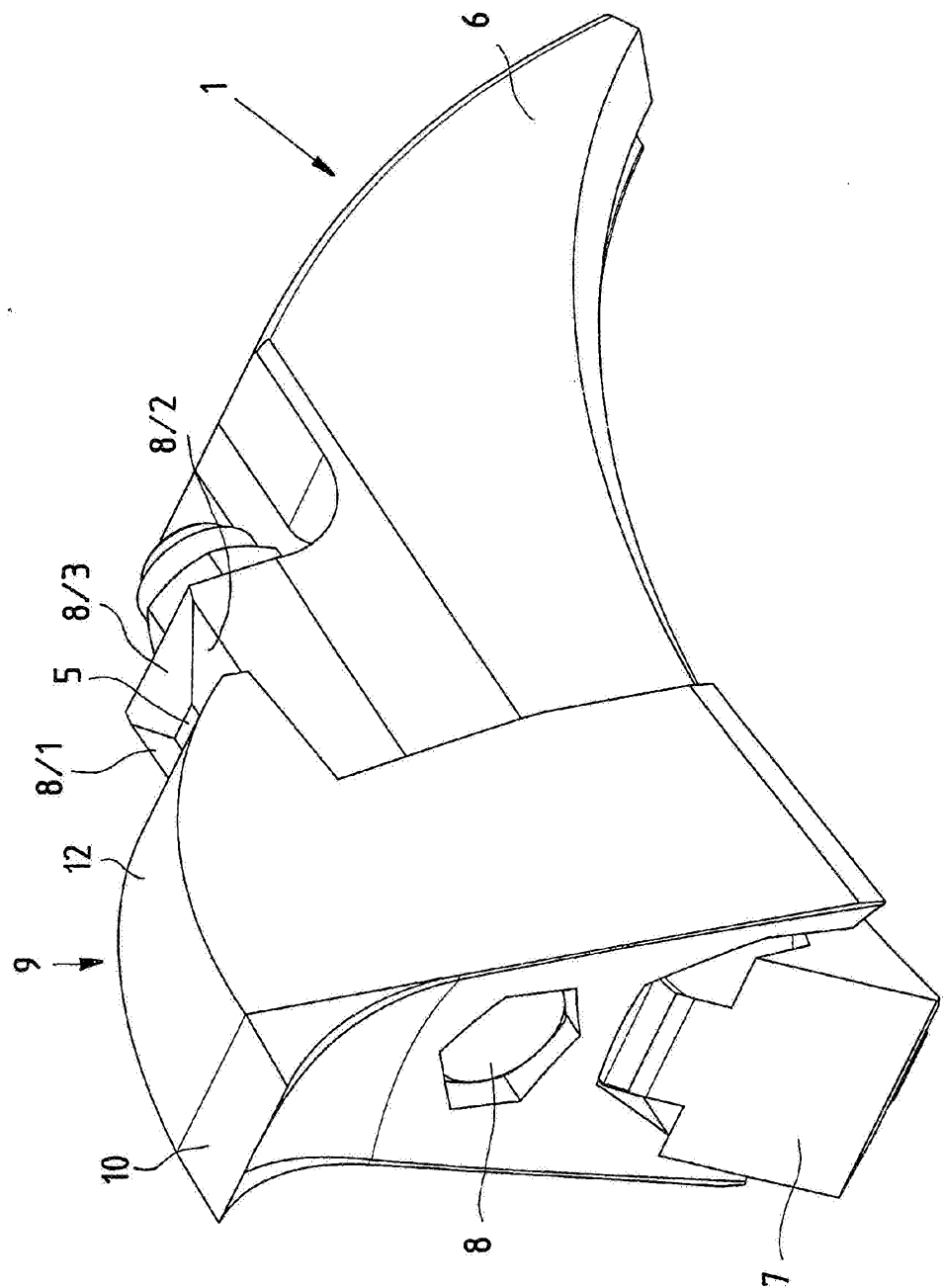


Fig.10